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Mineralogy and Geochemistry of Platinum-Group Element Enrichments in Berit (Maras) Chromitites, Southeastern Turkey

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The studied area is located in the eastern Taurus ophiolite belt of Turkey. The mantle tectonites of Berit Ophiolite Massif comprise serpentinized harzburgites, dunites and lherzolites. Above the mantle tectonites, cyclic cumulate sequences of ultramafic and mafic rocks (dunite, wehrlite, olivine gabro) are present. The chromitites form podiform lenses, up to 2-20 m in thickness and a hundred meters long. Electron microprobe analyses of the chromitites indicate that they have two different chemical compositions. The first group are high-Cr chromitites with Cr# numbers (100xCr/(Cr+Al)) of 60-70, whereas the second group of chromitites are high-Al chromitites with Cr# numbers of of 29-37. Bulk platinum-group element (PGE) data indicate that almost half of the chromitites from the Berit ophiolites are enriched in PPGE, with Pt contents between 10-1155 ppb and Pd contents between 3-2518 ppb. These are among the highest reported PPGE values for Turkish chromitites up to date. These samples also have high Pd/Ir ratios (1-230). The remaining samples are enriched in the IPGE, with high Ru contents between 17-783 ppb and Pd/Ir ratios between 0.01-0.7. The IPGE enriched samples display negative slopes in mantle normalised element ratio plots whereas PPGE enriched samples exhibit positive slopes in mantle normalised element ratio diagrams, which is unusual for podiform type chromitites. Microscopic examinations and electron microprobe analyses of the PPGE and IPGE- enriched samples reveal platinum-group element minerals (PGM) as euhedral(10-15 μm) inclusions in the chromite grains. The PGM hosted by IPGE-rich high-Cr chromitites are primary inclusions of laurite, irarsite, Ir sulphide and erlichmanite in chromite grains. Very

small Pd-Pt telluride phases (merenskyite-moncheite) are hosted by polyphase sulphide droplets in the PPGE-rich chromitites of Berit. In these chromitites, the PGM are most commonly associated with base metal sulphide minerals such as pentlandite, chalcopyrite, and to a lesser extent pyrite, pyrrhotite, bornite and rarely gold. Rutile was found as inclusions in chromite and also between chromite grains. The silicate inclusions in Berit chromites are olivine, calcic amphibole (pargasite, edenite, tremolite), clinopyroxene (diopside) and chlorite. The composite sulphide-PGM phases in the PPGE-enriched samples are hosted by high-Al chromitites. Laurite is the most abundant PGM in Berit chromitites forming single or polyphase inclusions with irarsite or erlichmanite and silicate (clinopyroxene), Ni sulphide and occasionally Ru oxide. The chemical formula of laurites is Ru0.64-0.88Os0.03-0.22Ir0.03-0.15S2. The laurites in high-Cr chromitites of Berit ophiolites are characterized by a wide range of Os-Ru substitution, the occasional presence of erlichmanite and a lack of Os-Ir-Ru alloys. This indicates high ČS2 conditions during the PGM precipitation in the chromitites. Considering the different chemical compositions of both chromitite and PGM at Berit, we suggest that their parent melts derived from two different magma sources. The presence of hydrosilicate inclusions and the depletion for compatible elements in high-Cr chromitites of Berit ophiolites suggested that they occurred as a result of higher degree partial melting of the upper mantle, probably from second stage melting of a residual source. The high-Al chromitites probably resulted from lower degrees of partial melting from a more fertile mantle source at more sulphur saturated conditions. The Berit chromitites could have formed both from magmas related to the initial rifting process and to subsequent supra-arc magmatism prior to obduction of the host ophiolite.