A PRIMITIVE MICROMETEORITE WITH AFFINITIES TO CV3 CHONDRITE MATRIX

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Introduction: Micrometeorites (MMs) are that fraction of the Earth's extraterrestrial dust flux that survive atmospheric entry and are recovered from the Earth's surface. The majority of MMs represent interplanetary dust and are thought to include samples of both asteroids and comets [e.g. 1]. Previous studies have suggested that most unmelted MMs (MMs) have affinities to matrix and chondrules from CM2 and ordinary chondrites [1]. Particles with affinities to CV3 chondrules have suggested by oxygen isotope studies [e.g. 2], however, their abundance has is likely to be low since CV3 matrix, which is mineralogically distinctive, has not been previously identified amongst fine-grained particles [3]. This paper reports the first discovery of a fine-grained MM (FgMM) with mineralogical similarities to CV3/CO3 chondrite matrix.

Results: Particle CP94-050-081 is a FgMM collected from Antarctic blue ice and part of a collection of 730 MMs. Characterisation of mineralogy by analytical TEM reveals it is dominated by a porous matrix of rounded, equant fayalitic olivines (Fa_{40}), 1-0.2 μm in size, with interstitial masses of ferrihydrite and smectite. Olivine grains contain abundant inclusions of Ni-bearing sulphides, up to 0.1 μm in size, and exhibit strain shadows and domains. Analytical SEM observations reveal the presence of sub-rounded granular aggregates of olivine up to 10 microns in size. An embayed enstatite crystal, 10 μm in size, is also present in the particle.

Discussion: The high abundance of fayalitic olivine, the presence of smectite, Ni-bearing sulphides, and embayed Mg-silicates together with its fine-grained porous nature strongly resembles the matrices of CV3 chondrites [4]. In detail, however, the rounded morphology of the fayalitic olivines and their high density of crystal defects is distinct from these meteorites.

The presence of Ni-bearing sulphides implies the particle is extraterrestrial, however, the high abundance of fayalitic olivine is observed in scoriaceous MMs (ScMM) heated in the atmosphere. The occurrence of defects within olivine, however, indicates minimal heating during atmospheric entry, precluding an origin as an etched fragment of a ScMM.

Several stages of parent body evolution can be inferred: (1) metasomatic/aqueous fayalite formation, (2) annealing to generate granular masses, (3) shock metamorphism, and (4) low temperature, incipient aqueous alteration. These processes are broadly consistent with those of the CV3 parent body and support suggestions that the CV3 parent body experienced two phases of aqueous alteration interrupted by collisional disruption [4].

Conclusion: The discovery of CP94-050-081 implies that particles from CV3 or CO3 parent bodies are present amongst MMs. The low abundance of such materials is consistent with suggestions that the high inclination asteroid families such as Eos are the parent bodies of CV3 and CO3 chondrites.

References: [1] Genge M. J. et al. 2008. *MAPS*, 43:497-515. [2] Gounelle M. et al. 2005. *MAPS* 40:917-932. [3] Genge M. J. 2008. *MAPS*, 36, 687-690. [4] Jogo K. et al. 2009. *EPSL*, 287, 320-328.