Ti-rich phases in the MgO–SiO_2–TiO_2 system at 10–24 GPa:composition, solid solutions, and structural features

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The influence of minor elements on structural peculiarities of high-pressure phases is poorly investigated, although incorporation of even small portions of them may have a certain impact on the PT-parameters of phase transformations. Titanium is one of such elements with the low bulk concentrations in the Earth's mantle (0.2 wt % TiO_2); however, Ti-rich lithologies may occur in the mantle as a result of oceanic crust subduction. Thus, the titanium content is ~2 wt% TiO_2 in MORB (Wilson, 1989). Accumulation of titanium in the Earth's mantle proceeds through crust-mantle interaction during the subduction of crustal material to different depths of the mantle.

Experiments were aimed on the study of the phase relations in the $MgSiO_3$–$MgTiO_3$ system at 10-24 GPa and 1600°C, as well as structural peculiarities, and compositional changes of Ti-rich phases with pressure using a Kawai-type multi-anvil apparatus. We investigated the full range of starting compositions, which allowed us to synthesize Ti-rich phases with a wide compositional range and plot the phase PX diagram for the system En–Gkl. The main phases obtained in experiments were: rutile, wadsleyite, enstatite, $MgTiO_3$-ilmenite, $MgTiSi_2O_7$ with the weberite structure type (Web), $Mg(Si,Ti)O_3$ and $MgSiO_3$ with perovskite-type structure.

Small crystals of $MgTiSi_2O_7$ phase were examined by single-crystal X-ray diffractometer. $MgTiSi_2O_7$ was found to crystallize with the weberite-3T structure type, space group $P3_121$, with lattice parameters a=6.3351(7), c=16.325(2) Å, V=567.4(1) $Å^3$ (Bindi et al., 2017).

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