INVESTIGATION OF ANTARCTIC METEORITES AND SELECTED CARBONACEOUS CHONDRITES BY RAMAN SPECTROSCOPY, ELECTRON MICROSCOPY AND MASS SPECTROMETRY

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Introduction: Concordia Antarctic micrometeorites (MMs) are micrometer-sized particles collected in Antarctic snow that are likely originating from asteroids and comets [1,2]. These samples, coming from primitive bodies (i.e. that have suffered low secondary processes), may have preserved information of the early stages of the Solar system. We analyzed three MMs from the Concordia collection (DC06-07-54, DC06-07-162 and DC06-09-249) and compare their mineralogical and elemental composition as well as the nature of their organic material with five selected carbonaceous chondrites with the goal of classifying them among meteorites families.

Methods: The MMs were deposited without pressing on gold targets of 1 cm x 1cm. They were first measured by Raman micro-spectroscopy using a Witec Alpha 3000 microscope and a 532 nm laser, with a spatial resolution of about 1 µm x 1 µm. We applied a low power (less than 2 mW) in order to preserve the samples from heating. We also acquired mappings at different depths in order to retrieve the 3D composition of the samples. The MMs have then been mapped by Energy Dispersive X-Ray Spectroscopy (EDX) in order to obtain the 2D elemental composition of the samples. Finally, Time-Of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS) data were acquired with the ground replica of the Rosetta instrument COSIMA [3] in order to compare the laboratory data with the composition of cometary dust particles collected and measured in situ in the inner coma of comet 67P/Churyumov-Gerasimenko.

Five carbonaceous chondrite samples (CI Orgueil, CM Murchison, CR Renazzo, CO Lancé and CV Allende) were mounted and pressed on a gold target. The 5 meteorites were analyzed with the same protocol as for the MMs.

Results and discussion: The three MMs show very diverse compositions. DC06-07-54 is composed of anhydrous silicates (olivine and pyroxenes) with small inclusions of anorthite and also contains Fe-sulfides and Fe-oxides. Its carbonaceous material, analyzed by Raman spectroscopy, shows similarity with the carbonaceous material of CI and CM chondrites. DC06-07-162 contains sulfates and Fe-oxides, which might result from aqueous alteration on its parent body. The Raman signatures of its carbonaceous material are very similar to the ones obtained for the CR chondrite Renazzo. DC06-09-249 shows only pyroxene and Fe oxides, has a very smooth texture and lacks organic material. This MM could either have suffered a high thermal alteration on its parent body or during atmospheric entry, or be related to ordinary chondrites.

The particle DC06-07-54 has a porous texture, does not show by-products of aqueous alteration (phyllosilicates, carbonates or sulfates) and its organic material shows similarities with the one of CI and CM chonrites.These characterisitcs are the closest to the properties of the cometary particles collected by COSIMA since these particles have a porous texture [4,5,6], they do not show evidence for aqueous alteration [7] and contain an organic material that shares similarity with the Insoluble Organic Matter extracted from carbonaceous chondrites [8,9].

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