Structure-elastic behaviour relationship in minerals at high-pressure

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Abstract

Since the first pioneer studies in the 1970s on the high-pressure behavior of single-crystal materials conducted with a diamond anvil cell using X-ray diffraction, continuous developments of cell design and instrumentation has given rise to an exponential increase of publications in a wide range of scientific disciplines including Earth and material sciences, chemistry, physics, biology etc. In Earth Sciences in particular, single-crystal X-ray diffraction has been used a powerful tool in several studies for the following reasons: 1) it allows determining the compressibility of different minerals in order to provide important constraint for thermodynamic models of the Earth's interior; 2) it allows the structural characterization of new high-pressure phases; 3) it gives insight on the structural variations of mineral as a function of composition, pressure and temperature and thus the influence that such changes have on their elastic properties. In this contribution we will use bridgmanite, the MgSiO3 perovskite-type structure, as an example to show how single-crystal X-ray diffraction data collected at room and high-pressure can be used to pinpoint the structural changes associated with Al and Fe substitution in the MgSiO3 end-member structure and how such changes influence the high-pressure behaviour of bridgmanite at the conditions of the Earth's lower mantle, providing important constrain on seismic models.

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