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Petrogenesis of Ophiolitic Chromitites from the Southeastern Turkey: Chromite Composition and Geochemistry and Mineralogy of Platinum Group Elements

Recep Melih Akmaz (1), Ibrahim Uysal (2), and Samet Saka (2)

(1) Department of Geological Engineering, Bülent Ecevit University, Zonguldak, Turkey (rmelihakmaz@gmail.com), (2) Department of Geological Engineering, Karadeniz Technical University, Trabzon, Turkey (uysal.ibrahim@gmail.com)

Ophiolitic chromitites from the southeastern Turkey are located within mostly mantle peridotites (harzburgite and dunite) in the form of veinlets and lenticular bodies. Chromitites show a wide range of composition in terms of Cr# (39–82) and Mg# (45–75). Platinum group element (PGE) concentrations in whole rock range between 42 and 348 ppb (mean 135 ppb) in most of the investigated samples. High–Cr chromitites (Cr# > 70; Mg# = 45–67) are represented by low content of TiO_2 ($\leq$0.2 %wt.) and higher content of total PGE (mean 158 ppb), whereas low–Cr ones (Cr# < 70; Mg# = 57–75) contain higher TiO_2 contents (0.2–0.4 %wt.) and are represented by lower content of total PGE (mean 84 ppb). However, two chromitite samples show significant enrichments of especially IPGE (Os, Ir, Ru) with total PGE contents reaching up to 1.1 and 2.7 ppm, respectively. The investigated ophiolitic chromitites contain primary inclusions of platinum group minerals (PGM), base metal minerals (BMM) and silicates. The Cr–rich chromitites were observed to contain various type of PGM (up to 10 microns in size) of which the laurite is the most abundant type, accompanied by few irarsite and Os–Ir alloys. Single or poly–phase laurite inclusions, associated with hydrous silicate of amphibole in most cases, are rich in Ru [Ru#; 100$\times$Ru/(Ru+Os) = 61–80]. Millerite is the most abundant base metal mineral in chromite grains. Pentlandite, polydimite, heazlewoodite, violarite and rarely pyrite are observed as the others BMMs. Olivine, amphibole, clinopyroxene, orthopyroxene have been also identified as primary inclusions. PGM and BMM mineralogy suggest that the chromites started to crystallize at high temperature ($\sim$1300oC) and low $fS2$ conditions, and followed to lower temperature (1000oC) and higher $fS2$ conditions. Chemical and mineralogical data from the southeastern Turkey ophiolitic chromitites and their inclusions indicate that the high–Cr chromitites were crystallized out of boninitic melt in a island arc environment, whereas chromitites of high–Al composition were thought to crystallize either from the MORB type melt in middle oceanic ridge setting or back–arc environment.