The Best Cosmic Dust Source in the World? The Origin and Significance of the Walcott Neve, Antarctica Micrometeorites. R. P. Harvey (1) and M. Maurette (2).

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Following Hagen's initial discovery of micrometeorites in glacial sediments returned from the Walcott Neve area of Antarctica (1), a followup study was initiated by one of us (RPH). Several kg of sediment from various locations around the Walcott Neve area were returned for sorting and analysis. In all cases, the collected sediment was sampled, weighed, and wet-sieved, with the residue of each sieve sorted under a binocular microscope for spheroidal or otherwise interesting grains. This method necessarily involves learning to recognize both extraterrestrial and local rock types, but has the advantage of allowing the discovery of unusual grains. In all these samples, a significant concentration was found, averaging roughly 20 spherules per g bulk sediment.

Figure 1 shows the size distribution and micrometeorite density (number of spherules per g of residue) within random samples from 4 localities, whose locations are shown in figure 2. The < 64 micron size fraction was not sorted. The size distribution of the samples vary, due to the efficiency of the traps present. Sample MM was collected near the crest of "meteorite moraine", roughly 1 km east of the well known Lewis Cliff ice tongue meteorite stranding surface (LCIT). The smallest size fractions are absent from Sample C, which is from a small moraine on a steep slope 300 meters southeast and above MM. D comes from the upwind face of the terminal moraine of the LCIT, just below its crest. J is a sample of weathering grus from behind a dolerite boulder exposed to a fierce wind on top of Lewis Cliff. A fifth sample, F (not plotted) is a collection of larger (>1 mm) visible debris from a patch of firm (rough snow) immediately downwind of the South Lewis Cliff icefield (SLCI).

The probable origin of these micrometeorite concentrations is intimately related to that of larger "normal" meteorites. Extraterrestrial material is constantly being incorporated into Antarctic snow over time, and as the snow compacts into ice, meteorites and micrometeorites become trapped within. Meteorite stranding surface areas such as the LCIT are places where ice containing extraterrestrial debris rises to the surface and ablates, allowing meteorites to accumulate (2). In the case of micrometeorites, however, the strong katabatic winds of Antarctica cause them to move. Micrometeorites thus are transported downwind and downslope to the nearest aeolian sediment trap. In the Walcott Neve, these traps are the crests of moraines, weathering debris around boulders and rough, exposed areas of snow (see figure 3). These traps can contain not only ancient micrometeorites abating out of the ice, but local recent arrivals as well.

The Walcott Neve sediments compare favorably with other sources of cosmic dust. While some of the Walcott Neve spherules so far studied show evidence of weathering, they are generally in much better shape than deep-sea or Greenland spherules (3). Compared to the Cap Prudhomme sediments, very few unmelted chondritic grains were found, perhaps due to "camouflaging" by the local terrestrial sediments (4). The Walcott Neve sediments, however, are much easier to collect than those found by melting Antarctic ice. In fact, when the background rock is of a single, readily distinguished rock type (as is the case with sample J) large numbers of micrometeorites can be quickly identified and collected. With simple equipment (a sieve and a microscope) a cosmic dust "factory" could be set up, resulting in the collection and separation of thousands of micrometeorites per day. There are significant numbers of largely unmelted "giant" cosmic dust grains, including representatives in a rare size range, between 0.5 to 10 mm. The majority of these come from sample F, where a dearth of terrestrial debris and a short distance from source to trap combine to allow easy identification of possible specimens. These sediments offer unique access to great numbers of large, unweathered cosmic dust and micrometeorites.

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Figure 1. Size distributions (mass in 6 size fractions) and micro-meteorite density (number of micrometeorites per g of residue) in 4 sediment samples from the Walcott Neve, Antarctica.

Figure 2. Site localities of micrometeorite-bearing sediments.

Figure 3. Cartoon showing how wind transport of small meteorites can lead to concentrations in several styles of aeolian sediment "traps".