IMPACT GLASSES IN HOWARDITES: K-RICH LITHOLOGIES AND GRANITES ON 4-VESTA.

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The howardites, are complex breccias that contain occasionally impact melt clasts, glass beads or debris, whose compositions mirror that of their source regions. Some K-rich impact glasses (up to 2 wt% K_2O) found during the course of this study, demonstrate that in addition to basalts and ultramafic cumulates, K-rich rocks are exposed on the 4-Vesta's surface. Additional K-rich glasses, with a granitic composition, provide the first evidence of highly-differentiated rocks on a large asteroid. They can be compared to the rare lunar granites [1] and suggest that magmas generated in a large asteroid are more diverse than previously thought.

In order to discuss the origin of glasses in HED, six glass-bearing howardites (Bununu, Kapoeta, Northwest Africa (NWA) 1664 and 1769, Yamato (Y) 7308 and 791208) have been selected. More than fifty glassy clasts or spherules have been analyzed. Unlike glasses found in the other howardites, mafic glasses found in NWA 1664 and NWA 1769 are unusually K-rich, with K_2O concentrations ranging from 0.18 to 2.33 wt%. High-K abundances were previously noticed in glasses from NWA 1664 [2], and from the Malvern howardite [3,4]. These K-abundances are much higher than those reported for most of the HED, which contain in most cases less than 0.1 wt% K_2O. Furthermore, a silica-rich glass has been found in a fragment of a spherule from NWA 1664, and displays high K_2O abundances ranging from 4 to 6.12 wt%. The compositions correspond to a high-K, low Na monzogranite. Interestingly, this glass resembles the lunar granites, but exhibits much higher Al_2O_3 abundances (about 18 wt% compared to 8.8-13 wt% in the lunar granites [1]).

The K-rich impact glasses found in howardites indicate that the rocks that outcrop on Vesta are not restricted to a series of mafic cumulates and basaltic flows, and we speculate that granites and rocks more evolved than those actually known in the HED collection will probably be observed during the surface mapping of Vesta by the Dawn spacecraft.

References: [1] J.J. Papike, G. Ryder, C.K. Shearer (1998), in Planetary Materials, J.J. Papike, Ed. (*Min. Soc. Am., Reviews in Mineralogy* **36**), 5-1 (1998). [2] G. Kurat, M.E. Varela, E. Zinner, T. Maruoka, F. Brandstätter (2003), *lunar Planet. Sci. Conf.*, **34**, 1733. [3] A.F. Noonan (1974), *Meteoritics* **9**, 233. [4] C. Desnoyers, J.Y. Jérome (1977), *Geochim. Cosmochim. Acta* **41**, 81.