

MS6 – P7: Ca-walstromite and its relevance in understanding ring carbonates at deep mantle conditions

Sula Milani^a, Davide Comboni^a, Paolo Lotti^a, Patrizia Fumagalli^a, Juliette Maurice^a, Marco Merlini^a

^aDipartimento di Scienze della Terra 'Ardito Desio', Università degli Studi di Milano, Milano, Italy

CaSiO₃ walstromite is the triclinic ring-silicate polymorph of CaSiO₃ and is stable between 3 and 9 GPa at ambient temperature. In the studies of the Earth's interior, it is considered important for two main reasons. Firstly, it is one of the main Ca-bearing phases in the Earth's mantle transition zone [1]. This has been proved by both laboratory experiments at high pressure (*P*) and temperature (*T*) and by natural findings in diamonds [1, 2]. Despite this, its thermoelastic behaviour and its stability at high *T* are still poorly known. The only existing phase diagram has been determined through multi-anvil experiments, which shows that walstromite transforms to an assemblage of CaSi₂O₅ + Ca₂SiO₄ [3]. Secondly, the different CaSiO₃ polymorphs constitute a low-*P* analogue for the study of ultra-high-*P* carbonate structures at conditions of the lower mantle. Carbonate minerals are considered as one of the main carbon-host phases in the mantle. They are stable from crust to lower mantle conditions, as demonstrated by direct observation of carbonates inclusions in superdeep diamonds [e.g. 4]. To date, the different possible structures adopted by carbonates during their polymorphic phase transitions are still unclear [5], even if recent important experimental [e.g. 6, 7] and theoretical studies [e.g. 8, 9] have demonstrated the transition in complex tetrahedral ring or chain carbonate structures. However, ring-carbonates are unquenchable at ambient *P* and *T* conditions and is extremely difficult to perform extreme high-pressure single crystal diffraction with suitable quality of data for accurate structural details determination. Since CaSiO₃ polymorphs show the same ring-structure and are quenchable, they constitute evaluable analogue to understand the crystal chemistry of HP-carbonate structures. We performed in-situ high-pressure Diamond Anvil Cell experiments on a synthetic sample of the triclinic Ca-walstromite polymorph at the beamline ID15b at ESRF (Grenoble). The sample was synthesized at 6.5 GPa and 1500°C with a multi-anvil module. We report its phase transition towards a monoclinic structure walstromite-II, at 8.5 GPa, studied by single crystal X-ray diffraction. The monoclinic structure is topologically similar to the triclinic one, but the arrangement of 3-fold ring silicate groups determines a denser structure by about 3%. The walstromite-II structure is significantly denser if compared to wollastonite chain silicate structure. Since the Ca-walstromite is a low-*P* quenchable structural analogue to 3-fold ring high-*P* carbonates (Fig. 1), from this preliminary high-*P* experiment we can envisage that also higher *P* carbonates, like dolomite IV (Fig. 1), might have a phase transition to higher density structures at extremely high *P*.

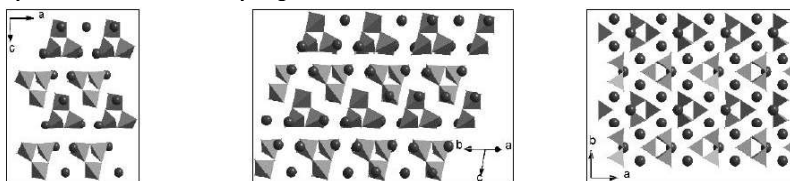


Figure 1. *Left* - crystal structure of the triclinic polymorph of the CaSiO₃; *centre* - crystal structure of the monoclinic polymorph and *right* - crystal structure of dolomite IV, where it is evident the presence of corner-sharing tetrahedral CO₃ units in threefold rings as in the Ca-walstromite structure (*left* and *centre*).

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