UMBERTO NICOSIA*, M. ALESSANDRA CONTI*, ANNA FARINACCI*,
DEMIR ALTINER**, ALI KOÇYIGIT*

* *Dipartimento di Scienze della Terra, Università "La Sapienza", Roma, Italy.*
** *Department of Geological Engineering, Middle East Technical University, Ankara, Turkey.*

WESTERN ANATOLIAN AMMONITICO ROSSO TYPE SEDIMENTS. DEPOSITIONAL HISTORY AND GEODYNAMIC MEANING

Ammonitico Rosso type sediments referring to the Trafo Member of the Bayırköy Fm. (Sinemurian-Pliensbachian), and to the calcareous and nodular Taşçıdere Member of the Taşçıbayırı Fm. (Callovian-Oxfordian), were examined in the North-Western Anatolia. The results of these analysis show these sediments in Turkey followed by supposed regressive events. This feature makes them different from those of other peri-Mediterranean regions where always trasgressive events follow. At the moment, it seems impossible to point out a single cause for the depositional origin of this type of sediments being related to the concurrent influence of biological and dynamic fattors which can prevail in turn. Finally, the ecological parameters, the influence of a quite energetic environment, the type of fossils and the clastics interfingering would show at least local independence by great depth.

KEY WORDS: *Rosso Ammonitico, Jurassic, sedimentation.*

INTRODUCTION

In the second half of the eighties a four years joint research project (1984-88) in western Anatolia (North-Western Turkey) was carried on by researchers of the Middle East Technical University of Ankara (Turkey) and of the Università "La Sapienza" of Rome (Italy) (Farinacci, this volume).

One of the main topics of this project was to examine, in a large area of the Central-Western Pontides, the relationships among Ammonitico Rosso type sediments and neighboring ones, mostly those deposited on, or somewhat tied to, the carbonate shelves. These relationships are in that region better exposed than in other regions thus we planned to study in such a way reports between the Ammonitico Rosso, still puzzling as far as regards its origin, and other facies with a clearer paleoenvironmental meaning.

The starting point was in fact that we hope for a better understanding of the parameters needing for the deposition and the depositional history of the sequences including Ammonitico Rosso type sediments.

This topic was very attractive due to the lack of a sure present equivalent the only one suggested equivalent being, according to Bernoulli (1972), the sediments dredged in the North Atlantic and the lack of clear ideas about its origin; these lacks and the doubts about the Ammonitico Rosso depositional history are evidenced by many different hypothesis on the origin of this type of sediments widespread in the literature (for a short historical review see Voros, 1986).

NOMENCLATURAL PROBLEMS

Previous works

In origin the name Rosso Ammonitico was born in the language of men that work in the quarry and was utilized to indicate a particular type of sediment widespread in Northern Italy (corona dei marmi, auct.) and intensively quarried for hundreds of years as facing stone; this type of sediment so characteristic and usually quite rich in fossils was then attractive for the geologist, apparently both simple to be recognized directly in the field and easy to be described by short nomenclatural definition; it is noticeable that already in the quarries the workers themselves subdivided this lithotype by means of some different trivial names (fiorito, mandorlato ecc.).

The large influence of German, Austrian and Italian geologist of alpine origin and the constant presence of a belt of more or less similar facies in the peri-mediterranean area stressed this phenomenon and this nomenclatural definition spread out to mean in the literature all the sediments somewhat similar. For a short history of this name see Farinacci & Elmi (1981).

Consequently the name Ammonitico Rosso is today not so indicative to represent a well defined facies, being too much inclusive to be meaningful indeed.

It was utilized in fact too extensively by many authors, since the beginning of the XIX century, to include different lithological meaning and depositional environments all around the Mediterranean Tethys, mostly in Jurassic times; moreover in particu-

lar in Italy, where the name was created, it assumes also lithostratigraphic meaning being utilized, as a traditional name, to individuate two different formations: the "Rosso Ammonitico Fm." of Toarcian age of the Umbro-Marchean sequence and the "Ammonitico Rosso Fm." of Bajocian-Kimmeridgian age of the Venetian region.

Unfortunately, starting from the 19sixties, after that Auboin (1964) utilized the Ammonitico Rosso type sediments as typical deposits of a well-defined period in his model of the dynamics of a geosyncline ("stade d'individualisation et période de vacuité de la phase d'état") the same name was utilized to point out indiscriminately many kind of sediments more or less red and more or less ammonite rich.

In such a way, it seems impossible today, by the simple utilization of this term, to understand directly what it means; then the most important thing was to start the study from a clearer definition (a classification) of the various lithotypes included in those words.

Some different attempts at classification of the Ammonitico Rosso facies are known (Auboin, 1964; Jenkins, 1974; Elmi, 1981a). Up to now, among them we like better the classification of Elmi. The author's subdivision in different types made it possible to recognize four well differentiated types in this kind of sediment.

Types of Ammonitico Rosso and their classification

In the quoted classification the Ammonitico Rosso (s.l.) was subdivided by the author into the following two types:

1) calcareous Ammonitico Rosso and 2) marly Ammonitico Rosso.

The first one is in turn subdivided in four types mainly on the basis of the type of nodularization:

1a) Stromatolitic nodular limestone; 1b) Bioturbated and bioeroded limestones; 1c) limestone subjected to bioturbation; 1d) true nodular limestone.

In general we agree that this classification seems to fit well with our data and with the results of our previous works on the same topic (Cecca et al., 1981; Farinacci et al., 1981a).

The ammonitico rosso environmental meaning

Facies of Ammonitico Rosso type are widespread but still puzzling as far as concerns its origin; in general: the origin of nodular sediments still creates some doubts. In general its formation is related now to a tectonically controlled instability of the bottom and such instability is considered as a primary factor controlling the others that directly influence the sedimentation. As seen also the "instability of the bottom", assumed in such large sense, seems to loose any meaning and to be more a way to describe a not well defined environmental scenery than a precise geodynamic moment. Some authors discard the bottom instability and assume other causes as primary factors.

Among the primary or secondary variables different causes are quoted as main controlling characteristics. Moreover some authors suggest a single controlling factor while others suggest many concurrent causes (Ogg, 1981) and frequently the Ammonitico Rosso origin is mixed with the formation of reduced and/or condensed sequences.

Among the other causes controlling this kind of sedimentation we can quote (take single or associated):

— topographic position and morphology of the bottom (Ameur & Elmi, 1981; Elmi 1981b),

— subsolution, below Calcite or Aragonite compensation depth (Hollmann, 1964),

— different types of diagenesis (Coudray & Michel, 1981),

— bioturbation (Dommergues *et al.*, 1981, Eller, 1981)

— organogenic origin of nodules (Massari, 1979, 1981).

A depth controlled sedimentation was thus directly or indirectly assumed by some authors and rejected by others. Another problem interfingers with the one of the formation of the Ammonitico Rosso that is the deposition of condensed levels. This problem is at least as complex as the one of the definition of the Ammonitico Rosso and must be treated in this work because, very frequently, condensed sediments in the Jurassic sequences aresomehow correlated to the Ammonitico Rosso.

WESTERN ANATOLIAN AMMONITICO ROSSO

All the studied sequences in our study area were grouped in four main types on the basis of the lithostratigraphy and of the paleogeography (Altıner *et al.*, this volume) and differentiated by tectonic control (Koçyiğit et al., this volume).

In the framework of those four types of sequences, the terms in some way referable to the facies of "Ammonitico Rosso" type outcrop in the following regions: Halılar, Bursa-Bilecik, Mudurnu-Beypazari, Aktaş. Moreover ammonite-rich condensed sequences, as before said in some way related to the Ammonitico Rosso, outcrop in the same regions (Fig. 1).

In our study area the lithofacies referable to Ammonitico Rosso in the most inclusive sense, show

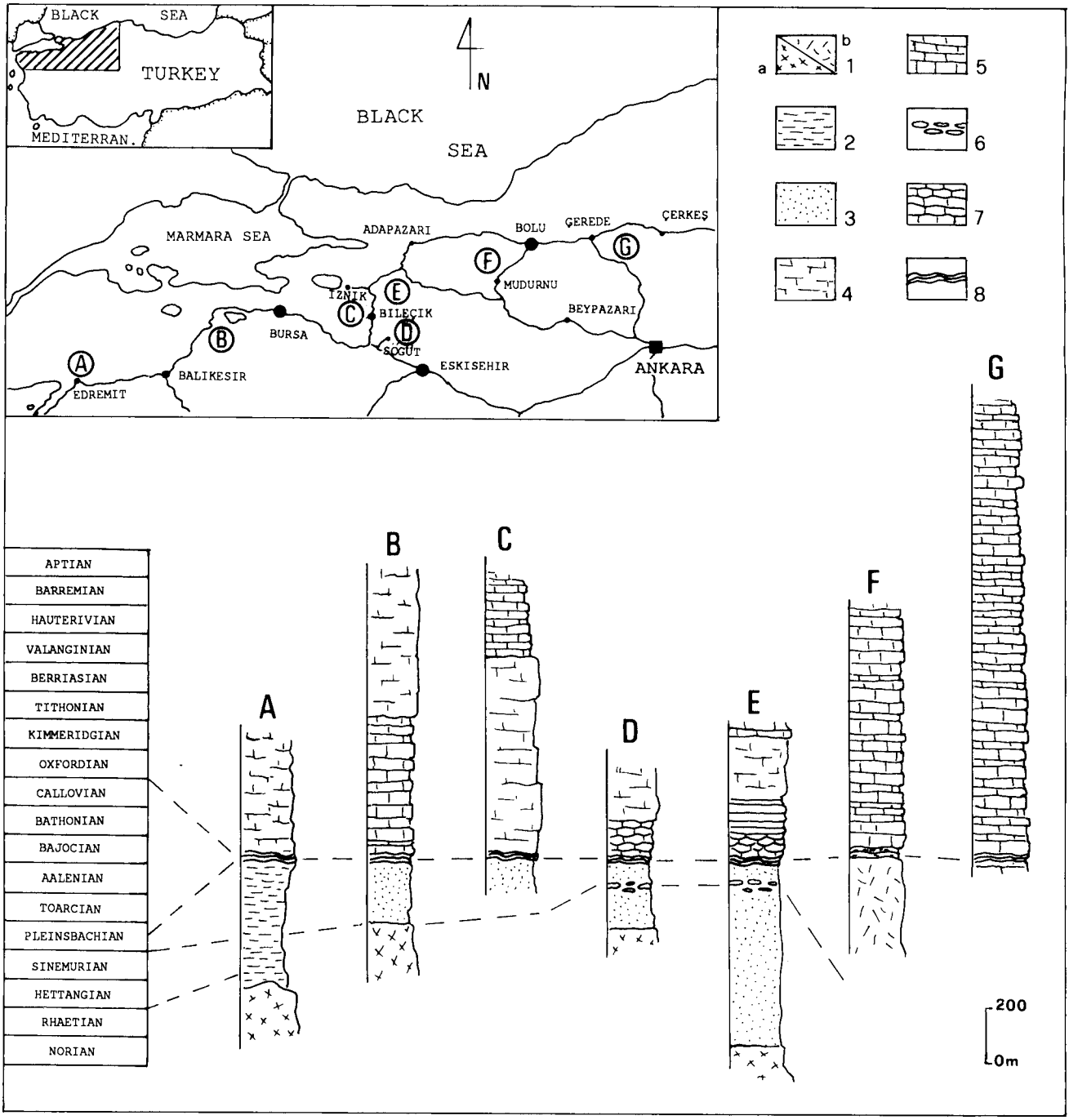


FIG. 1 — Map showing the main quoted outcrops and the schematic columnar sections for each area. Ammonitico rosso type sediments are indicated.
1) Clayey marly Ammonitico Rosso; 2) Nodular limestone; 3) Condensed levels; 4) Clastics; 5) Pelagic sediments; 6) Shelf type sediments; 7) Basement. (from Altiner *et al.*, this volume, redrawn and simplified)

very important differences in age and lithologic type, but they can be considered grouped on the basis of paleogeography, of sedimentary cycles to which they belong and mostly for the age, in two main types: the Liassic Clayey-Marly Ammonitico Rosso that fits in the type 2) of Elmi (1981a) and the middle-upper Jurassic Nodular Limestone including mainly lithotypes of the 1a), 1b) and 1d) type of the same classification. To these we have to add condensed levels cropping out scattered in various sequences. We shall examine now in particular all these types and their relationships with nearby facies.

1) *Clayey marly Ammonitico Rosso* (Trafo member of the Bayırköy Formation) about ten meters thick nodular deposit, of Sinemurian-Pliensbachian age that can be subdivided in its turn in two lithologies: 1a) *Clayey marly nodular levels* and 1b) *Nodular limy levels*, that can alternate. It cropps out in the Bilecik region (BGA, BT, BÇT, Bi-K sections) and in the Iznik region (I-Der section)(Fig. 1).

2) *Nodular limestone*, (Taşçıdere member of the Taşçıbayırı Formation of the Bilecik group) of Callovian-Oxfordian age, nearly ten meters thick, that cropps out in the Bilecik-Bursa area.

3) *Condensed levels*, a short comparison between the typical Ammonitico Rosso and the condensed levels cropping out in South-Western Anatolia is also given.

Obviously, further minor differences can be detected within all of them, from a lithological and a genetic point of view.

Clayey marly Ammonitico Rosso

1) The first type outcrops, lying on Liassic clastics and composed of decimetric alternations, frequently repetition of nodule rich marly-clayey levels with scattered more hardened nodular limestones. Only in a single outcrop (Iznik) it shows brecciated levels. In general may be subdivided furtherly in 1a) Clayey marly nodular levels and 1b) Nodular limy levels.

Some levels, mostly the marly ones, are very rich in fossils of many different taxa, while levels in which the limestone prevails show mainly oligotypic bivalve fauna. Locally sandy levels can interfinger the Ammonitico Rosso type lithologies. At the top Liassic clastics cover conformably the Ammonitico Rosso.

1a) *Clayey marly nodular levels*: Fossils present in the marly levels show different preservation but mainly are preserved as inner moulds; some of them were frequently reworked, reexhumed and encrusted or colonized. Textural characteristic of these levels is the coexistence of hardened nodules and unconsolidated matrix that differ in composition. Nodules at the same level sometimes may have different depositional history; time to time some "allochthonous" nodules, probably slightly more ancient, are mixed to the prevailing indigenous nodules just formed.

1 b) Nodular limy levels: Nodular limy levels show in general a fauna reduced in number of species, less frequently reworked in respect to those of the marly clayey levels, and perhaps mainly indigenous. Nodules and matrix, sometimes hardly distinguishable, present very similar textural characteristics. The bivalves show recrystalized shells.

In conclusion we can recognize that a very complex group of biological and physico-chemical events controlled the formation of the above mentioned 1a) and 1b) types of sediments.

Clayey marly Ammonitico Rosso: environmental characteristics

Environmental information can be detected by the very rich fauna collected; the faunal components are prevalently the usual nectonic and necroplanktonic forms as Ammonites (Cope, this volume) and Belemnites (Doyle & Mariotti, this volume) but other fossils foraminifers, ostracods (Lord & Lambourne, this volume), sponge, brachiopods (Ager, this volume), bivalves and gastropods

(Conti & Monari, this volume) and crinoids (Manni & Nicosia, 1990, this volume) are also widespread and show a quite large component of typical benthic forms. Intense incrustation, bioturbation and bioerosion testify also epifaunal and infaunal activity.

The more important environmental characteristic controlling the formation of the marly-clayey Ammonitico Rosso seems to be the joint influence of particular dynamic and biological processes, but mostly their timing, frequency and different intensity.

The dynamic ones, as for istance the frequently occurring one-way currents sweeping the fine limey argillaceous material, permitted reexumation and reworking. One-way currents are testified by crinoids of eudesicrinid type in the sequences of the Bilecik area and of cotyledermatid type in Iznik (Manni & Nicosia, this volume). The reexumation is testified by epizoans settling directly on fossil internal moulds (Manni, Nicosia & Pigliucci, this volume). The reworking is testified by many proofs as for istance the epizoans colonization on the opposite sides of the same Ammonite (Manni, Nicosia & Pigliucci, this volume).

The biological processes, including the very evident encrustation but mostly bioerosion and bioturbation, helped each other to destroy original sedimentary features, to let the fossils free in a unconsolidated matrix, to prepare finer portion to be swept. Both dynamic and biological processes caused low rate of sedimentation.

Other important characteristics, such as abrupt changes of the energy, are testified mostly by the scattered occurrence of nodular limy levels or also sandy levels. For the first ones we may suppose that a stop of the currents let the limy sediments, having time enough, diagenitize and become hard, also with the help of encrusting organisms (bivalves rich, bored hard-grounds in Bilecik region). Thus, on the whole, the sedimentation of the Clayey Marly Ammonitico Rosso could be attributed to an unstable environment in which abrupt and weak changes of energetic and biological parameters lead, in turn, to the formation of soft-, firm or hard-grounds rapidly changing to each other.

The Trafo member is enclosed (and locally interfingered with) into clastics of the Bayirköy Forma-

tion. As an example of the interfingering is testified very clearly by Belemnite-rich sandy level in Günören section (Doyle & Mariotti, this volume).

In the lower part, clastics crop out with different but important thickness (ranging from 600 m in the Bilecik area to 100 m in the Söğüt area) while in the upper part a quite constant small thickness of clastics (ranging from nearly 20 m to nearly 30 m in the whole area) ends the Liassic sedimentation.

Direct overlying and occasional interfingering let us suppose that quite similar environmental parameters controlled the sedimentation of both members and that sudden but weak changes of environmental characteristics were responsible for the deposition of the quickly changing lithologies.

The geodynamic meaning of this frame could be hypothesized, assuming that a growth fault system originated by the rifting, creates different basins. Differences in dimensions among those basins justify differences in thickness of the lower clastic member. The relative constancy in thickness of the upper part of the Liassic clastics and of the same Ammonitico Rosso seems to demonstrate that, before the deposition of the clayey marly Ammonitico Rosso, the main difference in the geometry of the basins was already disappeared, filled up by different amount of clastics. If this is true, from a purely sedimentological point of view, the start in the deposition of the Ammonitico Rosso facies could have the meaning of a reduction in the clastic supply tied to a tectonically controlled relative still stand of the sea level.

Thus this phase seems to be related to the end of a first phase of rifting, in which the downward movement prevailed; with the resulting diminishing erosion and thus the obvious less important clastic supply. The deposition of the clayey marly Ammonitico Rosso represents by this stand point a phase in which the distribution of sediments prevails on the deposition. Currents and lack in clastics lead to a general condensation and the laterally not continuous presence of the Ammonitico Rosso testifies that place to place redistribution of clastics does not permitted the formation (or lead to the erosion) of the Ammonitico Rosso itself.

All these characteristics let us hypothesize a phase of less intense tectonics. After the deposition of the clayey marly Ammonitico Rosso, clastics are newly present with a more constant, uniform but small thickness. This could be the result of a new deposition of clastics on the whole area and then of a new phase of erosion. If this is true, it could be controlled by a second phase of the rifting, in turn characterized by a prevailing uplift.

Nodular limestone

The type 2) nodular limestone outcrops in our study area as a complex of different sediments more than by a simple lithology. It overlies the Liassic clastics and the time of its formation was probably only a little heterochronous ranging Bathonian (locally Bajocian?) to Callovian.

All the characteristics of this complex of sediments are very much variable giving origin to different lithologies, whether if limestones absolutely prevail. Such lithologies can be: nodular limestone, bioturbated limestone, more or less intensively bioeroded limestones, protonodular limestone with nodules and crusts of cryptalgal origin. Matrix and nodules in a same bed show common textural characters and local differences in the degree of nodularization process, in the early diagenesis and, occasionally in dolomitization processes, caused differences in the lithologies.

The fauna is represented by absolutely predominant pelagic organisms such as Ammonites, Aptychi, Belemnites and thick walled Protoglobigerinids; the benthic organisms are represented almost exclusively by their activity (bioerosion and bioturbation) probably due to the type of sediments, the differential power of fossilization and the type of diagenesis.

Nodular limestone: environmental characteristics

Generally features controlling the sedimentation of the nodular limestone seem to be more constant, or at last less rapidly changing, than we have seen for the clayey marly Ammonitico Rosso, even if local quick changes in the environment are also testified. In this case too, the joined influence of the physical and biological processes controlled the deposition of this lithology but surely phenomena can be subdivided in two phases, more easily distinguishable than in the case of the clayey marly Ammonitico Rosso.

The first phase was characterized by early diagenesis and by repeated prevailing bioerosion (burrowing and boring). The second one by the prevailing removal of relics of the biological action, by redistribution of sediments and by compaction of nodules; obviously these phases can be repeated several times.

Thus on the contrary of what observed in the clayey marly Ammonitico Rosso, the main cause of nodular limestone origin seems to be derived from biological activity, in an environment in which the clastic influx was nearly absent and where wave motion controlled the formation of firm-ground or hard-ground. In fact the compaction of the relict nodules and the removing of the detrital remains, originated by the bioerosion, must happen mainly into the wave hydrodynamic action zone while current actions are not well or not at all testified. All these processes happened on a morphology and in an environment of "plateau" type.

The relationships with the terms of the underlying middle Liassic cycle do not need obvious explana-

tions depending by a general ingression, while the relations with the overlying terms suggest for the nodular limestone the persistence, for a relatively short time, of conditions near to the limit of the possibility for the spread out of a shelf facies. In fact the most of these types of sequence changes toward the top into carbonate shelf sediments.

Condensed sediments

Condensed sequences or condensed levels are also present in other parts of the studied area and may be correlated to the nodular limestone even if they are not truly Ammonitico Rosso type facies. They crop out in the Edremit, Bursa, Bilecik and Gerede sequences (Altiner *et al.*, this volume) and seem to be more or less isochronous with the transgression responsible of the nodular limestone deposition; this transgression occurred with a noticeable constancy, on the flat area in which Liassic clastics were cropping out, in the Callovian age (locally Bajocian to Late Bathonian?) and seems characterized by downward movements linked to the same rifting phase.

In a first time a sudden increase in water energy, after the submergence, lets again the redistribution prevail in respect to sedimentation and, place to place, we observe the formation of metallic - rich crusts, centimetric condensed levels, cryptalgal fabrics and ammonite - rich stromatolithic deposits. Fe-oolites and "pelagic" oolites formed frequently with nuclea originating from reexhumed particles of the underlying clastics.

Long time before emerged area stopped the clastic supply toward our study area and a carbonate sedimentation spread out on the whole area. This seems linked to a tectonical disjunction of our area in respect to the emerged zones in which clastics could be produced. The sedimentation rate was in this time very low and small thickness deposited. In slightly different conditions less high energy limy deposits were bioeroded and condensed and nodular limestones were formed. Only in a single area (Edremit) a trough was probably present before the formation of repeated condensed levels. These last, slightly different in ages (Early Bajocian-Upper Bajocian-Callovian), seem to show that this trough was nearly completely filled before Bajocian age.

A further increase in wave energy can also lead to the complete lack in sedimentation; obviously the same could occur in local raised zones. After this time another tectonically controlled general slow uplift took place in the whole area.

Condensed sediments§: environmental characteristics

From a genetic point of view the origin of condensed levels and of the nodular limestone could be considered equivalent. Most of the differences must be attributed either to local factors or to different degree in an ever increasing condensation process. Thus we can take into consideration these phenomena all together to recognize geodynamical trends.

The nodular limestone and the condensed levels lie on the Liassic clastics upon an erosional surface testifying a general nearly abrupt transgression on the whole area. The sedimentation of the Callovian-Oxfordian terms starts after a gap assumed as Late Pliensbachian to Bathonian or Callovian ages. Presence of condensed levels in area that, after passed to slope facies (Mudurnu) testifies that in those zones the sea bottom reached the same situations starting from different situation, filled by volcanics. Toward the top, nodular limestone change to shelf facies and in general the same occur with very few exceptions upon the condensed levels. Nodular and condensed levels are practically isochronous and widespread on the whole area.

Genetically such facies are linked to a quite energetic environment in the wave motion zone. Thus it seems that the general transgression, coming to a stop, lets the whole area in conditions in which nodular limestone and condensed levels may develop.

Later the tectonically controlled break up of the plateau created different isopic zones and some volcanics were deposited. Different thickness and some delays in the onset of true cor-algal facies testified the creation of margin-like structures and thus dynamically different zones.

In the Gerede area tectonics have controlled the sedimentation and shelf facies nearby slope sequences originated. For the above the beginning of the sedimentation of nodular limestone may be connected to a rapid deepening followed by an abrupt stopping.

The end of the nodular limestone sedimentation could be controlled by a general tectonic instability that broke up the area and created slight differences in the general frame of rifting and uplifting.

Relations and differences between marly-clayey Ammonitico Rosso and nodular limestone

In conclusion the most important environmental factors that differentiated the sedimentation of the marly-clayey Ammonitico Rosso in respect to the one of the nodular limestone were probably the quality of the biological action (prevailing bioturbation versus prevailing bioerosion), type of water energy (currents versus wave action) and the type of sediments (prevailing clastics versus prevailing limestones); furthermore an high number of less important

factors cooperate in the formation of both peculiar sediment types.

In the following scheme the main and the less important processes, identified in the studied outcrops of the Western Anatolian region, are summarized (Fig. 2).

AMMONITICO ROSSO TYPE FACIES IN OTHER REGION:

Relations and differences

As the facies of Ammonitico Rosso type, as defined in the introduction, are widespread and well-known around Mediterranean area, many genetic models were built for their interpretation, mostly based on local evidence. In general its formation was related to tectonically controlled instability of the bottom, but different causes are also quoted.

Some important differences, apart from time differences, emerge in our study area that differentiate the sequence and that oblige one to relate the Ammonitico Rosso that crops out in Western Anatolia, to, at least partially, different origins.

We can take as examples some of them that could represent a large spectrum of possibilities. The main differences among our outcrops and the ones cropping out in some different areas can be easily shown

		CLAYEY MARLY AMMONITICO ROSSO		NODULAR LIMESTONE
ALLOCHTONOUS ELEMENTS		COMMON		ABSENT
EPIFAUNA		COMMON		OCCASIONAL
INFAUNA		PRESENT		COMMON
BIOTURBATION		FREQUENT		WIDESPREAD
BIOEROSION		PRESENT		WIDESPREAD
REWORKING		FREQUENT		NOT TESTIFIED
REEXHUMATION		FREQUENT		NOT TESTIFIED
SOFT	BOTTOM	PRESENT		OCCASIONALLY PRESENT
FIRM	BOTTOM	OCCASIONALLY PRESENT		COMMON
HARD	BOTTOM	OCCASIONALLY PRESENT		WIDESPREAD
SWEEPING		NEARLY CONSTANT		PRESENT (CYCLIC)
% CLAY		HIGH (OCCASIONALLY REDUCED)		LOW / LACKING
ENERGY		PREVAILING CURRENT		PREVAILING WAVE MOTION

FIG. 2 — Main biological and dynamical processes recognized within the Ammonitico Rosso type sediments in our study area.

by the comparison. We will show shortly the situation in Algeria, Spain, Central and Northern Italy and in Southern Turkey because many other situations could be joined to one or other of them. Obviously the situations are laterally and vertically changing but we can take in examination it in a general way:

1) In Algeria (Oranie region - Tlemencian domain Ameur & Elmi, 1981) the Toarcian Ammonitico Rosso lies unconformably on pebbly limestone with belemnites, that is on limestone partially enriched by clastic material, and it is followed by the "Cancellophycus limestones" and successively by silica rich limestone of Bajocian age. All this testifies a continuing of subsidence of a portion of a submerging margin. According to the authors factor controlling the formation of the Ammonitico Rosso was mainly the topography of the bottom.

2) In Spain (Subbetic region, Braga *et al.*, 1981; Seyfried, 1981) Ammonitico Rosso facies, of Toarcian age, lie on Domerian limestone (or locally on Domerian Ammonitico Rosso) and somewhere it lies on swells. It is covered in general by Aalenian pelagic sediments. The facies shows also evidences of the step by step increasing influence of basin and slope facies. Both the Ammonitico rosso lying on slope and swells were drowned in the Late Jurassic.

3) In Central Italy (Umbrian-Marchean sequence) swells and trough alternate (Farinacci *et al.*, 1981b). In the trough Rosso Ammonitico Fm of Toarcian age, follows the limestone and cherty limestone of the Corniola Fm and it is overlain by thin shelled bivalves rich marls and limestone (Posidonia marls Auct), in some places its lower part is substituted by a more clayey and less nodular term (Serrone marls Pialli, 1969). Slumps and distal resedimentation phenomena are known, showing slope deposition. On the swells Ammonitico Rosso Fm is frequently lacking or, when present, it shows gaps; in both cases it is followed by a gap up to Middle Bajocian or later. Somewhere, on the swells, Tithonian Ammonitico Rosso could be present with peculiar characteristics (Cecca *et al.*, 1981). The whole area was definitively subsided in the Early Cretaceous. Thus also this sequence shows in general a transgressive trend even if many areas show repeated local emergences due to the local situation. 4) In Northern Italy ("Trento plateau" see Sturani, 1971; Winterer & Bosellini, 1980) the classical Ammonitico Rosso lies on "Posidonia alpina beds" starting from Aalenian-Lower Bajocian and it is characterized by repeated condensed levels, hardground and gaps (Martire, 1988, 1989). Usually the end of this kind of sedimentation is reached with a general transition to the Calpionellid rich limestone (Maiolica Formation). Locally the silica-rich "Fonzaso Formation" or radiolarites lies between lower and upper Ammonitico Rosso. Once more a definite transgressive tendance is testified.

In general the above described first three types resemble more the clayey-marly Ammonitico Rosso of the studied area while the last one resembles more the Callovo-Oxfordian nodular limestone. Obviously many other outcrop types could be examined but in general they might be joined to one type of the previously examined ones.

CONCLUSIONS

The main differences among Ammonitico Rosso type sediments of the above examined peri-mediterranean regions and the ones cropping out in Western Anatolia could be emphasized considering their geodynamic history. Clayey marly Ammonitico Rosso and nodular limestone, the Ammonitico Rosso type sediments, in our study area seem to be related to relatively negative sea level changes, in fact clastic sedimentation and emergence follow the Liassic clayey marly Ammonitico Rosso; progressive or abrupt transition toward shelf facies followed the Middle-Upper Jurassic nodular limestone. It can be summarized pointing out that in both cases we observe that the Ammonitico Rosso type sediments are followed by events interpreted as regressive while in other peri-mediterranean regions always transgressions are evidenced.

From a purely sedimentological point of view, as far as concerns the problem of causes that directly controlled the sedimentation, we observed that the different type of sediments were differentiated by the concurrent action of various biological and dynamic factors that can prevail in turn, thus we believe that at the moment it seems impossible to point out a single cause for the origin of this type of sediments. Concerning the problem of the depth the ecological parameters, presence of a quite energetic environment, type of fossils, clastics interfingering ecc. seem to show at least local independence by great depth.

RIASSUNTO

Sedimenti di tipo Ammonitico Rosso appartenenti al Trafo Member della Bayırköy Fm. (Sinemuriano - Pliensbachiano) e al Tascidere Member calcareo e nodulare della Tascibayiri Fm. (Calloviano - Oxfordiano) sono stati studiati nei Pontidi occidentali (Anatolia nord-orientale). Si è evidenziato fra l'altro che questi sedimenti in Turchia sono seguiti da eventi regressivi, mentre risulta il contrario in altre regioni perimediterranee, dove sono sempre seguiti da eventi trasgressivi.

Al momento sembra impossibile riconoscere una sola causa per l'origine di questo tipo di sedimenti. Infatti sia fattori biologici che dinamici concorrono a caratterizzare i Rossi Ammonitici, prevalendo alternativamente un fattore sull'altro.

I parametri ecologici, un ambiente caratterizzato da bassa energia, il tipo di fossili, la presenza di sedimenti terrigeni interposti, suggeriscono una indipendenza da grandi profondità.

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