A COMPARISON OF "IDENTICAL" ANTARCTIC MICROMETEORITES FROM GLACIAL ICE & AEOLIAN SEDIMENTS. K. A. Huwig[1], R. P. Harvey[1], and T. Henkel[2], Department of Geological Sciences, Case Western Reserve University, Cleveland, Ohio 44106 (huwig@case.edu), [2]School of Earth, Atmospheric and Environmental Sciences, The University of Manchester, Oxford Road, Manchester, M13 9PL, UK (torsten.henkel@manchester.ac.uk).

Introduction: Micrometeorites exhibit a broad range of compositions, textures and mineralogy that may be the result of a larger range of sampled extraterrestrial sources. However, the selection effects due to collection methods compound this wide variation. Micrometeorites and cosmic spherules are collected mainly from Antarctica by either melting large volumes of glacial ice [1,2], or collecting sediments from aeolian traps such as moraines near meteorite stranding grounds or glacially eroded mountaintops [3,4].

Aeolian particles are collected dry from moraine sediments or other aeolian traps and therefore do not have contact with hot liquid water during collection like the samples from glacial ice. However, the post collection sorting for micrometeorites is time consuming and laborious due to the high terrestrial background. The terrestrial history of the aeolian micrometeorites is also impossible to know. Particles within the moraine may have fallen millions of years ago or just the day before collection, and may or may not have been incorporated into glacial ice.

Samples collected from glacial ice have the advantage of a relatively rapid collection yielding tens of thousands of particles within a single collection [1]. Minimal post collection sorting is needed due to a very low terrestrial lithologic contamination, and their terrestrial history is better known. However, these particles spend many hours in warm liquid water during the melting of the ice.

This study was undertaken in order to determine if there are any differences between micrometeorites collected from glacial ice and aeolian traps due to collection methods.

Samples and analytical techniques: The glacial ice sample was from the 2004 expedition to Cap Prudhomme (CP) and collected as described in Maurette et al. (2004) [5].

The sample of aeolian sediment was collected from Station D (SD) located at the tip of the Lewis Cliff Ice Tongue, a meteorite stranding ground. The sediment was then wet sieved in cool filtered water, and magnetically separated to remove the bulk of the terrestrial lithologic contamination.

Both the CP and SD samples were sorted in 200 proof ethanol using an optical stereomicroscope. Sorting parameters were dark, irregularly shaped magnetic particles, features corresponding to unmelted finegrained, micrometeorites (fgMMs).

Approximately 40 potential fgMMs from each of the CP and SD samples were then mounted in EPO-TEK 301 and made into polished sections. Each particle was imaged using backscattered electron (BSE) imaging and EDS spectra to confirm features indicative of extraterrestrial origin such as a magnetite rim, the presence of Ni in metal or sulfides, or a "chondritic" composition. They were also examined on the size and shape of vesicles and compositional heterogeneity in order to select those that appeared least melted.

Two particles were selected, one each from CP and SD, based upon their similarities in BSE imaging and their relatively low degree of melting (Figure 1).

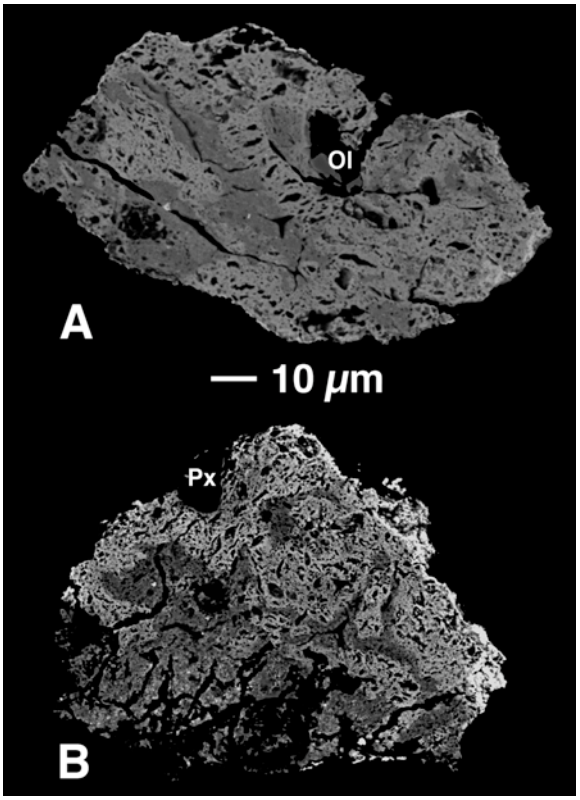

Figure 1: BSE image of (A) Cap Prudhomme particle – melted from glacial ice and (B) Station D particle aeolian sediment.

Both particles have magnetite rims indicative of atmospheric entry, both have regions of high and low Z, with the higher Z regions containing generally more vesicles. Both contain a large (>10µm) silicate grain in the section (Ol in the case of the CP and Px in the SD particle).

We then used the TOFSIMS at the University of Manchester to investigate elemental distributions. It allows imaging of almost all elements down to ppm-levels with high lateral resolution (~250nm) over wide areas [6]. For quantification, TEM analyses will be used.

Results: The major cations showed no obvious differences in distribution between the two particles.

The O^- ion also showed no discernable difference between the CP and SD particles. H^-, OH^-, S^- and F^- anions did show a marked difference in distribution and over all intensity of ion return. H^-, OH^- and S^- show clear hotspots throughout the CP particle (Figure 2A) but were mostly evenly distributed within the SD particle (Figure 2B).

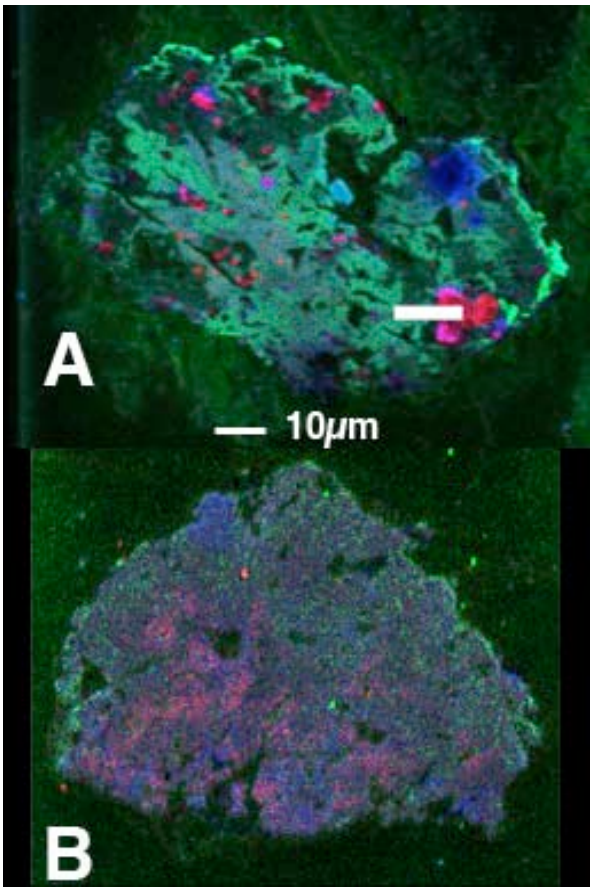

Figure 2: TOFSIMS elemental maps of (A) CP particle and (B) SD particle. Green: F^-; Blue: OH^-; Red:S^-. White bar represents location of TEM section. Dark regions in 2A show low total ion return.

The OH^- ion return from the CP particle was also significantly higher in the CP particle. The F^- ion showed the most dramatic difference in return, with the amount of F^- within the SD particle barely above the background level, while in the CP particle there is a very clear F^- signal in the whole particle.

Discussion: The disparity between the amount and distribution of the mobile ions H^-, OH^-, S^- and F^- is either due to pre-terrestrial differences or terrestrial weathering. It is certainly possible that these two particles came from different sources and therefore have different basic chemistry, but the similarity in BSE imaging and distribution of major and minor cations leads us to believe it is not a pre-terrestrial difference.

There are two options for terrestrial weathering to explain Figure 2. Terrestrial weathering causes leaching of the mobile elements in the SD particle. Or the anions in CP particle were mobilized and redeposited during residence time in the ice or during collection. A combination of these two processes cannot be ruled out at this point.

Future study: To determine whether leaching or redeposition has occurred, we will use TEM analysis. We have removed a TEM section (shown in Figure 3A) from the CP particle using FIB at LLNL. A TEM section will be removed from the SD for similar analysis. These analyses will tell us whether the host minerals for the mobile ions are primary or secondary.

References [1] Maurette M. et al. (1991) *Nature* 351, 44-47. [2] Taylor S. et al. (1996) *LPS. XXVII* #1319. [3] Harvey R. P. and Maurette M. (1991) *Proc. of the Lunar and Planet. Sci. Conf.* 21:569-578. [4] Gattacceca J. et al. (2005) *LPS XXXVI* #1315. [5] Maurette M. et al. (1994) in *Analysis of IDP AIP Conf. Proc.* 310, 277-289. [6] Henkel T. et al. (2006), *Rev. of Sci. Instruments*, submitted.