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REMNANTS OF PRE-ALPIDIC CRYSTALLINE BASEMENT IN THE EXTERNAL HELLENIDES

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The proof of pre-Alpidic basement within the Hellenides may provide important clues to the geodynamic evolution of the Aegean before the onset of the Alpidic orogenesis. For the internal zones of the Hellenides, the existence of pre-Alpidic relics is well documented. Most of the radiometric dates indicate a Hercynian stage of consolidation. The structural units of the external Hellenides are built up of sediments deposited in Mesozoic-Tertiary times. The basement of these sedimentary sequences is generally not exposed. Remnants of pre-Alpidic crystalline basement rocks were only observed on the island of Crete.

The structure of Crete is characterized by a pile of nappes consisting of rock units from different paleogeographic zones. The higher units (Uppermost Unit, Pindos Unit, Tripolitza Unit) are divided from the lower units (Phyllite-Quartzite Unit, Tripali Unit, Plattenkalk Unit) by a low-angle normal fault of pre-Serravallian age. The lower units were overprinted by blueschist-facies metamorphism in late Oligocene/early Miocene times caused by north-east dipping subduction in the Hellenic Arc which still goes on. By contrast, the higher tectonic units were not affected by this high-pressure event.

The sedimentary record within the different tectonic units of Crete goes back to the Permo-Triassic. For most of the units it is assumed that the sedimentary sequences were deposited on continental crust. During the nappe piling the sedimentary covers sheared off and left behind the basement. The whereabouts of this basement are unknown, and direct informations about the composition and age of the crust once underlying the different units are scarce.

Remnants of pre-Alpidic crystalline basement were first recognized in eastern Crete (Seidel 1978; Seidel et al. 1982). There, slices of crystalline rocks are intermingled with the Permo-Triassic volcano-sedimentary sequence of the allochthonous Phyllite-Quartzite Unit. The size of those slices may reach some kilometers in diameter. Amongst the crystalline rocks are amphibolites, micaschists and gneisses. In metapelites garnet, staurolite and kyanite were found besides muscovite, biotite and quartz. This assemblage is typical of the Barrovian-type amphibolite-facies metamorphism. The amphibolites with green hornblende and plagioclase show geochemical characteristics of tholeiitic basalts generated in an extensional tectonic environment (Franz 1992). The age of this tholeiitic magmatism, which probably took place within continental crust, is unknown. It must be older than the amphibolite-facies metamorphism. During the Tertiary high-pressure metamorphism the green hornblende in the amphibolites was partially replaced by blue amphibole.

Fragments of the crystalline rocks in Scythian sediments (Krahl et al. 1986) of the Phyllite-Quartzite Unit in eastern Crete testify to a pre-Triassic age of metamorphism. K-Ar dating on hornblendes and muscovites yielded model ages between 315 and 205 Ma (Seidel et al. 1982). The cluster of dates around 300 Ma and the few younger dates fit well with the concept of a Hercynian basement only weakly affected by the Alpidic very low-grade high P/T metamorphism.

Crystalline rocks closely resembling the Hercynian metamorphites within the Phyllite-Quarzite Unit of eastern Crete are known from the islands of Kalymnos, Leros and Lipsi in the Dodecanese far northeast of Crete. Like Crete, typical minerals in metapelites are garnet, staurolite and kyanite, and the amphibolites show geochemical characteristics of tholeiitic basalts (Franz 1992).

The crystalline rocks of the Dodecanese occur as slices at the base of a nappe. They are overlain by siliciclastic sediments of Permo-Triassic age and Jurassic-Cretaceous carbonate rocks (Dürr 1986). The siliciclastic sediments are foliated and show stretching lineation (Franz 1992).

K-Ar dating on hornblendes and muscovites from Kalymnos, Leros and Lipsi yielded model ages mainly between 320 and 230 Ma (Franz et al. in prep.). The dates of 405 and 539 Ma for two hornblendes can be disregarded because of very low potassium contents and consequently high sensitivity to excess argon. Like Crete, the dates are interpreted as Hercynian ages partially reset by a very low-grade Alpidic overprint.

* ΥΠΟΛΕΙΜΜΑΤΙΚΟΙ ΣΧΗΜΑΤΙΣΜΟΙ ΠΡΟ-ΑΛΠΙΚΟΥ ΚΡΥΣΤΑΛΛΙΚΟΥ ΥΠΟΒΑΘΡΟΥ ΣΤΙΣ ΕΞΩΤΕΡΙΚΕΣ ΕΛΛΗΝΙΔΕΣ

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Presumably the allochthonous slices of crystalline rocks in eastern Crete and in the Dodecanese belong to one, formerly coherent Hercynian basement complex in the southeastern Aegean.

Remnants of pre-Alpidic basement were also found in central Crete (Seidel et al. 1982; unpublished data of Seidel, Stöckhert, Theye). There, mudrocks, sandstones and conglomerates of Early Permian age (König and Kuss 1980) occur at the base of the Plattenkalk Unit which has the lowermost tectonic position in the Cretan nappe edifice. These rocks contain detrital grains of muscovite, paragonite, biotite, and plagioclase as well as pebbles of micaschists and very low-grade metamorphic rocks. Locally the siliciclastic rocks are associated with phyllites.

Two groups of white mica can be distinguished in the phyllites: coarse-grained isolated plates, often strongly deformed (mica fishes), and fine-grained evenly distributed flakes. Textural criteria indicate that the fine-grained white mica is younger than the coarse-grained. There are even differences in the chemical composition. Coarse muscovite plates have generally higher Si-contents per formula unit than fine muscovite flakes.

Two grain-size groups of white mica were also observed in sandstones and conglomerates at the base of the Plattenkalk Unit. The coarse-grained white micas are definitely clasts from an older source rock, whereas at least part of the fine-grained white mica was formed during the metamorphic overprint of the siliciclastic rocks. In their chemical composition coarse- and fine-grained muscovites correspond to those in the phyllites.

K-Ar and Ar-Ar dating on muscovites of three phyllite samples from one locality east of Galinos gave greatly differing model ages between 300 and 80 Ma. The Ar-Ar release pattern for one of the samples shows a high-temperature plateau around 300 Ma which probably records the crystallisation age of the muscovite. A later thermal overprint is obvious but badly constrained. If the phyllites represent pre-Alpidic basement rocks of the Plattenkalk Unit the dates have to be explained by a partial reset of the K-Ar systems during the Alpidic metamorphism.

This interpretation is supported by K-Ar dating on different sieve fractions of muscovite from a sandstone near Bali. The coarse sieve fraction (500-315 μm) yielded a model age of 305 Ma, the finer fractions gave 296 and 288 Ma, respectively. The date of 305 Ma is thought to be close to the formation age of the source rocks of the muscovite clasts. The younger model ages can be explained by gradual outgasing of the old muscovite or by admixture of newly formed muscovite.

The K-Ar and Ar-Ar dates indicate the exposure of Hercynian basement in the source region of the siliciclastic rocks at the base of the Plattenkalk Unit. Possibly this basement was connected with the Hercynian basement represented by the allochthonous slices in eastern Crete and the Dodecanese.

So far, there is no evidence of pre-Hercynian (Pan-African) crystalline basement in the external zones of the Hellenides.

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