**1. Purpose**

We evaluated the significance (or existence) of boundary layer effects on melt inclusion compositions to explore whether small inclusions can be useful in retrieving parent melt compositions of Martian meteorites. Our approach is to obtain chemical analyses by EMPA on small (< 20 µm) and large (~ 50 µm) melt inclusions in olivine crystals from the *Tissint olivine-phyric shergottite*.

**2. Inclusion Petrography**

Melt inclusions in olivines from Tissint occur in two textures:

**Small glassy inclusions** (Fig. 1a): < 20 µm, mostly < 10 µm; scattered throughout the olivines; contain only Si-rich glass (56-72 wt% SiO₂) ± an oxide/sulphide (?) bleb (although some inclusions contain µm-sized pyroxenes on the wall of the cavity).

**Large, partially crystallized inclusions** (Fig. 1b): to ~ 50 µm, only near the cores of the largest (0.5 to 1.5 mm) olivine crystals; contain Si-rich glass (59-66 wt% SiO₂), augite pyroxene (En21-32Fs18-24Wo50-54) as rims on inclusion walls and as skeletal crystals, and rare blebs of oxide and sulphide phases.

**3. Original Trapped Melt**

The composition of the original trapped melt (OTM) was reconstructed for each inclusion from its bulk composition by addition of wall olivine and correction for Fe-Mg equilibrium between the OTM and the host olivine [1]. The amount of wall olivine to be added (25-52 wt%) is constrained to yield a melt composition co-saturated in olivine and low-Ca pyroxene (projected from Wo [2], for the Mg# of the Tissint’s fusion crust). The Mg# of the OTM is adjusted to be in equilibrium with the host olivine using the Mg# of the wall olivine (Fo25-27) and \( K_{\text{OTM}}^{\text{wall}} = 0.35 \) [3].

**4. Why small inclusions should be rehabilitated**

- OTMs from small and large inclusions follow the same line of magmatic differentiation (Fig. 2).
- OTM compositions from small and large inclusions trapped in the same olivine crystal are consistent (Fig. 2).
- Abundances of cations that diffuse slowly toward the growing olivine and cations that are incompatible with respect to olivine (such as Ti, Al, P) are similar in small and large inclusions (at a given evolution step of the magma) (Fig. 2).
- Abundance ratios of elements having identical behaviors during melt differentiation in OTMs from small and large inclusions are similar (Fig. 3).

**Take home message**

For Tissint, the boundary layer around the growing-olivine had no effect on the composition of small inclusions and both small and large inclusions sampled the bulk melt during intermediate steps in the evolution of the magma.

References: