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Petrogenesis of mantle peridotite of the Jabal Ess ophiolite, NW Saudi Arabia

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Neoproterozoic ophiolites are widespread in the Arabian-Nubian Shield (ANS) and mostly occur along or within suture zones that extend roughly from north to south. These ANS ophiolites represent fragments of forearc-derived oceanic lithosphere generated during a stage of subduction initiation in the Mozambique Ocean. One of these ophiolites is the Jabal Ess ophiolite (JEO) which is the most complete of the Arabian ophiolites. The ~780 Ma JEO is situated in the far north of Saudi Arabia, where it crops out in an area more than 30 km east-west by 5 km north-south and comprises a segment of the Yanbu suture zone separating the Hijaz terrane from the Midyan terrane. The JEO comprises an assemblage of mantle peridotite, isotropic and layered gabbro, a dike complex, pillow basalt, boninite and pelagic sediments and the focus of this study is the mineralogy and geochemistry of the peridotite. Our study identifies predominantly serpentinized harzburgite in the NE and lesser serpentinite to the SW. Whole rock Al_2O_3/SiO_2 of 0.01–0.02 confirm a high degree of melt extraction for the serpentinized harzburgite; the two serpentinites yield Al_2O_3/SiO_2 of 0.04 and 0.08 with the higher value possibly due to silica-melt addition. Harzburgites exhibit U-shaped chondrite-normalized REE patterns with low concentration (∑REE 7.46–10.79 µg/g), typical of melts derived from a depleted mantle. These signatures probably represent residual mantle after boninite extraction. Alternatively, the two serpentinites have wider ranges of ∑REE=4.35–7.10 µg/g with one showing a U-shaped pattern akin to the harzburgite and one showing a LREE depletion (La/Yb_{CN} = 0.51) relative to the MREE and HREE. Mineral assemblages from the serpentinized harzburgite and serpentinite record greenschist facies metamorphism. The serpentinized harzburgite unit comprises Mg-rich olivine (Fo_{92-90}), bastite after orthopyroxene (En_{90-86}), minor clinopyroxene (Wo_{52-50}, En_{47-46}, Fs_{4-1}), and euhedral to anhedral spinel. Some enstatite shows crystallographic banding, indication of high temperature sub-solidus deformation within the plastic mantle. Serpentinites are characterized by abundant high-pressure antigorite and altered anhedral spinel, e.g., spinels which exhibit noticeable chemical zonation of cores rich in Al (a.p.f.u=0.47–0.49) and Cr (a.p.f.u=0.50–0.99) with Fe-enrichment (a.p.f.u=0.72–0.98) towards the rim. Based on spinel Cr# (0.56–0.72) the serpentinized harzburgites and serpentinites have undergone high degrees of partial melting of ~18–20% consistent with the low whole rock Al_2O_3/SiO_2. Moreover, based on Cr# vs Mg#

(0.48-0.61) the serpentinized harzburgite and serpentinite plot within the field of forearc peridotite. Results of oxygen fugacity and thermobarometry calculations will be discussed in the context of the compositional evolution of Jabal Ess harzburgite and serpentinite in the framework of formation during subduction initiation.