



Pyroxenite records in the oceanic mantle: insights from the Corsica ophiolites

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Pyroxenite layers are minor but diffuse lithotype in fertile mantle peridotites and are considered an important component in the mantle source of oceanic basalts. Their origin may involve different processes, e.g. recycling of oceanic crust, deep-seated melt intrusion or reactive melt percolation at depth. Pyroxenites are rarely documented in abyssal and ophiolitic peridotites representing residual mantle after melt generation, and few studies defining their origin are to date available. We present petrographic and geochemical investigations of the pyroxenite layers associated to the depleted peridotites from the Mt. Maggiore ultramafic body. Pyroxenites (mostly websterites) occur as parallel layers preserving the same orientation throughout the whole peridotite massif. They are affected by multiple episodes of melt-rock interactions, as recorded in the associated peridotites. In places, pyroxenite layers are partially dissolved by spinel-facies reactive melt migration, with large pyroxene porphyroclasts partly replaced by interstitial olivine. Subsequent plagioclase-facies melt impregnation leads to orthopyroxene + plagioclase intergrowths crystallized at the expense of olivine and clinopyroxene. Field and petrographic evidence thus indicates that pyroxenite emplacement preceded the multi-stage melt-rock interaction history that affected this mantle sector during Jurassic exhumation at the ocean floor. In the pyroxenites, both pyroxenes preserve relatively high Al_2O_3 contents, up to 4.9 wt% in orthopyroxene and 7.2 wt% in clinopyroxene, similar to abyssal pyroxenites from ultraslow-spreading ridges (Dantas et al., 2007), and indicative of magmatic segregation at pressures higher than 7 kbar. Accordingly, geothermometric estimates on orthopyroxene-clinopyroxene pairs prior to exsolution (using areal analyses as primary pyroxene composition) yield high magmatic equilibrium temperatures of 1220-1270°C. In the pyroxenites, both primary clinopyroxene and plagioclase crystallized by impregnating melts exhibit low Na_2O contents ($\text{Na}_2\text{O} = 0.08\text{-}0.24$ wt% in clinopyroxene; $\text{An} = 94\text{-}96$ mol% in plagioclase) and significant LREE depletion ($\text{CeN}/\text{SmN}(\text{cpx}) = 0.01\text{-}0.05$; $\text{CeN}/\text{SmN}(\text{plag}) = 0.05\text{-}0.2$). Such mineral compositions indicate a depleted signature of both pyroxenite parental melts and later impregnating melts. Coupled major and trace element modeling show that the relatively high Al_2O_3 and low Na_2O contents in clinopyroxenes from the pyroxenites are well reproduced by spinel-facies fractional crystallization (~ 1 GPa) of depleted melt increments formed after 6% fractional melting of a fertile lherzolite (DMM). The modeled melt composition also accounts for the high $\text{Ca}/(\text{Ca}+\text{Na})$ and LREE depletion of the impregnation-related phases. Pyroxenite parental melts likely originated as single depleted melt increments, similar to the subsequent impregnating melts. These pyroxenites thus represent an early product of deep crystallization from depleted melts percolating through a thick thermal boundary layer. Subsequent upward migration of similar depleted melts caused melt-rock interactions at spinel- and plagioclase-facies depths, as documented in both pyroxenites and peridotites. In a slow-spreading oceanic lithosphere, the thick thermal boundary layer allows only for low degrees of mantle melting, which in turn leads to minor melt extraction and prevents melt aggregation. These non-aggregated depleted melts show a complex magmatic evolution involving high-pressure crystallization of pyroxenites and a continuous melt-rock interaction history.

Dantas, C., Ceuleneer, G., Gregoire, M., Python, M., Freydier, R., Warren, J. & Dick, H.J.B. (2007) Pyroxenites from the Southwest Indian Ridge. *J.Pet.*, 48: 647-660.