



Geosites of the Ukrainian Carpathians — draft candidate list

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Abstract. The Ukrainian Carpathians abounds with objects of great geological interests: 84 geosites are registered here. The area belongs to the Carpathian mantle-fold system of the Alpine orogeny, formed mainly by the Cretaceous, Palaeogene and Neogene deposits. It is the geomorphological region of denudation-tectonic mountains. In the paper, 7 objects of the geological heritage of Ukrainian Carpathians representing different types of geosites, are being proposed for the draft candidate list of geosites of Central Europe.

Key words: geoconservation, European geosite network, Ukrainian Carpathians.

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Streszczenie. Karpaty ukraińskie obfitują w obiekty o dużym znaczeniu geologicznym: aż 84 geostanowiska są tu zarejestrowane. Obszar ten należy do karpacciego systemu płaszowinowo-fałdowego orogenezy alpejskiej i jest zbudowany głównie z osadów kredowych, paleogeńskich i neogeńskich. Geomorfologicznie jest to region górski, denudacyjno-tektoniczny. W pracy przedstawiono 7 obiektów geologicznego dziedzictwa Karpat ukraińskich reprezentujących różne typy geostanowisk, a które są proponowane na wstępną listę geostanowisk Europy Środkowej.

Słowa kluczowe: geochrona, europejska sieć geostanowisk, Karpaty ukraińskie.

The Ukrainian Carpathians (Fig. 1) form the easternmost sector of the Carpathian mountain system, located in the western region of Ukraine (Lviv, Ivano-Frankivsk, Chernivtsi and Zakarpattya districts). The mountain massif (area about 24,000 km²) is 280 km long and about 100 km wide. The mountain ranges divided by longitudinal depressions and intersected by transverse river valleys, extend from north-west to south-east. The basic longitudinal structures are complicated by the ring structures here and there. The heights of the mountains vary from 120–400 m a.s.l. in the foothills to 500–800 m in the inner depressions and up to 1500–2000 m at the crests of the main ranges. The highest summits: Goverla (2061 m a.s.l., the highest mountain summit of Ukraine), Petros (2020 m a.s.l.) and others — are located in the Chernogora massif.

The longitudinal extension of the Ukrainian Carpathians results from orientation of the main East-Carpathian tectonic structures. By structural conditions, the area belongs to the Carpathian mantle-fold system of the Alpine orogeny. The Cretaceous, Palaeogene and Neogene deposits are most important in the geological structure of the Ukrainian Carpathians, in particular the Cretaceous–Palaeogene flysch. The Jurassic limestones and Palaeozoic crystalline cherts are also known.

The Neogene volcanic rocks form one of the Carpathian mountain range and are represented by andesites, basalts and tuffs. According to the geomorphological division into regions of the Ukrainian territory, the Ukrainian Carpathians belongs to denudation-tectonic mountains.

The Ukrainian Carpathians are prominent from a viewpoint of the geological heritage of Ukraine and abounds with interesting geosites. 84 of them have been registered in the area: 32 geosites have already obtained geoconservation status, 23 are protected within different natural reserves (botanical, landscape, hydrological, etc.), while 29 are considered as prospective candidates for geoconservation.

Selected geosites of Ukrainian Carpathians

1. The Dora flexure and large gothic folds in the north outskirts of the Yaremcha town (Nadvirna administrative region of Ivano-Frankivsk district), on the right bank of the Prut river valley, within the flysch belt of the Carpathians mountains (590 m a.s.l.; 48°30' 13"N/24°38' 27"E).

Main features: sequence of Upper Cretaceous, folds, flexure.

The site represents a tectonic disconformity of sandy-argillite flysch rocks of the Striy site of the Upper Cretaceous. The interlayers of fucoid marls with remnants of bivalve, gastropod,

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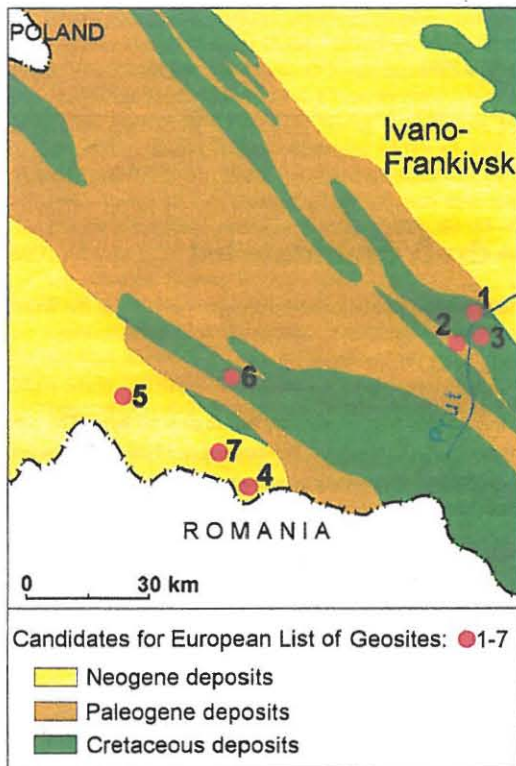


Fig. 1. Distribution of geosites in relation to geology of the Ukrainian Carpathians



Fig. 3. The large gothic folds of Upper Cretaceous flysch deposits in the Prut river valley



Fig. 2. The Dora flexure within Upper Cretaceous flysch deposits in the Prut river valley. All photos by E. Timchenko



Fig. 4. The Yaremcha rocks and Yaremchansky Guk waterfall on the Prut river

brachiopod and foraminifera can be also observed (Klyarovskiy & Biloush, 1985b). The flexure Dora (named after the nearest settlement) is formed as a thrust of the upthrown structural block on the horizontally bedded layers of these very rocks (Fig. 2). The height of the Dora flexure is 7–10 m. The flexure is especially interesting as it demonstrates the direction of tectonic movements just opposite to the typical Carpathian ones.

The series of the gothic folds consisting of the same rocks of the Striy site are located a little bit farther to the south-west from the flexure. The axial planes of the folds are almost vertical and diverge in a fan-shaped way. The folds are complicated by small fracture zones. Some fissure systems can be seen. The changes of their thickness show the slackening of tectonic tension in more plastic upper rocks.

The geosite is valuable as a demonstration of bilateral compression deformations under conditions of ascension movements, small static pressure and insignificant thickness of overlying rocks (Fig. 3).

The locality has been protected since 1972 in the area of 5 ha.

2. The Yaremcha rocks and waterfall Yaremchansky Guk in the Yaremcha town (Nadvirna administrative region of Ivano-Frankivsk district), within the flysch belt of the Carpathian mountains (590 m a.s.l.; 48°29'31"N/24°37'49"E).

Main features: exposure of the Palaeocene deposits, mineralogical associations, waterfall.

The site represents the exposure of the Palaeogene sandy-argillite flysch (the Yamna site of the Palaeocene). The sandstones are interlayered with thin parti-coloured aleurolites, argillites and gravelites. Some strata include an admixture of malachite, chalcopryrite, bornite, chalcocite and other minerals (Klyarovskiy & Bilous, 1985a).

Just near the exposure, the river Prut valley gets narrow. The river waters running the cascade of rapids fall down from the last step which is about 5 m high into the picturesque rounded basin (Fig. 4). Below the waterfall named the Yaremchansky Guk, the river channel turns to the right (almost at right angles). The further river flow is calm. The origin of rapids as well as of the deep basin is geologically related to the intersection of some tectonic faults just in this place. The massive quartz sandstones have been split up as a result.

Representative stratigraphic section, prominent manifestation of tectonic movements and magnificent waterfall show the significant value of the geosite.

The locality has been protected since 1972 in the area of 1 ha.

3. The Drybka site in the vicinity of the Yaremcha town (Nadvirna administrative region of Ivano-Frankivsk district), on the right bank of the river Prut valley (610 m a.s.l.; 48°26'39"N/24°35'18"E).

Main features: Quaternary stratigraphic sequence, Pleistocene river terrace, Cretaceous–Palaeogene pinnacles.

The Drybka geosite is the geological sequence of the Early Pleistocene high terrace of the river Prut valley located within a very picturesque rock-forest landscape locality. The sequence has been firstly described by Klapchuk (1992). 7 stratigraphic units of the Lower, Middle and Upper Pleistocene are represented by the cyclically alternated horizons of palaeosols and loess-like deposits which are related to interglacials and glacials, respectively. These units of the Ukrainian stratigraphic scheme of the Pleistocene (Veklich (ed.), 1993) — from the Lubny to the Uday units inclusive — correspond chronostratigraphically to the interval from the Cromer to the beginning of the Pleniglacial of the European scheme of the Quaternary subdivision.

The geosite deposits are rich in botanical microfossils. Pollen characteristics of each unit allow to recognise the vegetation successions during the corresponding time intervals (Gerasimenko, 1994). The palynological data make possible the correlation of stratigraphic units and palaeogeographical events of the mountain and plain territory of the Western Ukraine. The collection of pollen samples is preserved in the Institute of Geography of National Ukrainian Academy of Sciences.

The picturesque forms of the Cretaceous–Palaeogene rocks

(Fig. 5) above the Quaternary terrace surface have been caused by the latest weathering processes and include the cavern of the historical-ethnographic value.

The geosite is valuable as it shows a detailed stratigraphic subdivision of the Quaternary of the Ukrainian Carpathians, provides with a most representative data on the Pleistocene vegetation and climatic history of this mountain region and is aesthetically attractive. The locality has been protected within the framework of the Carpathian national natural park since 1972 in the area of 13.7 ha.

4. The Sotolvyno salt dome in the western outskirts of the Sotolvyno town (Tyachev administrative region of Zakarpattya district), in the south-western part of the Sotolvyno depression of the Ukrainian Carpathians (the Zaton locality) (470 m a.s.l.; 46°56'17"N/23°50'39"E).

Main feature: Neogene salt dome, salt weathering and salt karst relief features.

The salt dome of the Neogene age penetrates through the Pliocene and Quaternary alluvial deposits and shows itself as a series of deeply weathered, dissected by furrows elevations. As a result of the diapir structure uplift, the river Tyssa terraces have been deformed (for instance, the 3–5 m elevations of the III terrace surface). The elevations are separated by depressions with funnel-shaped karst forms and small salt ponds (Ivanchenko, 1985a).

The large part of the salt rocks have been eroded, nevertheless the remnants (salt mushrooms) are preserved here and there under the cover of the Quaternary alluvial pebbles and gravels (Fig. 6). Besides, the salt rocks are exposed in the steep erosional banks of the river valleys. In the exposures, the salt is characterized by the fine- and medium grained texture, which is emphasized by a colour of the salt, varying from snow-white to dark-grey, depending on the amount of clay particles. The latter are always present at the peripheral parts of a diapir structure.

The rock salt mine is situated in the locality. The main productive layer is bedded at the depth 350 m. The galleries connect a series of the large halls, which are up to 85 m high. The collection of samples are preserved in the mine museum.

The geosite is unique for Ukraine and represents an expressive manifestation of relatively recent tectonic processes and salt karst development. The locality has been protected since 1969 in the area of 3 ha.

5. The Khust volcanic remnant in the south-eastern out-skirts of the Khust town (Zakarpattya district), in the western part of the Sotolvyno depression of the Ukrainian Carpathians (330 m a.s.l.; 48°10'51"N/23°19'27"E).

Main features: Neogene volcano, denudation relief features.

The cone-shape remnant of the Neogene volcano is 160 m high above the surface of the right bank terrace of the river Tyssa (Fig. 7). This is a hill with steep (or even abrupt) slopes which is lengthened from east to west and covered with magnificent broad-leaved forest. It belongs to the Vygoliat-Gutynsky volcanic range but is separated from the nearest volcanic massifs: the Tolsty Verkh (in 3 km) and the Oash (in 2 km) — by the



Fig. 5. The Drybka site — sandstone tor in the Prut river valley

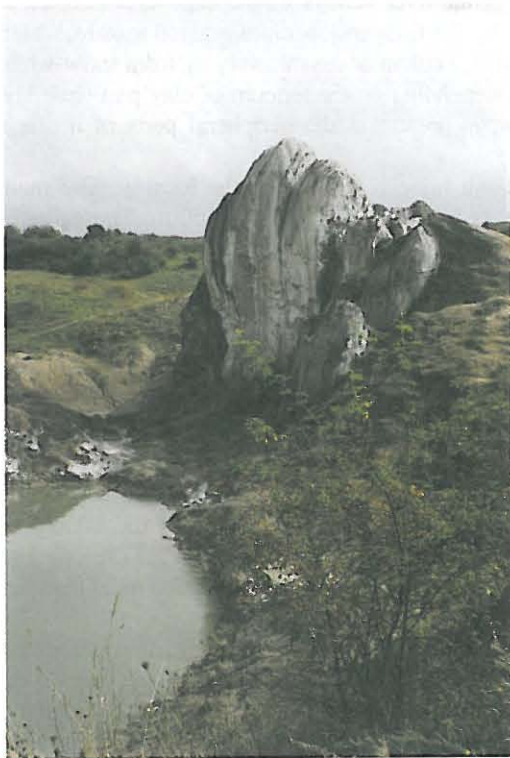


Fig. 6. The Soltvino salt dome



Fig. 7. Neogene Khust volcanic remnant



Fig. 8. The sequence of flysch in the Teresva landslide cirque

tectonic-erosional processes. The remnant is composed of andesites (Ivanchenko, 1985b).

The flat top of the hill has been utilised in the Middle Ages for the construction of a majestic castle. Its thick stone walls with remnants of the towers and bastions are preserved up to the present.

The geosite is valuable as the most representative combination of volcanic and latest erosional processes in the Ukrainian Carpathians. The locality has been protected since 1969 in the area of 10 ha.

6. The Molochny Kamin cave on the southern slope of the Molochny Kamin mountain (Tyachiv administrative region, Zakarpattia district), within the Rakhiv–Perechyn belt of limestone rocks (870 m a.s.l.; 48°13'42"N/23°38'19"E).

Main features: Karst cave, tectonic fractures, exposure of Cretaceous deposits.

The entrance to the cave is located at the foothill of the huge

rock consisting of the blue-white marmoraceous Cretaceous limestones and intersected by a large amount of tectonic fractures (Chernyshch, 1964). The cave of a karst origin has been formed according to the fissures. The cave entrance is so large (10 x 2,5 m) that all cavern is lit with a diffused daylight inside. The cave bifurcates 5 m below the entrance. The right passage is 5 m wide and leads to a chamber (10 x 15 m in size and 15 m in height), which walls are covered with calcite sinter. The next passage leads to the smaller chamber with beautiful sinter ribs and the large 2 m high stalagmite. The third chamber (10 x 5 m) is covered completely with the cascade sinter. The total cave length is 92 m, the volume 630 m³.

The geosite is valuable as a very expressive manifestation of the Carpathian karst, and due to the high aesthetic attractiveness of its rocks, sinter forms and natural lighting. The locality has been protected since 1972 in the area of 0.5 ha.

7. The Teresva landslide cirque in the vicinity of the Teresva town (Tyachiv administrative region of Zakarpattia district), within the flysch belt of the Ukrainian Carpathians (490 m a.s.l.; 48°03'42"N/23°42'29"E).

Main features: landslide cirque.

The geosite represents a huge landslide cirque on the right bank of the Teresva river (the right tributary of the Tyssa river). The shear surface of a classical crescent-shaped form is well exposed (1200–1300 m long, 30–35 m high). The Neogene sandy-clayey deposits are mainly exposed in the shear surface (Fig. 8). The landslide body (the area above 1.5 km²), slipped along the Palaeogene clay deposits, is characterized by almost plain surface with a weak inclination to the shear surface (Ivanchenko, 1985c). The landslide is supposed to be formed about 100 years ago. For many years its plain surface has been used as agricultural lands.

The geosite is valuable as the largest, the most representative

and the best preserved landslide of the Ukrainian Carpathians. This geosite is proposed for protection, area to be protected is 20 ha.

Conclusion

The sites selected for the draft candidate list represent some main features of the geological heritage of the Ukrainian Carpathians, as well as different types of geosites. Almost all of them are complex, many-sided. Nevertheless, small group of sites can not show all rich and diverse features of the Carpathian geological heritage. The further work on the draft candidate list of the geosites representative of the Ukrainian Carpathians is continued.

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