

Inclusions of immiscible sulfide melts in olivine phenocrysts from mantle-derived magmas

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Sulfide inclusions, droplets of immiscible sulfide melt trapped during crystal growth have been observed in olivine phenocrysts in lavas from a variety of tectonic settings including MORB, OIB, BABB, Island Arc and Continental Flood Basalts. These inclusions may present the only direct evidence for sulfur saturation and the composition of an immiscible sulfide liquid early in the fractionation history of a mantle-derived magma.

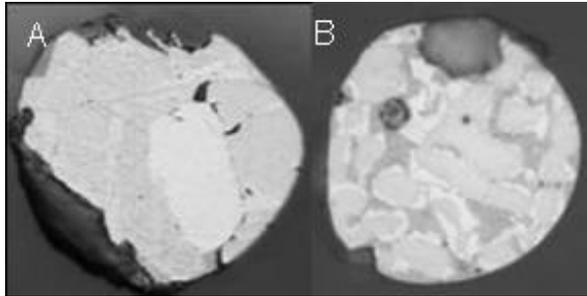


Figure 1: Naturally cooled (A) and reheated (B) sulfide inclusions in olivine (Fo_{89-90}). Both inclusions are $40\mu\text{m}$ diameter.

Sulfide inclusions are rare (in 0.1-3.5% of phenocrysts), range in size from <10 - $100\mu\text{m}$ and are generally coarsely recrystallised, to a three phase assemblage, during cooling (Fig. 1A), as described by Danyushevsky *et al.* [1]. Suitable inclusions were therefore reheated, in a custom-built low-inertia high-temperature heating stage, to 1100 - 1250°C and quenched to produce a 'homogeneous' 2- or 3-phase sulfide assemblage (Fig. 1B).

Compositions of the reheated sulfide inclusions were determined by EMPA and LA-ICPMS in order to evaluate the range of their variations within, and between, samples and to address the question of whether immiscible sulfide liquid compositions vary systematically between magmas from different tectonic settings.

We will present major and trace element composition of the sulphide inclusions and their host phenocrysts from 15 samples.

[1] Danyushevsky *et al.* (2001) *EOS* **82**, Fall Meet. Suppl. F1285.

Geochemistry of the Martian crust and constraints on the mantle

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Chemical compositions of Mars surface rocks and soils from orbital spectroscopy have been modified by weathering processes or represent incomplete analyses. The most complete chemical characterizations of Mars rocks and the regolith derived from them are based on *in situ* APXS analyses by rovers and on laboratory analyses of Martian meteorites. The cosmic-ray Mars launch ages of meteorites cluster into petrologically consistent groups, suggesting at least seven sites have been sampled – far more than by landed missions. A comparison of the compositions of Gusev RAT-ground rocks analyzed by MER and Mars meteorites indicates all are basaltic (as do orbital GRS measurements) with variable abundances of alkalis. None of these rocks are calc-alkaline, as inferred from some orbital remote sensing data, casting doubt on that interpretation. Depletion in Al, a defining geochemical characteristic of Mars meteorites and Mars Pathfinder rocks, is not observed in Gusev rocks and soils. Ca-Mg and Ni-Mg systematics, used to classify the meteorites, are distinct in Gusev rocks. However, Fe-rich compositions appear to be a general characteristic of all Mars rocks. Highly fractionated rocks, inferred from some orbital spectra, are not observed among surface materials and must be uncommon.

Not surprisingly, the mantle source regions for Martian igneous rocks are revealed to be diverse in the kinds of basaltic melts generated, as well as in their radiogenic isotope and incompatible trace element compositions and oxidation states. Primary liquid compositions represented in these suites are consistent with derivation from a mantle composition with high Fe/Mg and volatile element abundances, possibly including H_2O although that remains controversial.