



## ADDITIONAL NOTES ON GEOSITES OF THE UKRAINIAN ROZTOCZE

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**Abstract.** Geological investigations allowed to reconstruct sedimentary environments of the Miocene deposits from the Ukrainian part of the Roztocze Hills area. Moreover, three localities Stradc, Lozyna and Gleboviti are proposed as representative geosites of the Ukrainian Roztocze, which are spectacular from the geological point of view.

**Key words:** geosites, sedimentary environments, Miocene, Roztocze Hills, Ukraine.

**Abstrakt.** Badania geologiczne pozwoliły na zrekonstruowanie mioceńskich środowisk sedymentacji z obszaru ukraińskiej części Roztocza. Zaproponowano trzy lokalizacje na obszarze Ukraińskiego Roztocza: Stradc, Lozyna i Gleboviti, jako wybrane geostanowiska, unikatowe z geologicznego punktu widzenia.

**Słowa kluczowe:** geostanowiska, środowiska sedymentacji, miocen, Roztocze, Ukraina.

### INTRODUCTION

This paper contains additional information to Ivchenko paper on *Selected geosites of the Roztochya Hill (six years ago)* (Ivchenko, 2004). The Lower Badenian deposits, developed as the Opolo suite are exposed in the Lviv region (*see this volume*: Wysocka, Roniewicz, Fig. 2). These deposits rest here with a stratigraphical disconformity on an erosional surface of the Upper Cretaceous, Palaeogene or Karpatian. The Lower Badenian deposits form a continuous cover and they reach a maximum thickness of up to 80 metres in the area of the Roztocze Hills near Lviv (Buraczyński, 1997). They represent a set of lithologically diversified rocks with a predominance of sandy, quartz and quartz-glaucinite deposits, more rarely accompanied by calcarenites and *Lithothamnium* limestones. These deposits may pass laterally into each other, as well as occur several times within the sections.

The Middle Badenian deposits, in the Lviv region, are developed as the Tyras suite (*see this volume*: Wysocka, Roniewicz, Fig. 2). The rocks of this suite lie on an erosional surface of the Lower Badenian or the Upper Cretaceous (Bogucki *et al.*, 1998). The Tyras suite contains a complex lithological set: sulphate deposits — gypsum and anhydrites, chemogenic pelitic limestones (so-called the Ratyń Limestones), and sandy deposits. The lithofacies pass laterally into each other. Gypsum and anhydrites occur only on the southeastern slopes of the Roztocze Hills, in the transitional zone with the Carpathian Foredeep, where their thickness rarely exceeds 10 m.

The data come from the explorations conducted by many authors, and the most recent ones can be found in the Ph.D. dissertations by Wysocka (2002).

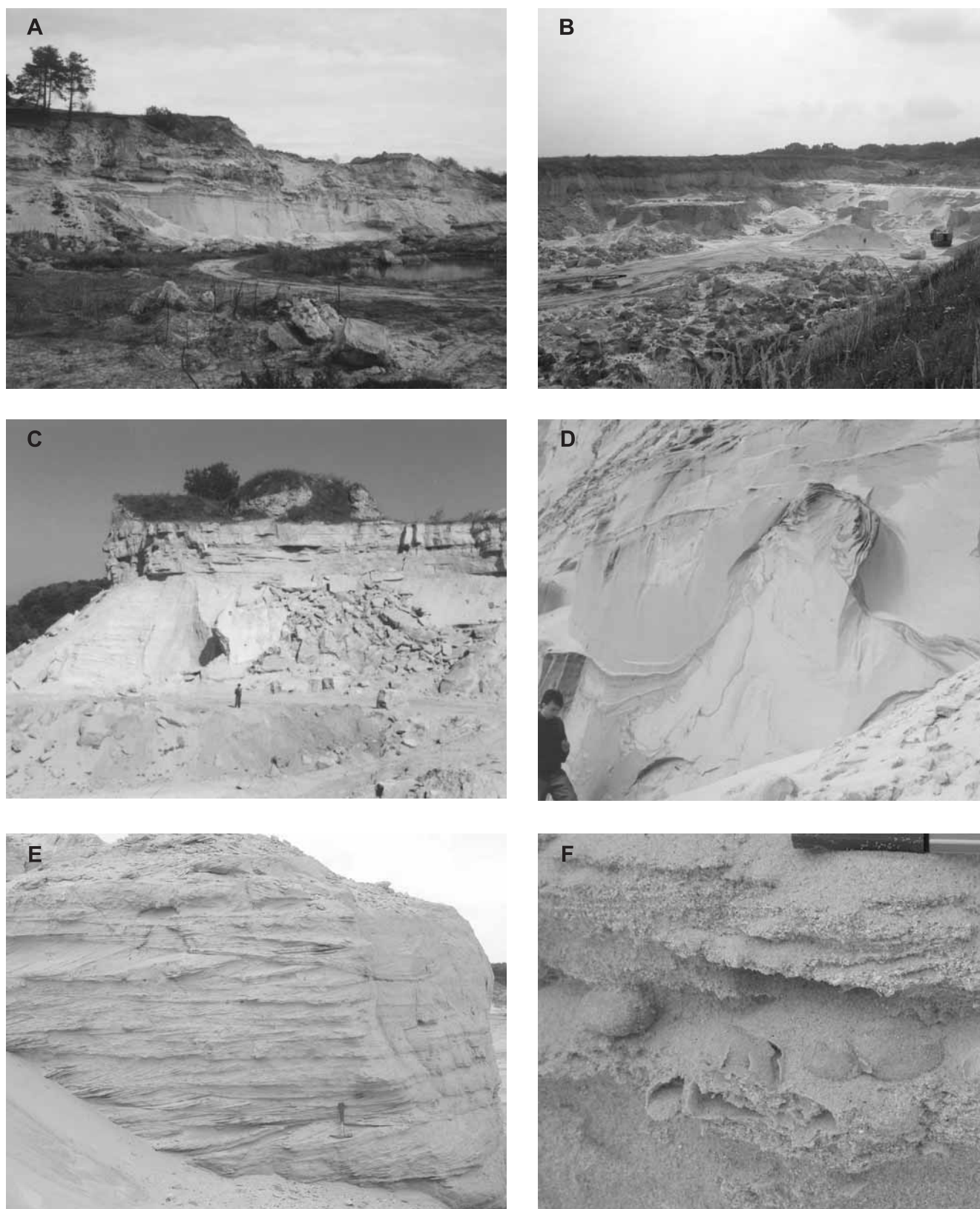
### CHARACTERISTIC OF THE SELECTED GEOSITES

**Stradc** (*see this volume*: Wysocka, Roniewicz, Figs. 1, 3). There is a vast, disused sandpit (Fig. 1A) on the southern slope of the Stradecka Hill in the Wereszczycza river valley, 20 km to the west of Lviv. An over 30 m thick section of Lower and Mid-

dle Badenian deposits — quartz sands, in some places slightly glauconitised, is exposed here.

The Stradc section is extraordinary, as far as sedimentary structures are concerned. Synsedimentarily disturbed stratifi-

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**Fig. 1. Representative geosites of the Ukrainian part of Roztocze**

**A** — general view of the Stradc sandpit; **B** — general view of the Gleboviti sandpit; **C** — general view of the Lozina I exposure; **D** — large scale fold deformation of diapir-type, in partly homogenous quartz sands (Stradc section); **E** — tabular sets of cross-bedding sands (Gleboviti section); **F** — streak of echinoid tests inside the cross-stratified sands (Gleboviti section)

cation and other deformational structures (Fig. 1D) occur within the sands. The style of sediment deformation is very varied, and ranges from small convolute folds within the ca. 10 cm thick layers, to diapirs with heights of 3 m. The occurrence of dispersed disturbed stratification, pillar water escape structures and dish structures has also been observed. The large-scale deformation forms are additionally associated with preferential cementation. Moreover, large-scale channel-like forms recur several times in this section.

On the western slope of the Stradecka Hill, above the sands, a 4 metre thick complex of Ratyń Limestones crops out. These limestones are developed as cream-coloured, pelitic, cavernous, strongly weathered rock. According to Łomnicki (1898), an important attribute of the Badenian deposits of the Stradc region is the presence of two levels of the Ratyń Limestones, separated by quartz sands. Unfortunately, these two separate levels cannot be found at present.

**Lozyna** (see this volume: Wysocka, Roniewicz, Figs. 1, 3). There are a sandpit (Lozyna I section) and a natural scarp in the Stara Rzeka valley (Lozyna II section), 7 km north of Stradc. The Lozyna I and II sections are about 2 km from one another.

In the Lozyna I section (Fig. 1C), the Lower Badenian deposits comprise, in ascending order, fine- and medium grained quartz sands; marly *Lithothamnium* limestones with abundant bivalve shells in their bottom parts; quartz sands with rhodoliths and *Lithothamnium* limestones in the top. These deposits are overlain by the Middle Badenian Ratyń Limestones.

In the Lozyna II section, quartz sandstones, marly *Lithothamnium* limestones with admixture of quartz and glauconite, strongly clayey quartz-glauconite sandstones with rhodoliths, *Lithothamnium* limestones with discontinuous interlayers of pelitic limestones and quartz limestones are exposed. They are overlain by the Ratyń Limestones. Modern karstic processes have developed between the quartz sandstones and the Ratyń Limestones.

**Gleboviti** (see this volume: Wysocka, Roniewicz, Figs. 1, 3). Next geosite of the Ukrainian Roztocze is the active sandpit

(Fig. 1B) with a section of Lower Badenian sandy and carbonate deposits, close to Bibrka village.

The Gleboviti section starts with tabular cross-stratified quartz sands (Fig. 1E). At the base of these sands an *in situ* occurrence of silicified taxodiaceous tree stumps has been noted (Radwański, Wysocka, 2001). Above, there is a 3 m thick, distinctly bipartite section, with numerous bioturbated horizons. The upper part of this set is very strongly bioturbated, with the bioturbation horizons occurring within the cross-stratified quartz sands. The sandy part is terminated by sands with sets of tabular cross-stratification, each set being about 10 cm thick. Higher in the section, quartz-rhodolithic sandstones and marly *Lithothamnium* limestones with coquina-like horizons rest on the sands with a distinct erosional boundary.

The sandy part of the Gleboviti section is unique because of the preservation of the biogenic structures. Preserved surfaces covered by echinoid burrows made by *Echinocardium leopolitanum* (Radwański, Wysocka, 2001) are observed relatively rarely because of poor lithification of the deposits. The echinoid tests from the Gleboviti section are exceptionally well preserved, commonly bearing an intact coat of spines (Fig. 1F). These echinoids, as well as their taphonomy and environmental (hydrodynamic) conditions of presumably lethal burial, were the subject of a separate paper (*op. cit.*).

The deposits from the Gleboviti section document a zone of deposition in the direct vicinity of the shoreline. In its lowermost part, an *in situ* occurrence of silicified stumps of taxodiaceans prove the continental conditions. The upper succession of biogenic structures reflects a gradual transition from the lower shore to progressively deeper offshore zones. It is expressed by the occurrence, in the lowermost part of the section, of traces of life activity of crabs, and higher in the section of numerous polychaetes and lobsters. These traces belong to the *Scolithos* and *Glossifungites* ichnofacies. The deposits occurring in the uppermost part of the sandy succession from the Gleboviti section and the assemblage of lobster and echinoid traces, belonging to the *Cruziana* ichnofacies, indicate the shallow-water conditions that are characteristic of the offshore areas.

## SEDIMENTARY ENVIRONMENT OF THE LOWER BADENIAN DEPOSITS OF THE UKRAINIAN PART OF ROZTOCZE

Most of the Miocenian sections of the Ukrainian part of Roztocze are of Early and Middle Badenian age. In the Early Badenian, the eastern part of Roztocze was a zone of shallow-water clastic sedimentation, characterised by constant intensive input of terrigenous material. This material consists mainly of well-sorted sand-grade quartz grains. This indicates that the land located to the north and the northeast was a low-lying area, devoid of substantial topography and covered by sandy weathering products. The source area of the material lay in Podole, where weathered material from crystalline rocks was reworked on multiple occasions. Quartz sands were delivered to the basin by rivers transporting substantial quantities of fine-grained material that probably formed deltas in the river mouths. Unfortunately, it is impossible today to directly recon-

struct the Early Badenian shoreline because of erosion of Badenian deposits from the area north and northeast of the Roztocze Hills. The depth of the basin never exceeded wave base during the Early Badenian. In such an environment the sedimentation was controlled mainly by changes in hydrodynamic conditions. These changes were induced by wind-driven waves causing the formation of currents. Strengthening of the influence of these currents, and therefore intensification of the sediment transport, probably took place during the storms. Generally, the transport of the material in this zone took place in a southward direction.

The period of deposition of the chemogenic series was preceded in this basin by facies unification. In the sections, organogenic and organodetritic deposits overlie the terri-

genous deposits. These are usually represented by sandy *Lithothamnium* limestones and marls. Their occurrence in the sections indicates a richer development of the red algae, probably connected with a decrease in the accumulation rate of the terrigenous material. These facies changes were connected with a lower energy of the environments, slight deepening and/or transition of the shoreline towards the north, and there-

fore with the shifting of the zone of intensive accumulation of terrigenous material in the same direction.

The Middle Badenian deposits, origin of which is connected with chemogenic processes, are developed as the Ratyń Limestones. Their occurrence has been observed only in some sections, among others in Lozyna and Stradc.

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