The effects of buoyancy on shear induced porosity bands in partially molten porous layers

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Simple shear of a solid matrix has been shown in both experiments (Holtzman *et al.* 2003) and numerical simulations (Katz *et al.* 2006) to produce bands of high melt fraction if the sample size is greater than the compaction length for the material and the solid matrix viscosity decreases with porosity. These melt bands have been proposed as a mechanism for both channelling and focusing melt toward the ridge axis in the upwelling mantle melt region. In this contribution, a new numerical model of porosity band formation will be introduced that incorporates the effects of the buoyancy of the melt phase. It will be shown that when buoyancy stresses are comparable to or greater than shear stresses, that the bands become oriented close to the direction of gravity. As a result, shear-induced melt bands may not be an efficient mechanism for melt focusing.

STXM analysis of NASA Stardust returned samples in low-density silica aerogel

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In 2006, the NASA Stardust spacecraft returned to earth with two unprecedented extraterrestrial samples captured in low-density silica aerogel [1]. The first is a collection of cometary dust from the comet 81P/Wild2. During the journey to its encounter with the comet, the Stardust spacecraft also collected a sample of contemporary interstellar dust from the galactic dust stream entering our solar system.

Comet Wild2

The comet dust formed hypervelocity impact tracks in aerogel with many fragments of the original impactor.

We used the Scanning Transmission X-ray Microscope (STXM) at Advanced Light Source (ALS) Beamline 11.0.2.2 to locate and characterize submicron-sized fragments of cometary particles in 50 µm thick slices of tracks from the Stardust aerogel collector. For example, we mapped Mg to locate particles in a section of impact track, then used Fe-L_{23} and Mg-K XANES to identify ferromagnesian silicates and measure crystallinity. Additional Ti or Al mapping highlighted refractory components.

Characterizing fragments in the original aerogel provides a greater number of particles than may be expeditiously extracted; it is a search for unexpected refractory cometary components; and it helps prioritize particles for extraction and further analysis (e.g. STXM/ C-XANES on extracted particle thin-sections).

Stardust Interstellar Dust

We apply a similar approach to the Stardust Interstellar Collector. Whole impact tracks are extracted in 50 µm thick volumes of aerogel “picokeystones” [2]. We will use STXM to locate sub-micron fragments, without damage to the sample using element maps, and verify whether they are spacecraft ejecta or the first contemporary interstellar dust particles ever collected.

[1] Brownlee *et al.* (2006) *Science* **314,** 1711-1716.
[2] Westphal *et al.* (2004) *Meteoritics & Planet. Sci.* **39**, 1375-1386.