Volatiles in a Spherule and Impact Clasts in the Bununu Howardite

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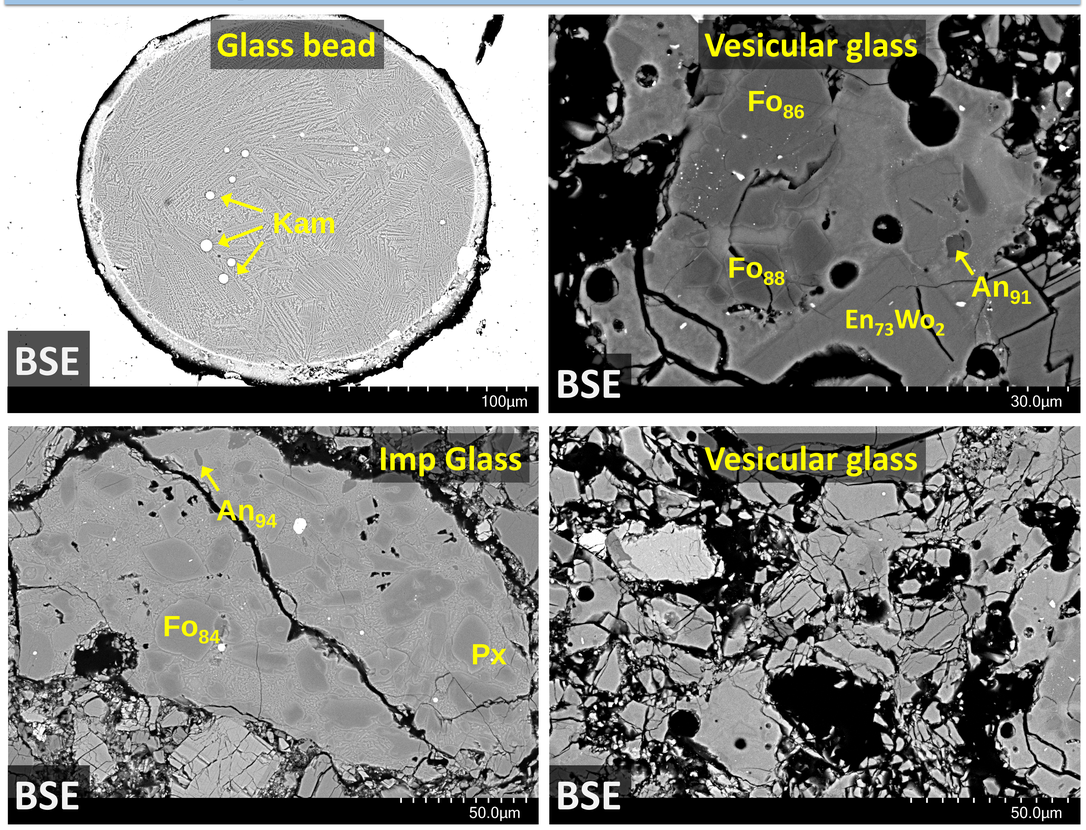
Introduction

- Impact products of the surface materials from the Moon have been demonstrated to be a good recorder of H and other volatiles from exogenic sources [1-2]
- H/OH on Vesta = dark materials on Vesta: suggested to be chondritic mixing [3-5]
- What are recorded in the impact melts in Vestan surface materials
- Howardites are surface materials, some of which are regolith breccias

Bununu [6-9]

- Howardite fall in 1942
- Abundant glass spheres & impact products
- Gas-rich breccia ≈ regolith [9]
- Ar-Ar ages of its plagioclase and glass are 4.42 ±0.04 Gyrs and 4.24 ±0.05 Gyrs, respectively, [9].
- Cosmic ray exposure age = ~20-22 Myr [15]

Impact Products in Bununu Studied



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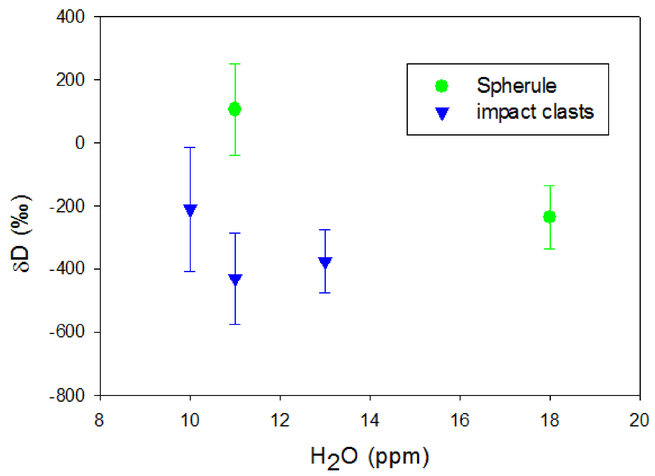
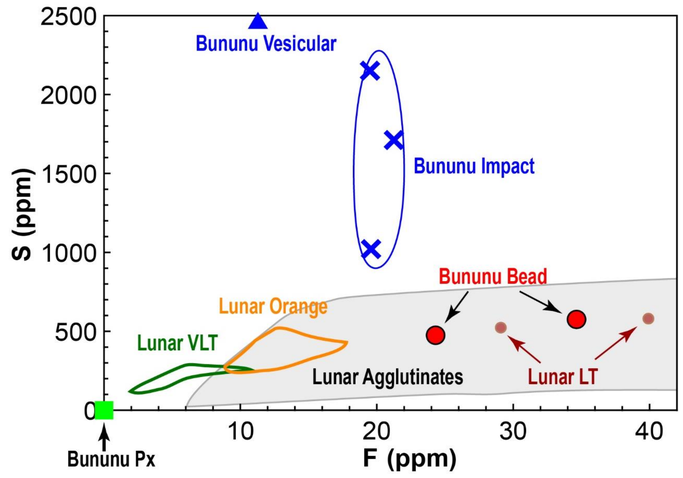
Preliminary Results

- Devitrified glass spherule: 11-18 ppm H_2O, 24-35 ppm F, and 470-570 ppm S, Cl < 0.3 ppm, CO_2 <10 ppm; CRE corrected δD: -73 ± 189‰ (n = 3, 1 standard deviation)
- Three impact clasts: 11-13 ppm H_2O, ~20 ppm F, 1020-2150 ppm S; 1-14 ppm Cl, CO_2 < 10 ppm; CRE corrected δD: -211 ± 197‰ to -431 ±145‰ (1σ) . The large errors are resulted from the very low OH concentrations.
- Major-element composition of Bununu glass bead ≈ Lunar VLT





Implications

- Compared to lunar samples, the Bununu spherule contains comparable H contents and hydrogen isotope compositions as the VLT glass beads, but higher F and S.
- The δD values of the spherule are also similar to those of apatites found in eucrites (-37 ±68‰ to -223 ±21‰ [18]). Potentially these hydrogen isotopic signatures may indicate a magmatic source for the volatiles on the HED parent body.
- Devitrified glass spherule = lunar low-Ti bead (15427) in F-S; and lower in dD
- The impact clasts contain low amounts, but noticeable D. The devitrification in the impact clasts indicates low- to medium-grade metamorphic conditions as suggested in [19], and potential de-volatilization, which could lead to decrease in H_2O contents and increase in δD (schematic arrow in Fig. 4). Thus, the pre-metamorphism H in the impact clasts may have even lower δD values, suggesting a possible solar wind contribution.

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