Single-crystal elastic properties of $Fe_{0.04}Mg_{0.96}SiO_3$ – perovskite at high pressure

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Perovskite structured $MgSiO_3$ is widely accepted to be the dominant phase in the Earth's lower mantle where it coexists with ferropericlase. An understanding of the plausible chemical variation of $MgSiO_3$-perovskite (enrichment with Fe/Al) in addition to the consequent effects on density and elastic properties is important in order to understand the origin of seismic velocity anomalies in the lower mantle reported in a number of studies [1-3].

In this study two differently oriented single-crystals of magnesium silicate perovskite containing 4 mol% of the $Fe^{2+}SiO_3$ component [$(Mg,Fe)SiO_3$] have been studied by means of Brillouin spectroscopy and X-ray diffraction in-situ in diamond anvil cells. Helium was used as the pressure transmitting medium and experiments were performed in the pressure range from 2 to 31 GPa. Ruby pressure markers were used to obtain similar pressure conditions in both diamond anvil cells. The Brillouin spectra were measured in symmetric platelet geometry for each crystal at different orientations in the plane of the platelet. The data at each pressure were fitted for both crystals simultaneously in order to reduce correlations of Cij constants. Using the data from two crystals with different non-specific orientations we were able to obtain all 9 independent Cij elastic constants for orthorhombic symmetry at 8 different pressure points. The orientation matrix and cell parameters for each crystal at every pressure point were refined using in-situ x-ray diffraction measurements. From sample densities obtained from x-ray diffraction data and simultaneous measurements of the adiabatic bulk modulus obtained from Brillouin measurements, it was possible to calculate the absolute pressure for all our experimental points. This approach allowed the elastic properties of $(Mg,Fe)SiO_3$-perovskite to be determined as a function of primary pressure, i.e. without resort to a secondary pressure standard. This consequently provides a more reliable data set to be compared with seismic data for the lower mantle.

[1] Ni *et al*. (2005), *Geophys. J. Int*. **161**, 283–294. [2] Masters *et al*. (2000), *AGU Monograph Series*, **117**, 63–87. [3] Garnero *et al*. (2005), *The Geological Society of America Special Paper,* **430**, 79–101.

Sedimentary osmium isotopic records of Mediterranean basins

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Mediterranean Sea has experienced an extreme event called Messinian Salinity Crisis (MSC) that represents a formation of gigantic evaporite deposits in deep basins (e.g., Ryan *et al*., 2009). In this study we report sedimentary Os isotopic record of marine sediment cores from four Deep-Sea Drilling Project (DSDP) sites in the Mediterranean Sea (Hsü & Montadert, 1978); DSDP Site 372 in the western Mediterranean (Balearic Basin), DSDP Site 374 in the central Mediterranean (Ionian Basin), and DSDP Sites 375 and 376 in the eastern Mediterranean (Florence Rise). Osmium isotopic ratios of the pre-MSC sediments of Miocene (Burdigalian to Serravallian) in the western Mediterranean are identical to that of the coeval ocean water. In contrast, the pre-MSC sediments (Langhian to early Messinian) in the eastern Mediterranean have significantly low $^{187}Os/^{188}Os$ values than those of the Middle to Late Miocene ocean water. This suggests that Os in the eastern Mediterranean was not fully mixed with that of other seas such as western Mediterranean and North Atlantic, and that the basin isolation has already started before the MSC, probably as early as Middle Miocene. The unradiogenic Os would have been supplied to the eastern Mediterranean by selective weathering of ultramafic rocks in the surrounding ophiolite bodies, which contains high amount of non-radiogenic Os. The isotopic compositions of Os in gypsum samples from all sites are significantly lower than the end-Miocene ocean water values, suggesting isolation of all Messinian basins. Sediments from Pliocene show Os isotopic ratios more radiogenic, and close to the seawater values of Pliocene but slightly less radiogenic, indicating that Os started mixing with global seawater again. We will further discuss possible scenarios about Mediterranean hydrology during the MSC, based on the sedimentary Os isotopic records.

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