AZHAR HJ. HUSSIN & NURAITENG TEE ABDULLAH: The Stratigraphy and Structure of the Cretan Pindos nappe

Dr. Azhar and Dr. Nuraiteng took turns to present the above-mentioned technical talk, which was billed as "Malam Crete" (Cretan Evening), following the talk by Dr. Nutalaya. To enable members get a better grasp of the various aspects of the talk, which is based on their Ph.D. theses area, the speakers have kindly furnished a summary of their talk.

Crete is composed of at least 6 structural units, and their relationships are shown in Fig. 1. The Plattenkalk and the Tripali unit constitute the lower nappe, and the Phyllite-Quartzite nappe, Tripolitza nappe, the Pindos nappe and possibly the High-grade metamorphics constitute the upper nappe.

The Pindos nappe is divided into 6 lithostratigraphical Formations ranging in age from Upper Triassic to probably Lower Miocene and constituting a total composite thickness of about 3000 m (Fig. 2).

The Limi Vigla Formation was deposited in Late Triassic-Jurassic and probably Lower Cretaceous. Shale, nodular shale, breccia, oolitic-pisolitic calciturbidite, calcilutite, massive oolitic limestone,

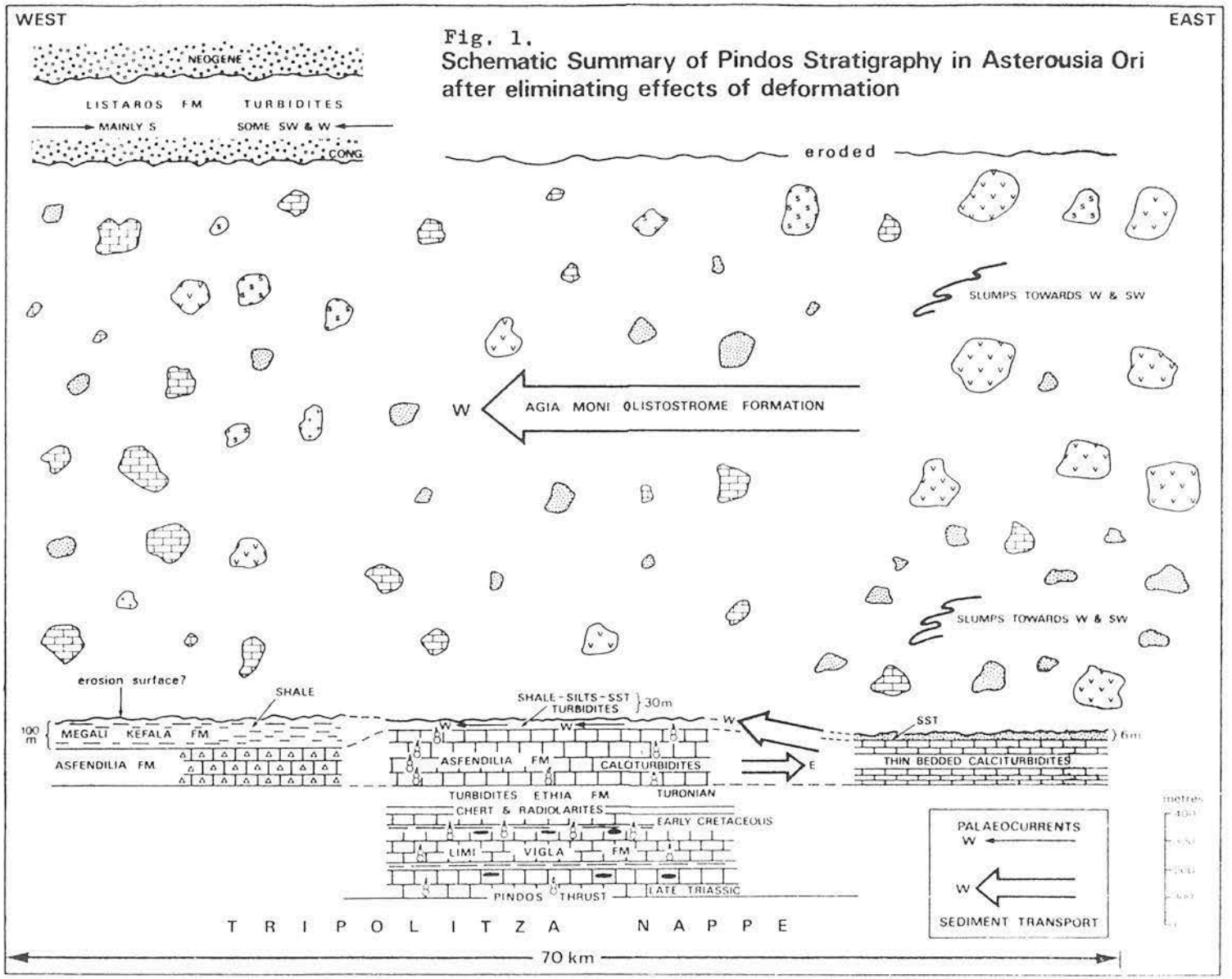

Fig. 1.
Schematic Summary of Pindos Stratigraphy in Asterousia Ori after eliminating effects of deformation

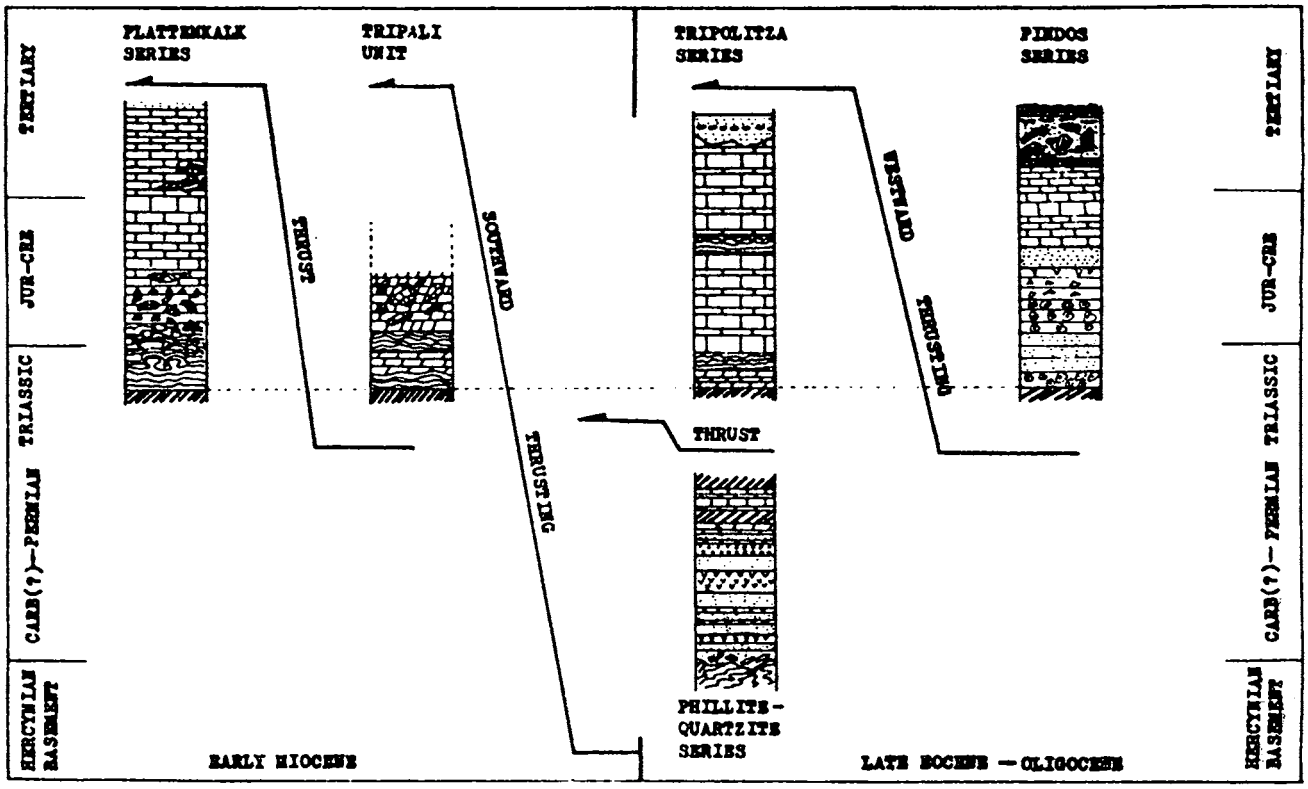

Fig. 2. The lithostratigraphical units of the Pindos nappe

ABS. AGE (m.y.)	AGE	ZONES
	LOWER EOCENE	G.(M.) aragonensis / G.(A.) bullbrooki (P7-P8?)
54		G.(M.) subbotinae (s.l.) (P6)
	PALEOCENE	G.(G.) pseudomenardii / G.(M.) velascoensis (s.l.) (P4-P5)
		G.(M.) angulata / G.(T.) pusilla (P3)
		G.(T.) uncinata (P2)
65		G.(T.) pseudobulloides (P1)
	EAASTRICHTIAN	Abathomphalus mayaroensis
		Racemiguembelina fructicosa / Gtr. contusa
71		Gtr. fornicata/Gtr. tricarinata
	CAMPANIAN	Globotruncana elevata
78	SANTONIAN	D. carinata / Gtr. elevata
		Dicarinella carinata

Fig. 3. Santonian to Lower Eocene foraminiferal zonal scheme for the Pindic-Ethia Series, Crete.

chert and red, Halobia-bearing limestone are present in this formation. During the Lower Cretaceous to Turonian, chert, radiolarite and siliciclastic sediments of the Ethia Formation were deposited. The Asfendilia Formation, of Upper Cretaceous to Lower Eocene age, is composed of calcibreccia, calciturbidite, calcilutite and shale. Thick breccias are found in the west. In central Asterousia Ori, the Asfendilia Formation is composed of thick calciturbidite and calcilutite. Eastwards, the formation consists of thinner bedded calciturbidite and calcilutite. This facies pattern suggests the derivation of carbonate clasts from the west.

Within the Asfendilia Formation, a total of 12 biozones based on the first appearances and extinctions of specific taxa of the Globigerinida were established to reflect the characteristic changes in the microfaunal assemblages observed throughout the interval from Upper Cretaceous to Lower Eocene (Fig. 3). The proposed zonation faciliates correlation of the sections examined here with other Pindic outcrops in Crete and in mainland Greece.

A similar faunal change was also observed in the assemblages of the larger benthonic foraminifera. The presence of these fossils in association with other shallow-water calcareous allochems (especially fragments of echinoderms and mollusks) and minor amounts of fine terrigenous material in the calciturbidites indicate that the Pindos basin was receiving derived materials from an adjacent reefal complex or complexes during this period of its depositional history.

The Megali Kefala Formation is characterized by a 6 m thick coarse-grained turbidite sequence in the east. This passes westwards into more than 100 m thick sequence of shale and silt-shale turbidites in the west. The Agia Moni Olistostrome Formation is composed of blocks of different lithologies and ages in a predominantly shale matrix. Paleocurrent directions, facies patterns and the change in thickness of the Megali Kefala Formation, as well as slumps in the Agia Moni Olistostrome, suggest that the siliciclastics were derived from the east.

In the west, the Agia Moni Olistostrome Formation is overlain by the Listaros Formation which is composed of conglomerate and turbidite. Paleocurrents suggest the transport direction was mainly to the south with minor westward movements.

The Pindos Series in the Asterousia Ori is strongly folded with axial directions on N-S and NNW-SSE. The axial planes vary from steeply dipping to slightly overturned. Near the base of the Pindos thrust sheet and in the Tertiary turbidites, some minor folds with axes oriented E-W have been found. The fold directions are interpreted as being related to two different periods of folding.

The sedimentological and structural observations together suggest the Pindos "isopic zone" in Asterousia Ori was oriented north-south, contrary to the generally held opinion that the orientation of the Cretan isopic zones is east-west. The tectonic development of Crete is interpreted to have occurred in two stages. (i) the westward transport of the upper nappe sometime in Eocene. (ii) the southward transport of the upper nappe during Oligocene-Miocene onto the lower nappe (see Fig. 1).