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Amphibole as a witness of chromitite formation and fluid metasomatism in ophiolites

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Abstract

Here we present new occurrences of amphibole in a suite of chromitites, dunites, and harzburgites from the mantle sequence of the Lycian ophiolite in the Tauride Belt, southwest Turkey. The amphibole occurs both as interstitial grains among the major constituent minerals and as inclusions in chromite grains. The interstitial amphibole shows generally decreasing trends in Na_2O and Al_2O_3 contents from the chromitites (0.14–1.54 wt% and 0.04–6.67 wt%, respectively) and the dunites (0.09–2.37 wt%; 0.12–11.9 wt%) to the host harzburgites (<0.61 wt%; 0.02–5.41 wt%). Amphibole inclusions in chromite of the amphibole-bearing harzburgites are poorer in Al_2O_3 (1.12–8.86 wt%), CaO (8.47–13.2 wt%), and Na_2O (b.d.l.–1.38 wt%) than their counterparts in the amphibole-bearing chromitites (Al_2O_3 = 6.13–10.0 wt%; CaO = 12.1–12.9 wt%; Na_2O = 1.11–1.91 wt%). Estimated crystallization temperatures for the interstitial amphibole grains and amphibole inclusions range from 706 to 974 °C, with the higher values in the latter. A comparison of amphibole inclusions in chromite with interstitial grains provides direct evidence for the involvement of water in chromitite formation and the presence of hydrous melt/fluid metasomatism in the peridotites during initial subduction of Neo-Tethyan oceanic lithosphere. The hydrous melts/fluids were released from the chromitites after being collected on chromite surfaces during crystallization. Different fluid/wall rock ratios are thought to have controlled the crystallization and composition of the Lycian amphibole and the extent of modification of the chromite and pyroxene grains in the peridotites. Considering the wide distribution of podiform chromitites in this ophiolite, the link between chromitite formation and melt/fluid metasomatism defined in our study may be applicable to other ophiolites worldwide.

Keywords: Amphibole, peridotite, chromitite, hydrous melts/fluids, ophiolite