# A computational and experimental study of $(Fe^{2+},Mg)SiO_3$ perovskite at lower mantle conditions

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We have studied $Fe^{2+}$/Mg replacement in $MgSiO_3$ perovskite over a range of thermodynamic conditions corresponding to the Earth's mantle using a combination of experimental (X-Ray diffraction and Mössbauer spectroscopy) and computational (density-functional theory) techniques. We analyzed the crystallochemical effects induced by the presence of Fe in the structure and we monitored the compressibility as a function of $Fe^{2+}$ spin state and Fe content. The compressibility of the structure is slightly anisotropic. The mechanism responsible for this is the tilt of octahedra that act closely as rigid bodies. We observed that low-spin $Fe^{2+}$ has a smaller effect on $MgSiO_3$ crystallochemical properties than the intermediate- or high-spin $Fe^{2+}$.

We derived the seismic properties of $(Mg,Fe)SiO_3$ perovskite as a function of $Fe^{2+}$ spin state and observed that the effects of $Fe^{2+}$ spin state are rather small on the compressional seismic wave velocities and larger on the shear seismic wave velocities. However, these variations might not be easily observable in the seismic profiles of the mantle because of other factors, like temperature, spin transitions in magnesiowüstite or the presence of other minor elements in perovskite.

# Concentrating the slab-fluid input to Newberry Volcano, Oregon

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Newberry Volcano is a large shield-shaped volcano situated east of the main Cascade volcanic front where the High Lava Plains (HLP) magmatic and tectonic province of eastern Oregon meets the Cascades. Newberry has been variably interpreted as a rear-arc Cascade volcano or as the western end of the HLP hot spot. Newberry and vents adjacent to the shield have erupted a variety of magma types including primitive high-alumina olivine tholeiites (HAOT). In basalts with MgO > 8 wt%, there is a bimodality in indicators of slab involvement (e.g. HFSE depletion, LIL enrichment) with, for example, a gap in Ba/Nb between basalts erupted high on the flanks of the Newberry shield (Ba/Nb > 60) and those from mid- and lower flanks and just east of the shield where Ba/Nb < 21, which is more typical of the widespread HLP basaltic volcanism. The strong distinction in e.g. Ba/Nb is most easily attributed to different source abundances of fluid-mobile elements rather than degree of melting or fractionation. High Ba/Nb lavas are characterized by high $K_2O$ (0.6-2%), Sr (517-1124 ppm), and $SiO_2$ (50.2–52.1%) compared to HAOT that have lower $K_2O$ (0.26–0.6%), Sr (300-412 ppm) and $SiO_2$ (48.8-49.5%). The compositional distinction is accompanied by higher $^{87}Sr/^{86}Sr$ (> 0.7036 vrs < 0.7034) and lower $\varepsilon_{Nd}$ (< 5.5 vrs > 6.5) in the high Ba/Nb group, but no clear distinction in Pb isotopic composition. Assuming that the Sr content in the high Ba/Nb group is dominated by slab fluid contribution, the relatively low $^{87}Sr/^{86}Sr$ (< 0.7039) rules out a major contribution from sediment and altered oceanic crust. The localization of slab signature at Newberry suggests strong focussing of slab input beneath this volcano where anhydrous melting of unusually hot upper mantle extends along the HLP. The geochemical studies described above are one component of a multidisciplinary investigation that includes both passive and active seismic imaging throughout eastern Oregon in order to elucidate the causes of widespread volcanism in this area and to understand the reason that the slab contribution east of the Cascade front is so highly focussed beneath centers like Newberry.