Chapter 14

Rudist Carbonate Ramp in Southeastern Anatolia, Turkey

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SUMMARY

Name: Arabian platform
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Location: From 36° to 38° 15' north latitude and 36° to 39° 30' east longitude, southeastern Anatolia
Geologic time interval: Late Cretaceous, Maastrichtian
Tectonic-sedimentary setting: Intracratonic basin
Basin type: Epeiric shelf
Paleoclimate: Semi-tropical
Platform type: Ramp
Platform geometry: 320 m thick, approximately 35 km wide, and 300 km long
Facies and fossils: Carbonates, conglomerates, sandstones, and shales; rudists, corals, algae, molluscs, benthonic and planktonic foraminifera
Systems tracts: Beach, shallow shelf, basin
Stacking patterns: Not determined

INTRODUCTION

Southeastern Anatolia is located on the northern side of the Arabian plate. In this region, Maastrichtian rudist limestone outcrops are observed mainly along the border folds belt, which lies geologically between the Taurus orogenic belt to the north and the foreland area to the south (Figure 1). Because of the oil potential in this area, the geology of southeastern Anatolia has been studied in detail by the Turkish Oil Company (T.P.A.O.). Righo de Righi and Cortesini (1964), Sungurlu (1974), Yalçın (1976), and Perinçek (1979, 1990) are significant references for the geologic evolution of southeastern Anatolia. The paleontology of the benthonic-planktonic foraminifera and rudists has been studied by Meriç (1965, 1987) and Özer (1986, 1988a,b, 1991). The sedimentologic characteristics of the Maastrichtian units have been presented by Perinçek (1979), Meriç et al. (1985, 1986), and Özer (1992).

REGIONAL GEOLOGIC SETTING

The Campanian–early Maastrichtian was a period of important tectonic movement in southeastern Anatolia. During this period in the northern part of the Arabian platform, the Kastel intracratonic basin was formed. The Kastel Formation, which consists of alternating shale and sandstone with planktonic foraminifera, was deposited in this basin (Figure 2). During the deposition
of the Kastel formation, two successive allochthonous units belonging to the Taurus belt (the Karadut Complex overlain by the Köçali complex) were transported into the basin by gravity slides. This caused a shift in the axis of the depocenter to the south (Figure 2). The Karadut Complex is Cenomanian–early Turonian in age based on its fossil content (Sungurlu, 1974), and it consists of shale, thick-bedded limestone, clayey limestone, pebbly limestone, interbedded chert, and turbiditic conglomerate. The Köçali Complex is composed of the following (from bottom to top): volcanics (submarine lava, spilitic basalt, and diabase), sedimentary rocks (limestone with pelagic foraminifera, dolomitic limestone, shale, radiolarian chert, and block limestone), and serpentinites. It is Late Jurassic–Early Cretaceous in age (Sungurlu, 1974).

As tectonic activity declined at the end of the early Maastrichtian, a transgression of the Arabian platform began from south to north. The transgressive sequence consists of three units, in ascending order: the
Terbüzek, Besni, and Germav formations (Figures 2 and 3). Each of these formations contains rudists. They crop out mainly between the Kahraman Maras and Diyarbakır regions (Figure 1). Maastrichtian rocks with rudists also crop out around Yaladagi–Antakya.

The transgressive Maastrichtian sequence of southeastern Anatolia was deposited on an epeiric shelf situated on the northern border of the Arabian plate. This shelf was located about 22° north paleolatitude, according to the Cretaceous map prepared by Decourt et al. (1985). The geometry of the transgressive facies is best exhibited around the areas of Terbüzek, Besni, and Kahta (Figure 1).

**DEPOSITIONAL SETTING AND LITHOFACIES DESCRIPTIONS**

The Maastrichtian transgressive sequence unconformably overlies the Koçali Complex. Elsewhere, it unconformably overlies the autochthonous Kastel Formation (Figures 2, 3, 4, and 5). This sequence is overlain by clastics of the Gerçüs Formation and the carbonate Midyat Formation of Eocene age (Figure 2). The Terbüzek and Besni formations and the lower part of the Germav Formation show lateral and vertical changes from one to another and are composed of...
Figure 4. Measured stratigraphic sections. Datum is the base of the Terbüzek Formation. Locations are shown in Figure 1. Key: Ca-Ma, Campanian–Maastrichtian; Pa, Paleocene; Eo, Eocene; (1) conglomerate, (2) sandstone, (3) shale, (4) limestone, (5) ophiolitic rocks, (6) rudists, (7) macrofossils, (8) corals, (9) echinoderms, (10) benthonic foraminifera, (11) pelagic foraminifera.

Figure 5. Panoramic view of the transgressive sequence around Terbüzek village, Adiyaman (locality 3 in Figure 1), view toward the northeast. For scale, the tree in the left corner of the photograph is about 15 m high. (a) Shales of the Kastel Formation, (b) conglomerates of the Terbüzek Formation, (c) limestones with rudists of the Besni Formation, and (d) shales of the Germav Formation. Note the angular unconformity (arrow) between the transgressive sequence and the Kastel Formation.
faunal components, such as rudists and benthonic and planktonic foraminifera, that reflect a middle-late Maastrichtian age. This indicates diachronity of these formations.

**Terbüzek Formation**

The Terbüzek Formation, which ranges from 5 to 90 m in thickness, is composed of red and green poorly sorted, thick- to very thick-bedded conglomerate and sandstone. It also contains red and green shale. The pebbles of the conglomerates were derived from the Koçali Complex. Fossils are sparse in the Terbüzek Formation, but five or six sandy limestone lenses near Alidami (northeastern Kahta–Adıyaman) are rich in rudists. These lenses are 0.5–4 m thick and 50–200 m long (Figures 4 and 6), and rudist biostromes are developed in the lower two lenses. Although rudists are dominant, large benthonic foraminifera, hermatypic corals, lamellibranchs, and algae are also present (Meriç et al., 1985). The rudist species *Vautrinia syriaca* (Vautrin) and *Vacinmites braciensis* Sladić–Trifunović are abundant and indicate a Maastrichtian age. *Pironacca anatolica* Karacabey suggests a middle Maastrichtian age (Özer, 1987, 1988a). The orbitoidal forams have been assigned a middle-late Maastrichtian age by Meriç (1987).

Similar deposition occurred in the Yayladagi–Antakya area, including rudist limestone lenses 0.5–1.0 m thick in clastics of the Alidami section (Figure 4). These rudists also indicate a Maastrichtian age (Özer, 1991); *Vautrinia syriaca* (Vautrin) is abundant.

**Besni Formation**

The lower part of the Besni Formation consists of yellowish gray sandstones 3–20 m thick with benthonic foraminifera, especially large *Loftusia* and some lamellibranches. Rudists are rare in the sandstones. A single layer of sandy limestone 1–1.5 m thick with large rudists has been observed near Eskikahta (Figure 4). Locally, *Biradiolites* forms small buildups.

The upper part of the Besni Formation is predominantly yellowish gray medium- to thick-bedded limestones 10–25 m thick (Figures 4 and 7). The limestones contain rudists, benthonic foraminifera, lamellibranches, echinoids, gastropods, corals, and red algae. The Besni Formation also contains a few interbedded dolomitict
limestones. Some levels of the limestone consist of radiolitid fragments. Rudist biostromes are developed in the area surrounding Kahta.

The rudists of the Besni Formation indicate a Maastrichtian age. A late Maastrichtian age for the Besni Formation has been accepted by previous studies (Merič, 1965; Sungurlu, 1974; Yalçın, 1976; Perinççek, 1979; Merič et al., 1986). A middle Maastrichtian age has been proposed by Özer (1987, 1988a) based on the stratigraphic positions of Pironaea spp. in Anatolia. Merič (1987) assigned a middle-late Maastrichtian age to the Besni Formation on the basis of foraminiferal zones.

**Germav Formation**

The Germav Formation is made up of alternating grayish green shales, sandstones, and local conglomerates. The thickness varies from 50 to 200 m. The dominant shales are rich in planktonic foraminifera. Around Alidami, three or four laterally persistent limestone bands 1–10 m thick were observed in the shales of the Germav Formation (Figures 4 and 8). The second band is a few kilometers long (Figures 6 and 8). Rudists are characteristic of these limestones; Dictyopychus euphratica Karabey-Öztemür is dominant. Lamellibranchs, corals, gastropods, and benthonic foraminifera are present locally. All of the faunal components are fragmented; rudists in life positions have not been found. In northwestern Diyarbakır around Çemik (Figure 1), small-scale limestone lenses contain abundant fragments of *Pironaea praeclavonica* Milovanovic, Sladic, Grubic. A sample of *Hippuritidae* with three pillars, *Hippuritella* (Tetracoccinae) sp., was also found. The age of the Germav Formation spans late Maastrichtian–Paleocene based on the planktonic foraminifera (Meric et al., 1986; Özkan, 1986; Merič, 1987).

**PLATFORM TYPE**

The Maastrichtian sequence of southeastern Anatolia consists of a transgressive systems tract exposed in the Terbüzek, Besni, and Germav formations. They were formed along a narrow belt having a slope on the northern side of the Arabian plate. The present east–west dimension of the shelf is about 300 km; its north–south dimension is up to 35 km wide. The platform is approximately 10–25 m thick in the updip area and as thick as 80–100 m in the downdip area to the south.

The transgressive facies represent an energy gradient on the distally steepened ramp ranging from high energy beach (shore) to shallow shelf and low energy basin environments (Figure 9). The direction of the gradients is toward the south.

The depositional facies indicate the presence of a low relief detrital platform at the beginning of the Maastrichtian transgression. High energy clastics, such as conglomerates and sandstones of the Terbüzek Formation, are localized near the shoreline of this platform. The rudist-bearing sandy limestone lenses within the clastics indicate the development of shallow marine conditions. Resistant bioclastic packstone lenses
are a few meters thick and contain both biogenic and terrigenous sand grains. Foraminifera, corals, echinoids, gastropods, algae, and rudists comprise the biogenic fragments. The presence of the coarse terrigenous materials suggests that high energy with clastic influx onto the platform continued during the deposition of the rudist limestone lenses. No typical rudist reefs have been recorded; however, some biostromes contain framestones of limited lateral extension formed by cylindrical or cylindrical-cone rudists such as *Vautrinia syriaca* (Vautrin), *Vaccinites bractensis* Sladić-Trifunović and *Dictyoptychus* Douville.

The lower part of the Besni Formation consists of transgressive sandstones formed in shallow water, moderate energy conditions. The sandstone characterized by the large benthonic foraminifera indicate shallow marine conditions. The presence of some lamellibranch bivalves and rare rudists may support this interpretation. The absence of corals, gastropods, and algae may have resulted from terrigenous sedimentation inhibiting the development of these communities.

The upper part of the Besni Formation consists of shallow marine limestones. The termination of the terrigenous influx allowed the development of carbonate deposits rich in benthonic macro- and microfossils. No reef structure can be seen, except for some rudist framestones of limited lateral extent. These bedded biostromes were constructed by cylindrical rudists such as certain hippuritids (*Hippurites cornucopiae* Defrance) and radiolitids (*Vautrinia syriaca* Vautrin). The limestones are mainly bioclastic packstones, with grainstones being rare.

Carbonates of the Besni Formation are transitional with low energy pelagic shales of the Germav Formation. Three to four lime floatstone beds (Embry and Klovan, 1971) are laterally persistent in the shales and are a few kilometers long (Figure 4, Alidami section). Some small floatstone beds also occur that are only 7-8 m long and 40-50 cm thick (around Çermik in northwestern Diyarbakır). The floatstones contain matrix-supported rudists, corals, molluscs, and benthonic foraminifera that were derived from the Besni limestone. The matrix also contains pelagic fossils and shale clasts. Their occurrence indicates periodic density currents on the slope. The persistence of the pelagic shales of the Germav Formation into the Palaeocene indicates the continuation of the transgression and the final drowning of the platform.

**CONCLUSIONS**

The Maastrichtian transgressive sequence of southeastern Anatolia was developed on a gently sloping, distally steepened carbonate ramp on the northern shelf of the Arabian plate. The shore line was essentially in an east-west direction, and the shelf faces south. The ramp includes beach and shallow shelf deposits with clastics and carbonates that grade seaward to basinal pelagic shales. The facies provide evidence for the drowning of a shallow ramp.

The carbonate shelf of southeastern Anatolia has no well-developed back reef lagoons, typical reefs, or
striking breaks in slope. This indicates the development of a shallow ramp. The lime floatstone beds on the distal ramp are interpreted as slope turbidites rather than downslope buildups on a homoclinal ramp, such as those cited by Read (1985). The persistence of low energy basal shales into the Paleocene suggests continued transgression and drowning of the ramp.

Some rudists of southeastern Anatolia, such as Vautrinia, Dictyoptychus, Halaya, Hippurites syriaca, and Pironaea syriaca, are characteristic of the Arabian plate. These are endemic forms having a geographic distribution limited to Syria, Iran, and the Oman Penninsula (Ozer, 1986, 1988b, 1991, 1992). Accordingly, the present author has called them "Arabian platform rudist fauna" (Ozer, 1992).

A clastic-dominated shelf developed in southeastern Anatolia rather than a carbonate shelf (as in the Arabian shield, Mosul, Basrah, and Oman Gulf) (Wilson, 1975) because of tectonic activity in the adjacent Taurus orogenic belt.

Maastrichtian clastic influxes during transgression and rapid subsidence may have inhibited development of a shallow carbonate shelf occupied by rudist and other biostructures, such as those that flourished in western Taurus and southwestern Turkey (Gutnic et al., 1979; Ozer, 1988b,c), around Izmir in western Turkey (Ozer and Irem, 1982; Ozer, 1989; Erdogan, 1990), on the Apulian platform (Combes et al., 1981; Accordi et al., 1982; Sladic-Trifunovic, 1987; Camoin et al., 1988; Eberli et al., Chapter 18, this volume), and in the Provence region of southern France (Masse and Philip, 1981).

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