

Which came first, amphibole or clinopyroxene? A new view on chemical evolution of metasomatic process

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A petrological study of mantle xenoliths from Harrow Peaks, Northern Victoria Land (Antarctica) has been carried out, aiming at mapping the evolution of this lithospheric mantle domain. Samples vary in composition from lherzolite to harzburgite with textural evidences of matrix/melt interaction. Olivine (ol), and more rarely orthopyroxene (opx) are mainly present as large grains. Clinopyroxene (cpx) is not texturally ascribable to residual peridotite phase; it occurs as large invasive veins in anhydrous peridotite matrix or as small disseminated crystals in association with amphibole (amph) and spinel, recalling a newly formed metasomatic phase. The presence of both “convex upward” REE pattern and LREE enrichment in cpx (L_{AN} from 9 to 30), suggests that Harrow Peaks lithospheric mantle was variably affected by secondary processes, i.e. refertilisation and metasomatism. Compared with the nearby amphibole-bearing xenolith area of Baker Rocks (Coltorti et al., 2004 [1]), Harrow Peaks amphibole presents lower TiO_2 contents and LREE enrichment that may be related to an incipient stage of peridotite/melt interaction. This fact may also justify the different geochemical features of amphibole that in some cases do not mimic the REE partitioning pattern of cpx suggesting still incomplete attainment of the equilibrium conditions. The fugacity values calculated on the basis of the anhydrous parageneses ($\log f_{O_2}(QFM)$ -2.78 to -0.24) strongly deviate from those obtained from amphibole dehydration equilibrium, applying the dissociation reaction, that record extremely oxidizing conditions ($QFM = +5; +6.8$; Gentili et al., 2015 [2]), at T varying between 800 to 1100 °C.

Considering amphibole and cpx as the main products of a hypothetical reaction between primary (ol-opx) paragenesis and infiltrating melt, the main geochemical features of the metasomatic agent were modelled through least square mass balance calculation. The resulting composition reflects a “silicic” melt, with high CaO and MgO contents, that may assign to a natural or experimental obtained carbonatite-like melt.

[1] Coltorti *et al.* (2004). *Lithos* **75**, 115–139.

[2] Gentili *et al.* (2015). *Miner. Petrol.* **109**, 741–759.