The extension of the Lycian nappes in the Aegean region

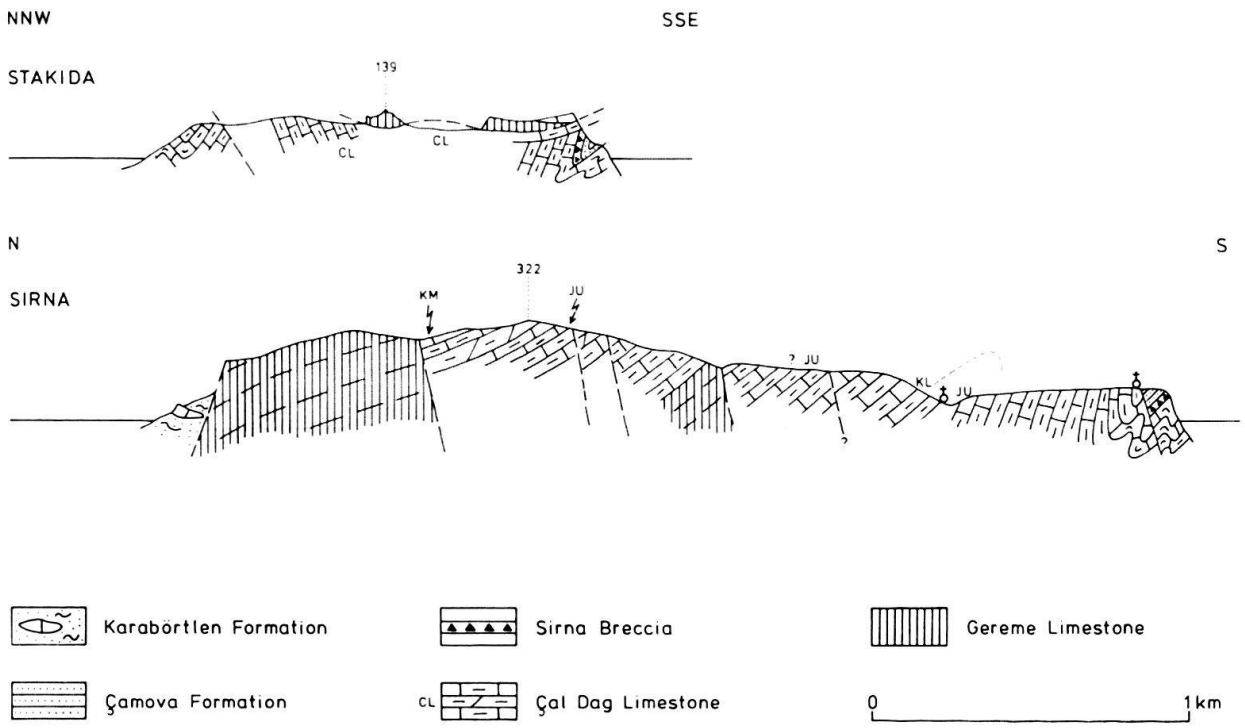

Fig. 31. Tectonic profiles through the islands of Sirna and Stakida.

and the Quaternary transgression. Still active faulting is suggested by young fault scarps hardly modified by erosion and by the general seismicity of the region.

5. The extension of the Lycian nappes in the Aegean region

The obvious region to investigate for the continuation of the Lycian nappes of southwestern Turkey is the area between the small Aegean islands, the Bodrum peninsula and the region of Fethiye-Köyceğiz. In this area stratigraphic sequences which closely ressemble the ones already described are found in the Datça Peninsula, on the islands of Symi and Tilos and possibly on the island of Rhodes.

Datça Peninsula

The sedimentary sequence of the Datça Peninsula has been described by OROMBELLI et al. (1967). The oldest stratigraphic unit, the Yelimlik Limestone, a massive, partly dolomitized limestone of Late Triassic to Liassic age, corresponds stratigraphically and lithologically to the Gereme Limestone. The uppermost part of this formation (as defined by OROMBELLI et al.) comprises thick-bedded cherty limestones with *Globochaete*, a planktonic form of unknown systematic position that indicates a definite pelagic influence and suggests a correlation with the lowermost Çal Dağ Limestone (? Upper Liassic). Above this, Middle to Upper Jurassic radiolarites (Sariabat Radiolarite) and marls and marly limestones with interbedded calcarenites (Kuru Dağ Marl) are found. Judging from OROMBELLI's descriptions, they could be compared with coeval rocks of the Bodrum peninsula (see p 60.). The overlying Cretaceous Mandalya Cherty Limestone is composed of pelagic limestones with bands and nodules of chert and closely ressembles the Cretaceous part of the Çal Dağ

Limestone: Both formation contain rich calpionellid faunas of Berriasian age and, from the Barremian onwards, lime turbidites with redeposited shallow-water material including displaced orbitolinids. According to OROMBELLI et al. (1967) the pelagic carbonate sedimentation persisted on the Datça Peninsula into the Lower Maastrichtian (cf. TATAR 1968). This of course would imply a major facies change within the depositional basin of the Köyceğiz series during the Late Cretaceous. An alternative interpretation would be a stratigraphic gap between the Sirna Breccia and the Çamova Formation with reworking of the scarce foraminiferal faunas in the latter.

The overlying Datça Flysch comprises, at the base, two members (Topanca and Kargi Members) that could be compared lithologically to the Çamova Formation; they are not dated by fossils. The Atolen Member is tectonically isolated from the rest of the sequence: it has been dated by larger foraminifera as Eocene. Locally blocks of pelagic limestones, radiolarites and pelagic lamellibranch limestones (Upper Triassic or Middle Jurassic?) are floating on top of the flysch, which, in the east, is overthrust by the Peridotite Nappe.

Symi

Data on the stratigraphic sequence of Symi are found in DESIO (1931), in CHRISTODOULOU (1969) and in OROMBELLI and POZZI (1967) who reexamined the material collected by DESIO. N. CREUTZBURG visited the island in 1970; he kindly allowed us to use his observations and put his samples and thin-sections at our disposal. From all these data it appears that the sequence of Symi is identical with the sequences described by us. It comprises the following formations:

1. Gereme Limestone: massive limestones with *Palaeodasycladus mediterraneus* (PIA). (CHRISTODOULOU 1969, N. CREUTZBURG, personal communication 1970.) OROMBELLI and POZZI (1967) compared this formation with the Salakos Limestone from Rhodes.
2. Çal Dağ Limestone: well-bedded limestones with bands and nodules of chert. They contain reworked pebbles of Berriasian limestones with calpionellids, displaced orbitolinids and planktonic foraminifera ranging from Aptian-Albian to Cenomanian.
3. The flysch is represented by well-bedded sequences of sandstones and shales and some outcrops of wildflysch (Karabörtlen Formation) containing blocks of red limestones and radiolarites.

Tilos (Piscopi)

According to DESIO (1931) the island of Tilos presents many analogies with the island of Symi. Judging from the unpublished observations by N. CREUTZBURG (personal communication 1971) lithologies of Lycian type are involved in a nappe edifice. This view seems to be confirmed by the data recently presented by CHRISTODOULOU and TATARIS (1972), we feel, however, that there are other possible interpretations of these data. CHRISTODOULOU and TATARIS (1972) recognize essentially two tectonic units, of which the upper would correspond to the Subpelagonian Zone and the lower to the Pindos Zone of continental Greece. According to CHRISTODOULOU and TATARIS (1972) the upper unit (series A) consists of neritic limestones containing Upper Triassic to Middle Liassic fossils. The lower tectonic unit (series B) comprises

thin-bedded pelagic limestones ranging in age from the Late Liassic to the Late Cretaceous with the intercalation of a shale-chert-sandstone complex with spilitic extrusives in the Jurassic. The overlying flysch is of Maastrichtian age and may range into the Paleocene.

From our examination of the material collected by N. CREUTZBURG we conclude that the Triassic and Liassic platform limestones, stratigraphically and litholocally, correspond exactly to the Gereme Limestone (and to the Yelimlik Limestone of the Datça Peninsula, OROMBELLI et al. 1967).

The tectonically lower sequence is dated by CHRISTODOULOU and TATARIS (1972) only in the Upper Liassic and from the Cenomanian onwards. In general the observed lithologies compare rather well with the Çal Dağ Limestone. The lowermost part of the sequence includes pelagic lamellibranch pack- to wackestones with redeposited pelagic wackestone pebbles, crinoids, calcitized radiolaria and fragments of altered basaltic volcanics. This facies is found in the Upper Triassic and in the Lower to Middle Jurassic the Mediterranean Mesozoic; it has also been noticed by OROMBELLI and POZZI (1967) and compared to the Upper Triassic of the Pindos Zone of Rhodes. An Upper Liassic to Middle Jurassic age, however, seems more probable. The shale-chert-sandstone complex of CHRISTODOULOU and TATARIS (1972) then could correspond to the Sariabat Radiolarite of Datça (OROMBELLI et al. 1967). In the Upper Jurassic to Lower Cretaceous (material of N. CREUTZBURG) we found grey bioclastic wackestones with calcite-replaced radiolarians, and sponge spicules, crinoid and ophiuroid ossicles, foraminifera, occasional calpionellids and *Saccocoma*. This facies matches again well with the Çal Dağ Limestone. Particularly striking is the analogy between the Cretaceous lithologies of Tilos described by CHRISTODOULOU and TATARIS (1972), and the Çal Dağ Limestone; as on the Datça Peninsula flysch sedimentation starts only during the Maastrichtian.

From the above it appears that the entire sequence from the island of Tilos corresponds well with the sequences of the Intermediate Complex, particularly with the one of the Datça Peninsula. We therefore would interpret the tectonic structure of the island as characterized by internal thrusts in the Intermediate Complex as observed in southwestern Turkey (Fig. 1 and 30) and on the islands of Symi (CHRISTODOULOU 1969) and Stakida (Fig. 31).

Kos

The pre-Neogene geology of this island is only poorly known, however, from the descriptions by DESIO (1931) the presence of a wildflysch formation with large olistoliths, possibly of Çal Dağ Limestone, can be inferred. This wildflysch could correspond to the Karabörtlen Formation or to the Atolen Member of the Datça Peninsula (OROMBELLI et al. 1967).

Rhodes and Alimnia

On the island of Rhodes, several slivers of allochthonous sediments which are thrusted on the Lower Oligocene Katavia Flysch, have been grouped by OROMBELLI and POZZI (1967) and MUTTI et al. (1970) as Archangelos Group. They comprise partly dolomitized skeletal limestone and marls of Carnian age (Cumuli Formation); shallow water dolomites and limestones with *Palaeodasycladus mediterraneus* (PIA);

limestones with *Cladocoropsis*, skeletal limestones with chert (Alimnia Member) and skeletal limestones with nummulites of Paleocene to Eocene age. Although these different limestone types occur in isolated masses scattered all over the Oligocene Flysch, they have been grouped together into one single formation (Salakos Limestone, OROMBELLI and POZZI 1967; MUTTI et al. 1970) that was thought to represent one continuous formation of shallow-water limestones. This formation was tentatively attributed by C. RENZ (1929) and by MUTTI et al. (1970) to the Parnasse Zone; but OROMBELLI and POZZI (1967) allocated it to the Gavrovo Zone because it occurs structurally below the Pindos Nappe (Profitis Ilias Group of MUTTI et al.). However, as AUBOUIN and DERCOURT (1970) pointed out, the formations grouped in the Archangelos Group could be derived from different tectonic units and may just represent allochthonous slivers of different origin resting on the flysch.

Of the different lithologies, the shallow-marine Upper Triassic to Liassic limestones that yielded Norian (see p. 58) and Early Jurassic floras (OROMBELLI and POZZI 1967), compare rather well with the Gereme Limestone. On the island of Alimnia these limestones are overthrust on a sequence of cherty limestones with lime turbidites containing displaced *Orbitolina*; this formation in turn recalls the Çal Dağ Limestone. The Paleocene-Eocene nummulite limestones are, however, not represented in the Lycian sequences, except for the nummulite limestones associated with the Atolen Member of the Datça Flysch.

Similar sequences occur, according to OROMBELLI and POZZI (1967) on the island of *Chalki*.

Towards the north-west, the westernmost ascertained occurrences of the Lycian complex are found on the islands Unia Nisia, Avgò and Karavi. Further west no sequences are found that are strictly comparable with the Lycian sedimentary sequences; most analogies, however, present some formations in the southwestern Argolis peninsula. Of these, the facies of the shallow-water to supratidal carbonates of the Upper Triassic–Lower Liassic "Pantokrator Limestone" (SÜSSKOCH 1967) is identical with the one of the Gereme Limestone. Both regions are further characterized by block-faulting and sinking during the Middle to Upper Liassic. Major differences, however, are found from the Middle Jurassic onwards: pelagic and turbiditic carbonate sedimentation in most of the Lycian complexes contrast with sedimentation of radiolarites and volcanic sandstones and the extrusion of basic volcanics in the Argolis (BANNERT and BENDER 1968; AUBOUIN et al. 1970). Associated olistoliths of Jurassic limestones and of serpentinites possibly indicate local compressional movements as early as the latest Jurassic or the Early Cretaceous; such Jurassic compressional movements, however, are not known from the Eastern Aegean Sea until now.

6. Conclusions

Our geological investigations, which were carried out independently from each other, demonstrate the striking similarities between the Mesozoic sequences of three fairly distant areas in the Lycian Taurus and of several islands in the southeastern Aegean Sea (Plate I). In southwestern Turkey these sequences are comprised in a number of thrust-sheets intercalated between an apparently autochthonous sequence in the south and the uppermost unit of the nappe pile, the Peridotite Nappe. Internally