A NEW MICROMETEORITE COLLECTION FROM ANTARCTICA AND ITS PRELIMINARY CHARACTERIZATION BY MICROOBSERVATION, MICROANALYSIS AND MAGNETIC METHODS.

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Introduction: In December 2003, the meteorite recovery party of the XIX PNRA expedition collected, hundreds of micrometeorites in the 100-800 µm size range from aeolian deposits at the top of Frontier Mountain (northern Victoria Land, Antarctica), a glacially eroded surface that may be as old as a few Myr. Micrometeorites embedded in sand were discovered thanks to a magnetic gradiometer, and magnetically extracted. Such large and well preserved population of micrometeorites offers a good opportunity to test and develop a magnetic classification procedure, in parallel to "classical" mineralogical and geochemical characterization (SEM, EMP).

After SEM imaging (Fig. 1), magnetic measurements were performed on individual particles with diameter above 150 µm. EDAX detectable Ni and Cr contents of the particles confirm their extraterrestrial origin. Hysteresis loop parameters, magnetic susceptibility and demagnetization of isothermal remanence at saturation were obtained on single particles.

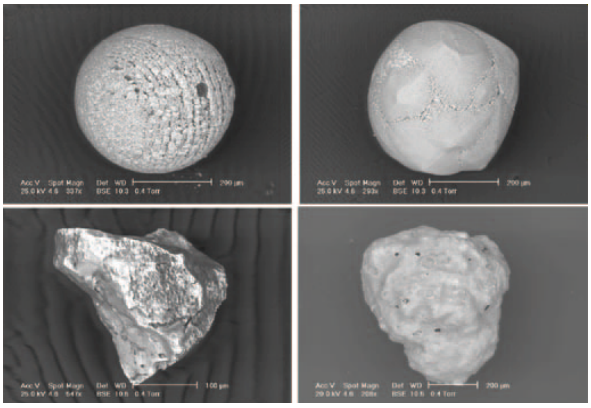

Figure 1. Backscattered SEM images of four micrometeorites collected at Frontier Mountain. Scale bar is 200 µm, 100 µm for lower left picture.

First results.

Magnetic measurements. The magnetic measurements allow the discrimination of two main populations of particles (Fig. 2). The largest population contains about 10 wt% magnetite with grain size below 10 µm. Another population contains around 2 wt% magnetite in smaller grains.

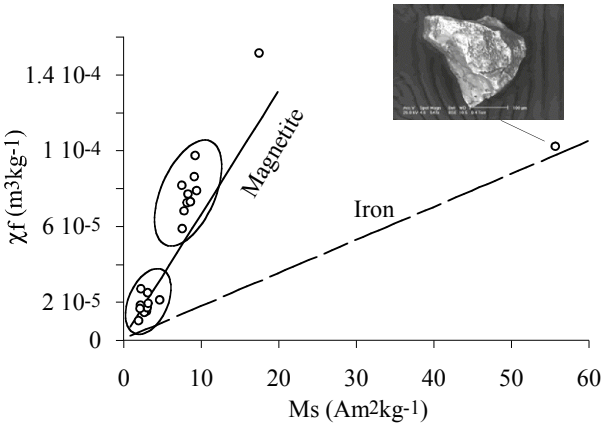

Figure 2. Ferromagnetic susceptibility vs. saturation magnetization for Frontier Mountain micrometeorites. Theoretical lines for magnetite and iron are indicated.

Chemical composition and mineralogy. Bulk chemical composition of micrometeorites interior obtained by EMP analyses compares well with other micrometeorites collections (Fig. 3)

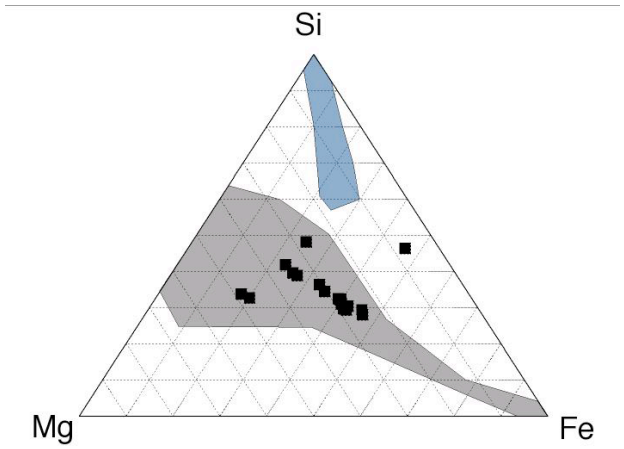

Figure 3. Solid boxes: Frontier Mountain micrometeorites (this study); gray field: literature data for micrometeorites [1, 3]; blue field: literature data for terrestrial igneous rocks [4].

The mineralogy of spherules (top two pictures in Fig. 1) mainly consists of micro- to cryptocrystalline olivine ($Fa_{\sim 18-26}$), Fe-oxydes (Ni, Cr-rich magnetite) and glass. Volatile elements are absent in the glass. This is in agreement with a complete fusion of the

original grain, loss of the most volatile elements (S, Na, K) and recrystallization of olivine and magnetite (Fig. 3). Apart from a minute external coating of carbonates and sulfates, interior weathering seems very limited. Grain interiors are devoid of sulfur.

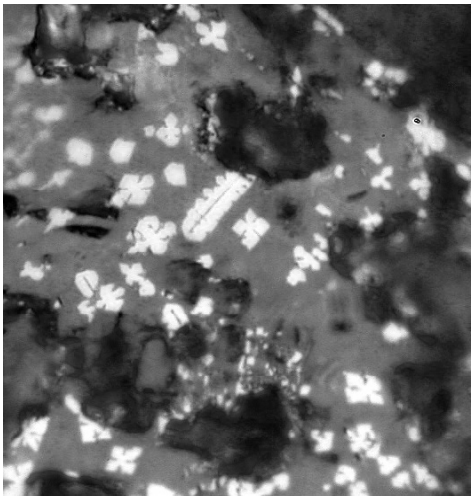

Figure 3. Reflected light picture of a magnetite-rich spherule showing abundant dendritic magnetite crystals. Picture is 50 µm wide.

The few unmelted micrometeorites (bottom right picture in Fig. 1) have a chondritic mineralogy with pyroxene, olivine (Fa21-26), chromite and FeNi metal grains (Ni ~wt 8%).

A single purely metallic particle was found (bottom left picture in Fig. 1). It contains Fe (98 wt%), Ni (1.6 wt%) and Co (0.2 wt%) but its extraterrestrial origin is not proven yet.

Conclusions.

The Frontier Mountain collection represents a new and large micrometeorite population. In the already studied size range (mostly >400 µm), spherules resulting from total (or nearly so) melting of the extraterrestrial precursor material predominate. Spherules constitute 73, 54 and <20% of the size fraction 400-800 µm (total 22 grains), 200-400 µm (total 418 grains), and 100-200 µm (total about 30 000 grains), respectively. A few irregular and porous particles show partly original mineralogy.

The magnetic classification correlates with chemical/mineralogical classification. This rapid and non-destructive technique will be applied to a large number of micrometeorites to compare the Frontier Mountain collection with other collections (e.g. South Pole [1] or Cap Prudhomme [2] collections). This may hopefully lead to discrimination of various extraterrestrial source materials.

References: [1] S. Taylor et al. (2000) *MAPS, 35*, 651-666, [2] M. Maurette et al. (1991) *Nature, 351*, 44-47, [3] C. Koeberl and E.H. Hagen (1989) *GCA, 52,* 937-944, [4] A. Hall (1987) Igneous petrology, Longman.