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NEW STRUCTURAL EVIDENCE FROM THE MESOZOIC-EARLY TERTIARY PAÏKON UNIT, NORTHERN GREECE

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ABSTRACT

Two mega-sequences exist in the Païkon unit of N. E. Greece, separated by a Late Jurassic (Kimmeridgian/Tithonian) unconformity. Three compressional (D1-3) and two extensional (E1-2) phases of deformation can be inferred. D1 (Late Jurassic) resulted in isoclinal folding about E-W axes. E1 (Late Cretaceous) caused flexural uplift then rift-related collapse. D2 (Early Tertiary) compression was followed by D3 dextral transpressive shear, possibly caused by post-suturing "tectonic escape". Finally, E2 refers to Neotectonic (Neogene-Quaternary) extension. Our D1 is equivalent to the previously recognised JE1 event, but there is no evidence of a "JE2" (Early Cretaceous) event in the Païkon unit. Tertiary deformation is more complex than previously realised.

INTRODUCTION

The Païkon unit of north-eastern mainland Greece lies centrally within the Axios (Vardar) isopic zone of the Eastern ("internal") Hellenides, between the Almopias and Peonias subzones (Mercier, 1968, Figs 1 & 2). To the east and west, respectively, it is bordered by oceanic crustal units of the Guevgueli (Bebien, 1982) and Meglenitsa (Sharp & Robertson, this volume; Sharp, 1994) ophiolites (Fig 3). The Païkon Massif was originally interpreted as including an island arc sequence of Jurassic age, following classic work in the area by Mercier (1968). Mercier concluded that the Païkon could be subdivided into two distinct tectono-stratigraphic units: the Païkon subzone in the west and the Pre-Peonias subzone in the east, separated by a major east-dipping reverse fault. Recently, however, new faunal and structural data presented by Godfriaux & Ricou (1991) have been interpreted to indicate that the Païkon massif is a "tectonic window" exposing crust of the Pelagonian zone to the west, and that the Païkon and Pre-Peonias subzones can be regarded as one unit which was overthrust by an ophiolitic nappe during the Tertiary. The debate concerning the nature and origin of the Païkon unit continues; the data presented here leads to the inference that the Païkon massif represents a single composite unit which was deformed and metamorphosed in Early Tertiary times. The structural history of the Païkon Massif was first synthesised by Vergely (1984). He concluded that, in common with the "internal" Hellenides as a whole, three distinct deformation events could be recognised. These he named: JE1, a compressional event of Upper Jurassic age; JE2, a compressional event of Lower Cretaceous age; CT1-2, a series of Tertiary compressional events.

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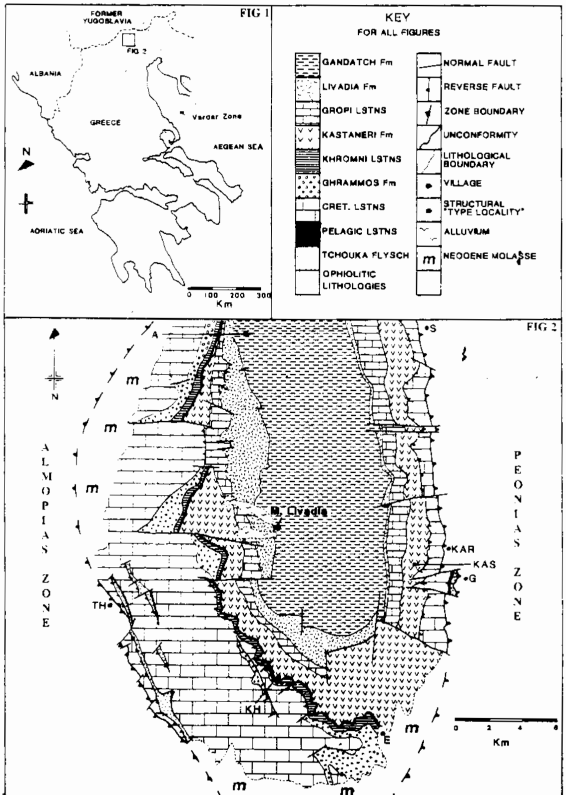

FIG 1 - Map of Greece showing the Vardar zone and the location of the Paikon unit in the North East

FIG 2 - Simplified geological map of the Paikon unit within the Vardar. Modified after Mercier, 1968.

G - Griva	KAR - Karpi	KAS - Kastaneri	A - Archangelos
S - Skra	KH - Khromni	TH - Theodoraki	E - Elifther ohori

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However, in this paper we will present new, mainly structural data, from within the Païkon unit that lead to a significant revision of this structural history.

TECTONO-STRATIGRAPHY OF THE PAÏKON UNIT

To place the new structural evidence in context we first review the stratigraphy of the Païkon unit, incorporating some new results from work in progress.

The Païkon unit can be simply regarded as comprising two mega-sequences, separated by a major structural and metamorphic discontinuity of pre-Kimmeridgian age (Fig 4). The lowermost and older of these mega-sequences, which underlies the unconformity surface referred to above, constitutes a

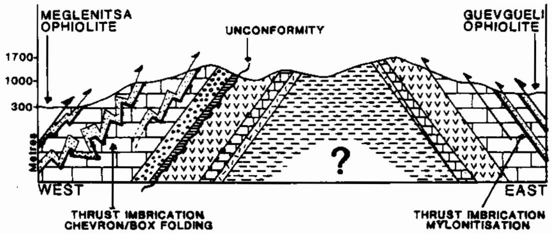

Fig. 3: Schematic cross - section through the Païkon anticline

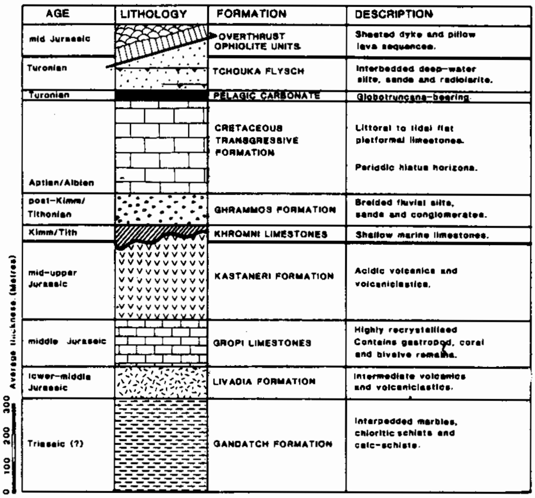

Fig 4 – Composite log of the Paikon Unit.

Fig. 4: Composite log of the Païkon Unit

normal (i.e. conformable) succession. From base to top this mega-sequence comprises: ?Triassic interbedded marbles, calc-schists and chloritic schists of the **Gandatch Formation** (Mercier, 1968), which were possibly deposited in a continental slope setting, and have been deformed under greenschist facies conditions (Baroz et al, 1987). Above these carbonates lies the mainly volcaniclastic **Livadia Formation** (Mercier, 1968). Sparse, massive, igneous flows within this unit are andesitic to basaltic-andesite in composition. Preliminary analyses of stable elements indicate a depleted island arc-type signature. The predominantly clastic component of the Livadia Formation has a pervasive schistocity and is commonly strongly altered. Occasional interbeds of coarse-grained volcaniclastics are interpreted as debris flows, and suggest deposition in an unstable slope setting.

Conformably above these volcaniclastics are found the Mid Jurassic **Gropi Limestones** (Mercier, 1968). The exact age of this unit is, as yet, poorly constrained due to extensive alteration and recrystallisation. A Mid Jurassic age was inferred from gastropods and foraminifera (Mercier, 1968) and recently an Aptian/Albian age has been suggested by Bonneau et al (1994). Due to the extensive thrust imbrication within the Païkon (Fig 3), it is possible that such Aptian/Albian dates have been obtained from an interslice of the Cretaceous limestones (see below). During this study, well preserved coral, bivalve and algal remains have been collected and these are currently being dated.

Resting upon the Gropi Limestones, again with a normal contact, are the acidic volcanics and volcaniclastics of the **Kastaneri Formation** (Mercier, 1968; also the Khromni Formation of Mercier, 1968). This unit is primarily composed of intermediate to acidic, fine-grained tuffs, ignimbrites and rhyolitic quartz porphyries. Lawsonite-bearing assemblages were reported by Baroz et al. (1987) and taken to indicate metamorphism of this formation under blueschist facies conditions. Shallow-water, oolitic, calc-arenitic interbeds appear towards the top of the unit and indicate periodic marine incursions.

An important metamorphic and structural unconformity exists between these Late Jurassic volcaniclastics (Kastaneri Formation) and the overlying carbonates, termed the **Khromni Limestones** ("Calcaires de Khromni" of Mercier, 1968). This unconformity can be clearly seen in south-western areas of the Païkon (e.g. around and below Khromni village, Fig 2), where clear structural discordance and a significant variance in metamorphic grade is shown, both by field observations and by petrographic analysis (i.e. lawsonite-bearing assemblages below and relatively undeformed, greenschist facies units above).

The Khromni Limestones were dated as Late Jurassic (Kimmeridgian/Tithonian) to Early Cretaceous (Valanginian) by Mercier (1968), using the bivalve *Iberina lusitanica* and the algae *Cladacoropsis*. Conformably above and interbedded with the Khromni Limestones is a red-bed clastic sequence, here termed the **Ghrammos Formation**, based on a well exposed locality in the valley of the River Ghrammos (Eohellenic Flysch of Mercier, 1968). A post-Portlandian to Aptian/Albian age is inferred for the Ghrammos Formation, based on the faunal assemblage of the underlying Khromni Limestones, and the Aptian/Albian-aged rudist bivalves (Mercier, 1968) within the limestone succession above, here termed the **Cretaceous Transgressive Formation**. Detailed logging and facies analysis of representative successions of the Ghrammos Formation reveal the most likely environment of deposition as a continental, braided, fluvial system, operating in a seasonally arid setting. Both the Khromni Limestones and clasts of the post-Portlandian Ghrammos Formation are exposed only on the western side of the Païkon anticline. These units appear to have been removed by Tertiary thrusting (i.e. tectonic cut out) in the east.

The thick rudist-bearing platform carbonates of the Cretaceous Transgressive Formation (Aptian/Albian to Turonian) rest with a **normal** contact upon the red-bed clastic succession (Ghrammos Fm). They are characterised by shallow-water, neritic facies, which exhibit periodic emergence/hiatus horizons, and then pass rapidly upwards into the deeper-water, pink, pelagic, Globotruncana-bearing carbonates, of Turonian and younger age. The presence of intraformational conglomerates and very rapid upward deepening, suggest tectonic collapse of the carbonate platform in Cenomanian to Turonian times (Sharp & Robertson, 1993).

The pink, pelagic carbonates then pass gradually upwards into deep-water clastics, termed the **Tchouka Flysch** (Sharp & Robertson, 1993). This unit consists of interbedded siltstones and sandstones, with local radiolarite and pelagic carbonate horizons. Well preserved radiolaria include *Pseudodictyomyta psuedomacrocephala* of Late Albian to Mid Turonian age and also a faunal assemblage of Turonian and younger age (P. De Wever, pers comm to I. Sharp, 1993). In places, a shallow, platform carbonate assemblage of Maastrichtian age was also reported by Mercier (1968); this will be discussed below.

The deep-water collapse sequence (i.e. platform limestones to pelagic limestones to flysch) was first documented by Sharp & Robertson (1993) on the western Païkon margin. Recent field observations (this work) have now shown that this event also affected Cretaceous units on the eastern Païkon margin (e.g. well exposed just west of Griva, Fig 2), suggesting that both sides of the Païkon anticline underwent essentially the same sedimentation and deformation history during the Cretaceous and Early Tertiary.

In summary, the stratigraphy of the Païkon unit comprises two conformable mega-sequences, one ?Triassic (Gandatch) to Late Jurassic (Kastaneri Fm) and the other Kimmeridgian/Tithonian (Khromni Limestones), to Maastrichtian (Tchouka Flysch). These successions are separated from one another by an important metamorphic and structural discontinuity (Fig 4). Having clarified the tectono-stratigraphy we now go on to discuss the structure of the Païkon unit.

STRUCTURAL ANALYSIS

Mercier (1968) recognised that the Païkon massif had been folded into a broad N-S anticline in post-Upper Cretaceous times: this has been confirmed by subsequent workers (Godfriaux & Ricou, 1991; this work, Fig 3). He also inferred the existence of a major structural break (as described above) between the Upper Jurassic, acidic volcaniclastics (Kastaneri Formation of this work; Khromni Formation of Mercier, 1968) and the Khromni Li-mestones. Following on from this work, Vergely (1984) later concluded that three distinct phases of regional deformation had affected the Païkon unit. These he named:

JE1 - Upper Jurassic: phase of compression and folding about E-W axes.

JE2 - Lower Cretaceous: phase of compression with eastward vergence.

CT1-2 - Tertiary: series of compressional phases with westward vergence.

During this study, and in contrast to the findings of Vergely, we have recognised three distinct compressional events (D1, D2 and D3) and two extensional events (E1 and E2) within the Païkon. We now go on to discuss these in turn and return subsequently to discuss the correlation of our revised structural history with that previously established by Vergely (1984).

COMPRESSION EVENT ONE (D1)

This initial phase of deformation affects all of the lithologies which lie below the major, Late Jurassic unconformity (i.e. the ?Triassic Gandatch Formation to the pre-Kimmeridgian Kastaneri Formation). This event is sealed by the unconformably overlying Khromni Limestones (Calcaires de Khromni of Mercier, 1968), which are known to be of Kimmeridgian/Tithonian-Portlandian age.

All the units below this unconformity were subjected to compressional deformation about east-west-trending axes, which produced tight isoclinal folds. The marbles, calc-schists and chloritic schists of the Gandatch Formation display this folding best, as observed in the centre of the Païkon unit, between Micra and Meghala Livadia (Fig 5; starred locality on Fig 2).

Where preserved, folds associated with the first phase of deformation have fairly consistent E-W fold axial trends and are typical of deep-level, essentially ductile deformation. They are associated with a marked axial planar cleavage, most prevalent in schistose horizons, and an axis-parallel intersection lineation (Fig 5).

The polarity or vergence of the D1 compressional event is impossible to determine, owing to the ductile nature of folding and the effects of subsequent deformation. It is, however, suggested here that the remarkably consistent east-west-trending lineation associated with D1 represents the original transport direction, but again, whether this transport was directed westward, or eastward is impossible to determine from structural data alone.

Fold structures associated with this D1 deformation event are rarely preserved within the volcaniclastics of the Livadia Formation or the Gropi Limestones, although the corresponding E-W lineation is common. This reflects the contrasting competencies of these lithologies. Tight isoclinal folds are, however, locally observed within the Gropi Limestones (e.g. 2km NNW of Kastaneri) and these tend to follow the general E-W, D1 structural trend of the area (Fig 5). Cleavages seen there are often spaced fracture cleavages, as opposed to pervasive refracted cleavages seen elsewhere. However, they still form parallel to the axial planes of D1 folds.

The acidic volcanics and volcaniclastics of the Kastaneri Formation display a wide variety of D1 structures. As with the Gandatch Formation, they are isoclinally folded about east-west axes and exhibit a well-developed axial planar cleavage and axis-parallel lineation traces. Clast-supported, primary debris flow horizons preserve vestiges of an early D1 fabric within competent siliceous clasts, as seen 1km north of Khromni village. The matrix of such debris flow horizons has been overprinted by the fabric of the succeeding D2 event (discussed below).

As stated above, Baroz et al.(1987) document the presence of lawsonite within the acidic Kastaneri Formation, and thus blueschist facies metamorphism. No evidence of this high pressure/low temperature metamorphism exists in any of the units which overlie the Upper Cretaceous unconformity, and thus we conclude that no Tertiary ophiolitic nappe overthrust the Païkon in post-Kimmeridgian times as suggested by Godfriaux & Ricou (1991). This conclusion is supported by the work of other authors (e.g. Ferriere & Stais, 1994; Mercier & Vergely, 1994; our unpublished data).

The compressional event which gave rise to the D1 structures had ended by Kimmeridgian/Tithonian times, when the Khromni Limestones were deposited. The second "mega-sequence" was then deposited free of compressive stress during Cretaceous and Early Tertiary times, when a shallow, platform carbonate succession accumulated (Cretaceous Transgressive Formation).

EXTENSIONAL EVENT ONE (E1)

A significant hiatus in deposition took place in Cenomanian-Turonian times within the Païkon unit. This break is marked by an iron-encrusted surface (up to 3cm thick) overlying an intraformational limestone conglomerate at the top of the stable carbonate platform succession (Cretaceous Transgressive Fm. Sharp & Robertson, 1993; and work in progress). This surface is overlain by *Globotruncana*-bearing, pelagic carbonates, as mentioned above.

An initial hypothesis stated that the iron crust formed during a period of non-deposition during collapse of the platform to a deeper-water, pelagic setting related to crustal extension (Sharp & Robertson, 1993). More recent evidence, in the form of rhizoliths and *Microcodium* (Sharp, 1994), suggests that emergence immediately preceded collapse. Our present

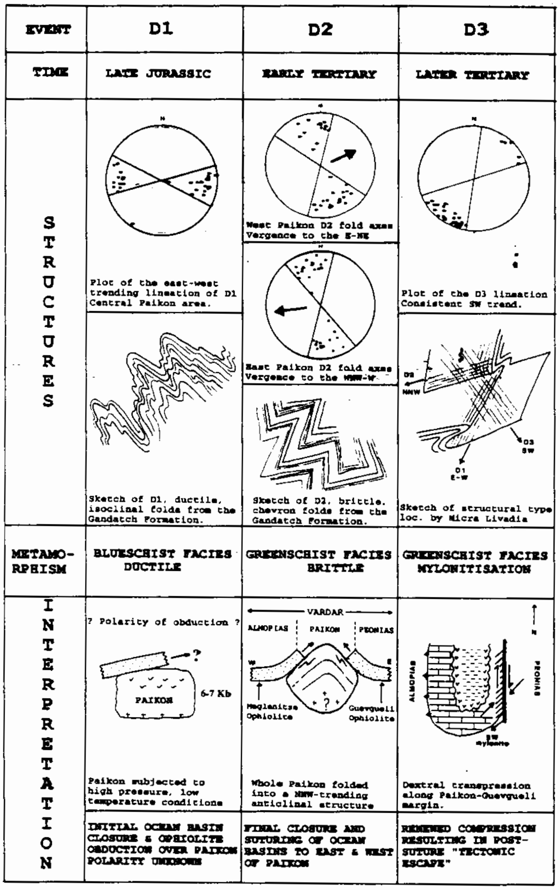

Fig. 5

view is that short-lived flexural uplift resulted from initial crustal extension, and that this was followed by rift-related collapse to form a deep-water basin. Evidence for Upper Cretaceous crustal extension further south in the Pelagonian zone in Greece was reported by Robertson (1990). Notably, this regional subsidence event predates the first evidence of compression-related flexural subsidence in the Eastern ("internal") Hellenides in the Early Tertiary.

As mentioned above, Mercier locally identified a shallow-water faunal assemblage of Maastrichtian age from parts of the Païkon unit. These findings may reflect normal faulting at this time, resulting in basinal areas undergoing pelagic/flysch deposition (as seen in southern Païkon), while coeval shallow-water deposition was concentrated on platform highs.

COMPRESSION PHASE TWO (D2)

Post-Maastrichtian tectonism saw the re-instigation of compressive stresses in the Païkon unit, resulting in D2 structures. During this stage an extensive fold-and-thrust belt developed across the western part of the Païkon unit, characterised by north-eastward vergence and NW-NNW-trending, axis-parallel lineation. Every unit in the area was affected by this phase of deformation and in several places the D2 structures can be seen to overprint those of D1, such as at the structural type locality (Fig 5) between Micra and Meghala Livadia (central Païkon) and just north of Khromni village (see Fig 2).

At the structural type locality (Fig 5), folds resulting from both D1 and D2 events are present. Those of D1 are ductile and isoclinal in nature and display a consistent E-W-trending axis-parallel lineation as described above, these were then refolded about the NNW-trending axes of brittle, chevron folds typical of D2. The D1 axis-parallel lineation is similarly refolded. North of Khromni village, a remnant D1 fabric is preserved within competent siliceous clasts, set in a less competent, schistose matrix in which the original E-W, D1 fabric has been completely obliterated by the NNW-trending D2 fabric. The D2 fabric is also seen in the clasts, but only crenulates the D1 fabric there.

Almost all fold and thrust structures associated with the D2 deformation in the western part of the Païkon unit have north-east polarity whereas those seen along the eastern Païkon margin (i.e. between Kastaneri and Micra Livadia, Fig 2) have W to NW vergence. D2 structures are much more common in the western and central areas of the Païkon unit than in the east, due to overprinting by subsequent structures associated with compressional deformation phase three (D3).

COMPRESSION PHASE THREE (D3)

The third phase of compressional deformation to influence the Païkon unit took place at some, poorly constrained time in the Tertiary after D2, but prior to Neogene-Quaternary extension.

The D3 structures are best developed along the eastern side of the Païkon, but can also be recognised throughout the unit, affecting all lithological units. The most conspicuous D3 structure is a pervasive stretching lineation, which plunges consistently towards the SW (Fig 5). In western and central areas, this lineation crenulates and often overprints the E-W and NNW-trending lineations, respectively of D1 and D2.

In the eastern areas (e.g. between Griva and Kastaneri, Fig 2), D3 deformation has given rise to a strong SW-trending mylonitic fabric, that affects the Tchouka "Flysch", the Cretaceous Transgressive Formation and the acidic volcaniclastics of the Upper Jurassic Kastaneri Formation. In all of these units in the east of Païkon, pre-existing structures and original sedimentary features have been almost entirely obliterated.

The sense of shear associated with this mylonite fabric has been determined using sheared wing structures (Hanmer & Passchier, 1991) in quartz porphyroblasts within the Kastaneri Formation, as well as duplex structures in the Cretaceous Transgressive Formation. In both cases, these structures indicate a top-to-the-SW sense of shear. Tangential WNW-directed thrusting and SW-verging open folds are also associated with the transpressive stress of D3 and has formed a narrow fold and thrust belt (i.e. a strike-slip duplex) just west of Griva. We thus conclude that dextral transpressive shear took place along the Païkon-Guevgueli margin at this time.

NEOTECTONIC EXTENSION (E2)

During the Neogene and Quaternary, much of the Hellenides were affected by a series of events, characterised by tensile crustal stress, which resulted in extensive normal faulting and graben formation. In the Païkon unit, most of these movements (E2) have been concentrated along previously existing thrust faults (formed during D2 and D3), producing normal and dip-slip slickensides on fault planes. E2 also produced many NNW to N-trending normal (dip-slip) faults, which can be seen cross-cutting all earlier structures; these generally follow the strike of Tertiary (D2) fold axes orientations.

The dip-slip component of many of these Neogene-Quaternary faults is evidenced by significant lateral displacements in lithological boundaries (as seen in southern, central Païkon, Fig 2).

DISCUSSION

We now go on to compare the D1-D3 phases recognised during this work, with those previously reported by Mercier (1968) and Vergely (1984).

D1 and JE1

We are in complete agreement with these authors' recognition of a major Upper Jurassic phase of compressional folding (JE1) within the Païkon unit. Here we simply note its presence in the Païkon unit, without assuming any necessarily wider significance. However, a widespread NE-SW-trending displacement is known from the eastern part of the adjacent Pelagonian zone (Mercier, 1968; Vergely, 1984).

There is no evidence from within the Païkon unit of what caused this compression, which is assumed, somehow, to be related to Late Jurassic "collisional events" within the Eastern ("internal") Hellenides. However, it is likely that the E-W lineation reflects the tectonic transport direction.

Non-existence of JE2

Subsequent to the Upper Jurassic (JE1) deformation, Vergely (1984) described a second phase of compressional deformation of Lower Cretaceous age (JE2). Any such structures attributed to this phase would have been sealed (and thus unconformably overlain) by the Aptian/Albian-aged Cretaceous Transgressive Formation. Field observations at key localities (e.g. 3km south of Khromni village), however, indicate that this is not the case and that the passage from Upper Jurassic shallow-water carbonates of the Khromni Limestones to the Aptian/Albian-aged Cretaceous Transgressive Formation is conformable (Fig 4). Also, we have not observed any significant differences between the structures or metamorphism affecting the Low-er and Upper Cretaceous lithologies (i.e. below and above "JE2"), and in-deed the contact between the two has itself been extensively folded by the D2 deformation.

Mercier (1968) documented the existence of the "Calcaires de Khromni" (Khromni Limestones) and the "Eohellenic Flysch" (Ghrammos Formation) in south-western parts of Païkon only. He concluded that, in light of this, the Cretaceous Transgressive Formation unconformably overlies these units in the north. Recent findings, however, reveal that these units extend over the whole length of the Païkon unit, from north to south, in western areas. They have been tectonically cut out in the east.

Hence, it is inferred here that no evidence exists within lithologies of the Païkon unit for a "JE2 event" and that all compressional structures formed subsequent to D1/JE1 can be attributed to Tertiary tectonism.

Cretaceous structures

In the Païkon unit, the Cretaceous period was comparatively stable tectonically. Small iron-encrusted horizons are common within the platform carbonates and are thought to reflect depositional hiatuses associated with fluctuations in eustatic sea-level and/or small extensional tectonic pulses. The Cretaceous Transgressive Formation has also been subjected to periodic emergence probably in response autocyclic processes, in keeping with an extremely shallow-water, tidal flat origin.

Late Cretaceous rift-subsidence

During the Cenomanian and Turonian both western and eastern margins of the Païkon unit underwent moderate flexural uplift, followed by rift-related subsidence, leading to the deposition of deep-water pelagic carbonates and radiolarites, as part of a regionally significant crustal extension event, found elsewhere in the Eastern ("internal") Hellenides. These include the Eastern Pelagonian margin (Sharp et al, 1991; Sharp, 1994), Eastern Argolis (Clift, 1992) and Eastern Euboea (Robertson, 1990).

The Late Cretaceous extensional event was first identified on the western Païkon margin by Sharp & Robertson (1993), but has recently been discovered on the eastern Païkon margin also (this work). This discovery is taken as evidence that the Païkon massif (i.e. both Païkon and Pre-Peonias subzones of Mercier, 1968) represents one coherent unit, which remained so at least until post-late Cretaceous times, with both western and eastern margins documenting identical sedimentological, structural and metamorphic histories. Similarly, it is concluded here that the Païkon massif can be described, simply, as an anticlinal structure, showing equivalent successions from its core to either margin.

Early Tertiary compression (D2)

Our work confirms the importance of a Tertiary compressional event (D2) equivalent to the CT1-2 of Vergely (1984). However, this event is more complex than previously interpreted. Only structures seen in the eastern part of the Païkon unit have a W to NW vergence, comparable to that inferred by Vergely (1984) for the massif as a whole. By contrast, the whole of the western part of the Païkon unit is characterised (fold, reverse fault and duplex structures) by north-eastward vergence.

Structural studies of the adjacent Almopias zone suggest that the D2 deformation of the western Païkon results from eastward overthrusting of the Meglenitsa Ophiolite (Sharp & Robertson, 1993; Sharp & Robertson, this volume; Sharp, 1994). On the other hand, we also infer that the westward vergence, as documented by Vergely, affects only the eastern Païkon, probably relating to westward overthrusting of the Guevgueli Ophiolite. The Païkon unit thus behaved as a "pop-up" between the two converging ophiolite units on either side, and it is very likely that the present, regional-scale, NNW-SSE-trending Païkon anticline developed during this stage (D2). We therefore do not support the hypothesis of Godfriaux & Ricou (1991), which views the Païkon anticline as an exposed tectonic window of the Pelagonian zone to the west.

Later Tertiary dextral transpression of eastern margin (D3)

The third, poorly dated, dextral transpressive phase is most intense along the eastern Païkon margin and was previously recognised only as a "sheared margin", and attributed to tectonic suturing of the Païkon unit with the Guevgueli Ophiolite (Bebien, 1982). We have now shown that dextral transpression affects the whole of the Païkon, although mylonitisation and the development of small strike-slip duplex were concentrated near the Païkon-Guevgueli margin rather than being simply suture-related. We think that post-suture "tectonic escape", resulting from regional transpression, is a likely explanation.

Quaternary extension (E2)

The Païkon unit was finally affected by a series of Neotectonic events that commonly exploited older structures, suturing the boundary between the Païkon unit and the Guevgueli unit to the east. Neotectonic structures are related to extensional stress.

CONCLUSIONS

The Mesozoic Païkon unit of northern, mainland Greece has been subjected to three distinct phases of compressional (D1 & D2) and/or transpressive (D3) deformation (Fig 5) and two phases of extensional (E1 & E2) deformation. The first compressive phase (D1) took place in the Upper Jurassic (~JE1 of Vergely, 1984) and is related to the initiation of ocean basin closure and ophiolite obduction in the Eastern ("internal") Hellenides. Pre-Kimmeridgian-aged lithologies of the Païkon unit (first mega-sequence) were subjected to ductile, isoclinal folding and now display an E-W-trending lineation, possibly reflecting transport direction. These structures developed, at least partly, under high confining pressures, capable of developing lawsonite (a subduction zone?)(Baroz et al, 1987). Such structures and high pressure-low temperature metamorphism does not affect the second, younger mega-sequence in the Païkon.

We have not confirmed the existence of a "JE2" compressional event of Lower Cretaceous age within the Païkon unit, or within the Pelagonian and Almopias zones to the west (Sharp, 1994; this work).

Sedimentary successions of Cretaceous age in the Païkon extend through the Cretaceous without any structural break. After a period of relatively stable carbonate platform deposition in the Upper Jurassic (Kimmeridgian) to Upper Cretaceous (?Cenomanian-Turonian), the Païkon experienced the first extensional event (E1) which caused inferred flexural uplift, then rift-related collapse (Turonian-Maastrichtian) to form deep basinal areas separated by platformal highs. Both western and eastern Païkon margins display such a collapse sequence, confirming the Païkon massif as one unit that was folded into a NNW-trending anticline, as opposed to two subzones separated by a major reverse fault (Païkon and Pre-Peonias subzones of Mercier, 1968).

The second phase of compressive deformation (D2) was marked by westward vergence in the eastern Païkon and north-eastward vergence of folds, thrusts and duplex structures in the western Païkon unit. By contrast, Vergely (1984) reported only westward vergence throughout the Païkon as a whole (CT1-2). This D2 compression is seen here as the result of north-east-directed ophiolite emplacement from the Almopias zone, and approximately east to west emplacement of the Guevgueli ophiolite from the Peonias zone to the east. Earlier, D1, ductile folds were re-folded about NNW-trending brittle fold axes (D2) and the whole of the Païkon was probably warped into a broad, ~N-S-trending, anticlinal dome at this stage. This again leads us to conclude that the possibility of the Païkon anticline being a tectonic window of Pelagonian units is highly unlikely.

Later in the Tertiary, a SW-trending mylonite fabric and pervasive stretching lineation developed, with associated tangential, NW-directed thrusting, concentrated near the Païkon-Guevgueli contact. A possible explanation is post-suture, dextral "tectonic escape".

Finally, during the Neogene-Quaternary there was a switch from compression to a second phase of extensional deformation (E2), commonly reactivating pre-existing major zones of structural weakness.

One final implication of this work is that while presumed compressional deformation phases have been inferred over the Eastern ("internal") Hellenides as a whole, often based on only reconnaissance work, this study has revealed important discrepancies. The concept of regionally extensive, correlative structural events in the Eastern ("internal") Hellenides needs to be re-evaluated, area by area.

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