Tr. J. of Earht Sciences
3 (1994) 23-28
© TÜBİTAK

Carboniferous and Permian Radiolarite Blocks From the Karakaya Complex in Northwest Turkey

Aral I. OKAY
İstanbul Teknik Üniversitesi, Maden Fakültesi, Jeoloji Mühendisliği Bölümü, Ayazağa, İstanbul-TÜRKİYE
Helfried MOSTLER
Instituts für Geologie und Palaontologie Universitat Innsbruck, Innrain 52 A-6020 Innsbruck - AUSTRIA

(Received: 10 / 8 / 1993; Accepted 2 / 11 / 1993)

Abstract: The Karakaya Complex is a strongly deformed, partially metamorphozed, heterogeneous assemblage of Permo-Triassic clastic, volcanoclastic, and basic volcanic rocks with wide outcrops in the Sakarya Zone of the Pontides. Here, we report for the first time, Upper Paleozoic pelagic sediments found as exotic blocks in the Karakaya Complex in the Biga Peninsula of northwestern Turkey. One such block occurs in the sandstones of the Hodul Unit of the Karakaya Complex northeast of Balya. It is a two-meter large block made up of intercalated, thinly bedded, red limestone and radiolarian chert. A sample from the limestone has yielded Bashkirian (Middle Carboniferous) conodonts. Blocks of radiolarian chert also occur in the siliceous shales of the Çal Unit of the Karakaya Complex southeast of Çan. A sample from the radiolarian chert has yielded Sakmarian to Artinskian (Lower Permian) radiolaria.

The discovery of Upper Paleozoic pelagic sediments in the Karakaya Complex indicates that the Karakaya Complex does not represent Triassic rift deposits as generally believed, but probably represents active margin units of Permo-Triassic age and includes possible oceanic acceretionary material as old as Carboniferous.

Introduction

The Karakaya Complex is a complexly deformed, partially metamorphozed, heterogeneous assemblage of Permo-Triassic clastic, volcanoclastic and basic volcanic rocks that represent various active margin units of the Paleo-Tethys (Tekeli, 1981; Okay et al., 1991). It outcrops over large regions in the Sakarya Zone of the Pontides and forms the basement to the relatively little deformed Upper Mesozoic sedimentary cover that starts with a Liassic transgression (Figure 1, Şengör et al., 1984; Okay, 1989). Detailed field work in the Biga Peninsula in northwestern Turkey has shown that the Karakaya Complex in this region consists of four Permo-Triassic tectonostratigraphic units that are generally juxtaposed along steeply dipping faults (Okay et al., 1991). The Nilüfer Unit is largely made up of metatuffs and metavolcanic rocks with marble and phyllite intercalations and constitutes the lowest of the Karakaya units. It probably represents Permo-Triassic fore-arc to intra-arc deposits. A thick sequence of arkosic sandstones overlain by the Norian shales, siltstones and olistostromes with Upper Permian limestone blocks constitutes the Hodul Unit. The Orhanlar Greywacke is made up of monotonous greywackes with subordinate shale and small Lower Carbonifereous limestone blocks and probably represents an accretionary complex (Okay et al., 1991). The Çal Unit consists of basic volcanic and pyroclastic flows, debris and grain flows with spilite and Upper Permian limestone fragments and blocks, volcanogenic sandstone and minor amounts of red radiolarian chert, calcarenite and pelagic limestone. Large blocks of Middle Triassic limestone (the Camialan Limestone) are associated with the Çal Unit (Okay et al., 1991).

One major problem with the interpretation of the the Karakaya Complex as Permo-Triassic active margin units of the Paleo-Tethys is the absence of Upper Paleozoic pelagic sediments and associated ophiolite in the Karakaya Complex that would show the existence of a deep and probably oceanic basin during these time intervals in the Sakarya Zone. Here, we report for the first time, Upper Paleozoic pelagic sediments that occur as blocks in the Karakaya Complex.

Paleozoic Pelagic Sedimentary Blocks in the Karakaya Complex

Carboniferous Pelagic Limestone-Radiolarite Blocks in the Hodul Unit

The Hodul Unit in northeast of Balya is made up of a several-hundred-meter thick, thickly bedded to massive arkosic sandstones that pass to greywackes

with numerous Upper Permian neritic limestone blocks up to one kilometer in size (Figure 2). The upper part of the Hodul Unit with the olistoliths contains a Norian macrofauna (Okay et al., 1991).

Blocks of pelagic sedimentary rock are very rare in the Hodul Unit. One such rounded block is found 2.5 km southeast of the village of İğneciler on the Balya-Ilıca road in the greywacke-type sandstones (Figure 2). It is a two-meter large block of red, thinly bedded radiolarian chert intercalated with thinly to medium bedded red limestone (radiolarian wackestone). The block has a discontinuous mm-scale envelope of spilitized basic volcanic rock which indicates that originally it was closely associated with basic volcanic rocks.

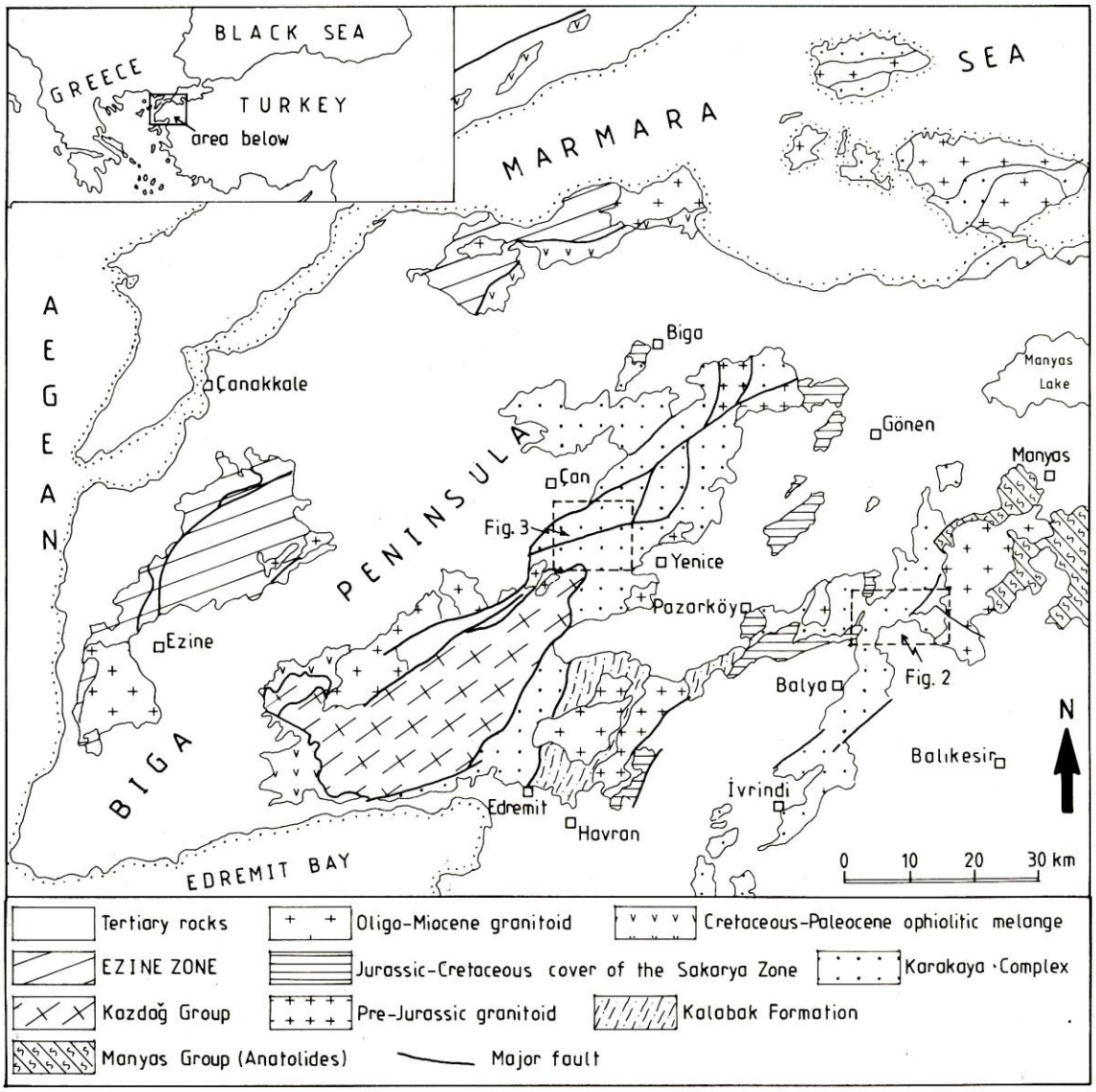

Figure 1. Tectonic map of northern Turkey showing the outcrops of the Karakaya Complex. The locations of Figure 2 and 3 are indicated.

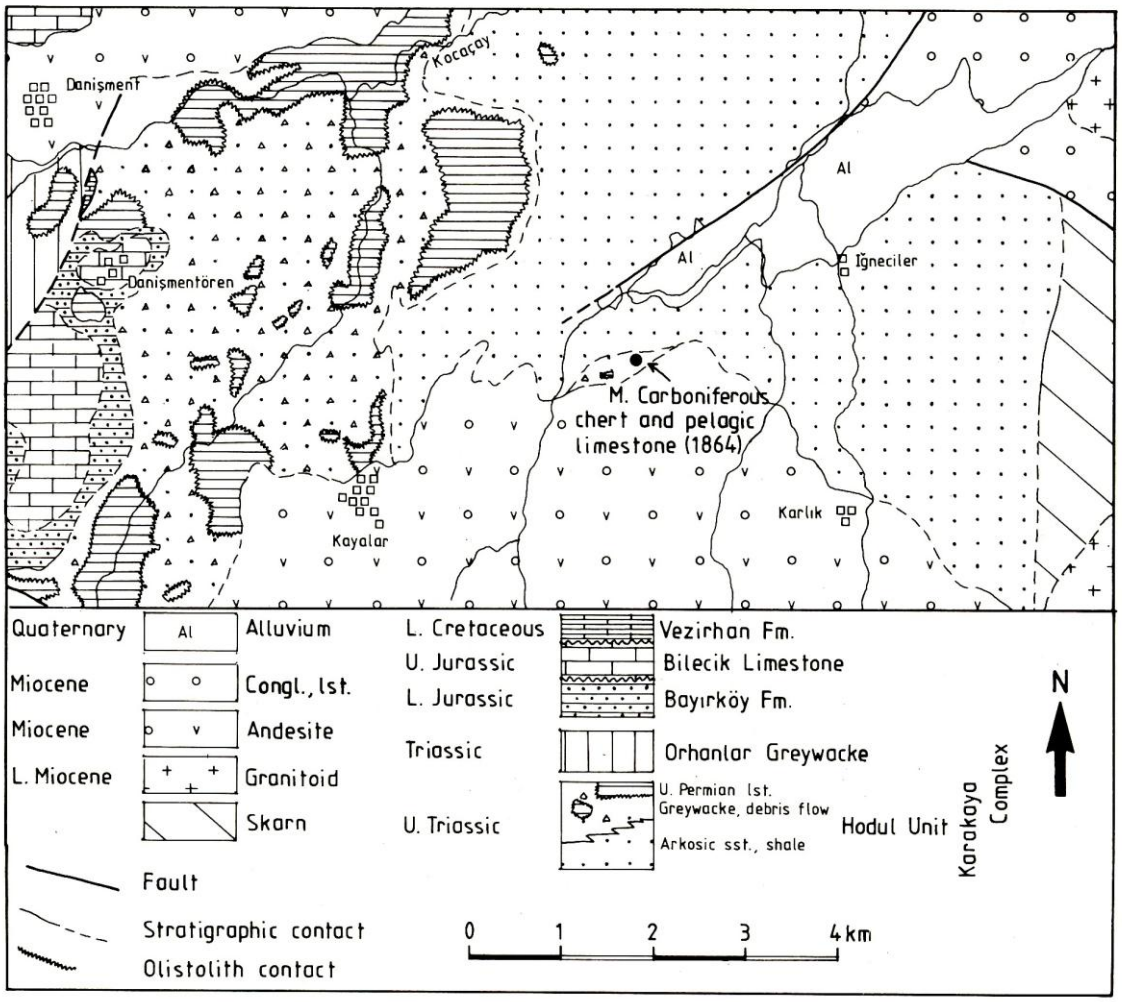

Figure 2. The geological map of the region north of Balya. The locality of the Middle Carboniferous pelagic limestone -radiolarite block (1864) is indicated.

The radiolarian chert (sample 1864B) has not yielded any identifiable radiolaria; however, the intercalated red pelagic limestone (1864A) contains the following conodonts that are characteristic of the Middle Carboniferous (Bashkirian): *Idiognathoides* cf. *optimus, Ozarkodina* sp., and *Hindeodus* sp.

Lower Permian Radiolarian Chert Blocks in the Çal Unit

The Çal Unit in its type locality around the village of Çal consists of spilized basic volcanic and pyroclastic rocks, grain and debris flows with Upper Permian neritic limestone and spilite rock fragments, volcanogenic sandstones and rare calciturbidites, radiolarian chert and pelagic limestone. It is uncorformably overlain by the Liassic sandstones of the Bakırköy Formation (Figure 3). In comparison with the Hodul Unit, the Upper Permian limestone blocks in the Çal Unit are smaller in size and are closely associated with basic volcanic rocks. The calciturbidites consist entirely of transported Upper Permian limestone fragments. The whole sequence is probably of Late Permian age and is highly tectonic which makes it very difficult to establish the primary stratigraphy.

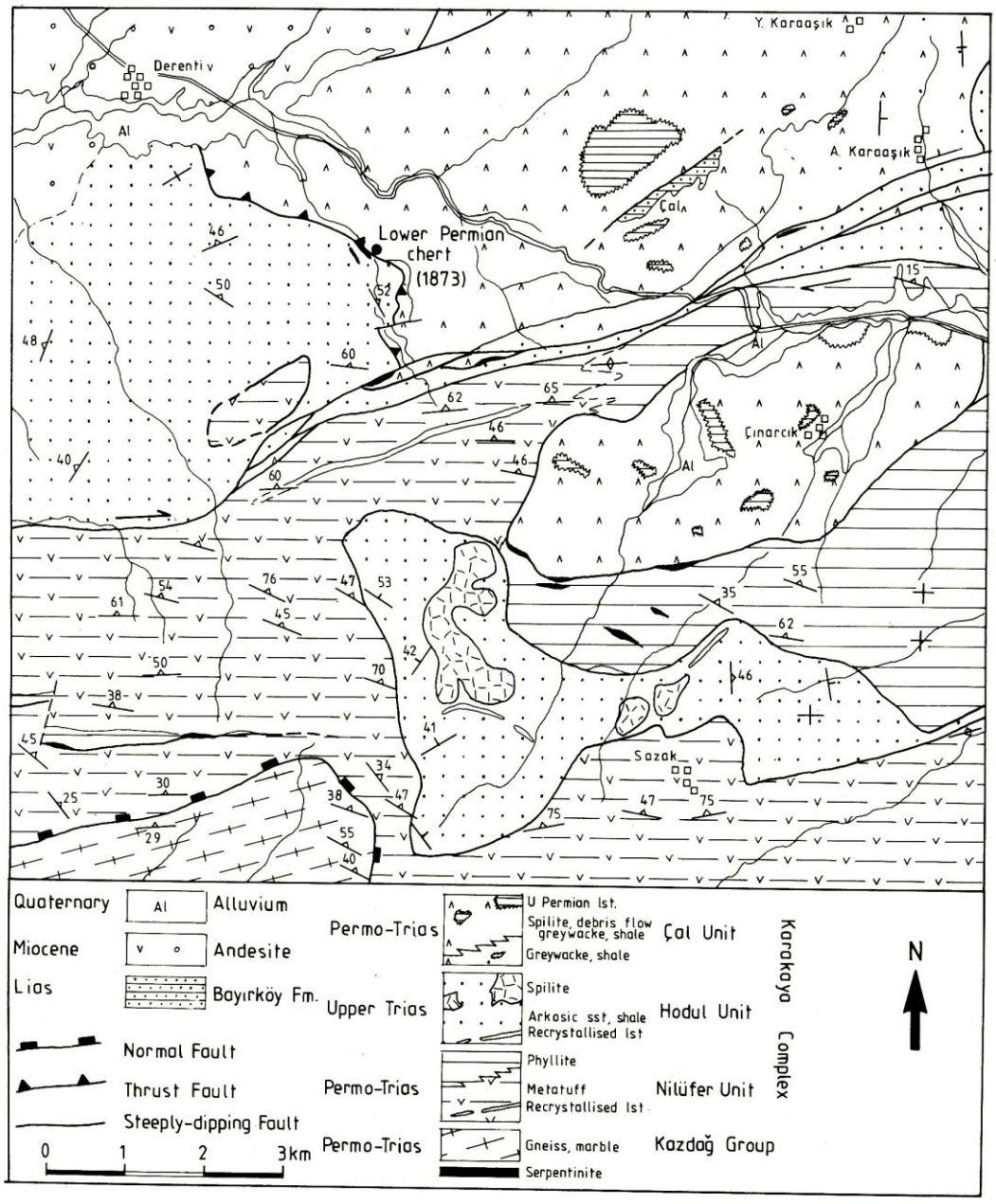

Figure 3. The geological map of the region south of Çan. The locality of the Lower Permian radiolarite block (1873) is shown.

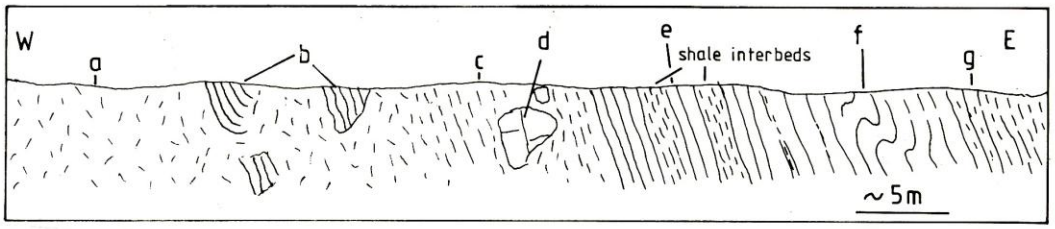

Figure 4. Field sketch of the road section with the Lower Permian radiolarian cherts in the Çal Unit. a) Highly fractured, very finely grained, hard, dark grey, siliceous shale; bedding not recognizable. b) Small radiolarian chert blocks. c) Pale greenish grey shale with cleavage. d) Recrystallized, white massive limestone (most probably Upper Permian). e) Green radiolarian chert with 2-3 cm thick beds. f) Thinly to medium bedded, red radiolarian chert with slump structures. g) Green, argillaceous radiolarian chert.

Several blocks of radiolarian chert ranging in size from 0.5 to 15 meters large, and a white, recrystallized, neritic limestone only a few meters large and probably of Late Permian age occurred in the highly fractured, dark grey, volcanogenic, siliceous shales of the Çal Unit 3.5 km southeast of the village of Derenti (Figures 3 and 4). The largest block is ca. 15 m thick and consists of red and green, thinly to medium bedded radiolarian chert with thin shale interbeds. Such blocks have probable tectonic contacts with shales, marked by the appearance of cleavage near the block margins (Figure 4), and may represent tectonically accreted slices into the Çal Unit. A sample from this block (1873C) contains a radiolarian fauna that completely consists of Entactinarian and Spumellarian. Surprizingly, Albailellidae and Nassellaria are not present. The recognizable forms are *Latentibifistula* cf. *triacanthophora, Holdisphaera* sp., *Praedeflandrella* sp., and *Copicyntra* sp. which indicate an age range from Early Sakmarian to Artinskian.

Conclusions

The presence of Middle Carboniferous and Lower Permian pelagic sedimentary blocks in the Karakaya Complex indicates the presence of a pelagic and, most probably, a deep marine basin in northwestern Turkey during the Late Paleozoic, and shows that the Karakaya Complex does not represent deposits of a Triassic rift and its closure products as suggested by Bingöl et al. (1975), Şengör and Yılmaz (1981), Şengör et al. (1984), and Yılmaz (1990). The latter three studies interpret the Karakaya Complex as a back-arc rift that opened during the Triassic above the south-dipping Paleo-Tethyan subduction zone by rupturing a Permian carbonate platform. The Akgöl Flysch in the central Pontides (Tüysüz, 1990) is interpreted by these authors as an accretionary complex related to the Paleo-Tethyan subduction. However, the distinction between the Karakaya Complex and Paleo-Tethyan accretionary material as represented by the Akgöl Flysch is artificial, and both of these probably represent accreted material formed during the Permo-Triassic subduction of the Paleo-Tethys as originally suggested by Tekeli (1981). The absence or scarcity of Middle Carboniferous and Lower Permian neritic sediments in the Karakaya Complex makes it very unlikely that the pelagic sediments of these ages are rift-related. The Upper Paleozoic pelagic sedimentary and associated volcanic rocks and small serpentinite slivers (Figure 3) in the Karakaya Complex in the Biga Peninsula most probably represent accreted ocean floor material. The scarcity of such Upper Paleozoic pelagic sediments in the Karakaya Complex is probably due to subduction of the ocean floor sediments with minor accretion; so that the Karakaya Complex largely represents trench and arc sediments of the Paleo-Tethys. In this model, the Paleo-Tethys in northwestern Turkey estimates to an age span which extends at least from the Early-Late Carboniferous to Late Triassic with subduction occurring during the Late Permian to Late Triassic, which is the probable total age span of the Karakaya Complex (Okay et al., 1991).

Late Paleozoic radiolaria are rare in the Tethyan region and are previously described only from Crete (Kozur and Krahl, 1987), from Oman (De Wever et al., 1988), from Sicily (Catalano et al., 1989, 1991), and recently from the Mashad region in Iran (Ruttner, 1991). In Crete, Middle Permian (Wordian) radiolaria occur within the Phyllite-Series which apparently shows pelagic sedimentation from Middle Carbonifer-

ous (Bashkirian) to the Early Triassic (Kozur and Krahl, 1987). In Sicily, Lower Permian radiolaria are described from limestone olistoliths. In Oman, Upper Permian (Upper Guadalupian) red radiolarian cherts overlying a volcanic basement occur in the Hawasina nappes that represent the northward-facing, passive margin of the Gondwana platform. These cherts are interpreted to indicate Late Permian rifting related to the opening of the Neo-Tethys. Here, described Carbonifereous and Permian radiolaria are reported for the first time from the Sakarya Zone of the Pontides.

Acknowledgements

This study was supported by TPAO and by TÜBİTAK-GloTek. We thank Leopod Krystyn for discussions and assistance with the samples. Drs. Demir Altıner and M. Cemal Göncüoğlu of Middle East Technical University are thanked for their careful review which led to the improvement of the manuscript.

References

Bingöl, E., Akyürek, B and Kormazer, B., 1975. Geology of the Biga Peninsula and some characteristics of the Karakaya blocky series. In : Congress of Earth Sciences on the Occasion of the Fiftieth Anniversary of the Turkish Republic, Maden Tetkik ve Arama Enstitüsü, Ankara, 71-77.

Catalano, R., Stefano, P.D. and Kozur, H., 1989. Lower Permian albaillelacea (radiolaria) from Sicily and their stratigraphic and paleogeographic significance. Ren. Accad. Sci. Fis. Mat. Napoli, 4, 80-113.

Catalano, R., Stefano, P.D. and Kozur, H., 1991. Permian circumpacific deep-water faunas from the western Tethys (Sicily, Italy)- New evidences for the position of the Permian Tethys. Palaeogeogr. Palaeocli. Palaeoeco., 87, 75-108.

De Wever, P., Bourdillon-de Grissac, C. and Bechennec, F., 1988. Permian age from radiolarites of the Hawasina nappes, Oman Mountains. Geology, 16, 912-914.

Kozur, H. and Krahl, J., 1987. Erster Nachweis von Radiolarin in tethyalen Perm Europas. N. Jb. Geol. Palaont. Abh., 174, 357-372.

Okay, A.I., 1989. Tectonic units and sutures in the Pontides, northern Turkey. In: A.M.C. Şengör, Tectonic Evolution of the Tethyan Region, Kluwer Academic Publishers, Dordrecht, 109-115.

Okay, A.I., Siyako, M. and Bürkan, K.A., 1991. Geology and tectonic evolution of the Biga Peninsula, northwest Turkey. Bulletin Technical University Istanbul, 44, 191-256.

Ruttner, A.E., 1991. The southern borderland of Laurasia in NE Iran. European Union of Geosciences, Strasbourg, Terra Abstracts, 3, 256-257.

Şengör, A.M.C. and Yılmaz, Y., 1981. Tethyan evolution of Turkey: A plate tectonic approach. Tectonophysics, 75, 181-241.

Şengör, A.M.C., Yılmaz, Y. and Sungurlu, O., 1984. Tectonics of the Mediterranean Cimmerides: Nature and evolution of the western termination of Paleo-tethys. Geol. Soc. London Spec. Publ., 17, 77-112.

Tekeli, O., 1981. Subduction complex of pre-Jurassic age, northern Anatolia, Turkey. Geology, 9, 68-72.

Tüysüz, O., 1990. Tectonic evolution of a part of the Tethyside orogenic collage: the Kargı Massif, northern Turkey. Tectonics, 9, 141-160.

Yılmaz, Y., 1990. Allochthonous terranes in the Tethyan Middle East: Anatolia and the surrounding regions. Phil. Trans. R. Soc. Lond. A. 331, 611-624.