The conductivity structure of the Slave's cratonic mantle

Alan G. Jones[1], Ian J. Ferguson[2], Alan D. Chave[3], Rob L. Evans[4] & Jessica Spratt[1]
[1]Geological Survey of Canada, 615 Booth St., Ottawa, Ontario, K1A 0E9
Phone: 613-992-4968 Fax: 613-943-9285, Email: ajones@cg.nrcan.gc.ca
[2] Dept. Of Geological Sciences, University of Manitoba, Winnipeg, Manitoba R3T 2N2
Phone: (204) 474-9154 Fax: (204) 261-7581, Email: ij_ferguson@umanitoba.ca
[3] Deep Submergence Laboratory, Dept. Applied Ocean Physics and Engineering, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543, USA
Phone: (508) 289-2833 Fax: (508) 457-2132, Email: achave@whoi.edu
[4] Dept. Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543, USA
Phone: (508) 289-2673 Fax: (508) 457-2150, Email: revans@whoi.edu

The Archean Slave craton is an ideal natural laboratory for investigating lithosphere formation and evolution processes, and has become an international focus of broad geoscientific investigation following the discovery of economic diamondiferous kimberlite pipes. Four deep-probing electromagnetic surveys, using the magnetotelluric (MT) technique, have recently been carried out on the craton using novel acquisition procedures.

The first involved conventional acquisition along the only all-weather road. The second was a three-part series of acquisition along the winter roads with the electrodes lowered through the ice to the lake bottoms and the magnetometers on land. The third experiment involved deploying seafloor MT instrumentation into lakes around the craton from float planes. The fourth involved installing long period only equipment on land using float planes and helicopters.

The MT responses reveal an unexpected and remarkable anomaly in electrical conductivity, collocated with the kimberlite field, which is modelled as a spatially confined upper-mantle region of low resistivity (<30 Ω•m) at depths of 80-100+ km. Given plausible mechanisms for conductivity enhancement, we interpret this conductivity anomaly as due to either dissolved hydrogen or carbon in graphite form. This geophysically anomalous upper-mantle region is also spatially coincident with a geochemically defined ultradepleted harzburgitic layer thought to be trapped Archean oceanic material. The tectonic processes that emplaced this structure are possibly related to the lithospheric subduction and trapping of overlying oceanic mantle at 2630-2620 Ma.

Name of presenter: Alan G. Jones

Session: Canada's Upper Mantle Through Geophysical Eyes

Type of Presentation: Oral (Computer projection preferred)