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Thermodynamic modelling of Sol Hamed serpentinite, South Eastern Desert of Egypt: implication for two serpentinization stages in the Arabian-Nubian Shield ophiolites

T. Abu-Alam (1,2) and M. Hamdy (2)

(1) Institut für Erdwissenschaften, Universität Graz, Universitätsplatz 2, A-8010 GRAZ, Austria (tamer.abu-alam@uni-graz.at), (2) Geology Department, Faculty of Science, Tanta University, Tanta, Egypt

The Arabian-Nubian Shield is the largest tract of juvenile continental crust of Neoproterozoic age on Earth. This crust was generated due to arc-arc collision associated with the closing of the Mozambique Ocean. Distribution of ophiolitic rocks marks fossils suture zones in the shield. Petrological, mineral chemistry, whole-rock chemistry and thermodynamic studies are carried out to examine the serpentinite component of Sol Hamed ophiolite in south Eastern Desert of Egypt. The protolith mantle was harzburgite and formed in subduction zone of forearc setting. Serpentinization occurred in two stages. The first by intrusion of high concentrated CO_2 fluid released from carbonate-bearing sediments and altered basalt at the subduction zone. The serpentinization achieved during isobaric cooling path at pressure of 1 kbar and before the emplacement. The minimum temperature limit of the serpentinization is above the breakdown of lizardite to antigorite and brucite (170 ºC). The fluid composition during the isobaric cooling path was buffered by the metamorphic reactions. The second stage of serpentinization took place through prograde path which led to formation of chrysotile after lizardite. The increasing in the pressure during this stage occurred as a result of extensive duplex array and thrusting of oceanic crust. The crust in the forearc basin was overloaded by 28 km of obducted and thrusted oceanic crust from both mid-oceanic and forearc basins, respectively.