Structure of Earth’s Shallow Outer Core: No Evidence for Stratification
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Summary
Recent studies of the shallow outer core region have predicted unusual features, such as
sediment accumulation (Buffett et al., 2000), immiscible fluid layers (Helffrich and Kaneshima,
2004) or stagnant convection (Lister and Buffett, 1998; Lay et al, 2008). Secular cooling and
compositional buoyancy drive vigorous convection that sustains the geodynamo, although
critical details of light-element composition and thermal regime remain uncertain. Seismic
velocity models can provide important constraints on the light element composition, however
global reference models, such as Preliminary Reference Earth Model (PREM; Dziewonski and
Anderson, 1981), IASP91 (Kennett and Engdahl, 1991) and AK135 (Kennett et al., 1995) vary
significantly in the 200 km below the core-mantle boundary (Eaton and Kendall, 2006). Past
studies of the outermost core velocity structure have been hampered by traveltime uncertainties
due to lowermost mantle heterogeneities (Souriau and Poupinet, 1991). The Empirical Transfer
Function method (ETF, Alexandrakis and Eaton, 2007) has been shown to reduce the traveltime
uncertainty by stacking global observations of SmKS teleseismic waves, a whispering-gallery
mode that propogates near the underside of the core-mantle boundary (Choy, 1977). Models
that fit our data all have a top-of-core velocity of 8.05±0.03 km/s. In the outermost 200 km of
the core, these models are also characterized by seismic velocities and depth gradients that
correspond best with PREM. This similarity to PREM, which has a smooth velocity profile that
satisfies the adiabatic Adams and Williamson equation, argues against the presence of an
anomalous layer of light material or other structure near the top of the core.

References
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