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Metal saturated picrites from Noril'sk - lunar equivalents?

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The Noril'sk magmatic province hosts tholeiitic to picritic compositions that have preserved five different melts (Fig. 1): a basaltic andesite with 5 wt.% MgO (1a), an Fe-C±S melt, Fe-S sulfide melt (1b), and in the mesostasis wedged between plagioclase laths two immiscible melts in the fayalite-leucite-P_2O_5-SiO_2 system (1c). Metal saturation occurred at ≥ 1130°C, the liquidus temperature of the andesitic inclusion in Fig. 1a, when the picritic parent magma intruded Carboniferous coal-bearing sediments and assimilated carbon. The early saturation with metallic Fe-C±S melt resulted in a differentiation path without much SiO_2 enrichment, quite unusual for terrestrial settings. The most fractionated phase observed in the picrite is pure fayalite.

We performed fractionation experiments from 1170 to 1030°C with the andesitic composition, to quantify the effect of fO_2 on the fractionation path. fO_2 was buffered at the wüstite-magnetite (WM) and 2 log-bar units below the iron-wüstite (IW) buffer, using graphite and metallic Fe capsules as sample containers. Under highly reduced conditions at IW-2, the composition fractionates pyroxene and plagioclase, and derivative melts move toward the miscibility gap in the fayalite-leucite-SiO_2 ternary. Two immiscible melts exsolve between 1050 and 1030°C, one FeO-P_2O_5 rich, and a second one silica enriched with up to 80 wt.% SiO_2. In experiments under oxidized conditions at WM outside Fe metal saturation, no liquid immiscibility is observed, and enrichment in SiO_2 with increasing fractionation is more pronounced than with Fe metal saturation.

The metal saturated picrites share many similarities with low TiO_2 lunar basalts. They carry oxide populations that correspond to those of lunar compositions. On the Moon, late-stage liquid immiscibility appears to be more widespread than in terrestrial compositions, and many lunar basalts carry phases enriched in Cr^{2+}, Ti^{3+}, and are Fe metal saturated. Lunar igneous rocks enriched in silica appear to be rare and may be related to the exsolution and large-scale segregation of immiscible silica-rich melts (Jolliff et al. 1999; Fig. 1C).

Jolliff, B.L. et al. (1999) Amer. Min. 84, 821–837.

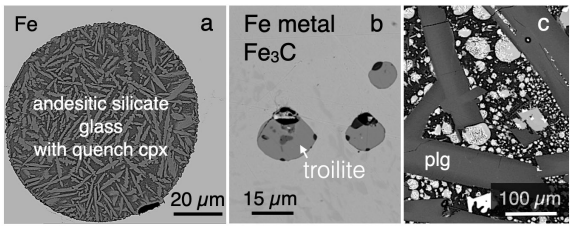

Fig. 1. Melts in the Noril'sk picrites.