THE ELECTRIC LITHOSPHRE OF THE SLAVE CRATON AND ITS TECTONIC INTERPRETATION

A.G.Jones (1), I.J. Ferguson (2), A.D. Chave (3), R. Evans (3), and G.W. McNeice (4)
(1) Geological Survey of Canada, (2) University of Manitoba, (3) Woods Hole Oceanographic Institution, (4) Geosystem

The Archean Slave craton, in the northwestern part of the Canadian Shield, is an ideal natural laboratory for investigating lithospheric creation. In addition, it has become an international focus of broad geoscientific investigation following the discovery of economic diamondiferous kimberlite pipes in the center of the craton in the early 1990s. As part of LITHOPROBE's and GSC's efforts to understand the history and tectonic development along the Slave to Northern Cordillera transect, four magnetotelluric (MT) surveys have been carried out on the craton since 1996, of which two involved novel acquisition through the frozen lake ice and on the bottom of lakes. The data revealed the existence of an unexpected and remarkable conductive anomaly in the center of the craton spatially collocated with the Eocene kimberlite field. The MT responses sampling 50 to 150 km depth exhibit a phase maximum which is explained in terms of an anomalous and spatially-confined upper-mantle region of extremely low resistivity (<30 ohm.m at depths of 80-120 km). The depth and position of this anomalous central Slave conductor (CSC) coincide with a geochemically-defined ultra-depleted harzburgitic layer interpreted as oceanic or arc-related lithosphere emplaced during early tectonism. We thus demonstrate for the first time spatially coincident geophysically and geochemically defined anomalous upper mantle regions. The CSC may be interpreted in terms of either ionic conduction from hydrogen diffusion or electronic conduction due to the presence of carbon in graphite form, neither of which can be excluded based on the existing evidence, but both of which imply specific tectonic processes.