Insight into the assembly and evolution of the Slave craton from teleseismic data analyses

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Archean cratons offer a unique window into the evolution of continents and plate tectonics over geological time. The Archean Slave province in the NW Canadian Shield is an ideal site to study the formation of cratons due to its high degree of preservation and petrological evidence that its lithosphere possesses a distinct stratification resulting from cratonic assembly. The last decade has witnessed an explosion of seismological work in the region, with more than 45 broadband seismic stations deployed over variable lengths of time. These data have been subjected to a wide array of seismic analyses: body- and surface-wave tomographic inversions were applied to the complete dataset, whereas receiver functions and shear-wave splitting were applied to subsets of the data. When considered together, these results yield an unprecedented seismic characterization of the Slave province. The Slave's lithosphere is 200-250 km thick and displays seismic velocities that are ~2-3% faster than surrounding Proterozoic orogens and ~2% faster than average cratonic values. At smaller scales, a low velocity anomaly centred to the south of the Lac de Gras kimberlite field is observed between 250-350 km depth. The anomaly has a radius of ~100 km, it exhibits a 2.8% slowness contrast with respect to the surrounding mantle, and may represent post-stabilization alteration of the cratonic lithosphere by processes responsible for kimberlite magmatism. Coherent results from shear-wave splitting and surface-wave analyses show evidence for at least two layers of anisotropy beneath the Slave craton: one in the uppermost lithosphere that may be associated with crustal structure from the last episode of regional deformation; and another one in the mantle lithosphere and possibly the asthenosphere, with a principal axis aligned with the direction of absolute plate-motion. Receiver functions show evidence of finer-scale anisotropic layering throughout the Slave's lithosphere - a possible sign of cratonic assembly by processes of shallow subduction and underplating. The seismic signature of the Slave craton therefore contains information about the entire evolution of the region, from its initial assembly during the Archean to its current deformation in response to plate motion.