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Predictions of the morphology and origin of plumes and LLSVPs from combined geodynamical and seismological modeling

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Low velocity anomalies that are imaged below hot spot islands and near the core-mantle boundary are generally linked to mantle plumes and thermochemical piles respectively. Due to various limitations and assumptions in the seismological imaging the recovered structures are certainly less unique, more underresolved, more ambiguous, and blurrier than the actual dynamical features.

We will use geodynamical modeling to predict the shape of mantle plumes and thermochemical piles using dynamical constraints (such as buoyancy flux at hotspots) to predict the shape of these features. We will then use a number of seismological modeling techniques to estimate how well these dynamical features can be recovered in tomographic imaging. Our results show that it is difficult to rule out or prove the deep mantle origin for most plumes with present day techniques. The long-term recycling of oceanic crust can explain the relative volumes of LLSVPs if the oceanic crust has sufficiently high excess density compared to the ambient mantle. Our study provides quantitative suggestions for the design of future experiments intended to study the deep roots of hotspots.