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Outer core compositional stratification

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The liquid outer core of the earth is nearly pure iron, but contains light elements that affect its density and seismic wavespeed. From the earliest detailed studies of the outer core seismic structure, the topmost part of the outer core appeared to differ from the core's main bulk. We report on a detailed investigation of the structure of the topmost outer core. As other workers did, we use differential $SmKS$-$SnKS$ travel times and slownesses, with path multiplicities (m, n) between 2 and 5. Unlike previous studies, we use array measurements to obtain the travel time and slowness estimates. The results, inverted with a $\tau - p$ method, yield a well constrained velocity structure for the topmost 500 km of the outer core. The uppermost 300 km is gradationally slower than the PREM model by up to 0.3%. Applying a homogeneity test to the velocity profile shows that it differs significantly at the 95% confidence level from compression of a simple liquid. Thus the outer core is stratified in composition. The light element addition probably arises from the growth of the inner core, and a rough material balance may be made. Maintaing a 300 km thick layer agains mixing by outer core convection is problematic and suggests that the outermost core is stagnant.