Contribution ID: **3** Type: **Oral**

Asteroid composition: recent results by the JAXA Hayabusa2 and NASA OSIRIS-REx missions

Monday 21 October 2019 16:45 (40 minutes)

The investigation of asteroids remains one of the major topics of planetary science. As primitive leftover building blocks of the solar system formation process, they offer clues to the chemical mixture from which the planets formed some 4.6 billion years ago and provide information on the development of life on Earth.

Several asteroids have been observed by space missions, but the majority of knowledge on asteroid composition is obtained, still today, by ground spectroscopy and analysed as taxonomic trends. The taxonomical classes have been defined and associated to meteorites, giving the asteroid mineralogy composition on the basis of meteoritic laboratory analysis. Nevertheless, about 2/3 of the mass of the asteroid belt seems absent from our meteorite collections, in particular for those taxonomical classes associated to the dark primitive objects, rich in volatiles and organics.

The two missions Hayabusa2 and OSIRIS-REx, respectively launched by JAXA and NASA, will return samples from the primitive asteroids Ryugu and Bennu to revolutionize our understanding of the primitive matter of the solar system.

Ryugu and Bennu have primitive surfaces with very dark albedo (4.4 % and 4.5 % respectively) (Watanabe et al. 2019, Science 364, 268, and Lauretta et al. 2019, Nature 568, 55). Both objects have a spinning-top shape with an equatorial ridge, low density, and high porosity and are consistent with a rubble-pile structure.

The analysis of the present missions'data shows two objects with different compositional and geomorphological properties. The preliminary spectroscopic data for both asteroids show spectral similarity with those of CM and/or CI meteorites. However, Bennu has a higher content of water-bearing minerals. The discovery of particle ejection from Bennu's surface by the OSIRIS-Rex team indicate that Bennu is an active asteroid.

The samples returned to Earth from the two asteroids, together with the data analysis from the Rosetta and Stardust missions, will allow us to better understand the origin of the solar system and the relation between asteroids and comets.

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Session Classification: Solar System