OLIVINE TEXTURES AND COMPOSITIONS IN BIT-58 ABLATION DEBRIS. K. A. Huwig[1] and R. P. Harvey[1], [1]Department of Geological Sciences, Case Western Reserve University, Cleveland, Ohio 44106 (huwig@case.edu)

Introduction: In 1995 a layer of dark, rounded particles was found during a systematic sampling of tephra layers in the East Antarctic ice sheet. Studies of a small sample of this debris layer (BIT-58) suggested it was the result of a single meteoritic event that occurred approximately 2.5-2.8 mya [1]. Due to the small size of the initial sample, however, the cosmogenic nuclide data is questionable. The study determined that BIT-58 was most consistent with an H ordinary chondrite due to the major element data. However, cosmogenic data suggested an iron parent body, and trace element analyses provided mixed results [1].

In early 2003 more of the BIT-58 layer was collected and the current study was begun to define the mineralogy and chemistry of the sample. A further goal was to produce a split of "clean" (no terrestrial debris) BIT-58 to eliminate possible contamination of age.

Sorting: The particles were first separated using a magnet into non-magnetic, somewhat magnetic, and strongly magnetic groups. The reason for making this first split was to remove most of the possible terrestrial contaminants, namely feldspathic volcanic glass and eolian debris. Those particles that were most magnetic were further separated under an optical stereomicroscope for morphological features into six main groups: spherical (~7% of the mass), semi-spherical (~10%), "opaque" (~15%), "striped" (~8%), "cloudy", (~15%) and "blotchy" (~45%) as well as a group that included oddities. The less magnetic and non-magnetic groups have not been sorted.

Analyses: A representative sample from the semi-spherical, "opaque" and "blotchy" morphological groups has been mounted in epoxy and sectioned for some preliminary electron probe characterization. The particles imaged in the "blotchy" category (consisting of particles that contained both clear and dark phases) all consist of olivine in glass. The semi-spherical and "opaque" groupings exhibited a much greater range of textures, such as olivine in glass and magnetite dendrites. Both the semi-spherical and "opaque" morphological groups contained very similar textures. All of the particles that have been imaged so far are extraterrestrial.

Olivines: The "olivine in glass" texture is the most prevalent among the imaged particles, but the relationships between the phases vary. We do not know whether the olivines are relict grains that survived during the ablation process that created the BIT-58 debris or have re-crystallized from a total melt of the precursor material. Understanding the nature of the olivine and its relationship to the glass is of particular interest as it may lead to a better picture of the ablative process.

The particle in Fig. 1a is an example of one kind, where there are a number of smaller sized, well-defined, zoned olivine grains that have Fe-rich rims around Mg-rich cores. In between the olivine grains is the interstitial glass that is Fe-rich. Another similar example is that in Fig. 2a, that shows a similar set of olivine and glass. The olivine grains in this particle show a very characteristic crystal form.

Quite large olivine grains make up almost the entirety of some particles, such as in Fig. 1b. This grain also has an Mg-rich core and an Fe-rich rim, and a small amount of glass is present at the top of the image. This grain also includes a number of bright phases near the core, and also near one edge.

The zoning in the olivine grains is not always straightforward. In Fig. 1c there is some degree of Fe-rich rims, but the cores of the olivines are much more complicated, particularly in the large grain that encompasses the right side of the particle in the image. This particle also contains a small amount of Fe-rich glass in the lower left corner, but lacks any spots of a bright phase within the olivine grains.

Some particles contain olivine grains that are not strongly zoned, such as in Fig 2b and 2c. Both of these particles also exhibit a much more Fe-rich interstitial glass.

A number of particles contain olivine grains with no zoning and appear to have been frozen in the process of either melting or forming from the glass. Fig. 1d and 3a are examples of comparatively Mg-rich olivines in an Fe-rich glass. There are spots of a bright phase within the olivine grains of both particles.

There are also particles as in Fig. 1e, 1f, 2d and 3b where there isn't much glass and the olivine grains do not show clear zoning. The olivines in these particles can be randomly oriented, as in Fig. 1e and 3b, or take on a more ordered arrangement as in Fig. 1f and 2d.

Figure 1g shows a few elongate olivine crystals (going from the upper left to the right) in a particle

that contains a large number or relatively large, Fe-rich blebs.

Further Study: In order to further our understanding of the role of olivine in BIT-58 particles we plan to collect major and trace element zoning profiles from a number of representative grains. Particular attention will be paid to transition metals whose behavior varies with oxidation. Our hope is to be able to distinguish profiles due to melting, recrystallization and/or solid-state diffusion. We will also study included phases, such as oxides or melt, whose location and chemistry may provide further clues to whether the olivine is relict or recrystallized.

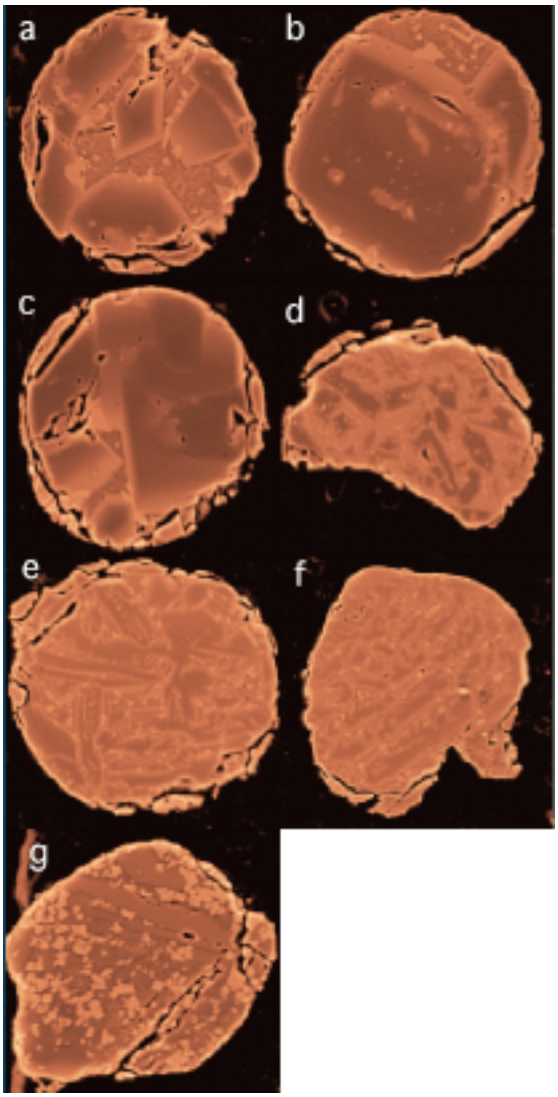

Figure 1: Select particles imaged from the semi-spherical morphological group.

We also hope to examine BIT-58 as an analog for dispersed chemical signals from meteorite impacts, that may lead to a better understanding of how such signals get dispersed and what they should represent from a projectile.

References: [1] Harvey R. P. et al. (1998) *Geology, 26,* 607-610.

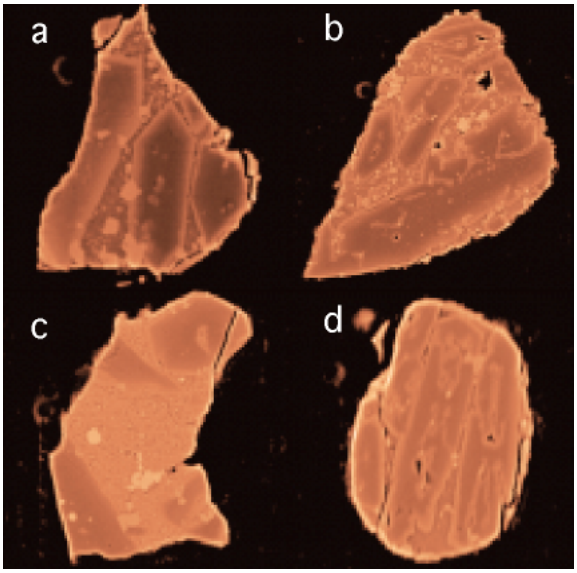

Figure 2: Select particles imaged from the "blotchy" morphological group.

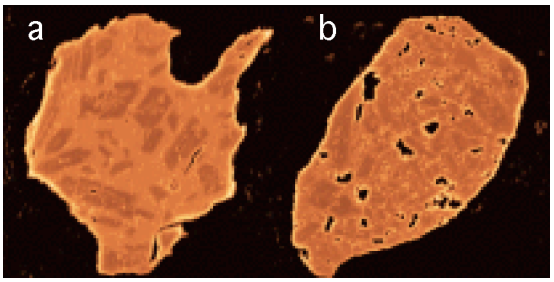

Figure 3: Select particles imaged from the "opaque" morphological group.