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Seismic Constraints on an Enstatite Chondrite Earth
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Recently, Javoy et al., EPSL, 2010 suggested the possibility that Earth had an initial enstatite chondrite composition due to their similar oxygen isotopes. Currently, the calculations of the bulk silicate Earth (BSE) are based on the assumption that the initial Earth began with a composition very close to that of a carbonaceous chondrite. Thus, it is necessary to evaluate whether the 1D seismic properties of the Earth are more consistent with an initial enstatite or chondritic composition. The BSE of an enstatite chondrite Earth (ECE) is different from that of a carbonaceous chondrite since the magnesium/silicon ratio is much lower for the former, resulting in a lower mantle that is almost devoid of Mg. Hence, the primitive lower mantle of an ECE consists mostly of iron-rich perovskite and pure silica. The seismic velocities of these phases are much slower than Mg-perovskite which, by itself, is faster than PREM (the slower MgO phase is necessary to match PREM velocities). However, the present-day lower mantle would be a mix of the primitive upper mantle (ie. pyrolite) and the Mg-depleted lower mantle. The latest mineral physics results are used to calculate possible 1-D seismic profiles of the Earth associated with these two scenarios and to compare with those observed for the Earth today.