Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Earth Physics Branch
Direction de la physique du globe

1 Observatory Crescent
Ottawa Canada
K1A 0Y3

1 Place de l'Observatoire
Ottawa Canada
K1A 0Y3

Geomagnetic Service of Canada

Service géomagnétique du Canada

PRELIMINARY RESULTS OF THE MAGNETOTELLURIC SURVEY IN THE MIRAMICHI, N.B. EARTHQUAKE ZONE

by

R.D. Kurtz and J.A. Ostrowski
Division of Seismology and Geomagnetism
Earth Physics Branch
Energy, Mines and Resources Canada
Ottawa, Ontario
K1A 0Y3

EARTH PHYSICS BRANCH OPEN FILE NO. 84-18

pp. **9 pages**
Price/Prix: **$4.00**

ABSTRACT

The report presents preliminary results of the magnetotelluric survey in the Miramichi, New Brunswick earthquake zone. Inversion of tensor MT data shows a 2 km layer of about 10,000 Ω-m underlain by a layer of 100,000 Ω-m extending down to about 30 km. AMT measurements along a 7.5 km profile detected two conductive anomalies trending NNW.

RÉSUMÉ

Le rapport présente les résultats préliminaires d'un sondage magnétotellurique effectué dans la zone sismique active de Miramichi au Nouveau-Brunswick. L'inversion numérique des tenseurs MT fait apparaître une première couche de 2 km d'épaisseur et d'environ 10,000 Ω-m. Une seconde couche sous-jacente, de résistivité égale à 100,000 Ω-m, atteint une profondeur de 30 km. Par ailleurs, un profil AMT qui s'étend sur 7.5 km a permis de détecter deux anomalies conductrices orientées NNO.

A magnetotelluric (MT) survey was conducted between July 6 and August 3, 1983 by personnel of the Earth Physics Branch in the Miramichi earthquake zone, located in central New Brunswick.

Tensor MT soundings were made at 11 locations, as shown in Fig. 1, in the frequency range from .00055 Hz (1818s) to 384 Hz, using a system manufactured by Phoenix Geophysics Ltd. of Toronto. Each site was occupied from one to three days, depending on the signal quality. In addition, scalar audio-magnetotelluric (AMT) soundings were made at each of these locations with the sensors oriented in both the major and minor axes of anisotropy. This extended the apparent resistivity data up to 5000 Hz frequency.

AMT measurements were also made at 75 locations along an approximately east-west profile (Fig. 1) using an instrument produced by SYGEQ Ltd. of Montreal. Data were collected at seven frequencies (8, 26, 70, 250, 700, 1500, and 5000 Hz) with the telluric line oriented north-south and then east-west.

Partial results of the AMT measurements are shown in Fig. 2 in the form of apparent resistivity (ρ_a) profiles for both sensor orientations at 8 Hz and 250 Hz. In Fig. 3, all the data are displayed in the form of apparent resistivity pseudosections.

The apparent resistivity values span more than three decades, from 186 to 351,000 Ω-m. Generally, apparent resistivity is high in the western part of the profile and very high in the central part, but there is a broad less resistive zone in the eastern part of the profile centered near station 64 (Fig. 2).

Superimposed on the general trend is a number of small-scale (100-300m wide) features. Two of the most striking conductive anomalies, marked with heavy arrows in Fig. 1, occur at stations 27-28 (with a probable extension to station 21) and between stations 61 and 66. The former feature coincides with an NNW trending EM conductor (see Fig. 1) found by J.J. Chandra of New Brunswick Department of Natural Resources using VLF equipment (private communication). The anomaly at stations 27 and 28 is observed at neighbouring stations at lower frequencies which would normally imply that it is not of a purely surficial origin. The anomaly centered at station 64 is observed at both orientations of the sensors; this indicates that it intersects the profile at an oblique angle, since narrow conductors do not strongly influence measurements made with the telluric line parallel to them. The anomaly is more pronounced for the tellurics E-W orientation which suggests that its strike is close to NNW. This is confirmed by the direction of polarization, 37° west of north, of the electric field for tensor station 6.

The AMT data in general show a fairly uniform structure with a layer of approximately 10,000 Ω-m overlaying highly resistive basement of more than 50,000 Ω-m. This general character is confirmed by the data from the tensor station 7. As shown in Fig. 4 the major and minor curves for both apparent resistivity and phase are of similar character. Their 1-D inversions yield similar results with a 1.7 to 2.0 km layer of 10,000 to 11,000 Ω-m underlain by a very resistive (over 100,000 Ω-m) layer extending to the depth of about 30 km. Beneath it there is a conductive zone, the resistivity of which is not well resolved because of larger errors in the measurements at longer periods.

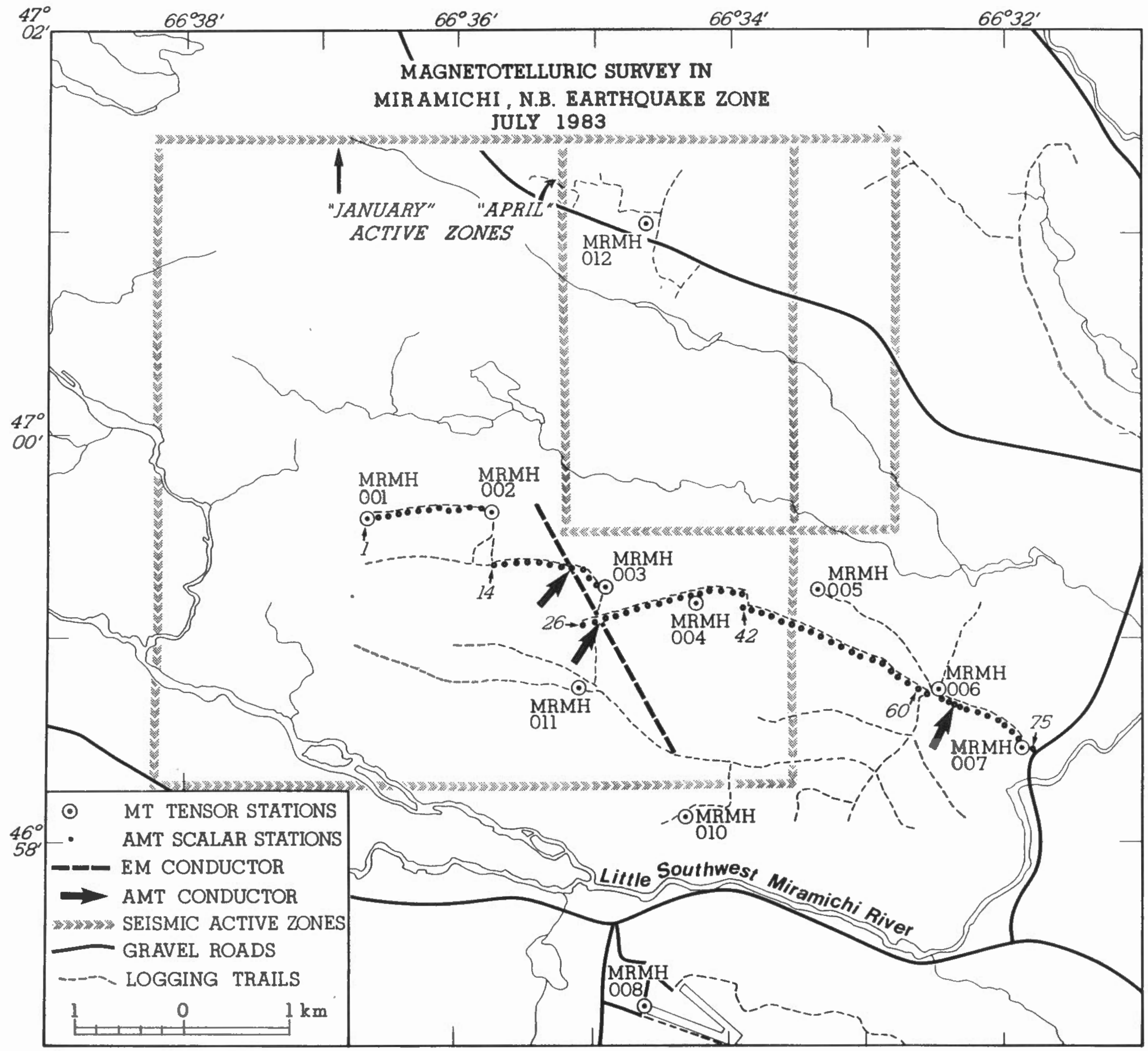

Fig. 1 Location of the MT (circles) and AMT (dots) measuring sites. Boundaries of the seismic "active zones" are taken from the paper "Aftershock sequences of the 1982 Miramichi, New Brunswick earthquakes" by R.J. Wetmiller, J. Adams, F.M. Anglin, H.S. Hasegawa and A.E. Stevens (in press in the BSSA).

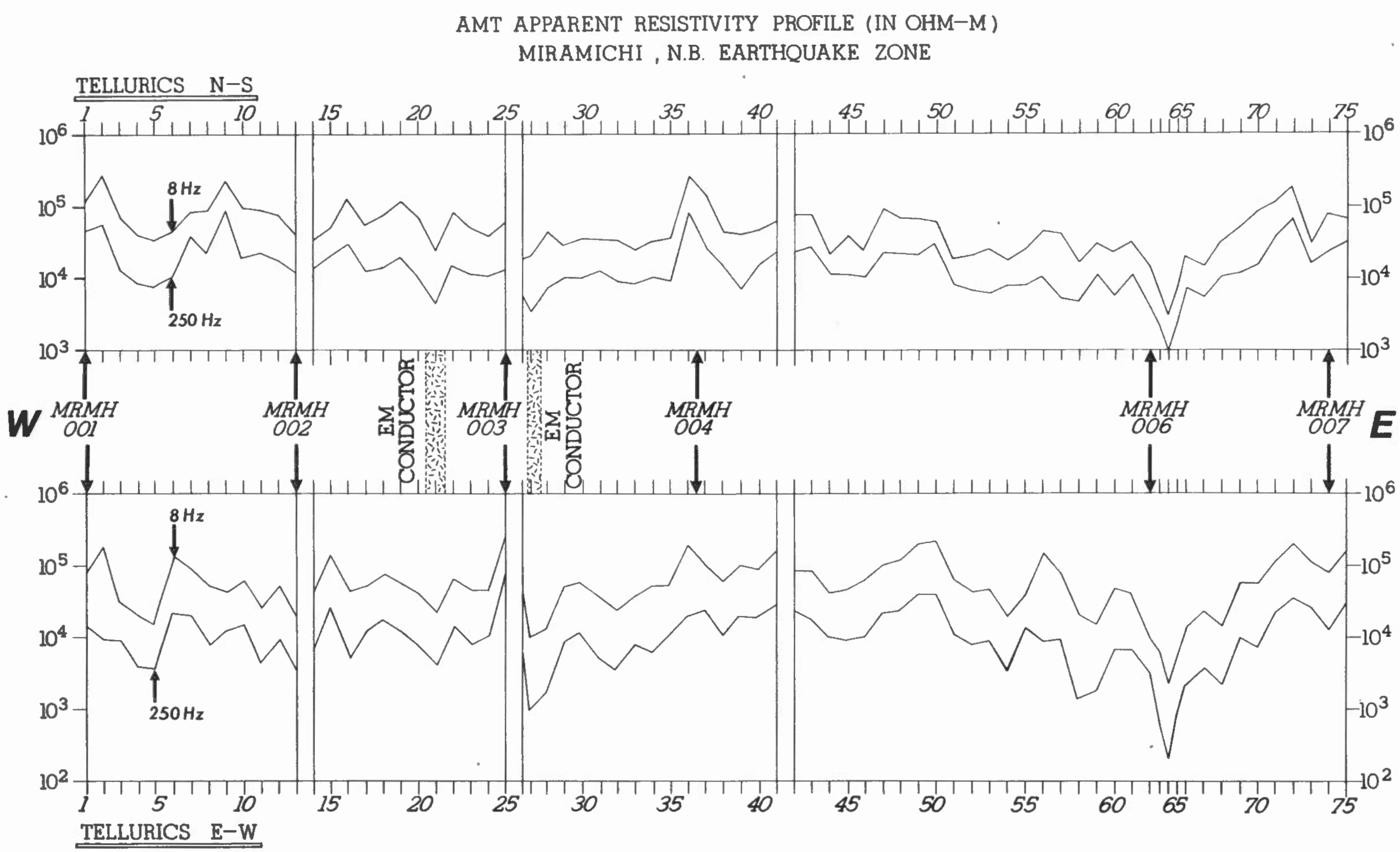

Fig. 2 AMT apparent resistivity profiles at 8 and 250 Hz

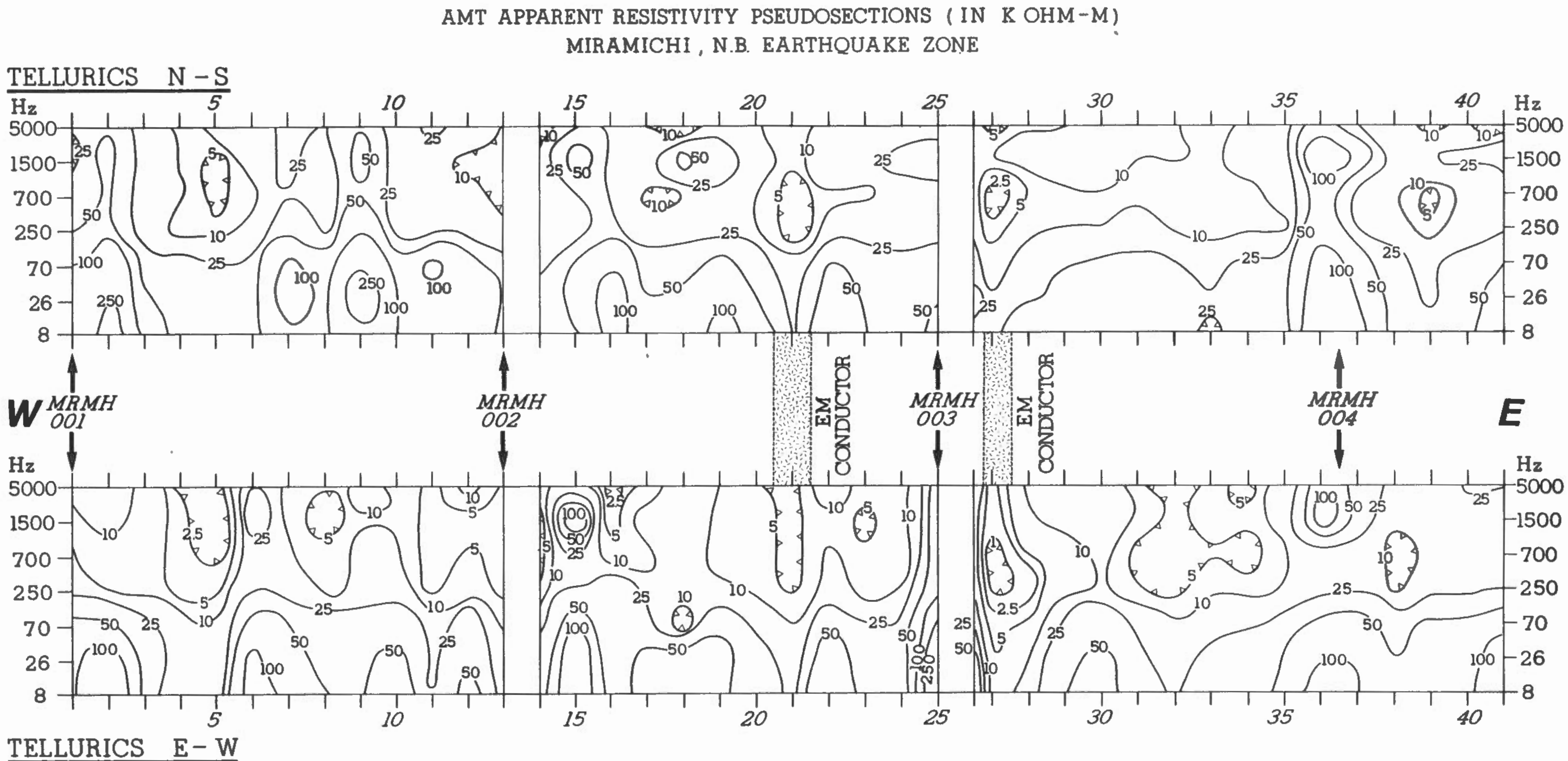

Fig. 3 AMT apparent resistivity pseudosections

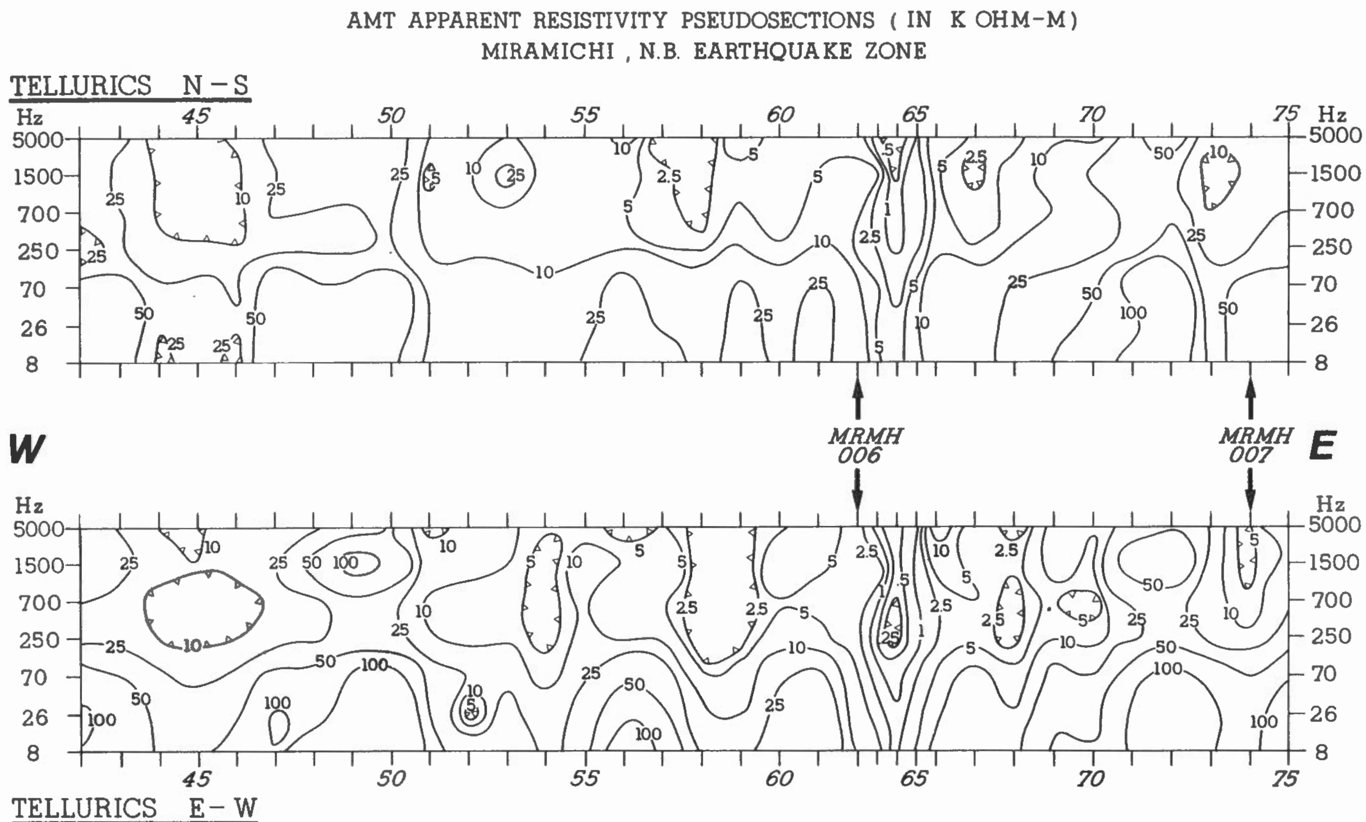

Fig. 3 (Cont'd) **AMT** apparent resistivity pseudosections

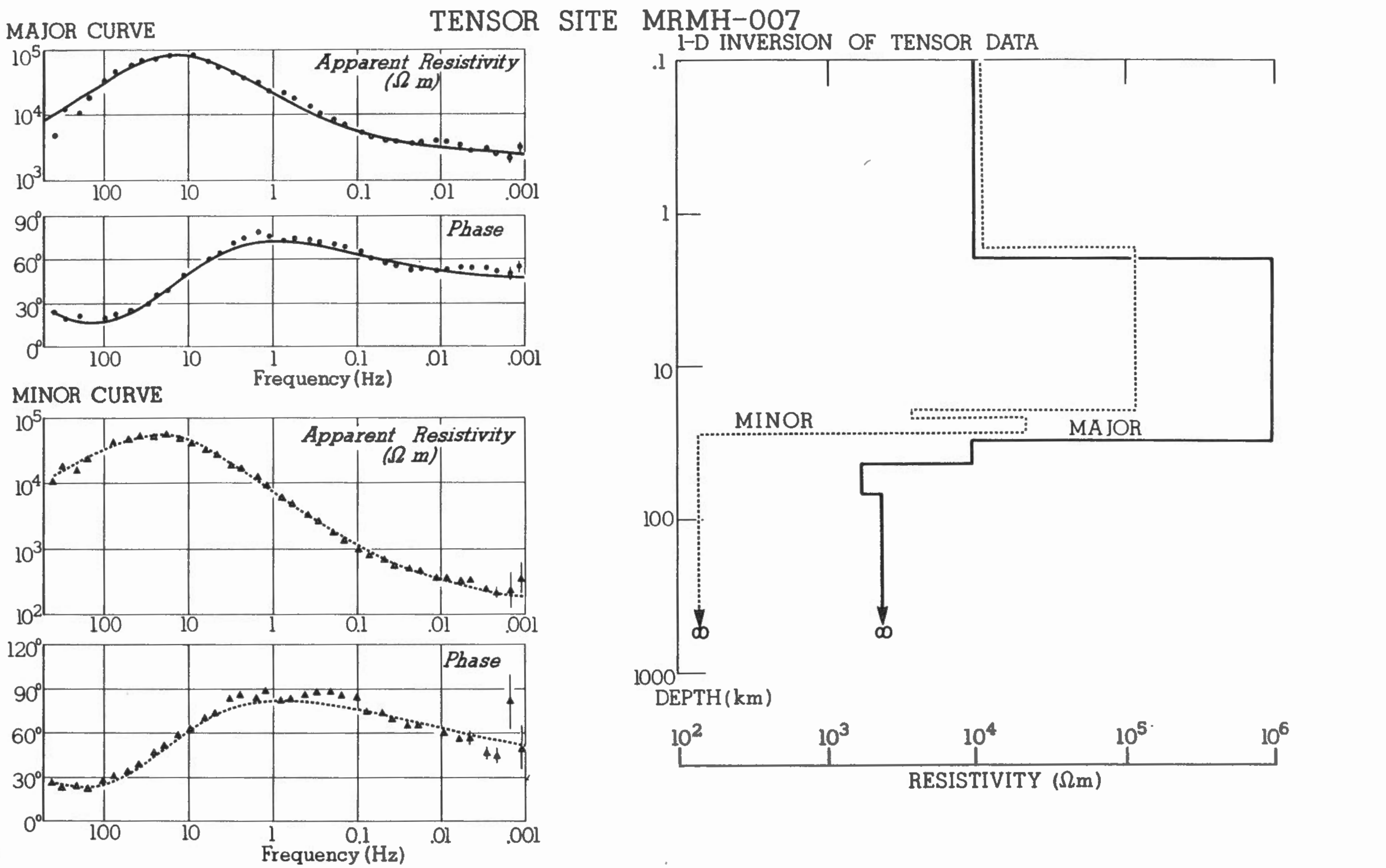

Fig. 4 Tensor MT data from station 7 and their 1-D inversion. Solid lines show the response of the model.