AN INTERPRETATION OF SOME MAGNETO TELLURIC DATA RECORDED IN NORTHEAST BRITISH COLUMBIA DURING 1969

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ABSTRACT

Two magneto telluric dip sections are shown which illustrate some results obtained in a recent survey in Northeastern British Columbia.

In general, the Triassic Paleozoic sediments appear to be highly conductive, probably due to the presence of salt water. This is illustrated on Line A, where the section above the Triassic is quite resistive.

There are places, however, where the shales above the Triassic are quite conductive and the problem becomes one of distinguishing between them and the conductive section below the Near Top Triassic. This interface seems to be accompanied by a change of electrical anisotropy and is illustrated on Line B.

INTRODUCTION

Several lines of magneto telluric data were recorded along dip lines at sites spaced at about 6,600 feet.

The major observation following the initial examination of the data seemed to be that the Triassic and Paleozoic section was highly conductive, probably due to the presence of salt water. In addition, certain portions of the Cretaceous and Jurassic exhibited conductive areas. The problem thus becomes one of distinguishing between the two.

With the aid of concurrent refraction seismic data and a careful observation of the anisotropic properties of the magneto telluric data as described herewith, an interpretation is produced showing the correlation of the Near Top Triassic. A correlation of electrical basement is also given. There is no guidance at that level from seismic data.

DATA ACQUISITION, PROCESSING AND MODELLING

The data was acquired, processed and modelled by Geoscience Incorporated, to produce the sections in Figures 1 and 2.

Recording was carried out at sites spaced at about 6,600 feet along dip lines. Electrode spacing was 2,000 feet, in two sets of pairs, one along the dip line and one perpendicular to it. Magnetic field sensors consisted of mu-metal core coils, two paralleling the electrode alignments and one vertical. All data was recorded digitally in the field. Access to the sites was by helicopter.

Computed quantities consisted of rotated tensor apparent resistivity, rotation angle (related to strike direction) and magnetic field properties, all as a function of frequency (frequency range .001 to 10 c.p.s.)

Rotated tensor apparent resistivities are the two computed resistivity values paralleling strike and dip direction. These will, except in the simplest geologic situations, be different. This is because structural features, if they involve resistivity contrast, cause the bulk or average resistivity when viewed from the surface, to vary with azimuth.

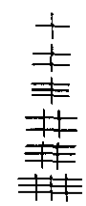
Apparent resistivity as a function of frequency for both strike and dip direction were converted to true resistivity depth relationship by assuming a theoretical model which will satisfy the observed results. The interpreted electrical sections in Figures 1 and 2 are the result of this procedure.

The final interpretive step in relating these sections to geological structures is the subject matter of this paper.

LOGARITHMIC CODE

In order to aid correlation by studying resistivity characteristics, a logarithmic code was adopted whereby both strike and dip resistivity are taken into account in plotting the sections and in the subsequent interpretation. Resistivity values are ordered by orders of magnitude, each line representing an order of ten, vertical referring to strike quantities and horizontal to dip quantities. The first number refers to dip resistivity in ohm - meters and the second to strike resistivity.

10/10
100/10
1000/10
100/100
1000/100
1000/1000



There is some ambiguity in defining orders of magnitude in places, but this symbolism is only an aid, so judgment is required. For example, is 500 in the order of hundreds or thousands?

DISCUSSION OF INDIVIDUAL LINES

LINE A (FIGURE 1)

The sediments below Near Top Triassic are interpreted as shown, being largely low resistivity in the strike direction, there being some variation in the dip direction. Above the Triassic, the Jurassic and Cretaceous beds exhibit high resistivity in both directions. The basement is interpreted to be at the interface where a large change in resistivity takes place, particularly in the strike direction.

On Site 67, the Near Top Triassic is interpreted to be at the top of a resistivity quantity of 1000/100. The deeper correlation would give 6,000 feet of dip between sites 56 and 67 which is considered unreasonable.

LINE B (FIGURE 2)

The Near Top Triassic to Basement is correlated, in general, as a zone of low strike resistivity. The difficulties with respect to distinguishing between Cretaceous shales and Paleozoic conductors are illustrated on this line. On Sites 1 and 01 the Top Triassic is correlated as an interface between high and low dip resistivity, this being the only physical change observable at the expected level. A phantom pick is made on Site 01 as a result of dips above and dip at basement level. The criteria here seems to be to phantom low since we are in a low strike resistivity Cretaceous area.

At Stations 03 and 04, the Near Top Triassic is picked as the interface between low and high dip resistivity, this being the reverse of the direction of change at Sites 1 and 01.

On Sites 46, 33, 23, 12, 02, the Near Top Triassic is picked at the base of very high strike and dip resistivity.

The basement is picked where a large resistivity change takes place, near a level in the order of 10,000 to 15,000 feet below the Near Top Triassic. There seems to be no consistency as to which tensor (dip or strike) produces the change.

CONCLUSION

We seem to be able to distinguish between generally conductive beds above the Triassic and the conductive Triassic Paleozoic complex by an anisotropic change at the expected level.

ACKNOWLEDGMENT

The author wishes to thank the Texas Gulf Sulphur Company for permission to publish this paper.

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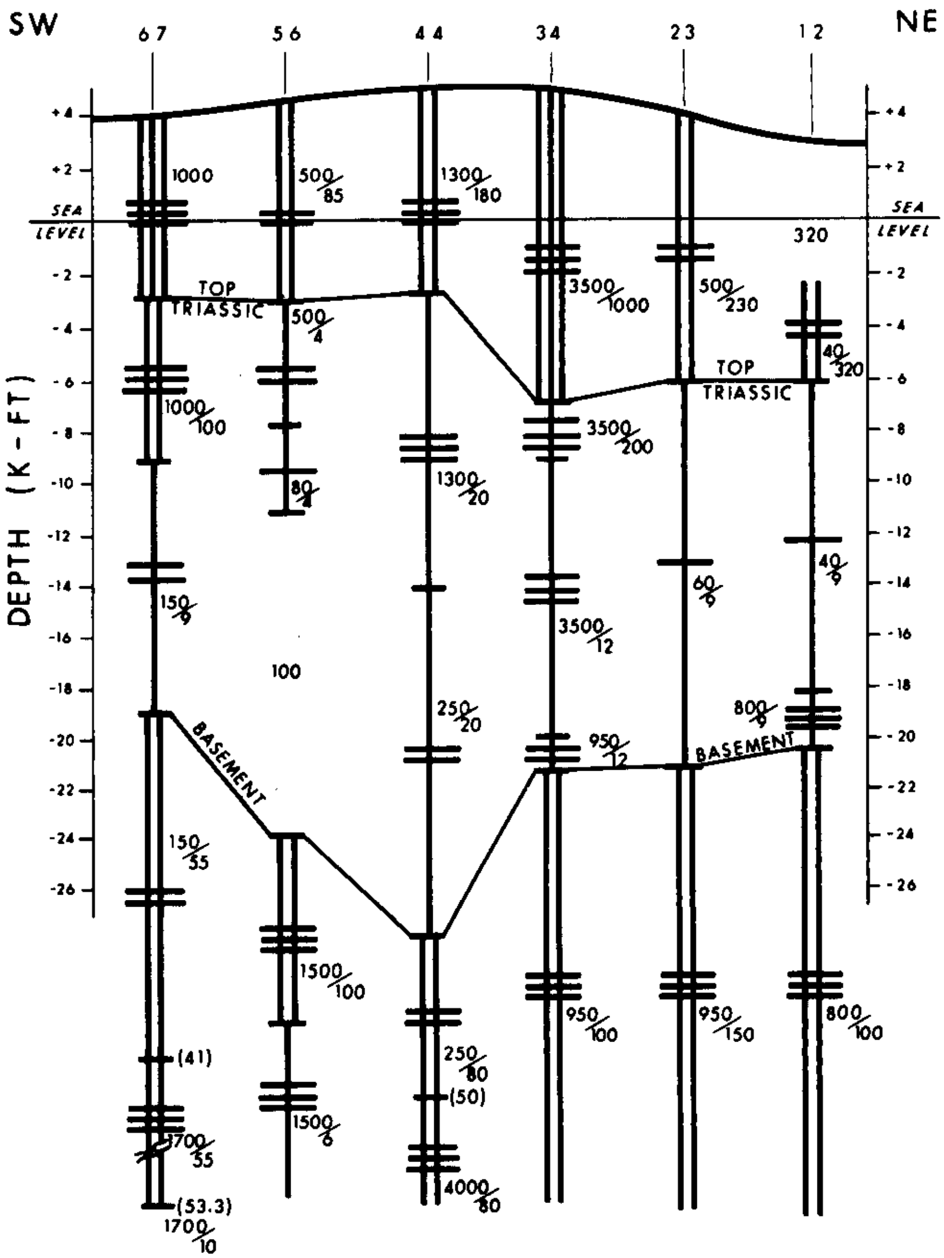
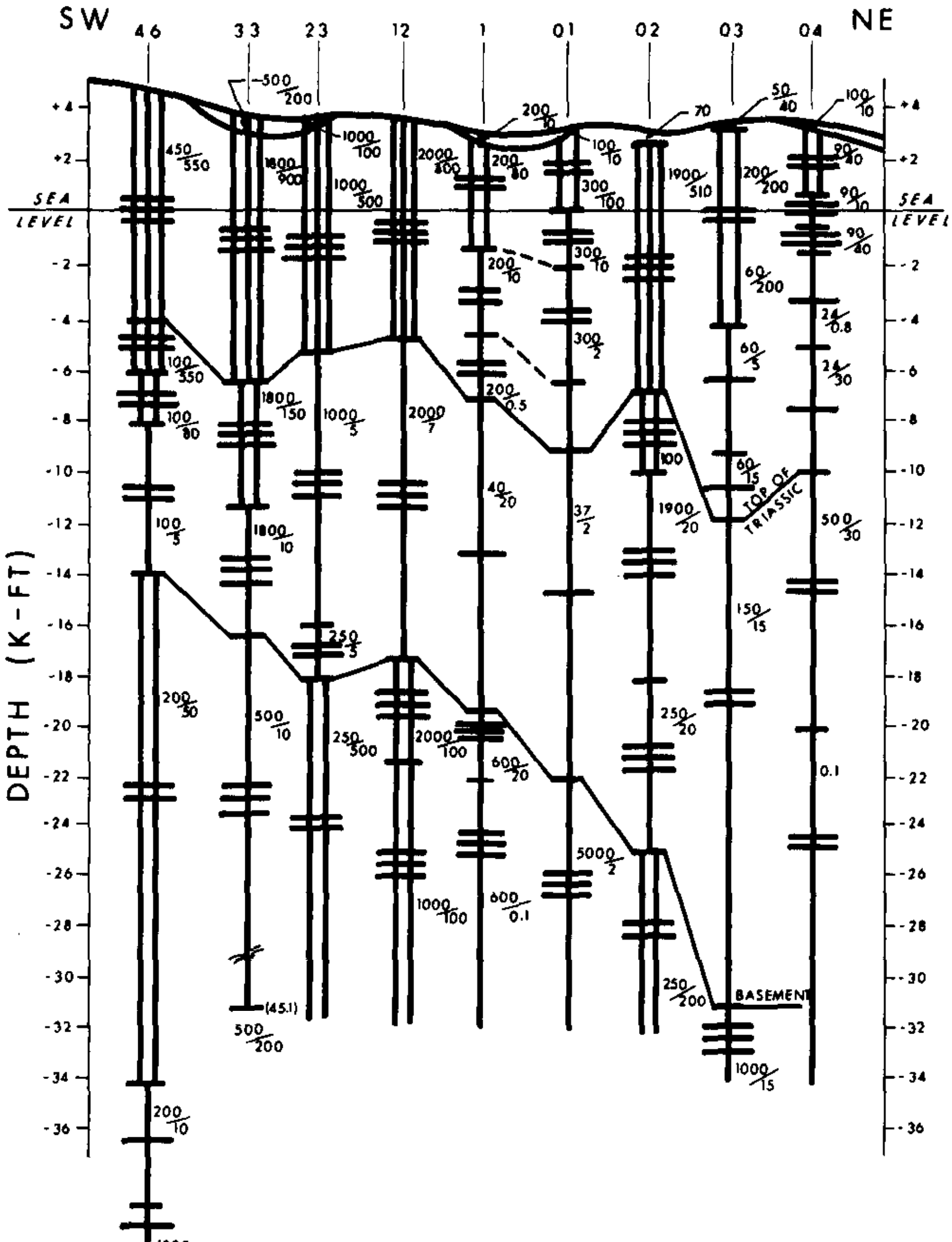


T.G.S. MAGNETO TELLURIC SURVEY
LINE A
INTERPRETED ELECTRICAL SECTION
(APPARENT RESISTIVITIES IN OHM-METERS) Figure 1



T.G.S. MAGNETO TELLURIC SURVEY
LINE B
INTERPRETED ELECTRICAL SECTION
(APPARENT RESISTIVITIES IN OHM-METERS)

Figure 2