STUDY OF A SERIES OF FINE-GRAINED AMMs: MULTI-ANALYTICAL CHARACTERIZATION AND COMPARISON WITH CARBONACEOUS CHONDRITES

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Introduction: Micrometeorites are extraterrestrial micrometric particles that survived their atmospheric entry. Being the dominant contribution of extraterrestrial matter on Earth [1], they complete the sampling of small bodies of the Solar System represented by meteorites, Interplanetary Dust Particles and samples returned by space missions. Here, we report on the analysis of a series of Antarctic micrometeorites (AMMs) from the Concordia collection [2]. The present work is focused on the organic matter and hydration state of the AMMs in comparison to primitive chondrites. Our objective is to have a better appraisal of compositional variability across cosmomaterials.

Samples and methods: We considered a series of 58 AMMs from the Concordia 2006 and 2016 collections. This set of AMMs provides a large range of textural types reflecting different intensities of heating experienced during the atmospheric entry [3]: 40 unmelted fine-grained particles (Fgs), 12 particles intermediate partially melted (Fg-Scs), 1 partially melted scoriaceous particle (Sc) and 5 completely melted cosmic spherules (CSs). Each of these AMMs were characterized by Raman and IR spectroscopy [4]. Raman spectroscopy, sensitive to the structure of the polyaromatic carbonaceous matter, allows to constrain the thermal history of each sample and to distinct asteroidal thermal metamorphism from atmospheric flash heating. IR spectroscopy allows to characterize the aliphatic organic matter as well as the hydration state and the mineralogy of each sample. The bulk carbon and nitrogen isotopic composition of some Fg-AMMs were also determined (NanoSIMS). Systematic comparison with CM, CR and CI carbonaceous chondrites were led. We also performed some heating experiments of chondritic matrix grains, that we subsequently characterized through the same analytical sequence. Altogether these analytical and experimental results allow to disentangle modification induced by post-accretion processes and by atmospheric entry.

Results and discussion: The combination of Raman and IR techniques reveals differences among AMMs in terms of abundance, structure and chemical composition of the organic matter, mineralogy and hydration state. Heating laboratory experiments, on CM, CR and CI carbonaceous chondrite matrices, confirm that the atmospheric entry can induce : a dehydration of the samples, a decrease in the abundance of organic material and a structural modification of polyaromatic organic matter. The identification of Fgs-AMMs that are non-hydrated reveals that, in spite of their fine-grained texture, they may have experienced significant heating during the atmospheric entry. This study clearly shows that the hydration state and the organic matter are tracers of heating experienced by the micrometeorites during their atmospheric entry more sensitive than their texture [4]. We identified seven Fgs-AMMs that are hydrated and appear as the least affected by the atmospheric entry. Intrinsic differences, which cannot be explained by the atmospheric entry, are also revealed between those and CM, CR and CI chondrites. These differences are *(i)* a specific spectral signature of silicates in IR, *(ii)* enrichment in polyaromatic and aliphatic organic matter in comparison to chondrites and *(iii)* different characteristics of the aliphatic organic matter. Moreover, the analysis of the bulk isotopic composition of carbon and nitrogen shows large variabilities among AMMs, in contrast with observations among carbonaceous chondrites. All of these intrinsic differences are explained here as AMMs and carbonaceous chondrites having most likely sampled distinct parent bodies [4].

References: [1] Love S. G. and Brownlee D. E. (1993) *Science*, 262: 550. [2] Duprat J. et al. (2007) *Advances in Space Research*, 39: 605-611. [3] Genge M. J. et al. (2008) *Meteoritics and Planetary Science*, 43: 497-515. [4] Battandier M. et al. (2018) Icarus 306: 74-93.