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BIOSTRATIGRAPHIC AND PALEOECOLOGICAL CHARACTERISTICS OF ALB–CENOMANIAN SEDIMENTS OF KOSMAJ, SERBIA

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A very rich and varied fauna of **Ammonoidea, Bivalvia, Gastropoda, Brachiopoda,** and **Anthozoa** (total of 142 species) was collected from an Alb-Cenomanian fossiliferous lens on Kosmaj Mt. (near Belgrade). The fauna was studied for its biostratigraphic and paleoecological significance. The assumption is stated on the formation of the fossiliferous lens.

INTRODUCTION

Kosmaj Mountain is situated some forty kilometres south of Belgrade within the tectonic unit of the Shumadides (fig. 1).

The greatest area of Kosmaj Mt. is built-up of Upper Cretaceous flysch sediments, followed by serpentinites, and the subordinate Albian, Alb-Cenomanian, and Cenomanian sediments.

BIOSTRATIGRAPHY

An instructive section of Alb-Cenomanian sediments enclosing a fossiliferous lens with extremely rich and varied macrofauna was found in the village of Koracica on the eastern Kosmaj Mt. slope. The section is composed of clastic-carbonate sediments, and the lens of clay-marl. The lens is roughly two metres long, and up to half a metre thick. This small volume is including a concentration of hundreds of fossil forms, of which 142 species have been identified from nearly all groups of Mesozoic Invertebrata: **Gastropoda** (the highest incidence of 45 species), **Ammonoidea** (41 species), **Bivalvia** (36 species), **Echinoidea** (13 species), **Brachiopoda** (4 species), and **Anthozoa** (3 species). Unlike it, both under- and over-lying sediments are very poor in fauna (fig. 2).

The full list of the determined species is given below:

Anthozoa:

Caryophyllia cupuliformis Stol., Thamnastrea conifera Edw., Trotho-

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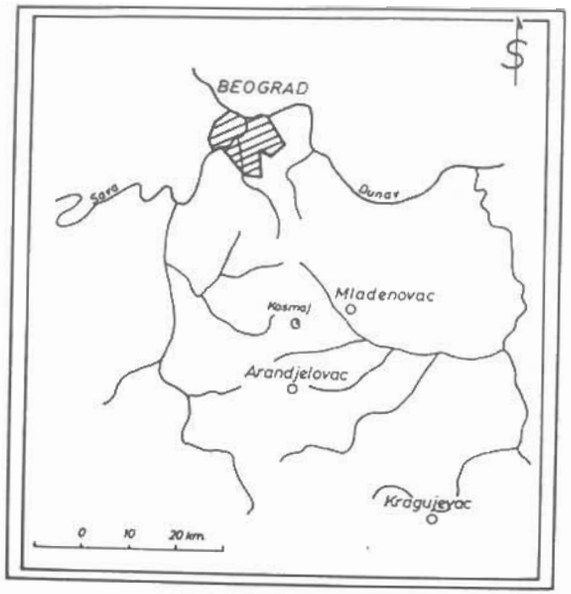

Fig. 1. General orientation of the examined locality
③ Fossiliferous lens

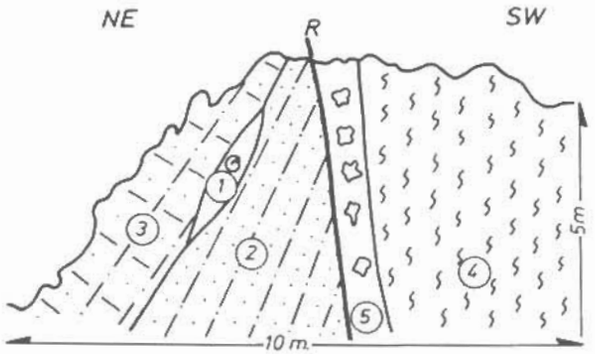

FIG. 2. A SECTION THROUGH ALB-CENOMANIAN SEDIMENTS OF KOSMAJ MT.

1. Fossiliferous lens composed of clay-sandy sediments

2. Marly and marly-sandy sediments

3. Massive sandy limestones

4. Serpentinite

5. Fault zone

smilia faba From.

Gastropoda:

Ampulina gabonensis Meun., A.giganthea Tav., Aporhais baylei Ether., Avelana alpina Pict.Roux, Chemnitzia boulei Col., Cirochilus cf.granulosus Stol., Claviscala rhodani Pict.Roux, Columbella insignis Gein., Eumargarita (Solariella) radiatula Forbes, Gyrodes cf.excavata Mich., Leptomaria pricei Cox, Littorina strenna Stol., Natica bulbiformis Sow., N.clementina d'Orb., N.cosnensis Lor., N.dupinii Leym., N.hebertiana Cott., N.gaultina d'Orb., N.lehardi Bray.-Corn., N.lyrata Sow., N.(Ampullina) cf.pagoda Forb., N.(Gyrodes) pansus Stol., N.pricei Lor., Nerinea aunisiana d'Orb., N.banga d'Orb., Neritopsis robineausiana d'Orb., Phasianella ervina d'Orb., Ph.incerta Forb., Pleurotomaria loricatula Stol., Pterodonta inflata d'Orb., P.intermedia d'Orb., P.gaultina Pict.Roux, Ringenella inflata d'Orb., Thylostoma ellipticum Pict.Camp., Th.cf.materinum Lor., Th.rochatianum d'Orb., Th.syriacum Anitab., Trochus conoideus Fitton, T.nevirnensis Lor., T.sarthinus d'Orb., T.striolatus Stol., T.waterloti Coll., Turritella cf.difficilis d'Orb., T.pondicherriensis Forb., Vanikoropsis (Natica) cassisiana d'Orb.

Bivalvia:

Anisocardia crassa Tav., A.orientalis Cour., A.pafleri Coqu., Arcostraea carinata Lam., Callista plana Sow., Cardium alpinum Pict.Roux, C.(Trachicardium)productum Sow., C.aff.raulinianum d'Orb., Corbis (Sphera) glabosa Sequ., Crasatella (Pachythearus)collignoni Fren., C.(Paachythearus) collignoni subteali Fren., Cuculaea glabra Parq., C.(Idonacra) shuberti Fren., Cyclorisma vibrayana d'Orb., Exogira (Thinchostrea) columbeana mermeti Coqu., E.cf.halothidea Sow., Granocardium (Cardium) proboscideum Sow., Idonoarca glabra Parqu., Isocardia agassizi Pict. Roux,Neithea (Neithea) aequicostata Lam., N.(Neithea) cf.coquandi Peron, N.(Neithea) dutrugei Coqu., N.(Neithea) faurenmuretae Fren., N.(Neithea) regularis Schloth., Opis glareosa Lor., O.hungardiana d'Orb. Pecten (Coneptonectes)dichotomus Sequ., P.(Aequipecten) cf.royanus d'Orb., Protocardia cf.birdena Whitf., Spondylus cf.striatus Sow., Thetironia laevigata Sow., T.major Sow., T.minor Sow., Thetis santaecrucis Pict.Camp., Trigonoarca lecointrei Fren., Velopecten aff.studeri Pict.

Ammonoidea:

Algerioceras boghariense Coqu., Beudenticeras laevigatum (Sow.)Spath., Brancoceras prosicostatum Breistr., Deiradoceras cunigteni Spath., Diploceras bouchardianum d'Orb., D.pseudoan Spath., B.cf.rectangularis Spath., Eotetrago-

nites laemensis Bresitr., Faronidella blancheti Hobe, F.gardiana Hobe, Hysterioceras baylei Breistr., H.binum Spath., H.carinatum Spath., H.chofatti Spath., H.orbignyi Spath., H.subinum Spath., H.varicostum Sow., Latidorsella latidorsata Mich., L.lemonei Coll., L.obesa, Pervinquieria cf.arictiformis Spath., P.cf.barbouri Haas, P.nana Spath., P.pricei Spath., P.quadratus Spath., P.rigida Spath., Phylloceras cypris Fallo., Puzosia ambligua Coll., P.cf.angladei Sayn., P.comunis centabrigens Spath., P.decaryi Coll., P.furnitana (Pervinqu.) Spath., P.mayoriana d'Orb., P.odensis Cossm., P.orientalis Mals., P.praecompressa Coll., P.quensteti P. et B., P.spathi Breistr., Tetragonites kiliani Jacob., T.cf.timateanus Pict., Uhligella walleranti Jacob.

Brachiopoda:

Lyra lyra d'Orb., Terabratula alpina Pict., T.capitata d'Arch., T.nicasei Coqu.

Echinoidea:

Cidaris dixoni Cott., Codiopsis doma Ag., Cottaldia benettae Cott., Discoidea rotula Ag., Echinoconus nucula d'Orb., E.orbicularis d'Orb., E.rhotomagense d'Orb., Holaster loevis (Deluc.)Ag., H.nodulosus Goldf., Pseudocidaris clunifera Ag., Pseudodiadema brogniarti Desor, Pyrina inflata d'Orb., Salenia scutigera Gray.

The Alb-Cenomanian age of the sediments was inferred from the species - related stratigraphy. Marl and marly limestone levels correspond to the lower, and the fossiliferous lens to the upper Alb-Cenomanian levels. The upper levels are indicated primarily by **Ammonoidea** species of the following genera: **Pervinquieria, Diploceras, Hysteroceras, Puzosia**, etc.

PALEOECOLOGY

In accordance with the great variety of the systematic faunal composition, the ecological composition was also highly varied. A great part of the ecological complex belonged to the vagrant benthos (Bivalvia, Gastropoda, Echinoidea). Note that Bivalvia, which could be generally taken for vagrant benthos, included some active swimmers (some of **Pectinida**) and those that were able to move but dwelt on the bottom more or less imobile (**Exogyra**). Finally, Bivalvia included forms of the sessile benthos (Spondylus, attached to the substratum by cementing its lower valve). Most of Gastropoda in the considered locality also belonged to the vagrant benthos. There were, however, among them forms that burrowed themselves in the loose sea bottom (Natica). Echinoidea also were vagrant forms that dwelt on sea bottom, but a significant number of

Irregularia (among Spatangoida in particular) burrowed in the loose substratum and lived more or less unmoving.

The abundant Ammonoidea belonged to active swimmers - the nekton - but of various mobility (good and poor swimmers). The forms with large, massive, much sculptured skeletons were supposed to had led benthonic life.

Brachiopoda invariably were forms of the sessile benthos, with different only the attachment to the substratum. The commonest attachment was supporting on a pedicle, or spines, or cementation of the lower valve. All of the Brachiopoda in the studied locality were supported on footstalks.

Corals were few in number, all the colonial forms.

If the Bivalvia, Gastropoda, and Echinoidea were taken together for a vagrant benthos, they would have constituted the largest part of the ecological complex (96 species or about 65%). Nekton included only Ammonoidea (41 species or about 30%). Organisms of the sessile benthos were the fewest (Brachiopoda and Corals in a total of 7 species or nearly 5%).

All the forms were purely stenohaline, living in a shallow and warm sea with good aeration.

For a paleoecological interpretation, i.e. reconstruction of life conditions that prevailed in the studied locality during the Alb-Cenomanian, a taphonomic study is very important, primarily for identification of the authochtony or allochthony of the fossil fauna, besides the study of its ecological or rather paleoecological characteristics. To this purpose, much consideration was given to the position of fossils in the rock (attitude to the sediment, between themselves, presence or absence of orientation, etc.). Also, the size of fossils was observed to distinguish between young and adult forms, and to see which of them prevailed, and was the material graded. Finally, various kinds and degrees of skeleton damage were studied.

Skeletons of fossil organisms were scattered in a chaotic pattern in the rock, oriented neither to the rock nor one to another. One beside the other lay forms of different groups in any position. Ammonites commonly took horizontal, rarely inclined, position. Bivalves had preserved only one or both valves; where only one valve, the concave surface was downside or upside. Most of echinoids were found in horizontal position with aboral or oral side upward. Not a single of the few sessile benthos (Brachiopoda and Corals) representative was found in its natural position taken when alive.

The fossils varied in size within a wide range, both in a group and on the whole. Grading of material was not noted.

Skeletons suffered mechanical damage in a high degree; the number of undamaged specimens with very well preserved sculpturing was proportionally

The commonest damage was the wear (erosion) of the external test surface, more or less conspicuous. In the most drastic case, the test was completely destroyed and the fossil preserved in a mould. Test erosion to various degrees was noted in many groups: Gastropoda, Bivalvia, Ammonoidea, Echinoidea.

The fractures that led to the damage were noted in each group of Invertebrata found in the studied locality: Anthozoa, Brachiopoda, Gastropoda, Bivalvia, Ammonoidea, and Echinoidea. This was the only kind of damage in the former two groups.

Fractured skeletons were noted among Gastropoda, Ammonoidea, and Echinoidea. In each case, the fractures were filled with calcite, which indicated their formation soon after the animal had died and filling with calcite during the fossilization.

Deformation of a skeleton was the rarest occurrence, noted only in one ammonitic species. The deformation was elastic-peliotomorphic.

The high percentage of skeleton damage, chaotic distribution of fossils, common presence of vagrant and sessile benthos and nekton, might suggest a prevailance of the allochthonous component in the oryctocenosis, although the transport could have been very short. In this respect, the fauna (though dominantly allochthonous) can be used in reconstructing the life conditions that prevailed in the studied locality during the Alb-Cenomanian. It could be summarized as: salinity normal, temperature high, sea shallow and aeration good.

The rich concentration of various groups of fossil fauna in a lens of only two metres in length can be explained by the presence of a small, shallow depression or a "pocket" on the platform bottom. Currents above the sea bottom, which washed out almost the entire shelf surface and carried any tests of both benthos and planktons, left this organic material "trapped" in the depression, because the currents either overpassed them or were too weak. Besides, a percentage of organisms was those in situ. The likely presence of a depression with the concentrated fauna was also indicated by the clay-sandy composition of the lens, in contrast to the well stratified terrigene-carbonate rocks under- and over-lying the lens.

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PLATE I

Fig. 1. Thamnastrea conifera Edw.
Fig. 2. Trochosmilia faba From.
Fig. 3. Vanikoropsis (Natica) cassisiana d'Orb.
Fig. 4. Ringenella inflata d'Orb.
Fig. 5. Pterodonta intermedia d'Orb.
Fig. 6. Chemnitzia boulei Col.
Fig. 7. Phasianella eryina d'Orb.
Fig. 8. Pleurotomaria loricatula Stol.
Fig. 9. Trochus striolatus Stol.
Fig. 10. Natica lyrata Sow.
Fig. 11. Turritella pondicheriensis Forb.
Fig. 12. Anisocardia pafleri Coqu.
Fig. 13. Isocardia agassizi Pict.
Fig. 14. Exogira halothidea Sow.
Fig. 15. Neithea (neithea) aequicostata Lam.
Fig. 16. Corbis (Sphera) glabosa Sequ.
Fig. 17. Neithea (neithea) regularis Schloth.
Fig. 18. Opis glareosa Lor.
Fig. 19. Hysterioceras carinatum Spath.
Fig. 20. Pervinquieria pricei Spath.
Fig. 21. Puzosia decaryi Coll.
Fig. 22. Hysterioceras orbigni Spath.

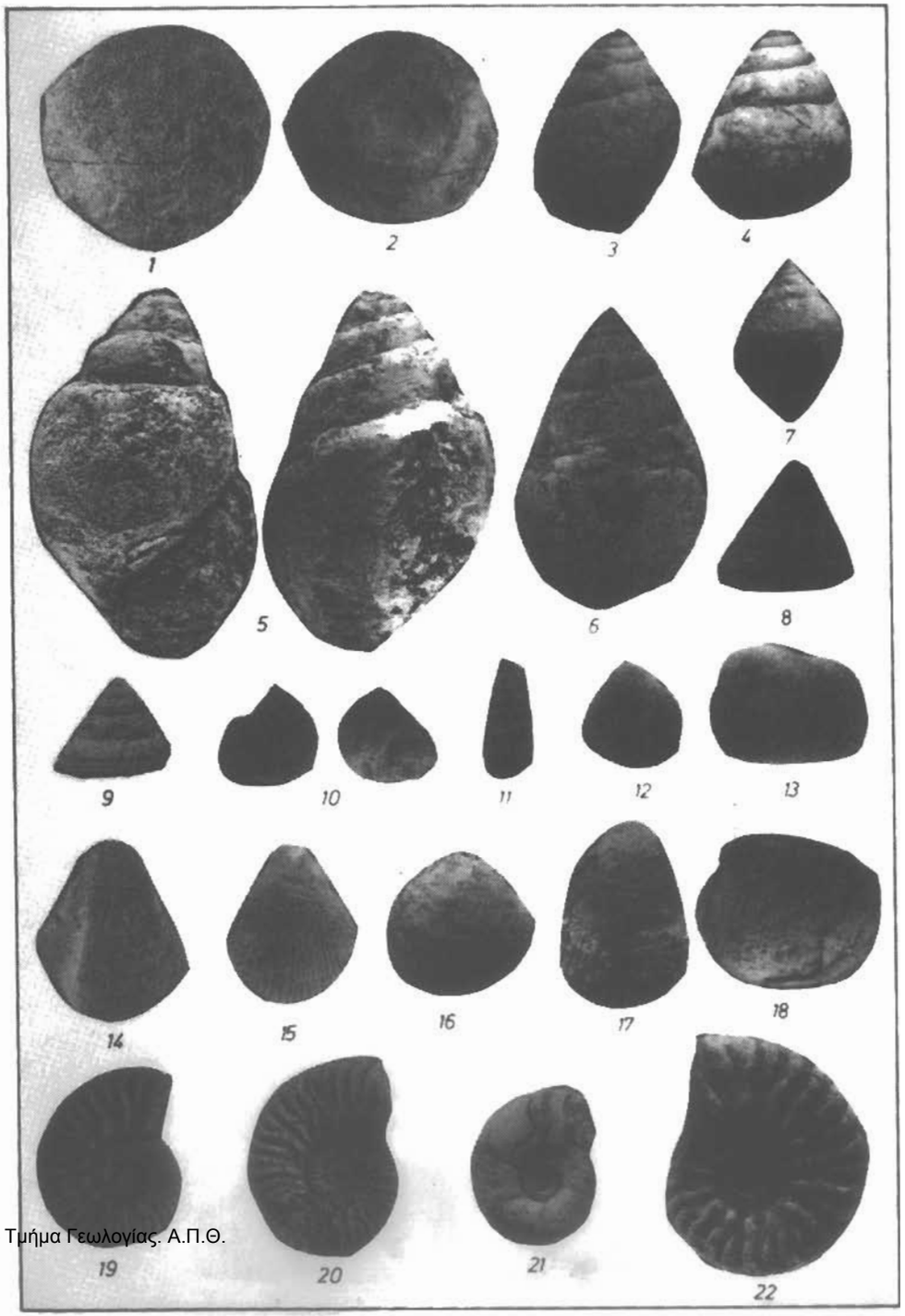

PLATE II

Fig. 1. Faronidella adriana Hobe.
Fig. 2. Hysterioceras baylei Breistr.
Fig. 3. Faronidella blancheti Hobe.
Fig. 4. Puzosia orientalis Mals.
Fig. 5. Deiradoceras conigteni Spath.
Fig. 6. Terebratula nicasei Coqu.
Fig. 7. Lyra lyra d'Orb.
Fig. 8. Echinoconus nucula d'Orb.
Fig. 9. Holaster loevis (Deluc.)Ag.
Fig. 10. Pseudocidaris clunifera Ag.
Fig. 11. Salenia scutigera Gray.
Fig. 12. Pseudodiadema brogniarti Desor.
Fig. 13. Discoidea rotula Ag.