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LITHOSTRATIGRAPHY OF CYCLIC CONTINENTAL TO MARINE EOCENE DEPOSITS IN NW TRANSYLVANIA, ROMANIA

BY

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ABSTRACT

Two sedimentary cycles, deposited on the NW Transylvania shelf, have been recognized in the Eocene-Middle Oligocene interval. Each cycle displays a remarkable similarity and consists of red-bed deposits followed by gypsum-evaporites and capped by shallow water, normal marine sediments.

This paper describes the facies variation, cyclicity and genesis of the Eocene-Middle Oligocene formations in three distinct sedimentary areas, taking into consideration the stratigraphic relationships and interpreting the latest advances in the paleontological research of the study area. Finally, an unitary correlation scheme (Fig. 3) and biozonation chart (Fig. 19) was proposed, providing a reliable basis for correlations with other European Paleogene basins.

This paper describes the lithostratigraphy of the Eocene-early Oligocene deposits of NW Transylvania, the largest shallow-water sedimentary area in Romania during that time, and forms part of a larger study recently submitted (Popescu 1979) as PhD thesis.

The correlation of the lithostratigraphic units, their facies description and development (Fig. 2) are presented in the following. The petrology and paleogeography of the evaporite and carbonate sequences will be presented in a forthcoming paper (in preparation).

The broad lithostratigraphic description of the sedimentary evolution as well as the columns attached to this paper are believed to be for the most part self-explanatory and each reader may integrate and/or alter this interpretation of the geological history of the Transylvania basin.

The paleontological content of the Eocene stratigraphic units (Fig. 19) has been described by numerous authors, such as–more recently–Meszaros (1957),

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Tatarim (1963), Bombita (1963), Olteanu, Popescu (1973), Popescu *et al.* (1978), Iva, Rusu (1982), Gheţa (in print). Syntheses of the basin's Cenozoic stratigraphy are provided by the authors mentioned below.

PREVIOUS WORKS

For some two hundred years, a number of Austrian, Hungarian and Romanian geologists have intensively surveyed the Paleogene of NW Transylvania. A first, important synthesis was published by Hauer and Stache in 1863 and was followed by the major contributions of Hofmann (1879) and Koch (1894). After the Second World War, Raileanu and Saulea (1956), Dumitrescu (1957), Joja (1956) resumed the mapping of NW Transylvania and the re-interpretation of the previously acquired data.

Recent monographs on the Oligocene (Moisescu 1975, Rusu 1977) and a number of other papers considerably increased the knowledge on the stratigraphy, paleontology and basin evolution during the Paleogene.

GEOGRAPHIC AND GEOLOGIC SETTING

The Transylvania intramountain depression is roughly located in the central, northwest part of Romania. The Carpathian folded arch encompasses the tabular Transylvania plateau which, as a whole, corresponds to the present Transylvania basin. It is however noteworthy that the Transylvania basin, as known in the geological literature, started its sedimentary evolution as early as the Middle Miocene.

The Transylvania basin is Neogene-Quaternary in age and unconformably overlies the Late Cretaceous-Early Miocene post-tectonic deposits of the Western Carpathians and/or the crystalline basement and its Mesozoic cover of the Oriental and Southern Carpathians; to the north, the basin is limited by the Transcarpathian Flysch zone and several crystalline massifs.

The shallow-water epicontinental Paleogene sediments crop out on the western, northern and, occasionally, on the southern margin of the basin. Data gathered from previous geophysical surveys and wells show that Paleogene sediments may extend eastward below the Miocene cover to a north-south trending arc located in the central part of the basin (Sandulescu, verbal communication).

A possible pathway, the Alba Iulia-Aiud couloir, may have been opened between the northwestern shelf and the southern part of the present Transylvania basin as early as the Middle Eocene (Priabonian), when *Nummulites fabianii*-bearing deposits were sedimented in both areas.

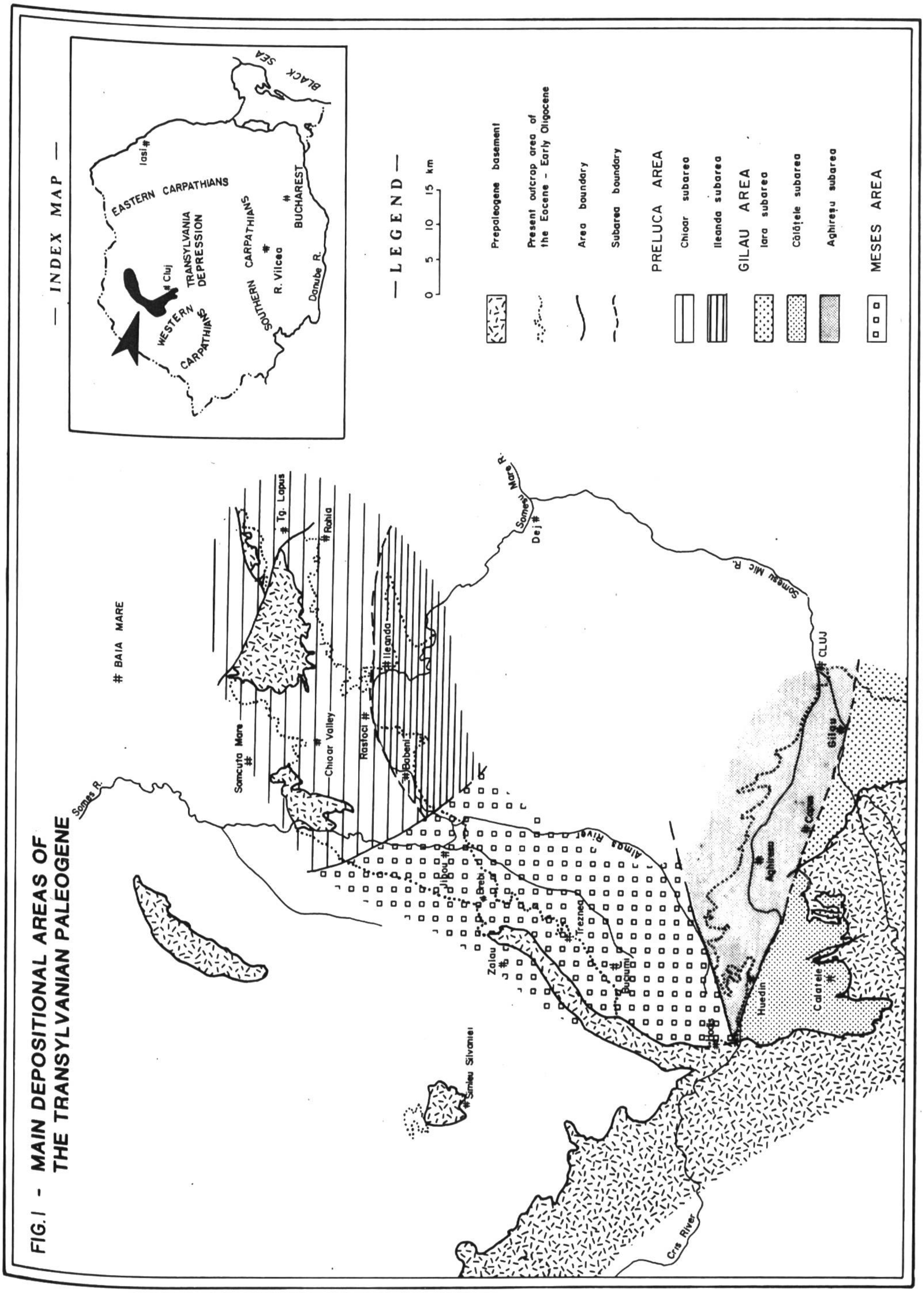


FIG. 1 - MAIN DEPOSITIONAL AREAS OF THE TRANSYLVANIAN PALEOGENE

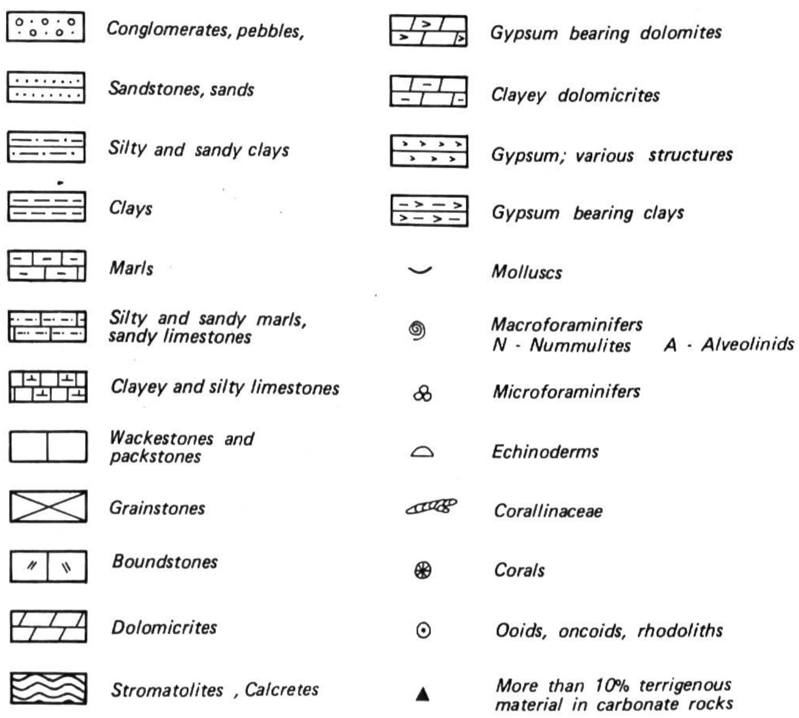
LITHOSTRATIGRAPHY

During the last two centuries, the proliferation of the stratigraphic nomenclature on the Transylvanian Paleogene resulted in a sizeable list of lithostratigraphic units, most of which inevitably became synonymous. A comprehensive review was recently made (Popescu 1978) and a new unitary, genetic scheme proposed (Fig. 3).

As early as last century, Hofmann (1879) and Koch (1894) and subsequently Raileanu and Saulea (1956) realized that the basin correlation in the study area had to be done by comparing at least the two distinct sedimentary areas: Cluj and Jibou. Recent works show that there actually are three sedimentary areas which began their evolution in the Priabonian (Popescu 1976) and reached full individuality in the Oligocene (Rusu 1970). These are: Gilau on the southern part of the NW Transylvania shelf, Meseş in the central/western part and Preluca in its northern part. The Gilau and Preluca areas have been further divided (Popescu 1979) into subareas (Fig. 1).

The Eocene-Early Oligocene sedimentary sequences display a somewhat similar cyclicity. Due to a mild tilting and subsidence, each cycle starts with continental deposits, overlain by gypsum-evaporites and capped by shallow, normal marine clastics and carbonates. None of these cycles has received more than cursory attention from the point of view of sedimentary petrology.

FIG. 2 — KEY TO SYMBOLS USED IN FIGURES 3 to 18



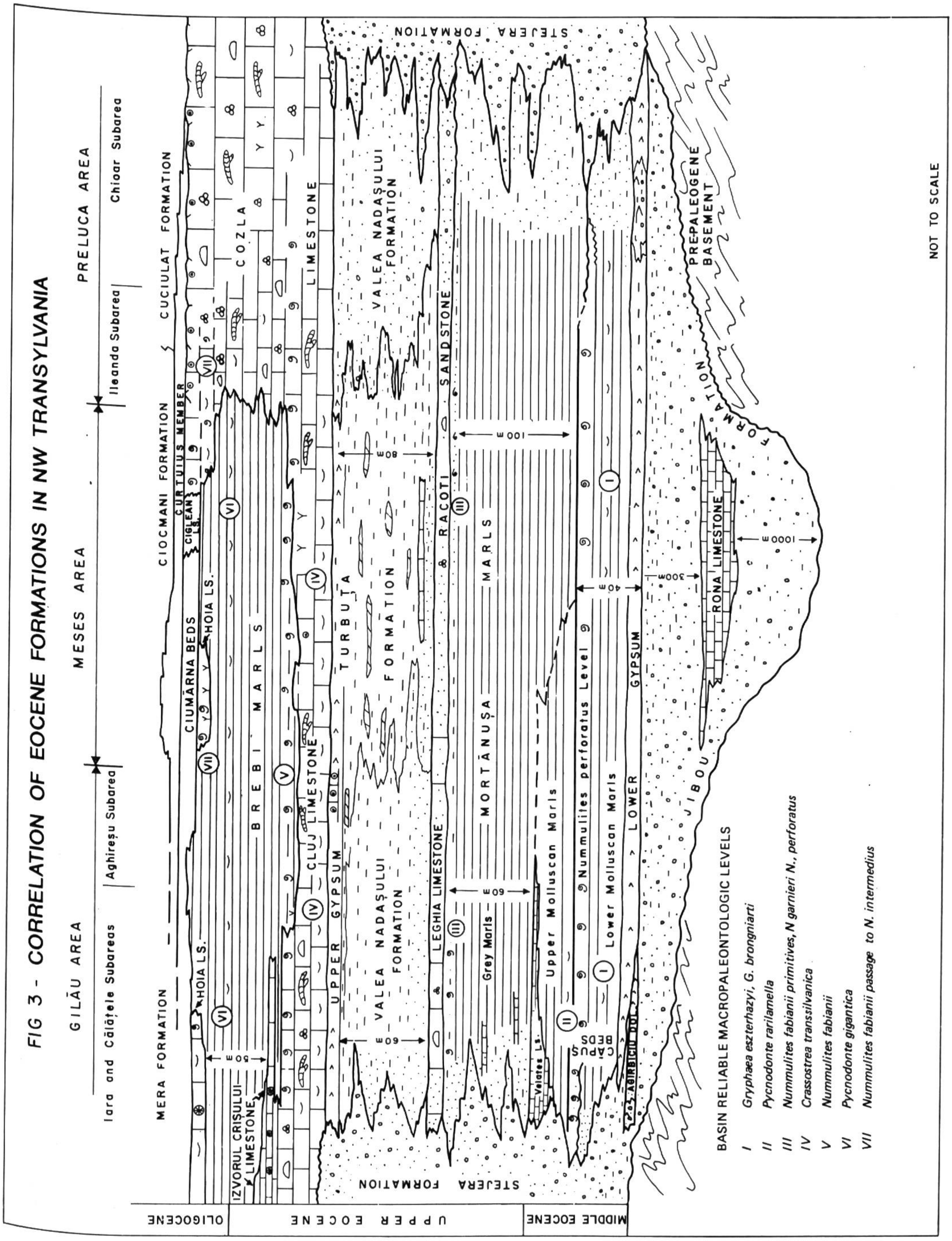


FIG 3 - CORRELATION OF EOCENE FORMATIONS IN NW TRANSYLVANIA

JIBOU FORMATION

The Jibou Formation is the first unit of the Paleogene which unconformably overlies the crystalline basement and/or the Senonian Gosau Formation. Due to the scarcity of fauna, its age is only inferred; the Late Lutetian conformably covers the Jibou Formation whose lower part may be Early Lutetian or even older in age.

The Jibou Formation consists of three informal members: Lower Red Member, Rona Limestone, and Upper Variegated Member. All three are well exposed at the stratotype site in the Meses area. The exposed thickness of the whole formation varies from a few meters up to 1,700 meters or a sedimentation rate of some 100 m/0.25 million years if a Lutetian age is assumed.

Gilau Area

One of the most representative sections of the Jibou Formation in the Gilau area crops out on the left slope of the Agîrbiciu valley. Here, unconformably overlying Senonian quartzose conglomerates, is a 60 m thick sequence of poorly-sorted conglomerates and gravels, with sandy or red clay matrix. These, in turn, are overlain by red clays and silts, locally containing pebbly and gravelly crystalline blocks and sandy, sheet-like, sedimentary bodies.

The arenitic and ruditic wedges often show rapid and important, lateral and vertical facies variations. They are non-bedded, irregularly-bedded or well bedded with upward fining, cross-bedding and cut and fill structures. Irregular-bedded, lithified levels cemented with gypsum and/or dolomicrite may occur. The texturally immature sediments are believed to be piedmont to intermediate, alluvial fan-facies deposits.

The red siltstones and mudstones are bioturbated, fine to massive-bedded and locally rich in soft pebbles. The sedimentary environment of finer sediments was subaqueous and of a great lateral extent; these sediments were probably deposited during periods of fan inactivity, from density flow in lakes and are interpreted as distal lacustrine facies.

The Jibou Formation is overlain by the Agîrbiciu "limestone" (Fig. 4, col. 1-3) which consists of two beds, 4 m in thickness, separated by clay seams and by 15 m of well-bedded red mudstones and siltstones, previously included in the Jibou Formation. The Agîrbiciu "limestone" (Draghinda 1952, unpublished paper) is actually a cross-bedded, ooidic or ooidic-bioclastic dolostone with scattered gypsum nodules. Due to its regional development, it has been named the **Agîrbiciu Level** (Popescu *et al.*, 1978); it is considered as a first evidence of the evaporite environment and is assigned to the Lower Gypsum Formation.

The Jibou Formation crops out almost continuously on the left slopes of the Capus and Somes rivers in the Aghiresu subzones, in the southern Calatele subarea, and west of the Iara subzone. Its exposed thickness rarely exceeds 100 m in the Gilau area.

Meseş Area

Downstream Jibou, along the Someş river, one can examine the most complete and thick section of the Jibou Formation in NW Transylvania. In this subsiding area, unconformably overlying the Ticau crystalline massif, there is a sequence of gravels and conglomerates with a sandy matrix, gravels and sands with a red clayey matrix, red and gray silty clays and clays. Cross-bedded, channel, graded-bedded and bioturbation structures are common.

This lower part of the Jibou Formation is informally named the **Lower Red Member** and has a maximum thickness of 1,000 m in the stratotype area. It is noteworthy that near the contact with the crystalline basement, there are a number of benthonitic clay lenses on the weathered crystalline surface.

Oil seeps and bitumen impregnation are known on both banks of the Somes river, upstream from Benesat. Some shallow wells were drilled last century as well as after the Second World War, but proved non-commercial. The origin of these hydrocarbon shows in the Paleogene is not yet clearly understood, as there are no known source rocks in the Cretaceous-Early Eocene deposits. The oil may have migrated laterally from the adjacent Simleu zone.

The **Rona Limestone** conformably overlies the Lower Red Member and consists of alternating black to grey organic limestone and dolomitic beds, up to 1 m thick, and black or green mudstones or clayey sands. The transition from the Lower Red Member to the Rona Limestone and into the Upper Variegated Member is gradational. The carbonate intercallations in the red clays and sands get thicker and become progressively more frequent in the lower part of the Rona Limestone. The siliciclastic red material replaces the limestones and green mudstones in the upper transition zone.

The carbonates are mostly cryptocrystalline to microsparitic with rare ostracod and gastropod skeletal grains; the framboidal pyrite and the calcedony seldom replace the micrite. Lumachelles of fresh-water gastropods (*Galba* and *Australorbis* species) were found on the upper surface of some black limestones and some black clays yielded a brackish water ostracod association (Olteanu, verbal communication).

The Rona Limestone is one of the thickest fresh-water carbonate developments in the European Eocene. It is an almost lacustrine, lens-shaped body which reaches its maximum thickness of about 300 m in the neighbourhood of Jibou and Rona and gets thinner to the northeast, disappearing between the Gard and Caselor streams. To the west, the Rona Limestone is transgressively overlain by the Badenian (M. Miocene) deposits.

The **Upper Variegated Member** is a red, continental-lacustrine deposit in which the coarse-grained lithology is either less than, or volumetrically equal to, the clays and sands. The member is finely laminated and has a maximum thickness of 400 m in the Meseş area. The percentage of the coarse-grained component increases to the west and southwest of Jibou and separation of the two red members of the Jibou Formation becomes difficult in the absence of the median Rona Limestone. If the hypothesis of the largest areal extension of the Upper Variegated Member in the NW Transylvania is accepted, the red deposits situated east of the Meseş crystalline, as well as those near Magura Silvaniei and in wells near Zalau should be assigned to the upper part of the Jibou Formation.

Preluca Area

The Jibou Formation in the Preluca area crops out in a few places such as the Valea Chioarului and Glod anticlines, as well as on the east slope of the Ticau and on the west slope of the Preluca crystalline massifs.

The lithology is similar to that described for the same interval in the Gilau area: gravels and conglomerates with red, clayey matrix, quartzose sands with red or kaolinitic clay matrix and sandy or silty clays.

Near Stejera village, the red coarse facies predominates and continuously develops between the basement up to the Cozla Limestone (Upper Eocene). This facies, called the **Stejera Formation** (Raileanu and Saulea, 1956), includes the stratigraphic equivalents of the deposits between the Jibou Formation and the Cozla Limestone (Fig. 3).

Stejera Formation was deposited in a near-shore to subaerial coastal plain environment. Frequent erosional features (channels) and graded and cross-bedding structures have been observed within the whole thickness of the formation. Sandy marine intercallations occasionally exist in the lower part of the formation, corresponding to Capus Beds depositional time. A possible emersion took place during the deposition of the Upper Gypsum Formation and the Cozla Limestone may unconformably cover the continental deposits of the upper part of the Stejera Formation.

A carbonate deposit with an uncertain stratigraphic position has been described in scattered outcrops directly lying on the Preluca crystalline schists (Marinescu and Marinescu, 1962). It is composed of oncolithic and micritic yellowish limestones, slightly dolomitic in places; associated clayey and porous limestones contain a rich Characean fauna.

The stratigraphic position of this carbonate deposit is difficult to establish since it is unconformably overlain by the younger Turbuţa Formation (Priabonian). These limestones were assigned to the Rona Limestone (Dumitrescu, 1957), or to an undisclosed part of a marginal facies equivalent to the marine Racoţi Group by Marinescu and Marinescu (1962); these limestones may also represent a coeval, nearshore deposit of the marine Racoţi Sandstone (Early Priabonian).

The Jibou Formation has a maximum thickness of 400 m near Fericea and becomes thinner to the east (100 m at V. Chioarului and 30 m at Buteasa) where it is transgressively overlain by the Racoţi (or Rakoczy) Sandstone.

LOWER GYPSUM FORMATION

The transition from the continental-lacustrine Jibou Formation to the marine Capus Beds is gradual; the red clays become greenish and admit thin intercallations of creamy dolomicrites, marly limestones and gypsum. This sequence was assigned to the Lower Gypsum Formation (Hofmann, 1879).

The formation is easy to separate in the Gilau and Meseş areas, whereas in the Preluca area its equivalent is either included in the uppermost part of the Jibou Formation, or may correspond to a non-depositional event due to a subaerial exposure.

Facies variations are wide and important. The upper limit is heterochronous, being traced either above the *Anomia*-bearing dolomites or below the normal marine *Anomia*-bearing green marls.

Gilau Area

The quarries near Leghia (Fînului and Foidas) are the best outcrops of Lower Gypsum of the Gilau Area (Fig. 4, col. 2, 3). In both quarries, the evaporite unit starts with the **Agirbiciu Level** (1-2 m thick) overlain by two meters of red clays and an alternation of green clays, gypsiferous and dolomitic clays, dolomicrites, massive-bedded gypsum, capped by the Anomia dolomitic bed and oolitic limestones, all of which underlie the normal marine Capuş Beds.

The facies variation is rapid due to the supratidal and very shallow marine setting which allowed local development of various sedimentary environments (Popescu, 1976). For instance, the Agîrbiciu Level is oolitic and bioclastic in the Leghia-Dumbrava-Agîrbiciu locales, becoming more terrigenous to the east (left slope of the Capuş valley) and further to the east, conglomeratic with sandy, dolomitic and/or gypsiferous matrix. Conglomerates with local poikilotopic gypsum cements have also been encountered at several locations. Also, the red clay interval between the Agîrbiciu Level and the first dolomicrites and gypsum beds, gets thinner northward and eastward of Agîrbiciu village.

Northward, on the Leghia village meridian, the gypsum pinches out and southward, at Paniceni, the Lower Gypsum Formation is only 10 m thick and consists of dolomicrites and green clays without gypsum.

On the left slopes of the Somes and Capus valleys, eastward of Leghia, the lens-shaped development of gypsum is obvious; the gypsum beds disappear near Gilau where only white dolomicrites and greenish clays are interbedded between the Jibou Formation and the Capuş Beds.

South of Somes (Iara subarea), at Luna, macronodules of gypsum, up to 2 meters in diameter, were found in red clays and in the Anomia-bearing dolomicrites, whereas the Agîrbiciu Level is missing. Further south, at Haşdate, the Lower Gypsum Formation consists of a thin sequence of dolomicrites, red clays and Anomia-bearing limestones (Fig. 4, col. 5).

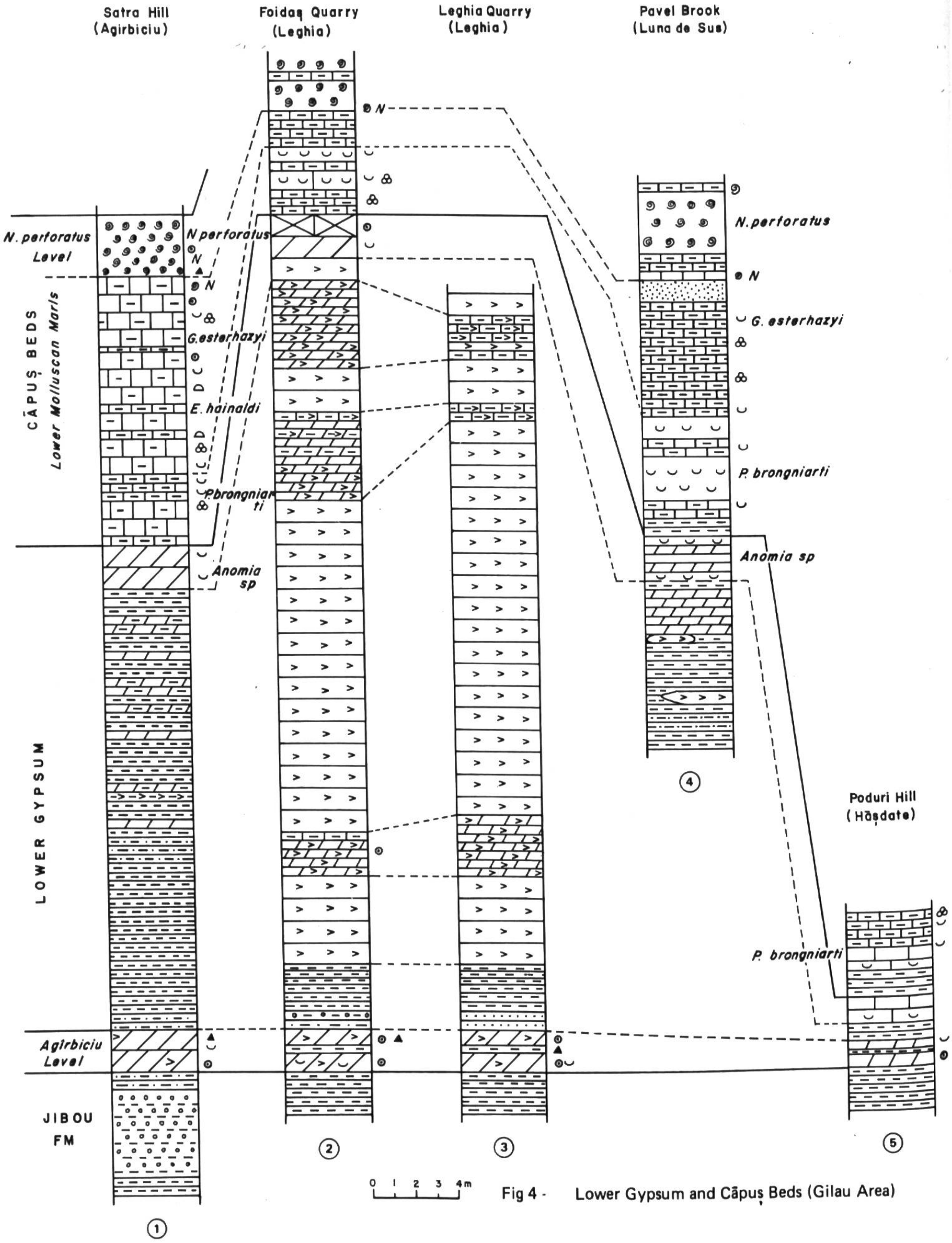


Fig 4 - Lower Gypsum and Căpuş Beds (Gilau Area)

West of the Paniceni spur (Caltaţele subarea), about 20 meters of the Lower Gypsum Formation were penetrated in some water wells. In the Calaţele subarea, south/southeast of Huedin, the formation is overlapped by the Capuş Beds which unconformably lie over the Jibou Formation.

Meseş Area

The Lower Gypsum Formation crops out in the Jibou vicinity and thins to the northeast; westward of Jibou, the formation is continuous eastward of the Meseş

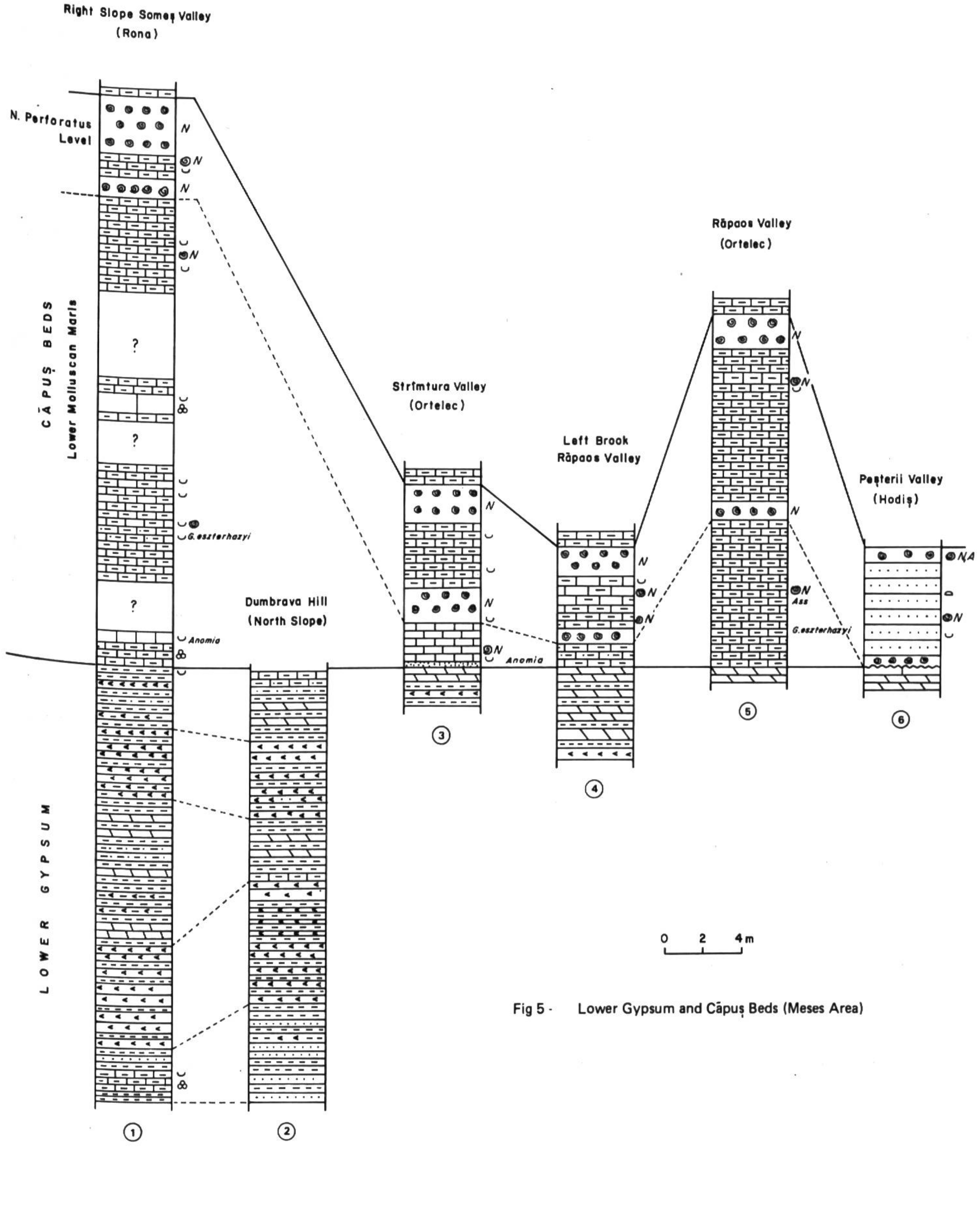


Fig 5 · Lower Gypsum and Căpuş Beds (Meses Area) fault. In the central and southern Meseş area, the formation is exposed on several tributaries of the Agrij valley.

In the Meseş area, one may recognize the same rock and environment types described in the Gilau area.

The main difference between the Meseş and Gilau areas is in the position of the *Anomia* level and in the transition from the Jibou Formation to the evaporites. In this area, the *Anomia* level does not represent the end of the evaporite sequence as in the Gilau area; it is here included in the marine Capuş Beds or is replaced by clastic facies (Fig. 5, col. 1, 3). Another difference is related to the development of a normal marine sequence in the lower part of the evaporite unit in the Meseş area, whereas in the Gilau area it is missing. This marine sequence was first described by Hofmann (1879) near Rona village and has recently been recognized on the northern slope of the Dumbrava Hill (Fig. 5, col. 2). The marine deposits consist of foraminiferal-molluscan pelites and miliolid wakestones and calcareous sandstones, 3 to 8 m thick.

Preluca Area

The Lower Gypsum crops out poorly in the Ileanda subarea (Hîrtoape valley) and is missing in the northern Chioar subarea.

Some shallow tests along the Someş river penetrated the Lower Gypsum Formation at the Ileanda and Rus locations, not far from the afore-mentioned exposure, but no further details are available.

CAPUŞ BEDS

The first normal marine formation of the NW Transylvanian Eocene was named by Popescu (1978) for the sequence that overlies the Lower Gypsum and underlies the Mortanuşa Marls. Hofmann (1879) gave a somewhat similar description of his "Perforata Sichten", whereas Koch (1894) included the Lower Gypsum in the same "Perforata Sichten".

Capuş Beds consist of two members: Lower Molluscan Marls and the *Nummulites perforatus* Level.

Gilau Area

Lower Molluscan Marls — The separation of this member is easily followed in the Gilau area. The member develops between the *Anomia* marls and dolomites (Lower Gypsum Formation) and the *Nummulites perforatus* lumachelle, a distinct, regional lithologic and paleontologic marker of NW Transylvania.

The Lower Molluscan Marls are recognized in the entire Gilau area, excepting the marginal parts of the Iara and Calaţele subareas. Complete exposures are, however, rare. Some good outcrops are found in the Leghia-Capuş area (Fig. 4, col. 1-2), some of them being man-made (gypsum and iron ore quarries); less well-exposed outcrops occur on the left bank of the Someş valley and in northern part of the Iara and Calaţele subareas.

Some palaeontologic levels with a restricted areal development have been recognized in the marly facies of this member. In the Leghia area, a *Gryphaea brongniarti* level was found to the lower part of the Lower Molluscan Marls. In the Capuş-Agîrbiciu area (Fig. 4, col. 1), the *G. brongniarti* level is followed by the *Euspatangus hainaldi* level and *Gryphaea eszterhazyi* level; the latter is in a ferruginous oolitic facies, exploited in a number of quarries since the early sixties.

The thickness of the Lower Molluscan Marls steadily increases eastward of the Paniceni crystalline spur. The member consists of pelitic-carbonate deposits with local limestone and marly limestone interbeds. The oolitic level with *G. eszterhazyi* is wedging out to the north and east and the ferruginous oolithes are replaced by glauconitic and quartz sands in the same direction.

Nummulites Perforatus Level — This is one of the most constant bio- and lithostratigraphic markers of the Paleogene deposits in NW Transylvania. In the Gilau area, this level has been found wherever the Capuş Beds are present. It consists of a nummulitic lumaschelle with pelitic or sandsize matrix and is locally oolitic (Capuş-Agîrbiciu area). The thickness varies between 0.5 and 3 m.

Meseş Area

Facies variations and thicknesses of the Capuş Beds are more important here than in the Gilau area. The Capuş Beds reach their maximum thickness in Transylvania in the Jibou area. In the southernmost part of the area (Hodiş), the upper part (Nummulites perforatus level) directly overlies the Lower Gypsum Formation.

Lower Molluscan Marls — These are exposed at Rona and in a number of tectonized outcrops near the Meseş fault (Fig. 5). An isolated outcrop has recently been found near the Meseş hut, in a graben west of the Meses overthrust fault, supporting the idea of a larger extension of the basin during the mid-Eocene.

At Rona (Fig. 5, col. 1) on about 25 meters, the pelitic sequence of this unit includes the *Anomia* level at the lowermost part, the *Gryphaea eszterhazyi* in the median part and a level with small nummulites, from the *N. varioularius* and *N. striatus* group, to the upper part. In the central part of the Meseş area, the Lower Molluscan Marls have only 2 m or less (Fig. 5, col. 3, 4) and pinch out to the southern Meseş area (Fig. 5, col. 6).

Nummulites Perforatus Level — This level consists of several, separate beds of lumachelle with thicknesses varying between decimeters to about two meters. Intercallations of Molluscan Marls, and silts as well as of *Serpula* limestone can be found at different levels in the interval assigned to the *Nummulites perforatus* unit. It is recalled that in the southern Meseş area (Fig. 5, col. 6) the level transgressively overlaps the Lower Gypsum Formation.

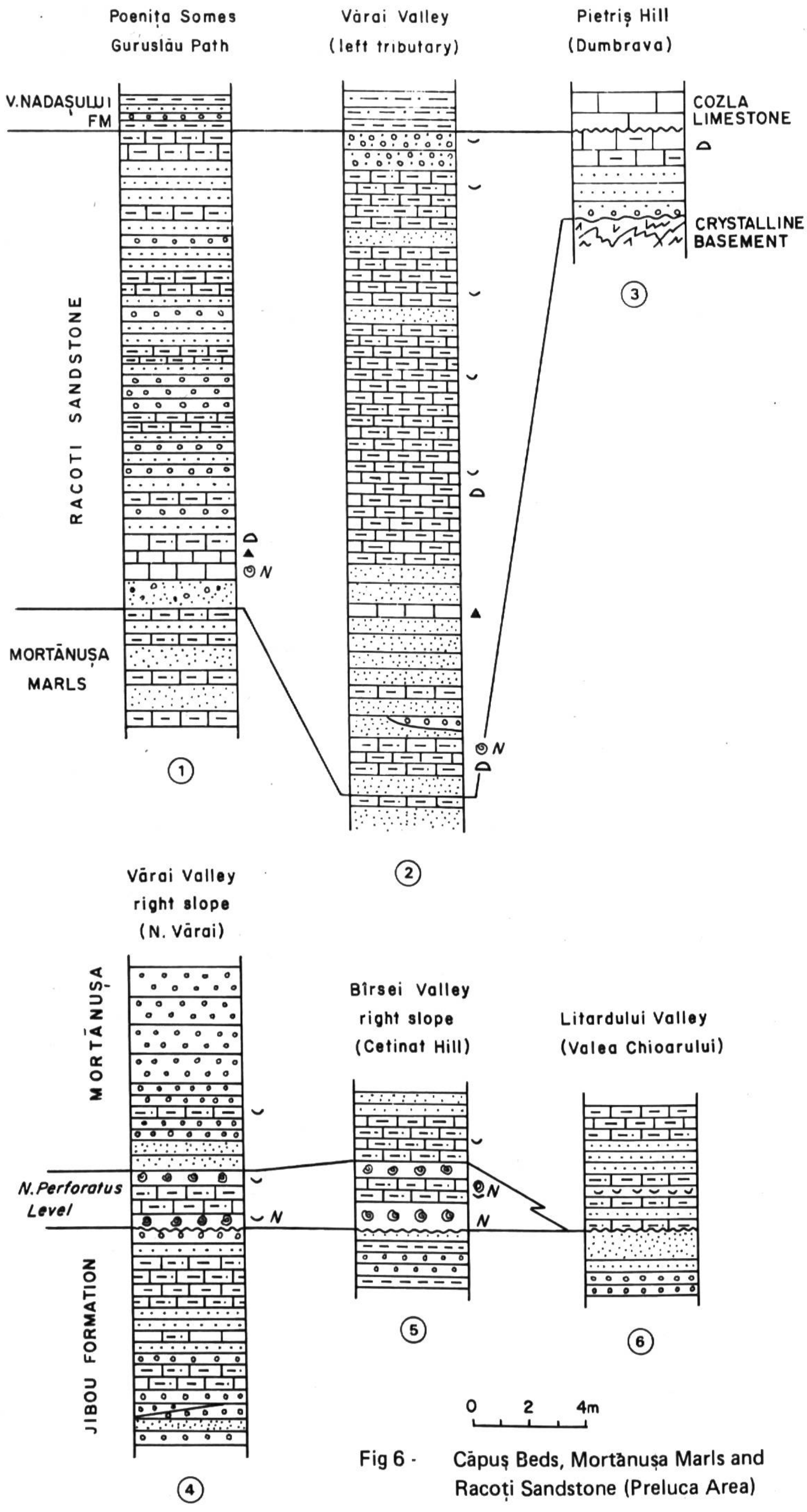


Fig 6 - Căpuș Beds, Mortănușa Marls and Racoți Sandstone (Preluca Area)

Preluca Area

Here, the Capuş Beds become progressively arenaceous and less fossiliferous, making separation of the unit from the adjacent deposits difficult.

These beds have been encountered in the central part of the Chioar subarea and their ingressive character is obvious at several locations in the marginal parts. Thus, towards the Ticau crystalline massif, fossiliferous marls and sands with *Nummulites perforatus* were found directly overlying the Jibou Formation or interbedded with the Stejera Formation. Eastward, to the Preluca crystalline massif, the *Nummulites perforatus* level is overlapped by the Mortanuşa Marls (SE of V. Chioarului village), disappearing farther to the east and northeast, where the Mortanuşa Marls unconformably lie over the Jibou Formation (Fig. 6, col. 4, 5).

In the Ileanda subarea on the Glod anticline, in the only exposure showing the Capuş Beds, one may notice the absence, both of the *Nummulites perforatus* level, and of the fossils characteristic of the Lower Molluscan Marls. It is possible that the Mortanusa Marls are replacing or unconformably overlapping the Capuş Beds in this subarea.

MORTANUŞA MARL FORMATION

This unit covers the stratigraphic interval between the *Nummulites perforatus* level and the Leghia Limestone or Racoţi (Racoczy) Sandstone. It is mostly a marine terrigenous formation and is continuously present in the study area, from the Iara embayment to the Preluca massif. East and northeast of the Preluca massif, the Mortanuşa Marls (or Mortanuşa Formation) disappear under the overlapping Racoti Sandstone and/or of the Turbuţa Formation.

Gilau Area

In this area, particularly in the Aghireşu subarea, the following three units have been recognized (Popescu, 1970, unpublished report): Upper Molluscan Marls, *Velates* Limestone and Grey Marl Members.

Upper Molluscan Marl Member — Consists of normal marine, very fossiliferous marls in the Aghireşu subarea. In the Iara and Calaţele subareas, the unit becomes calcareous; the large mollusc moulds and alveolinids remains indicate a shallower water, near shore, depositional environment in these later subareas. Thickness of Upper Molluscan Marls range between 1 to 10 m.

Velates Limestone — This unit was first named by Dragos (1952, unpublished report) in the Calaţele embayment and could be equivalent to the "Horizon of Large Molluscs and Limestones" of Tatarim (1963) in the Iara embayment (subarea). The *Velates* Limestone is a good lithologic marker in the Aghireşu subarea, where it helps separate the two lithologically similar pelitic members: Upper Molluscan Marls and Grey Marls.

The *Velates* Limestone is gradually replacing downward the Upper Molluscan Marls facies in the Iara and Calaţele subareas, and these limestone deposits were locally found directly lying over the *Nummulites perforatus* level. In this part of the Gilau area, the *Velates* Limestone is a bioclastic lutaceous calcarenite with important terrigenous admixtures. Petrographically it resembles the Leghia Limestone, the upper unit of the Racoţi Group. Thinner intercallations of similar limestone facies were also observed in the overlying Grey Marls.

Grey Marl Member — This is an informal lithostratigraphic unit of the upper part of the Mortanuşa Formation and is well exposed in the northern part of the Gilau area. It consists of a monotonous, massive-bedded, and poor fossiliferous, relatively thick sequence of marls, silty micaceous clays with local bioclastic limestone and/or quartzose sand intercallations ranging in thickness up to 80 m. In the Iara subarea, red clay tongues have been locally encountered. Its upper part is usually coarser and has a nummulitic assemblage, which seems to indicate the basis of the Napocian (Late Eocene) local stage, in contradiction with the nannoplancton fauna, which indicates a Bartonian (? Late Eocene) age, far below this level, in the Lower Molluscan Marls (Gheţa, in print).

In the Aghireşu subarea, the *Velates* Limestone wedges out east of Gilau, rendering the separation between Upper Molluscan Marl and Grey Marl members difficult. In order to define the mineralogical content and obtain possible differences between these two pelitic units, the clay and heavy minerals were investigated by Popescu *et al.* (1978) and Anastasiu, and Popescu (1979), but only minor differences were found.

Meseş Area

In this area, the three afore-mentioned informal members of the Mortanuşa Formation cannot be identified since the Velates Limestone is missing and the remaining lithology is uniform. Here, the formation is somewhat more silty and/or sandy compared to the Gilau area; calcarenite intercallations are very rare. The Mortanuşa Marl Formation in the Meseş area is about 100 m thick.

The coarse-grained fraction increases toward the northeast (Fig. 8, col. 5), where the upper sandy part of the formation makes the boundary with the overlying Racoţi Sandstone indiscernible in places. To the south, the upper part of the Mortanuşa Marls consists of an alternation of sands and marls and the Racoţi Sandstone is well differentiated (Fig. 8, col. 1-3). The Mortanuşa Marls are also identified west of the Meseş fault, near the Meseş hut in a graben on the crystalline basement. Clay and heavy minerals associations are almost the same as in the Gilau area, suggesting a genetic unity of source areas during the Mortanuşa Marls deposition.

Preluca Area

The Mortanuşa Formation develops mostly in the central and southern part of the area. As previously mentioned, facies variations make the identification of the lithostratigraphic units between the Jibou Formation and Cozla Limestone problematic in the northern Preluca area (e.g. Stejera Formation).

In the southwestern part of the Chioar subarea, the presence of the *Nummulites perforatus* Level and of the Racoţi Sandstone allows the Mortanuşa Formation section to be easily recognized (Fig. 6, col. 4, 5). It is sandy, and has only thin, sporadic, pelitic intercallations and is occasionally fossiliferous. To the north and northeast, the formation becomes coarse terrigenous with red clay interbeds grading laterally into the Stejera facies.

In the Ileanda subarea, the Mortanuşa Marl Formation extends between the Lower Molluscan Marls of the Capuş Beds (the *Nummulites perforatus* Level is missing here) and the Racoţi Sandstone. The lithology consists mostly of silty clays and marls, similar to those already described. Exposed thickness may reach 100 m.

LEGHIA LIMESTONE

The Leghia Limestone is the uppermost unit of the Racoţi Group (or of the Lower Marine Series of Raileanu and Saulea, 1956) in the Gilau area. It is easily recognized on the field as it stands out as a cornice of about 5 m in thickness between the two contiguous soft rocks of the Mortanuşa Marl and the Valea Nadaşului Formations (Fig. 7).

The Leghia Limestone is a normal marine, lutaceous, bioclastic calcarenite made up of two beds of about the same thickness, separated by a marly interbed.

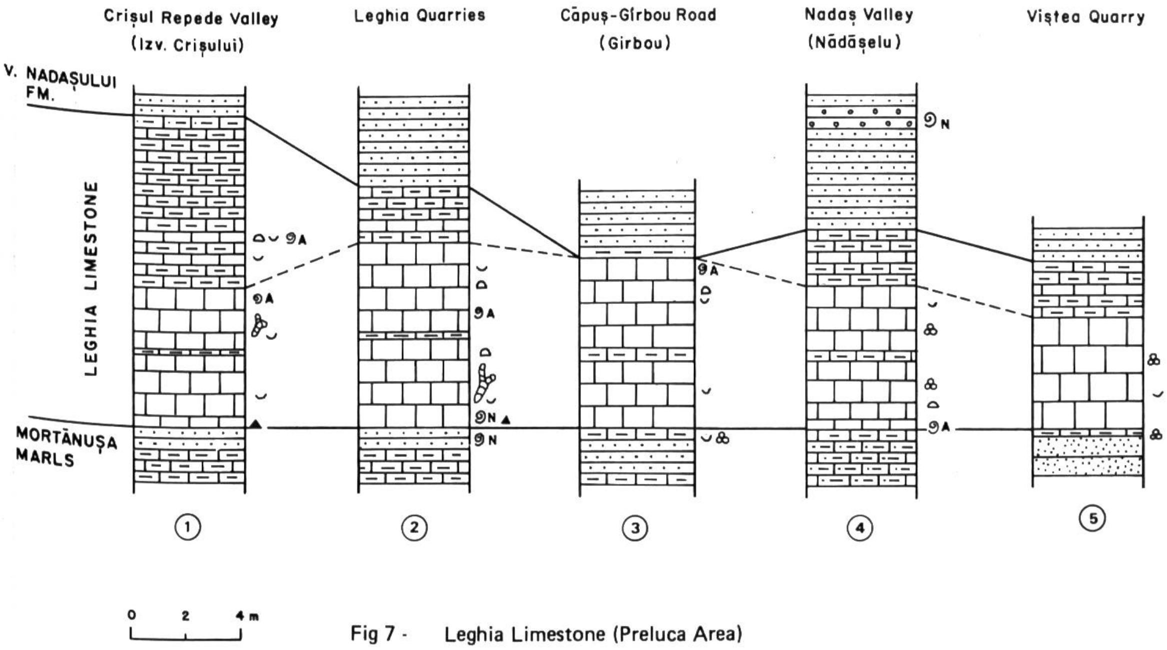


Fig 7 - Leghia Limestone (Preluca Area)

In the near shore facies in the Calaţele and Iara subareas, the predominant bioclasts are the alveolinids and miliolids, further to the north, the miliolids and molluscs dominate, and further basinward (Aghireşu subarea), the miliolids and corallinaceans are dominant.

The transition to the overlying continental Valea Nadaşului Formation includes a 1 to 5 m grey marl sequence with centimetric intercallations of limestone (Fig. 7, col. 1, 2, 4, 5) of the same facies and paleontologic content as the Leghia Limestone; consequently, this transition zone should be included in the Leghia Limestone unit.

RACOŢI SANDSTONE

In the Meseş and Preluca areas, the Racoţi (or Rakoczy) Sandstone is the stratigraphic equivalent of the Leghia Limestone. In fact, the Racoţi Sandstone is a calcarenite in which the quantity of the terrigenous quartz progressively increases from south to north, where the unit becomes a quartzarenite. This transition, from the well-bedded Leghia Limestone into the massive Racoţi Sandstone (Fig. 8, col. 2, 5) can easily be surveyed in the Meseş area.

Meseş Area

The Racoţi Sandstone was found on both the west and east sides of the Meseş fault. West of the Meseş fault, and in the Preluca area, the Racoţi Sandstone directly lies on the crystalline basement (Fig. 6, col. 3), revealing its transgressive character in the marginal areas of the basin.

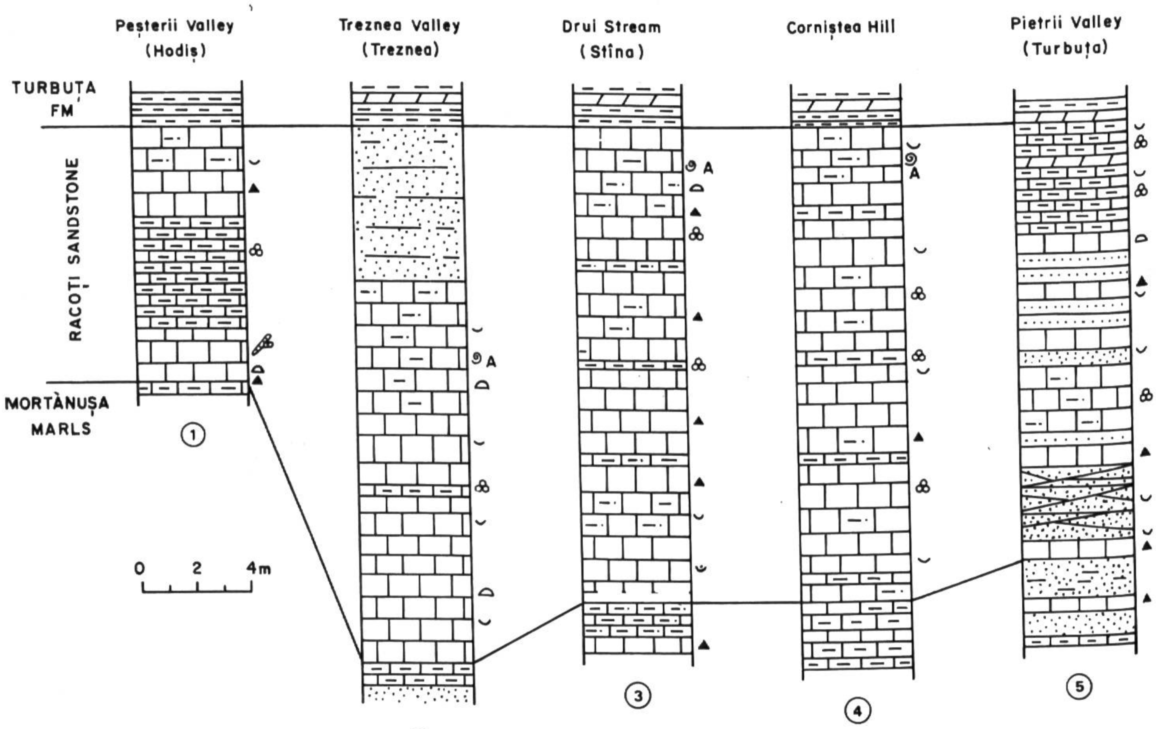


Fig 8 - Racoti Sandstone (Meseş Area)

The terrigenous siliciclastic component of the Racoţi Sandstone becomes dominant in the central part of the Meseş area (Fig. 8, col. 2). Northeastward, in the uppermost part of this unit (Fig. 8, col. 5) pelites, marly limestones, dolomicrites or oolitic limestones with a typical marine fauna were found. These may be a near-shore equivalent of the upper transition zone described at the same stratigraphic level in the Gilau area. The late Late Eocene association of nummulites and *Linderina* is located in the lowermost part of the formation, revealing a somewhat isochronous lower limit of the Leghia Limestone and Racoţi Sandstone. Thickness may reach up to 20 m.

Preluca Area

In the northern part (Chioar subarea) terrigenous quartz and/or microconglomerates are the main constituent of the Racoţi Sandstone (Fig. 6, col. 1, 2). It can reach up to 20 m in thickness and is massive or cross-bedded. Near the crystalline massifs of Preluca and Ticau, in the Stejera facies area, the identification of a paleontologic assemblage, characteristic of the Racoţi Sandstone, makes it locally possible to distinguish the stratigraphic equivalent of this formation.

West of Chioar Valley, the Racoţi Sandstone is transgressively overlapped by the Valea Nadaşului Formation. On the Petriş anticline (Fig. 6, col. 3), the Racoţi Sandstone lies unconformably on the crystalline basement and is directly overlain by the Cozla Limestone.

In the Ileanda subarea, the Racoţi Sandstone has a thickness of 25-30 meters and crops out only in the Glod anticline, where it is microconglomeratic. Here, in the uppermost part, as in the neighbourhood of the Turbuţa village (Meseş area), a marine fauna was found in quartzarenites and marls.

VALEA NADAŞULUI FORMATION

This formation lies between the Leghia Limestone and the Upper Gypsum Formation in the Gilau area, and between the Racoţi Sandstone and the Cozla Limestone in the Preluca area. In the Meses area, the Turbuţa Formation replaces it.

The Valea Nadaşului Formation is a continental-lacustrine, terrigenous unit with a thickness of 40 to 60 meters. Red clays are the principal petrographic constituent, as well as the matrix material for other rock types, such as sands, sandstones and conglomerates. It much resembles, petrologically and genetically, the Jibou Formation.

Gilau Area

Large areas are covered by this formation in all three subareas. In some places, in the marginal Iara and Calaţele subareas, the overlying Upper Gypsum Formation is replaced by the red bed facies of the underlying Valea Nadaşului Formation. Generally, the Valea Nadaşului Formation consists of a lower, massive or cross-bedded sandy sequence (5-15 m thick) and an upper, generally well-bedded, clayey sequence (40-50 m thick). The lower quartzose, well-sorted sands include small amounts of volcanic glass which indicate coeval volcanic extrusive activity on land (Popescu *et al.*, 1978). An eolian origin of these sands can be inferred although a detailed facies study has not been made. The clayey sequence is made up of texturally mature and climatically controlled lacustrine and fluvial red or green clays, silty clays, sands and occasionally, coarse microconglomeratic sands. Convolute, dish and pillar, as well as cut and fill structures are common.

The transition into the Upper Gypsum is gradual; green clays become abundant and the dolomicritic and marly limestones intercallations become frequent in the upper 5 to 10 meters. The boundary between these two formations is established below the lowest massive dolomicritic beds or dolomitic-siliciclastic sequence, considered to be the earliest manifestation of a new evaporitic regime in the depositional environment.

Preluca Area

The facies distribution inside the stratigraphic interval discussed strongly supports the distinction of two sedimentary subareas in the Preluca area. In the Chioar subarea, a typical Valea Nadaşului Formation facies is present, whereas in the Ileanda subarea, the Turbuţa facies prevails.

In the Chioar subarea, arrenaceous and ruditic material is widespread, the red clays being present as matrix or thin interbeds; the lower part of the formation is somewhat more clayey. Some bituminous limestones with *Limnaea* and *Australorbis* have been found on the eastern flank of the Ticau massif. Incomplete successions were surveyed on the Preluca crystalline massif and on the Pietriş anticline.

In the Ileanda subarea, the sequence between the Racoţi Sandstone and the Cozla Limestone is assigned to the Turbuţa Formation (the so-called "southern facies" of Dumitrescu, 1957).

UPPER GYPSUM FORMATION

This formation is typically developed only in the Gilau and Meseş areas. It is a transitional evaporite unit between the underlying continental and the overlying Cluj Group marine deposits. The depositional environment is similar to that already described for the Lower Gypsum Formation.

For the Meseş area, the Upper Gypsum Formation equivalent will be described later with the Turbuţa Formation, the original definition of which included this gypsum evaporite sequence.

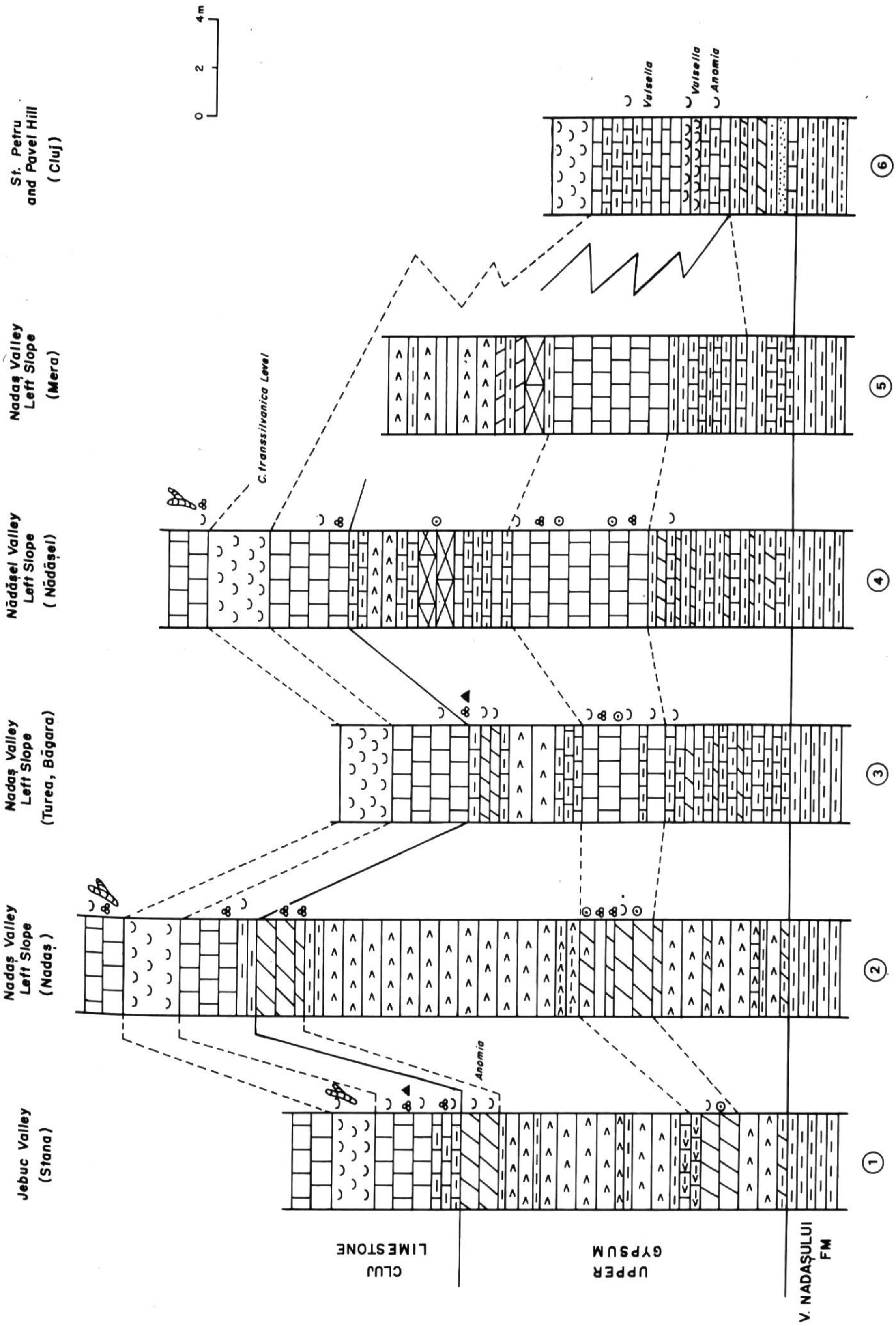


Fig 9 - Upper Gypsum (Gilău Area)

Gilau Area

The upper evaporite formation is well developed in the Aghireşu subarea where a number of quarries and natural outcrops show good exposures. In the entire area, one can notice the following general succession: green clays and thin dolomicrites in the lower part; 1 to 5 meters of oolitic-bioclastic limestones; 3 to 15 meters of gypsum, and in the upper part, one or two bioclastic dolostone or marly limestone beds with *Anomia* lumachelles (Fig. 9). Upper Gypsum is up to 20 m thick.

The lower oolitic calcarenite bed contains a normal marine fauna of miliolids, echinoids, corralinaceans and planktonic foraminifera. Oolits increase from west to east while the bioclasts decrease in the same direction.

The gypsum beds display great variation in thickness and structure. They may be massive-bedded, bedded-mosaic, nodular, or discoidal with interbeds of dolomicrites or dolomitic clays. A few intercallations of marine calcarenites (Fig. 9, col. 2-4) with planktonic foraminifera have also been found in the gypsum sequence. To the east of the Aghireşu subarea, the gypsum is replaced by a black clay sequence, 7,5 meters thick, in which a brackish water ostracod fauna has been found.

The *Anomia*-bearing dolostones and marls are locally oolitic. Above this level, the marine sedimentation of the Cluj Limestone begins and forms the first marine unit of the Cluj Group.

In the Iara embayment, only the lower clays and dolomicrites and the oolitic calcarenites occur; in the Calaţele subarea, the sulfatic evaporites were found only in its northeastern part, directly overlying the red clays of the Valea Nadaşului Formation. In the western part of the Calaţele subzone, the basal green clays are followed by massive dolomites and green clays with red spots and thin dolomicrites.

TURBUŢA FORMATION

The Turbuţa Formation, as originally defined by Hofmann (1879), consists of a green clay and dolomitcritic sequence overlain by the Upper Gypsum stratigraphic equivalent. It vertically develops between the Racoţi Sandstone and the Cluj and/or Cozla Limestone on a thickness averaging about 80 m.

Some three informal subdivisions of this formation can be made: the lower (2-10 m), black bituminous pelites and limestones with fresh water molluscs; the middle (60-70 m), non-fossiliferous bluish-green clays and dolomicrites with occasional red clay intercallations and gypsum lenses and the upper (5-40 m) gypsum and dolomicrites.

The lower unit is well exposed near the Meses tectonic line and in the neighbourhood of Jibou (Fig. 10, col. 2-5). It consists of black, lacustrine, bioturbated organic clays, and decimetric, bituminous micrites with fresh water molluscs. Near

Jibou, the bituminous dolomicrites are replaced by thin oolitic limestones, lumpal dolomicrites and stromatolites of a possible marine, near-shore origin (Fig. 10, col. 2).

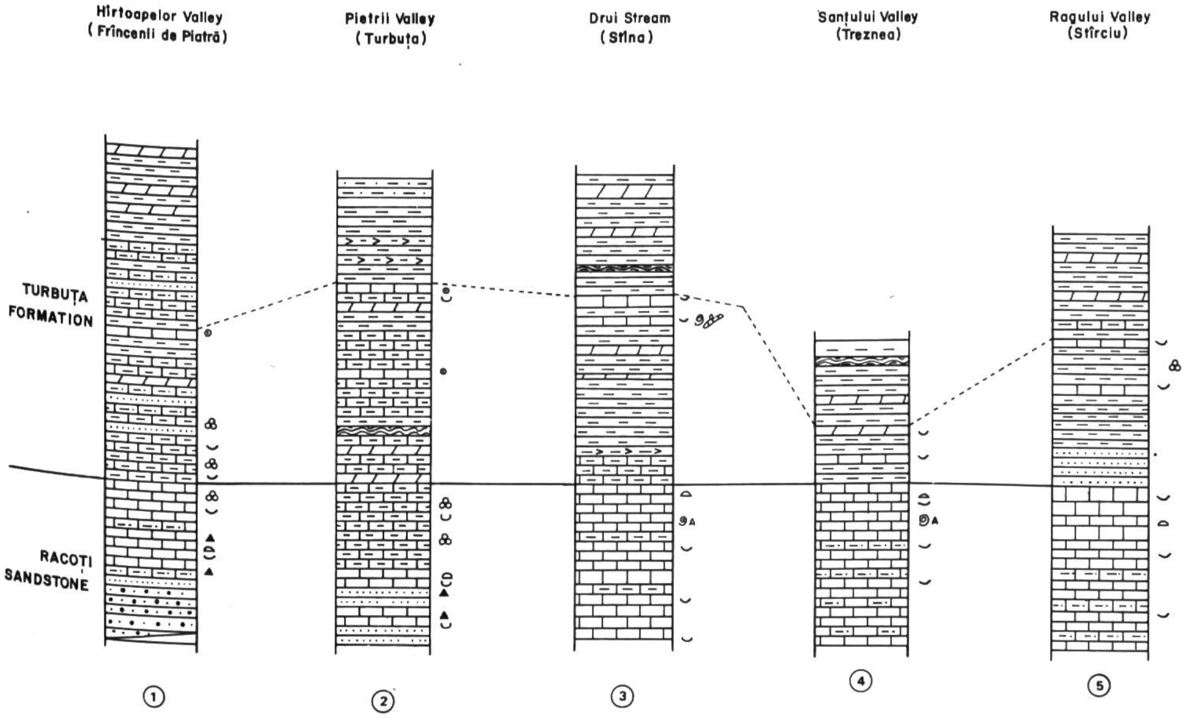


Fig 10 - Lower part of Turbuța Formation (Meseș Area)

The middle unit represents the "Turbuța facies" type; it is composed of lacustrine and lagoonal evaporitic green clays with subordinate intercallations of creamy bioturbated dolomicrites, locally with root moulds, gypsum lenses, stromatolites and oolitic limestone wedges. In the southern part of the Meses area, the red beds are more frequent, especially in the lower half of the formation. On the right slope of the Somes river, downstream Rona there is, below the gypsum-bearing upper unit, a calcareous and dolomitic level with *Anomia*, miliolids and bryozoans of a normal marine to brackish marine origin. The "Turbuța facies" were deposited in the coastal ephemeral lakes of a subtropical climate, in which considerable pene-contemporaneous dolomite quantities precipitated, similar to the present Coorong Lagoon in Australia.

The upper unit is actually the equivalent of the Upper Gypsum Formation of the Gilau area with almost the same petrological composition (Fig. 11). In the southernmost part of the Meses area, it is composed of only 20 cm of light-coloured dolomicrites, situated just below the Cluj Limestone (Fig. 13, col. 1).

No gypsum-bearing or other evaporitic deposits are known at this stratigraphic level in the southern part of the Preluca area (Ileanda subarea) below the Cozla Limestone.

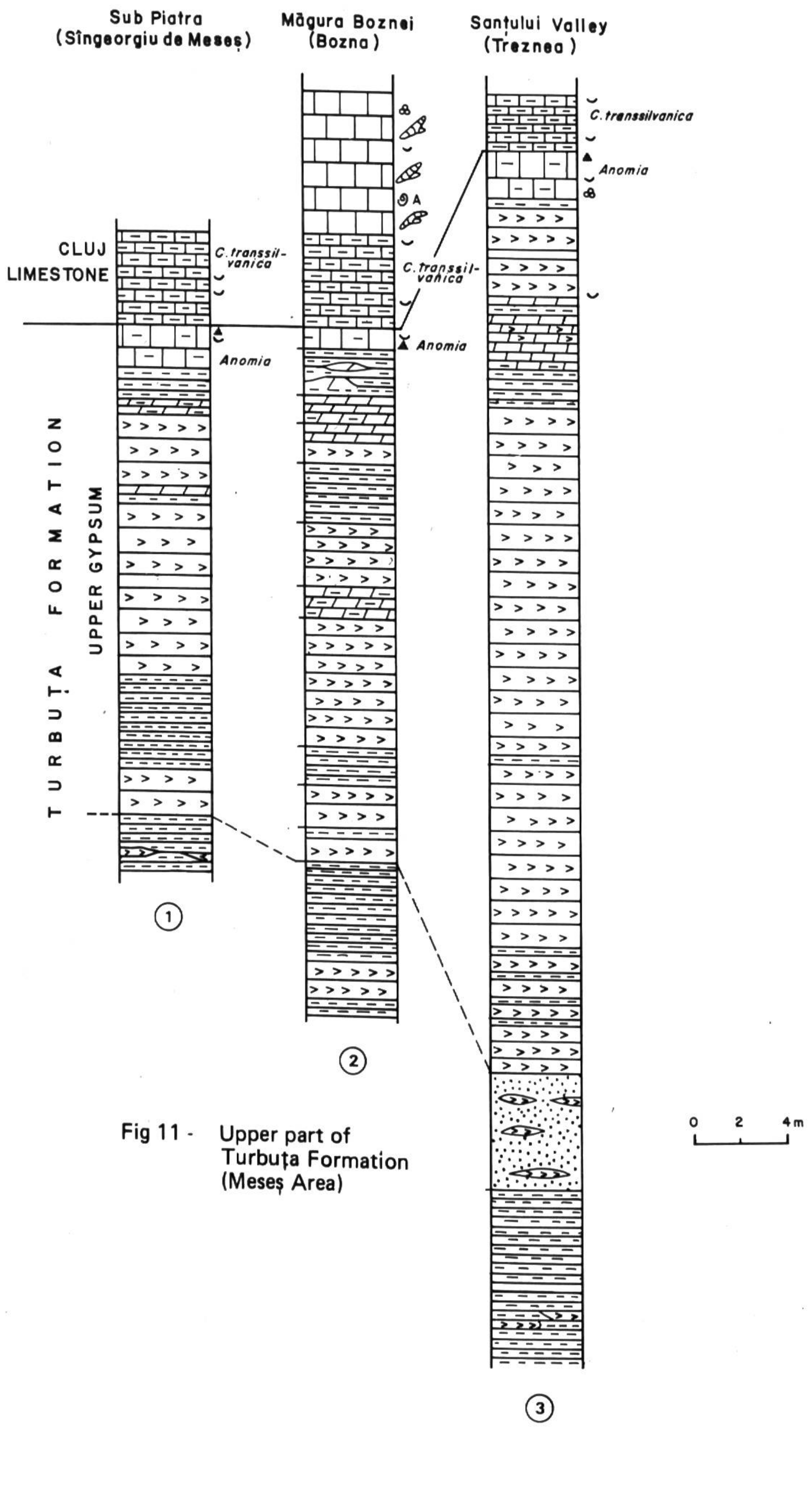


Fig 11 - Upper part of Turbuţa Formation (Meseş Area)

CLUJ LIMESTONE

The lower limit of this normal marine, shallow-water formation is easily traceable where the *Anomia*-bearing carbonates can be found, some meters below the *Crassostrea transilvanica* level. The upper boundary is gradational to the Brebi Marls and corresponds approximatively to the *Nummulites fabianii* level which can be found either in the Cluj Limestone or in the Brebi Marls.

Gilau Area

The Cluj Limestone in the Gilau area is made up of a lower part (3 to 5 m) of marly limestones with marine molluscs and echinoderms (in the eastern region) and/or well-bedded, submetric calcarenites (western region). This lower unit is overlain by the *Crassostrea transsilvanica* level, a regional marker, 1 to 3 m thick (Fig. 12, col. 1, Fig. 9, col. 1-4, 6).

The upper part of the Cluj Limestone consists of 10 to 25 meters of very fossiliferous calcarenites with thin marly interbeds. Some local paleontological levels can be recognized in that upper part: *Campanile* level in the Iara and Calaţele subareas, *Echinolampas* level in the Aghireşu subarea. A basinal paleontologic marker, the *Nummulites fabianii* level, is located either in the uppermost Cluj Limestone or in the lowermost Brebi Marls, or in both formations (Fig. 12).

In the Aghireşu subarea (at the sources of the Criş river or near Gilau), overlying the *Nummulites fabianii* level in a Brebi Marl facies, there is a reefal limestone bar named **Izvorul Crişului Limestone** by Popescu *et al.* (1978). It consists of calcarenites and calcirudites with corals, crustose coralinaceans, nummulites, rotalids and rare molluscs, much resembling the Cozla Limestone of the Preluca area. Basinward, in the northern part of the Gilau area, the Izvorul Crişului Limestone is thinning out and is replaced by the Brebi Marls (Fig. 3).

Meseş Area

The Cluj Limestone is developed in the Meseş area northwestward until Poeniţa village where it passes to the lower Cozla Limestone, a carbonate formation which includes the stratigraphic equivalents of the Cluj Limestone, Brebi Marls and Hoia Formation.

In the Meseş area, the *Anomia* level (situated at the uppermost part of the Turbuţa Formation) is no longer dolomitized and shows a normal marine facies. However, the ubiquity of the *Crassostrea transsilvanica* level and the presence of a 2 to 5 m thick sequence of calcarenites below it eases the separation between the pelitic Turbuţa and the calcareous Cluj formations.

Overlying the *Crassostrea transsilvanica* level, in the southern Meseş area, there is a unit consisting of bioclastic calcarenites, nodular calcilutites and sandy marls

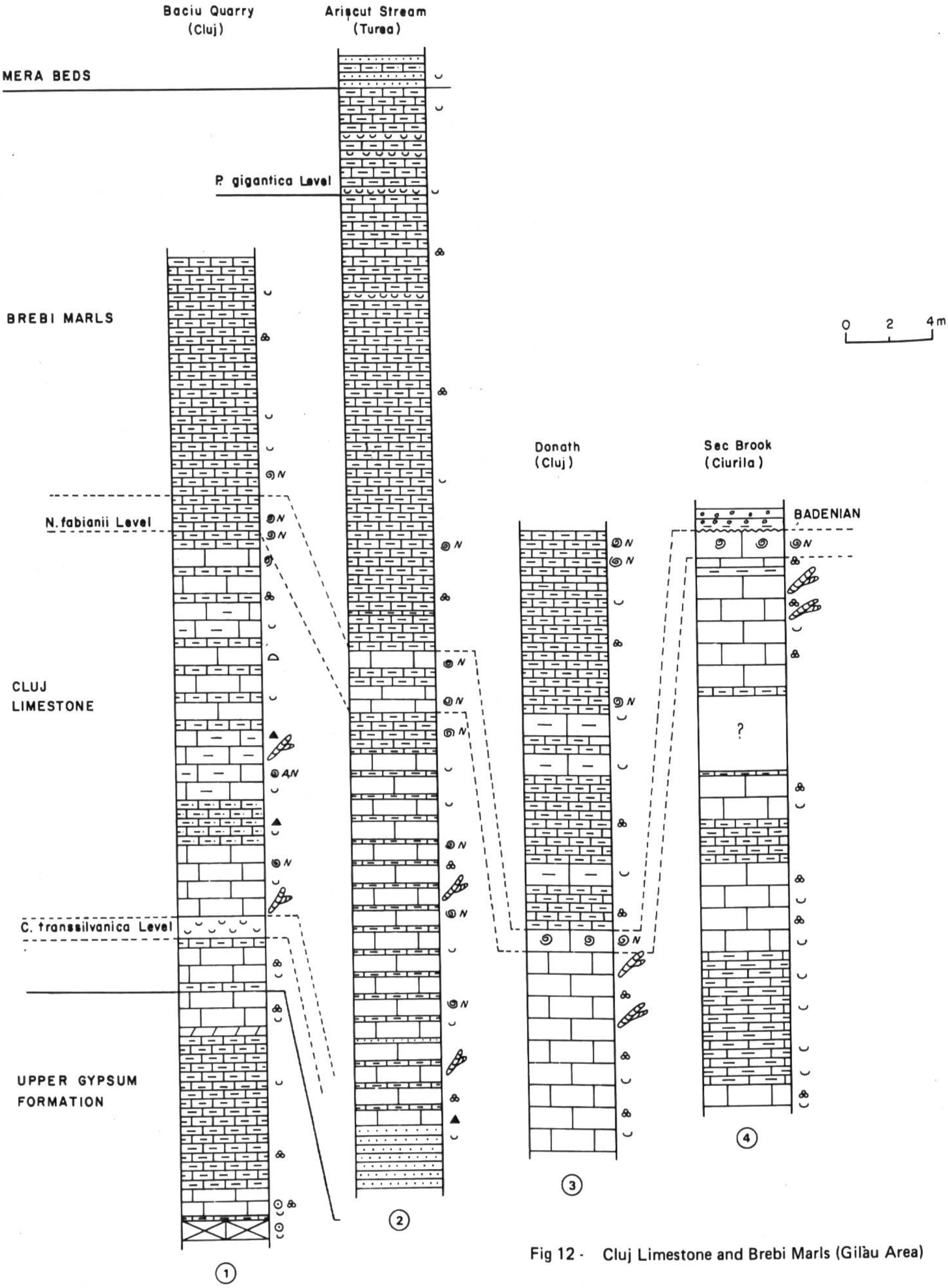


Fig 12 - Cluj Limestone and Brebi Marls (Gilău Area)

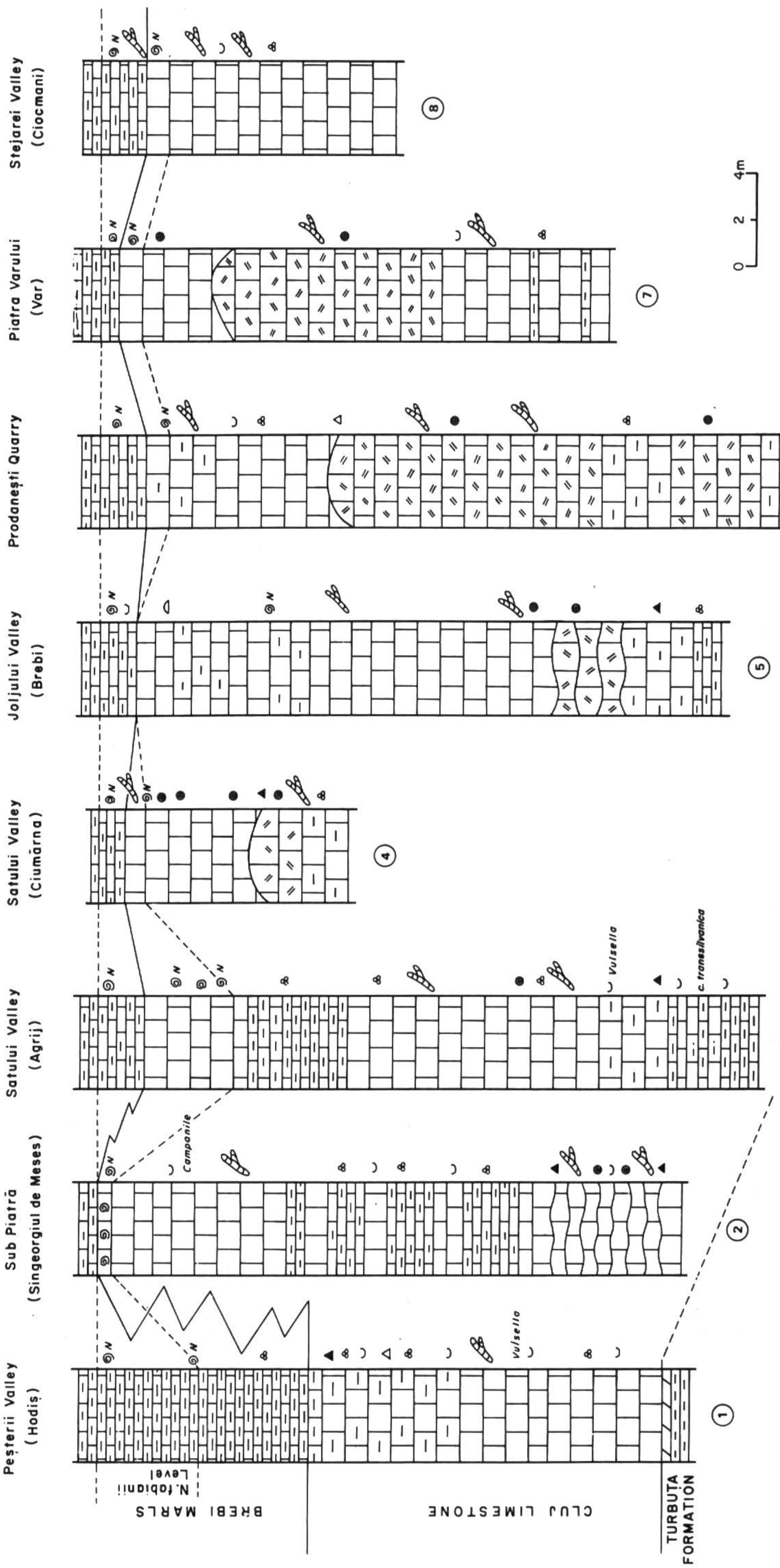


Fig 13 - Cluj Limestone (Meseș Area)

with rhodoliths and coral heads; the *Nummulites fabianii* level is here generally located in the Brebi Marls, above the last limestone bed (Fig. 13).

In the northern part of the Meseş area, the coral-reef mounds become abundant in the upper part of the Cluj Limestone. Usually, they are 2 to 10 m high and 10 to 30 m wide (Fig. 13, col. 4-7). The *Nummulites fabianii* level extends here in both Cluj and Brebi formations.

BREBI MARLS

Developed only in the Gilau and Meseş areas, they are a normal marine, carbonate, pelitic unit deposited in somewhat deeper water conditions. In the upper third, a level with *Pycnodonte gigantica* can be observed in the above-mentioned areas and locally in the Preluca area, in the Cozla Limestone.

Gilau Area

The Brebi, or Bryozoan Marls, occur in the whole Aghireşu subarea and at few locations in the Iara and Calatele subareas.

The formation is 50-70 m thick, rather uniform in lithology and is composed of green, carbonate clays very rich in bryozoans, foraminifera and molluscs. Thin bioclastic limestone interbeds (e.g. *Chlamys* lumachelles) have occasionally been observed. Much of the initially aragonitic fossil moulds are pyritized and, when weathered, they are transformed into pulverulent limonite nodules. The *Pycnodonte gigantica* level was recognized on almost all sections where the formation crops out.

Mineralogically, the Brebi Marls of the Gilau area consist of clays (64%, of which 55% is illite and 35% montmorillonite), calcium carbonate (10% to 30% with an average of 26%) quartz and feldspars (7%) and minor amounts of various accessory minerals (Olteanu and Popescu, 1973).

Meseş Area

The Brebi Marls crop out in the eastern part of this area, in few locations near the Meseş fault and in the southernmost part at Hodiş. The formation is about 50 m thick and is more calcareous than in the Gilau area. It includes, mostly at the lower and upper parts, submetric beds of marly limestones and/or very calcareous, indurated clays. As in the Gilau area, the formation is rich in foraminifera, molluscs, but poor in bryozoans.

Between the villages of Var and Ciocmani, a level with *Dyscoliclina* was identified in the basal part of the Brebi Marls. At the upper part, the *Pycnodonte gigantica* level can also be observed over all the Meseş area.

In the vicinity of Poeniţa village (north of Ciocmani), the Brebi Marls are laterally replaced by the calcareous facies of the Cozla Limestone, over a distance of several hundred meters.

HOIA FORMATION

This normal marine, and locally brackish formation practically represents the end of the Paleogene, normal marine, carbonate sedimentation in N.W. Transylvania. Some marine calcareous sandstones and bioclastic limestones locally occur in the Oligocene Mera, Ciocmani and Cuciulat Beds; they are thin, locally brackish water, and interbedded in predominantly terrigenous sequences.

The Hoia Formation has recently been divided (Rusu, 1977) into two members: the Hoia Limestone and the Ciumarna Beds. The Hoia Formation is typically developed in the Gilau and Meseş areas. In the Preluca area, it is included in the uppermost Cozla Limestone.

Gilau Area

The Hoia Formation was found only in the northern, Aghiresu, subarea. In the Gilau area, this formation can be divided into two members — as Rusu (1977) did for the Meşes area. They are named Hoia Limestone and Lower *Scutella* Level. The latter is a rough equivalent to the Ciumarna Beds. The Lower *Scutella* Level was, in our opinion, erroneously assigned to the overlying Mera Beds by a number of authors.

The transition from the underlying Brebi Marls is gradual. The lower **Hoia Limestone** member is a calcarenite, in places clayey, and contains a very rich fauna of molluscs, nummulites and corals. It has a 1,10 to 1,80 m thickness.

In the northeastern part of the Gilau area (Fig. 14, col. 1, 2), the calcarenites of the Hoia Limestone member are progressively replaced by Brebi Marls-like pelites. However, thin calcareous sandstones, sandy marls or even calcarenite interbeds have been recognized in this zone. Further westward, the entire Hoia Formation is replaced by Brebi Marls-like pelites.

The upper **Lower Scutella Level** member is developing in the northern part of the Aghireşu subarea. It is missing in the southern part of this subarea (e.g. Hoia, Mînaştur, Fig. 14, col. 4, 5), possibly due to subaerial exposure after the deposition of the regressive Hoia Limestones member.

The Hoia Formation is generally overlain by green and black clays with *Tympanotonos* and *Turritella* (fresh and brackish water environment) belonging to the overlying Mera Beds.

Meseş Area

The Hoia Formation can be observed continuously in the Meseş area. At Poenita it laterally grades into the uppermost Cozla Limestone (Fig. 18).

The lower **Hoia Limestone** member of the Hoia Formation is a carbonate unit, the thickness of which ranges from 0.5 to 2 m. It consists of corallinacean, nummulitic calcarenites in the nearshore areas (Fig. 15, col. 1) and of coral bound-

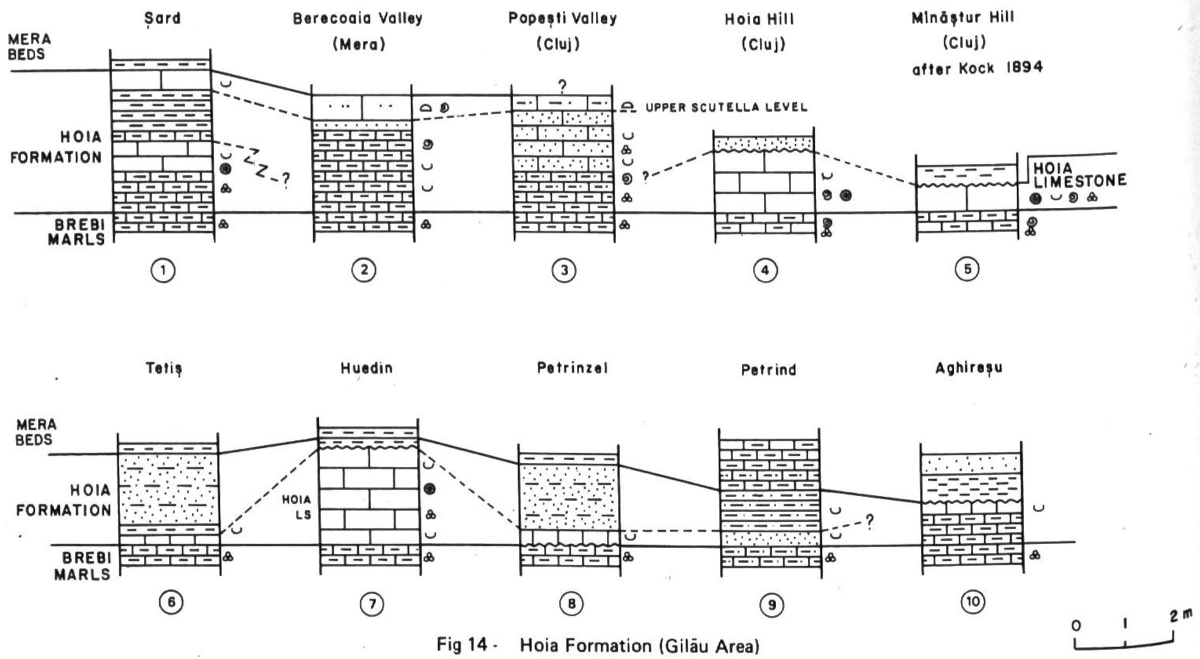


Fig 14 - Hoia Formation (Gilău Area)

stones and mollusc, miliolid calcarenites further to the east. Basinward, the limestone facies are again replaced by marls and clays with nummulites, planktonics and molluscs resembling the Brebi Marls (Fig. 15, col. 7-9).

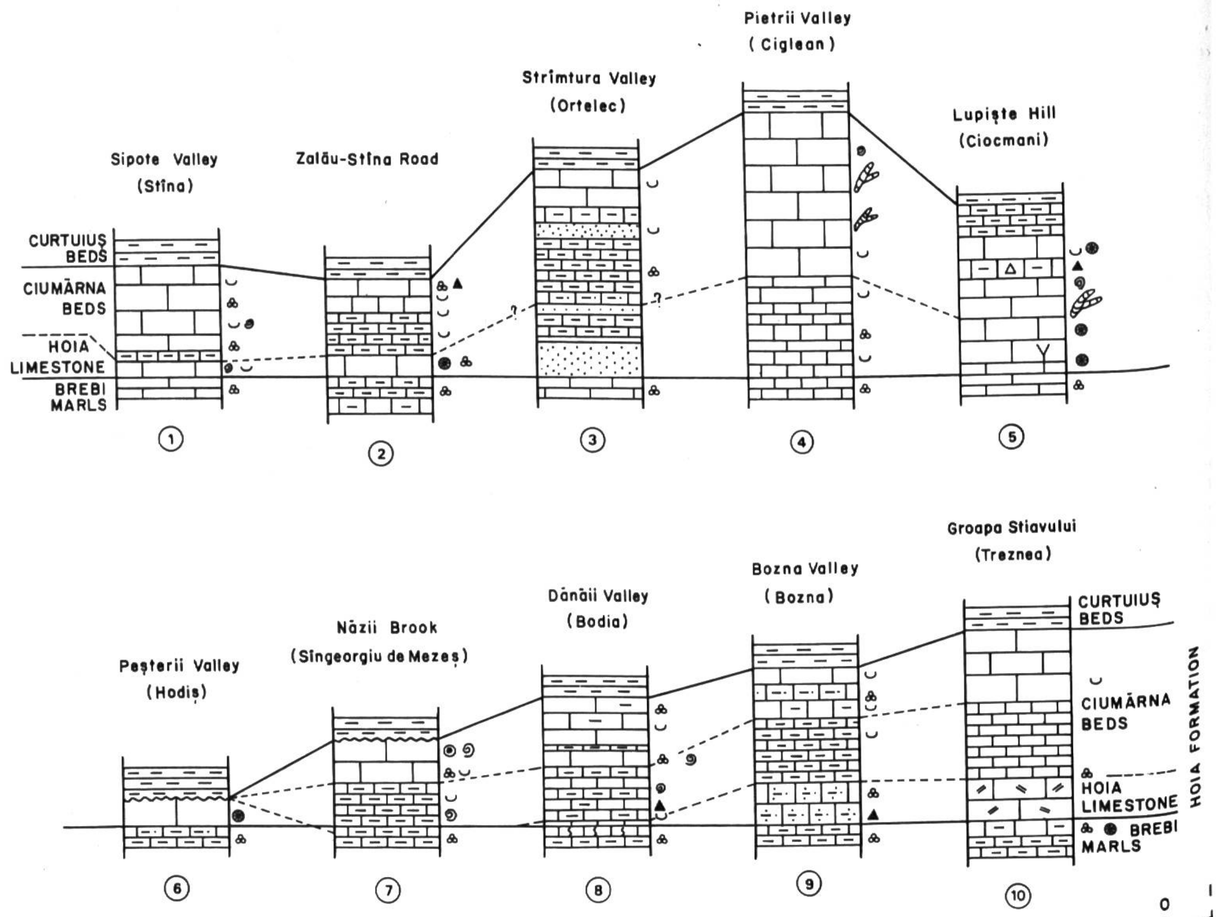


Fig 15 - Hoia Formation (Meses Area)

A 3 to 4 m thick corralinacean calcarenite, the **Ciglean Limestone**, deserves special attention. It was first correlated with the entire Hoia Formation (Rusu and Draganescu, 1976) and then with the upper part of the formation (Popescu, 1979) or the Ciumarna Beds (Fig. 15, col. 4).

The **Ciumarna Beds** are made up of thin beds of limestone with marly and clayey intercallations between the Hoia Limestone and Curtuiuş Beds. They contain a very rich fauna of nummulites, foraminifera and molluscs.

COZLA LIMESTONE

This formation is the main carbonate unit of the NW Transylvania Paleogene and is exposed only in the Preluca area (Figs. 16, 17).

The Cozla Limestone is 50 to 60 m thick and represents the stratigraphic equivalent of the Cluj Limestone, Brebi Marls and Hoia Formation. It overlies the Turbuţa and/or Valea Nadaşului Formations and underlies the Cuciulat Beds. Its thickness decreases progressively to the northeast where, on the Pietriş Hill, it unconformably lies on the crystalline basement and is less than 25 m thick.

This carbonate mass accumulated on an uplifted, shallow marine shelf with a continuous, mild subsidence, in climatic conditions similar to the present subtropical areas. Significantly, the carbonate platform margin occurs in the vicinity of the Jibou subsiding zone.

Some paleontologic levels, such as *Nummulites fabianii*, *Pycnodonte gigantica* (Fig. 16, col. 2-4), *Scutella subtrigona* (already mentioned in the equivalent formations of the adjacent areas) can be surveyed in the southern part of Chioar and in the Ileanda subareas. The *Crassostrea transsilvanica* level has not yet been found at the lower part of the Cozla Limestone; instead, *Vulsella* and *Orbitolites complanatus* levels have been recognized in its lower part (Fig. 17, col. 2-4). The limestones of this unit are very rich fossiliferous and, with rare exceptions, mud-supported, lutaceous calcarenites and calcirudites.

The Cozla Limestone may informally be divided into two units (Popescu, 1979): a lower unit, mainly calcareous with same terrigenous intercallations (5-8 m thick) resembling the Cluj Limestone and an upper unit, consisting of well-bedded lutaceous calcarenites and calcirudites (40 m thick) which locally may accommodate coral mounds (Figs. 16, 17). The top of the Cozla Limestone was calcreted during the weathering period subsequent to the deposition of the formation (Fig. 18).

The Cozla Limestone could be a good hydrocarbon reservoir if, the now exposed Preluca carbonate platform, extended northward of the Ticau-Preluca crystalline massifs, under the mollasic and flysch deposits of the Transcarpathian area.

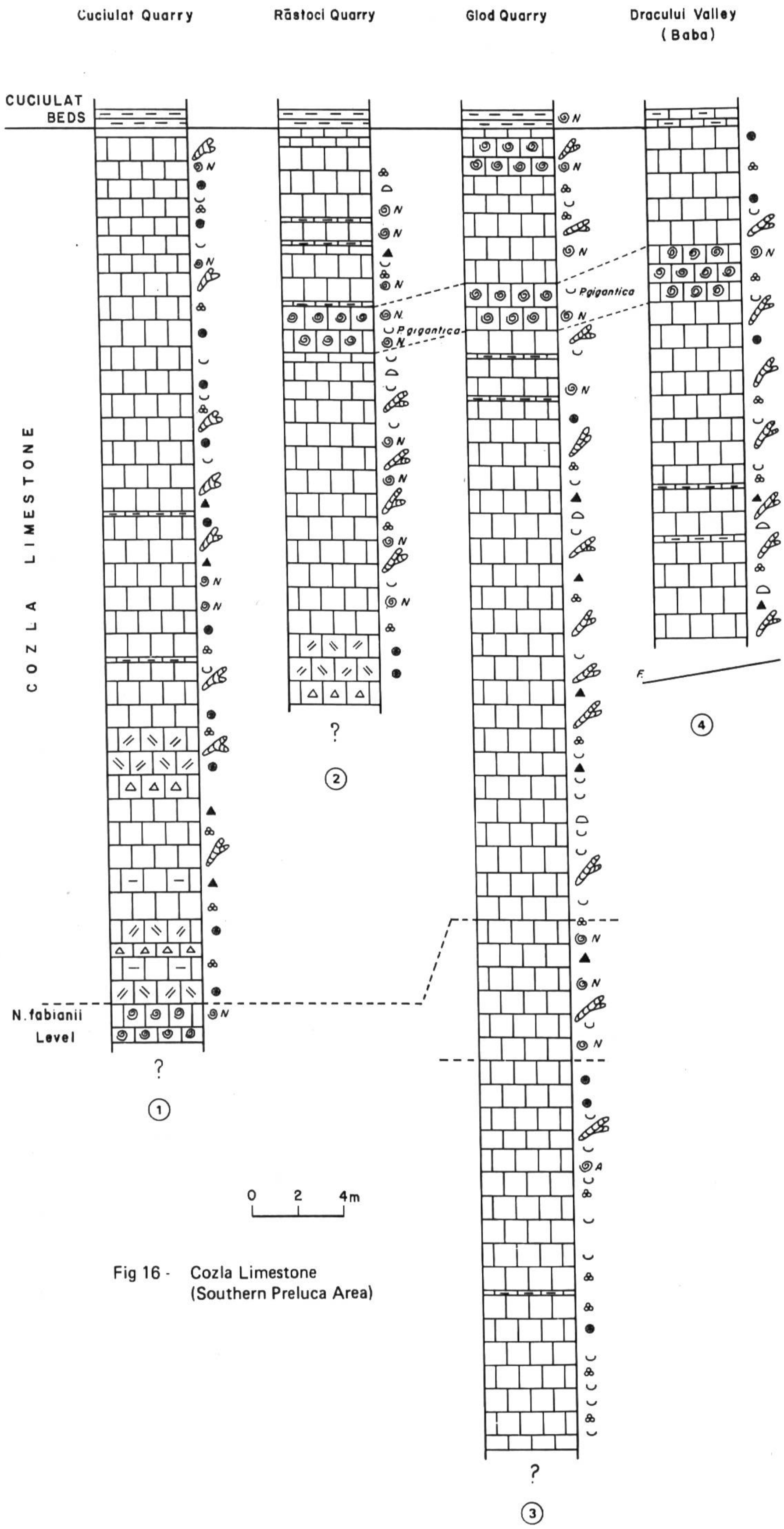


Fig 16 - Cozla Limestone (Southern Preluca Area)

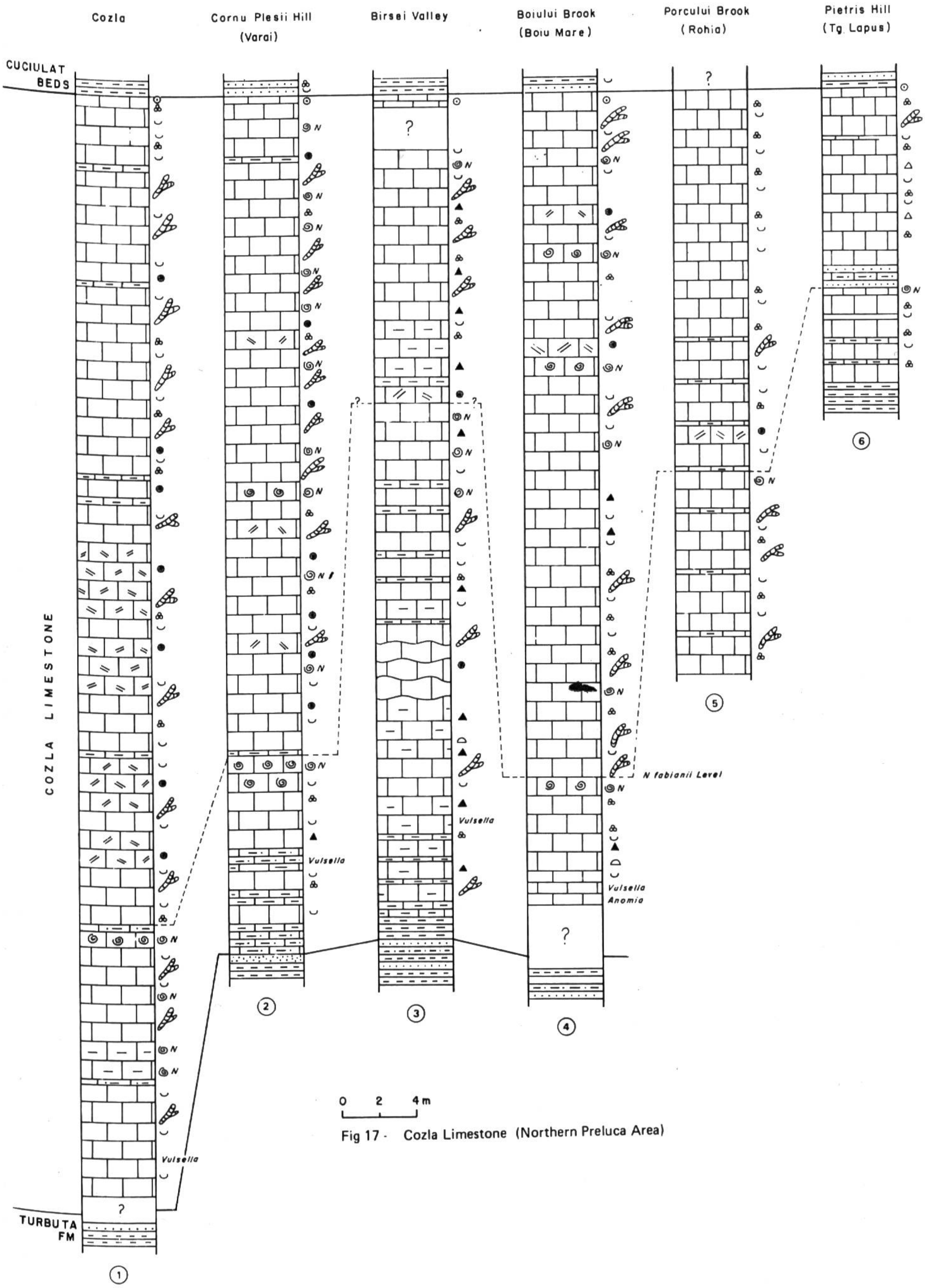


Fig 17 - Cozla Limestone (Northern Preluca Area)

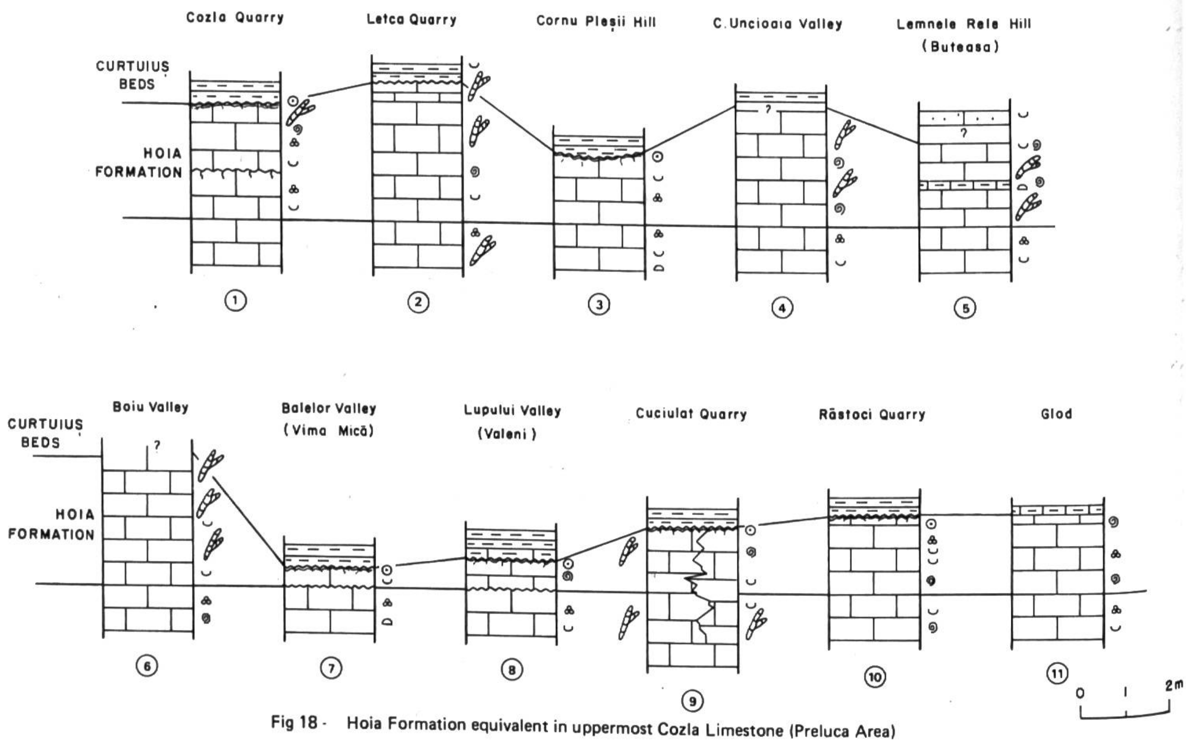


Fig 18 - Hoia Formation equivalent in uppermost Cozla Limestone (Preluca Area)

Overlying the Eocene-Early Oligocene deposits described in this paper, a new sedimentary cycle started in N V Transylvania. It consists of marine, terrigenous and rare carbonate, coal-bearing fresh and brackish water deposits and red-beds which belong to the Oligocene Almaş Group.

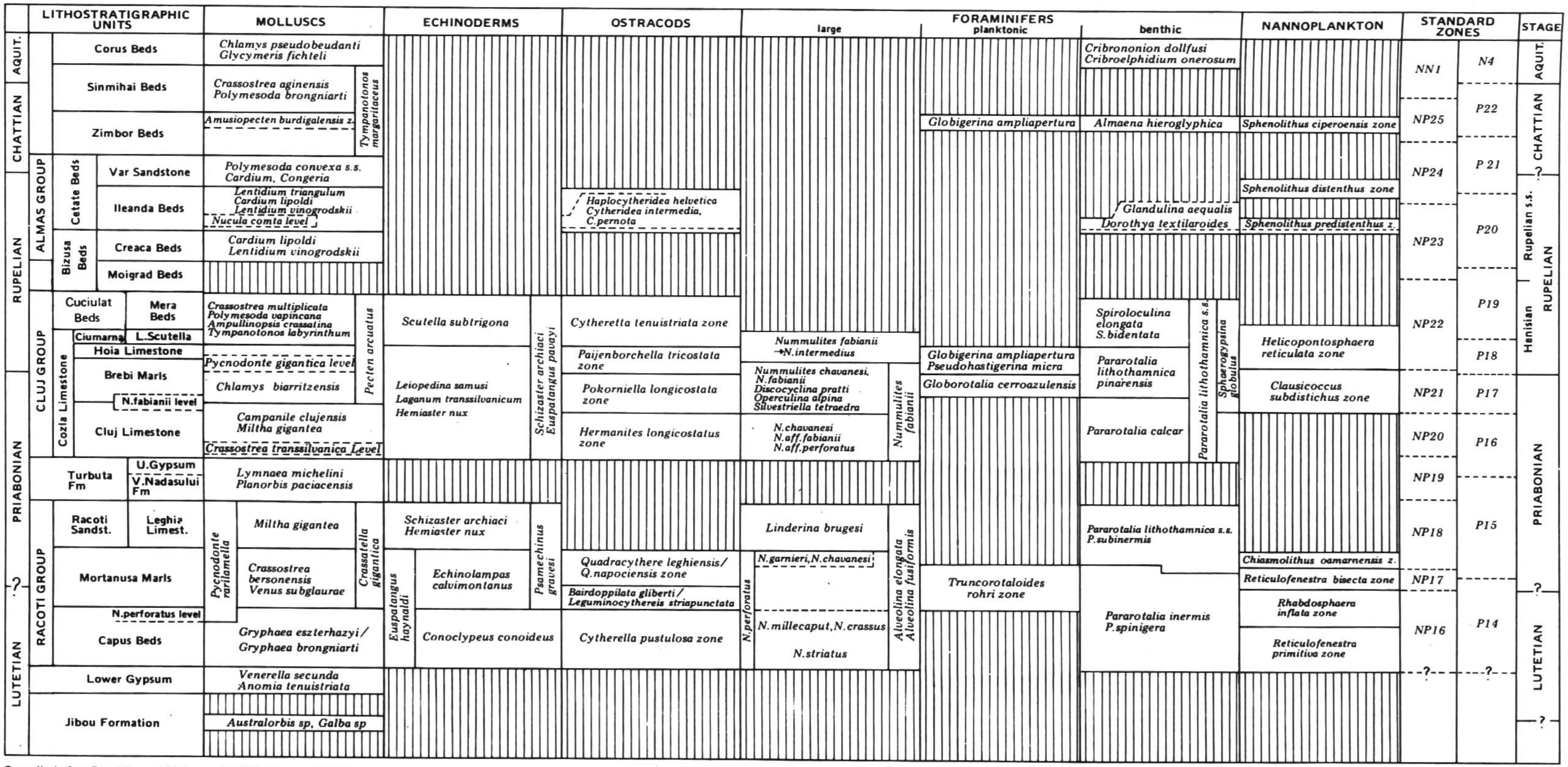
CONCLUSIONS

In the Middle Eocene to Middle Oligocene, the sedimentary sequence of the NW Transylvania shelf consisted of two, rather similar cycles. Paleontology, facies and paleogeographic evidences allowed the delineation of three distinct sedimentary areas — Gilau, Meseş and Preluca — in the Paleogene depocenter.

The first cycle (Lutetian-Early Priabonian) started with the red continental and bituminous lacustrine Jibou formation. It graded into gypsum-bearing sediments, indicative of the persistence of an arid climate as well as the first influence of the marine environment. The normal marine, siliciclastic Capuş and Mortanuşa Marls overlie conformably the evaporites and show the weathering of a warm and more humid land. The last terms of the marine Racoţi Group, Legia Limestone (Gilau area) and Racoţi Sandstone (Meseş and Preluca areas) are regressive and were deposited in near-shore areas.

Due to a probable eustatic falling of the sea level, the second cycle (Early Priabonian-Early Oligocene) commenced again with the deposition of continental red beds

FIG.19 – BIOZONATION OF THE NW TRANSYLVANIA PALEOGENE



Compiled after Bombita and Moisescu (1968), Olteanu (1977),
Popescu et al (1978), Rusu and Iva (1982) and Gheta (1984)

in the Gilau and most of the Preluca areas (Valea Nadaşului Formation) or lacustrine, evaporite-bearing sediments, in the Meşes and southern Preluca areas (Turbuţa Formation). Similar to the first cycle, a second gypsum-bearing unit made the transition between the continental and marine deposits. The overlying marine sequence is composed mostly of carbonates (Cluj and Cozla Limestones) and marly facies (Brebi Marls), bearing a very rich, tropical fauna. There is a carbonate platform in the uplifted Preluca area and deeper water marls were deposited in the subsident Meseş and northern Gilau areas. The Hoia Formation (the last of the Cluj Group) marks the beginning of a new regression and eustatic sea level change. The Cozla carbonate platform has it uppermost part calcreted and marginal parts of the Gilau area were subaerially eroded during that time. The overlying Curtuiuş and Mera facies are brackish or paralic, coal-bearing and belongs to another sedimentary cycle.

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Enclosures : 3 Geological Maps.