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EXOTIC CLASTS OF ORGANODETRITIC ALGAL LIMESTONES FROM LITHOSOMES OF THE BABICA CLAY, SKOLE UNIT (OUTER FLYSCH CARPATHIANS, POLAND)

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Abstract: The paper deals with exotic clasts of Lithothamnium calcarenites and calcirudites occurring in the central part of the Skole Unit. The clasts are confined exclusively to those lithosomes of the Babica Clay (upper Paleocene) which occur within the Variegated Shale Formation, overlying the Bircza Lithothamnium Limestone Bed (BLLB). The exotic clasts represent fragments of talus deposits, formed due to degradation of algal reefs which were situated along the northern margin of the Skole basin. They were transported into the basin by dense cohesive flows that built pebbly mudstones lithosomes of the Babica Clay. Exotic clasts of calcarenites contain silicified cores formed after clast deposition. The age of exotic rocks was determined as the turn of the Early and Late Paleocene basing on foraminifers.

Abstrakt: Scharakteryzowano grupę litotamniowych, kalkarenitowych i kalcyrudytowych egzotyków, z centralnej części jednostki skolskiej. Występują one tylko w tych litosomach iłów babickich (późny paleocen), które usytuowane są w obrębie formacji pstrych łupków, powyżej warstwy litotamniowego wapienia z Birczy /wt/. Egzotyki te są fragmentami stożków nasypowych, formujących się z degradacji raf glonowych usytuowanych wzdłuż północnej krawędzi zbiornika tej jednostki. Ich transport w głąb zbiornika odbywał się w gęstych, kohezyjnych spływach żwirowców ilastych formujących litosomy iłów babickich. Egzotyki kalkarenitowe posiadają zsylifikowane jądro, utworzone po ostatecznej depozycji egzotyka. Na podstawie zawartej w egzotykach mikrofauny otwornicowej określono ich wiek na przełom wczesnego i późnego paleocenu.

Key words: Skole Unit, Babica Clay, organodetritic exotic clasts, calcareous algae, silicification, cherts, Paleocene, Outer Flysch Carpathians.

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INTRODUCTION

The object of this study are clasts of organodetritic algal limestones which fall into the category of exotic rocks (*cf.* Jaroszewski *et al.*, 1985). The clasts have been found in lithosomes of the Babica Clay occurring in the central part of the Skole Unit (Fig. 1), between Rzeszów and Ustrzyki Dolne (Rajchel, 1976a, 1989, 1990). The lithosomes with exotic rocks occur only above the Bircza Lithothamnium Limestone Bed (BLLB; Gucik, 1961; Kotlarczyk, 1978; Rajchel, 1976a, 1989; *cf.* Figs. 2, 3).

The Babica Clay represents strongly differentiated deposits of the pebbly mudstone type. They have been distinguished first by Kropaczek (1917a, b) near Babica village on the Wisłok River, and later described under this name from numerous sites of Upper Cretaceous–Lower Palaeogene strata in the Skole Unit. At present, the name "Babica Clay" is applied exclusively to those deposits of this type which occur in lense-like lithosomes within Paleocene strata of the Wola Korzeniecka Member, Ropianka Formation, and in the Paleocene sequence of the Variegated Shale Formation of the Skole Unit (Kotlarczyk, 1978; Rajchel, 1990).

The majority of exotic rocks studied do not show close resemblance to the older allodapic limestones of the BLLB (Rajchel & Myszkowska, *in press*). Some specimens resemble, in turn, carbonate conglomerates from the top of the Ropianka Fm, occurring in the north-eastern and central parts of the Skole Unit (Fig. 2; *cf.* Rajchel, 1976a, 1989; Kotlarczyk, 1988a).

The aim of our paper is to characterise the lithology of exotic rocks and to compare them with deposits of similar type and age. Such a comparison could help in documenting differences in appearance and mode of sedimentation of these deposits, as well as to confirm the exotic character of the clasts studied. Basing on foraminifer tests preserved within exotic rocks, the age of parent rocks has also been

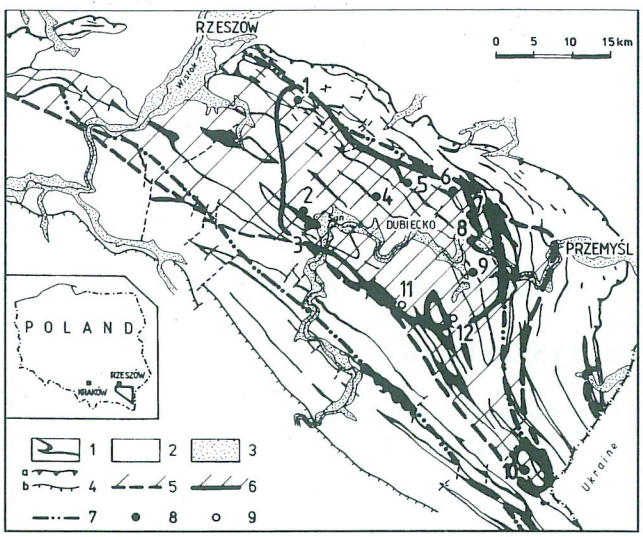

Fig. 1. Locations of exotic clasts of organodetritic Lithothamnium limestones in the Skole Unit (after Świdziński, 1958 and Rajchel, 1990; simplified and modified). *1* – Variegated Shale and Hieroglyphic Fm, *2* – Spas Shale Fm, Dołhe Fm, Ropianka Fm, Menilite Fm and Krosno Fm, *3* – Quaternary sediments, *4* – principal thrusts: *a* – Carpathian over thrust, *b* – other thrusts, *5* – extent of the Babica Clay lithosomes at the base of the Variegated Shale Formation, *6* – extent of exotic organodetritic limestones within lithosomes of the Babica Clay, weathering regolith, colluvia and alluvia, *7* – extent of the Bircza Lithothamnium Limestone Bed, *8-9* – outcrops of exotic clasts of organodetritic limestones: *8* – *in situ*, *9* – within weathering regolith. Sites: 1 – Zabratówka Wieś, 2 – Siodmówka, 3 – Przedmieście Dynowskie, 4 – Kosztowa, 5 – Drohobyczka Dolna, 6 – Skopów, 7 – Skopów Buczacz, 8, 9 – Bachów, 10 – Jureczkowa, 11 – Żohatyn, 12 – vicinities of Bircza

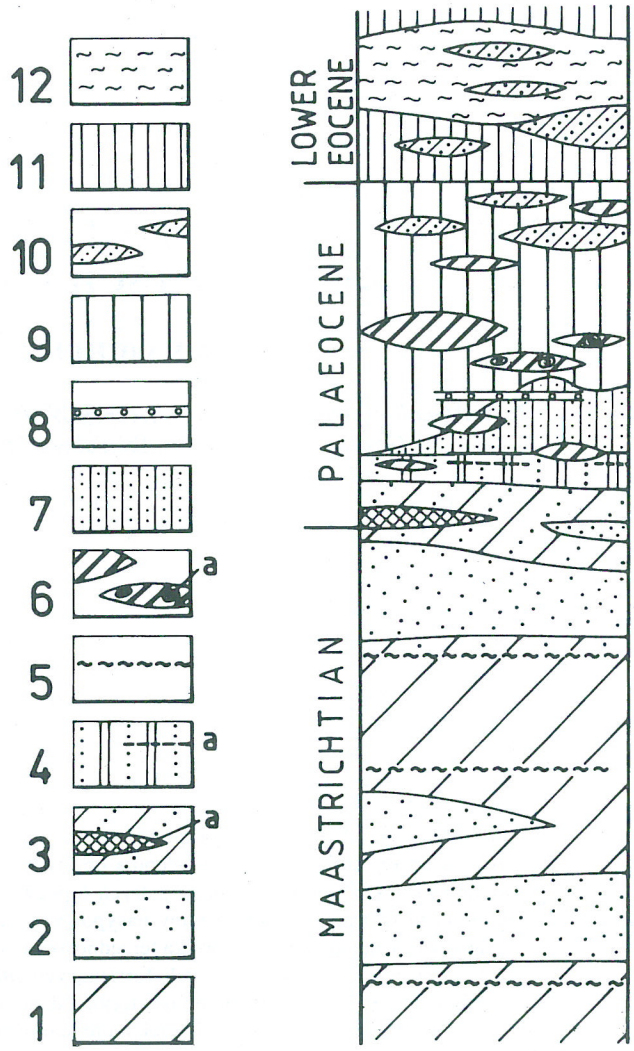

Fig. 2. Schematic lithostratigraphy of upper part of the Ropianka Fm and Variegated Shale Fm of the central part of Skole Unit (after Kotlarczyk, 1978 and Rajchel, 1990; modified and supplemented, not to scale). *1-5* – Ropianka Fm: *1* – thin-bedded sandstones and calcareous shales, *2* – thick-bedded calcareous sandstones, *3* – thin- and medium-bedded sandstones with intercalations of conglomerates and submarine slump deposits, *a* – Baculites marls, *4* – thin-bedded brittle sandstones and noncalcareous shales, *a* – Lithothamnium calcareous conglomerates and calcirudites, *5* – variegated shales markers, *6* – Babica Clay, *a* – exotic clasts of organodetrital limestones, *7-12* – Variegated Shale Fm: *7* – Boguszówka Sandstone Member, *8* – Bircza Lithothamnium Limestone Bed, *9* – Żohatyn Variegated Shale Member, *10* – Kosztowa Sandstone, *11* – variegated shales of the Lower Eocene, *12* – Trójca Variegated Shale Member

determined.

Our study makes it possible to reconstruct sedimentary environment of the northern margin of the Skole basin in Late Paleocene times, i.e. before its closing due to the Early Styrian orogenic movements (Kotlarczyk, 1988a).

BABICA CLAY LITHOSOMES: CHARACTERISTICS

Lithosomes of the Babica Clay were formed due to cohesive flows shed from the northern slope of the Skole basin (Bukowy, 1957a, b; Gucik *et al.*, 1962; Kotlarczyk & Śliwowa, 1963), wherefrom only the largest flows could have reached the axial part of the basin (Fig. 1; *cf.* Rajchel, 1990, fig.8). Moreover, the western part of the Skole Unit bears traces of the Babica Clay flows, derived from the southern basin margin (Szymakowska, 1961; Jasionowicz, 1962; Gucik *et al.*, 1962). The dispersive phase of such flows was usually composed of strongly sandy, black, carbonate clayey substance. Their dispersed phase, in turn, were lithologically differentiated exotic rocks, as well as rocks eroded from the base of the flow, occurring in variable proportions and showing different sizes. The dispersive phase usually dominates over the dispersed one, although the reverse situation can also be encountered (Fig. 3). The Babica Clay deposits rarely contain olistoliths.

The submarine slump origin of the Babica Clay results in the presence of irregularly spaced lense-like lithosomes of variable size and thickness up to 30 m.

The petrographic inventory of exotic rocks comprised in the Babica Clay can be reconstructed on the basis of numerous papers (Bukowy, 1956, 1957a, b; Kotlarczyk, 1961;

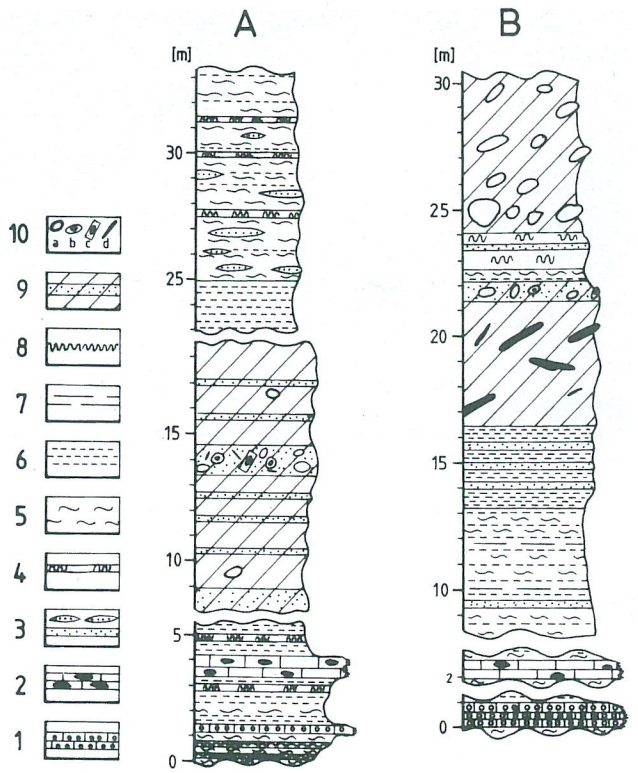

Fig. 3. Detailed lithostratigraphy of the lower part of the Variegated Shale Fm bearing lithosomes of the Babica Clay with exotic clasts of organodetrital Lithothamnium limestones: A – site 4 (Kosztowa), B – site 10 (Jureczkowa). *1-2* – layers associated with the Bircza Lithothamnium Limestone Bed: *1* – limestones with a high admixture of inorganic material, as well as sandstones and conglomeratic sandstones with large proportion of calcareous material, *2* – chert-bearing limestones with low admixture of noncalcareous material; *3* – very fine-grained white sandstones, *4* – ash-coloured-green mudstones, *5* – greyish red clayey shales, *6* – green clayey shales, *7* – grey clayey shales, *8* – deep-blue clayey shales, *9* – Babica Clay: black, calcareous, sandy shales with interlayers of clayey sandstones, *10a* – exotic clasts of organodetritic limestones, *10b* – clasts of limestones derived from the Bircza Lithothamnium Limestone Bed, *10c* – clasts of black shales, *10d* – other exotic rocks

Geroch & Kotlarczyk, 1963; Kotlarczyk & Śliwowa, 1963; Nowak, 1963; Dżułyński *et al.*, 1979; Skulich, 1986; Rajchel, 1989, 1990). The Štramberk-type limestones are the dominant component. Dolomites, marls, phyllites, porphyres, andesites, granites and other igneous rocks occur subordinately, alongside with clasts derived from the substratum, *i.e.* sandstones, shales and marls of the Ropianka Fm, and limestones originated from the BLLB. Exotic sandstones, conglomerates, quartzites and metamorphic rocks, as well as fragments of Carboniferous coal occur more rarely. These exotic rocks display highly variable sizes and diversified degree of roundness. The Babica Clay deposits also contain unusually abundant macrofauna of bivalves, gastropods, bryozoans, and corals, as well as fragmented and sometimes not dismembered Lithothamnium rodoliths.

LITHOLOGY OF EXOTIC ORGANODETRITIC LIMESTONES

The object of our study is a set of several tens of exotic rocks representing algal calcarenites and calcirudites. These clasts are usually prolate or circular, 10 to 30 cm in diameter. Most of them do not show any regular arrangement of components. Singular specimens (Kosztowa, site 4) display poorly marked horizontal lamination or grading. Infrequent specimens bear hollows of different depth and diameter (Fig. 4 & 5), left by boring organisms.

The population studied is dominated by calcarenite-type exotic rocks, the majority of which contain a central cherty core (Fig. 4). Carbonate components of these exotics are beige in colour algal biocalcarenites of variable content of sand fraction (Czermiński, 1955) (Fig. 6). Such a sedi-

Fig. 4. Polished slab of an exotic organodetritic Lithothamnium limestone of calcarenitic type. Irregular outer surface is visible along with central cherty core which reflects the shape of the surface and contain equally-spaced enclaves of unsilicified rock (arrowed). Site 4 (Kosztowa); bar scale in centimetres

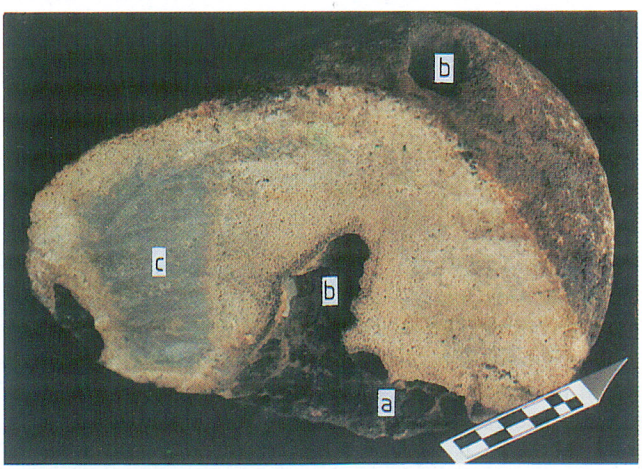

Fig. 5. Section through exotic rock built up of highly psamitic, organodetritic calcarenite. Clast pierced by borings produced by organisms (a), 6 cm deep and 1.5 cm in diameter, as well as a tunnel (b) of similar diameter. On the left – asymmetric silicification area (c), postdating the borings. Site 12 (vicinity of Bircza); from collection of Prof. Dr. J. Kotlarczyk; bar scale in centimetres