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HAYABUSA 2 ASTEROID SAMPLE RETURN

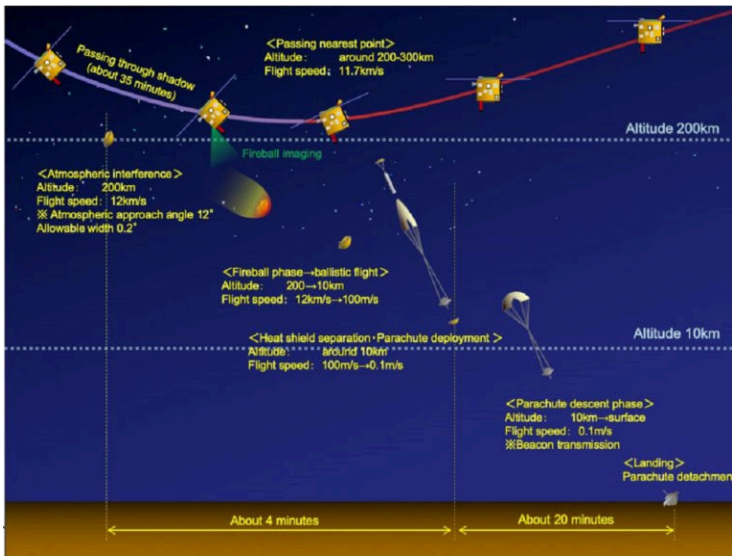
By Umberto Cavallaro

In 2020, after a journey of more than six years and over five billion kilometres, the expected uncontaminated samples of extraterrestrial rocks from Ryugu *(see note 1)* finally arrived. They were parachuted into Australia by the Japanese Hayabusa-2 spacecraft, which flew over our planet at an altitude of about 200 km above the Earth's atmosphere and, after releasing the container containing the precious fragments in the “forbidden zone” of Woomera - the historic military polygon of southern Australia - promptly resumed its fascinating journey of Solar System exploration.

On 6 December 2020, after a thorough search, the JAXA helicopter located and recovered the precious container, which was secured by JAXA technicians and taken to Tokyo for initial analysis. In 2021, the samples were distributed to 6 groups of scientists in different countries for in-depth study.

The Japanese probe Hayabusa-2 (はやぶさ, “peregrine falcon” in Japanese) was launched on 3 December 2014 from the Tanegashima

Jaxa recovery crew.



Hayabusa-2 return schedule.

Space Centre with the aim of studying the Solar System.

Italian Scientists

Italian scientists were also part of the team for this incredible mission, including Stefania Soldini, responsible for the trajectory design (at JAXA since 2016), several researchers from the INAF (National Institute for Astrophysics), including Ernesto Palomba, co-investigator of the ONC (Optical Navigation Camera) in Rome, and Davide Perna, co-investigator with Palomba of the NIRS3 infrared spectrometer.

Towards the end of June 2018, after 1302 days of interplanetary travel, the “Falcon” approached its prey and entered the orbit of the asteroid Ryugu. It began studying the small asteroid to identify the most suitable place to

The capsule with the samples collected by the Hayabusa2 probe on the asteroid Ryugu has landed in Australia, from where it has been taken to Japan to analyze its solid content (such as the black sand grains seen in the last image) and gaseous content.

land and collect soil samples for return to Earth. Thirteen suitable areas were identified and given names from children's stories, mostly Japanese.

Samples from the asteroid were collected in two stages in February and July 2019. The first samples were taken directly from the surface, the second from the subsurface after a bullet had created a small crater to reveal material that had not been altered by cosmic radiation.

Major Transformations

Until then, the only extraterrestrial body from which we had taken samples was essentially the Moon *(see note 2)*. It has been shown that the Moon, like all large celestial bodies, has undergone major transformations and profound changes during its life due to internal thermal processes, developing crusts, mantles and cores, and is unable to provide any information about the origin of the Solar System itself.

Asteroids, on the other hand, have preserved the characteristics of the primordial Solar System due to their small size, and can be considered as "celestial fossils" that have undergone very few changes in the last 4.5 billion years, leaving aside the discussion about the different types of asteroids that exist.

Solar Nebula

Asteroid Ryugu is a peculiar diamond-shaped body less than a kilometre in diameter.

Scientists have high hopes for these fragments, which could tell us much about the history of the Solar System and provide clues to the origin of life on Earth. Earth, like the other solar planets, was formed from the small rocky bodies of the original "Solar Nebula".

Asteroids are the remnants of this long process. By studying asteroids, scientists hope to unlock many secrets about the formation of the Solar System and answer the key question:

Japan issued a stamp in 2008 for the Hayabusa 2 (left) and a cover (right).

"Did the building blocks of life evolve on Earth, or were they already present in this nebula?"

Building Blocks of Life

If the building blocks of life were already present in the nebula, we should be able to find traces of them on Ryugu. And if we discover that they were already there at the time of the Earth's birth, that would mean that life could be much more common in the Universe than we think.

Sample-return missions are therefore opening up a new and important chapter in research that will touch on several areas.

After analysing the material returned by Hayabusa-2, scientists will compare the data with those obtained from the samples taken from the asteroid Bennu by NASA's Osiris Rex spacecraft, which returned to Earth in 2023.

This mission also includes an important Italian contribution, provided by the INAF (National Institute for Astrophysics).

Asteroid explorations will become more frequent in the coming years, including the Lucy (launch 16 October 2021) and Psyche (launch 13 October 2023) missions by NASA. We will discuss this further in due course.

Note 1: Ryugu ("Dragon Palace" in Japanese) is a small asteroid 280 million km from Earth.

Note 2: In fact, some very small fragments were returned by the first Hayabusa-1 spacecraft that visited the Itokawa asteroid in 2005, and fragments were recovered from the Wild-2 comet in 2006 at the end of NASA's Stardust mission. But they didn't provide any useful data.

Three first day covers for the Hayabusa 2.