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A PELAGIC PALAEOCENE SEOUENCE IN THE BİGA PENINSULA NORTHWEST TURKEY

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ABSTRACT.- A sequence of pelagic limestone, calciturbidite, debris flow, greywacke, basalt and limestone blocks. up to several hundred metres across, occur west of the town of Biga in northwest Turkey. The pelagic limestones in this seguence, named as the Ballıkaya formation, comprise pelagic foraminifera of Palaeocene age. Neritic limestone of Mid-Eocene age lies unconformably over the Ballıkaya formation. The age and the sedimentary environment of the Ballıkaya formation indicate the presence of a tectonically active deep sea environment in northwest Turkey during the Palaeocene, and constrain the main Alpide deformation in northwest Turkey to the Late Palaeocene - Early Eocene interval.

İNTRODUCTİON

Late Cretaceous and Palaeocene are critical tectonic periods in Anatolia. Subduction, ophiolite obduction, regional metamorphism and Aipide deformation occurred or started during this time span. Upper Cretaceous-Palaeocene stratigraphy has, therefore, a special importance in Turkey. However, Upper Cretaceous-Palaeocene outcrops have not been described over a very large region extending from Bursa westwards to the Aegean Sea, and information of the palaeogeographic and tectonic evolution of northwest Turkey during the Late Cretaceous and Palaeocene is very limited. In this context the discovery of a Palaeocene seguence in the Biga peninsula in the immediate vicinity of the town of Biga is of special importance for the tectonics of northwest Turkey. This paper describes the Palaeocene sequence in Biga and discusses its significance for the tectonics of western Anatolia.

GEOLOGİCAL SETTING

The eastern part of the peninsula belongs to the Sakarya zone of the Pondides. The Sakarya zone consists of Late Triassic subduction-accretion units, collectively named as the Karakaya complex, unconformably overlain by a Jurassic-Cretaceous sedimentary sequence. Rocks of the Karakaya complex crop out widely in the eastern part of the Biga peninsula (Bingöl et al., 1975; Okay et al., 1991). These rocks are unconformably overlain by the Liassic Bayırköy formation and the Middle-Upper Jurassic Bilecek limestone. Cretaceous rocks generally do not crop out in the Biga peninsula and farther east, probably due to erosional removal during the Tertiary. In the Biga peninsula the Jurassic Bileck limestone is unconformably overlain by the Upper Oligocene-Miocene Volcanic and volcanoclastic rocks. An exception to this situation is observed west of Balya, where a sequence of Bilecik limestone, 800 m thick, is overlain unconformably by thinly to medium bedded pelagic shaley limestones. The pelagic limestones are only 30 m thick, and are in turn unconformably overlain by the Neogene Volcanic rocks. They contain the foraminifera *Bonetocardiella conoidea,* characteristic for the Albian to Cenomanian period (Okay et al,

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1991). Similar pink pelagic limestone seguences with *Hedbergella* sp. form small outcrops west of Gönen, around the margins of the Hamdibey-Kalkım Neogene basin and north of Balya. In these regions the stratigraphic position of these Cretaceous limestones is not clear. Upper Cretaceous ophiolitic melanges crop out in the centre of the Biga peninsula along a zone extending from Küçükkuyu to Karabiga (Fig. 1). Upper Cretaceous pelagic limestone blocks have been described in these ophiolitic melanges, which mark the western boundary of the Sakarya zone (Brinkmann et al., 1977; Okay et al., 1991).

The Palaeocene seguence described in this paper occurs immediately west of the town of Biga and forms an outcrop, two kilometres wide, surrounded by the Neogene volcanic rocks and Eocene sandstones.

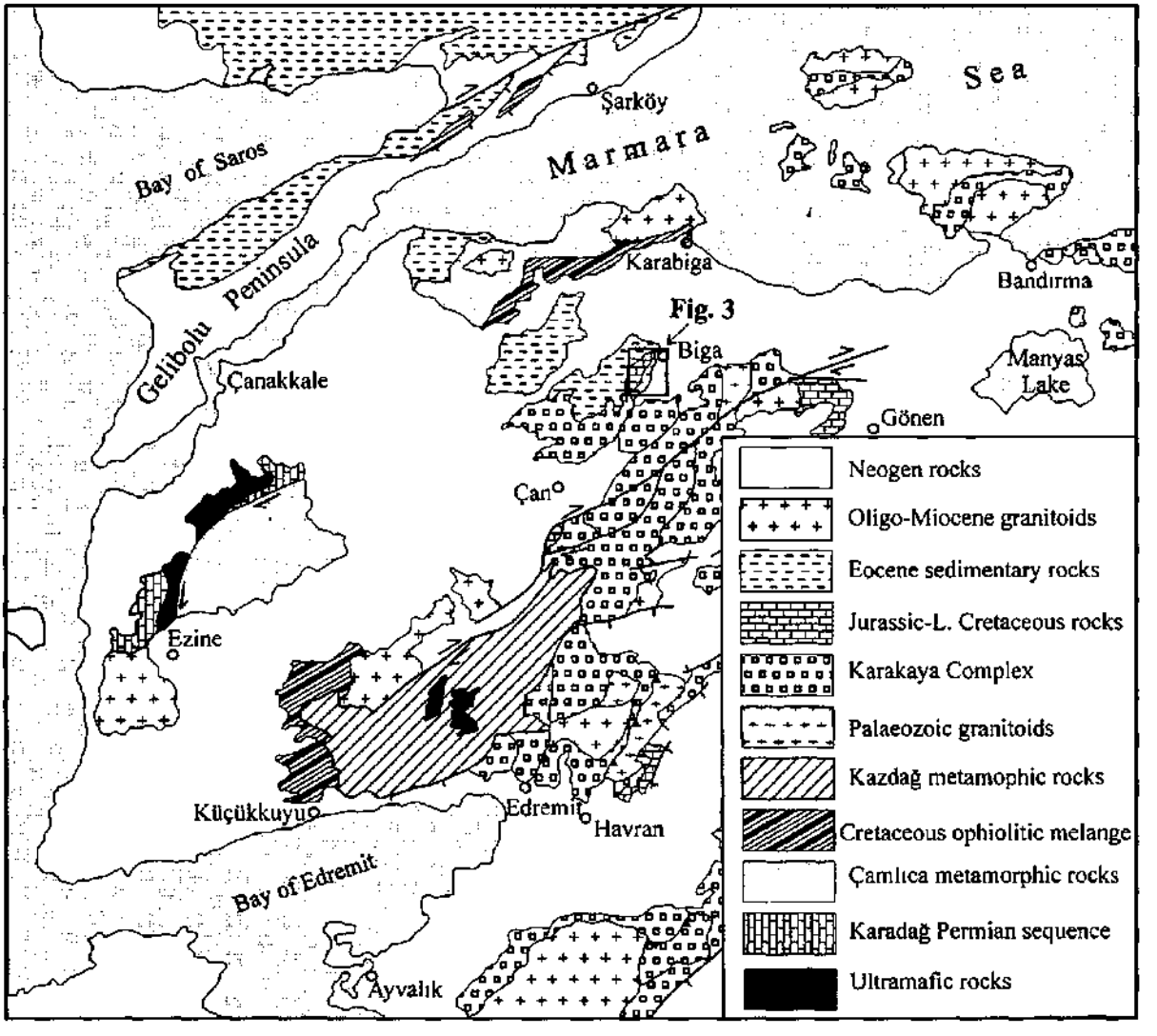

Fig. 1- Simplified geological map of the Biga peninsula and the surroundings (Okay et al., 1991). The area of study southwest of Biga is outlined.

GEOLOGY OF THE WEST BİGA REGİON

In the area studied, southwest of the town of Biga, the Palaeocene Ballıkaya formation is the lowest exposed unit (Fig. 2). It is overlain unconformably by the Eocene limestone, sandstone and shale. The Palaeocene and Eocene seguence is cut by a Neogene microgranodiorite and is overlain unconformably by the Neogene acidic tuffs.

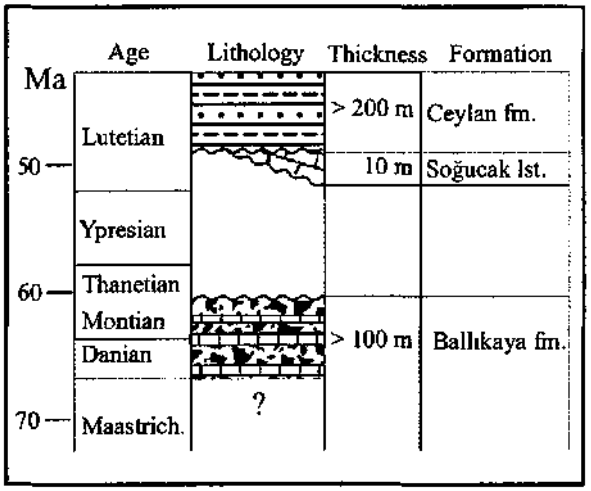

Fig. 2- Stratigraphic section west of Biga

Ballıkaya formation

The Ballıkaya formation, first described in this study, consists of pelagic limestone, calciturbidite, debris an grain flows, greywacke and basalt and large number of neritic limestone blocks of various sizes. The name of the formation comes from the Ballıkaya hill, 500 m west of the town of Biga, where the best and most representative outcrops are located (Fig. 3). The geographic coordinates of the type section are north 40°13'25" and east 27° 14'15".

Most of the Ballıkaya formation consists of grey, pale grey, thickly bedded to massive limestone blocks up to several hundred metres across. Lithologically these limestone blocks resemble the Jurassic Bilecik limestone, which outcrops around Balya and Gönen. The limestone blocks in the Ballıkaya formation constitute the hills west of Biga. The matrix to the blocks, which crops out in the valleys, consists of pelagic limestone, calciturbidite, debris and grain flows, greywacke and basalt. In the previous Studies, the matrix was not recognized and the region was ascribed to the Bilecik limestone (Okay et al., 1991).

Pelagic limestones and the intercalated calciturbidites are best observed on the Ballıkaya hill west of Biga. Similar outcrops of pelagic limestone also occur southwest of the village of Havdan (Fig. 3). The pelagic limestones are red, violet, thinly to medium bedded micrites with radiolaria and foraminifera (Plate 1 - fig. 2). The micrites are intercalated with pink, red and white calciturbidites and calcirudites. The limestone clasts in the calciturbidites and calcirudites are poorly sorted (0.5-25 cm) and medium to poorly rounded (Plate 1 - fig. 1). Red, brown debris flows with a volcanogenic matrix are observed on the Ahlatlı hill southwest of Biga. The debris flows comprise poorly sorted (1-75 cm) limestone and mudstone clasts and are intercalated with, grey, laminated mudstones and silstones. Greyish green greywacke and spilitic basalt forms rare outcrops in the Ballıkaya formation east of Havdan.

The Ballıkaya formation is dated through the abundant pelagic foraminifera in the red pelagic limestones. Three samples of micritic limestone around the Ballıkaya hill (sample numbers 146A, B, 163A) contain radiolaria and the foilowing foraminifera characteristic for the Early Palaeocene (Danian) *Morozovella pseudobulloides* (Plummer), *M. uncinata* (Bolli), *M.* cf. *trinidadensis* (Bolli), *Morozovella* sp., *Planorotalites compressa* (Plummer), *Planorotalites* sp., *Globigerina triloculinoides*

Plummer, *Globigerina* sp., *Racemiquembelina* sp., *Bolivina* sp. (Plate 1 - fig. 3). Another specimen of micrite from the same region (number 160) contains *Morozovella velascoensis* (Bolli), *Planorotalites* sp. and Radiolaria indicative for the Late Palaeocene (Thanetian) (Plate 1 - figs. 4 and 5). Another micrite sample collected from southwest of the village of Havdan (sample number 93) contains *Planorotalites compresssa* (Plummer), *Planorotalites sp., P. Morozovella sp., Globoconusa* sp., *Globotruncanita* cf. *stuarti* (d'Lapparent), *Globotruncanita* sp., *Abathomphalus* sp. (Plate 1 - fig. 6). These foraminifera indicate latest Maastrichtian and earliest Palaeocene. The Globotruncana forms in the sample are probably reworked from the Upper Cretaceous limestones. The foraminifera in the pelagic limestones indicate a Palaeocene age (Danian-Thanetian) for the Ballıkaya formation.

The presence of large number of limestone blocks in the Ballıkaya formation, as well as the scarcity of bedding, make the estimation of its thickness difficult. However, a minimum thickness of two hundred metres can be estimated for the Ballıkaya formation. In the area of study the base of the Ballıkaya formation is not observed, it is overlain unconformably by the Soğucak limestone of Middle Eocene age.

Soğucak limestone

The neritic limestones, that lie unconformably over the Ballıkaya formation, are called Soğucak limestone following the stratigraphic nomenclature in the Thrace basin and in the Biga peninsula. (Siyako et al., 1989). The Soğucak limestone is made up of yellowish, thickly bedded to massive reefal limestones with abundant nummulites, corals and algae. In the study are the Soğucak limestone is only observed on the Ballıkaya hill west of Biga (Fig. 3). In this locality limestones with abundant nummulites lie unconformably over the limestone blocks of the Ballıkaya formation. In other regions Eocene sandstones and shales lie directly over the Ballıkaya formation without the intervening Soğucak limestone (Fig. 3). West of Biga the Soğucak limestone has a thickness of about ten meters and is overlain by the sandstones and shales of the Ceylan formation. The contact between the Soğucak limestone and the Ceylan formation could not be observed in the field.

The Soğucak limestone west of Biga contains abundant nummulites and other benthic foraminifera. Samples of the Soğucak limestone from this region contain *Nummulites beaumonti* d'Archiac and Haime, *Nummulites* spp., *Discocyclina* sp., *Asterocyclina* sp., *Operculina* sp., *Quinqeuloculina* sp., Rotaliidae, Rupertidae, *Anomalina* sp., and indicate a Middle Eocene (Lutetian) for the Soğucak limestone.

Ceylan formation

Eocene sandstone, siltstone, mudstone and microconglomerate form a belt around the Ballıkaya formation west of Biga (Fig. 3). This Clastic sedimentary unit has been named as the Ceylan formation following the stratigraphic nomenclature in the Thrace basin and the Biga peninsula (Siyako et al., 1989). The dominant lithology of the Ceylan formation in the area of study is medium bedded, fine-grained yollowish brown sandstones. Locally siltstone, mudstone and microconglomerate beds are intercalated with the sandstones. Outcrops of the Ceylan sandstones are very rare in the area studied. In Thrace, the Ceylan formation is known to consist of siliciclastic turbidites.

No fossils have been found in the Ceylan formation in the area studied. However, its stratigraphic position above the Lutetian Soğucak Limestone, as well as palaeontological data from other parts of the Biga peninsula (Siyako et al., 1989) indicate a Mid-to Late Eocene age for the Ceylan formation west of Biga.

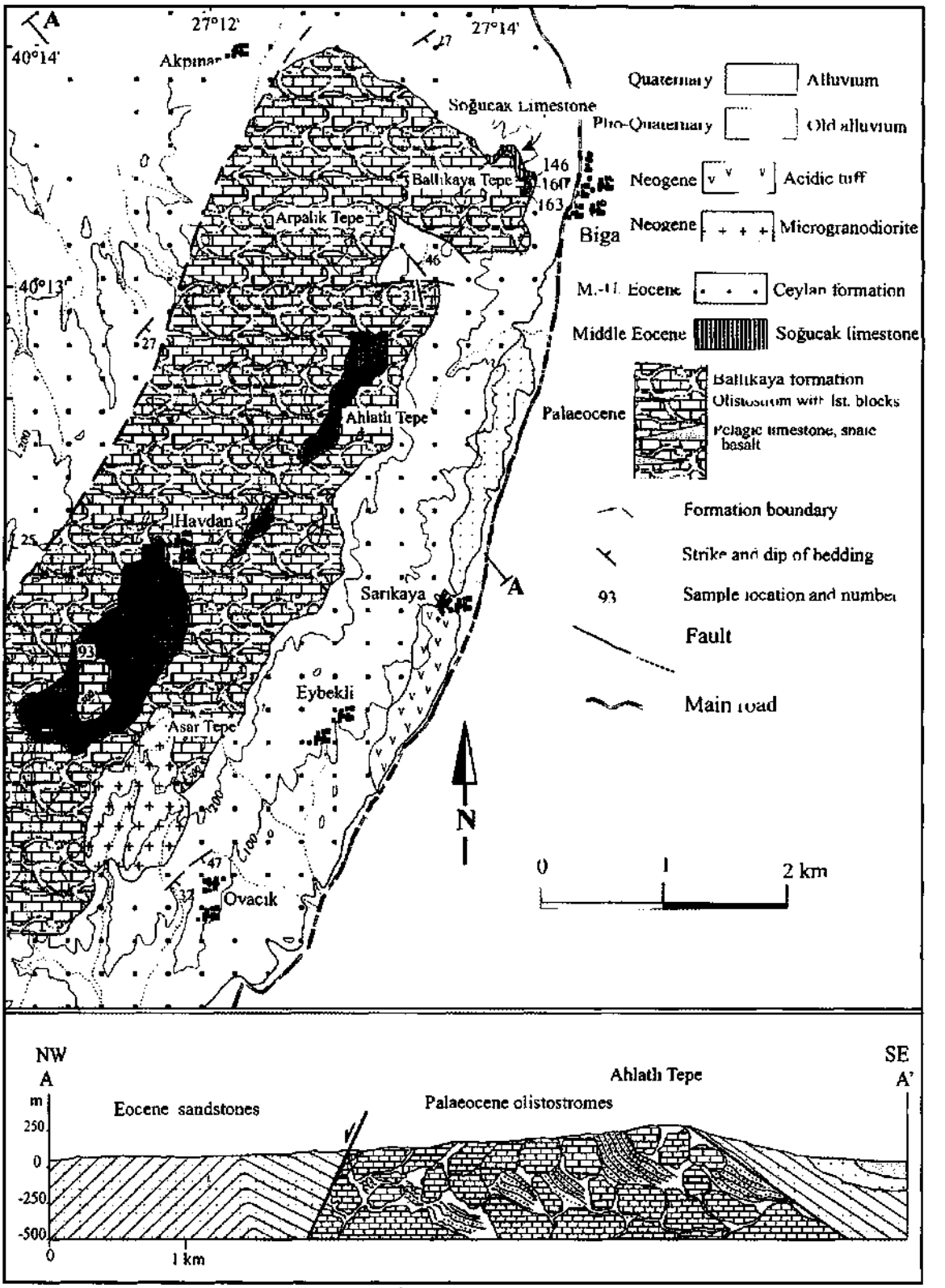

Fig. 3- Geological map and cross-section west of Biga. For location see Fig. 1

Neogene rocks

A small microgranodiorite cuts the Ballıkava and Ceylan formations in the southwest. The microgranodiorite consists mainly ot quartz and plagioclase with minor amounts of bioiite and amphibole. Extensive zoning in the plagioclase crystals in microgranodiorite indicates a shallow intrusion.

On the main road between Biga and Çan, white acitic tuffs lie unconformably over the Ceylan formation. The microgranodiorite and the acidic tuff are products of the extensive late Oligocene-Early Miocene calc-alkaline magmatism in northwest Turkey.

DISCUSSIONS AND CONCLUSIONS

A Palaeocene sequence of pelagic limestone, calciturbidite, debris and grain flows, greywacke, basalt and large number of limestone blocks crops out west of the town of Biga. This sequence is unconformably overlam by the Soğucak Limestone of Middle Eocene age.

Palaeocene outcrops in the northwestern Turkey are scarce. Upper Cretaceous-Palaeocene limestones have been described form the northern margin of the Gelibolu peninsula under the name of Lört formation (Önal, 1986). Blocks of Upper Cretaceous (Maastrichtian) and Lower to mid-Palaeocene (Danian and Montian) pelagic limestone, together with blocks of serpentinite, metadiabase, reefal Upper Eocene limestone blocks have been described as olistoliths in an Upper Eocene Clastic seguence north of Şarköy (Okay and Tansel, 1994). The Lört limestone could also be a large block in the Eocene seguence.

The Palaeocene rocks in Biga, Gelibolu and Şarköy indicate the presence of a tectonically active, deep sea to oceanic environment in northwestern Turkey during this period. This deep marine environment could be related to the Intra-Pontide ocean. The Alpide deformation and uplift in trtis region, probably related to the closure of the Intra-Pontide ocean, in constrained in northwest Turkey to the late Palaeocene-Early Eocene.

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PLATE

PLATE-I

Fig. 1- Field photograph of the calcirudites in the Palaeocene Ballıkaya formation, Ballıkaya hill, west of Biga.

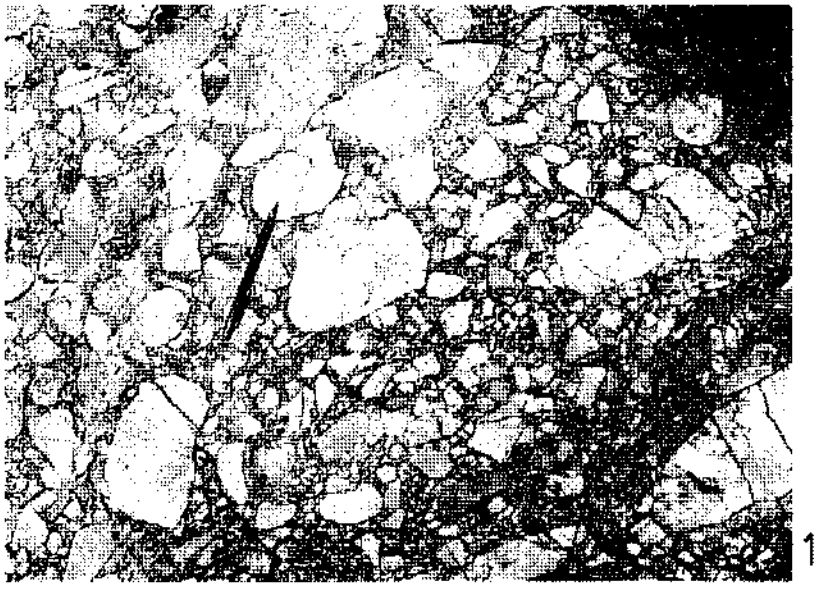
Fig. 2- Microphoto of a typical pelagic micrite in the Palaeocene Ballıkaya formation with radiolaria and foraminifera *(Morozovella pseudobulloides* (Plummer)), sample number 163A, the long edge of the photo is 2 mm,

Fig. 3- *Morozovella pseudobulloides* (Plummer), sample 163A, Ballıkaya formation, Danian, long edge 0.41 mm.

Fig. 4- *Morozovella* sp., sample 160, Ballıkaya formation, Palaeocene, long edge 0.82 mm.

Fig. 5- *Morozovella velascoensis* (Bolli), sample 160, Ballıkaya formasyonu, Thanetian, long edge 0.41 mm.

Fig. 6- *Planorotalites compresssa* (Plummer), sample 93 Ballıkaya formation, Danian; long edge 0.41 mm.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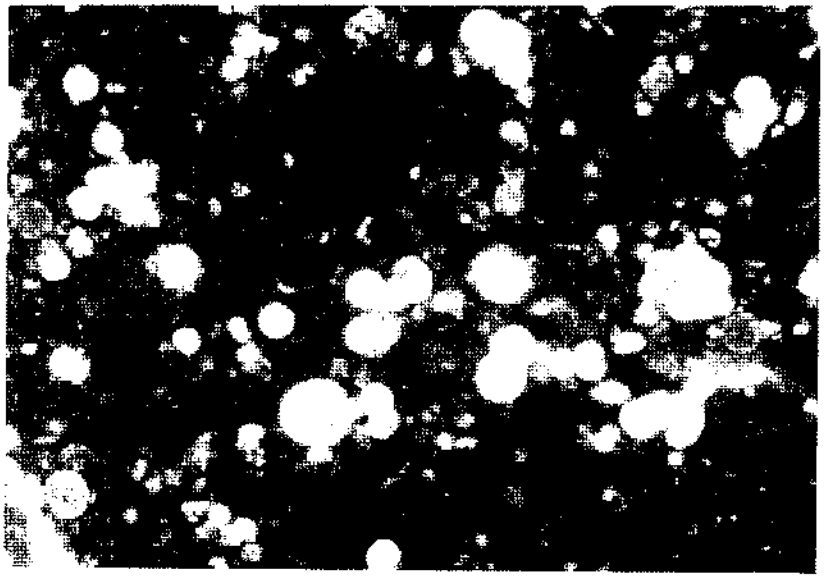
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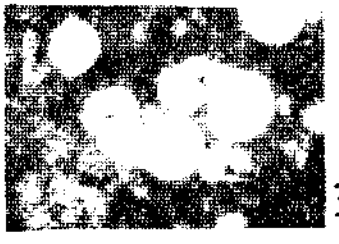
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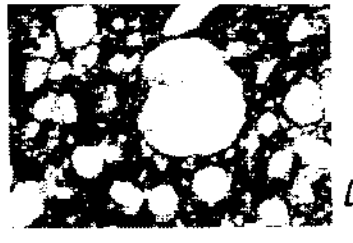
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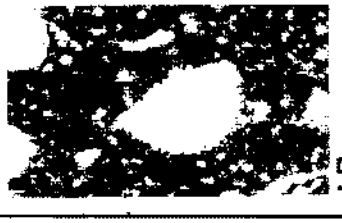
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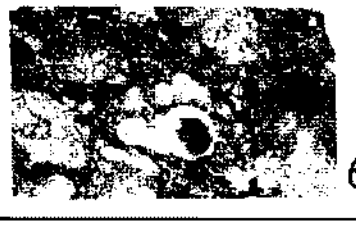
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