



Origin of spinel lamella and/or inclusions in olivine of harzburgite from the Pauza ultramafic rocks from the Kurdistan region, northeastern Iraq

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Exsolution lamellae and octahedral inclusions of chromian spinel occur in olivine of harzburgite of the Pauza ultramafic rocks, Kurdistan region, northeastern Iraq. The lamella is up to 80 μ m long and up to 50 μ m wide. The lamellae and octahedral inclusions of chromian spinel are distributed heterogeneously in the host olivine crystal. They are depleted in Al₂O₃ relative to the subhedral spinel grains in the matrix and spinel lamella in orthopyroxene. Olivine (Fo₉₂₋₉₃) with spinel lamellae occurs as fine-grained crystals around orthopyroxene, whereas olivine (Fo₉₀₋₉₁) free from spinel is found in matrix.

Based on back-scattered images analyses, enrichments of both Cr # and Fe⁺³ in the chromian spinel lamella in olivine (replacive olivine) relative to that in adjacent orthopyroxene. As well as the compositions of chromian spinel lamellae host olivine are more Mg-rich than the matrix olivine. Furthermore the restriction of olivine with spinel lamellae and octahedral inclusions on around orthopyroxene, and the similarity of spinel lamella orientations in both olivine and adjacent orthopyroxene. This study concludes that the spinel inclusions in olivine are remnant (inherited from former orthopyroxene) spinel exsolution lamella in orthopyroxene, that has been formed in upper mantle conditions (T = 1200 °C, P = 2.5 GPa).

Replacive olivine are formed by reaction of ascending silica poor melt and orthopyroxene in harzburgite as pressure decrease the solubility of silica-rich phase (orthopyroxene) in the system increase, therefore ascending melt dissolve pyroxene with spinel exsolution lamella and precipitate replacive olivine with spinel inclusions. We can conclude that the olivines with spinel lamella are not necessary to be original and presenting ultrahigh-pressure and/or ultra deep-mantle conditions as previously concluded. It has been formed by melting of orthopyroxene (orthopyroxene with spinel exsolution lamella = olivine with spinel lamellae and octahedral inclusions + Si-rich melt; 2Mg SiO₃= Mg₂SiO₄+SiO₂) in about 700 °C.