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"Venus: Death of a Planet": Post-Editing a Documentary

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TABLE OF CONTENTS

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INTRODUCTION

The present thesis aims to explore the world of post-editing (PE), in particular when related to Audiovisual Translation (AVT). Specifically, it reports on a PE task concerning a documentary entitled "Venus: Death of a Planet", i.e. a popularising product featuring the specialised language of astronomy.

The dissertation is organised into four chapters. The first three chapters focus on the theoretical background, whereas the fourth one offers an analysis of the PE work.

In particular, the first chapter concentrates on AVT, providing a definition, a historical overview, and a description of its main types, i.e. subtitling, dubbing, fansubbing and fan/fundubbing, voice-over and respeaking. Special attention will be devoted to media accessibility in AVT, especially referring to subtitling for the deaf and hard of hearing (SDH) and audio description (AD) for the blind and the partially sighted. Again, the historical context and a definition of these topics will be proposed, as well as a description of their main features.

In the second chapter, automation and AVT will be the focal points. After exploring their history, the principal types of MT systems will be introduced and described, i.e. ruled-based, example-based, statistical, and neural machine translation systems. Artificial intelligence (AI) will be addressed too, with special reference to its origin and applications. Finally, a specific section is dedicated to PE. First, the different types of PE will be described and then its main features, with an eye to its application in AVT.

The third chapter will provide a general overview of special languages (LSPs) and specialised translation. The key features and the different levels of specialisation of LSPs will be addressed. Then, a more detailed analysis will be offered of the scientific discourse and language of astronomy, which are closely linked to the documentary chosen for the PE work, which is an astronomical documentary. First of all, the language of science will be addressed, by defining its historical background and its principal features, and then the language of astronomy will be explored through the description of its main characteristics. The final section of this chapter will be dedicated to science popularisation. The central focus will be on its history, its relationship with translation and the difference between scientific specialised texts and popularisations.

The fourth and last chapter includes a commentary on the PE of the documentary "Venus: Death of a Planet". First, the objectives of this work will be underlined. The documentary is then introduced, by starting with the rationale for its selection to then examine its storyline. Then, the methods and tools applied for this project will be presented, with a focus on *Trados Subtitling*, i.e. the computer-assisted translation tool adopted for the PE project. The final section will be dedicated to the commentary of the post-edited version, which will be illustrated through selected examples showcasing the main issues found during this phase. In particular, these issues will be divided into eight principal groups, i.e. segmentation and writing conventions, register, idiomaticity, terminology and phraseology, language and grammar, additions and mistranslations, inconsistent translations, untranslated and omitted subtitles. To conclude, the main strengths and drawbacks of using an MT for translating a documentary will be delineated and accompanied by my personal thoughts and considerations about this particular experience.

CHAPTER 1
AUDIOVISUAL TRANSLATION

Audiovisual Translation (AVT) "is a branch of translation studies concerned with the transfer of multimodal and multimedial texts into another language and/or culture" (Pérez González 2009: 13). Its "mission […] is to allow widespread access to the art of film" (Bogucki 2019: 13) and, as a new branch of the discipline, it has improved and redefined the field of Translation Studies (Bogucki 2019: 11)

In this first chapter, the definition (1.1) and history (1.2) of AVT are explored. Then, the analysis will focus on the relationship between AVT and translation (1.3). This will be followed by a description of some AVT modes and their functions, with special reference to subtitling, dubbing, fansubbing and fan/fundubbing, lip-synchronisation, voice-over, and respeaking (1.4). Finally, the issue of media accessibility in AVT will be addressed, with a focus on subtitling for the deaf and hard-of-hearing (SDH) and audio description (AD) for the blind and the partially sighted (1.5).

1.1 Defining Audiovisual Translation (AVT)

Nowadays we are used to adopting the term "audiovisual translation" to refer to the "umbrella term used to refer to the translation of programmes in which the verbal dimension is only one of the many shaping the communication process" (Díaz Cintas 2010: 344). Similarly, Patrick Zabalbeascoa (2008: 23) focuses on the term "audiovisual" claiming that

> if we have two types of signs and two different channels of communication, we get four different types of signs: audio-verbal (words uttered), audio-nonverbal (all other sounds), visual-verbal (writing), visual-nonverbal (all other visual signs).

He also offers a visual representation of the four dimensions of an AV text, shown in Figure 1.1.

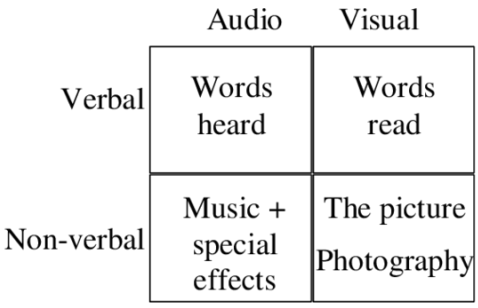


Figure 1.1: The four components of the audiovisual text (Zabalbescoa 2008: 23).

He underlines that AV texts should follow three specific criteria. The first consists of "a combination of verbal, nonverbal, audio, and visual elements to the same degree of importance" (Zabalbeascoa 2008: 23), meaning that during this process, eyesight and ears are used, as well as speech, writing, and body language if an interactive screen communication is taking place. The second criterion highlights that these four components are supposed to be complementary and indivisible. In addition, he suggests that music is usually chosen to accompany pictures and words "or any other combination of AV text items made to complement each other", no matter if they "had been produced prior to their inclusion in the audiovisual production" (Zabalbeascoa 2008: 24). Finally, according to the third criterion, "there are three main stages of production" (Zabalbeascoa 2008: 24), which are:

(a) pre-shooting (script writing, casting, rehearsing, etc.) and/or planning;
(b) shooting (including directing, camera operating, make-up, and acting);
(c) post-shooting (editing and cutting).

AVT "is the most common expression being used currently in English and in many other languages" (Bogucki and Díaz Cintas 2020: 12). Initially, the terms "film translation" and "cinema translation" were used, but they were soon replaced as they did not involve every translation mode, such as the television and the DVD modes (Remael 2010: 13). For this reason, the concept of "film and TV translation" was introduced (Bogucki and Díaz

Cintas 2020: 12). Another name that was employed was "constrained translation", which was chosen because when translating the written text of a film,

> one is up against the same situation as translating any other written form of communication plus the additional constraint of having to synchronise the words of the translation with the picture (and, presumably, the original sound effects), i.e. having to place the string of words alongside the parallel movement of the picture. […] So, the concept of constrained translation has sometimes been used as a label to brand any variety of translation that forced the unwilling theorist to consider the important role of nonverbal elements, including the translation of songs and comics.
>
> (Zabalbeascoa 2008: 22)

The term "screen translation" was suggested as well. Yet, it fails to cover surtitling for the stage and includes the concept of localisation, which is not a usual AVT mode (Remael 2010: 13). Afterwards, the concepts of "multimedia translation" and "multimedia localisation" were proposed. The first one involved both translation for the stage and translation for the screen, taking into account the different media and channels applied in global and local communication, while the second one was only occasionally used just to refer to AVT productions (Remael 2010: 14). AVT has also been referred to as a form of "media accessibility", especially when dealing with subtitling for the deaf and hard-of-hearing (SDH) and with audio description for the blind and the partially sighted (AD) (Remael 2010: 14). Eventually, the most suitable option was deemed to be audiovisual translation, "abbreviated as AVT, which is the most common expression being used currently in English and in many other languages" (Bogucki and Díaz Cintas 2020: 12).

1.2 AVT: Historical Overview

Probably, the first AVT form in history has been the intertitles of silent films, however sound films of the 1920s were the ones that made clear the increasing necessity of translation for AV content (Remael 2010: 12). In 1927, the very first sound film, *The Jazz*

Singer, was displayed and from that moment intertitles ceased to be seen, indicating "the end of the silent film era" and the fact that "the new soundtrack had to be replaced by means of subtitles or dubbing" (Zárate 2021: 1).

Until 1995 AVT has not been investigated or at best under-researched. Two important factors that were decisive for the development of AVT in 1995 were the mobilisation of minorities, who understood that AVT could help them to build up their identity, and the spread of technologies which brought to the development of the Internet and the CD-ROM (Gambier 2008: 13). Since then, AVT has gained more and more recognition in the field of Translation Studies: many conferences, thesis and volumes were written on this subject, especially in Germany, Austria, Belgium, Spain, Finland and Italy (Gambier 2008: 14).

The 1990s were crucial also because of digitalisation, which was much faster than the previous analogue technology and thus contributed to the spread and improvement of AVT: DVD (Digital Versatile Disc) technology could support up to 32 subtitles and dubbed soundtracks in eight languages (Gambier 2008: 25-26). One of the most recent innovation concerns the so called "over-the-top (OTT) media providers", thanks to which "any given programme will be made available accompanied by various sound and subtitle tracks in different languages as well as access services like subtitling for the deaf and the hard-of-hearing (SDH) and audio description (AD) for the blind and the partially sighted" (Bogucki and Díaz Cintas 2020: 15).

A pivotal aspect related to AVT that changed over time relates to AVT norms and guidelines. Norms aim to create a high-quality and easily understandable AV production. They can be explicit, "when norms are codified in guidelines and similar prescriptive instruments", or implicit, i.e. "'unwritten rules that translators follow, often without even thinking about them, or being instructed to do so" (Pedersen 2020: 418). The term "guideline", on the other hand, stands for "the document that sets out the norms that govern the behaviour of practitioners in a community" (Pedersen 2020: 419). Initially, there were simple instructions for intertitles in silent films, but in the late 1920s and early 1930s, with the advent of sound films, new norms had to be created. In the early 1950s, the development of television changed the game once again, especially since norms did not just depend on the different AVT types that were used, but also on the medium and the particular country taken into account (Pedersen 2020: 420-421). For example, Italy is

generally considered a 'dubbing country' – together with Austria, France, Germany and Spain – while subtitling is generally preferred in Greece, Portugal, Scandinavia and the UK (Antonini and Chiaro 2009: 97). Changes in AVT norms and guidelines were also brought about by the development of the personal computer in the 1980s and globalisation in the 1990s. The introduction of computers was particularly important for subtitling, as they "meant shorter exposure times, higher reading speeds and less condensation, giving viewers more subtitled content" (Pedersen 2020: 421). On the other hand, globalisation allowed new AVT companies to prosper and more TV channels to be implemented, with the consequent need to develop new norms, which mostly implied "reading speed, exposure time and line length being standardized" (Pedersen 2020: 422). From the 1990s till the first decade of the 21st century, norms remained quite the same until the development of computer-aided-translation (CAT) tools and MT. Moreover, DVDs, which were used mostly between the 1990s and the 2000s, were replaced by video on demand (VoD) technology, thanks to which streaming AV content has become faster and easier. Finally, in the late 2010s, the development platforms like Netflix, Amazon and HBO required a new revision of AVT norms. For instance, VoD norms began to be focused on English-language guidelines for intralingual subtitles, as they were dominant in English-speaking countries (Pedersen 2020: 422-423).

1.3 AVT and Translation

AVT is "one of the most prolific areas of research in the field of Translation Studies, if not the most prolific one" (Díaz Cintas and Remael 2020: 1). Whitin Translation Studies, Roman Jakobson's (1959, as cited in Venuti 2012: 126) distinctions of the three forms of translation is the most well-established. The author distinguishes between intralingual translation or 'rewording', which is described as "an interpretation of verbal signs by means of other signs of the same language"; interlingual translation or 'translation proper', which is "an interpretation of verbal signs by means of some other language"; and intersemiotic translation or 'transmutation', defined as "an interpretation of verbal signs by means of signs of nonverbal sign systems" (Jakobson 1959, as cited in Venuti 2012: 126).

Following Katharina Reiss (1977/1989), the text is "the level at which communication is achieved and at which equivalence must be sought" (Reiss 1977/1989: 113-114). For this reason, the author distinguishes four text types. The first one is the "informative text type", which is a "plain communication of facts" in which "the language dimension used to transmit the information is logical or referential, [and] the content or 'topic' is the main focus of the communication" (Reiss 1977/1989: 108-109). The second one corresponds to the "expressive text type", i.e. a "creative composition" where "the author uses the aesthetic dimension of language. The author or 'sender' is foregrounded, as well as the form of the message" (Reiss 1977/1989: 108-109). The third one is the "operative text type", which is aimed at

> inducing behaviour responses: the aim of the appellative function is to appeal to or persuade the reader or 'receiver' of the text to act in a certain way, for example to buy a product (if an advert), or to agree to an argument (if a political speech or a barrister's concluding statement). The form of language is dialogic and the focus is appellative.
>
> (Reiss 1977/1989: 108-109)

The fourth and last one consists of "audio-medial texts", like "films and visual and spoken advertisements which supplement the other three functions with visual images, music, etc." (Reiss 1977/1989: 108-109). Based on this distinction, she also delineates some specific translation methods based on these four text types. For informative texts, she suggests that the target text (TT)

> should transmit the full referential or conceptual content of the ST. The translation should be in 'plain prose', without redundancy and with the use of explicitation when required. So, the translation of an encyclopaedia entry of, say, the Tyrannosaurus Rex, should focus on transmitting the factual content and terminology and not worry about stylistic niceties.
>
> (Reiss 1977/1989: 20)

Expressive TTs

> should transmit the aesthetic and artistic form of the ST, in addition to ensuring the accuracy of information. The translation should use the 'identifying' method, with the translator adopting the standpoint of the ST author. So, the translator of James Joyce would need to try to write from the perspective of the author. In literature, the style of the ST author is a priority.
>
> (Reiss 1977/1989: 20)

Operative TTs

> should produce the desired response in the TT receiver. The translation should employ the 'adaptive' method, creating an equivalent effect among TT readers. So, the TT of an advert needs to appeal to the target audience even if new words and images are needed.
>
> (Reiss 1977/1989: 20)

Finally, as regards audio-medial texts Reiss states that they need to follow what she defines as "the 'supplementary' method, supplementing written words with visual images and music" (Reiss 1977/1989: 20).

1.4 Main Types of AVT and Their Functions

AVT can be divided into different "types" or "modes", among which "subtitling and dubbing are […] commonly regarded as the two main AVT modes, with voiceover being the third" (Remael 2010: 12). The spread of AV texts since the 20th century contributed to the development of new AVT modes – e.g. surtitling for the stage, subtitling for the deaf and hard-of-hearing (SDH), live subtitling with speech recognition, intralingual subtitling – as well as to the increase of interdisciplinary research. Changes in AVT, including the development of these types, were mostly due to globalisation, the advent of the TV and the improvement of the film industry, digitalisation, and other technological

advances, which led, for example, to the spread of the Internet and mobile phones (Remael 2010: 12).

1.4.1 Subtitling

Subtitling "consists in rendering in writing the translation into a TL of the original dialogue exchanges uttered by the different speakers, as well as of all other verbal information that is transmitted visually (letters, banners, inserts) or aurally (lyrics, voices off)" (Díaz Cintas 2010: 344).

An important distinction is the one between "interlingual subtitles" and "intralingual subtitles". Interlingual subtitling is "a type of language transfer" in which the subtitles "do not replace the original Source Text (ST), but rather, both are present in synchrony in the subtitled version" (Georgakopoulou 2009: 21). On the other hand, in intralingual subtitling, called "captions" in American English, "the language of the subtitles and the programme coincide" (Díaz Cintas 2010: 347). In particular, intralingual subtitles are most frequently employed in subtitling for the deaf and the hard-of-hearing, which will be discussed later in this chapter. In 2008, YouTube decided to include intralingual subtitles in their AV content to favour their deaf and hard-of-hearing audience, which was possible thanks to a special auto-captioning component of Google's Voice Search. Afterwards, interlingual subtitles were implemented as well through machine translation powered by Google Translate, in order to allow its users to have subtitles in the chosen language just by clicking the CC button on the screen (Bogucki and Díaz Cintas 2020: 18).

Subtitles first appeared at the beginning of the 20th century, first at the cinema, in 1909, and eventually on TV, in 1938 (Perego and Pacinotti 2020: 42). In the past, translators' work was quite different than it is today. For example, they had to write subtitles manually starting from a script because they seldom had access to the film. Further, no specific technical skills were required of them, as technicians were in charge of identifying the errors (Bogucki 2019: 74).

Today, technology is instead crucial for subtitling. Subtitlers are frequently assisted by machine translation (MT) and translation memory (TM) tools during the process (Bogucki and Díaz Cintas 2020: 18). Moreover, they need to be aware of space

and timing conventions. For example, subtitles are usually placed horizontally at the bottom of the screen, excluding Japan where vertical subtitles are allowed. They need to be synchronised with images and dialogues during a process called "synchronisation", which is performed by translators or technicians who can use subtitling programmes (Díaz Cintas 2010: 344). A strategy that is usually helpful to synchronisation is keeping both the same syntactic structure and the same chronology of the ST (Díaz Cintas 2010: 346). Time, or "timing", is also crucial during this process, and it "depends both on the speed at which the original exchange is delivered and on the viewers' assumed reading speed" (Díaz Cintas 2010: 344). Traditionally, the so-called "6-second rule" establishes that "two full lines of around 35 characters each can be comfortably read in six seconds" (Díaz Cintas 2010: 345), while the minimum time is one second.

In addition, subtitles should be coherent, logical, syntactically right and readable. For this reason, in the processes of spotting and line-breaking, words need to be "intimately connected by logic, semantics or grammar should be written on the same line or subtitle whenever possible" (Díaz Cintas 2010: 345). As far as the language is concerned, if the subtitler's first language is not that of the subtitles, he/she could face the so-called "cultural untranslatability" (Bogucki 2019: 80), which mainly affects the passage from oral to written, as some elements, especially cultural references, are particularly difficult to adapt. For instance, different accents and colloquialisms, as well as swearwords and taboo expressions, are not always reproduced in subtitles, as they are thought to be more offensive when written (Díaz Cintas 2010: 346).

As regards the elements that can be omitted in subtitling, Irena Kovačič (1991: 409) offers a three-level hierarchy. On the top, there are indispensable elements, which must be translated; then partly dispensable elements, which can be shortened; and, finally, dispensable elements, which can be completely omitted if necessary. In this scenario, redundancy in a case in point (Bogucki 2019: 53-54). AVT and subtitling are frequently referred to as constrained forms of translation, as they are reductive and, sometimes, they need to adapt the original text. In particular, reduction in subtitling is the principal strategy. It is applied to redundant fragments of original dialogues, which are left out in the target-language subtitles. Examples include hesitations, elements of linguistic politeness, wrong starts, repetitions and linking expressions (Bogucki 2019: 54). Reduction can be partial if just some parts of the original are omitted, or total when the

original is completely absent in the TT. Either way, information which is explicitly conveyed by images should not be translated, while subtitlers should be careful not to remove crucial and pivotal elements of the ST (Díaz Cintas 2010: 346). Other strategies that are used by subtitlers include (Dewi, Jaswadi and Wardana 2024: 87-89):

- condensation, in which sentences of the ST are summarised when transferred to the TT without replacing the original meaning;
- imitation, which is used to maintain the same components of the ST without translating it in the TT;
- paraphrase, thanks to which elements of the ST are modified while keeping the same message conveyed by the TT;
- transcription, where a third language or a language that is hard to translate is used for the TT as they convey the same writing of the ST;
- deletion, which is used to completely remove some irrelevant parts of the ST.

1.4.2 Dubbing

Dubbing is "a type of interlinguistic audiovisual translation which presupposes complete change of the sound track of the source language into soundtrack of the target language with the aim of broadcasting in countries where the original language is not their mother tongue" (Matkivska 2014: 39-40).

Dubbing needs to be adapted to the existing standards of the target language (TL) and audience. Dubbers work with the script and the video at once, where the script contains information about the text or the video, such as text length and intonation (Matkivska 2014: 40). As for subtitling, synchronisation and spotting are key techniques for dubbing as well. Synchronisation is carefully carried out by audiovisual translators who "rephrase, condense or adapt the text so as to match the images and the time slots available" (Ortiz-Boix 2016: 281), while spotting consists of "defining in and sometimes out time codes of each voice-over or off-screen dubbing unit" (Ortiz-Boix 2016: 281).

As mentioned earlier in this chapter, countries can be divided according to their preferred AVT type. In Europe, in particular,

> countries where the FIGS languages – that is, French, Italian, German and Spanish – are spoken, along with the Czech Republic, Slovakia and Hungary, have traditionally preferred dubbing, while Poland, Russia, Ukraine and the Baltic states are well known for their voiceover practices. Subtitling is favoured in the remaining countries.
>
> (Bogucki and Díaz Cintas 2020: 13)

While, outside Europe, "dubbing has been coveted in nations with large populations like Brazil, China, India, Iran, Japan, Pakistan, the Philippines and Turkey" (Bogucki and Díaz Cintas 2020: 13). This distinction between subtitling and dubbing countries is due to several factors. For example, dubbing countries are mainly the ones that have experienced authoritarian regimes, in which censorship is frequently used, such as for original dialogue soundtracks. Moreover, dubbing is preferred in illiterate or less educated countries as the majority of the population cannot read subtitles. Subtitling, on the other hand, is closely related to commercial reasons, as it is way cheaper and faster than dubbing, but it is also linked to language reasons, as it is preferred by people who would like to hear or improve their language skills in a foreign language. Finally, there are countries in which public service broadcasters use dubbing, while in other countries the private TV apply subtitling. As for social media, these "have made of subtitling the main tool of globalisation all over the world" (Bogucki and Díaz Cintas 2020: 14).

Interestingly, dubbing was one of the last AVT modes to implement MT and other AI tools. They are used mostly for non-fiction genres with "a very restricted audiovisual configuration, specific terminology and usually involving off-screen voices or only one character speaking in front of the camera" (De los Reyes Lozano and Mejías-Climent 2023: 6). At the same time, however, relevant international companies like Google, Amazon and Disney have decided to add automatic dubbing in their systems, in order to automatically replace "the audio track of an original audiovisual text with synthetic speech in a different language, taking into consideration the relevant synchronies" (De los Reyes Lozano and Mejías-Climent 2023: 10).

Recently, OTT (over-the-top) media providers have contributed to the development of AVT productions, especially the ones related to subtitling, dubbing and voice-over. Professional translation has been placed side by side with other amateur

activities, such as fansubbing and fan/fundubbing (Perego and Pacinotti 2020: 47). The first example of fansubbing appeared in the 1980s in the US, where people wanted to have access to Japanese anime that were becoming more and more popular in those years, and they also wanted a more precise translation as they featured several interesting cultural references (Perego and Pacinotti 2020: 47). Fan/fundubbing "is home-made dubbing produced non-professionally by fans for fun"; for this reason, fan/fundubbers "use their own voices to replace and lip-synch the original lines" (Perego and Pacinotti 2020: 48). It was born in the 1990s but it did not become as famous as fansubbing and it was mainly applied to cartoons, anime, trailers, TV series and parodies of famous blockbuster films.

Lip-synchronisation dubbing, also called lip-sync, is a process that aims to imitate "the lip movements of the original actors in a way that the audience does not notice eye-catching violations at all" (Matkivska 2014: 39). Generally speaking, it is considered the most famous form of revoicing. It is usually carried out by professional actors (Matkivska 2014: 40) and it is employed in the translation of films, TV series, and sitcoms (Díaz Cintas and Anderman 2009: 4). Voice is a very important element in AV productions, as it conveys information, such as the atmosphere of a situation as well as the moods and emotions of the characters. Both voice and intonation communicate precious information about the speakers and the context of the utterance. Intonation usually changes from language to language, and, similarly, pitch, stress, rhythm and volume depend on many factors. Some elements are, however, considered to be universal, e.g. those concerning the expression of emotions like pain, joy and sadness (Tveit 2009: 93).

In his *Linguistic and psychological problems of film synchronization*, Fodor (1969, as cited in Díaz Cintas and Orero 2010: 443) identifies three different types of synchrony, which are phonetic synchrony, character or kinetic synchrony, and isochrony. The first type is most commonly referred to as "lip sync(hrony)" and it "takes care of fitting the target text into the mouth openings of the onscreen characters, particularly in instances of close-ups" (Fodor 1969, as cited in Díaz Cintas and Orero 2010: 443). For this reason, translators need to focus on syllables and letters more than on whole sentences with the aim of creating dialogues which appear identical to the original ones when overlapped with images and sounds. To this end, translators can rely on some strategies, such as "the adjustment of the rhythm at which the final text is delivered, the deletion of

some words, and the introduction of padding expressions" (Fodor 1969, as cited in Díaz Cintas and Orero 2010: 443). The second type was originally called "character synchrony" by Fodor and then renamed "kinetic synchrony" by Whitman-Linsen (1992: 19). It consists of ensuring that dialogues and images are visually synchronised so that if characters shake their head during a particular scene, their words will be negative as well. Lastly, isochrony aims to guarantee the synchronicity between the duration of both the translated dialogues and the original ones so that "the utterances can be comfortably fitted between the moments the actors open and shut their mouth" (Fodor 1969, as cited in Díaz Cintas and Orero 2010: 443).

1.4.3 Voice-over

When dealing with voice-over, Yves Gambier (2003: 172) notices there is a connection between voice-over (VO) and dubbing, which is why he defines the first one as "half-dubbing". However, the main distinction between these AVT types is that VO "is used to translate the words of interviewed experts and spontaneous dialogue, generally on camera". In contrast, "off-screen dubbing is mostly used for narrators off-camera" (Ortiz-Boix 2016: 289). So, generally speaking, voice-over is "the final product we hear when watching a programme where a voice in a different language than that of the original programme is heard on top of the original sound-track" (Orero 2009: 132). Usually, voice-over translation follows three main constrains. The first one concerns time, as VO translation needs to be done within a very short period of time; the second one deals with the fact that written texts are not provided to translators, so much that they need to translate from the screen; finally, according to the third one, translators need to work with unedited material that will be then translated and checked by other professionals (Orero 2009: 137). Moreover, VO "does not usually show regional accents in the target text and does not generally reproduce specific oral features such as fluffs, hesitations or grammatical mistakes" (Ortiz-Boix 2016: 273). It consists of orally translating a ST while the SL voices can still be heard under the translation. The most common technique involves keeping both the translation and the original soundtrack that can be heard in the background. The original can usually be heard a few seconds before the translation starts; the original soundtrack is then lowered so that viewers can easily hear the translation. The

translation ends some seconds before the original and the sound is raised again to allow the viewers to follow the original soundtrack once more (Díaz Cintas and Orero 2010: 441).

1.4.4 Respeaking

Respeaking can be described as "the production of real-time subtitles by means of speech recognition software transcribing a simultaneous reformulation of the source text dictated by the operator, or respeaker, to the computer" (Eugeni 2008: 38).

Its origins seem to be connected to Horace Webb, an American court reporter who conducted some experiments on the matter in the early 1940s. Back then, the term "respeaking" was not used, but this process was referred to as "voice writing". Although speech recognition and live transcription were not present yet, the principal features of respeaking had already been developed.

Respeaking was firstly used in the US in 1999, when another court reporter named Chris Ales decided to write down a meeting in the Circuit Court in Michigan with a particular ASR software tool known as Dragon Naturally Speaking (Romero-Fresco and Eugeni 2020: 271). Respeaking is also a type of "isosemiotic translation", meaning it applies the oral-acoustic channel for the acquisition of the ST and the creation of the TT, even though the respeaker does not produce the TT, but a "middle text" which is then translated by a speech recognition software (Eugeni 2008: 38). Accuracy is fundamental, because making mistakes is relatively easy in such a complex process (Bogucki 2019: 43). In order to create an accurate product, respeakers do not need just their own skills, but they also have to rely on speech recognition software, which will make their work simpler and less time-consuming (Bogucki 2019: 29). The BBC is reported to be the television broadcaster with the most important respeaking tradition in the world (Eugeni 2008: 39).

1.5 Media Accessibility in AVT

Nowadays, media accessibility has raised much interest in the field of AVT, especially when it comes to subtitling for the deaf and hard-of-hearing (SDH), also called "closed caption (CC)" in American English (Szarkowska 2020: 249), and to audio description (AD) for the blind and the partially sighted (Bogucki 2019: 24). These are the principal forms of accessibility in AVT and, specifically, SDH is the most well-known type of intralingual subtitling for hearing-impaired people (Díaz Cintas 2010: 347), while AD is a particular case of revoicing for visually impaired people (Bogucki 2019: 27).

1.5.1 Historical context of SDH

SDH history begins with the development of intertitles, also known as "title cards". They were written in white on a black background and described as "short sentences, drawn or printed on paper, filmed and placed between sequences of the film" (Zárate 2021: 1). Even though intertitles were not created explicitly for hearing-impaired people, they turned out to be the best solution for them as all sound-related components appeared on the screen, which allowed them to easily access every AV production (Zárate 2021: 2). Today, most of SDH is intralingual, meaning it is carried out using the same language of the ST, but it can be interlingual as well, implying that the final product will be a translation in the language spoken by the hearing-impaired audience (Szarkowska 2020: 250). In subtitling countries, SDH is easily conveyed by traditional interlingual subtitling, thanks to which spoken dialogues and other sound-related elements can be translated into the target language, while in dubbing countries, SDH is specifically created for deaf and hard-of-hearing people when it comes to foreign AV productions. Similarly, SDH is expressly produced for them in countries which prefer VO, as foreign AV products could not be accessed otherwise (Szarkowska 2020: 250).

In 1947, Emerson Romero, himself deaf, developed the first attempt of SDH by using a "text-only frames" method between the scenes of AV productions, as it happens in intertitles (Szarkowska 2020: 257). The first film with subtitles was displayed in 1949 in London thanks to J. Arthur Rank's idea of showing subtitles on a smaller screen in the lower left corner of the bigger screen (Szarkowska 2020: 257). It was again in the UK that the first TV programme with SDH audience was transmitted in 1979, in particular

using Ceefax, which is "the world's first Teletext information service, developed by the British Broadcasting Corporation (BBC) in 1971" (Zárate 2021: 2). In Europe, the first countries that introduced SDH in the 1980s were Belgium, France, West Germany, Italy and the Netherlands, followed by Portugal and Spain in the 1990s (Zárate 2021: 2). On the other hand, the United States were the country that first provided CC for a film, precisely for *The French Chef*, which was "aired in 1972 on WGBH, the Public Broadcasting Service (PBS) station licensed to Boston, Massachusetts" (Zárate 2021: 2). Live subtitling, also called "real-time captioning", were first presented by the National Captioning Institute (NCI) to some live events. To this followed the increasing demand for live subtitling, which, during the 1990s, was provided through stenography until a more modern and economical technique called respeaking was introduced in the 2000s. Thanks to this, live subtitling spread rapidly first in the US and the UK, and then also in some European countries like Belgium, Germany, Spain, France and Italy (Zárate 2021: 3).

1.5.2. Legislation and accessibility

Legislation on accessibility began to be issued in 1959 in the US thanks to the Captioned Film Act and the directives of the Federal Communications Commission (FCC) that aimed to find suitable solutions to allow access to all services for the deaf and hard-of-hearing in America (Szarkowska 2020: 258). In Europe, there are both national directives and EU regulations that each Member State had to follow. The most recent EU regulation is Directive 2018/1808 according to which "media service providers should cater for the needs of viewers with disabilities, and required the providers to regularly report to national regulatory bodies how they implement their accessibility services and meet the requirements" (Szarkowska 2020: 258).

Internationally, the Convention on the Rights of Persons with Disabilities (CRPD) "is an international human rights treaty issued by the United Nations and aimed at protecting the rights and dignity of people with disabilities" (Zárate 2021: 6). Currently, 164 countries all around the world are signatories", meaning they have signed the Convention, and 191 countries are "States parties", as they have ratified it (United

Nations, 2006, art. 18)[1]. The main difference between signing and ratifying the Convention is that signing it means agreeing with the Convention and wanting to carry on with the established procedure while ratifying it indicates that those countries are legally tied to the Convention (Zárate 2021: 6). An important change related to the CRPD was the switch from analogue TV to digital TV in all Member States, which allowed "greater flexibility, higher-resolution pictures, better sound quality, the use of a wider range of colours and a multitude of complex fonts" (Zárate 2021: 7-8). Today, the right to accessibility in Europe is guaranteed by the well-known Audiovisual Media Services Directive (AVMSD).

As far as national regulations are concerned, examples like the FCC in the US and the Office of Communications (Ofcom) in the UK take care of determining quality standards, guidelines and targets for SDH. Specifically, the FCC establishes that captions' main features should be accuracy, as they need to suit verbal elements and add nonverbal components when necessary; synchronicity, keeping in mind that captions should match spoken words, dialogues and sounds; completeness, meaning captions need to be visible throughout the entire programme; and placement, as they should not be put on top of other visual elements (Szarkowska 2020: 258-259).

With respect to cinema, subtitles are usually provided by distributors, especially when it comes to mainstream productions, but not all AV screenings are available for a deaf and hard-of-hearing audience. For instance, in the UK, productions coming from large and medium distributors usually contain SDH, while it is not always available for the ones coming from independent distributors, as it depends on the budget available. On the contrary, American legislation demands that "cinemas have and maintain the equipment necessary to provide SDH at a film patron's seat when showing a digital movie which is made available with subtitles" (Zárate 2021: 11). At the same time, in the UK subtitles in cinemas are frequently "open", which means that everybody can see them through the entire production, being them deaf or hard-of-hearing or not. However, specific solutions for hearing-impaired people have been attempted as well, such as the Sony glasses for subtitles, thanks to which subtitles can be seen on the screen just when people wear them. This solution is widespread in the US, but it has not become equally

[1] https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=iv-15&chapter=4&clang=_en (last accessed on 4/11/2024)

successful in other parts of the world (Zárate 2021: 12). In 2014, a further option, i.e. the "Off-Screen Cinema Subtitle System", was developed thanks to which people wearing appropriate glasses could see the subtitles in a particular display placed below the main screen, so that the rest of the audience could watch the film without subtitles (Zárate 2021: 12). Finally, in 2020, the London Short Film Festival presented the "first UK pilot in cinemas of the National Theatre's smart-caption glasses at the British Film Institute (BFI)" (Zárate 2021: 12), during which people could watch some AV productions while wearing these special glasses for subtitles.

1.5.3 Main features of SDH and AD

From a medical point of view, there is a difference between being deaf and being hard-of-hearing. The impairment of deaf people is so severe that they cannot grasp linguistic information through their hearing while hard-of-hearing people can catch some sounds as the hearing loss is not total, even though it can be permanent in some cases (Neves 2009: 154). Juridically speaking, a person is recognised as deaf "only when s/he has lost more than 70 decibels of hearing before the age of 12 or if s/he has lost her/his hearing because of military or civil reasons" (Eugeni 2008: 40). There is also a cultural difference between these two conditions. Deaf people usually recognise themselves to be part of the deaf culture or community, which includes all individuals whose main channel of communication is the visual one, and they are a minority with their own language, the national sign language, and their own identity that differs from the hard-of-hearing and hearers ones. In particular, deaf people's first language is different from the one spoken in the country they live in, which is the reason why they are usually considered to be bilingual and bicultural (Neves 2009: 154). On the other hand, hard-of-hearing individuals are not a minority but they consider themselves as a part of the hearing group. This is because they developed this partial hearing loss during their life, but they were born and raised as hearing individuals, and their first language is the national one (Neves 2009: 155). Similarly, the reading competence of deaf individuals is different from that of hearing and hard-of-hearing people, which is why the reception of subtitles is different as well. Subtitles are a support and a memory exercise for the hard-of-hearing and are the only way deaf individuals can access AV products. For this reason, redundancy is key to

facilitating access to acoustic and visual elements and guaranteeing an easier reading of the subtitles to these people, which is why images, sounds and dialogues usually are very redundant (Neves 2009: 156).

From a more technical point of view, SDH include dialogues, sounds, music, speakers' identification and other non-verbal elements. For instance, SDH can use name tags, colours and "speaker-dependent placement" (Szarkowska 2020: 253) to identify different speakers in an AV product. Name tags can be positioned in parentheses, square brackets and capital letters before the actual dialogue to facilitate deaf and hard-of-hearing people to identify who is talking. Colours are used for the same purpose, and usually the same colour is attributed to the same character not to create confusion among deaf and hard-of-hearing viewers. Finally, the so-called "speaker-dependent placement" is employed to place the subtitles in specific areas of the screen according to where characters are to be found in the scene (Szarkowska 2020: 253-254). Speech and non-speech sounds are also conveyed by SDH. For example, speech sounds can be "accents ('in a British accent'), manner of speaking ('whispers'), foreign language ('in French')" (Szarkowska 2020: 254), while non-speech sounds include music, silence, pauses, ambient sounds and other onomatopoeic words. A particular case is music, as there are several ways in which it can be added to the subtitles. It can be described by focusing on its genre, such as "jazz", "classical music", "instrumental music", "cheerful music". The name of the singer or the compositor can be added whenever he/she is famous. Lyrics can be included as well by adding a note (♪) and the beginning or at the end or both of the subtitle or by adding a # symbol, as it is usually done in the UK (Szarkowska 2020: 255). AD appeared for the first time in the US in the 1960s. In the 1970s, it started to be researched and, in the 1980s, it was finally implemented as a AVT type. It seems to be particularly efficient in English-speaking countries, being interlingual AVT less necessary for these audiences (Bogucki 2019: 25).

Usually, AD is produced by a group of two or three people, in which one of them is blind, as the aim is to create a more accurate product as possible. The process is generally divided into three main stages. In the first one, all the material that will be audio described is examined; the second stage consists of producing the script and the commentary, following the original chronology; in the last stage, the script is turned into the audio description, which will be orally delivered (Bogucki 2019: 25). In so doing,

audio describers need to follow industry standards, being the Independent Television Commission Guidance on Standards for Audio Description the most common one. These standards were set thanks to "questionnaires, viewing sessions, setting up focus groups and interviews" in order to analyse visually impaired audience's "viewing habits, expectations, difficulties in following audiovisual content, and product quality" (Bogucki 2019: 26). When audio describing, frequent mistakes are overinterpreting, spoiling the plot and employing complicated structures or sentences. Additionally, audio describers need to be objective when describing the scenes, avoiding giving their personal interpretation. And they are also required to differentiate essential elements that need to be reported from optional features that can be omitted (Bogucki 2019: 26).

CHAPTER 2
AUTOMATION AND AUDIOVISUAL TRANSLATION

Since the beginning of the 20th century, technology and automation have had a pivotal role in access to the internet and the spread of AVT, especially for subtitling and dubbing, and has allowed reaching more and more people around the world (De los Reyes Lozano and Mejías-Climent 2023: 2). The impact of automation in AVT is the focus of this chapter, which explores different types of translation-oriented automation systems, i.e. translation memories (2.1), machine translation (2.2) and artificial intelligence (2.3), with an eye to the guidelines to the use of automated output in AVT products (2.4).

2.1 Translation Memories

A translation memory (TM) is a "database that stores segments of texts that have been previously translated" (O'Brien 2022: 111). TMs help translators to "re-use previously translated segments improving the consistency of translations and increasing translators' productivity" and are the most used computer-aided translation (CAT) tools in modern translation (Schneider, Zampieri and van Genabith 2018: 734).

TMs were first conceptualised in the 1970s, but they started to be on the market only in the 1990s (Screen 2016: 1), when translators "working in the burgeoning software localization industry" (Kenny 2022: 30) noticed that very frequently the documents they were translating contained similar information, even within the same document, that they had to translate for scratch. Hence, to improve this time-consuming process, they created a "translation memory tool" that made their work easier and faster, which is "the software application that is used to access, edit and update the text in this database" (Torres-Hostench 2022: 11). A CAT tool usually works on a segment base, i.e. by dividing the ST into sentences or paragraphs, depending on the segmentation settings. Every time a segment is translated, it is saved together with its corresponding SL segment in the TM so that it be later retrieved for reuse any time a match with a new ST segment is detected by the CAT tool (Nitzke and Hansen-Schirra 2021: 44). During the translation process, a CAT tool can suggest "exact matches", i.e. 100% matches, or "fuzzy matches", i.e. having

a 75% or higher affinity, from the TM(s) and the translator can decide whether to use the suggested translation, to edit it or to offer a completely new translation of the segment. TMs can be used on their own or in combination with termbases, dictionaries and MT systems (Nitzke and Hansen-Schirra 2021: 44).

TMs can be created in different ways. Translators can start from their own translations and save them in a single TM or multiple TMs according to specific parameters, such as the text type, the domain, and the client. TMs can also be created by others and later imported into the CAT tool, e.g. when "clients […] deliver a translation memory containing the translations of other translators" (Nitzke and Hansen-Schirra 2021: 44). TMs can be populated through translation or alignment, i.e. by importing translation units from previously translated texts aligned with their corresponding STs (Nitzke and Hansen-Schirra 2021: 44).

Using a TMs is beneficial for translators, as redundant and time-consuming work is reduced (Nitzke and Hansen-Schirra 2021: 44) and errors are very rare, as a TM is generally kept up-to-date and well-preserved (O'Brien 2022: 112).

2.2 Machine Translation

Machine translation (MT), "is the translation, by means of a computer using suitable software, of a text written in the *source language* (SL) which produces another text in the *target language* (TL) which may be called its *raw translation*" (Forcada 2010: 215).

2.2.1 Brief history of MT

As stressed by Dorothy Kenny (2022: 32), MT "was one of the first non-numerical applications of the digital computers that emerged in the aftermath of the Second World War". In its summary of the history of MT, Thierry Poibeau (2017: 31-33) suggests that automatic translation began to be taken into account around the 1940s, but since it could not be tested back then, it was not possible to put it into practice. From the 1940s to the 1960s, the rise of the first computers permitted the development of the first MT systems, and in the early 1950s, several researchers, such as Joshua Bar-Hillel and Rudolf Carnap, started to propose the first approaches to MT.

A major milestone in the history of MT is the ALPAC Report by the Automatic Language Processing Advisory Committee, published in November 1966 (Poibeau 2017: 57). In 1964, a group of experts was asked by American funding agencies of MT programmes to develop the ALPAC Report to stress the importance of translation and show the progress of MT systems. However, the report concluded that the research done until that moment was inaccurate and funding was being drastically reduced. It also pointed out that more research had to be done taking into account both computers and linguistics in order to guarantee progress in text comprehension (Poibeau 2017: 32).

In the 1980s, MT was not very prolific in the US, but some new groups of scholars in Europe and in other countries put their efforts in this field, and in the 1990s a new approach became popular, which considered both statistics and large bilingual corpora. This was largely the fruit of the work by an IBM research group from Yorktown Heights, New York, between the 1980s and the 1990s, who "decided to develop a machine translation system based on techniques initially developed for speech transcription" (Poibeau 2017: 89). After this first IBM model, based on the simple idea that any word of a TL can be translated into any other word of the SL, other IBM models followed, which were more and more precise, improved and based on statistics as well as on bilingual corpora (Poibeau 2017: 101).

As reported by Nitzke and Hansen-Schirra (2021: 16), the first patents for the so-called "translating machines" were proposed by Georges Artsrouni and Petr Troyanskii back in 1933, but they remained unknown until the end of the 1950s. The main symbol of the research on MT seems to be a memorandum written by Warren Weaver in 1949 called *Translation*, as it allowed more and more people to know and read about this specific topic for the first time. In 1952, the MIT hosted the first conference on MT, which talked about "pre-editing and post-editing, controlled language, domain restrictions, syntactic analysis as well as computer hardware, programming and funding" (Nitzke and Hansen-Schirra 2021: 16). Few years later, in 1968, the first commercial statistical machine translation system (SMT), called Systran, was built (Nitzke and Hansen-Schirra 2021: 18). In 1992, automatic evaluation of MT developed, while 1993 saw the launch of the first commercial computer-assisted translation tool, named TRADOS (TRAnslation and DOcumentation Software) (Nitzke and Hansen-Schirra 2021: 19). 1997 was an important year too, as the first free online MT tool was presented to the world under the

name “Babel Fish” by the American search engine Alta Vista, which was then suspended in 2008. Between 2001 and 2005, the so-called “BLEU score” (“Bilingual Evaluation Understudy”) was created. Its main aim was to compare reference human translations with machine-translations output in order to find similarities between the two (Nitzke and Hansen-Schirra 2021: 20). Afterwards, in 2002, Language Weaver, “the first company to commercialise a statistical approach to automatic language translation and natural language processing” (Nitzke and Hansen-Schirra 2021: 20), was founded by Kevin Knight and Daniel Marcu. In 2006, Google Translate became accessible to everyone. Its most interesting aspect was that it used a statistical MT system. In the same year, Google was also one of the first to present a neural machine translation (NMT), which was called “Google Neural Machine Translation system (GNMT)”, in order to improve fluency and correctness in its systems (Nitzke and Hansen-Schirra 2021: 21). In 2006, the CAT tool SDL Trados Studio 2017 implemented a “self-learning machine translation engine” (Nitzke and Hansen-Schirra 2021: 21) with adaptive MT, and in 2017 Linguee presented a new NMT system named DeepL.

2.2.1 Types of MT systems

Over the years, different approaches for the automation of the translation process were developed. These include “ruled-based machine translation (RBMT)”, “example-based MT”, “segment-based MT”, “statistical machine translation (SMT)” and “neural machine translation (NMT)” (cf. Kenny 2022: 35; Nitzke and Hansen-Schirra 2021: 22; Poibeau 2017).

RBMT systems “attempt to define the individual characteristics of the source language and how these need to be converted into the target languages” (Nitzke and Hansen-Schirra 2021:22). They can adopt three different approaches, i.e. “direct MT”, which involves morphological analysis of ST words which will then be searched for in a dictionary, “transfer-based MT”, which uses a grammar with bilingual transfer rules that will help the production of the TT, and “interlingua-based MT”, used for multilingual systems and which requires an Interlingua, either by a natural or an artificial language, so that the ST can be translated into the Interlingua and then into the TL (Nitzke and Hansen-Schirra 2021:22).

SMT and NMT are instead "data-driven machine translation", thanks to which "translation problems and their solutions can be captured at segment level in the translation units stored in translation memories and other parallel corpora" (Kenny 2022: 36). In particular, SMT "generate[s] a translation from a parallel training corpus by calculating the most likely equivalent of a source word/phrase/sentence in the target language" (Nitzke and Hansen-Schirra 2021: 24). These models need corpus data to be created, which can be both mono- or bilingual corpora. The main benefit of SMT systems is that they usually make the same mistakes until they are expanded with other corpora, which means that errors are predictable and thus easy to detect and correct.

SMT systems use small components of neural networks for the translation process, while NMT systems construct larger neural networks and use training data to learn in an automatic way (Nitzke and Hansen-Schirra 2021: 25). For this reason, NMT is thought to be the most efficient type of MT, but it also has some disadvantages and limitations. For example, NMT systems work with one sentence at a time, meaning they are not able to 'understand' that similar words or phrases were present in the previous sentence or will appear in the next one. Moreover, they usually produce fluent outputs that can, however, be inaccurate, which is why extra care is necessary during the post-editing process (Kenny 2022: 43). A well-known example of NMT system is DeepL Translator, created in 2016 with the purpose of processing high-quality translations. Nowadays, it can translate from and into more than 20 languages, in both a formal and informal register (Bellés-Calvera and Caro 2021: 144).

Example-based MT was first developed in Japan in the 1980s by Makoto Nagao, as he observed that RBMT systems were becoming more and more difficult to use and to maintain (Poibeau 2017: 79). Moreover, he understood that bilingual corpora were extremely helpful, as they are composed of many fragments of translation and information that can be cleverly applied to the translation "rather than trying to develop new dictionaries and new analysis or transfer rules between the languages at hand" (Poibeau 2017: 79). Example-based MT works following the stages: a first stage in which the system collects all fragments in the corpora that could be useful for the translation process; a second stage where the system analyses the equivalences of the TL; and a third stage that consists of the incorporation of all translation fragments in order to form an exact translation in the TL (Poibeau 2017: 80).

In the late 1980s, the development of the first IBM model was the starting point of other IBM models that "include different optimizations to deal with multiword expressions in the target language, or with words with no equivalent in the other language" (Poibeau 2017: 93). In particular, between the 1990s and the 2000s, the idea of translating segments was first introduced in these IBM models, whereas previously only words were taken into consideration for translations (Poibeau 2017: 101). This was quite a helpful solution that permitted to better understand the overall context and to have a final high-quality translation. The quality of the output is closely related to the training data: which means that the larger the dataset, the more accurate the translation. However, some problems can occur when the system cannot always recognise the right piece of information among all the translation fragments (Poibeau 2017: 104). This is the reason why, nowadays, the statistical approach is preferred. In fact, the example-based and the segment-based approaches are functional just when similar languages are implicated, as they probably share parallel linguistic structures, as it happens with French and English or German and English (Poibeau 2017: 110). SMT systems not only need a large corpus of bilingual texts, but some of them also consider English as their pivot language because, most of the time, there is not enough data for all languages, as in the case of Greek and Finnish, for which the most suitable solution is to translate Greek into English and then English to Finnish (Poibeau 2017: 112), even though this multiple translation often produces mistakes.

2.2.3 MT evaluation

MT is believed to be "imperfect technology" (O'Brien 2022: 105), as in the same text it can suggest perfectly accurate and faulty translation, omissions or additions and stylistic issues. Today, the great majority of evaluation models are error-based, meaning that errors are "counted, classified and weighted according to their severity by a senior translator or reviewer" (Castilho et al. 2018: 14). Some examples of errors produced by MT can be grammatical errors, syntactic errors, additions or omissions, lexical or terminological errors, collocational or stylistic errors. All these issues usually depend on various factors, such as "the language pair and direction, the content type, and the data or techniques used to train the MT engine" (O'Brien 2022: 106).

Translation quality is normally due to several factors. For instance, different solutions can be acceptable for the same ST, which makes translation evaluation not always objective. This is all the more so in the case of human evaluators, who might be biased by their subjectivity and can have different ideas on the quality level of the same translation (Rossi and Carré 2022: 53). Human evaluation usually resorts to two main criteria when assessing a translation, i.e. adequacy and fluency. Adequacy is needed to measure "the amount of meaning in the source segment that is rendered in the machine-translated segment" (Rossi and Carré 2022: 57). Fluency is needed to understand whether the translation adheres to the rules of the TL or not (Rossi and Carré 2022: 57). According to Castilho et al. (2018: 18), both these criteria "are typically assessed using ordinal scales in the form of Likert scales" (Castilho et al. 2018: 18), which usually takes into account just sentences or segments but not the overall context. In particular, adequacy is measured on a scale from 1 to 4, in which 1 indicates that the MT segments do not convey the same meaning as the ST segments, and 4 expresses that both MT and ST segments convey the same meaning.

Similarly, as far as fluency is concerned, evaluators take into account the TT more than the ST and rank each segment on a scale from 1, i.e. no fluency, to 4, i.e. "native-like segment" (Rossi and Carré 2022: 57). This type of evaluation can be time-consuming and expensive. Thus, as an alternative method, the outputs produced by two MT systems are contrasted to determine which achieves higher quality without necessarily explaining the reasons. In 2017, Microsoft applied this approach so that its users could evaluate the outputs proposed by its SMT and NMT (Rossi and Carré 2022: 57). Other criteria used in human evaluation are readability, comprehensibility, and acceptability. Readability refers to the level of easiness with which the TT can be read. Readability measures normally focus on both linguistic and extra-linguistic aspects, e.g. word frequency, sentence length, formatting and spacing (Castilho et al. 2018: 18). Comprehensibility specifies if a given text is easily understandable for its readers or not, which is why it is highly dependent on the different readers of the text, while readability is based just on the text. Generally, it is measured on Likert scales or through "cloze testing", also called gap-filling, to analyse the amount of information people can recall after reading a text. Finally, acceptability "refers to the degree to which the target or output text meets the needs and expectations of its reader(s) or user(s)" (Castilho et al. 2018: 20) and it is divided into

other subcategories, that are usability, satisfaction and quality. A possible scale to measure acceptability is provided by Castilho et al. (2018: 18) and is visible in Figure 2.1.

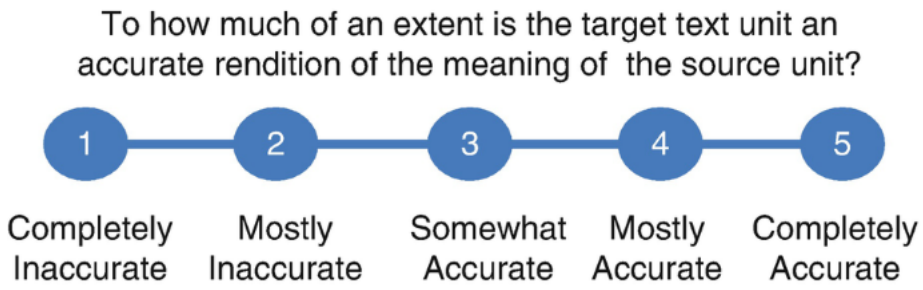


Figure 2.1: An example of an operationalised measure of accuracy from a TQA task in an MT research project (Castilho et al. 2018: 18).

MT evaluation can also be automatic. As opposed to human evaluation, automatic evaluation is deemed to be more objective and low-cost. However, automatic evaluation is also believed to be less understandable and accurate than manual one, as it does not specify the type of errors found in the translated text (Castilho et al. 2018: 25). In addition, automatic MT evaluation metrics "compare the output of an MT system (the so-called translation hypothesis) to one or several reference translations, which are assumed to be good, because they are human quality" (Castilho et al. 2018: 25).

One of the first metrics was the Word Error Rate (WER) applied by Nießen et al. (2000, as cited in Castilho et al. 2018: 25). One of the most widely used is the Bilingual Evaluation Understudy (BLEU), which is a string-matching metric (Karakanta 2022: 174) that considers the number of matching and word order and that "represents the n-grams shared between a candidate machine translation and a reference translation" (Rossi and Carré 2022: 71). In particular, "BLEU scores are usually computed over entire corpora, not individual sentences" (Rossi and Carré 2022: 72), which could be a problem as precision metrics "can be tricked by systems that produce translations only for words the system is sure of" (Rossi and Carré 2022: 72). This is the reason why BLEU applies the so called "brevity penalty", which is "the ratio between the number of words in the candidate translation and in the reference translation" (Rossi and Carré 2022: 72).

2.3 Artificial Intelligence (AI)

The first and most well-known definition of artificial intelligence (AI) is attributed to John McCarthy and his colleagues (McCarthy et al. 1955, as cited in Kavanagh 2019: 13), who in 1955 described it as the process of "making a machine behave in ways that would be called intelligent if a human were so behaving". More precisely, AI is "concerned with not just understanding but also building intelligent entities – machines that can compute how to act effectively and safely in a wide variety of novel situations" (Norvig and Russell 2020: 1).

2.3.1 Historical outline of AI

The first work dealing with AI is considered to be the one developed by Warren McCulloch and Walter Pitts in 1943 (Norvig and Russell 2020: 17). Nonetheless, the very first proposal of AI as a "system to increase human knowledge and understanding" (Antebi 2021: 31) was made by Vannevar Bush in 1945. In 1947, Alan Turing began to hold some lessons on this subject at the London Mathematical Society (Norvig and Russell 2020: 17) and in 1950 he published an article about "the capabilities of machines to simulate human beings and their ability to perform intelligent actions such as playing chess" (Antebi 2021: 31). In the same year, Marvin Lee Minsky and Dean Edmonds developed the first neural network computer, called the "SNARC".

The name "artificial intelligence" was first used and coined by John McCarthy, who held the first academic conference on AI in 1956, and by Marvin Lee Minsky, according to whom AI was "the science of making machines do things that would require intelligence if done by men" (Minsky 1968, as cited in Antebi 2021: 31).

The history of AI can be understood thanks to three main waves (Antebi 2021: 32). These were delineated by the Defense Advanced Research Projects Agency (DARPA) of the US Department of Defense by considering four main capabilities:

1. Perceiving: the ability to discern global events.
2. Learning: the ability to learn things and adapt to various situations.
3. Abstracting: the ability to take knowledge discovered at a certain level and to deduce from it or apply it to another level.

4. Reasoning: the ability to explain logically, or to make logical decisions.

(Antebi 2021: 33)

The first wave is related to "handcrafted knowledge" as experts took into consideration all the existing knowledge on a specific topic and defined it "within the framework of rules that could apply to a computer, which in turn could learn their implications" (Antebi 2021: 33). Following the four capabilities, this wave "enables reasoning over narrowly defined problems" but has "no learning capability and poor handling of uncertainty" (Antebi 2021: 33). The second wave consists of "statistical learning", which is characterised by "nuanced classification and prediction capabilities" but, at the same time, "no contextual capability and minimal reasoning ability" (Antebi 2021: 34). The third wave relates to "contextual adaptation". It has to do with explanation and is still being studied, which is why its capabilities are still poor. For now, what is known is that it is expected to create models that can delineate specific subjects based on algorithms or other systems, working with information in an abstract way (Antebi 2021: 35-36). Some examples of this wave of AI are the so-called "smart assistants", e.g. Siri and Alexa, but also technologies like Google Duplex, which can book appointments and reservations autonomously "while managing a coherent vocal conversation with a human service representative" (Antebi 2021: 36).

2.3.2 AI applications

Today, AI is implemented in many domains, e.g. communications, healthcare, disease control, education, agriculture, transportation, space exploration, science, and entertainment (Kavanagh 2019: 13). Moreover, it deals with several subdisciplines, such as deep machine learning, natural language processing, machine inference, statistical machine learning and robotics (Kavanagh 2019: 13). In particular, the most well-known applications and achievements in AI are related to machine learning, which is a branch of computational statistics connected to prediction (Antebi 2021: 32; Agrawal, Gans and Goldfarb 2019: 31).

As AI is part of the data science field, data, especially big data, are needed in order

to “generate significant insights with the help of learning algorithms” (Antebi 2021: 32). However, algorithms are essential as well, as they are used to analyse all the data collected. Machine learning algorithms were and are still being studied, and can be found in contemporary systems as well as in “actions such as image identification and autonomous driving” (Antebi 2021: 32). In particular, these systems deal with the so-called “narrow” or “weak” AI, which uses algorithms that are “designed to deal with a cluster of specific problems, such as games, image identification, or navigation” (Antebi 2021: 32).

AI applications normally deal with three main categories (De Spiegeleire, Maas and Sweijs 2017: 45-46). The first one is information aggregation, which includes:

> integration & analysis, AI systems currently include search engines, sentiment analysis (opinion mining), speech and handwriting recognition, spoken language understanding and interface, stock market analysis; health monitoring; news categorization & weather prediction. (De Spiegeleire, Maas and Sweijs 2017: 45)

The second category concerns practical tools, e.g. those used for:

> face detection, spam filters, derivatives training, game playing, software testing & automatic cyber-vulnerability testing, machine translation, medical diagnosis, hearing aids; mood analysis, brain-machine interfaces (in prosthetics), optical character recognition, recommendation systems, and robotic locomotion. (De Spiegeleire, Maas and Sweijs 2017: 45-46)

The third and last category is services, which involves

> targeted advertising and customer segmentation, classifying DNA sequences, computer-vision object recognition, bioinformatics and chemical analysis, and legal case research. (De Spiegeleire, Maas and Sweijs 2017: 46)

The main AI applications in today's market are summarised in Figure 2.2.

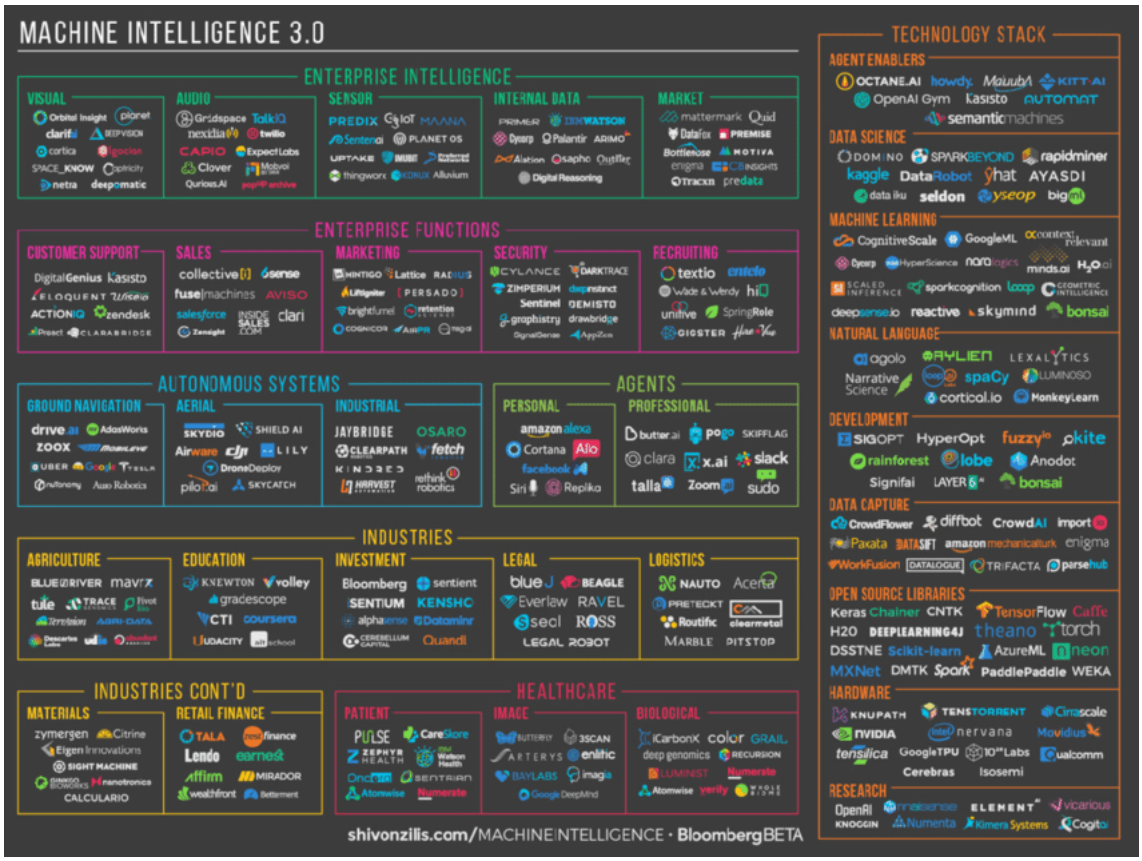


Figure 2.2: An overview of the competitive market landscape for machine intelligence (De Spiegeleire, Maas and Sweijs 2017: 46).

AI can also be implemented in AVT to improve accuracy, efficiency, and accessibility. For example, in dubbing, AI is helpful in order to "automatically synchronize audio with lip movements" while "sophisticated algorithms match the tones and styles of actors' voices" (Martin 2024: 24). It also helps dubbing to develop thanks to automatic translation and audio adaptation for different foreign languages. Similarly, in the field of subtitling AI has improved the quality, accuracy, efficiency and accessibility of subtitles, as it now recognises colloquial speech, slang and contextual information. It also creates more accurate and synchronised subtitles almost instantaneously, which is very advantageous for live broadcasts and streaming (Martin 2024: 24-25). Some the most recent improvements in AI in the field of AVT include the ability of synthetic voices to recognise both cultural and emotional information of multiple characters and in different languages in dubbing, and an increase in the quality of real-time subtitling as well as new

tools for automatic subtitles and editing, which made live broadcasts even more accessible to everyone (Martin 2024: 25). In particular, speech recognition and other AI tools have been implemented by popular services like Facebook Live's Automatic Video Captioning and Microsoft Azure Speech Services' Live Captioning, so that real-time captioning could be more precise during live presentations, lessons and conferences. Despite that, smoothness is still problematic in certain cases as well as speed and cultural sensitivity, which still need to be improved (Martin 2024: 25).

2.4 Using machine-translated and machine-generated outputs: The main principles of post-editing in AVT

Post-editing (PE) "is a bilingual language processing task", which is usually carried out by professional translators defined as "post-editors" (O'Brien 2022: 106). They are used to working with computer-aided translation tools, such as TM, terminology and MT, which is the reason why they do not just post-edit a text, but they frequently need to correct a fuzzy match, or translate a whole sentence or post-edit an entire part of the translation provided. Normally, their task is to revise the TT suggested by the MT system without forgetting the ST and "identify any errors, devise a strategy for fixing them, and implement those revisions" (O'Brien 2022: 106).

2.4.1 Different types of PE

The first distinction that is usually associated with post-editing is the one between light post-editing and full post-editing. The first means that "only essential fixes should be implemented and that this should be done rapidly", while the second one presumes that "all errors in the MT output should be fixed" (O'Brien 2022: 107), therefore is a longer process than the first one. Light PE "has a quick turn-around and only essential errors are corrected" (Castilho et al. 2018: 27), which means that it is usually applied for "short-lived translated texts for internal circulation" (Castilho et al. 2018: 27). Conversely, full PE needs more corrections in order to produce a high-quality text and is "typically employed to disseminate high-visibility or sensitive texts" (Castilho et al. 2018: 27).

Nevertheless, they both aim at improving the translation process as regards time and quality (O'Brien 2022: 107).

Follow TAUS's guidelines, light PE should:

- Aim for semantically correct translation.
- Ensure that no information has been accidentally added or omitted.
- Edit any offensive, inappropriate or culturally unacceptable content.
- Use as much of the raw MT output as possible.
- Basic rules regarding spelling apply.
- No need to implement corrections that are of a stylistic nature only.
- No need to restructure sentences solely to improve the natural flow of the text.

(Nitzke and Hansen-Schirra 2021: 30-31)

Full PE should instead:

- Aim for grammatically, syntactically and semantically correct translation.
- Ensure that key terminology is correctly translated and that untranslated terms belong to the client's list of "Do Not Translate" terms.
- Ensure that no information has been accidentally added or omitted.
- Edit any offensive, inappropriate or culturally unacceptable content.
- Use as much of the raw MT output as possible.
- Basic rules regarding spelling, punctuation and hyphenation apply.
- Ensure that formatting is correct.

(Nitzke and Hansen-Schirra 2021: 31)

A further distinction concerns monolingual vs. bilingual post-editing (Nitzke and Hansen-Schirra 2021: 32). Bilingual PE "involves the comparison of source and target text", hence the post-editor needs to examine "the quality of the translation but he/she also has to assess whether the adequate meaning of the source text has been transferred by the MT

system" (Nitzke and Hansen-Schirra 2021: 32). Monolingual PE (MPE) "suggests that the quality control of the translation can be carried out without taking the source text into account" (Nitzke and Hansen-Schirra 2021: 32). In this regard, Lucas Nunes Vieira (2019: 4) reports that PE is usually thought to be bilingual PE, but, according to the author, MPE should be taken more into account as it "would cut costs by simplifying the task and potentially reducing the need for bilingual expertise". Moreover, MPE is particularly performing as regards fluency and when it is carried out by specialists, while bilingual PE is more effective in terms of adequacy (Vieira 2019: 4).

2.4.2 ISO 18587:2017

The International Standards Organisation (ISO) provides guidance for the evaluation of post-editing. The first ISO standard touching upon PE was ISO 17100: 2015 "Translation services – Requirements for translation services" (Latorraca 2023: 2), which delineated the processes and means to create a high-quality translation. This was followed by ISO 18587:2017 "Translation services – Post-editing for machine translation output – Requirements" (Latorraca 2023: 2), which was developed to address MT and PE specifically. In particular, this last standard is "aimed at translation service providers, clients and post-editors" and it "describes both the requirements for undertaking PE tasks and the competencies required by post-editors" (De los Reyes Lozano and Mejías-Climent 2023: 7). According to Nitzke and Hansen-Schirra (2021: 34), the client, the translation service provider (TSP), and the post-editor are the three main parts this standard takes into consideration. In sum, its main guidelines are very similar to those developed by TAUS:

> - the post-edited MT output must be comprehensible;
> - the content in the source text must correspond to the content in the target language;
> - the post-editor must comply with the agreed requirements and specifications.
>
> (Nitzke and Hansen-Schirra 2021: 35)

On top of that, post-editors should always understand whether the MT solutions need to be edited or if a completely new translation is required based on the target audience.

The ISO standard also describes the six competences required of post-editors. Post-editors need to possess "translation competences as well as linguistic and textual competences in the source and target languages"; they need to "be able to conduct efficient research to find and process information"; moreover, "cultural competences are necessary to ensure that the target text audience understands the final text" (Nitzke and Hansen-Schirra 2021: 35). Post-editors also require "technical competences to be able to process the text using the appropriate tools" and "must have knowledge of the domain that the text deals with" (Nitzke and Hansen-Schirra 2021: 35). Finally, their qualification "must be similar to those of a translator", meaning it needs to "include a degree in translation, another university degree and two years of full-time professional experience in translation or post-editing" or, alternatively, it has to involve "five years of full-time professional experience in translation or post-editing" (Nitzke and Hansen-Schirra 2021: 35). Naturally, post-editors have to be able to produce a comprehensible, fluent and accurate text with respect to grammar, style, syntax and punctuation, which is why they should always consult the ISO standard for PE (Nitzke and Hansen-Schirra 2021: 36).

2.4.3 AVT techniques and PE

Post-editing (PE) is "the correction of raw machine-translated output by a human translator according to specific guidelines and quality criteria" (O'Brien 2011: 197-198). In particular, "human post-editing (PE) consists in manually correcting the system output according to the input" and "in PE-based evaluation, instead of evaluating how good the output is, the focus is given to how much work is needed to fix it" (Karakanta 2022: 77). Hans P. Krings (2001: 178) developed a method in order to evaluate effort in post-editing, which he based on temporal effort, technical effort, and cognitive effort. Temporal effort is the easiest to measure and is connected to the amount of time spent during the post-editing process. Technical effort refers to the modifications proposed by post-editors (Krings 2001: 178). In particular, as far as AVT types are concerned, three specific processes are fundamental, i.e. spotting, synchronisation and access to audiovisual content (Ortiz-Boix 2016: 271). As already mentioned in Section 1.4.1, spotting is pivotal

for many AVT modes, above all for dubbing, voice-over and subtitling, during which it can be carried out by a professional before or after the translation process. Synchronisation is closely linked to spotting, and it consists of comparing the written translation to the AV content, possibly with MT, which is why this process is usually performed during the PE phase (Ortiz-Boix 2016: 284). Finally, the written original text must also be taken into account, especially during the PE phase, as visuals and audio usually are not contemplated in the automatic process. For this reason, having the script or the transcript of the audio is essential to achieve fluency and accuracy in the translation, as well as synchronisation between the written and the AV content (Ortiz-Boix 2016: 285).

With special reference to post-editing in subtitling, word error rate (WER) is normally used to evaluate subtitles' quality in AV productions (Koglin et al. 2022: 9). This method "consists of dividing the number of errors – from a set of categories – by the total amount of words in the subtitle" (Koglin et al. 2022: 9). It is applied especially to live subtitles' quality, while it is not always accurate when used for other types of subtitles. For this reason, it was adapted to other models "that considered other specificities of subtitling, such as the CRIM model, the NERD model, the NER model and the FAR model itself" (Koglin et al. 2022: 10). The FAR model was devised by Jan Pedersen, who describes it as a model that aims to look at "renderings of languages that are not 'near' you (i.e. your own) but 'far' from you (i.e. foreign)" (Pedersen 2017: 217). It is an adaptation of the previous NER model, whose original name was NERD model, which consists of "a generalized model designed to evaluate the quality of interlingual subtitles" (Koglin et al. 2022: 10). According to Pedersen (2017: 217), the name "FAR model" indicates the three main areas that are taken into consideration, which are: functional equivalence, i.e. "how well the message or meaning is rendered in the subtitled translation"; acceptability of the subtitles, i.e. "how well the subtitles adhere to target language norms; and readability, i.e. "how easy the subtitles are for the viewer to process" (Pedersen 2017: 217). Moreover, this model is based on error analysis: a penalty point is attributed to every error and the severity of the errors is divided into minor, standard and serious errors, as it happened in the NER model. Minor errors do not affect the text's comprehensibility; they are usually assigned a score of 0.25 and are identified just through a scrupulous analysis. Standard errors have a score of 0.5 and are "likely to break the

contract and ruin the subtitle for most viewers" (Pedersen 2017: 217). Finally, serious errors receive a penalty of 1 and they influence subtitles' comprehensibility, either because they carry misinformation or because "it takes a while for the user to let go of it and resume automated reading of subtitles" (Pedersen 2017: 217). Error scores are then calculated in the three areas mentioned above. In the area of functional equivalence, penalty points for semantic errors are considered to be very serious as they affect the comprehensibility and fluency of the AV production, which can make it more difficult for viewers to follow it. In the acceptability area, the score is determined by "adding up the penalty points for grammar, spelling and idiomaticity" (Pedersen 2017: 224). While readability takes into account all the errors related to "spotting and segmentation, punctuation and reading speed and line length" (Pedersen 2017: 224). Afterwards, a score for each of these areas can be calculated by dividing "the penalty score by the number of subtitles" (Pedersen 2017: 224), and the total score can be identified as well just by calculating the penalty scores before dividing it by the subtitles. However, according to Pedersen (2017: 224), this model has some weaknesses, for example, it does not always convey accurate solutions as it is built on error analysis. Then, subjectivity is very present in this model, especially when it is related to identifying equivalence and idiomatic errors or to determining errors' severity and penalty score, which creates a degree of fussiness (Pedersen 2017: 224).

CHAPTER 3
SPECIAL LANGUAGES, POPULARISATION AND TRANSLATION

This chapter focuses on specialised translation and special languages and explore their main features and challenges (3.1). The focus will then shift to the scientific and astronomical discourses, which will be explored especially from a historical and linguistic point of view (3.2). Finally, science popularisation will be addressed, with special reference to its historical background, its principal features and its relation with translation (3.3).

3.1 Specialised Translation and Special Languages

According to Federica Scarpa (2020: 1), "translation is an ancient craft but a relatively young discipline" as it was initially thought to be part of linguistics and began to be theorised only in the 1960s. At the beginning of the 1970s, it started to be conceived as an autonomous discipline, mainly thanks to the coining of the term "Translation Studies" by James Holmes in his *The Name and Nature of Translation Studies*, a paper he proposed at the Third International Conference of Applied Linguistics in Amsterdam in 1972. From this moment on, translation's focus transitioned from the translation product to the process and Translation Studies started to be seen as "a discipline that itself influences the conceptual and methodological frameworks of other research areas" (Scarpa 2020: 2). Moreover, new concepts like "textual domains" and "similar communicative situations" of both the ST and the TT were established. They were particularly relevant for specialised translation since they contributed to the acknowledgement of the prominent role of the so-called "comparable texts" or "parallel texts", meaning "texts similar in topic and text type that were produced independently of each other by the source language and target language" (Scarpa 2020: 2).

The question about specialised discourse started to be addressed before the one about translation. Maurizio Gotti (2011: 9) explains that its history started around the 1920s and the 1930s when some scholars of the Prague school began to use the so-called "functional style", usually employed in scientific and technical discourses. At the

beginning, their approach was merely conservative, meaning it was completely different from everyday language and discourse. Word morphology and word formation were the very first features they started to analyse in different specialised discourses together with the scientific and technical ones. Word morphology concerned "foreign words retaining their original plural suffix, obsolete forms of verbs and adjectives", while word formation was about "the use of typically classical prefixes, certain types of nominal premodification" (Gotti 2011: 9). After the Second World War, another important concept that was analysed was the one of register, whose studies aimed to "identify the morphosyntactic, lexical and stylistic features" of specialised discourse (Gotti 2011: 9). Curiously, "studies on register analysis were part of a wider enquiry into language varieties" (Gotti 2011: 9) and this meant that

> the transition from an uncontextualised view of language, typical of the Chomskyan tradition, to its perception as a highly flexible means of communication employed in different situations placed the study of specialized discourse within the wider spectrum of situational-contextual varieties.
>
> (Gotti 2011: 9-10)

For instance, British linguists usually focused their analysis on the autonomy of specialised discourse in contrast with general language. However, scholars tended to direct their attention to lexical features, which were the most recurring and simple to detect. Yet, there are many other relevant elements that characterise special discourse and register analysis has helped to move from a mainly statistical-qualitative approach to a qualitative one, or, in other words, to an approach which aims to recognise specialised texts' peculiarities "in a perspective that is not only microlinguistic but takes into account the discourse in which they are embedded" (Gotti 2011: 11).

Talking specifically about English, Imola Katalin Nagy (2015: 262) highlights that when dealing with English for Specific Purposes (ESP), many terms are employed in order to address it, such as

> specialized languages, special languages, specialized communication, technical English, scientific English, English for special or specific purposes - ESP, English for Occupational Purposes, Professional English or, more recently, Academic and Professional Languages.
>
> (Nagy 2015: 262)

ESP history officially started in the 1960s, although some books and materials on the topic were already circulating in the first decades of the 20th century, especially regarding teaching business and economic English to specialists. According to the author, ESP has developed thanks to four crucial phases. The first one started between the 1960s and the 1970s and was characterised by the education of ESP at a sentence level, meaning the early analyses focused just on lexis and grammar of professional registers, above all English for Science and Technology (EST). For instance, researchers found out that some of EST's main features concerned the frequent employment of the present simple, passive form and noun compounds (Nagy 2015: 262). The second phase can be traced back to the late 1970s and the early 1980s. In this phase, ESP's analysis started to consider rhetorical functions together with the previous features. It was in this context that differences between distinct ESP registers began to be taken into account, especially thanks to Tarone et al.'s work (1981), who focused on rhetorical analysis and particular branches of English for Science, like astrophysics (Nagy 2015: 263). The third phase put together the features of the first two phases, taking the target and spoken communication into account. These features led to the "notion-functional curriculum or approach", according to which

> the communicative purposes (or functions) of the speaker, the setting for language use and the mode of communication and the keyword of the whole approach is the functional nature of communication.
>
> (Nagy 2015: 263)

The fourth phase is to be found in the second half of the 1980s. Its focal point concerned the strategies learners used in order to study a language. It was only in the 2000s that lexicographers and terminologists' focused on the description of specialised languages with their main features instead of just on the strategies to teach them. Moreover, in this

period of time, the notion of "Academic and Professional Languages" came to life, which is considered to be the most recent concept used to refer to specialised language (Nagy 2015: 264).

3.1.1 Main features of LSPs

LSPs are functional language varieties that depend on a specialised field of knowledge or sphere of activity and that are used by a small group of speakers in order to satisfy the communicative needs of that specialised field (Cortelazzo 1994: 8). Special attention is usually put on the information they convey, which can be aimed at "a more or less restricted target specialist community" (Scarpa 2020: 3), i.e. it can address experts as well as non-experts who can have "very specific professionally or subject-related communicative needs and expectations" (Scarpa 2020: 3). Special languages have different terminology and specialised textual, syntactical and lexical features compared to "Language for General Purposes (LGP)" or "general language". However, LSPs' main features are not exclusive, which means that they are to be found more frequently in these language varieties, but they can appear in general language as well (Scarpa 2020: 3).

As pointed out by Cabré (1999: 62):

a. the distinctive elements of special languages are not isolated phenomena, but rather interrelated sets of characteristics;
b. the purpose of communication is more important than other, complementary functions;
c. the special nature consists of differences in subject field, user knowledge, and area of usage.

The contact between LSPs and general language is bidirectional (Cortelazzo 1994: 24-25). This means that, for instance, special languages have influenced general language at a lexical level, above all through newspapers, television and other mass media, but also through speakers' personal experiences in specialised and technical fields. In this passage from special languages to common language, specialised words may maintain their semantic content or acquire a metaphorical meaning. In particular, in the first case,

specialised words lose their specificity, but gain more expressiveness (Cortelazzo 1994: 24-25). At the same time, LSPs need a specialised vocabulary, which is created starting from general language but also from regional languages, some foreign languages, and classical languages. For example, at a lexical level, this includes words coming from general language, but their meanings and applications are more complex and technical in relation to the common sense. In fact, specialised fields usually have to do with objects and concepts which are foreign to common experience, and the analyses carried out are far more elaborate (Cortelazzo 1994: 25). The lexical level is the only one that really distinguishes the specialised vocabulary from the general one, and it is also the level that makes it possible to identify different specialised languages, such as the language of science, the legal language, the language of technology, and the like (Cortelazzo 1994: 9-10). Nevertheless, special languages generally share some key features, like the use of Latin as the language of the specialised discourse, the use of regional terms coming from arts and craft, the need for a specialised vocabulary, and their history, as in the 17th and 18th centuries special languages started to be created and their main features started to be identified, even though they were established just in the 19th century (Cortelazzo 1994: 22). Three main groups of lexemes that characterise special language texts can be identified (Nagy 2015: 267):

a. general language lexical items, which are words coming from general language that keep their significance when in specialised discourse;
b. specific lexical items or semi-technical terms that are to be found both in general and special languages, and which usually are polysemic;
c. lexical items specific to special texts or technical terms, applied just to specialised discourse and related to univocity, accuracy, normalization and standardisation.

Some crucial structures and features that distinguish special texts from general ones also include morphological structures based on Greek or Latin, abbreviations and symbols, nominalisations based on verbs, straightforward sentence structure with little complex subordination (Nagy 2015: 267). On the contrary, general language differs from specialised one mainly because of colloquial affixes, certain verb forms like the second

person and imperatives, pronouns, especially second-person pronouns, and particular sentence types, e.g. exclamations (Nagy 2015: 267).

Specialised discourse can be represented as a "coordinate system", consisting of a horizontal and a vertical dimension, as illustrated in Figure 3.1.

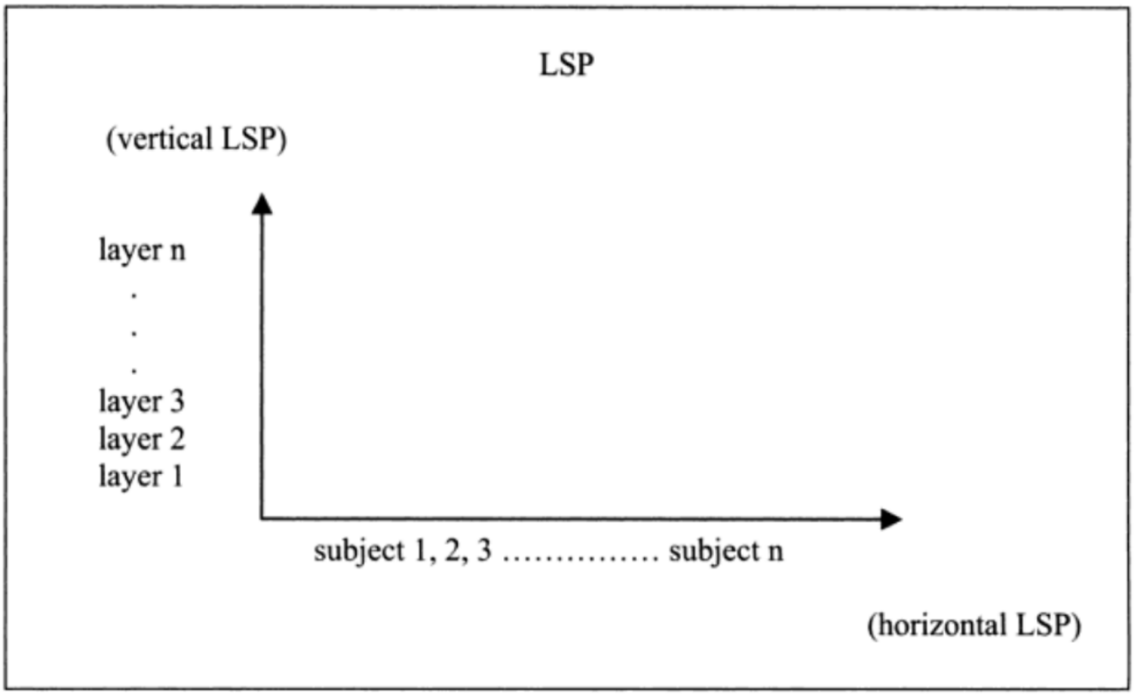


Figure 3.1: Coordinate system for the representation of specialised discourse (Trosborg 1997: 16, as cited in Gotti 2011: 13).

The horizontal dimension is related to "the disciplinary domain dealt with (e.g. economic discourse, legal discourse, scientific discourse, etc.)", while the vertical dimension is the sociolinguistic one (Cortelazzo 1994: 3) and concerns "its sociological 'layer' (e.g. its degree of formality and functional style)" (Gotti 2011: 13). In particular, the vertical dimension deals with the context in which LSP texts are produced, which can depend on:

- the *external* situational context of use and the wider cultural context in which the text is embedded (social/cultural context);
- the *internal* cognitive factors that can influence one another in linguistic acts (cognitive context).

(Scarpa 2020: 8)

As stressed by Scarpa (2020: 5-6), special languages are not homogeneous, as they carry many internal variations that depend on the different contexts in which they are to be found and used. This is the reason why LSPs themselves should be considered in relation to specialised registers, which are

> varieties of language that users consider appropriate to specific situations, govern the selection of linguistic features at all the levels of a text and contribute to implementing different textual genres.
>
> (Scarpa 2020: 5)

Similarly, specialised texts' peculiarity should be identified through the parameter of field, that is "the disciplinary domain of the text as reflected mainly in its terminology (e.g. medical, legal, economic etc.)" (Scarpa 2020: 6) and related to the horizontal dimension of the coordinate system. The content is the most crucial element in order to satisfy "the very specific professionally or subject-related communicative needs and expectations of specialised discourse communities" (Scarpa 2020: 6) and help the translator analyse LSP texts in a less time-consuming and more intuitive way.

LSP texts' main function is the referential one, which suggests that their principal aim is to convey information. This is related to Roman Jakobson's concept of "context", which can be "either verbal or capable of being verbalized" (Jakobson 1960: 353) and it refers to "the thing 'spoken of' and its truth value in the reference universe" (Scarpa 2020: 10). Together with the referential function, there are four other important functions dealing with LSP texts, which are the metalinguistic function, related to the interconnection between special languages and specialised context and to the formation of new words and meanings that requires some knowledge about the use of language, the conative function, crucial for LSP's authors who want to persuade their readers to do something they would not think to do otherwise, the phatic function, which makes it possible to establish a connection with the readers, and the expressive function, which is linked to the writer's personal point of view, as well as to the "figurative language", that is to be found frequently in the language of science (Scarpa 2020: 11).

Hoffmann (1984, as cited in Gotti 2011: 21) suggests other eleven main criteria of specialised discourse, which are:

1. exactitude, simplicity and clarity;
2. objectivity;
3. abstractness;
4. generalization;
5. density of information;
6. brevity or laconism;
7. emotional neutrality;
8. unambiguousness;
9. impersonality;
10. logical consistency;
11. use of defined technical terms, symbols and figures.

Not all these criteria can be applied to all LSPs, and those that usually characterise a specific specialised language do not always apply to that LSP's genre. What is more, it is easy for Hoffmann's criteria to go through some incongruities, as the criterion of clarity may clash with the one of simplicity, and the criterion of unambiguousness may be in opposition to those of conciseness and abstractness. For this reason, Sager et al. (1980, as cited in Gotti 2011: 21) proposed three main criteria that define specialised discourse, which are: economy, precision and appropriateness. Their main advantage is that they are interdependent, as the "maximum communicative effectiveness is achieved when the requirements of all three are satisfied" (Sager at al. 1980, as cited in Gotti 2011: 21) and their equilibrium makes it possible to achieve efficiency in specialised discourse. If two of these criteria clash for some reasons, the third one is essential in order to restore the balance between them.

Following Gotti (2011), specialised discourse is characterised by specific lexical and syntactic features. In particular, lexical features include:

1. **Monoreferentiality**, which suggests that "in a given context only one meaning is allowed" (Gotti 2011: 25). Together with transparency, it is crucial in order to convey referential precision at a pragmatic and terminological level, as these two features avoid ambiguity (Scarpa 2020: 18). Historically speaking, this concept can be traced back to the 17th and 18th centuries, when European scientists needed

a solution to avoid lexical repetition, as well as to create a specific and universal language free from ambiguity coming from general language (Scarpa 2020: 18).

2. **Lack of emotion**, as terms normally have a denotative function, and specialised discourse is usually neutral "as its illocutionary force derives from the logical, consequential arrangement of concepts" and its focus is on "supporting evidence rather than the use of emphatic language" (Gotti 2011: 27). However, generally speaking, specialised texts are not just informative, but they can have a pragmatic function as well, which is why emotion can be spotted in specialised texts too and neutrality is considered to be related to a purely linguistic matter (Gotti 2011: 27; Scarpa 2020: 20).
3. **Precision**, specifically referential precision, which implies that "every term must point immediately to its own concept" (Gotti 2011: 27). In the 17th century, during the scientific revolution, scientists needed precision and clarity in their works. When referential precision relates to the economy of the language, their relation is particularly important for word formation, as new terms are created through the processes of affixation and abbreviation, e.g. acronyms (Scarpa 2020: 19).
4. **Transparency** "of a term's meaning through its surface form" (Scarpa 2020: 18). An example of this is Lavoisier's nomenclature system for chemical compounds that aimed to facilitate the process of recognition of these compounds' nature. Lavoisier's system consisted of assigning a specific meaning to a precise suffix, usually a Greek-based one, so that similar terms and compounds could be easily distinguished from others, and they could be grouped following their similar physical features. Additionally, the employment of conventional affixes is frequently used in specialised texts in order to convey transparency, as it allows the cataloguing of similar terms into logical and organised groups (Scarpa 2020: 18).
5. **Conciseness**, according to which concepts need to be described in the shortest way possible as this will help reach communicative effectiveness and efficiency (Gotti 2011: 31; Scarpa 2020: 63). To this end, processes of reduction are used, such as zero derivation, thanks to which affixes are deleted; the combination of two lexemes into one word; and juxtaposition, that allows the omission of

prepositions and premodifiers. Finally, acronyms and abbreviations are frequently used too (Gotti 2011: 32).

6. **Conservatism**, according to which "old formulae are preferred to newly-coined words" due to "their century-old history and highly codified, universally accepted interpretations" (Gotti 2011: 32). Conservatism aims to prevent ambiguity thanks to the preservation of traditional linguistic features, even though they are no longer present in general language, and it usually happens in legal and business language (Gotti 2011: 33).
7. **Redundancy in specialised discourse**. This is usually avoided thanks to the conciseness and simplicity criteria, as they condense information and prevent structural and textual redundancy (Scarpa 2020: 18). However, some specialised fields expressly require redundancy in some cases, as it happens with legal language. In fact, it frequently violets the conciseness criterion in favour of its redundant use of lexical items. Interestingly, this violation is not always planned but has to do with a diachronic matter as some words that today are considered to be synonymous and redundant were not so similar in the past (Gotti 2011: 38).
8. **The relationship with general language**, regarding the fact that words belonging to general language are usually to be found in the specialised one but with a specialised meaning. More precisely, during the 17th and 18th centuries "the specialization of words borrowed from everyday language was particularly intense" (Gotti 2011: 40), as a consequence of the several technological and scientific innovations. For instance, prefixes like *kilo-*, *micro-*, *multi-* are frequently used in specialised language but come from classical-rooted general language words (Gotti 2011: 41).
9. **Metaphor in specialised discourse**, following the metaphorisation process typical of general language as well. In particular, in specialised discourse, this process is crucial to both explain and produce new theories and new specialised terminology (Scarpa 2020: 73). This process is also very useful for transparency when metaphors are used instead of neologisms, for conciseness, as metaphors usually refer to a precise and well-known piece of information and avoid using long and complex explanations or definitions, and it is advantageous also to easily describe abstract and difficult concepts (Gotti 2011: 42). At the same time,

however, metaphors may lead to ambiguity, especially if they are imprecise as their interpretation will be ambiguous as well (Gotti 2011: 43).

10. **Lexical productivity**, which relates to the high number of specialised words used in everyday language, which "has convinced many linguists that the lexical system of specialized discourse is more productive than that of standard language" (Gotti 2011: 47). This lexical productivity is due to "the rapid evolution of disciplinary fields" and also to "the constant redefinition of existing terms and concepts" (Gotti 2011: 47).

The main syntactic characteristics of specialised texts would include (Gotti 2011):

1. **Omission of phrasal elements**, which is the easiest way to convey conciseness in sentences of specialised texts. This kind of omission does not affect the understanding of the text, as context and prior knowledge can help in comprehending the text despite omitted elements. A clear example of this deals with Italian manuals, in which articles and prepositions are frequently omitted in favour of conciseness (Gotti 2011: 49-50).
2. **Expressive conciseness**, used in order to make sentences more compact by avoiding relative clauses. However, this method is not exclusive to specialised language, but it is to be found in general language as well (Gotti 2011: 51). Some common examples of specialised texts are the replacement of relative clauses with adjectives obtained by the process of affixation, the simplification of relative clauses carrying passive forms by deleting the subject and the auxiliary or by changing the verb of the clause into a past participle but using it as a premodifier (Gotti 2011: 51-52). Moreover, some frequent expressions used to replace and avoid relative clauses are "thus", "so", whereby" (Gotti 2011: 53).
3. **Premodification**, resulting from the aforementioned reduction of relative clauses. In the "right-to-left construction" in languages like English, nominal adjectivation, i.e. "the use of a noun to specify another with an adjectival function" (Gotti 2011: 55), is very frequent. In specialised texts nominal adjectivation is commonly used, as it allows sentences to be denser and confers them a considerable semantic weight, which is also the reason why attributive nouns are preferred to adjectives. Therefore, premodification is useful for textual

conciseness, but sometimes it challenges conceptual clarity, which can be overcome just by the specialist's linguistic knowledge and competence regarding the topic, the context and the co-text (Gotti 2011: 57).

4. **Nominalisation**, i.e. "the use of a noun instead of a verb to convey concepts relating to actions or processes" (Gotti 2011: 58). Nominalisation is used especially in specialised texts. It occurs in general language as well, but while here the nouns constitute 28% of words, in specialised language they account for 44% of words (Sager et al. 1980, as cited in Gotti 2011: 58). As a consequence of nominalisation, verbs lose their value in the sentence and are very likely to be used just as a copula, to link together intricate noun phrases (Gotti 2011: 60).
5. **Lexical density**, i.e. "a high percentage of content words within a text" (Gotti 2011: 61), as a direct consequence of nominalisation and premodifying techniques in specialised discourse. It is usually to be found in written texts, where there are less hesitations and redundancy compared to oral discourse (Gotti 2011: 61).
6. **Sentence complexity** is directly linked to nominalisation, as this process is used to make sentences' structure simpler thanks to the easier pattern NOUN PHRASE + VERB + NOUN PHRASE, but at the same time noun phrases are particularly complicated. Therefore, specialised texts are easier as regards textual comprehension, but more complex when it comes to interpretation because of a high level of lexical density and complicated noun phrases (Gotti 2011: 63).
7. **Sentence length**, similarly to sentence complexity, has to do with the difficulty of textual comprehension in specialised discourse, which, in this case, is mainly due to the fact that sentences are longer in specialised texts than in general ones, especially in legal language (Gotti 2011: 65).
8. **Use of verb tenses**, among which the present indicative seems to be the most frequent one in specialised discourse (89%) (Barber 1985: 8). Other verb tenses usually employed in English scientific texts are the present simple active (64%), the present simple passive (25%), the future simple active (3.7%), the present perfect passive (1.7%), the present perfect active (1.4%), the past simple active (1.2%), the past simple passive (1.2%), the future simple passive (0.7%), the present progressive active (0.6%), and the imperative (0.3%) (Barber 1985: 8).

Infinitive and non-finite forms, such as the past participle and the *-ing* form, are very likely to be found in specialised texts too (Gotti 2011: 73).

9. **Use of the passive**, which appears between 26% and 28% in specialised discourse (Huddleston 1971; Barber 1985; Rumszewicz 1985, as cited in Gotti 2011: 74). As a matter of fact, passive forms are very frequent in English specialised texts as they are the main way to achieve depersonalisation in specialised discourse, which "generally emphasises the effect or outcome of an action rather than its cause or originator" (Gotti 2011: 74). However, both active and passive forms can be used in the same text, for instance in a research article the "Methods" section is usually dense of passive verbs, while the "Literature Review" section shows a higher number of active forms (Gotti 2011: 75).
10. **Depersonalisation**, which is a key feature in specialised discourse. This objectivity is usually supported by verbs like "demonstrate", "suggest", "highlight", "indicate", "confirm", which are preceded by subjects referring to facts, elements and events (Gotti 2011: 76-77). Another feature that suggests depersonalisation is the way in which authors speak to or of themselves in the third person, e.g. "the author" and "the research team" (Gotti 2011: 77).

3.1.2 Translating LSPs

When dealing with the translation of specialised texts the translator usually goes through two main phases, the first one being a preparatory phase and the second one being the actual translation of the text. Specifically, the preparatory phase

> serves the purpose of identifying the translation task and becoming familiar with both the document to be translated and the explicit (or implicit) specifications of the translation project that are contained in the translation brief.
>
> (Scarpa 2020: 189)

In this phase the translator starts to become familiar with the text to be translated, spotting all the possible translation problems and thinking how to address them by reading parallel

texts. In other words, the translator formulates a "mental map" of the ST, but also of the TT, by choosing a "macrostrategy" that will then be used in order to create a pragmatically correct TT (Scarpa 2020: 189). The second phase "is operational and consists of the actual production of the translation by reformulating the ST into the TL" (Scarpa 2020: 201). Moreover, during this phase, the translator does not need just to create the TT by translating the ST but also has to read, process and revise the text, and during the translation process, the translator has to solve all the translation problems encountered by identifying and applying the proper strategy "in the light of the general macrostrategy which she has identified at the end of the preparatory stage" (Scarpa 2020: 202). To start this process, the first choice the translator needs to make is whether to opt for a literal translation or paraphrase, bearing in mind that literal translation is

> a fundamental translation method that conveys in the TL the sense of the ST in the most direct way by keeping the same basic constituents of the ST and adapting its syntactic and lexical structures to the lexicogrammatical and stylistic norms of the TL.
>
> (Scarpa 2020: 209)

While paraphrase is

> is a translation method that is used in all cases when literal translation proves to be inadequate to solve a problem related to the translation of a specific ST segment which cannot thus be translated on the basis of an accepted one-to-one correspondence due to the SL and TL contrasting lexical, morphosyntactic or stylistic norms.
>
> (Scarpa 2020: 212)

To solve translation problems, the translator needs to select and apply the most suitable translation strategy among the ones that Scarpa (2020: 220) has categorised as textual, syntactical and lexical strategies. The author explains that textual strategies have to do with "the amount of information that needs to be given in a text", as well as with "the sequence of Given/New information in the thematic and information structure of the text"

and with "the use of intra- and inter-sentential connectives and punctuation" (Scarpa 2020: 221-222). For instance, Italian is an author-oriented language that requires more formality compared to English, which is a reader-oriented language. Therefore, an Italian TT will not be just more formal than the English ST, but it is likely that it will also be more concise, as "a more formal register in the TT can involve a higher degree of conciseness compared to the ST" (Scarpa 2020: 222). However, sometimes explicitation is also required, which helps achieve a greater TT cohesion, as it will make the TT easier to understand, while reducing the TT's conciseness. Finally, other changes typical of textual strategies involve voice change, such as passivisation and nominalisation, which are frequently used when translating an English text into Italian, as it happens in the following examples proposed by Scarpa (2020: 224)

Passivisation: EN *In the next section we discuss...*
IT *Nella prossima sezione saranno analizzati...*

Nominalisation: EN *A study was carried out of the behaviour of...*
IT *È stato studiato il comportamento...*

As far as syntactic strategies are concerned, they "address the pragmatic and linguistic problems relating to cross-language rhetorical differences produced by the syntactic features of the text" (Scarpa 2020: 230). In addition, syntactic strategies usually have to do with register, with author-oriented languages having a higher and more formal register than reader-oriented languages, as already stated before. In order to achieve this formality, depersonalisation and generalisation are frequently applied when translating a reader-oriented language into an author-oriented one, as it happens with the English first person plural "we" which in Italian is usually translated with the impersonal pronoun "si". In fact, languages that have passive voice and passive reflexives prefer them instead of agentless passives and use them in order to express impersonality and increase the distance between writer and reader (Scarpa 2020: 233-234). Similarly, nominalisation is commonly applied when translating author-oriented languages as it avoids adding subordinate clauses to already complex sentences, as it happens in languages like Italian, but also because it guarantees a high degree of formality and distance between writer and

addressee. Curiously, in the English-Italian translation pair, nominalisation is used both to reach formality in the TT but also to preserve "the nominal style of the ST by translating a nominal form by a nominal form" (Scarpa 2020: 242). Lastly, a quite problematic situation is the one concerning the translation of modal verbs in LSPs. For example, in the English-Italian pair, syntactic strategies are usually applied to translate modal verbs like "should", "may", and "will". When "should" and "may" are to be found in English prescriptive specialised texts and express a "deontic function of inescapable obligation" (Scarpa 2020: 245), explicitation is used, and they are translated with the Italian modal verb "dovere" in the indicative mode. Similarly, the English modal "will", indicating that a situation is very likely, even though not certainly, going to happen in the future is translated into Italian with a present indicative or with a periphrasis that expresses this high level of probability (Scarpa 2020: 246). Finally, lexical strategies have to do with phraseology and terminology. As regards phraseology, the translator needs to identify an "LSP collocation in the ST" and, after that, "search for its translation by extracting the equivalent collocation in comparable native texts in the TL" (Scarpa 2020: 247). As far as terminology is concerned, the translator has to recognise main terms and expressions in both languages, together with their characteristics and behaviour patterns and has to use them to produce a bilingual specialised corpus. After that, the translator needs to extract these terms and expressions, either by hand or thanks to term extraction systems, in order to store them into multilingual termbases. One of the most common lexical strategies deals with neologisms, which are created thanks to "term-formation processes such as derivation, compounding and blending" and thanks to "the strategy of borrowing a term from another language", that produces "direct borrowings or loanwords, or adapted borrowings or loan translations/semantic calques" (Scarpa 2020: 250-251). Usually, neologisms are useful as they make it possible to address new concepts or products by avoiding ambiguity. Yet, there are cases in which they start to be used as terminological variations of existing terms having the same meaning, with one of them prevailing over the others. For this reason, neologisms are considered to be very problematic when it comes to translating them. However, as regards loanwords in particular, there are some characteristics that could make the translation process easier. Loanwords are to be found mainly in specialised fields that lack "established terminology and terminological consistency" (Scarpa 2020: 252), such as social sciences, IT, marketing, natural sciences,

medicine, physics, mineralogy. Furthermore, they are more frequently nouns, but a special kind of loanwords are acronyms and initialisms, which, for instance, are used in Italian with the same lettering as in English, as it happens with AIDS, ROM and RAM (Scarpa 2020: 252-253). Besides neologisms, other lexical strategies applied to avoid repetition are adaptation and explicitation, as well as the use of cohesive devices like reference, conjunction and ellipsis (Scarpa 2020: 257). These strategies are frequently taken into consideration when translating culture-specific terms and expressions, which is another major translation problem. Together with these strategies, deletion is used too, especially when the SL term is not relevant or appropriate in the TL (Scarpa 2020: 260).

3.1.3 Different levels of specialisation

As stated by Scarpa (2020: 8)

> the strong link between language and the situation in which it is produced and used determines an internal stratification of each LSP corresponding to different levels of discourse specialisation, with each LSP variation being characterised by a conventional situation of use and standard appropriateness conditions.

This means that a specific specialised matter can be dealt with in different ways according to the readers it is referring to (Scarpa 2020: 8). In particular, it is important to always keep in mind "the roles of participants, their communicative purposes, and their existing knowledge" (Xia 2022: 71). Moreover, at times some information is taken for granted by writers, who do not specify it but leave it implicit, as they suppose readers will already have some knowledge about it (Scarpa 2020: 8-9). However, the level of specialisation is directly proportional to the target readers of a specialised text: "the higher the specialisation level of a text, the more information can be assumed to be shared by the readers and left implicit in the text" (Scarpa 2020: 9), which is why in an expert-to-expert communication the level of implicitness will be very high, as the level of specialisation is high as well.

Some important concepts to bear in mind are the ones of field, tenor and mode, which appear in Halliday's systemic functional linguistics (SFL) model (Halliday 1978, as cited in Munday 2016: 142). This model appears as shown in Figure 3.2.

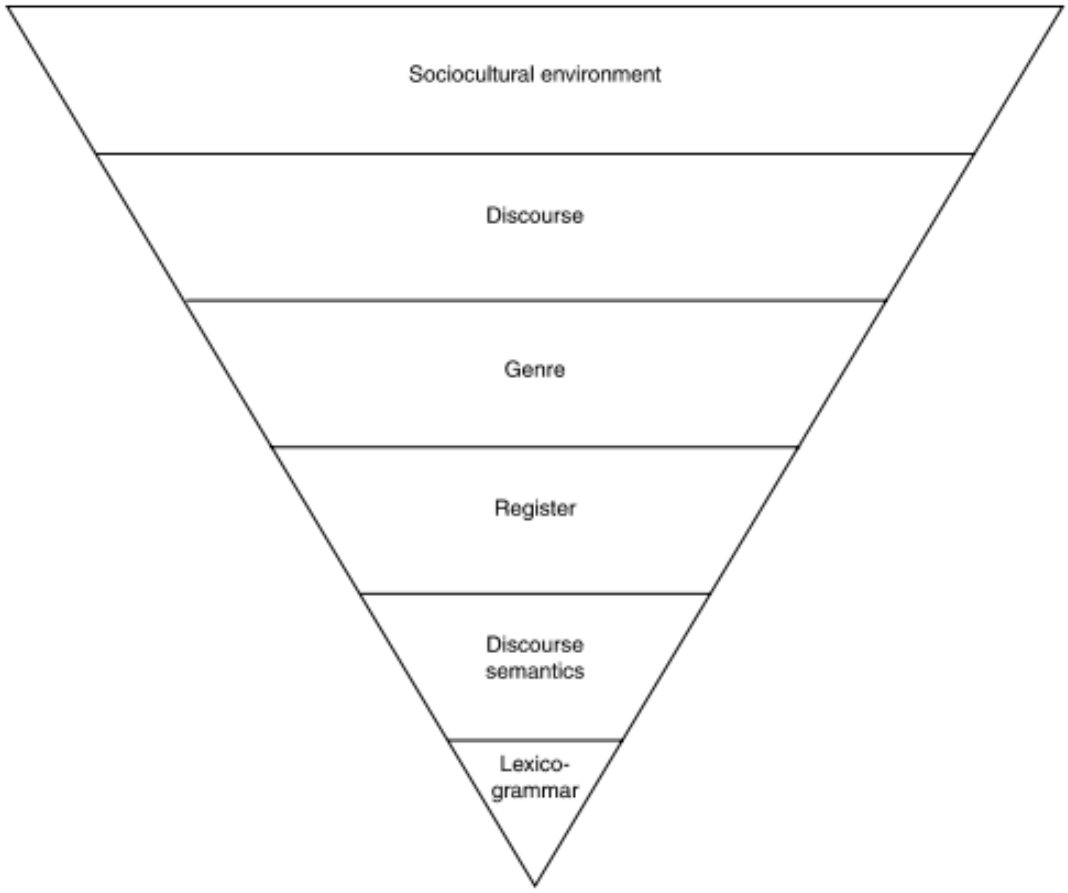


Figure 3.2: The Hallidayan model of language (Munday 2016: 143).

In particular, according to Munday (2016: 144), the sociocultural environment affects the genre, that is "the conventional text type that is associated with a specific communicative function" (Munday 2016: 144). In addition to that, "genres are strategically constructed by authors to achieve certain communicative purposes" and they use it "to address targeted audiences in the context of recurring rhetorical situations" (Xia 2022: 72). Similarly, genre influences other elements, such as register, which has not to be understood just as the formal/informal level, but in SFL it is made up of these three important elements:

(1) **Field**: what is being written about, e.g. the price for a delivery of goods;
(2) **Tenor**: who is communicating and to whom, e.g. a sales representative to a customer;
(3) **Mode**: the form of communication, e.g. written or spoken, formal or informal.

(Munday 2016: 144)

Juliane House (2015: 127) proposes another model that aims to describe the lexical, syntactic and textual components that construct Register, which is shown in Figure 3.3.

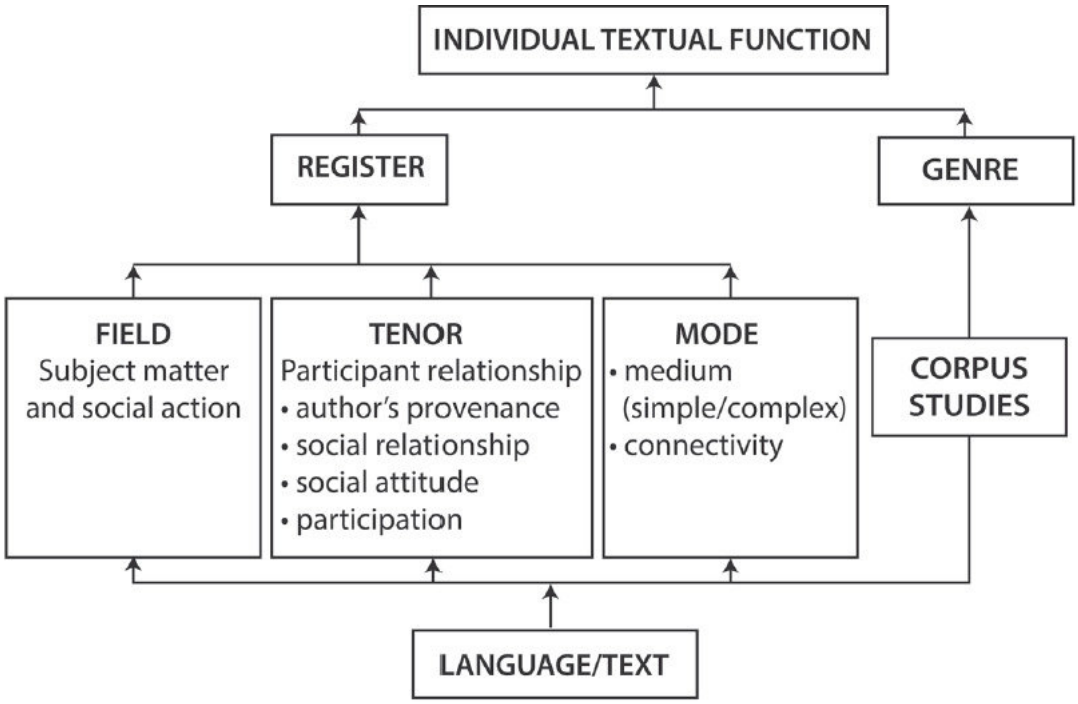


Figure 3.3: A revised scheme for analysing and comparing original and translated texts (House 2015: 127).

The author takes up Hallyday's concept of register and its three elements, adding that

- **Field** refers to the subject matter and social action, and covers the specificity of lexical items.

- **Tenor** includes 'the addresser's temporal, geographical and social provenance as well as his [or her] intellectual, emotional or affective stance (his [or her] "personal viewpoint")' […] 'Social attitude' refers to formal, consultative or informal style. There is an element of individuality to this, as there is to stance.
- **Mode** relates to 'channel' (spoken/written, etc.) and the degree of participation between addresser and addressee (monologue, dialogue, etc.).

(Munday 2016: 146-147)

To go back to the different levels of communication, Gotti (2011: 17-18) affirms there are "three different situations in which a specialist may address a topic relating to his profession" (Gotti 2011: 17). The first situation deals with experts referring to other specialists for academic or professional reasons, for example "to describe a research project, report results, explain the use of equipment, etc." (Gotti 2011: 17). In this case, also known as "peer or academic writing" (Scarpa 2020: 9), there is extensive specialised terminology with little explanation, as the author assumes the addressees have the same specialised knowledge about the topic in question. Consequently, explanations are usually given just when the author coins new terms or reformulates already existing words and concepts (Gotti 2011: 17). The second situation has to do with specialists addressing non-specialists for educational or instructional reasons, as it happens with academic textbooks and instruction manuals, where specialised terms and concepts are usually illustrated when they appear for the first time (Gotti 2011: 17). The third situation is the one of "popular science" (Scarpa 2020: 9), in which specialists give technical information to the general public using everyday terminology in order to explain specialised concepts through their everyday experience (Gotti 2011: 18). This happens for instance in newspapers and magazine articles reporting scientific or technical content, and the aim of this situation is to reach a wider public (Gotti 2011: 18). These three different situations convey three different uses of specialised language, even though just the first two make an actual use of specialised terminology, and their level of specificity is respectively reported as "scientific exposition", "scientific instruction" and "scientific journalism" (Widdowson 1979: 52-53). According to Scarpa (2020: 9), there can be two further situations in which specialised language is used. One happens when a technician refers to other technicians, usually in an informal way, "for eminently practical occupational

purposes" (Scarpa 2020: 9). While the other concerns the case in which a specialist addresses other specialists or even non-specialists for promotional purposes.

In addition, the functions and the genres related to the different relationships among the participants should be considered (Vargas 2005: 308). For instance, in an expert-to-expert relationship, the proper functions and genres are

- *Informative texts*, which aim to "transmit academic/professional knowledge with a professional audience in mind" (Vargas 2005: 308), and usually this function is very likely to be found in "articles of specialised journals, specialised commercial articles, project reports, technical reports, catalogues with technical specifications, yearbooks" (Vargas 2005: 308).
- *Juridical-normative texts*, having the communication of information as their main communicative function, especially when dealing with "norms that regulate products, services or test methods" (Vargas 2005: 309), and the principal genres involved are "patents, work regulations and the test norms" (Vargas 2005: 309).
- *Didactic-instructive texts*, used not just to spread information, but also to show their practical employment. "Instruction manuals, work instructions and production plans" (Vargas 2005: 309) are the genres implicated.
- *Compilation texts*, such as "vocabularies, dictionaries and glossaries, especially those of a prescriptive nature" (Vargas 2005: 309). Their main communicative function is to unify and standardise the terminology used in a particular field (Vargas 2005: 309).

Whereas the functions and genres that usually appear in a relationship between an expert and a semi-expert are

- *Informative texts*, which in this case are written for an audience having a higher level of specialised knowledge, as in the case of "specialised or sectorial journal articles, commercial articles, catalogues, monographs, yearbooks" (Vargas 2005: 309).

- *Didactic-instructive texts*, like "technical manuals, text-books, and the instruction manuals (for machines, materials, anchors, assembling, maintenance, etc.)" (Vargas 2005: 309).
- *Compilation texts*, which this time "offer a general view of knowledge in an easily accessible way" (Vargas 2005: 310). Some typical examples are "encyclopaedic articles, vocabularies, dictionaries and glossaries" (Vargas 2005: 310).

Finally, in a relationship between an expert and a layman, there are two main types of texts, which are

- *Popularised texts*, which have the description of an argument from a general point of view as their main communicative function, as happens with "popularised articles, advertising brochures, catalogues" (Vargas 2005: 311).
- *Compilation texts*, which aim to "offer a general and more accessible view of a specific knowledge and facilitate its access" (Vargas 2005: 311). The most emblematic genres of this function are "encyclopaedic articles, vocabularies, dictionaries and glossaries" (Vargas 2005: 311).

3.2 The Scientific Discourse and the Language of Astronomy

In this section, the language of science, with special reference to that of astronomy, will be taken into consideration. The scientific discourse will be addressed first, and the focus will be mainly on its history and its principal characteristics. Then, the language of astronomy will be explored, concentrating mostly on the linguistic aspects related to it.

3.2.1. The language of science

The language of science is "precise, clear and unambiguous" (Nagy 2015: 165). It is used in many different situations, such as in academic, institutional, educational, and public contexts, where the main aim is to create, spread and popularise scientific knowledge (Musacchio and Zorzi 2019: 482).

3.2.1.1 *Historical background*

The modern science communication was established in the 17th century thanks to the work of the Royal Society, the national scientific academy in the UK. In 1665, the academy published *The Philosophical Transactions of the Royal Society*, a scientific journal that outlined the scientific accreditation practices still in force today, especially the peer-reviewing process. This was followed by the publication of other European journals, such as the Italian *Giornale de' letterati d'Italia* (1710). These were the first attempts to create journals dedicated to science, usually meant for readers of average cultural level and a high social status (Bevilacqua 2014: 387). In the 19th century, the daily press started to deal with science through the "feuilleton scientifique", abandoning specialised magazines aimed just at a specialised audience. In the 20th century, the figure of the science journalist, interpreter and translator developed as a consequence of the increasing need to have a professional that could mediate between two extremely different realities, namely the scientific sphere, represented by scholars with their research, and the public sphere, made up by more or less educated people (Bevilacqua 2014: 487-388). At the same time, scholars wanted to understand the relationship between the public and mass media. Curiously, the first theories on this subject appeared in the 1940s, when mass communication started to increasingly spread and the regimes made an instrumentalised use of propaganda for their own benefit exclusively. So much so that messages proposed by mass media immediately reached their audience's brain with the purpose of manipulating and controlling it (Bevilacqua 2014: 388). As a result, science popularisation acquired new connotations and the previous idea according to which scientific knowledge started from the top and reached the bottom in a linear way, was replaced by a more articulated and horizontal structure in which the key elements to take into consideration were the public, so the object of science popularisation, the scientists, as main source of scientific knowledge, scientific knowledge itself, and the effects resulting from the scientific process (Bevilacqua 2014: 388). However, in 1985, the Royal Society published the "Bodmer report", according to which there was a deterioration in the relation between science and public opinion. For this reason, the report suggested that scientists' main duty was to communicate with the public through the media, and journalists needed to understand and accept scientists' opinions (Bevilacqua 2014: 388). Moreover, it underlined the importance of writing and reading about science, technology

and health in journals. These requests were particularly important for the concept of "Public Understanding of Science (PUS)", which appeared many times during the 20th century and during the Cold War, but that never consolidated before this moment. Thanks to this concept, the attention of analysts and politicians was explicitly shifted to the public and the understanding of both science and technology. However, the PUS concept was soon replaced by the newest "Public Engagement with Science and Technology (PEST)" notion, according to which the public needed to be involved in the decisions regarding scientific issues having social consequences (Bevilacqua 2014: 388).

2.2.1.2 *Exploring the language of science*

In the language of science, the features that usually stand out are "impersonal statements, logical thinking, clear and accurate descriptions". On the contrary, "metaphors, humour or affective connotations" are totally omitted (Nagy 2015: 265). As regards the language, English is considered the "lingua franca" of both science and technology. Indeed,

> over 80% of scientific publication takes place in English, as do the vast majority of international scientific meetings, symposia, research programmes and other exchanges (in international settings).
>
> (Montgomery 2009: 7)

And having a global language is crucial in order to easily address and communicate with the international scientific community (Scarpa 2020: 77). Moreover, English for science implies a special scientific vocabulary in which words of Latin and Greek origin are predominant and which developed over time as a consequence of the evolution of science and of the new scientific discoveries (Nagy 2015: 265). In the 17th century, for instance, British scientists believed there was a need to improve this vocabulary, especially with new specialised words and with more scrupulous meanings of these terms. In order to do so, they followed two main ways: the first one consisting of using English to coin new words or to confer a new specialised connotation to an existing term, and the second one involving words and concepts from a foreign language. An example of the first case is the word "gravity" employed by Isaac Newton, which assumed a new meaning after some

crucial developments in physics, and which allowed the formation of new terms like "gravitate" and "gravitation" (Gotti 2011: 157). On the other hand, an example of "calques and borrowings" (Scarpa 2020: 76) is related to Latin words ending in *-atio*, which became *-ation* in English, or other suffixes of classical languages like *-ology* and *-meter*, which led to the creation of specialised terms such as "archaeology", "pathology", "thermometer", "hydrometer" (Gotti 2011: 158).

On a syntactical level, nominalisation is one of the most common techniques to create a scientific vocabulary. It is considered to be the feature that mostly differentiates scientific language from common language. This mainly because in scientific texts the verb has the pure syntactic function of joining nominal elements in sentences, while the amount of information it conveys is very poor, and, at the same time, indications of manner, time and people are usually neutralised by the third person, either singular or plural, of the indicative present tense (Cortelazzo 1994: 30). Moreover, nominalisation makes it possible to create greater objectivity and abstraction, as it brings the message to a general, timeless level, proper to scientific discourse, and it makes communication more economical through the elimination of redundant elements (Cortelazzo 1994: 31). At the same time, another important process is juxtaposition, especially nominal juxtaposition (Cortelazzo 1994: 31; Gotti 2011: 163). This process follows the criterion of transparency, which is crucial for the scientific discourse, and it permits the creation of transparent terms starting from existing English words. In particular, the shortness of these English words benefitted this process, as most were monosyllables and could "be easily linked to form compounds, which in turn were not too long" (Gotti 2011: 163). Scientific discourse also has a specific grammar, as it favours accurate and unambiguous terms, which generates repetitive expressions as well as a recurring use of relative pronouns and adverbials (Nagy 2015: 265). Other key elements are linking words "that express contradiction, explanation, and conclusion" (Nagy 2015: 265), and which usually are conjunctions, like "and", "though", "although", "as", "since", prepositions, such as "during" and "despite", and adverbs, e.g. "firstly", "secondly", "usually", "meanwhile". Moreover, scientific texts are generally made up of long and complicated sentences, with complex internal structures and noun phrases, as well as passive constructions, which contributes to the impersonality proper to scientific texts, and neologisms. Non-verbal elements are also present, as in the case of graphics, models, images and tables, even

though they are usually accompanied by a written explanation (Nagy 2015: 265). Elena Croitoru (2004: 21) outlines that the main points of the English scientific language are

- Nominative + infinitive with present and past reference, pointing to both simultaneity and anteriority relationship
- Accusative + infinitive with simultaneity relationship
- Preposition + gerund and verbal nouns
- Verbal adjectives
- Gerund as a subject
- Passive constructions, which have the highest frequency in specialised texts. Subjunctive mood is specific to formal English, hence to specialised texts.

In addition, English scientific texts have an emphatic use, which is usually needed to highlight specific elements, as well as comparative sentences and constructions, *wh* relative clauses, and the *-ing* form, used in post-modification (Croitoru 2004: 21).

3.2.2. The language of astronomy

According to Encyclopedia Britannica (2024), astronomy is the "science that encompasses the study of all extraterrestrial objects and phenomena"[2]. These include "objects we can see with our naked eyes, like the Sun, the Moon, the planets, and the stars" (*American Museum of Natural History*), as well as objects that can be seen just through telescopes or other similar devices, as in the case of galaxies and small particles. Moreover, it has to do with objects that still are invisible to us, such as dark material[3].

[2] https://www.britannica.com/science/astrophysics (last accessed on 8/10/2024)
[3] https://www.amnh.org/explore/ology/astronomy/what-is-astronomy (last accessed on 8/10/2024)

3.2.2.1 *Exploring the language of astronomy*

The word "astronomy" has Greek origins. It derives from the Greek terms *Astron*, meaning "astro", and *Nomos*, which stands for "law" (Gatti 2021: 16). Curiously, according to the Greeks, astronomy was a branch of mathematics and, for this reason, "an astronomer (astronomos (ἀστρονόμος) but also astrologos (ἀστρολόγος) could also be called mathēmatikos (μαθηματικός)" (Schironi 2024: 11). At the same time, astronomy deals with "'appearances' or 'visible phenomena' (ta phainomena (τὰ φαινόμενα))" (Schironi 2024: 12), which is the reason why astronomical texts often contain descriptive elements. In the beginning, astronomy was linked to mystical-religious convictions and superstitions, as people believed that astronomical phenomena happened mysteriously and in a cyclical way. They also thought that these phenomena were related to their daily life, so, for example, they used the starts to foretell their future (Gatti 2021: 17-18). According to Encyclopedia Britannica (2024), originally astronomy studied the position of the Sun, the Moon and the planets for calendrical and astronomical reasons, and later also for navigational and scientific purposes. In the 17th century, the telescope was invented and the laws of motion and gravity started to be theorized. And it is thanks to these innovations that nowadays astronomy studies more distant subjects, like the solar system, the Milky Way Galaxy and other galaxies. Finally, since the 19th century, astrophysics is a branch of astronomy dealing with "the properties and structure of cosmic objects, including the universe as a whole" (Encyclopedia Britannica 2024)[4].

As far as astronomical language is concerned, advances in astronomy over the last century have stimulated a radical reorganisation of the astronomical dictionary. However, this does not mean that every term has been completely changed, on the contrary, there is a strong relation and continuity between the past and the present, between scientific and popular vocabulary, and between technical and general language (Capponi 2015: 138). Moreover, in our everyday language, we tend to use words coming from the astronomical dictionary, so technical terms have started to be commonly used. But sometimes it is astronomy itself that draws on the general vocabulary, as in the case of Galileo Galilei, who preferred using words coming from tradition instead of new and innovative terms (Capponi 2015: 139). An example of this second scenario is the word "galaxy", which

[4] https://www.britannica.com/science/astrophysics (last accessed on 8/10/2024)

comes from the classical tradition, especially from the Greek tradition (*gakaksías kúklos*), and which was originally used to indicate the Milky Way, believed to be produced by the milk of Hera, Zeus' partner (Capponi 2015: 139). Today, this term is generally used to refer to any star system. Its more recent meaning stands for "important people", as in English its common sense is related to a large group of impressive people and things (Capponi 2015: 140). The adjective coming from this term, "galactic", takes on the figurative meaning of "grandiose, exceptional" (Capponi 2015: 139-140). An example of terms closely related to the scientific language and tradition are the ones starting with the prefixes *cosmo-* and *astro-* such as "cosmology", "cosmonaut", "cosmography", "astronaut", "astronautics", "astronavigation" (Capponi 2015: 141-142). In particular, the prefix *astro-* experienced a wide popular circulation before its scientific specialisation of the 20th century. For instance, the word "astrology" had several popular meanings, such as "weirdness", "conjecture" or even "companionship". As a consequence, the term "astrologist" has many secondary meanings, like "fortune-teller", "impostor", "strange, bizarre man". Curiously, the feminine form of the word "astrologist" together with these meanings carries the denotations of "smart woman" and "hard-working woman" (Capponi 2015: 143). Another interesting word is "asteroid", as it derives from a Greek form used to refer to stars, which is *astér*, and compounded with the suffix *-oeidés*. The term "asterisk" comes from the same base, which is the diminutive of the word *aster*, and is used to identify the typical star sign (*) (Capponi 2015: 144). Going on with the analysis of other words concerning the astronomical dictionary, "satellite" originally stood for the bodyguards of Tarquin the Proud and, consequently, in Latin it meant the "guard of a sovereign". Just in the 17th century, it started to be used to refer to "Jupiter's satellites" and then to any celestial body in orbit around another body. Historically and politically speaking, it was also used with the meaning of "satellite peoples or countries", a geopolitical term that appeared for the first time in Friedrich Naumann's volume titled *Mitteleuropa* (1915) and widely used in the years of the Second World War (Capponi 2015: 145). Finally, some astronomical terms that became part of the general language are commonly used in popular expressions and sayings. This is the case of the stars and the moon, as it happens with expressions like "follow your own star", "being born under a lucky or unlucky star", "reach for the stars", "reach for the moon", "ask for the moon", "being lunatic" (Capponi 2015: 146-147). Planets, too, are to be found in the everyday

language, as in the case of some adjectives that derive from planets' names. For example, a "jovial" person is someone cheerful and this adjective comes from the beneficial influence that astrologists attributed to Jupiter, while a "saturnine" person is someone melancholic and sad, which is due to the negative influence of Saturn. A "mercurial" person usually is very shrewd, astute, and smart, thanks to the influence of Mercury, who is the messenger of the deities, but also the divinity of merchants, of deceit, of thieves and inventions (Capponi 2015: 147-148).

3.3 Science Popularisation

In this section the popularisation of science will be addressed. First of all, its historical background will be analysed in order to understand how and why it developed. After that, its relationship with the translation process will be addressed, with a special focus on their main similarities, highlighting, at the same time, science popularisation's principal features. Finally, a confrontation between scientific specialised texts and popularisations will be proposed to underline the dominant differences that differentiate these two text types.

3.3.1 Brief history of science popularisation

The history of science popularisation has much to do with the "shifting relationships between episteme (scientific or specialist knowledge) and doxa (public knowledge)" (Perrault 2013: 37). In the 17th century, for instance, this relationship was so close that episteme and doxa were almost the same thing and science was not separated from other disciplines. In this regard, Francis Bacon highlighted that laymen's knowledge about the natural world was extremely important and therefore should be taken into consideration (Conner 2005: 250). Moreover, Bacon's beliefs were to be found in the Royal Society's goal "to making knowledge available to serve human uses" (Perrault 2013: 38), as science was meant to be helpful and useful for people. The fact that science was not distinguished from other practices can be found also in the Royal Society's members, as at the beginning they were not elected for their scientific knowledge but for their wealthiness, in fact "in the first ten years of the Society, only 57 of the 261 members had scholarly or

medical training" (Inwood 2003: 26). In addition to that, in the 17th and especially during the scientific revolution, science communication was subjected to the control of the authorities, being mainly religious and civil authorities. Galileo Galilei was an emblematic figure of this period, as he became the symbol of the battle of science against scientific prejudice and obscurantism, while other scientists, like René Descartes and Baruch Spinoza, had to wait for their works to be published or they even had to go abroad to make this happen (Castelli 2012: 61).

The indivisibility of science and other disciplines that characterised the 17th century continued in the 18th and in the early 19th centuries. Nonetheless, in the late 18th century there was a gradual shift that reached its maximum point in the late 19th century and that saw a greater specialisation in science as well as "a more information-oriented approach to science" (Perrault 2013: 40). The main aim was to create a more professional and impersonal scientific discourse, to finally separate science from other disciplines and, consequently, scientists from ordinary people doing science. For this reason, many "science-focused institutions, such as national academies of sciences" (Perrault 2013: 40) supported scientific specialisation and progress, thanks to which science became a more and more professional and specialised discipline. Moreover, after the Industrial Revolutions of the 18th and 19th centuries, the link between science and technology was increasingly stronger and in the second half of the 19th century science began to enjoy great social authority, which was strengthened by the many technological discoveries and innovations, such as the development of the railway and of the airplane, as well as the discovery of vaccines and of electricity (Castelli 2012: 61-62). It is in this period that the concept of "sanctity of science" was introduced, and the scientist became the figure that could give society definite answers about the world and about life, reshaping in this way the millenary custom that saw religion and philosophy as central sources of knowledge (Castelli 2012: 62). Moreover, as far as science communication is concerned, "scientific writing shifted further and further away from personal trust and personal prose and toward a more information-oriented approach" (Atkinson 1999: 154). However, in the 20th century, the sacral vision of science weakens and the paradigm of the "Public Understanding of Science" gradually asserts itself. This paradigm moved around the need to adequately explain the criteria of scientific research, discoveries and possible applications. In particular, scientists had to ensure the correct understanding of their

scientific works to society and had to show people the opportunities offered by new scientific discoveries and innovations so as to carry on with ongoing studies and so that new areas of research could be taken into consideration (Castelli 2012: 62). At the same time, scientists realised that detachment from society could be dangerous for them, as they dealt with public opinion, i.e. the set of socially shared ideas that are translated into political decisions and thus directly into funds for scientific research or into laws concerning delicate ethical aspects of experimentation (Castelli 2012: 62). In this regard, the relationship between science and society or public opinion went through a first stage which began in the 20th century and continued until the end of the Second World War and in which confidence in science was more and more consolidated. Afterwards, this relationship changed into the "old social contract", which was "an understanding in which scientists were given funding and autonomy, and was expected to produce goods" (Perrault 2013: 43). Then, a crucial consequence of scientific specialisation was that scientific texts were not accessible to anyone, as they were becoming too specialised not just for ordinary people but also for specialists themselves. "A scientist in biology could not expect to understand a publication in chemistry" and, similarly, "a specialist in one branch of chemistry often could not understand the technical material of another branch" (Perrault 2013: 43). The 20th century was the century in which there was a shift not only in the way science was done but also in the way people saw scientific research. People's trust was not unconditioned as it happened in the previous centuries, but they began to be more critical and attentive, so much so that they started to pose more questions about science (Perrault 2013: 45). This was not a sudden shift, but some crucial aspects contributed to making this change happen. Firstly, the "increasing ties between science and the private sector have undermined science's reputation for unbiased truth-telling" (Perrault 2013: 45). Secondly, the "revelations about unethical research have raised questions even about public science and the ability of sciences to regulate themselves" (Perrault 2013: 45). And thirdly, "a growing awareness of the environmental and human health costs of scientific 'progress' has brought challenges to the scientistic worldview" (Perrault 2013: 46). Nevertheless, people generally continue to have a great respect for science as a discipline and their scepticism does not mean they do not trust it anymore, but just that they are more critical when it comes to particular scientific areas and specific matters (Perrault 2013: 46).

3.3.2 Science popularisation and translation

The concept of popularisation has not always found a unanimous definition. Nonetheless, it often coincides with the spread of specialist knowledge for educational or informative purposes. The main characteristics of this process have often been found in the lack of conceptual innovation and in its target audience, which is a non-specialist audience, even though this last parameter is not entirely adequate as, for instance, it does not admit a clear separation between these texts and instructive ones (Gotti 2012: 145).

Interestingly, popularisation has frequently been linked to the translation process, as they apparently share some common features. First of all, they both have to do with the creation of a TT starting from a ST. In the case of an interlingual translation, the TT's language is different from the original one, whereas in the case of popularisation, an intralingual translation process takes place and "information is transferred linguistically in a way similar to periphrasis or to intralinguistic translation" (Gotti 2011: 180). Another aspect that associates these processes is the fact that both of them create TTs that are not completely equivalent to the STs. In fact, a popularised text aims to convey the same content as in the ST, even if it usually does so in an approximate way and without the methodological and terminological rigour typical of specialised language. This phenomenon of approximation is fostered by the extensive use of metaphors and similes in popularisations, which makes it possible to establish a direct relationship between specialised terms or concepts and the general knowledge of non-experts as to facilitate the complexity of the text (Gotti 2012: 148).

According to Musacchio and Zorzi (2019: 482), popularisation can easily be found in news, being one of the main non-specialised contexts in which journalists should not just inform their audience but also entertain them. These two aspects are accompanied by other communicative functions, like argumentation and persuasion, especially when the scientific discourse is more controversial, as in the case of issues dealing with public health, politics and ethics. Popularisation has also been described as "a form of rewriting scientific research documents" (Musacchio and Zorzi 2019: 482-483), where rewriting was thought to be a kind of translation, as the new text created was not completely equal to the ST and re-contextualisation was needed in order to make this new text comprehensible for the target audience. To make it clear, re-contextualisation is "the transformation of information in mediated discourse through additions, deletions,

substitutions, rearrangements, and elaborations" (Musacchio and Zorzi 2019: 483). Some translation processes that are linked to re-contextualisation and that are part of mediation are rewriting, transediting and transcreation. In particular, rewriting is "a metalinguistic process that reinterprets or manipulates content to serve a range of ideological motives" (Musacchio and Zorzi 2019: 483), transediting is "a pragmatic translation strategy meant to smooth and improve the readability of a text" (Musacchio and Zorzi 2019: 483), and transcreation is "a practice going beyond translation to recast the source text in a new language while preserving the intended content" (Musacchio and Zorzi 2019: 484). In their work, Musacchio and Zorzi conclude that translations into Italian go more frequently through rewriting and transediting processes. Specifically, the main procedures are rearrangements, meaning there are some rewriting changes in phrases and clauses order to achieve fluency, and situational transediting, with the purpose of matching the functions of the TT (Musacchio and Zorzi 2019: 505). Similarly, Gotti (2012) writes about popularisation as re-contextualisation, highlighting that the popularisation process implies not only a reformulation of the specialised discourse but also its re-contextualisation for an audience having a limited knowledge about its content. A typical example of this can be found in medical popularisation, which appears widely in mass media, through newspaper reports, documentaries, scientific programmes and health promotion campaigns (Gotti 2012: 149). Therefore, the populariser is expected to have a very active role in this process, as the text created by a specialist needs to be reformulated and adapted to the needs and expectations of the target audience. Moreover, this reformulation implies more than a mere adaptation of terminology, as a series of modifications at various levels are usually to be done as well, such as the identification of the communicative function of the TT, the choice of its formal structure, the verification of the new target audience's knowledge on the subject, the consequent change of both register and language. In addition, during the editing process the TT is usually subjected to important revisions concerning both the content and the form of the popularised message (Gotti 2012: 150). The process of re-contextualisation begins with an initial phase in which the author addresses the audience and arouses their interest by creating a possible situation that could occur in their everyday life. Additionally, to make the TT clearer and more convincing for the target audience, the author uses simple language and concrete examples, making often use of metaphors and similes in order to

describe complex facts and abstract concepts in an easier way (Gotti 2012: 150). An example of re-contextualisation of specialised knowledge can be seen in the popularisation of health-related information. In this case, popularisation occurs at all levels and makes use of all the channels available, such as television, radio, newspapers, magazines and the Internet. In doing so, the popularised message adopts the style and conventions typical of the channel taken into consideration. For instance, in his analysis of the popularisation of medical information in Australian teenage magazines, McKay (2006: 316-317) reveals that the technique of personal narration by teenagers who have gone through similar experiences is often chosen to give information about diseases, their symptoms and their treatments. In this way, a re-contextualisation of medical concepts in real-life situations is created, and the information appears more credible to the target audience (McKay 2006: 318).

3.3.2.1 *Scientific specialised texts vs popularisations*

According to Gotti (2011: 179), the key feature that differentiates specialised texts from popularisations is the target audience they refer to. Specialised texts address an expert audience while popularised texts are meant for non-experts. Nonetheless, as already mentioned in this chapter, this feature is not enough to describe and distinguish these two text types. Another important factor deals with their principal focus, as works referring to non-experts usually are pedagogic texts, such as "undergraduate textbooks and instruction manuals", and popularisations, like "popular scientific magazines, books published for a wide readership, videocassettes and specialized articles in daily newspapers" (Gotti 2011: 180). In particular, popularisations address a wider audience than pedagogic texts and their aim is to give specialised information to a non-expert audience by using a language as close as possible to everyday experiences (Gotti 2012: 145). Moreover, in pedagogic texts, much space is given to the illustration of specialised concepts as well as to the definition of relevant terminology, which itself becomes the object of study for their audience, while in popularisation there are fewer specialised terms and definitions, and illustrations are less technical (Gotti 2011: 180). As far as definitions are concerned, they are created in different ways depending on the text type in which they are to be found. For instance, terminological definitions are not common in

specialised discourse, since the meaning of specialised terms is taken for granted. For this reason, authors provide definitions only when new terms are introduced or if they change the meaning of already-existing terms (Gotti 2012: 146). To emphasise their own original contribution, authors generally use a very personal style centred on the use of pronouns and adjectives referring to themselves, as in the following examples:

> 1) "**We** shall call the unit in which the quantity of employment is measured the labour-unit; and the money-wage of a labour-unit **we** shall call the wage-unit" (Keynes 1936/1973: 41, as cited in Gotti 2011: 183).
> 2) "The classical postulates do not admit of the possibility of the third category, which **I** shall define below as 'involuntary' unemployment" (Keynes 1936/1973: 6, as cited in Gotti 2011: 183).
> 3) "**My** definition is, therefore, as follows: [...]" (Keynes 1936/1973: 15, as cited in Gotti 2011: 183).

Similarly, definitions are very rare even in popularisation, and since specialised lexis is not frequently used, there is no need for explicitation. However, when some definitions are provided, they generally lack a personal style, in line with the limited argumentative value of this type of text, while impersonal or passive forms are preferred, as shown in the following examples:

> 1) "First, individual genes are involved in multiple biological processes – **a widely accepted concept** known as pleiotropy" (*Scientific American*: 22, as cited in Gotti: 183).
> 2) "**A term that has been applied to describe** what has happened to many metropolitan areas of the U.S. since World War II is 'doughnut complex'. In many places the hole in the doughnut is a decaying central city and a ring is a prosperous and growing suburban region" (*Scientific American*: 40, as cited in Gotti 2011: 183-184).

Further, they make use of juxtaposition, a technique in which the specialised term is followed by its own periphrasis and the two parts are commonly separated by a comma, a dash, a parenthesis or the disjunctive conjunction "or", as in the following cases:

> 1) "That year, John Vane, a British researcher, discovered that aspirin interferes with the synthesis of prostaglandins **–** short-lived**,** hormone-like substances made by most cells in the body after an injury" (*Discovery*: 19, as cited in Gotti 2011: 184).
> 2) "More than 99 per cent of atmospheric water vapor is in the troposphere**,** the turbulent**,** weather-producing zone below about 40,000 feet" (*Discovery*: 40, as cited in Gotti 2011: 184).
> 3) "A one-inch-diameter rod of super-pure glass is heated and drawn down to a fiber just 125 microns **(**five thousandths of an inch**)** thic" (*Popular Science*: 72, as cited in Gotti 2011: 184).

Yet, this technique does not always succeed in defining a particular term, especially when it makes the explanation too short (Gotti 2011: 186). To go on, metalinguistic expressions like "called", "known as", "that is", "meaning", are frequently used to connect two parts of a definition and when a specialised word appears in the text it is put in inverted commas or in italics, in order to visually differentiate it from general language (Gotti 2011: 185-186). Finally, sometimes the definitions contain metalinguistic expressions that imply a comment of the periphrasis made by authors themselves. This comment is usually indicated by metalinguistic items such as "a little", "like", and "a sort of", e.g. in "The brain is **a sort of** computer" (Gotti 2011: 187).

Chapter 4
POST-EDITING "VENUS: DEATH OF A PLANET"

This third and last chapter is dedicated to the analysis of the PE work. First, the main objective, methods and materials that were applied for this work will be presented (4.1) Then, the actual PE work will be addressed, highlighting the principal questions and issues that emerged during this process (4.2). These aspects will be divided into some specific categories and for each of them some examples and explanations will be proposed. Finally, the chapter will end with some concluding remarks about the main strengths and drawbacks that emerged during the PE phase, which are accompanied by personal impressions and considerations based on this experience (4.3).

4.1 The Study: Objectives, Materials and Methods

The main aim of this thesis is to investigate the principal strengths and drawbacks of MT when applied to an AVT, with special reference to subtitles, in order to understand its major benefits and disadvantages. In particular, the main research questions (RQs) are the following ones:

- In what ways can interlingual subtitlers benefit from post-editing and MT?
- Does MT produce accurate subtitles when dealing with the specialised language of astronomy?
- In the post-editing phase, do any recurrent issues emerge in the raw output?

In order to address these RQs, the analysis was carried out by two main stages. A first stage in which the ST was pre-translated using a MT engine, and a second stage in which the raw output went through the post-editing phase, with special attention to segmentation and writing conventions, register, idiomaticity, terminology and phraseology, language and grammar, additions and mistranslations, and inconsistent translations.

4.1.1 The AV product: “Venus: Death of a Planet”

“Venus: Death of a Planet” is an American 50-minutes documentary that was first released in 2020, with David Brody being its director, and Thomas Lucas its producer. It can easily be found on “SpaceRip” YouTube channel, but it is also available on other websites and platforms, such as IMDb, MagellanTV and Apple TV. Amazon Prime Video offers it as well, but it is not currently accessible in Italy. It is available in English only with official American English subtitles, even though YouTube gives the opportunity to watch it with English automatic subtitles. At the time of this writing, automatically translated subtitles in several languages, including Italian, are also available, as shown in Figure 4.1.

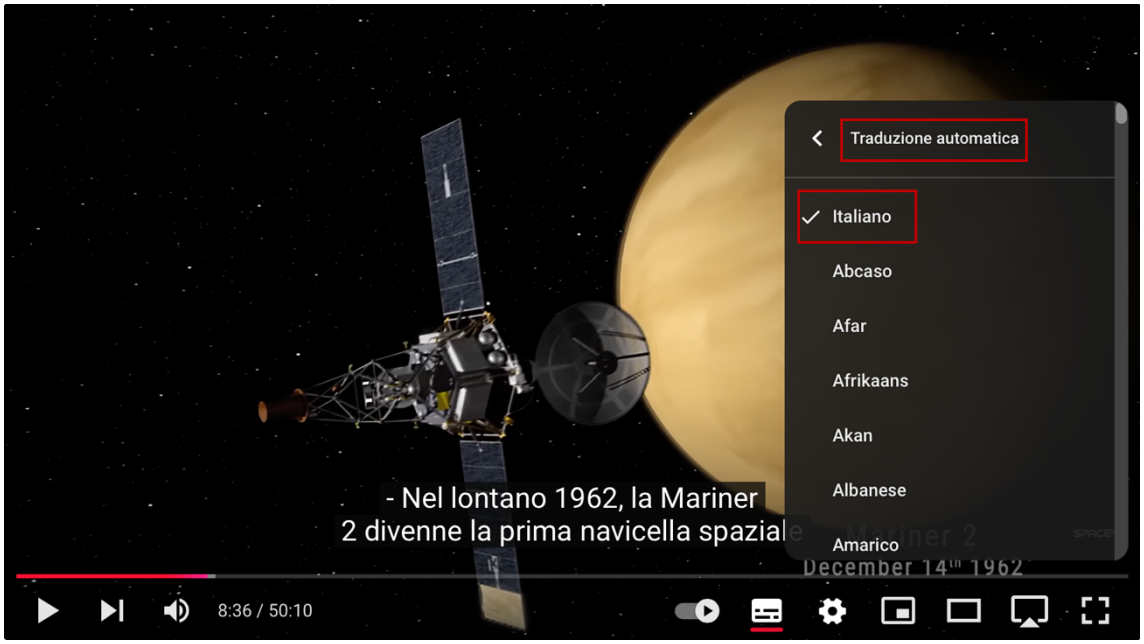


Figure 4.1: Automatic Italian translation suggested by YouTube.

4.1.1.1 *Why this documentary*

The choice of this particular documentary, “Venus: Death of a Planet”, was due to mainly two reasons. The first was a personal one as I have always been curious about astronomy and everything that has to do with space. In particular, Venus has always intrigued me, since it is the closest planet to Earth, but still, it is not habitable and does not have the same living conditions as Earth. Afterwards, thanks to this documentary, I had the chance to understand why and to learn a little bit more about its incredible history, which I found

fascinating. Moreover, I deeply wished to work with astronomical language to broaden my knowledge of it, and I also wanted to challenge myself with a new translation technique I had never practised before.

The second reason has to do with my desire to make this documentary accessible to Italian speakers as well. In particular, I believe this documentary to be very interesting and engaging, as it deals with Venus' tragic history, comparing it to the Earth's, and it suggests, through the words of some NASA's experts, scientists and researchers, several solutions and experiments that could bring us to this planet. Therefore, I wished it could be seen and understood by Italian speakers as well, hoping it would arouse their curiosity and encourage them to know more about Venus and about new scientific discoveries that could be crucial to us as human beings.

4.1.1.2 *The documentary's storyline*

On YouTube, this documentary is available from the 16th of October 2020 in American English with American English subtitles and English subtitles that are automatically generated. A transcription is provided as well as a highlight of the documentary's key moments, which are named and divided into chapters, such as "Mariner 2", "Super Rotation", "Pancake Domes". As the title itself suggests, this documentary deals with the history of the planet Venus, which billions of years ago used to be a hospitable and habitable planet, but gradually turned into a hellish earth. Today its atmosphere is 95% carbon dioxide, and its clouds are full of sulfuric acid, which means that it is so hot and corrosive that no human being could survive there. However, scientists affirm that, back in time, Venus was precisely like Earth, holding oceans, rivers, lakes, trees, and life-preserving habitats. This is the main reason why scientists and scholars have been studying and observing Venus since the 17th century, beginning with Galileo Galilei, who, in 1610, discovered that the planet went through some phases similar to the moon ones and that it orbited the sun, precisely like Earth, but it was not enough to determine its main characteristics. It was just in 1761 that Mikhail Lomonosov, a Russian astronomer, found out that more or less once every 100 years, Venus travels between the sun and the Earth, and when it reaches and then leaves the disk of the sun there is a distortion, known as the "black drop", which made Lomonosov realise that Venus had an atmosphere. In

1962, the first exploration of Venus took place thanks to the spacecraft called “Mariner 2”, which became also the first expedition to another planet that ended successfully. Nevertheless, the first time a spaceship landed on the planet was in 1970, with the Soviet Union’s “Venera 7”, which registered the first official data of Venus’ surface. Afterwards, almost five years later, “Venera 9” and “Venera 10” offered us the first photographs of its aspect and landscape. NASA contributed to exploring Venus too with its flagship called “Magellan”, thanks to which 97% of Venus’ terrain was delineated. Scientists supposed that Venus and Earth were quite similar at the beginning, as they had the same size and density, they were pretty close to one another, they both had an atmosphere, and they probably had warm oceans and a beginning of life, but for some reasons, one managed to survive while the other was not able to evolve in this direction. At the same time, Venus and Earth have some differences too. For instance, a day on Venus, meaning a complete rotation of the planet, corresponds to more than 243 days on Earth, and to complete such rotation, Venus moves in the opposite direction compared to Earth, so that the sun rises in the West and sets in the East. On Venus, the atmosphere rotates faster than the planet itself, thanks to a phenomenon known as “superrotation”, which was recently discovered by the Japanese Akatasuki probe, or Venus Climate Orbiter. Another crucial difference with Earth is that Venus does not seem to have protection between its surface and its atmosphere, which is probably the main reason why its oceans and sources of water evaporated and it became the hot and dry planet we know today. This condition got even worse as the sun became increasingly brighter and hotter, creating a continuous greenhouse effect on the planet. It is also important to keep in mind that Venus is geologically a volcanic planet and its surface is covered with different types of volcanoes, such as the so-called “shield volcanoes” or the “pancake domes”, which were named in these ways after their peculiar shapes. The biggest type of volcanoes, however, is known as “coronae”: it was thought to be pretty similar to Earth’s “calderas”, which are characterised by concentric fractures, like the ones that can be seen in Hawaii. But even though Venus’ surface is covered with volcanoes, its temperature seems to be more and more cool the higher you go, precisely as it happens on Earth. This discovery made it possible to imagine a new and potentially successful mission to Venus’ atmosphere, which consists of sending an airship platform 130 meters long to Venus, named the High-Altitude Venus Operational Concept (HAVOC), in which experiments and sensors could

be carried out without ever touching its deadly ground. Furthermore, this platform could gradually turn into an actual science city in Venus' clouds and atmosphere, 50 kilometres up in the sky, where the pressure is similar to the one at sea level on Earth and the temperature is way cooler than on its surface, which is considered to be the second hottest surface in the solar system after the sun. This so-called "ballon science" was already proposed in 1985 by Soviet scholars with their "Vega 2 probe", which went through hurricane-like currents at 240 kilometres per hour and found its stability at 54 kilometres. Therefore, this suggests that the balloons on Venus could easily detect earthquakes and scientists could have the chance to analyse them. Another important aspect that scientists will need to study deals with Venus' molecular fossils, meaning noble gases like argon, neon, xenon and krypton, which have been present in its atmosphere since the planet was born and which could help scientists identify the original atmosphere and aspect of Venus. Like Earth, Venus has some solar power, but it is not as much as the one on Earth, and its 60-day night makes it hard to use solar panels efficiently. Therefore, other energy sources have been taken into consideration to explore Venus' surface, such as wind, which happens to be the best solution as winds on Venus tend to be very strong, about 100 meters per second. To conclude, there probably was a time in which Venus and Earth were twin planets and were both considered to be within the so-called "habitable zone", but further studies have to be done before knowing for sure and before understanding whether Venus could be our new home in some way.

4.1.1.3 *Main language features*

As far as language is concerned, it can be said this is an expert-to-semi-expert documentary, as throughout the whole narration, various experts interchange to speak about different topics or aspects of the same matter. Even when the narrator talks, the vocabulary is very rich of astronomical terms. Some of these words are taken for granted and come from the general language, such as "surface", "feature(s)", "oven", "clock", "radio", "water", "behaviour", "mix", "history", "feedback". Other words are assumed to be well-known even though they belong to astronomical specialised language, e.g. "planet", "Venus", "Earth", "telescope", "Milky Way galaxy", "satellite", "astronomer(s)", "exoplanets", "meteorites". But there are also some instances of LSP

thought to be new and unknown; therefore, they usually are preceded or followed by an explanation as to help non-experts understand their meaning. This is the case, for instance, of the term "black drop", which is introduced and explained by the expert David Grinspoon, a senior scientist of the Planetary Science Institute. He does not just mention this phenomenon, but before even name it he describes it as a particular distortion that happens once every 100 years when Venus travels between the Earth and the sun. Similarly, later on, another expert proposes some names of volcanoes and peculiar domes that are to be found in Venus' surface, such as "shield volcanoes", "pancake domes", "ticks", and "arachnoids", always explaining why and where they took their name from. There are also other specialised terms that do not come from the astronomical field but from other scientific areas, as in the case of "atmosphere", "habitable zone", "CO2", "hydrogen", "plate tectonics", "greenhouse effect", "plateau", "dome", "hot springs", "geysers", "magma", "crust", which are not accompanied by a definition or illustration.

4.1.1.4 *Post-editing work: methods and tools*

The first choice that needed to be made for carrying out the post-editing work was finding the right tool. For this reason, several tools were taken into consideration and analysed according to the parameters shown in Table 4.1.

	MT/AI	**Time code**	**Video**	**Subtitles Import/Export**	**Free access**	**Professional use**	**Compatible with Mac**
Aegisub	X	√	√	√	√	X	√*
Filmora	√ (AI)	√	√	X	√*	√	√
Uniconverter	√ (AI)	√	√	X	X	√	√
Ooona	X	√	√	√*	√*	√	√
Trados Subtitling	√ (MT)	√*	√	√	X	√	X*

Table 4.1: Main parameters adopted to choose the final CAT tool.

The CAT tools under examination were *Aegisub, Filmora, Uniconverter, Ooona* and *Trados Subtitling*. The key parameters and requirements that were considered in order to select one of these tools were first of all the presence of an MT or AI in the tool, which was needed for the translation of the subtitles and then for the PE phase. The second parameter dealt with time code, as the chosen tool needed to allow the user to both see

and modify the subtitles' time code when needed. Similarly, watching and checking if the subtitles matched with the video was a crucial requirement, too. As regards subtitles, importing and exporting them was not just preferable but highly necessary because this would have saved a lot of time and made the work quicker since the documentary was very long and, consequently, the subtitles were too many to be inserted manually. A further criterion questioned their accessibility, in particular if they were free or if a payment or a particular licence were needed in order to use them. The last two parameters were more technical, as they concern the level of professionality and compatibility with *MacBook*, i.e. the operative system used for the work. As seen in Table 4.1, *Aegisub* is not a professional tool, does not support MT or AI, and frequently crashes on MacBooks. *Filmora* and *Uniconverter* were quite similar in terms of requirement and problems, probably since they are both part of *Wondershare* group. However, they have different subtitles import/export parameter as *Filmora* only allows for video vs subtitles importing; then, it uses AI for the translation, but in the trial period this function is available just for files containing videos under 30 minutes. On the other hand, *Uniconverter* had both the import and export functions for the subtitles, but to use them it was necessary to create an account and pay for a subscription. *Ooona* met all the requirements, but unfortunately, at the time of post-editing, the MT function was not available. For this reason, it had to be discarded. Finally, *Trados Subtitling* seemed to be the most suitable tool, for the reasons discussed in the next section.

Trados Subtitling

Trados Subtitling was the chosen CAT tool for the PE work because it integrates MT, supports time coding and videos, the import and export function of subtitles and is a professional tool. It is a licenced tool that can be accessed via the University of Padova subscription, and, even though it is not compatible with *MacBooks*, it can freely be accessed through the University of Padova's Virtual Lab (VLAB), a virtual machine which can run Windows OS also on MacBooks.

First, the plug-in had to be downloaded from the *RWS AppStore* for the specific version of *Trados Studio*, in our case *Trados Studio 2024*, and open it in *Trados*. Once the installation is complete, the video and subtitling file can be uploaded. The supported file types include ASS, SRT, webVTT, STL, SBV and TTML. I personally used a SRT

file, but, in order to create and upload it, I had to choose another software to add all the right time codes of the subtitles and to export the work as a SRT filetype. In this case I chose *Ooona* and, specifically, I used its "Create + Translate" tool, which allows the user to import, create, edit and translate the subtitles. Since MT is not supported yet, the translation must be manual. In my case, I used this tool to import my SRT file, which was a TXT file, and the English subtitles of the documentary were taken by YouTube's transcription. Two sets of subtitles were available, i.e. the one that came with the video and the automatic one. For this post-editing task, the first set of subtitles was used. Then, the video was imported. Time coding for each English subtitle was set manually in the working pan while watching the video. In order to see the time code and the video in *Trados Subtitling*, two icons need be clicked in the "View" tab of the ribbon, i.e. "Subtitling Data" and "Subtitling Preview" (Figure 4.2).

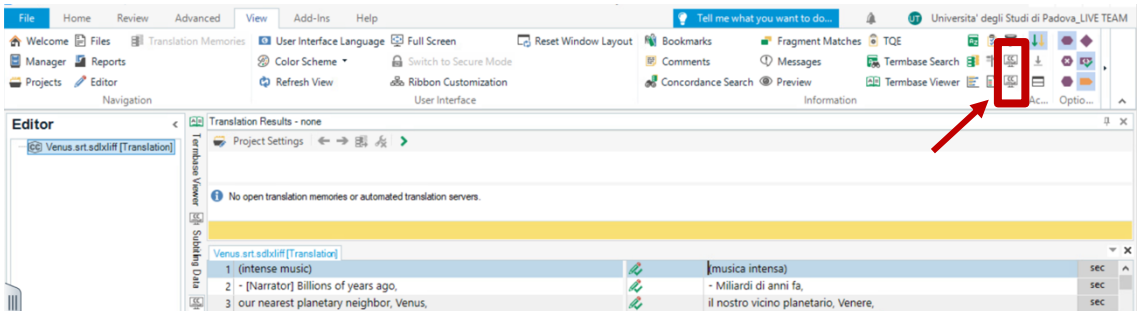
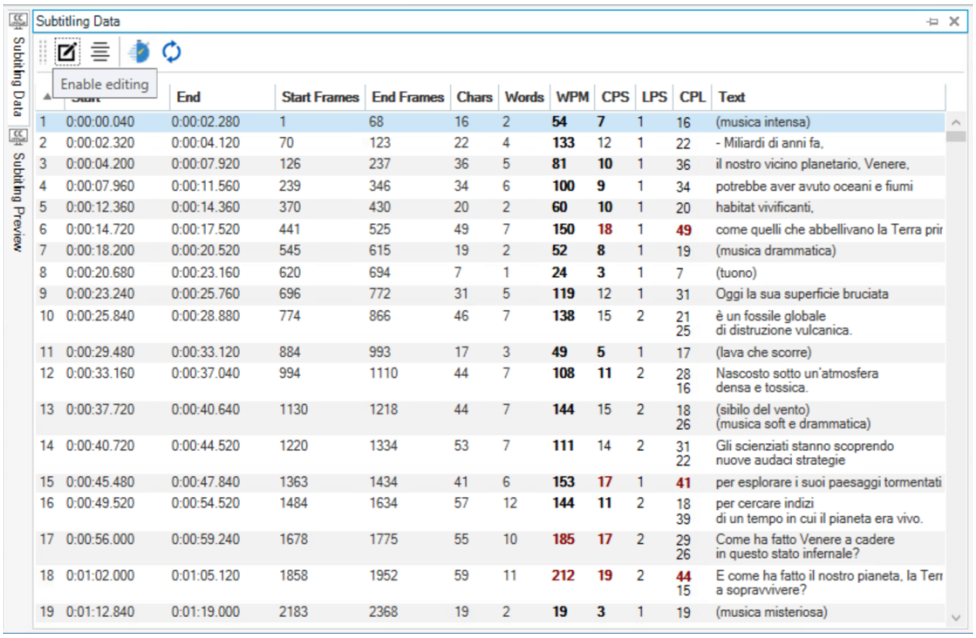


Figure 4.2: "Subtitling Data" and "Subtitling Preview" icons in Trados.

After clicking them, two windows will open, showing respectively the time code and the video with the translated subtitles, as indicated in Figures 4.3 and 4.4



	Start	End	Start Frames	End Frames	Chars	Words	WPM	CPS	LPS	CPL	Text
1	0:00:00.040	0:00:02.280	1	68	16	2	54	7	1	16	(musica intensa)
2	0:00:02.320	0:00:04.120	70	123	22	4	133	12	1	22	- Miliardi di anni fa,
3	0:00:04.200	0:00:07.920	126	237	36	5	81	10	1	36	il nostro vicino planetario, Venere,
4	0:00:07.960	0:00:11.560	239	346	34	6	100	9	1	34	potrebbe aver avuto oceani e fiumi
5	0:00:12.360	0:00:14.360	370	430	20	2	60	10	1	20	habitat vivificanti,
6	0:00:14.720	0:00:17.520	441	525	49	7	150	18	1	49	come quelli che abbellivano la Terra prir
7	0:00:18.200	0:00:20.520	545	615	19	2	52	8	1	19	(musica drammatica)
8	0:00:20.680	0:00:23.160	620	694	7	1	24	3	1	7	(tuono)
9	0:00:23.240	0:00:25.760	696	772	31	5	119	12	1	31	Oggi la sua superficie bruciata
10	0:00:25.840	0:00:28.880	774	866	46	7	138	15	2	21 25	è un fossile globale di distruzione vulcanica.
11	0:00:29.480	0:00:33.120	884	993	17	3	49	5	1	17	(lava che scorre)
12	0:00:33.160	0:00:37.040	994	1110	44	7	108	11	2	28 16	Nascosto sotto un'atmosfera densa e tossica.
13	0:00:37.720	0:00:40.640	1130	1218	44	7	144	15	2	18 26	(sibilo del vento) (musica soft e drammatica)
14	0:00:40.720	0:00:44.520	1220	1334	53	7	111	14	2	31 22	Gli scienziati stanno scoprendo nuove audaci strategie
15	0:00:45.480	0:00:47.840	1363	1434	41	6	153	17	1	41	per esplorare i suoi paesaggi tormentati
16	0:00:49.520	0:00:54.520	1484	1634	57	12	144	11	2	18 39	per cercare indizi di un tempo in cui il pianeta era vivo.
17	0:00:56.000	0:00:59.240	1678	1775	55	10	185	17	2	29 26	Come ha fatto Venere a cadere in questo stato infernale?
18	0:01:02.000	0:01:05.120	1858	1952	59	11	212	19	2	44 15	E come ha fatto il nostro pianeta, la Ter a sopravvivere?
19	0:01:12.840	0:01:19.000	2183	2368	19	2	19	3	1	19	(musica misteriosa)

Figure 4.3: "Subtitling Data" window in Trados.

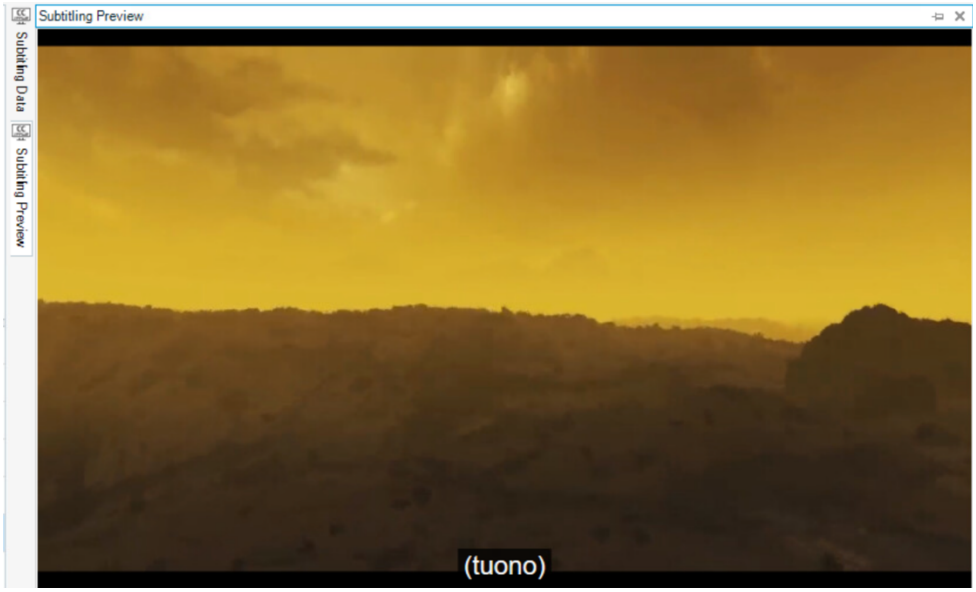


Figure 4.4: "Subtitling Preview" window in Trados.

The next step was to translate the English ST file into Italian, which I did using Trados NMT called *Language Weaver*, as shown in Figure 4.5.

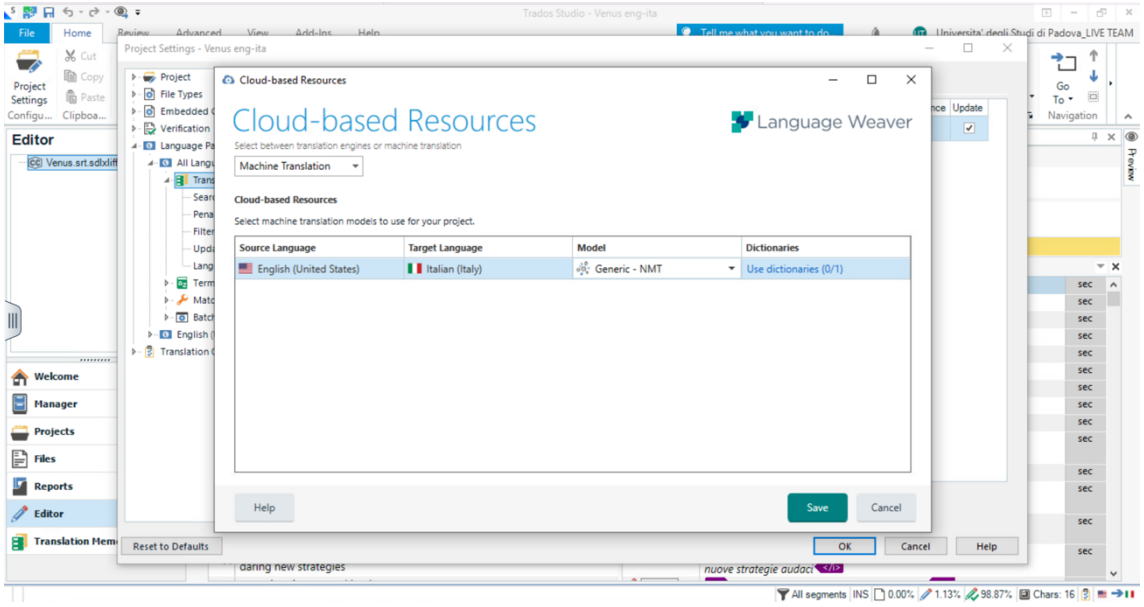


Figure 4.5: Trados NMT Language Weaver.

It created an automatic translation which became the raw output for my post-editing work, which was the following stage. The major translation issues will be discussed in Section 4.2.

The Italian raw output already presented subtitling elements for the deaf and hard-of -hearing, which were kept during the post-editing phase. The main features that were carefully analysed in the machine-translated version concerned:

1. **Segmentation and writing conventions**, i.e. whether the subtitles were segmented properly and had the right time code in the raw output, but also whether the subtitles for different speakers could be easily recognised and distinguished.
2. **Register**, i.e. whether the level of formality and technicality was appropriate.
3. **Idiomaticity**, i.e. whether the translation of the segments was idiomatic.
4. **Terminology and phraseology**, i.e. whether the translated segments contained accurate Italian terminology and phraseology.
5. **Language and grammar**, i.e. whether language and grammar were accurate in the translated subtitles and whether they carried idiomatic meanings or not.
6. **Additions and mistranslations**, i.e. whether the additions reported were appropriate or not and whether there were some mistranslations that needed to be modified.

7. **Inconsistent translations**, i.e. whether there were some translations that resulted being inconsistent and needed to be changed.
8. **Untranslated and omitted subtitles**, i.e. whether some parts of the original video were not turned into subtitles in the ST, therefore they were not present in the raw output and they had to be manually added and translated in the post-editing work.

Aegisub

Aegisub is a free, open-source subtitling tool. It has been used too during the PE phase, in order to overcome the lack of *Trados Subtitling* of moving and placing the subtitles where needed in the video. *Aegisub* allows this procedure thanks to the blue arrows icon that can be found in the vertical column at the left side of the video, as shown in Figure 4.6.

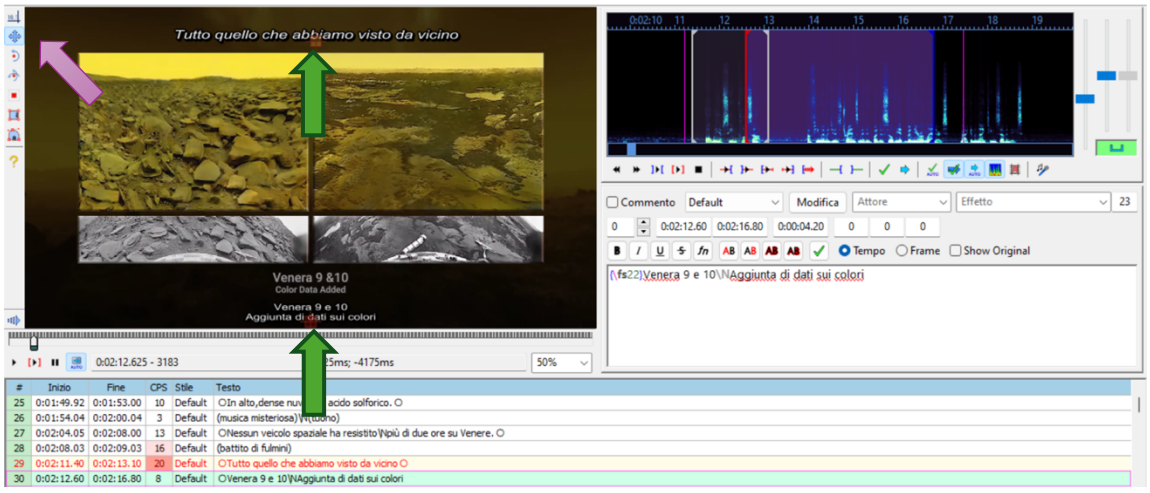


Figure 4.6: Blue arrows icon in Aegisub to move subtitles around.

As signalled in the image, when the blue arrow icon is selected, a little square with a red outline automatically appears below the subtitle. This is needed in order to move the subtitles and place them elsewhere on the screen. In this specific case, I used this function to avoid overlapping two different subtitles, placing the one referring to the on-screen text at the bottom and the one indicating the speaker's name at the top of the screen. Depending on the on-screen text position, I had to decide whether to put the translated

subtitles immediately above or below it (cf. Figure 4.3) in order to clarify at what part it refers to.

Moreover, *Aegisub* offers the possibility to choose also the size of the subtitle. In both cases, tags are provided by the too. As shown in Figure 4.7, the orange arrow signals the tag that the position of the subtitle has been changed position while the pink one refers to the tag of the changed font size.

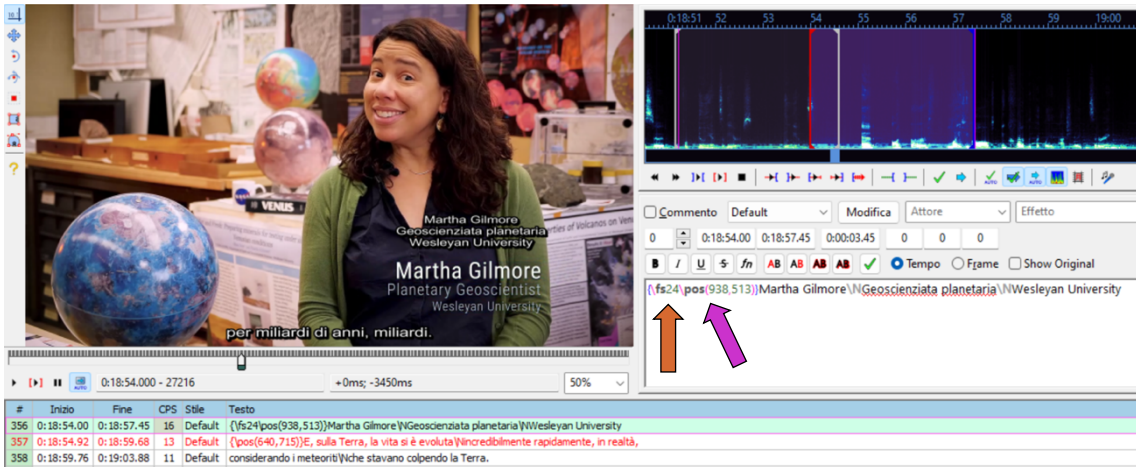


Figure 4.7: Tags in *Aegisub* referring to the changed position and font size of the subtitle.

4.2 Commentary on the Post-Editing Work

This section deals with the actual PE work that was realised in *Trados Subtitling*. Selected illustrative examples, shown in tables or figures, will be commented on to finally draw some final conclusions on the use of MT for subtitling purposes.

4.2.1 MT and translation issues

As pointed out in Section 4.1.1, the principal elements that were taken into account during the PE work were segmentation and writing conventions, register, idiomaticity, terminology and phraseology, language and grammar, additions and mistranslations, and inconsistent translations. A further aspect that was considered has to do with untranslated subtitles that were manually added and translated from scratch in the PE phase. For each category, some explicative examples will be presented and described. Those are displayed in tables including the English ST, the raw output, and the final post-edited text. The

significant changes that were made during the PE phase will be underlined to make them visually clear and recognisable. At the end of this chapter, a more complete table will be provided, containing all subtitles divided again into these three sections, which is proposed as a reading mode, while the actual PE work was carried out in Trados.

The examples might include more issues besides the ones taken into account for the analysis, but each of them will be described and explained in the appropriate section. Furthermore, segment numbering might not always coincide in the three different columns of the tables, especially in the third one dedicated to the post-edited text, as some subtitles were added during this phase, as clarified in Section 4.2.1.8.

4.2.1.1 *Segmentation and writing conventions*

This section addresses some common segmentation mistakes that can be found in the raw output as well as the solutions adopted during the PE phase.

Example 1

Source Text	Raw Output	Post-Edited Text
2 00:00:02:10 --> 00:00:04:03 - [Narrator] Billions of years ago,	2 00:00:02:10 --> 00:00:04:03 - [Narrator] miliardi di anni fa,	2 00:00:02:10 --> 00:00:04:03 - *Miliardi di anni fa,*

Example 2

Source Text	Raw Output	Post-Edited Text
122 00:07:23:22 --> 00:07:26:07 - [Narrator] The idea that Venus was like Earth	122 00:07:23:22 --> 00:07:26:07 - L'idea che Venere fosse come la Terra	135 00:07:23:22 --> 00:07:26:07 - *L'idea che Venere* *fosse come la Terra*

In *Example 1* it can be noticed that both in the ST and in the raw output, when the narrator starts speaking the element "[Narrator]" is added. However, in the raw output this element was not always present (see *Example 2*), even though it is to be found in the ST. As already explained in Section 1.5.3, adding colours, symbols or tags is useful as to visually

differentiate the speakers that are intervening in an AV product. For this reason, the solution implemented in this case is using italics in order to visually signal to the target audience when the narrator is speaking, as shown in Figure 4.8.

Figure 4.8: Use of italics when the narrator is speaking.

Example 3

Source Text	Raw Output	Post-Edited Text
467 00:27:20:12 --> 00:27:23:21 - [Rosaly] Corona on Venus are in a way similar	467 00:27:20:12 --> 00:27:23:21 - [Rosaly] Corona su Venere è in un modo simile	513 00:27:20:12 --> 00:27:23:21 - Le coronae su Venere sono, in un certo senso, simili

Example 4

Source Text	Raw Output	Post-Edited Text
490 00:28:30:27 --> 00:28:33:04 - [Tony] About 500 million years	490 00:28:30:27 --> 00:28:33:04 - [Tony] circa 500 milioni di anni	542 00:28:30:27 --> 00:28:33:04 - Circa 500 milioni di anni

Example 5

Source Text	Raw Output	Post-Edited Text
589 00:34:13:12 --> 00:34:15:18 - [Geoff] The nice thing about the balloons	589 00:34:13:12 --> 00:34:15:18 - [Geoff] la cosa bella dei palloncini	647 00:34:13:12 --> 00:34:15:18 - La cosa bella dei palloni

Something similar happens with the subtitles concerning the experts' interventions. Both the ST and the raw output put the name of the speaker into square brackets before he or she starts talking, as it can be seen in *Examples 3* to *5*.

Example 6

Source Text	Raw Output	Post-Edited Text
35 00:02:37:08 --> 00:02:37:26 - We think of it 36 00:02:37:28 --> 00:02:41:03 as this sort of ugly, forbidding, scary place,	35 00:02:37:08 --> 00:02:37:26 Ci pensiamo 36 00:02:37:28 --> 00:02:41:03 come questo posto brutto, proibitivo, spaventoso,	37 00:02:37:08 --> 00:02:37:26 - Lo vediamo 38 00:02:37:28 --> 00:02:41:03 come un luogo brutto, proibito, spaventoso,

Example 7

Source Text	Raw Output	Post-Edited Text
478 00:27:58:10 --> 00:28:00:18 - [Sue] There are a couple of very big features.	478 00:27:58:10 --> 00:28:00:18 - Ci sono un paio di caratteristiche molto importanti.	528 00:27:58:10 --> 00:28:00:18 - Ci sono un paio di strutture molto grandi.

Example 8

Source Text	Raw Output	Post-Edited Text
784 00:43:59:20 --> 00:44:01:01 - [Lori] Mars, we think at some point,	784 00:43:59:20 --> 00:44:01:01 - Marte, pensiamo ad un certo punto,	849 00:43:59:20 --> 00:44:01:01 - Marte, pensiamo che ad un certo punto,

However, as it happened in the previous case, the raw output does not always use this solution and sometimes does not put any element before the dialogue, as demonstrated by *Examples 6* to *8*. This inconsistency was solved by simply adding a dash before the different speakers to indicate that a new discourse from a new speaker had begun. Another solution implemented during PE was to visually differentiate the speakers by using different colours. However, *Trados Subtitling* does not allow adding new colours in the TT which are not already present in the ST. A workaround was thus used, i.e. the desired colours were added to the ST that was uploaded.

Example 9

Source Text	Raw Output	Post-Edited Text
198 00:12:23:07 --> 00:12:25:13 and to some extent the atmosphere of a planet,	198 00:12:23:07 --> 00:12:25:13 e in una certa misura l' atmosfera di un pianeta,	220 00:12:23:07 --> 00:12:25:13 e, in parte, l'atmosfera di un pianeta,

Example 10

Source Text	Raw Output	Post-Edited Text
509 00:29:28:19 --> 00:29:32:00 Venus sentenced its surface to climatic death.	509 00:29:28:19 --> 00:29:32:00 Venere condannò la sua superficie alla morte climatica	563 00:29:28:19 --> 00:29:32:00 *Venere ha condannato la sua superficie* *alla morte climatica.*

Example 11

Source Text	Raw Output	Post-Edited Text
659 00:37:56:22 --> 00:37:59:00 - [Narrator] A profile of the early atmosphere	659 00:37:56:22 --> 00:37:59:00 - [Narrator] Un profilo della prima atmosfera	717 00:37:56:22 --> 00:37:59:00 - *Un profilo <u>della</u> prima atmosfera*

As explained in Section 1.4.1, line-breaking is a crucial aspect of subtitles. *Examples 9* to *11* highlight errors due to the incorrect line breaking of the ST. In particular, in *Example 9* the article and the noun it refers to must go on the same line, which, in this case, also contributes to making the subtitle clearer and easier to read. *Example 10* displays a similar case in which the Italian possessive adjective "sua" ("its") is set apart from the word "superficie" ("surface"). Finally, *Example 11* reports a case in which the subtitle in the post-edited text is to be found on just one line, while in the ST and the raw output, it is articulated in two different lines. This is mainly because in the post-edited text, the element [Narrator] is removed, so that the subtitle fits perfectly in just one line.

Example 12

Source Text	Raw Output	Post-Edited Text
30 00:02:13:28 --> 00:02:17:03 a few images transmitted by the Soviet Venera landers	30 00:02:13:28 --> 00:02:17:03 Alcune immagini trasmesse dai sovietici di Venera	31 00:02:13:28 --> 00:02:17:03 *non sono che alcune immagini trasmesse* *dai lander sovietici <u>"Venera"</u>*

Another solution that is proposed in the post-edited text which is not present either in the ST or in the raw output deals with the use of inverted commas when a specific astronomical term is introduced. This choice was made in order to visually differentiate the specialised language of astronomy from general language, as it can be seen, for instance, with the name of the Soviet landers, "Venera", in subtitle #31 of the post-edited text (*Example 12*).

Example 13

Source Text	Raw Output	Post-Edited Text
57 00:03:54:16 --> 00:03:58:20 - [Narrator] Sumerian priests saw it as one, Inanna,	57 00:03:54:16 --> 00:03:58:20 - [Narrator] i sacerdoti sumeri lo vedevano come un tutt'uno, Inanna,	62 00:03:54:56 --> 00:03:56:87 - *I sacerdoti sumeri* *lo vedevano come una sola entità,* 63 00:03:57:60 --> 00:03:59:20 *Inanna,*

In *Example 13,* subtitle #57 was split into two different subtitles in the post-edited text in order to match both the narrator's speech and the word "Inanna" that appears on the screen.

Example 14

Source Text	Raw Output	Post-Edited Text
288 00:17:05:14 --> 00:17:08:08 - [Narrator] Though the surface creeps along without hurry,	288 00:17:05:14 --> 00:17:08:08 - [Narrator] anche se la superficie scorre senza fretta,	318 00:17:05:14 --> 00:17:08:08 - *Anche se la superficie si muove senza fretta,*

Example 15

Source Text	Raw Output	Post-Edited Text
835 00:46:40:18 --> 00:46:44:15 - [Narrator] Two planets born together,	835 00:46:40:18 --> 00:46:44:15 - [Narrator] due pianeti nati insieme,	901 00:46:40:18 --> 00:46:44:15 - *Due pianeti nati insieme,*

Another segmentation issue that I have encountered during the PE phase deals with the correct use of capitalization. *Examples 14* and *15* show how Trados often fails to recognise when a capital letter is needed, especially when another element is to be found before the beginning of a sentence. In these examples, for instance, the element [Narrator]

is only capitalised, as if it was the beginning of the sentence, even though the ST rightly reports capital letters after this specific element.

Example 16

Source Text	Raw Output	Post-Edited Text
830 00:46:18:04 --> 00:46:21:13 (laughs) It's Venus. It's right there.	830 00:46:18:04 --> 00:46:21:13 (Ride) è Venere. È proprio lì.	896 00:46:18:04 --> 00:46:21:13 (ride) È Venere. È proprio lì.

Similarly, *Example 16* shows that Trados capitalised the first element "(Ride)" as if it was the start of the sentence and, consequently, kept the lowercase letter after it. Once again, this occurred even though capitalisation was correct in the ST and, for this reason, was also implemented in the post-edited text.

Example 17

Source Text	Raw Output	Post-Edited Text
142 00:08:44:12 --> 00:08:47:22 Unfortunately, that was not very good for Venus exploration 143 00:08:47:24 --> 00:08:52:02 because all the classical ideas about Venus being habitable	142 00:08:44:12 --> 00:08:47:22 Sfortunatamente, questo non è stato molto buono per l'esplorazione di Venere 143 00:08:47:24 --> 00:08:52:02 Perche' tutte le idee classiche sul fatto che Venere sia abitabile	158 00:08:44:12 --> 00:08:47:22 Purtroppo, questo non fu positivo per l'esplorazione di Venere, 159 00:08:47:24 --> 00:08:52:02 perché tutte le classiche ipotesi sul fatto che Venere fosse abitabile,

Example 18

Source Text	Raw Output	Post-Edited Text
680 00:39:10:24 --> 00:39:12:12 but we've learned more recently 681 00:39:12:13 --> 00:39:15:03 of all these extremophile organisms on Earth,	680 00:39:10:24 --> 00:39:12:12 ma abbiamo imparato più di recente 681 00:39:12:13 --> 00:39:15:03 Di tutti questi organismi estremofili sulla Terra,	738 00:39:10:24 --> 00:39:12:12 ma abbiamo appreso più di recente 739 00:39:12:13 --> 00:39:15:03 di tutti questi organismi estremofili sulla Terra,

At the same time, there are cases in which the capital letter has been improperly used in the raw output, as it happens in *Examples 17* and *18,* where it has been applied when the lowercase letter was needed instead. As can be easily noticed, this issue occurs because Trados does not 'understand' when a segment is linked to the previous one, therefore it automatically applies the capital letter as if it were a new sentence. Again, this happens regardless of the ST, where this aspect is correct.

Example 19

Source Text	Raw Output	Post-Edited Text
471 00:27:33:22 --> 00:27:35:16 - A plume of hot stuff comes up,	471 00:27:33:22 --> 00:27:35:16 - Viene fuori Un pennacchio di roba calda,	519 00:27:33:22 --> 00:27:35:16 - Un getto di materiale caldo sale,

Example 20 (a) and (b)

Source Text	Raw Output	Post-Edited Text
538 00:31:24:16 --> 00:31:27:27 So far, Venus has not told us	538 00:31:24:16 --> 00:31:27:27 Finora, Venere non CE l'ha detto	592 00:31:24:16 --> 00:31:27:27 *Finora, Venere non ci ha detto*
861 00:48:46:12 --> 00:48:48:16 we're gonna be like, "Wow, nobody told us.	861 00:48:46:12 --> 00:48:48:16 Faremo: "Wow, nessuno CE l'ha detto.	927 00:48:46:12 --> 00:48:48:16 faremo tipo: "Wow, nessuno ce l'aveva detto".

A curious instance is the one suggested by *Examples 19* and *20 (a) and (b)*, in which the capital letter has been applied for apparently no reason. In *Example 19* "Un" ("a") is unnecessarily capitalised, given that it lies in the middle of the sentence. Likewise, *Example 20 (a) and (b)* displays two similar cases in which "CE" (referring to "us") has been written in capital letters for no reason. Further, the ST does not include the same mistake.

Example 21

Source Text	Raw Output	Post-Edited Text
106 00:06:45:15 --> 00:06:47:17 It's almost like the edge of the sun	106 00:06:45:15 --> 00:06:47:17 E' quasi come il bordo del sole	119 00:06:45:15 --> 00:06:47:17 È quasi come se il bordo del sole

Example 22

Source Text	Raw Output	Post-Edited Text
348 00:20:01:28 --> 00:20:04:00 but there's no way to remove that CO2.	348 00:20:01:28 --> 00:20:04:00 Ma non c'e' modo di rimuovere la CO2.	381 00:20:01:28 --> 00:20:04:00 ma non c'è modo di rimuovere quella CO2.

Example 23

Source Text	Raw Output	Post-Edited Text
403 00:23:23:14 --> 00:23:26:18 - Plate tectonics is really what makes Earth tick.	403 00:23:23:14 --> 00:23:26:18 - La tettonica a placca e' davvero cio' che fa tacere la Terra.	437 00:23:23:14 --> 00:23:26:18 - La tettonica a placche è davvero ciò che fa muovere la Terra.

Examples 21,22 and *23* aim to highlight a mistake that frequently appears in the raw output, i.e. the use of accents in Italian, which often needed correction, e.g. in "È" and "è" ("is"), "c'è" ("there's"), and "ciò" ("what"), which were all written with wrong accents.

Example 24

Source Text	Raw Output	Post-Edited Text
246 00:15:11:29 --> 00:15:14:09 but that's where the similarities end.	246 00:15:11:29 --> 00:15:14:09 ma è qui che finiscono le somiglianze	284 00:15:11:29 --> 00:15:14:09 *ma qui finiscono le somiglianze.*

Example 24 is the only example in which it can be noticed that in the raw output a full stop is missing at the end of subtitle #246, while, generally speaking, these typos were not found.

Example 25

Source Text	Raw Output	Post-Edited Text
113 00:07:04:26 --> 00:07:05:26 And they said, "Oh, wow!	113 00:07:04:26 --> 00:07:05:26 E loro hanno detto: "Oh, wow!	126 00:07:04:26 --> 00:07:05:26 Fu lo stupore generale
114 00:07:05:29 --> 00:07:07:14 "It's basically the same size as Earth.	114 00:07:05:29 --> 00:07:07:14 "È praticamente delle stesse dimensioni della Terra.	127 00:07:05:29 --> 00:07:07:14 "È praticamente delle stesse dimensioni della Terra."
115 00:07:08:02 --> 00:07:10:03 "It's the size of Earth, and yet it's so bright.	115 00:07:08:02 --> 00:07:10:03 "È grande quanto la Terra, eppure è così luminosa.	128 00:07:08:02 --> 00:07:10:03 "È grande quanto la Terra, eppure è così luminoso."
116 00:07:10:05 --> 00:07:11:08 "Why is it so bright?	116 00:07:10:05 --> 00:07:11:08 "Perché è così brillante?	129 00:07:10:05 --> 00:07:11:08 "Perché è così luminoso?"

Finally, *Example 25* shows an issue concerning the right use of inverted commas. As can be observed in the post-edited text, the inverted commas are added at the beginning and at the end of every subtitle to signal the end of the sentence/utterance. On the other hand, both in the ST and in the raw output, they are to be found only at the beginning of the subtitles. The same mistake was the present in the raw output.

All in all, I believe that the segmentation issues reported in this paragraph do not affect the overall comprehension of the subtitles, but they definitely influence their readability and consistency. Interestingly, several of these errors appeared in the raw output because they were already present in the ST. Therefore, it can be concluded that *Trados Subtitling* and its MT cannot recognise and correct segmentation errors that are already present in the ST.

4.2.1.2 *Register*

This section addressed the translation issues related to register. The following examples aim to summarise the most frequent errors encountered during the PE phase.

Example 26

Source Text	Raw Output	Post-Edited Text
96 00:06:14:03 --> 00:06:15:28 and you can see that little dot of Venus 97 00:06:16:00 --> 00:06:18:03 moving across the face of the sun.	96 00:06:14:03 --> 00:06:15:28 E potete vedere quel piccolo punto di Venere 97 00:06:16:00 --> 00:06:18:03 si muove attraverso la faccia del sole.	108 00:06:14:03 --> 00:06:15:28 e si può vederlo come un piccolo punto 109 00:06:16:00 --> 00:06:18:03 che attraversa la superficie del sole.

Example 27

Source Text	Raw Output	Post-Edited Text
264 00:16:01:28 --> 00:16:03:27 so that if you were on the surface of Venus 265 00:16:03:29 --> 00:16:05:03 and could see the sun,	264 00:16:01:28 --> 00:16:03:27 Quindi, se lei fosse sulla superficie di Venere 265 00:16:03:29 --> 00:16:05:03 e poteva vedere il sole,	292 00:16:01:28 --> 00:16:03:27 così che se ci si trovasse sulla superficie di Venere 293 00:16:03:29 --> 00:16:05:03 e si potesse vedere il sole,

266 00:16:05:06 --> 00:16:09:12 it would rise in the west and set in the east.	266 00:16:05:06 --> 00:16:09:12 Sorgerebbe ad ovest e si troverebbe ad est.	294 00:16:05:06 --> 00:16:09:12 questo sorgerebbe a ovest e tramonterebbe a est.

In *Example 26*, the phrase "you can see" has been translated as "potete vedere" in Italian. This is a mistake because, as mentioned in Section 3.1.2, Italian is an author-oriented language requiring more formality than a reader-oriented language like English. For this reason, Italian prefers passivisation, which was rendered in the PE through the impersonal pronoun "si": "si può vedere". Likewise, in *Example 27* the phrase "if you were" cannot be literally translated into Italian as "se lei fosse", i.e. by using the third-person politeness form. Rather, the impersonal construction suggested in the post-edited text "se ci si trovasse" is more appropriate for the same reason as the previous example. Consequently, the following verb "could see", where the subject is the same "you" of the former sentence, needs to be interpreted as "si potesse vedere" and not as "poteva vedere", as it is proposed in the raw output.

Example 28

Source Text	Raw Output	Post-Edited Text
270 00:16:17:03 --> 00:16:18:26 So you have to be up in a jet airplane 271 00:16:18:28 --> 00:16:21:07 if you wanted the sunset to last forever.	270 00:16:17:03 --> 00:16:18:26 Quindi deve salire su un aereo a reazione 271 00:16:18:28 --> 00:16:21:07 se volessi che il tramonto durasse per sempre.	298 00:16:17:03 --> 00:16:18:26 Bisognerebbe salire su un aereo a reazione 299 00:16:18:28 --> 00:16:21:07 se si volesse far durare il tramonto per sempre.

Example 29

Source Text	Raw Output	Post-Edited Text
752 00:42:27:28 --> 00:42:30:22 You want to directly use that wind energy 753 00:42:30:23 --> 00:42:33:28 to move yourself mechanically around the surface of Venus.	752 00:42:27:28 --> 00:42:30:22 Volete usare direttamente quell'energia eolica 753 00:42:30:23 --> 00:42:33:28 Per muoversi meccanicamente intorno alla superficie di Venere.	815 00:42:27:28 --> 00:42:30:22 Bisogna usare direttamente quell'energia eolica 816 00:42:30:23 --> 00:42:33:28 per muoversi meccanicamente sulla superficie di Venere.

As suggested in Section 3.1.2, Italian is an author-oriented, more formal and impersonal language than English. To match the register required in the TL, then, the English phrases "you have to be up" and "You want to directly use" in subtitles #270 and #752 need not be translated with the second person singular, as in the raw output, but by using a more impersonal solution. For this reason, the post-edited text translates these phrases, respectively, as "bisognerebbe salire" and "bisogna utilizzare" ("one needs to get on" and "one needs to use"). Finally, for the same reason, passivisation was used in the post-edited text to translate subtitle #271.

Example 30

Source Text	Raw Output	Post-Edited Text
713 00:40:45:09 --> 00:40:46:18 - Let me show you something.	713 00:40:45:09 --> 00:40:46:18 - Lascia che ti mostri una cosa.	773 00:40:45:09 --> 00:40:46:18 - Lasciate che vi mostri una cosa.

In *Example 30*, the speaker is directly addressing the audience, so passivisation and impersonality that were applied to translate *Examples 26* to *29* are not appropriate here. The raw output is still not adequate because the Italian second person singular is too informal in this context. Thus, the PE opted for the second person plural, "Lasciate che *vi* mostri qualcosa", which conveys a greater degree of formality without being impersonal.

In sum, the most common register issues have to do with the subtitles' level of formality and were addressed through passivisation and impersonality. As it happened for

segmentation issues, these errors too do not affect the overall understanding of the subtitles, but the suggestions offered in the post-edited text help to make them more readable and adequate to the target culture.

4.2.1.3 *Idiomaticity*

The examples reported in this section concern the idiomatic use of language.

Example 31

Source Text	Raw Output	Post-Edited Text
14 00:00:40:20 --> 00:00:44:14 Scientists are now unveiling daring new strategies	14 00:00:40:20 --> 00:00:44:14 Gli scienziati stanno svelando nuove strategie audaci	14 00:00:40:20 --> 00:00:44:14 *Gli scienziati stanno scoprendo nuove audaci strategie*

In *Example 31*, the phrase “daring new strategies” is to be found as “nuove strategie audaci” in the raw output, which is perfectly acceptable. However, to increase idiomaticity and shift the focus of the clause from the noun to the attribute, in the post-edited text the words “strategie” and “audaci”.

Example 32

Source Text	Raw Output	Post-Edited Text
142 00:08:44:12 --> 00:08:47:22 Unfortunately, that was not very good for Venus exploration 143 00:08:47:24 --> 00:08:52:02 because all the classical ideas about Venus being habitable	142 00:08:44:12 --> 00:08:47:22 Sfortunatamente, questo non è stato molto buono per l’esplorazione di Venere 143 00:08:47:24 --> 00:08:52:02 Perche' tutte le idee classiche sul fatto che Venere sia abitabile	158 00:08:44:12 --> 00:08:47:22 Sfortunatamente, questo non fu positivo per l’esplorazione di Venere, 159 00:08:47:24 --> 00:08:52:02 perché tutte le classiche ipotesi sul fatto che Venere fosse abitabile

144 00:08:52:04 --> 00:08:55:16 with people and forests living on the surface 145 00:08:55:17 --> 00:08:56:21 just went out the door.	144 00:08:52:04 --> 00:08:55:16 con persone e foreste che vivono in superficie 145 00:08:55:17 --> 00:08:56:21 sono appena uscita dalla porta.	160 00:08:52:04 --> 00:08:55:16 e che persone e foreste vivessero sulla sua superficie 161 00:08:55:17 --> 00:08:56:21 furono abbandonate.

Example 32 reports a case in which Trados did not recognise that a way of saying was present in the ST and, consequently, it suggested a literal translation for it. In fact, "[all the classical ideas about Venus being habitable] just went out the door" should be interpreted with the equivalent Italian phrase "furono abbandonate", as proposed in the post-edited text.

Example 33

Source Text	Raw Output	Post-Edited Text
849 00:48:05:11 --> 00:48:07:24 But Venus, we have very little knowledge of, 850 00:48:09:07 --> 00:48:11:20 so we need to start learning how to go to Venus. 851 00:48:12:14 --> 00:48:14:07 Learn about the circulation of Venus, 852 00:48:14:10 --> 00:48:17:13 learn about the climate, learn about the weather.	849 00:48:05:11 --> 00:48:07:24 Ma Venere, abbiamo pochissime conoscenze, 850 00:48:09:07 --> 00:48:11:20 Quindi dobbiamo iniziare a imparare ad andare a Venere. 851 00:48:12:14 --> 00:48:14:07 Conoscere la circolazione di Venere, 852 00:48:14:10 --> 00:48:17:13 impara a conoscere il clima, impara a conoscere il clima.	915 00:48:05:11 --> 00:48:07:24 Ma di Venere sappiamo poco, 916 00:48:09:07 --> 00:48:11:20 quindi dobbiamo prima di tutto capire come andare su Venere. 917 00:48:12:14 --> 00:48:14:07 Conoscerne la circolazione, 918 00:48:14:10 --> 00:48:17:13 conoscerne il clima, conoscerne il tempo.

Example 33 shows the translation of the phrasal verb "learn about", which is inconsistently translated in subtitle #851 ("conoscere", i.e. "get to know") and #852 ("impara a conoscere", i.e. "learn how to get to know"). Subtitle #852 also includes an inflection error as the verb is conjugated in the second-person singular rather than in the third-person singular. In this case, it is better to translate this verb in the same way in both segments, especially because they are two consecutive subtitles talking about the same topic and carrying the same verb in the English ST. A consistent translation would thus keep the same rhetorical effect of the ST conveyed through syntactic parallelism and anaphora. Hence, the translation selected in the post-edited text, where all three instances of "learn about" were translated as "conoscere".

Example 34 (a) and (b)

Source Text	Raw Output	Post-Edited Text
26 00:01:54:00 --> 00:02:00:02 (eerie music) (thunder rumbling)	26 00:01:54:00 --> 00:02:00:02 (musica inquietante) (tuono che urla)	26 00:01:54:00 --> 00:02:00:02 (musica misteriosa) (tuono)
46 00:03:09:00 --> 00:03:16:00 mystical music) (thunder rumbling)	46 00:03:09:00 --> 00:03:16:00 (musica mistica) (tuono che urla)	49 00:03:09:00 --> 00:03:16:00 (musica mistica) (tuono)

Example 34 (a) and *(b)* report the same inconsistent translation of the English phrase "thunder rumbling", which was translated as "tuono che urla" in Italian. So, not only is the subject personified, but the translation features a non-idiomatic collocation . The post-edited translation thus only includes the reference to "tuono" ('thunder') for both segments.

Example 35

Source Text	Raw Output	Post-Edited Text
589 00:34:13:12 --> 00:34:15:18 - [Geoff] The nice thing about the balloons 590 00:34:15:20 --> 00:34:18:22 in the atmosphere of Venus, if they're very, very large, 591 00:34:19:05 --> 00:34:21:21 is that they'd be riding with the inside pressure	589 00:34:13:12 --> 00:34:15:18 - [Geoff] la cosa bella dei palloncini 590 00:34:15:20 --> 00:34:18:22 Nell'atmosfera di Venere, se sono molto, molto grandi, 591 00:34:19:05 --> 00:34:21:21 e' che cavalcerebbero con la pressione interna	647 00:34:13:12 --> 00:34:15:18 - La cosa bella dei palloni 648 00:34:15:20 --> 00:34:18:22 nell'atmosfera di Venere, se sono molto, molto grandi, 649 00:34:19:05 --> 00:34:21:21 è che viaggerebbero con la pressione interna

Lastly, *Example 35* shows a particular case where the senseless translation of the verb "riding" deeply affects the understanding of the subtitle. This happens because the word "cavalcerebbero" does not exist in the Italian language.

4.2.1.4 *Terminology and phraseology*

The following examples underline the most common terminological and phraseological issues found in the raw output.

Example 36

Source Text	Raw Output	Post-Edited Text
461 00:26:55:20 --> 00:26:59:02 Arachnoids because they have a fracture pattern	461 00:26:55:20 --> 00:26:59:02 Arachnoidi perché hanno uno schema di frattura	504 00:26:55:20 --> 00:26:59:02 "Aracnoidi" perché hanno una rete di fratture

Example 37

Source Text	Raw Output	Post-Edited Text
464 00:27:10:15 --> 00:27:13:26 - [Narrator] The enormous volcanic features called coronae	464 00:27:10:15 --> 00:27:13:26 - [Narrator] le enormi caratteristiche vulcaniche chiamate coronae	508 00:27:10:15 --> 00:27:13:26 *- Le enormi strutture vulcaniche chiamate "coronae"*

Examples 36 and *37* show two similar instances dealing with the incorrect translation of astronomical terms. In subtitle #461, "fracture pattern" refers to some specific characteristics of Venus' surface. In Italian, they are usually called "rete di fratture"[5] , so the term "schema di frattura" suggested in the raw output is not appropriate. Likewise, "caratteristiche vulcaniche" cannot be used to translate "volcanic features" in *Example 37*, since the equivalent term in Italian is "strutture vulcaniche"[6] .

Example 38

Source Text	Raw Output	Post-Edited Text
595 00:34:32:23 --> 00:34:34:11 of a Venus cloud city.	595 00:34:32:23 --> 00:34:34:11 Di una città di Venere nuvola.	653 00:34:32:23 --> 00:34:34:11 *di una città nuvola di Venere*.

Example 38 highlights a case in which the word "nuvola" ("cloud") is linked to the wrong noun in the raw output. In fact, as indicated in the post-edited text, it refers to "città" ("city") and not "Venere" ("Venus"). Therefore, the right translation would be "città nuvola di Venere".

[5] http://www.bo.astro.it/~universo/letture/webcorso/webuniverso/battistini/battistinia2.html#:~:text=Queste%20strutture%2C%20dette%20aracnoidi%2C%20sono,del%20magma%20affiorato%20in%20superficie (last accessed on 18/1/2024).

[6] https://www.media.inaf.it/2020/07/20/una-venere-vulcanica/#:~:text=Si%20conoscono%20più%20di%20500,interessate%20dalla%20compressione%20della%20crosta (last accessed on 18/11/2024).

Example 39

Source Text	Raw Output	Post-Edited Text
369 00:21:13:12 --> 00:21:15:27 growing undersea mountains push aside	369 00:21:13:12 --> 00:21:15:27 crescendo le montagne sottomarine si mettono da parte	403 00:21:13:12 --> 00:21:15:27 *si creano dei rilievi sottomarini che spingono via*

In *Example 39*, the term "undersea mountains" is translated as "montagne sottomarine" in the raw output, but this is a case of terminology and phraseology error as the correct equivalent in Italian is "rilievi sottomarini", like suggested in the post-edited text.

Example 40

Source Text	Raw Output	Post-Edited Text
371 00:21:19:15 --> 00:21:22:12 (plates rumbling)	371 00:21:19:15 --> 00:21:22:12 (piastre che urlano)	405 00:21:19:15 --> 00:21:22:12 (rumore delle placche)

In *Example 40*, not only a literal translation is offered, but also a nonsensical meaning is conveyed. In fact, the verb "rumbling" in "plates rumbling" is translated with the Italian verb "urlare", writing "piastre che urlano" in the raw output. So, the subject is both personified and given a nonsensical translation in Italian.

The issues analysed in this section referring to terminology and phraseology divides in issues that concern accuracy but that do not affect the general understanding of the subtitles, as it can be noticed in *Examples 36, 37* and *39*, and cases that do influence the meaning and, consequently, the comprehensibility of the subtitles, like in *Examples 38* and *40.*

4.2.1.5 *Language and grammar*

This section is dedicated to language and grammar issues encountered in the Italian raw output, to which some solutions will be proposed in the post-edited text.

Example 41

Source Text	Raw Output	Post-Edited Text
31 00:02:17:06 --> 00:02:18:26 back in the 1970s.	31 00:02:17:06 --> 00:02:18:26 negli anni ‘1970.	32 00:02:17:06 --> 00:02:18:26 *negli anni ‘70.*

Example 41 features a language error in the raw output due to the use of the apostrophe before the full year, while it can only be used before decades, as shown in the post-edited text.

Example 42

Source Text	Raw Output	Post-Edited Text
138 00:08:32:13 --> 00:08:36:15 - Way back in 1962, Mariner 2 became the first spacecraft 139 00:08:36:17 --> 00:08:39:00 to explore Venus on a flyby.	138 00:08:32:13 --> 00:08:36:15 - Nel 1962, Mariner 2 è diventato il primo veicolo spaziale 139 00:08:36:17 --> 00:08:39:00 Per esplorare Venere in sorvolo.	152 00:08:32:13 --> 00:08:36:15 - Nel 1962, Mariner 2 divenne il primo veicolo spaziale 154 00:08:36:17 --> 00:08:39:00 ad esplorare Venere in sorvolo.

Example 43

Source Text	Raw Output	Post-Edited Text
391 00:22:38:27 --> 00:22:42:00 The hot springs and geysers we come here to admire	391 00:22:38:27 --> 00:22:42:00 Le sorgenti termali e i geyser che veniamo qui per ammirare	425 00:22:38:27 --> 00:22:42:00 *Le sorgenti termali e i geyser* *che veniamo ad ammirare qui*

Example 42 and *Example 43* show two wrong colligations in the raw output. Both subtitles #139 and #391 use the Italian preposition “per” to translate the English “to” while the right preposition to use is “a”, with the addition of the letter “d” because the following verbs start with a vowel. To avoid doubts, it is worth highlighting that in *Example 42* there is a missing subtitle between subtitles #152 and #154. This was an

untranslated and omitted subtitle which was not relevant for this analysis. The issue about untranslated and omitted subtitles will be addressed in Section 4.2.1.8.

Example 44

Source Text	Raw Output	Post-Edited Text
22 00:01:35:12 --> 00:01:39:22 At the surface, the air is 95% carbon dioxide. 23 00:01:40:25 --> 00:01:44:12 So dense, it's more like an ocean than an atmosphere. 24 00:01:45:00 --> 00:01:47:10 And it's hot enough to melt lead.	22 00:01:35:12 --> 00:01:39:22 In superficie, l'aria è al 95% di anidride carbonica. 23 00:01:40:25 --> 00:01:44:12 Così denso, è più come un oceano che un'atmosfera. 24 00:01:45:00 --> 00:01:47:10 Ed è abbastanza caldo da fondere il piombo.	22 00:01:35:12 --> 00:01:39:22 *In superficie,* *l'aria è per il 95% anidride carbonica.* 23 00:01:40:25 --> 00:01:44:12 *Così densa da essere più un oceano* *che un'atmosfera.* 24 00:01:45:00 --> 00:01:47:10 *Calda abbastanza da fondere il piombo.*

Example 45

Source Text	Raw Output	Post-Edited Text
127 00:07:58:04 --> 00:08:00:20 - I remember seeing a book when I was a kid	127 00:07:58:04 --> 00:08:00:20 Ricordo di aver visto un libro quando ero piccolo	140 00:07:58:04 --> 00:08:00:20 - Ricordo di aver visto un libro quando ero piccola

Example 46

Source Text	Raw Output	Post-Edited Text
564 00:32:35:29 --> 00:32:37:05 This platform, 565 00:32:37:06 --> 00:32:41:08 called the High-Altitude Venus Operational Concept, HAVOC,	564 00:32:35:29 --> 00:32:37:05 Questa piattaforma, 565 00:32:37:06 --> 00:32:41:08 Chiamato il concetto operativo High-Altitude Venus, HAVOC,	618 00:32:35:29 --> 00:32:37:05 *Questa piattaforma,* 619 00:32:37:06 --> 00:32:41:08 *chiamata High-Altitude Venus Operational Concept, HAVOC*

Examples 44, 45 and *46* highlight a common issue in the raw output, i.e. gender agreement, especially in the feminine form. In *Example 44*, the subject of the sentence is "l'aria" ("the air"), a feminine noun in Italian, which requires the attributes being in the feminine form. For this reason, the adjectives "denso" ("dense") and "caldo" ("hot"), being in the masculine form, must be corrected. Similarly, in *Example 45*, the person who is speaking is a female expert; therefore, subtitle #127 cannot refer to her with the masculine adjective "piccolo" ("young"), but with "piccola" in the feminine form. In *Example 46,* the subject "piattaforma" ("platform") is equally feminine, so the following participle, "called", needs to be in the feminine form "chiamata" and not "chiamato".

Example 47

Source Text	Raw Output	Post-Edited Text
420 00:24:04:05 --> 00:24:07:10 But the skin of Venus is about twice as thick,	420 00:24:04:05 --> 00:24:07:10 Ma la pelle di Venere è circa il doppio dello spessore,	454 00:24:04:05 --> 00:24:07:10 *Ma la superficie di Venere* *è circa il doppio dello spessore,*

In *Example 47*, the term "skin" is literally rendered as "pelle", i.e. a general-language word, while the term "superficie" ("surface") was to be used given the specialised context in which it appears.

Example 48

Source Text	Raw Output	Post-Edited Text
264 00:16:01:28 --> 00:16:03:27 so that if you were on the surface of Venus 265 00:16:03:29 --> 00:16:05:03 and could see the sun, 266 00:16:05:06 --> 00:16:09:12 it would rise in the west and set in the east.	264 00:16:01:28 --> 00:16:03:27 Quindi, se lei fosse sulla superficie di Venere 265 00:16:03:29 --> 00:16:05:03 e poteva vedere il sole, 266 00:16:05:06 --> 00:16:09:12 Sorgerebbe ad ovest e si troverebbe ad est.	292 00:16:01:28 --> 00:16:03:27 così che se ci si trovasse sulla superficie di Venere 293 00:16:03:29 --> 00:16:05:03 e si potesse vedere il sole, 294 00:16:05:06 --> 00:16:09:12 questo sorgerebbe a ovest e tramonterebbe a est.

Example 49

Source Text	Raw Output	Post-Edited Text
784 00:43:59:20 --> 00:44:01:01 - [Lori] Mars, we think at some point, 785 00:44:01:03 --> 00:44:02:20 used to have more atmosphere 786 00:44:02:22 --> 00:44:05:05 and was potentially warmer and wetter.	784 00:43:59:20 --> 00:44:01:01 - Marte, pensiamo ad un certo punto, 785 00:44:01:03 --> 00:44:02:20 una volta aveva più atmosfera 786 00:44:02:22 --> 00:44:05:05 ed era potenzialmente più caldo e umido.	849 00:43:59:20 --> 00:44:01:01 - Pensiamo che Marte, ad un certo punto, 850 00:44:01:03 --> 00:44:02:20 avesse più atmosfera 851 00:44:02:22 --> 00:44:05:05 e fosse potenzialmente più caldo e umido.

Both *Examples 48* and *49* show some issues concerning verb translation and verbal inflection. *Example 48* shows that the Italian translation "troverebbe" of subtitle #266 in the raw output is incorrect both from a linguistic and a grammatical point of view. Since the sentence refers to the sun, translating the English verb "to set" with the Italian verb "trovare" (to find) is inaccurate and also fails to use correct verbal mood and tense, i.e. present conditional, as shown in the PE. Curiously, in the same subtitle, the first verb "would rise" is instead translated by correctly using present conditional. This is probably

due to the fact that the modal verb “would” was only deemed as related the first verbal instance and not the second one. *Example 49* points out a case in which MT failed to use the Italian *congiuntivo imperfetto* (imperfect subjunctive). In the raw output, the verbs “used to have” and “was” are translated with the Italian *imperfetto* while hypothesis here required the imperfect subjunctive.

Example 50 (a), (b) and (c)

Source Text	Raw Output	Post-Edited Text
208 00:12:53:28 --> 00:12:55:26 It's the only planet 209 00:12:55:28 --> 00:12:58:15 that is likely to be still geologically active	208 00:12:53:28 --> 00:12:55:26 È l’unico pianeta 209 00:12:55:28 --> 00:12:58:15 è probabile che sia ancora geologicamente attivo	231 00:12:53:28 --> 00:12:55:26 È l’unico pianeta 232 00:12:55:28 --> 00:12:58:15 ad essere probabilmente ancora geologicamente attivo
222 00:13:39:16 --> 00:13:43:12 The radar data hold intriguing clues to a watery past, 223 00:13:45:06 --> 00:13:48:08 including vast plateaus made up of granite rocks 224 00:13:48:10 --> 00:13:51:06 that likely formed at the bottom of an ocean.	222 00:13:39:16 --> 00:13:43:12 I dati radar contengono indizi intriganti su un passato acquoso, 223 00:13:45:06 --> 00:13:48:08 comprende vasti altipiani composti da rocce granitiche 224 00:13:48:10 --> 00:13:51:06 probabilmente si è formato sul fondo di un oceano.	246 00:13:39:16 --> 00:13:43:12 *I dati radar contengono interessanti indizi* *di un passato fatto di acqua,* 247 00:13:45:06 --> 00:13:48:08 *con vasti altipiani* *costituiti da rocce granitiche* 248 00:13:48:10 --> 00:13:51:06 *che si sono formati probabilmente* *sul fondo di un oceano.*

391 00:22:38:27 --> 00:22:42:00 The hot springs and geysers we come here to admire 392 00:22:42:06 --> 00:22:44:16 are fueled by a dome of magma 393 00:22:44:25 --> 00:22:47:10 that is building deep below ground.	391 00:22:38:27 --> 00:22:42:00 Le sorgenti termali e i geyser che veniamo qui per ammirare 392 00:22:42:06 --> 00:22:44:16 sono alimentati da una cupola di magma 393 00:22:44:25 --> 00:22:47:10 si sta costruendo in profondità.	425 00:22:38:27 --> 00:22:42:00 *Le sorgenti termali e i geyser* *che veniamo ad ammirare qui* 426 00:22:42:06 --> 00:22:44:16 *sono alimentati da una cupola di magma* 427 00:22:44:25 --> 00:22:47:10 *che si sta formando in profondità.*

Example 50 (a), (b) and *(c)* features some illogical sequences due to the lack of linking words, e.g. the relative pronoun "that"/"che". This can easily be noticed in subtitles #209, #224 and #393, where the determiner is present in the ST and has been translated in the equivalent subtitles #232, #248 and #427 in the post-edited text but is not suggested in the raw output.

Example 51

Source Text	Raw Output	Post-Edited Text
630 00:36:37:06 --> 00:36:38:26 Triangulating their positions, 631 00:36:39:02 --> 00:36:41:12 they could form a global sensor network 632 00:36:41:28 --> 00:36:44:08 to pick up signs of seismic activity.	630 00:36:37:06 --> 00:36:38:26 Triangolazione delle loro posizioni, 631 00:36:39:02 --> 00:36:41:12 potrebbero formare una rete globale di sensori 632 00:36:41:28 --> 00:36:44:08 rilevare segni di attività sismica.	688 00:36:37:06 --> 00:36:38:26 Triangolando le loro posizioni, 689 00:36:39:02 --> 00:36:41:12 potrebbero formare una rete globale di sensori 690 00:36:41:28 --> 00:36:44:08 per rilevare segni di attività sismica.

In *Example 51*, “Triangulating” was normalised in the Italian translation, which features the noun “Triangolazione”. This breaks the logical connection between the two clauses in the same sentence, which hold a causative relation.

4.3.1.6 *Additions and mistranslations*

The following examples concern wrong additions and mistranslations in the raw output.

Example 52

Source Text	Raw Output	Post-Edited Text
519 00:30:17:15 --> 00:30:19:28 That search, conducted by a growing array	519 00:30:17:15 --> 00:30:19:28 Quella ricerca, condotta da un gruppo crescente	573 00:30:17:15 --> 00:30:19:28 *La ricerca, condotta da un numero crescente*
520 00:30:20:01 --> 00:30:22:14 of ground and space-based observatories,	520 00:30:20:01 --> 00:30:22:14 di osservatori terrestri e spaziali,	574 00:30:20:01 --> 00:30:22:14 *di osservatori terrestri e spaziali,*
521 00:30:22:29 --> 00:30:25:24 has so far turned up over 4,000 planets	521 00:30:22:29 --> 00:30:25:24 finora ha scoperto oltre 4.000 pianeti	575 00:30:22:29 --> 00:30:25:24 *ha finora scoperto oltre 4.000 pianeti*
522 00:30:25:26 --> 00:30:28:28 with thousands more detected, but not yet confirmed.	522 00:30:25:26 --> 00:30:28:28 con migliaia di <u>persone</u> rilevate, ma non ancora confermate.	576 00:30:25:26 --> 00:30:28:28 *e ne ha rilevati altre migliaia,* *che devono ancora essere confermati.*

Example 52 reports a case of unnecessary addition in the raw output. In subtitle #522, the word “persone” (people) has been added for no apparent reason, as this element is not present in the ST and the sentence refers to the number of planets that have been already discovered or detected during the search for solar systems.

Example 53

Source Text	Raw Output	Post-Edited Text
127 00:07:58:04 --> 00:08:00:20 - I remember seeing a book when I was a kid 128 00:08:00:22 --> 00:08:05:01 that said that Venus might have prehistoric jungles	127 00:07:58:04 --> 00:08:00:20 Ricordo di aver visto un libro quando ero piccolo 128 00:08:00:22 --> 00:08:05:01 Detto questo, Venere potrebbe avere giungle preistoriche	140 00:07:58:04 --> 00:08:00:20 - Ricordo di aver visto un libro quando ero piccola 141 00:08:00:22 --> 00:08:05:01 che diceva che Venere potrebbe aver avuto giungle preistoriche

Example 54 (a) and (b)

Source Text	Raw Output	Post-Edited Text
311 00:18:20:05 --> 00:18:22:20 kicked off a runaway greenhouse effect	311 00:18:20:05 --> 00:18:22:20 ha dato il via a un effetto serra in fuga	342 00:18:20:05 --> 00:18:22:20 ha dato il via a un rapido effetto serra
355 00:20:18:22 --> 00:20:21:16 and it ends up in that runaway greenhouse state.	355 00:20:18:22 --> 00:20:21:16 e finisce in quello stato di serra in fuga.	388 00:20:18:22 --> 00:20:21:16 e si ritrova in quello stato di rapido effetto serra

In *Example 53*, the English expression "that said" has been interpreted as "detto questo", while the right translation was "che diceva" as 'that' here introduces a defining relative clause. *Example 54 (a)* and *(b)* reports a case of inaccurate, nonsensical translation in two different subtitles. In particular, the adjective "runaway" referring to the term "greenhouse effect" was translated as "in fuga" ("running away") instead of "rapido" ("fast"). Moreover, the Italian term "effetto serra" is correctly expressed just in the first subtitle, where the equivalent term in English is to be found in the ST, whereas it is translated just as "serra" in the second subtitle, since the ST writes just "greenhouse", and the CAT tool did not grasp that this word had to do with the actual greenhouse effect.

4.2.1.7 *Inconsistent translations*

This section is dedicated to some issues related to inconsistent translations present in the Italian raw output.

Example 55

Source Text	Raw Output	Post-Edited Text
33 00:02:29:25 --> 00:02:32:19 Radar images from the Magellan Mission in the '90s	33 00:02:29:25 --> 00:02:32:19 Immagini radar della missione Magellana degli anni ‘90	35 00:02:29:25 --> 00:02:32:19 *Immagini radar della missione Magellano* *negli anni ‘90*
39 00:02:48:04 --> 00:02:50:02 But when you look at the Magellan imagery	39 00:02:48:04 --> 00:02:50:02 Ma quando guardate le immagini di Magellano	42 00:02:48:04 --> 00:02:50:02 Ma quando nelle immagini della Magellano
176 00:10:52:62 --> 00:10:54:40 Magellan's imaging radar	176 00:10:52:62 --> 00:10:54:40 il radar di imaging di Magellan	197 00:10:52:62 --> 00:10:54:40 *il radar per immagini della Magellano*
178 00:11:04:18 --> 00:11:08:18 Among Magellan's findings, the volcanic surface of Venus	178 00:11:04:18 --> 00:11:08:18 Tra le scoperte di Magellano, la superficie vulcanica di Venere	200 00:11:04:18 --> 00:11:08:18 *Una delle scoperte della Magellano fu che* *la superficie vulcanica di Venere*
284 00:16:58:17 --> 00:17:00:23 and by Magellan, and even by Venus Express,	284 00:16:58:17 --> 00:17:00:23 E da Magellano, e anche da Venus Express,	314 00:16:58:17 --> 00:17:00:23 e dalla Magellano, e anche da Venus Express,
444 00:25:51:21 --> 00:25:52:29 - [Narrator] The Magellan Mission	444 00:25:51:21 --> 00:25:52:29 - La missione di Magellano	481 00:25:51:21 --> 00:25:52:29 - *La missione Magellano*

Example 55 has to do with the translation of subtitles dealing with the Magellan Mission of the 1990s. In Italian the only possible solution is “missione Magellano”, not to be confused with the expedition of Ferdinand Magellan in the 17th century (Britannica)[7]. So,

[7] https://www.britannica.com/biography/Ferdinand-Magellan (last accessed on 18/11/2024)

translations like “missione Magellana”, “missione di Magellano”, “di Magellano”, “di Magellan” and “da Magellano” suggested in the raw output are all inaccurate. Most importantly, they show great inconsistency throughout the machine-translated text.

Example 56 (a) and (b)

Source Text	Raw Output	Post-Edited Text
412 00:23:44:09 --> 00:23:45:12 come down to plate tectonics. 413 00:23:45:14 --> 00:23:47:23 And Venus doesn’t have plate tectonics.	412 00:23:44:09 --> 00:23:45:12 scendete alla tettonica delle placche. 413 00:23:45:14 --> 00:23:47:23 E Venere non ha la tettonica a placca.	446 00:23:44:09 --> 00:23:45:12 sono riconducibili alla tettonica delle placche. 447 00:23:45:14 --> 00:23:47:23 E Venere non ha la tettonica delle placche.
481 00:28:08:29 --> 00:28:10:20 evidence of plate tectonics,	481 00:28:08:29 --> 00:28:10:20 evidenza di tettonica a placca,	532 00:28:08:29 --> 00:28:10:20 prove di tettonica delle placche,

Similarly, *Example 56 (a)* and *(b)* shows that “plate tectonics” is correctly translated just in subtitle only, with the other instances featuring inconsinte terminology. As it can be noticed, in fact, it is accurately interpreted as “tettonica delle placche” just in subtitle #412 of the raw output, while the immediately following subtitle #413 reports it like “tettonica a placca” and the same happens in subtitle #481.

Example 57

Source Text	Raw Output	Post-Edited Text
9 00:00:23:07 --> 00:00:25:22 Today, it's burned-out surface 10 00:00:25:24 -->00:00:28:26 is a global fossil of volcanic destruction.	9 00:00:23:07 --> 00:00:25:22 Oggi è una superficie bruciata 10 00:00:25:24 --> 00:00:28:26 è un fossile globale di distruzione vulcanica.	9 00:00:23:07 --> 00:00:25:22 *Oggi la sua superficie bruciata* 10 00:00:25:24 --> 00:00:28:26 *è un fossile globale* *di distruzione vulcanica.*

Example 58

Source Text	Raw Output	Post-Edited Text
232 00:14:21:24 --> 00:14:23:07 That's where we want to go. 233 00:14:23:09 --> 00:14:26:10 That's where I wanted to go is to these areas,	232 00:14:21:24 --> 00:14:23:07 Ecco dove vogliamo andare. 233 00:14:23:09 --> 00:14:26:10 È qui che volevo andare, in queste aree,	258 00:14:21:24 --> 00:14:23:07 È lì che vogliamo andare. 259 00:14:23:09 --> 00:14:26:10 È qui che voglio andare, in queste aree,

Finally, *Example 57* and *Example 58* reports two particular cases in which the raw output contains a wrong translation because the ST is faulty in the first place. Subtitle #9 writes "it's" while what the speaker is uttering is "its", and this can be noticed both by listening to the audio of the documentary and by reading the whole sentence. Likewise, the verb "wanted" in subtitle #233 is wrongly reported, as the speaker clearly says "want", as it happens in the previous subtitle. As a consequence, the translation in the raw output mirrors the transcribed ST, but is incorrect when contrasting the transcription with the audio.

4.2.1.8 *Untranslated and omitted subtitles*

This paragraph offers some examples of the most common type of untranslated and omitted subtitles. Omitted subtitles were included in the post-edited text thanks to *Aegisub*.

Example 59 (a) and (b)

Source Text	Raw Output	Post-Edited Text
11 00:00:29:14 --> 00:00:33:03 (lava sloshing)	11 00:00:29:14 --> 00:00:33:03 (lava sloshing)	11 00:00:29:14 --> 00:00:33:03 (lava che scorre)

611 00:35:28:28 --> 00:35:32:22 (lava sloshing) (light music)	611 00:35:28:28 --> 00:35:32:22 (lava sloshing) (musica leggera)	669 00:35:28:28 --> 00:35:32:22 (lava che scorre) (musica leggera)

Example 60

Source Text	Raw Output	Post-Edited Text
147 00:08:58:15 --> 00:08:59:25 - [Narrator] Stranger still, 148 00:08:59:27 --> 00:09:04:14 NASA's Mariner 2 found that the planet rotates very slowly 149 00:09:05:06 --> 00:09:07:18 and backwards compared to Earth.	147 00:08:58:15 --> 00:08:59:25 - [Narrator] Stranger ancora, 148 00:08:59:27 --> 00:09:04:14 Il Mariner 2 della NASA ha scoperto che il pianeta ruota molto lentamente 149 00:09:05:06 --> 00:09:07:18 E indietro rispetto alla Terra.	163 00:08:58:15 --> 00:08:59:25 - *Cosa ancora più strana,* 164 00:08:59:27 --> 00:09:04:14 *il Mariner 2 della NASA scoprì che Venere ruota molto lentamente* 165 00:09:05:06 --> 00:09:07:18 *e in senso contrario rispetto alla Terra.*

Example 61

Source Text	Raw Output	Post-Edited Text
535 00:31:11:26 --> 00:31:13:12 Or is it a fluke?	535 00:31:11:26 --> 00:31:13:12 O si tratta di un caso fluke?	589 00:31:11:26 --> 00:31:13:12 *O è un caso?*

Example 62

Source Text	Raw Output	Post-Edited Text
175 00:10:49:36 --> 00:10:52:50 - [Narrator] Looping pole to pole more than 4,000 times,	175 00:10:49:36 --> 00:10:52:50 - [Narrator] Looping pole to pole più di 4.000 volte,	196 00:10:49:36 --> 00:10:52:50 *Passando da un polo all'altro più di 4.000 volte,*

Example 63

Source Text	Raw Output	Post-Edited Text
644 00:37:16:05 --> 00:37:17:01 - [Narrator] Though it may appear 645 00:37:17:03 --> 00:37:19:14 as a featureless planet-wide cloud bank,	644 00:37:16:05 --> 00:37:17:01 - [Narrator] anche se può sembrare 645 00:37:17:03 --> 00:37:19:14 come una banca cloud senza funzioni su tutto il pianeta,	702 00:37:16:05 --> 00:37:17:01 *- Anche se può apparire* 703 00:37:17:03 --> 00:37:19:14 *come un banco di nuvole* *senza caratteristiche su tutto il pianeta,*

Examples 59 to *63* all feature some untranslated words or phrases in the raw output, i.e. "lava sloshing" in *Example 59 (a)* and *(b)*, "Stranger still" in *Example 60*, "a fluke" in *Example 61*, "Looping pole to pole" in *Example 62,* and "could bank" in *Example 63.*

These untranslated segments cause first of all confusion, because the audience will not be able to comprehend them and, consequently, this affects the overall understanding of the subtitles. Moreover, the Italian text is logically disconnected and difficult to read, because these segments do not make sense in Italian, hence they seem to be independent of the rest of the sentence.

Figure 4.9: Example of on-screen text subtitled with Aegisub.

The first example of omitted subtitles concerns on-screen texts reporting indications about time, place, specific astronomical words or, generally speaking, some emphasised terms. For instance, Figure 4.9 shows the on-screen text "~2000 BC Yellow River - China", which was translated into Italian and placed on the left side of the screen, immediately above the element it refers to, to avoid overlapping with the subtitle indicating the narrator is speaking.

Figure 4.10: Example of on-screen text subtitled with Aegisub.

Figure 4.10 displays a frequent example in which the on-screen text that was omitted deals with the language of astronomy. In particular, the English subtitle is "Pancake Domes ~65km diameters", which was translated as "Cupole a pancake ~65km di diametro" and placed immediately below the subtitle it refers to, as it occurred in the previous example.

Figure 4.11: Example of on-screen text subtitled with Aegisub.

Another type of omitted subtitle that can be frequently found deals with on-screen texts carrying information about the experts who intervene in the documentary. As can be noticed by Figure 4.11, usually these texts report the full name of the experts, their job positions and the institute or the laboratory where they work. In this case, the newly translated subtitle is to be found above the on-screen text it refers to, as there was not enough space to put it below it as in the previous cases, and the subtitle reporting the expert's words is left in the lower centre of the screen.

4.2.2 MT main strengths and drawbacks for PE purposes

This last section is dedicated to the final considerations about the main strengths and drawbacks that can be noticed during the PE phase.

The translation process has been undeniably easier and less time-consuming as *Trados* NMT pre-translated the whole text. However, as it was previously discussed in Section 4.1.1.4, the choice of the right CAT tool to carry out this kind of work was not so simple. Moreover, *Trados Subtitling* alone was not enough to complete it, in fact *Ooona* was used in the first place to create the SRT file to be uploaded in *Trados*, and *Aegisub* was taken into account too since *Trados* did not allow specific subtitles to be moved to the desired position on the screen.

Given the main issues analysed in the preceding sections, there are some important considerations to be made concerning the raw output. For instance, as regards time code, line-breaking and punctuation the raw output usually follows the ST, meaning that if some mistakes are already present in the English ST, *Trados* does not recognise them and simply reports them as they are, while if the ST is correct the MT translation will supposedly be precise as well. In my case, the ST was pretty accurate and so the raw output was as well. At the same time, it should be underlined that a recurring punctuation issue in the raw output has to do with the fact that *Trados* automatically adds the capital letter whenever a new subtitle begins, so I had to frequently correct this aspect during the PE phase.

Similarly, *Trados* performed generally well with reference to gender and number agreement. Issues concerning this aspect occurred just when a new segment is created and so *Trados* does not identify what the subject is anymore. A major benefit that I have encountered is that *Trados* easily recognised those words needing capitalisation in Italian as it happens in English, such as proper names, e.g. "la Terra" ("the Earth"), "Venere" ("Venus") and "Marte" ("Mars"), while it maintains the lowercase letter for more general terms as "terra" ("soil"). In addition, the system could acknowledge the difference between the planet Venus and the goddess Venus and correctly translate the sentences related to the planet in the masculine form, while the ones that refer to the goddess in the feminine form. Another advantageous aspect concerning Trados is that whenever a word of a whole sentence is modified in the TT, it automatically corrects all the identical segments, which makes the PE work even faster.

As regards terminology, phraseology and idiomaticity, the solutions offered by *Trados* were not always accurate, but in most cases this did not affect the general understanding of the subtitles. In particular, the specialised language of astronomy often passed undetected and was generally translated as general language.

On the contrary, language and grammar issues generally affected the comprehensibility of the subtitles. The most peculiar examples are related to the translation of some phrases, which were correctly translated in some segments, but appeared with a different and wrong translation in others. In these cases, *Trados'* function of automatic correction mentioned above was particularly helpful, as I had to correct these specific phrases just once and then it automatically corrected the others.

Finally, untranslated and omitted subtitles are crucial issues for the PE work as well. On the one hand, untranslated subtitles had mainly to do with some phrases that were left in English in the Italian raw output, which is why they did not make sense and created confusion. Moreover, they were problematic because they deeply affected subtitles' understanding and readability. Omitted subtitles were not reported in the raw output just because they were not present in the ST, so if they were, *Trados* would have translated them as it did with all the other segments. The main problem dealing with this situation is the already mentioned impossibility of relocating subtitles on the screen, which is a function that hopefully will be added in *Trados Subtitling* as well.

All things considered, PE an AV product was stimulating and challenging since it put me in front of several obstacles. I can conclude that MT can enhance the translator's efficiency when dealing with semi-specialised, popularising AV products, but if the right CAT tool is used, i.e. one supporting all the functions that are necessary in order to complete this kind of work, without having to use multiple software to achieve the desired result. With a few improvements, *Trados* could be the right CAT tool, as it already proposes some important aspects for this kind of work, such as the function to automatically change the same segments with the right translation or the possibility to modify the time code directly in the tool if needed, as well as the chance to both upload and see the video with the translated subtitles to check whether they are correct or need to be changed.

CONCLUSION

The present work aimed at translating a documentary by using machine translation. Specifically, the documentary in question, "Venus: Death of a Planet", dealt with astronomy. It is broadcast by the YouTube American channel "SpaceRip" since 16th October 2020. The CAT tool chosen for the translation and PE processes was *Trados Subtitling*, even though *Aegisub* was used too to translate on-screen texts.

When deciding on the topic of this thesis, my intention was to work with two aspects of my interest, namely AVT and the language of astronomy, although I was not an expert and I did not know much about them. But, thanks to this work, I had the chance to learn more about these topics, both historically and theoretically speaking, but also from a practical point of view, as I could post-edit subtitles in which the specialised language of astronomy was used. Moreover, I had the possibility to acquire new skills, precisely linguistic and technical ones, that contributed to improving my translation competence and allowed me to explore the world of PE, which was quite unknown to me until now.

The first three chapters outlined the theoretical aspects, especially regarding AVT, MT, PE and LSPs, with a particular focus on the scientific discourse and the specialised language of astronomy. The main aim of proposing a theoretical insight on these topics before talking about the actual post-editing work was to provide an adequate overview of them and to properly define all the aspects related to PE. The fourth and final chapter, instead, revolved around the PE work. In particular, the analysis focused on the main issues encountered during this phase, which were related to segmentation and writing conventions, register, idiomaticity, terminology and phraseology, language and grammar, additions and mistranslations, inconsistent translations. The last section related to untranslated and omitted subtitles, which were manually added and translated during the PE process. Segmentation and writing conventions issues had much to do with subtitles accuracy and readability, but it was concluded that they did not affect the overall understanding of the text. The most common segmentation errors concerned the way in which the narrator and the speakers of the documentary were addressed, for which the solution was to use italics whenever the narrator was speaking and to put a dash every time a new speaker started to talk. Punctuation was another frequent issue, as well as

some cases in which line-breaking was not appropriate. Register mistakes, i.e. the use of too informal vocabulary or inadequate level of technicality, often required passivisation, impersonality and formality when translating into Italian, being this an author-oriented language, in contrast with English, which is reader-oriented. Similarly, most errors concerning idiomaticity, terminology and phraseology did not influence the subtitles' readability and comprehension since they mostly dealt with incorrect terms which were, however, mostly transparent to the target audience. On the contrary, as regards language and grammar issues, there were some cases in which these issues affected the subtitles. It was particularly interesting to note that some of these language and grammar mistakes were often repeated in the raw output, while others involved phrases or terms that were initially correct but that turned out to be wrong in other segments. Although the majority of these errors were to be found in the raw output because of incorrect MT output, some of them occurred because the English ST was incorrect in the first place. This adds to considerable number of untranslated and omitted subtitles. *Trados Subtitling*, which was used in the PE phase, did not allow subtitles to be moved and placed wherever on the screen, but it automatically positioned them down in the centre. Thus, a different tool, i.e. *Aegisub*, tool was used for the specific subtitles that were not present in the ST and that, consequently, were not translated by the MT. A table displaying the ST, the raw output and the post-edited text side by side is provided in Appendix 1.

To conclude, this has been a very challenging and demanding work for me, but at the same time, it has been very stimulating and instructive because it allowed me to familiarise myself with the world of PE and the world of astronomy. I had the chance to work as a post-editor and experience all the satisfactions and troubles of this type of practice. Working with *Trados Subtitling* for the majority of the PE phase has been generally simple, as I had the chance to use *Trados* during my master's degree course. Yet, it has also been new and tough at times since it was the first time that I used *Trados Subtitling* specifically. I would have liked to work with the same CAT tool for the entire PE phase, which is why I hope *Trados* will implement and improve its functions to ensure complete PE work.

Appendix 1: Raw vs post-edited subtitles

Source Text	Raw Output	Post-Edited Text
1 00:00:00:01--> 00:00:02:08 (intense music)	1 00:00:00:01 --> 00:00:02:08 (musica intensa)	1 00:00:00:01 --> 00:00:02:08 (musica intensa)
2 00:00:02:10 --> 00:00:04:03 - [Narrator] Billions of years ago,	2 00:00:02:10 --> 00:00:04:03 - [Narrator] miliardi di anni fa,	2 00:00:02:10 --> 00:00:04:03 *- Miliardi di anni fa,*
3 00:00:04:06 --> 00:00:07:27 our nearest planetary neighbor, Venus,	3 00:00:04:06 --> 00:00:07:27 Il nostro vicino planetario più vicino, Venere,	3 00:00:04:06 --> 00:00:07:27 *il pianeta a noi più vicino, Venere,*
4 00:00:07:29 --> 00:00:11:16 may have had oceans and rivers,	4 00:00:07:29 --> 00:00:11:16 potrebbe aver avuto oceani e fiumi,	4 00:00:07:29 --> 00:00:11:16 *potrebbe aver ospitato oceani e fiumi,*
5 00:00:12:10 --> 00:00:14:10 life-giving habitats,	5 00:00:12:10 --> 00:00:14:10 habitat donatori di vita,	5 00:00:12:10 --> 00:00:14:10 *habitat favorevoli alla vita,*
6 00:00:14:21--> 00:00:17:15 like the ones that graced the early Earth.	6 00:00:14:21 --> 00:00:17:15 Come quelli che hanno abbellito la Terra.	6 00:00:14:21 --> 00:00:17:15 *come quelli che un tempo offriva la Terra.*
7 00:00:18:05 --> 00:00:20:15 (dramatic music)	7 00:00:18:05 --> 00:00:20:15 (musica drammatica)	7 00:00:18:05 --> 00:00:20:15 (musica drammatica)
8 00:00:20:20 -->00:00:23:04 (thunder rumbling)	8 00:00:20:20 --> 00:00:23:04 (tuono)	8 00:00:20:20 --> 00:00:23:04 (tuono)
9 00:00:23:07 --> 00:00:25:22 Today, it's burned-out surface	9 00:00:23:07 --> 00:00:25:22 Oggi è una superficie bruciata	9 00:00:23:07 --> 00:00:25:22 *Oggi la sua superficie bruciata*

10 00:00:25:24 -->00:00:28:26 is a global fossil of volcanic destruction.	10 00:00:25:24 --> 00:00:28:26 è un fossile globale di distruzione vulcanica.	10 00:00:25:24 --> 00:00:28:26 *è un enorme fossile* *di distruzione vulcanica.*
11 00:00:29:14 --> 00:00:33:03 (lava sloshing)	11 00:00:29:14 --> 00:00:33:03 (lava sloshing)	11 00:00:29:14 --> 00:00:33:03 (lava che scorre)
12 00:00:33:04 --> 00:00:37:00 Concealed beneath a dense toxic atmosphere.	12 00:00:33:04 --> 00:00:37:00 Nascosto sotto un' atmosfera densa e tossica.	12 00:00:33:04 --> 00:00:37:00 *Nascosta sotto un'atmosfera* *densa e tossica.*
13 00:00:37:20 --> 00:00:40:18 (wind whooshing) (soft dramatic music)	13 00:00:37:20 --> 00:00:40:18 (battito del vento) (musica morbida e drammatica)	13 00:00:37:20 --> 00:00:40:18 (sibilo del vento) (leggera musica drammatica)
14 00:00:40:20 --> 00:00:44:14 Scientists are now unveiling daring new strategies	14 00:00:40:20 --> 00:00:44:14 Gli scienziati stanno svelando nuove strategie audaci	14 00:00:40:20 --> 00:00:44:14 *La scienza sta sviluppando* *nuove audaci strategie*
15 00:00:45:13 --> 00:00:47:24 to explore its tortured landscapes,	15 00:00:45:13 --> 00:00:47:24 per esplorare i suoi paesaggi tormentati,	15 00:00:45:13 --> 00:00:47:24 *per esplorare i suoi paesaggi desolati,*
16 00:00:49:14 --> 00:00:54:14 to search for clues from a time when the planet was alive.	16 00:00:49:14 --> 00:00:54:14 per cercare indizi di un tempo in cui il pianeta era vivo.	16 00:00:49:14 --> 00:00:54:14 *per cercare indizi* *di un tempo in cui il pianeta era vivo.*
17 00:00:55:28 --> 00:00:59:05 How did Venus descend into this hellish state?	17 00:00:55:28 --> 00:00:59:05 Come ha fatto Venere a scendere in questo stato infernale?	17 00:00:55:28 --> 00:00:59:05 *Come ha fatto Venere a ridursi* *in questo inferno?*
18 00:01:02:00 --> 00:01:05:04 And how did our planet, Earth, manage to survive?	18 00:01:02:00 --> 00:01:05:04 E come ha fatto il nostro pianeta, la Terra, a sopravvivere?	18 00:01:02:00 --> 00:01:05:04 *E come ha fatto il nostro pianeta,* *la Terra, a sopravvivere?*

19 00:01:12:25 --> 00:01:19:00 (mysterious music)	19 00:01:12:25 --> 00:01:19:00 (musica misteriosa)	19 00:01:12:25 --> 00:01:19:00 (musica misteriosa)
20 00:01:30:24 --> 00:01:32:20 (thunder rumbling) (lightning clapping)	20 00:01:30:24 --> 00:01:32:20 (battito di fulmini) (battito di fulmini)	20 00:01:30:24 --> 00:01:32:20 (tuoni) (fulmini)
21 00:01:32:22 --> 00:01:35:10 (slow music)	21 00:01:32:22 --> 00:01:35:10 (musica lenta)	21 00:01:32:22 --> 00:01:35:10 (musica lenta)
22 00:01:35:12 --> 00:01:39:22 At the surface, the air is 95% carbon dioxide.	22 00:01:35:12 --> 00:01:39:22 In superficie, l'aria è al 95% di anidride carbonica.	22 00:01:35:12 --> 00:01:39:22 *In superficie,* *l'aria è per il 95% anidride carbonica.*
23 00:01:40:25 --> 00:01:44:12 So dense, it's more like an ocean than an atmosphere.	23 00:01:40:25 --> 00:01:44:12 Così denso, è più come un oceano che un'atmosfera.	23 00:01:40:25 --> 00:01:44:12 *Così densa da essere più un oceano* *che un'atmosfera.*
24 00:01:45:00 --> 00:01:47:10 And it's hot enough to melt lead.	24 00:01:45:00 --> 00:01:47:10 Ed è abbastanza caldo da fondere il piombo.	24 00:01:45:00 --> 00:01:47:10 *Calda abbastanza da fondere il piombo.*
25 00:01:49:26 --> 00:01:52:29 Overhead, thick clouds of sulfuric acid.	25 00:01:49:26 --> 00:01:52:29 Nuvole spesse e sovratesta di acido solforico.	25 00:01:49:26 --> 00:01:52:29 *In alto, dense nuvole di acido solforico.*
26 00:01:54:00 --> 00:02:00:02 (eerie music) (thunder rumbling)	26 00:01:54:00 --> 00:02:00:02 (musica inquietante) (tuono che urla)	26 00:01:54:00 --> 00:02:00:02 (musica misteriosa) (tuono)
27 00:02:04:05 --> 00:02:08:00 No spacecraft has lasted longer than two hours on Venus.	27 00:02:04:05 --> 00:02:08:00 Nessun veicolo spaziale è durato più di due ore su Venere.	27 00:02:04:05 --> 00:02:08:00 *Nessun veicolo spaziale ha resistito più di due* *ore su Venere.*

28 00:02:08:03 --> 00:02:09:03 (lightning clapping)	28 00:02:08:03 --> 00:02:09:03 (battiti fulminei)	28 00:02:08:03 --> 00:02:09:03 (fulmini)
29 00:02:11:18 --> 00:02:13:10 All we have seen close up,	29 00:02:11:18 --> 00:02:13:10 Tutto quello che abbiamo visto da vicino,	29 00:02:11:40 --> 00:02:13:10 *Quello che abbiamo visto da vicino,*
		30 00:02:12:60 --> 00:02:16:80 Venera 9 e 10 Aggiunta di dati sui colori
30 00:02:13:28 --> 00:02:17:03 a few images transmitted by the Soviet Venera landers	30 00:02:13:28 --> 00:02:17:03 Alcune immagini trasmesse dai sovietici di Venera	31 00:02:13:28 --> 00:02:17:03 *non sono che alcune immagini trasmesse dai lander sovietici "Venera"*
31 00:02:17:06 --> 00:02:18:26 back in the 1970s.	31 00:02:17:06 --> 00:02:18:26 negli anni '1970.	32 00:02:17:06 --> 00:02:18:26 *negli anni '70.*
		33 00:02:18:88 --> 00:02:23:00 Venera 13 Aggiunta di dati sui colori
32 00:02:23:09 --> 00:02:25:25 (mystical music)	32 00:02:23:09 --> 00:02:25:25 (musica mistica)	34 00:02:23:09 --> 00:02:25:25 (musica mistica)
33 00:02:29:25 --> 00:02:32:19 Radar images from the Magellan Mission in the '90s	33 00:02:29:25 --> 00:02:32:19 Immagini radar della missione Magellana degli anni '90	35 00:02:29:25 --> 00:02:32:19 *Immagini radar della missione Magellano negli anni '90*
34 00:02:32:21 --> 00:02:34:26 have stoked our desire for more.	34 00:02:32:21 --> 00:02:34:26 abbiamo alimentato il nostro desiderio di qualcosa di più.	36 00:02:32:21 --> 00:02:34:26 *hanno alimentato il nostro desiderio di saperne di più.*

35 00:02:37:08 --> 00:02:37:26 - We think of it	35 00:02:37:08 --> 00:02:37:26 Ci pensiamo	37 00:02:37:08 --> 00:02:37:26 - Lo vediamo
36 00:02:37:28 --> 00:02:41:03 as this sort of ugly, forbidding, scary place,	36 00:02:37:28 --> 00:02:41:03 come questo posto brutto, proibitivo, spaventoso,	38 00:02:37:28 --> 00:02:41:03 come un luogo brutto, proibito, spaventoso, 39 00:02:38:85 --> 00:02:42:20 David Grinspoon Ricercatore senior Planetary Science Institute
37 00:02:41:05 --> 00:02:44:01 because we've seen these few Russian lander images	37 00:02:41:05 --> 00:02:44:01 Perché abbiamo visto queste poche immagini di lander russi	40 00:02:41:05 --> 00:02:44:01 perché abbiamo visto queste poche immagini dei lander russi
38 00:02:44:03 --> 00:02:47:28 of these sort of eroded rocks and crushing atmosphere.	38 00:02:44:03 --> 00:02:47:28 di questo tipo di rocce erose e atmosfera frantumata.	41 00:02:44:03 --> 00:02:47:28 di rocce erose e un’atmosfera pesante.
39 00:02:48:04 --> 00:02:50:02 But when you look at the Magellan imagery	39 00:02:48:04 --> 00:02:50:02 Ma quando guardate le immagini di Magellano	42 00:02:48:04 --> 00:02:50:02 Ma quando nelle immagini della Magellano
40 00:02:50:06 --> 00:02:52:04 and you see this bewildering array	40 00:02:50:06 --> 00:02:52:04 e si vede questa schiera sconcertante	43 00:02:50:06 --> 00:02:52:04 si vede questa sconcertante serie
41 00:02:52:13 --> 00:02:56:00 of volcanic forms and flows	41 00:02:52:13 --> 00:02:56:00 di forme e flussi vulcanici	44 00:02:52:13 --> 00:02:56:00 di formazioni e flussi vulcanici
42 00:02:56:02 --> 00:03:01:04 and bizarre and interesting canyons and valleys and channels	42 00:02:56:02 --> 00:03:01:04 E canyon, valli e canali bizzarri e interessanti	45 00:02:56:02 --> 00:03:01:04 e di strani canyon, valli e canali

43 00:03:01:07 --> 00:03:03:01 that have been carved by liquid lava	43 00:03:01:07 --> 00:03:03:01 che sono state scolpite dalla lava liquida	46 00:03:01:07 --> 00:03:03:01 scolpiti dalla lava liquida
44 00:03:03:03 --> 00:03:05:16 and volcanoes of different sizes and shapes,	44 00:03:03:03 --> 00:03:05:16 e vulcani di diverse dimensioni e forme,	47 00:03:03:03 --> 00:03:05:16 e vulcani di diverse forme e dimensioni,
45 00:03:05:18 --> 00:03:08:26 I think the surface of Venus is probably really beautiful.	45 00:03:05:18 --> 00:03:08:26 Penso che la superficie di Venere sia probabilmente molto bella.	48 00:03:05:18 --> 00:03:08:26 penso che la superficie di Venere sia probabilmente molto bella.
46 00:03:09:00 --> 00:03:16:00 (mystical music) (thunder rumbling)	46 00:03:09:00 --> 00:03:16:00 (musica mistica) (tuono che urla)	49 00:03:09:00 --> 00:03:16:00 (musica mistica) (tuono)
47 00:03:17:25 --> 00:03:20:00 (dramatic music)	47 00:03:17:25 --> 00:03:20:00 (musica drammatica)	50 00:03:17:25 --> 00:03:20:00 (musica drammatica)
48 00:03:21:01 --> 00:03:22:19 - [Narrator] Thousands of years ago,	48 00:03:21:01 --> 00:03:22:19 - [Narrator] migliaia di anni fa,	51 00:03:21:01 --> 00:03:22:19 - *Migliaia di anni fa,* 52 00:03:20:78 --> 00:03:24: 62 ~2000 a.C. Fiume giallo - Cina
49 00:03:22:22 --> 00:03:26:02 Asian skywatchers saw Venus as two separate stars.	49 00:03:22:22 --> 00:03:26:02 Gli osservatori asiatici vedevano Venere come due stelle separate.	53 00:03:22:22 --> 00:03:26:02 *gli osservatori asiatici vedevano Venere* *come due stelle separate.*
50 00:03:29:11 --> 00:03:30:04 (speaking in foreign language),	50 00:03:29:11 --> 00:03:30:04 (parla in lingua straniera),	54 00:03:29:11 --> 00:03:30:04 (parla in lingua straniera),

51 00:03:30:10 --> 00:03:32:10 the Beginner of Brightness in the morning.	51 00:03:30:10 --> 00:03:32:10 Il principiante della luminosità al mattino.	55 00:03:30:10 --> 00:03:32:10 *la 'Creatrice della luce' al mattino.*
52 00:03:35:15 --> 00:03:36:20 And (speaking in foreign language),	52 00:03:35:15 --> 00:03:36:20 E (parlante in lingua straniera),	56 00:03:35:15 --> 00:03:36:20 *E* (parla in lingua straniera),
53 00:03:36:29 --> 00:03:39:22 the Exalted Western One in the evening.	53 00:03:36:29 --> 00:03:39:22 Quella occidentale esaltata la sera.	57 00:03:36:29 --> 00:03:39:22 *la 'Gloria d'occidente' alla sera.*
54 00:03:41:09 --> 00:03:44:11 - It's always sort of flirting with the edges of night.	54 00:03:41:09 --> 00:03:44:11 - E' sempre una specie di flirtare con i bordi della notte.	58 00:03:41:09 --> 00:03:44:11 - Come se accarezzasse i confini della notte.
55 00:03:44:12 --> 00:03:47:28 You'll never see Venus at midnight up high in the sky.	55 00:03:44:12 --> 00:03:47:28 Non vedrete mai Venere a mezzanotte in alto nel cielo.	59 00:03:44:12 --> 00:03:47:28 Venere non è mai visibile a mezzanotte.
56 00:03:48:00 --> 00:03:52:01 It's always just in the edges of dawn and dusk.	56 00:03:48:00 --> 00:03:52:01 E' sempre ai margini dell'alba e del tramonto.	60 00:03:48:00 --> 00:03:52:01 Ma solo ai confini dell'alba e del tramonto. 61 00:03:52:80 --> 00:03:56:70 1650 a.C. Mezzaluna fertile - Sumeri
57 00:03:54:16 --> 00:03:58:20 - [Narrator] Sumerian priests saw it as one, Inanna,	57 00:03:54:16 --> 00:03:58:20 - [Narrator] i sacerdoti sumeri lo vedevano come un tutt'uno, Inanna,	62 00:03:54:56 --> 00:03:56:87 *- I sacerdoti sumeri* *lo vedevano come una sola entità,* 63 00:03:57:60 --> 00:03:59:20 *Inanna,*

58 00:03:59:26 --> 00:04:05:29 goddess of sex, fertility, physical beauty, and attraction. 59 00:04:06:01 --> 00:04:08:19 (woman singing in foreign language) 60 00:04:10:12 --> 00:04:13:20 Inanna became Aphrodite to the Greeks. 61 00:04:13:22 --> 00:04:15:28 Born from the foam of the sea, 62 00:04:16:00 --> 00:04:17:25 protector of those who sail, 63 00:04:17:27 --> 00:04:19:24 the Hellenic goddess of love 64 00:04:19:27 --> 00:04:22:12 beckoned us to venture into the unknown. 65 00:04:22:29 --> 00:04:24:14 (dramatic music)	58 00:03:59:26 --> 00:04:05:29 dea del sesso, della fertilità, della bellezza fisica e dell'attrazione. 59 00:04:06:01 --> 00:04:08:19 (donna che canta in lingua straniera) 60 00:04:10:12 --> 00:04:13:20 Inanna divenne Afrodite per i Greci. 61 00:04:13:22 --> 00:04:15:28 Nati dalla schiuma del mare, 62 00:04:16:00 --> 00:04:17:25 protettore di coloro che navigano, 63 00:04:17:27 --> 00:04:19:24 La dea ellenica dell'amore 64 00:04:19:27 --> 00:04:22:12 ci ha convinto ad avventurarci nell'ignoto. 65 00:04:22:29 --> 00:04:24:14 (musica drammatica)	64 00:03:59:26 --> 00:04:05:29 *dea del sesso, della fertilità,* *della bellezza fisica e dell'attrazione.* 65 00:04:06:01 --> 00:04:08:19 (donna che canta in lingua straniera) 66 00:04:10:20 --> 00:04:13:70 ~ 400 a.C. Periodo classico - Grecia 67 00:04:10:12 --> 00:04:13:20 *Inanna divenne Afrodite per i Greci.* 68 00:04:13:22 --> 00:04:15:28 *Nata dalla schiuma del mare,* 69 00:04:16:00 --> 00:04:17:25 *protettrice dei marinai,* 70 00:04:17:27 --> 00:04:19:24 *la dea ellenica dell'amore* 71 00:04:19:27 --> 00:04:22:12 *ci spinge ad avventurarci nell'ignoto.* 72 00:04:22:29 --> 00:04:24:14 (musica drammatica) 73 00:04:24:80 --> 00:04:29:00 1° aprile 10 a.C. Primo Impero Romano

66 00:04:24:28 --> 00:04:27:25 Roman leaders declared April the month of Venus 67 00:04:27:28 --> 00:04:29:01 throughout the empire. 68 00:04:30:09 --> 00:04:32:08 During the festival of Veneralia, 69 00:04:32:09 --> 00:04:36:15 Romans honored purity and piety and affairs of the heart. 70 00:04:39:24 --> 00:04:40:24 Across the Atlantic, 71 00:04:40:25 --> 00:04:43:17 Venus was seen as the little brother of the sun. 72 00:04:44:17 --> 00:04:47:22 - In a way, the most astute Venus observers 73 00:04:47:25 --> 00:04:52:20 were the Mesoamericans, the Aztecs, the Maya, the Toltecs.	66 00:04:24:28 --> 00:04:27:25 I capi romani dichiararono aprile il mese di Venere 67 00:04:27:28 --> 00:04:29:01 in tutto l'impero. 68 00:04:30:09 --> 00:04:32:08 Durante la festa di Veneralia, 69 00:04:32:09 --> 00:04:36:15 I romani onoravano la purezza, la pietà e gli affari del cuore. 70 00:04:39:24 --> 00:04:40:24 Dall'altra parte dell'Atlantico, 71 00:04:40:25 --> 00:04:43:17 Venere era visto come il fratellino del sole. 72 00:04:44:17 --> 00:04:47:22 - In un certo senso, gli osservatori più astuti di Venere 73 00:04:47:25 --> 00:04:52:20 Erano i mesoamericani, gli Aztechi, i Maya, i Toltechi.	74 00:04:24:28 --> 00:04:27:25 *I capi romani dichiararono aprile* *il mese di Venere* 75 00:04:27:28 --> 00:04:29:01 *in tutto l'impero.* 76 00:04:30:09 --> 00:04:32:08 *Durante la festività dei Veneralia,* 77 00:04:32:09 --> 00:04:36:15 *i romani celebravano la purezza,* *la pietà e gli affari di cuore.* 78 00:04:39:24 --> 00:04:40:24 *In tutto l'Atlantico,* 79 00:04:40:25 --> 00:04:43:17 *Venere era visto* *come il fratello minore del sole.* 80 00:04:40:40 --> 00:04:43:65 10 d.C. America centrale 81 00:04:44:17 --> 00:04:47:22 - In un certo senso, gli osservatori più acuti di Venere 82 00:04:47:25 --> 00:04:52:20 erano i mesoamericani: gli Aztechi, i Maya, i Toltechi.

74 00:04:53:00 --> 00:04:57:24 For those cultures, Venus was this male macho warrior	74 00:04:53:00 --> 00:04:57:24 Per quelle culture, Venere era un guerriero macho maschile	83 00:04:53:00 --> 00:04:57:24 Per quelle culture, Venere era un virile guerriero,
75 00:04:57:25 --> 00:05:01:07 with a spear going down into the underworld	75 00:04:57:25 --> 00:05:01:07 con una lancia che scende negli inferi	84 00:04:57:25 --> 00:05:01:07 con una lancia che scendeva negli inferi,
76 00:05:01:09 --> 00:05:05:16 and doing battle against the enemies of humanity.	76 00:05:01:09 --> 00:05:05:16 e combattere contro i nemici dell'umanità.	85 00:05:01:09 --> 00:05:05:16 che combatteva contro i nemici dell'umanità.
77 00:05:06:28 --> 00:05:07:26 (light music)	77 00:05:06:28 --> 00:05:07:26 (musica leggera)	86 00:05:06:28 --> 00:05:07:26 (musica lieve) 87 00:05:08:70 --> 00:05:12:50 "La Nascita di Venere" Sandro Botticelli ~ 1485
78 00:05:07:28 --> 00:05:10:02 We think of Venus as Botticelli's Venus,	78 00:05:07:28 --> 00:05:10:02 Pensiamo a Venere come alla Venere di Botticelli,	88 00:05:07:28 --> 00:05:10:02 Pensiamo a Venere come alla Venere di Botticelli,
79 00:05:10:04 --> 00:05:12:11 the feminine figure in our culture.	79 00:05:10:04 --> 00:05:12:11 la figura femminile della nostra cultura.	89 00:05:10:04 --> 00:05:12:11 la figura femminile della nostra cultura.
80 00:05:12:14 --> 00:05:14:03 But, around the world,	80 00:05:12:14 --> 00:05:14:03 Ma, in tutto il mondo,	90 00:05:12:14 --> 00:05:14:03 Ma, nel mondo,
81 00:05:14:05 --> 00:05:17:05 Venus has had a lot of very different manifestations.	81 00:05:14:05 --> 00:05:17:05 Venere ha avuto molte manifestazioni molto diverse.	91 00:05:14:05 --> 00:05:17:05 Venere ha avuto molte manifestazioni diverse.

		92 00:05:18:30 --> 00:05:21:30 Venere - Afrodite Casa di Marco Fabio Rufo
82 00:05:21:10 --> 00:05:23:22 - [Narrator] In time, the Venus of myth	82 00:05:21:10 --> 00:05:23:22 - Nel tempo, la Venere del mito	93 00:05:21:10 --> 00:05:23:22 *- Nel tempo, la Venere del mito*
83 00:05:24:00 --> 00:05:26:18 gave way to the scrutiny of science.	83 00:05:24:00 --> 00:05:26:18 ha lasciato il posto al controllo della scienza.	94 00:05:24:00 --> 00:05:26:18 *ha lasciato posto all'indagine scientifica.*
84 00:05:32:02 --> 00:05:33:26 (soft upbeat music)	84 00:05:32:02 --> 00:05:33:26 (musica soft upbeat)	95 00:05:32:02 --> 00:05:33:26 (allegra musica soft)
85 00:05:33:28 --> 00:05:38:07 In 1610, Galileo Galilei observed crescent Venus	85 00:05:33:28 --> 00:05:38:07 Nel 1610, Galileo Galilei osservò Venere a mezzaluna	96 00:05:33:28 --> 00:05:38:07 *Nel 1610, Galileo Galilei* *osservò Venere crescente*
86 00:05:38:09 --> 00:05:40:19 changing through phases like the moon.	86 00:05:38:09 --> 00:05:40:19 cambiare attraverso fasi come la luna.	97 00:05:38:09 --> 00:05:40:19 *attraversare diverse fasi come la luna.*
87 00:05:41:14 --> 00:05:44:12 Yet another clue that planets orbit the sun.	87 00:05:41:14 --> 00:05:44:12 Un altro indizio che i pianeti orbitano attorno al sole.	98 00:05:41:14 --> 00:05:44:12 *Un altro indizio che* *i pianeti orbitano attorno al sole.*
88 00:05:45:15 --> 00:05:47:00 But even through his telescope,	88 00:05:45:15 --> 00:05:47:00 Ma anche attraverso il suo telescopio,	99 00:05:45:15 --> 00:05:47:00 *Ma anche con il suo telescopio,*
89 00:05:47:04 --> 00:05:50:00 Galileo could not discern its features.	89 00:05:47:04 --> 00:05:50:00 Galileo non riusciva a distinguere le sue caratteristiche.	100 00:05:47:04 --> 00:05:50:00 *Galileo non riusciva a distinguere le sue caratteristiche.*

90 00:05:53:20 --> 00:05:58:27 Finally, in May 1761, thanks to a rare alignment,	90 00:05:53:20 --> 00:05:58:27 Infine, nel maggio 1761, grazie ad un raro allineamento,	101 00:05:53:20 --> 00:05:58:27 *Infine, nel maggio 1761,* *grazie ad un raro allineamento,* 102 00:05:54:30 --> 00:05:58:20 Maggio 1761 San Pietroburgo, Russia
91 00:05:58:29 --> 00:06:01:22 the Russian astronomer, Mikhail Lomonosov,	91 00:05:58:29 --> 00:06:01:22 L'astronomo russo, Mikhail Lomonosov,	103 00:05:58:29 --> 00:06:01:22 *l'astronomo russo Mikhail Lomonosov*
92 00:06:01:23 --> 00:06:03:27 glimpsed its distinctive character.	92 00:06:01:23 --> 00:06:03:27 ne ha dato un'occhiata al suo carattere distintivo.	104 00:06:01:23 --> 00:06:03:27 *vide ciò che lo rende unico.*
93 00:06:05:23 --> 00:06:07:00 (shimmering music)	93 00:06:05:23 --> 00:06:07:00 (musica scintillante)	105 00:06:05:23 --> 00:06:07:00 (musica scintillante)
94 00:06:07:08 --> 00:06:09:11 - About once every 100 years or so,	94 00:06:07:08 --> 00:06:09:11 - Circa una volta ogni 100 anni circa,	106 00:06:07:08 --> 00:06:09:11 - Una volta ogni 100 anni circa,
95 00:06:09:13 --> 00:06:14:01 Venus actually passes in between the sun and the Earth,	95 00:06:09:13 --> 00:06:14:01 Venere passa tra il sole e la Terra,	107 00:06:09:13 --> 00:06:14:01 Venere transita tra il sole e la Terra,
96 00:06:14:03 --> 00:06:15:28 and you can see that little dot of Venus	96 00:06:14:03 --> 00:06:15:28 E potete vedere quel piccolo punto di Venere	108 00:06:14:03 --> 00:06:15:28 e si può vederlo come un piccolo punto
97 00:06:16:00 --> 00:06:18:03 moving across the face of the sun.	97 00:06:16:00 --> 00:06:18:03 si muove attraverso la faccia del sole.	109 00:06:16:00 --> 00:06:18:03 che attraversa la superficie del sole.
98 00:06:18:10 --> 00:06:21:07 (dramatic music)	98 00:06:18:10 --> 00:06:21:07 (musica drammatica)	110 00:06:18:10 --> 00:06:21:07 (musica drammatica)

99 00:06:21:10 --> 00:06:23:23 At the moment when the dot of Venus	99 00:06:21:10 --> 00:06:23:23 Nel momento in cui il punto di Venere	111 00:06:21:10 --> 00:06:23:23 Nel momento quel puntino
100 00:06:23:24 --> 00:06:26:05 starts to cross the disk of the sun,	100 00:06:23:24 --> 00:06:26:05 inizia ad attraversare il disco del sole,	112 00:06:23:24 --> 00:06:26:05 inizia ad attraversare il disco solare,
101 00:06:26:18 --> 00:06:28:26 the very first moment and the very last moment	101 00:06:26:18 --> 00:06:28:26 il primo e l'ultimo momento	113 00:06:26:18 --> 00:06:28:26 nel momento in cui inizia e in quello in cui termina
102 00:06:28:28 --> 00:06:32:04 when the dot of Venus moves off the disk of the sun,	102 00:06:28:28 --> 00:06:32:04 Quando il punto di Venere si sposta dal disco del sole,	114 00:06:28:28 --> 00:06:32:04 il suo transito sul disco solare,
103 00:06:32:19 --> 00:06:34:01 something weird happens.	103 00:06:32:19 --> 00:06:34:01 succede qualcosa di strano.	115 00:06:32:19 --> 00:06:34:01 succede qualcosa di strano.
104 00:06:34:03 --> 00:06:37:17 There's a distortion, what is called the black drop.	104 00:06:34:03 --> 00:06:37:17 C'è una distorsione, quella che viene chiamata la goccia nera.	116 00:06:34:03 --> 00:06:37:17 C'è una distorsione, che viene chiamata la "goccia nera".
		117 00:06:36:70 --> 00:06:45:00 "Goccia nera" Transito di Venere
105 00:06:38:00 --> 00:06:41:02 (mystical music)	105 00:06:38:00 --> 00:06:41:02 (musica mistica)	118 00:06:38:00 --> 00:06:41:02 (musica mistica)
106 00:06:45:15 --> 00:06:47:17 It's almost like the edge of the sun	106 00:06:45:15 --> 00:06:47:17 E' quasi come il bordo del sole	119 00:06:45:15 --> 00:06:47:17 È quasi come se il bordo del sole
107 00:06:47:19 --> 00:06:49:15 kinda leaps off towards it,	107 00:06:47:19 --> 00:06:49:15 un po' salta verso di essa,	120 00:06:47:19 --> 00:06:49:15 gli si avvicinasse,

108 00:06:49:17 --> 00:06:52:02 and then is distorted inwards.	108 00:06:49:17 --> 00:06:52:02 e poi viene distorta verso l'interno.	121 00:06:49:17 --> 00:06:52:02 e poi venisse distorto verso l'interno.
109 00:06:55:08 --> 00:06:57:28 And Lomonosov realized that that would make sense	109 00:06:55:08 --> 00:06:57:28 E Lomonosov si rese conto che avrebbe avuto senso	122 00:06:55:08 --> 00:06:57:28 E Lomonosov si rese conto che sarebbe possibile
110 00:06:57:29 --> 00:07:00:25 if Venus had an atmosphere.	110 00:06:57:29 --> 00:07:00:25 Se Venere avesse un'atmosfera.	123 00:06:57:29 --> 00:07:00:25 se Venere avesse un'atmosfera.
111 00:07:01:00 --> 00:07:02:09 Once you know that,	111 00:07:01:00 --> 00:07:02:09 Una volta che lo saprete,	124 00:07:01:00 --> 00:07:02:09 Una volta che lo appura,
112 00:07:02:12 --> 00:07:04:25 then you can deduce the diameter of Venus.	112 00:07:02:12 --> 00:07:04:25 Allora si può dedurre il diametro di Venere.	125 00:07:02:12 --> 00:07:04:25 allora si può dedurre il diametro di Venere.
113 00:07:04:26 --> 00:07:05:26 And they said, "Oh, wow!	113 00:07:04:26 --> 00:07:05:26 E loro hanno detto: "Oh, wow!	126 00:07:04:26 --> 00:07:05:26 Fu lo stupore generale.
114 00:07:05:29 --> 00:07:07:14 "It's basically the same size as Earth.	114 00:07:05:29 --> 00:07:07:14 "È praticamente delle stesse dimensioni della Terra.	127 00:07:05:29 --> 00:07:07:14 "È praticamente delle stesse dimensioni della Terra."
115 00:07:08:02 --> 00:07:10:03 "It's the size of Earth, and yet it's so bright.	115 00:07:08:02 --> 00:07:10:03 "È grande quanto la Terra, eppure è così luminosa.	128 00:07:08:02 --> 00:07:10:03 "È grande quanto la Terra, eppure è così luminoso."
116 00:07:10:05 --> 00:07:11:08 "Why is it so bright?	116 00:07:10:05 --> 00:07:11:08 "Perché è così brillante?	129 00:07:10:05 --> 00:07:11:08 "Perché è così luminoso?"
117 00:07:11:09 --> 00:07:13:02 "Oh, because it must be covered in clouds."	117 00:07:11:09 --> 00:07:13:02 "Oh, perché deve essere coperto di nuvole."	130 00:07:11:09 --> 00:07:13:02 "Oh, perché deve essere coperto di nuvole."

118 00:07:13:29 --> 00:07:15:29 And they were right about that, as well.	118 00:07:13:29 --> 00:07:15:29 E avevano ragione anche su questo.	131 00:07:13:29 --> 00:07:15:29 E avevano ragione anche su questo.
119 00:07:16:00 --> 00:07:19:03 And the assumption at that time, which was reasonable,	119 00:07:16:00 --> 00:07:19:03 E il presupposto allora, che era ragionevole,	132 00:07:16:00 --> 00:07:19:03 Al tempo, l'ipotesi del tutto ragionevole,
120 00:07:19:06 --> 00:07:21:08 was that the clouds are made out of water.	120 00:07:19:06 --> 00:07:21:08 era che le nuvole erano fatte d'acqua.	133 00:07:19:06 --> 00:07:21:08 era che le nuvole fossero fatte d'acqua.
121 00:07:21:10 --> 00:07:23:20 (intense music)	121 00:07:21:10 --> 00:07:23:20 (musica intensa)	134 00:07:21:10 --> 00:07:23:20 (musica intensa)
122 00:07:23:22 --> 00:07:26:07 - [Narrator] The idea that Venus was like Earth	122 00:07:23:22 --> 00:07:26:07 - L'idea che Venere fosse come la Terra	135 00:07:23:22 --> 00:07:26:07 *- L'idea che Venere* *fosse come la Terra*
123 00:07:26:08 --> 00:07:27:26 sparked the imaginations	123 00:07:26:08 --> 00:07:27:26 ha scatenato l'immaginazione	136 00:07:26:08 --> 00:07:27:26 *ha scatenato l'immaginazione*
124 00:07:27:28 --> 00:07:30:03 of fantasy and science fiction writers.	124 00:07:27:28 --> 00:07:30:03 di scrittori di fantasy e fantascienza.	137 00:07:27:28 --> 00:07:30:03 *di scrittori di fantasy e fantascienza*.
125 00:07:30:05 --> 00:07:35:00 (dramatic music)	125 00:07:30:05 --> 00:07:35:00 (musica drammatica)	138 00:07:30:05 --> 00:07:35:00 (musica drammatica)
126 00:07:35:12 --> 00:07:41:00 (singers vocalizing)	126 00:07:35:12 --> 00:07:41:00 (cantanti che vocalizzano)	139 00:07:35:12 --> 00:07:41:00 (cantanti che vocalizzano)
127 00:07:58:04 --> 00:08:00:20 - I remember seeing a book when I was a kid	127 00:07:58:04 --> 00:08:00:20 Ricordo di aver visto un libro quando ero piccolo	140 00:07:58:04 --> 00:08:00:20 - Ricordo di aver visto un libro quando ero piccola

128 00:08:00:22 --> 00:08:05:01 that said that Venus might have prehistoric jungles	128 00:08:00:22 --> 00:08:05:01 Detto questo, Venere potrebbe avere giungle preistoriche	141 00:08:00:22 --> 00:08:05:01 che diceva che Venere potrebbe aver avuto giungle preistoriche
129 00:08:05:04 --> 00:08:07:03 and dinosaur-type animals.	129 00:08:05:04 --> 00:08:07:03 e animali di tipo dinosauro.	142 00:08:05:04 --> 00:08:07:03 e animali simili ai dinosauri.
130 00:08:07:05 --> 00:08:08:29 I thought that would be really exciting,	130 00:08:07:05 --> 00:08:08:29 Pensavo che sarebbe stato davvero emozionante,	143 00:08:07:05 --> 00:08:08:29 Pensavo che sarebbe stato davvero emozionante,
131 00:08:09:01 --> 00:08:11:01 but turned out to be nothing like that.	131 00:08:09:01 --> 00:08:11:01 ma si è rivelato niente del genere.	144 00:08:09:01 --> 00:08:11:01 ma non si è rivelato nulla del genere.
132 00:08:18:09 --> 00:08:20:02 (engines roaring)	132 00:08:18:09 --> 00:08:20:02 (motori che ruggono)	145 00:08:18:09 --> 00:08:20:02 (motori che rombano) 146 00:08:20:50 --> 00:08:24:60 27 agosto 1962 Cape Canaveral, Florida - USA
133 00:08:20:05 --> 00:08:22:08 - [Astronaut] (indistinct) be advised, three.	133 00:08:20:05 --> 00:08:22:08 - [Astronauta] (indistinto) attenzione, tre.	147 00:08:20:05 --> 00:08:22:08 - [Astronauta] (indistinto) attenzione, tre.
134 00:08:23:05 --> 00:08:25:04 - [Dispatcher] 30 seconds, this is programming, over.	134 00:08:23:05 --> 00:08:25:04 - 30 secondi, questa e' la programmazione, finita.	148 00:08:23:05 --> 00:08:25:04 - 30 secondi, programmazione, fine.
135 00:08:25:06 --> 00:08:26:24 - [Narrator] At the dawn of the Space Age,	135 00:08:25:06 --> 00:08:26:24 - [Narrator] all'alba dell'era spaziale,	149 00:08:25:06 --> 00:08:26:24 *- All'alba dell'era spaziale,*
136 00:08:27:16 --> 00:08:30:05 Mariner 2 was the first successful mission	136 00:08:27:16 --> 00:08:30:05 Mariner 2 fu la prima missione di successo	150 00:08:27:16 --> 00:08:30:05 *Mariner 2 fu la prima missione*

137 00:08:30:07 --> 00:08:31:13 to another planet. 138 00:08:32:13 --> 00:08:36:15 - Way back in 1962, Mariner 2 became the first spacecraft 139 00:08:36:17 --> 00:08:39:00 to explore Venus on a flyby. 140 00:08:39:15 --> 00:08:41:20 And it made a fantastic discovery 141 00:08:41:21 --> 00:08:43:25 that the Venus surface was very hot. 142 00:08:44:12 --> 00:08:47:22 Unfortunately, that was not very good for Venus exploration 143 00:08:47:24 --> 00:08:52:02 because all the classical ideas about Venus being habitable	137 00:08:30:07 --> 00:08:31:13 su un altro pianeta. 138 00:08:32:13 --> 00:08:36:15 - Nel 1962, Mariner 2 è diventato il primo veicolo spaziale 139 00:08:36:17 --> 00:08:39:00 Per esplorare Venere in sorvolo. 140 00:08:39:15 --> 00:08:41:20 E ha fatto una scoperta fantastica 141 00:08:41:21 --> 00:08:43:25 Che la superficie di Venere era molto calda. 142 00:08:44:12 --> 00:08:47:22 Sfortunatamente, questo non è stato molto buono per l'esplorazione di Venere 143 00:08:47:24 --> 00:08:52:02 Perche' tutte le idee classiche sul fatto che Venere sia abitabile	151 00:08:30:07 --> 00:08:31:13 *ad arrivare su un altro pianeta.* 152 00:08:32:13 --> 00:08:36:15 - Nel 1962, Mariner 2 divenne il primo veicolo spaziale 153 00:08:33:00 --> 00:08:36:56 Mariner 2 14 dicembre 1962 154 00:08:36:17 --> 00:08:39:00 ad esplorare Venere in sorvolo. 155 00:08:39:40 --> 00:08:44:48 Sanjay Limaye Ricercatore senior Space Science and Engineering - UW 156 00:08:39:15 --> 00:08:41:20 E fece una scoperta fantastica: 157 00:08:41:21 --> 00:08:43:25 che la superficie di Venere era molto calda. 158 00:08:44:12 --> 00:08:47:22 Sfortunatamente, questo non fu positivo per l'esplorazione di Venere, 159 00:08:47:24 --> 00:08:52:02 perché tutte le classiche ipotesi sul fatto che Venere fosse abitabile

144 00:08:52:04 --> 00:08:55:16 with people and forests living on the surface	144 00:08:52:04 --> 00:08:55:16 con persone e foreste che vivono in superficie	160 00:08:52:04 --> 00:08:55:16 e che persone e foreste vivessero sulla sua superficie
145 00:08:55:17 --> 00:08:56:21 just went out the door.	145 00:08:55:17 --> 00:08:56:21 sono appena uscita dalla porta.	161 00:08:55:17 --> 00:08:56:21 furono abbandonate.
146 00:08:56:24 --> 00:08:58:11 (intense music)	146 00:08:56:24 --> 00:08:58:11 (musica intensa)	162 00:08:56:24 --> 00:08:58:11 (musica intensa)
147 00:08:58:15 --> 00:08:59:25 - [Narrator] Stranger still,	147 00:08:58:15 --> 00:08:59:25 - [Narrator] Stranger ancora,	163 00:08:58:15 --> 00:08:59:25 - *Cosa ancora più strana,*
148 00:08:59:27 --> 00:09:04:14 NASA's Mariner 2 found that the planet rotates very slowly	148 00:08:59:27 --> 00:09:04:14 Il Mariner 2 della NASA ha scoperto che il pianeta ruota molto lentamente	164 00:08:59:27 --> 00:09:04:14 *il Mariner 2 della NASA scoprì* *che Venere ruota molto lentamente*
149 00:09:05:06 --> 00:09:07:18 and backwards compared to Earth.	149 00:09:05:06 --> 00:09:07:18 E indietro rispetto alla Terra.	165 00:09:05:06 --> 00:09:07:18 *e in senso contrario rispetto alla Terra.*
150 00:09:09:26 --> 00:09:12:01 Americans celebrated the triumph.	150 00:09:09:26 --> 00:09:12:01 Gli americani hanno celebrato il trionfo.	166 00:09:09:26 --> 00:09:12:01 *Gli americani celebrarono il trionfo.*
		167 00:09:12:00 --> 00:09:15:40 Venere a Pasadena Mariner 2 degli U.S.
151 00:09:21:00 --> 00:09:23:29 (soft music)	151 00:09:21:00 --> 00:09:23:29 (musica soft)	168 00:09:21:00 --> 00:09:23:29 (musica soft)
152 00:09:24:01 --> 00:09:25:09 Not to be out done,	152 00:09:24:01 --> 00:09:25:09 Per non essere fuori,	169 00:09:24:01 --> 00:09:25:09 *Per non essere superata,*

153 00:09:25:27 --> 00:09:29:29 the Soviet Union attempted at least 16 missions to Venus	153 00:09:25:27 --> 00:09:29:29 L'Unione Sovietica tentò almeno 16 missioni su Venere	170 00:09:25:27 --> 00:09:29:29 *l'Unione Sovietica tentò almeno* *16 missioni su Venere*
154 00:09:30:12 --> 00:09:33:04 between 1961 and 1984.	154 00:09:30:12 --> 00:09:33:04 tra il 1961 e il 1984.	171 00:09:30:12 --> 00:09:33:04 *tra il 1961 e il 1984.*
155 00:09:34:15 --> 00:09:36:02 (air whooshing)	155 00:09:34:15 --> 00:09:36:02 (soffiatura pneumatica)	172 00:09:34:15 --> 00:09:36:02 (fruscio dell'aria)
		173 00:09:36:69 --> 00:09:40:10 Venera 7 10 dicembre 1970
156 00:09:36:04 --> 00:09:41:25 December 1970, Venera 7 made the first successful landing	156 00:09:36:04 --> 00:09:41:25 Nel dicembre 1970, Venera 7 fece il primo atterraggio di successo	174 00:09:36:04 --> 00:09:41:25 *A dicembre 1970, Venera 7* *compì il primo atterraggio di successo*
157 00:09:45:02 --> 00:09:48:05 and the first transmission of data from its surface.	157 00:09:45:02 --> 00:09:48:05 e la prima trasmissione di dati dalla sua superficie.	175 00:09:45:02 --> 00:09:48:05 *e la prima trasmissione di dati* *dalla sua superficie.*
158 00:09:52:13 --> 00:09:54:03 Nearly five years later,	158 00:09:52:13 --> 00:09:54:03 Quasi cinque anni dopo,	176 00:09:52:13 --> 00:09:54:03 *Quasi cinque anni dopo,*
		177 00:09:52:50 --> 00:09:56:20 Venera 9 e 10 Ottobre 1975
159 00:09:54:05 --> 00:09:58:06 Venera 9 and Venera 10 captured the first images	159 00:09:54:05 --> 00:09:58:06 Venera 9 e Venera 10 catturarono le prime immagini	178 00:09:54:05 --> 00:09:58:06 *Venera 9 e Venera 10* *catturarono le prime immagini*

160 00:09:58:08 --> 00:10:00:28 of Venus's tormented landscape. 161 00:10:04:15 --> 00:10:06:19 In December 1978, 162 00:10:06:21 --> 00:10:09:05 the American Pioneer Venus Orbiter 163 00:10:09:06 --> 00:10:12:02 began a 13-year radar mapping mission. 164 00:10:13:19 --> 00:10:16:15 It was followed by a separate Pioneer MultiProbe 165 00:10:16:25 --> 00:10:18:11 dropped into the atmosphere. 166 00:10:20:02 --> 00:10:21:01 - [Dispatcher] Atlantis, Houston.	160 00:09:58:08 --> 00:10:00:28 Del tormentato paesaggio di Venere. 161 00:10:04:15 --> 00:10:06:19 Nel dicembre 1978, 162 00:10:06:21 --> 00:10:09:05 Il pioniere americano Venus Orbiter 163 00:10:09:06 --> 00:10:12:02 ha iniziato una missione di mappatura radar di 13 anni. 164 00:10:13:19 --> 00:10:16:15 È stata seguita da una Pioneer Multiprobe separata 165 00:10:16:25 --> 00:10:18:11 caduto nell'atmosfera. 166 00:10:20:02 --> 00:10:21:01 - Atlantis, Houston.	179 00:09:58:08 --> 00:10:00:28 *del desolato paesaggio di Venere.* 180 00:10:04:15 --> 00:10:06:19 *Nel dicembre 1978,* 181 00:10:07:00 --> 00:10:10:50 Pioneer Orbiter 4 dicembre 1978 182 00:10:06:21 --> 00:10:09:05 *la sonda americana Pioneer Venus Orbiter* 183 00:10:09:06 --> 00:10:12:02 *iniziò una missione di mappatura radar* *di 13 anni.* 184 00:10:13:19 --> 00:10:16:15 *Questa fu seguita* *da un'altra sonda, la Pioneer Multiprobe,* 185 00:10:16:25 --> 00:10:18:11 *fatta cadere nell'atmosfera.* 186 00:10:20:02 --> 00:10:21:01 - [Dispatcher] Atlantis, Houston. 187 00:10:20:08 --> 00:10:25:20 Missione Magellano Lancio della navicella spaziale 5 maggio 1989

167 00:10:21:02 --> 00:10:22:13 Sunnyvale had a good direct check	167 00:10:21:02 --> 00:10:22:13 Sunnyvale ha fatto un buon controllo diretto	188 00:10:21:02 --> 00:10:22:13 Sunnyvale ha avuto un buon controllo diretto
168 00:10:22:15 --> 00:10:23:23 and their command is complete.	168 00:10:22:15 --> 00:10:23:23 e il loro comando è completo.	189 00:10:22:15 --> 00:10:23:23 e il loro comando è completo.
169 00:10:24:00 --> 00:10:25:06 - [Narrator] And a decade later,	169 00:10:24:00 --> 00:10:25:06 - [Narrator] e un decennio dopo,	190 00:10:24:00 --> 00:10:25:06 *- E un decennio dopo,*
170 00:10:25:09 --> 00:10:27:14 NASA's flagship, Magellan,	170 00:10:25:09 --> 00:10:27:14 L'ammiraglia della NASA, Magellan,	191 00:10:25:09 --> 00:10:27:14 *l'ammiraglia della NASA, la Magellano,*
171 00:10:27:18 --> 00:10:29:23 was deployed from the Space Shuttle	171 00:10:27:18 --> 00:10:29:23 È stato schierato dallo Space Shuttle	192 00:10:27:18 --> 00:10:29:23 *fu lanciata dalla navicella spaziale*
172 00:10:29:26 --> 00:10:34:18 on an unusually long 15-month journey inward to Venus.	172 00:10:29:26 --> 00:10:34:18 In un viaggio insolitamente lungo di 15 mesi verso Venere.	193 00:10:29:26 --> 00:10:34:18 *in un viaggio insolitamente lungo* *di 15 mesi verso Venere.*
173 00:10:34:27 --> 00:10:36:23 - [Command Control] Okay, Peter, we copy checkout.	173 00:10:34:27 --> 00:10:36:23 - [Controllo comando] Ok, Peter, copiamo il check-out.	194 00:10:34:27 --> 00:10:36:23 - Ok, Peter, ti riceviamo, passo e chiudo.
174 00:10:36:25 --> 00:10:42:00 (intense music)	174 00:10:36:25 --> 00:10:42:00 (musica intensa)	195 00:10:36:25 --> 00:10:42:00 (musica intensa)
175 00:10:49:09 --> 00:10:54:09 - [Narrator] Looping pole to pole more than 4,000 times,	175 00:10:49:09 --> 00:10:54:09 - [Narrator] Looping pole to pole più di 4.000 volte,	196 00:10:49:36 --> 00:10:52:50 *Passando da un polo all'altro* *più di 4.000 volte,*
176 00:10: --> 00:10:54:09 Magellan's imaging radar	176 00:10: --> 00:10:54:09 il radar di imaging di Magellan	197 00:10:52:62 --> 00:10:54:40 *il radar per immagini della Magellano*

177 00:10:54:12 --> 00:10:58:11 mapped more than 97% of Venus's landforms.	177 00:10:54:12 --> 00:10:58:11 Ha mappato più del 97% delle forme del terreno di Venere.	198 00:10:54:44 --> 00:10:58:44 *ha mappato più del 97%* *della topografia di Venere.* 199 00:10:59:50 --> 00:11:08:90 Venere della Magellano Mappa globale del suolo
178 00:11:04:18 --> 00:11:08:18 Among Magellan's findings, the volcanic surface of Venus	178 00:11:04:18 --> 00:11:08:18 Tra le scoperte di Magellano, la superficie vulcanica di Venere	200 00:11:04:18 --> 00:11:08:18 *Una delle scoperte della Magellano fu che* *la superficie vulcanica di Venere*
179 00:11:08:20 --> 00:11:11:13 overlies a surprisingly thick crust.	179 00:11:08:20 --> 00:11:11:13 sovrasta una crosta sorprendentemente spessa.	201 00:11:08:20 --> 00:11:11:13 *è ricoperta da una crosta sorprendentemente spessa.*
180 00:11:21:02 --> 00:11:27:01 (mystical music)	180 00:11:21:02 --> 00:11:27:01 (musica mistica)	202 00:11:21:02 --> 00:11:27:01 (musica mistica)
181 00:11:29:13 --> 00:11:32:17 Remarkably, about three billion years ago,	181 00:11:29:13 --> 00:11:32:17 Sorprendentemente, circa tre miliardi di anni fa,	203 00:11:29:13 --> 00:11:32:17 *Circa tre miliardi di anni fa,*
182 00:11:32:28 --> 00:11:35:18 Venus was probably much more like Earth.	182 00:11:32:28 --> 00:11:35:18 Venere era probabilmente molto più simile alla Terra.	204 00:11:32:28 --> 00:11:35:18 *Venere era probabilmente molto più simile alla* *Terra.*
183 00:11:37:28 --> 00:11:39:11 (gas hissing)	183 00:11:37:28 --> 00:11:39:11 (sibilo di gas)	205 00:11:37:28 --> 00:11:39:11 (sibilo di gas)
184 00:11:39:13 --> 00:11:42:12 Each one nurtured the promise of life.	184 00:11:39:13 --> 00:11:42:12 Ognuno ha coltivato la promessa di vita.	206 00:11:39:13 --> 00:11:42:12 *Entrambe coltivavano una promessa di vita.*

185 00:11:42:15 --> 00:11:45:29 (water bubbling)	185 00:11:42:15 --> 00:11:45:29 (bolle d'acqua)	207 00:11:42:15 --> 00:11:45:29 (acqua che bolle)
186 00:11:49:05 --> 00:11:50:15 - They're the same size.	186 00:11:49:05 --> 00:11:50:15 - Sono della stessa dimensione.	208 00:11:49:05 --> 00:11:50:15 - Sono della stessa dimensione.
187 00:11:50:17 --> 00:11:53:06 They formed in roughly the same place.	187 00:11:50:17 --> 00:11:53:06 Si sono formati più o meno nello stesso posto.	209 00:11:50:17 --> 00:11:53:06 Si sono formati più o meno nello stesso posto.
188 00:11:53:18 --> 00:11:55:14 There's a lot of circumstantial evidence	188 00:11:53:18 --> 00:11:55:14 Ci sono molte prove indiziarie	210 00:11:53:18 --> 00:11:55:14 Ci sono molte prove indiziarie
189 00:11:55:17 --> 00:11:57:18 that Venus had a more Earth-like environment	189 00:11:55:17 --> 00:11:57:18 Che Venere aveva un ambiente più simile alla Terra	211 00:11:55:17 --> 00:11:57:18 secondo cui Venere aveva un ambiente più simile alla Terra
190 00:11:57:20 --> 00:11:58:16 when it was young.	190 00:11:57:20 --> 00:11:58:16 quando era giovane.	212 00:11:57:20 --> 00:11:58:16 quando era giovane.
191 00:11:58:18 --> 00:12:01:20 So they may have both had warm oceans	191 00:11:58:18 --> 00:12:01:20 Quindi potrebbero aver avuto entrambi oceani caldi	213 00:11:58:18 --> 00:12:01:20 Potrebbero aver avuto entrambi oceani caldi
192 00:12:01:22 --> 00:12:05:29 and all the other conditions necessary for an origin of life	192 00:12:01:22 --> 00:12:05:29 e tutte le altre condizioni necessarie per un'origine della vita	214 00:12:01:22 --> 00:12:05:29 e tutte le altre condizioni necessarie per dare origine alla vita
193 00:12:06:01 --> 00:12:09:12 at the time when Earth apparently had an origin of life.	193 00:12:06:01 --> 00:12:09:12 Al momento in cui la Terra apparentemente aveva un'origine di vita.	215 00:12:06:01 --> 00:12:09:12 nel momento in cui sulla Terra stava probabilmente nascendo la vita.

194 00:12:11:25 --> 00:12:14:16 - Our biggest problem with Venus 195 00:12:14:17 --> 00:12:18:07 is that we have so little information 196 00:12:18:09 --> 00:12:20:15 about its ancient past. 197 00:12:21:21 --> 00:12:23:05 The surface of a planet, 198 00:12:23:07 --> 00:12:25:13 and to some extent the atmosphere of a planet, 199 00:12:25:15 --> 00:12:26:27 are like a crime scene. 200 00:12:27:24 --> 00:12:31:26 Venus is the worst crime scene imaginable 201 00:12:31:28 --> 00:12:36:07 because it's been almost completely disrupted over time. 202 00:12:36:09 --> 00:12:38:10 And the big question for those of us	194 00:12:11:25 --> 00:12:14:16 - Il nostro più grande problema con Venere 195 00:12:14:17 --> 00:12:18:07 è che abbiamo così poche informazioni 196 00:12:18:09 --> 00:12:20:15 sul suo antico passato. 197 00:12:21:21 --> 00:12:23:05 La superficie di un pianeta, 198 00:12:23:07 --> 00:12:25:13 e in una certa misura l' atmosfera di un pianeta, 199 00:12:25:15 --> 00:12:26:27 sono come una scena del crimine. 200 00:12:27:24 --> 00:12:31:26 Venere è la peggiore scena del crimine immaginabile 201 00:12:31:28 --> 00:12:36:07 perché è stato quasi completamente interrotto nel tempo. 202 00:12:36:09 --> 00:12:38:10 E la grande domanda per quelli di noi	216 00:12:11:25 --> 00:12:14:16 - Il problema principale con Venere 217 00:12:14:17 --> 00:12:18:07 è che abbiamo poche informazioni 218 00:12:18:09 --> 00:12:20:15 sul suo antico passato. 219 00:12:21:21 --> 00:12:23:05 La superficie di un pianeta, 220 00:12:23:07 --> 00:12:25:13 e, in parte, l'atmosfera di un pianeta, 221 00:12:25:15 --> 00:12:26:27 sono come una scena del crimine. 222 00:12:27:24 --> 00:12:31:26 Venere è la peggiore scena del crimine possibile 223 00:12:31:28 --> 00:12:36:07 perché è andato tutto quasi completamente distrutto nel tempo. 224 00:12:36:09 --> 00:12:38:10 E la grande domanda per quelli di noi

203 00:12:38:12 --> 00:12:41:21 who are trying to study Venus and understand its history	203 00:12:38:12 --> 00:12:41:21 Che stanno cercando di studiare Venere e capire la sua storia	225 00:12:38:12 --> 00:12:41:21 che cercano di studiare Venere e di capire la sua storia è
204 00:12:41:23 --> 00:12:46:18 is, when did Venus's evolution really diverge	204 00:12:41:23 --> 00:12:46:18 Quando l'evoluzione di Venere è davvero divergente	226 00:12:41:23 --> 00:12:46:18 quando l'evoluzione di Venere si allontana davvero
205 00:12:46:28 --> 00:12:48:18 from Earth's evolution?	205 00:12:46:28 --> 00:12:48:18 Dall'evoluzione della Terra?	227 00:12:46:28 --> 00:12:48:18 dall'evoluzione della Terra?
206 00:12:49:00 --> 00:12:51:05 (mysterious music)	206 00:12:49:00 --> 00:12:51:05 (musica misteriosa)	228 00:12:49:00 --> 00:12:51:05 (musica misteriosa)
207 00:12:51:11 --> 00:12:53:24 - Venus and Earth are the twin planets.	207 00:12:51:11 --> 00:12:53:24 - Venere e Terra sono i pianeti gemelli.	229 00:12:51:11 --> 00:12:53:24 - Venere e la Terra sono pianeti gemelli.
		230 00:12:54:80 --> 00:12:59:00 Sue Smrekar Geofisica planetaria Jet Propulsion Laboratory della NASA
208 00:12:53:28 --> 00:12:55:26 It's the only planet	208 00:12:53:28 --> 00:12:55:26 È l'unico pianeta	231 00:12:53:28 --> 00:12:55:26 È l'unico pianeta
209 00:12:55:28 --> 00:12:58:15 that is likely to be still geologically active	209 00:12:55:28 --> 00:12:58:15 è probabile che sia ancora geologicamente attivo	232 00:12:55:28 --> 00:12:58:15 ad essere probabilmente ancora geologicamente attivo
210 00:12:58:20 --> 00:13:00:20 in some of the same ways as the Earth.	210 00:12:58:20 --> 00:13:00:20 In qualche modo come la Terra.	233 00:12:58:20 --> 00:13:00:20 in modi simili alla Terra.

211 00:13:00:29 --> 00:13:04:00 It's really a huge laboratory for understanding the Earth	211 00:13:00:29 --> 00:13:04:00 È davvero un enorme laboratorio per capire la Terra	234 00:13:00:29 --> 00:13:04:00 È davvero un enorme laboratorio per capire la Terra
212 00:13:04:03 --> 00:13:05:26 because of its many similarities,	212 00:13:04:03 --> 00:13:05:26 a causa delle sue molte somiglianze,	235 00:13:04:03 --> 00:13:05:26 grazie alle sue molteplici somiglianze,
213 00:13:05:28 --> 00:13:07:10 as well as some differences.	213 00:13:05:28 --> 00:13:07:10 oltre ad alcune differenze.	236 00:13:05:28 --> 00:13:07:10 così come ad alcune differenze.
214 00:13:07:12 --> 00:13:08:18 (lava sloshing)	214 00:13:07:12 --> 00:13:08:18 (lava sloshing)	237 00:13:07:12 --> 00:13:08:18 (lava che scorre)
215 00:13:08:20 --> 00:13:13:00 - So Venus is kind of the Earth's evil twin sister.	215 00:13:08:20 --> 00:13:13:00 - Quindi Venere è una specie di sorella gemella malvagia della Terra.	238 00:13:08:20 --> 00:13:13:00 - Quindi Venere è una specie di sorella cattiva della Terra.
216 00:13:14:03 --> 00:13:18:25 It shows how two worlds of similar size, similar density,	216 00:13:14:03 --> 00:13:18:25 Mostra come due mondi di dimensioni simili, densità simile,	239 00:13:14:03 --> 00:13:18:25 La prova di come due mondi con dimensioni e densità simili
217 00:13:18:26 --> 00:13:23:01 not that far apart in terms of distance to the sun,	217 00:13:18:26 --> 00:13:23:01 non molto distanti in termini di distanza dal sole,	240 00:13:18:26 --> 00:13:23:01 non molto lontani tra loro in termini di distanza dal sole,
218 00:13:23:17 --> 00:13:25:12 evolved very differently.	218 00:13:23:17 --> 00:13:25:12 si è evoluta in modo molto diverso.	241 00:13:23:17 --> 00:13:25:12 si siano evoluti in modo molto diverso.
219 00:13:25:15 --> 00:13:31:15 (mysterious music)	219 00:13:25:15 --> 00:13:31:15 (musica misteriosa)	242 00:13:25:15 --> 00:13:31:15 (musica misteriosa)
220 00:13:31:20 --> 00:13:32:22 - [Narrator] Early on,	220 00:13:31:20 --> 00:13:32:22 - [Narrator] presto,	243 00:13:31:20 --> 00:13:32:22 - *Inizialmente,*

221 00:13:32:24 --> 00:13:36:20 Venus was on a path similar to its sister planet, Earth.	221 00:13:32:24 --> 00:13:36:20 Venere era su un percorso simile al suo pianeta gemello, la Terra.	244 00:13:32:24 --> 00:13:36:20 *Venere stava facendo un percorso simile* *a quello del suo pianeta gemello, la Terra.* 245 00:13:38:80 --> 00:13:46:80 Aphrodite Terra Dati di elevazione radar
222 00:13:39:16 --> 00:13:43:12 The radar data hold intriguing clues to a watery past,	222 00:13:39:16 --> 00:13:43:12 I dati radar contengono indizi intriganti su un passato acquoso,	246 00:13:39:16 --> 00:13:43:12 I dati radar contengono interessanti indizi di un passato fatto di acqua,
223 00:13:45:06 --> 00:13:48:08 including vast plateaus made up of granite rocks	223 00:13:45:06 --> 00:13:48:08 comprende vasti altipiani composti da rocce granitiche	247 00:13:45:06 --> 00:13:48:08 con vasti altipiani costituiti da rocce granitiche
224 00:13:48:10 --> 00:13:51:06 that likely formed at the bottom of an ocean.	224 00:13:48:10 --> 00:13:51:06 probabilmente si è formato sul fondo di un oceano.	248 00:13:48:10 --> 00:13:51:06 che si sono formati probabilmente sul fondo di un oceano.
225 00:13:53:29 --> 00:13:57:12 - There are areas on Venus that look like continents.	225 00:13:53:29 --> 00:13:57:12 Ci sono aree su Venere che sembrano continenti.	249 00:13:53:29 --> 00:13:57:12 - Ci sono aree su Venere che sembrano continenti. 250 00:13:57:70 --> 00:14:02:15 Martha Gilmore Geoscienziata planetaria Wesleyan University
226 00:13:57:14 --> 00:14:00:13 They're high-standing. They're kinda wrinkly.	226 00:13:57:14 --> 00:14:00:13 Sono di alto livello. Sono un po’ ruvidi.	251 00:13:57:14 --> 00:14:00:13 Sono alti. Sono un po’ ruvidi.

227 00:14:00:24 --> 00:14:04:22 They are also the oldest rocks on Venus	227 00:14:00:24 --> 00:14:04:22 Sono anche le rocce più antiche di Venere	252 00:14:00:24 --> 00:14:04:22 Sono anche le rocce più antiche di Venere
228 00:14:05:07 --> 00:14:08:19 because Venus has had this weird history	228 00:14:05:07 --> 00:14:08:19 Perché Venere ha avuto questa storia strana	253 00:14:05:07 --> 00:14:08:19 perché Venere ha avuto questa strana storia
		254 00:14:06:60 --> 00:14:11:00 Ovda Regio Altopiano crostale
229 00:14:08:25 --> 00:14:11:22 where much of the surface is new.	229 00:14:08:25 --> 00:14:11:22 dove gran parte della superficie è nuova.	255 00:14:08:25 --> 00:14:11:22 per cui gran parte della superficie è nuova.
230 00:14:13:28 --> 00:14:16:23 So these rocks are the only rocks	230 00:14:13:28 --> 00:14:16:23 Quindi queste rocce sono le uniche rocce	256 00:14:13:28 --> 00:14:16:23 Quindi queste rocce sono le uniche rocce
231 00:14:17:01 --> 00:14:20:09 from the first 80% of the history of Venus.	231 00:14:17:01 --> 00:14:20:09 Dal primo 80% della storia di Venere.	257 00:14:17:01 --> 00:14:20:09 del primo 80% della storia di Venere.
232 00:14:21:24 --> 00:14:23:07 That’s where we want to go.	232 00:14:21:24 --> 00:14:23:07 Ecco dove vogliamo andare.	258 00:14:21:24 --> 00:14:23:07 È lì che vogliamo andare.
233 00:14:23:09 --> 00:14:26:10 That’s where I wanted to go is to these areas,	233 00:14:23:09 --> 00:14:26:10 È qui che volevo andare, in queste aree,	259 00:14:23:09 --> 00:14:26:10 È qui che voglio andare, in queste aree,
234 00:14:26:12 --> 00:14:28:20 which are called tessera terrain	234 00:14:26:12 --> 00:14:28:20 che si chiamano terreno tessera	260 00:14:26:12 --> 00:14:28:20 chiamate “tessere”
		261 00:14:29:20 --> 00:14:36:40 Regione Alfa ~ 1500 km di lunghezza

235 00:14:28:28 --> 00:14:31:17 because of their tile-like appearance.	235 00:14:28:28 --> 00:14:31:17 a causa del loro aspetto simile a piastrelle.	262 00:14:28:28 --> 00:14:31:17 per il loro aspetto simile a piastrelle.
236 00:14:32:29 --> 00:14:36:00 Whatever it is that spurred the formation of life,	236 00:14:32:29 --> 00:14:36:00 Qualunque cosa abbia stimolato la formazione della vita,	263 00:14:32:29 --> 00:14:36:00 Qualunque sia il motivo che ha portato alla formazione della vita,
237 00:14:36:05 --> 00:14:39:04 in my mind, why wouldn't it have happened everywhere?	237 00:14:36:05 --> 00:14:39:04 nella mia mente, perché non sarebbe successo ovunque?	264 00:14:36:05 --> 00:14:39:04 a mio parere, perché non sarebbe potuto accadere ovunque?
238 00:14:39:21 --> 00:14:41:15 And that's the record that we're looking for	238 00:14:39:21 --> 00:14:41:15 E questo è il record che stiamo cercando	265 00:14:39:21 --> 00:14:41:15 E questa è la documentazione che stiamo cercando
239 00:14:41:18 --> 00:14:43:16 in the rocks of the tessera.	239 00:14:41:18 --> 00:14:43:16 nelle rocce della tessera.	266 00:14:41:18 --> 00:14:43:16 nelle rocce delle tessere.
240 00:14:44:08 --> 00:14:46:09 Were there evidence of ancient environments	240 00:14:44:08 --> 00:14:46:09 C'erano prove di ambienti antichi	267 00:14:44:08 --> 00:14:46:09 Esistevano prove di antichi ambienti
241 00:14:46:11 --> 00:14:47:21 that would support life?	241 00:14:46:11 --> 00:14:47:21 questo sosterrebbe la vita?	268 00:14:46:11 --> 00:14:47:21 in grado di supportare la vita?
242 00:14:48:13 --> 00:14:54:00 (gas hissing) (mystical music)	242 00:14:48:13 --> 00:14:54:00 (sibilo di gas) (musica mistica)	269 00:14:48:13 --> 00:14:54:00 (sibilo di gas) (musica mistica)
243 00:15:03:12 --> 00:15:06:12 (light music)	243 00:15:03:12 --> 00:15:06:12 (musica leggera)	270 00:15:03:12 --> 00:15:06:12 (musica lieve)

244 00:15:06:18 --> 00:15:07:24 - [Narrator] Venus is close to Earth 245 00:15:07:26 --> 00:15:11:04 in size, mass, and rocky composition, 246 00:15:11:29 --> 00:15:14:09 but that's where the similarities end. 247 00:15:15:19 --> 00:15:17:16 - Now, one thing we've learned in general 248 00:15:17:18 --> 00:15:19:10 about the formation of the planets 249 00:15:19:12 --> 00:15:22:08 is that the final stages of planetary formation 250 00:15:22:09 --> 00:15:23:19 were characterized by a small number 251 00:15:23:22 --> 00:15:25:10 of really huge collisions. 252 00:15:25:12 --> 00:15:29:13 (planets sizzling) 253 00:15:29:17 --> 00:15:33:05 Those last few violent collisions happened on Earth	244 00:15:06:18 --> 00:15:07:24 - Venere è vicino alla Terra 245 00:15:07:26 --> 00:15:11:04 dimensioni, massa e composizione rocciosa, 246 00:15:11:29 --> 00:15:14:09 ma è qui che finiscono le somiglianze. 247 00:15:15:19 --> 00:15:17:16 - Ora, una cosa che abbiamo imparato in generale 248 00:15:17:18 --> 00:15:19:10 sulla formazione dei pianeti 249 00:15:19:12 --> 00:15:22:08 è che le fasi finali della formazione planetaria 250 00:15:22:09 --> 00:15:23:19 erano caratterizzati da un numero ridotto 251 00:15:23:22 --> 00:15:25:10 di collisioni davvero enormi. 252 00:15:25:12 --> 00:15:29:13 (pianeti sfrigolanti) 253 00:15:29:17 --> 00:15:33:05 Queste ultime violente collisioni sono avvenute sulla Terra	271 00:15:06:18 --> 00:15:07:24 - *Venere è simile alla Terra* 272 00:15:07:26 --> 00:15:11:04 *per dimensioni, massa e composizione rocciosa,* 273 00:15:11:29 --> 00:15:14:09 *ma qui finiscono le somiglianze.* 274 00:15:15:19 --> 00:15:17:16 - Ora, una cosa che abbiamo imparato in generale 275 00:15:17:18 --> 00:15:19:10 sulla formazione dei pianeti 276 00:15:19:12 --> 00:15:22:08 è che le fasi finali della formazione planetaria 277 00:15:22:09 --> 00:15:23:19 erano caratterizzate da un numero ridotto 278 00:15:23:22 --> 00:15:25:10 di violente collisioni. 279 00:15:25:12 --> 00:15:29:13 (movimento di pianeti) 280 00:15:29:17 --> 00:15:33:05 Queste ultime violente collisioni avvennero sulla Terra

254 00:15:33:07 --> 00:15:35:28 in just such a way as to leave it with a moon 255 00:15:36:06 --> 00:15:38:05 and on Venus, through a different combination 256 00:15:38:08 --> 00:15:40:26 of impact size and impact angles, 257 00:15:41:01 --> 00:15:43:20 it may have had been left with no moon, 258 00:15:43:22 --> 00:15:46:20 but with its very slow rotation. 259 00:15:47:24 --> 00:15:50:10 - [Narrator] Compared to our 24 hour day, 260 00:15:50:13 --> 00:15:53:09 it takes more than 243 Earth days 261 00:15:53:11 --> 00:15:55:28 for Venus to rotate just once, 262 00:15:56:01 --> 00:15:58:08 the longest day in the solar system.	254 00:15:33:07 --> 00:15:35:28 in modo tale da lasciarla con una luna 255 00:15:36:06 --> 00:15:38:05 E su Venere, attraverso una combinazione diversa 256 00:15:38:08 --> 00:15:40:26 delle dimensioni d'impatto e degli angoli d'impatto, 257 00:15:41:01 --> 00:15:43:20 potrebbe essere stato lasciato senza luna, 258 00:15:43:22 --> 00:15:46:20 ma con la sua rotazione molto lenta. 259 00:15:47:24 --> 00:15:50:10 - [Narrator] rispetto al nostro giorno di 24 ore, 260 00:15:50:13 --> 00:15:53:09 Ci vogliono più di 243 giorni sulla Terra 261 00:15:53:11 --> 00:15:55:28 Affinché Venere ruoti una sola volta, 262 00:15:56:01 --> 00:15:58:08 il giorno più lungo del sistema solare.	281 00:15:33:07 --> 00:15:35:28 lasciandole una luna 282 00:15:36:06 --> 00:15: e su Venere, attraverso una combinazione diversa 283 00:15:38:08 --> 00:15:40:26 di dimensioni e angoli d'impatto, 284 00:15:41:01 --> 00:15:43:20 che potrebbe essere rimasto senza luna, 285 00:15:43:22 --> 00:15:46:20 ma con una rotazione molto lenta. 286 00:15:47:24 --> 00:15:50:10 *- Rispetto al nostro giorno di 24 ore,* 287 00:15:50:13 --> 00:15:53:09 *ci vogliono più di 243 giorni terrestri* 288 00:15:50:44 --> 00:15:53:32 243,0212 "giorni terrestri" 289 00:15:53:11 --> 00:15:55:28 *affinché Venere ruoti una sola volta,* 290 00:15:56:01 --> 00:15:58:08 *il giorno più lungo del sistema solare.*

263 00:15:59:14 --> 00:16:01:24 - And it rotates in the opposite direction,	263 00:15:59:14 --> 00:16:01:24 - E ruota nella direzione opposta,	291 00:15:59:14 --> 00:16:01:24 - E ruota nella direzione opposta,
264 00:16:01:28 --> 00:16:03:27 so that if you were on the surface of Venus	264 00:16:01:28 --> 00:16:03:27 Quindi, se lei fosse sulla superficie di Venere	292 00:16:01:28 --> 00:16:03:27 così che se ci si trovasse sulla superficie di Venere
265 00:16:03:29 --> 00:16:05:03 and could see the sun,	265 00:16:03:29 --> 00:16:05:03 e poteva vedere il sole,	293 00:16:03:29 --> 00:16:05:03 e si potesse vedere il sole,
266 00:16:05:06 --> 00:16:09:12 it would rise in the west and set in the east.	266 00:16:05:06 --> 00:16:09:12 Sorgerebbe ad ovest e si troverebbe ad est.	294 00:16:05:06 --> 00:16:09:12 questo sorgerebbe a ovest e tramonterebbe a est.
267 00:16:09:14 --> 00:16:11:24 (light music)	267 00:16:09:14 --> 00:16:11:24 (musica leggera)	295 00:16:09:14 --> 00:16:11:24 (musica lieve)
268 00:16:11:27 --> 00:16:15:08 On Earth, the sun moves along in the sunrise	268 00:16:11:27 --> 00:16:15:08 Sulla Terra, il sole si muove all’alba	296 00:16:11:27 --> 00:16:15:08 Sulla Terra, all’alba il sole si muove
269 00:16:15:10 --> 00:16:17:01 at hundreds of miles per hour.	269 00:16:15:10 --> 00:16:17:01 a centinaia di miglia all’ora.	297 00:16:15:10 --> 00:16:17:01 a centinaia di chilometri all'ora.
270 00:16:17:03 --> 00:16:18:26 So you have to be up in a jet airplane	270 00:16:17:03 --> 00:16:18:26 Quindi deve salire su un aereo a reazione	298 00:16:17:03 --> 00:16:18:26 Quindi bisognerebbe salire su un aereo a reazione
271 00:16:18:28 --> 00:16:21:07 if you wanted the sunset to last forever.	271 00:16:18:28 --> 00:16:21:07 se volessi che il tramonto durasse per sempre.	299 00:16:18:28 --> 00:16:21:07 se si volesse che il tramonto durasse per sempre.

272 00:16:21:08 --> 00:16:25:00 On Venus though, it's four or five miles per hour.	272 00:16:21:08 --> 00:16:25:00 Su Venere, però, sono quattro o cinque miglia all'ora.	300 00:16:21:08 --> 00:16:25:00 Su Venere, invece, sono quattro o cinque chilometri all'ora.
273 00:16:25:02 --> 00:16:27:26 So you could kind of walk along at a good clip	273 00:16:25:02 --> 00:16:27:26 Quindi si potrebbe andare a piedi ad una buona clip	301 00:16:25:02 --> 00:16:27:26 Quindi si potrebbe camminare a passo spedito
274 00:16:27:28 --> 00:16:30:25 and keep the sunset going	274 00:16:27:28 --> 00:16:30:25 e continua il tramonto	302 00:16:27:28 --> 00:16:30:25 e continuare a vedere il tramonto
275 00:16:30:27 --> 00:16:33:16 or the sunrise going as long as you wanted.	275 00:16:30:27 --> 00:16:33:16 o l'alba che va tutto il tempo che volevi.	303 00:16:30:27 --> 00:16:33:16 o l'alba per tutto il tempo che si vuole. 304 00:16:32:90 --> 00:16:36:60 David Grinspoon Ricercatore senior Planetary Science Institute
276 00:16:33:18 --> 00:16:39:14 The pace of the planetary rotation is a human walking pace.	276 00:16:33:18 --> 00:16:39:14 Il ritmo della rotazione planetaria è un passo umano che cammina.	305 00:16:33:18 --> 00:16:39:14 Il ritmo della rotazione planetaria è quello di una camminata.
277 00:16:41:01 --> 00:16:44:12 - [Narrator] Even that slow pace may be winding down.	277 00:16:41:01 --> 00:16:44:12 - [Narrator] anche quel ritmo lento potrebbe essere in calo.	306 00:16:41:01 --> 00:16:44:12 *- Anche questo ritmo lento* *potrebbe star cessando.*
278 00:16:45:17 --> 00:16:47:20 - The very thick atmosphere of Venus	278 00:16:45:17 --> 00:16:47:20 - L'atmosfera molto densa di Venere	307 00:16:45:17 --> 00:16:47:20 - L'atmosfera molto densa di Venere
279 00:16:47:23 --> 00:16:50:04 is actually being pushed and pushing back	279 00:16:47:23 --> 00:16:50:04 in realtà viene spinto e spinto indietro	308 00:16:47:23 --> 00:16:50:04 viene in realtà spinta e respinta

280 00:16:50:07 --> 00:16:51:08 from the typography (>topography)	280 00:16:50:07 --> 00:16:51:08 dalla tipografia	309 00:16:50:07 --> 00:16:51:08 dalla topografia
281 00:16:51:10 --> 00:16:53:12 and changing its rotation rate very slowly	281 00:16:51:10 --> 00:16:53:12 e cambiando la velocità di rotazione molto lentamente	310 00:16:51:10 --> 00:16:53:12 cambia la sua velocità di rotazione molto lentamente
282 00:16:53:14 --> 00:16:55:20 and very slightly over the decades.	282 00:16:53:14 --> 00:16:55:20 e molto leggermente nel corso dei decenni.	311 00:16:53:14 --> 00:16:55:20 e di poco nel corso dei decenni.
		312 00:16:53:60 --> 00:16:57:70 Mike Way Scienziato planetario Goddard Institute for Space Studies
283 00:16:55:22 --> 00:16:58:16 And that has been measured by ground-based units	283 00:16:55:22 --> 00:16:58:16 E questo è stato misurato da unità basate su terra	313 00:16:55:22 --> 00:16:58:16 Questa misurazione è stata fatta da unità a terra
284 00:16:58:17 --> 00:17:00:23 and by Magellan, and even by Venus Express,	284 00:16:58:17 --> 00:17:00:23 E da Magellano, e anche da Venus Express,	314 00:16:58:17 --> 00:17:00:23 e dalla Magellano, e anche da Venus Express,
285 00:17:00:25 --> 00:17:02:25 the most recent European mission.	285 00:17:00:25 --> 00:17:02:25 La più recente missione europea.	315 00:17:00:25 --> 00:17:02:25 la più recente missione europea.
286 00:17:02:27 --> 00:17:03:22 (wind whooshing)	286 00:17:02:27 --> 00:17:03:22 (battito del vento)	316 00:17:02:27 --> 00:17:03:22 (sibilo del vento)
287 00:17:03:24 --> 00:17:05:12 (mystical music)	287 00:17:03:24 --> 00:17:05:12 (musica mistica)	317 00:17:03:24 --> 00:17:05:12 (musica mistica)

288 00:17:05:14 --> 00:17:08:08 - [Narrator] Though the surface creeps along without hurry,	288 00:17:05:14 --> 00:17:08:08 - [Narrator] anche se la superficie scorre senza fretta,	318 00:17:05:14 --> 00:17:08:08 *- Anche se la superficie si muove* *senza fretta,*
289 00:17:08:10 --> 00:17:13:00 the clouds move quickly and their speeds change.	289 00:17:08:10 --> 00:17:13:00 le nuvole si muovono rapidamente e le loro velocità cambiano.	319 00:17:08:10 --> 00:17:13:00 *le nuvole si muovono rapidamente* *e le loro velocità cambiano.*
290 00:17:15:17 --> 00:17:17:16 The Japanese Akatasuki probe,	290 00:17:15:17 --> 00:17:17:16 La sonda giapponese Akatasuki,	320 00:17:15:17 --> 00:17:17:16 *La sonda giapponese Akatsuki*,
291 00:17:17:18 --> 00:17:20:09 also known as the Venus Climate Orbiter,	291 00:17:17:18 --> 00:17:20:09 Noto anche come Venus Climate Orbiter,	321 00:17:17:18 --> 00:17:20:09 *anche nota come "Venus Climate Orbiter",*
292 00:17:20:15 --> 00:17:23:11 recently found that the atmosphere spins much faster	292 00:17:20:15 --> 00:17:23:11 recentemente ha scoperto che l' atmosfera gira molto più velocemente	322 00:17:20:15 --> 00:17:23:11 *recentemente ha scoperto che l'atmosfera gira* *molto più velocemente*
293 00:17:23:13 --> 00:17:24:29 than the planet itself,	293 00:17:23:13 --> 00:17:24:29 del pianeta stesso,	323 00:17:23:13 --> 00:17:24:29 *del pianeta stesso,*
294 00:17:25:05 --> 00:17:27:25 a phenomenon called superrotation.	294 00:17:25:05 --> 00:17:27:25 un fenomeno chiamato superrotazione.	324 00:17:25:05 --> 00:17:27:25 *un fenomeno chiamato "superrotazione".*
295 00:17:30:10 --> 00:17:32:20 This movement is driven by heat	295 00:17:30:10 --> 00:17:32:20 Questo movimento è guidato dal calore	325 00:17:30:10 --> 00:17:32:20 *Questo movimento è guidato dal calore*
296 00:17:32:22 --> 00:17:35:00 rising continually from the surface.	296 00:17:32:22 --> 00:17:35:00 in continuo aumento dalla superficie.	326 00:17:32:22 --> 00:17:35:00 *che risale continuamente dalla superficie.*
297 00:17:36:05 --> 00:17:37:07 (gentle music)	297 00:17:36:05 --> 00:17:37:07 (musica dolce)	327 00:17:36:05 --> 00:17:37:07 (musica dolce)

298 00:17:37:09 --> 00:17:39:27 Mysteriously, the planet lacks a key feature	298 00:17:37:09 --> 00:17:39:27 Misteriosamente, il pianeta non ha una caratteristica chiave	328 00:17:37:09 --> 00:17:39:27 *Stranamente,* *il pianeta non ha una specifica caratteristica*
299 00:17:39:29 --> 00:17:42:04 that protects Earth and its atmosphere,	299 00:17:39:29 --> 00:17:42:04 Che protegge la Terra e la sua atmosfera,	329 00:17:39:29 --> 00:17:42:04 *che protegge la Terra e la sua atmosfera,*
300 00:17:43:06 --> 00:17:45:04 a strong magnetic field.	300 00:17:43:06 --> 00:17:45:04 un forte campo magnetico.	330 00:17:43:06 --> 00:17:45:04 *un forte campo magnetico.*
301 00:17:45:08 --> 00:17:48:05 (intense music)	301 00:17:45:08 --> 00:17:48:05 (musica intensa)	331 00:17:45:08 --> 00:17:48:05 (musica intensa)
302 00:17:48:07 --> 00:17:50:02 Without this protective shield,	302 00:17:48:07 --> 00:17:50:02 Senza questo scudo protettivo,	332 00:17:48:07 --> 00:17:50:02 *Senza questo scudo protettivo,*
303 00:17:50:11 --> 00:17:52:25 intense ultraviolet rays from the sun	303 00:17:50:11 --> 00:17:52:25 raggi ultravioletti intensi provenienti dal sole	333 00:17:50:11 --> 00:17:52:25 *gli intensi raggi ultravioletti del sole*
304 00:17:52:27 --> 00:17:55:23 split water molecules apart in the high atmosphere.	304 00:17:52:27 --> 00:17:55:23 separare le molecole d’acqua nell’alta atmosfera.	334 00:17:52:27 --> 00:17:55:23 *dividono le molecole d'acqua* *nell'alta atmosfera.*
305 00:17:58:26 --> 00:18:01:20 Then the sun’s intense stream of charged particles,	305 00:17:58:26 --> 00:18:01:20 Poi l’intenso flusso del sole di particelle cariche,	335 00:17:58:26 --> 00:18:01:20 *Poi l’intenso flusso* *di particelle solari cariche,*
306 00:18:01:28 --> 00:18:06:03 the solar wind carries much of the hydrogen away into space.	306 00:18:01:28 --> 00:18:06:03 il vento solare trasporta gran parte dell’idrogeno nello spazio.	336 00:18:01:28 --> 00:18:06:03 *il “vento solare”,* *trasporta gran parte dell'idrogeno nello spazio.*

307 00:18:07:27 --> 00:18:09:27 - In the very early solar system,	307 00:18:07:27 --> 00:18:09:27 - Nel primo sistema solare,	337 00:18:07:27 --> 00:18:09:27 - Nel primissimo sistema solare, 338 00:18:09:50 --> 00:18:13:54 Geoff Landis Scienziato / ingegnere e autore Glenn Research Center della NASA
308 00:18:10:14 --> 00:18:13:18 When the sun was not quite as bright as it was now,	308 00:18:10:14 --> 00:18:13:18 Quando il sole non era così luminoso come lo era ora,	339 00:18:10:14 --> 00:18:13:18 quando il sole non era luminoso come adesso,
309 00:18:14:10 --> 00:18:15:26 Venus was much more habitable.	309 00:18:14:10 --> 00:18:15:26 Venere era molto più abitabile.	340 00:18:14:10 --> 00:18:15:26 Venere era molto più abitabile.
310 00:18:16:25 --> 00:18:20:02 But just a little bit of increase in solar brightness	310 00:18:16:25 --> 00:18:20:02 Ma solo un po' di aumento della luminosità solare	341 00:18:16:25 --> 00:18:20:02 Ma un leggero aumento di luminosità solare
311 00:18:20:05 --> 00:18:22:20 kicked off a runaway greenhouse effect	311 00:18:20:05 --> 00:18:22:20 ha dato il via a un effetto serra in fuga	342 00:18:20:05 --> 00:18:22:20 ha dato il via a un rapido effetto serra
312 00:18:23:06 --> 00:18:24:27 where the oceans evaporated,	312 00:18:23:06 --> 00:18:24:27 quando gli oceani sono evaporati,	343 00:18:23:06 --> 00:18:24:27 per cui gli oceani evaporarono,
313 00:18:25:06 --> 00:18:27:00 put water vapor into the atmosphere	313 00:18:25:06 --> 00:18:27:00 mettere il vapore acqueo nell'atmosfera	344 00:18:25:06 --> 00:18:27:00 rilasciarono vapore acqueo nell'atmosfera
314 00:18:27:01 --> 00:18:28:20 that increased the greenhouse,	314 00:18:27:01 --> 00:18:28:20 questo ha aumentato la serra,	345 00:18:27:01 --> 00:18:28:20 che aumentò l'effetto serra,

315 00:18:29:02 --> 00:18:32:20 and it ran away to become the very hot, very dry planet	315 00:18:29:02 --> 00:18:32:20 ed è scappato per diventare il pianeta molto caldo e molto secco	346 00:18:29:02 --> 00:18:32:20 diventando così il pianeta molto caldo e molto secco
316 00:18:32:22 --> 00:18:33:25 we see today.	316 00:18:32:22 --> 00:18:33:25 vediamo oggi.	347 00:18:32:22 --> 00:18:33:25 che vediamo oggi.
317 00:18:34:29 --> 00:18:38:20 - We definitely believe that Venus had much more water	317 00:18:34:29 --> 00:18:38:20 - Crediamo che Venere avesse molta più acqua	348 00:18:34:29 --> 00:18:38:20 - Siamo convinti che Venere avesse molta più acqua
		349 00:18:36:37 --> 00:18:40:12 Sue Smrekar Geofisica planetaria Jet Propulsion Laboratory della NASA
318 00:18:38:22 --> 00:18:41:05 at the surface than it does today.	318 00:18:38:22 --> 00:18:41:05 in superficie di quanto non faccia oggi.	350 00:18:38:22 --> 00:18:41:05 in superficie di quanta ne abbia oggi.
319 00:18:41:09 --> 00:18:43:21 Potentially, a shallow ocean’s worth of water.	319 00:18:41:09 --> 00:18:43:21 Potenzialmente, un oceano poco profondo ha un’acqua.	351 00:18:41:09 --> 00:18:43:21 Potenzialmente, un oceano poco profondo pieno d’acqua.
320 00:18:44:13 --> 00:18:45:27 We really have no information	320 00:18:44:13 --> 00:18:45:27 Non abbiamo davvero nessuna informazione	352 00:18:44:13 --> 00:18:45:27 Non abbiamo davvero nessuna informazione
321 00:18:45:28 --> 00:18:48:07 about when that water was lost.	321 00:18:45:28 --> 00:18:48:07 di quando quell’acqua è andata perduta.	353 00:18:45:28 --> 00:18:48:07 di quando quell’acqua è andata perduta.
322 00:18:49:07 --> 00:18:50:29 - That water could have persisted	322 00:18:49:07 --> 00:18:50:29 - Quell’acqua avrebbe potuto persistere	354 00:18:49:07 --> 00:18:50:29 - Quell’acqua avrebbe potuto rimanere

323 00:18:51:05 --> 00:18:54:18 for billions of years, billions.	323 00:18:51:05 --> 00:18:54:18 per miliardi di anni, miliardi.	355 00:18:51:05 --> 00:18:54:18 per miliardi di anni, miliardi. 356 00:18:54:00 --> 00:18:57:45 Martha Gilmore Geoscienziata planetaria Wesleyan University
324 00:18:54:28 --> 00:18:59:20 And, on Earth, life evolved incredibly quickly, actually,	324 00:18:54:28 --> 00:18:59:20 E, sulla Terra, la vita si è evoluta incredibilmente rapidamente, in realtà,	357 00:18:54:28 --> 00:18:59:20 E, sulla Terra, la vita si è evoluta incredibilmente rapidamente, in realtà,
325 00:18:59:23 --> 00:19:03:28 considering the meteorites that were hitting the Earth.	325 00:18:59:23 --> 00:19:03:28 Considerando i meteoriti che stavano colpendo la Terra.	358 00:18:59:23 --> 00:19:03:28 considerando i meteoriti che stavano colpendo la Terra.
326 00:19:04:00 --> 00:19:05:14 So why not Venus?	326 00:19:04:00 --> 00:19:05:14 Allora perché non Venere?	359 00:19:04:00 --> 00:19:05:14 Allora perché non Venere?
327 00:19:05:23 --> 00:19:08:00 And if the answer is, “It didn’t happen on Venus,”	327 00:19:05:23 --> 00:19:08:00 E se la risposta e’: “ Non e’ successo su Venere,”	360 00:19:05:23 --> 00:19:08:00 E se la risposta è: “Non è successo su Venere,”
328 00:19:08:02 --> 00:19:09:20 that tells us something, too.	328 00:19:08:02 --> 00:19:09:20 anche questo ci dice qualcosa.	361 00:19:08:02 --> 00:19:09:20 anche questo ci dice qualcosa.
329 00:19:12:04 --> 00:19:13:16 (eruptions rumbling)	329 00:19:12:04 --> 00:19:13:16 (eruzioni, rombo)	362 00:19:12:04 --> 00:19:13:16 (eruzioni)
330 00:19:13:18 --> 00:19:15:18 - [Narrator] As Venus lost its water,	330 00:19:13:18 --> 00:19:15:18 - [Narratore] mentre Venere ha perso la sua acqua,	363 00:19:13:18 --> 00:19:15:18 - *Man mano che Venere perdeva la sua acqua,*

331 00:19:16:06 --> 00:19:17:22 its atmosphere gave way 332 00:19:17:24 -> 00:19:20:20 to the noxious outpourings of volcanoes, 333 00:19:21:17 -> 00:19:23:27 the primary source of carbon dioxide. 334 00:19:24:03 --> 00:19:27:06 (soft music) 335 00:19:27:08 --> 00:19:30:19 But Venus lost its ability to recapture that carbon, 336 00:19:31:28 --> 00:19:34:18 trapping itself in a terrifying loop. 337 00:19:36:22 --> 00:19:38:08 - Ultimately, the oceans boiled off 338 00:19:38:10 --> 00:19:40:20 partly because of the greenhouse property 339 00:19:40:22 --> 00:19:42:13 of water vapor itself, 340 00:19:42:14 --> 00:19:44:00 leading to this positive feedback	331 00:19:16:06 --> 00:19:17:22 la sua atmosfera ha ceduto 332 00:19:17:24 --> 00:19:20:20 alle fuoriuscite nocive di vulcani, 333 00:19:21:17 --> 00:19:23:27 la fonte primaria di anidride carbonica. 334 00:19:24:03 --> 00:19:27:06 (musica soft) 335 00:19:27:08 --> 00:19:30:19 Ma Venere ha perso la sua capacità di recuperare quel carbonio, 336 00:19:31:28 --> 00:19:34:18 intrappolarsi in un ciclo terrificante. 337 00:19:36:22 --> 00:19:38:08 - Alla fine, gli oceani si sono ribolliti 338 00:19:38:10 --> 00:19:40:20 in parte a causa della proprietà della serra 339 00:19:40:22 --> 00:19:42:13 del vapore acqueo stesso, 340 00:19:42:14 --> 00:19:44:00 che porta a questo feedback positivo	364 00:19:16:06 --> 00:19:17:22 *la sua atmosfera lasciava il posto* 365 00:19:17:24 --> 00:19:20:20 *alle emissioni nocive dei vulcani,* 366 00:19:21:17 --> 00:19:23:27 *fonte primaria di anidride carbonica.* 367 00:19:24:03 --> 00:19:27:06 (musica soft) 368 00:19:27:08 --> 00:19:30:19 *Ma Venere ha perso la sua capacità* *di recuperare quel carbonio,* 369 00:19:31:28 --> 00:19:34:18 *entrando in un terribile circolo vizioso.* 370 00:19:36:22 --> 00:19:38:08 - Alla fine, gli oceani sono evaporati 371 00:19:38:10 --> 00:19:40:20 in parte a causa della proprietà dell'effetto serra 372 00:19:40:22 --> 00:19:42:13 del vapore acqueo stesso, 373 00:19:42:14 --> 00:19:44:00 che porta a questo feedback positivo

341 00:19:44:02 --> 00:19:46:16 where the more water that evaporates,	341 00:19:44:02 --> 00:19:46:16 dove più acqua evapora,	374 00:19:44:02 --> 00:19:46:16 per cui più acqua evapora,
342 00:19:46:18 --> 00:19:47:20 the more the planet heats up	342 00:19:46:18 --> 00:19:47:20 più il pianeta si riscalda	375 00:19:46:18 --> 00:19:47:20 più il pianeta si riscalda
343 00:19:47:21 --> 00:19:50:00 because of the greenhouse effect of the water vapor.	343 00:19:47:21 --> 00:19:50:00 a causa dell' effetto serra del vapore acqueo.	376 00:19:47:21 --> 00:19:50:00 a causa dell'effetto serra del vapore acqueo.
344 00:19:50:07 --> 00:19:52:06 And then, once the oceans boil off	344 00:19:50:07 --> 00:19:52:06 E poi, una volta che gli oceani si sono calmati	377 00:19:50:07 --> 00:19:52:06 E poi, una volta che gli oceani evaporano
345 00:19:52:07 --> 00:19:53:28 and Venus loses its oceans,	345 00:19:52:07 --> 00:19:53:28 E Venere perde i suoi oceani,	378 00:19:52:07 --> 00:19:53:28 e Venere perde i suoi oceani,
346 00:19:54:07 --> 00:19:56:24 then that destroys the carbon cycle	346 00:19:54:07 --> 00:19:56:24 allora questo distrugge il ciclo del carbonio	379 00:19:54:07 --> 00:19:56:24 questo distrugge il ciclo del carbonio
347 00:19:57:05 --> 00:20:01:26 because you still have CO2 coming out of volcanoes on Venus,	347 00:19:57:05 --> 00:20:01:26 Perché hai ancora CO2 che esce dai vulcani su Venere,	380 00:19:57:05 --> 00:20:01:26 perché c'è ancora CO2 che esce dai vulcani su Venere,
348 00:20:01:28 --> 00:20:04:00 but there's no way to remove that CO2.	348 00:20:01:28 --> 00:20:04:00 Ma non c'e' modo di rimuovere la CO2.	381 00:20:01:28 --> 00:20:04:00 ma non c'è modo di rimuovere quella CO2.
349 00:20:04:03 --> 00:20:07:08 The sink disappeared when the water disappeared	349 00:20:04:03 --> 00:20:07:08 Il lavandino scomparve quando l'acqua scomparve	382 00:20:04:03 --> 00:20:07:08 Il bacino scomparve quando l'acqua scomparve
350 00:20:07:18 --> 00:20:11:09 and then the thermostat sorta gets pegged in the red zone	350 00:20:07:18 --> 00:20:11:09 e poi il termostato si aggancia nella zona rossa	383 00:20:07:18 --> 00:20:11:09 e poi il termostato si è bloccato nella zona rossa

351 00:20:11:10 --> 00:20:13:06 because you're just adding more and more CO2	351 00:20:11:10 --> 00:20:13:06 Perché stai aggiungendo sempre più CO2	384 00:20:11:10 --> 00:20:13:06 perché viene aggiunta sempre più CO2
352 00:20:13:07 --> 00:20:14:24 to the atmosphere from volcanoes.	352 00:20:13:07 --> 00:20:14:24 all'atmosfera dai vulcani.	385 00:20:13:07 --> 00:20:14:24 all'atmosfera dai vulcani.
353 00:20:15:00 --> 00:20:16:22 And it can't lose it anymore	353 00:20:15:00 --> 00:20:16:22 E non può più perderla	386 00:20:15:00 --> 00:20:16:22 E non può più perderla
354 00:20:16:23 --> 00:20:18:20 without that mediating effect of water,	354 00:20:16:23 --> 00:20:18:20 senza l'effetto mediatore dell'acqua,	387 00:20:16:23 --> 00:20:18:20 senza l'effetto mediatore dell'acqua,
355 00:20:18:22 --> 00:20:21:16 and it ends up in that runaway greenhouse state.	355 00:20:18:22 --> 00:20:21:16 e finisce in quello stato di serra in fuga.	388 00:20:18:22 --> 00:20:21:16 e si ritrova in quello stato di rapido effetto serra
356 00:20:21:19 --> 00:20:24:27 (eruptions rumbling)	356 00:20:21:19 --> 00:20:24:27 (eruzioni, rombo)	389 00:20:21:19 --> 00:20:24:27 (eruzioni che ribollono)
357 00:20:24:29 --> 00:20:28:08 (dramatic music)	357 00:20:24:29 --> 00:20:28:08 (musica drammatica)	390 00:20:24:29 --> 00:20:28:08 (musica drammatica)
358 00:20:28:09 --> 00:20:31:19 - [Narrator] Why did volcanic CO2 runaway on Venus	358 00:20:28:09 --> 00:20:31:19 - [Narrator] perché la CO2 vulcanica è scappata su Venere	391 00:20:28:09 --> 00:20:31:19 *- Perché la CO2 vulcanica* *è fuoriuscita su Venere*
359 00:20:33:18 --> 00:20:35:28 while Earth kept it at trace levels?	359 00:20:33:18 --> 00:20:35:28 Mentre la Terra l'ha tenuta a livelli di traccia?	392 00:20:33:18 --> 00:20:35:28 *mentre la Terra l'ha mantenuta a livelli minimi?*
360 00:20:39:08 --> 00:20:41:10 One reason is a basic difference	360 00:20:39:08 --> 00:20:41:10 Una delle ragioni è una differenza fondamentale	393 00:20:39:08 --> 00:20:41:10 *Una delle ragioni è una differenza fondamentale*

361 00:20:41:12 --> 00:20:43:15 in the geology of the two planets.	361 00:20:41:12 --> 00:20:43:15 nella geologia dei due pianeti.	394 00:20:41:12 --> 00:20:43:15 *nella geologia dei due pianeti.*
362 00:20:44:15 --> 00:20:48:23 Earth, like Venus, harbors a core of molten iron.	362 00:20:44:15 --> 00:20:48:23 La Terra, come Venere, ospita un nucleo di ferro fuso.	395 00:20:44:15 --> 00:20:48:23 *La Terra, come Venere,* *ospita un nucleo di ferro fuso.*
363 00:20:50:04 --> 00:20:54:06 Over time, the radioactive decay of uranium thorium,	363 00:20:50:04 --> 00:20:54:06 Nel corso del tempo, il decadimento radioattivo del torio di uranio,	396 00:20:50:04 --> 00:20:54:06 *Nel corso del tempo, il decadimento radioattivo* *di uranio, torio*
364 00:20:54:08 --> 00:20:56:18 and potassium generates heat.	364 00:20:54:08 --> 00:20:56:18 e il potassio genera calore.	397 00:20:54:08 --> 00:20:56:18 *e potassio genera calore.*
365 00:20:59:19 --> 00:21:01:28 Hot liquid rock punches through	365 00:20:59:19 --> 00:21:01:28 La roccia liquida calda viene perforata	398 00:20:59:19 --> 00:21:01:28 *La roccia liquida calda penetra*
366 00:21:02:00 --> 00:21:05:12 where Earth’s crust is thinnest, in the middle of oceans,	366 00:21:02:00 --> 00:21:05:12 Dove la crosta terrestre è più sottile, in mezzo agli oceani,	399 00:21:02:00 --> 00:21:05:12 *dove la crosta terrestre è più sottile,* *in mezzo agli oceani,*
367 00:21:06:00 --> 00:21:08:05 and floods the seafloor with lava.	367 00:21:06:00 --> 00:21:08:05 e inonda il fondale marino di lava.	400 00:21:06:00 --> 00:21:08:05 *e inonda il fondale marino di lava.*
368 00:21:10:00 --> 00:21:12:14 In a process called plate tectonics	368 00:21:10:00 --> 00:21:12:14 In un processo chiamato tettonica a placca,	401 00:21:10:00 --> 00:21:12:14 *Nel processo della “tettonica a placche”,* 402 00:21:11:50 --> 00:21:15:29 “Tettonica delle placche”
369 00:21:13:12 --> 00:21:15:27 growing undersea mountains push aside	369 00:21:13:12 --> 00:21:15:27 crescendo le montagne sottomarine si mettono da parte	403 00:21:13:12 --> 00:21:15:27 *si creano dei rilievi sottomarini che spingono via*

370 00:21:16:00 --> 00:21:19:10 raft-like sections of the crust, the plates.	370 00:21:16:00 --> 00:21:19:10 sezioni della crosta simili a zattera, i piatti.	404 00:21:16:00 --> 00:21:19:10 *porzioni di crosta simili a zattere:* *le placche.*
371 00:21:19:15 --> 00:21:22:12 (plates rumbling)	371 00:21:19:15 --> 00:21:22:12 (piastre che urlano)	405 00:21:19:15 --> 00:21:22:12 (rumore delle placche)
372 00:21:22:13 --> 00:21:25:05 When they collide with thicker continental crust,	372 00:21:22:13 --> 00:21:25:05 Quando si scontrano con la crosta continentale più spessa,	406 00:21:22:13 --> 00:21:25:05 *Quando si scontrano* *con croste continentali più spesse,*
373 00:21:25:20 --> 00:21:27:19 they can dive beneath them.	373 00:21:25:20 --> 00:21:27:19 possono immergersi sotto di loro.	407 00:21:25:20 --> 00:21:27:19 *possono scivolare al di sotto.*
374 00:21:29:25 --> 00:21:34:14 As they do, grinding friction causes rocks to melt,	374 00:21:29:25 --> 00:21:34:14 Come fanno, l’attrito di molatura causa la fusione delle rocce,	408 00:21:29:25 --> 00:21:34:14 *Questo forte attrito* *provoca la fusione delle rocce,*
375 00:21:34:27 --> 00:21:40:03 hasten by oceanic water, forming reservoirs of magma.	375 00:21:34:27 --> 00:21:40:03 affrettati con l’acqua oceanica, formando bacini di magma.	409 00:21:34:27 --> 00:21:40:03 *che, accelerata dall’acqua oceanica,* *forma serbatoi di magma.*
376 00:21:42:18 --> 00:21:44:14 The pressure increases,	376 00:21:42:18 --> 00:21:44:14 La pressione aumenta,	410 00:21:42:18 --> 00:21:44:14 *La pressione aumenta,*
377 00:21:44:28 --> 00:21:48:00 until finally, a volcano erupts.	377 00:21:44:28 --> 00:21:48:00 fino alla fine, un vulcano erutta.	411 00:21:44:28 --> 00:21:48:00 *finché, alla fine, un vulcano erutta.*
378 00:21:48:02 --> 00:21:53:05 (intense music) (eruption booming)	378 00:21:48:02 --> 00:21:53:05 (musica intensa) (eruzione esplosiva)	412 00:21:48:02 --> 00:21:53:05 (musica intensa) (scoppio dell’eruzione)

379 00:21:53:07 --> 00:21:54:23 Plate tectonics generates	379 00:21:53:07 --> 00:21:54:23 La tettonica delle piastre genera	413 00:21:53:07 --> 00:21:54:23 *La tettonica a placche genera*
380 00:21:54:25 --> 00:21:57:18 up to 80 volcanic eruptions each year.	380 00:21:54:25 --> 00:21:57:18 fino a 80 eruzioni vulcaniche ogni anno.	414 00:21:54:25 --> 00:21:57:18 *fino a 80 eruzioni vulcaniche all'anno.*
381 00:21:59:09 --> 00:22:02:14 Sometimes, this process can release energy	381 00:21:59:09 --> 00:22:02:14 A volte, questo processo può rilasciare energia	415 00:21:59:09 --> 00:22:02:14 *A volte, questo processo può rilasciare energia*
382 00:22:02:15 --> 00:22:04:13 on such a large scale	382 00:22:02:15 --> 00:22:04:13 su così vasta scala	416 00:22:02:15 --> 00:22:04:13 *su scala così vasta*
383 00:22:04:19 --> 00:22:07:18 that it changes the course of Earth's history.	383 00:22:04:19 --> 00:22:07:18 Che cambia il corso della storia della Terra.	417 00:22:04:19 --> 00:22:07:18 *da cambiare il corso della storia della Terra.*
384 00:22:07:21 --> 00:22:13:00 (lava sizzling)	384 00:22:07:21 --> 00:22:13:00 (lava sfrigolante)	418 00:22:07:21 --> 00:22:13:00 (lava che bolle)
385 00:22:15:07 --> 00:22:18:15 Today, Yellowstone National Park in North America	385 00:22:15:07 --> 00:22:18:15 Oggi, il parco nazionale di Yellowstone in Nord America	419 00:22:15:07 --> 00:22:18:15 *Oggi, il parco nazionale di Yellowstone,* *in Nord America*
386 00:22:19:03 --> 00:22:22:17 is an open laboratory of Earth's remarkable geology.	386 00:22:19:03 --> 00:22:22:17 È un laboratorio aperto della straordinaria geologia della Terra.	420 00:22:19:03 --> 00:22:22:17 *è un laboratorio a cielo aperto* *della straordinaria geologia della Terra.*
387 00:22:22:18 --> 00:22:26:20 (geyser rumbling)	387 00:22:22:18 --> 00:22:26:20 (rombo del geyser)	421 00:22:22:18 --> 00:22:26:20 (rombo del geyser)
388 00:22:26:22 --> 00:22:30:16 The rich mix of organic chemicals and geothermal energy	388 00:22:26:22 --> 00:22:30:16 Il ricco mix di prodotti chimici organici ed energia geotermica	422 00:22:26:22 --> 00:22:30:16 *Il ricco mix di sostanze chimiche organiche ed* *energia geotermica*

389 00:22:30:19 --> 00:22:33:13 in places like this may have given rise	389 00:22:30:19 --> 00:22:33:13 in posti come questo potrebbero aver dato origine	423 00:22:30:19 --> 00:22:33:13 *in posti come questo potrebbe aver dato origine*
390 00:22:33:14 --> 00:22:36:14 to living organisms billions of years ago.	390 00:22:33:14 --> 00:22:36:14 agli organismi viventi miliardi di anni fa.	424 00:22:33:14 --> 00:22:36:14 *a organismi viventi miliardi di anni fa.*
391 00:22:38:27 --> 00:22:42:00 The hot springs and geysers we come here to admire	391 00:22:38:27 --> 00:22:42:00 Le sorgenti termali e i geyser che veniamo qui per ammirare	425 00:22:38:27 --> 00:22:42:00 *Le sorgenti termali e i geyser* *che veniamo ad ammirare qui*
392 00:22:42:06 --> 00:22:44:16 are fueled by a dome of magma	392 00:22:42:06 --> 00:22:44:16 sono alimentati da una cupola di magma	426 00:22:42:06 --> 00:22:44:16 *sono alimentati da una cupola di magma*
393 00:22:44:25 --> 00:22:47:10 that is building deep below ground.	393 00:22:44:25 --> 00:22:47:10 si sta costruendo in profondità.	427 00:22:44:25 --> 00:22:47:10 *che si sta formando in profondità.*
394 00:22:47:16 --> 00:22:51:20 (soft dramatic music)	394 00:22:47:16 --> 00:22:51:20 (musica soft e drammatica)	428 00:22:47:16 --> 00:22:51:20 (musica soft e drammatica)
395 00:22:51:23 --> 00:22:55:12 At intervals of roughly every 600,000 years,	395 00:22:51:23 --> 00:22:55:12 A intervalli di circa ogni 600.000 anni,	429 00:22:51:23 --> 00:22:55:12 *A intervalli di circa ogni 600.000 anni,*
396 00:22:55:18 --> 00:22:59:17 this dome pushes the land up into a broad plateau.	396 00:22:55:18 --> 00:22:59:17 questa cupola spinge la terra in un ampio altopiano.	430 00:22:55:18 --> 00:22:59:17 *questa cupola spinge la terra verso l'alto* *in un esteso altopiano.*
397 00:23:01:04 --> 00:23:04:12 Inevitably, hot gas and lave explode	397 00:23:01:04 --> 00:23:04:12 Inevitabilmente, il gas caldo e la lastra esplodono	431 00:23:01:04 --> 00:23:04:12 *Inevitabilmente, il gas caldo e la lava esplodono*
398 00:23:04:15 --> 00:23:06:08 through the cracks in the land.	398 00:23:04:15 --> 00:23:06:08 attraverso le crepe nel terreno.	432 00:23:04:15 --> 00:23:06:08 *attraverso le crepe nel terreno.*

399 00:23:07:14 --> 00:23:10:12 The plateau suddenly and violently collapses, 400 00:23:10:13 --> 00:23:12:19 triggering eruptions so large, 401 00:23:12:21 --> 00:23:15:03 they'd blanket the continent with ash. 402 00:23:15:04 --> 00:23:21:00 (eruptions booming) (intense music) 403 00:23:23:14 --> 00:23:26:18 - Plate tectonics is really what makes Earth tick. 404 00:23:27:05 --> 00:23:31:08 Plate tectonics is the sort of overall organizing principle, 405 00:23:31:10 --> 00:23:32:13 almost, of Earth's behavior. 406 00:23:32:15 --> 00:23:34:12 Not just the obvious continental drift 407 00:23:34:14 --> 00:23:35:24 and the movement of the continents,	399 00:23:07:14 --> 00:23:10:12 L'altopiano crolla improvvisamente e violentemente, 400 00:23:10:13 --> 00:23:12:19 innescando eruzioni così grandi, 401 00:23:12:21 --> 00:23:15:03 avrebbero coperto il continente di cenere. 402 00:23:15:04 --> 00:23:21:00 (eruzioni in forte espansione) (musica intensa) 403 00:23:23:14 --> 00:23:26:18 - La tettonica a placca e' davvero cio' che fa tacere la Terra. 404 00:23:27:05 --> 00:23:31:08 La tettonica a placca è il tipo di principio organizzativo generale, 405 00:23:31:10 --> 00:23:32:13 Quasi, del comportamento della Terra. 406 00:23:32:15 --> 00:23:34:12 Non solo l'evidente deriva continentale 407 00:23:34:14 --> 00:23:35:24 e il movimento dei continenti,	433 00:23:07:14 --> 00:23:10:12 *L'altopiano crolla improvvisamente* *e violentemente,* 434 00:23:10:13 --> 00:23:12:19 *scatenando eruzioni così grandi* 435 00:23:12:21 --> 00:23:15:03 *da ricoprire il continente di cenere.* 436 00:23:15:04 --> 00:23:21:00 (eruzioni in forte espansione) (musica intensa) 437 00:23:23:14 --> 00:23:26:18 - La tettonica delle placche è davvero ciò che fa muovere la Terra. 438 00:23:27:05 --> 00:23:31:08 La tettonica delle placche è il tipo di principio organizzativo generale, 439 00:23:31:10 --> 00:23:32:13 più o meno, del comportamento della Terra. 440 00:23:32:15 --> 00:23:34:12 Non solo l'evidente deriva continentale 441 00:23:34:14 --> 00:23:35:24 e il movimento dei continenti,

408 00:23:35:26 --> 00:23:38:04 but even the carbon cycle and the climate cycle	408 00:23:35:26 --> 00:23:38:04 ma anche il ciclo del carbonio e il ciclo climatico	442 00:23:35:26 --> 00:23:38:04 ma anche il ciclo del carbonio e il ciclo del clima
409 00:23:38:05 --> 00:23:39:25 and all of these other aspects of Earth	409 00:23:38:05 --> 00:23:39:25 E tutti questi altri aspetti della Terra	443 00:23:38:05 --> 00:23:39:25 e tutti questi altri aspetti della Terra
410 00:23:39:26 --> 00:23:41:25 that have to do with the way things cycle	410 00:23:39:26 --> 00:23:41:25 questo ha a che fare con il modo in cui le cose vanno	444 00:23:39:26 --> 00:23:41:25 che hanno a che fare con il modo in cui le cose si muovono
411 00:23:41:26 --> 00:23:44:05 between the interior and the surface	411 00:23:41:26 --> 00:23:44:05 tra l'interno e la superficie	445 00:23:41:26 --> 00:23:44:05 tra l'interno e la superficie
412 00:23:44:09 --> 00:23:45:12 come down to plate tectonics.	412 00:23:44:09 --> 00:23:45:12 scendete alla tettonica delle placche.	446 00:23:44:09 --> 00:23:45:12 sono riconducibili alla tettonica delle placche.
413 00:23:45:14 --> 00:23:47:23 And Venus doesn't have plate tectonics.	413 00:23:45:14 --> 00:23:47:23 E Venere non ha la tettonica a placca.	447 00:23:45:14 --> 00:23:47:23 E Venere non ha la tettonica delle placche.
414 00:23:47:26 --> 00:23:50:13 (slow music)	414 00:23:47:26 --> 00:23:50:13 (musica lenta)	448 00:23:47:26 --> 00:23:50:13 (musica lenta)
415 00:23:50:16 --> 00:23:51:17 - [Narrator] You can see why	415 00:23:50:16 --> 00:23:51:17 - Potete vedere il perché	449 00:23:50:16 --> 00:23:51:17 - *Si può capire il perché*
416 00:23:51:19 --> 00:23:54:12 by cutting into the crust of these sister planets.	416 00:23:51:19 --> 00:23:54:12 tagliando la crosta di questi pianeti gemelli.	450 00:23:51:19 --> 00:23:54:12 *tagliando la crosta* *di questi pianeti gemelli.*
417 00:23:56:06 --> 00:23:58:11 Earth has only about eight kilometers	417 00:23:56:06 --> 00:23:58:11 La Terra ha solo otto chilometri	451 00:23:56:06 --> 00:23:58:11 *La Terra ha solo circa otto chilometri*

418 00:23:58:13 --> 00:24:00:10 of hard crust under the oceans	418 00:23:58:13 --> 00:24:00:10 di crosta dura sotto gli oceani	452 00:23:58:13 --> 00:24:00:10 *di crosta dura sotto gli oceani*
419 00:24:00:12 --> 00:24:03:08 and no more than 30 kilometers under land.	419 00:24:00:12 --> 00:24:03:08 e non più di 30 chilometri di terra.	453 00:24:00:12 --> 00:24:03:08 *e non più di 30 chilometri sotto terra.*
420 00:24:04:05 --> 00:24:07:10 But the skin of Venus is about twice as thick,	420 00:24:04:05 --> 00:24:07:10 Ma la pelle di Venere è circa il doppio dello spessore,	454 00:24:04:05 --> 00:24:07:10 *Ma la superficie di Venere* *è circa il doppio dello spessore,*
421 00:24:07:15 --> 00:24:11:29 acting as a rigid lid, locking the surface in place.	421 00:24:07:15 --> 00:24:11:29 funge da coperchio rigido, bloccando la superficie in posizione.	455 00:24:07:15 --> 00:24:11:29 *fungendo da coperchio rigido,* *bloccando la superficie al proprio posto.*
422 00:24:13:20 --> 00:24:15:05 - If Earth did not have volatile cycling	422 00:24:13:20 --> 00:24:15:05 - Se la Terra non avesse un ciclo volatile	456 00:24:13:20 --> 00:24:15:05 - Se la Terra non avesse avuto un ciclo instabile 457 00:24:16:20 --> 00:24:20:20 Mike Way Scienziato planetario Goddard Institute for Space Studies
423 00:24:15:08 --> 00:24:16:25 throughout most of its history,	423 00:24:15:08 --> 00:24:16:25 nella maggior parte della sua storia,	458 00:24:15:08 --> 00:24:16:25 per la maggior parte della sua storia,
424 00:24:16:27 --> 00:24:19:01 and we had a stagnant plate mode,	424 00:24:16:27 --> 00:24:19:01 e avevamo un piatto stagnante,	459 00:24:16:27 --> 00:24:19:01 e avessimo avuto una modalità di placca stabile,
425 00:24:19:04 --> 00:24:21:09 like we have on Venus today,	425 00:24:19:04 --> 00:24:21:09 Come abbiamo su Venere oggi,	460 00:24:19:04 --> 00:24:21:09 come quella che si trova su Venere oggi,

426 00:24:21:10 --> 00:24:23:14 then all of the nitrogen and all the carbon dioxide	426 00:24:21:10 --> 00:24:23:14 poi tutto l'azoto e tutto il biossido di carbonio	461 00:24:21:10 --> 00:24:23:14 allora tutto l'azoto e tutta l'anidride carbonica
427 00:24:23:16 --> 00:24:24:28 that we see in Venus's atmosphere	427 00:24:23:16 --> 00:24:24:28 Che vediamo nell'atmosfera di Venere	462 00:24:23:16 --> 00:24:24:28 che si vedono nell'atmosfera di Venere
428 00:24:25:00 --> 00:24:27:02 would be in our atmosphere in the same way.	428 00:24:25:00 --> 00:24:27:02 sarebbe nella nostra atmosfera allo stesso modo.	463 00:24:25:00 --> 00:24:27:02 sarebbero nella nostra atmosfera allo stesso modo.
429 00:24:27:04 --> 00:24:30:03 (soft dramatic music)	429 00:24:27:04 --> 00:24:30:03 (musica soft e drammatica)	464 00:24:27:04 --> 00:24:30:03 (musica soft e drammatica)
430 00:24:30:07 --> 00:24:31:21 - [Narrator] The dense shell of Venus	430 00:24:30:07 --> 00:24:31:21 - [Narrator] la densa conchiglia di Venere	465 00:24:30:07 --> 00:24:31:21 *- Il denso guscio di Venere*
431 00:24:31:24 --> 00:24:34:17 may never have separated into continental plates,	431 00:24:31:24 --> 00:24:34:17 potrebbe non essersi mai separato in piatti continentali,	466 00:24:31:24 --> 00:24:34:17 *potrebbe non essersi mai separato* *in placche continentali,*
432 00:24:35:15 --> 00:24:37:20 but the heat must still find a way out.	432 00:24:35:15 --> 00:24:37:20 ma il caldo deve ancora trovare una via d'uscita.	467 00:24:35:15 --> 00:24:37:20 *ma il calore deve comunque trovare una via d'uscita.*
433 00:24:37:27 --> 00:24:43:27 (foreboding music)	433 00:24:37:27 --> 00:24:43:27 (musica anticipata)	468 00:24:37:27 --> 00:24:43:27 (musica intimidatoria)
434 00:25:09:25 --> 00:25:13:13 - Venus is a really volcanic planet.	434 00:25:09:25 --> 00:25:13:13 - Venere è un pianeta vulcanico.	469 00:25:09:25 --> 00:25:13:13 - Venere è un pianeta molto vulcanico.
435 00:25:14:07 --> 00:25:17:04 Most of the surface of Venus is actually covered	435 00:25:14:07 --> 00:25:17:04 La maggior parte della superficie di Venere è effettivamente coperta	470 00:25:14:07 --> 00:25:17:04 La maggior parte della superficie di Venere è infatti coperta

436
00:25:17:06 --> 00:25:21:26
by volcanoes and several
different types of volcanoes.

437
00:25:23:27 --> 00:25:26:27
- From the smallest
things that we can measure

438
00:25:26:28 --> 00:25:28:06
in the radar data,

439
00:25:28:11 --> 00:25:31:02
which is about a hundred meters per pixel,

440
00:25:31:05 --> 00:25:34:10
to huge lava flows,

441
00:25:34:12 --> 00:25:39:00
just lava flows that stretch
for thousands of kilometers.

442
00:25:39:02 --> 00:25:45:02
(slow music)

436
00:25:17:06 --> 00:25:21:26
da vulcani e diversi
tipi di vulcani.

437
00:25:23:27 --> 00:25:26:27
- Dalle
cose più piccole che possiamo misurare

438
00:25:26:28 --> 00:25:28:06
nei dati radar,

439
00:25:28:11 --> 00:25:31:02
che è circa cento metri per pixel,

440
00:25:31:05 --> 00:25:34:10
a enormi flussi di lava,

441
00:25:34:12 --> 00:25:39:00
solo flussi di lava che si estendono
per migliaia di chilometri.

442
00:25:39:02 --> 00:25:45:02
(musica lenta)

471
00:25:17:06 --> 00:25:21:26
da vulcani e da diversi tipi di vulcani.

472
00:25:23:27 --> 00:25:26:27
- Dalle cose più piccole
che possiamo misurare

473
00:25:25:75 --> 00:25:31:00
Piccoli coni
Caratteristica più comune di Venere

474
00:25:26:28 --> 00:25:28:06
nei dati radar,

475
00:25:28:11 --> 00:25:31:02
che sarebbero circa un centinaio di metri per pixel,

476
00:25:31:05 --> 00:25:34:10
alle enormi colate di lava,

477
00:25:34:12 --> 00:25:39:00
solo colate di lava
che si estendono per migliaia di chilometri.

478
00:25:39:63 --> 00:25:44:80
Colate di lava
Regione della Lada Terra

479
00:25:39:02 --> 00:25:45:02
(musica lenta)

443 00:25:46:20 --> 00:25:51:11 (mystical music)	443 00:25:46:20 --> 00:25:51:11 (musica mistica)	480 00:25:46:20 --> 00:25:51:11 (musica mistica)
444 00:25:51:21 --> 00:25:52:29 - [Narrator] The Magellan Mission	444 00:25:51:21 --> 00:25:52:29 - La missione di Magellano	481 00:25:51:21 --> 00:25:52:29 *- La missione Magellano*
445 00:25:53:01 --> 00:25:55:19 documented a zoo of volcano types.	445 00:25:53:01 --> 00:25:55:19 documentato uno zoo di tipi vulcanici.	482 00:25:53:01 --> 00:25:55:19 *ha documentato uno zoo di tipi di vulcani.*
		483 00:25:58:55 --> 00:26:01:00 Ushas Mons 415km di lunghezza
		484 00:25:59:50 --> 00:26:02:00 “Vulcano a scudo”
446 00:26:00:07 --> 00:26:02:10 - Venus has some shield volcanoes.	446 00:26:00:07 --> 00:26:02:10 - Venere ha dei vulcani a scudo.	485 00:26:00:07 --> 00:26:02:10 - Venere ha dei vulcani a scudo.
447 00:26:02:26 --> 00:26:05:05 Shield volcanoes have low slopes,	447 00:26:02:26 --> 00:26:05:05 I vulcani a scudo hanno pendenze basse,	486 00:26:02:26 --> 00:26:05:05 I vulcani a scudo hanno basse pendenze,
448 00:26:05:07 --> 00:26:09:29 and they look like warrior shields laid on the ground.	448 00:26:05:07 --> 00:26:09:29 e sembrano scudi guerrieri posti a terra.	487 00:26:05:07 --> 00:26:09:29 e assomigliano a scudi di guerrieri posati a terra.
449 00:26:10:00 --> 00:26:11:18 That’s where the name came from.	449 00:26:10:00 --> 00:26:11:18 E’ da qui che viene il nome.	488 00:26:10:00 --> 00:26:11:18 Ecco da dove viene il nome.
		489 00:26:11:25 --> 00:26:13:70 Sapas Mons 400km di lunghezza

450 00:26:11:20 --> 00:26:13:24 In fact, it came from Iceland. 451 00:26:15:07 --> 00:26:20:07 Venus also has several other types of volcanoes 452 00:26:20:08 --> 00:26:24:06 that we don't see in other places in the solar system. 453 00:26:24:20 --> 00:26:27:22 For example, one very unusual type 454 00:26:27:24 --> 00:26:31:13 are some domes that we call pancake domes, 455 00:26:31:21 --> 00:26:35:03 and that's because they really look like pancakes. 456 00:26:35:04 --> 00:26:36:25 They are flat on top. 457 00:26:36:26 --> 00:26:39:02 They have steep sides.	450 00:26:11:20 --> 00:26:13:24 In effetti, veniva dall'Islanda. 451 00:26:15:07 --> 00:26:20:07 Venere ha anche diversi altri tipi di vulcani 452 00:26:20:08 --> 00:26:24:06 che non vediamo in altri posti del sistema solare. 453 00:26:24:20 --> 00:26:27:22 Ad esempio, un tipo molto insolito 454 00:26:27:24 --> 00:26:31:13 sono alcune cupole che chiamiamo cupole per pancake, 455 00:26:31:21 --> 00:26:35:03 e questo perché sembrano davvero dei pancake. 456 00:26:35:04 --> 00:26:36:25 Sono piatte sulla parte superiore. 457 00:26:36:26 --> 00:26:39:02 Hanno lati ripidi.	490 00:26:11:20 --> 00:26:13:24 In effetti, veniva dall'Islanda. 491 00:26:15:07 --> 00:26:20:07 Venere ha anche diversi altri tipi di vulcani 492 00:26:20:08 --> 00:26:24:06 che non vediamo in altri posti del sistema solare. 493 00:26:24:20 --> 00:26:27:22 Ad esempio, un tipo molto insolito 494 00:26:27:24 --> 00:26:31:13 sono alcune cupole che chiamiamo "cupole a pancake", 495 00:26:27:85 --> 00:26:31:70 "Cupole a pancake" ~65km di diametro 496 00:26:31:21 --> 00:26:35:03 e questo perché sembrano davvero dei pancake. 497 00:26:35:04 --> 00:26:36:25 Sono piatte nella parte superiore. 498 00:26:36:26 --> 00:26:39:02 Hanno lati ripidi.

		499 00:26:38:40 --> 00:26:42:70 Cupole Regione Alfa ~25km di diametro
458 00:26:43:21 --> 00:26:48:05 Some of these domes have some fractured and jagged edges,	458 00:26:43:21 --> 00:26:48:05 Alcune di queste cupole hanno bordi fratturati e frastagliati,	500 00:26:43:21 --> 00:26:48:05 Alcune di queste cupole hanno bordi frammentati e frastagliati
459 00:26:48:23 --> 00:26:50:22 and they are known as ticks	459 00:26:48:23 --> 00:26:50:22 e sono note come zecche	501 00:26:48:23 --> 00:26:50:22 e sono note come “ticks” (zecca)
		502 00:26:49:25 --> 00:26:53:30 “Tick” ~30km di diametro
460 00:26:50:25 --> 00:26:54:08 because they look like squashed bugs.	460 00:26:50:25 --> 00:26:54:08 perché sembrano insetti schiacciati.	503 00:26:50:25 --> 00:26:54:08 perché sembrano insetti schiacciati.
461 00:26:55:20 --> 00:26:59:02 Arachnoids because they have a fracture pattern	461 00:26:55:20 --> 00:26:59:02 Arachnoidi perché hanno uno schema di frattura	504 00:26:55:20 --> 00:26:59:02 “Aracnoidi” perché hanno una rete di fratture
		505 00:26:55:70 --> 00:27:01:50 “Aracnoidi” ~50 – 225 km di diametro
462 00:26:59:04 --> 00:27:01:16 similar to a spider’s web,	462 00:26:59:04 --> 00:27:01:16 simile alla ragnatela,	506 00:26:59:04 --> 00:27:01:16 simile a una ragnatela,
463 00:27:01:18 --> 00:27:05:22 with some concentric fractures and some radial fractures.	463 00:27:01:18 --> 00:27:05:22 con alcune fratture concentriche e alcune fratture radiali.	507 00:27:01:18 --> 00:27:05:22 con alcune fratture concentriche e alcune fratture radiali.

464 00:27:10:15 --> 00:27:13:26 - [Narrator] The enormous volcanic features called coronae	464 00:27:10:15 --> 00:27:13:26 - [Narrator] le enormi caratteristiche vulcaniche chiamate coronae	508 00:27:10:15 --> 00:27:13:26 *- Le enormi strutture vulcaniche chiamate "coronae"* 509 00:27:12:50 --> 00:27:17:70 Ba'het e Onatah 510 00:27:12:50 --> 00:27:18:00 "Coronae" 240 km x 150 km
465 00:27:14:06 --> 00:27:16:21 hint that Venus may be subducting rocks	465 00:27:14:06 --> 00:27:16:21 Suggerisce che Venere potrebbe sottrarre rocce	511 00:27:14:06 --> 00:27:16:21 *suggeriscono che Venere potrebbe subdurre rocce*
466 00:27:16:22 --> 00:27:18:24 back into its interior, after all.	466 00:27:16:22 --> 00:27:18:24 torna nel suo interno, dopotutto.	512 00:27:16:22 --> 00:27:18:24 *al suo interno, dopotutto.*
467 00:27:20:12 --> 00:27:23:21 - [Rosaly] Corona on Venus are in a way similar	467 00:27:20:12 --> 00:27:23:21 - [Rosaly] Corona su Venere è in un modo simile	513 00:27:20:12 --> 00:27:23:21 - Le coronae su Venere sono, in un certo senso, simili
468 00:27:23:23 --> 00:27:25:02 to calderas on Earth,	468 00:27:23:23 --> 00:27:25:02 Alle calderie sulla Terra,	514 00:27:23:23 --> 00:27:25:02 alle caldere sulla Terra, 515 00:27:22:91 --> 00:27:26:87 Aruru Corona ~450 km di lunghezza
469 00:27:25:04 --> 00:27:28:04 where you have a pattern of concentric fractures.	469 00:27:25:04 --> 00:27:28:04 dove si ha una serie di fratture concentriche.	516 00:27:25:04 --> 00:27:28:04 dove si ha una serie di fratture concentriche.

470 00:27:28:19 --> 00:27:31:14 There is a collapse or successive collapses.	470 00:27:28:19 --> 00:27:31:14 C'è un collasso o collassi successivi.	517 00:27:28:19 --> 00:27:31:14 C'è un collasso o collassi consecutivi. 518 00:27:30:70 --> 00:27:33:30 Vencor Corona ~30 km di diametro
471 00:27:33:22 --> 00:27:35:16 - A plume of hot stuff comes up,	471 00:27:33:22 --> 00:27:35:16 - Viene fuori Un pennacchio di roba calda,	519 00:27:33:22 --> 00:27:35:16 - Un getto di materiale caldo sale,
472 00:27:35:22 --> 00:27:38:04 pushes up the surface, breaks the surface,	472 00:27:35:22 --> 00:27:38:04 spinge verso l'alto la superficie, rompe la superficie,	520 00:27:35:22 --> 00:27:38:04 spinge verso l'alto la superficie, rompe la superficie,
473 00:27:38:06 --> 00:27:40:11 and a bunch of vulcanism forms at the surface,	473 00:27:38:06 --> 00:27:40:11 e un mucchio di vulcanismo si forma in superficie,	521 00:27:38:06 --> 00:27:40:11 e un gruppo di attività vulcaniche si forma in superficie,
474 00:27:40:13 --> 00:27:42:16 much like what we see at Hawaii.	474 00:27:40:13 --> 00:27:42:16 Proprio come quello che vediamo alle Hawaii.	522 00:27:40:13 --> 00:27:42:16 proprio come quello che vediamo alle Hawaii. 523 00:27:41:90 --> 00:27:48:25 Hawai'i: "La grande isola" dalla Stazione Spaziale Internazionale
475 00:27:44:28 --> 00:27:47:05 - [Narrator] The two volcanoes that built the Big Island	475 00:27:44:28 --> 00:27:47:05 - I due vulcani che hanno costruito la Big Island	524 00:27:44:28 --> 00:27:47:05 *- I due vulcani* *che hanno costruito la grande isola*
476 00:27:47:07 --> 00:27:50:21 are, together, about 150 kilometers across.	476 00:27:47:07 --> 00:27:50:21 sono, insieme, circa 150 chilometri di distanza.	525 00:27:47:07 --> 00:27:50:21 *hanno, insieme,* *un diametro di circa 150 chilometri.*

477 00:27:52:20 --> 00:27:57:02 But a few of the coronae on Venus have grown much larger.	477 00:27:52:20 --> 00:27:57:02 Ma alcune coronae su Venere sono diventate molto più grandi.	526 00:27:52:20 --> 00:27: *Ma alcune coronae su Venere* *sono diventate molto più grandi.* 527 00:27:56:03 --> 00:28:03:00 Artemis Corona ~2600 km di lunghezza
478 00:27:58:10 --> 00:28:00:18 - [Sue] There are a couple of very big features.	478 00:27:58:10 --> 00:28:00:18 - Ci sono un paio di caratteristiche molto importanti.	528 00:27:58:10 --> 00:28:00:18 - Ci sono un paio di strutture molto grandi.
479 00:28:00:28 --> 00:28:04:01 One is 2,600 kilometers across.	479 00:28:00:28 --> 00:28:04:01 Uno è a 2.600 chilometri di distanza.	529 00:28:00:28 --> 00:28:04:01 Una è 2.600 chilometri di lunghezza. 530 00:28:06:70 --> 00:28:09:83 Fotla Corona ~150 km di lunghezza
480 00:28:06:23 --> 00:28:08:27 - On Venus, where we don’t see	480 00:28:06:23 --> 00:28:08:27 - Su Venere, dove non vediamo	531 00:28:06:23 --> 00:28:08:27 - Su Venere, dove non vediamo
481 00:28:08:29 --> 00:28:10:20 evidence of plate tectonics,	481 00:28:08:29 --> 00:28:10:20 evidenza di tettonica a placca,	532 00:28:08:29 --> 00:28:10:20 prove di tettonica delle placche,
482 00:28:10:24 --> 00:28:12:24 volcanoes are really the primary way	482 00:28:10:24 --> 00:28:12:24 i vulcani sono davvero la via principale	533 00:28:10:24 --> 00:28:12:24 i vulcani sono davvero il modo principale
483 00:28:12:26 --> 00:28:14:28 that we believe Venus is trying to lose its heat	483 00:28:12:26 --> 00:28:14:28 Che crediamo che Venere stia cercando di perdere il calore	534 00:28:12:26 --> 00:28:14:28 in cui crediamo che Venere stia cercando di perdere il suo calore

484 00:28:14:29 --> 00:28:16:10 or has lost its heat.	484 00:28:14:29 --> 00:28:16:10 o ha perso il calore.	535 00:28:14:29 --> 00:28:16:10 o abbia perso il suo calore.
485 00:28:16:12 --> 00:28:19:18 And so that record that we see of volcanism on the surface	485 00:28:16:12 --> 00:28:19:18 E così quel record che vediamo del vulcanismo sulla superficie	536 00:28:16:12 --> 00:28:19:18 E così quella documentazione che vediamo del vulcanismo in superficie 537 00:28:18:32 --> 00:28:22:03 Lori Glaze Direttrice, NASA Divisione di scienze planetarie
486 00:28:19:20 --> 00:28:23:14 is essentially telling us how Venus is trying to cool off,	486 00:28:19:20 --> 00:28:23:14 Ci sta essenzialmente dicendo come Venere sta cercando di raffreddarsi,	538 00:28:19:20 --> 00:28:23:14 ci sta essenzialmente dicendo come Venere sta cercando di raffreddarsi,
487 00:28:23:16 --> 00:28:25:12 how its interior is losing heat	487 00:28:23:16 --> 00:28:25:12 come il suo interno sta perdendo calore	539 00:28:23:16 --> 00:28:25:12 come il suo interno sta perdendo calore
488 00:28:25:14 --> 00:28:28:26 and moving that hot magma and hot lava onto the surface.	488 00:28:25:14 --> 00:28:28:26 e spostando quel magma caldo e la lava calda sulla superficie.	540 00:28:25:14 --> 00:28:28:26 e spostando quel magma caldo e la lava calda sulla superficie.
489 00:28:28:28 --> 00:28:30:25 (eruption rumbling) (sinister music)	489 00:28:28:28 --> 00:28:30:25 (eruzione brontola) (musica sinistra)	541 00:28:28:28 --> 00:28:30:25 (eruzione esplosiva) (musica sinistra)
490 00:28:30:27 --> 00:28:33:04 - [Tony] About 500 million years	490 00:28:30:27 --> 00:28:33:04 - [Tony] circa 500 milioni di anni	542 00:28:30:27 --> 00:28:33:04 - Circa 500 milioni di anni 543 00:28:32:00 --> 00:28:35:82 Voce di: **Tony Del Genio** - Goddard Institute for Space Studies

491 00:28:33:07 --> 00:28:35:20 to a billion years or so ago,	491 00:28:33:07 --> 00:28:35:20 a circa un miliardo di anni fa,	544 00:28:33:07 --> 00:28:35:20 a circa un miliardo di anni fa,
492 00:28:36:02 --> 00:28:38:10 something catastrophic happened.	492 00:28:36:02 --> 00:28:38:10 e' successo qualcosa di catastrofico.	545 00:28:36:02 --> 00:28:38:10 qualcosa di catastrofico è accaduto.
		546 00:28:38:00 --> 00:28:45:60 Cratere meteoritico
493 00:28:38:21 --> 00:28:42:14 When you look at Venus's surface from satellites	493 00:28:38:21 --> 00:28:42:14 Quando si guarda la superficie di Venere dai satelliti	547 00:28:38:21 --> 00:28:42:14 Quando si guarda la superficie di Venere dai satelliti
494 00:28:42:20 --> 00:28:45:22 and you count the craters that you see on the surface,	494 00:28:42:20 --> 00:28:45:22 e contate i crateri che vedete sulla superficie,	548 00:28:42:20 --> 00:28:45:22 e si contano i crateri che si vedono sulla superficie,
495 00:28:45:24 --> 00:28:49:03 we find out that the vast majority of Venus's surface	495 00:28:45:24 --> 00:28:49:03 Scopriamo che la stragrande maggioranza della superficie di Venere	549 00:28:45:24 --> 00:28:49:03 si scopre che la stragrande maggioranza della superficie di Venere
496 00:28:49:04 --> 00:28:51:26 is geologically very young.	496 00:28:49:04 --> 00:28:51:26 è geologicamente molto giovane.	550 00:28:49:04 --> 00:28:51:26 è geologicamente molto giovane.
497 00:28:51:28 --> 00:28:53:02 (lava sloshing)	497 00:28:51:28 --> 00:28:53:02 (lava sloshing)	551 00:28:51:28 --> 00:28:53:02 (lava che scorre)
498 00:28:53:04 --> 00:28:54:14 - Half a billion years ago,	498 00:28:53:04 --> 00:28:54:14 - Mezzo miliardo di anni fa,	552 00:28:53:04 --> 00:28:54:14 - Mezzo miliardo di anni fa,
499 00:28:54:19 --> 00:29:00:16 Venus had cause to erupt volcanoes over its entire surface,	499 00:28:54:19 --> 00:29:00:16 Venere ha causato l'eruzione di vulcani su tutta la sua superficie,	553 00:28:54:19 --> 00:29:00:16 Venere ha causato l'eruzione di vulcani su tutta la sua superficie,

500 00:29:00:19 --> 00:29:02:14 its entire Earth-sized surface.	500 00:29:00:19 --> 00:29:02:14 L'intera superficie terrestre.	554 00:29:00:19 --> 00:29:02:14 la sua intera superficie di dimensioni terrestri
501 00:29:03:01 --> 00:29:05:10 And we're still trying to figure out	501 00:29:03:01 --> 00:29:05:10 E stiamo ancora cercando di capire	555 00:29:03:01 --> 00:29:05:10 E stiamo ancora cercando di capire
502 00:29:05:12 --> 00:29:07:05 how that happened and why.	502 00:29:05:12 --> 00:29:07:05 come è successo e perché.	556 00:29:05:12 --> 00:29:07:05 come sia successo e perché.
503 00:29:07:12 --> 00:29:12:05 (lava sloshing) (mysterious music)	503 00:29:07:12 --> 00:29:12:05 (lava sloshing) (musica misteriosa)	557 00:29:07:12 --> 00:29:12:05 (lava che scorre) (musica misteriosa)
504 00:29:12:10 --> 00:29:13:06 - [Narrator] With its steadily	504 00:29:12:10 --> 00:29:13:06 - [Narrator] con il suo costante	558 00:29:12:10 --> 00:29:13:06 - *Con il suo costante*
505 00:29:13:09 --> 00:29:14:28 declining stores of water,	505 00:29:13:09 --> 00:29:14:28 deposito di acqua in declino,	559 00:29:13:09 --> 00:29:14:28 *deposito di acqua in diminuzione,*
506 00:29:16:06 --> 00:29:17:20 lack of magnetic field,	506 00:29:16:06 --> 00:29:17:20 mancanza di campo magnetico,	560 00:29:16:06 --> 00:29:17:20 *mancanza di campo magnetico,*
507 00:29:19:02 --> 00:29:22:22 no plate tectonics to drag carbon down into its crust,	507 00:29:19:02 --> 00:29:22:22 nessuna tettonica a placca per trascinare il carbonio verso il basso nella sua crosta,	561 00:29:19:02 --> 00:29:22:22 *nessuna tettonica delle placche* *che trascini il carbonio giù nella sua crosta,*
508 00:29:23:23 --> 00:29:27:17 but hordes of volcanoes blasting CO2 into its skies,	508 00:29:23:23 --> 00:29:27:17 Ma orde di vulcani che esplodono CO2 nei suoi cieli,	562 00:29:23:23 --> 00:29:27:17 *ma orde di vulcani* *che rilasciano CO2 nei suoi cieli,*
509 00:29:28:19 --> 00:29:32:00 Venus sentenced its surface to climatic death.	509 00:29:28:19 --> 00:29:32:00 Venere condannò la sua superficie alla morte climatica.	563 00:29:28:19 --> 00:29:32:00 *Venere ha condannato la sua superficie alla* *morte climatica.*

510 00:29:34:08 --> 00:29:36:12 A planet turned inside out.	510 00:29:34:08 --> 00:29:36:12 Un pianeta e' tornato dentro.	564 00:29:34:08 --> 00:29:36:12 *Un pianeta capovolto.*
511 00:29:36:14 --> 00:29:41:01 (dramatic music)	511 00:29:36:14 --> 00:29:41:01 (musica drammatica)	565 00:29:36:14 --> 00:29:41:01 (musica drammatica)
512 00:29:46:16 --> 00:29:49:20 (light music)	512 00:29:46:16 --> 00:29:49:20 (musica leggera)	566 00:29:46:16 --> 00:29:49:20 (musica leggera)
513 00:29:49:24 --> 00:29:53:09 Meanwhile, its sister planet, Earth, managed to survive,	513 00:29:49:24 --> 00:29:53:09 Nel frattempo, il suo pianeta gemello, la Terra, è riuscito a sopravvivere,	567 00:29:49:24 --> 00:29:53:09 *Nel frattempo, il suo pianeta gemello, la Terra,* *è riuscito a sopravvivere,*
514 00:29:53:23 --> 00:29:56:18 to nurture a complex and evolving biosphere.	514 00:29:53:23 --> 00:29:56:18 per coltivare una biosfera complessa e in evoluzione.	568 00:29:53:23 --> 00:29:56:18 *a sviluppare una biosfera complessa* *e in evoluzione.*
515 00:29:59:20 --> 00:30:02:05 The contrasting stories of Earth and Venus	515 00:29:59:20 --> 00:30:02:05 Le storie contrastanti della Terra e di Venere	569 00:29:59:20 --> 00:30:02:05 *Le storie contrastanti della Terra e di Venere*
516 00:30:02:11 --> 00:30:05:24 are central to one of the greatest quests in science today.	516 00:30:02:11 --> 00:30:05:24 sono al centro di una delle più grandi missioni della scienza di oggi.	570 00:30:02:11 --> 00:30:05:24 *sono al centro di una delle più grandi ricerche* *della scienza di oggi.*
517 00:30:07:05 --> 00:30:09:00 The search for solar systems	517 00:30:07:05 --> 00:30:09:00 La ricerca di sistemi solari	571 00:30:07:05 --> 00:30:09:00 *La ricerca di sistemi solari*
518 00:30:09:08 --> 00:30:12:10 and life-bearing worlds out in the galaxy.	518 00:30:09:08 --> 00:30:12:10 e mondi portatori di vita nella galassia.	572 00:30:09:08 --> 00:30:12:10 *e mondi portatori di vita nella galassia.*
519 00:30:17:15 --> 00:30:19:28 That search, conducted by a growing array	519 00:30:17:15 --> 00:30:19:28 Quella ricerca, condotta da un gruppo crescente	573 00:30:17:15 --> 00:30:19:28 *Quella ricerca, condotta da un gruppo crescente*

520 00:30:20:01 --> 00:30:22:14 of ground and space-based observatories,	520 00:30:20:01 --> 00:30:22:14 di osservatori terrestri e spaziali,	574 00:30:20:01 --> 00:30:22:14 *di osservatori terrestri e spaziali,*
521 00:30:22:29 --> 00:30:25:24 has so far turned up over 4,000 planets	521 00:30:22:29 --> 00:30:25:24 finora ha scoperto oltre 4.000 pianeti	575 00:30:22:29 --> 00:30:25:24 *ha finora scoperto oltre 4.000 pianeti*
522 00:30:25:26 --> 00:30:28:28 with thousands more detected, but not yet confirmed.	522 00:30:25:26 --> 00:30:28:28 con migliaia di persone rilevate, ma non ancora confermate.	576 00:30:25:26 --> 00:30:28:28 *con altri migliaia rilevati,* *ma non ancora confermati.*
523 00:30:29:06 --> 00:30:32:01 (mystical music)	523 00:30:29:06 --> 00:30:32:01 (musica mistica)	577 00:30:29:06 --> 00:30:32:01 (musica mistica)
524 00:30:32:04 --> 00:30:34:17 Increasing numbers of these exoplanets	524 00:30:32:04 --> 00:30:34:17 Un numero crescente di questi esopianeti	578 00:30:32:04 --> 00:30:34:17 *Un numero crescente di questi esopianeti*
525 00:30:34:19 --> 00:30:36:26 are close in size to Earth and Venus.	525 00:30:34:19 --> 00:30:36:26 Sono di dimensioni vicine alla Terra e a Venere.	579 00:30:34:19 --> 00:30:36:26 *è di dimensioni simili alla Terra e a Venere.*
526 00:30:38:14 --> 00:30:40:06 With orbits within the habitable zones	526 00:30:38:14 --> 00:30:40:06 Con orbite all'interno delle zone abitabili	580 00:30:38:14 --> 00:30:40:06 *Con orbite all'interno delle zone abitabili*
527 00:30:40:08 --> 00:30:41:22 of their solar systems,	527 00:30:40:08 --> 00:30:41:22 dei loro sistemi solari,	581 00:30:40:08 --> 00:30:41:22 *dei loro sistemi solari,*
528 00:30:42:10 --> 00:30:44:26 where water can exist in all three states,	528 00:30:42:10 --> 00:30:44:26 dove l'acqua può esistere in tutti e tre gli stati,	582 00:30:42:10 --> 00:30:44:26 *dove l'acqua può esistere in tutti e tre gli stati,*
529 00:30:45:11 --> 00:30:47:11 liquid, ice, and steam,	529 00:30:45:11 --> 00:30:47:11 liquido, ghiaccio e vapore,	583 00:30:45:11 --> 00:30:47:11 *liquido, solido e gassoso,*

530 00:30:48:13 --> 00:30:52:10 statistical studies indicate there could be billions of them 531 00:30:52:12 --> 00:30:54:20 tucked into the nooks and crannies of our galaxy. 532 00:30:59:16 --> 00:31:01:12 (gentle music) 533 00:31:01:16 --> 00:31:04:18 Is life, even intelligent life, 534 00:31:05:24 --> 00:31:08:08 a natural product of the laws of nature? 535 00:31:11:26 --> 00:31:13:12 Or is it a fluke? 536 00:31:14:18 --> 00:31:16:20 Its chances mostly killed off 537 00:31:16:22 --> 00:31:19:24 by all that can go wrong with planetary evolution. 538 00:31:24:16 --> 00:31:27:27 So far, Venus has not told us 539 00:31:27:29 --> 00:31:30:00 all it can about these questions.	530 00:30:48:13 --> 00:30:52:10 gli studi statistici indicano che potrebbero esserci miliardi di loro 531 00:30:52:12 --> 00:30:54:20 nascosto negli angoli e negli angoli della nostra galassia. 532 00:30:59:16 --> 00:31:01:12 (musica dolce) 533 00:31:01:16 --> 00:31:04:18 È la vita, anche la vita intelligente, 534 00:31:05:24 --> 00:31:08:08 un prodotto naturale delle leggi della natura? 535 00:31:11:26 --> 00:31:13:12 O si tratta di un caso fluke? 536 00:31:14:18 --> 00:31:16:20 Le sue possibilità sono quasi sempre state uccise 537 00:31:16:22 --> 00:31:19:24 tutto ciò può andare storto con l'evoluzione planetaria. 538 00:31:24:16 --> 00:31:27:27 Finora, Venere non CE l'ha detto 539 00:31:27:29 --> 00:31:30:00 tutto il possibile su queste domande.	584 00:30:48:13 --> 00:30:52:10 *studi statistici* *indicano che potrebbero essercene miliardi* 585 00:30:52:12 --> 00:30:54:20 *nascosti negli angoli e nelle insenature della* *nostra galassia.* 586 00:30:59:16 --> 00:31:01:12 (musica dolce) 587 00:31:01:16 --> 00:31:04:18 *È la vita, anche la vita intelligente,* 588 00:31:05:24 --> 00:31:08:08 *un naturale prodotto delle leggi della natura?* 589 00:31:11:26 --> 00:31:13:12 *O è un caso?* 590 00:31:14:18 --> 00:31:16:20 *Le sue possibilità sono in gran parte azzerate* 591 00:31:16:22 --> 00:31:19:24 *da tutto ciò che può andare storto* *nell'evoluzione planetaria.* 592 00:31:24:16 --> 00:31:27:27 *Finora, Venere non ci ha detto* 593 00:31:27:29 --> 00:31:30:00 *tutto quello che poteva su queste domande.*

540 00:31:32:20 --> 00:31:34:03 - For years and years,	540 00:31:32:20 --> 00:31:34:03 - Per anni e anni,	594 00:31:32:20 --> 00:31:34:03 - Per anni e anni,
541 00:31:34:05 --> 00:31:37:07 after we began to really understand Venus,	541 00:31:34:05 --> 00:31:37:07 Dopo che abbiamo iniziato a capire davvero Venere,	595 00:31:34:05 --> 00:31:37:07 dopo che abbiamo iniziato a capire davvero Venere,
542 00:31:37:23 --> 00:31:40:05 all of the scientists and the space advocates	542 00:31:37:23 --> 00:31:40:05 tutti gli scienziati e i sostenitori dello spazio	596 00:31:37:23 --> 00:31:40:05 tutti gli scienziati e i sostenitori dello spazio
543 00:31:40:07 --> 00:31:42:09 were saying, “Oh, no, Venus is the one place	543 00:31:40:07 --> 00:31:42:09 Dicevano: “Oh, no, Venere è l’unico posto	597 00:31:40:07 --> 00:31:42:09 dicevano: “Oh, no, Venere è l'unico posto
544 00:31:42:11 --> 00:31:47:04 “we don’t want to go to because it’s so hot on the surface.	544 00:31:42:11 --> 00:31:47:04 “non vogliamo andare a perché è così caldo in superficie.	598 00:31:42:11 --> 00:31:47:04 in cui non vogliamo andare perché è così caldo in superficie”.
545 00:31:47:24 --> 00:31:49:19 “It’s hot enough to melt land.”	545 00:31:47:24 --> 00:31:49:19 “Fa abbastanza caldo da fondere la terra.”	599 00:31:47:24 --> 00:31:49:19 “Fa abbastanza caldo da fondere la terra.”
546 00:31:50:05 --> 00:31:52:17 But it turns out that, like Earth,	546 00:31:50:05 --> 00:31:52:17 Ma a quanto pare, come la Terra,	600 00:31:50:05 --> 00:31:52:17 Ma a quanto pare, come sulla Terra,
547 00:31:52:18 --> 00:31:54:20 as you get higher in the atmosphere,	547 00:31:52:18 --> 00:31:54:20 man mano che si aumenta l’atmosfera,	601 00:31:52:18 --> 00:31:54:20 man mano che si sale nell’atmosfera,
548 00:31:55:09 --> 00:31:56:20 the temperature gets cooler.	548 00:31:55:09 --> 00:31:56:20 la temperatura diventa più fredda.	602 00:31:55:09 --> 00:31:56:20 la temperatura diventa più fredda.
549 00:31:57:02 --> 00:31:58:26 And there’s a region where Venus	549 00:31:57:02 --> 00:31:58:26 E c’è una regione dove Venere	603 00:31:57:02 --> 00:31:58:26 E c’è una regione dove Venere

550 00:31:58:28 --> 00:32:00:27 is very, very much like the conditions	550 00:31:58:28 --> 00:32:00:27 e' molto, molto simile alle condizioni	604 00:31:58:28 --> 00:32:00:27 è molto, molto simile alle condizioni
551 00:32:00:29 --> 00:32:02:11 at the sea level on Earth.	551 00:32:00:29 --> 00:32:02:11 Al livello del mare sulla Terra.	605 00:32:00:29 --> 00:32:02:11 a livello del mare sulla Terra.
552 00:32:02:20 --> 00:32:04:06 (wind whooshing) (gentle music)	552 00:32:02:20 --> 00:32:04:06 (battito del vento) (musica dolce)	606 00:32:02:20 --> 00:32:04:06 (sibilo del vento) (musica dolce)
553 00:32:04:07 --> 00:32:06:04 - [Narrator] The presence of hospitable conditions	553 00:32:04:07 --> 00:32:06:04 - La presenza di condizioni ospitali	607 00:32:04:07 --> 00:32:06:04 *- La presenza di condizioni ospitali*
554 00:32:06:06 --> 00:32:08:00 in Venus's upper atmosphere	554 00:32:06:06 --> 00:32:08:00 Nella parte superiore dell'atmosfera di Venere	608 00:32:06:06 --> 00:32:08:00 *nell'atmosfera superiore di Venere*
555 00:32:08:27 --> 00:32:11:08 led to one of the most innovative mission ideas	555 00:32:08:27 --> 00:32:11:08 ha condotto a una delle idee di missione più innovative	609 00:32:08:27 --> 00:32:11:08 *ha portato a una delle idee di missione* *più innovative*
556 00:32:11:10 --> 00:32:12:20 on the books.	556 00:32:11:10 --> 00:32:12:20 sui libri.	610 00:32:11:10 --> 00:32:12:20 *in circolazione.*
557 00:32:14:00 --> 00:32:16:00 Imagine an entry vehicle penetrating	557 00:32:14:00 --> 00:32:16:00 Immaginate che un veicolo entrante penetri	611 00:32:14:00 --> 00:32:16:00 *Immaginate che un veicolo entrante penetri*
558 00:32:16:02 --> 00:32:18:20 the outer most layers of Venus's atmosphere.	558 00:32:16:02 --> 00:32:18:20 Gli strati più esterni dell'atmosfera di Venere.	612 00:32:16:02 --> 00:32:18:20 *negli strati più esterni* *dell'atmosfera di Venere.*
559 00:32:20:02 --> 00:32:22:00 Instead of continuing to the surface,	559 00:32:20:02 --> 00:32:22:00 Invece di proseguire verso la superficie,	612 00:32:20:02 --> 00:32:22:00 *Invece di proseguire verso la superficie,*

560 00:32:23:08 --> 00:32:25:08 it deploys an inflating envelope.	560 00:32:23:08 --> 00:32:25:08 si attiva un involucro gonfiabile.	614 00:32:23:08 --> 00:32:25:08 *dispiega un involucro gonfiabile.*
561 00:32:25:10 --> 00:32:28:18 (balloon flapping)	561 00:32:25:10 --> 00:32:28:18 (flapping bollatura)	615 00:32:25:10 --> 00:32:28:18 (sbattito del pallone)
562 00:32:28:20 --> 00:32:32:05 An airship up to 130 meters in length.	562 00:32:28:20 --> 00:32:32:05 Dirigibile di lunghezza massima di 130 metri.	616 00:32:28:20 --> 00:32:32:05 *Un dirigibile lungo fino a 130 metri.*
563 00:32:32:10 --> 00:32:35:27 (soft dramatic music)	563 00:32:32:10 --> 00:32:35:27 (musica soft e drammatica)	617 00:32:32:10 --> 00:32:35:27 (musica soft e drammatica)
564 00:32:35:29 --> 00:32:37:05 This platform,	564 00:32:35:29 --> 00:32:37:05 Questa piattaforma,	618 00:32:35:29 --> 00:32:37:05 *Questa piattaforma,*
565 00:32:37:06 --> 00:32:41:08 called the High-Altitude Venus Operational Concept, HAVOC,	565 00:32:37:06 --> 00:32:41:08 Chiamato il concetto operativo High-Altitude Venus, HAVOC,	619 00:32:37:06 --> 00:32:41:08 *chiamata High-Altitude Venus Operational Concept, HAVOC*
566 00:32:41:24 --> 00:32:44:16 would host a series of experiments and sensors.	566 00:32:41:24 --> 00:32:44:16 ospiterebbe una serie di esperimenti e sensori.	620 00:32:41:24 --> 00:32:44:16 *ospiterebbe una serie di esperimenti* *e sensori.*
567 00:32:45:00 --> 00:32:48:03 (low intense music)	567 00:32:45:00 --> 00:32:48:03 (musica a bassa intensità)	621 00:32:45:00 --> 00:32:48:03 (musica bassa e intensa)
568 00:32:48:06 --> 00:32:49:22 And its most far-ranging.	568 00:32:48:06 --> 00:32:49:22 E la sua più ampia gamma.	622 00:32:48:06 --> 00:32:49:22 *E la sua più ampia portata.*
569 00:32:51:04 --> 00:32:53:14 It’s the start of a permanent human outpost.	569 00:32:51:04 --> 00:32:53:14 E' l'inizio di un avamposto umano permanente.	623 00:32:51:04 --> 00:32:53:14 *È l’inizio di una* *postazione umana permanente.*

570 00:32:58:03 --> 00:33:01:20 A science city built in the clouds of Venus. 571 00:33:01:28 --> 00:33:07:18 (light music) 572 00:33:07:20 --> 00:33:09:02 The concept takes advantage 573 00:33:09:03 --> 00:33:11:19 of the unique profile of Venus's atmosphere. 574 00:33:13:19 --> 00:33:17:04 At ground level, the pressure is like being 900 meters deep 575 00:33:17:06 --> 00:33:18:12 in Earth's oceans.	570 00:32:58:03 --> 00:33:01:20 Una città della scienza costruita tra le nuvole di Venere. 571 00:33:01:28 --> 00:33:07:18 (musica leggera) 572 00:33:07:20 --> 00:33:09:02 Il concetto ne trae vantaggio 573 00:33:09:03 --> 00:33:11:19 Del profilo unico dell'atmosfera di Venere. 574 00:33:13:19 --> 00:33:17:04 A livello del suolo, la pressione è come essere profonda 900 metri 575 00:33:17:06 --> 00:33:18:12 Negli oceani della Terra.	624 00:32:58:03 --> 00:33:01:20 *Una città della scienza* *costruita tra le nuvole di Venere.* 625 00:33:01:28 --> 00:33:07:18 (musica lieve) 626 00:33:07:20 --> 00:33:09:02 *Il concetto trae vantaggio* 627 00:33:09:03 --> 00:33:11:19 *dal profilo unico* *dell'atmosfera di Venere.* 628 00:33:13:19 --> 00:33:17:04 *A livello del suolo, la pressione* *è come trovarsi a 900 metri di profondità* 629 00:33:13:33 --> 00:33:16:60 ALTITUDINE (CHILOMETRI) 630 00:33:13:33 --> 00:33:16:60 PRESSIONE (ATMOSFERE) 631 00:33:16:60 --> 00:33:27:60 TEMPERATURA (CELSIUS) 632 00:33:17:06 --> 00:33:18:12 *negli oceani della Terra.*

576 00:33:18:24 --> 00:33:21:16 It's hotter than anywhere else in the solar system, 577 00:33:21:18 --> 00:33:22:26 except the sun. 578 00:33:24:02 --> 00:33:26:24 But 50 kilometers up, among the clouds, 579 00:33:27:18 --> 00:33:30:08 the pressure has dropped to that of sea level on Earth. 580 00:33:31:01 --> 00:33:34:12 It's no warmer than a day in June in Europe or the U.S. 581 00:33:36:00 --> 00:33:37:08 (propellers clicking) 582 00:33:37:11 --> 00:33:40:23 That's where balloon-born habitats could perpetually float. 583 00:33:40:25 --> 00:33:47:00 (gentle music) 584 00:33:48:16 --> 00:33:52:15 Consider a crew of scientist astronauts aboard an airship.	576 00:33:18:24 --> 00:33:21:16 È più caldo che in qualsiasi altro posto del sistema solare, 577 00:33:21:18 --> 00:33:22:26 tranne il sole. 578 00:33:24:02 --> 00:33:26:24 Ma 50 chilometri più in alto, tra le nuvole, 579 00:33:27:18 --> 00:33:30:08 La pressione è scesa a quella del livello del mare sulla Terra. 580 00:33:31:01 --> 00:33:34:12 Non è più caldo di un giorno a giugno in Europa o negli Stati Uniti 581 00:33:36:00 --> 00:33:37:08 (le eliche scattano) 582 00:33:37:11 --> 00:33:40:23 E' qui che gli habitat nati dai palloncini potrebbero fluttuare per sempre. 583 00:33:40:25 --> 00:33:47:00 (musica dolce) 584 00:33:48:16 --> 00:33:52:15 Considerate un equipaggio di astronauti scienziati a bordo di un dirigibile.	633 00:33:18:24 --> 00:33:21:16 *È più caldo che in qualsiasi altro posto del* *sistema solare,* 634 00:33:21:18 --> 00:33:22:26 *tranne il sole.* 635 00:33:24:02 --> 00:33:26:24 *Ma a 50 chilometri di altezza, tra le nuvole,* 636 00:33:27:18 --> 00:33:30:08 *la pressione è scesa a quella* *del livello del mare sulla Terra.* 637 00:33:31:01 --> 00:33:34:12 *Non è più caldo di un giorno a giugno in Europa* *o negli Stati Uniti.* 638 00:33:36:00 --> 00:33:37:08 (rumore di eliche) 639 00:33:37:11 --> 00:33:40:23 *È qui che gli habitat nati dai palloni* *potrebbero fluttuare per sempre.* 640 00:33:40:25 --> 00:33:47:00 (musica dolce) 641 00:33:48:16 --> 00:33:52:15 *Consideriamo un equipaggio* *di astronauti scienziati a bordo di un dirigibile.*

585 00:33:52:24 --> 00:33:54:15 (thunder rumbling)	585 00:33:52:24 --> 00:33:54:15 (tuono)	642 00:33:52:24 --> 00:33:54:15 (tuono)
586 00:33:54:16 --> 00:33:57:12 Making their way through the sulfuric acid clouds,	586 00:33:54:16 --> 00:33:57:12 Attraverso le nuvole di acido solforico,	643 00:33:54:16 --> 00:33:57:12 *Che si fanno strada* *tra le nuvole di acido solforico,*
587 00:33:58:25 --> 00:34:01:26 their ships' electric motors powered by the sun,	587 00:33:58:25 --> 00:34:01:26 i motori elettrici delle loro navi alimentati dal sole,	644 00:33:58:25 --> 00:34:01:26 *i motori elettrici delle loro navi alimentati dal sole,*
588 00:34:03:17 --> 00:34:06:17 on their way home from a survey mission.	588 00:34:03:17 --> 00:34:06:17 tornano a casa da una missione di indagine.	645 00:34:03:17 --> 00:34:06:17 *sulla via del ritorno da una missione di ricerca.* 646 00:34:16:29 --> 00:34:24:20 Voce di: **Geoff Landis** –Glenn Research Center della NASA
589 00:34:13:12 --> 00:34:15:18 - [Geoff] The nice thing about the balloons	589 00:34:13:12 --> 00:34:15:18 - [Geoff] la cosa bella dei palloncini	647 00:34:13:12 --> 00:34:15:18 - La cosa bella dei palloni
590 00:34:15:20 --> 00:34:18:22 in the atmosphere of Venus, if they're very, very large,	590 00:34:15:20 --> 00:34:18:22 Nell'atmosfera di Venere, se sono molto, molto grandi,	648 00:34:15:20 --> 00:34:18:22 nell'atmosfera di Venere, se sono molto, molto grandi,
591 00:34:19:05 --> 00:34:21:21 is that they'd be riding with the inside pressure	591 00:34:19:05 --> 00:34:21:21 e' che cavalcerebbero con la pressione interna	649 00:34:19:05 --> 00:34:21:21 è che viaggerebbero con la pressione interna
592 00:34:21:22 --> 00:34:23:26 about the same as the outside pressure.	592 00:34:21:22 --> 00:34:23:26 più o meno uguale alla pressione esterna.	650 00:34:21:22 --> 00:34:23:26 più o meno uguale alla pressione esterna.

593 00:34:25:02 --> 00:34:28:04 It wouldn't burst like a balloon in a catastrophic failure.	593 00:34:25:02 --> 00:34:28:04 Non esploderebbe come un pallone in un fallimento catastrofico.	651 00:34:25:02 --> 00:34:28:04 Non scoppierebbe come un pallone in un fallimento catastrofico.
594 00:34:30:00 --> 00:34:32:20 - [Narrator] These sequences show a well-developed version	594 00:34:30:00 --> 00:34:32:20 - [Narrator] queste sequenze mostrano una versione ben sviluppata	652 00:34:30:00 --> 00:34:32:20 *- Queste immagini mostrano* *una versione ben sviluppata*
595 00:34:32:23 --> 00:34:34:11 of a Venus cloud city.	595 00:34:32:23 --> 00:34:34:11 Di una città di Venere nuvola.	653 00:34:32:23 --> 00:34:34:11 *di una città nuvola di Venere.*
596 00:34:36:02 --> 00:34:38:22 The construction of stations this large and complex	596 00:34:36:02 --> 00:34:38:22 La costruzione di stazioni così grandi e complesse	654 00:34:36:02 --> 00:34:38:22 *La costruzione di stazioni* *così grandi e complesse*
597 00:34:39:06 --> 00:34:41:16 depends on our ability to harvest materials,	597 00:34:39:06 --> 00:34:41:16 dipende dalla nostra capacità di raccogliere materiali,	655 00:34:39:06 --> 00:34:41:16 *dipende dalla nostra capacità* *di raccogliere materiali,*
598 00:34:42:00 --> 00:34:44:26 like carbon fiber, directly from the atmosphere.	598 00:34:42:00 --> 00:34:44:26 come la fibra di carbonio, direttamente dall'atmosfera.	656 00:34:42:00 --> 00:34:44:26 *come la fibra di carbonio,* *direttamente dall'atmosfera.*
599 00:34:46:20 --> 00:34:51:08 (propellers clicking)	599 00:34:46:20 --> 00:34:51:08 (le eliche scattano)	657 00:34:46:20 --> 00:34:51:08 (eliche che scattano)
600 00:34:51:10 --> 00:34:54:14 Its core mission to serve as a field station	600 00:34:51:10 --> 00:34:54:14 La sua missione principale è quella di fungere da stazione di campo	658 00:34:51:10 --> 00:34:54:14 *La sua missione principale* *di fungere da stazione di campo*
601 00:34:54:16 --> 00:34:57:04 for deploying research probes around the planet	601 00:34:54:16 --> 00:34:57:04 per l'implementazione di sonde di ricerca in tutto il pianeta	659 00:34:54:16 --> 00:34:57:04 *per l'implemento di sonde di ricerca* *in tutto al pianeta*

602 00:34:58:22 --> 00:35:00:18 and down to its hostile terrain.	602 00:34:58:22 --> 00:35:00:18 e fino al suo terreno ostile.	660 00:34:58:22 --> 00:35:00:18 *e fino al suo terreno ostile.*
603 00:35:06:00 --> 00:35:07:22 From their floating platforms,	603 00:35:06:00 --> 00:35:07:22 Dalle loro piattaforme galleggianti,	661 00:35:06:00 --> 00:35:07:22 *Dalle loro piattaforme galleggianti,*
604 00:35:08:03 --> 00:35:10:08 these experimenters would investigate	604 00:35:08:03 --> 00:35:10:08 questi sperimentatori indagherebbero	662 00:35:08:03 --> 00:35:10:08 *questi sperimentatori studierebbero*
605 00:35:10:10 --> 00:35:12:20 the deep history of Venus's surface	605 00:35:10:10 --> 00:35:12:20 La profonda storia della superficie di Venere	663 00:35:10:10 --> 00:35:12:20 *la storia profonda della superficie di Venere*
606 00:35:13:10 --> 00:35:16:02 and how land and atmosphere connect.	606 00:35:13:10 --> 00:35:16:02 e come la terra e l'atmosfera si connettono.	664 00:35:13:10 --> 00:35:16:02 *e come terra e atmosfera sono collegate.*
607 00:35:17:22 --> 00:35:18:16 (lava sloshing)	607 00:35:17:22 --> 00:35:18:16 (lava sloshing)	665 00:35:17:22 --> 00:35:18:16 (lava che scorre)
608 00:35:18:18 --> 00:35:21:10 They would check for signatures of live volcanoes	608 00:35:18:18 --> 00:35:21:10 Controllavano le tracce di vulcani vivi	666 00:35:18:18 --> 00:35:21:10 *Controllerebbero le tracce* *di vulcani vivi*
609 00:35:22:10 --> 00:35:25:24 and the interaction of the atmosphere's physical, chemical,	609 00:35:22:10 --> 00:35:25:24 e l'interazione fisica, chimica dell'atmosfera,	667 00:35:22:10 --> 00:35:25:24 *e l'interazione dei componenti fisici, chimici*
610 00:35:25:27 --> 00:35:28:25 and possibly biological components.	610 00:35:25:27 --> 00:35:28:25 e forse componenti biologici.	668 00:35:25:27 --> 00:35:28:25 *ed eventualmente biologici dell'atmosfera.*
611 00:35:28:28 --> 00:35:32:22 (lava sloshing) (light music)	611 00:35:28:28 --> 00:35:32:22 (lava sloshing) (musica leggera)	669 00:35:28:28 --> 00:35:32:22 (lava che scorre) (musica lieve)

612 00:35:32:24 --> 00:35:34:06 (air whooshing)	612 00:35:32:24 --> 00:35:34:06 (soffiatura pneumatica)	670 00:35:32:24 --> 00:35:34:06 (fruscio dell'aria)
613 00:35:34:08 --> 00:35:36:08 All in a quest to discover	613 00:35:34:08 --> 00:35:36:08 Tutto in una missione da scoprire	671 00:35:34:08 --> 00:35:36:08 *Tutto in una missione per scoprire*
614 00:35:36:10 --> 00:35:39:12 what went so terribly wrong on Venus.	614 00:35:36:10 --> 00:35:39:12 Cosa è andato così male su Venere.	672 00:35:36:10 --> 00:35:39:12 *cos'è andato così storto su Venere.*
615 00:35:41:14 --> 00:35:44:14 (soft dramatic music)	615 00:35:41:14 --> 00:35:44:14 (musica soft e drammatica)	673 00:35:41:14 --> 00:35:44:14 (musica soft e drammatica)
616 00:35:44:16 --> 00:35:47:18 Soviet researchers first demonstrated balloon science	616 00:35:44:16 --> 00:35:47:18 I ricercatori sovietici hanno dimostrato per la prima volta la scienza dei palloncini	674 00:35:44:16 --> 00:35:47:18 *I ricercatori sovietici dimostrarono* *per la prima volta la scienza dei palloni*
617 00:35:47:20 --> 00:35:50:01 with the 1985 Vega 2 probe,	617 00:35:47:20 --> 00:35:50:01 Con la sonda 1985 Vega 2,	675 00:35:47:20 --> 00:35:50:01 *con la sonda del 1985 Vega 2,*
618 00:35:50:21 --> 00:35:53:08 riding turbulent hurricane-force thermal currents	618 00:35:50:21 --> 00:35:53:08 cavalcare correnti termiche turbolente di forza uragana	676 00:35:50:21 --> 00:35:53:08 *che cavalcava correnti termiche turbolente di* *forza uragano*
619 00:35:53:10 --> 00:35:55:08 at 240 kilometers per hour.	619 00:35:53:10 --> 00:35:55:08 a 240 chilometri orari.	677 00:35:53:10 --> 00:35:55:08 *a 240 chilometri orari.*
620 00:35:59:27 --> 00:36:02:24 Vega 2's three and a half meter diameter balloon	620 00:35:59:27 --> 00:36:02:24 Il pallone di Vega 2 con un diametro di tre metri e mezzo	678 00:35:59:27 --> 00:36:02:24 *Il pallone di Vega 2* *con un diametro di tre metri e mezzo*
621 00:36:03:00 --> 00:36:06:12 found a stable altitude at about 54 kilometers.	621 00:36:03:00 --> 00:36:06:12 trovato un'altitudine stabile a circa 54 chilometri.	679 00:36:03:00 --> 00:36:06:12 *trovò un'altitudine stabile* *a circa 54 chilometri.*

622 00:36:06:17 --> 00:36:07:17 (lightning clapping)	622 00:36:06:17 --> 00:36:07:17 (battiti fulminei)	680 00:36:06:17 --> 00:36:07:17 (battito di fulmini)
623 00:36:07:21 --> 00:36:10:12 In the most active of the planet's three cloud layers,	623 00:36:07:21 --> 00:36:10:12 Nel più attivo dei tre strati nuvolosi del pianeta,	681 00:36:07:21 --> 00:36:10:12 *Nel più attivo dei tre strati nuvolosi del pianeta,*
624 00:36:11:10 --> 00:36:13:26 it traveled more than 7,400 kilometers	624 00:36:11:10 --> 00:36:13:26 ha percorso più di 7.400 chilometri	682 00:36:11:10 --> 00:36:13:26 *percorse più di 7.400 chilometri*
625 00:36:14:04 --> 00:36:15:26 around to the day side of Venus.	625 00:36:14:04 --> 00:36:15:26 Verso il lato giorno di Venere.	683 00:36:14:04 --> 00:36:15:26 *intorno al lato giorno di Venere.*
626 00:36:15:28 --> 00:36:17:10 (thunder rumbling)	626 00:36:15:28 --> 00:36:17:10 (tuono)	684 00:36:15:28 --> 00:36:17:10 (tuono)
627 00:36:17:11 --> 00:36:23:12 (propellers clicking) (gentle music)	627 00:36:17:11 --> 00:36:23:12 (le eliche scattano) (musica delicata)	685 00:36:17:11 --> 00:36:23:12 (eliche che scattano) (musica dolce)
628 00:36:25:24 --> 00:36:28:18 Vega 2's descendants may deploy from airships	628 00:36:25:24 --> 00:36:28:18 I discendenti di Vega 2 possono schierarsi dai dirigibili	686 00:36:25:24 --> 00:36:28:18 *I discendenti di Vega 2* *possono sganciarsi da dirigibili*
629 00:36:29:00 --> 00:36:30:24 to sample specific altitudes. 6 30	629 00:36:29:00 --> 00:36:30:24 per campionare altitudini specifiche.	687 00:36:29:00 --> 00:36:30:24 *per campionare altitudini specifiche.*
630 00:36:37:06 --> 00:36:38:26 Triangulating their positions,	630 00:36:37:06 --> 00:36:38:26 Triangolazione delle loro posizioni,	688 00:36:37:06 --> 00:36:38:26 *Triangolando le loro posizioni,*
631 00:36:39:02 --> 00:36:41:12 they could form a global sensor network	631 00:36:39:02 --> 00:36:41:12 potrebbero formare una rete globale di sensori	689 00:36:39:02 --> 00:36:41:12 *potrebbero formare una rete globale di sensori*

632 00:36:41:28 --> 00:36:44:08 to pick up signs of seismic activity.	632 00:36:41:28 --> 00:36:44:08 rilevare segni di attività sismica.	690 00:36:41:28 --> 00:36:44:08 *per rilevare segni di attività sismica.*
633 00:36:45:12 --> 00:36:49:29 (ground rumbling)	633 00:36:45:12 --> 00:36:49:29 (rombo di massa)	691 00:36:45:12 --> 00:36:49:29 (rimbombo della terra)
634 00:36:50:00 --> 00:36:52:28 - So our balloon can listen for earthquakes	634 00:36:50:00 --> 00:36:52:28 - Così il nostro pallone può ascoltare i terremoti	692 00:36:50:00 --> 00:36:52:28 - Quindi, il nostro pallone può sentire i terremoti
635 00:36:53:13 --> 00:36:55:00 as it floats around Venus,	635 00:36:53:13 --> 00:36:55:00 Mentre galleggia intorno a Venere,	693 00:36:53:13 --> 00:36:55:00 mentre fluttua intorno a Venere,
636 00:36:55:18 --> 00:36:56:26 taking advantage of the fact	636 00:36:55:18 --> 00:36:56:26 approfittando del fatto	694 00:36:55:18 --> 00:36:59:10 approfittando del fatto
637 00:36:56:28 --> 00:36:59:10 that the Venus atmosphere is so thick	637 00:36:56:28 --> 00:36:59:10 Che l'atmosfera di Venere è così spessa	695 00:36:56:28 --> 00:36:59:10 che l’atmosfera di Venere è così spessa
638 00:36:59:11 --> 00:37:02:15 that sound waves from earthquakes will propagate up	638 00:36:59:11 --> 00:37:02:15 che le onde sonore dei terremoti si propagheranno	696 00:36:59:11 --> 00:37:02:15 che le onde sonore dei terremoti si propagherebbero
639 00:37:02:16 --> 00:37:03:18 through the atmosphere	639 00:37:02:16 --> 00:37:03:18 attraverso l'atmosfera	697 00:37:02:16 --> 00:37:03:18 attraverso l’atmosfera
640 00:37:03:20 --> 00:37:07:00 and can be measured from balloon or from orbit.	640 00:37:03:20 --> 00:37:07:00 e può essere misurato dal palloncino o dall'orbita.	698 00:37:03:20 --> 00:37:07:00 e potrebbero essere misurate dal pallone o dall’orbita.
641 00:37:07:02 --> 00:37:08:12 It’s astounding.	641 00:37:07:02 --> 00:37:08:12 E' sorprendente.	699 00:37:07:02 --> 00:37:08:12 È sorprendente.

642
00:37:09:00 --> 00:37:12:23
(ground rumbling)

643
00:37:12:25 --> 00:37:16:02
(dramatic music

644
00:37:16:05 --> 00:37:17:01
- [Narrator] Though it may appear

645
00:37:17:03 --> 00:37:19:14
as a featureless planet-wide cloud bank,

646
00:37:20:00 --> 00:37:23:10
Venus's atmosphere has its
own complex stories to tell.

647
00:37:25:10 --> 00:37:26:26
- One of the most important things

648
00:37:26:28 --> 00:37:28:28
in the atmosphere of Venus that we need

649
00:37:29:01 --> 00:37:32:26
is to understand some
of the molecular fossils

650
00:37:32:28 --> 00:37:35:05
that are left in Venus's atmosphere.

642
00:37:09:00 --> 00:37:12:23
(rombo di massa)

643
00:37:12:25 --> 00:37:16:02
(musica drammatica)

644
00:37:16:05 --> 00:37:17:01
- [Narrator] anche se può sembrare

645
00:37:17:03 --> 00:37:19:14
come una banca cloud senza funzioni su tutto il
pianeta,

646
00:37:20:00 --> 00:37:23:10
L'atmosfera di Venere ha le sue
storie complesse da raccontare.

647
00:37:25:10 --> 00:37:26:26
- Una delle cose più importanti

648
00:37:26:28 --> 00:37:28:28
Nell'atmosfera di Venere di cui abbiamo bisogno

649
00:37:29:01 --> 00:37:32:26
è capire alcuni
dei fossili molecolari

650
00:37:32:28 --> 00:37:35:05
Che rimangono nell'atmosfera di Venere.

700
00:37:09:00 --> 00:37:12:23
(rimbombo della terra)

701
00:37:12:25 --> 00:37:16:02
(musica drammatica)

702
00:37:16:05 --> 00:37:17:01
- Anche se può apparire

703
00:37:17:03 --> 00:37:19:14
come un banco di nuvole
senza caratteristiche su tutto il pianeta,

704
00:37:20:00 --> 00:37:23:10
l'atmosfera di Venere
ha le sue storie complesse da raccontare.

705
00:37:25:10 --> 00:37:26:26
- Una delle cose più importanti

706
00:37:26:28 --> 00:37:28:28
nell'atmosfera di Venere di cui abbiamo bisogno

707
00:37:29:01 --> 00:37:32:26
è capire alcuni dei fossili molecolari

708
00:37:32:28 --> 00:37:35:05
che sono rimasti nell'atmosfera di Venere.

651
00:37:35:08 --> 00:37:39:13
The noble gases of argon,
neon, xenon, krypton,

652
00:37:40:10 --> 00:37:43:00
those gases that don't
react with anything else.

653
00:37:43:25 --> 00:37:46:00
They've been in the
atmosphere since Venus formed,

654
00:37:46:02 --> 00:37:47:16
since the atmosphere formed.

655
00:37:47:18 --> 00:37:48:25
And if we can measure those,

656
00:37:48:28 --> 00:37:50:29
they provide us these fossil evidence

657
00:37:51:01 --> 00:37:54:08
of what that original
atmosphere on Venus looked like.

658
00:37:54:11 --> 00:37:56:20
(gases hissing)

659
00:37:56:22 --> 00:37:59:00
- [Narrator] A profile
of the early atmosphere

651
00:37:35:08 --> 00:37:39:13
I gas nobili di argon,
neon, xeno, krypton,

652
00:37:40:10 --> 00:37:43:00
quei gas che non
reagiscono con nient'altro.

653
00:37:43:25 --> 00:37:46:00
Sono nell'
atmosfera da quando Venere si è formata,

654
00:37:46:02 --> 00:37:47:16
da quando l'atmosfera si è formata.

655
00:37:47:18 --> 00:37:48:25
E se riusciamo a misurarli,

656
00:37:48:28 --> 00:37:50:29
ci forniscono queste prove fossili

657
00:37:51:01 --> 00:37:54:08
Di come
appariva quell'atmosfera originale su Venere.

658
00:37:54:11 --> 00:37:56:20
(sibilo di gas)

659
00:37:56:22 --> 00:37:59:00
- [Narrator] Un profilo
della prima atmosfera

709
00:37:35:08 --> 00:37:39:13
I gas nobili di
argon, neon, xenon, kripton,

710
00:37:40:10 --> 00:37:43:00
quei gas
che non reagiscono con nient'altro.

711
00:37:43:25 --> 00:37:46:00
Sono nell'atmosfera
da quando Venere si è formata,

712
00:37:46:02 --> 00:37:47:16
da quando l'atmosfera si è formata.

713
00:37:47:18 --> 00:37:48:25
E se riusciamo a misurarli,

714
00:37:48:28 --> 00:37:50:29
ci forniscono queste prove fossili

715
00:37:51:01 --> 00:37:54:08
di come appariva
quell'atmosfera originaria su Venere.

716
00:37:54:11 --> 00:37:56:20
(sibilo di gas)

717
00:37:56:22 --> 00:37:59:00
- *Un profilo della prima atmosfera*

660
00:37:59:02 --> 00:38:02:06
would tell us whether Venus
once held lakes and rivers

661
00:38:02:08 --> 00:38:03:22
on its surface.

662
00:38:08:22 --> 00:38:13:29
(propellers ticking)
(intense music)

663
00:38:14:01 --> 00:38:17:18
If humans do someday visit
the acidic clouds of Venus,

664
00:38:17:27 --> 00:38:21:23
they may find, strictly
speaking, that they're not alone.

665
00:38:23:16 --> 00:38:25:10
For more than 100 years,

666
00:38:25:13 --> 00:38:29:06
astronomers on Earth have
noticed enigmatic dark patches

667
00:38:29:08 --> 00:38:31:28
that appear only at
ultraviolet wavelengths.

668
00:38:33:13 --> 00:38:36:05
- My Venus atmosphere friends talk about

660
00:37:59:02 --> 00:38:02:06
Ci direbbe se Venere
una volta possedeva laghi e fiumi

661
00:38:02:08 --> 00:38:03:22
sulla sua superficie.

662
00:38:08:22 --> 00:38:13:29
(le eliche ticchettano)
(musica intensa)

663
00:38:14:01 --> 00:38:17:18
Se gli umani un giorno visitano
le nuvole acide di Venere,

664
00:38:17:27 --> 00:38:21:23
potrebbero scoprire, a rigor
di termini, che non sono soli.

665
00:38:23:16 --> 00:38:25:10
Per oltre 100 anni,

666
00:38:25:13 --> 00:38:29:06
Gli astronomi sulla Terra hanno
notato delle macchie scure enigmatiche

667
00:38:29:08 --> 00:38:31:28
che appaiono solo alle
lunghezze d'onda ultraviolette.

668
00:38:33:13 --> 00:38:36:05
- I miei amici di Venere Atmosphere parlano

718
00:37:59:02 --> 00:38:02:06
ci direbbe se Venere
una volta aveva laghi e fiumi

719
00:38:02:08 --> 00:38:03:22
sulla sua superficie.

720
00:38:08:22 --> 00:38:13:29
(eliche che scattano)
(musica intensa)

721
00:38:14:01 --> 00:38:17:18
Se gli umani un giorno visitassero
le nuvole acide di Venere,

722
00:38:17:27 --> 00:38:21:23
potrebbero scoprire, strettamente parlando,
che non sono soli.

723
00:38:23:16 --> 00:38:25:10
Da oltre 100 anni,

724
00:38:25:13 --> 00:38:29:06
gli astronomi sulla Terra
notano enigmatiche macchie scure

725
00:38:29:08 --> 00:38:31:28
che appaiono solo
alle lunghezze d'onda ultraviolette.

726
00:38:33:13 --> 00:38:36:05
- I miei amici dell'atmosfera di Venere parlano

669
00:38:36:07 --> 00:38:39:14
the fact that there is a
signature in the atmosphere

670
00:38:39:16 --> 00:38:40:26
that they can’t explain.

671
00:38:41:22 --> 00:38:43:17
And there is something in the clouds

672
00:38:43:19 --> 00:38:47:12
that absorbs UV radiation and
they don’t know what it is.

673
00:38:48:03 --> 00:38:53:22
That signature may be due
to absorption by biota,

674
00:38:54:02 --> 00:38:56:08
by cloud creatures.

675
00:38:58:03 --> 00:39:01:07
- There are nutrients. There’s liquid.

676
00:39:01:08 --> 00:39:02:23
There are a lot of the elements

677
00:39:02:25 --> 00:39:06:00
that we think of being
requirements for life.

678
00:39:06:06 --> 00:39:08:12
The one impediment to life

669
00:38:36:07 --> 00:38:39:14
il fatto che ci sia
una firma nell'atmosfera

670
00:38:39:16 --> 00:38:40:26
che non sanno spiegare.

671
00:38:41:22 --> 00:38:43:17
E c'è qualcosa tra le nuvole

672
00:38:43:19 --> 00:38:47:12
Assorbe le radiazioni UV e
non sanno cosa sia.

673
00:38:48:03 --> 00:38:53:22
Tale firma può essere dovuta
all’assorbimento da parte del biota,

674
00:38:54:02 --> 00:38:56:08
da creature nubi.

675
00:38:58:03 --> 00:39:01:07
- Ci sono dei nutrienti. C'è del liquido.

676
00:39:01:08 --> 00:39:02:23
Ci sono molti elementi

677
00:39:02:25 --> 00:39:06:00
che pensiamo siano
requisiti per la vita.

678
00:39:06:06 --> 00:39:08:12
L'unico ostacolo alla vita

727
00:38:36:07 --> 00:38:39:14
del fatto che ci sia
una traccia nell’atmosfera

728
00:38:39:16 --> 00:38:40:26
che non sanno spiegare.

729
00:38:41:22 --> 00:38:43:17
E c’è qualcosa tra le nuvole

730
00:38:43:19 --> 00:38:47:12
che assorbe i raggi UV
e non sanno cosa sia.

731
00:38:48:03 --> 00:38:53:22
Questa traccia potrebbe essere dovuta
all’assorbimento da parte del biota,

732
00:38:54:02 --> 00:38:56:08
da creature delle nuvole.

733
00:38:58:03 --> 00:39:01:07
- Ci sono sostanze nutritive. C’è del liquido.

734
00:39:01:08 --> 00:39:02:23
Ci sono molti elementi

735
00:39:02:25 --> 00:39:06:00
che pensiamo siano
requisiti per la vita.

736
00:39:06:06 --> 00:39:08:12
L’unico impedimento alla vita

679
00:39:08:14 --> 00:39:10:18
may be the strong acid in the clouds,

680
00:39:10:24 --> 00:39:12:12
but we've learned more recently

681
00:39:12:13 --> 00:39:15:03
of all these extremophile
organisms on Earth,

682
00:39:15:04 --> 00:39:17:18
including what we call
acidophilic organisms

683
00:39:17:20 --> 00:39:20:08
or organisms that love
living in strong acid.

684
00:39:20:12 --> 00:39:22:25
(dramatic music)

685
00:39:22:28 --> 00:39:24:12
- There are bacteria on Earth,

686
00:39:24:14 --> 00:39:27:05
Thiobacillus ferroxidans, for example,

687
00:39:27:19 --> 00:39:28:29
which have an absorption spectrum

679
00:39:08:14 --> 00:39:10:18
può essere l'acido forte nelle nuvole,

680
00:39:10:24 --> 00:39:12:12
ma abbiamo imparato più di recente

681
00:39:12:13 --> 00:39:15:03
Di tutti questi
organismi estremofili sulla Terra,

682
00:39:15:04 --> 00:39:17:18
compresi quelli che chiamiamo
organismi acidofili

683
00:39:17:20 --> 00:39:20:08
o organismi che amano
vivere in un forte acido.

684
00:39:20:12 --> 00:39:22:25
(musica drammatica)

685
00:39:22:28 --> 00:39:24:12
- Ci sono batteri sulla Terra,

686
00:39:24:14 --> 00:39:27:05
Thiobacillus ferroxidans, per esempio,

687
00:39:27:19 --> 00:39:28:29
che hanno uno spettro di assorbimento

737
00:39:08:14 --> 00:39:10:18
potrebbe essere l'acido forte nelle nuvole,

738
00:39:10:24 --> 00:39:12:12
ma abbiamo appreso più di recente

739
00:39:12:13 --> 00:39:15:03
di tutti questi
organismi estremofili sulla Terra,

740
00:39:15:04 --> 00:39:17:18
compresi quelli che chiamiamo
"organismi acidofili"

741
00:39:17:20 --> 00:39:20:08
o organismi che amano
vivere in un forte acido.

742
00:39:20:12 --> 00:39:22:25
(musica drammatica)

743
00:39:22:28 --> 00:39:24:12
- Ci sono batteri sulla Terra,

744
00:39:24:14 --> 00:39:27:05
il Thiobacillus ferroxidans, per esempio

745
00:39:27:19 --> 00:39:28:29
che hanno uno spettro di assorbimento

		746 00:39:28:05 --> 00:39:30:70 Sanjay Limaye Ricercatore senior Space Science and Engineering - UW
688 00:39:29:00 --> 00:39:31:21 which is very similar to what we see on Venus.	688 00:39:29:00 --> 00:39:31:21 Il che è molto simile a quello che vediamo su Venere.	747 00:39:29:00 --> 00:39:31:21 molto simile a quello che vediamo su Venere.
689 00:39:33:26 --> 00:39:36:12 - [Narrator] Could life have developed and migrated upward	689 00:39:33:26 --> 00:39:36:12 - [Narrator] la vita potrebbe essersi sviluppata e migrata verso l'alto	748 00:39:33:26 --> 00:39:36:12 *- La vita potrebbe essersi sviluppata* *e migrata verso l'alto*
690 00:39:36:14 --> 00:39:38:05 as the surface became lethal?	690 00:39:36:14 --> 00:39:38:05 quando la superficie è diventata letale?	749 00:39:36:14 --> 00:39:38:05 *quando la superficie è diventata letale?*
691 00:39:39:20 --> 00:39:40:19 In Earth's atmosphere,	691 00:39:39:20 --> 00:39:40:19 Nell'atmosfera terrestre,	750 00:39:39:20 --> 00:39:40:19 *Nell'atmosfera terrestre,*
692 00:39:40:20 --> 00:39:43:20 microbes have been found at altitudes up to 40 kilometers.	692 00:39:40:20 --> 00:39:43:20 microbi sono stati trovati ad altitudini fino a 40 chilometri.	751 00:39:40:20 --> 00:39:43:20 *dei microbi sono stati trovati* *ad altitudini fino a 40 chilometri.*
693 00:39:43:22 --> 00:39:47:29 (air whooshing) (light music)	693 00:39:43:22 --> 00:39:47:29 (battito d'aria) (musica leggera)	752 00:39:43:22 --> 00:39:47:29 (fruscio dell'aria) (musica lieve)
694 00:39:48:02 --> 00:39:49:08 - [Mike] Earth has had 4 billion years	694 00:39:48:02 --> 00:39:49:08 - [Mike] la Terra ha avuto 4 miliardi di anni	753 00:39:48:02 --> 00:39:49:08 - La Terra ha avuto 4 miliardi di anni
695 00:39:49:10 --> 00:39:52:06 for life to fill every ecological niche possible.	695 00:39:49:10 --> 00:39:52:06 per la vita a riempire ogni nicchia ecologica possibile.	754 00:39:49:10 --> 00:39:52:06 per permettere alla vita di riempire ogni nicchia ecologica possibile.

		755 00:39:52:55 --> 00:39:55:80 Voce di: **Mike Way** - Goddard Institute for Space Studies
696 00:39:52:16 --> 00:39:54:10 And we find life everywhere we go.	696 00:39:52:16 --> 00:39:54:10 E troviamo la vita ovunque andiamo.	756 00:39:52:16 --> 00:39:54:10 E troviamo la vita ovunque andiamo.
697 00:39:54:12 --> 00:39:56:15 We dig deep wells, we find life down there.	697 00:39:54:12 --> 00:39:56:15 Scavando pozzi profondi, troviamo la vita laggiù.	757 00:39:54:12 --> 00:39:56:15 Scaviamo pozzi profondi, troviamo la vita lì sotto.
698 00:39:56:16 --> 00:39:58:00 We find life in the clouds.	698 00:39:56:16 --> 00:39:58:00 Troviamo la vita tra le nuvole.	758 00:39:56:16 --> 00:39:58:00 Troviamo la vita tra le nuvole.
699 00:40:00:11 --> 00:40:02:16 - If we have the opportunity to go to Venus	699 00:40:00:11 --> 00:40:02:16 - Se abbiamo l'opportunità di andare a Venere	759 00:40:00:11 --> 00:40:02:16 - Se avremo l’opportunità di andare su Venere
700 00:40:02:23 --> 00:40:04:12 and float in the Venus clouds,	700 00:40:02:23 --> 00:40:04:12 E galleggiare tra le nuvole di Venere,	760 00:40:02:23 --> 00:40:04:12 e fluttuare tra le nuvole di Venere,
701 00:40:04:23 --> 00:40:06:25 we should at least think about	701 00:40:04:23 --> 00:40:06:25 dovremmo almeno pensare	761 00:40:04:23 --> 00:40:06:25 dovremmo almeno pensare
702 00:40:06:29 --> 00:40:09:08 if we can measure the conditions	702 00:40:06:29 --> 00:40:09:08 se riusciamo a misurare le condizioni	762 00:40:06:29 --> 00:40:09:08 se riusciamo a misurare le condizioni
703 00:40:09:11 --> 00:40:12:00 that might be reasonable for life today	703 00:40:09:11 --> 00:40:12:00 potrebbe essere ragionevole per la vita di oggi	763 00:40:09:11 --> 00:40:12:00 che potrebbero essere ragionevoli per la vita oggi
704 00:40:12:12 --> 00:40:15:28 and also any signature of life in the clouds of Venus today.	704 00:40:12:12 --> 00:40:15:28 E anche qualsiasi segno di vita nelle nuvole di Venere oggi.	764 00:40:12:12 --> 00:40:15:28 e anche qualsiasi traccia di vita nelle nuvole di Venere oggi.

705 00:40:16:00 --> 00:40:22:11 (soft dramatic music)	705 00:40:16:00 --> 00:40:22:11 (musica soft e drammatica)	765 00:40:16:00 --> 00:40:22:11 (musica soft e drammatica)
706 00:40:22:13 --> 00:40:25:05 (intense music)	706 00:40:22:13 --> 00:40:25:05 (musica intensa)	766 00:40:22:13 --> 00:40:25:05 (musica intensa)
707 00:40:25:06 --> 00:40:27:14 - [Narrator] Though the cloud tops may be temperate,	707 00:40:25:06 --> 00:40:27:14 - [Narrator] anche se le cime delle nuvole possono essere temperate,	767 00:40:25:06 --> 00:40:27:14 *- Sebbene le cime delle nuvole* *siano temperate,*
708 00:40:28:04 --> 00:40:30:21 the hot surface is merciless.	708 00:40:28:04 --> 00:40:30:21 la superficie calda è spietata.	768 00:40:28:04 --> 00:40:30:21 *la superficie calda è spietata.*
709 00:40:32:10 --> 00:40:35:15 Venus engineers must take a mechanical approach	709 00:40:32:10 --> 00:40:35:15 Gli ingegneri Venus devono adottare un approccio meccanico	769 00:40:32:10 --> 00:40:35:15 *Gli ingegneri di Venere* *devono adottare un approccio meccanico*
710 00:40:35:21 --> 00:40:38:00 because even the most robust electronics	710 00:40:35:21 --> 00:40:38:00 perché anche i componenti elettronici più robusti	770 00:40:35:21 --> 00:40:38:00 *perché anche i sistemi elettronici più robusti*
711 00:40:38:02 --> 00:40:39:12 developed for the military	711 00:40:38:02 --> 00:40:39:12 sviluppato per l'esercito	771 00:40:38:02 --> 00:40:39:12 *sviluppati per l’esercito*
712 00:40:39:22 --> 00:40:43:06 stop working at about 125 degrees Celsius.	712 00:40:39:22 --> 00:40:43:06 Smettere di lavorare a circa 125 gradi Celsius.	772 00:40:39:22 --> 00:40:43:06 *smettono di funzionare a circa 125 gradi Celsius.*
713 00:40:45:09 --> 00:40:46:18 - Let me show you something.	713 00:40:45:09 --> 00:40:46:18 - Lascia che ti mostri una cosa.	773 00:40:45:09 --> 00:40:46:18 - Lasciate che vi mostri una cosa.
714 00:40:46:21 --> 00:40:47:18 So this it’s a clock	714 00:40:46:21 --> 00:40:47:18 Questo è un orologio	774 00:40:46:21 --> 00:40:47:18 Questo è un orologio

		775 00:40:48:40 --> 00:40:51:45 Jonathan Sauder Ingegnere meccatronico senior Jet Propulsion Laboratory della NASA
715 00:40:47:20 --> 00:40:49:15 that is fully made out of stainless steel.	715 00:40:47:20 --> 00:40:49:15 e' completamente in acciaio inossidabile.	776 00:40:47:20 --> 00:40:49:15 che è completamente in acciaio inossidabile.
716 00:40:49:17 --> 00:40:52:28 It’s been baked out at 460 degrees Celsius	716 00:40:49:17 --> 00:40:52:28 E' stato cotto a 460 gradi Celsius	777 00:40:49:17 --> 00:40:52:28 È stato cotto a 460 gradi Celsius
717 00:40:53:02 --> 00:40:55:02 and has been operated in an oven.	717 00:40:53:02 --> 00:40:55:02 ed e' stato gestito in un forno.	778 00:40:53:02 --> 00:40:55:02 ed è stato fatto funzionare in un forno.
718 00:40:55:16 --> 00:40:58:09 And our goal with this was to start to understand,	718 00:40:55:16 --> 00:40:58:09 E il nostro obiettivo era iniziare a capire,	779 00:40:55:16 --> 00:40:58:09 E il nostro obiettivo era di iniziare a capire,
719 00:40:58:11 --> 00:41:01:03 what are the challenges when you build mechanisms	719 00:40:58:11 --> 00:41:01:03 quali sono le sfide quando si costruiscono meccanismi	780 00:40:58:11 --> 00:41:01:03 quali sono le sfide quando si costruiscono meccanismi
720 00:41:01:04 --> 00:41:03:14 to operate in Venus conditions?	720 00:41:01:04 --> 00:41:03:14 Per operare in condizioni Venere?	781 00:41:01:04 --> 00:41:03:14 per operare nelle condizioni di Venere?
721 00:41:03:16 --> 00:41:05:24 First of all, the spring material was really important.	721 00:41:03:16 --> 00:41:05:24 Prima di tutto, il materiale della molla era molto importante.	782 00:41:03:16 --> 00:41:05:24 Prima di tutto, il materiale della molla era molto importante.
722 00:41:05:26 --> 00:41:07:20 We have a clock spring here,	722 00:41:05:26 --> 00:41:07:20 Abbiamo una molla a spirale qui,	783 00:41:05:26 --> 00:41:07:20 Abbiamo una molla dell’orologio qui

723 00:41:07:22 --> 00:41:09:16 as well as also a balance spring right here,	723 00:41:07:22 --> 00:41:09:16 oltre a una molla di bilanciamento proprio qui,	784 00:41:07:22 --> 00:41:09:16 oltre a una molla di bilanciamento proprio qui,
724 00:41:09:17 --> 00:41:11:08 that is built out of Inconel.	724 00:41:09:17 --> 00:41:11:08 E' costruito da Inconel.	785 00:41:09:17 --> 00:41:11:08 che è costruita in inconel.
725 00:41:11:15 --> 00:41:13:14 Even when you're going to extreme temperatures,	725 00:41:11:15 --> 00:41:13:14 Anche in caso di temperature estreme,	786 00:41:11:15 --> 00:41:13:14 Anche in caso di temperature estreme,
726 00:41:13:17 --> 00:41:16:06 like Venus, 462 degrees Celsius,	726 00:41:13:17 --> 00:41:16:06 Come Venere, 462 gradi Celsius,	787 00:41:13:17 --> 00:41:16:06 come Venere, 462 gradi Celsius,
727 00:41:16:12 --> 00:41:19:00 the entire assembly would just expand and contract together	727 00:41:16:12 --> 00:41:19:00 l'intero assieme si espanderebbe e si contratterebbe insieme	788 00:41:16:12 --> 00:41:19:00 l'intero meccanismo si espanderebbe e si contrarrebbe insieme
728 00:41:19:02 --> 00:41:20:16 and you wouldn't get jamming.	728 00:41:19:02 --> 00:41:20:16 e non ti bloccherai.	789 00:41:19:02 --> 00:41:20:16 e non ci si incepperebbe.
729 00:41:20:18 --> 00:41:22:15 And we were able to demonstrate and show that	729 00:41:20:18 --> 00:41:22:15 E siamo stati in grado di dimostrarlo e dimostrarlo	790 00:41:20:18 --> 00:41:22:15 E siamo stati in grado di dimostrarlo e mostrarlo
730 00:41:22:18 --> 00:41:24:02 by operating this clock.	730 00:41:22:18 --> 00:41:24:02 azionando questo orologio.	791 00:41:22:18 --> 00:41:24:02 azionando questo orologio.
731 00:41:24:04 --> 00:41:26:19 (clock clicking)	731 00:41:24:04 --> 00:41:26:19 (orologio che scatta)	792 00:41:24:04 --> 00:41:26:19 (orologio che scatta)
732 00:41:26:20 --> 00:41:31:24 (dramatic music)	732 00:41:26:20 --> 00:41:31:24 (musica drammatica)	793 00:41:26:20 --> 00:41:31:24 (musica drammatica)

		794 00:41:30:65 --> 00:41:34:70 “Curiosity” Rover di Marte
733 00:41:31:26 --> 00:41:32:28 - [Narrator] As on Mars,	733 00:41:31:26 --> 00:41:32:28 - [Narrator] come su Marte,	795 00:41:31:26 --> 00:41:32:28 - *Come su Marte,*
734 00:41:33:28 --> 00:41:37:07 exploring the surface of Venus will require mobility.	734 00:41:33:28 --> 00:41:37:07 Esplorare la superficie di Venere richiederà mobilità.	796 00:41:33:28 --> 00:41:37:07 *esplorare la superficie di Venere richiederà mobilità.*
735 00:41:39:28 --> 00:41:42:04 But strategies that work for other worlds	735 00:41:39:28 --> 00:41:42:04 Ma strategie che funzionano per altri mondi	797 00:41:39:28 --> 00:41:42:04 *Ma le strategie che funzionano per altri mondi*
736 00:41:43:00 --> 00:41:44:16 don’t work on Venus.	736 00:41:43:00 --> 00:41:44:16 Non lavorare su Venere.	798 00:41:43:00 --> 00:41:44:16 *non funzionano su Venere.*
737 00:41:46:12 --> 00:41:47:28 Not even solar power.	737 00:41:46:12 --> 00:41:47:28 Nemmeno l'energia solare.	799 00:41:46:12 --> 00:41:47:28 *Nemmeno l’energia solare.*
		800 00:41:46:90 --> 00:41:50:75 InSight di Marte Laboratorio geofisico
738 00:41:50:02 --> 00:41:52:26 - Venus does have some solar power on the surface.	738 00:41:50:02 --> 00:41:52:26 - Venere ha un po' di energia solare in superficie.	801 00:41:50:02 --> 00:41:52:26 - Venere ha un po’ di energia solare sulla superficie.
739 00:41:52:29 --> 00:41:56:26 Although, it’s a fraction of what is available here on Earth	739 00:41:52:29 --> 00:41:56:26 Anche se è una frazione di ciò che è disponibile qui sulla Terra	802 00:41:52:29 --> 00:41:56:26 Anche se è una frazione di ciò che è disponibile qui sulla Terra

740 00:41:56:28 --> 00:41:59:01 is actually available on the surface of Venus	740 00:41:56:28 --> 00:41:59:01 È effettivamente disponibile sulla superficie di Venere	803 00:41:56:28 --> 00:41:59:01 è effettivamente disponibile sulla superficie di Venere
741 00:41:59:06 --> 00:42:01:04 due to the thick cloud layers,	741 00:41:59:06 --> 00:42:01:04 a causa degli strati spessi delle nuvole,	804 00:41:59:06 --> 00:42:01:04 a causa degli spessi strati di nuvole,
742 00:42:01:06 --> 00:42:02:28 due to also the red shifting of the light,	742 00:42:01:06 --> 00:42:02:28 a causa anche del cambiamento di colore rosso della luce,	805 00:42:01:06 --> 00:42:02:28 a causa anche del cambiamento rosso della luce
743 00:42:03:00 --> 00:42:05:04 and that solar panels don’t work as efficiently.	743 00:42:03:00 --> 00:42:05:04 e che i pannelli solari non funzionano in modo efficiente.	806 00:42:03:00 --> 00:42:05:04 e che i pannelli solari non funzionano con la stessa efficienza.
744 00:42:05:22 --> 00:42:08:03 The other big challenge with using solar on Venus	744 00:42:05:22 --> 00:42:08:03 L'altra grande sfida con l'uso del solare su Venere	807 00:42:05:22 --> 00:42:08:03 L’altra grande sfida di usare energia solare su Venere
745 00:42:08:05 --> 00:42:12:10 is that Venus has a very long night, about 60 days.	745 00:42:08:05 --> 00:42:12:10 È che Venere ha una notte molto lunga, circa 60 giorni.	808 00:42:08:05 --> 00:42:12:10 è che Venere ha una notte molto lunga, circa 60 giorni.
746 00:42:12:22 --> 00:42:15:16 Therefore, one of the places we’re looking to get energy	746 00:42:12:22 --> 00:42:15:16 Quindi, uno dei posti che stiamo cercando di ottenere energia	809 00:42:12:22 --> 00:42:15:16 Quindi, uno dei posti da cui stiamo cercando di ottenere energia
747 00:42:15:18 --> 00:42:16:21 is from the wind.	747 00:42:15:18 --> 00:42:16:21 viene dal vento.	810 00:42:15:18 --> 00:42:16:21 è dal vento.
748 00:42:16:26 --> 00:42:19:05 The idea is you have low-speed, high-density wind	748 00:42:16:26 --> 00:42:19:05 L'idea è che hai vento a bassa velocità e ad alta densità	811 00:42:16:26 --> 00:42:19:05 L’idea è di avere vento a bassa velocità e ad alta densità

749
00:42:19:07 --> 00:42:21:19
coming at you, collect
that with a wind turbine,

750
00:42:21:21 --> 00:42:23:20
and then directly transfer
that to the wheels

751
00:42:23:22 --> 00:42:27:12
to drive you at low speed, high torque.

752
00:42:27:28 --> 00:42:30:22
You want to directly use that wind energy

753
00:42:30:23 --> 00:42:33:28
to move yourself mechanically
around the surface of Venus.

754
00:42:35:01 --> 00:42:37:20
- We have the sensors on the surface.

755
00:42:37:28 --> 00:42:39:18
We have the radio on the surface.

756
00:42:39:23 --> 00:42:43:13
But most of the processing
power, most of the computers,

757
00:42:43:16 --> 00:42:45:15
most of the things that run the mission

749
00:42:19:07 --> 00:42:21:19
venendo da te, prenditelo
con una turbina eolica,

750
00:42:21:21 --> 00:42:23:20
e poi trasferirlo direttamente
alle ruote

751
00:42:23:22 --> 00:42:27:12
per guidare a bassa velocità e coppia elevata.

752
00:42:27:28 --> 00:42:30:22
Volete usare direttamente quell'energia eolica

753
00:42:30:23 --> 00:42:33:28
Per muoversi meccanicamente
intorno alla superficie di Venere.

754
00:42:35:01 --> 00:42:37:20
- Abbiamo i sensori in superficie.

755
00:42:37:28 --> 00:42:39:18
Abbiamo la radio in superficie.

756
00:42:39:23 --> 00:42:43:13
Ma la maggior parte della
potenza di elaborazione, la maggior parte dei computer,

757
00:42:43:16 --> 00:42:45:15
la maggior parte delle cose che gestiscono la
missione

812
00:42:19:07 --> 00:42:21:19
che viene verso di te,
raccoglierlo con una turbina eolica

813
00:42:21:21 --> 00:42:23:20
e poi trasferirlo direttamente alle ruote

814
00:42:23:22 --> 00:42:27:12
per farti guidare a bassa velocità, alta intensità.

815
00:42:27:28 --> 00:42:30:22
Bisogna utilizzare direttamente quell'energia eolica

816
00:42:30:23 --> 00:42:33:28
per muoversi meccanicamente
sulla superficie di Venere.

817
00:42:35:01 --> 00:42:37:20
- Abbiamo i sensori sulla superficie.

818
00:42:37:28 --> 00:42:39:18
Abbiamo la radio sulla superficie.

819
00:42:39:23 --> 00:42:43:13
Ma la maggior parte della potenza di
elaborazione, la maggior parte dei computer,

820
00:42:43:16 --> 00:42:45:15
la maggior parte delle cose che gestiscono la
missione

758 00:42:45:24 --> 00:42:47:06 would be high overhead.	758 00:42:45:24 --> 00:42:47:06 sarebbe alto.	821 00:42:45:24 --> 00:42:47:06 sarebbero in alto.
759 00:42:47:22 --> 00:42:49:28 We could either put them perhaps in an airplane	759 00:42:47:22 --> 00:42:49:28 Potremmo metterli su un aereo	822 00:42:47:22 --> 00:42:49:28 Potremmo metterli forse su un aereo
760 00:42:50:00 --> 00:42:54:10 flying 50 kilometers above, or maybe in a satellite.	760 00:42:50:00 --> 00:42:54:10 volare 50 chilometri sopra, o forse in un satellite.	823 00:42:50:00 --> 00:42:54:10 che vola a 50 chilometri di altezza, o forse in un satellite.
761 00:42:54:12 --> 00:42:56:04 (propellers clicking)	761 00:42:54:12 --> 00:42:56:04 (le eliche scattano)	824 00:42:54:12 --> 00:42:56:04 (eliche che scattano)
762 00:42:56:05 --> 00:42:58:12 The winds of Venus are pretty ferocious.	762 00:42:56:05 --> 00:42:58:12 I venti di Venere sono piuttosto feroci.	825 00:42:56:05 --> 00:42:58:12 I venti di Venere sono piuttosto feroci.
763 00:42:58:14 --> 00:43:01:22 The winds of Venus are going 100 meters per second.	763 00:42:58:14 --> 00:43:01:22 I venti di Venere stanno andando a 100 metri al secondo.	826 00:42:58:14 --> 00:43:01:22 I venti di Venere vanno a 100 metri al secondo.
764 00:43:02:08 --> 00:43:04:20 Well, one thing we could do is just fly around	764 00:43:02:08 --> 00:43:04:20 Beh, una cosa che potremmo fare e' volare in giro	827 00:43:02:08 --> 00:43:04:20 Beh, una cosa che potremmo fare è volare intorno
765 00:43:04:27 --> 00:43:07:10 and let the wind take us where the wind takes us,	765 00:43:04:27 --> 00:43:07:10 e lasciamo che il vento ci porti dove ci porta il vento,	828 00:43:04:27 --> 00:43:07:10 e lasciare che il vento ci porti dove il vento ci porta,
766 00:43:07:20 --> 00:43:10:12 as long as we can fly faster than that wind	766 00:43:07:20 --> 00:43:10:12 basta che riusciamo a volare più veloce di quel vento	829 00:43:07:20 --> 00:43:10:12 purché riusciamo a volare più velocemente di quel vento

767 00:43:10:16 --> 00:43:12:10 so we can stay in the sunlight.	767 00:43:10:16 --> 00:43:12:10 così possiamo rimanere alla luce del sole.	830 00:43:10:16 --> 00:43:12:10 in modo da rimanere alla luce del sole.
768 00:43:14:28 --> 00:43:18:17 (dramatic music) (singers vocalizing)	768 00:43:14:28 --> 00:43:18:17 (musica drammatica) (cantanti che cantano)	831 00:43:14:28 --> 00:43:18:17 (musica drammatica) (cantanti che vocalizzano)
769 00:43:18:19 --> 00:43:21:02 - [Narrator] Venus's extreme surface heat	769 00:43:18:19 --> 00:43:21:02 - [Narrator] l'estremo calore superficiale di Venere	832 00:43:18:19 --> 00:43:21:02 *- L'estremo calore della superficie di Venere*
770 00:43:21:07 --> 00:43:24:26 drives a blustery atmosphere of toxic acid rain.	770 00:43:21:07 --> 00:43:24:26 guida un'atmosfera blustosa di pioggia acida tossica.	833 00:43:21:07 --> 00:43:24:26 *provoca un'atmosfera burrascosa* *di pioggia acida tossica.*
771 00:43:24:27 --> 00:43:27:17 (lightning clapping) (thunder rumbling)	771 00:43:24:27 --> 00:43:27:17 (battito di fulmini) (battito di tuono)	834 00:43:24:27 --> 00:43:27:17 (battito di fulmini) (tuono)
772 00:43:27:18 --> 00:43:29:00 But the planet lies within	772 00:43:27:18 --> 00:43:29:00 Ma il pianeta è dentro	835 00:43:27:18 --> 00:43:29:00 *Ma il pianeta è all'interno*
773 00:43:29:02 --> 00:43:32:08 what astronomers would think of as the habitable zone.	773 00:43:29:02 --> 00:43:32:08 quello che gli astronomi penserebbero come la zona abitabile.	836 00:43:29:02 --> 00:43:32:08 *di quella che gli astronomi considerano* *la zona abitabile.*
774 00:43:34:10 --> 00:43:35:25 - Venus is a really interesting case	774 00:43:34:10 --> 00:43:35:25 - Venere è un caso davvero interessante	837 00:43:34:10 --> 00:43:35:25 - Venere è un caso davvero interessante
775 00:43:35:27 --> 00:43:40:10 because it forces us to think of where is the inner edge	775 00:43:35:27 --> 00:43:40:10 perché ci costringe a pensare a dove si trova il bordo interno	838 00:43:35:27 --> 00:43:40:10 perché ci costringe a pensare a dove sia il limite interno

776 00:43:40:13 --> 00:43:41:20 of the habitable zone.	776 00:43:40:13 --> 00:43:41:20 della zona abitabile.	839 00:43:40:13 --> 00:43:41:20 della zona abitabile.
777 00:43:41:22 --> 00:43:43:20 Presumably now, in our solar system,	777 00:43:41:22 --> 00:43:43:20 Presumibilmente ora, nel nostro sistema solare,	840 00:43:41:22 --> 00:43:43:20 Presumibilmente ora, nel nostro sistema solare,
778 00:43:43:22 --> 00:43:46:14 it’s somewhere between Earth and Venus.	778 00:43:43:22 --> 00:43:46:14 E' da qualche parte tra la Terra e Venere.	841 00:43:43:22 --> 00:43:46:14 è da qualche parte tra la Terra e Venere.
779 00:43:46:29 --> 00:43:49:00 And yet, there was a time earlier	779 00:43:46:29 --> 00:43:49:00 Eppure, c'era un tempo prima	842 00:43:46:29 --> 00:43:49:00 Eppure, c’è stato un periodo precedente
780 00:43:49:14 --> 00:43:51:13 in the life of our solar system	780 00:43:49:14 --> 00:43:51:13 nella vita del nostro sistema solare	843 00:43:49:14 --> 00:43:51:13 nella vita del nostro sistema solare
781 00:43:51:17 --> 00:43:54:04 when Venus was within the habitable zone,	781 00:43:51:17 --> 00:43:54:04 Quando Venere era all'interno della zona abitabile,	844 00:43:51:17 --> 00:43:54:04 in cui Venere era all’interno della zona abitabile,
782 00:43:54:06 --> 00:43:56:24 when there probably was an ocean on Venus.	782 00:43:54:06 --> 00:43:56:24 Quando probabilmente c'era un oceano su Venere.	845 00:43:54:06 --> 00:43:56:24 quando probabilmente c’era un oceano su Venere. 846 00:43:57:10 --> 00:44:02:60 Marte antico Visualizzazione topografica
783 00:43:56:26 --> 00:43:59:18 (dramatic music) (singer vocalizing)	783 00:43:56:26 --> 00:43:59:18 (musica drammatica) (voce cantante)	847 00:43:56:26 --> 00:43:59:18 (musica drammatica) (cantante che vocalizza) 848 00:44:00:50 --> 00:44:04:20 Voce di: **Lori Glaze** - HO Divisione di scienze planetarie della NASA

784 00:43:59:20 --> 00:44:01:01 - [Lori] Mars, we think at some point,	784 00:43:59:20 --> 00:44:01:01 - Marte, pensiamo ad un certo punto,	849 00:43:59:20 --> 00:44:01:01 - Marte, pensiamo che ad un certo punto,
785 00:44:01:03 --> 00:44:02:20 used to have more atmosphere	785 00:44:01:03 --> 00:44:02:20 una volta aveva più atmosfera	850 00:44:01:03 --> 00:44:02:20 avesse più atmosfera
786 00:44:02:22 --> 00:44:05:05 and was potentially warmer and wetter.	786 00:44:02:22 --> 00:44:05:05 ed era potenzialmente più caldo e umido.	851 00:44:02:22 --> 00:44:05:05 e fosse potenzialmente più caldo e umido.
		852 00:44:07:60 --> 00:44:12:45 Venere antico Visualizzazione topografica
787 00:44:06:07 --> 00:44:08:17 And Venus probably had less atmosphere,	787 00:44:06:07 --> 00:44:08:17 E Venere probabilmente aveva meno atmosfera,	853 00:44:06:07 --> 00:44:08:17 E Venere probabilmente aveva meno atmosfera,
788 00:44:08:19 --> 00:44:09:23 at some point in the past,	788 00:44:08:19 --> 00:44:09:23 ad un certo punto del passato,	854 00:44:08:19 --> 00:44:09:23 ad un certo punto in passato,
789 00:44:09:25 --> 00:44:13:08 and had significantly more water than we see today,	789 00:44:09:25 --> 00:44:13:08 e aveva molta più acqua di quella che vediamo oggi,	855 00:44:09:25 --> 00:44:13:08 e aveva molta più acqua di quella che vediamo oggi,
790 00:44:13:10 --> 00:44:15:08 which today it seems very, very dry.	790 00:44:13:10 --> 00:44:15:08 che oggi sembra molto, molto secco.	856 00:44:13:10 --> 00:44:15:08 che oggi sembra molto, molto secco.
791 00:44:15:26 --> 00:44:18:13 And so it’s possible, when Venus did have less atmosphere,	791 00:44:15:26 --> 00:44:18:13 E quindi è possibile, quando Venere aveva meno atmosfera,	857 00:44:15:26 --> 00:44:18:13 E quindi è possibile che, quando Venere aveva meno atmosfera,
792 00:44:18:16 --> 00:44:21:15 it was habitable when it had more water available	792 00:44:18:16 --> 00:44:21:15 era abitabile quando aveva più acqua disponibile	858 00:44:18:16 --> 00:44:21:15 fosse abitabile quando aveva più acqua disponibile

793 00:44:21:22 --> 00:44:23:00 and less atmosphere.	793 00:44:21:22 --> 00:44:23:00 e meno atmosfera.	859 00:44:21:22 --> 00:44:23:00 e meno atmosfera.
794 00:44:23:03 --> 00:44:25:20 We very definitely think that it has changed over time.	794 00:44:23:03 --> 00:44:25:20 Siamo convinti che sia cambiato nel tempo.	860 00:44:23:03 --> 00:44:25:20 Siamo convinti che sia cambiato nel tempo.
795 00:44:25:22 --> 00:44:31:19 (soft dramatic music) (lava crackling)	795 00:44:25:22 --> 00:44:31:19 (musica soft drammatica) (lava crackling)	861 00:44:25:22 --> 00:44:31:19 (musica soft e drammatica) (crepitio della lava)
796 00:44:31:21 --> 00:44:34:00 - [Narrator] Looking out in our Milky Way galaxy,	796 00:44:31:21 --> 00:44:34:00 - [Narrator] guardando la nostra galassia della via Lattea,	862 00:44:31:21 --> 00:44:34:00 *- Guardando nella nostra galassia* *della Via Lattea,*
797 00:44:34:20 --> 00:44:37:13 astronomers are seeking a broader understanding	797 00:44:34:20 --> 00:44:37:13 gli astronomi stanno cercando una comprensione più ampia	863 00:44:34:20 --> 00:44:37:13 *gli astronomi stanno cercando* *una comprensione più ampia*
798 00:44:37:15 --> 00:44:41:06 of how planets form and what conditions can nurture	798 00:44:37:15 --> 00:44:41:06 di come si formano i pianeti e di quali condizioni possono nutrire	864 00:44:37:15 --> 00:44:41:06 *di come si formano i pianeti* *e quali condizioni possono nutrire*
799 00:44:41:08 --> 00:44:42:16 an Earth-like world.	799 00:44:41:08 --> 00:44:42:16 Un mondo simile alla Terra.	865 00:44:41:08 --> 00:44:42:16 *un mondo simile alla Terra.*
800 00:44:44:08 --> 00:44:46:23 All other exoplanets lie too far away	800 00:44:44:08 --> 00:44:46:23 Tutti gli altri esopianeti sono troppo lontani	866 00:44:44:08 --> 00:44:46:23 *Tutti gli altri esopianeti sono troppo lontani*
801 00:44:46:25 --> 00:44:48:08 for us to know much about them.	801 00:44:46:25 --> 00:44:48:08 per noi sapere molto su di loro.	867 00:44:46:25 --> 00:44:48:08 *perché noi possiamo saperne qualcosa.*

802 00:44:50:00 --> 00:44:52:06 But Venus is giving scientists a chance	802 00:44:50:00 --> 00:44:52:06 Ma Venere sta dando una possibilità agli scienziati	868 00:44:50:00 --> 00:44:52:06 *Ma Venere sta dando agli scienziati la possibilità*
803 00:44:52:08 --> 00:44:55:28 to understand the alien planet next door.	803 00:44:52:08 --> 00:44:55:28 per capire il pianeta alieno qui accanto.	869 00:44:52:08 --> 00:44:55:28 *di capire il pianeta alieno qui accanto.*
804 00:44:59:29 --> 00:45:02:08 (gentle music) (singer vocalizing)	804 00:44:59:29 --> 00:45:02:08 (musica dolce) (voce cantante)	870 00:44:59:29 --> 00:45:02:08 (musica dolce) (cantante che vocalizza)
805 00:45:02:11 --> 00:45:06:21 (water sloshing)	805 00:45:02:11 --> 00:45:06:21 (sciabordio dell'acqua)	871 00:45:02:11 --> 00:45:06:21 (acqua che scorre)
806 00:45:06:24 --> 00:45:10:20 - There's probably millions, likely billions, of planets	806 00:45:06:24 --> 00:45:10:20 - Probabilmente ci sono milioni, probabilmente miliardi, di pianeti	872 00:45:06:24 --> 00:45:10:20 - Ci sono probabilmente milioni, forse miliardi, di pianeti
807 00:45:10:28 --> 00:45:13:08 that are like Earth and like Venus.	807 00:45:10:28 --> 00:45:13:08 Sono come la Terra e come Venere.	873 00:45:10:28 --> 00:45:13:08 che sono come la Terra e come Venere.
808 00:45:13:17 --> 00:45:15:07 And we'd like to understand	808 00:45:13:17 --> 00:45:15:07 E vorremmo capire	874 00:45:13:17 --> 00:45:15:07 E vorremmo capire
809 00:45:15:08 --> 00:45:19:08 what made the one turn into a hot desert.	809 00:45:15:08 --> 00:45:19:08 cosa l'ha fatto diventare un deserto caldo.	875 00:45:15:08 --> 00:45:19:08 cosa ha fatto diventare uno un deserto caldo.
810 00:45:24:21 --> 00:45:25:29 And Earth, on the other hand,	810 00:45:24:21 --> 00:45:25:29 E la Terra, d'altra parte,	876 00:45:24:21 --> 00:45:25:29 E la Terra, d'altra parte,
811 00:45:26:01 --> 00:45:29:16 turn into a planet with liquid water and habitable for life.	811 00:45:26:01 --> 00:45:29:16 trasformatevi in un pianeta con acqua liquida e abitabile per la vita.	877 00:45:26:01 --> 00:45:29:16 diventare un pianeta con acqua liquida e abitabile per la vita.

812 00:45:29:18 --> 00:45:35:28 (soft dramatic music)	812 00:45:29:18 --> 00:45:35:28 (musica soft e drammatica)	878 00:45:29:18 --> 00:45:35:28 (musica soft e drammatica)
813 00:45:36:00 --> 00:45:38:18 - Different aspects of Venus's evolutionary history	813 00:45:36:00 --> 00:45:38:18 - Diversi aspetti della storia evolutiva di Venere	879 00:45:36:00 --> 00:45:38:18 - Diversi aspetti della storia evolutiva di Venere
814 00:45:38:20 --> 00:45:40:25 would put it into the habitable zone.	814 00:45:38:20 --> 00:45:40:25 lo metterebbe nella zona abitabile.	880 00:45:38:20 --> 00:45:40:25 lo collocherebbero nella zona abitabile.
815 00:45:40:27 --> 00:45:42:26 Then that tells the exoplanet astronomers	815 00:45:40:27 --> 00:45:42:26 Allora questo dice agli astronomi esopianeti	881 00:45:40:27 --> 00:45:42:26 Allora questo dice agli astronomi degli esopianeti
816 00:45:42:29 --> 00:45:44:18 that they should not just discard these worlds	816 00:45:42:29 --> 00:45:44:18 che non dovrebbero semplicemente scartare questi mondi	882 00:45:42:29 --> 00:45:44:18 che non dovrebbero semplicemente scartare questi mondi
817 00:45:44:20 --> 00:45:46:18 as hot inhospitable planets,	817 00:45:44:20 --> 00:45:46:18 come caldi pianeti inospitali,	883 00:45:44:20 --> 00:45:46:18 come pianeti caldi e inospitali,
818 00:45:46:20 --> 00:45:48:28 and that they should go take a look at them.	818 00:45:46:20 --> 00:45:48:28 e che dovrebbero andare a vederli.	884 00:45:46:20 --> 00:45:48:28 e che dovrebbero andare a dare un'occhiata.
819 00:45:49:01 --> 00:45:51:11 And that would expand the idea of the habitable zone	819 00:45:49:01 --> 00:45:51:11 E questo amplierebbe l' idea della zona abitabile	885 00:45:49:01 --> 00:45:51:11 E questo amplierebbe l'idea della zona abitabile
820 00:45:51:14 --> 00:45:53:10 to much closer reaches to the star	820 00:45:51:14 --> 00:45:53:10 molto più vicino alla stella	886 00:45:51:14 --> 00:45:53:10 a distanze molto più vicine alla stella
821 00:45:53:13 --> 00:45:55:08 than we would otherwise think.	821 00:45:53:13 --> 00:45:55:08 di quanto penseremmo altrimenti.	887 00:45:53:13 --> 00:45:55:08 di quanto si possa pensare.

822 00:45:55:10 --> 00:46:01:16 (gentle music) (water sloshing)	822 00:45:55:10 --> 00:46:01:16 (musica delicata) (sciabordio d'acqua)	888 00:45:55:10 --> 00:46:01:16 (musica dolce) (acqua che scorre)
823 00:46:01:19 --> 00:46:02:28 - When we look out in the galaxy	823 00:46:01:19 --> 00:46:02:28 - Quando guardiamo alla galassia	889 00:46:01:19 --> 00:46:02:28 - Quando guardiamo nella galassia
824 00:46:03:00 --> 00:46:04:15 and we see all these Earth-like planets,	824 00:46:03:00 --> 00:46:04:15 E vediamo tutti questi pianeti simili alla Terra,	890 00:46:03:00 --> 00:46:04:15 e vediamo tutti questi pianeti simili alla Terra,
825 00:46:04:18 --> 00:46:06:05 we're looking for another Earth, right?	825 00:46:04:18 --> 00:46:06:05 Stiamo cercando un'altra Terra, giusto?	891 00:46:04:18 --> 00:46:06:05 stiamo cercando un'altra Terra, giusto?
826 00:46:06:06 --> 00:46:10:18 We're looking for another place that is like our own.	826 00:46:06:06 --> 00:46:10:18 Stiamo cercando un altro posto che sia come il nostro.	892 00:46:06:06 --> 00:46:10:18 Stiamo cercando un altro posto che sia come il nostro.
827 00:46:11:22 --> 00:46:14:06 We're looking at Earth-sized planets	827 00:46:11:22 --> 00:46:14:06 Stiamo guardando pianeti di dimensioni terrestri	893 00:46:11:22 --> 00:46:14:06 Stiamo guardando pianeti di dimensioni terrestri
828 00:46:14:12 --> 00:46:16:08 and the closest Earth-sized planet	828 00:46:14:12 -> 00:46:16:08 E il pianeta più vicino delle dimensioni della Terra	894 00:46:14:12 -> 00:46:16:08 e il pianeta più vicino delle dimensioni terresti
829 00:46:16:10 --> 00:46:18:02 happens to be the closest planet to Earth.	829 00:46:16:10 -> 00:46:18:02 Si dà il caso che sia il pianeta più vicino alla Terra.	895 00:46:16:10 -> 00:46:18:02 si dà il caso sia il pianeta più vicino alla Terra.
830 00:46:18:04 --> 00:46:21:13 (laughs) It's Venus. It's right there.	830 00:46:18:04 --> 00:46:21:13 (Ride) è Venere. È proprio lì.	896 00:46:18:04 --> 00:46:21:13 (ride) È Venere. È proprio lì.
831 00:46:21:14 --> 00:46:25:20 So it tells us about how Earth-sized planets form	831 00:46:21:14 --> 00:46:25:20 Quindi ci dice come si formano i pianeti delle dimensioni della Terra	897 00:46:21:14 --> 00:46:25:20 Quindi, ci dice come i pianeti di dimensioni terrestri si formano

832 00:46:25:22 --> 00:46:27:04 and whether or not they’re habitable.	832 00:46:25:22 --> 00:46:27:04 e che siano abitabili o meno.	898 00:46:25:22 --> 00:46:27:04 e se sono abitabili o meno.
833 00:46:27:12 --> 00:46:34:09 (gentle music) (singer vocalizing)	833 00:46:27:12 --> 00:46:34:09 (musica dolce) (voce cantante)	899 00:46:27:12 --> 00:46:34:09 (musica dolce) (cantante che vocalizza)
834 00:46:35:22 --> 00:46:40:16 (soft dramatic music)	834 00:46:35:22 --> 00:46:40:16 (musica soft e drammatica)	900 00:46:35:22 --> 00:46:40:16 (musica soft e drammatica)
835 00:46:40:18 --> 00:46:44:15 - [Narrator] Two planets born together,	835 00:46:40:18 --> 00:46:44:15 - [Narrator] due pianeti nati insieme,	901 00:46:40:18 --> 00:46:44:15 *- Due pianeti nati insieme,*
836 00:46:46:05 --> 00:46:48:17 nearly the same size and mass.	836 00:46:46:05 --> 00:46:48:17 quasi la stessa dimensione e massa.	902 00:46:46:05 --> 00:46:48:17 *quasi la stessa dimensione e massa.*
837 00:46:49:05 --> 00:46:51:08 (lava crackling)	837 00:46:49:05 --> 00:46:51:08 (scricchiolio di lava)	903 00:46:49:05 --> 00:46:51:08 (crepitio della lava)
838 00:46:51:10 --> 00:46:53:02 Built of the same stuff.	838 00:46:51:10 --> 00:46:53:02 Costruito con le stesse cose.	904 00:46:51:10 --> 00:46:53:02 *Fatti delle stesse cose.*
839 00:46:57:21 --> 00:47:01:24 At the start of their lives, each harbored oceans,	839 00:46:57:21 --> 00:47:01:24 All'inizio della loro vita, ogni oceano ospitava,	905 00:46:57:21 --> 00:47:01:24 *All’inizio della loro vita,* *ciascuno ospitava oceani*
840 00:47:04:08 --> 00:47:06:22 and atmospheres laden with water vapor.	840 00:47:04:08 --> 00:47:06:22 e atmosfere cariche di vapore acqueo.	906 00:47:04:08 --> 00:47:06:22 *e atmosfere cariche di vapore acqueo.*
841 00:47:16:15 --> 00:47:20:24 Over time, one increasingly draped itself	841 00:47:16:15 --> 00:47:20:24 Nel corso del tempo, si è sempre più drappeggiato	907 00:47:16:15 --> 00:47:20:24 *Nel corso del tempo, uno si è sempre più rivestito*

842 00:47:20:26 --> 00:47:22:26 in the greens and blues of life.	842 00:47:20:26 --> 00:47:22:26 nel verde e nel blu della vita.	908 00:47:20:26 --> 00:47:22:26 *dei verdi e dei blu della vita.*
843 00:47:28:11 --> 00:47:32:06 While the other became enshrouded in a toxic haze.	843 00:47:28:11 --> 00:47:32:06 Mentre l'altro era avvolto da una foschia tossica.	909 00:47:28:11 --> 00:47:32:06 *Mentre l'altro* *è stato avvolto da una foschia tossica.*
844 00:47:37:10 --> 00:47:41:00 Its surface paved over with volcanic outpourings.	844 00:47:37:10 --> 00:47:41:00 La sua superficie è lastricata di formazioni vulcaniche.	910 00:47:37:10 --> 00:47:41:00 *La sua superficie è lastricata* *di formazioni vulcaniche.*
845 00:47:48:23 --> 00:47:53:06 Which type of world is most common in the cosmos?	845 00:47:48:23 --> 00:47:53:06 Quale tipo di mondo è più comune nel cosmo?	911 00:47:48:23 --> 00:47:53:06 *Quale tipo di mondo è più comune* *nel cosmo?*
846 00:47:58:16 --> 00:48:00:02 - We know a lot about Mars.	846 00:47:58:16 --> 00:48:00:02 Sappiamo molto su Marte.	912 00:47:58:16 --> 00:48:00:02 - Sappiamo molto su Marte.
847 00:48:00:16 --> 00:48:02:20 We've sent a dozen probes to Mars.	847 00:48:00:16 --> 00:48:02:20 Abbiamo inviato una dozzina di sonde su Marte.	913 00:48:00:16 --> 00:48:02:20 Abbiamo inviato una dozzina di sonde su Marte.
848 00:48:02:21 --> 00:48:04:25 We've sent rovers across the surface.	848 00:48:02:21 --> 00:48:04:25 Abbiamo inviato i rover in superficie.	914 00:48:02:21 --> 00:48:04:25 Abbiamo inviato dei rover sulla superficie.
849 00:48:05:11 --> 00:48:07:24 But Venus, we have very little knowledge of,	849 00:48:05:11 --> 00:48:07:24 Ma Venere, abbiamo pochissime conoscenze,	915 00:48:05:11 --> 00:48:07:24 Ma di Venere, abbiamo pochissime conoscenze,
850 00:48:09:07 --> 00:48:11:20 so we need to start learning how to go to Venus.	850 00:48:09:07 --> 00:48:11:20 Quindi dobbiamo iniziare a imparare ad andare a Venere.	916 00:48:09:07 --> 00:48:11:20 quindi dobbiamo prima di tutto capire come andare su Venere.

851 00:48:12:14 --> 00:48:14:07 Learn about the circulation of Venus,	851 00:48:12:14 --> 00:48:14:07 Conoscere la circolazione di Venere,	917 00:48:12:14 --> 00:48:14:07 Conoscere la sua circolazione,
852 00:48:14:10 --> 00:48:17:13 learn about the climate, learn about the weather.	852 00:48:14:10 --> 00:48:17:13 impara a conoscere il clima, impara a conoscere il clima.	918 00:48:14:10 --> 00:48:17:13 conoscere il clima, conoscere il tempo.
853 00:48:18:21 --> 00:48:21:06 Venus needs to be not the forgotten planet	853 00:48:18:21 --> 00:48:21:06 Venere non deve essere il pianeta dimenticato	919 00:48:18:21 --> 00:48:21:06 Venere non deve essere il pianeta dimenticato
854 00:48:21:08 --> 00:48:22:12 in the solar system.	854 00:48:21:08 --> 00:48:22:12 nel sistema solare.	920 00:48:21:08 --> 00:48:22:12 nel sistema solare.
855 00:48:24:03 --> 00:48:27:16 If we understand Venus, we learn about the Earth.	855 00:48:24:03 --> 00:48:27:16 Se capiamo Venere, scopriremo la Terra.	921 00:48:24:03 --> 00:48:27:16 Se comprendiamo Venere, impariamo a conoscere la Terra.
856 00:48:27:24 --> 00:48:33:27 (soft dramatic music)	856 00:48:27:24 --> 00:48:33:27 (musica soft e drammatica)	922 00:48:27:24 --> 00:48:33:27 (musica soft e drammatica)
857 00:48:33:29 --> 00:48:37:26 - I imagine, imaged with the right kind of whatever drone	857 00:48:33:29 --> 00:48:37:26 Immagino, con il giusto tipo di drone	923 00:48:33:29 --> 00:48:37:26 - Immagino che, con il giusto tipo di drone
858 00:48:37:28 --> 00:48:41:22 or spacecraft or even humans ultimately going there	858 00:48:37:28 --> 00:48:41:22 o veicoli spaziali o anche umani che alla fine ci vanno	924 00:48:37:28 --> 00:48:41:22 o navicella spaziale o anche umani che alla fine ci vanno
859 00:48:41:24 --> 00:48:43:27 in very well-protected suits,	859 00:48:41:24 --> 00:48:43:27 in tute molto ben protette,	925 00:48:41:24 --> 00:48:43:27 con tute molto ben protette,
860 00:48:44:07 --> 00:48:46:10 when we get to see it in the right way,	860 00:48:44:07 --> 00:48:46:10 quando lo vedremo nel modo giusto,	926 00:48:44:07 --> 00:48:46:10 quando riusciremo a vederlo nel modo giusto,

861 00:48:46:12 --> 00:48:48:16 we’re gonna be like, “Wow, nobody told us.	861 00:48:46:12 --> 00:48:48:16 Faremo: "Wow, nessuno CE l'ha detto.	927 00:48:46:12 --> 00:48:48:16 faremo tipo: “Wow, nessuno ce l’aveva detto”.
862 00:48:48:18 --> 00:48:51:10 “This place is beautiful and it’s massive.”	862 00:48:48:18 --> 00:48:51:10 "Questo posto è bellissimo ed è enorme."	928 00:48:48:18 --> 00:48:51:10 “Questo posto è bellissimo ed è enorme.”
863 00:48:51:14 --> 00:48:53:22 Remember, there’s much more land area on Venus	863 00:48:51:14 --> 00:48:53:22 Ricorda, c'è molto più terreno su Venere	929 00:48:51:14 --> 00:48:53:22 Ricorda, c’è molta più superficie terrestre su Venere
864 00:48:53:24 --> 00:48:56:26 than there is on Earth since Earth is two-thirds ocean,	864 00:48:53:24 --> 00:48:56:26 Di quanto ci sia sulla Terra, visto che la Terra è due terzi dell'oceano,	930 00:48:53:24 --> 00:48:56:26 di quanta ce ne sia sulla Terra, visto che la Terra è per due terzi oceano,
865 00:48:56:29 --> 00:49:00:07 and it’s going to be just a thrilling place to explore fully	865 00:48:56:29 --> 00:49:00:07 e sarà solo un luogo emozionante da esplorare a fondo	931 00:48:56:29 --> 00:49:00:07 e sarà un luogo emozionante da esplorare a fondo
866 00:49:00:09 --> 00:49:01:14 when we get the opportunity.	866 00:49:00:09 --> 00:49:01:14 quando ne avremo l'opportunità.	932 00:49:00:09 --> 00:49:01:14 quando ne avremo l’opportunità.
867 00:49:01:16 --> 00:49:05:28 (soft dramatic music)	867 00:49:01:16 --> 00:49:05:28 (musica soft e drammatica)	933 00:49:01:16 --> 00:49:08:40 (musica soft e drammatica)
868 00:49:11:18 --> 00:49:13:16 (light music)	868 00:49:11:18 --> 00:49:13:16 (musica leggera)	934 00:49:11:18 --> 00:49:13:16 (musica lieve)

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RIASSUNTO

La presente tesi, dal titolo *"Venus: Death of a Planet": Post-Editing a Documentary*, si pone l'obiettivo di esplorare il mondo del post-editing (PE) nel momento in cui viene associato alla traduzione audiovisiva (TAV). Nello specifico, il contenuto audiovisivo scelto è un documentario riguardante l'ambito astronomico e intitolato "Venus: Death of a Planet". Si tratta di un documentario americano, prodotto da David Brody e Thomas Lucas, della durata di 50 minuti e distribuito per la prima volta nel 2020. Attualmente può essere trovato su IMDb, MagellanTV, Apple TV, YouTube e Amazon Prime, anche se in quest'ultima piattaforma è disponibile solo in America. Su YouTube, la piattaforma che ho utilizzato, è stato pubblicato da un canale americano chiamato "SpaceRip", in cui si possono trovare numerosi contenuti di ambito astronomico. Per quanto riguarda la lingua, attualmente è disponibile solo in lingua inglese e i sottotitoli ufficiali sono in inglese americano in tutte le piattaforme sopra menzionate, anche se YouTube dà anche la possibilità di poterlo guardare con dei sottotitoli generati automaticamente in diverse lingue, tra cui l'italiano. Questa limitazione è stata proprio una delle motivazioni che mi hanno portata inizialmente a scegliere questo documentario nello specifico, così da poter fornire una traduzione italiana il più accurata possibile e rendere accessibile questo contenuto anche alle persone madrelingua italiana che non hanno una buona padronanza dell'inglese. La seconda ragione ha a che vedere, invece, con un aspetto più personale, in quanto il mondo dell'astronomia mi affascina sin da piccola. Per questo motivo, ho voluto lavorare con il linguaggio specializzato dell'astronomia, del quale avevo solo delle basi, ma che grazie a questo lavoro ho potuto approfondire e che, al tempo stesso, mi ha permesso di approcciarmi ad una nuova tecnica di traduzione in cui non mi ero mai cimentata finora. Questo documentario in particolare ha subito accesso la mia curiosità, sia perché tratta dell'affascinante storia del pianeta Venere, il pianeta più vicino alla terra ma inabitabile per noi esseri umani, sia perché all'interno del documentario sono presenti numerosi interventi di esperti che parlano della storia di Venere insieme a svariati esperimenti che sono stati fatti o che si potrebbero fare in futuro per scoprire cos'è andato storto su Venere e se e come potremmo vivere in questo pianeta.

La presente tesi è strutturata in quattro capitoli. I primi tre capitoli delineano il contesto teorico, mentre il quarto si focalizza sull'analisi e il commento del lavoro di post-editing.

Il primo capitolo si concentra sulla TAV, innanzitutto definendo questo concetto come un termine generico utilizzato per riferirsi alla traduzione di contenuti audiovisivi. Dopodiché, lo stesso concetto viene descritto da un punto di vista storico, a partire dai film muti degli anni '20, al primo film sonoro del 1927, intitolato *The Jazz Singer,* fino tutte le novità introdotte nell'ambito audiovisivo che hanno contribuito al suo sviluppo e che hanno portato ad un graduale cambiamento delle sue norme e linee guida. Tra queste novità, il CD-ROM e il DVD (Digital Versatile Disc) negli anni '90, lo sviluppo dei computer negli anni '80 e la globalizzazione degli anni '90, il servizio di video on demand (VoD) che rimpiazzò quasi completamente i DVD, e, infine, le più recenti piattaforme come Netflix, Amazon e HBO.

Le principali tipologie di TAV descritte in questo capitolo sono il sottotitolaggio, il doppiaggio, di cui fanno parte anche il fansub, il fandub e la sincronizzazione labiale, il voice-over o voce fuori campo, e il respeaking, chiamato anche rispeakeraggio in italiano. Per quanto riguarda il sottotitolaggio, una distinzione importante è quella tra sottotitoli interlinguistici e sottotitoli intralinguistici. La maggiore differenza tra i due riguarda il fatto che, mentre i sottotitoli interlinguistici prevedono una traduzione scritta dei dialoghi da una lingua di partenza ad una lingua di arrivo, i sottotitoli intralinguistici vengono proposti nella stessa lingua dei dialoghi, quindi senza alcuna traduzione. I sottotitoli devono seguire delle convenzioni per essere accurati, come le convenzioni spaziali e temporali, secondo cui i sottotitoli devono essere disposti orizzontalmente in fondo allo schermo e devono essere sincronizzati con le immagini e i dialoghi. Inoltre, essi devono essere anche coerenti, logici, sintatticamente corretti e facili da leggere, requisiti che solitamente vengono messi a punto nei processi chiamati "spotting" e "line-breaking". Rispetto al doppiaggio, invece, è importante sottolineare che in Europa i paesi che lo prediligono sono quelli in cui si parlano le cosiddette lingue FIGS, ovvero il francese, l'italiano, il tedesco e lo spagnolo. Insieme a questi paesi, anche la Repubblica Ceca, la Slovacchia e l'Ungheria utilizzano il doppiaggio, mentre la Polonia, la Russia, l'Ungheria e i paesi baltici preferiscono il voice-over. Il sottotitolaggio è invece usato in tutti gli altri paesi. In merito al voice-over, sembra esserci una correlazione tra

quest'ultimo e il doppiaggio. Nonostante ciò, queste due pratiche differiscono per il fatto che voice-over viene usato per tradurre i dialoghi mentre si è in onda, mentre il doppiaggio viene effettuato fuori onda. Parlando di voice-over nello specifico, solitamente questa tecnica segue tre principali regole. La prima riguarda il tempo, in quanto il voice-over deve essere eseguito in un breve lasso di tempo, la seconda ha a che vedere con il fatto che la traduzione debba essere fatta direttamente dallo schermo, mentre secondo la terza i traduttori sono tenuti a lavorare con materiale inedito che verrà poi tradotto e controllato da altri professionisti in un secondo momento. Infine, il respeaking è la produzione di sottotitoli in tempo reale attraverso dei software di riconoscimento vocale che effettuano una traduzione simultanea del testo di partenza (TP) dettato dal respeaker.

Il primo capitolo si conclude con un approfondimento dedicato all'accessibilità ai media nella TAV, riguardante in particolar modo il sottotitolaggio per i non udenti e l'audiodescrizione per persone cece e ipovedenti. Essendoci una differenza tra le due condizioni, anche la ricezione dei sottotitoli sarà diversa. Infatti, per i non udenti i sottotitoli sono principalmente un supporto e un esercizio per la memoria, mentre per le persone cece e ipovedenti sono l'unico modo in cui possono accedere ai contenuti audiovisivi. Per questo motivo, ci sono alcuni elementi chiave che vengono inseriti per aiutare e facilitare la lettura dei sottotitoli a queste persone, come l'uso di colori diversi per identificare i vari oratori o l'aggiunta di particolari simboli per segnalare che qualcuno sta cantando o che c'è della musica in sottofondo.

Nel secondo capitolo, l'automazione e la TAV sono i due punti focali. Per prima cosa vengono definiti i concetti di memoria di traduzione e traduzione automatica (Machine Translation). Da una parte, la memoria di traduzione è un database che memorizza segmenti di testi precedentemente tradotti, dall'altra la traduzione automatica è la traduzione eseguita da un computer che utilizza un software adeguato e che traduce un testo scritto in una lingua di partenza in un altro testo nella lingua di arrivo. Dopodichè, vengono elencati e descritti i diversi tipi di traduzione automatica, quali la ruled-based machine translation (RBMT), l'example-based machine translation, la segment-based machine translation, la statistical machine translation (SMT) e la neural machine translation (NMT). La prima tipologia, ovvero la RBMT, si pone come obiettivo quello di definire le caratteristiche della lingua di partenza e come queste debbano essere

convertite nelle lingue di arrivo. Sia la SMT che la NMT sono delle cosiddette "data-driven machine translation" che permettono di identificare i problemi di traduzione a livello di segmento nelle unità di traduzione conservate nelle memorie di traduzione e in altri corpora paralleli. Mentre le example-based machine translation e le segment-based machine translation sono funzionali solo quando sono coinvolte lingue simili, in quanto solitamente condividono strutture linguistiche parallele, come accade per il francese e l'inglese o per il tedesco e l'inglese.

Un'altra questione trattata in questo capitolo è quella dell'intelligenza artificiale (IA), la cui prima definizione ufficiale fu data da John McCarthy e Marvin Lee Minsky nel 1956, secondo i quali l'IA è la scienza di far fare alle macchine cose che richiederebbero intelligenza se fatte dagli uomini. Al giorno d'oggi, l'IA viene utilizzata in molteplici settori, come quelli della comunicazione, della sanità, del controllo delle malattie, dell'istruzione, dell'agricoltura, dei trasporti, dell'esplorazione spaziale, della scienza e dell'intrattenimento. In particolare, la sua applicazione ha a che fare con tre categorie principali, che sono l'aggregazione di informazioni, strumenti pratici e i servizi.

Infine, viene descritto il processo chiave di questo lavoro, ovvero il post-editing (PE) applicato alla TAV. Il PE consiste in un lavoro di elaborazione linguistica bilingue che di solito viene svolto da traduttori professionisti definiti "post-editors". Il PE si divide in "light post-editing" e "full post-editing", in cui nel primo vengono fatte solo le correzioni essenziali e solitamente è un processo rapido, mentre nel secondo vengono corretti tutti gli errori incontrati dalla traduzione della traduzione automatica. Un'altra importante distinzione è quella tra "monolingual post-editing" e "bilingual post-editing", tra cui la differenza sostanziale riguarda il fatto che il "bilingual post-editing" fa una comparazione tra il TP e il TA, mentre il "monolingual post-editing" non prende in considerazione il TP. Di particolare rilevanza è l'International Standards Organisation (ISO), in quanto si occupa di fornire una guida per la valutazione del post-editing. Nel dettaglio, lo standard ISO 18587:2017, chiamato "Translation services – Post-editing for machine translation output – Requirements", è quello che si occupa della traduzione automatica e del PE nello specifico. Le linee guida che propone riguardano il fatto che il lavoro di post-editing debba essere comprensibile, che il contenuto del TP corrisponda a quello di destinazione e che il post-editor deve sempre rispettare i requisiti e le specifiche concordate. Per quanto riguarda il PE applicato alla TAV, ci sono tre processi

fondamentali che devono essere presi in considerazione, ovvero lo "spotting", la sincronizzazione e l'accesso al contenuto audiovisivo. Nel sottotitolaggio, in particolare, il post-editing solitamente segue il tasso di errore delle parole o metrica WER (Word error rate). Il modello utilizzato più di frequente è invece il "FAR model", in base al quale le tre aree principali da tenere a mente sono l'equivalenza funzionale, l'accettabilità dei sottotitoli e la loro leggibilità.

Il terzo capitolo si concentra sulla traduzione specializzata e sulle lingue speciali. Innanzitutto, è importante sottolineare che il linguaggio per scopi specifici (Language for Specific Purposes) ha a che vedere con varietà linguistiche funzionali che dipendono da un campo specializzato di conoscenza o da una sfera di attività e che vengono utilizzate da un piccolo gruppo di parlanti per soddisfare le esigenze comunicative di quel determinato campo specializzato. Le lingue speciali, inoltre, hanno una terminologia diversa e delle caratteristiche testuali, sintattiche e lessicali specializzate rispetto al linguaggio per scopi generali (Language for General Purposes). Nonostante ciò, alcune caratteristiche delle lingue speciali possono essere incontrate anche nel linguaggio comune e ci sono alcuni ambiti in cui le lingue speciali hanno influenzato particolarmente questo linguaggio, soprattutto a livello lessicale, come succede per i giornali, la televisione e altri mezzi di comunicazione di massa. Al tempo stesso, il linguaggio specializzato richiede un vocabolario specializzato, che costruisce a partire dalla lingua comune ma anche dalle lingue regionali, da alcune lingue straniere e dalle lingue classiche, specialmente greco e latino. La categoria che distingue maggiormente questo linguaggio da quello comune è sicuramente il lessico, in quanto deve necessariamente essere un lessico specializzato, e il quale permette anche di differenziare i diversi linguaggi specializzati tra di loro, come il linguaggio scientifico, il linguaggio giuridico, il linguaggio della tecnologia. Il discorso specializzato è formato da alcuni tratti caratteristici. In primis i tratti lessicali, che sono la monoreferenzialità, l'assenza di emozione, la precisione, la trasparenza, la concisione, il conservatorismo, la ridondanza, la relazione con il linguaggio comune, le metafore e la produttività lessicale. Altri tratti caratteristici riguardano la sintassi e, in particolare, l'omissione degli elementi frasali, la concisione espressiva, la pre-modificazione, la nominalizzazione, la densità lessicale, la complessità della frase, la lunghezza della frase, l'uso dei tempi verbali, l'uso del passivo e la depersonalizzazione. Nel momento in cui si vuole tradurre il linguaggio specializzato,

ci sono alcuni accorgimenti a cui fare attenzione. Innanzitutto, la traduzione deve passare attraverso due fasi principali, ovvero una prima fase preparatoria in cui si prende confidenza con il testo da tradurre e con il tema trattato e in cui si cominciano ad individuare possibili errori, e una seconda fase operativa in cui viene effettuata la traduzione vera e propria. In questa seconda fase, il traduttore deve sempre fare riferimento alle strategie testuali, sintattiche e lessicali per produrre una traduzione accurata. Per esempio, quando si traduce un testo dall'inglese all'italiano, bisogna tenere a mente che l'italiano è una lingua orientata verso l'autore, mentre l'inglese è orientata verso il lettore. Questo fa sì che in italiano ci sia un maggior bisogno di formalità, generalizzazioni, depersonalizzazioni e passivizzazioni rispetto all'inglese. Inoltre, è importante anche sottolineare che esistono diversi tipi di specializzazione in base al pubblico di riferimento, ovvero un testo può essere scritto da esperti per esperti, oppure da esperti per semi-esperti, o, ancora, da esperti per non esperti del tema trattato. In base al livello di specializzazione del pubblico a cui ci si riferisce, il testo sarà più o meno specializzato.

Due tipi di linguaggio specializzato che vengono definiti in questo capitolo sono il linguaggio scientifico e il linguaggio astronomico, in quanto oggetti del documentario scelto e, di conseguenza, del lavoro di post-editing. Da un lato, il linguaggio scientifico è preciso, chiaro e privo di ambiguità. È caratterizzato da affermazioni impersonali, ragionamenti logici e descrizioni accurate. In inglese, in particolare, il vocabolario scientifico è ricco di parole derivanti dal greco e dal latino, come conseguenza dell'evoluzione della scienza e delle nuove scoperte scientifiche. Il linguaggio astronomico, d'altro canto, riguarda tutto ciò che ha a che fare con il mondo dello spazio e con oggetti che possono essere visti solo attraverso il telescopio o strumenti simili. Questo linguaggio è ricco di parole provenienti soprattutto dal greco, a partire dal termine "astronomia" che contiene due parole greche al suo intero, "Astron" (astro) e "Nomos" (legge).

A concludere questo capitolo è la descrizione del concetto di divulgazione scientifica, il quale spesso viene fatto coincidere con la diffusione di conoscenze specialistiche a scopo educativo o informativo. Una delle caratteristiche chiave per distinguere i testi di divulgazione scientifica dai testi scientifici specializzati è il pubblico a cui questi due diversi tipi di testi fanno riferimento. A questa caratteristica si affianca il

focus principale che questi due tipi di testi hanno, in quanto solitamente i testi di divulgazione scientifica sono indirizzati ad un pubblico non esperto e si tratta di testi pedagogici, riviste scientifiche di divulgazione, libri pubblicati per un ampio pubblico, videocassette e articoli specializzati su quotidiani, mentre i testi scientifici specializzati hanno un target più ristretto e il linguaggio utilizzato è spesso molto settoriale.

Il quarto e ultimo capitolo è incentrato sull'analisi del lavoro di post-editing. Come prima cosa, viene chiarito che l'obiettivo finale di questa tesi consiste nell'identificare i maggiori punti di forza e di debolezza della traduzione automatica quando viene applicata alla TAV e al sottotitolaggio in particolare.

Il lavoro è diviso in due fasi fondamentali, ovvero una prima fase di traduzione, effettuata tramite la traduzione automatica del CAT tool *Trados*, chiamata Language Weaver, la quale, più precisamente, è una "neural machine translation (NMT)". La seconda fase, invece, riguarda il lavoro di post-editing, realizzato con *Trados Subtitling*, un plug-in di *Trados*. In questa seconda fase, le questioni salienti incontrate sono riportate e divise per categorie, ovvero segmentazione e convenzioni di scrittura, registro, espressioni idiomatiche, terminologia e fraseologia, linguaggio e grammatica, aggiunte e traduzioni errate, traduzioni inconsistenti e, infine, sottotitoli non tradotti e omessi.

Per quanto riguarda la segmentazione e le convenzioni di scrittura, alcune modifiche fatte durante la fase di post-editing riguardano la scelta di aver applicato il corsivo a tutti i sottotitoli riferiti al narratore e di aver inserito un trattino ogni volta che un esperto comincia il suo intervento, così da rendere visivamente chiaro che il narratore o un esperto sta parlando. Un'altra soluzione che si può adottare in questi casi è quella di differenziare i vari speaker attraverso l'uso di colori diversi. Tuttavia, questo non è stato possibile in quanto *Trados* non permette di aggiungere dei nuovi colori ai vari segmenti se questi colori non sono già presenti nel TP. Altri esempi riguardo questa categoria hanno a che fare con dei casi comuni in cui *Trados* aggiunge automaticamente la lettera minuscola quando incontra un elemento che precede una frase, in quanto non riconosce che quel particolare elemento sia a sé stante e non l'inizio effettivo della frase. Al contrario, ci sono casi in cui aggiunge automaticamente la lettera maiuscola all'inizio di un segmento perché non comprende che si tratta di segmenti facenti parte della stessa frase. Un caso interessante è riferito alla punteggiatura, infatti spesso *Trados* utilizza degli accenti che in italiano risultano errati.

Rispetto al registro, i casi più comuni hanno a che fare con l'insufficiente uso di formalità, generalità e impersonalità di cui necessita l'italiano essendo una lingua orientata verso l'autore. Allo stesso modo, l'uso della forma passiva e del pronome impersonale "si" non sono stati spesso applicati in modo adeguato o non applicati affatto.

Gli errori riguardanti le forme idiomatiche sono molteplici e diversi tra loro. Alcuni si riferiscono alla traduzione errata di alcuni modi di dire che spesso sono stati tradotti letteralmente, altri hanno a che fare con delle scelte personali di utilizzare la stessa traduzione per lo stesso termine o lo stesso verbo, soprattutto se si trovano in segmenti consecutivi così da mantenere lo stesso effetto retorico del TP, altri ancora comprendono la traduzione di termini che non hanno senso in italiano o che, addirittura, non esistono.

Tutte le questioni sopracitate tendenzialmente interessano soprattutto l'accurata e la corretta traduzione dei sottotitoli, ma non influenzano la loro comprensione e la facilità di lettura generale. Questo tendenzialmente vale anche per i casi riguardanti la terminologia e la fraseologia, i quali si riferiscono in particolar modo a delle traduzioni scorrette di termini provenienti dal linguaggio specializzato dell'astronomia, segno che *Trados* non riconosce questo tipo di linguaggio quando lo incontra. Ci sono, però, un paio di casi che influiscono sulla comprensione generale dei sottotitoli, soprattutto quando la traduzione proposta non ha un senso logico in italiano.

Sicuramente, però, gli esempi riportati nella sezione dedicata agli errori linguistici e grammaticali sono quelli in cui una traduzione sbagliata o poco accurata impatta maggiormente sulla comprensibilità totale dei sottotitoli. Ciò succede specialmente nei casi di traduzioni completamente sbagliate e in quelli di traduzioni inconsistenti, in quanto l'intero significato della frase viene travisato e, di conseguenza, la leggibilità e la comprensione dei sottotitoli risultano più difficili se non impossibili. Dei casi particolarmente interessanti riguardano degli esempi in cui la traduzione suggerita da *Trados* risulta sbagliata perché i segmenti riportati nel TP sono sbagliati in primo luogo. Di fatti, in questi casi la correzione viene segnalata nel testo di post-editing, ma viene anche sottolineato il fatto che la traduzione automatica sia erronea solo perché il testo da tradurre è in partenza sbagliato.

Infine, in merito ai sottotitoli non tradotti, si tratta di sottotitoli che sono stati erroneamente lasciati in inglese dalla traduzione automatica e che, per tanto, non hanno una traduzione italiana corrispondente. Bensì siano errori sporadici, nel momento in cui

li si incontra risultano completamenti scollegati dal resto della frase e, per questo, creano confusione al pubblico che li sta leggendo. Mentre, i casi collegati a sottotitoli omessi si riferiscono ad esempi abbastanza frequenti di sottotitoli che non solo non sono stati tradotti dalla traduzione automatica, ma non sono nemmeno presenti nel TP. Precisamente, si tratta di parti di testo che appaiono nello schermo, riguardanti principalmente indicazioni di spazio e tempo, termini astronomici specifici o parole che vogliono essere enfatizzate, e informazioni sui vari esperti che stanno facendo il loro intervento, che non sono state inserite nel TP e, per questo, non sono state tradotte dalla traduzione automatica.