Unveiling the origin and evolution of dust in comets

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Investigating the properties of dust released by comets is of major interest to constrain their formation models. Instruments flying-by comet Halley had discovered the presence of organics, and pointed out the low albedo and extremely low density of the dust. Analyses of IDPs and remote spectroscopic observations have indicated that cometary dust consists of an un-equilibrated heterogeneous mixture of organic refractory materials and of amorphous and crystalline silicate minerals, as recently confirmed by Stardust. Observations of the solar scattered light, together with elaborate simulations, have revealed physical properties of the dust. For a well-documented comet, the mass ratio between silicates and absorbing organics, the size distribution and the structure of the dust particles, can be estimated, suggesting that a fair amount consists in fluffy aggregates built up from submicronic grains [1,2], as recently confirmed by the dust craters and tracks on Stardust collector.

On board the Rosetta probe, MIDAS experiment will provide unique information on the dust texture, shape, size and flux, during the rendezvous with comet Churyumov-Gerasimenko. Moreover, the CONSERT experiment will investigate the deep interior of the nucleus from measurements of the propagation delay of long wavelength radio waves [3]. A detailed analysis of the waves passing through the nucleus will put constraints on the materials and on the heterogeneities within the nucleus. While it is now established that nuclei have low densities and are significantly fragile, it will then be possible to better constrain their formation process and their origin.

References

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Partial melting of eclogite to form high-pressure granitic rock: A case from the Erzgebirge, Southeast Germany

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We describe an eclogite body from the shore of the Saidenbach reservoir in the Erzgebirge, Germany, that appears to have partially melted to produce a high-pressure granite. The primary eclogite assemblage is omphacite (commonly altered to jd-poor cpx + plag (An_{10} – An_{17}) symplectites) + garnet + quartz + phengite + rutile. Within these rocks are numerous veins (1 mm to 5 cm wide) and pockets of potassium feldspar + quartz + plagioclase (An_{11}) + phengite + garnet + rutile. This coarse-grained leucocratic material also occurs somewhat diffusely throughout portions of the eclogite matrix, in direct contact with unaltered omphacite.

Textural evidence leads us to believe that the leucocratic material is derived from fluid-fluxed partial melting of the host eclogite. Anatexis of metabasalt compositions typically leads to the formation of tonalites and trondhjemites, but at high pressures partial melting of potassium-enriched eclogites can produce granite over a significant range of melt fractions (Schmidt *et al*., 2004). The major element composition of the granitic veins in the Saidenbach eclogites is very similar to experimentally generated, basalt-derived granitic melt compositions, with K:Na ratios of ~1.4 (Schmidt *et al*., 2004).

The granitic melt generated by partial melting of the Saidenbach eclogite may also be related to diamondiferous quartzofeldspathic rocks outcropping on the shore of the same reservoir. These kyanite-bearing rocks have been interpreted as high-pressure metasediment melts due to their high aluminum content (Massonne, 2003). However, experiments have shown that high-pressure eclogite melts can also be aluminous (Schmidt *et al*., 2004). Mineral assemblages of the eclogite leucosomes and the nearby quartzofeldspathic rocks are extremely similar, except for occurence of kyanite and a higher abundance of carbon (in form of graphite and/or diamond) in the latter. By comparing the geochemistry of the two rock types, we have the rare opportunity to work out the similarities and differences of possibly sediment-derived and clearly eclogite-derived melts, allowing more precise statements about the metasomatic capacity of high pressure melts.

References

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