Merging Geological, Seismic-Reflection and Magnetotelluric Data in the Purcell Anticlinorium, Southeastern British Columbia

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Cook, F.A. (2017): Merging geological, seismic-reflection and magnetotelluric data in the Purcell Anticlinorium, southeastern British Columbia; *in* Geoscience BC Summary of Activities 2016, Geoscience BC, Report 2017-1, p. 257–258.

Introduction

The purpose of this project is to combine geological, seismic-reflection and magnetotelluric (MT) data in southeastern British Columbia (BC) to target concentrations of sulphide mineralization in the subsurface. Existing MT data will be reprocessed with two-dimensional (2-D) inversions, where possible, and the results will be combined with reprocessed seismic-reflection profiles and drillhole information. The seismic data and drillholes allow detailed mapping of structural and stratigraphic variations, while the MT data will help to characterize the electrical properties, and thus perhaps the presence or not of metals, at different stratigraphic levels.

The Belt-Purcell Basin of southeastern BC and northern Montana (Figure 1) contains a number of stratigraphically controlled massive-sulphide deposits, most notably the now-closed Sullivan mine near Kimberley, BC. Ever since Cominco began to phase out their mining operations at the Sullivan, there have been a number of efforts to find 'another Sullivan'. Most of the efforts have focused on the stratigraphic interval between the top of the Mesoproterozoic Lower Aldridge Formation and the middle part of the Middle Aldridge Formation (colloquially known as the 'Sullivan zone' or 'Sullivan horizon'). However, there are also stratigraphic intervals, either above or below the Sullivan zone, that may contain economic quantities of metals. For example, the Creston Formation (Revett Formation in the United States) is a major producing interval for copper minerals in the Troy, Montanore, Rock Creek and other deposits in Montana, and the upper Aldridge is host to the St. Eugene vein system near Moyie, BC. Thus, the approach described here may also be helpful for finding metals in various stratigraphic levels (Cook and Jones, 1995).

Previous Work

Seismic reflection profiling was undertaken in the mid-1980s for petroleum exploration and for regional studies throughout the Purcell Anticlinorium (Figure 1). Regional data were recorded by LITHOPROBE but are not of sufficiently high resolution for this study. Data acquired for hydrocarbon exploration were recorded by Duncan Energy Inc. and then provided to the University of Calgary for analysis (Cook and van der Velden, 1995). The data were initially reprocessed for large-scale regional studies (Cook and van der Velden, 1995). Even though the data were recorded nearly 30 years ago, they provide a unique view of the Belt-Purcell Basin that is not available with any other geological or geophysical dataset. A deep (3.477 km) exploration drillhole ('DEI' location shown in Figure 1) was drilled by Duncan Energy in 1985 and provides definitive correlations of seismic reflections to stratigraphic (in this case, sill) horizons along a number of seismic profiles.

More than 200 MT stations were recorded during the 1980s in a series of lines that cross the eastern part of the Purcell Anticlinorium in Montana and BC (Cook and Jones, 1995; Gupta and Jones, 1995). Seventy-eight MT stations were acquired in BC along eight lines or partial lines, three of which were analyzed by Gupta and Jones (1995). Initial (1-D) inversions of the MT data by Gupta and Jones (1995) indicated that there is a strong, regional, electrically conductive zone at a depth of a few kilometres beneath the anticlinorium. However, when the work was done, 2-D inversions were not commonly applied. Thus, more advanced techniques may provide enhanced detail so that the electrical structure can be correlated to stratigraphic and structural features that are observed in the seismic data. This approach was undertaken by Cook and Jones (1995) for data in the vicinity of the DEI drillhole.

Project Plan

Available data have been obtained from the Geological Survey of Canada. The MT inversions will be completed by a contractor such that the results can be combined with the seismic geometry, surface geology and drillhole data to map the subsurface variations in electrical conductivity. The inversions should be completed by the end of 2016, so merging of the results with the seismic data should be completed in early 2017. The results should help to delineate stratigraphically controlled zones with high electrical conductivity in the subsurface that may contain concentrations of sulphides but which, at the present time, are not visible.

Keywords: *British Columbia, geophysics, seismic reflection, magnetotelluric, Purcell Anticlinorium, Sullivan deposit*

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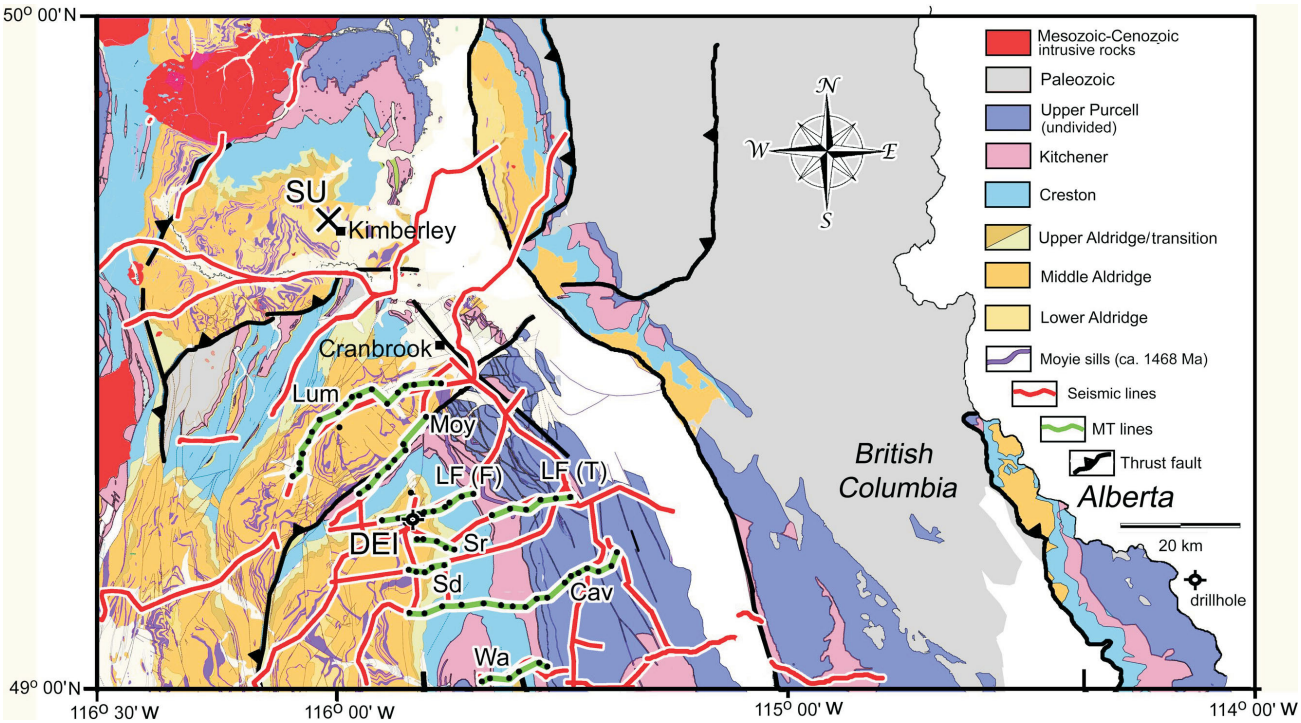

Figure 1. Geology of southeastern British Columbia (modified from Cook and van der Velden, 1995). Red lines are locations of seismic-reflection profiles and green lines with dots are MT station locations. Both datasets were acquired in the mid-1980s. Abbreviations: DEI, Duncan Energy Inc. drillhole; LF, Longfarrell MT profile in two segments; Cav, Caven Creek profile; Lum, Lumberton profile; Moy, Moyie fault profile; Sd, Sundown Creek; Sr, Sunrise Creek; SU, Sullivan mine; Wa, Ward Creek.

References

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