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Purang Ultramafic Complex and Their Geological Origin, Southwest Tibet

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Neoproterozoic ophiolitic Serpentinites are common in the Arabian–Nubian Shield (ANS) of the Eastern Desert (ED) of Egypt, which were formed in arc stage in different tectonic setting. Thus they might subject to exchange with the crustal material derived from recycling subducting oceanic lithosphere. This caused metasomatism enriching the rocks in incompatible elements and forming non-residual minerals. Herein, we present detailed mineral chemical and geochemical investigation of four ophiolitic serpentinite masses (from W. Mubarak, G. El-Maiyit, W. Um El Saneyat and W. Atalla) in the ED of Egypt was carried out to better understand the melting and metasomatism in the Neoproterozoic mantle beneath the ED (Fig. 1).

These rocks are highly serpentinized, except some samples from W. Mubarak and Um El-Saneyat, which contain primary olivine (Fo#=90-92mol %) and orthopyroxene (En#=86-92mol %) relics. They have harzburgite composition (Fig. 2). These rocks are restites formed after partial melting between 16.58 in W. Atalla to 24% in G-El Maiyit. Melt extraction occurred under oxidizing conditions in peridotites from W. Mubarak and W. Atalla and under reducing conditions in peridotites from G. El-Maiyit and Um El-Saneyat.

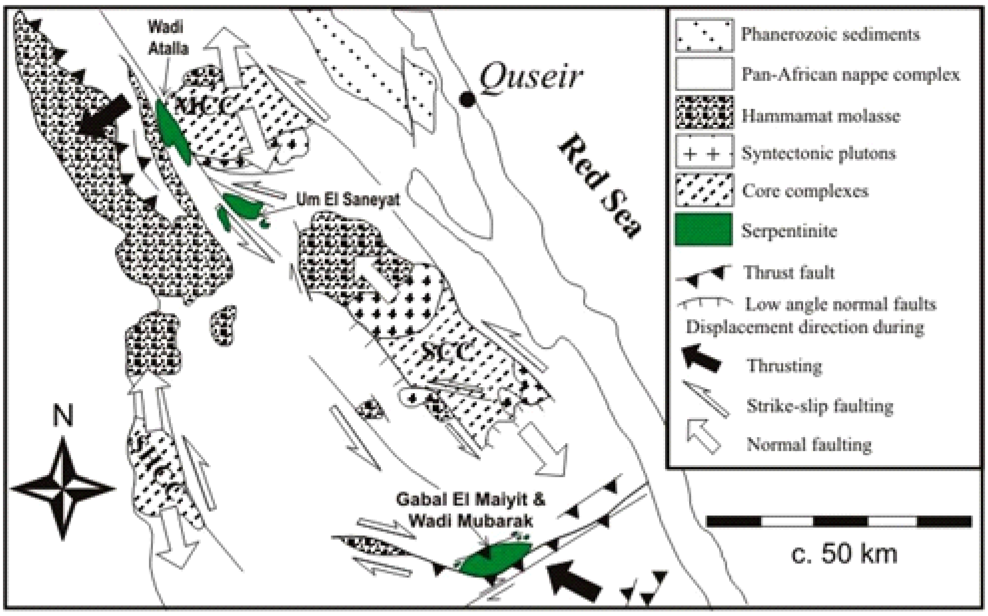

Fig. 1 Location of the studied serpentinite masses and their relations, to the major structural trends and to the distribution of metamorphic and magmatic core complexes (MCC, Meatiq; SCC, Sibai and SHCC, El -Shlul) and to late tectonic plutons and molasse basins in the Pan-African Orogen in the Central Eastern Desert of Egypt (major structures are after Fritz et al., 1996 and Abd El-Wahed and Kamh, 2010) Bregar et al., 2002)

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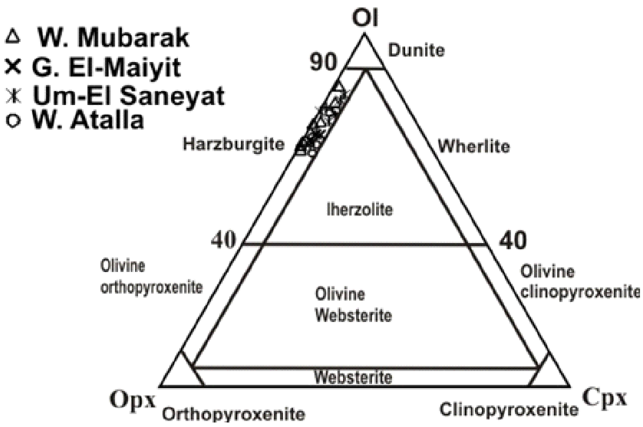

Fig. 2. Nomenclature of the studied serpentinized mantle slices based on Ol-Opx-Cpx normative composition (after Streckeisen, 1976).

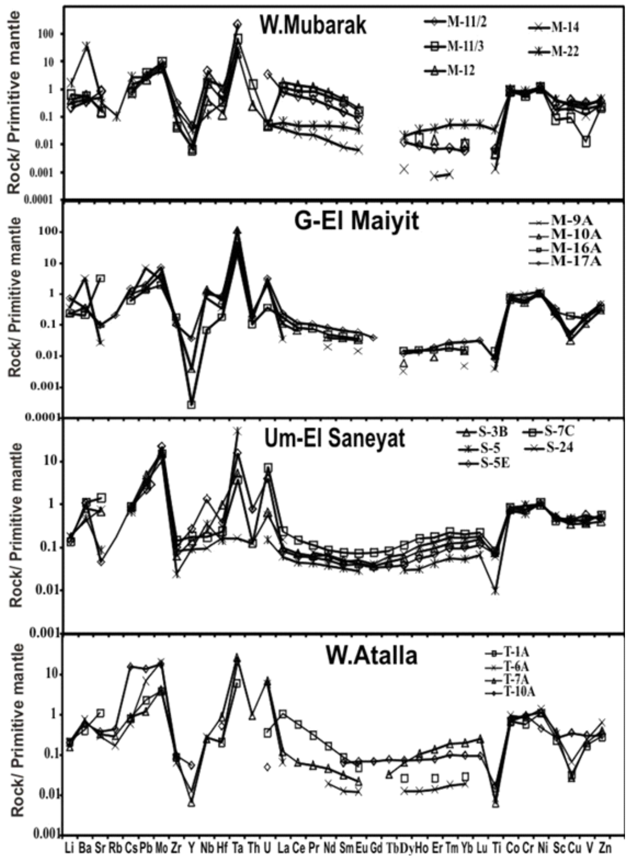

Fig. 3 Whole-rock multi-element diagrams normalized to primitive mantle (McDonough and Sun 1995) for the mantle slices serpentinized peridotites

Cryptic metasomatism in the studied mantle slice peridotites is evident. This includes enrichment in incompatible elements in minerals and whole rocks if compared with the primitive mantle (PM) composition and the trend of the depletion in melt. In opx the Mg# doesn't correlate with TiO_2, CaO, MnO, NiO and Cr_2O_3 concentrations. In addition, in serpentinites from W. Mubarak and W. Atalla, the $TiO_{2spinel}$ is positively

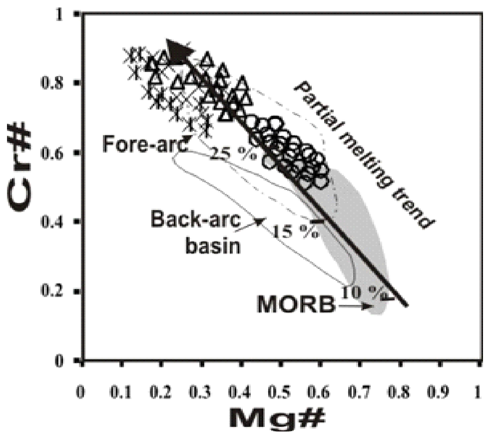

Fig. 4 Cr# versus Mg# for the analyzed spinels (adopted from Stern et al., 2004) and the melting trend of primitive mantle after Dick and Bullen (1984)

correlated with the $TiO_{2whole-rock}$, proposing enrichment by the infiltration of Ti-rich melts, while in G. El- Maiyit and Um El-Saneyat serpentinites they are negatively correlated pointing to the reaction with the Ti-rich melts.

All rocks are enriched LREE, FMEs and HFSEs (Fig. 3). This took place mostly by different agents. As the H_2O-rich liquid, which seems to have been produced from the subducting oceanic slab percolating peridotites, gradually loses trace elements, the HFSEs are fractionated from LILEs and REEs. This could explain the high ratios of $(Nb/La)_N$ and $(Nb/Ba)_N$ of some of the studied rocks. All the studied serpentinized mantle slices have subchonddritic to near chondritic ratios of Nb/Ta (<13.8) and Zr/ Hf (< 36.09). It is suggested that Nb did not fractionate from Ta and Zr from Hf. There are might be silicate melts enriched the peridotites in Ta rather than Nb causing a much great decrease in the Nb/Ta especially serpentinites from W. Mubarak. This melt/fluid might have been derived from recycled subducted oceanic crust or from hot asthenosphere. Concentrations of U in all the studied samples (except for W. Mubarak serpentinites) are positively correlated with LILEs, Pb and Mo, indicating that the studied serpentinites were enriched in these elements from the same fluids, most probably derived from subducted oceanic lithosphere. Positive anomalies of Li (in W. Mubarak and G. El-Maiyit serpentinites), U (except for W. Mubarak serpentinites), Mo and Pb are characteristics of hydrothermally altered ocean-floor peridotites. High Sr/ Nd ratios may be typical of the hydrous metasomatism caused by hydrous melt/fluid.

Based on the Cr# and Mg# of the unaltered spinel cores, all rocks formed in oceanic mantle wedge in the fore-arc setting, except those from W. Atalla formed in nascent fore -arc (Fig. 4). This implies that the polarity of the subduction during the arc stage was from the west to the east (Fig. 5) .

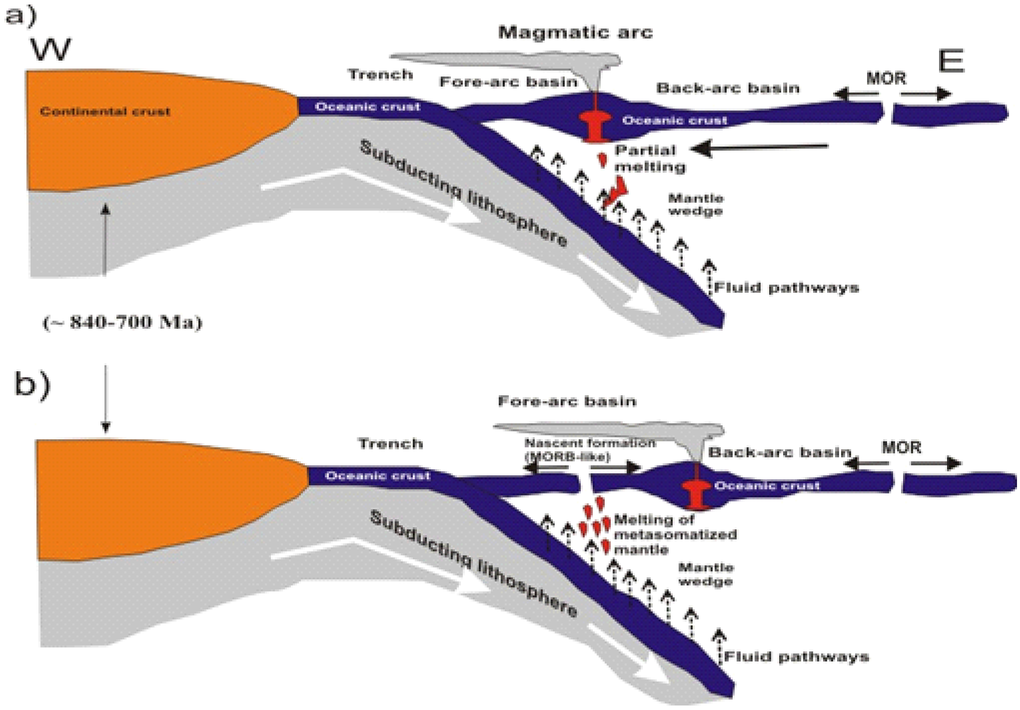

Fig. 5 Tectonic model for evolution of the studied peridotites and ANS

(a) partial melting of mantle beneath fore-arc during subduction of oceanic lithosphere. Arrows show approximate direction of flow and released fluid from subducting slab. (b) Formation of nascent fore-arc peridotites with MORB-like affinity due to melting of metasomatized mantle

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