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GEOLOGY

Woźniki Limestone (? Lower Jurassic, Upper Silesia)

by

S. M. GĄSIOROWSKI and E. PIEKARSKA

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Summary. Woźniki Limestone, ?Lower Jurassic, extends in Upper Silesia between Zawiercie and Lubliniec. The main original deposit was a calcareous mud precipitated by organisms and by desiccation, containing an admixture of gypsum, in a shallow lake followed by a playa. Brecciation of the Woźniki Limestone was due to mud-cracking and caliche. The elongate sedimentary basin was of some 600 km².

This note presents some results of a study made in 1971–75. The petrographical work was done by Ewa Piekarska, the geological work by S. M. Gąsiorowski.

Definition. The term "Woźniki Limestones" ("wapienie woźnicko-lublinieckie" of Pusch 1836–46 [2], "Wojschniker Kalk" of Roemer 1870 [3]) has been used to mean indiscriminately: (1) local calcareous and dolomitic intercalations, as a rule marly, frequently sandy, dark, with animal macrofossils, from a few centimeters exceptionally to 5 m thick, contained in the Keuper and Rhaetian variegated clays in Upper and Lower Silesia together with the intercalations of the Lisów Breccia; (2) an almost pure limestone, most of it white breccias, seemingly devoid of animal macrofossils, up to 40 m thick, overlying the Keuper–Rhaetian in the large area of Upper Silesia between the environs of Zawiercie in the E and the environs of Lubliniec in the W.

We propose to use the term "Woźniki Limestone" (singular) to mean only (2). This is formally justified by the absence of outcrops of (1) in the type locality of Woźniki.

Occurrence. The Woźniki Limestone occurs as sheets capping some hills scattered over an elongate area of about 400 km². The division in particular sheets was presumably due to erosion, as the distribution of facies of the Woźniki Limestone (vide infra) seems to imply a single sedimentary basin. The distribution of fragments of the Woźniki Limestone in younger rocks suggests that the original area of the Woźniki Limestone was of about 600 km² (Fig. 1).

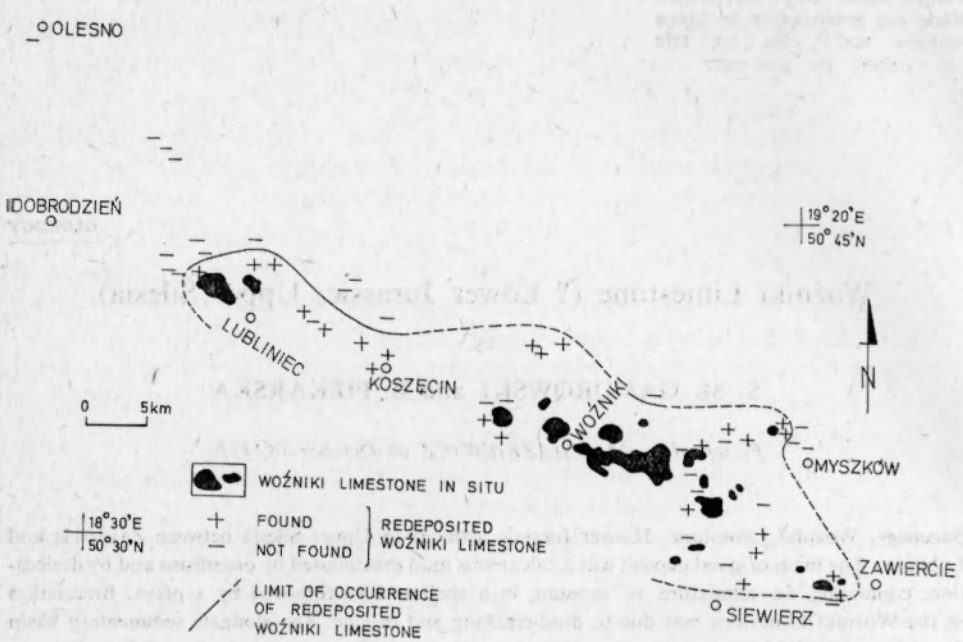

Fig. 1. Occurrence of Woźniki Limestone

Stratigraphical position. The Woźniki Limestone overlies directly (Fig. 2) the Keuper-Rhaetian clays dated by plant spores (cf. [1]). In most places, the lowermost part of the Woźniki Limestone (ca. 1.5 m) is somewhat marly and contains intercalations of red or green clays. This may be interpreted either as sedimentary continuity or as due to mechanical mixing of an argillaceous mud derived from the substratum with a calcareous mud precipitated over it. Locally, there occur slumps up to 12 m thick involving both clays and limestones. Data from boreholes reveal that the thickness of the Keuper-Rhaetian underlying the Woźniki Limestone is rather variable, which might suggest angular unconformity.

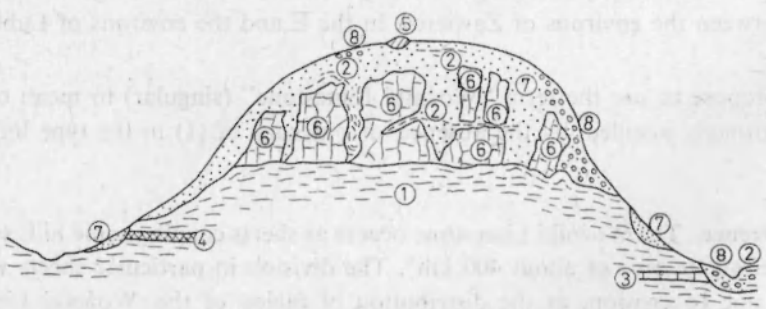

Fig. 2. Idealized section of an "island" of the Woźniki Limestone

1—Keuper-Rhaetian clays in situ; 2—redeposited Keuper-Rhaetian clays; 3—carbonate intercalation in the Keuper-Rhaetian clays; 4—Lisów breccia *in situ*; 5—redeposited Lisów breccia; 6—Woźniki Limestone; 7—ferruginous sands; 8—ferruginous gravels ("Polomia Beds")

The upper surface of the Woźniki Limestone is clearly erosional. It is covered successively by redeposited Keuper-Rhaetian clays mixed with ferruginous fine sands, a complex of ferruginous-argillaceous fine sands containing fragments, blocks and sheets of redeposited Keuper-Rhaetian, and ferruginous gravels. The clays, sands, and the lower part of the gravels contain redeposited fragments of the Woźniki Limestone. In some places, one or both lower members are lacking, and the sands or the gravels directly overlie the Woźniki Limestone. All three members are entirely unfossiliferous excepting fossils in the redeposited fragments of the Keuper-Rhaetian and of the Woźniki Limestone. The next member are Quaternary deposits dated by the presence of Scandinavian clastics.

The ferruginous gravels were called Połomia Beds by Znosko and placed in the Lower Lias on stratigraphical position in some profiles outside the area of the Woźniki Limestone [4]. However, it seems that several gravel horizons were formed in Upper Silesia in post-Triassic pre-Quaternary times, and it has not been shown that the gravels overlying the Woźniki Limestone or containing fragments of it correspond to the Lower Liassic horizon rather than to some other one.

The only fossils of some stratigraphical value found in the Woźniki Limestone are poorly preserved vascular plant remains indicating a Mesozoic, probably Rhaetian or Lower Jurassic, age according to Mrs. Ilona Zgierska of the Institute of Botany, Polish Academy of Sciences, Cracow (personal communication).

Composition and lithology. The Woźniki Limestone is almost pure autochthonous Ca carbonate. The autochthonous admixtures are: Mg carbonate, locally up to 3%; silica forming locally rare small cherts; iron compounds, locally colouring the rock red or yellow; and the original sediment should have contained an admixture of gypsum as implied by pseudomorphoses. The allochthonous sedimentary admixtures are: argillaceous substances, mostly in the lower part; locally common grains of presumably Middle Triassic limestones or dolomites; abundant clastic fragments of the Keuper-Rhaetian clays in the uppermost part; quartz dust. The allochthonous post-sedimentary material is mainly silica infiltrating down to some 4 m below the erosional surface, and iron compounds infiltrating through karst systems.

All fossils were calcified. The autochthonous fossils are cyanophytan or algal remains and locally ostracod shells. The allochthonous fossils determined by Mrs. Ilona Zgierska (personal communication) are vascular plant remains, namely horse-tail stems, cycadophyte leaves, conifer shoots and cones.

The following types of limestone may be distinguished: (1) entirely micritic limestone; (2) micritic limestone with small more or less rounded fragments of micritic limestone; (3) "shadow" breccias consisting of large fragments of micritic limestone not clearly delimited from the micritic matrix; (4) breccias with rounded or angular fragments of micritic limestone or of other breccias, cemented partly by micrite and partly by sparite; (5) as (4), but sparite prevails, and voids are common. Locally organic ooids and stromatolites are present. The bedding is as a rule very vague, except when indicated by ooids or stromatolites.

Deposition and post-depositional processes. Some previous authors (for bibliography, vide [4]) thought that the Woźniki Limestone was deposited directly by sources. It seems however not quite probable that sources produced directly a monotonous calcareous sheet up to some 40 m thick over an area of some 600 km² underlain by impermeable clays. We think that the usual original deposit was a calcareous mud with an admixture of gypsum, precipitated by organisms and by evaporation. Because of the very shallow water, allochonous clastics were generally left in the marginal parts of the basin. Allochonous plant detritus reached further due to lesser specific density, possibly also wind-driven over a desiccated surface in times of drought. The quartz dust is possibly eolian. It cannot be excluded that some calcareous and argillaceous dusts have also been transported by wind.

The brecciation of the usual original deposit may be explained by the single process of flooding and desiccation repeated several times. This process was not always achieved: the breccias (2) to (5) may be thought to represent, in this order, successive stages of interrupted desiccation.

Desiccation of a carbonate deposit may result in breccia by mud-cracking and by internal caliche. Several generations of caliche veins may be distinguished in the Woźniki Limestone. We believe that they may be divided into two groups: pre-erosional, and post-erosional karst-linked. The karst-linked caliche veins brecciation of the Woźniki Limestone seems to be still going on in some places.

The silification reaching down to some 4 m from the erosional surface may be interpreted as a desert varnish. In any case, the silification was posterior to the initial and anterior to the latest stages of erosion.

The iron compounds mineralizing the Woźniki Limestone along karst cavities and fissures could have been derived from the overlying ferruginous sands and gravels.

Distribution of Facies. The Woźniki Limestone is clearly bipartite (Figs. 3,4). The lower part seems to have been formed in a shallow lake seldom completely desiccated. The upper part, or white breccias, may be interpreted as playa deposits.

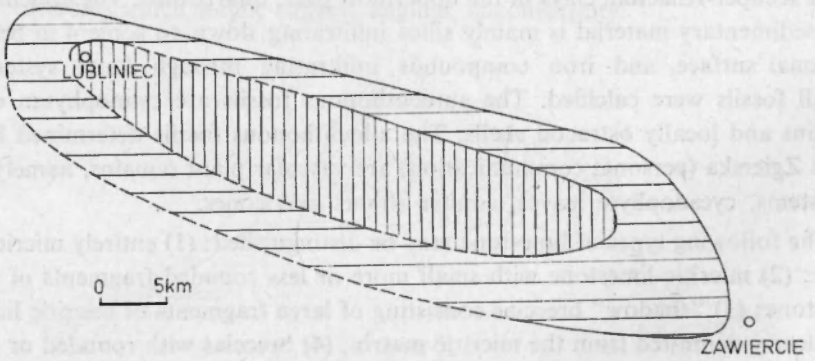

Fig. 3. Reconstruction of the sedimentary basin of the lower part of the Woźniki Limestone

Vertical lines: central facies: mainly white, micritic limestone caliche veins poorly developed; horizontal lines: marginal facies: argillaceous-calcareous mudflows or red, yellow or white limestones with organic ooids and with stromatolites, allochonous vascular plant remains, small clastic fragments of Muschelkalk, caliche veins very well developed, admixtures of gypsum

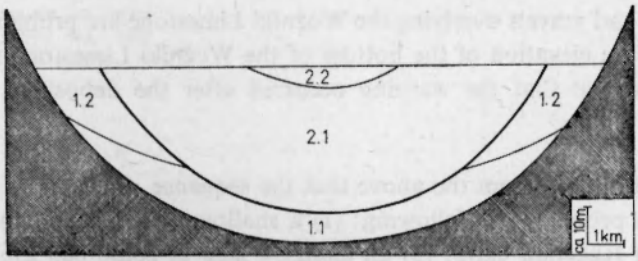

Fig. 4. Reconstruction of a transverse section of the Woźniki Limestone

Shaded: Keuper-Rhaetian clays: 1—lower part of Woźniki Limestone, 1.1 central facies, 1.2 marginal facies; 2—upper part of Woźniki Limestone, white breccias with gypsum, 2.1 without, 2.2 with fragments of Keuper-Rhaetian clays

Tectonics. Roughly parallel to the S margin of the E part of the Woźniki Limestone area there extends an anticline with the Devonian outcropped in the core, called Dziewki Anticline by some authors. The last important folding of this anticline was evidently pre-Woźniki Limestone and post-Muschelkalk. Some faulting occurred in the Dziewki Anticline after the deposition of the lower part of the ferruginous gravels overlying the Woźniki Limestone. In one of the "islands" of the Woźniki Limestone over the Dziewki Anticline dips up to 15° were measured. In the whole remaining area, the dips of the Woźniki Limestone are too small to be directly measured, and only mapping reveals a gentle warping or a slight faulting (Fig. 5).

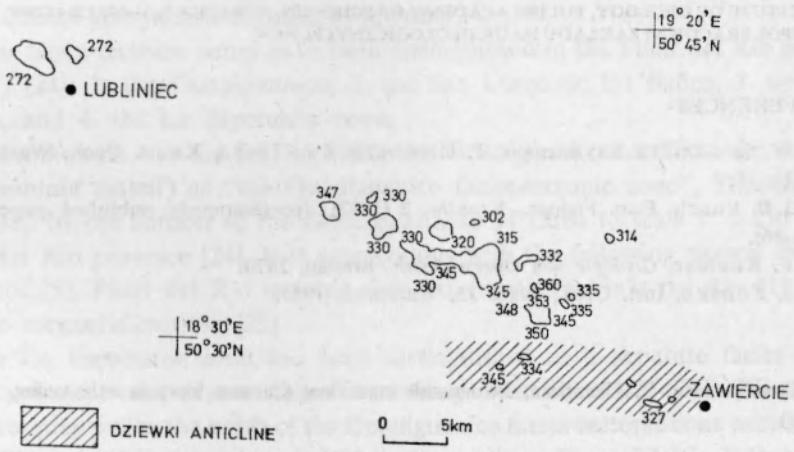

Fig. 5. Position of the bottom of the Woźniki Limestone in meters above sea level

On the other hand, gravitational sliding of blocks of the Woźniki Limestone over the Keuper-Rhaetian clays is very common (cf. Fig. 2). This seems to have begun before the deposition of the cover of the Woźniki Limestone, and it is going on in several "islands". Dips up to 40° reported by some authors were presumably measured in such blocks.

The sands and gravels overlying the Woźniki Limestone are probably the thickest in the area of an elevation of the bottom of the Woźniki Limestone near Pińczyce. This might suggest that the warping occurred after the deposition of the sands and gravels.

History. It follows from the above that the sequence of events in the area dealt with here was probably the following: (1) a shallow closed depression was formed in the Keuper-Rhaetian clays; (2) an elongate lake of some 600 km² appeared in the depression, followed by a playa; the main sediment was a bio- or evaporation--precipitated limestone mud, containing an admixture of gypsum; (3) the lake sediments were eroded with valleys reaching down to at least 30 m from their bottom, karstified, and partly silicified downwards from the erosional surface; the whole area has been buried successively by redeposited Keuper-Rhaetian clays, ferruginous sands, and ferruginous gravels with fragments of the Woźniki Limestone; erosion, silification, and deposition, were going on simultaneously in different parts of the area; (4) the valleys were re-excavated, and buried by the ferruginous gravels without fragments of the Woźniki Limestone; (5) slight tectonic movements resulted in a gentle warping of the bottom of the Woźniki Limestone; (6) in the Quaternary, the pre-ferruginous sands valleys were once more excavated, the remains of the cover of the Woźniki Limestone were deformed by cryoturbation, solifluction and glacitectonics, and partly mixed with erratic material and with material derived from the Upper Jurassic of the Cracow-Częstochowa questa.

INSTITUTE OF GEOLOGY, POLISH ACADEMY OF SCIENCES, SENACKA 3, 31-002 CRACOW
(ZESPÓŁ PRACOWNI ZAKŁADU NAUK GEOLOGICZNYCH, PAN)

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С. Н. Гонсёровски, Е. Пекарска, Возницкий известняк (?нижне юрские отложения, Верхняя Силезия)

Содержание. Возницкий известняк ?нижне юрские отложения — распространяется в Верхней Силезии между Заверцием и Люблиньцом. Главным первичным осадком является известняковый шлам, выделенный фотосинтезирующими животными и высушиванием, содержащий примеси гипса. Выделение состоялось в мелком озере, а затем в плеясе. Брекчии в Возницком известняке возникают в следствии крекинга из высушивания и каличе. Поверхность продолговатого бассейна была около 600 км².