American Mineralogist, Volume 84, pages 564–569, 1999

Magnetite lamellae in olivine and clinohumite from Dabie UHP ultramafic rocks, central China

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ABSTRACT

Ultrahigh-pressure (UHP) minerals of the Maowu mafic-ultramafic complex in the Dabieshan, east-central China exhibit many exsolution textures. Magnetite lamellae are common in olivines and Ti clinohumites from harzburgite and garnet pyroxenite. Monazite-(Ce) lamellae occur in apatites from the garnet pyroxenite. Independent *P-T* estimates suggest that these ultramafic rocks formed at $P > 5$ GPa and $T = 700 \pm 50$ °C. The lamellae-bearing minerals are believed to preserve an earlier, higher *P-T* record prior to exsolution. Compositions and unit-cell parameters of the magnetite and host olivine and intergrowth relations were determined using a newly developed X-ray diffraction microprobe technique employing synchrotron radiation. The host olivine and magnetite lamellae bear a topotaxial relation with $[220]_{Mag} \,||\, [200]_{Ol}$, $[111]_{Mag} \,||\, [3\,\bar{3}\,\bar{1}]_{Ol}$, $[11\,\bar{1}]_{Mag} \,||\, [331]_{Ol}$, $[242]_{Mag} \,||\, [2\,\bar{2}\,0]_{Ol}$. The recalculated composition of primary olivine may contain up to 1.5 wt% Fe_2O_3. Four hypotheses may explain the observed intergrowths of oriented magnetite lamellae in olivine: (1) oxidation of olivine; (2) decomposition of Fe^{3+}-bearing olivine formed at >6 GPa; (3) exsolution of a spinel (wadsleyite) solid-solution Fe_3O_4-$(Fe,Mg)_2SiO_4$ during decompression; and (4) breakdown of phase A $[Mg_7Si_2(OH)_6]$ + enstatite. The third hypothesis appears to be the most likely inasmuch as no additional silicate phase occurs as associated inclusions in the olivine host. However, the actual mechanism for exsolution of magnetite from olivine remains to be studied experimentally.