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A re-assessment of the shallow paleomagnetic inclinations of the Western Cyclades, Greece

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A RE-ASSESSEMENT OF THE SHALLOW PALEOMAGNETIC INCLINATIONS OF THE WESTERN CYCLADES, GREECE

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Abstract
Consistently shallow paleomagnetic inclinations measured in Early to Middle Miocene lacustrine and dacitic volcanic rocks of the Kymi-Aliveri basin have been cited as evidence for an anomalous geomagnetic field geometry or northward drift of the Aegean Sea region. We present new paleomagnetic data from the lacustrine beds that are instead not anomalously shallow and consistent with deposition near their present-day latitude as predicted by global apparent polar wander paths. Anomalously shallow inclinations and easterly declinations reported from the Oxylithos volcanics are an artifact of an inappropriate tilt correction. The excessively shallow paleomagnetic inclinations reported from the deformed Middle Miocene plutons on Mykonos and Naxos are consistent with reorientation of an original thermoremanent magnetization acquired during cooling below 580°C by subsequent ductile strain at temperatures of 400-500°C. Magnetization overprints observed in these rocks may reflect the acquisition of a stable chemical remanent magnetization lying parallel to the transposed high-temperature magnetization as the result of low-temperature (<350°C) maghemitization. We therefore find no convincing evidence for an anomalous Middle Miocene field geometry, northward drift of the Aegean, or back-tilting of the low-angle normal faults that constitute the North Cycladic Detachment System.

Key words: Tectonics, paleomagnetism, detachment, paleolatitude, Kymi-Aliveri basin.

Περίληψη
Στις Μεσο-Μειοκαινικές λιμναίες αποθέσεις και τα δακιτικά ηφαιστειακά πετρώματα της λεκάνης Κύμης-Αλιβερίου έχουν παρατηρηθεί σταθερά μικρές εγκλίσεις σε παλαιομαγνητικές μετρήσεις οι οποίες έχουν αναφερθεί ως αποδεικτικά στοιχεία για την τοπική γεωμαγνητική ανωμαλία ή για μετατόπιση προς βορρά της περιοχής του Αιγαίου. Παρουσιάζονται νέα δεδομένα παλαιομαγνητισμού σε λιμναία στρώματα και δακιτικά ηφαιστειακά πετρώματα τα οποία συμβατά με το σημερινό γεωγραφικό πλάτος των λιμνών στρώματα έχουν αναφερθεί ως αποδεικτικά στοιχεία για την τοπική γεωμαγνητική ανωμαλία. Στην περίπτωση οι μικρές εγκλίσεις και αποκλίσεις προς τα ανατολικά που έχουν αναφερθεί στις παλαιομαγνητικές μετρήσεις δεν συμβατά με την ανωμαλία που έχει αναφερθεί στην περιοχή του Αιγαίου και ένας πιθανός παράγοντας για την ουσία της συμπλήρωσης της περιοχής είναι η παρουσία κυνήγοντων συστήματος με δεδομένα παλαιομαγνητισμού σε λιμναία στρώματα και δακιτικά ηφαιστειακά πετρώματα που συμβατά με την τοπική γεωμαγνητική ανωμαλία. Η περίπτωση αυτή έχει σημαντική σημασία για την κατανόηση της τοπικής γεωμαγνητικής ανωμαλίας της περιοχής και την κατανόηση των γεωτεχνικών διαδικασιών που έχουν προκύψει στην περιοχή αυτή.
Οξύλιθος είναι αποτελέσματα ακατάλληλης διόρθωσης ως προς οριζόντιο άξονα. Οι υπερβολικά μικρές παλαιομαγνητικές εγκλίσεις που έχουν αναφερθεί στα πλούτωνα σώματα της Μυκόνου και τη Νάξου, Μέσο-Μειοκαινικής ηλικίας παραμόρφωσης, είναι συμβατές με επαναπροσανατολισμό μιας αρχικής θερμο-παραμόρφωσης μαγνήτης που προέκυψε κατά την ψύξη τους κάτω από 580°C την οποία ακολούθησε εξωδολιαστική παραμόρφωση σε θερμοκρασίες 400-500°C. Δευτερεύουσες μαγνήτες που παρατηρήθηκαν στα πετρώματα αυτά αντικατοπτρίζουν, πιθανότατα, τη διαδικασία μίας σταθερής χημικής προέλευσης-παραμόρφωσης μαγνήτης, παράλληλα με την προϊστορική μαγνήτης υφήλια μαγνητικής επαναπροσανατολισμός ως αποτέλεσμα της δημιουργίας μαγκεμίτη σε χαμηλή θερμοκρασία (<350°C). Κατά συνέπεια δεν μπορούμε να βρούμε ικανοποιητικές αποδείξεις είτε για τοπική μαγνητική ανωμαλία ή μετακίνηση του Αιγαίου προς βορρά είτε για περιστροφή των μικρών κλίσεων κανονικών ρηγμάτων που συνθέτουν το σύστημα αποκόλλησης των Βορείων Κυκλάδων.

Αδειες κλειδί: Τεκτονική, παλαιομαγνητικός, ρήμα αποκόλλησης, παλαιογεωγραφικό πλάτος, λεκάνης Κύμης-Αλιβερίου.

![Generalized geological maps of the western Cycladic archipelago and the Kymi-Aliveri basin. Box in left panel shows location of the Kymi-Aliveri basin, shown in detail in the right panel. Location of map in Fig. 2C is given by box in right panel. Star: site for which we have calculated an expected Miocene field geometry.](http://epublishing.ekt.gr)
polar wander (APW) paths of Torsvik et al., 2008]. This is essentially indistinguishable from their present latitude, and implies that they have been mostly stationary since this time. However, paleomagnetic inclinations reported from rocks of Miocene and younger age in the Aegean region range from 25 to 50°, thus exhibiting a systematic inclination shallowing (Beck and Schermer, 1994). This has led to suggestion that the local time-averaged geomagnetic field was different from the GAD model (Morris and Anderson, 1996; Avigad et al., 1998), that the Aegean region was actually ~500 km south of its present position in Miocene time (Beck and Schermer, 1994; Beck et al., 2001; Aidona et al., 2008; Kondopoulou et al., 2011), or that the paleomagnetic data exhibit systematic shallow biases (Krijgsman and Tauxe, 2004; Tauxe et al., 2008).

With respect to the latter, small amounts of inclination shallowing can be attributed to a variety of factors. Shallow inclinations in sedimentary rocks can result from processes of grain settling and subsequent compaction flattening, as in the case of the Miocene marine rocks of Crete (Krijgsman and Tauxe, 2004; Tauxe et al., 2008). Small datasets (N < 20 site mean directions) are statistically biased toward shallow inclinations by up to ~5° (Krijgsman and Tauxe, 2004), as are rapidly-cooled igneous rocks that temporally under sample paleosecular variation. The use of unit vectors instead of total vectors (which require paleointensity data) for calculation of mean directions can result in artificial shallowing of several degrees as a purely mathematical effect (Creer, 1983).

However, these mechanisms are insufficient to account for the large amount of inclination shallowing observed at several critical localities. In particular, shallow inclinations reported from Early to Middle Miocene lacustrine and volcanic rocks of the Kymi-Aliveri basin on the island of Evia and Middle Miocene plutons and dykes on the nearby islands of Tinos, Mykonos, and Naxos (Figure 1) have been considered as strong evidence for a systematic Aegean shallow inclination bias (Morris and Anderson, 1996; Avigad et al., 1998). These rocks were deposited or emplaced during development of the North Cycladic Detachment System, which consists of a set of closely related, northeasterward-dipping low-angle normal faults that accommodated exhumation of deep-seated metamorphic rocks to Earth’s surface (Lister et al., 1984; Jolivet et al., 2010).

Because paleomagnetism of pre-, syn-, and post-detachment igneous rocks can uniquely constrain aspects of the kinematics of late-stage exhumation and subsequent regional block rotation, resolution of the shallow inclination problem in this region is of critical importance. Here, we address this problem by re-examining the paleomagnetic data from the Kymi-Aliveri basin and the islands of Tinos, Mykonos, and Naxos.
2. The Kymi-Aliveri Basin

The Kymi-Aliveri basin consists of a basal sequence of Early to Middle Miocene lacustrine marls, siltstones, and sandstones (Figure 2) that pass upward into and are locally unconformably overlain by Middle Miocene fluvial/alluvial conglomerates (Bradley et al., 2013). The Middle Miocene Oxylithos dacites were intruded into (and perhaps locally erupted onto; Pe-Piper and Piper, 1994) this sequence. The Kymi-Aliveri basin developed synchronously with the main period of exhumation of rocks to shallow crustal levels along low-angle normal faults in the adjacent Attic-Cycladic Complex, and is bounded to the southeast by the South Evia-North Attica Fault (Fig. 1) (Xypolias et al., 2003; Papanikolaou and Royden, 2007; Papanikolaou and Papanikolaou, 2007 Jolivet et al., 2010; Soukis and Stockli, 2012).

The close association between a thick succession of well-exposed sediments and coeval volcanics makes the Kymi-Aliveri basin an attractive location for paleomagnetic sampling (Kissel et al., 1986; Morris, 1995; Bradley et al., 2013). Pioneering paleomagnetic studies in the Kymi-Aliveri basin yielded consistent paleomagnetic directions from both the Kymi Formation and the Oxylithos volcanics (Kissel et al., 1986; Morris, 1995). All sites in these studies exhibited mean inclinations of ~40-45° after tilt correction, well below the expected inclination of 56.5°. Notably, these studies sampled only reversed-polarity intervals of the Kymi Formation (Kissel et al., 1986; Morris, 1995). In order to test whether the reported shallow inclinations were due in part to shallow biases of reversed-polarity directions, we intensively sampled ~750 m of stratigraphic section of the Kymi Formation. The samples were analysed in the MIT Paleomagnetism Laboratory, with details of the analytical procedures, demagnetization characteristics, quality criteria, and stability tests presented in Bradley et al. (2013).

Out of 311 accepted characteristic remanence directions, the reversed-polarity directions are on average 7.2° shallower than those with normal polarity (Figure 2A). In the Kymi-Aliveri basin, the
normal-polarity intervals are characterized by carbonate-rich marls and lacustrine limestones, while the reversed-polarity intervals exhibited higher silt content (Figure 2B), suggesting that enhanced compaction of silty beds could explain the shallow bias of the reversed-polarity dataset. Application of the elongation-inclination method (Krijgsman and Tauxe, 2004; Tauxe et al., 2008) to the reversed-polarity directions yields an elongation-corrected mean inclination of 52.1° (+6.0, -3.5), bracketing the expected Middle Miocene inclination (Figure 2C). Alternatively, the shallow nature and higher dispersion of reversed-polarity specimens may reflect incomplete thermal cleaning of a modern normal-polarity viscous overprint from the reversed-polarity specimens (Paris and van der Voo, 2013). The normal-polarity magnetization of the Kymi Formation therefore appears to be most closely representational of the ambient field direction during deposition. This interpretation is supported by observation of similar effects in large paleomagnetic datasets with depositional paleolatitudes that are independently known from plate reconstructions (Tauxe et al., 2008).

The Oxylithos intrusive dacies yielded highly consistent site-mean directions (Figure 3A) in three separate studies (Kissel et al., 1986; Morris, 1995; Bradley et al., 2013). These dacies do not exhibit bedding or paleohorizontal indicators. Kissel et al. (1986) and Morris (1995) applied a tilt correction to these directions based on the attitude of southward-dipping marls exposed along the nearby Kymi-Platana road. Application of this correction to the combined dataset yields an anomalously shallow mean inclination similar to that of the reversed-polarity data from the Kymi Formation and a large inferred clockwise vertical-axis rotation of ~58° (Figure 3B). Based on new geological mapping, we instead find that the dacies are intruded into and slightly postdate the lacustrine section, invalidating this tilt correction. We propose an alternative tilt-correction that restores to horizontal the youngest beds intruded by the dacies (Figure 3). Application of this correction to the combined dataset yields a mean inclination of 54±5° and an inferred clockwise vertical-axis rotation of 32±8°, consistent with the magnetization of the slightly older Kymi Formation (Figure 3C). We therefore find no evidence from the sedimentary rocks or volcanics of the Kymi-Aliveri basin for a Middle Miocene Aegean inclination anomaly.

3. Paleomagnetism of Northwestern Cycladic Igneous Rocks

Figure 4. Summary of published paleomagnetic and magnetic fabric data from the islands of Tinos, Mykonos, and Naxos. Data are from Morris and Anderson (1996), Avigad et al. (1998), and Denèle et al. (2012). Gray bands show the expected Middle Miocene inclination.

From 15-10 Ma, a variety of plutons and dacies were intruded into the Attic-Cycladic Complex (Bohbar et al., 2010; Jolivet et al., 2010). On Tinos, a syn-detachment 14.73±0.22 Ma granodiorite (s.l.) pluton and a set of 11.55±0.43 Ma post-detachment dacitic dacies are exposed (Avigad et al., 1998; Bohbar and Ring, 2010). On Mykonos and Naxos, ~13.4-11 Ma granodiorite (s.l.) plutons are also exposed (Bohbar et al., 2010; Brichau et al., 2008).

Remanent magnetizations for the Tinos pluton and dacies are characterized by final unblocking temperatures of ~580°C and little unblocking below 500°C, indicating that low-Ti titanomagnetite
dominates the magnetic remanence (Avigad et al., 1998). In contrast, paleomagnetic remanence at Mykonos and Naxos is dominated by a component with low unblocking temperatures (\(\sim 350^\circ\)C) and a subordinate component with high unblocking temperatures of up to 580°C, carried by low-Ti titanomagnetite (Morris and Anderson, 1996). The published mean inclinations for Tinos, Mykonos, and Naxos are 41.9 ± 9.9°, 23.0 ± 7.3°, and 37.6 ± 8.6°, respectively (Morris and Anderson, 1996; Avigad et al., 1998) (Figure 4). These authors argued that such shallow inclinations, which are statistically distinguishable from the expected Middle Miocene inclination of 56.5±2.5°, should be interpreted in the context of the −42° mean inclination reported for the contemporary rocks of the Kymi-Aliveri basin under the assumption of a regional inclination anomaly. Our revision of the paleomagnetism of the Kymi-Aliveri basin invalidates this correction, exacerbating rather than mitigating the shallow inclination problem in the western Cyclades.

The published mean inclination of 41.9 ± 9.9° at Tinos depends strongly on two sites exhibiting nearly equatorial inclinations. These specific sites incorporate only 3 out of 6 (for site T1) and 2 out of 5 (for site T4) specimens (Avigad et al., 1998), the lowest ratios of analyzed to utilized specimens in the dataset. Furthermore, site T1 exhibits a nearly reversed polarity, but its mean direction is not antipodal to the cluster of normal-polarity sites, suggesting that it records a transitional direction. Exclusion of T1 and T4 as well as the site with greatest scatter (T13; Fisher 95% confidence interval \(\alpha_{95} = 19.5°\)) yields a revised mean inclination of 49.3 ± 9.9°. As the confidence interval for this inclination overlaps with the expected magnetic inclination for a Middle Miocene GAD (Figure 4), inference of an anomalous shallow inclination depends on inclusion of the three lowest-reliability sites, suggesting that the inferred shallow inclination could be an artefact of the small number of analysed samples and sites.

The simplest way to explain shallow paleomagnetic inclinations within extensional terranes is by back-tilting of fault-bounded blocks. This mechanism requires minimum back-tilting of Tinos, Mykonos and Naxos by 7.2°, 33.5° and 18.9°, respectively. However, the similar strike of vertical andesite dykes on Tinos and barite dykes on Mykonos indicate that there has been little relative vertical-axis rotation or differential tilting between the footwalls of those islands since ~11 Ma (Avigad et al., 1998). The difference in magnetic inclination of ∼26.3° between coeval rocks at Tinos and Mykonos cannot be explained solely by block tilting.

We therefore seek an alternative model for the origin of shallow inclinations at Mykonos and Naxos. All sites at these localities were drilled within rocks exhibiting a pronounced non-

![Figure 5](http://epublishing.ekt.gr)

Figure 5. Transposition of a primary thermal remanent magnetization (TRM; open star) acquired during cooling below 580°C by oblate or prolate coaxial strain at temperatures of 350-500°C (after Borradaile, 1997). Green arrow: paleomagnetic remanence direction.
magmatic foliation and a well-developed mineral lineation. This lineation parallels the principal (k1) axis of the anisotropy of magnetic susceptibility tensor measured at each paleomagnetic drill site (Figure 4; Morris and Anderson, 1996). The tectonic fabrics record crystal-plastic deformation at temperatures down to ~350°C, well below the 560-580°C blocking temperature of low-Ti titanomagnetite (Lee and Lister, 1992). Temperatures of mylonitization of 400-500°C have been observed in other metamorphic core complexes where syn-detachment plutonic rocks that are lithologically and structurally comparable to the Tinos and Mykonos plutons (e.g., Singleton and Mosher, 2012). Any primary thermoremanent magnetization acquired by cooling of low-Ti titanomagnetite grains below 580°C during initial post-crystallization cooling would therefore have significantly predated the cessation of ductile deformation.

Paleomagnetic remanence vectors carried by robust, elongate magnetic grains can rotate as passive lines under ductile deformation due to grain reorientation (Borradaile, 1997), with the mean remanence vector following an arcuate path toward the intermediate strain axis before converging on the maximum elongation direction (Figure 5A-C). While this effect has not to our knowledge been described in granite mylonites, the basic physical principles are closely analogous to well-studied examples (Borradaile, 1997). The magnitude and sense of angular deflection of a magnetization originally acquired in the expected (GAD) local field direction can therefore be estimated from finite strain measurements, assuming that strain was dominantly coaxial and that the axes of the anisotropy of magnetic susceptibility tensor measured at the paleomagnetic drill sites represent the finite strain axes. This approach requires knowledge of the paleo-north direction independent of the magnetization directions of the Cycladic plutons. Realignment of footwall lineations across the Mid-Cycladic Lineament (Walcott and White, 1998) requires ~50° of relative vertical-axis rotation between Mykonos and Naxos (Philippon et al., 2011). As the region northwest of the Mid-Cycladic Lineament is known to have rotated by ~25° clockwise since Middle Pliocene time (Bradley et al., 2013), the region to the southeast, including the island of Naxos, must have rotated counter-clockwise by ~25°.

Figure 6. Hypothesized evolution of the paleomagnetic remanence of Tinos, Mykonos, and Naxos, accounting for ductile deflection of a primary thermoremanent magnetization using the strain ellipsoids measured on Naxos (Koukouvelas and Kokkalas, 2003) oriented by the principal axes of the magnetic susceptibility tensors measured at the paleomagnetic drill sites on both Naxos and Mykonos (Morris and Anderson, 1996).

For the case of Naxos, we adopt the 23 finite strain measurements of Koukouvelas and Kokkalas (2003), with the k1 and k3 axes of Morris and Anderson (1996) taken as the maximum and minimum elongation directions, respectively, of the finite strain ellipsoid. The resulting average remanence direction is ~005°/41° (a flattening of 15.5°), which restores to a present-day remanence direction of 340°/41° after accounting for post-Miocene counter-clockwise rotation of 25° (Figure 6). Finite strain data are not presently available for the Mykonos pluton. If we assume

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that the style and intensity of strain in the Mykonos pluton is similar to that at Naxos, but with the
direction of maximum elongation oriented toward the k1 and k3 axes measured at Mykonos
(Morris and Anderson, 1996; Denèle et al., 2011), we predict a deflected remanence direction of
015°/30° and, after accounting for post-Miocene clockwise rotation of 25°, a present-day
remanence direction of 040°/30° (Figure 6). Because the largest amount of flattening and rotation
of the remanence occurs at relatively low strain (strain ratio RXZ < 2; Figure 5F), the magnitude
of the predicted deflection does not depend strongly on the details of the finite strain, so long as a
stretching lineation is present and significant flattening has occurred (Figure 6, inset at upper right).

Ductile transposition of magnetizations acquired by cooling below 580°C in the expected ambient
gemagnetic field can therefore explain the relative magnitude of inclination shallowing observed
at Mykonos (25.5° lower than expected) and Naxos (15.5° lower than expected), as well as the
more easterly declination of the remanence at Mykonos compared with Tinos.

However, our proposed model fails to explain strong demagnetization of specimens from Naxos
and Mykonos at temperatures <350-400°C. If this temperature range represents blocking
temperatures, then magnetization must have postdated mylonitization. These magnetizations were
originally attributed to monoclinic pyrrhotite, which demagnetizes upon heating to ~320°C
(Gromvold and Haraldsen, 1952). However, to date no iron sulfides have been petrographically
identified within the Mykonos or Naxos plutons. An alternative magnetic carrier is cation-deficient
titanomaghemite, which undergoes inversion to hematite upon heating to ~350°C, resulting in
demagnetization in the same temperature range as pyrrhotite-bearing rocks (O’Reilly, 1983). Low-
temperature (<350°C) oxidation of fine-grained, acicular titanomagnetite can result in the
production of intimately overgrown secondary titanomaghemite bearing a stable chemical
remanent magnetization parallel to that of the original titanomagnetite grain (Heider and Dunlop,
1987). We suggest that after cooling through the brittle/ductile transition at temperatures of ~300-
350°C, low-temperature oxidative alteration led to growth of fine-grained titanomaghemite that
acquired a remanence parallel to the already rotated high-temperature paleomagnetic remanence,
which is now the primary paleomagnetic signal. In contrast, the dykes and plutonic rocks of Tinos,
where sampled, were not penetratively strained or altered and therefore preserve both their igneous
magnetic mineralogy and primary remanence direction.

4. Conclusions

Early to Middle Miocene sedimentary and volcanic rocks exposed in the Kymi-Aliveri basin and
on the island of Tinos preserve paleomagnetic inclinations that are consistent with emplacement
near their present-day latitude. Standard interpretation of the remanence directions at Mykonos and
Naxos requires large fault-block tilts incompatible with independent structural constraints. We
suggest an alternative interpretation of ductile transposition of a primary thermal remanent
magnetization carried by low-Ti titanomagnetite followed by low-temperature maghemitization.
This model can explain the progressive flattening and rotation toward the mylonitic stretching
direction of paleomagnetic remanences at Mykonos and Naxos. Based on this new interpretation,
the paleomagnetic data from the Central Greece and the western Cyclades do not require
anomalous field geometries, significant northward drift of Aegean, or back-tilting of the low-angle
normal faults of the North Cycladic Detachment System (Avigad et al., 1998). Our proposed
model can and should be directly tested by coupled microstructural, rock magnetic, and
paleomagnetic studies of deformed footwall plutons, as exemplified by the recent study of
Zananiri et al. (2013) of the deformed Symvolon and Vrondou plutons of northern Greece.

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6. References


Philippon M., Brun J. P. and Gueydan F. 2011. Deciphering subduction from exhumation in the segmented Cycladic Blueschist Unit (Central Aegean, Greece), Tectonophysics, 524-525, 116-134.


