Rosetta - on the hunt for our origin

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The reason for the name of the Rosetta mission is linked to a concept that dates back some 40 years. According to this concept, crucial information about the origin of the Solar System can be gained by sending spacecraft to Solar System objects that have been left unaltered by geological evolution. Reading the message of such primitive objects may be as enlightening as was once the deciphering of the hieroglyphs with the aid of the Rosetta stone.

The idea is thus that such objects may retain the primordial material that they were built of, in contrast to the Earth where all rocks are products of magmatic or sedimentary processes that reflect the evolution of our planet and its surface layers (the lithosphere and hydrosphere).

On the other hand, many meteorites are known to consist of a mix of chemical elements that is virtually identical to that in the surface layers of the Sun. Such a composition is obviously unaffected by any earthly, or planetary processes so that we may indeed be dealing with the solid material that the planets were made of. So where do the meteorites come from? Asteroids were suspected long ago, and this suspicion has grown ever stronger and turned into virtual knowledge with the new findings of the last decades.

The idea of a space mission to seek our origin by going to an object made of primitive material has always had a place on the scientific agenda of space research. But the question of which object to go to has not been very easy to answer. In the early days, the Moon was thought to be a possible target, but the analysis of lunar samples from the Apollo missions in the early 1970's showed that these rocks are not primitive at all. Attention then turned to the small bodies of the Solar System - asteroids and comets.

But the asteroids showed a range of spectral behaviour reminiscent of all kinds of meteorites - not only the primitive ones but also those that have resulted from a planet-like evolution, like iron meteorites or stony irons. One therefore has to exert great care when selecting the target asteroid of such an ambitious mission.

Of immense importance was the exploration of comets that took off with the international flotilla of spacecraft to Halley's comet in 1986. The most successful of those was the European one - ESA's Giotto mission. Perhaps the most significant result was that this famous comet seemed to be made of grains very much like those that once existed in the presolar cloud, i.e., the interstellar cloud of gas and dust from which the Solar System formed.

This picture has been strengthened by spectral analysis of several later comets, especially Hyakutake and Hale-Bopp. The mix of molecules in a cometary nucleus has turned out to be very similar to that of the present star-forming clouds in the Galaxy (today's counterparts of the presolar nebula), and the ice that carries these molecules seems to be amorphous rather than crystalline - just like we expect from the presolar grains.

There are two important consequences of this. One is that a Rosetta mission really worthy of its name has to be launched to a comet, and the other is that such a mission may take on an even deeper significance than one had ever thought of. The cometary material is so primitive that it may even predate the formation of the Solar System and take us back to our origin in its deepest sense.

This makes it understandable that comets have been chosen as targets, not only for the ESA Rosetta mission but for several ongoing or planned US missions as well, like Stardust and Deep Impact. If successful, these will all bring precious information about the structure and formation of cometary nuclei - the oldest witnesses of the formation of the Solar System. Furthermore, they will be complementary so the scientific return will be maximised. But, no doubt, the most ambitious and potentially revealing of them all is Rosetta. ■

Part of the Rosetta Stone, with the hieroglyphs as are the basis for much of the knowledge about our culture.
Picture: ESA

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