Is there evidence for a paleo-LLSVP beneath Eurasia?: Implications for the origin of the Siberian Traps

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The massive eruption during the latest Permian, which precipitated the Earth's most severe known extinction event, is one of the largest known volcanic events on Earth. However, the cause of the active volcanism remains incompletely understood. Recent seismological analysis has revealed that currently active volcanoes are related to seismic low-velocity anomalies which are almost vertically continuous from the core-mantle boundary (CMB) to shallow depths. Here we infer the seismic velocity structure beneath Eurasia in order to confirm whether formerly active volcanism is also related to a mantle upwelling.

We apply the 3-D localized waveform inversion methods to about 5,500 transverse-component of broadband body-wave seismograms observed at Japan for 3 intermediate and deep earthquakes occurred in Europe, European stations for 116 events occurred beneath the western Pacific subduction zone and Canadian stations for 5 events occurred beneath the Hindu Kush. We use waveform data obtained from the National Research Institute for Earth Science and Disaster Prevention (NIED), Observation & Research Facilities for European Seismology (ORFEUS) and Canadian National Data Centre (CNDC).

We found a high-velocity anomaly about 100 km above the CMB beneath Lake Baikal and two low-velocity anomalies immediately above the CMB beneath the cities of Perm and Irkutsk, Russia, respectively. Plate reconstructions show there are some large igneous provinces (LIPs) and slab remnants beneath Eurasia. Our results suggest two scenarios: one where two low-velocity anomalies used to be united and larger than present size but divided and weakened by the subducted cold slab and another where two low-velocity anomalies were originally separated with each other and became different LIPs. In either case, our findings suggest that the cause of a massive eruption during the latest Permian was a plume upwelling from the CMB.

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