SNORCLE CORRIDOR 3 MAGNETOTELLURIC EXPERIMENT

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Summary

The Canadian Cordillera comprises a region of oceanic and island-arc terranes accreted to western North America since the Neoproterozoic, with most of this westward growth occurring during the Mesozoic [Monger 1992]. These terranes have been since been displaced northward along large dextral strike-slip faults due to the motion between the Pacific ocean basin and the North American continent [Gabrielse and Yorath, 1991]. Morphogeologically and physiographically, these terranes can be divided into five major belts (Fig. 1) broadly representing fault-zone bounded geological units of regional extent. With the exception of the Foreland Belt, each belt comprises a collage of predominantly allochthonous terranes, and each terrane is characterized by its own geological and tectonic history different from its neighbors. Within the multidisciplinary study Slave-Northern Cordillera Lithospheric Evolution (SNORCLE) associated to LITHOPROPE (Canada's National Geoscience Project) [Clowes et al., 1992], the SNORCLE-Northern Cordillera MT experiment was carried during the summer-fall 1999. The SNORCLE-Northern Cordillera MT experiment (Fig. 1) included three regional-scale profiles crossing the main geological structures and a high resolution profile crossing the Tintina Fault along the Ketza River Mine road [Ledo et al., 2002].

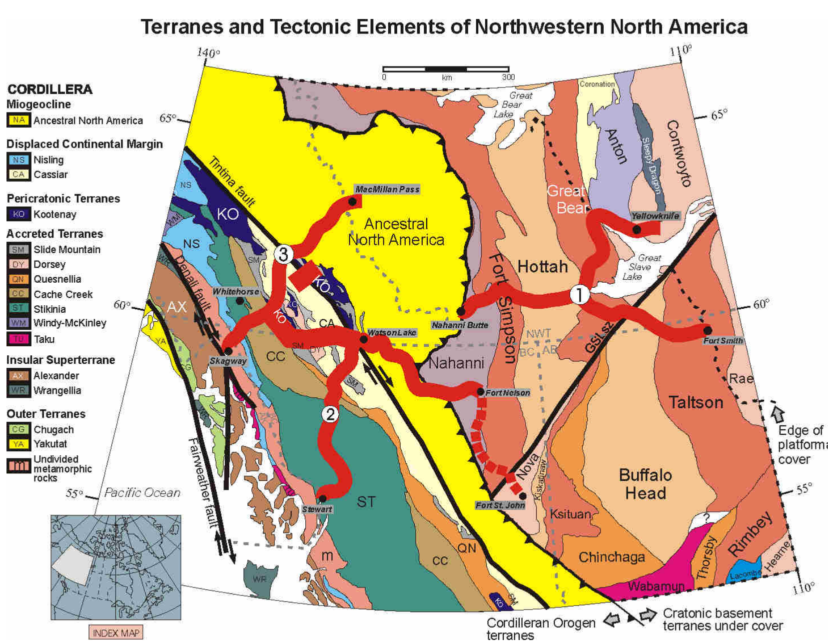

Figure 1. Terranes and tectonic elements of Northwestern North America and location of magnetotelluric profiles.

We focus on results for corridor 3, which is located mainly in the Yukon province and extends for 470 km from north of Skagway (Alaska), to the MacMillan Pass at the border between Yukon and the Northwestern Territories. The SNORCLE-Northern Cordillera corridor 3 MT experiment was planned to determine the electrical resistivity structure of the crust and the upper mantle across the accreted terranes and the ancestral North America beyond the Tintina Fault. From west to east, the profile starts in the Coastal Belt past through the contiguous Intermontane Belt and then crosses the Teslin fault that it is the limit between the Intermontane and Omineca Belts and after traversing the intracontinental strike-slip Tintina fault (TTF) samples the Ancestral North America rocks.

In total, forty-one MT soundings were acquired with a period range of 0.001 to 3000 seconds. In addition, long period data (LiMS) with a period range of 20-20,000 s were acquired at every other site. The maximum separation between sites was of 15 km and the minimum distance was of 5 km for the sites located close to the TTF. We used the Groom and Bailey MT tensor decomposition technique [Groom and Bailey, 1989] to identify and remove distortions caused by local near-surface features, and derive the regional two-dimensional (2-D) MT impedances in the most appropriate geoelectric strike directions. After that, a regional-scale 2D resisitivity model is achieved through a minimum norm inversion scheme develoved by Siripunvaraporn and Egbert [2000]. The resulting resistivity model is presented in figure 2.

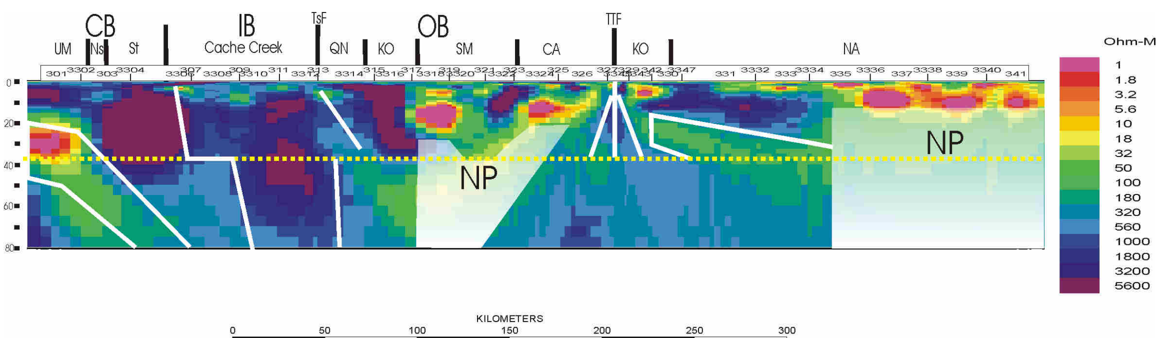

Figure 2. Magnetotelluric model of SNORCLE corridor 3, and its interpretation. NP: zones of no penetration.

2D model main structures and its geological interpretation

- Below the Coastal Belt (CB) at lower-crust and mantle depths (20-70 km) there is a northeast dipping conductive structure (3-100 Ohm.m) that could be related to plate subduction processes.
- The limit between the Coastal and Intermontane belts is imaged as a decrease of the resistivity. Within the Intermontane Belt, the upper crust is less resistive than the lower crust.

- The Intermontane Belt presents a lateral change at mantle depths that can be associated with the results obtained by Abraham et al. (2001) from the study of Tertiary to Recent alkaline lavas.
- The Teslin Fault is imaged as a northeast conductive dipping structure, this result agrees with the high-resolution study of the Teslin zone done by Snyder and Roberts (2001).
- The boundary between the Intermontane and Omineca belt is imaged as an important decrease of the conductivity of the Omineca belt. The presence of conductive structures below the Slide mountain terrane and the Cassiar terrane is consistent with the magnetotelluric model obtained for corridor 2 by Weenberg et al. (2002).
- The Tintina Fault is imaged at mid and lower crustal depths as a high resistivity feature. A more detailed study of the Tintina Fault at three different locations was done by Ledo et al. (2002).
- Within the ancestral North America the most significant feature is the presence of near surface high conductivity structures in the northeastern part of the model that may be associated with the presence of mineral deposits.

Acknowledgments

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