Upper Mantle Structure of the Slave Craton from Teleseismic Body-Wave Tomography

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Abstract

Cratons form the core of the majority of Earth’s continents and offer a unique window into the evolution of continents and plate tectonics over geologic time. The dynamics that led to the evolution and stabilization of cratons over one billion years ago, however, remain poorly understood. The Archean Slave province, located in the NW Canadian Shield, is an ideal site to study the formation of cratons due to its high degree of preservation and evidence that its lithosphere possesses a distinct stratification resulting from cratonic assembly. In addition, numerous geochemical and petrological analyses have been performed over the past 15 years on xenoliths from kimberlite pipes. The Slave craton's mantle lithosphere is inferred to be thin relative to other cratons, and this thinning supports an observation of mantle depletion that is consistent with the Slave craton's evolution.

Telemics Data

Location of events used in tomographic inversion are shown relative to the Slave craton. Events selected for inversion were located between 30 and 100° of north distance from the Slave craton. Event coverage is adequate for all back-azimuths with the exception of 155-230°. The teleseismic travel-time data set consists of 2619 teleseismic travel-time measurements from 267 events recorded during reconnaissance survey and with POLARIS network. Input spike anomalies of ±5% were used in teleseismic travel-time inversion. "Preliminary Pick of P-wave Arrival Time Made for Each Record" (VanDecar, 1991). Input spike anomalies were grouped into 8 equal back-azimuth ranges to assess if any regions were oversampled. Only one back-azimuth range can bias the inversion. To limit this effect events were grouped into 8 equal back-azimuth ranges to assess if any region were oversampled. Only events whose P waveforms are most correlated between each station pair (average correlation coefficient = 0.92) were used between the back-azimuths of 135-160° and 315-330°.