Stratification of the Earth's core by SiO_2 crystallization

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The topmost ˜300 km of the Earth's core features slightly lower wavespeeds than the one dimensional radial earth model PREM. One way this could arise is if this lower speed layer represents a crystallization boundary inside the core, similar to the cloud base in the atmosphere where water-saturated air condenses out water. In the case of the Earth's core, saturation in Si+O could crystallize SiO_2 that rises upward to the CMB and leaves the core due to SiO_2 being even less dense than the base of the Earth's present mantle. This mechanism addresses a criticism of stable core stratification arising from study of the secular variation of the Earth's magnetic field, which seems to require radial fluid motions that strict stratification forbids. Motion of core liquid through a saturation front, which changes its composition, temperature and wavespeeds, facilitates patterns of secular variation attributable to radial motion. We explore this scenario by finding SiO_2 saturation parameters consistent with experimental partitioning of Si and O in metal, and derive the temperature and core compositions compatible with the observed wavespeed profile in the outer core.

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