Diopside lamellae within chromites in Luobusa ophiolite, Tibet: Is it evidence for high-pressure polymorph of chromite?

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Chromite, in general, occurs in various kinds of rocks and minerals, including mafic and ultramafic igneous rocks, metamorphic rocks and even diamond. In this study, we first discovered needle-shaped clinopyroxene, hereafter cpx rods, within chromites of podiform chromitite in the Luobusa ophiolite, Tibet. We confirmed the chemical composition and crystal structure of the cpx rods using SEM-DES, Laser-Raman and Transmission Electron Microscopy (TEM) at Tokyo Institute of Technology. The cpx rods have almost 1um width and few tens microns under the microscopic observation, but we found very small, ten nanometers-size, cpx rods under electron microscope. Although crystal orientation of the cpx rods seems random at a glance, those of some cpx rods are parallel each other. These textures of the cpx rods within chromite are very similar to that of pyroxene lamellae within garnet in ultramafic mantle xenoliths (Haggerty and Sautter 1990). Hence, the similarity suggests that the cpx rods were formed as exsolution lamellae from the host chromite. It is well-known that ilmenite occurs as exsolution lamellae in chromite (e.g. Rollinson et al., 2002) but diopside lamellae in chromite has not been known yet, because previous experimental and mineralogical works showed that CaO and SiO2 are not incorporated in spinel structure due to their cation size.

How were the cpx lamellae generated? Recently, high-pressure polymorphs of chromite, $CaFe_2O_4$ (CF) and $CaTi_2O_4$ (CT) structures, were discovered in the shock veins of the Suizhou meteorite (Chen et al. 2003a). And then, they performed laser-heated diamond anvil cell experiments to confirm that chromite transforms to CF at 12.5 GPa, and to CT structures above 20GPa. They mentioned the possibility that the chromite polymorphs, CF and CT phases, incorporate Ca, Si, Ti, and Fe as $CaFe_2O_4$ and $CaTi_2O_4$ solid solutions (Chen et al. 2003b). It suggests that diopside component can be solved in high-pressure polymorphs of chromite. The line of evidence implies that the chromites with the cpx lamellae were formed as the CaO- and SiO2-bearing polymorphs under the high-pressure condition, over 12.5 GPa.

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