THE WEATHERING OF MICROMETEORITES.

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Introduction: The dry, cold and clean conditions in Antarctica make it particularly favorable for the preservation of meteorites and micrometeorites. Despite the favorable conditions, effects of terrestrial weathering are frequently observed in Antarctic meteorite finds [1]. Micrometeorites recovered in similar environments, such as on ice-free tops of nunataks for the Transantarctic Mountains (TAM) collection and in glacial moraine for the Larkman nunatak (LK) collection, may have old terrestrial ages [2], and yet there have been no systematic studies of their alteration. Here we present a study focusing on the weathering of micrometeorites from Antarctica.

Methods: 388 micrometeorites from LK and 25 from the TAM were studied. Micrometeorites were studied by SEM-BSE for structural and textural observations and WDS to determine their chemical composition. EBSD was used to study the crystallinity of secondary phases in 10 glass cosmic spherules. FTIR was used on 4 cosmic spherules to study olivine alteration.

Weathering of cosmic spherules: FeNi metal and sulphides, when present in metal droplets [3], are first to weather and form Fe-oxide. Glass in all cosmic spherule types weathers by hydration and formation of a hydrous gel similar to palagonite [4]. In olivine-bearing cosmic spherules, etch-pits typical of congruent dissolution are observed large crystals of olivine [5]. FTIR spectra show that congruent dissolution also occurs in fine-grained olivine. The sequence of alteration of glass and olivine is mainly controlled by fayalite (Fa) content of olivine, with olivine weathering before glass when Fa content is typically <30, and vice versa when Fa-content >30. In all particles, magnetite is unaffected by weathering. As a consequence, metal-free I-type cosmic spherules from LK appear unweathered.

Weathering of scoriaceous micrometeorites: The presence of jarosite in vesicles of TAM particles suggests that these are efficient structures for the circulation of weathering fluids. As a consequence, the decrease in porosity is an important aspect of weathering in scoriaceous micrometeorites. FeNi metal and sulphides weather first. Congruent dissolution of olivine also commonly occurs.

Weathering of unmelted micrometeorites: Fine-grained UMM from the TAM and LK collections studied here appear unweathered. Weathering of chondritic coarse-grained micrometeorites is similar to that of chondritic meteorites [1]. First FeNi metal and sulphides are altered to form Fe-oxides. Then congruent dissolution of olivine occurs. Pyroxene and glass/feldspar are more resistant to weathering than olivine. As weathering progresses, Fe in silicate is oxidized and Mg, Si and other lithophile elements are progressively removed from the system.

Implications: Progressive weathering of micrometeorites produces a sequence of mineralogical and textural changes that might be used as an approximate terrestrial residence scale.

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