

ΣΕΙΣΜΟΛΟΓΙΑ.— **On the experimental evidence of a SES vertical component in seismic electric signals**, by *Antonopoulos G.* and *Kopanas J.**, διὰ τοῦ Ἀκαδημαϊκοῦ κ. Καίσαρος Ἀλεξοπούλου.

ABSTRACT

Since 1988 measurements have been carried out in the Zakynthos area, aiming at the detection of a vertical component in the seismic electric signals (SES).

During almost three years of monitoring a few cases have been noticed in which a vertical-SES component was registered. An example is shown where a signal appeared simultaneously with an SES detected at Ioannina station. On the same registrations the vertical electric component of magnetotelluric disturbance could be studied.

Theoretical aspects for the explanation of the precursor Seismic Electric Signals (SES) (Varotsos and Alexopoulos, 1984) do not preclude, in inhomogeneous areas, the existence of a vertical component. Such an existence enhances the detectability of the VAN-method in view of the following reasons:

1. High frequency magnetotelluric noise as well as cultural noise (of a certain type) is expected to decrease with depth and
2. the ratio and the polarities of the two horizontal SES components contribute to the determination of the epicenter of impending earthquakes (Varotsos and Lazaridou, 1990); therefore the knowledge of a vertical component offers additional information for the improvement of the accuracy of epicentral determination.

It is the scope of the present paper to give a preliminary report on the experimental detection of a SES-vertical component in the area of Zakynthos island (Fig. 1).

The measuring site was on the boundary between the inner island and the rugged coast (Fig. 2). It was intentionally selected to be in the vicinity of an area exhibiting strong changes of local conductivity.

Two independent boreholes (a) and (b) with depth of 200m were used. Electrical dipoles were installed by putting electrodes at the surface and the bottom of the boreholes. The simultaneous appearance of a transient electrical variation at *both* boreholes (lying at a distance of 92 m) excludes the possibility

* Γ. ΑΝΤΩΝΟΠΟΥΛΟΣ καὶ Ι. ΚΟΠΑΝΑΣ, Παρατήρηση κατακόρυφης συνιστώσης εἰς τὰ ἠλεκτρικὰ προσεισμικὰ σήματα ἐντὸς τῆς γῆς.

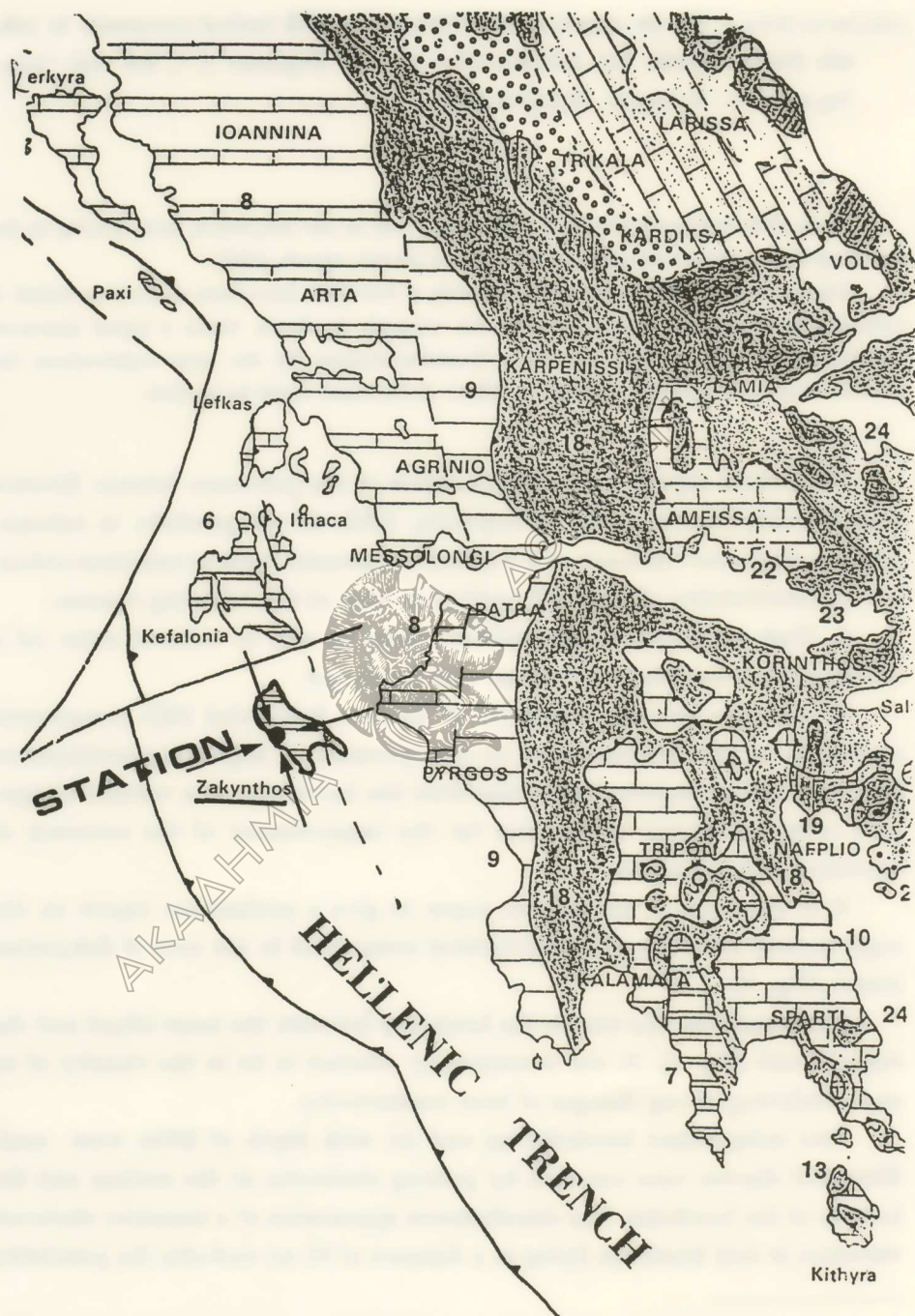


Fig. 1. Map of Zakyntos island showing the site of the station

to attribute them to contact problems of the electrodes (Varotsos and Alexopoulos, 1984).

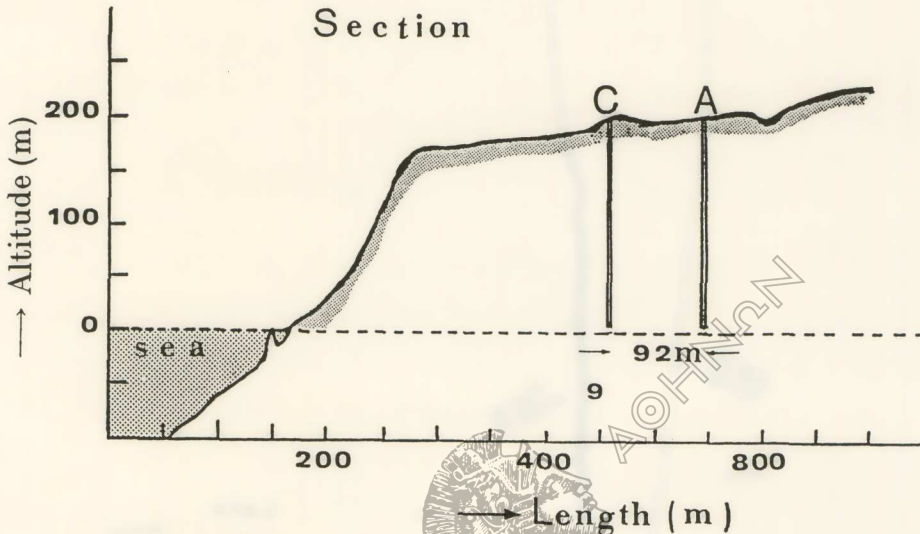


Fig. 2. Profile of the station area indicating the sites of the electrodes

Figure 3 illustrates a transient change of the vertical electric field detected in both dipoles on May 28, 1988. This change was simultaneously detected in the horizontal field at Ioannina station (IOA) lying at a distance about 200 km to the North of Zakythos. By applying the criteria described by Varotsos and Lazaridou (1990) and by Varotsos, Alexopoulos, Nomicos, Lazaridou, Dologlou, Eftaxias, Hadjicontis, 1990 the Ioannina signal was verified as being a SES.

The Zakythos station also detects magnetotelluric changes of the electric field of the earth. In Figure 4, curves (a) and (b), are an example of changes detected on the vertical dipoles (a) and (b). Curve (c) shows the field between the lower electrodes and this is an indication of the magnetotelluric field at a depth of 200 m. The fact that these changes are of magnetotelluric origin is verified by comparing to the registrations of the other stations of the VAN-telemetric network (Varotsos and Alexopoulos, 1984).

An analysis for the impedance tensor estimation is currently being carried out.

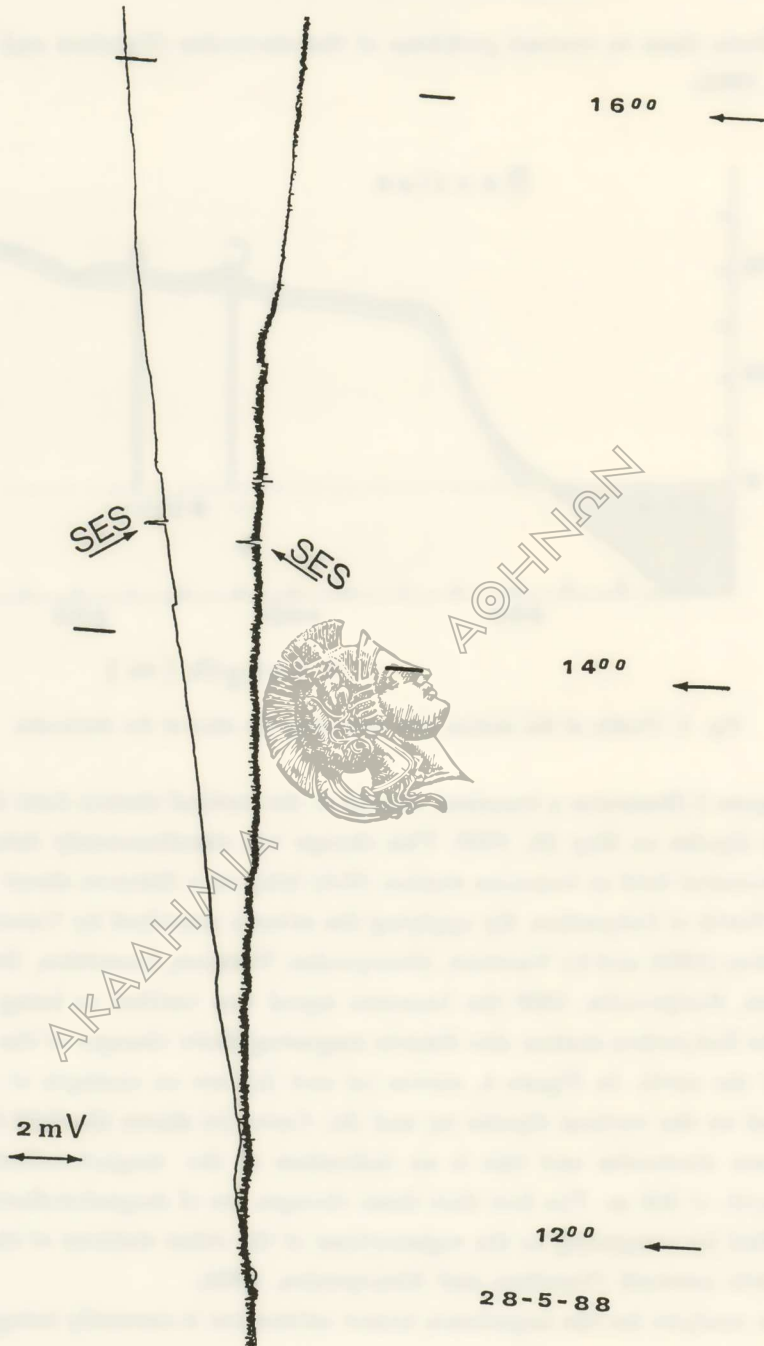


Fig. 3. A SES recorded at two vertical dipoles with the same length ($L = 200\text{m}$) installed at different boreholes. The same SES was simultaneously recorded at IOA station (see the text).

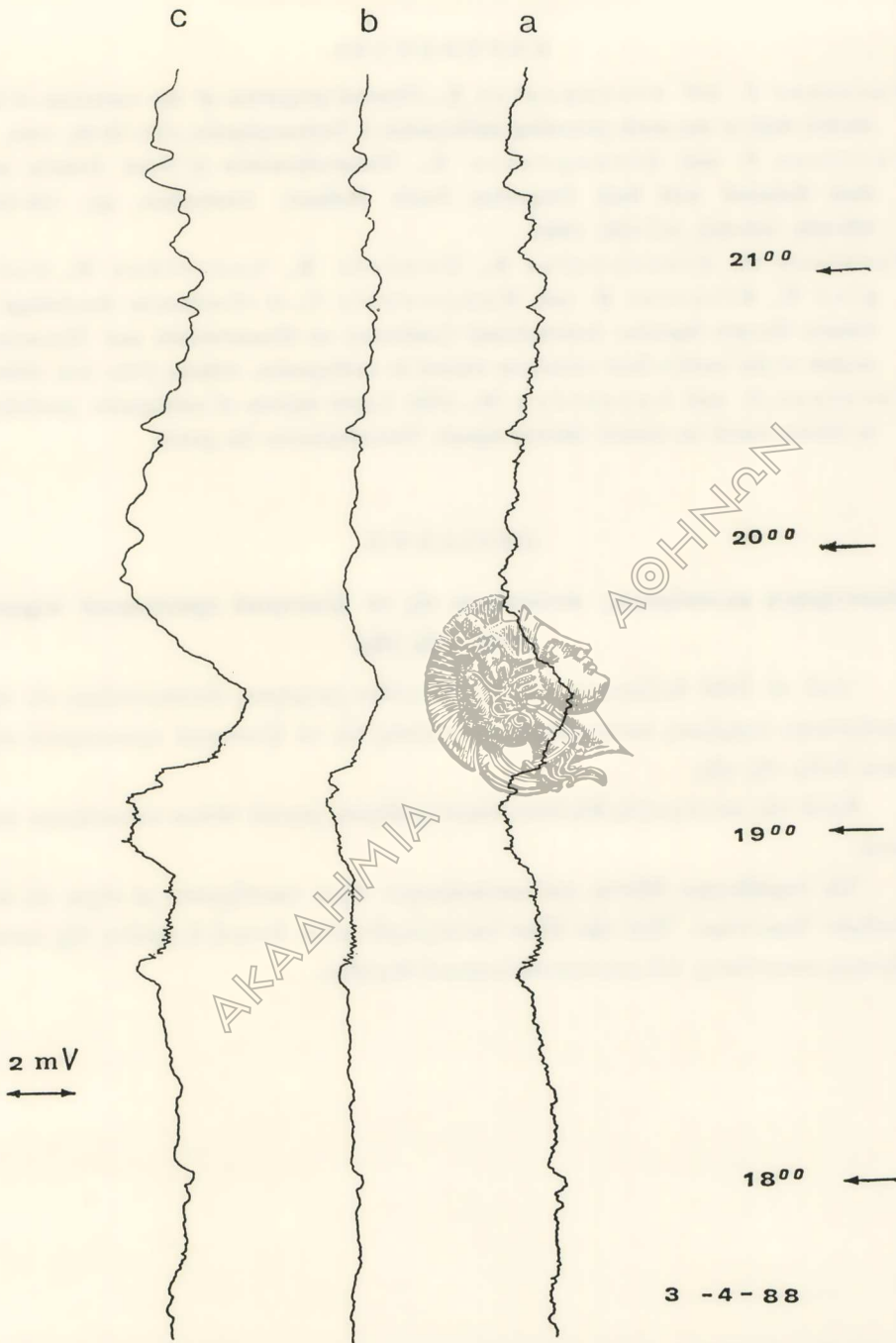


Fig. 4. A magnetotelluric changes observed at horizontal and vertical dipoles: Curves (a) and (b) correspond to two (independent) vertical dipoles installed at the two boreholes; curve (c) correspond to a dipole connecting the electrodes placed at the bottom of the two boreholes.

REFERENCES

- Varotsos P. and Alexopoulos K., Physical properties of the variations of the electric field of the earth preceding earthquakes I. *Tectonophysics*, 110: 73-98, 1984.
- Varotsos P. and Alexopoulos K., *Thermodynamics of Point Defects and their Relation with Bulk Properties*. North Holland; Amsterdam, pp. 136-142, 403-406, 410-412, 417-420, 1986.
- Varotsos P., Alexopoulos K., Nomicos K., Lazaridou M., Dologlou E., Eftaxias K. and Hadjicontis V., in «Continuous Recordings of Seismic Electric Signals»: International Conference on Measurements and Theoretical models of the earth's field variations related to earthquakes, Athens, Febr. 6-8, 1990.
- Varotsos P. and Lazaridou M., 1990. Latest aspects of earthquake prediction in Greece based on seismic electric signals. *Tectonophysics* (in press).

ΠΕΡΙΛΗΨΗ

Παρατήρηση κατακόρυφης συνιστώσης εις τὰ ηλεκτρικά προσεισμικά σήματα εντός τῆς γῆς.

Ἐκ τῆς 1988 διεξάγονται εἰς τὴν Ζάκυνθον μετρήσεις ἀποσκοποῦσαι εἰς τὴν διαπίστωσιν ὑπάρξεως κατακόρυφου συνιστώσης εἰς τὰ ηλεκτρικά προσεισμικά σήματα ἐντὸς τῆς γῆς.

Κατὰ τὰς καταγραφὰς δύο ἐτῶν παρατηρήθησαν μερικὰ τέτοια κατακόρυφα σήματα.

Ὡς παράδειγμα δίδεται καὶ κατακόρυφον σῆμα ταυτόχρονον μὲ σῆμα εἰς τὸν σταθμὸν Ἰωαννίνων. Ἐπὶ τῶν ἰδίων καταγραφῶν εἶναι δυνατὴ ἡ μελέτη τῆς κατακόρυφης συνιστώσης τοῦ μαγνητοτελλουρικοῦ θορύβου.