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Rheological and anisotropic boundaries within the lithosphere of the Superior Province, Canada

A. Frederiksen (1), F. Darbyshire (2), and D. Eaton (3)
(1) University of Manitoba, (2) Université du Québec à Montréal, (3) University of Calgary

The Superior Province is the largest region of stable Archean crust in existence, bounded by Proterozoic orogens to the west, north and east, and by the ca. 1 Ga Mid-Continent Rift to the south, with an E-W internal grain. The western Superior is a region of high shear-wave splitting (up to 2 s) with E-W orientation; recently, sufficient data has become available to map the Superior's velocity and anisotropy structure using body and surface waves. We found that the Superior lithosphere contains a NNW-SSE oriented boundary that cross-cuts crustal boundaries, separating high-velocity, strongly anisotropic material in the west from lower-velocity, more weakly anisotropic material in the east. Recently collected data from the westernmost portion of the Superior indicates that strong anisotropy ends ca. 300 km east of the boundary with the Trans-Hudson Orogen; we can therefore restrict the anomalous Western Superior lithosphere to a region located well within the boundaries of the province itself. The Superior lithosphere contains two more recent features that may be dated: a low-velocity anomaly within the Nipigon Embayment (a branch of the Mid-Continent Rift, ca. 1 Ga) in age, which lies within the inferred region of fast, anisotropic lithosphere, and a low-velocity track within the Eastern Superior, attributed to the Great Meteor hotspot and presumably ca. 170 Ma in age. The Nipigon mantle anomaly corresponds closely to its crustal boundaries and is interpreted to be in situ, while the Great Meteor track appears displaced in a fashion consistent with deformation by basal drag. To reconcile these observations, we interpret the observed velocity/anisotropy boundary between the eastern and western Superior to have a rheological component, making the Western Superior lithosphere anomalously strong as well as fast. We will need to alter our notions of continental lithosphere to include variations in mechanical prop-

erties within what have been assumed to be undeformable cratonic roots.