

ΓΕΩΛΟΓΙΑ. – Ἡ γεωτεκτονικὴ ἐνότης τῆς Ἑλληνικῆς Χερσονήσου καὶ τοῦ Αἰγαίου χώρου, ὑπὸ Λουκᾶ Μούσουλου καὶ Παντελῆ Τσόφλια *.

Κατὰ γενικὴν παραδοχὴν ἡ περιοχὴ τοῦ Αἰγαίου ἀποτελεῖ, ἀπὸ γεωλογικῆς ἀπόψεως, τὸ πολυπλοκώτερον τμῆμα τῆς Μεσογείου. Ἐντονος κατακερματισμὸς χαρακτηρίζει τὴν περιοχὴν ταύτην ὅπου ἀπαντοῦν ἐκτεταμένοι νεογενεῖς καὶ τεταρτογενεῖς σχηματισμοὶ ἐπικαθήμενοι ἐπὶ ἀλπικοῦ καὶ προαλπικοῦ ὑποβάθμου.

Μεταξὺ τῶν παλαιοτέρων μελετητῶν, ὁ Τρικαλινὸς [23, 24] ἀποδίδει τὸν ὥστε ἄνω κερματισμὸν εἰς τὴν Πασαδενικὴν φάσιν. Κατὰ τὴν φάσιν ταύτην ἡ προϋπάρχουσα κυκλαδικὴ μᾶζα ἐχωρίσθη εἰς διάφορα μικρὰ τεμάχη, τὰ δόποια σήμερον ἔχεζουν ὑπεράνω τῆς θαλάσσης, ὡς μεμονωμέναι νῆσοι.

Νεώτεραι ἐργασίαι πλήθους ξένων καὶ Ἑλλήνων ἐρευνητῶν ἔφεραν εἰς φῶς τὴν γεωτεκτονικὴν ἐνότητα τῆς Ἑλληνικῆς Χερσονήσου καὶ ὀλοκλήρου τοῦ Αἰγαίου χώρου μέχρι τῶν δυτικῶν παρυφῶν τῆς Μικρᾶς Ἀσίας. Ὁλως ὅμως ἐσχάτως προεβλήθη, ὑπὸ τοῦ Τούρκου γεωλόγου E. Bignöll [5], ἡ ἀποψις ὅτι ἡ Δυτικὴ Μικρὰ Ἀσία καὶ αἱ ἀνατολικαὶ νῆσοι τοῦ Αἰγαίου ἀνήκουν εἰς ἑνιαῖον τέμαχος, τοῦ δόποιον αἱ τελευταῖαι σινιστοῦν τοπικας μορφολογικάς ἔξαρσεις.

Ἡ παροῦσα ἀνακοίνωσις ἀποσκοπεῖ εἰς τὴν διερεύνησιν τῆς ὥστε ἄνω ἀπόψεως βάσει γεωλογικῶν καὶ γεωφυσικῶν δεδομένων ἐρανισμένων ἐπὶ τῶν μέχρι τοῦδε ἀποτελεσμάτων τῶν ἐργασιῶν τῶν διαφόρων μελετητῶν τοῦ τμήματος τούτου τῆς Μεσογείου.

ΓΕΝΙΚΑΙ ΓΕΩΛΟΓΙΚΑΙ ΠΑΡΑΤΗΡΗΣΕΙΣ

Συμφώνως πρὸς τα δεδομενα τῆς στρωματογραφίας, τῆς νεοτεκτονικῆς, τῆς γεωφυσικῆς καὶ τῆς ὡκεανογραφίας, ἡ περίοδος μεταβάσεως ἀπὸ τοῦ Μειοκαίνοι πρὸς τὸ Πλειόκαινον εἶναι ἡ περίοδος τῆς ἐνάρξεως τοῦ σχηματισμοῦ τῆς Μεσογείου καὶ ἀπετέλεσε κατὰ τὸν Bourcart [6] τὴν ἐναρξιν τῆς λεγομένης «Πλειοκαινικῆς Ἐπαναστάσεως». Κατὰ τὴν περίοδον αὐτὴν ὁ κατακερματισμὸς τῶν προ-

* L. MOUSSOULOS - P. TSOFLIAS, The Geotectonic entity of the Greek Peninsula.

νεογενῶν ἔνοτήτων μετέβαλε τὴν ὑφισταμένην γεωγραφικὴν εἰκόνα, ὅπως φανερώνουν αἱ τεκτονικαὶ τάφροι μὲ τοὺς μολασσικοὺς σχηματισμοὺς καὶ τὰ τεκτονικὰ κέρατα, τὰ δῆτα ἀπετέλεσαν τὰς νήσους τῆς πλειοκαινικῆς θαλάσσης. Πολλὰ ἀπὸ τὰ κέρατα ταῦτα κατέχουν καὶ σήμερον ἀκόμη τὴν ἀρχικήν των θέσιν.

Οἱ προνεογενεῖς σχηματισμοὶ τοῦ Αἰγαίου ἀποτελοῦν γεωλογικῶς συνέχειαν τῶν δύο γειτονικῶν ἡπειρωτικῶν περιοχῶν τῆς Ἑλλάδος καὶ τῆς Τουρκίας. Ἐπεκτείνονται βιορείως ἕως τὰς Ἀλπεις καὶ ἀνατολικῶς ἕως τὰς Ζαγρίδας ὁροσειράς.

Ἀναλυτικότερον, οἵ ἐν λόγῳ σχηματισμοὶ ἀποτελοῦν τὴν συνέχειαν τῶν Λειναρικῶν Ἀλπεων, αἱ δῆται διὰ τῶν Ἑλληνίδων ὁροσειρῶν ἐνοῦνται μετὰ τῶν Ταυρίδων τῆς Μ. Ἀσίας, σχηματίζουσαι τὸ καλούμενον Δειναροταυρικὸν τόξον. Αἱ Ταυρίδες ὁροσειρὰ τῆς Μ. Ἀσίας (*Taurus Lycien*) ἀνίκουν, ὡς γνωστόν, εἰς τὸν τελευταῖον τομέα τῶν Ἑλληνίδων.

Τοὺς προνεογενεῖς σχηματισμοὺς τοῦ Δειναροταυρικοῦ τόξου προσέβαλεν ἡ τεκτονικὴ τοῦ Μειοκαίνου καὶ τοῦ Πλειο-Τεταρτογενοῦς, ἡ δῆτα ἔδωσε τὴν παροῦσαν μορφὴν εἰς τὸν χῶρον τοῦ Αἰγαίου.

Ἐὰν ἔξετάσωμεν ἀπὸ ἀπόψεως θέσεως τὸ Δειναροταυρικὸν τόξον, θὰ παρατηρήσωμεν, ὅτι ἀπὸ τὴν περιοχὴν τῶν Ἀλπεων κατέρχεται πρὸς τὰ ΝΑ/κά, κάμπτεται πρὸς ἀνατολὰς εἰς τὸν ἐλληνικὸν γεωγραφικὸν χῶρον καὶ εἰσέρχεται εἰς τὴν Μ. Ἀσίαν. Ἐχομεν δηλαδὴ συγκεκριμένον ἔνιαῖον προσανατολισμὸν τῶν προνεογενῶν τεκτονικῶν ἔνοτήτων.

Ἄπο τοῦ Μειοκαίνου καὶ ἐντεῦθεν αἱ σχηματισθεῖσαι λεκάναι, αἱ δῆται ἀπαντοῦν καθ' ὅλην τὴν ἔκτασιν τοῦ Δειναροταυρικοῦ τόξου, διερίζονται εἰς δυνάμεις ἐφελκυσμοῦ καὶ συμπιέσεως. Οἱ προσανατολισμοὶ τῶν λεκανῶν τούτων δὲν ἀκολουθεῖ τας γενικαὶ διευθύνσεις τῶν προνεογενῶν σχηματισμῶν.

Εἰς τὴν Εἰκ. 1 συνοψίζονται τα προέχοντα γεωμορφολογικά χαρακτηριστικά τῆς περιοχῆς τοῦ Αἰγαίου Πελάγους καὶ τοῦ ἐκεῖθεν αὐτοῦ θαλασσίου χώρου. Νοτίως καὶ ΝΔυτικῶς τῆς Κρήτης σημειοῦται ἡ διελευσίς βαθείας τάφρου, τῆς καλούμενης ἐλληνικῆς τάφρου, ἡ δῆτα νοτιώτερον πλαισιοῦται ὑπὸ ὑβρίματος γνωστοῦ ὡς φάρις τῆς Ἀνατολικῆς Μεσογείου. Εἰς τὸ βόρειον Αἰγαῖον ἀπαντᾷ ἐτέρα τάφρος ἀνατολικῆς - βορειοανατολικῆς διευθύνσεως. Εἶναι ἡ τάφρος τοῦ Βορείου Αἰγαίου, ἡ δῆτα διερίζεται εἰς δυνάμεις ἐφελκυσμοῦ. Μεταξὺ τῶν δύο τάφρων ενδίσκεται τὸ ἐλληνικὸν ἥφαιστειακόν τόξον, τὸ δῆτα ἀναπτύσσεται παραλήιως πρὸς τὴν ελληνικὴν τάφρον καὶ εἰς ἀπόστασιν 200 περίπου χιλιομέτρων ἀπ' αὐτήν.

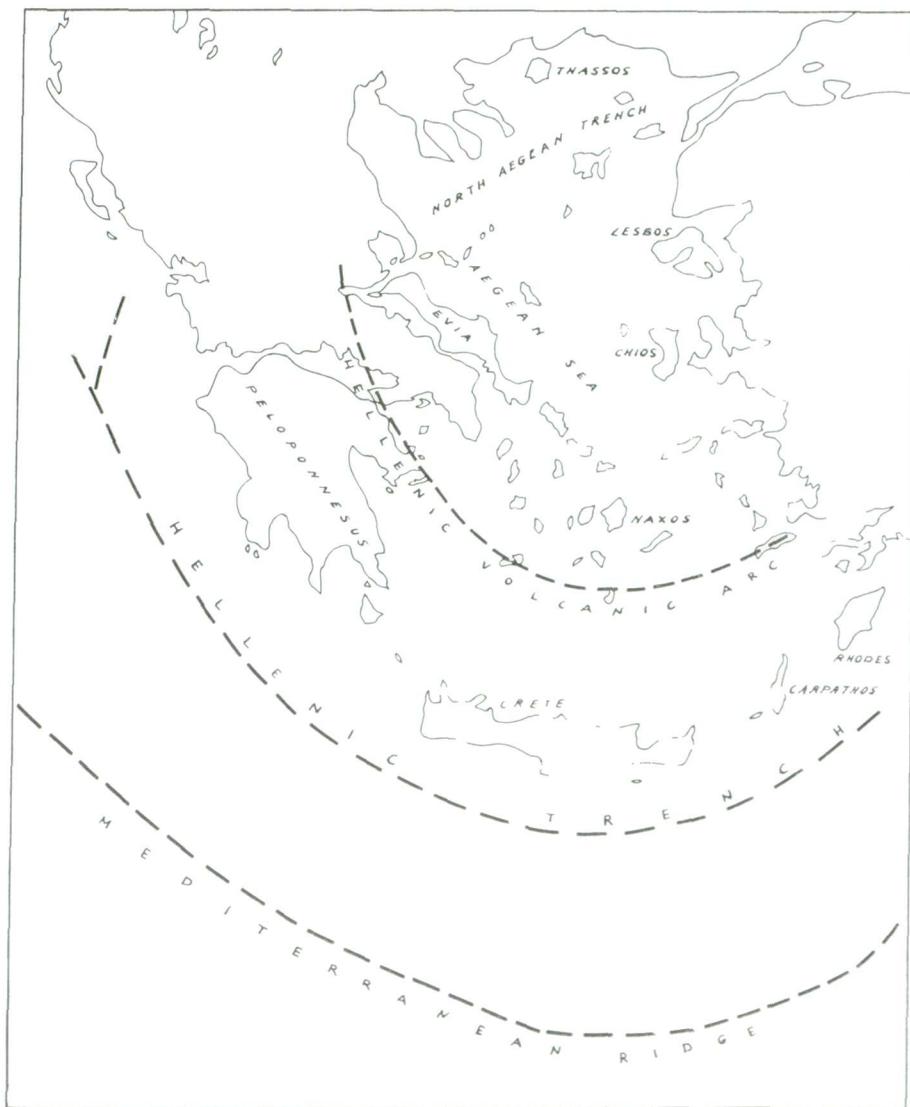


Fig 1 Map showing the prominent geomorphological characteristics of the Aegean Sea and the adjoining area

Εικ 1 Χαρτης δεικνύων τα κύρια γεωμορφολογικά χαρακτηριστικά του χωρού του Αιγαίου και τής γειτονικής περιοχής

ΣΕΙΣΜΟΤΕΚΤΟΝΙΚΑ ΔΕΔΟΜΕΝΑ

Ο McKenzie, είς ἐκ τῶν κυριωτέρων ἐρευνητῶν τῆς γεωλογίας τῆς ἀνατολικῆς Μεσογείου, ἀποδίδει τὴν κατανομὴν τῶν σεισμῶν τῆς περιοχῆς αὐτῆς εἰς τὴν κίνησιν δύο μικρῶν λιθοσφαιρικῶν πλακῶν, αἱ δόποιαι κεῖνται μεταξὺ Ἀφρικῆς καὶ Εὐρώπης, δηλαδὴ μεταξὺ τῆς ἀφρικανικῆς λιθοσφαιρικῆς πλακὸς καὶ τῆς εὐρωπασιατικῆς τοιαύτης [12, 13, 14]. Η θέσις τῶν ἐν λόγῳ μικροπλακῶν, τὰς δοποίας δύνομάζει τὴν μίαν Τουρκικὴν καὶ τὴν ἄλλην Πλάκα τοῦ Αἰγαίου, σημειοῦται εἰς τὴν Εἰκ. 2.

Η μικροπλάκα τοῦ Αἰγαίου περιστοῦται εἰς τὰς δυτικὰς παραυφάς τῆς Μικρᾶς Ἀσίας καὶ περιλαμβάνει τὸ Αἰγαίον Πέλαγος, τὴν Κρήτην καὶ τὸ μεγαλύτερον τμῆμα τῆς Ἑλληνικῆς Χερσονήσου (Εἰκ. 2). Τὸ βόρειον δριον τῆς πλακὸς ταύτης διασχίζει τὸ Βόρειον Αἰγαίον, διέρχεται βορείως τῆς Εύβοίας καὶ τῆς Πελοποννήσου, διὰ νὰ συνεχισθῇ μέχρι τῆς Κεφαλληνίας. Ἐπακριβέστερον, τὰ ὅρια τῆς μικροπλακὸς τοῦ Αἰγαίου δεικνύονται εἰς τὸν χάρτην τῆς Εἰκ. 3. Εἰς τὸν αὐτὸν χάρτην δεικνύονται ἐπίσης τὰ ὅρια τοῦ δυτικοῦ τμήματος τῆς Τουρκικῆς μικροπλακός. Οἱ Finetti καὶ Morelli [9] δέχονται, ἐπὶ τῇ βάσει σεισμικῶν δεδομένων, ὅτι ἡ ράχις τῆς ἀνατολικῆς Μεσογείου εἶναι βυθισμένον μεσοζωικὸν τέμαχος, τὸ δρόποιον καλύπτεται ἀπὸ νεώτερα ίζηματα καὶ συσχετίζονται τοῦτο μὲ τὴν περιοχὴν τῆς Ἀπούλιας.

Η Τουρκικὴ μικροπλάκα μετατίθεται πρὸς τὰ δυτικὰ κατὰ μῆκος τοῦ βορείου δριον τῆς καὶ ὥθετι πρὸς τὰ ΝΔ/καὶ τὴν Αἰγαίαν μικροπλάκαν, ἡ δροία ἀπωθεῖται ἐπὶ τῆς Ἀφρικανικῆς Πλακός. Τοῦτο ἀπεδείχθη ἀπὸ τὰς ἐρεύνας τῶν McKenzie [12], Παπαζάχου, Κομνηνάκη [18], οἱ δροῖοι παρετήρησαν ὅτι ἡ κατανομὴ τῶν σεισμῶν ἀκολουθεῖ τὸ ἐπίπεδον τοῦ Benniof, ἡ ἔκφρασις τῆς ἐπιφανείας τοῦ δροίου εἶναι ἡ Ἑλληνικὴ τάφρος. Ή δὲ παρουσία τῆς τάφρου ταύτης ἔξηγει τὸ ὀκεανικὸν βάθος τῆς ἀνατολικῆς Μεσογείου [16] νοτίως τῆς Κρήτης. Εἰς ὅ,τι ἀφορᾷ εἰς τὴν τάφρον τοῦ βορείου Αἰγαίου νεώτεραι ἐρευναὶ τῶν Needhan et al. [16] ἐνισχύουν τὰς ἀπόψεις τοῦ McKenzie, ὅτι αὕτη ἐσχηματίσθη εἰς τὸ δριόν ἀποκλίσεως τῆς Αἰγαιακῆς μικροπλακὸς καὶ τῆς Εὐρωπαϊκῆς πλακὸς (Εἰκ. 2).

ΔΕΔΟΜΕΝΑ ΕΚ ΤΗΣ ΗΦΑΙΣΤΕΙΟΤΗΤΟΣ ΚΑΙ ΤΗΣ ΤΕΚΤΟΝΙΚΗΣ

Η ἡφαιστειακὴ δραστηριότης εἰς τὸν εὐρύτερον χῶρον τοῦ Αἰγαίου ἀρχεται ἀπὸ τοῦ Ὀλιγοκαίνου - Μειοκαίνου καὶ συνεχίζεται ἔως τὸ Τεταρτογενές, ὅπως ἀναφέρεται ὑπὸ πλείστων ἐρευνητῶν. Αὕτη ἐντοπίζεται κυρίως εἰς τὰς πα-

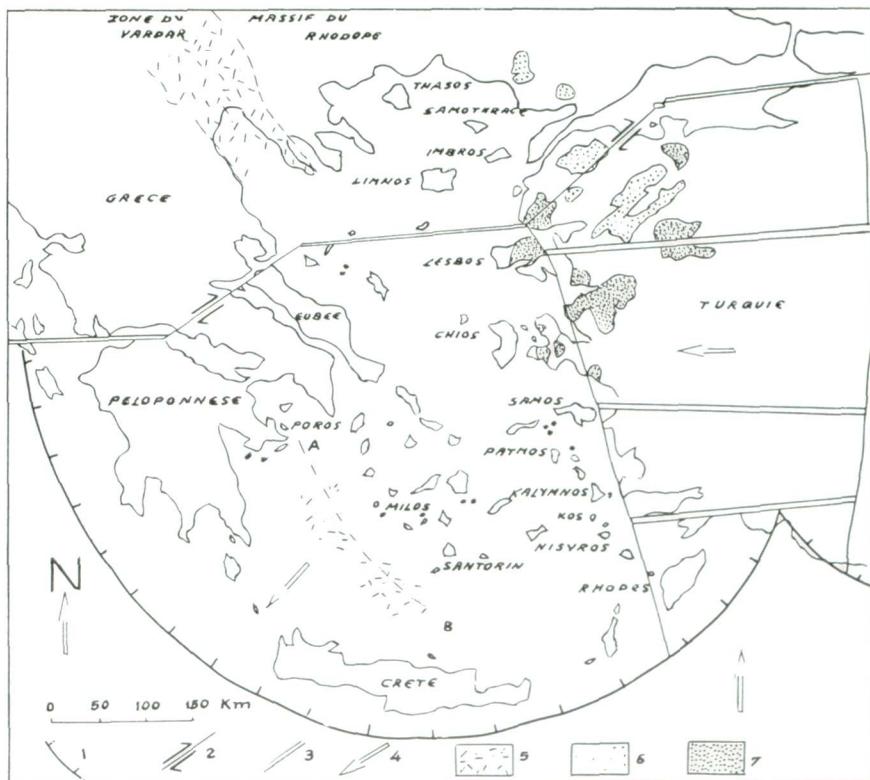


Fig. 2. Map showing the position of the Aegean minor plate
 1. Hellenique trench (Subdaction zone) 2. Transforming fault 3. Extension zone 4. Direction of the plates in relation with Europe 5. Oceanics paleozones. 6. Oligo-miocene volcanisme 7. Plioquaternary volcanisme.
 (Vilminot and Robert)

Eix. 2. Χάρτης δεικνύων την θέσιν τής μικρού - πλακός του Αιγαίου.

1. Ελληνική ταφρος (ζωνη βυθίσεως). 2. Ρήγμα μετασχηματισμού 3. Ζωνη έφελκυσμού 4. Διεύθυνσις τῶν πλακῶν ἐν σχέσει προς τὴν Εύρωπην 5. Παλαιοζώναι ὥκεανικαι. 6. Ὀλιγομετοκαινική ηφαιστειότης 7. Πλειοτεταρτογενῆς ηφαιστειότης.

ρυφάς τῆς Ἀττικοκυκλαδικῆς μάζης καὶ παρουσιάζει σημαντικήν ἀνάπτυξιν πρὸς τὴν νοτιοανατολικὴν καὶ νοτίαν αὐτῆς πλευράν, ὅπου συνιστᾶ τὸ καλούμενον Ἐλληνικὸν Ἡφαιστειακὸν Τόξον (Εἰκ. 1 καὶ 2).

Τὸ ἐν λόγῳ τόξον περιλαμβάνει τοὺς ἥφαιστειας τῆς Κρωμιωνίας (Εἰκ. 2) τῶν Μεθάνων, τοῦ Πόρου, τῆς Αἰγίνης, τῆς Μήλου, τῆς Σαντορίνης, τῆς Νισύρου καὶ τῆς ἀπέναντι χερσονήσου τῆς Ἀλικαρνασοῦ Οἱ Κομητηνάκης καὶ Παπαζάχος [18] δέχονται, ὅτι τὸ Ἐλληνικὸν Ἡφαιστειακὸν Τόξον εὑρίσκεται ὑπεράνω σεισμικῶν ἔστιῶν μέσου βάθους 150 km. Οἱ Vilminot καὶ Robert [21] δέχονται, ὅτι ἔχει ἡλικίαν πλειοτεταρτογενῆ καὶ θέσιν παράλληλον πρὸς τὴν Ἐλληνικὴν τάφρον, ἀπὸ τῆς δοπίας εὑρίσκεται εἰς ἀπόστασιν περίπου 200 km.

Ἐξ ἥφαιστείου τεταρτογενοῦς ἡλικίας τῆς νήσου Μήλου, οἱ Vilminot καὶ Robert [21] ἀναφέρουν τὴν ἀποβολὴν τεμαχίων πλουτωνίων πετρωμάτων συνδευομένων ἀπὸ γλαυκοφανῆ καὶ λαουζονίτη. Τὰ ὑλικὰ ταῦτα μαρτυροῦν προέλευσιν μεγάλου βάθους, ἀπὸ παλαιὰν ζώνην βυθίσεως (subduction) καὶ ἀκριβέστερον ἀπὸ περιοχὴν ἔχουσαν σχέσιν μὲ τάφρον.

Κατὰ ταῦτα, ἡ ἥφαιστειότης τοῦ Πλειοτεταρτογενοῦς, ἡ δοπία ἀναπτύσσεται εἰς τὰς παρυφάς τῆς Ἀττικοκυκλαδικῆς μάζης, σχηματίζει παράλληλον τόξον ὃς πρὸς τὴν Ἐλληνικὴν τάφρον εἰς ἀπόστασιν ἀπὸ αὐτὴν 200 χιλιομ. πρὸς τὸ ἐσωτερικὸν τῆς Αἰγαίας πλακός. Πρόκειται διὰ τὴν πλέον πρόσφατον ἥφαιστειότητα καὶ εἶναι ἡ μόνη, ἡ δοπία δύναται ἀπὸ τὴν ἡλικίαν τῆς καὶ ἀπὸ τὴν θέσιν τῆς να εἶναι συνδεδεμένη μὲ σύγχρονον ζώνην βυθίσεως. Εἶναι ἥφαιστειότης ἐνεργοῦ ἡπειρωτικοῦ περιθωρίου, συγκρίσιμος μὲ αὐτὴν τῆς παρυφῆς τοῦ Εἰρηνικοῦ. Οἱ ἥφαιστεῖται ἔχουν τυπικὸν ἀσβεστοαλκαλικὸν χαρακτῆρα μὲ ὑπερέχοντας τους ἀνδεσίτας καὶ τους δακίτας, καθὼς καὶ τοὺς ρυολίθους, οἱ δοποὶ ἀφθονοῦν εἰς τὴν Μήλον. Τοὺς ἥφαιστεῖτας τοῦ Αἰγαίου ἡ Δάβη [7] κατατάσσει, βάσει τοῦ γημισμοῦ των, εἰς τὸν εἰρηνικὸν ἔως ἀσθενῆ μεσογειακὸν τύπον.

Πλὴν τῆς πλειοτεταρτογενοῦς ἥφαιστειότητος, εἰς τὸν χῶρον τοῦ Αἰγαίου ἐσημειωθῇ ἐπίσης ἔντονος ἥφαιστειακὴ δρᾶσις κατὰ τὴν Ὁλιγο-μειοκαινικὴν περιοδον. Εἰς τὴν δρᾶσιν ταύτην ἀνήκουν οἱ ἥφαιστεῖται τῶν νήσων Σαμοθράκης, Ἰμβρου, Λήμνου, Ἀγίου Εὐστρατίου, οἱ ἥφαιστεῖται τῶν διαφόρων περιοχῶν τῆς Ἀνατολίας (Ezine, Bergana, Kabouzam, Izmir) καθὼς καὶ νοτιώτερον οἱ ἥφαιστεῖται τῆς Σάμου, Πάτμου, Καλύμνου, Κῶ καὶ τῆς Χερσονήσου Bodrum (Εἰκ. 2)

Ἡ ὡς ἄνω Ὁλιγο-μειοκαινικὴ ἥφαιστειακὴ δρᾶστηριότης ἔχει διεύθυνσιν περίπου B-N καὶ ὄφείλεται, πιθανότατα, εἰς παλαιὰς ἥπαλαις ζώνας βυθίσεως, δηλαδὴ εἰς παλαιὰν μικροπλάκαν καὶ οὐχὶ εἰς σύγχρονον βύθισμα ἐπιπέδου

Benioff. Κατὰ τοὺς Dewey et al. [8] ἀπὸ τὸ Ἡώκαινον ἕως τὸ Μειόκαινον (Βουρδιγάλιον) ἡ Τουρκία καὶ ἡ Ἑλλὰς ἐξειλίχθησαν μαζὶ ἀνήκουσαι εἰς τὴν ἴδιαν παλαιο-πλάκαν. Ἡ προαναφερθεῖσα ἡφαιστειότης εἶναι σύγχρονος τοῦ τέλους τῶν μεγάλων ἡπειρωτικῶν κινήσεων, αἱ ὅποιαι ἔλαβον χώραν κατὰ τὸ Μειόκαινον καί, αἱ ὅποιαι ἀπετέλεσαν πρόδομον τῆς «πλειοκαινικῆς ἐπαναστάσεως»

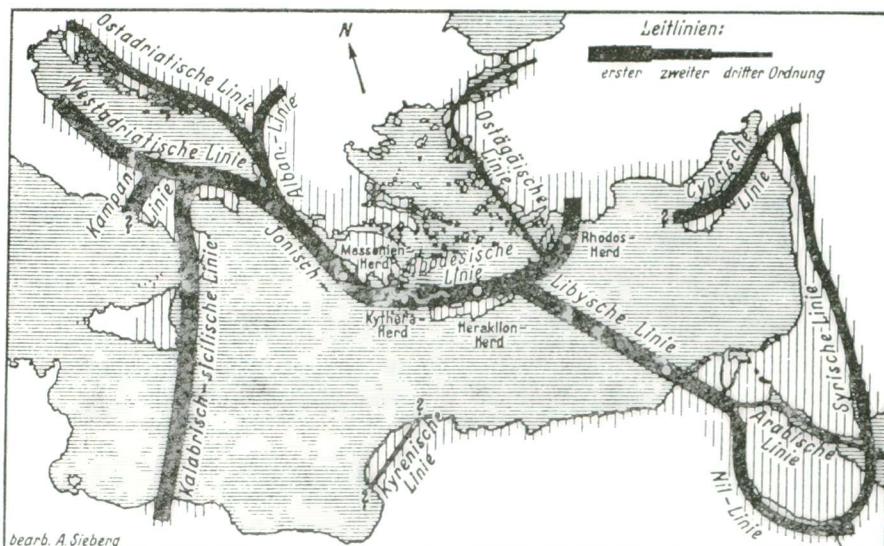


Fig. 3 Seismic energy conductive lines (Sieberg makroseismische Leitlinien, 1932) showing the boundaries of the large tectonic units in the eastern Mediterannean
(From A Galanopoulos work 1977)

Εἰκ. 3. Γραμμαὶ σεισματικῆς ἐνεργείας δεικνύουσαι τὰ ὄρια τῶν μεγάλων τεκτονικῶν τεμαχῶν τῆς ἀνατολικῆς Μεσογείου

κατὰ τὴν διάρκειαν τῆς ὅποιας διεμορφώθησαν αἱ προαναφερθεῖσαι νεομικρο-πλάκαι τοῦ Αἴγαίου καὶ τῆς Τουρκίας.

Συμφώνως πρὸς τὸν Aubouin [2] ἡ νεο-μικροπλάκα τοῦ Αἴγαίου τέμνει καθέτως ὅλας τὰς προαλπικὰς καὶ ἀλπικὰς τεκτονικὰς ἐνότητας τοῦ Δειναροταυρικοῦ Τόξου καθὼς καὶ ἐκείνας τοῦ Μειοκαίνου

Εἰς πρόσφατον ἐργασίαν του δ Γαλανόπουλος [10] ὑποστηρίζει ὅτι βαθέα οήγματα χωρίζουν τὴν Μικρὰν Ἀσίαν ἀπὸ τὸν Αἴγαιακὸν χῶρον. Τοῦτο, ἐπιβεβαιοῦται, ὅπως ὁ ἴδιος παρατηρεῖ καὶ ἐκ τῶν γραμμῶν σεισμικῆς ἐνεργείας, τὰς ὅποιας ὁ Sieberg ἐχάραξε (Εἰκ. 3) βάσει τῆς μελέτης διαφόρων μεγάλων σεισμῶν εἰς τὴν

περιοχὴν τῆς ἀνατολικῆς Μεσογείου. Εἶναι ἀξιοσημείωτον τὸ ὅτι, κατὰ μῆκος τῆς δυτικῆς ἀκτῆς τῆς Μικρᾶς Ἀσίας διήκει γραμμὴ σεισμικῆς ἐνεργείας συμπίπτοντα μὲ τὸ δυτικὸν ὄριον τῆς μεταβατικῆς ζώνης μεταξὺ τῆς Τουρκικῆς καὶ τῆς Αἰγαίακῆς μικροπλακὸς τοῦ McKenzie [12].

Κατὰ ταῦτα, ἡ ὑπαρξίας μεγάλου ρήγματος κατὰ μῆκος τῆς δυτικῆς ἀκτῆς τῆς Μικρᾶς Ἀσίας ἀποδεικνύεται μὲ τεκτονικὰ καὶ σεισμικὰ δεδομένα [10]. Τὴν ὑπαρξίαν ταύτην ἐπιβεβαιοῦν ἐπίσης, κατὰ τὸν Μακρὸν [15] καὶ βαρυτομετρικὰ δεδομένα.

ΣΥΜΠΕΡΑΣΜΑΤΑ

Ἐξ ὅσων ἀνωτέρω ἐκτίθενται προκύπτει, ὅτι ἡ ἀπόψις τοῦ Bignöl, κατὰ τὰς δόπιας αἱ Ἑλληνικαὶ νῆσοι τοῦ Αἰγαίου πελάγους ἀνήκουν μετὰ τῆς δυτικῆς Μικρᾶς Ἀσίας εἰς τὴν αὐτὴν λιθοσφαιρικὴν πλάκαν καὶ ἔξειλίχθησαν ἀνεξαρτήτως τῆς ἡπειρωτικῆς Ἑλλάδος δὲν εὐσταθεῖ. Αἱ ἀπόψεις αὗται ἔρχονται εἰς ἀντίθεσιν μὲ τὰ πορίσματα 300 καὶ πλέον ἐπιστημονικῶν ἐργασιῶν, αἱ δόποια ἀναφέρονται εἰς γεωλογικάς, γεωφυσικάς καὶ σεισμολογικάς ἔρευνας τοῦ τομέως Δειναρίδες - Ἑλληνίδες, Τόξον τοῦ Αἰγαίου, Ταυρίδες. Ἡ ὑπαρξίας τῆς μικροπλακὸς τοῦ Αἰγαίου, ἔξελισσομένης ἀνεξαρτήτως τῆς Τουρκικῆς μικροπλακὸς ἀπὸ τοῦ Πλειοκαίνου καὶ ἐντεῦθεν, ἔχει πλήρως ἀποδειχθῆ καὶ εἶναι ἀποδεκτὴ ὑπὸ ὅλων γενικῶν τῶν ἐρευνητῶν, οἵ δόποιοι ἀσχολοῦνται μὲ τὴν μελέτην τῶν περιοχῶν τῆς ἀνατολικῆς Μεσογείου.

Ἡ μικροπλάκα τοῦ Αἰγαίου περιλαμβάνει τὸ μεγαλύτερον μέρος τῆς Ἑλληνικῆς χερσονήσου, τὴν Κρήτην, τὴν Ρόδον καὶ ἐκτείνεται ἀπὸ τοῦ Ἰονίου Πελάγους μεχρι τῶν παρυφῶν τῆς δυτικῆς Ἀνατολίας. Ὁλος αὐτὸς ὁ χῶρος ἀποτελεῖ σήμερον γεωτεκτονικὴν ἐνότητα ἀνεξάρτητον τῆς Μικρασιατικῆς χερσονήσου. Διὰ τῶν δυτικῶν παρυφῶν τῆς χερσονήσου ταύτης διέρχεται μὲ διεύθυνσιν Βορρᾶς - Νότος, μία ἐνεργὸς εἰσέτι ζώνη διαρρήξεως, ἡ δόποια διαχωρίζει τὴν μικροπλάκαν τοῦ Αἰγαίου ἀπὸ τὴν Τουρκικὴν μικροπλάκαν

THE GEOTECTONIC ENTITY OF THE GREEK PENINSULA

It is generally accepted that the area of the Aegean Sea is, from a geological point of view, the most complex part of the Mediterranean basin.

In this heavily fragmented area extensive neogene formations are lying over the alpine and prealpine basement.

Among the earlier researchers Trikkalinos [23, 24] attributes this fragmentation to the Posadnic phase. During this phase, the preexisting cycladic mass was separated into several small blocks which appear today over the surface of the sea as isolated islands.

More recent studies by a great number of foreign and Greek researchers have brought to light the geotectonic entity of the Greek peninsula and of the entire Aegean region, up to the western limits of Asia Minor. However, lately the (Turkish) geologist E. Bignol [5] advanced a theory whereby western Asia Minor and the eastern Aegean islands belong to a single continuous block, of which the islands constitute local morphological elevations.

The object of this paper is to examine the above mentioned theory on the basis of geological and geophysical data, which have been collected from the results of the work which has been carried out so far by various investigators of this part of the Mediterranean region.

GENERAL GEOLOGICAL OBSERVATIONS

In accordance with stratigraphic, neotectonic, geophysical and oceanographic data, the transition period from the Miocene to the Pliocene is the period during which the formation of the Mediterranean began and constitutes, according to Bourcart [6], the commencement of the «Pliocene Revolution». During this period, the fragmentation of the pre-neogene units changed the existing geographical picture, as demonstrated by the grabens with molassic formations and the horsts which formed the islands of the Pliocene sea. Many of these horsts occupy, even today, their original position.

The pre-neogene formations of the Aegean sea constitute, geologically, the continuity of the two neighbouring continental areas of Greece
ΠΑΑ 1978

and Turkey. They extend northwards to the Alps and eastwards to the Zagrides.

In more detail, the above formations are the extension of the Dinarides, which are joined to the Taurides of Asia Minor through the Hellenides, thus forming the Dinaro-Tauric Arc. As it is known, the Taurides of Asia Minor belong to the last section of the Hellenides.

The tectonic activity of the Miocene and the Plio-Quaternary affected the pre-neogene formations of the Dinaro-Tauric arc and gave to the Aegean area its present form.

If we examine the Dinaro-Tauric Arc, with respect to its position, we will observe that it moves from the Alps towards south-east, it is then deflected eastwards over the Greek geographical space and finally it enters Asia Minor, in other words, we can ascertain a unique orientation of the pre-neogene tectonic units.

From the Miocene onwards the basins formed, which are found along the Dinaro-Tauric Arc, are due to tensional and compressional forces. The orientation of these basins does not follow the general direction of the pre-neogene formations.

In Fig. 1 the most prominent geomorphological characteristics of the Aegean Sea and adjoining region are outlined.

A deep trench can be noted to the south and south-west of Crete, known as the Hellenic Trench, which farther south is surrounded by a rise, the East Mediterranean Ridge. An additional trench can be noted, in the north Aegean, showing a north-east direction. This is the north Aegean Trench which is due to tensional forces. Between the two trenches, lies the Hellenic Volcanic Arc, running in a direction parallel to the Hellenic Trench and at a distance of about 200 km from it.

SEISMO TECTONIC DATA

McKenzie, one of the most prominent researchers on the geology of the Eastern Mediterranean, attributes the distribution of earthquakes in this region to the movement of two minor lithospheric plates, located between Africa and Europe, in other words, between the African lithospheric plate and the Euro-Asian one [12, 13, 14]. The position of

those two plates, which McKenzie calls the Turkish and the Aegean, is shown in Fig. 2.

The Aegean minor plate terminates at the Western boundaries of Asia Minor and includes the Aegean Sea, Crete and the greater part of the Hellenic Peninsula (Fig. 2). The Northern limit of this plate runs through the North Aegean, it then passes North of Euboea and the Peloponnesus and continues up to Cefallinia, where it meets its Western limit. The limits of the Aegean minor plate are shown, in detail, in Fig. 2. On the same map, the limits of the Western and of the Turkish minor plate can, also, be seen. Finetti and Morelli [9] accept, on the basis of seismic data, that the East Mediterranean Ridge is a down thrown Mesozoic block, covered by younger sediments and they connect this to the Apoulian Region.

The Turkish minor plate is moving Westwards, along its Northern limit, and pushes the Aegean plate in a South-west direction, thus forcing the latter on to the African plate. This was proved by the research of McKenzie [12], Papazachos and Comninakis [18], who deduced that the distribution of earthquakes follows the Benioff zone, the surface expression of which is the Hellenic Trench. In addition, the presence of this trench can explain the oceanic depth of the Eastern Mediterranean, South of Crete.

With respect to the North Aegean Trench, recent research by Needham et al. [16] supports McKenzie's views, that it was formed in the divergence boundary, between the Aegean minor plate and the European plate (Fig. 1).

VOLCANIC AND TECTONIC DATA

The volcanic activity in the greater Aegean area began during the Oligocene-Miocene and continued up to the Quarternary, as it is stated by many researchers. This activity is basically concentrated on the borders of the Attico-Cycladic mass and shows considerable development towards its southern and south-eastern boundaries, where it forms the so called Hellenic Volcanic Arc (Fig. 1 and 2).

This arc embraces the volcanic formations of Chromionia, Methana, Poros, Egina, Milos, Santorini, Nisyros and on the opposite side the

Alicarnassos formations. Comninakis and Papazachos [18] accept that the Hellenic Volcanic Arc is lying over an earthquake foci of an average depth of 150 km. Vilminot and Robert [21] accept that its age is Plio-Quaternary and that it is lying in a direction parallel to the Hellenic Trench and at a distance of about 200 km from it.

Vilminot and Robert [21] report the rejection of blocks of plutonic rock, accompanied by glaucophane and lowzonite from a volcano of quaternary age on the island of Milos. Such materials indicate an origin of great depth, from an old subduction zone and more precisely, from a region related to a trench.

As a result, the volcanism of the Plio-Quaternary developed on the boundaries of the Attico-Cycladic mass, forms an arc parallel to the Hellenic Trench at a distance of 200 km from it, towards the inner side of the Aegean plate. It is the most recent volcanism, as well as the only one capable, due to its age and location, to be connected to a recent subduction zone. This is a volcanism of an active continental margin, comparable to the one of the Pacific margin. The volcanic rocks have a typical calco-alcaline character, with a prominent presence of andesites, dacites and rhyolites, the latter being abundant in Milos. Davi [7] classifies the Aegean volcanics, according to their chemistry, into the pacific type and up to the weak mediterranean type.

Besides the Plio-Quaternary volcanism, an intense volcanic activity took place in the Aegean Region, during the Oligo-Miocene period. The results of this activity are the volcanics of the islands of Samothraki, Imvros, Limnos, Agios Efstrathios, Lesbos, Chios, that of several localities of eastern Anatolia (Ezine, Bergama, Kabouzam, Izmir) and to the south, the volcanics of Samos, Patmos, Kalymnos, Kos and of the Bodrum Peninsula.

This Oligo-Miocene volcanic activity has an approximate North to South direction and is caused probably by an old subduction zone, in other words, by an old minor plate and not by an active subduction of a Benioff zone. According to Dewey et al. [8], from the Eocene to the Miocene (Bourdigalian) Turkey and Greece developed together, belonging to the same paleo-plate. The above stated volcanism, is contemporaneous with the end of the tectonic activity, in other words with the great continental movements, which occurred during the Miocene and

were the presage of the «Pliocene Revolution». During this time, the Aegean and the Turkish minor neo-plates were formed.

According to Aubouin [2], the Aegean minor neo-plate intersects at right angles all the pre-alpine and alpine tectonic units of the Dinaro-tauric Arc as well those of the Miocene.

In a recent article, Galanopoulos [10] argues that deep faults separate Asia Minor from the Aegean area. This is verified, he notes, by the lines of seismic energy, which have been traced by Sieberg (Fig. 3), based on a study of various major earthquakes in the area of the eastern Mediterranean. It is noteworthy that a line of seismic energy, which coincides with the western limit of the transitional zone between the Turkish and the Aegean minor plates of McKenzie [12], runs along the western coast of Asia Minor.

Consequently the existence of a major fault along the western coast of Asia Minor is proved by tectonic and seismic data [10]. The existence of this fault is further proved according to Makris [15], by gravimetric data.

C O N C L U S I O N S

From the above documentation it follows that the theory advanced by E. Bignol, whereby the Greek islands of the Aegean sea belong, together with western Asia Minor, to the same lithospheric plate and that they have developed independently of continental Greece, is unfounded.

This theory is in complete disagreement with the results of more than 300 scientific studies, which refer to the geological, geophysical and seismological investigation of the Dinarides - Hellenides - Aegean Arc - Taurides sector.

The existence of the Aegean minor plate, independently developed from the Turkish one from the Pliocene onwards, has been fully proven and is accepted by all researchers, who have studied the East Mediterranean region.

The Aegean minor plate includes the greatest part of the Greek peninsula, Crete and Rhodes and extends from the Ionian Sea to the borders of western Anatolia. This whole region constitutes to day a

geotectonic entity, which is independent of the Asia Minor peninsula. Along the western limits of this peninsula runs a still active fracture zone, bearing North-South, which separates the Aegean minor plate from the Turkish minor plate.

ΒΙΒΛΙΟΓΡΑΦΙΑ

1. J. Angelier, La néotectonique cassante et sa place dans un arc insulaire : l'arc égéen méridional. Bull. Soc. Géol. Fr., S. 7, t. XVIII, n° 5, p. 1257 - 1265, 1976.
2. J. Aubouin, Paléotectonique, Tectonique, Tarditectonique et Néotectonique en Méditerranée moyenne : A la recherche d'un guide pour la comparaison des données de la géophysique et de la géologie. C. R. Acad. Sc. Paris, t. 276, S. D - 457, 1973.
3. J. Aubouin - X. Le Pichon - E. Winterer and M. Bonneau, The Hellenides as a model for Alpine plate tectonics, VI Colloquium on the Geologie of the Aegean region Athens, p. 163 - 169, 1977.
4. B. Biju-Duval - J. Dercourt et X. Le Pichon, From the Thethys ocean to the Mediterranean Sea : a plate tectonic model of the evolution of the western alpine system. International symposium on the structural history of the Mediterranean Basins. Split Yugoslavia 25 - 29 October 1976, p. 143 - 154, 1976.
5. E. Bignöll, Evolution géotectonique de l'Anatolie de l'Ouest. Bull. Soc. Géol. Fr., (7), t. XVIII, n° 2, p. 431 - 450, 1976.
6. J. Bourcart, Livre Mêm. Poul. Fallot 1, p. 103 - 116, 1960.
7. E. Davis, Die jungvulkanischen Gesteine von Aegina, Methana und Poros deren stellung im Rahmen der Kykladenprovinz. Publ. Stif. Vulk. I. Freid , 6, Zürich, 1957.
8. J. F. Dewey - W. G. Pitman - W. B. F. Ryan and J. Bonnin, Plates tectonics and the Evolution of the Alpine System. Geol. Soc. Amer , t. 84, p. 3137 - 3180, 1973.
9. I. Finetti - C. Morelli, Wide scale digital seismic exploration of the Mediterranean sea. Bull. Soc. Geol of Greece, t. 10, p. 65 - 66, 1973.
10. A. Galanopoulos, The Greek Sovereignty over the Aegean Shelf resources. Ann. Géol. Pays Héll , t. 28, p. 1 - 7, 1977.
11. ——, A New Model Accounting for the intermediate earthqaskes at the convex side of the Hellenic arc. Ann. Géol. Pays Héll , 27, p. 355 - 370, 1975.
12. D P McKenzie, Plates Tectonics of the Mediterranean Region. Nature, Vol. 226, p. 239 - 243, 1970
13. ——, Active Tectonics of the Mediterranean Region. Geophys. J. R. Astr. Soc , t. 30, p. 109 - 185, 1972.

14. ——, Active tectonics of the Egean region VI Colloquium on the Geology of the Aegean region (sous presse).
 15. J. Makris, Somme Geophysical Aspects of the Evolution of the Hellenides, Bull. Géol. Soc. of Greece, t. 10, p. 206-213, 1973.
 16. H. D. Needham - X. Le Pichon - M. Melguen - G. Pautot - Y. Renard - P. Avedik et D. Carre, North Aegean Sea through: 1972 Jean charcot C₁ cruise se. Bull. Soc. Geol. of Greece, t. 10, p. 152-153, 1973.
 17. U. Robert and J. M. Cantagrel, The Basaltic Volcanism in the South-Eastern Aegean sea. Geochronological data and relation with geological structures. VI Colloquium on the geology of the Aegean region, p. 45, 1977.
 18. B. Papazachos - R. E. Comninakis, Geophysical and Tectonic Fractures of the Aegean Arc. your Geoph. Res., t. 76, p. 8517-8533 1971.
 19. D. G. Stanley and C. Perissoratis, Aegean sea ridge barrier-and-bassin sedimentation Patterns. Marin Geologie, t. 24, p. 97-107. Elsevier Scintific Publishing Company, Amsterdam, 1977.
 20. X. Τσουρέλη - Ε. Χιώτη. Γεωλογική δομή τῆς ἀνατολικῆς Μεσογείου ὑπὸ τῷ φῶς τῶν νεωτέρων ἐρευνῶν καὶ ἀπόψεων. Ἐπετηρίς Πολυτεχνείου, σ. 167-181, 1973.
 21. J. C. Vilminot et U. Robert, A propos des relation entre le volcanisme et la tectonique en Mer Egée. C R Acad. Sc. Paris, t. 278, S D, p. 2099-278 1974
 22. J. C. Vilminot, Présence de roches métamorphiques à glaucophane et lawsonite sur l'île de Milos (arc egeen interne). C. R. Somm. Soc. Géol. Fr., fac. 2, p. 101-103, 1977
 23. J. Trikkalinos, Die auswirkungen junger, sehr starker Diluvialer und rezenter orogener bewegungen im gebiete Grechenlands. Geotect. Symp. Ehr H Stille, p. 64-76, 1956
 24. ——, Beiträge zur erforschung des tectonischen Baues Griechenlands über die ob. Kreidettangres sion auf den Kristallinen schichten Der Insel Paros. Ann. Géol. des Pays Hell. p. 1 6, 1947
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