MIDDLE JURASSIC-LOWER CRETACEOUS BIOSTRATIGRAPHY 
IN THE CENTRAL PONTIDES (TURKEY): REMARKS ON PALEOGEOGRAPHY 
AND TECTONIC EVOLUTION

BORA ROJAY* & DEMIR ALTINER**

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Riassunto. Nelle Pontidi, la deposizione dei carbonati del Giurassico-Cretaceo Inferiore fu controllata dall'evoluzione di un margine continentale di tipo atlantico rivolto verso la Tettide. Lo studio di numerose sezioni stratigrafiche da scaglie e blocchi alloctoni del Melange Olistosito delle Anatolia Settentrionale, ha permesso di analizzare l'evoluzione paleogeografica delle Pontidi Centrali nel Giurassico Medio e nel Cretaceo Inferiore. Le successioni Calloviano-Aptiane comprendono le seguenti biozoni: Globuligerina gr. osfordiana, Clypeina jurassica (equivalente alla zona a Talibiphys thursonensis), Protoperoplos ulfragranulata (inclusa la sottozona a Haplophragmoids joukowskyi), MONTSELAVERIA SEALEMISI, HEDBERGELLA DELTICRINIS - HEDBERGELLA PLANISPINA - LEUPOIDINA - GLOBIGERINELLOIDES e GLOBIGERINILIOIDES ALGERIANUS.

Nelle successioni studiate vengono inoltre riconosciuti due principali laminae stratigrafiche, corrispondenti all'età pre-Calloviano e Haueteriano-Aptiano. Studi litostratigrafici e bioestratigrafici documentano la presenza di movimenti analoghi nell'evoluzione delle successioni nella regione di Amasya (Pontidi Centrali) e nel plateau di Biga-Bursa-Bilecik (Anatolia Nord Occidentale).

Abstract. The deposition of Jurassic-Lower Cretaceous carbonates in the Pontides was controlled mainly by the evolution of an Atlantic-type continental margin in the Tethys. The study of several stratigraphic sections from allochthonous slices and blocks of the North Anatolia Ophiolite Melange provided insight into the Middle Jurassic-Early Cretaceous paleogeographic evolution of the Central Pontide Belt. The Callovian-Aptian successions span the Globuligurina gr. osfordiana, Clypeina jurassica (equivalent of the Taubibphys thursonensis zone), Protoperoplos ulfrangulata (with the Haplophragmoids joukowskyi subzone), MONTSELAVERIA SEALEMISI, HEDBERGELLA DELTICRINIS - HEDBERGELLA PLANISPINA - LEUPOIDINA - GLOBIGERINELLOIDES and GLOBIGERINILIOIDES ALGERIANUS biozones.

Two major stratigraphic gaps corresponding to the pre-Callovian and Haueterian-Early Aptian ages are recognised in the successions. Lithostratigraphic and biostratigraphic studies indicate strong similarities in the evolution of the successions in the Amasya region (Central Pontides) and Baja-Bursa-Bilecik Platform (North-western Anatolia).

Introduction.

Tethyan ophiolites, Cretaceous ophiolitic melanges and Jurassic-Lower Cretaceous carbonates in northern Anatolia (Pontides) form a significant, continuous tectonic belt from the Varáz Zone (Aubouin, 1963), through the İzmir-Ankara-Erzincan Suture Belt (IAES) (Brinkmann, 1976; Sengör & Yilmaz, 1981), to the Şevan-Akera Zone (Adamia et al., 1977) (Fig. 1).

The Pontide Belt is an orogenic belt evolved since the Triassic by progressive accretion of continental terrains, with attached oceanic fragments, during the closure of the Paleo- and Neo-Tethyan oceans (Sengör & Yilmaz, 1981; Sengör, 1984). These orogenetic processes and strike-slip tectonics made the central part of the Pontides much more fragmentary and complicated. The area under study lies within this fragmentary and complicated region, to the north of IAES (Fig. 1).

Jurassic-Lower Cretaceous units in the Central Pontides, between NAFL and IAES (Fig. 1), were reported in several studies (Otunk, 1942; Blumenthal, 1950; Alp, 1972; Öztürk, 1979; Özcan et al., 1980; Rojay, 1993; 1995; Tüysüz, 1996).

Two different Liassic sequences underlying the Middle Jurassic-Lower Cretaceous carbonates were recognised in the southern Central Pontides, including the Amasya region (Blumenthal, 1950; Alp, 1972). Submarine volcanism is the major geologic criterion used to differentiate the two Liassic sequences. To the north of the Amasya region, submarine volcanism contributed to the Liassic deposition and continued to be active throughout the Middle Jurassic (Blumenthal, 1950; Alp, 1972; Öztürk, 1979; Özcan et al., 1980). However, evidence of submarine volcanism and units of Dogger age are missing in the Amasya region (Otunk, 1942; Blumenthal, 1950; Alp, 1972).

The unconformity between Upper Jurassic-Lower Cretaceous carbonates and Liassic clastics, together with an intra-Lower Cretaceous unconformity between the Neocomian and Aptian, have been documented in the

*Middle East Technical University, Department of Geological Engineering, Ankara, Turkey, e-mail: brojay@rorqual.cc.mesu.edu.tr
**Marine Micropaleontology Research Unit, Middle East Technical University, Department of Geological Engineering, Ankara, Turkey.
Amasya region by several authors (Blumenthal, 1950; Alp, 1972; Özütk, 1979; Özcen et al., 1980; Rojay, 1993; 1995; Tüysüz, 1996). The majority of the Upper Jurassic-Lower Cretaceous carbonate units were considered as tectonic slices and blocks within the Cretaceous ophiolitic melanges (Özcen et al., 1980; Kocyigit et al., 1988; Rojay, 1995; Tüysüz, 1996). Alternatively, the tectonic emplacement of these allochthonous carbonates has been interpreted as the result of regional “gravity tectonics” in the Amasya region (Alp, 1972).

Several studies carried out to the north of NAFZ (northern Central Pontides) report that the Malm-Lower Cretaceous units, which consist of a basal conglomerate (Bürrüük Formation), shelf carbonates (İnaltı Formation) and finally flyschoid clastics and carbonates (Çalayat Formation), unconformably overlie the pre-Malm crystalline basement rocks (Yılmaz, 1990; Tüysüz, 1990; Yılmaz & Tüysüz, 1991). This succession displays a lithostratigraphic evolution considerably different from that of the Amasya region.

The stratigraphy and Tethyan plate tectonic evolution of the Central Pontides is still in question and needs further clarification. Consequently, the main focus of this paper will be the chronostratigraphic calibration of the Jurassic to Lower Cretaceous stratigraphy in this region, based on foraminiferal and algal biostratigraphy, followed by an interpretation of the Tethyan evolution in the Central Pontides.

**Stratigraphy.**

The tectonostratigraphic units of the Amasya region, distinguished by age, lithostratigraphic evolution, internal organisation and tectonic position, are grouped into two units, the pre-Campanian (allochthonous) and the Campanian-Neogene, respectively (Rojay, 1993; 1995). The pre-Campanian Units comprise pre-Liassic low-grade metamorphics, a Triassic sedimentary complex, Jurassic-Cretaceous clastics and carbonates, and a Cretaceous ophiolitic melange. The unconformably overlying Campanian-Neogene Units are characterised mainly by siliciclastic sedimentary sequences consisting of a Campanian-Maastrichtian forearc flysch sequence, Eocene molasse to peripheral basinial sequences and Plio-Pleistocene molasse deposits (Fig. 2, 3).

Within this stratigraphic frame, the Amasya Group, representing the main carbonate succession of the Phanerozoic of the Central Pontides, crops out extensively in the area under study (Fig. 3).

Amasya Group (Ja) (Amasya Kalke: Blumenthal, 1950).

The Amasya Group is a thick, predominantly carbonate sequence composed of: a) Liassic clastics, including bioclastic carbonates; b) Callovian-Valanginian carbonates, including ammonitico Rosso facies at the base;
and c) Aptian-Cenomanian deep-sea pelagic carbonates and turbidite clastics (Fig. 2).

a) The Liassic clastics consist of massive polygenetic conglomerates, bioclastic calcareous conglomerates-sandstones and detrital limestones rich in echinoid and crinoid debris with subordinate rock fragments set in sparriy calcite cement. The carbonate debris consists mainly of fossil fragments. These bioclasts were transported, sorted and deposited as carbonate sand bodies. The presence of metamorphic quartz and metamorphic rock fragments in the clastic portions indicates a continental source, likely represented by the underlying low-grade metamorphics.

The deposition of Liassic clastics consisting of both continental and shallow marine facies was interrupted by a major unconformity in the central Amasya region. The development of a typical Atlantic-type margin sequence ceased and the region was uplifted. A considerable hiatus, spanning almost the entire middle Jurassic, followed. The Liassic sequence is overlain with a sharp boundary by Callovian carbonates.

b) The unconformably overlying Callovian-Vanginian carbonates consist of nodular limestones (Ammonitico Rosso facies) and shallow marine platform carbonates (Fig. 4). The Ammonitico Rosso facies contains ammonites, belemnites, thin-shelled bivalves and foraminifers in a micritic matrix. This facies shows a gradual upward transition to oolitic limestones that are dolomitized at the top of the sequence and then continues with characteristic oncolithic and foraminiferal-pelletoidal limestones (N of Vermis village section, Fig 4). Shallowing-upward, cyclic carbonate deposition (meter-scale) is represented by alternations of oncolithic (locally brecciod) and pelecypod and gastropod-rich limestones, and stromatolitic-pelletoidal and algal limestones. After a densely stylolitic limestone level, the sequence continues upward with oncolithic-algal limestones, gastropod-rich intraclastic limestones, algal to brecciod limestones, pelletoidal limestones and oncolithic limestones (Sel Creek and Yaniklik Hill sections, Fig. 4). Algal, miliolid and other foraminifer-bearing limestones constitute the top of the Callovian-Vanginian carbonates (Yassical Hill section, Fig. 4). The micritic matrix and faunal assemblage of the basal parts indicate a relatively deep, stagnant and pelagic depositional setting on an emerged pelagic plateau. However, the fragmentary nature and heterogeneous distribution of fossils indicate current action during the deposition. These observations suggest that the depositional setting is an open sea environment, likely related to an emerged pelagic plateau (Aubouin, 1965; Jenkyns & Hsu, 1974; Farinacci & Elmi, 1981). The predominance of intrabionomicrites and oomicrites in a shallow marine carbonate sequence indicates a deposition in a wide, sheltered lagoon behind some kind of a barrier, or an open shelf affected by only moderate ω

<table>
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<th>AGE</th>
<th>THICKNESS (m)</th>
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<tr>
<td>Triassic</td>
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<td>Cenomanian</td>
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| Pre-Campanian | 1600 |                      | Fore-arc flysch sequence        |              |
| Pre-Campanian |      |                      | Rudistid Buildups               |              |
| Eocene       | 240  |                      | Triassic Sedimentary Complex    |              |
| Pre-Neogene  |      |                      | Ophiolite Melange               |              |
| Plio. Qua.   | >160 |                      | Molasse                         |              |
low wave action. Shallow marine detritus, remains of gastropods, echinoids and bivalves are all fragmented and were probably swept off the platform by underwater currents. The virtual absence of frame-building, massive colonial corals and the presence of dasycladacean algae and encrusting blue-green algae suggest that algal-fragmental facies may have been the most common facies types in northern Turkey. Fossil evidence also indicates a wide range of depositional settings, from restricted lagoon to open sea carbonate platform.

c) The Aptian-Cenomanian sequence consists predominantly of pelagic carbonates and turbidite pelagic clastics, and unconformably overlies the shallow marine Valanginian carbonates (Amasya Castle and TCK Camping area, Fig. 4). From bottom to top, the succession is characterized mainly by *Nannoceras*-bearing limestones, alternations of radiolaria- and planktonic foraminifera-bearing limestones, radiolaria-bearing limestones and turbidite sandstones-marls-siltstones. The Aptian age of the *Nannoceras*-bearing part of the sequence was determined on the basis of pelagic foraminifers. The radiolaria and planktonic foraminifer-rich facies range from the latest Aptian to the Cenomanian, while the clastic portion of the sequence is Albian-Cenomanian in age. The planktonic biota and the lithology with microturbidites and slump structures indicate a tectonically active, deep sea, pelagic depositional setting (Bernoulli & Jenkyns, 1974). The relationship between the direct onlap and overlap of the unit and the underlying platform carbonates possibly indicate a sudden deepening as a result of block faulting during the pre-Aptian period, and a progressive supply of sediments onto the sunken carbonate platform, likely through deep sea canyons. The lack of erosional features on the platform and the absence of carbonate clasts with shallow marine biota in the pelagic successions overlaying the platform carbonates may indicate non-deposition (due to sweeping of underwater currents), sudden deepening (due to block faulting) or the occurrence of both processes.

Biostratigraphy.

The biostratigraphic framework of the Jurassic-Lower Cretaceous carbonates in the Amasya region is based on benthic and planktonic foraminifers and algae. It includes 4 zones and 2 subzones in the Callovian-Valanginian pelagic to shallow marine carbonates and 2 zones in the Aptian pelagic carbonates (Fig. 4). This biozonation scheme is nearly identical to that of the Biga-Bursa-Bilecik (BBB) platform (Altiner, 1991). The fundamental difference between the biozonation scheme of the Amasya and BBB platform is the presence of the Kimmeridgian-Tithonian *Clypeina jurassica* Zone in the Amasya region, corresponding chronostatigraphically to the *Tabiphytes morronensis* Zone in the BBB platform, and the general absence of Upper Valanginian-Barremian Zones, corresponding to a stratigraphic gap in the Amasya region (Fig. 4).

The Jurassic-Lower Cretaceous biostratigraphy in the Amasya region was studied along seven stratigraphic sections and with a large number of spot samples (Fig. 3, 4).

Zone I (*Globuligerina* gr. *oxfordiana* Zone).

The zone was recognized in the lowest portion of the Jurassic-Lower Cretaceous carbonates, unconformably overlying the Liassic clastics (N of Vermis village section, Fig. 3, 4). The upper limit is poorly defined because of intense dolomitization. In addition to the consistent presence of *Globuligerina* gr. *oxfordiana* (Grigsby) (Pl. 1, fig. 1-3), the zone also contains *Globuligerina* sp. (Pl. 1, Fig. 4), *Palsaeomiliolina sramosum* (Günbel), *Ophthalimidium sp.*, *Reophax sp.*, *Spirillina sp.* and *Globobaetia alpina* Lombard.

The association is nearly identical to that of the *Globuligerina* gr. *oxfordiana* Zone (Altiner, 1991) which is calibrated with the presence of Callovian and Oxfordian ammonites in the BBB platform (Cope, 1991). It should be noted that previously this characteristic lithostatigraphic horizon (Ammonitico Rosso facies) was dated imprecisely as Sinemurian-Toarcian, based on ammonites in the Amasya region (Alp, 1972).

Zone II (*Clypeina jurassica* Zone).

The *Clypeina jurassica* Zone, attaining a thickness of more than 1000 m in the Amasya region, is a well known biostratigraphic unit within the Mediterranean realm (Sartoni & Crescenti, 1962; Farinacci & Radioico, 1964; Nikler & Sokac, 1968, Gusic, 1969, Velić, 1977; Altiner et al., 1986; Chiocchini et al., 1994). Although the lower limit is not defined precisely, the upper boundary is clear and marked by the first appearance of *Protopenoplos ultragranulata* (Gorbatschik).

The zone was studied in three sections in the Amasya region (N of Vermis village, Sel Creek and Ya-

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The Clypeina jurassica Zone of the Amasya region is the chronostratigraphic equivalent of the Tubiphytes morronensis Zone of the BBB platform. Both zones extend between the Globigerina gr. oxfordiana and Protoperopelis ultragranulata Zones. In the BBB platform, the first appearances of Tubiphytes morronensis Crescenti and Protoperopelis ultragranulata were calibrated with ammonites as Kimmeridgian (Altiner 1991; Cope, 1991) and with calpionellids as Late Tithonian (A2 subzone; Altiner & Özkan, 1991), respectively. Therefore, the Clypeina jurassica Zone, as defined in this study, is considered to represent the Kimmeridgian-Upper Tithonian interval.

Subzone Ila (Mesoendothrya izujumiana - Alveosepta - Labyrinthina - Protoperopelis striata Subzone).

The lower part of the Clypeina jurassica Zone in the Amasya region is characterised by two frequently occurring important markers of the Kimmeridgian, namely Alveosepta gr. jaccardi (Pl. 1, fig. 8-10) and Mesoendothrya izujumiana (Pl. 1, fig. 4-7). This subzone was calibrated with Kimmeridgian ammonites in the BBB platform, Mudurnu Trough and Aktas-Sekinindoruk High in NW Anatolia (Altiner, 1991; Altiner et al., 1991; Cope, 1991). The other two zonal markers, i.e. Labyrinthina and Protoperopelis striata Weysenchek, were not recorded in the N of Vermis village and Sel Creek sections (Fig. 3, 4).

Zone II. (Protoperopelis ultragranulata Zone).

This zone is characterised as an interval between the successive appearances of Protoperopelis ultragranulata (Pl. 1, fig. 11-13) and Montsalevias salevensis (Charollais, Brönnimann and Zaninetti) (Pl. 1, fig. 16-18). It contains a diversified foraminiferal fauna and algal flora, almost identical to those of the BBB platform, Mudurnu Trough and Aktas-Sekinindoruk High in NW Anatolia (Altiner, 1991; Altiner et al., 1991). The fossils are Earlandia brevis Arnaud-Vanneau, Earlandia sp., Protoperopelis ultragranulata (Pl. 1, fig. 11-13), Ammobaculites sp., Feurtilla sp., Euretvicyclammina sp., Pseudocyctlammina lituus Yokoyama, Pseudocyctlammina sp., Haplophragmoids joukowski Charollais, Brönnimann and Zaninetti (Pl. 1, fig. 14-15), Mayncina sp., Dobrogelina sp., Valvulina sp., Belorussiella sp., Ataxopagmidae, Textularia sp., Quinquiloculina cf. robusta Neagu, Hectina sp., Microsiphon, Trocholina odakianensis Dessazagie, Trocholina alpina (Leupold), Trocholina elongata, Trocholina delphinesis Arnaud-Vanneau, Boisseau and Darsac, Trocholina sp. and Salpingoporella annulata Carozzi, Ceyxvixia sp. and Favreina sp.

In the Amasya region, the Protoperopelis ultragranulata Zone was recognised in the Sel Creek, Yaniklish Hill, Ortaçal Hill and Yassical Hill sections (Fig. 3, 4). In the Sel Creek and Yaniklish Hill sections, the succession is truncated by an unconformity surface and followed by uppermost Aptian to Cenomanian pelagic units. The upper boundary of the zone was recognised only along the Yassical Hill section, where the levels containing the first Montsalevias salevensis overlies the Protoperopelis ultragranulata Zone.

The successive occurrences of Protoperopelis ultragranulata and Montsalevias salevensis were calibrated by calpionellids in NW Anatolia (Altiner, 1991; Altiner & Özkan, 1991). The first appearance of the former species was dated as Late Tithonian (A2 subzone of calpionellids). Therefore, the Protoperopelis ultragranulata Zone is considered to represent the Upper Tithonian-Berriasian interval in the Amasya region.

Subzone IIIa (Haplophragmoids joukowski Subzone).

This subzone was defined in NW Anatolia as the interval between the first appearance of Haplophragmoids joukowski (Pl. 1, fig. 14-15) and the appearance of Montsalevias salevensis (Pl. 1, fig. 16-18) (Altiner, 1991). In the Amasya region, a similarly defined subzone contains most of the taxa already quoted in the Protoperopelis ultragranulata Zone. Among them, the appearance of Trocholina delphinesis might be significant for the identification of the subzone.

The subzone was recognised in the Yaniklish Hill, Ortaçal Hill and Yassical Hill sections. It is type section (Mudurnu Trough, NW Anatolia), the subzone was calibrated by the C, D1, D2 and part of D3 calpionellid zones and subzones (Altiner, 1991; Altiner & Özkan, 1991) and represents the Berriasian stage. The chronostratigraphic value of the first appearance of Protoperopelis ultragranulata, which probably corresponds to a...
well-defined datum in the Tithonian, was emphasized by data from Sicily (Italy) (Bucur et al. 1996).

Zone IV (Montselevia salevensis Zone).

The zone, which was originally defined as the interval between the successive first appearances of Montselevia salevensis and Meandrospira favreti Charollais, Brönnimann and Zaninetti (Altiner, 1991), is unconformably over lain by lower Aptian pelagic units in the Amasya region (Fig. 4). In addition to Montselevia salevensis (Pl. 1, fig. 16-18), the other foraminifer associations are Earlania sp., Haplophragmoides jowkowski (Pl. 1, fig. 14-15), Quinqueloculina cf. robusta and Trocholina spp.

The rock unit representing the Valanginian was recognized in the Yassical Hill, Amasya Castle and TCK camping area sections in the Amasya region (Fig. 3, 4). The chrono-stratigraphic calibration of the zone was made with calpionellids in the Mudurnu Trough (NW Anatolia) (Altiner, 1991; Altiner & Özkan, 1991). When it is associated with calpionellids, Montselevia salevensis appears in the upper part of the D3 subzone and disappears above the E Zone, corresponding to the latest occurrence of Tintinnobipella carpatica (Murgeanu and Filipešcu) (F Zone of Altiner & Özkan, 1991).

Zone VIII (Hedbergella delrioensis - Hedbergella planispina - Leupoldina - Globigerinelloides Zone).

The pelagic carbonate succession in the Amasya region (Amasya Castle and TCK camping area sections, Fig. 3, 4), unconformably overlying the Montselevia salevensis Zone, contains at its base an assemblage of planktonic foraminifers including Hedbergella delrioensis (Casey) (Pl. 1, fig. 19-22), Hedbergella planispina (Tappan), Favusellidae, Leupoldina cabri (Sigal), Globigerinelloides ferreolensis (Moullade) (Pl. 1, fig. 28-29) and Globigerinelloides spp. This interval, whose upper boundary is marked by the appearance of Globigerinelloides algerianus Cushman and Ten Dam (Pl. 1, Fig. 30), is identical to Zone VIII, defined in the Sogukcam Limestone, a lithostratigraphic unit widely exposed in NW Anatolia (Altiner, 1991).

The chrono-stratigraphic interval of the Zone is defined by the appearance of the taxa quoted above (Capon, 1985; Sliter, 1989; Altiner, 1991) and corresponds to the Lower to Upper Aptian.

Zone IX (Globigerinelloides algerianus Zone).

This Zone, introduced in NW Anatolia as the total range interval of Globigerinelloides algerianus (Altiner, 1991), was recognized also in the Amasya Castle and TCK camping area sections. The planktonic foraminifers recognized in this Zone are Globigerinelloides algerianus (Pl. 1, fig. 30), Globigerinelloides ferreolensis (Pl. 1, fig. 28-29), Hedbergella delrioensis (Pl. 1, fig. 19-22), Hedbergella planispina (Pl. 1, fig. 24), Hedbergella gorbachikae Longoria (Pl. 1, fig. 27), Hedbergella trocoides (Gandolfi) (Pl. 1, fig. 25-26) and Hedbergella spp.

Several authors agree on the chrono-stratigraphic value of Globigerinelloides algerianus, which is a Late Aptian index fossil (Moullade, 1966; Longoria, 1974; Van Hinte, 1976; Sigal, 1977; Capon, 1985; Sliter, 1989; Altiner, 1991; Chiocchini et al., 1994).

In the Amasya region, the continuation of the pelagic carbonates characterized by radiolaria-bearing limestones and sandstone-marl-siltstone of turbidite origin was not zoned in this study. The radiolaria-bearing limestones either directly overlie the Globigerinelloides algerianus Zone (Amasya Castle and TCK camping area sections, Fig. 4) or rest unconformably on the Protoperoplis utragranulata Zone (Sel Creek and Yaniklihal Hill sections, Fig. 4). The ophiolitic melange of pre-Middle Campanian age tectonically overlies the unit upper boundary (Kocyigit et al., 1988) (Fig. 2, 3, 4). In addition to Radiolaria and Pabonella, more evolved planktonic foraminifer assemblages are present in the succession, including post-Aptian hedbergellid forms, Praeglo-

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PLATE 1

Culluvian - Aptian microfossil assemblage from the Central Pontides.

Fig. 1-3 - Globigerina gr. costulata (Grigolini) (Sample No: 882k, X 200).
Fig. 4 - Globigerina sp. (Sample No: 882b, X 200).
Fig. 5 - Globigerinelloides formosa (Lamarck) (Sample No: 868w, X 90).
Fig. 6-7 - Mesoendothyrina izumriana Dain (Sample No: 868a-d, X 110).
Fig. 8-10 - Alocosa gr. jaccardi (Ehlers) (Sample No: 882b, 868, X 65).
Fig. 11-13 - Protoperoplis utragranulata (Gorbachik) (Sample No: 545b-a, X100).
Fig. 14-15 - Haplophragmoides jowkowski Charollais, Brönnimann and Zaninetti (Sample No: 545a-a, X 110).
Fig. 16-18 - Montselevia salevensis (Charollais, Brönnimann and Zaninetti) (Sample No: 545a-a, X 110).
Fig. 19-22 - Hedbergella delrioensis (Casey) (Sample No: 545b-b, X 110).
Fig. 23 - Hedbergella sp. (Sample No: 545b, X 200).
Fig. 24 - Hedbergella planispina (Tappan) (Sample No: 545b-b, X 200).
Fig. 25-26 - Hedbergella trocoides (Gandolfi) (Sample No: 545b, X 200).
Fig. 27 - Hedbergella gorbachikae Longoria (Sample No: 545b, X 200).
Fig. 28-29 - Globigerinelloides ferreolensis (Moullade) (Sample No: 545b, X 200).
Fig. 30 - Globigerinelloides algerianus Cushman and Ten Dam (Sample No: 545b, X 200).
botruncana stephani (Gandolfi), Praeglobotruncana gibba Klaus, Rotalipora greenbormenis (Morrow), Rotalipora spp. A latest Aptian to Cenomanian age is attributed to the succession considering also the deposits overlying the Globigerinelloides algerianus Zone.

Jurassic-Early Cretaceous evolution of the Central Pontides in the Amasya region.

The Jurassic - Early Cretaceous interval is one of the most active periods in the evolution of the Neo-Tethys. The margins of the Northern Continents (Rhodope-Pontide and Sakarya Fragments) were passive throughout the entire Jurassic, but started to be destroyed by the Cretaceous subduction. The Tauride- Anatolide Platform and Northern Continents continued to converge and collided during the Cretaceous-Paleogene period in the Amasya region.

The Jurassic-Early Cretaceous Neo-Tethyan evolution began with the deposition of Liassic siliciclastics and detrital carbonates (Liassic transgression) on the rifted pre-Triassic basement of the Central Pontides (Blumenthal, 1950; Rojay, 1995) as recorded in NW Anatolia (Kruhensky et al., 1980; Altiner et al., 1991; Kocyigit et al., 1991a; 1991b), in the Ankara region (Kocyigit, 1987) and in the Eastern Pontides (Robinson et al., 1995) (Fig. 5, 6).

Liassic rifting and transgression ceased, and the platform in the central Amasya region was uplifted to form a high-standing area, while the rate of ongoing rifting increased to the north and south (Alp, 1972; Öztürk, 1979; Özcan et al., 1980). A paleo-high thus emerged in the central Amasya region during the post-Liassic-pre-Callovian time. While sedimentation ceased and erosion affected the paleo-high, submarine volcanism contributed extensively to the deposition of the Liassic-Dogger clastic sequence in the north (Öztürk, 1979; Özcan et al., 1980).

The uplifted, eroded platform turned into an open marine depositional realm as a result of a sudden onsetting of subsidence during the Callovian. As rifting continued, the deposition of Ammonitico Rosso facies took place in an open marine, pelagic environment during the Callovian-Oxfordian interval (Fig. 6). However, this period of deepening, which resulted in an open marine to pelagic depositional environment, was followed by a regressive, restricted carbonate platform deposition. A lagoonal to tidal flat-subtidal environment, without the volcanic influx present in the Eastern Pontides (Robinson et al., 1995), developed during the Kimmeridgian-Valanginian, indicating sea-level fluctuations triggered by regional tectonics.

After a short period of non-deposition and/or sweeping by currents, the ongoing block faulting during the Aptian-Cenomanian produced a deepening of the basin, with deposition of deep-sea pelagic sediments and pelagic turbidites on the uplifted, tilted and faulted Callovian-Valanginian carbonate platform (Fig. 6). The passive (Atlantic-type) margin was destroyed during post-Cenomanian - pre-Campanian time in the Amasya region and turned into an active continental margin as a result of the northward subduction of the northern Neo-Tethyan oceanic crust beneath the Pontides. The accreted ophiolitic mass and the associated Jurassic to Lower Cretaceous carbonates were unconformably overlain by the middle Campanian-Maastrichtian forearc units (Kocyigit et al., 1988; Rojay, 1995).

Conclusion.

The geologic evolution of the Amasya region in the Pontides is a good example of a block-faulted Atlantic-type passive margin in the Mesozoic. Its Jurassic-Cretaceous evolution is marked by four main unconformities, namely pre-Liassic, pre-Callovian, pre-Aptian and pre-middle Campanian, which are all biostratigraphically calibrated.
The pre-Liassic basement of the Central Pontides in the Amasya region was unconformably overlain by the Liassic siliciclastic-detrital carbonate sands (echinoid-crinoid sands) which were deposited during the initial rifting phase in the Amasya region.

After the aborted Liassic rifting in the central Amasya region, an intra-Jurassic unconformity was recorded by the deposition of Callovian Ammonitico Rosso facies (Globuligerina gr. oxfordiana Zone) over the Liassic detrital carbonate sands, indicating a new phase of sudden subsidence.

After the deposition of Ammonitico Rosso facies, the platform carbonate deposition continued with a regressive trend until the end of the Valanginian, that is represented by Clypeina jurassica, Protoperoplopis ultragranulata and Montselevia salevensis Zones. After a period of non-deposition or sweeping by under-water currents, which was noted by the absence of the Maevospira futrei, Globuligerina hoteviaca and Hedbergella sigali Zones, the platform subsided and was unconformably overlain by Aptian-Cenomanian deep-

sea pelagic sediments and turbidite pelagic clastics. The Aptian is represented by the Hedbergella delrioensis - Hedbergella planispina - Lepidopina - Globigerinelloides and Globigerinelloides algerianus Zones.

The biozonation in the Amasya region is nearly identical to that of the BBB platform. The fundamental difference between the biozonation patterns in the Amasya region and BBB platform is the presence of the Kimmeridgian-Tithonian Clypeina jurassica Zone in the Amasya region, which corresponds chronostratigraphically to the Tubiphytes morronensis Zone in the BBB platform, and the general absence of Upper Valanginian to Barremian zones that correspond to a stratigraphic gap in the Amasya region.

These close biostatigraphic similarities between the BBB Platform and Amasya Region, suggest that both paleogeographic domains were part of the same carbonate platform which extended from the western to the central Pontides.

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