CAI like Fragments Detected in Wild 2 Cometary Impact Track C2012, 110

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Calcium-Aluminum-rich inclusions (CAIs) are thought to originate near the center of the protoplanetary disc in the early state of its formation. The presence of CAIs in the outer regions - beyond the frost line - were comets are formed indicate unexpected highly dynamic processes of mixing and mass transport during the early stage of the solar system. The first CAI-like material ("Inti") discovered in comet Wild 2 samples was found in track 25 (Zolensky et al., McKeegan et al. and Brownlee et al. 2006). This object contains several refractory minerals, like anorthite, Ca-, Al-, Ti rich clinopyroxene, gehlenite, spinel, corundum, and probably perovskite.

As such material is usually rich in Ca, Al and Ti it can be identified in situ (within the aerogel collector material) by the means of synchrotron XRF (S-XRF) methods scanning for Ca and Ti-rich phases. Applying high resolution techniques even very small CAI-fragments ($<$ a few microns), containing several different mineral species, can be recognized.

We analyzed the entire impact track No. 110 (C 2012, 180μm long) with S-XRF at ID13 at the ESRF (Grenoble, France). The incident X–ray beam (13keV) size varied between 300x1000nm and 300x300nm depending on the respective set-up. The fluorescence radiation was simultaneously collected in a conventional and a confocal detection mode. The confocal mode allows efficient reduction of the signal from the surrounding aerogel.

The track consists of a terminal particle (TP) and four "larger" particles (a few microns in size) along the track which have been characterized and localized by mapping the Ca, Ti, Fe, Ni and Mn content in a broad overview scan. The most interesting grains detected were the 2x2μm^2 sized TP and a single 1.5x1.5μm^2 sized fragment ("Marvin") that are enriched in Ca and Ti. Quantitative results for Ca obtained by *Fundamental Parameter method* (FPM) of the point spectra in the confocal detection mode vary between 13wt.% (Marvin) and 27wt.% (TP), Ti is 1wt.% (Marvin) and 0.1wt.% (TP) (Schmitz et al., in prep.). Due to the chemical signature, the mineral phases involved might be gehlenite (TP) and anorthite (Marvin). The high spatial resolution of the experimental set-up shows that the observed concentrations for Ca, Ti, Fe and Ni of both fragments vary within each grain which indicates the existence of polyphase mineral grains. Both, the detected composition and the polyphase nature of the fragments are in agreement with the CAI like grain "Inti". Thus, our data indicate the in situ detection of a new CAI-like candidate.

References

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