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"Current geomagnetic induction research in Western Canada"

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Results of previous work in this area have been published in several papers (for ex. CANER et al, 1967 and 1969; CAMFIELD et al, 1971; COCHRANE and HYNDMAN, 1970) and need not be further discussed. More recent work (up to 1970) by the Victoria Observatory/ University of British Columbia group has been summarized in two papers which are currently in press; since they are expected to be available within a few months, and contain in effect "cummulative" results of previous work as well, there is no point in spending too much time on these results. They will therefore be summarized only briefly, as a relevant basis for a description of our really current (i.e. 1971) projects. Figure 1 shows the location of the geomagnetic (GDS) stations up to 1970, and Figure 2 the conductivity structure models for an east-west cross-section across the high-Z/low-Z discontinuity. This discontinuity has now been mapped to higher latitudes as shown in Fig. 1. A second discontinuity, apparently much sharper and deeper (see LAJOIE and CANER, 1970) has also been identified, striking roughly EW near latitude 49°. Our data are insufficient to provide much information about its nature or extent, but it poses some very interesting puzzles about the nature of deep geomagnetic anomalies.

This work, and the two "cummulative" papers, mark the completion of a distinct phase in our long-term plans:
a) large-scale mapping (by GDS) of major discontinuities in conductivity structure within the area accessible to road transport, and
b) first-order interpretation of these structures (mainly by MT at selected sites within the previously mapped zones). Subsequent work is now to be concentrated on: a) detailed-scale mapping and interpretation of specific anomalies which were noted, though not studied in detail, by the large-scale surveys, and b) more sophisticated analysis of the structures themselves, which in turn required the

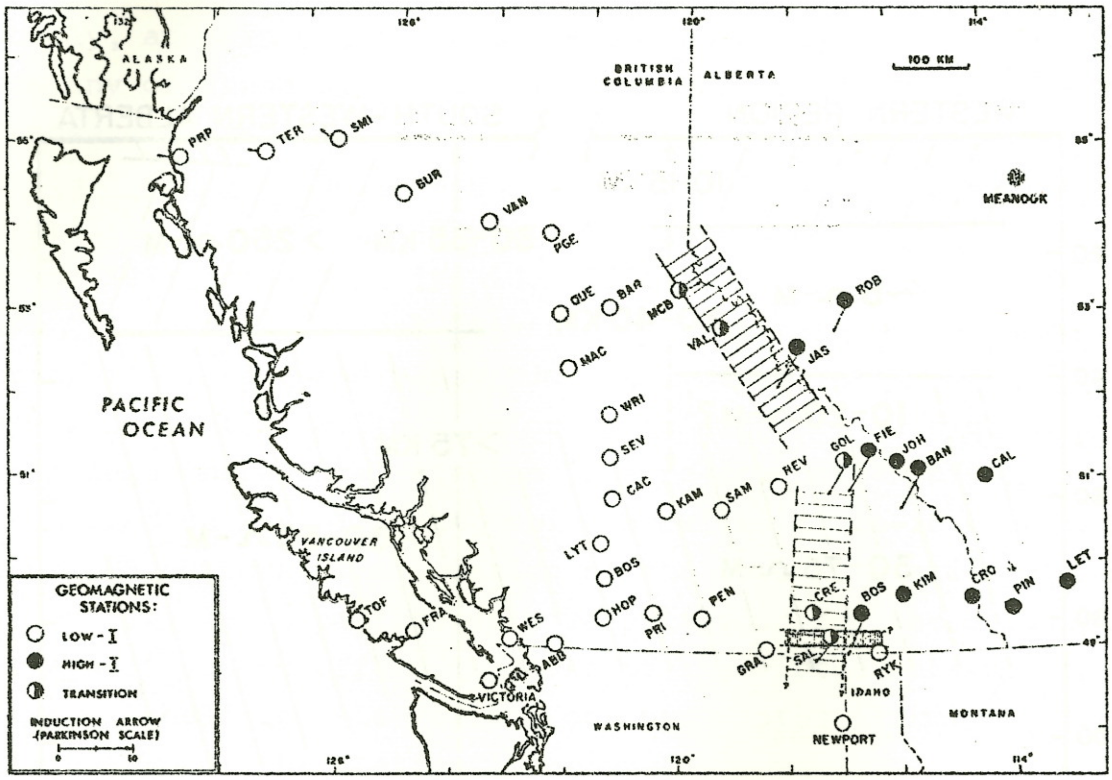

Fig. 1: Location of GDS stations up to 1970, and outline of major conductivity discontinuities.

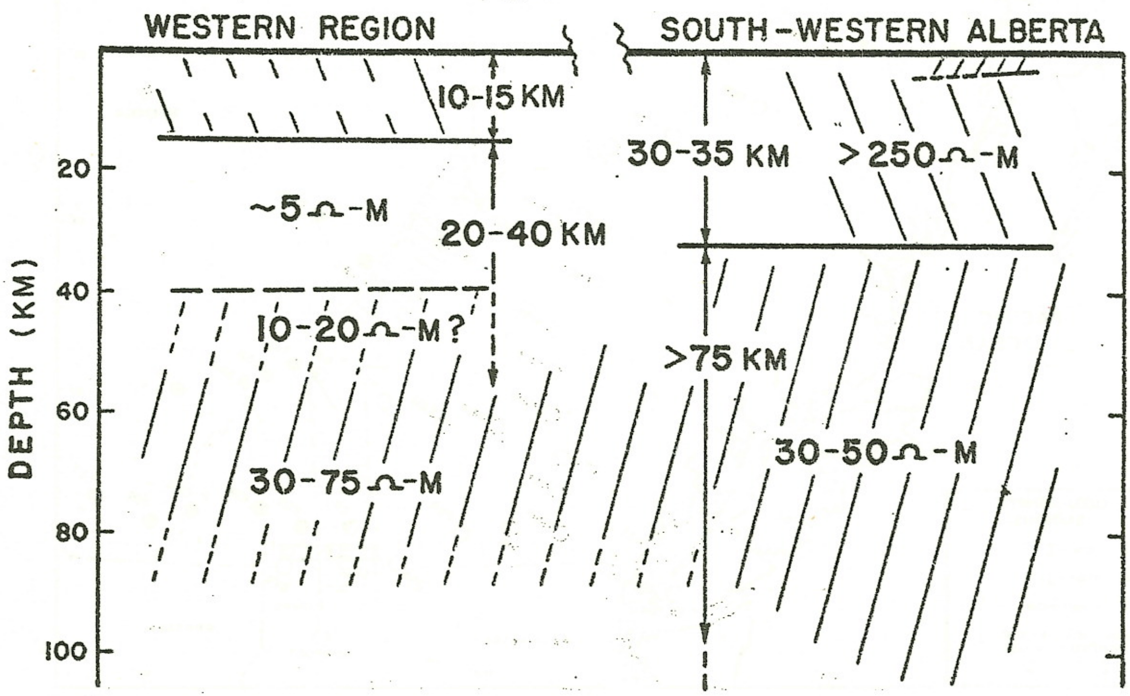

Fig. 2: Conductivity structure model for the two main zones in western Canada.

development of instrumentation capable of providing the necessary broad-band data.

Development of the broad-band instrumentation has already been described in an earlier paper at this Kolloquium. Figure 3 shows the location of the three field projects which were undertaken during 1971; two were joint Observatory/University of B.C. projects, the third (volcanology) was a separate Observatory project. Obviously, at this stage (Sept. 1971), no results can be provided from any of these projects - just a short description of their purpose and execution:

1) Coast effect. The geomagnetic coast effect had previously been identified at latitude 49°N (LAMBERT and CANER, 1965). The purpose of the 1971 project is its identification at higher latitudes. Five "standard" stations (Askania)were operated simultanwously during the spring and early summer, located very closely on the same geomagnetic latitude in order to simplify subsequent analysis. The inland "reference" station is a re-occupation of the Cache Creek (CAC on Fig. 1) site, which provides a tie-in with the previous GDS network. The location of the coastal stations (TAS and SAD on Fig. 1) is particularly advantageous for the study of the geomagnetic coast effect, because of the virtual absence of a continental shelf in this region; oceanic depths (2 km) are reached within 5 km of the station location.

Data analysis is currently under way, being carried out by Mr. H. MILLER, a Doctoral candidate at the University of British Columbia. Preliminary results indicate a clear identification of the coast effect at TAS, but predictably a rather complex overall picture emerges from the entire network, perhaps reflecting secondary effects from the shallow inland passage (see for example EDWARDS et al, 1971). In addition to the above 5 simultaneous stations, a sixth station was operated independently at Port Hardy (POR on Fig. 1) in order to aid in interpretation of such secondary effects.

A separate longer-term (2 months) continuous record was obtained for two of the stations simultaneously (SAD and CAC) during a magnetically quiet period, in order to provide data for high-resolution analysis of very long periods (diurnal and tidal).

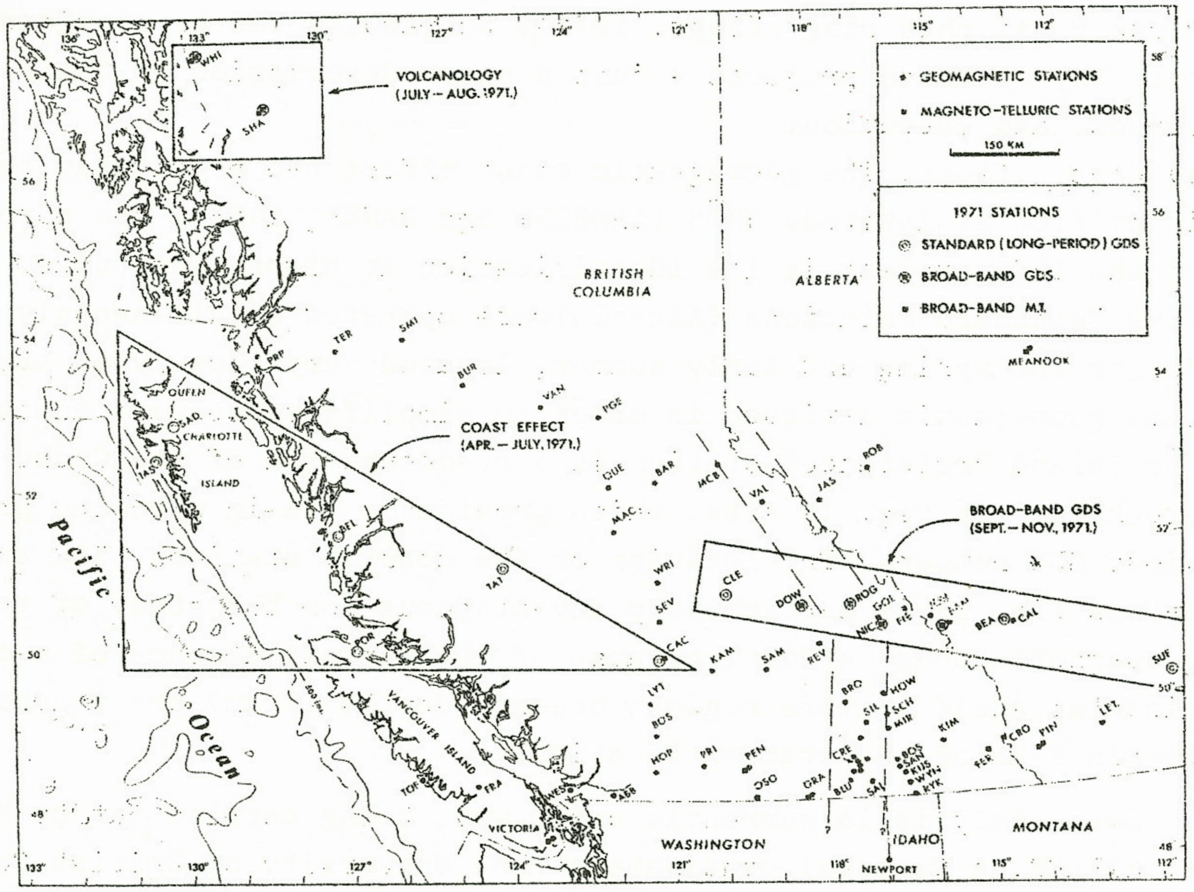

Fig. 3: Location of current (1971) field projects.

2) Volcanology. The mapping of active and recently extinct tectonic "ridges" is an essential facet of any understanding of the tectonic history of a region. The identification of volcanic lineaments is a very strong indication for the existence of such ridges. Several such lineaments have been identified in the Canadian Cordillera (SOUTHER, 1970); sections of several hundreds of km in length can be clearly identified on the basis of surface information, but extrapolated sections and offsets need to be verified by other methods. Geomagnetic induction techniques, with their high sensitivity to thermal contrasts, should provide a very efficient and relatively economical tool for such work.

The current work is planned as a "pilot" project in order to investigate experimentally the feasibility of these methods in this application. Two broad-band induction (5-component) stations were operated simultaneously; one (SHA on Fig. 1) is located over a known active volcanic zone: the Mount Edziza complex (57° 40'N, 130° 40'W), which has a history of volcanic activity from the Miocene until the present. The second ("reference") station is located 130 km eastward at the same geomagnetic latitude. In addition, data from the permanent observatory at Meanook will be available for qualitative comparison to a "normal eastern-type" structure, at these high geomagnetic latitudes (61.5 - 62.5° N) spatial coherence is not expected to be adequate for quantitative work over such long distances.

The newly developed broad-band systems (periods about 10^4 sec. to 5 sec.) were successfully operated at these sites. No data analysis has as yet been carried out; a superficial visual examination indicates that SHA shows abnormally low-ΔZ features, but whether this indicates simply a northward extension of the Cordilleran low-ΔZ region, or whether it indicates the local "volcanic" environment, remains to be determined by comparison with "reference" data.

3) Broad-band geomagnetic depth-sounding. Previous profiles across the low-ΔZ/high-ΔZ discontinuity, using "standard" equipment (mainly Askania variographs), have defined its approximate location. However, quantitative analysis of the structures has been frustrated by a) the relatively wide station separations (~ 100 km) and

b) the lack of valid short-period (< 2000 sec.) data in ΔZ at the western and transition stations. Our quantitative models have therefore been based primarily on MT soundings at stations well removed to either side of the discontinuity, rather than on a study of the "edge" itself. The current project involves a more closely-spaced profile across the discontinuity (see Fig. 1), using four of the new broad-band GDS system over the discontinuity itself, as well as three Askania variographs (with increased chart speeds) as "reference" stations. This work is currently in progress (being planned and carried out by Mr. H. DRAGERT, a Doctoral candidate at the University of British Columbia), and will be continued into the winter months for as long as necessary to obtain the required data. It is hoped that these data will permit determination of the nature and characteristics of the actual edge structure.

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