"Evolution and dynamics of the lithosphere in northwestern Canada"

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Abstract:

The lithosphere of northwestern Canada recorded more than 2.5 Gy of complex tectonic evolution, from the formation of the ancient cores of the continental lithosphere such as the Slave craton to the Phanerozoic Cordilleran orogeny with substantial variations in crust and upper mantle. Present-day northwestern Canada juxtaposes a thin and hot Cordilleran lithosphere to the thick and cold cratonic lithosphere, which has important implications for regional geodynamics. Recently, seismic station coverage has drastically increased across northwestern Canada, allowing the development of seismic tomography models and other passive-source seismic methods at high resolution in order to investigate the tectonic evolution and dynamics of the lithosphere in this region. At mid-to-lower crustal depths, our surface-wave tomography model reveals an anomalously low-velocity region across the northern Canadian Cordillera (NCC), which likely reflects elevated crustal temperatures that buoyantly support regional high elevations. Geophysical and seismological evidence confirm the presence of a buried craton, the "Mackenzie Craton" across the Yukon and Northwest Territories. Further, the mechanically strong craton lithospheres at the north and south ends of the Mackenzie Mountains act like buttresses. Based on mantle shear patterns and seismic velocities, we propose that the Tintina fault is a newly identified lithospheric-scale shear zone, and that a portion of the Mackenzie Craton has been chiseled and displaced to the northwest by the Tintina fault between the Late Cretaceous and Eocene. Finally, the low-velocity region between the Tintina and Denali faults at upper mantle depths likely reflects upwelling asthenosphere, and postdates the 430 km of previously estimated Eocene lithosphere-scale horizontal displacement along the Tintina fault.

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