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Seismic Velocity Model of Great Bear Fault Zone, NWT, Canada

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The Slave “Diamond Corridor” is a north northwest trend that appears to have controlled the emplacement of the most significantly diamondiferous kimberlites of the Slave craton of northern Canada and any extension of the corridor is prime diamond exploration country. A northern extension of the corridor into the Lena West diamond area of the Northwest Territories that includes the diamondiferous Darnley Bay and Dharma kimberlites requires major left-lateral displacements (~350km) that are not generally recognized and are not identified in the surface geology [1].

Major continental scale wrench faults were recognized by Zolnai [2] including the Great Bear Fault Zone. Analysis of the available geomorphological and geophysical (magnetic, seismic and gravity) information supports his ideas. Euler deconvolution analysis of regional airborne magnetic surveys covering Lena West shows little response in the near surface platform rocks but outline strong linear breaks coinciding with other evidence of faulting in the deeper basement rocks.

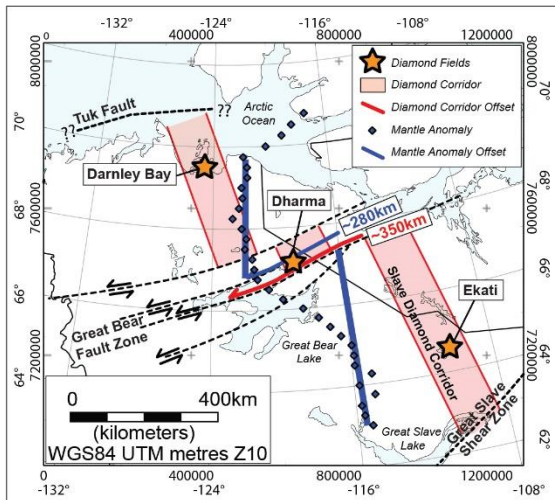


Figure 1: Displacement of Mantle anomalies compared to Slave "Diamond Corridor" offset.

A seismic velocity model of North America data SL2013NA computed by Scheffer et al [3] on a ~280km triangular grid shows large scale regional structures and confirms the existence of a cratonic basement (Mackenzie Craton) under the Lena West Paleozoic sedimentary rocks. The final model was made public at 3D grid spacing of 0.25 degrees longitude and latitude covering North America from 25km to 575km depth at 25km intervals. Extractions from this grid were made to produce east-west cross-sections.

The character of the seismic velocity response shows little change from the south end of the Slave craton to the north end of the Mackenzie craton. However, a major left

lateral displacement (~250km) of deep structures within the mantle (~200km to below 575km depth) is recognized in the region of the Great Bear Fault Zone suggesting that the Mackenzie Craton is simply the faulted northern extension of the Slave Craton (figure 1). There are marked changes to the character of the seismic velocity model across the recognized faults to the south (Great Slave Shear Zone) and to the north (Tuk Fault).

Regional sampling programs across Lena West have recovered widespread kimberlite indicator minerals with good diamond association chemistry, including 18 diamonds in field samples. However, the source of these indicator minerals has not been found. Extension of the Slave "diamond corridor" through Lena West is incentive for further exploration of the region, focused on a north northwest striking zone that includes Darnley Bay and extends south to Great Bear Lake.

Example.....

References:

- [1] Davies R and Davies A W (2013) Proceedings 10th International Kimberlite Conference, 2: 143-156
- [2] Zolnai G (1991) AAPG Continuing Education Course Note Series #30, Second Edition (Revised)
- [3] Schaeffer A J and Lebedev S (2014) Earth and Planetary Science Letters 402: 26–41

Example.....
