Textural investigations of possible fluid-mineral interactions in eucrites

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Eucrites are meteorites with basaltic compositions and textures that derive from the crust of a small differentiated asteroid, most probably 4-Vesta (e.g., [1]). These meteorites are generally assumed to be dry, because clear evidence for hydrous minerals such as in chondrites is lacking. However, evidence for fluid-mineral interactions in eucrites are difficult to discern. Petrographic observations indicate that Fe enrichment zones and fayalitic olivine veins crosscutting pyroxenes may be due to metasomatic overprints, but this is controversial [1-3]. Here we present SEM-EBSD and FIB-TEM analyses of minerals in the eucrites Pasamonte and Juvinas in order to distinguish contrasting hypotheses. Although the origin of Pasamonte from 4-Vesta is still controversial [1], it may still serve as an analogue for processes on small asteroids. In case of a melt injection we may see a change in orientation across interfaces due to equilibration of the host with the melt. In contrast, a metasomatic or hydrous agent would not influence crystal orientations and contacts should be very sharp [4].

In EBSD patterns across Fe enrichment veins in pyroxenes of Pasamonte and Juvinas, the orientation of the host diopside is the same on either side of the vein. The same holds true for textural interfaces over fayalitic olivine – diopside veins in Juvinas. These sharp interfaces are even more compellingly demonstrated by nm-resolution STEM-EDX spectrum images over a diopside – olivine boundary in Pasamonte using an aberration-corrected FEI Titan G^2 S/TEM. These extremely sharp contacts between the olivine vein and the diopside host in orientation maps and by FIB-TEM could therefore support the fluid-mineral interaction model. The main source of fluid was probably a nearby mass of volatile-rich carbonaceous chondrite matter that hit the asteroid at low enough velocity to remain mostly intact [3].

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[1] Barrat, J.A. et al. (2011), *GCA* **75**, 3839. [2] Roszjar J. et al. (2011), *MAPS* **46** (11), 1754. [3] Warren, P. H. et al. (2014), *GCA* **141**, **199**. [4] Putnis A. (2009), in: RiM&G 30, 87.