

# Localized aqueous alteration of an UltraCarbonaceous Antarctic MicroMeteorite: Earliest stages of cometary alteration

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UltraCarbonaceous Antarctic MicroMeteorites (UCAMMs) represent a small fraction of interplanetary dust particles reaching the Earth's surface and contain large amounts of organic matter not found elsewhere [1-2]. UCAMMs most probably originate from comets, as suggested by large amounts of carbonaceous matter that can be locally enriched in deuterium by a factor of ~15 relative to SMOW [1]. Similar particles containing large amounts of carbonaceous matter were detected in comet 1P/Halley in 1986 [3], and organic molecules enriched in deuterium have been found in comet Hale-Bopp [4]. Previous transmission electron microscopy studies of UCAMMs revealed mineral assemblages consisting mainly of anhydrous minerals embedded within the organic matter [1-2]. However, several studies indicate the presence of varied hydrous phases in these pristine Antarctic micrometeorites, which suggest that these samples record an early stage of aqueous activity [2, 5].

The purpose of this study is to provide mineralogical and petrographic details of the mineral assemblages embedded within the organic matter of UCAMMs, using transmission electron microscopy. The objective is to understand the formation mechanisms of carbonates and assess the potential role of fluids in the earliest stages of cometary alteration. We characterize the mineralogy of one UCAMM, focusing on the association of aqueous alteration phases and primitive anhydrous materials. Three focused ion beam sections were prepared from the UCAMM, focusing on the regions that contain Ca carbonate. The Ca carbonates are associated with Ni-rich and Ni-poor sulfides, phyllosilicates, and numerous primitive Glass with Embedded Metal and Sulfides objects. Previous studies describing this UCAMM indicate the absence of hydrated phases other than carbonates [2]. However, this newly analyzed fragment from the same micrometeorite shows the presence of different phases formed in the presence of aqueous fluids suggesting a high heterogeneity of materials at the micrometer scale and indicating a very localized aqueous alteration in these samples.

[1] Duprat J. et al. (2010) *Science*, 328,742.

[2] Dobrică et al. (2012) *Geochim. Cosmochim. Acta*, 76, 68-82.

[3] Lawler and Brownlee (1992) *Nature*, 359, 810.

[4] Meier et al. (1998) *Science* 279, 1707-1710.

[5] Guérin B. et al (2020) *Lunar Planet. Sci.* 51, #2117.