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CONTENU

STRATIGRAPHY OF THE OUTCROPPING CRETACEOUS DEPOSITS IN SOUTHERN DOBROGEA (SE ROMANIA)[1]

BY

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Cretaceous. Lithostratigraphy. Lithofacies. Epicratonic sedimentation. Coastal environments. Offshore environments. Biofacies. Biostratigraphy. Dobrogea — Southern Dobrogea.

Abstract

The exposed Cretaceous deposits of Southern Dobrogea are here demonstrated to encompass a sequence of geological formations standing for distinct sedimentary cycles separated by major stratigraphic gaps : Cernavoda Formation (Upper Tithonian ?-Berriasian-Valanginian) ; Ramadan Formation (Bedoulian ; locally, Barremian-Bedoulian) ; Gherghina Formation (Gargasian ; locally, Bedoulian ?-Gargasian- ?Clansayesian) ; Cochirleni Formation (Clansayesian ?-Albian) ; Peştera Formation (Lower Cenomanian) ; Cuza Vodă Formation (Middle ?, Turonian) ; Murfatlar Formation (Santonian-Lower Campanian). Considering both the lithologies and the faunas, it is to conclude that most formations have been accumulated within coastal or subcoastal marine settings, under either prevailingly carbonate facies (Cernavoda, Ramadan) or mainly detrital terrigeneous facies (Cochirleni, Peştera, Cuza Vodă). Subordinate sedimentation under continental conditions (Gherghina) or, contrarily, under neritico-pelagic (but shallow) marine conditions (Murfatlar) can be noted. The biostratigraphical data have allowed for an accurate chronostratigraphical localisation of most distinguished formations, and good insights into dating their lithostratigraphic component terms as well as into delineating the time spans covered by the inter-formational stratigraphic gaps ; the latter ones correspond to the following time intervals : Hauterivian ; Clansayesian ; Upper Albian, in places Vraconian only ; Middle-Upper Cenomanian ; Coniacian-lowermost Santonian ; Middle Campanian-Maastrichtian.

Résumé

La stratigraphie des dépôts crétacés affleurant dans la Dobrogea méridionale (SE de la Roumanie). On a séparé dans le Crétacé de la Dobrogea du Sud une succession de formations géologiques représentant des cycles de sédimentation distincts délimités par des lacunes stratigraphiques majeures : formation de Cernavoda (Tithonique supérieur ?-Berriasien-Valanginien), formation de Ramadan (Bedoulien ; localement Barrémien-Bedoulien), formation de Gherghina (Gargasien ; localement Bedoulien ?-Gargasien- ?Clansayésien), formation de Cochirleni (Clansayésien ?-Albien), formation de Peştera (Cénomanien inférieur), formation de Cuza Vodă (Turonien moyen ?), formation de Murfatlar (Santonien-Campanien inférieur). La plupart des formations ont été déposées dans des conditions costales ou subcostales, en faciès à prédominance carbonatée (Cernavoda, Ramadan) ou bien en faciès surtout détritique (Cochirleni, Peştera, Cuza Vodă). Hormis celles-là il y a des formations sédimentées en des conditions continentales (Gherghina) ou en des conditions à prédominance néritique-pélagique mais de petite profondeur (Murfatlar). L'étude biostratigraphique a précisé la distribution chronostratigraphique de ces formations ainsi que des lacunes stratigraphiques qui les séparent, les dernières correspondant aux intervalles : Hauterivien, Clansayésien, Albien supérieur (localement Vraconien seulement), Cénomanien moyen-supérieur, Coniacien-Santonien basal, Campanien moyen-Maastrichtien.

I. INTRODUCTION

The field and laboratory work carried out during a period of several years by the authors of the present note has provided an image rather different and, we think, more precise as compared to those published so far upon the stratigraphy of the Cretaceous deposits in Southern Dobrogea.

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From the whole data bulk, the identification and definition of the geological formations as well as their areal distributions, gross lithologies and mutual stratigraphic relationships stand for the result of the joint mapping undertaken by the first three authors (E.A., A. D., L. S.); the lithological-petrological, lithostratigraphical, facies (ecological-sedimentological) and environmental aspects within each formation have been refined by Drăgănescu; the macropaleontological-macrobiostratigraphical study has been accomplished by Avram and Szász with regard to the Lower and, respectively, Upper Cretaceous; the micropaleontological-microbiostratigraphical data have been supplied by Neagu; the english version of this paper has been achieved by one of the authors (A. D.).

Present study follows chronologically a series of gradually more and more detailed papers concerning the geology of Southern Dobrogea, whose beginnings are placed by the middle of the previous century. The pioneering works by Reuss (1865) and Peters (1867) were subsequently supplemented with new data by Anastasiu (1898, 1908), Toula (1904), Paquier (1901), Simionescu (1906, 1926). The basic contribution to the knowledge of the south-dobrogean Cretaceous sequence was brought, however, by Macovei (1911, 1934 — in Macovei, Atanasiu, 1934); his classical work has been recently followed by papers authored chiefly by Chiriac (1956, 1957, 1960, 1961, 1968, 1981), Băncilă (1973), Chiriac et al. (1977) and Neagu et al. (1977). The completion of the present paper was preceded by the publication under a graphical form (geological maps 1|50,000, Medgidia and Peştera) of the field mapping data by the first three authors (Avram, Drăgănescu and Szasz, in Ghenea et al., 1984 a, 1984 b)[4].

The Dobrogea county is located in SE Romania, between the Danube lower course and the Black Sea. The Cretaceous sequences of Southern Dobrogea belong to the slightly deformed, Paleozoic-Mesozoic, sedimentary cover of the Moesian Platform. The Dobrogean sector of this structural unit includes the Central and Southern Dobrogea compartments, and stands for the Moesian sector displaying the highest overall structural position, exposing both the Precambrian basement and the Jurassic and Cretaceous cover terms (e.g. Drăgănescu, 1974; Drăgănescu in Drăgănescu et al., 1978, 1979, and in Mureşan et al., 1982); the Cretaceous terms are largely developed in Southern Dobrogea and southernmost Central Dobrogea only; northwards, they make up scattered and restricted patches.

The Cretaceous deposits in Southern Dobrogea (here included also those of southernmost Central Dobrogea) are almost tabular. They are exposed along valleys as discontinuous strips usually located in the lower part of the slopes but in places occupying the whole slope height. The stratigraphic relationships with the pre-Cretaceous terms, the latter outcropping only within Central Dobrogea, are usually obscured by the thick Quaternary loess cover; they can be noticed in places just along the southernmost border of this unit, here the Meso- and Neocretaceous terms transgressively overlying older (Jurassic and pre-Jurassic) formations. The Cretaceous successions underlie local Paleogene or Upper Badenian deposits or, directly, widespread Middle Sarmatian and Quaternary sediments, the latter (loess) covering more than 90 percent of the surface of the investigated area.

Given the outcropping conditions (exposures relatively frequent but discontinuous and linear), the judicious identification, interpretation and correlation of the lithostratigraphic units have required a rigurous interdisciplinary, paleontological-petrological, approach of the Cretaceous sedimentary pile. Finally, we have been able to define formations (and eventually members) with distinctive lithologic and biologic features, and to refine or to modify the previously accepted bio-/chronostratigraphical and ecological-sedimentological images.

Because of the substantial depositional gaps accompanied by more or less drastic erosional effects, gaps corresponding to the stratigraphic discontinuites noted between the distinguished formations, both present-day areal extent and conserved thickness of every Cretaceous formation are often considerably diminished as against the original (directly post-depositional) picture; this statement is clearly supported by the more or less discontinuous areal development and the more or less incomplete stratigraphic column currently shown by the studied formations, as well as by the frequent reworking of faunas proceeding from eroded sequences of different Cretaceous formations, within overlying, younger Cretaceous formations. The restoration of the original extent and

[4] Meantime, between the present paper submission and its publication, two notes have been published on the Lower Cretaceous deposits of South Dobrogea: Neagu T., Dragastan O., 1984 — Stratigrafia depozitelor jurasice şi eocretacice din Dobrogea de sud (Stud. cerc. geol., geofiz. geogr., Geol., 29, p. 80—87, Bucureşti) — and Dragastan O., 1985 — Upper Jurassic and Lower Cretaceous formations and facies in the eastern area of the Moesian Platform (South Dobrogea included) (Anal. Univ. Bucureşti, Geol., XXXIV, p. 77—85]. These notes put forward stratigraphical images partly similar to those depicted in the already published maps (geological sheets Medgidia and Peştera 1:50,000, 1984, see Introduction and references), but the supplied descriptions are, unfortunately, rather simplifying and confuse.

anatomy of every formation has been accomplished by assembling the data supplied by extant exposures and, subsidiarily, considering also (when available reliable data) the evidence provided by drillings.

Seven formations have been identified and named by three of the present authors (E. A., A. D. and L. S.) in the exposed Cretaceous sedimentary succession of Southern Dobrogea. They are described successively and in ascending stratigraphical order in the next section of the paper. For their cartographical representation the reader is referred to the maps published by the first three authors (in Ghenea et al., 1984 a, 1984 b). A simplified geological map and a general stratigraphical column are published in the present paper (Plates I and II).

II. DESCRIPTION OF THE GEOLOGICAL FORMATIONS

A. Lower Cretaceous

The outcropping Eocretaceous deposits within Southern Dobrogea are clustered here into four formations :

1. Cernavoda Formation (Upper Tithonian ?-Berriasian-Valanginian) ;
2. Ramadan Formation (Bedoulian ; locally, Barremian-Bedoulian) ;
3. Gherghina Formation (Gargasian ; locally, Bedoulian ?-Gargasian- ?Clansayesian) ;
4. Cochirleni Formation (Clansayesian ?-Albian).

1. Cernavoda Formation (Upper Tithonian?-Berriasian-Valanginian)

The Cernavoda Formation, an essentially carbonate and subordinately marly-clayey (also evaporite in subsurface) rock sequence, crops out discontinuously between the Danube to the west and the Poarta Albă—Dumbrăveni alignment to the east, and between the upper course of Agicabul valley (south of Kogălniceanu village) to the north and the Romanian—Bulgarian frontier to the south. South of the Capidava—Ovidiu lineament, it has been crossed by drillings only westwards from the Palazu Mare—Valu lui Traian—Cobadin—Plopeni—Negru Vodă alignment (Vasilescu, Dragomirescu, 1977).

The most characteristic (complete, thick and multifacies) successions of this formation occur in the Cernavoda town area (here chosen as type area of the formation), if considered both surface (our investigation) and published subsurface (Băncilă, 1973) data. However, the subcropping sections are beyond the present paper purposes. The most complete outcropping sequence in this area (see Alimanu Member description below) is exposed in the Danube right-bank cliff between the Cernavoda bridge, to the north, and the northern tip of Hinog eyot, to the south ; this sequence — here designated as the outcropping main type section of the formation — is complemented by several auxiliary type sections in the same area : artificial exposures at Saligny lock on the Danube—Black Sea channel (cut along the Carasu valley) and at the Cernavoda nuclear-electric plant (artificial slopes at the Cişmelei valley mouth), as well as natural outcrops in the Danube cliff immediately south of Cochirleni village. Other exposed auxiliary type sections include the type sections of the component members ; they are situated in different areas.

In the foregoing type area as well as in the whole region located between the Capidava—Ovidiu and Rasova—Peştera—Cobadin alignments (region including the type area), the lowermost lithologic term of the formation consists of a "gypsiferous complex" and an associated "polycoloured marly-clayey series" and it has been recognised only in boreholes (Băncilă, 1973) ; this term was demonstrated by Drăgănescu (1976) to stand for the eastward prolongation, on the Dobrogean territory, of the Neocomian gypsiferous-anhydritic sequences subcropping in the east-wallachian sector of the Moesian Platform ; the term is outside the scope of the present paper, being developed only in subsurface. However, the published petrological descriptions (Băncilă, 1973 ; Drăgănescu, 1976) enable the sedimentological conclusion that, as a whole, this term illustrates coastal marine depositional conditions ranging from primarily evaporitic (sulfate) tidal flats (sabkhas) (the gypsiferous sequences) to predominantly brackish tidal flats (the variegated pelites). This term is ascribed to the Tithonian—Berriasian interval by previous students (Băncilă, 1973 ; Chiriac et al., 1977). However, its location around the Berriasian/Tithonian boundary seems to be beyond any doubt at present time.

In the whole area of development, the Cernavoda Formation overlies directly the Upper Jurassic carbonate deposits (contact not exposed ; drilling data). In its turn, it is covered disconformably (contacts exposed) and discontinuously by deposits belonging to younger Cretaceous formations and generally, and sometimes directly, by Neogene or Quaternary deposits. The noticeable stratigraphical relationships with various younger Cretaceous formations are of a direct interest for the purposes of the present study. Thus, the Cernavoda Formation is disconformably overlain directly by terms belonging to the following Cretaceous formations: Ramadan Formation (Cişmelei valley sector, i.e. at atomo-electric plant and at 1.3 km east of it, within a shallow boring; Carasu valley, immediately south of Saligny lock; Remus Opreanu valley, south of Medgidia subsidiary railway station; Baciu valley; at Lipniţa; SE of Bugeac lake; and in Băneasa drilling); Gherghina Formation (Danube cliff between Cernavoda and Hinog valley mouth); Carasú valley, west of Saligny, west of Medgidia, at Castelu and, on the channel floor, at Poarta Albă; Remus Opreanu valley, directly SE of the homonymous village; upper course of the Agicabul valley); Cochirleni Formation (Danube cliff, south of Hinog; Peştera—Cochirleni valley at 2 km SE of Ivrinezu Mare; Baciu valley; Adamclisi—Alimanu valley, in the Şipote village area; Canaraua Fetii valley; in the cliffs of the Oltina and Bugeac lakes); Peştera Formation (Dăulari valley, east of Peştera village); and Murfatlar Formation (Poarta Albă locality area: right slope of Carasu valley and quarries in the left slope of Cocoşu valley lowermost course).

The Cernavoda Formation can be divided, according to our data (A. D.), into three outcropping members (corresponding to three distinct major lithofacies associations developed essentially as three large rock bodies):

a. Poarta Albă Member (Berriasian): an essentially dolomitic unit;

b. Medgidia Member (Berriasian): a polygenous (dolomitic-marly-clayey-calcareous) unit;

c. Alimanu Member (Upper Berriasian—Valanginian): an almost exclusively calcareous unit.

The stratigraphical relationships between the last two members are essentially of superposition (and, certainly, conformity); on the contrary, the first two members are mostly synchronous (and laterally interfingering), their possible partial superposition (involving the possibility for the uppermost terms of the Medgidia Member to be stratigraphically placed above the last terms of the Poarta Albă Member) remaining still a matter of debate.

a. *The Poarta Albă Member* (*dolomitic member*) is typically exposed in the quarries situated in the vicinity of Poarta Albă locality (local right slope of the Carasú valley, and left slope of the lowermost course of the Cocoşu valley along a length of 2—2.5 km); additional outcropping can be noted along the Adamclisi—Alimanu valley in the Adamclisi locality area; this member has also been exhumated temporarily on the floor of the Danube—Black Sea channel (Carasú valley thalweg along a distance of about 1 km in front of the Poarta Albă railway station).

The most appropriate type section (consequently, thoroughly examined by the authors) would have been provided by the continuous succession artificially exposed along the channel floor at Poarta Albă; but this temporary exposure is no longer accessible and, thus, the only available sections in the Poarta Albă type area are presently supplied by the foregoing quarries concentrated, roughly speaking, at the Cocoşu valley mouth.

This member is composed of a sequence of medium- to thick-bedded dolostones (individual beds being 3—4 dm up to a few meters thick) containing subordinate intercalations of greenish marlstones or claystones, in places highly fissile (marly|clayey shales), these intercalations reccurring more frequently towards the lower part of the exposed sequence; locally, the rocks are slightly gypsiferous. It is to be stressed that both the lower portion of the stratigraphic succession of this member and its lithological transition to the subjacent (variegated clayey-marly and gypsiferous) lowermost term of the Cernavoda Formation are not exposed, but developed only in subsurface and crossed by drillings in the Poarta Albă—Nazarcea area; the drillings seem to corroborate the exposed lithology and suggest a gradual downward passage of this dolomitic member to the variegated pelitic sequence; unfortunately, the extracted cores have not been available for a petrological (but only micropaleontological) study to the authors.

From sedimentological viewpoint, the dolostones (highly variable as size and shape of the replacive, syngenetic-early diagenetic, component dolomite crystals) consist of alternating beds or bedsets exhibiting either intense bioturbation (chiefly mottling) or undisturbed, millimetric, even planar lamination of a mechanical nature (mechanical laminites), therefore suggesting slightly supersaline, intertidal to supratidal depositional settings. The marly|clayey interbeds show similar sedimentary structures and suggest the same depositional conditions (chiefly supratidal flats and pools) but, however, variable lower salinities (normal marine to subsaline environment) and sudden abundant clayey influxes of a probably direct continental derivation during ephemeral humid periods. The scattered occurrence of gypsum microcrystals and nodules dispersed within some dolomitic or marly-dolomitic beds or bedsets supplies evidence for the episodic existence of highly supersaline supratidal conditions. The sparsely associated, brackish to freshwater, fossils (characeae and foraminifera; see below) support the above-assumed salinity variability and the above-emphasized depositional environments (schizohaline tidal flats). As a whole, the lithologies, the sedimentary (non-biogenic and biogenic) structures and the biological remnants are consistent with a marine tidal flat facies association of a prevailingly dolomitic type, hence currently evolved under slightly supersaline conditions, but transiently displaying either normal saline to drastically subsaline or considerably supersaline episodes.

The age of this member can be estimated considering a characean assemblage provided by the underlying multicoloured clayey-marly suite (93—138 m subsurface depth interval) and a foraminiferal assemblage supplied by the very here-discussed member (at 68 m and 93 m subsurface depths), both assemblages being obtained from the Nazarcea borehole. The former assemblage, containing *Flabelochara grovesi* (Harris), *Nodosoclavator bradleyi* (Harris), *Globator mailardi* (Saporta), *Clypeator corrugatus* (Peck), is indicative of the uppermost Purbeckian interval; the latter assemblage, including *Danubiella cernavodensis* Neagu, *Anchispirocyclina maynci* (Hottinger), *Everticyclammina virguliana* (Koechlin), *Rectocyclammina chouberti* Hott, points to the Upper Berriasian. Accordingly, the Poarta Albă Member sequences begin probably in the Lower Berriasian and extend upwards into the Upper Berriasian.

The exposed thickness of this member can be established just approximately, given the lack of continuous sections, at some 25—30 m.

b. *The Medgidia Member* (*polygenous member*) exhibits its typical outcropping (chosen here as type section) in the southern slope of the Carasu valley in the neighbourhood of the Medgidia town (between the cement factory quarry and the new harbour to the east, and 1.5—2 km west of the town stadium to the west); additional typical exposure occurs in the Danube cliff at the Peştera—Cochirleni valley mouth and directly upstream (southwards); the uppermost part of this member was temporarily exposed also by the excavations made at the Saligny lock (on the Danube—Black Sea channel) and at the atomo-electric plant location. In all these sectors, the passage to the suprajacent Alimanu Member is also exposed. The maximum exposed thickness of the Medgidia Member lies within 15 m and corresponds to its (upper and top) outcropping parts.

This member stands for the lithostratigraphic unit displaying the largest lithologic diversity and the fastest vertical and lateral change in gross lithology, among the units composing the Cernavoda Formation. It consists of an uneven, decimetric to metric, and irregular, apparently disordered, interbedding of limestones, dolostones, marly limestones, marlstones and claystones; the rocks are sporadically gypsiferous. These lithologies are further on briefly described in terms of those sedimentologic-biologic features diagnostic of the depositional conditions.

The limestones are represented by foraminiferal-oncolitic(-locally oolitic) calcarenites, pelletal-peloidal calcarenites, (locally conspicuously microfossiliferous) calcilutites and, subsidiarily, oolitic calcarenites and biocalcirudites (the latter dominated by dwarf nerineids and variable-sized naticids). By their petrography, the limestones typify lagoonal-tidal flat environments. They are stratified, the beds ranging between 2—5 dm and 1—2 m in thickness. From macrostructural standpoint, the limestone beds (irrespective of their foregoing petrography) look either homogeneous (structureless, usually owing to the thorough biogenic mixing, or, otherwise stated, mirroring the extreme bioturbation of the original lime sediments), or intensely bioturbated (churned|mottled|spotted|speckled structures, all of them being varieties of the same biological activity: biogenic mottling), or mm-laminated in a (micro)crinkled|wrinkled pattern (microbial, probably cryptalgal, laminites) and in an even planar pattern (mechanical laminites); the former two structure types are strongly indicative of subtidal to lower intertidal accumulations, and the latter ones (the laminites) — of upper intertidal to supratidal accumulations. The faunas typify lagoonal-peritidal conditions, with variable salinity ranging from normal marine to brackish (euryhaline lagoonal foraminifera: dicyclinid lituolaceans — *Ammocycloloculina*, abundant miliolids, frequent spirocyclinid lituolaceans; ostracodes; euryhaline macrofauna, often dwarf). The cyanophycean products in profusion, both as loose corpuscles (oncoliths: algal oncoliths s.str., algal pellets, algal lumps, etc.) and attached crusts (algal laminites), argue for lagoonal subtidal-intertidal conditions. As a whole, the limestones, extremely sensitive environment receptors and thus critical factors in environmental estimates, point, in the present case, to the whole range of slack-water subtidal (lagoonal, commonly slightly subsaline) through supratidal (usually equally slightly subsaline) conditions.

The dolostones, more or less marly, are commonly microcrystalline and make up decimetric beds often highly fissile and having a strong appearance of papery shales, highly suggesting upper intertidal-supratidal, penecontemporaneous-dolomitized (by slightly supersaline solutions), clayay-calcareous, mechanical-laminitic muds as their precursor.

The marly limestones, the marlstones and the (kaolin-rich or ordinary) claystones occur as decimetric (seldom metric) beds interspersed among the other lithologies, and show either homogeneous or an even planar mm-laminitic structure; they contain ostracodes, characeae and, in places, foraminifera similar to those found in the interbedded limestones. This continuous petrologic spectrum of clay-bearing mudrock varieties asks, by its features, for supratidal (flat and pool|pan) environmental conditions under commonly (slightly to drastically) decreased marine salinities (brackish- to freshwaters).

The sporadical occurrence of sulfate evaporites (scattered crystals and nodules, the latter frequently calcitized) both within clayey-bearing rocks and in the fine-grained laminitic limestones, is a strong evidence for the temporary existence of hypersaline supratidal episodes.

Assembling the above data, the lithologies, the depositional structures and the fossils conclusively substantiate depositional conditions ranging from slightly restrictive (more or less subsaline) marine lagoonal subtidal environments up to moderately or highly restrictive (hypersaline through freshwater) intertidal and supratidal peri-marine settings. Accordingly, the whole succession of the Medgidia Member stands for the product of a marginal-marine sedimentation of a calcareous-clayey, usually subsaline, tidal flat type.

This lithology, transitional between the dolomitic facies of the Poarta Albă Member and that exclusively calcareous of the Alimanu Member (see below), places the Medgidia Member into an intermediate position between the other two members, but only from facies viewpoint.

As for the chronostratigraphic position, we assign an overall Berriasian age to the Medgidia Member, without supplementary age specifications or connotations, for three reasons :

— only one section of the member (southern slope of the Carasu valley, 1 km west of the Medgidia stadium, within a set of marly beds) has provided a characteristic foraminiferal assemblage ; it certifies an Upper Berriasian age : *Ammocycloloculina erratica* (Jack. & Favr.), dominant (Pl. III, Fig. 2), *Pseudocyclammina lituus* Yabe & Hanzava, *P. parvula* Hott., *Rectocyclammina chouberti* Hott. (accompanied by innumerable characeae, mostly belonging to the genus *Nodosoclavator*, and ostracods) ; since the position of the dated beds within the stratigraphic column of the member cannot be accurately defined, it is not possible to make a clear cut between the lithostratigraphic interval belonging to the Upper Berriasian and the one pertaining eventually to the Lower Berriasian ;

— the Medgidia Member grades upwards into the Alimanu Member whose lowermost terms point already to a certain Upper Berriasian age, these facts claiming a localisation of the upper boundary of the Medgidia Member within the Upper Berriasian interval ;

— as neither the base of the Medgidia Member crops out nor the relationships between this member and Poarta Albă Member are visible for lack of exposures, the base of the Medgidia Member cannot be precisely dated ; it can be only stated that, given its location above the subcropping marly-gypsiferous complex, it does not descend into Tithonian but it remains within the Berriasian interval.

Accordingly the age of the Medgidia Member is mostly Upper Berriasian, probably descending also in Lower Berriasian.

c. *The Alimanu Member* (*calcareous member*) is particularly well exposed. It crops out largely in the very type section of the formation — the Danube cliff between the Cernavoda bridge and the Hinog valley mouth — , in the Cernavoda harbour area (Danube and Carasú valley mouth cliffs), in the Carasu valley slopes (between Cişmelei valley mouth and Remus Opreanu valley mouth, as well as in the cement factory quarry near Medgidia), in the Remus Opreanu valley, along the Dăulari and Roşeanu valleys (right-hand tributaries of Peştera valley), in the steep slopes and cliffs of almost all the course of both the Baciu valley and the Dumbrăveni—Şipote—Adamclisi—Alimanu valley (the latter accommodating the sequence designated here as the type section of this member), then in Rariştea—Mîrleanu valley, along Canaraua Fetii valley and around the Bugeac lake. The characteristical manner of exposure of this member is expressed by (low to high) long continuous cliffs or walls bordering valleys or lakes. The member base and the passage to the underlying Medgidia Member crop out only in the areas of Medgidia Member exposure (see description above).

The type section has been chosen by us in the cliffs of the Adamclisi—Alimanu valley in the Alimanu village area, here the member under discussion being widely (and its diagnostic features typically) exposed ; unfortunately, its base does not outcrop. The member consists here of a calcareous succession, some 30—40 m in thickness, medium bedded to thick bedded (0.2—2 m thick individual beds), and making up a gently folded tabular structure largely exposed in both (very steep) slopes of the valley (the latter known under the local name of Vederoasa valley). The succession involves a pile of algal (chiefly oncolitic, subordinately dassycladacean) and zoogenous (skeletal $\pm$ microcoprolitic) calcarenites and calcirudites randomly interbedded, the petrologic end-terms being often composed nearly exclusively either of foraminiferids and molluscan shells or shell debris, or of oncolitic $\pm$ dassyclad $\pm$ faecal-pelletal products ; the succession accomodates several beds rich in robust pelecypods (ostreids, trigoniids, miids, subordinately pachiodonts) and|or gastropods (abundant specimens of *Nerinea*, *Natica*, *Trochonatica*, *Leviathania*, *Ampulina*, *Purpuroidea*, *Harpagodes*). This succession is overlain by a calcareous sequence, 10—12 m thick, containing numerous intercalations (1—5 dm) of greenish (and subordinately reddish) marls and sporadical decimetric beds of dolostones, pertaining, if considered the micropaleontologic data, to the Barremian (see below the Ramadan Formation).

The outcropping main type section of the Cernavoda Formation (Danube cliff between Cernavoda bridge and Hinog valley mouth) consists practically only of the (slightly south dipping) succession of the Alimanu Member. It is entirely similar in almost all respects to the Alimanu (Vederoasa) valley section. The calcareous succession, 30—35 m thick, consists of the same biocalcarenitic-biocalciruditic background containing the foregoing shell-rich beds abunding in more or less diversified pelecypods and|or gastropods; it should be stressed the occurrence of some beds flatly dominated either by pachiodonts (± gastropods) or by ostreids, trigoniids and|or gastropods; also worth noting is the subordinate reccurrence of beds exhibiting either beautiful stromatolitic algal structures, or (nests of) relatively frequent calcisponges|hydrozoans|chaetetids, or sporadical tiny coral colonies, or sparse brachiopods.

It is obvious, from the above description, that the macrofauna is generally dominated by pelecypods and gastropods, commonly illustrated by thick-walled and large-sized specimens. The brachiopods (± ostreids) make up the dominant fauna only within a few, slightly indurated, marly-calcareous beds located in the upper part of the member succession in a few sections (atomo-electric plant near Cernavoda; southern slope of the Carasú valley also in Cernavoda area, by the railroad, at some 500 m NNW of Saligny lock bridge, here the brachiopod-rich beds occurring at 5—6 m beneath the top of the member sequence; and within both valley slopes in the type section at Alimanu). Similarly, the corals, usually sparse, show enhanced frequency only in the upper part of the member succession, at present excavated, at the Cernavoda atomo-electric plant. Worth specifying is the detailed paleontological approach achieved by Neagu et al. (1977) upon the sequence here defined as the Alimanu Member. For the macrofaunal and microfloral aspects, the reader is referred to that paper, and for microfaunal ones — to both (that and present) papers.

In order to restore the depositional conditions, we should consider the petrography, the depositional structures and the faunal-floral evidence. The petrography, briefly outlined above, points to muddy to perfectly winnowed calcarenites and calcirudites, mostly skeletal-oncolitic ± microcoprolitic, whose constituents are exclusively biogenic products (see below) fairly documenting prevailing brackish to normal marine lagoonal-peritidal conditions. As for the depositional structures, the limestone beds, irrespective of their petrography and thickness (averaging 0.5—1.5 m) display several internal structural patterns also commonly indicative of lagoonal-peritidal environments: homogeneous structures (or structureless rocks: usually suggesting total homogenisation by extreme bioturbation); bioturbation structures, either reticular (burrow fill networks) or spotted/speckled (biogenic mottling); mm-laminitic structures, either even planar (mechanical laminites) or irregularly (micro)wavy-crinkled (cryptalgal laminites); sporadical decimetric-long lenses of laterally linked domal megastromatoliths. In places, the calcarenites exhibit large-scale very low-angle tabular cross-lamination suggesting transient beach berm or upper tidal flat accumulations, or high-angle microcross-lamination (hering-bone cross-lamination) of a typically tidal nature (tidal channels or gullies). As regards the organic remains, the commonest fossil groups are either euryhaline (cyanophyceans, miliolids, lituolaceans, ostracodes, serpulids, nerineids, ostreids) or specific to (or at least equally accepting) lagoonal conditions (cyanophycean products; dassycladaceans; codiaceans; *Favreina* and other types of faecal pellets; miliolid-ostracode association; spirocyclinid, dicyclinid; pfenderinid, etc. lituolaceans — see below; involutinids — several species of *Trocholina*, see below; spirillinids — *Ichnusella*, see below; calcareous sponges; miids; probably the few marly brachiopod ± ostreid mass accumulations). The fauna usually accounting for constantly fairly agitated and normal saline marine environments (the open marine reefal environments) exhibits, instead, an occurrence restricted to several beds in some exposed sections (in our case: reliable reefal indicators: diceratids, trigoniids, caprotinids, monopleurids and probably naticids and strombids; then, possible reefal indicators: tiny coral colonies, solitary corals, hydrozoans, chaetetids, sparse bryozoans, sporadical brachiopods), and it is illustrated not by frame builders but practically only by frame dwellers or encrusters. Actually, the "neutral groups" with respect to the "reefal-versus-lagoonal" environmental option seem to be rather numerous: nerineids, naticids, strombids, ostreids, corals, hydrozoans, chaetetids, brachiopods, bryozoans, calcisponges; the decision can be taken only by using not single groups but group assemblages placed in the context of the host-rock lithologic features. However, worth mentioning is the systematical lack, from the whole fauna, of the strictly stenohaline groups of the echinoderms and the silicosponges (two exceptions so far found: echinoids — *Codiopsis lorini* Cotteau —, asterozoas and holoturids relatively abundant within a bed in the calcareous succession exposed in the Danube cliff at the foot of the Cernavoda bridge; and echinoderm fragments present in a bed in the Alimanu section).

Finally, the combined evidence supplied by the lithologies, the depositional structures and the fossil content firmly supports prevalent depositional conditions expressed by more or less restrictive lagoonal environments irregularly ranging from slightly subsaline marine to brackish, and randomly alternating from subtidal to intertidal (e.g. the huge bodies of foram-algal limestones, the bodies of coprolitic-algal limestones); considerably subordinate normal-saline marine episodes (interbeds) occur suggesting open lagoonal conditions (the echinoderm-bearing interbeds, the brachiopod lumachelles, most hydrozoan|chaetetid|calcisponge-bearing beds) or open back-reef conditions (commonly the highly macrofossiliferous interbeds dominated by pachiodonts|trigoniids ± ostreids| gastropods, except the nerineid or ostreid "monogenous" accumulations equally suggesting also variably restrictive, back-reef to lagoonal environments).

The age of the Alimanu Member can be established chiefly on micropaleontological grounds (see also Neagu et al., 1977).

Thus, in the Danube cliff, directly south of the Cernavoda bridge, the lower part of the exposed calcareous section supplies, from the first 8.5 m thick stratigraphic interval, a foraminiferal assemblage characteristic of the Upper Berriasian : *Ammocycloloculina erratica*, *Danubiella cernavodensis*, *D. gracilis* Neagu (species exclusively Upper Berriasian), accompanied by *Pseudochrysalidina arrabica* Henson, *Pseudotextulariella salevensis* Charol, Bronn. & Zaninet., *Freixialina planispira* Ramalho, *Anchispirocyclina mainci* and by *Trocholina bourlini* Gorbatchik, *T. molesta* Gorb., *T. cavernosa* (Kali) as well as sparse and minute *T. elongata* (Leupold). The passage from the Berriasian foraminiferal assemblage to the Lower Valanginian one is gradual so that the assemblage characteristic of the Lower Valanginian becomes typical just at the top of an additional 7.2 m thick stratigraphic interval (approximately 15.5 m above the exposed section base) : an assemblage flatly dominated by large specimens of *Trocholina alpina* (Leupold) and *T. elongata*, and maintaining up to the top of the cliff near the Cernavoda bridge. In this point, however, has been collected (by our late young colleague Ion Manea), 5 m beneath the cliff top, the ammonite species *Karakaschiceras* cf. *biassalense* (Kar.) (Pl. III, Fig. 1) supporting a Middle Valanginian age (between the middle of the *Campilotoxum* Zone and the *Verrucosum* Zone, after Kemper et al., 1981). Resuming the microfauna description, the *Trocholina alpina* — *T. elongata* assemblage can be pursued further southwards and upwards in the section up to 31 m above the section base. The next, last, 4 m thick, stratigraphic interval shows an abrupt disappearance of the trocholinids and an assemblage retaining few characteristic fossils, namely *Ichnusella trocholinaeformis* (Dieni & Massari) and *Melathrocherion spirale* (Gorbatchik), indicative of an Upper Valanginian age. The drastic decrease in foraminifera diversity at the top of the above-described calcareous succession is due to the definitive installation of brackish lagoonal conditions by the end of the Cernavoda Formation accumulation.

In the (Vederoasa) type section of the Alimanu Member (Alimanu village area), the succession of the foraminiferal assemblages is similar to that of the above-presented Danube cliff section at Cernavoda : abundant trocholinids, lituolaceans and miliolids in the Lower Valanginian, and explosive occurrence of *Ichnusella* accompanied by numerous ostracods in the Upper Valanginian (Neagu et al., 1977, emend.). But here, this sequence is followed by a pile of calcareous-marly, brackish and then marine, deposits developed in the terminal part of the southern wall of the Vederoasa (Adamclisi—Alimanu) valley NE of the Alimanu village; although relatively similar in lithofacies to the final (Upper Valanginian) Neocomian terms preserved in the Danube cliff south of Cernavoda, they seem here to be Barremian in age according to the micropaleontological data, therefore representing the base of the next Cretaceous formation (see below). The importance of this possible Barremian sequence lies in the fact that it would stand for the oldest post-Valanginian stratigraphic term exposed disconformably over the Cernavoda Formation.

Consequently, we can state that the deposits corresponding to the Hauterivian interval are completely missing (depositional and|or erosional gap) within the whole territory of Southern Dobrogea (according to the surface data).

2. **Ramadan Formation (Bedoulian ; locally, Barremian-Bedoulian)**

The Ramadan Formation is developed, considering the exposure data, only in the western Southern Dobrogea, i.e. in a region comprised between the Danube course and a line passing east of the Dunărea—Ţibrinu—Medgidia—Băneasa localities. This formation overlies disconformably the Cernavoda Formation (Cernavoda atomo-electric plant area; Baciu valley; Remus Opreanu valley, south of Medgidia; Alimanu village area; Lipniţa village area; and certainly in two drillings too : Cişmelei valley and Băneasa); it underlies also disconformably the Cretaceous Gherghina Formation (Dunărea village; southern shore of Ramadan and Ţibrinu lakes; Cişmelei valley, east of the atomo-electric plant), the Cretaceous Cochirleni Formation (Danube rocky shore and cliff between Hinog valley and Cochirleni valley mouths (both slopes of Baciu valley, NW of Abrud village; south of Medgidia town), or, at last, directly Neogene or Quaternary (loess) deposits.

The 1.5 km long, flat-lying, almost complete succession provided by the southern steep slope of the Ramadan lake (lowermost course of Ţibrinu valley) is designated here as the type section of this formation. The formation is here broadly exposed; its base is not visible, but the sequence includes, to the largest extent, the lithologic and biologic features characteristic of this formation instead. The succession, some 15 m thick, consists of two superposed lithologic units. The lower unit is composed of a (vertical and lateral) irregular alternation, some 10 m thick, of quartzo-bioclastic sands and gravels showing commonly coarse arenitic to fine ruditic grain size and variable cementation degrees (if indurated becoming sandstones|calcarenites and conglomerates| calcirudites), and compositionally ranging from exclusively quartzous through quartzous-orbitolinid to exclusively orbitolinid or to macrofauna-rich quartzous-orbitolinid rocks (macrofauna represented by pachiodonts and ostreids, as entire to more or less fragmented shells); these quartzo-bioclastic rocks, whose diversity is due to the large variation in participation of the same petrographic constituents, constantly display perfect washing and mechanical sedimentary structures illustrated by parallel laminations or low-angle tabular cross-laminations; there are some rock bodies or layers where the mechanical laminations are replaced, or highly obliterated, by bioturbation structures (mottling or burrow fill networks). The upper unit consists of pachyodont-dominated (pelecypod-gastropod-brachiopod) lumachellic limestones (Urgonian facies), some 4—5 m thick, and may be pursued eastwards, in the southern slope of the Ţibrinu lake, up to 1 km west of the Ţibrinu locality. In the type section, the age of the sequence can be judged accounting on data in Chiriac (1981); this author reports, from the basal part of the exposed sequence, the species *Deshayesites flequosus* Chiriac and *Cheloniceras ramadanicus* Chiriac; these forms, considering the stratigraphic occurrence range of the genera, point to a relatively narrow interval corresponding approximately to the *Deshayesi* Zone (Middle Bedoulian). For the overlying sequence, some 15 m thick, an Upper Bedoulian age can be inferred and accepted.

The oldest terms of the Ramadan Formation crop out poorly, being exposed over highly restricted areas within only two sections far distant southwards from the type section: in the upper wall of the left-bank cliff of the Adamclisi—Alimanu valley 1 km upstream from the Alimanu village; and in the Bugeac lake cliff at Gîrliţa. Their description is presented below.

The first section (Alimanu) exposes only the lowermost part of the formation, 10—12 m thick, developed under an unusual facies, and overlying the Valanginian limestones of the Cernavoda Formation. The lower interval, 8—10 m thick, exhibits an alternation of greenish and reddish marlstones, limestones and dolostones, the former containing agglutinant foraminifera of a Barremian type and brackish water miliolids; the upper interval, 2 m thick, consists of algal-foraminiferal calcarenites accommodating large-sized gastropods and subordinate greenish marlstone interbeds; these latter marly interbeds have supplied the species: *Dobrogelina discorbiformis* Neagu, *Istriloculina alimanensis* Neagu, *Derventina filipescui* Neagu, *Trocholina aptiensis* Iovceva, *Quinqueloculina robusta* Neagu, most of them being reported also from the ammonitic Barremian of France by Arnould—Vanneau (1980). The above-described succession displays a lagoonal facies evolving upwards from brackish to normal marine; this facies is a singular occurrence in the entire Ramadan Formation; its affiliation to this formation is still a problematical matter.

The second section (Gîrliţa) provides a succession, some 20 m thick, of pachyodont-rich pelecypod-gastropod lumachellic limestones interbedded with foraminiferal calcarenites and marlstones whose foraminiferal assemblage accounts for an Upper Barremian age (*Derventina filipescui* Neagu, *Andersenia rumana* Neagu, species also found in different highly ammonitic sequences in Romania by Neagu, 1975, and in France by Arnould—Vanneau, 1980) or an Uppermost Barremian — Lowermost Aptian age (*Choffatella decipiens* Schl., *Dictyoconus reicheli* Guillaume, *D. kiliani* (Préver) *Orbitolinopsis bruccifer* A. Vanneau & Thiel.).In this second section, the succsesion already displays the marine facies typical for the Ramadan Formation and generally defined, from the biological standpoint, by an alternation of layers bearing marine foraminifera and layers containing Urgonian pachyodonts. This section is the only firm evidence consistent with a Barremian local age of the Ramadan Formation.

In all the other foregoing exposures, the formation is represented only by terms synchronous (Bedoulian) and usually lithologically similar to those of the type section. Their features are further on summarized. For paleontological inventories, the reader is referred to Neagu et al. (1977) and Chiriac et al. (1977).

Quartzous sands and gravels, sometimes patchily limonite cemented, crop out at the Cernavoda atomo-electric plant (on the low hill between Cişmelei valley and Carasu valley), on the left bank of the Carasu valley at the Lupilor Hill foot, and in the Remus Opreanu valley in front of the Medgidia subsidiary railway station. [At the nuclear-electric plant, the middle and upper portions of the sequence present a peculiar, sandy-clayey facies of local extent and expressing a protected restrictive coastal type including sporadical normal marine episodes, the latter represented by a few thin intercalations both of fossiliferous sandstones (containing pelecypods, gastropods and, seldom, solitary corals) and red clays (with holoturid sclerites)]. In the Remus Opreanu valley, the pebbles contain echinoid plates and pelecypod shells.

Orbitolinid sands, sandstones and calcarenites are exposed in the Ştefan cel Mare village (low outcrop at the Quaternary loess wall toe, some 500 m NW of railway station), on the Danube shore off the southern tip of Hinog eyot (some 600 m long exposure beneath the cliff of glauconitic sands of the Cretaceous Cochirleni Formation), and at Lipniţa village in the Iordmac quarry (orbitolinid-bearing foraminiferal sands overlying a *Toucasia*-bearing Urgonian limestone layer, this sequence being underlain by Valanginian limestones of the Cernavoda Formation).

At last, in other places (Adîncata valley, Baciu valley, and at Canlia near Lipniţa), quartzous-bioclastic to lithic-bioclastic sands and fine gravels, flat- to cross-laminated, 10–30 m thick belonging also to the here-discussed formation, occur and sporadically incorporate decimetric to submetric sandstone intercalations rich in brachiopods, gastropods and pelecypods of Urgonian type.

The performed drillings have encountered the orbitolinid-bearing deposits specific to this formation at Tortomanu, Gherghina and Mircea Vodă (fide Chiriac, 1981), as well as at Dunărea and Băneasa.

Treating the exposures as a whole, the sands, the sandstones and the calcarenites (as well as their coarser, fine ruditic-microruditic counterparts) composing commonly the lower portion of the formation, make up a single lithofacies association that is unitary both in the depositional petrographic composition (chiefly quartzous-orbitolinid rocks) and in the depositional structures and textures (systematically : parallel or very low-angle tabular cross-lamination|stratification ; intensely bioturbated rock layers or bodies ; coarse arenitic to fine ruditic mode range ; perfect washing) ; these features are consistent with a wave|wind-dominated, exposed coastal marine sedimentation of a sandy beach type, the accumulation area probably standing for a broad belt of sandy coastal bars and banks accommodating backshore, beach berm and beach face (foreshore to shoreface) environments. The pachyodont-rich lumachellic sequence, composed of pachyodonts, ostreids, gastropods, brachiopods, corals, echinoids, and usually located in a suprajacent position, points to a facies transgression (facies retrogradation), namely the advance, over the sandy coastal sedimentation, of a marine reefal terrace consisting of bioconstructed to bioaccumulated, pelecypod-dominated banks.

3. Gherghina Formation (Gargasian ; locally Bedoulian ?-Gargasian- ?Clansayesian)

The Gherghina Formation includes (alluvial and lacustrine) continental deposits developed in the northern Dobrogea and exposed along the following valleys : Dăulari valley (east of Peştera) ; Carasú valley, between Cernavoda town and Poarta Albă locality ; Carasú valley tributaries (Cişmelei valley, Mircea Vodă valley, Agicabul valley, Castelu valley, Nisipari valley, Carierei valley-Nazarcea village, Cocoşu valley, Vîntului valley) ; Ţibrinu valley between the western margin of the Ramadan lake and the eastern end of the Ţibrinu lake) ; Siliştea valley ; Boasgic valley ; and Danube cliff between the Peştera—Cochirleni valley mouth and the Dunărea village.

This formation often overlies disconformably directly the Cernavoda Formation : upper course of Agicabul valley ; Carasú valley (channel floor at 500 m north of Poarta Albă railway station ; valley southern slope in Medgidia town area : beneath the Medgidia stadium, at Medgidia cement factory quarry, and 1.5 km west of stadium ; NE of Ştefan cel Mare village ; NW of the Saligny lock in the valley southern slope) ; Remus Opreanu valley, SE of homonymous village ; Danube cliff between Cernavoda and Hinog valley mouth ; Dăulari valley, east of Peştera village. The formation also rests, with sharp sedimentary discontinuity, upon the Ramadan Formation in a few places : Dunărea village ; drillhole in Cişmelei valley ; and Ţibrinu valley lower course (Ramadan—Ţibrinu lakes area).

The Gherghina Formation underlies various younger Cretaceous formations : Cochirleni Formation (Ţibrinu valley at Gherghina ; Cişmelei valley 1.3 km E of atomo-electric plant ; Carasú valley, W of Medgidia ; Docuzol valley ; Agicabul valley, near Cuza Vodă village) ; Peştera Formation (Dăulari valley ; right tributary of the Roşeanu valley, east of Peştera) ; Murfatlar Formation (channel floor in Carasú valley at Poarta Albă village ; quarries in Ovidiu village area ; southern bank of Carasú valley, directly south of Castelu).

The type section of the formation has been chosen by us in the Ţibrinu valley between the Gherghina village and the Ţibrinu village ; the formation is here well exposed, especially in Gherghina area, in a sequence of large quarries ; it lies disconformably over the Ramadan Formation (at the eastern extremity of the Ţibrinu lake) and under the Cochirleni Formation (south of Gherghina) ; its exposed thickness is approximately 50—60 m.

The lithology of the formation consists of an orderless succession of disorganised pebbles and sands, common clays and fire-clays, the latter worked in quarries in the Ţibrinu—Gherghina area and in the Agicabul valley directly SE of the Cuza Vodă village. Most lithologies suggest a multitude of subfacies within a poorly organised and immature alluvial fan/plain depofacies association controlled by a fast-changing network of ephemeral and short braided streams (streams, overbanks, marshes|lakes, all small-sized and short-lived). Only in two localities (Dăulari valley 2 km upstream its mouth ; and Nazarcea drilling), the lowermost (and apparently earliest ; see below) term of the formation is represented by multicoloured silty clays containing characeae and supporting an initial (patchily developed and starving) lacustrine stage.

The age of the formation is highly interpretative, relying on geometrical-stratigraphical grounds. The only direct, paleontological-based, age evidence found within this formation is provided by the above-cited characeae-bearing clays ; the characean assemblage, similar in both occurrence localities (most characteristic species being *Atopochara trivis trivolvis* Peck, represented by abundant specimens, and *Clypeator europaeus* Mädler), accounts for an Aptian age, somehow favouring a Lower Aptian age (Neagu, Georgescu—Donos, 1973, emend.). This age suggests the lower part of the Gherghina Formation in the areas located eastwards from the territory occupied by the Ramadan Formation, to be synchronous, at least partly, with the latter.The general age (Bedoulian ? — Gargasian — ? Clansayesian) of the Gherghina Formation has been, however, inferred from the stratigraphical position of this formation between the Ramadan Formation (Bedoulian) and the Cochirleni Formation (Uppermost Aptian ?—Albian).

4. Cochirleni Formation (Clansayesian ?-Albian)

The Cochirleni Formation crops out intermittently within western and central Southern Dobrogea between the Danube and an eastern alignment lying east of Cuza Vodă — Medgidia — Şipote localities. It overlies disconformably either the Cernavoda Formation [Carasu valley between Medgidia and Remus Opreanu valley mouth ; Danube cliff south of Hinog valley mouth ; Peştera—Cochirleni valley east of Ivrinezu Mare village (in its southern slope, coincident with the northern terminations of the Sarapciculac hill) and in its tributary — Roşeanu valley (2.5 km upstream the confluence with the Dăulari valley) ; Adamclisi—Alimanu valley at Şipote ; around Oltina and Bugeac lakes], or the Ramadan Formation (in Baciu valley), or the Gherghina Formation (Ţibrinu valley at Gherghina ; Cişmelei valley 1.3 km east of atomo-electric plant ; Mircea Vodă valley ; Docuzol valley and Agicabul valley, in the proximity of Cuza Vodă village ; Carasú valley west of Medgidia, in the southern slope : beneath the stadium and 1.5 km west of stadium). In its turn, the Cochirleni Formation underlies disconformably the younger Cretaceous Peştera Formation in the Danube cliff north of Seimenii Mari village, in the Carasú valley southern slope between Medgidia and Saligny village (as well as in its tributaries : Mircea Vodă valley, Agicabul valley and Remus Opreanu valley), in the slopes of the Peştera—Cochirleni valley, and in the Adamclisi—Alimanu valley in the Şipote village area.

a. *Lithology, lithostratigraphy and sedimentology*

The Danube cliff between the Hinog valley mouth and the Peştera—Cochirleni valley mouth and, farther, on the latter valley southern slope upstream the Ivrinezu Mic village, therefore a rather long but efficient geological section is here designated as the type section of the Cochirleni Formation ; this name is derived from the homonymous village that approximately centers the area bearing the type section. The Danube cliff exposes the subjacent terms, the base and the lower part of the formation ; while the Cochirleni—Peştera valley exposes the upper part of the formation and the contact with the overlying Peştera Formation.

The lower and middle parts of the type section (maximum cummulate thickness of 30—35 m : the lower 20—25 m — uppermost Aptian ?—Lower Albian, and the upper 10 m — Middle Albian) as well as almost all the other sections of the formation supply a sequence of glauconitic-quartzous clayey sands, slightly or at all indurated, subordinately containing discontinuous to continuous interbeds of glauconitic-quartzous sandstones perfectly (or almost) winnowed and more or less close- to widespaced ; all deposits show various intense bioturbations ; the lower part of this succession (Danube cliff in type section and, similarly, at Cuza Vodă, and in the quarry at the Remus Opreanu valley mouth), or, alternatively, only the lowermost part of the succession (southern slope of Carasú valley between Alivantu valley mouth and Remus Opreanu valley mouth), includes loose or indurated quartzous and quartzous-phosphatic microrudites (micropebbles|microconglomerates) containing both allochthonous (transported) and autochthonous (in situ) faunas. This glauconitic sand succession (Uppermost Aptian ?—Lower Albian) passes upwards to a sandstone succession (Middle Albian) where the winnowed sandstone framework accommodates the clayey sands as network meshes or as microlenses ; the rocks retain the same quartzous-glauconitic composition ; this sandstone sequence is exposed in the type section in the Peştera—Cochirleni valley, NW of Ivrinezu Mic village.

To complete the lithostratigraphic picture, two additional lithologic sequences must be added.

Thus, a facies partially synchronous to the sandstone sequence but also extending in the lower part of the Upper Albian, is preserved in an extremely restricted area in the Danube slope at 1.5 km NE of Seimenii Mari village; it is a strongly condensed (Middle + Upper Albian within a stratigraphic thickness of some 1.2 m) and very fossiliferous layer consisting of a bed (15 cm) of highly organogenous sandstone rich in pelecypods and gastropods (in situ and completely phosphatized) as well as ammonites, followed by a lumachelle (50 cm) composed of in situ and phosphatized pelecypods and gastropods as well as ammonites and belemnites, and finally ending in quartzous-glauconitic clayey sandstones and sands (60 — 70 cm), laminitic and still fossiliferous in their lower portion.

At last, the Bugeac lake area sporadically exposes a succession (several metres thick) Middle Albian in age and exhibiting a quite different facies flatly dominated by greyish monotonous silty marls containing ammonites.

Therefore, four lithostratigraphic units (Lower Albian glauconitic sand-dominated unit; Middle Albian glauconitic sandstone-dominated unit; Middle + Upper Albian glauconito-phosphatic condensed unit; and Middle Albian marl unit), corresponding to the four distinguished lithologic associations, contribute the stratigraphical image of the Cochirleni Formation; despite the scattered outcropping pattern and the sparse preservation of the upper terms of the formation, these four lithostratigraphic units might theoretically be treated in terms of members; but, because the above image is slightly simplified as against the field evidence, we think that a firm decision in this respect is practically still premature. At present we prefer to discuss the foregoing units in terms of corresponding lithofacies, therefore submitting them to a sedimentologic analysis only.

From sedimentologic standpoint, the Cochirleni Formation exhibits three flatly distinct depositional lithofacies: 1) the glauconitic clayey sand-sandstone lithofacies (with two sublithofacies, depending on the framework-rock: sand versus sandstone sublithofacies), Uppermost Aptian?-Lower Albian-Middle Albian in age, and clustering almost all outcropping deposits here included the type section succession; 2) the intensely phosphatic lithofacies, exposed in a single outcrop, restricted to the Middle Albian-early Upper Albian time span and depicting a peculiar version of the preceding lithofacies (the glauconitic sand-sandstone lithofacies in a highly condensed and intensely phosphatized regime); and 3) the silty marl lithofacies, also quite locally outcropping and strictly installed beginning in the Middle Albian.

The first lithofacies generally consists of a succession of more or less loose sands; the sands are silty-clayey (therefore non-winnowed but muddy), quartzous-glauconitic (detrital quartz/quartzite, silt-sized to coarse-arenite-sized grains; penecontemporaneous/paulopost, autigenic glauconite as usually arenite-sized diffuse-outlined grains, often profusely imbuing the rock matrix), unbedded and physically structureless (massive), and characteristically disclosing intense bioturbations (isolated to reticular-anastomosing burrow fills: scattered burrow fills to burrow fill networks), abundant long conical tubes of calcareous tubicole worms, and frequent ostreids (usually dwarf). This loose sandy-muddy monotonous series contains irregular-spaced interbeds of highly indurated sandstones quite similar in composition and grain-size to the sands except for the clayey matrix that is completely (or almost) missing (the matrix lack enabling strong induration of the original soft sediment, i.e. sand-to-sandstone conversion, by both compaction and calcite cementation); the sandstones occur as (sub)metric-long and decimetric-thick, grossly ovoidal lenses, isolated to lateral-linked, commonly aligned at various levels and, when closely lateral-linked, originating in stratiform intercalations of variable decimetric thicknesses (often displaying an irregular pinch-and-swell morphology). Alternatively, instead of planar arrangement, the sandstones may occur as irregular-shaped to somehow sphaeroidal bodies (decimetric to metric in diameter) and loosely to tightly tridimensionally interconnected into a spatial network (even completely merged as a continuous broader body). All sandstones are thoroughly bioturbated, exhibiting either speckled/spotted (mottled) structures, or reticulate structures (burrow fill networks, usually close-meshed), or massive structures (homogenisation by total, extreme bioturbation). The marine faunas (ammonites, nautiloids, belemnites, echinids and, subsidiarily, pelecypods and gastropods) are by far accommodated preferentially in sandstones or in the microruditic episodes interbedded in the sand sequence.

The lack of the mechanical sedimentary structures both in sands and sandstones, the presence, instead, of bioturbations in the muddy sands, in association with usually brackish fauna, and the markedly enhanced abundance of these bioturbations in the sandstones, as well as the preferential association of the marine faunas to the sandstone bodies or intercalations, all of these lines of evidence are fully consistent with a protected coastal (marginal-marine) sedimentary setting randomly ranging (both in space and time) from brackish swamps (the sands) to normal marine (euhaline) marshes (the sandstones), the marsh-swamp system being located in a near-shore position (paralic marshes/swamps). This interpretation is favoured also by the intense glauconitization largely noted in all the deposits of this lithofacies, as well as by the sporadical phosphatizations of the cephalopod, pelecypod and gastropod shells (except ostreids; thus, replaced the aragonitic skeletons): phosphatic-glauconitic coastal marshes and swamps. The microruditic episodes are thought storm-/wave-induced spillovers.

The two distribution patterns of the sandstones — the discontinuous to continuous stratiform pattern (the lateral-linkage-involving planar pattern) and the tridimensional-interconnected irregular/sphaeroidal body network pattern (the omnidirectional-linkage-involving spatial pattern) — point to two distinct sublithofacies, the first being practically restricted to the Uppermost Aptian ? — Lower Albian successions and the second being characteristically developed in the Middle Albian series (although both sublithofacies show exceptions in their stratigraphical distribution; thus, the former is locally present in the Middle Albian as bimetric layers; similarly, the latter occurs somehow frequently, in northern areas, also in Lower Albian sequences, but disclosing "attenuated" features still giving rise to sand-dominated sequences owing to the rather loose interconnection of the irregular-sphaeroidal sandstone bodies within the tridimensional network; these occurrences complicate the lithofacies distribution picture, hindering the attempts of unravelling the lithostratigraphic anatomy of this formation). Consequently, the Uppermost Aptian ?-Lower Albian sequences commonly depict an uneven alternation of massive clayey sand layers, of metric thicknesses, and fragmentary to continuous, decimetric sandstone beds (the sand-dominated sublithofacies); in opposition, the Middle Albian sequence under this facies (uniquely preserved in the Peştera—Cochirleni valley, among the exposed successions of this formation) provides usually a sandstone pile consisting of continuous to reticulate (network-patterned) sandstones, in this latter case the sandstone network meshes being occupied by clayey sands (the sandstone-dominated sublithofacies). All these structural-lithologic variations are accounted for by the variable degree (as intensity and diversity) of bioturbation of an initial monotonous clayey-sandy sediment whose clayey fraction is penecontemporaneously removed in places, i.e. in the case of sandstones, by biofiltering (according to our interpretation). The two sublithofacies are here interpreted as the products of outer and, respectively, inner marsh/swamp environments.

The second lithofacies, consanguinous with the former and representing the highly condensed and strongly phosphatized version of this one in the Seimeni area during the Middle-Upper Albian, is a highly phosphatic-glauconitic-macrofossiliferous, starved sedimentary facies; it points to an accumulation under similar marsh/swamp conditions (specific to the Albian glauconitic sequences), prevalent brackish, exhibiting in situ proliferations of (euryhaline) pelecypods and gastropods and offshore supplies of typically marine nektonic faunas (cephalopods, probably water-drift dead specimens), but showing extremely low sedimentary rates (starved accumulative area) thus favouring lumachellic accumulations, intense shell phosphatizations, strong sediment glauconitization, and extreme biozonal and sedimentary condensation. The fossiliferous sandstones and the lumachelle entering the succession of this facies (see above) are intensely bioturbated (churned), a fact responsible, among other consequences, for the mixing of the (originally successive) ammonitic faunas within the mentioned lumachelle (evidence corroborating the strong condensation of the succession of this facies). A starved inner marsh/swamp environment of a mainly inner brackish swamp type is accepted for this facies.

The third lithofacies, characterised by monotonous silty-marly and ammonitic sequences corresponds to an accumulation of pelagites under typical offshore conditions on a shallow shelf.

Finally, a special mention should be made concerning the Şipote area: the Cochirleni Formation displays here a sequence typically developed under the clayey sand sublithofacies characteristic of the Lower Albian, but the upper half of the sequence (several meters thick) exhibits medium-angle tabular cross-lamination (within the same, clayey-glauconitic-quartzous, sands constantly composing this lithofacies) and the whole sequence is devoid of sandstones; this evidence suggests an outermost marsh facies overlain by a chenier-type accumulation (lagoonal/marsh-deposit-overlying "island bar") in a low to moderate energy environment; this exposure is important because it points to a slow (north-eastwards) facies transgression (retrogradation) in the south Southern Dobrogea, a fact corroborated by the concomitant occurrence in a same area in SW Southern Dobrogea (Ceamurlia-Gîrliţa-Bugeac lakes area) of both the Lower Albian glauconitic marsh facies and the Middle (-Upper ?) Albian pelagic marly facies (therefore, the marsh facies succeeded by the offshore facies); on the other hand, the Şipote exposure stands for the "missing link" from the depofacies standpoint because it highly suggests the (former) existence of a protective narrow barrier bar system located between the shoreward-lying marsh/swamp system (restricted and protected nearshore system) and the seaward pelagic shelf (offshore shelf system) in the Lower-Middle Albian sea. The existence of this paleobarrier system is supported not only by its remnants preserved as chenier deposits in the Şipote area, but also by the regressive (progradational) trend noticeable in the marsh/swamp facies belt (i.e. the inner subfacies extending progressively southwards, over the outer subfacies) during the Lower—Middle Albian, this evolution suggesting an increasing regional shelter effect yielded by the concomitant development of a seaward-located barrier belt.

The final facio-sedimentologic conclusions are as follows : the Cochirleni Formation is the product of three synchronous juxtaposed depofacies belts displaying the following distribution pattern : a north-eastern, broad coastal marsh|swamp belt, an intermediate, narrow protective barrier bar (island bars|submarine bars|cheniers) belt, and a south-western, pelagic shelf belt ; the first two belts are nearshore systems, the third belt is an offshore system ; the marsh|swamp belt has evolved under a (southwards) prograding regime concurrent with (and thanks to the protection by) the upbuilding of the barrier bar belt and the (northwards) retrograding migration of the barrier belt-off shore belt couple, during the whole Uppermost Aptian ?-Lower Albian-Middle Albian time span ; as for the late Middle Albian-Upper Albian time interval, a facies stagnation, even progradation, evolving under sediment-starved and drastic accumulative rate slowdown conditions can be easily inferred from the general and abundant occurrence of reworked Seimeni-type phosphatized fossils in the basal terms of the succeeding Cretaceous formations (see below) ; leaving aside the paleogeographic aspects and approaching the subsidential (paleotectonic) ones, it is to remark that no other Cretaceous formation in Southern Dobrogea shows such a drastic and fast decrease in the sedimentary and subsidential rates at the terminal stage of its accumulation as the Cochirleni Formation does : "normal" rates in Lower-Middle Albian and abrupt slowdown in these rates by the end of Middle Albian and maintainance of these minute values during the whole Upper Albian ; in addition, the slight shoreward shift in the facies belts during Lower-Middle Albian suggests subsidence-by-sedimentation noncompensation (subsidence slightly exceeding accumulation), while the Upper Albian facies stagnation to slight progradation support subsidence-sedimentation steady state relationships or a slight advantage of the sedimentation over the subsidence (both of extremely low rates).

b. *Bio- and chronostratigraphical data*

Attempts of chronostratigraphic estimates upon the deposits referred to, in this paper, as the Cochirleni Formation belong to Macovei (1911), Macovei, Atanasiu (1934) and, recently, to Chiriac (1981). We have selected, from the inventories published by the mentioned students, those characteristic species the autochthonous (in situ) stratigraphic position of which has proved to be certain ; we have further added to these forms the fossils collected by us (marked with an asterisk) ; the final image thus acquired upon the fossiliferous sites so far identified is the following :

1) *Uppermost Aptian ?-Lower Albian* (*glauconitic sand-sandstone lithofacies : sand-dominated sublithofacies*)

— Left slope of the Boasgic valley, directly south (some 700 m) of the Dunărea village : *Beudanticeras ligatum* (Newton & Juckes Br.) *, *B. arduennense* Br., *Douvilleiceras mammillatum* (Schl.) = Lower Albian, *Mammillatum* Zone ; the fossiliferous site consists of an alternation of sands and sandstones, some 10 m thick and overlain directly by fossiliferous Upper Badenian deposits ;

— Southern shore of the former Purcăreţ lake, some 1200 m east of the Cernavoda-Dunărea road : *Leymeriella tardefurcata tardefurcata* (Leym.), *L. tardefurcata densicostata* Spath, *Douvilleiceras monile* (Sow.), *D. inaequicostatum* Chiriac, *Douvilleiceras* sp. * and *Cleoniceras* (*Neosaynella*) cf. *inornatum* Casey * (Pl. IV, Fig. 1) = Lower Albian, *Tardefurcata* and *Mammillatum* Zones ; the exposure measures some 10 m in stratigraphic thickness, and the fossils collected by us proceed from the base of the uppermost sandstone bed, directly beneath the loess ;

— Southern slope of the Ţibrinu valley, at Gherghina : *Acanthohoplites uhligi* (Anthula) and *Leymeriella* sp. = Lower-Middle Clansayesian (according to Drushchits, 1960) and, respectively, Lower Albian (*Tardefurcata* Zone) ; the glauconitic sands are here exposed, some 7—8 m thick, at the top of the slope, directly beneath the Sarmatian limestones, and the two layers having supplied the two cited fossils are 1 m distant from each other (fide Chiriac, 1981) ;

— Left slope of the Docuzol valley, west of Cuza Vodă village : *Hypacanthoplites discoidalis* Chiriac, *Leymeriella tardefurcata* * (Pl. III, Fig. 6), *L. macoveii* Chiriac = Lower Albian, *Tardefurcata* Zone ; the lowermost *Leymeriella*-bearing sandstones are here located at less than 1 m above the formation base ;

— Left slope of the Agicabul valley, NE of the Cuza Vodă village : *Douvilleiceras* sp. = Lower Albian, *Mammillatum* Zone ;

— Medgidia town (in Macovei, Atanasiu, 1934 ; unspecified site) : *Douvilleiceras mammillatum ;* W Medgidia (in Chiriac, 1981 ; unspecified site) : *Douvilleiceras monile ;* both species are indicative of Lower Albian, *Mammillatum* Zone ;

— Left slope of the Carasu valley at 2.5 km W of the Medgidia town stadium (i.e. northern slope of the Alibei Ciair hill) : *Beudanticeras dupinianum* (d'Orb.) * (Pl. V, Fig. 1), *B.* aff. *ligatum* * (Pl. III, Fig. 8), *Sonneratia rotator* Casey * (Pl. IV, Fig. 2), *S.* cf. *kitchini ovalis* Casey * (Pl. IV, Fig. 3) = Lower Albian, *Mammillatum* Zone ;

— Remus Opreanu valley mouth (quarry in the right slope): *Beudanticeras* sp. *, *Douvilleiceras* sp. *, *Hemisonneratia cantiana* Casey * (Pl. III, Fig. 3) = Lower Albian, *Mammillatum* Zone;

— Morthern slope of the Carasu valley, at the Ştefan cel Mare village: *Acanthohoplites* sp. *Leymeriella* sp. = Clansayesian? and Lower Albian, *Tardefurcata* Zone; the two fossils collected by the middle of the exposure height, at about 1 m vertical distance from each other (fide Chiriac, 1981;

— Danuble cliff. at some 300 m south of the Hinog valley mouth (beneath Axiopolis fortress): *Hypacanthoplites turgidus* Chiriac, *Acanthohoplites aschiltaensis rotundatus* Sinzow, *H.* aff *simmsi* (Forbes) aff. *milletioides* Casey *, *Leymeriella* cf. *fusseneggeri* Seitz * (Pl. III, Fig. 4) = Lower Albian, *Tardefurcata* Zone;

— Right slope of the Canaraua Fetii valley (Ciamurlia lake): *Hypacanthoplites milletianus* (d'Orb.), *H. trivialis* Br. *Leymeriella tardefurcata tardefurcata*, *L. elegans* Chiriac = Lower Albian, *Tardefurcata* Zone;

— Southern shore of the Gîrliţa (Bugeac) lake: *Leymeriella tardefurcata tardefurcata* = Lower Albien, *Tardefurcata* Zone.

2) *Midlbian* (*glauconitic sand-sandstone lithofacies: sandstone-dominated sublithofacies*)

— Left slope of the Peştera-Cochirleni valley at some 2 km NW of the Ivrinezu Mic village: *Anahoplites* cf. *intermedius* Spath * (Pl. IV, Fig. 4), *A.* cf. *mantelli* Spath * (Pl. IV, Fig. 5), *A.* cf *praecox* Spath * (Pl. V, Fig. 2) = Middle Albian, *Loricatus* Zone, *Intermedius* Subzone.

3) *Middle-Upper Albian* (*highly phosphatized condensed lithofacies*)

— Danube (right) slope at 1.5 km north of the Seimenii Mari village, by the Cernavoda Dunărea road: lumachelle of phosphatized fossils, some 50 cm thick (see description above), con taining a mixed fauna belonging to the whole interval between the *Loricatus* Zone — *Intermedius* Subzone of the Middle Albian and the *Inflatum* Subzone of the Upper Albian. The faunal mixing is pointed out by the occurrence of the ammonites characteristic of the Middle Albian (*Intermedius* Subzone) — *Anahoplites praecox* (Pl. V, Fig. 3) — not only in the lowermost part of the lumachelle and in the directly underlying sandstone, but also in the upper part of the former, while its median part has supplied *Epihoplites compressus* (Parona & Bonarelli) (Pl. V, Fig. 4), *Hysteroceras varicosum* (d'Orb.) (Pl. III, Fig. 5) and *Mortoniceras* cf. *inflatum* (Sow.), fossils characteristic of the *Orbignyi*, *Varicosum* and, eventually, *Inflatum* Subzones of the lower Upper Albian.

The above-mentioned fossils are certainly consistent with the conclusion that almost all deposits of the Cochirleni Formation belong to the Lower Albian (*Tardefurcata* and *Mammillatum* Zones).

The evidence supporting a Clansayesian age is scarce and debatable: all species of *Hypacanthoplites* cited above (except for the new species proposed by Chiriac, 1981, whose occurrence range is to be established) are either generally known from both Clansayesian and Lower Albian, or accompanied by *Leymeriella* specimens in the Dobrogean sequences; in addition, the cited *Acanthohoplites* specimens, constantly illustrated only by relatively large-sized whorl fragments, can be taken into account as age evidence only in a quite general way because their exact specific (and even generic) identification is hindered by the lack of the inner whorls. However, an indisputable reality is the relative abundance of the ammonite specimens of the *Acanthohoplites-Hypacanthoplites* group in the basal term of the formation (inclusively in the drillholes in Peştera, Ivrinezu and Şipote areas — fide Chiriac, 1981), this fact supporting an Uppermost Clansayesian or Lower Albian age for this term.

Accordingly, almost all exposed successions of the Cochirleni Formation end into the Lower Albian. Younger, Middle Albian outcropping deposits of the formation are preserved only accidentally (Peştera-Cochirleni valley NW of the Ivrinezu Mic village, here the succession closing probably in the *Intermedius* Subzone of the *Loricatus* Zone). At last, between this level and the Vraconian, at least within the median and northern regions of the Southern Dobrogea, the fossils seem to have had experienced only accumulative regimes of the Seimenii Mari type; thus, accumulations similar to the latter have probably been widespread enough over the South Dobrogea territory, if considered the frequency of the Middle and Upper Albian phosphatized fossils reworked in the basal conglomerate of the Cenomanian, in the basal conglomerate and the succeeding sands and pebbles of the Turonian, and in the basal conglomerate of the Santonian sequences (see descriptions below); moreover, the eventual local preservation of this phosphatic and condensed facies in areas currently covered by younger deposits could account for an explanation to the eventual subsurface (boreholes) occurrence of Upper Albian (here included also Vraconian) fossils within upper terms of the formation while surface sequences located in the direct proximity belong to the Lower Albian (e.g. see Peştera drilling, in Chiriac, 1981).

4) *Lower Albian (glauconitic sand facies)*

In the southernmost Southern Dobrogea, the Lower Albian glauconitic sand facies passes upwards to the Middle (and Upper?) Albian fossiliferous marly-silty facies. This latter facies exposed in the Bugeac lake cliff has supplied an ammonitic assemblage including many specimens of *Anahoplites* ex gr. *intermedius*; it has also been transected by the drilling performed in the Ghioclemeş hill, near Văleni village (fide Chiriac, 1981).

B. Upper Cretaceous

The Upper Cretaceous deposits exposed in Southern Dobrogea are here ascribed to three formations :

1. Peştera Formation (Lower Cenomanian);
2. Cuza Vodă Formation (Middle?, Turonian);
3. Murfatlar Formation (Santonian-Lower Campanian).

1. Peştera Formation (Lower Cenomanian)

The lithological successions of the Peştera Formation generally consist of a lower term composed of quartzous (locally, glauconitic-quartzous) coarse sands or sandstones and subordinate (irregular-lensoidal) pebbles, and an upper term represented by more or less sandy, glauconitic chalks. The successions bear constantly, in all outcropping areas, a thin basal conglomerate lying within 30—80 cm range in thickness. In places, a terminal term consisting of chalky sands or sandstones and overlying the glauconitic chalk, can be noted. The passage between the two main terms of the formation — the lower sands or sandstones and the upper, chalky succession — is steadily accomplished through a narrow sequence of slightly cemented, chalky glauconitic-quartzous sandstones.

Both (lower and upper) boundaries of the formation are stratigraphic disconformities, the formation commonly overlying various terms of the Albian Cochirleni Formation (and seldom older formations) and underlying younger deposits of various ages (Turonian to Sarmatian).

The most complete section of the Peştera Formation is exposed in the slopes of the Peştera-Cochirleni valley between the villages of Peştera and Ivrinezu Mic, here being noticeable all terms and facies variations characteristic of this formation; this section is designated here as the type section of the formation.

Beside this type area, the formation crops out in many other places too. Major exposures are supplied by the slopes of the Carasu valley between the Medgidia town and the Saligny village; excellent exposures are also noted in the vicinity of the villages of Mircea Vodă and Remus Opreanu; all these exposures provide successions more or less complete and exhibiting significant features. Worth mentioning is the northernmost outcrop of this formation, located about 1 km north of the Seimenii Mari village, here the formation being represented solely by its basal conglomerate exposed along a distance of only some 20 meters and displaying 40 cm in maximum thickness. Near the Cuza Vodă village, the formation is merely 4 m thick, consisting in the basal conglomerate followed by sands and sandstones. In the Peştera-Cochirleni valley, downstream and upstream from the type section, the formation shows cliff-like excellent exposures in the southern slope of the valley between the Ivrinezu Mic and Cochirleni villages (both sand-sandstone-dominated sequences and chalk-dominated sequences being typically represented) and, respectively, east of the Peştera village (prevailingly sand-sandstone-dominated successions). In addition, the Peştera Formation is well exposed in the Caramancea valley and along the Adamclisi-Negreşti valley (between the Petroşani village and the Şipote village area). Scattered outcrops can be noted at Văleni, Lespezi, Dobromiru and on the northern border of Bugeac lake.

It may be remarked that the deposits of the Peştera Formation do not outcrop north of the Dunărea-Cuza Vodă alignment, east of the Medgidia-Negreşti alignment, and along the Danube shore between Ostrov and Seimeni. At present state of knowledge, it is difficult to decide if, in those areas of present-day missing of its deposits, this formation had been eroded or, alternatively, it had not been accumulated. As regards the Cenomanian deposits transected by drillings in areas outside the region of outcropping of the Peştera Formation, the data available to us are too scarce to enable us to assign them to the here-described formation; accordingly, we do not insist upon this topic.

To conclude, the most complete and informative sections of the Peştera Formation occur in the following sectors : Peştera-Ivrinezu-Cochirleni; Carasu valley (southern slope) between 2 km west of Medgidia and the Remus Opreanu valley mouth; Remus Opreanu valley lower course; and Petroşani-Şipote segment of the Adamclisi-Negreşti valley.

a. *Lithology-lithostratigraphy, macrofaunas and sedimentology*

The most complete successions of the Peştera Formation reach a maximum stratigraphic thickness of 40 m, and encompass 5 distinct lithologic terms extremely variable in thickness from a section (or area) to another and acting as both well individualized lithostratigraphic units and distinctive lithofacies|depofacies. These terms are as follows : (a) lowermost unit : thin basal conglomerate (several dm thick) ; (b) lower unit : sequence of quartzous to quartzous-glauconitic, perfectly washed sands, sandstones and, subsidiarily, pebbles (2—25 m) ; (c) intermediate unit : chalky glauconitic sandstones (1—3 m) ; (d) upper unit : more or less glauconitic-slightly sandy, chalk (1—15 m) ; and (e) terminal unit : chalky sandstones (5—10 m ; sparsely preserved).

The most variable in thickness are by far the lower (b), sand-sandstone unit and the upper (d), chalk unit, and furthermore these two units often display a reverse variation in thickness between various sections (or areas). Accordingly, considering the participation of both the lower sands and sandstones and the upper chalky rocks, the successions of the Peştera Formation can be ascribed to two types of lithologic sequences : the lithologic sequences of Peştera type, widespread and characterized by the presence of the lower, sand-sandstone unit (up to 25 m thick), and the lithologic sequences of Ivrinezu type, restricted to the Ivrinezu village surroundings, flatly dominated by the chalky succession (units c-e ; 25 m maximum total thickness) and lacking the lower, sand-sandstone unit ; therefore, the Peştera-type sequences consist of the a—b—c$\pm$d$\pm$e terms (unit b thin to usually moderate or thick, unit d thin or absent to locally thick and unit e usually absent) while the Ivrinezu-type sequences include the a—c—d—e terms (unit d constantly thick, unit e present, and unit b completely missing) ; these two lithologic regimes of development of the Peştera Formation account for the most pronounced variations in thickness noted for the component terms. The total thickness of the formation (considering the more or less complete sections) lies within the 15—40 m range.

The type section of the formation (Peştera-Ivrinezu section, see above for location) includes both types of lithologic sequences in complete stratigraphic development and at maximum thickness values. It is the only section supplying Ivrinezu-type sequences, beside the Peştera-type ones.

The lithologic succession described below is valid for the type section as well as for the other (more or less complete) sections of the formation.

(a) The basal conglomerate of the Peştera Formation is essentially quartzous-phosphatic (detrital quartz|quartzite grains to pebbles ; detrital phosphate grains to pebbles, standing for completely phosphatized and more or less fragmented and rounded fossils reworked from Albian deposits ; and reworked Albian fossils, i.e. lithoskels, either as completely phosphatised but perfectly conserved entire tests, or as tests only partly or at all phosphatised). This conglomerate unit is omnipresent in the outcrops exposing the formation base. It is commonly represented by a 30—50 cm thick bed individualized at the base of both the Peştera sand-sandstone sequences and the Ivrinezu chalky sequences. However, its lithology is neither unitary nor uniform. Thus, it occurs in places as a 0.8—1 m thick layer consisting of two conglomerate beds separated (gradual transition) by microconglomerates. In opposition, in other places, the existence of a conglomeratic basal tendency is marked by the presence of various centimetric|subcentimetric-sized pebbles, phosphate nodules and reworked Albian fauna (more or less phosphatized fossils), scattered within a coarse sandstone matrix.

The reworked fauna belongs to various Albian biozones. Worth emphasizing is the fauna of the *Stoliczkaia dispar* Biozone of the Uppermost Albian (= Vraconian), which occurs integrally and exclusively in reworked position in the Cenomanian basal conglomerate. Accordingly, the in situ occurrence of the Vraconian fauna (Chiriac, 1981) is not confirmed by our investigations. Thus, even north of Seimenii Mari, in the Albian condensed fossiliferous sequence ("the polyzonal bed" of Chiriac, 1981), the in situ Albian fauna rises up to *Mortoniceras inflatum* Zone inclusively, while the specimens of Vraconian fauna : *Mortoniceras* (*Durnovarites*) *perinflatum* (Spath) (Pl. VI, Fig. 1), *Anisoceras* sp. aff. *A. perarmatum* Pict. & Camp. (Pl. V, Fig. 6), are embedded within a thin conglomerate bed displaying whitish, quartzous-slightly glauconitic, perfectly winnowed sandstone matrix, quite different in lithological features from the subjacent Albian deposits but, instead, perfectly comparable to the basal conglomerate of the Peştera Formation ; consequently, we think that the Seimenii Mari section also exposes only Vraconian fauna reworked in the Lower Cenomanian. On another hand, the occurrence of a single specimen of *Ostlingoceras puzosianum* (d'Orb.) at the top of the Albian sequence in Amzalia hill (cf. Chiriac, 1981) seems to us rather strange, if taken into account the lithologic features of the respective succession (quite similar to the Lower Albian sequences in other sections) as well as the observation that there is no evidence here to suggest the existence, at the upper part of the Albian sequence, of a terminal condensed succession bearing ammonites Middle and Upper Albian in age. A similar situation can be noted at Peştera, here Chiriac (1981) also citing another isolated specimen of *Ostlingoceras puzosianum*.

Relying on the sedimentary and paleontological features of the Albian deposits (see Cochirleni Formation described above), we conclude that no in situ Vraconian deposits outcrop in Southern Dobrogea, and the whole Vraconian fauna of the *Stoliczkaia dispar* Zone, identified here, occurs actually resedimented in the basal conglomerate of the Cenomanian Peştera Formation. Considering the good state of preservation of this reworked fauna, a nonconsolidated state can be inferred for the supplying (corresponding) former Albian deposits (a conclusion largely corroborated, even anticipated, by the still loose current appearance of most Albian deposits).

The highest concentration of reworked fauna belonging to *Stoliczkaia dispar* Zone occurs between the villages of Peştera and Ivrinezu Mic (Amzalia hill, Sarapciculac hill, and Ivrinezu Mic hill cliff), then in several additional places : 3 km west of Medgidia (southern slope of the Carasu valley), Bugeac lake cliff, and Seimenii Mari. Best illustrated by a large number of specimens are the species : *Ostlingoceras puzosianum*, *Anisoceras perarmatum*, *Mariella bergeri* (Brogn.), *M. miliaris* (Pict. & Camp.), *Mortoniceras* (*Durnovarites*) *perinflatum*, *Hyphoplites campichei* Spath, *Stoliczkaia* spp., *Puzosia* spp., etc.

The proper (in situ) fauna of the basal conglomerate bed includes pelecypods (ostreids, *Lima*, *Pecten*), brachiopods, echinids and ammonites. Considering the proper ammonites, the upper part of the basal conglomerate already contains *Mantelliceras mantelli* (Sow.), *M. cantianum* Spath, *Neostlingoceras carcitanense* (Math.), *Mariella cenomanense* (Schlüter), *Hypoturrilites tuberculatus* (Bose), etc., but this situation (stratigraphically in situ ammonites in the upper portion of the basal conglomerate) can be noted only in those sections exposing the Cenomanian formation represented by Ivrinezu-type sequences, i.e. basal conglomerate directly followed by the chalky succession (units c—e) (Amzalia hill, Sarapciculac hill); instead, the Peştera-type sequences, involving sand-sandstone successions following the basal conglomerate, exhibit no proper ammonites but only Vraconian (or older) reworked ammonites in the conglomeratic basal term (west of Medgidia, Remus Opreanu railway station, etc.).

As regards its sedimentary features, the basal conglomerate is thin, omnipresent, massive, devoid of peculiar sedimentary structures, perfectly washed (free from pelito-siltic matrix), mineralogically mature (well rounded quartzous and detritophosphatic-lithoskelic pebbles to granules) but poorly sorted (coarse, quartzous-detritophosphatic-detritoglauconitic sandstone matrix, equally poorly sorted, the rocks ranging from sandy pebblestones or granulestones to subordinate pebbly sandstones). It is composed exclusively of detrital (quartzous, phosphatic and glauconitic) material derived from underlying former Albian deposits submitted to in place rapid erosion and vigurous winnowing (excellent selective mineralogical sorting but poor size sorting in the arenite to rudite size class range, evolving in the context of a "grain-by-grain" type reworking of Albian deposits) and finally to strong concentration of the remaining material in a narrow blanket of a placer type : detritophosphatic-lithoskelic-detritoglauconitic-quartzous placer, merely standing for highly condensed and thoroughly mineralogically selected resedimented Albian deposits, i.e. in place and highly selective reaccumulation of Albian middle-upper terms as basal term of the next, Cenomanian sedimentary cycle. The stratigraphically in situ biogenic material consists of autochthonous penecontemporaneous fossils (ostreids, pectinids, brachiopods, echinoids) and, locally, probably paulopost fossils (Cenomanian ammonites probably related to unit c accumulative stage), the former pointing to nearshore marine environments. Genetically, this basal conglomerate represents a typical marine transgression lag (condensed and coarse-grained basal term of a fast marine transgression). Although sedimentologically diachronous, it should be regarded stratigraphically as isochronous according to faunal evidence (conclusion corroborating the inferred fast marine transgression). Petrologically, it illustrates a quartzous, detritoglauconitic, detrital bone-bed facies (unlike the Albian glauconitic-phosphatic deposits which stand for both authigenous glauconitic and authigenous bone-bed facies ; see above, the Cochirleni Formation). It should be clearly stated here that, while the Albian Cochirleni Formation can be described in terms of glauconitization and phosphatization (authigenic glauconite and authigenic phosphate/phosphorites), the Cenomanian transgression lag, although glauconitic and highly phosphatic (in places originating in a genuine phosphorite bed), cannot be described in similar terms because it contains only detrital glauconite and detrital phosphate (both minerals being reworked from Albian sequences). This conglomeratic lag can be briefly designated petrogenetically as a quartzo-phosphoritic marine placer.

(b) The next sand-sandstone unit accounts for the lower part of the Peştera Formation in most outcropping areas (the Peştera-type sequences) except the Ivrinezu village surroundings including the Ivrinezu hill, Amzalia hill and Sarapciculac hill areas (the Ivrinezu-type sequences, essentially chalky). This unit consists of quartzous (to glauconitic-quartzous), commonly coarse, loose sands and slightly indurated sandstones (and subordinate pebble lenses). This term is highly variable in thickness ; it attains a maximum thickness of 25 m near Peştera village and west of Medgidia town ; in other areas, it lies within 2—15 m thickness range.

This lithologic unit contains rather few organic remnants, such as echinids (Conulus, Discoides) and ostreids in Peştera quarry, or ostreids and brachiopods in several other sections.

The pile of sands and sandstones (with local granule to pebble interbeds) composing this unit displays a spectrum of distinct but inter-related sedimentary structure assemblages, laterally intergradational and controlled by (i.e. narrowly connected to) the unit thickness, while the petrographic background retains constant features : quartzous to quartzous-moderately detritoglauconitic, perfectly washed arenites and subordinate rudites. Thus, the thicker successions (exceeding 10 m, as a rough estimate) display commonly low-angle to very low-angle tabular planar cross-laminations and subordinately parallel laminations or trough cross-laminations, and contain coastal marine faunas (usually tiny ostreids, subsidiarily brachiopods, echinids, etc.) as scattered specimens, nests, or lamination-paralelling sheet-like accumulations ; these successions are consistent with a wave-dominated marginal-marine coastal sedimentation of a sandy-micropebbly beach type within beach berm to beach face (foreshore) settings, generally suggesting low-lying (flat) barrier island accumulations. The thinner successions (gradually decreasing from 10 m to 2 m, as a gross estimate, areally interposed between (and laterally alternating with) the thicker ones, exhibit the mechanical stratifications (mentioned above) getting progressively obliterated by bioturbations, the deposits gradually passing laterally to exclusively bioturbated arenites (burrow fill networks, and mottlings), lacking any trace of wave-induced structures, exactly in the median parts of the areas showing thinned successions of the unit (b) ; the thinned successions support therefore a gradual lateral passage from distal foreshore to shoreface environments, the latter centering (or trending along the axix of) inter--bar shallow channels or depressions ; thus, the thinner successions point to coastal accumulations within shallow marine channels, or elongate depressions, located (and winding) between (and bounded by) the afore-inferred barrier islands. The areas containing thickenned successions of the unit (b) and those accommodating thinned successions of this unit alternate laterally at a mean spacing rate several hundreds of meters. Accordingly, the final spatial image of the sedimentary setting distribution pattern within the sectors exposing the unit (b) is as follows : these sectors, widespread and constantly consisting of alternating areas with thicker and, respectively, thinner successions of this unit, correspond to broad belts composed of low-lying barrier island rows (the thicker successions) alternating with (and separated by) shallow inter-bar channels (or depressions) (the thinned successions). As a whole, the unit (b) corresponds to a wide nearshore (coastal or shoreline-fringing) sandy-micropebbly barrier bar system (coastal accumulation).

(c) The intermediate, chalky glauconitic-quartzous sandstone unit (1—3 m) is loosely cemented and shows downwards and upwards gradational lithologic passages to the adjacent units. In most areas, this unit is located (and lithologically transitional) between the lower (b), sand-sandstone unit and the upper (d), chalk unit (the Peştera-type sequences). However, at several localities, in the Ivrinezu village neighbourhoods this chalky-gritty unit rests directly (and fast-gradationally) on the Cenomanian basal conglomerate (the Ivrinezu-type sequences : Ivrinezu hill, Sarapciculac hill, Amzalia hill).

This transitional lithologic term is gritty (quartzous), glauconitic (probably in situ, detrital-to-authigenic glauconite conversion), chalky (infestation with genuine chalk ooze) and highly fossiliferous (cephalopods, pelecypods, brachiopods ; see below) ; it displays abundant bioturbation structures (mottlings) and sporadic mechanical parallel laminations ; it still suggests a (distal) nearshore (marine) sedimentation, but within an open exposed (non-barred, possibly fore-barrier if still any barrier behind) shoreface setting (subcoastal accumulation).

This lithologic unit is of a major biostratigraphical importance since it accommodates most of the Cenomanian fauna in the investigated territory. Thus, the macrofauna is fairly abundant and diversified, consisting of ammonites, inoceramids, echinids, neohibolites, brachiopods, etc. The richest fossiliferous sites are located along the Peştera-Cochirleni valley (west of Peştera village ; Amzalia hill ; Sarapciculac hill ; Ivrinezu hill cliff in Ivrinezu Mic village ; and southern slope of the valley at some 2 km downstream the Ivrinezu Mic village) ; in addition, the southern slope of the Carasú valley has supplied ammonites and inoceramids at the Remus Opreanu valley mouth and in several other westerlymore localities ; rich collections of ammonites, inoceramids and echinids have been obtained from the eastern slope of the Adamclisi-Dumbrăveni valley at the Şipote village, and from the slope bordering northwards the Bugeac lake. The fauna is relatively homogeneous and does not show any qualitative differences between different localities.

Worth mentioning are the neohibolitids whose occurrence can be noted everywhere, in places even originating in nests composed of hundreds of specimens (Şipote, Ivrinezu Mic) ; as well, the genus *Hypoturrilites* gives rise to a remarkable concentration of specimens at Şipote.

Among the fossils collected by us, we have identified the species : *Mantelliceras mantelli*, *M. cantianum*, *M. saxbii* (Sharpe), *M. couloni* (d'Orb.), *M. picteti* (Hyatt), *M. aff. dixoni* Spath *Neostlingoceras carcitanense*, *Hypoturrilites gravesianus* (d'Orb.), *H. mantelli* (Sharpe), *Mariella ceno-*

manense, *Hyphoplites* spp., *Stoliczkaia* (*Lamnayella*) *sanctaecatherinae* Wright & Kennedy, etc. Rather frequently found are the forms : ***Neohibolites ultimus*** (d'Orb.), *Inoceramus crippsi* Mantell, ***Discoides*** spp., *Holaster* spp., etc.

(d) The upper unit is composed of chalks, more or less glauconitic-slightly gritty (quartzous), apparently marly in places, and 1—15 m thick. The maximum thickness (15 m) of this unit is reached in the Ivrinezu Mic, Remus Opreanu, west-Medgidia and Mircea Vodă areas. In other areas, the chalks are highly reduced in thickness, even absent (Peştera, Văleni, Lespezi, Medgidia and Cuza Vodă areas) mostly owing to subsequent erosion. In fact, the rather drastic changes in thickness of this unit between different areas seem to be due primarily to erosional processes subsequent to the accumulation of this formation ; this interpretation is supported chiefly by the existence of areas exposing Peştera-type sequences (west-Medgidia, Remus Opreanu) where the thick sand-sandstone unit is followed by a chalk unit quite similar in thickness to the thick chalk unit developed at Ivrinezu Mic (the Ivrinezu-type sequences). On the contrary, the thickness variations of the subjacent, (b) unit (the sand-sandstone pile) are certainly controlled by the depositional conditions differential from an area to another (see above, unit (b) description). In this context, worth mentioning is the paleontological observation that the ammonitic fauna of the transitional, sandy-chalky layer (unit c) remains practically identical irrespective whether this layer is underlain by the (thick) sand-sandstone (b) unit (Peştera-type succession) or directly by the basal conglomerate (Ivrinezu-type succession); on the other hand, Peştera-type sequences, i.e. sequences exhibiting the basal conglomerate overlain by a (thick) sand-sandstone succession (west-Medgidia, Remus Opreanu, etc.), disclose their basal conglomerate systematically devoid of ammonites indicative of a certain Cenomanian age, according to our investigations (this conclusion being opposite to the statements in Chiriac, 1981); these sequences contain Cenomanian ammonites, as pointed out by our research, just in the transitional, sandy chalk, (c) unit located between the sand-sandstone, (b) unit and the chalk, (d) unit ; according to this paleontological evidence, one of the authors (L. S.) thinks firmly that no lateral interfingering can be accepted between the sandy succession and the chalky succession ; already unconceivable from sedimentologic viewpoint (A. D.) given the flat incompatibility between these two successions (the thick sand-sandstone unit of the sequences of Peştera type and the thick chalk unit of the sequences of Ivrinezu type)with regard to the required depositional environments, the impossibility for their past lateral alternation within a defined area at a certain accumulative moment (therefore, impossibility of their synchronous accumulation ; hence, impossibility of their present-day lateral interfingering) as well as the fully isochronous nature of the chalky-sandy unit (c) receive, thus, a strong support from the paleontology by the above-mentioned macrofaunal evidence.

The macrofauna found in chalk is relatively sparse and poorly preserved : specimens of the foregoing species of *Mantelliceras*, inoceramids (*Inoceramus crippsi* Mantell, *I. virgatus* Schlüt.), echinids, etc.

This chalk unit, by its faunal remnants (macro- and microfaunas dominated by pelagic and/or planktonic groups/forms) and its unbedded and highly bioturbated nature (mottled structures, of partial bioturbation, to massive structure, of a total biogenic homogenization), suggests typical offshore shelf conditions (shelf pelagites accumulated at depths of several tens of meters).

(e) The uppermost unit of the Peştera Formation, of a quite local preservation, consists of a massive succession, 5—10 m thick, of highly bioturbated chalky-quartzous sands and sandstones. It points to the maintenance of the same, offshore conditions. This unit is exposed on the southern slope of the Peştera-Cochirleni valley between Peştera and Ivrinezu Mic villages, as well as at Remus Opreanu (in this latter area being clearly intensely bioturbated and highly chalky). So far no macrofaunal remains have been found in this unit.

Considered in its totality, the vertical facies evolution within the Peştera Formation provides a clear case of facies retrogradation : the nearshore facies are progressively replaced upwards by offshore facies.

b. *Bio- and chronostratigraphical data*

The deposits composing the Peştera Formation have already been ascribed to the Cenomanian by Macovei (1911) but the fossils cited as evidence favouring this age belong actually to the Vraconian and proceed from the basal conglomerate. However, the Cenomanian age has been estimated by Macovei (1911) considering the Vraconian („*Schloenbachia inflata*" Zone) as pertaining to the Cenomanian and the fauna of this Vraconian zone, occurring in the basal conglomerate, as being partly reworked and partly in situ, an idea retained as such also in the next work by this author (Macovei, Atanasiu, 1934). In this latter work, species characteristic of the Cenomanian are also cited : *Hyphoplites curvatus* (Mant.), *Acanthoceras (Mantelliceras) mantelli* (Sow.), *A. (Calycoceras) naviculare* (Mant.), etc. The presence of the last two species would suggest the existence here of the whole Cenomanian; but, we must specify that the three specimens of Acanthoceratidae of Macovei's collection (found at I.G.G.) belong actually to the genus *Mantelliceras*. One specimen (I.G.G. — 873) has already been reidentified as *Mantelliceras cantianum* Spath by Chiriac (1981, p. 128, Pl. 31, Fig. 1, Pl. 32, Fig. 1). We are almost sure that this one is the „*Calycoceras naviculare*" species of Macovei, because the type of the species *M. cantianum* has been figured by Sharpe (1857, Pl. 18, Fig. 2) under the name of "*Ammonites navicularis*". Another specimen (I.G.G. — 872), labelled as "*Mantelliceras mantelli*", has been identified by us (Szász, 1983, Pl. 13, Fig. 2) as being actually *M. picteti* Hyatt. The third specimen (I.G.G. — 3233) belongs, according to Chiriac (1981, p. 126, Pl. 31, Fig. 5) to the species *Mantelliceras couloni* (d'Orb.).

Another specimen has been mentioned by Simionescu (1944, p. 333) as *Mantelliceras mantelli* and proceeds from Medgidia. This specimen, existent in the collection of the Faculty of Geology, Bucharest (L.P.B. — 1101), actually stands for the species *M. picteti* Hyatt (Szász, 1983, p. 247, Pl. 14, Fig. 2).

The faunal inventory of the Peştera Formation has considerably been enhanced thanks to the research undertaken by Chiriac (1956, 1960, 1981) who cited: echinids: *Holaster nodulosus* Goldf., *H. subglobosus* Leske, *Discoides subuculus* Klein, *D. cylindricus* Lamark, etc. (Chiriac, 1956); turrilitids: *Hypoturrilites mantelli* (Sharpe), *H. tuberculatus* (Bosc.), *H. gravesianus* (d'Orb.), „*H.*" *carcitanensis* (Matheron), *Mariella cenomanensis* (Schlüter), *M. essenensis* Geinitz (Chiriac, 1960); *Turrilites costatus* Lamark, *T. acutus sharpei* Chiriac, *Mariella lewesiensis amzaliensis* Chiriac (Chiriac, 1981); other heteromorphous ammonites: *Sciponoceras baculoide* (Mant.), *Idiohamites alternatus vectensis* Spath, *I. compressus exilis* Chiriac, *I. compressus compressus* Chiriac, *I. irregularis* Chiriac, *I. rarituberculatus* Chiriac, *Anisoceras plicatile* (Sow.), etc.; normal-coiled ammonites: *Sharpeiceras laticlavium* (Sharpe) *Mantelliceras mantelli* (Sow.), *M. tuberculatus* (Mantell), *M. couloni* (d'Orb.), *M. saxbii* (Sharpe), *M. cantianum* Spath, *Calycoceras concinnus* Chiriac, *Hyphoplites crassifalcatus* (Semenow), *H. curvatus* (Mantell), *Forbesiceras* sp., *Acanthoceras* sp., etc. (Chiriac, 1981). In the last work of Chiriac (1981), an assemblage of planktonic foraminifera is also reported including: *Rotalipora appenninica* (Renz), *Praeglobotruncana stephani* (Gandolfi), *R. monsalvensis* (Morrow).

The macrofauna identified by us is mentioned above, in the section describing the lithologic units of the formation, and the general assemblage listed by us is grossly similar to the inventory by Chiriac (op. cit.).

We have also identified, in the Peştera Formation, an extremely rich assemblage of benthic and planktic calcareous foraminiferids, by surveying in detail the most representative sections of the formation (Ivrinezu Mic, Amzalia hill, Şipote). The benthonic foraminiferid assemblage is particularly rich, consisting of species belonging to the genera *Spiroplectammina*, *Textularia*, *Tritaxis*, *Dorothia*, *Hagenowia*, *Arenobulimina*, *Eggerellina*, *Gaudryna*, *Nodosaria*, *Dentalina*, *Cytharina*, *Frondicularia*, *Lenticulina*, *Marginulina*, *Planularia*, *Vaginulina*, *Ramulina*, *Tristix*, *Cibicides*, *Gavelinella*, etc. The sandy facies contain an assemblage extremely rich in *Patellina subcretacea* Cushmann & Alexander. The planktonic foraminiferids, occurring all-over within the chalky-sandy and chalk lithologies, are represented also by various species: *Hedbergella delrioensis* (Carssey), *H. planispira* (Tappan), *Praeglobotruncana delrioensis* (Plummer), *P. stephani* (Gandolfi), *Thalmanninella appeninica appeninica* (Renz), *Th. appeninica evoluta* Sigal, *Th. appeninica gandolfii* Luterbacher & Premoli-Silva, *Th. brotzeni* Sigal, *Th. micheli* (Sacal & Debouile).

The macrofaunal and microfaunal data preclude any doubts upon the Cenomanian age of the Peştera Formation. According to Chiriac (1981), the whole Cenomanian would be present except its lowermost and eventually uppermost parts.In order to support the presence, beside the Lower Cenomanian, of at least the Middle Cenomanian too, this author uses as evidence the occurrence of the species *Turrilites costatus* Lam., *T. acutus sharpei* Ch., *Calycoceras newboldi spinosum* (Kossm.), *Acanthoceras* sp. and the microfaunal assemblage mentioned in his recent work (Chiriac, 1981); as well, this author accepts, as Cenomanian zones, the broad zones proposed by Hancock (zones with *Mantelliceras mantelli*, with *Acanthoceras rhotomagense* and with *Calycoceras naviculare*) considering the zones identified by Juignet and Kennedy (1976) in the anglo-parisian basin as subzones. We specify that this author does not separate distinct associations for subzones but supplies a single assemblage for the Lower Cenomanian and another, common assemblage, including the foregoing species, for the Middle and Upper Cenomanian.

A close examination of all faunas so far reported from the Peştera Formation reveals that the overwhelming majority of the ammonite genera and species is located strictly in the Lower Cenomanian. It is also obvious that the hiatus between the accumulation of the Uppermost Albian (*Stoliczkaia dispar* Zone) deposits and that of the first Cenomanian deposits has been quite short; this statement is corroborated by the very good state of preservation of the Vraconian fauna reworked in the basal conglomerate of the Cenomanian Peştera Formation; as this reworking has been operating upon still nonconsolidated deposits, the latter could have been easily removed from the body chamber of the Vraconian ammonite fossils and replaced with Cenomanian chalky sands/granules much less glauconitic than the Vraconian sediments (note : in fact, we think that this very filling replacement accounts for the previous misidentification of some ammonite specimens belonging to the *Stoliczkaia dispar* Zone as representing the proper, in situ fauna of the Cenomanian basal conglomerate) ; another evidence supporting a short-term hiatus between the Albian and Cenomanian depositional cycles, is the presence within the Cenomanian deposits of the whole assemblage of the zone with *Neostlingoceras carcitanense* of western Europe, this zone being thought the first Cenomanian zone in this latter region.

The Lower Cenomanian ammonitic assemblage of the Southern Dobrogea is rather unitary. The species commonly proceed from the transitional, chalky-gritty unit (c) (which in places rests directly on the basal conglomerate; see previous chapter), or from the upper part of the very basal conglomerate. In most exposures the identified species were collected from the gritty-chalky, transitional unit (c), some 1—2 m thick, overlying the lower, sand-sandstone unit (b) ; the transitional unit in these exposures accomodates species both of the *Mantelliceras mantelli-M. cantianum* group and of the *M. saxbii* group ; accordingly, there is no possibility here to distinguish a lower assemblage corresponding to the zone with *Neostlingoceras carcitanense* and with globulous forms of *Mantelliceras*, and an upper assemblage with *Mantelliceras saxbii*. This is one of the reasons urging us to adopt the zone with *Mantelliceras mantelli* as the first Cenomanian zone in Dobrogea and equivalent to the *Neostlingoceras carcitanense* Zone and *Mantelliceras saxbii* Zone of the anglo-parisian basin (Szász, 1982 b). We think that the zone with *Mantelliceras mantelli* in the sense understood by us (Szász, 1982 b) satisfies at a higher degree the requirements necessary to be fulfilled by a standard biozone than the other zones proposed for the lower part of the Lower Cenomanian, because the index species is frequent over the whole interval of the respective zone, can be easily identified and exhibits a broad areal of geographical distribution. Moreover, accepting *Mantelliceras mantelli* as index for the first Cenomanian chronozone, it becomes possible to elaborate a biozone division of this stage relying on the evolution of a single family, i.e. the family Acanthoceratidae, very well represented in the Cenomanian and displaying phyletic relationships with both Albian and Turonian faunas.

As regards the presence of the upper part of the Lower Cenomanian (zone with *Mantelliceras orbignyi)* in the Peştera Formation, so far we have acquired no certain macropaleontological evidence in this respect ; however, the occurrence of some specimens of *Mantelliceras* related to *M. dixoni (M.* aff. *dixoni* Spath — Szász, 1983, p. 248, Pl. 8, Fig. 4) enables supposing the existence of this interval. This interpretation is also supported by the presence of the species *Turrilites costatus*, a species cited in England beginning from the upper part of the Lower Cenomanian (Kennedy 1971, p. 30).

As regards the occurrence of outcropping Middle and Upper Cenomanian deposits in Southern Dobrogea, we have not found any macrofaunal evidence, and the evidence put forward by Chiriac (1981) is not conclusive. Thus, as already mentioned above, the species *Turrilites costatus* appears still from the Lower Cenomanian ; thus, it does not provide an argument for the precise existence of the Middle Cenomanian. Concerning the species *Turrilites acutus sharpei* Chiriac, it also cannot represent by itself a chronological indicator ; in addition, some specimens ascribed to the species *T. acutus* are reported from the Lower Cenomanian in Mozambiques (Förster, 1975, Pl. 7, Fig. 10). As regards the existence of some specimens belonging, according to Chiriac (1981), to the genus *Acanthoceras*, we feel that an erroneous identification is involved, because at Şipote, where these specimens are cited from, a single ammonitic layer occurs and here all specifically identifiable specimens pertain to the Lower Cenomanian. As regards the existence of the genus *Calycoceras* at Şipote and in the Sarapciculac hill (cf. Chiriac, 1981, Pl. 33, Figs. 2—3 — under the name of *Calycoceras concinnus* n.sp.), we are certain that the specimens assigned to this genus actually belong to the genus *Stoliczkaia (Lamnayella)*, being very proximate to the species *S.(L.) sanctaecatherinae-S.(L.) juigneti* Wright & Kennedy (Wright, Kennedy, 1978). A final short discussion should be born upon the specimen described by Patrulius (in Ciocîrdel, Patrulius, 1950) under the name of *Acanthoceras newboldi* var. *spinosa* Kossm. This specimen has been subsequently refigured by us under the name of *Calycoceras (Lotzeites)* aff. *barruei* (Pervinquière) (Szász, 1983, Pl. 17, Fig. 3) and it is certainly a faunal element younger than the Lower Cenomanian ; however, it does not occur within the deposits exposed in Southern Dobrogea but within a subsurface succession drilled in the vicinity of the Lumina village, in Central Dobrogea ; here, considering the published lithological description (Ciocîrdel, Patrulius, 1950), only the lowermost deposits, 4—5 m thick, conglomeratic, whitish, and containing *Inoceramus crippsi* and *Hypoturrilites* sp. (aff. *H. tuberculatus)*, display conspicuous affinities to the Peştera Formation ; the overlying, slightly glauconitic, whitish-grayish calcareous sandstones highly remind the Cenomanian deposits of the southern shore of the Golovița lake (Szász, 1982 a), and the species „*Acanthoceras newboldi* var. *spinosa*" proceeds from a yellowish-grayish argillaceous layer (some 2 m thick) which, at least until now, has no lithologic counterpart neither in the Cenomanian of the Southern Dobrogea nor in the Cenomanian of the Babadag basin ; in addition, the specimen under discussion (col. I.G.G. — no. 3055) is obviously phosphatised, therefore being possible to be reworked in deposits younger than Cenomanian in age; at any rate, the most proximate site supplying a fauna younger than the Lower Cenomanian is the southern part of the Babadag basin; consequently, the assumption can be made that either deposits of similar age extend southwards to the Lumina village area (the site of collection of thie herediscussed specimen), or the respective specimen has been reworked from the Babadag basn area and embedded within post-Cenomanian deposits in the Lumina village area.

As regards the microfauna, the whole planktonic foraminiferal assemblage belongs to the Lower Cenomanian, namely to the zone with *Thalmanninella appenninica* and *Th. brotzeni* containing a lower subzone — with *Th. appenninica* and *Th. appenninica evoluta* —, and an upper subzone — with *Th. micheli*). The total lack of the species *Th. reicheli* and *Th. montsalvensis* makes questionable even the presence of the terminal part of the Lower Cenomanian; accordingly, there is no evidence consistent with the occurrence of planktonic foraminiferal assemblages characteristic of Middle Cenomanian, occurrence claimed by Chiriac (1981).

As a general conclusion, the macro- and micropaleontological data so far available demonstrate that the outcropping deposits of the Peştera Formation (as well as the subcropping ones pertaining to this formation) entirely belong to the Lower Cenomanian, except for the deposits indicative of the basal and terminal parts of this substage which are missing. The ammonitic fauna is rather unitary and points to the same biozone, irrespective whether it is located in the upper part of the basal conglomerate or in the transitional, chalky-gritty (c) unit situated either between this basal conglomerate and the chalk (d) unit (Ivrinezu-type sequences) or between the sand-sandstone (b) unit and the chalk (d) unit (Peştera-type sequences); in this latter case, the basal conglomerate [separated from the transitional, fossiliferous chalky-gritty (c) unit by the sterile sand-sandstone (b) unit] does not contain proper ammonite fauna; hence, the ammonitic fauna cannot be used for further refining the biostratigraphy of this formation.

2. Cuza Vodă Formation (Middle?, Turonian)

This formation crops out within a highly restricted area, i.e. exclusively east of the Cuza Vodă village within a (currently abandoned) large quarry excavated in the left slope of the lower course of the Agicabul valley. This quarry (directly east of Cuza Vodă) provides the only knovn exposure of this sequence, exposure here designated as the type section of this formation. Therefore, the descriptions below refer implicitly only to the type section.

The Cuza Vodă Formation lies disconformably on the Peştera Formation (Cenomanian, slightly glauconitic, quartzous sandstones) and is overlain also disconformably (stratigraphic disconformity accompanying a marked depositional gap) by the Santonian Murfatlar Formation (glauconitic-chalky-quartzous sandstones bearing a distinct basal conglomerate, both sandstones and conglomerate containing reworked and proper characteristic faunas).

a. *Lithostratigraphy, faunas and sedimentology*

The Cuza Vodă Formation, approximately 10 m thick in the preservation area, consist of a narrow basal conglomerate, some 40 cm thick, slightly cemented, quartzous, composed of quartzite pebbles and reworked (Upper Albian) phosphatized fauna, this conglomerate grading upwards into sands and (micro)pebbles, more or less indurated (cemented), massive (unbedded and mechanically structureless), quartzous, poorly washed (silty to pelito-silty), rich in reworked phosphatized Vraconian fauna (ammonites, selacian teeth) in their upper part, and irregular-reticularly strongly cemented in their median part, some 3 m thick; this median, induraed layer consists of quartzous sandstones and (micro) conglomerates exhibiting a reticular pattern of development (superposed/braided networks of anastomosed burrow fills) including irregular and large net meshes of loose silty/silto-pelitic sands and pebbles, and containing, over all its thickness, numerous specimens of in situ echinids belonging to the genus *Conulus*, such as : *C. subrotundus* Mantell, *C. subsphaeroides* d'Archiac, *C. rhotomagensis elevatus* Chiriac, *C. nucula* Gras, etc.; these species are identical to those reported by Chiriac (1956) from this quarry, but this author citing them not from the Turonian sandstone layer mentioned above, but from the overlying basal conglomerate (bearing reworked Turonian echinids) of the next, suprajacent Santonian sequence (see discussion below). The median sandstone-microconglomerate layer, rich in echinids, stands for the only succession containing proper, Turonian fauna within the Cuza Vodă Formation. On another hand, the proper fauna is exclusively restricted to these echinids, any other remains of proper macrofauna or microfauna being completely missing. The echinid assemblage cited above is generally consistent with a Turonian (probably Middle Turonian) age.

The exclusive occurrence of echinids (restricted only to the indurated, median layer), the absence of any other in situ macro- or microbiotas, the massive character of the whole sequence, the coarse (arenitic-ruditic) grain-size beside the omnipresence of the silty or silto-pelitic matrix (except the reticular-patterned sandstones and microconglomerates of the median layer, pointing to good washing and intense bioturbation, and accounting thus for an intense biofiltering resulting in the removal of the fine-grained matrix and the correlative possibility of manifestation of a cementation process), the absence of the mechanical structures (present eventually only as faint parallel laminations within the median, highly bioturbated, sandstone-microconglomerate-sand layer of the sequence), all these lines of evidence support a marine sedimentation evolving within a coastal environment, on the one hand, and within a protected environment, on the other hand. Accordingly, we are confronted here either with a lower (outer) shoreface environment located in front of an exposed beach, or with a nonrestrictive lagoonal (shallow marine channel) environment situated behind a beach-bearing barrier island. However, the presence of a beach in the direct proximity is imminent (considering the grain-size of sediments), but the available evidence is not conclusive for a precise localisation of the exposed Turonian sequence in relation with this marine beach setting (either in front of it, or behind it). Similarly to the Peştera Formation, the basal conglomerate stands for a transgression lag; and the whole sequence argues here, from the phosphate content viewpoint, for a detrital bone-bed facies (i.e. phosphatic facies lacking own phosphatization processes but containing only reworked, detrital phosphatic material consisting, in our case, of reworked Albian phosphatized faunas).

b. *Bio-and chronostratigraphic comments*

The presence of the Turonian within the deposits in the vicinity of Cuza Vodă (Docuzol) village has already been noted by Macovei (1911) relying on specimens of "*Echinoconus castanea* (d'Orb.)", *Discoides subnucula* Klein, *D. pentagonalis* Cott., the same age being assumed also for other deposits displaying an apparently similar lithologic composition. Later, the existence of the Turonian in the respective deposits has been supported also by Chiriac (1956, 1964) accounting on the occurrence of echinid faunas (similar to the above-listed one), but this author considers a portion of those deposits of Peştera village area ascribed to the Turonian by Macovei as actually belonging to the Cenomanian, and the deposits near the Castelu village — to the Senonian. However, a close inspection of the data reported by Chiriac reveals, if taken into account the description of the succession he assigns to the Turonian at Cuza Vodă, that this author (Chiriac, 1956, p. 98) does not refer to the deposits described by us under the name of Cuza Vodă Formation, because he writes about "a bed of conglomerate containing *Conulus subrotundus*", 0.40—0.65 m in thickness, underlying the Senonian succession represented by whitish slightly conglomeratic sandstones, and overlying Albian deposits. Therefore, it is quite clear that the lithologic entity distinguished by us as the Cuza Vodă Formation is considered by Chiriac (op. cit.) to belong still to the Albian (this author failing to notice the occurrence of the proper echinid fauna in these deposits), while the conglomerate assigned to the Turonian by Chiriac (1956) owing to the presence of a reworked echinid assemblage, actually represents the basal conglomerate of the Santonian. [Recently, on the map and in the geological section featuring the Cretaceous succession at Cuza Vodă, Chiriac (1981) brings, as only notable modification, the figuration of the Cenomanian as a narrow cartographic strip interposed between the Albian and the Turonian; unfortunately, these graphical representations are too general to be explicit with regard to the lithologic entities corresponding to the respective stages, and, on the other hand, this new interpretation involving the introduction of the Cenomanian in the stratigraphic succession at Cuza Vodă is not discussed at all in the text of this work by Chiriac (1981)]. We consider that, similarly to the so-called "Turonian" described by previous authors at Cuza Vodă, the deposits formerly ascribed to the Turonian at Peştera and in the Adînca valley (west-Ovidiu) also represent actually the Santonian basal conglomeratic term containing reworked Turonian macrofaunas, although in these two exposures this conglomerate does not overlie deposits comparable to the Cuza Vodă Formation but it rests directly upon Cenomanian deposits (at Peştera) or upon Aptian deposits (in Adînca valley). As regards other exposures of Turonian deposits reported by Chiriac (1964) in areas east of the Medgidia town, we cannot put forward any comments because these exposures are no longer accessible being meantime either obscured by various man-made slope-leveling fillings or removed during working of the Neocomian limestones in the huge quarry directly east of Medgidia.

To conclude, the Cuza Vodă Formation (and, implicitly, the Turonian) crops out only in the area of the homonymous locality, all the other occurrences so far reported being either misidentifications or currently uncheckable former exposures.

3. **Murfatlar Formation (Santonian-Lower Campanian)**

Under the name of Murfatlar Formation we encompass an exposed sedimentary succession composed essentially of white chalk and bearing almost constantly, at its lower part, a comparatively thin sandy-gritty-chalky layer beginning with a pluridecimetric basal conglomerate (the latter containing reworked faunas and lithoclasts from subjacent formations).

The maximum stratigraphic thickness of the formation, according to the surface records does not exceed 40 m, the conglomeratic and sandy, lower terms accounting for some 4—6 m at the base of the formation.

The Murfatlar Formation displays strongly marked transgressive trends, its deposits disconformably covering previous formations extremely diverse in age : Upper Jurassic dolostones at Ovidiu, Neocomian limestones and dolostones at Poarta Albă and probably at Lespezi, Aptian deposits at Castelu and in Adînca valley, Albian deposits north of Cuza Vodă, Cenomanian sands and chalks south of Satu Nou and probably in Lespezi-Dobromiru area, Turonian sandstones and microconglomerates at Cuza Vodă, etc. In their turn, the deposits of the formation are disconformably overlain by various sediments ranging in age from Lower Eocene to Quaternary.

The southern slope of the Carasu valley between the village of Basarabi (previously named Murfatlar) and the Castelu village, supplying a chalk succession displaying the maximum known outcropping thickness (some 30 m) and grading downwards to the equally well-exposed, basal, detrital-chalky term of the formation, is here designated as the type section of the Murfatlar Formation. Good exposures occur also east of Cuza Vodă (quarries providing primarily the basal terms), south of Satu Nou (southern slope of the Carasu valley, supplying a somehow peculiar biofacies if considered the abundance in belemnitellids, brachiopods and ostreids), in the Adînca valley (west of Ovidiu) and in the steep slope bordering westwards the Siutghiol lake between Ovidiu and Palazu Mare. Scattered outcrops have been recorded in the southernmost South Dobrogea, at Lespezi and at Dobromiru. The westernmost outcrops exposing the Murfatlar Formation occur at Dobromiru, at Peştera and north of Satu Nou.

It seems that the initial extent of the Murfatlar Formation, at least towards north and west, has been considerably larger than the present-day conserved one. This opinion is supported by two main lines of evidence : the occurrence of numerous specimens of *Belemnitella mucronata* within pockets of glauconitic sands preserved within carstic excavations formed on the surface of the Upper Jurassic limestones at Topalu, Central Dobrogea (Bărbulescu, 1973) ; and the presence of chalk blocks within a Quaternary megabreccia (a polygenous megabreccia including deposits various in age, such as Santonian-Campanian chalk blocks, Albian glauconitic sands, etc.) exposed in the Danube cliff between Cochirleni and Cernavoda. In addition, the lower terms of the formation contain in places, beside the proper fauna, mass accumulations of fragmented thick-walled inoceramid shells (of a Coniacian type) obviously reworked from older deposits located in relatively distant areas (because the sequences underlying at present the Murfatlar Formation do not accommodate inoceramid shells comparable in thickness and ornamentation to the fragments reworked in the Santonian deposits). Given that the most proximate place containing in situ thick-walled inoceramid shells is the Babadag basin (the Lower Coniacian at Caugagia), it may be estimated (L.S.) that the source of the inoceramid shell fragments in the basal sandy terms of the Murfatlar Formation is represented by the Coniacian deposits of the Babadag basin ; this statement enables speculating (L.S) that the respective Coniacian deposits had a consistently larger southward extension than that shown at present, on the one hand, and that the Santonian transgression covered broadly the present-day territory of the Central Dobrogea, northwards reaching probably the proximity of the Peceneaga-Camena fault, on the other hand. This latter affirmation seems to be supported by the occurrence on the Sinoe lake shore (near Lupilor Eyot), of a succession of glauconitic sands and conglomerates containing inoceramid fragments and sparse specimens of *Echinocorys vulgaris* ; the age of these deposits, as well as that of the overlying yellowish chalky limestones, is not precisely defined so far owing to the lack of conclusive characteristical micro- and macrofaunas.

a. *Lithostratigraphy/lithology, faunas and sedimentology*

The complete successions (at most 40 m thick) of the Murfatlar Formation consist of three successive lithostratigraphic terms (units), the lower two terms exhibiting large variation in composition, structure-texture and thickness from a section to the other :

(a) lowermost unit (0—80 cm thick) : basal conglomerate (pebblestone, subordinately pebbly sand/pebbly sandstone), reworking much petrographic material from the regional substratum ; it is mineralogically well sorted (grains/granules/pebbles commonly of quartz/quartzites ; biodetrital phosphate pebbles ; reworked faunal fossils, i.e. Albian phosphatized specimens, Turonian often perfectly conserved skeletons, or Coniacian shell debris), but texturally poorly sorted in the arenite-rudite modal range although usually well washed (seldom autochthonous glauconitic-chalky, fine-grained matrix) ; similarly to the conglomerates opening the sedimentary cycles corresponding to the previous formations, this basal conglomerate stands for the condensed coarse-grained term announcing the onset of the marine sedimentation (transgression lag) ;

(b) lower unit (1—4 m thick) : transitional sequence ranging in lithology from chalky-glauconitic-quartzous sandstones or sands to glauconitic-quartzous chalks ; these rocks are more or less friable, usually massive (unbedded), internally structureless (=homogeneous structure) but locally exhibiting subcentimetric parallel laminations or intense bioturbations; the accommodated macrofauna consists either in specimens reworked from previous Cretaceous formations or in proper forms (chiefly echinids) displaying a moderate (locally high) frequency; the glauconite looks authigenous in nature;

(c) upper (main) unit (20–30 m in maximum thickness in those areas escaped from the post-Campanian erosion): homogeneous to bioturbated (mottled), massive (nonbedded), white chalk representing typical foraminiferal-coccolitic nannomuds (nannobial skeletal accumulations); it is in places highly macrofossiliferous; here and there, commonly towards its lower part, it is glauconitic (authigenous glauconite); some chalk volumes or layers contain decimetric, irregular-shaped (rod--like to randomly-branching) silicifications (silexes, seldom chailles, both flints with chert-type structure) scattered within the rock, standing for former burrow fills (penecontemporaneous-silicified burrow fillings) and testifying an excessively intense local bioturbating activity of a synsedimentary endichnial burrowing type.

As a whole, the succession is consistent with a depositional facies evolution from a thin term representing a transgression lag (a), through a passage term indicative of nearshore conditions of a lower (outer) shoreface type (b), to a long-term sedimentation within offshore shelf conditions in a shallow epeiric sea typified by an intense nannoplankton bloom and by the thriving of both planktonic and benthonic calcareous foraminifera as well as of bioturbating infaunal biotas (c). This latter sedimentation stage (c) accounts for the main bulk of the deposits of the Murfatlar Formation, i.e. the chalk succession, which can be best defined as shallow epeiric shelf pelagites; they exhibit sedimentary features and depositional conditions typical of the late Upper Cretaceous chalk sequence within the whole fore-alpine Europe. However, the maximum water depth is here estimated as not having exceeded probably 50–60 m.

We resume further on the description of the formation, stressing upon the paleontological aspects. The description below is valid for the type section as well as for the other sections supplying more or less complete sequences.

(a) The basal conglomerate of the Murfatlar Formation (usually 30–40 cm thick, consisting of centimetric pebbles of quartzites and, subsidiarily, pebbles of Precambrian green schists and of Jurassic and Neocomian limestones) contains frequent fragments of reworked Albian phosphatized fossils and numerous specimens of *Conulus* reworked from Turonian deposits; beside the reworked (mainly Turonian) faunas, the conglomerate accommodates at places (Adînca valley, Poarta Albă, Nisipari) abundant specimens of brachiopods about which it is difficult to state whether reworked or in situ; at any rate, the brachiopod assemblage discloses by far larger affinities with the Senonian assemblages than with the Turonian ones, of Poland and the Russian Platform (A. Bărbulescu — oral communication); the basal conglomerate has also supplied inoceramid specimens but, unfortunately, they could not be identified specifically.

(b) The next, (chalky-glauconitic-quartzous) chalky-gritty succession following the basal conglomerate, involves usually friable, massive (nonbedded) and structureless rocks which, beside the reworked fragments of (Coniacian) inoceramids, already mentioned above, lodge a relatively rich proper fauna mostly illustrated by echinids among which the previous students (Macovei, 1911, 1934; Chiriac, 1956) identified the species: *Echinocorys vulgaris* Brey., *E. vulgaris striata* Lamark, *E. marginatus* Goldf., *Conulus conicus* Brey., *C. subconicus* d'Orb., *C. oblongus* d'Orb., *Micraster coranguinum* Klein, etc.

(c) The above-described unit grades upwards, by a slightly glauconitic-quartzous chalk, to the thick, massive, white chalk displaying only homogeneous to biogenic mottled structures and, in places, containing concentrations of scattered irregular-shaped burrow fillings commonly completely silicified and converted into silex-type or chaille-type siliceous accidents (flints), as already described above. Usually friable and soft, the chalk becomes, in some sections, excessively hard, casant and porcelainous in appearance.

The macrofaunas encountered in the chalk succession is neither considerably rich nor evenly distributed into the rock.

In the quarries at Basarabi (= Murfatlar) and south of Dorobanţu railway station, we have collected inoceramid specimens belonging to the forms: *Inoceramus (Cordiceramus) mülleri recklingensis* Seitz, *I. (Co.)* ex gr. *platycephalus* Sornay, *I. mülleri* Petr. ssp. ind., etc. As well, echinid specimens have been here reported and ascribed to the species: *Offaster pilula* Desor (Macovei, 1934), *Izomicraster* cf. *stolleyi* Lambert and *Spatangoides striatoradiatus* Leske (Chiriac, 1956). In addition, the chalk contains here also a rich fauna of silicosponges: *Ventriculites radiosus*, *V. striatus*, *Calyptsella beothae*, *Leiostracosia punctata*, etc.

Special mention should be made of the sandy chalks south of Satu Nou, which are highly macrofossiliferous; the brachiopods are represented by species such as *Crania craniolaris* Linné, *C. antiqua* (Defr.), *Cyclothyris samodurovi* Makridin & Kalz, *Neolithyrina obesa* Sahni, *Gibbithyris* *gibba* Sahni, *Carneithyris carnea* Sow., etc. (Bărbulescu et al., 1979); frequent specimens are recorded belonging to diverse varieties of the species *Belemnitella mucronata* Jeletzky, *Pycnodonta vesicularis* Lamk., etc.

In other sections, the chalk is rich in tiny brachiopods (Dobromiru; Siutghiol lake western cliff).

The chalk successions of the Murfatlar Formation are extremely rich in microfaunas, especially benthonic calcareous foraminifera, but also planktonic ones. A systematical sampling of the chalk sequences has been carried out at Basarabi (= Murfatlar) and south of Dorobanţu railway station; in addition, many samples have been collected in the Siutghiol lake cliff at Palazu Mare, in the Carasú valley southern slope south of Satu Nou, and in sections exposed at Lespezi and Dobromiru; accordingly, no area exposing the Senonian chalk has escaped from sampling for micropaleontological purposes.

The benthic foraminiferal assemblages identified in the chalk sections include the genera: *Lituola*, *Dorothia*, *Eggerellina*, *Heterostomella*, *Arenobulimina*, *Gaudryina*, *Haplophragmium*, *Ataxophragmium*, *Marginulinopsis*, *Neoflabellina*, *Frondicularia*, *Ramulina*, *Pyramidina*, *Allomorphina*, *Gavelinella*, *Gyroidina*, *Osangularia*, *Globorotalites*, *Stensioina*, *Cibicides*, *Tritaxia*, *Nodosaria*, *Dentalina*, *Citharinella*, *Marginulina*, *Saracenaria*, *Lenticulina*, *Pyrulinoides*, *Bullopora*, *Pullenia*, *Clavulinoides*, *Verneuilina*, *Beissellina*, *Spiroplectammina*, *Guttulina*, *Bolivina*, *Bolivinoides*, *Praebulimina*, *Vaginulinopsis*, *Textularia*, *Eouvigerina*, *Ventilabrella*, etc.

The planktonic foraminiferal assemblages recorded in different areas are as the follows:

— Basarabi-Dorobanţu area: lower assemblage containing: *Dicarinella concavata concavata* (Dalbiez), *Marginotruncana pseudolinneiana* Pessagno, *M. coronata* (Bolli), *M. sigali* (Reichel) (very rare), *Arhaeglobigerina cretacea* (d'Orb.), *Globotruncana bulloides* Vogler; upper assemblage including : *Globotruncana elevata* Brotz., *Marginotruncana renzi* (Gandolfi), *M. angusticarinata* (Gandolfi), *Dicarinella* cf. *indica* (Jacob & Satry), *Globotruncana bulloides* Vogler, *Arheoglobigerina cretacea* (d'-Orb.); in the first 2 m interval from its appearance, *Globotruncana elevata* consists of sporadical and primitive specimens, then this species becoming quite frequent;

— south of Satu Nou: *Globotruncana bulloides* Vogler, *G. linneiana* (d'Orb.), *G. cretacea* Cushman, *G. arca* (Cushman), *Rugoglobigerina rugosa* Bronimann & Brown.;

— Lespezi: *Globigerinelloides multispinatus* (Lalick.), *Marginotruncana cretacea* (d'Orb.), *Globotruncana fornicata* (Plumm.), *G. fornicata scutilla* (Gandolfi), *G. arca* (Cushman), *Globotruncanita elevata* (Brotz);

— Dobromiru: *Marginotruncana cretacea* (d'Orb.), *Globotruncanita elevata* (Brotz), *Globotruncana ventricosa* White, *G. arca* (Cushmann), *G. fornicata* (Plumm.), *Marginotruncana marginata* (Reuss);

— Siutghiol lake cliff: *Marginotruncana cretacea* (d'Orb.), *M. marginata* (Reuss), *Globotruncanita elevata* (Brotz), *G. linneiana* (d'Orb.), *G. fornicata* (Plumm.), *Globigerinelloides multispinatus* (Lalick.).

b. *Bio- and chronostratigraphical interpretations*

Accounting on the echinid fauna present in the lower (sandy-gritty-chalky) part of the sequence here designated as the Murfatlar Formation , Chiriac (1956, 1964, 1981) estimates a Santonian age for this lower layer and assigns the overlying chalks to the Campanian-Lower Maastrichtian (or only to the Campanian, if considered the ages figured on the maps enclosed to his work published in 1981). As concerns our opinions, we cannot add any supplementary age estimates with regard to the sandy-gritty lower term for lack of additional paleontological evidence and owing to the impossibility of obtaining precise information (and, accordingly, refined estimates), from the available data, concerning the moment of the Santonian transgression. Instead, evidence is available supporting the sandy-gritty-chalky layer not to represent the whole Santonian succession of South Dobrogea; thus, at least the lower half of the overlying white chalk sequence exposed between Valu lui Traian and Castelu still pertains to the Santonian on both macro- and microfaunal grounds; thus, the inoceramid species here identified are characteristic of the Upper Santonian and do not occur above the Santonian/Campanian boundary (Seitz, 1961, 1967) or extend at most also in the Lowermost Campanian (Sornay, 1982); on the other hand, the planktonic foraminiferal assemblage here recorded in the lower part of the chalk succession up to the first appearance of the species *Globotruncana elevata*, confirms the Upper Santonian age (*Dicarinella concavata carinata* Zone — upper part).

As regards the upper 10—12 m thick interval of the chalk succession in the Valu lui Traian--Castelu area, as well as the chalk sequences in all the other sections examined for the microfauna content, all of these chalk sequences have supplied planktonic foraminiferal assemblages doubtless pointing to a Lower Campanian age (*Globotruncana elevata* Zone). A few areas (Satu Nou, Dobromiru) enable accepting also at most the presence of the lowermost Middle Campanian (basal part of the *Globotruncana ventricosa* Zone).

Many species of benthic calcareous foraminifera confirm the presence of the Lower Campanian and, furthermore, some of them are thought index-fossils for this time span (cf. Akimetz et al., 1983) : *Neoflabellina rugosa* (Wedeck), *Gavelinella clementina* (d'Orb.), *G. stelligera* (Maric), *Stensioina pommerana* Brotz., *Bolivinoides decorata* (Jones), etc. Some of the macrofaunal species reported from the chalk sequences either are regarded as biozone-indicative fossils characteristic of the Lower Campanian (*Offaster pilula* — cf. Atabekian, 1979), or make their first appearance in the Lower Campanian (*Belemnitella mucronata* — cf. Naidin, Kopaevitsch, 1977) and consequently do not rule out the age defined on microfaunal grounds.

We can conclude that the Murfatlar Formation is the product of a depositional cycle opening in the Santonian by a basal conglomeratic lag followed by chalky sands/sandstones, and continuing during the Upper Santonian-Lower Campanian time interval by the sedimentation of the white pure chalk ; the passage between the sandy-gritty term and the chalk is transitional, and the boundary between these two terms is more or less isochronous and represents merely a lithologic boundary non coincident with a chronostratigraphic one. Thus, the Santonian/Campanian boundary is not marked by a change in lithology but only by a modification in the planktonic foraminiferal assemblage. However, worth emphasizing is the fact that, at the beginning of the Campanian, a strong marine ingression can be noted as demonstrated by the Lower Campanian age of the whole chalk succession exposed in many places (Lespezi, south of Satu Nou). We can firmly state that there is no evidence for the occurrence of exposed chalk sequences belonging to the Middle Campanian-Maastrichtian time span in South Dobrogea.

Some papers (e.g. Chiriac et al., 1977) accept the subsurface presence of Maastrichtian deposits in the drillholes of the Eforie Sud area ; however, no paleontological arguments favouring this age are supplied, and no data concerning the relationships between these deposits and the (outcropping) Santonian-Lower Campanian ones are provided in these papers.

III. GENERAL CONCLUSIONS

The main contribution of the present paper can be summarised as follows :

1. The exposed Cretaceous deposits of Southern Dobrogea are here demonstrated to encompass a sequence of geological formations standing for distinct sedimentary cycles separated by major stratigraphic gaps : Cernavoda Formation (Upper Tithonian?-Berriasian-Valanginian) ; Ramadan Formation (Bedoulian ; locally, Barremian-Bedoulian) ; Gherghina Formation (Gargasian ; locally, Bedoulian ?-Gargasian- ?Clansayesian) ; Cochirleni Formation (Clansayesian ?-Albian) ; Peştera Formation (Lower Cenomanian) ; Cuza Vodă Formation (Middle ?, Turonian) ; Murfatlar Formation (Santonian-Lower Campanian).

2. Considering both the lithologies and the faunas, it is to conclude that most formations have been accumulated within coastal or subcoastal marine settings, under either prevailingly carbonate facies (Cernavoda, Ramadan) or mainly detrital terrigenous facies (Cochirleni, Peştera, Cuza Vodă). Subordinate sedimentation under continental conditions (Gherghina) or, contrarily, under neritico-pelagic (but shallow) marine conditions (Murfatlar) can be noted.

3. The biostratigraphical data have allowed for an accurate chronostratigraphical localisation of most distinguished formations, and good insight into dating their lithostratigraphic component terms as well as into delineating the time spans covered by the inter-formational stratigraphic gaps ; the latter ones correspond to the following time intervals : Hauterivian ; Clansayesian ; Upper Albian, in places Vraconian only ; Middle-Upper Cenomanian ; Coniacian-lowermost Santonian ; Middle Campanian-Maastrichtian.

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STRATIGRAFIA DEPOZITELOR CRETACICE EXPUSE LA ZI ÎN DOBROGEA DE SUD

(Rezumat)

Datele de ordin litostratigrafic, biostratigrafic şi sedimentologic-ecologic asupra depozitelor cretacice care apar la zi în Dobrogea de sud, obţinute de autorii lucrării de faţă, vin să le completeze şi, pe alocuri, să le clarifice pe acelea publicate succesiv de : Reuss (1865), Peters (1867), Anastasiu (1898, 1908), Paquier (1901), Toula (1904), Simionescu (1906, 1926), Macovei (1911, 1934, in Macovei, Atanasiu, 1934), Chiriac (1956, 1957, 1960, 1961, 1968, 1981), Băncilă (1973), Chiriac et al. (1977) şi Neagu et al. (1977). Recent, datele noastre au fost prezentate sintetic în formă grafică în foile Medgidia şi Peştera ale Hărţii geologice a României, scara 1 : 50 000 (Ghenea et al., 1984 a, b).

Succesiunile cretacice ale Dobrogei de sud se dispun transgresiv peste formaţiunile jurasice şi prejurasice şi sînt, la rîndul lor, acoperite local de depozite paleogene sau badenian superioare şi, cu caracter mai general, de depozite sarmaţian medii şi cuaternare, ultimele ocupînd mai mult de 90% din suprafaţa întregului teritoriu investigat. Cercetările pe care le-am întreprins asupra depozitelor cretacice ne-au permis să distingem şapte formaţiuni geologice, cu caractere litologice şi biologice distincte, separate de discontinuităţi stratigrafice. Ultimele, constînd în întreruperi de sedimentare însoţite de etape erozionale, au condus la conservarea areală discontinuă şi la conservarea stratigrafică mai mult sau mai puţin incompletă a formaţiunilor şi, de asemenea, la fenomene frecvente de resedimentare a faunelor.

De la vechi la nou, formaţiunile cretacice identificate de noi în depozitele care apar la suprafaţă sînt caracterizate după cum urmează (formaţiuni şi denumiri conform Avram, Drăgănescu, Szász, în Ghenea et al., 1984 a, b).

A. Cretacicul inferior

1. *Formaţiunea de Cernavoda (Tithonic superior ?-Berriasian-Valanginian)*

Formaţiunea de Cernavoda este o entitate litostratigrafică esenţialmente carbonatică şi subordonat marnoasă-argiloasă (-evaporitică în secvenţele bazale, nedeschise la zi), care aflorează discontinuu de la Dunăre către est pînă la linia Poarta Albă-Dumbrăveni şi de la obîrşia văii Agicabul pînă la frontiera româno-bulgară. În foraje, ea a putut fi urmărită de la sud de aliniamentul Capidava-Ovidiu numai la vest de linia Palazu Mare-Valu lui Traian-Cobadin-Plopeni-Negru Vodă (Vasilescu, Dragomirescu, 1977).

Secţiunea-tip a formaţiunii a fost aleasă în faleza Dunării, de la podul Cernavoda către sud, pînă la capătul nordic al ostrovului Hinog.

Pentru termenii săi inferiori, care nu apar la suprafaţă, au fost luate în considerare datele din forajele săpate în arealul cuprins între aliniamentele Capidava-Ovidiu şi Peştera-Cobadin. Astfel, succesiunea formaţiunii cuprinde în bază un „complex gipsifer" şi un pachet de „argile policolore" (Băncilă, 1973), recunoscute numai în foraje şi atribuite intervalului Tithonic superior-Berriasian inferior (Băncilă, 1973, Chiriac et al., 1977).

Termenii care apar la suprafaţă ai formaţiunii pot fi grupaţi după cum urmează :

a) subformaţiunea de Poarta Albă (Berriasian);
b) subformaţiunea de Medgidia (Berriasian);
c) subformaţiunea de Alimanu (Berriasian superior-Valanginian).

Relaţiile dintre ultimele două subformaţiuni sînt, în cea mai mare parte, de superpoziţie; pe de altă parte, primele două sînt în cea mai mare parte sincrone, superpoziţia parţială a celei de-a doua peste depozitele primeia rămînînd încă să fie dovedită.

a) *Subformaţiunea de Poarta Albă*, dezvoltată în versantul drept al văii Carasú la Poarta Albă, în versantul stîng al văii Cocoşu de la vărsare pînă la 2—2,5 km spre est şi pe valea Adamclisi în zona localităţii Adamclisi, oferă succesiunea-tip deschisă la zi în carierele din versantul stîng al văii Cocoşu, în raza localităţii Poarta Albă.

Subformaţiunea este constituită dintr-o succesiune de dolomite în strate decimetrice pînă la metrice, cu intercalaţii subordonate de marno-argile verzui, uneori şistoase, mai frecvente către partea sa inferioară; rocile sînt local slab gipsifere.

Din punct de vedere sedimentologic, dolomitele şi intercalaţiile marno-argiloase constau într-o alternanţă de pachete intens bioturbate şi pachete cu laminaţie milimetrică algală sau mecanică; aporturile continentale de material argilos sînt de natură, probabil, eoliană şi coluvială. În ansamblu, litologiile, structurile sedimentare şi materialul fosilifer (characee şi foraminifere) indică un facies marin de tip tidal-flat dolomitic, predominant uşor suprasalin, cu episoade subordonate normal marine şi subsaline.

Vîrsta berriasian superioară a subformaţiunii a putut fi apreciată după o asociaţie de foraminifere recunoscută în depozitele sale în forajul Nazarcea (la 68 şi 93 m adîncime): asociaţie cu *Danubiella cernavodensis* Neagu, *Anchispirocyclina maynci* (Hott.), *Everticyclammina virguliana* (Koech.), *Rectocyclammina chouberti* Hott. Întrucît în acelaşi foraj, între 93—138 m adîncime „pachetul de marne policolore" situat imediat sub depozitele subformaţiunii a oferit o asociaţie purbeckian terminală de characee (cu *Flabellochara gravesi* (Harris), *Nodosoclavator bradleyi* (Harris), *Globator maillardi* (Saporta), *Clypeator corrugatus* (Peck)), limita inferioară a subformaţiunii de Poarta Albă nu se poate situa mai jos de Berriasianul inferior.

Grosimea subformaţiunii, apreciată doar aproximativ în lipsa unor profile continue, este de cca 25—30 m.

b) *Subformaţiunea de Medgidia* oferă succesiuni caracteristice în versantul sudic al văii Carasú în sectorul oraşului Medgidia (secţiunea-tip), de la fosta carieră a fabricii de ciment către vest, pînă la cca 2 km vest de stadionul localităţii, şi în faleza Dunării la gura văii Peşterea Cochirleni.

Subformaţiunea este constituită dintr-o alternanţă, de la centimetrică la metrică, de calcare (calcarenite peletale, calcarenite foraminiferice-oncolitice, calcilutite $\pm$microfosilifere şi subordonat calcarenite oolitice şi biocalcirudite), dolomite mai mult sau mai puţin marnoase, marnocalcare, argile şi marne; sporadic, rocile sînt gipsifere.

În ansamblu, litologiile şi faunele arată condiţii depoziţionale de la lagunare slab restrictive la intertidale şi supratidale restrictive (tidal flat calcaros-argilos, de regulă subsalin).

Vîrsta erriasian superioară a subformaţiunii a fost precizată într-un singur punct — în malul sudic al văii Carasú, la 1 km vest de stadionul Medgidia, unde a fost identificată o asociaţie de foraminifere cu *Ammocycloloculina erratica* (Jack. & Favr.), *Pseudocyclammina lituus* Yabe & Hanzava, *P. parvula* Hott., *Retrocyclammina chouberti* Hott., etc. Întrucît partea inferioară a subformaţiunii de Alimanu, suprajacentă, se situează tot în Berriasianul superior, apartenenţa părţii superioare a subformaţiunii de Medgidia la această vîrstă este sigură. Pe de altă parte, apartenenţa la Berriasianul inferior a părţii sale bazale poate fi doar presupusă în lipsa deschiderilor la limita cu subformaţiunea de Poarta Albă care să arate raporturile clare cu aceasta din urmă.

Grosimea maximă a subformaţiuuii vizibilă în aflorimente, este de cca 15 m.

Subformaţiunea de Alimanu oferă secţiunea-tip în versanţii văii Adamclisi-Alimanu din sectorul satului Alimanu, fiind deschisă la zi şi în faleza Dunării, între podul Cernavoda şi Valea Hinogului, în zona portului Cernavoda, în versanţii văii Carasú de la Valea Cişmelei pînă la cariera fabricii de ciment Medgidia, pe valea Remus Opreanu, afluenţii pe dreapta ai văii Peştera (văile Dăulari şi Roşeanu), pe Valea Baciului, valea Dumbrăveni-Sipote-Adamclisi-Alimanu, valea Rariştea-Mîrleanu, valea Canaraua Fetii şi în jurul lacului Bugeac.

Subformaţiunea cuprinde calcarenite algale şi zoogene (foraminiferice ± microcoprolitice) cu nivele calciruditice dominate de lamellibranchiate şi gasteropode mari, cu structuri algale stromatolitice şi, sporadic, cu corali şi brachiopode.

Litologia, structurile sedimentare (predominant masive, laminitice sau bioturbate) şi organismele asociate arată condiţii depoziţionale de mediu lagunar-peritidal mai mult sau mai puţin restrictiv, variind de la marin uşor subsalin la salmastru şi alternînd de la sub- la intertidal; sporadic s-au instalat condiţii normal marine de tip back-reef (indicate de nivelele bogat macrofosilifere, predominant pachiodontice-gasteropodice).

Vîrsta subformaţiunii a fost precizată pe baza studiului micropaleontologic : la partea sa inferioară, în profilul-tip al formaţiunii de Cernavoda — o asociaţie berriasian superioară de foraminifere, cu *Ammocycloloculina erratica*, care trece gradat la asociaţia valanginian inferioară-medie cu *Trocholina alpina* (Leupold) şi *T. elongata* (Leupold), ultima fiind înlocuită brusc la partea superioară a profilului cu o asociaţie valanginian superioară cu *Ichnusella trocholinaeformis* (Dieni & Masari) şi *Melathrocherion spirale* (Gorb.). La partea superioară a pachetului caracterizat de asociaţia cu *Trocholina alpina* şi *T. elongata*, amonitul *Karakaschiceras* cf. *biassalense* (Kar.) indică vîrsta valanginiană medie.

La partea terminală a succesiunii calcaroase valanginiene numărul de foraminifere se reduce sensibil datorită instalării generale a unui facies lagunar salmastru, cu care se încheie primul ciclu de sedimentare din cuprinsul Cretacicului inferior.

În secţiunea-tip a subformaţiunii de Alimanu, la partea superioară a succesiunii (ultimii 10—12 m), peste depozitele valanginiene se dezvoltă calcarenite algale şi zoogene asemănătoare celor tipice pentru această subformaţiune, ca şi numeroase intercalaţii decimetrice (0,1—0,5 m) de marne verzui sau, subordonat, roşietice şi, mai rar, de dolomite în strate decimetrice care au fost datate micropaleontologic ca barremiene. Acestea ar reprezenta cel mai vechi termen stratigrafic postvalanginian din Dobrogea de sud, care ar aparţine, deci, părţii inferioare a formaţiunii de Ramadan. Deocamdată păstrăm rezerve asupra poziţiei stratigrafice exacte a acestui termen.

2. *Formaţiunea de Ramadan (Bedoulian; local Barremian-Bedoulian)*

Formaţiunea de Ramadan se dezvoltă numai în partea de vest a Dobrogei de sud, între cursul Dunării şi linia Dunărea-Ţibrinu-Medgidia-Băneasa. Ea se dispune discordant peste depozitele formaţiunii de Cernavoda şi suportă transgresiv fie depozite ale formaţiunii de Gherghina, fie ale formaţiunii de Cochirleni, fie depozite neogene sau cuaternare.

Secţiunea-tip a formaţiunii a fost stabilită în lungul malului sudic al lacului Ramadan, unde succesiunea sa este compusă, pe cca 10 m grosime, dintr-o alternanţă neregulată (atît pe verticală, cît şi lateral) de nisipuri/gresii şi pietrişuri/conglomerate, de la cuarţoase-orbitolinice sau exclusiv orbitolinice pînă la cuarţoase-orbitolinice, bogat macrofosilifere (cu pachiodonte şi ostreide); ele se prezintă perfect spălate, cu laminaţii paralele sau slab încrucişate tabulare, la unele nivele structurile mecanice fiind mascate de structuri bioturbate (mottling sau reţea de burrow fills). Acestea suportă calcare lumaşelice cu pachiodonte. În acest profil baza formaţiunii a fost datată de Chiriac (1981) ca fiind bedouliană, pe baza a două specii noi de *Deshayesites* şi, respectiv, de *Cheloniceras*.

Termenii cei mai vechi ai formaţiunii de Ramadan apar la zi numai în două secţiuni : în malul stîng al văii Alimanu şi în malul lacului Bugeac, la Gîrliţa.

În prima dintre acestea, descrisă în capitolul privind formaţiunea de Alimanu, marnele verzui şi roşietice care apar la zi în alternanţă cu calcare şi dolomite conţin foraminifere aglutinante de tip barremian şi miliolide salmastre; ultimii 2 m ai succesiunii sînt formaţi din calcarenite algale foraminiferice cu gasteropode mari şi cu specii de foraminifere (*Dobrogelina discorbiformis* Neagu etc.) regăsite în parte în Barremianul amonitic din Franţa. Succesiunea îmbracă un facies lagunar care evoluează de la salmastru la normal marin, constituind o prezenţă insolită în cadrul formaţiunii de Ramadan prin faciesul atipic pe care îl prezintă. Afilierea sa la această formaţiune este discutabilă.

În al doilea punct (Gîrliţa) apar la zi pe cca 20 m grosime calcare lumaşelice cu pachiodonte, în alternanţă cu calcarenite foraminiferice şi marne a căror asociaţie de foraminifere (*Derventina filipescui* Neagu, *Andersenia rumana* Neagu etc.) arată vîrsta barremian superioară sau limita Barremian-Apţian (*Choffatella decipiens* Schl., *Dictyoconus* spp., *Orbitolinopsis buccifer* Vanneau Thiel.). Aici succesiunea se încadrează la faciesul marin costal neprotejat, tipic formaţiunii de Ramadan.

În celelalte regiuni în care formaţiunea apare la zi, ea este reprezentată doar prin termeni similari litologic şi sincroni celor din secţiunea-tip.

Considerînd depozitele formaţiunii în ansamblu, litologia şi structurile sedimentare indică sedimentare marină costală neprotejată, de plajă nisipoasă, sedimentele alcătuind o zonă întinsă de cordoane şi bancuri costale, parţial emerse, de nisip. Pachetul lumaşelic de pachiodonte, de regulă suprajacent, indică transgresiune facială (retrogradare facială) : avansarea peste sedimentarea costală nisipoasă a unor terase marine recifale ilustrate prin bancuri (trotuare) organogene pelecipodice bioconstruite la bioacumulate.

3. *Formaţiunea de Gherghina (Gargasian ; local Bedoulian ?-Gargasian- ? Clansayesian)*

Formaţiunea de Gherghina cuprinde depozite continentale esenţialmente aluviale care se dezvoltă în partea nordică a Dobrogei de sud pe Valea Dăularilor (est Peştera), valea Carasú (între Cernavoda şi Poarta Albă) şi afluenţii săi, pe valea Tibrinu (de la capătul vestic al lacului Ramadan pînă la coada lacului Tibrinu), pe valea Siliştea şi Valea Boasgicului pînă aproape de obîrşie şi pe malul drept al Dunării, între vărsarea văii Peştera-Cochirleni şi localitatea Dunărea.

Secţiunea-tip a formaţiunii a fost aleasă în valea Ţibrinu, de la localitatea Gherghina pînă la vest de localitatea Ţibrinu. Aici formaţiunea este deschisă într-o succesiune de cariere, este dispusă peste formaţiunea de Ramadan (la coada lacului Tibrinu) şi este acoperită de nisipurile glauconitice ale formaţiunii de Cochirleni (la sud de Gherghina), iar grosimea sa atinge cca 50—60 m.

Litologia formaţiunii de Gherghina constă într-o succesiune dezordonată de pietrişuri şi nisipuri dezorganizate, argile comune şi argile caolinoase, ultimele exploatate în cariere în sectorul Ţibrinu-Gherghina şi pe valea Agicabul la sud de Cuza Vodă ; numai în două puncte — pe Valea Dăularilor, la 2 km spre amonte de confluenţa sa cu valea Roşeanu, şi în forajul Nazarcea —, la baza sa au fost întîlnite argile siltice lacustre multicolore cu characee. În ansamblu, formaţiunea prezintă un facies continental de tip aluvial (cu numeroase subfaciesuri, inclusiv lacustru), local premers de un facies lacustru independent şi de scurtă durată.

Singura indicaţie de vîrstă din cuprinsul formaţiunii a fost oferită de argilele cu characee amintite mai sus. Asociaţia, comună celor două puncte (*Atopochara trivolvis trivolvis* Peck, *Clypeator europaeus* Mädler etc.), indică vîrsta apţiană, mai curînd inferioară. Această vîrstă sugerează că partea inferioară a formaţiunii de Gherghina din arealul situat la est de aria de dezvoltare a formaţiunii de Ramadan este cel puţin în parte sincronă cu aceasta din urmă. Vîrsta generală a formaţiunii (Bedoulian ?-Gargasian- ? Clansayesian) am apreciat-o însă prin poziţia sa stratigrafică între formaţiunea de Ramadan (Bedoulian) şi cea de Cochirleni (Apţian terminal ?-Albian).

4. *Formaţiunea de Cochirleni (Clansayesian ?-Albian)*

Formaţiunea de Cochirleni aflorează discontinuu în lungul văilor mari din partea vestică şi centrală a Dobrogei de sud, de la Dunăre către est, pînă la est de aliniamentul Cuza Vodă-Medgidia-Şipote. Ea se aşterne peste diferiţi termeni ai formaţiunii de Cernavoda, de Ramadan şi de Gherghina şi este acoperită discordant de depozite ale formaţiunii de Peştera.

Secţiunea-tip a formaţiunii a fost aleasă în raza localităţii Cochirleni, începînd cu faleza Dunării de la Valea Hinogului către sud pînă la Cochirleni şi continuă în versantul sudic al văii Peştera-Cochirleni, pînă la localitatea Ivrinezu Mic. Faleza Dunării permite observarea relaţiilor cu termenii stratigrafici subjacenţi (formaţiunea de Cernavoda şi formaţiunea de Ramadan) şi deschide partea inferioară a formaţiunii ; valea Peştera-Cochirleni expune partea sa superioară şi relaţiile cu formaţiunea de Peştera, suprajacentă.

Formaţiunea de Cochirleni este constituită în cea mai mare parte din nisipuri argiloase şi gresii spălate, ambele cuarţoase, bogat glauconitice şi cu bioturbaţii frecvente (intervalul Clansayesian ?-Albian inferior). La baza sa, în malul sudic al văii Carasú, între valea Alivantu şi valea Remus Opreanu, şi la diferite nivele în cuprinsul ei (la Cuza Vodă, cariera de la gura văii Remus Opreanu, faleza Dunării la sud de Hinog) apar uneori intercalaţii de micropietrişuri şi microconglomerate cuarţoase şi cuarţofosfatice, cu faună transportată şi autohtonă.

Partea sa superioară (Albian mediu) apare la zi în valea Peştera-Cochirleni la NV de Ivrinezu Mic, unde este predominant grezoasă, nisipurile argiloase apărînd ca ochiuri şi ca microlentile.

În sfîrşit, ca facies parţial sincron cu acesta din urmă, dar cuprinzînd şi partea inferioară a Albianului superior, se păstrează pe un areal restrîns, în versantul Dunării la 1,5 km NE de Seimenii Mari, un pachet de cca 1,2 m grosime compus dintr-un strat de cca 15 cm gresie fosiliferă bogată în lamellibranchiate, gasteropode şi amoniţi fosfatizaţi, urmat de un lumaşel de 50 cm grosime format din cochilii fosfatizate de lamellibranchiate, gasteropode, amoniţi şi belemniţi şi încheiat cu gresii şi nisipuri (60—70 cm) cuarţoase-glauconitice, argiloase, laminitice, încă fosilifere la partea inferioară.

În fine, în sectorul Bugeac aflorează sporadic Albianul mediu într-un facies diferit, marnos-siltic cenuşiu, cu amoniţi.

Din punct de vedere sedimentologic, formaţiunea de Cochirleni se dezvoltă sub trei faciesuri : litofaciesul nisipos-grezos argilos, glauconitic, de vîrstă Apţian superior ? -Albian inferior-Albian mediu, căruia îi aparţine majoritatea covîrşitoare a depozitelor la zi ; litofaciesul intens fosfatic, cu aflorare punctiformă în sectorul Seimeni, limitat la intervalul Albian mediu-Albian superior timpuriu şi ilustrînd un caz particular al litofaciesului precedent (litofaciesul glauconitic, puternic condensat şi intens fosfatizat); şi litofaciesul marno-siltic, cu aflorare de asemenea locală, în sectorul Bugeac şi instalat strict începînd din Albianul mediu.

Primul litofacies este caracterizat prin absenţa structurilor sedimentare mecanice atît în nisipuri, cît şi în gresii, şi prin prezenţa bioturbaţiilor în nisipurile vazoase, alături de faună de regulă salmastră şi abundenţa deosebită a acestor bioturbaţii în gresiile spălate (biofiltrate), în care se regăseşte preferenţial faună marină; alte caracteristici sînt glauconitizarea largă constantă în aceste depozite şi fosfatizările sporadice ale cochiliilor de amoniţi, bivalve şi gasteropode. Ansamblul caracterelor menţionate demonstrează caracterul de sedimentare costală în regim de mediu protejat de tip mlaştină salmastră (nisipurile) la normal marină (gresiile), mlaştini situate în poziţie juxtapusă ţărmului. Subfaciesul predominant nisipos (Albian inferior) indică condiţii de mlaştină externă, pe cînd cel grezos (Albian mediu) — condiţii de mlaştină internă.

Al doilea litofacies, consangvin cu primul şi reprezentînd varianta intens condensată şi puternic fosfatizată a acestuia, în intervalul Albian mediu-superior, bogat macrofosilifer, indică o acumulare în condiţii de mlaştină internă (specifică Albianului mediu glauconitic), predominant salmastră, cu faună de lamellibranchiate şi gasteropode proliferînd in situ şi cu aporturi dinspre larg de faună nectonică tipic marină (amoniţi şi belemniţi; probabil exemplare moarte flotate), şi cu rată de sedimentare extrem de redusă. Gresiile şi lumaşelul de fosile fosfatizate descrise din acest litofacies sînt intens bioturbate, fapt care determină, printre altele, amestecul faunelor de amoniţi în intervalul lumaşelului.

Al treilea litofacies, monoton marnos-siltic, amonitic, indică condiţii tipice neritice (off-shore) de shelf puţin adînc.

Vîrsta formaţiunii a fost stabilită pe baza fosilelor (în special amoniţi) publicate succesiv de Macovei (1911, 1934), Chiriac (1981) şi celor recoltate de autorii lucrării de faţă.

Speciile de amoniţi recunoscute în cuprinsul litofaciesului grezos-nisipos-argilos, glauconitic, arată pentru cea mai mare parte a acestuia vîrsta albiană inferioară, după cum urmează:

— *Leymeriella terdefurcata tardefurcata* (Leym.), *L. tardefurcata densicostata* Spath, *L.* cf. *fusseneggeri* Seitz, *L. elegans* Chiriac (zona *Tardefurcata*); din aceleaşi aflorimente şi asociate uneori în acelaşi strat cu acestea au fost citate şi cîteva specii de *Acanthohoplites* şi de *Hypacanthoplites*: *A. uhligi* (Anth.), *A. aschiltaensis rotundatus* Sinz., *H. milletianus* (d'Orb.), *H. trivialis* Br., *H.* aff. *simsi* (Forbes) aff. *milletioides* Casey, *H. turgidus* Chiriac — de regulă specimene fragmentare de talie relativ mare a căror identificare specifică sigură este împiedicată de lipsa turelor interne, dar care prin frecvenţa lor relativă lasă deschisă posibilitatea apartenenţei la Clansayesian a bazei formaţiunii.

— *Douvilleiceras mammillatum* (Schl.), *D. monile* (Sow.), *D. inaequicostatum* Chiriac, *Sonneratia rotator* Casey, *S.* cf. *kitchini ovalis* Casey, *Hemisonneratia cantiana* Casey, *Cleoniceras (Neosaynella)* cf. *inornatum* Casey, *Beudanticeras dupinianum* (d'Orb.), *B. ligatum* (New. & Juck.-Br.), *B. arduennense* Br. (zona *Mammillatum*).

— *Anahoplites* cf. *intermedius* Spath, *A.* cf. *mantelli* Spath, *A.* cf. *praecox* Spath recoltate de la partea superioară a faciesului grezos-nisipos (sublitofacies predominant grezos, dezvoltat local pe valea Peştera) indicînd Albianul mediu (zona *Loricatus*, subzona *Intermedius*).

Litofaciesul intens fosfatic, condensat, conţine o faună amestecată aparţinînd întregului interval cuprins între zona *Loricatus*, subzona *Intermedius* a Albianului mediu şi subzona *Inflatus* a Albianului superior: *Anahoplites praecox*, *Epihoplites compressus* (Parona & Bonarelli), *Hysteroceras varicosum* (d'Orb.), *Mortoniceras* cf. *inflatum* (Sow.) etc.

În aproape întreaga arie de apariţie la zi, succesiunea formaţiunii de Cochirleni se încheie în Albianul inferior. Depozite mai noi ale formaţiunii apar numai în valea Cochirleni-Peştera, la NV de Ivrinezu Mic, unde succesiunea pare să se încheie cu subzona *Intermedius* din zona *Loricatus* (Albian mediu). În sfîrşit, de la acest nivel pînă în Vraconian se pare că au existat numai condiţii de acumulare în regim condensat de tipul celui de la Seimenii Mari — cel puţin în partea mediană şi septentrională a Dobrogei de sud.

În extremitatea meridională a Dobrogei de sud, de la nisipurile glauconitice ale Albianului inferior se trece la faciesul marnos-siltic, bogat fosilifer, al Albianului mediu şi superior. Acest facies aflorează în malul lacului Bugeac, unde asociaţia de amoniţi cuprinde numeroase exemplare de *Anahoplites* ex gr. *intermedius*; el a fost întîlnit, de asemenea, în forajul din dealul Ghioclemeş, lîngă Văleni (fide Chiriac, 1981).

B. Cretacicul superior

1. *Formaţiunea de Peştera (Cenomanian inferior)*

Formaţiunea de Peştera este alcătuită în ansamblu dintr-un pachet inferior de nisipuri şi gresii cuarţoase (local cuarţoase-glauconitice) grosiere, cu lentile de pietrişuri, şi un pachet superior de crete glauconitice mai mult sau mai puţin grezoase. În toate sectoarele de aflorare a formaţiunii se remarcă existenţa unui nivel de conglomerat bazal, cu grosime variabilă. La partea terminală a formaţiunii, peste creta glauconitică apar nisipuri şi gresii cretoase. Trecerea de la nisipurile şi gresiile inferioare la succesiunea superioară cretoasă se face prin intermediul unor gresii cuarţo-glauconitice cretoase, slab cimentate. Considerînd ponderea nisipurilor şi gresiilor în raport cu cea a cretelor, în cadrul formaţiunii se pot deosebi o succesiune litologică de tip Peştera, unde nisipurile şi gresiile ating grosimi pînă la 25 m, şi o succesiune de tip Ivrinezu, dominată net de pachetul cretos, cu grosimi de 15—20 m. Grosimea maximă a întregii formaţiuni nu depăşeşte 40 m.

Secţiunea-tip a formaţiunii de Peştera este oferită de versanţii văii Peştera-Cochirleni, între localităţile Peştera şi Ivrinezu Mic, în care se pot observa toţi termenii şi toate variaţiile litofaciale din cadrul ei. Către nord de acest sector depozitele formaţiunii apar la zi pînă la linia Dunărea-Cuza Vodă, iar către est pînă la aliniamentul Medgidia-Negreşti.

Formaţiunea de Peştera cuprinde cinci termeni litologici distincţi, cu grosimi extrem de variabile de la o secţiune (sau sector) la alta : (a) un conglomerat bazal subţire (pluridecimetric); (b) un pachet inferior de nisipuri, gresii şi, subordonat, pietrişuri cuarţoase la cuarţoase-moderat glauconitice, perfect spălate (2—25 m grosime); (c) un pachet intermediar de gresii glauconitice cretoase (1—3 m grosime); (d) un pachet superior de cretă, mai mult sau mai puţin glauconitică-slab grezoasă (1—15 m grosime); şi (e) un pachet terminal de gresii cretoase, conservat cu totul local (5— —10 m grosime). Cele două regimuri litologice sub care apare această formaţiune — succesiunile de tip Peştera şi cele de tip Ivrinezu — subliniază tocmai variaţiile în grosime ale termenilor componenţi menţionaţi mai sus, succesiunile de tip Peştera constînd în termenii a-b-c-d-e, iar cele de tip Ivrinezu, din termenii a-c-d-e.

(a) Conglomeratul bazal, cuarţos fosfatic, este lipsit de structuri sedimentare particulare, este perfect spălat (fără matrice pelito-siltică), matur (cuarţos-detritofosfatic), slab sortat (matrice grezoasă grosieră, de asemenea slab sortată) şi ilustrează un caz tipic de transgression lag (=termen bazal condensat, grosier, de transgresiune). El conţine numeroase fosile fosfatizate, dintre care cele aparţinînd zonei cu *Stoliczkaya dispar* a Vraconianului sînt cu siguranţă resedimentate. În succesiunile în care deasupra conglomeratului bazal se dezvoltă depozite de tip Ivrinezu au fost identificate la partea superioară a acestuia fosile in situ aparţinînd Cenomanianului bazal, între care : *Mantelliceras mantelli* (Sow.), *M. cantianum* Spath, *Neostlingoceras carcitanense* (Mth.), *Mariella cenomanense* (Schl.), *Hypoturrilites tuberculatus* (Bose) etc.

(b) Nisipurile şi gresiile cuarţoase, relativ grosiere, cu lentile de pietrişuri, ajung la maximum 25 m lîngă localitatea Peştera şi la vest de Medgidia şi lipsesc complet în succesiunile din dealurile Ivrinezu, Amzalia şi Sarapciculac. Ele sînt moderat glauconitice şi prezintă stratificaţie de tip încrucişat tabular la unghi redus şi, subordonat, de tip paralel sau de tip încrucişat concav, ceea ce demonstrează sedimentare în condiţii de plajă de tip beach berm la beach face, ilustrînd un facies de tip barrier island (cordoane litorale).

(c) Pachetul de gresii glauconitice cretoase, de tranziţie de la conglomeratul bazal sau de la pachetul de nisipuri şi gresii către cretă şi gresiile cretoase glauconitice, prezintă abundente texturi de bioturbare de tip mottling (amestec de sediment) şi rare structuri mecanice laminare paralele şi dovedeşte o sedimentare de tip shore face (sublitorală). El cuprinde cea mai mare parte a faunei cenomaniene din regiune, între care speciile de cefalopode : *Mantelliceras mantelli*, *M. cantianum*, *M. saxbii* (Sharpe), *M. couloni* (d'Orb.), *M. picteti* (Hyatt), *M.* aff. *dixoni* Spath, *Neostlingoceras carcitanense*, *Hypoturrilites gravesianus* (d'Orb.), *H. mantelli* (Sharpe), *Mariella cenomanense*, *Hyphoplites* spp., *Stoliczkaya (Lamnayella) sanctaecatherinae* Wright & Kennedy etc.

(d) Pachetul de cretă mai mult sau mai puţin glauconitică-argiloasă, cu grosime variabilă datorită (probabil) eroziunii, este intens bioturbat, de la subtotal (textură tip mottling) la total (textură masivă de omogenizare totală biogenă), sugerînd condiţii tipice de larg (off-shore). El conţine macrofosile relativ rare şi rău păstrate, între care specimene de *Mantelliceras* aparţinînd speciilor menţionate mai sus, inocerami *(I. crippsi* Mantell, *I. virgatus Schlüt.)*, echinide etc.

(e) Ultimul termen al formaţiunii de Peştera, conservat local în arealul localităţii Peştera, cuprinde nisipuri şi gresii cretoase puternic bioturbate, indicînd menţinerea condiţiilor de tip off-shore; el este bine vizibil pe versantul sudic al văii Peştera-Cochirleni între localităţile Peştera-Ivrinezu Mic, precum şi la Remus Opreanu (aici fiind mai cretos şi mai intens bioturbat). În acest pachet nu s-a găsit pînă în prezent macrofaună.

În ansamblu, evoluţia verticală facială notată în cadrul formaţiunii de Peştera oferă un exemplu de retrogradare facială, în cadrul căreia faciesurile costale sînt substituite ascendent prin faciesuri de larg.

Precizarea vîrstei formaţiunii de Peştera se datorează autorilor Macovei (1911), Macovei, Atanasiu (1934), Simionescu (1944), Chiriac (1956, 1963, 1981) şi, de asemenea, autorilor lucrării de faţă pe baza speciilor de cefalopode citate mai sus şi a numeroase specii de foraminfere bentonice şi planctonice.

Analizînd întreaga asociaţie de fosile recunoscută în formaţiunea de Peştera se constată că majoritatea covîrşitoare a genurilor şi speciilor de amoniţi este strict localizată în Cenomanianul inferior. Mai mult, prezenţa părţii terminale a Cenomanianului inferior poate fi apreciată doar pe baza unor specimene de *Mantelliceras* apropiate de *M. dixoni* Spath (*M.* aff. *dixoni* — in Szasz, 1983) şi de *Turrilites costatus* Lamk, care este citat în Anglia începînd cu partea superioară a Cenomanianului inferior; prezenţa în regiune a unor argumente pentru existenţa Cenomanianului mediu în cuprinsul formaţiunii — fide Chiriac, 1981 — este discutabilă, acestea fiind fie specii indicatoare pentru un interval mai larg, care începe în Cenomanianul inferior (*Turrilites costatus*), fie taxoni nou propuşi, deci cu valoare cronostratigrafică încă de precizat (*T. acutus sharpei* Chiriac), fie specimene determinate eronat sau nesigur în loc. În ceea ce priveşte microfauna, întreaga asociaţie de foraminifere planctonice aparţine Cenomanianului inferior, respectiv zonei cu *Thalmaninella appenninica* şi *Th. brotzeni*; lipsa totală din această asociaţie a speciilor *Th. reicheli* şi *Th. monsalvensis* pune sub semn de întrebare prezenţa chiar a părţii terminale a Cenomanianului inferior.

2. *Formaţiunea de Cuza Vodă (Turonian, mediu?)*

Această formaţiune aflorează în prezent numai într-o carieră situată la est de localitatea Cuza Vodă, în versantul stîng al văii Agicabul, unde se aşterne discordant peste gresiile cuarţoase cenomaniene ale formaţiunii de Peştera şi suportă, de asemenea discordant, depozitele santoniene ale formaţiunii de Murfatlar.

Pachetul de strate atribuit formaţiunii de Cuza Vodă, gros de cel mult 10 m, este alcătuit dintr-un nivel bazal subţire (cca 40 cm) de conglomerat grezos slab cimentat, cu galeţi de cuarţite şi faună fosfatizată albian superioară remaniată, de la care se trece treptat la nisipuri şi (micro)pietrişuri cuarţoase, mai mult sau mai puţin cimentate, masive (nestratificate-nestructurate), slab spălate (siltice la silto-pelitice), bogate în faună vraconiană fosfatizată remaniată (la partea superioară) şi puternic cimentate neregulat-reticular în partea mediană, pe o grosime de cca 3 m; pachetul median cimentat constă în gresii şi microconglomerate cuarţoase dezvoltate reticular (reţele suprapuse/împletite de burrow fills anastomozate) incluzînd ochiuri largi şi neregulate de nisip şi pietriş siltic necimentat şi conţinînd, pe toată grosimea sa, numeroase exemplare de echinide in situ aparţinînd genului *Conulus*, între care : *C. subrotundus* Mantell, *C. sphaeroidalis* d'Arch., *C. rhotomagensis elevatus* Chiriac, *C. nucula* Gras etc. Acest pachet constituie singurul nivel cu faună proprie, turoniană, al formaţiunii. Asociaţia de echinide citată mai sus indică în ansamblu vîrsta turoniană.

Prezenţa exclusivă a echinidelor (limitate numai la pachetul median, cimentat), absenţa oricăror alte elemente macro- sau micropaleontologice, caracterul masiv al întregii succesiuni, granulaţia grosieră (psamito-psefitică) alături de omniprezenţa matricei siltice la silto-pelitice cu excepţia pachetului median de gresii şi conglomerate dezvoltate reticular (bine spălate şi intens bioturbate, demonstrînd o intensă biofiltrare însoţită de extragerea matricei fin granulare, ceea ce a permis şi apariţia procesului de cimentare), absenţa structurilor mecanice (prezente eventual doar prin vagi laminaţii paralele cantonate în partea mediană, intens bioturbată, grezo-conglomeratico-nisipoasă a succesiunii), toate aceste elemente constituie argumente pentru o sedimentare marină, pe de o parte costală, dar pe de altă parte în mediu protejat, deci fie de tip lower shoreface, fie de tip lagunar nerestrictiv.

3. *Formaţiunea de Murfatlar (Santonian-Campanian inferior)*

Formaţiunea de Murfatlar cuprinde un pachet de depozite formate predominant din cretă albă, avînd la partea inferioară în mod aproape constant un facies nisipos-grezos-cretos relativ subţire, ce debutează printr-un conglomerat bazal pluridecimetric ce remaniază faune şi fragmente litologice din formaţiunile subjacente; grosimea depozitelor sale deschise la zi nu depăşeşte 40 m, din care nisipurilor din partea sa inferioară (inclusiv conglomeratul bazal) le revin cca 4—6 m.

Caracterul transgresiv al formaţiunii de Murfatlar este foarte evident, ea aşternîndu-se peste depozite jurasice (la Ovidiu), necomiene (la Poarta Albă şi, probabil, la Lespezi), apţiene (la Castelu şi Valea Adîncă), albiene (la nord de Cuza Vodă), cenomaniene (la sud de Satu Nou şi, probabil, în sectoul Lespezi-Dobromiru) şi turoniene (la Cuza Vodă). La rîndul lor, depozitele formaţiunii suportă depozite de vîrstă diferită, de la Eocen inferior pînă la Cuaternar.

Depozitele formaţiunii se întîlnesc la zi la est de aliniamentul Satu Nou-Peştera-Dobromiru, cu dezvoltare maximă în versantul sudic al văii Carasú între localităţile Basarabi (anterior Murfatlar) şi Castelu, unde a fost stabiiit şi profilul-tip.

Succesiunea litologică completă a formaţiunii de Murfatlar implică trei termeni litostratigrafici succesivi, primii doi prezentînd largi variaţii compoziţionale, texturale-structurale şi de grosime de la o secţiune la alta :

(a) conglomerat (sau gresie/nisip conglomeratic) bazal, resedimentînd mult material din substratul regional, bine sortat mineralogic (granule/galeţi de cuarţ/cuarţite, galeţi de fosfaţi biodetritici, faună resedimentată), dar slab sortat granulometric, deşi, de regulă, bine spălat (rareori matrice cretoasă-glauconitică de natură autohtonă), reprezentînd, ca şi în cazul conglomeratului cenomanian, termenul condensat de instalare a sedimentării marine (0—80 cm grosime); fauna sa constă în fragmente de fosile fosfatizate remaniate din Albian, exemplare numeroase de *Conulus* resedimentate din Turonian şi, mai rar, brahiopode şi inocerami;

(b) pachet intermediar de gresii/nisipuri cuarţo-glauconitice-cretoase la crete coarţoase-glauconitice mai mult sau mai puţin friabile, de regulă masive (nestructurate intern), local cu laminaţii paralele subcentimetrice sau intens bioturbate (1—4 m grosime); pe lîngă fragmente remaniate de inocerami, succesiunea conţine o faună proprie relativ bogată, alcătuită mai ales din echinide: *Echinocorys vulgaris* Brey., *E. vulgaris striata* Lamk, *E. marginatus* Goldf., *Conulus conicus* Brey., *C. subconicus* d'Orb., *C. oblongus* d'Orb., *Micratser coranguinum* Klein etc. (cf. Macovei, 1911; Macovei, Atanasiu, 1934; Chiriac, 1956);

(c) cretă albă, masivă, omogenă la bioturbată (mottled), reprezentînd nannomîluri coccolitice-foraminiferice, local bogat macrofosiliferă, pe alocuri glauconitică (de regulă spre partea inferioară) şi conţinînd zone cu silicifieri neregulat ramificate, disperse (majoritatea silicifierilor reprezentînd forme burrow fills şi indicînd o activitate bioturbantă excesiv de intensă local) (grosime maximă de 20—30 m în sectoarele menajate de eroziunea postcampaniană; macrofauna întîlnită în crete este reprezentată prin inocerami (*Inoceramus (Cordiceramus) mülleri recklingensis* Seitz, *I. (C.)* ex gr. *platycephalus* Sornay, *I. mülleri* Petr. ssp ind. etc), echinide (*Offaster pilula* Desor, *Izomicraster* cf. *stolleyi* Lambert şi *Spatangoides striatoradiatus* Leske — fide Macovei, Atanasiu, 1934, Chiriac, 1956), brahiopode (*Crania craniolaris* Linné, *C. antique* (Defr.), *Cyclothyris samodurovi* Makr. & Kalz, *Neolithyrina obesa* Sahni, *Gibbithyris gibba* Sahni, *Carneithyris carnea* Sow. etc.), belemniţi (*Belemnitella mucronata* Jeletzky), spongieri silicioşi etc.; microfauna este reprezentată în secţiunea-tip prin foraminifere bentonice calcaroase, foarte numeroase şi foraminifere planctonice formînd o asociaţie inferioară cu *Dicarinella concavata concavata* (Dalb.), *Marginotruncana pseudolineiana* Pessagno, *M. coronata* (Bolli), *M. sigali* (Reichel), *Arhaeglobigerina cretacea* (d'Orb.), *Globotruncana bulloides* Vog. şi o asociaţie superioară cu *Globotruncanita elevata* Brotz, *Marginotruncana renzi* (Gand.), *M. angusticarinata* (Gand.), *Dicarinella* cf. *indica* (Jak. & Satry), *Globotruncana bulloides*, *Arhaeglobigerina cretacea*.

Vîrsta santoniană a termenului b din cuprinsul formaţiunii a fost stabilită de Chiriac (1956, 1964, 1981) pe baza faunei de echinide pe care acesta o cuprinde. De asemenea, jumătatea inferioară a pachetului de crete care aflorează între Valu lui Traian şi Castelu, în profilul tip, este de vîrstă santonian superioară pe baza unor specii de inocerami şi a microfaunei care aparţine părţii superioare a zonei cu *Dicarinella concavata carinata*. Numai ultimii 10—12 m din totalul de cca 30 m ai cretelor aparţin în profilul-tip Campanianului inferior (zona cu *Globotruncanita elevata)*, în alte sectoare (sud de Satu Nou, Dobromiru) putîndu-se admite cel mult şi prezenţa părţii bazale a Campanianului mediu (=partea bazală a zonei cu *Globotruncana ventricosa)*.

În ansamblu, succesiunea indică o evoluţie facială de la un termen de tip transgression lag (a), printr-un termen indicînd condiţii de near-shore de tip lower shoreface (condiţii subcostale) (b), la o sedimentare neritico-pelagică (off-shore) în condiţii de tip mare epeirică superficială (shallow epeiric sea), însoţite de o explozie intensă de nannoplancton alături de care prosperau foraminiferele calcaroase planctonice şi bentonice şi organismele infaunale bioturbante (c). Masa principală a depozitelor formaţiunii de Murfatlar (creta), reprezentînd shallow epeiric pelagites, ilustrează de altfel condiţiile depoziţionale tipice pentru acest interval de timp în întreaga Europă cisalpină.

EXPLANATION OF PLATES

Plate III

Fig. 1 a, b — *Karakaschiceras* cf. *biassalense* (Kar.). ×1/2. Danube cliff by the Cernavoda bridge. Cernavoda Formation (Allmanu Member), Middle Valanginian.

Fig. 2 — *Ammocycloloculina erratica* (Jack. & Favr.). × 1. Southern slope of the Carasu valley, 1 km west of Medgidia. Upper Berriasian; Cernavoda Formation (Medgidia Member).

Fig. 3 a, b — *Hemisonneratia cantiana* Casey. × 1. Quarry in the right slope at the Remus Opreanu valley mouth. Lower Albian (*Mammillatum* Zone), Cochirleni Formation.

Fig. 4 a-c — *Leymeriella* cf. *fusseneggeri* Seitz. × 1. Danube cliff beneath Axiopolis fortress. Lower Albian, Cochirleni Formation.

Fig. 5 a, *b* — *Hysteroceras varicosum* (Sow.). × 1. Seimenii Mari. Upper Albian, Cochirleni Formation.

Fig. 6 — *Leymeriella tardefurcata* (Leym.). × 1. Left slope of the Docuzol valley. Basal term of the Cochirleni Formation, Lower Albian.

Plate IV

Fig. 1 a, b — *Cleoniceras (Neosaynella)* cf. *inornatum* Casey. Southern border of Purcăreţ lake. Lower Albian *(Mammillatum* Zone), Cochirleni Formation.

Fig. 2 a, b — *Sonneratia rotator* Casey. × 1. Left slope of the Carasu valley, 2.5 km west of Medgidia stadium. Lower Albian *(Mammillatum* Zone), Cochirleni Formation.

Fig. 3 — *Sonneratia* cf. *kitchini ovalis* Casey. Same location as 2.

Fig. 4 a, b — *Anahoplites* cf. *intermedius* Spath. Left slope of the Cochirleni — Peştera valley, 1 km downstream Ivrinezu Mic. Middle Albian (*Intermedius* Subzone), Cochirleni Formation.

Fig. 5 — *Anahoplites* cf. *mantelli* Spath. Same location as 4

Plate V

Fig. 1 a, b — *Beudanticeras dupinianum* (d'Orb.). × 1. Left slope of the Carasu valley, 2.5 km west of Medgidia stadium. Lower Albian *(Mammillatum* Zone), Cochirleni Formation.

Fig. 2 — *Anahoplites* cf. *praecox* Spath. × 1. Left slope of the Cochirleni — Peştera valley, 1 km downstream Ivrinezu Mic. Middle Albian, Cochirleni Formation.

Fig. 3. — *Anahoplites praecox* Spath. × 1. Seimenii Mari. Base of the condensed layer Middle-Upper Albian in age. Cochirleni Formation.

Fig. 4 a, b — *Epihoplites compressus* (Parona & Bonarelli). × 1. Seimenii Mari. Upper Albian, Cochirleni Formation.

Fig. 5 a, b — *Mortoniceras* cf. *inflatum* (Sow.) × 1. Seimenii Mari. Upper Albian, Cochirleni Formation.

Fig. 6 a, b — *Anisoceras* sp. aff. *A. perarmatum* Pict. & Camp. × 1. Seimenii Mari. Reworked into the basal conglomerate of the Peştera Formation.

Plate VI

Fig. 1 a, b — *Mortoniceras (Durnovarites) perinflatum* Spath. × 1. Seimenii Mari. Reworked into the basal conglomerate of the Peştera Formation.

Fig. 2 a, b — *Mantelliceras saxbii* (Sharpe). × 1. Lower Cenomanian (base of the chalky succession, Ivrinezu Mic-type sequence), Ivrinezu Mic, southern slope of the Cochirleni-Peştera valley.

Fig. 3 a, b — *Mantelliceras saxbii* (Sharpe). × 1. Lower Cenomanian. Ostrov (northern slope of the Bugeac lake).

Fig. 4 a, b — *Mantelliceras cantianum* Spath. × 1. Lower Cenomanian, Şipote.

Fig. 5 a, b, c — *Mantelliceras mantelli* (Sow.). × 1. Lower Cenomanian. Toe of Sarapciculac hill (southern slope of Peştera-Cochirleni valley).

Fig. 6 — *Ostlingoceras puzosianum* (d'Orb.). × 1. Uppermost Albian *(Dispar* Zone). Reworked in the Cenomanian basal conglomerate, Amzalia hill.

Fig. 7 — *Mariella taeniata* (Pict. & Camp.). × 1. Base of Lower Cenomanian, Sarapciculac hill (southern slope of Peştera-Cochirleni valley).

Fig. 8 — *Mariella cenomanensis* (Schlüt). × 1. Lower Cenomanian, toe of Sarapciculac hill (southern slope of Peştera-Cochirleni valley).

Fig. 9, 10 — *Hypoturrilites tuberculatus* (Bosc). × 1. Lower Cenomanian, toe of Sarapciculac hill (southern slope of Peştera-Cochirleni valley).

Plate VII

Fig. 1 a, b, c — *Mantelliceras mantelli* (Sow.) × 1. Lower Cenomanian, Amzalia hill (northern slope of Peştera-Cochirleni valley)

Fig. 2, 3 — *Stoliczkaia (Lamnayella) sanctaecaterinae* Wright & Kennedy. × 1. Lower Cenomanian, Şipote.

Fig. 4 a, b — *Mantelliceras cantianum* Spath. × 1. Lower Cenomanian, Şipote.

Fig. 5 a, b — *Mantelliceras cantianum* Spath. × 1. Lower Cenomanian, Amzalia hill.

Fig. 6 a, b — *Mantelliceras couloni* (d'Orb.). × 1. Lower Cenomanian, Amzalia hill.

Fig. 7 — *Mantelliceras picteti* Hyatt. × 1. Lower Cenomanian. West of Medgidia (southern slope of Carasu valley) (Macovei coll.).

Fig. 8 *a, b*, 9 a b — *Neostlingoceras carcitanense* (Math.). × 1. Lower Cenomanian, Amzalia hill.

Plate VIIII

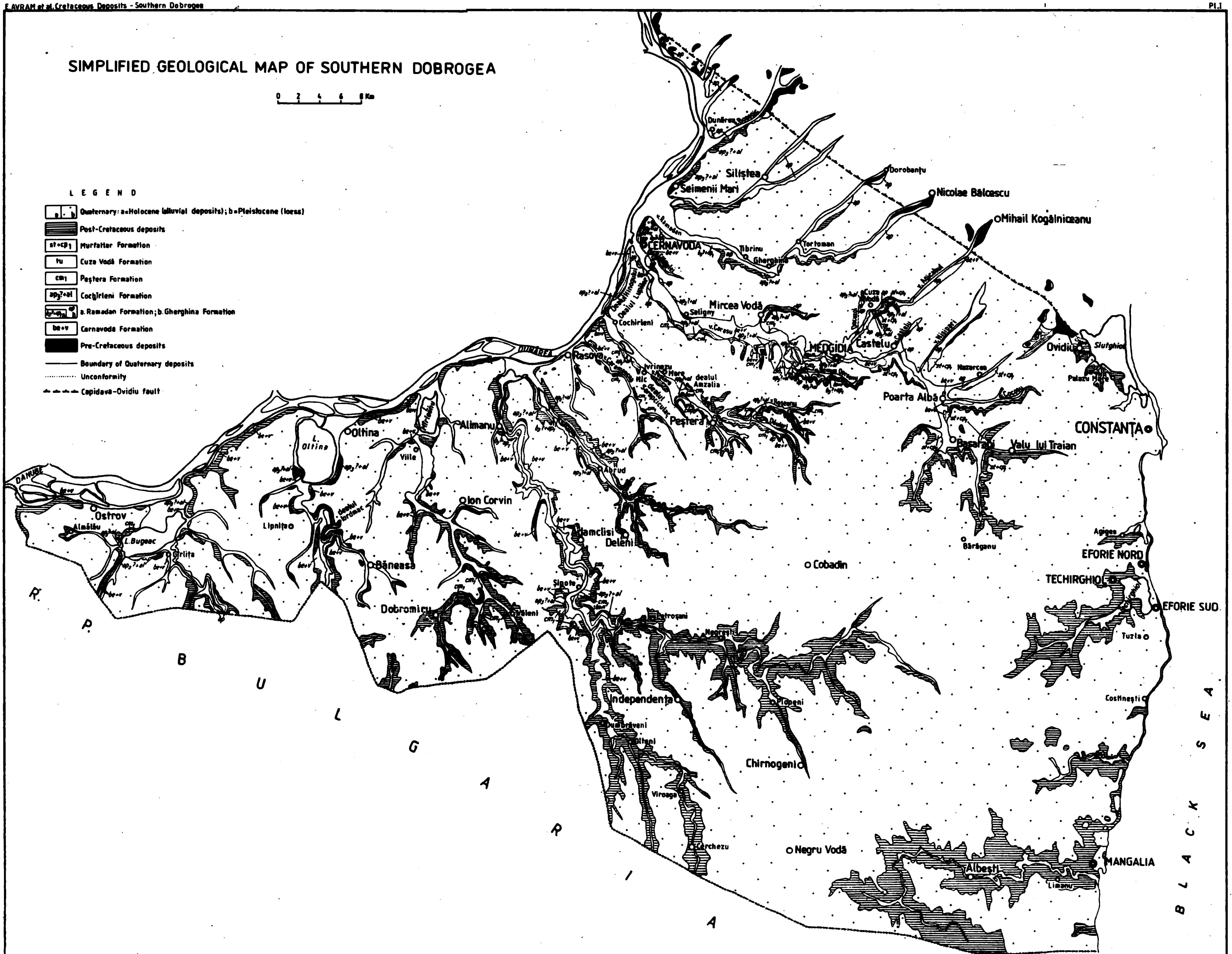
Fig. 1 — *Mantelliceras picteti* Hyatt. × 2/3. Lower Cenomanian. West of Medgidia (southern slope of Carasu valley).

Fig. 2 — *Inoceramus (Cordiceramus) mülleri recklingensis* Seitz. × 2/3. Upper Santonian-Lowermost Campanian, southern slope of Carasu valley, off the Dorobanţu railway station.

Fig. 4 — *Inoceramus (Cordiceramus)* ex gr. *platycephalus* Sornay. × 2/3. Upper Santonian-Lowermost Campanian. Basarabi, wall of the Danube-Black Sea channel.

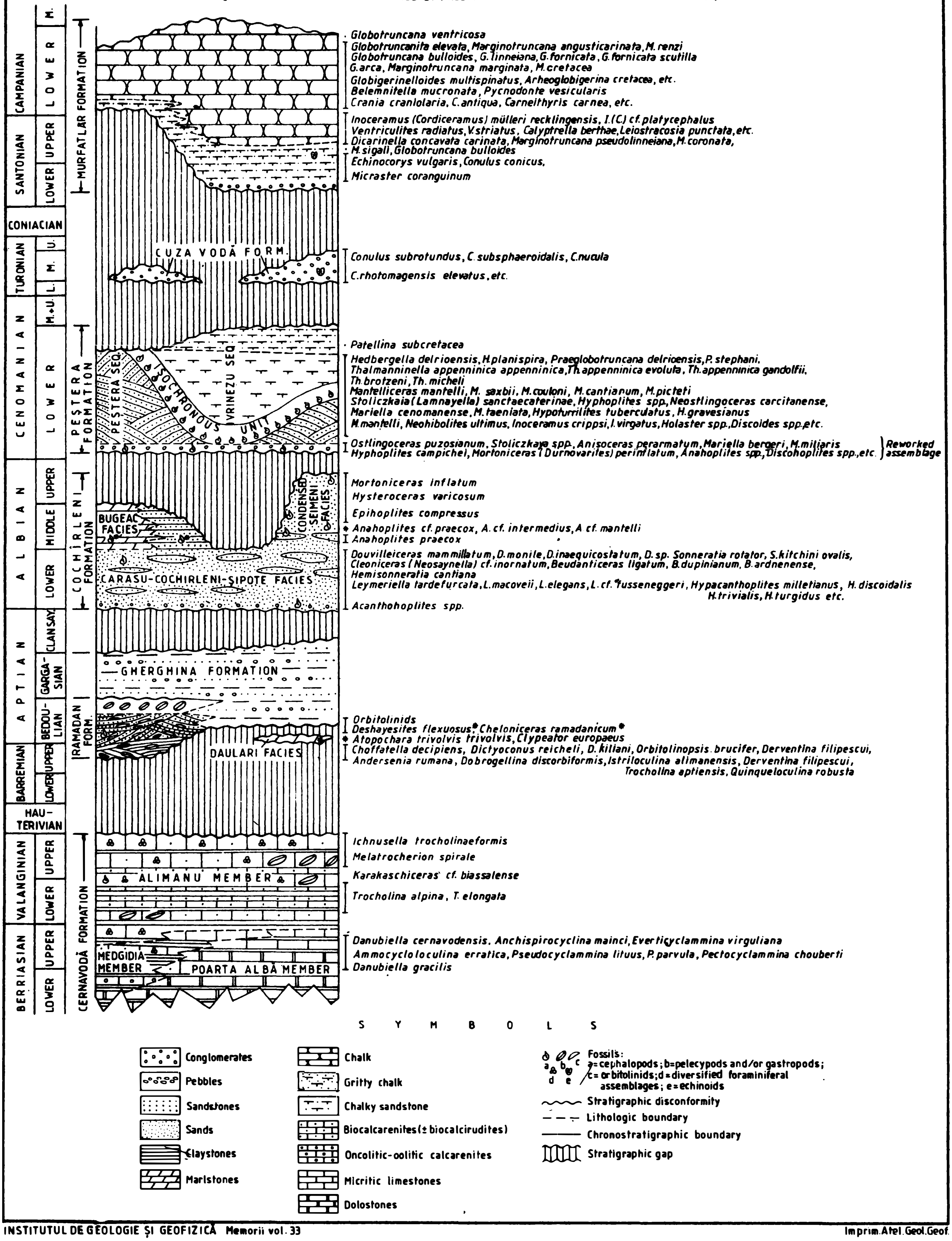
Fig. 5 — *Mantelliceras saxbii* (Sharpe). × 1. Lower Cenomanian, Amzalia hill.

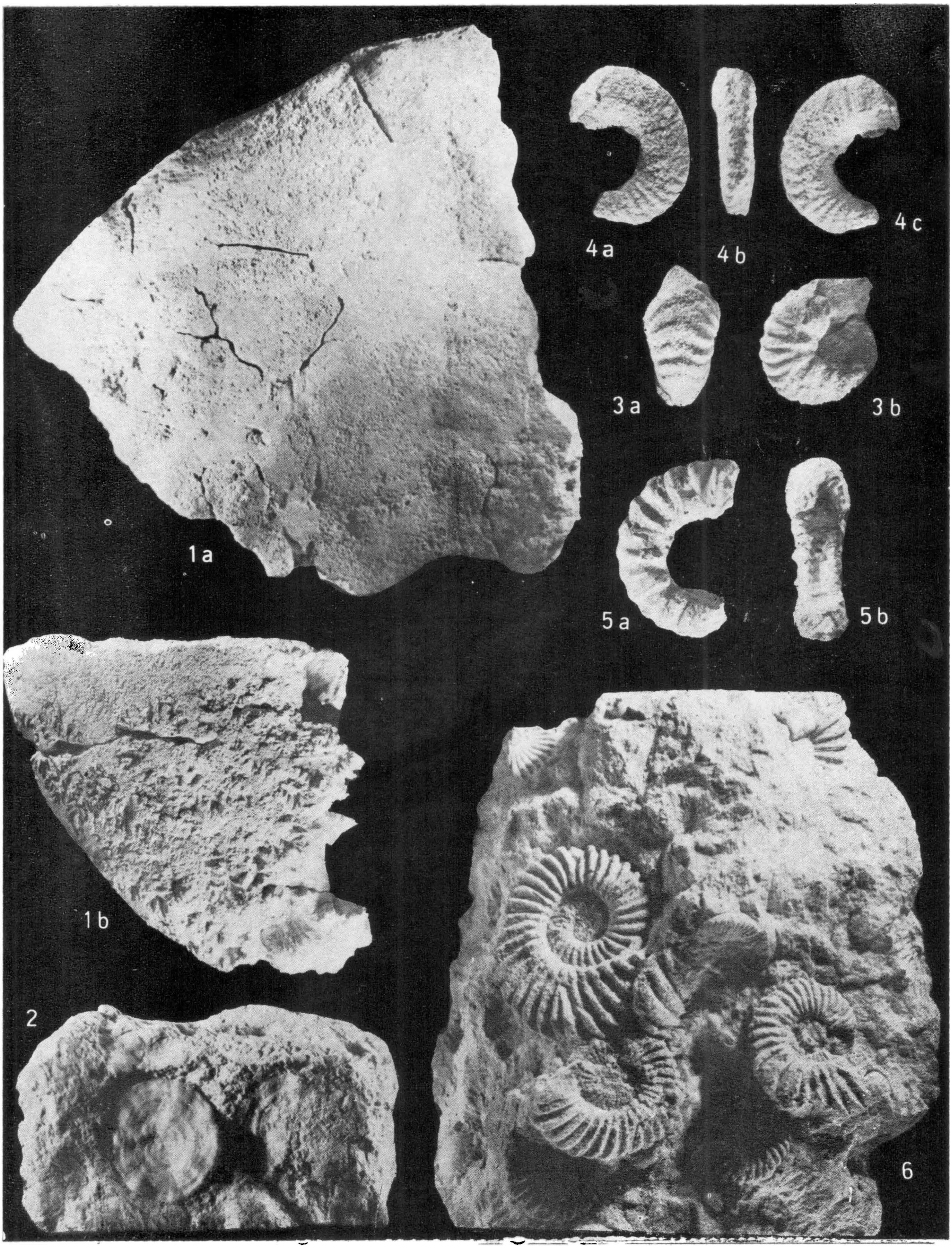
Fig. 6 a, b — *Mantelliceras saxbii* (Sharpe). × 1. Lower Cenomanian, Şipote.


SIMPLIFIED GEOLOGICAL MAP OF SOUTHERN DOBROGEA
0 2 4 6 8 Km
LEGEND
Quaternary: a=Holocene (alluvial deposits); b=Pleistocene (loess)
Post-Cretaceous deposits
st+cp1 Murfatlar Formation
tu Cuza Vodă Formation
cm1 Peştera Formation
ap2?+al Cochirleni Formation
a. Ramadan Formation; b. Gherghina Formation
be+v Cernavoda Formation
Pre-Cretaceous deposits
Boundary of Quaternary deposits
Unconformity
Capidava-Ovidiu fault
DUNĂREA
DANUBE
Dunărea veche
Siliştea
Seimenii Mari
Dorobanţu
Nicolae Bălcescu
Mihail Kogălniceanu
CERNAVODĂ
Tibrinu
Tortoman
Gherghina
Mircea Vodă
Saligny
Cochirleni
MEDGIDIA
Castelu
Nazarcea
Ovidiu
Siutghiol
Palazu Mare
Rasova
Ivrinezu
Amzalia
Peştera
Poarta Albă
CONSTANŢA
Basarabi
Valu lui Traian
L. Oltina
Oltina
Aliman
Abrud
Ion Corvin
Ostrov
Almălău
L. Bugeac
Lipniţa
Băneasa
Adamclisi
Deleni
Cobadin
Agigea
EFORIE NORD
TECHIRGHIOL
EFORIE SUD
Tuzla
Dobromiru
Sipote
Petroşani
Negreşti
Independenţa
Plopeni
Costineşti
Dumbrăveni
Chirnogeni
Viroaga
Negru Vodă
Albeşti
Limanu
MANGALIA
Cerchezu
R. P. BULGARIA
BLACK SEA

GENERAL STRATIGRAPHICAL COLUMN OF THE EXPOSED CRETACEOUS SEQUENCES IN SOUTHERN DOBROGEA

CHARACTERISTIC FOSSILS IDENTIFIED BY PRESENT AUTHORS (EXCEPT: * = FIDE CHIRIAC 1981)

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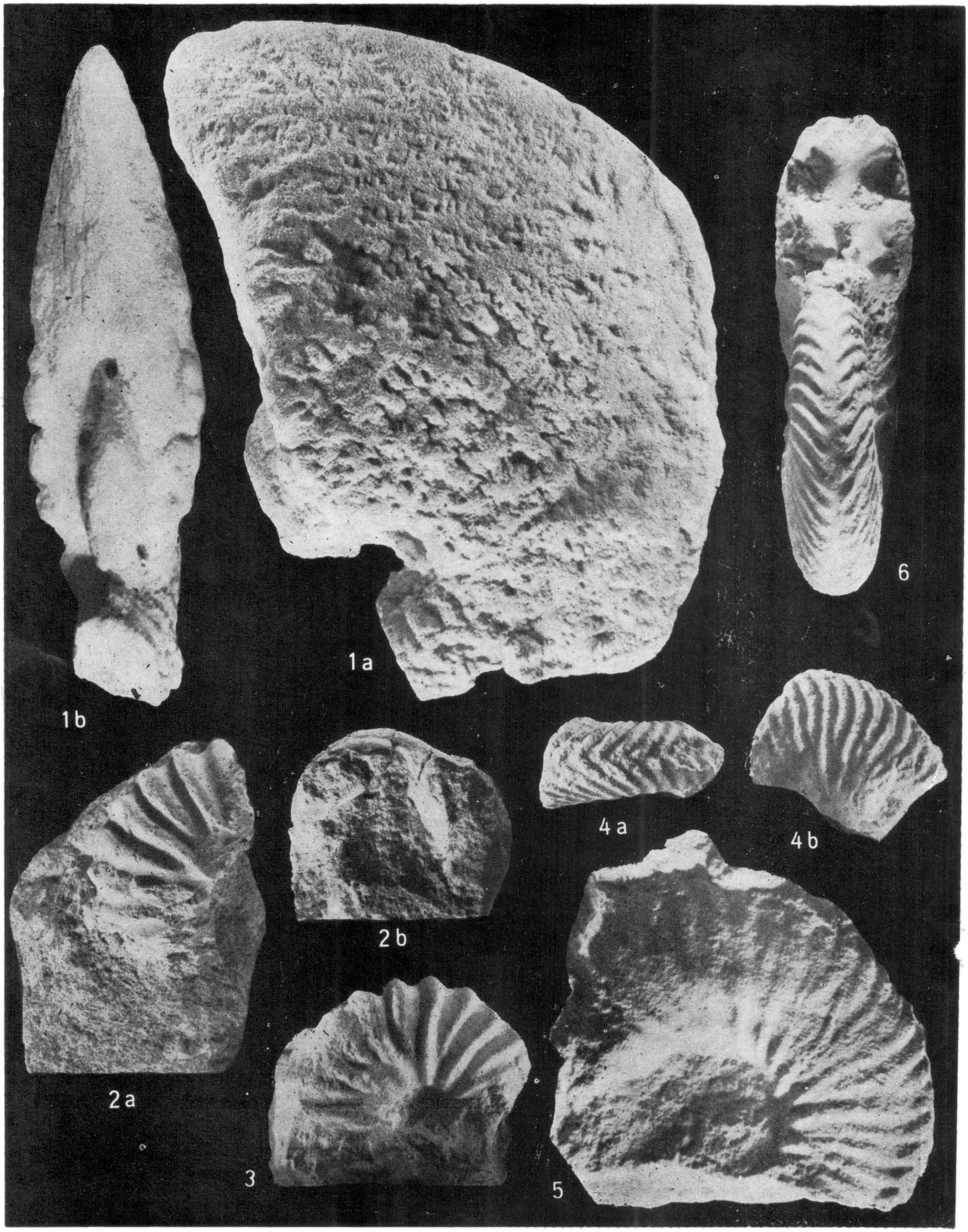
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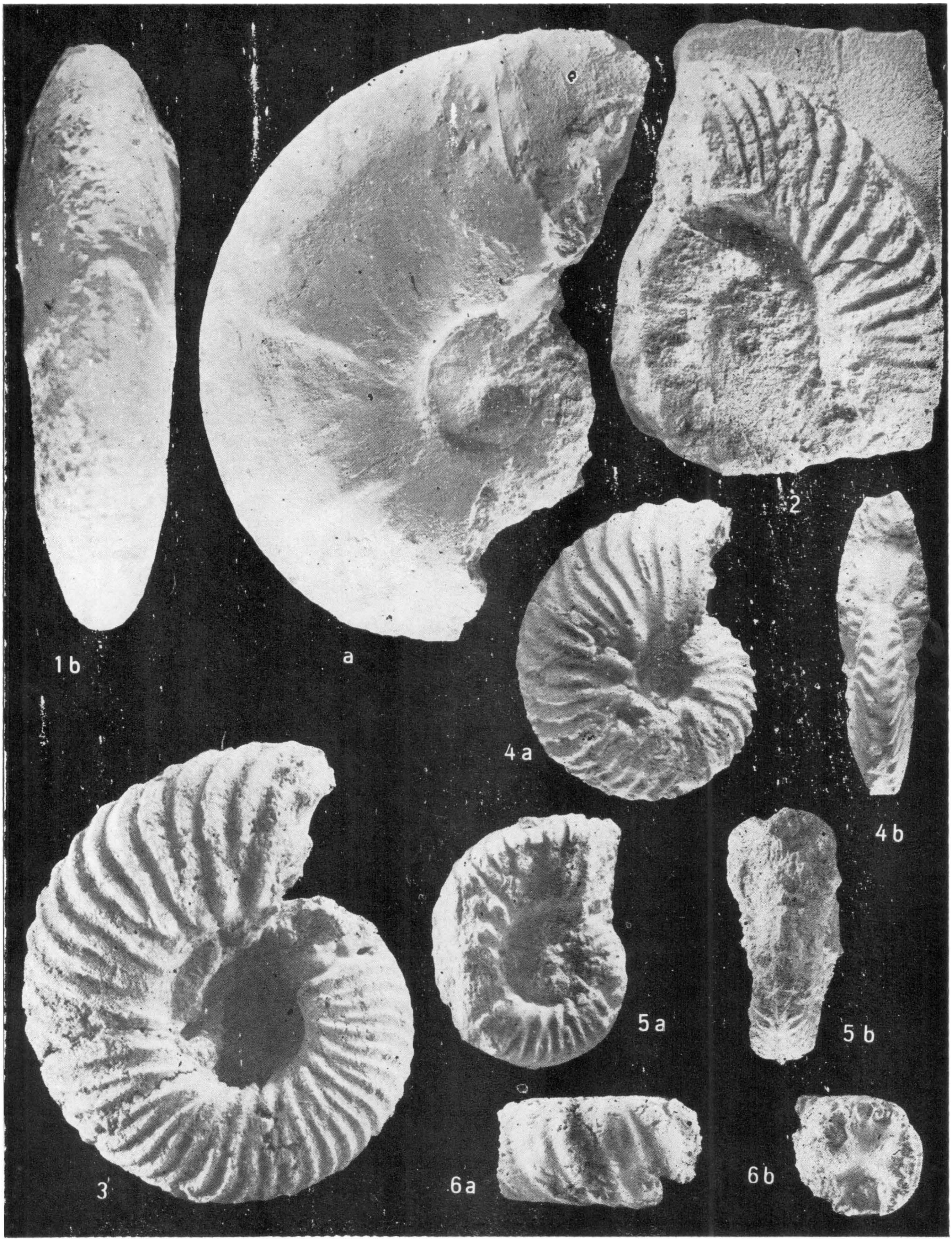
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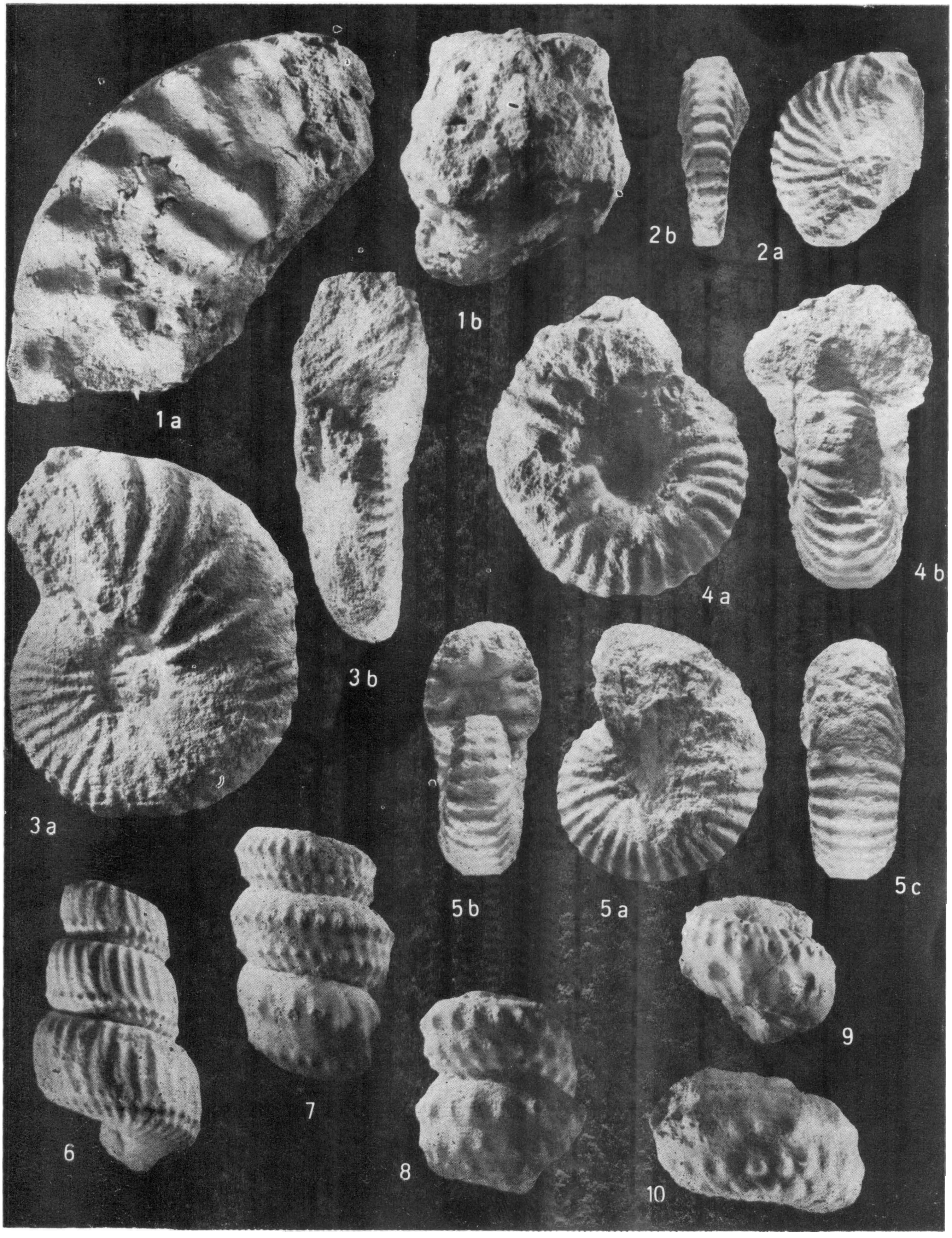
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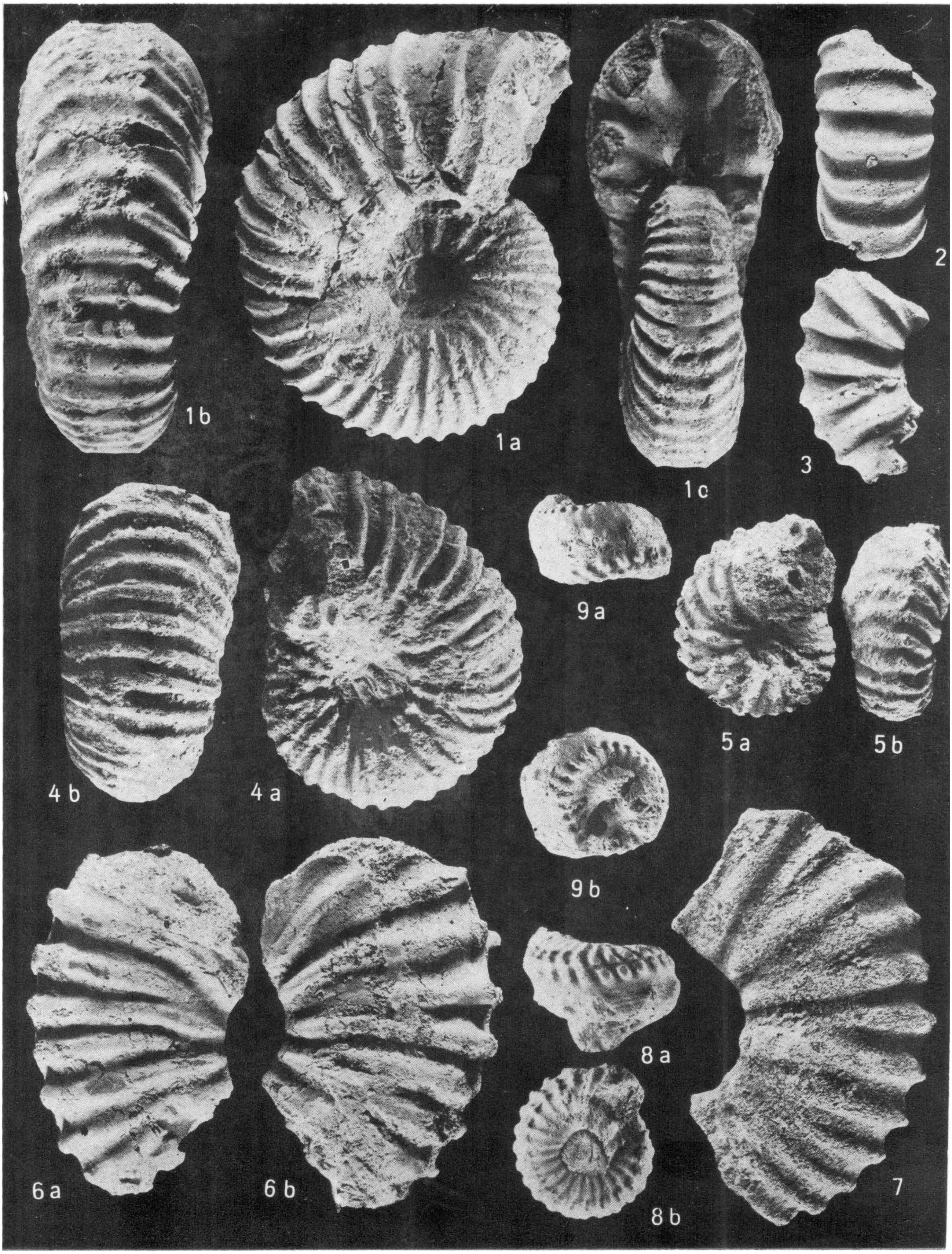
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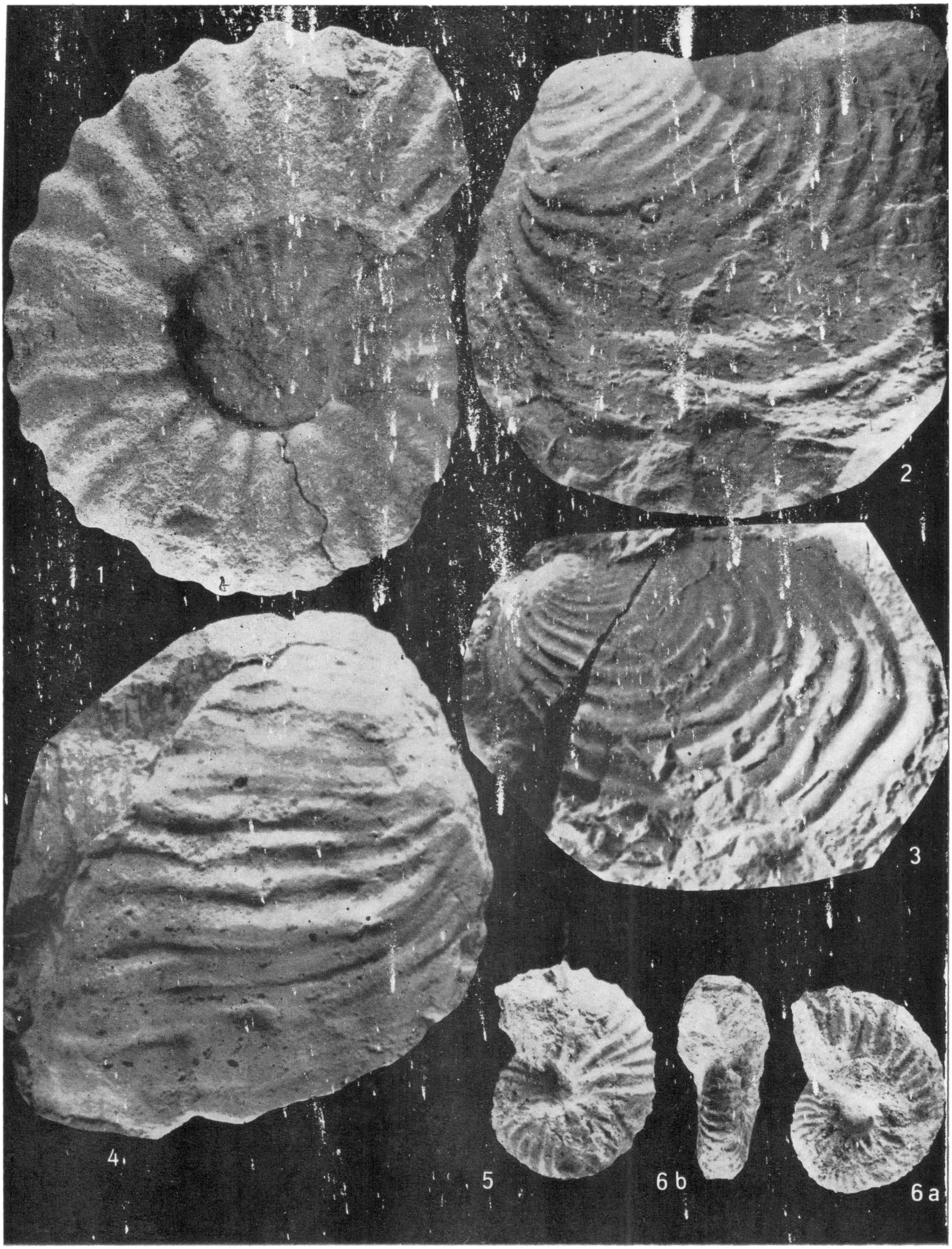
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