Searching for calcium-aluminum-rich inclusions in cometary grains with Rosetta/COSIMA

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The calcium-aluminum-rich inclusions (CAIs) found in chondritic meteorites are probably the oldest solar system solids, dating back to 4567.30 ± 0.16 million years ago. They are thought to have been formed in the proto solar nebula within a few AU of the sun, and at a temperature of around 1300 K [1]. The Stardust mission found evidence of CAI-like material in samples recovered from comet Wild 2 [2]

The appearance of CAIs in comets, which are thought to be formed low temperatures and at large distances from the sun [3] is only explicable if some mechanism allows the efficiently transfer of such objects from the inner solar nebula to the outer solar nebula. Such mechanisms have been proposed such as an x-wind [4] or turbulence [5] [6].

In this work, grains collected from the vicinity of Comet 67P/Churyumov–Gerasimenko by the COSIMA experiment aboard the Rosetta spacecraft will be examined for compositional evidence of CAIs. COSIMA (the COmetary Seconday Ion Mass Analyzer) [7] uses secondary ion mass spectrometry to analyze the composition of cometary dust captured on metal targets.

While CAIs can have a radius of centimeters, they are more typically a few hundred microns in size, and can range down to as small as 30 microns [8], so it is conceivable that grains visible on COSIMA targets (ranging in size from about 10 microns to hundreds of microns) could contain CAIs. Using a fitting technique, a set of grains will be studied, looking for material rich in both calcium and aluminum.

[1] Connelly *et al*. (2012) *Science*, **338**, 651-655. [2] Simon *et al*. (2008) *MAPS* **43**, 1861-1877. [3] Levison and Morbidelli (2003) *Nature* **426**, 419-421. [4] Shu *et al*. (1997) *Science* **277**, 1475-1479. [5] Bockelée-Morvan *et al*. (2002) *A&A* **384**, 1107-118. [6] Ciesla (2007) *Science* **318**, 613-615. [7] Kissel *et al*. (2007) *Sp. Sci. Rev*. **128**, 823-867.