Heterogeneous primary melts of the Emeishan picrites: contribution from eclogite to “plume” magmas

M.B. KAMENETSKY[1], V.S. KAMENETSKY[1], CRAWFORD[1], S.-L. CHUNG[2], A.J. D.V. KUZMIN[3] AND A.V. SOBOLEV[3]

[1] CODES, University of Tasmania, Australia; Maya.Kamenetsky@utas.edu.au
[2] Department of Geosciences, National Taiwan University, Taiwan; sunlin@ntu.edu.tw
[3] MPI, Mainz, Germany; asobolev@mpch-mainz.mpg.de

The Late Permian Emeishan flood basalt province in SW China is characterised by unique occurrence of picritic lavas with high-Fo olivines. We aimed at reconstructing the compositions of parental/primary melts and their evolution during crystallisation, using olivine phenocrysts and olivine-hosted inclusions from picrite lavas in the Dukou area [1]. Picrites are massive high MgO rocks (16-18 wt%) with abundant olivine (Fo 75.9-91.6 mol%) and clinopyroxene phenocrysts. Variable trace elements in olivine at a given Fo (e.g., 0.25-0.45 wt% CaO, 0.3-0.4 wt% NiO) suggest different parental melts, rather than control from crystal fractionation. NiO is exceptionally high (up to 0.5 wt%) in some crystals Spinel inclusions in olivine are characterised by high Cr# (50-82 mol%) and variable TiO_2 contents (2-8 wt%) for a given composition of the host olivine.

Crystallised melt inclusions in olivine were heated at 1320^{o}C in a vertical furnace and quenched into glass. The glass compositions were recalculated in order to account for FeO depletion (5-12 wt%, c.f. 12 wt% in whole rocks) and to match the equilibrium with host olivines. Melt inclusions have broad geochemical similarities to the whole rocks and OIB, but the overall variations in major and trace elements and their ratios are significant (e.g., CaO/Al_2O_3 1-1.5; K_2O/TiO_2 0.15-0.47; La/Sm 2.2-5.1; Gd/Yb 3.6-5.7). High Gd/Yb point to large content of residual garnet in the melting source, possibly exceeding amount of garnet in a “plume” mantle source of OIB. Copper accumulates in the melt during crystal fractionation to very high levels (~600 ppm).

Variations in the compositions of olivine, spinel and melt inclusions argue for significant compositional heterogeneities among parental magmas. We invoke mixing between two principal magmas that derived from the mantle peridotite (“plume”) and pyroxenite. The latter was formed by reaction between partial melt derived from crustal eclogite and mantle peridotite [2]. The presence of reaction pyroxenite in the source is justified by high Ni and low Mn in olivine phenocrysts [2], the elevated MREE/HREE in melt inclusions and unradiogenic Nd isotopes (εNd(T)=+4 to -4 [1]).

References

[1] Chung S.L., and Jahn B.-m. (1995) *Geology* **23**, 889-892.
[2] Sobolev A.V. et al. (2005) *Nature* **434**, 590-597.