

# On the regional distribution of critical metamorphic minerals in Crete and the Cyclades islands

by

M. OKRUSCH and SEIDEL

*Technische Universität Braunschweig, Mineralogisch-Petrographisches Institut (Germany)*

Distribution maps of the critical metamorphic mineral assemblages are given for the island of Crete and the Cyclades archipel.

## Crete

The investigations are concentrated on two different tectonic units of Crete, the phyllite-quartzite series and the serpentinite-amphibolite association.

The *phyllite-quartzite series* was metamorphosed under high-pressure conditions and under temperatures which increased during the *temporal* evolution of the metamorphism (western Crete); moreover, there is a *regional* increase in metamorphic grade from western to eastern Crete. The first low-T assemblage in the meta-basalts of western Crete is :

(1) glaucophane + lawsonite ± pumpellyite + chlorite + albite + aragonite.

The subsequent increase of temperature is documented by the assemblages :

(2) glaucophane + epidote ± pumpellyite + chlorite + albite + calcite  
in the meta-basalts and

(3) chloritoid + chlorite + phengitic white mica + quartz in the adjacent metapelites.

In the phyllite-quartzite series of central Crete, glaucophane-epidote bearing meta-basalts are also present as well as chloritoid bearing metapelites in which biotite already begins to grow.

The meta-basalts of the phyllite-quartzite series in eastern Crete are characterized by the assemblage

(4) common green hornblende + glaucophane + epidote + plagioclase, while the country rocks are phyllonitic micaschists of the assemblage:

(5) garnet ± kyanite + biotite + white mica + plagioclase + quartz. So far, no staurolite was recorded, although the micaschists of eastern Crete contain chlorite aggregates pseudomorph possibly after staurolite.

The upper parts of the *serpentinite-amphibolite association* are formed by more or less extended serpentinite bodies resting on a basal metamorphic complex. Both sub-units are probably divided by a tectonic unconformity. Typical constituents of the basal complex are amphibolites, gneisses, micaschists, calc-silicate rocks, and marbles of high metamorphic grade.

Typical assemblages are:

(6) common green or brown hornblende + plagioclase  
in the metabasites and

(7) sillimanite ± andalusite + cordierite ± garnet + biotite

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+ K-feldspar + muscovite (retrograde?) + plagioclase + quartz in the adjacent metapelites. By the occurrence of andalusite, a metamorphic pressure is indicated, markedly lower than in the phyllite-quartzite series.

The phyllite-quartzite series on the one hand and the high-grade constituents of the serpentinite-amphibolite association on the other can possibly be interpreted as the two members of a "paired metamorphic belt" defined by MIYASHIRO [1961] which are now superimposed.

#### **Gavdos**

The metamorphic rocks exposed on the island of Gavdos were supposed to be equivalent, in their tectonic position, to the serpentinite-amphibolite association of Crete. However, marked differences are recognized with respect to the metamorphic assemblages and the bulk rock composition of individual constituents. The metabasites of Gavdos are unusually rich in potassium and contain the assemblage:

(8) blue-green hornblende + glaucophane + epidote + plagioclase ± K-feldspar + white mica ± garnet,

while the adjacent metapelites are characterized by the assemblage:

(9) garnet + biotite + white mica + K-feldspar + plagioclase + quartz.

#### **Cyclades archipel**

On the islands of Syros and Siphnos glaucophane bearing rocks of different chemical composition (metabasites, metapelites, calc-silicate rocks, marbles) are very frequent, containing the assemblages:

(10) glaucophane + epidote ± garnet + chlorite + white mica ± albite ± quartz ± calcite and

(11) jadeitic clinopyroxene ± glaucophane ± epidote ± garnet ± chlorite ± white mica ± albite ± quartz.

Within the glaucophane rocks of Syros, relictic sclogite lenses are recorded which are, in part, unusually rich in rutile. The assemblage jadeite + quartz points to very high pressures, realized at least in part of the Cyclades crystalline area during the metamorphic history.

Further results are presented for the islands of Tinos, Mykonos, Delos, and Evvia in a preliminary distribution map.

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## **Intervention**

*D. Matthews* — Do you have the age of these rocks or of this metamorphism?

*Réponse* — Within the phyllite-quartzite series of western Crete, metamorphosed limestones are known, which contain fossils of Triassic age. Consequently, the metamorphism of this series must be post-Triassic. In contrast, the age of the metamorphism which affected the basal complex of the serpentinite-amphibolite association is still unknown. A radiometric dating program is in progress.