Silica polymorphs in Yamato-75011 eucrite: Implications for their formation conditions

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Although there are not so many detailed reports on silica minerals in meteorites, they can be a good indicator of the formation conditions of meteorites because of the presence of a number of polymorphs [e.g., 1]. In eucrites, silica minerals are mostly monoclinic tridymite, but quartz is found in Serra de Magé cumulate eucrite and considered to have been precipitated by a hydrothermal activity [2]. In this study, we focus on silica polymorphs in a brecciated eucrite Yamato-75011 (Y-75011) and discuss their formation conditions especially by paying attention to the presence of secondary silica minerals.

We observed a thin section of Y-75011 by using optical microscopy and FEG-SEM, and analyzed it using EPMA, micro Raman spectroscopy, and EBSD.

Three species of silica polymorphs (tridymite, cristobalite, and quartz) were found in Y-75011. Tridymite is found as an independent fragment (~400 μm). Quartz and cristobalite co-exist in the basaltic clasts that are mainly composed of extensively zoned pyroxene and lathy plagioclase, suggesting formation near the surface. They show complexly mixed textures and each crystal size is ~100 μm. Quartz contains many FeS inclusions and vesicles. Similarly, cristobalite contains abundant tiny inclusions. There are areas where quartz is present without cristobalite between pyroxene and plagioclase. In such areas quartz grains are smaller and intrude into pyroxene. Pyroxene is homogeneous and exsolution-free where it is contacted with quartz. This suggests that quartz crystallized by some melting phenomenon, for instance, replacing pyroxene by resorption. On the earth, cristobalite and quartz co-crystallize with alkaline solution under hydrothermal reaction conditions [e.g., 3], and the similar occurrence in basaltic clasts of Y-75011 may support a hydrothermal origin of these silica phases. If this is the case, a eucrite parent body (presumably, 4Vesta) experienced a secondary hydrothermal activity near the surface, and such events may have been global, being combined with the presence of quartz veins in Serra de Magé cumulate eucrite [2] and possible hydrothermal quartz in Juvinas [4].

[1] Kimura *et al*. (2005) *MAPS* **40**, 855-868. [2] Treiman *et al*. (2004) *EPSL* **219**, 189-199. [3] Zhu *et al*. (2005) *Materials. Sci. J.* **40**, 3829-3831. [4] Kanamaru *et al*. (2016) This volume.