

GEOTOURISTIC SITES OF THE VOLHYNIAN BASALTS

Derevska K.I.^a, Shumlanskyi V.O.^a, Solecki A.T.^{b*}

^aInst. of Fundamental Studies USA, O4050, Kyiv, vul. Melnikova 30 a, Ukraine

^bIns. Geol. Sci. U.Wr. pl. M. Borna 9,50-204, Wrocław, Poland

Abstract

Getouristic sites illustrating geology of unique European occurrence of flood basalts similar to Siberian and Deccan Traps. Volhynian basalts being Precambrian (Vendian) in age are significantly older than the Siberian and Deccan ones, which formed at the end of Permian and Cretaceous respectively. In the case of Volhynian basalts additional point of interest is their native copper mineralization comparably with the legendary Lake Superior world's largest occurrence of native copper.

1. Introduction

The Volhynian basalt extruded in Vendian, at the north western margin of Ukrainian Craton (Fig.1, A). They form vast cover, extending for 140 000 km² at the western margin of the East-European Craton which developed during last stages of Rodinia rifting and preceding the formation of Tornquist Ocean (Poprawa et al., 1999). Significant part of Volhynian Basalts is nowadays covered by younger strata so they are not so well exposed as their younger equivalents: Siberian (Permian), Deccan (Cretaceous) or Columbia (Miocene) Traps. However, their native copper mineralization (Fig.1,B) make them unique geological phenomenon in Europe, which can be compared only with Lake Superior world's largest occurrence of native copper exploited by Indians for 4500 years.

2. Early studies of Volhynian basalts

The first scientific remarks on the Volhynian basalts has been published by Tyszeckij (1862), who noticed Cretaceous sediments overlying basalt series and assumed pre-Cretaceous age of volcanic rocks. Blumel (1867) after petrographical examination called them melaphyres. Karpinskij (1873) classified the Volhynian basalts as anamesites and described the basalt quarry Żałzne with overlying conglomerate with *Terebratula carnea* Sow. *Rhynchonella plicatilis* Sow.? and unidentified: snails, brachiopods and mollusks. He noticed that conglomerate was covered by Cretaceous sediment with numerous *Terebratula semiglobosa* Sow. Pfaffius (1886) described Volhynian basalts as augite porphyrite to avoid name basalt reserved in those years for Tertiary rocks and noticed that they are covered by Cretaceous sediments.

* corresponding author e-mail : asol@ing.uni.wroc.pl (A.T. Solecki)

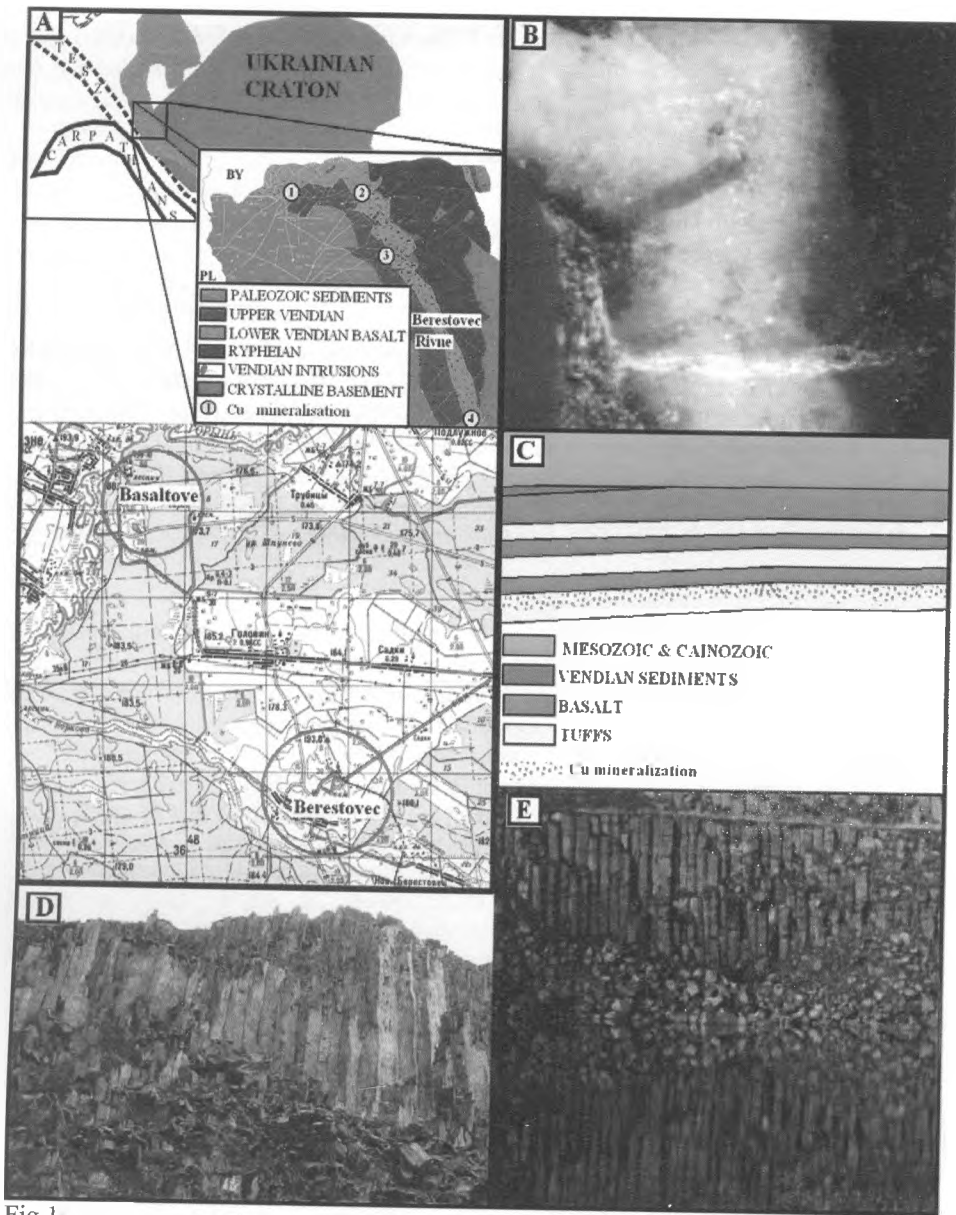


Fig.1.

A - Localization; B - Quartz vein from the Volhynian basalt with native copper; C - Stratigraphic position of copper mineralization; D - Columnar jointing in basalts (Berestovec); E - Abandoned quarry in Bazaltove.

Giedrojc (1895) noticed green sands overlying basalts in Podluzne. Significant controversy about age of Volhynian basalts existed in the past. Some authors (Tutkowskij, 1903; Siemiradzki, 1909; Morozewicz, 1921; Małkowski, 1929, 1931) supported the idea about their Cretaceous or even Tertiary age and intrusive character, others (Tyszeckij, 1862; Kamiński, 1927; Mazurek, 1928) stressed their effusive character and transgressive position of Cretaceous cover. Summary list of these early studies has been published by Lazarenko et al., (1960).

In the second half of the XX-th century their early Vendian age became fully accepted (Volovnik, 1975; Alenko et al., 1990). According to K-Ar data overlying sedimentary rocks yielded ages 591-546 Ma (Sokolov, Fedokin, 1990, fide Compston et al., 1990) and the uppermost tuff of Slavatyce series correlated with Volhynian Series has been found to be as old as 551 ± 4 Ma (Compston et al., 1990). Detailed petrologic description has been published recently by (Białowolska et al., 2002).

3. Copper mineralization

The very first reports on occurrence of native copper in Wielki Mydzk have been published by Małkowski (1929, 1931). The biggest native copper specimens found during his studies were 892, 820 and 807 g respectively. According to chemical analyses copper content of native specimens was 99.819 what means extremely high purity. Area of the discovered zone was of order 1 ha and total reserves estimated to be of order 2740 kg Cu. As a result of borehole investigation he also who found that copper mineralization was nested at the basal contact of the basalt cover with underlying psammite (tuff). Extensive works of Ukrainian geologist after WWII resulted in more precise image and significantly extended knowledge about the range of this unique phenomenon (Fig.1, C).

4. Archeological context

In his report Małkowski pointed out that significant amount of copper have been mined by ancient unidentified miners. Occurrence of copper must have been known to local people since the part of the waste land "Dubnyk" has been called "Miedziszczce" or "Miediszczce" from ancient times and local stream is called "Miedzianka". According to Małkowski the XVI century name of the locality "Medsko" is connected with copper. Słownik Geograficzny Królestwa Polskiego refers to "Mydsk" as village which in 1572 belonged to ihumen Sylwester from "Monasterzyszcze" (near "Stepań"). There is no historical documentation of copper mining in this area. In Małkowski's opinion obvious conclusion is that any such activity must have take place in prehistoric times. Dziekoński (1960) mentioned Bronze Age native copper exploitation in the Volhyn area.

What is especially interesting is the fact that numerous mining shafts have been discovered during prospecting works in 1929-30. These ancient works were filled with waste rock, with pieces of charcoal, ceramic, crushed bones and stone tools made of red psammite.

The eldest known traces of European copper exploitation are dated 4400 B.C. in Varna, Bulgaria. The first transitional stage of the Copper Age is often referred to as

so called Chalcolithic period when native copper was used without any metallurgical process. The real metallurgy of copper and its alloys started 2500 B.C. in SE Europe and next in Aegean culture. N. Polonska-Vasylenko (1995) refers to copper deposits only in Don, Lugansk and Bakhmut area suggesting influence of Aegean culture. M. Hruszewski (1913) stated that copper and bronze were imported to Ukraine from the south (Black Sea and Danube area). Orest Subtelny (1991) refers to rare copper items found in Tripilska culture (2000 B.C.) as Asian import.

The eldest Copper Age culture of the Volhyn area is the Strzyżowska culture (named after Strzyżów in eastern Poland, Kmiecinski, 1989). This culture developed at the end of the Stone Age (1500-1700 B.C). Numerous copper jewelry of Strzyżów culture in Volhyn might have been connected with native copper occurrence. What must be stressed is the fact that people of this culture were familiar with mining technology which they used for exploitation of cherts (e.g. Gorodok near Rivne).

5. Proposed geotouristic sites

Proposed geotouristic sites (Fig. 1 A, D, E) are:

1. Berestovec quarry.
2. (Partly abandoned) quarries in Basaltove (Janowa Dolina).

Both sites create opportunity to study basalt outcrops and good examples of columnar jointing advantage of the second site is picturesque Horyn valley and easy access to the outcrops which in the case of Berestovec needs previous permission of quarry management.

References

- Alenko V.P., Polkunov V.F., Pomianovskaya G.M., Filshytynskiy L.E., Syenkovdkiy Yu.,M., Cygielniuk P. D., Znamenskaya T.A., Shulga V.F., Jacenko G.M., Chebanenko I.I., Velikanov V.A., Verkhovcev V.G., Vyshnyakov J.B., Vla-sov B.J., Volovnik B. Ya., Dulub V., Kiryanov V.V., Kurynchuk L.V., Med-vedev A.P., Markovskiy V.A., 1990: Geotektonika Volhyno-Podoli. Naukova Dumka. Kiev.
- Białowolska A., Bakun-Czubarow N., Fedoryshyn Y., 2002: Neoproterozoic flood basalts of the upper beds of the Volhynian Series. Geological Quaterly, 46 (1), p. 37-57.
- Compston W., Sambridge M.S., Reinfrank R.F., Moczydlowska M., Vidal G., Cleason S., 1995: Numerical ages of volcanic rocks and the earliest faunal zone within the Late Precambrian of East Poland. J. Geol. Soc., 152 (4), p.599-611.
- Dziekoński T., 1960: Epoka brązu. miedzi, ołowiu, srebra, złota. (in) Jan Pazdur [ed] Zarys Dziejów Górnictwa na Ziemiach Polskich. Wyd. Górnicz-Hutnicze. Katowice.
- Giedrońc A., 1895: Geologiczeskija izsledowanja w gub. Wilenskoj, Grodnenskoj, Minskoj, Wołynskoj i siewiernoej cz. Carstwa Polskago. Materiały dla Geologii Ross, T. 17.
- Hruszewskij M., 1913: Ilustrowana Istoria Ukrainy.

- Kamieński M., 1927: Tufy wulkaniczne w Berestowcu. Kosmos T. 52. Z. III-IV, Lwów.
- Kamieński M., 1929: Bazalty wołyńskie Kosmos R. LIV Ser. A, Z III-IVs. 675-701.
- Karpiński A., 1873: Anamezit w Ewropejskiej Rossi. Sbornik Gornogo Instituta Petersburg, 1873.
- Kmieciński, J. 1989: Pradzieje Ziemi Polskich. PWN Warszawa Łódź
- Kuźniar Cz., 1922: Uralidy w Europie Środkowej i północnej Spraw. PIG T. I.
- Lazarenko E.K., Małkowski O.I., Vinar O.M., Shashkina V.P., Gnativ G.M., 1960: Mineralogija vyverzenich kompleksu Zachidnoi Volhyni. Vid-vo L'vivsko-go universitetu.
- Małkowski S., 1926: Rozmieszczenie i warunki występowania bazaltów w dorzeczu Horynia. Spraw. PIG. Tom III z-3-4, p. 493-501.
- Małkowski S., 1923: Sprawozdanie z badań geologicznych bazaltów okolic Berestowca, Podłużnego i Policy na Wołyniu. Pos. Naukowe PIG. Nr. 5.
- Małkowski S., 1928: Nowe spostrzeżenia nad występowaniem bazaltów berestowiekich. Pos. Naukowe PIG. Nr. 19-20.
- Małkowski S., 1929: O odkryciu złoża miedzi rodzimej w Mydzku na Wołyniu. Pos. Nauk. P.I.G., Nr. 24, p.16.
- Małkowski S., 1931: O złożu miedzi rodzimej w Wielkim Mydzku na Wołyniu. Spraw. PIG. Tom VI p.757-774.
- Mazurek A., 1931: Transgresja kredy na bazaltach w Berestowcu i Janowej Dolinie na Wołyniu. Spraw. Polskiego Inst Geol T.VI, Z 3. p. 465-484.
- Morozewicz J., 1922: Sprawozdanie z wycieczki na Wołyń. Posiezenie Nauk. PIG Nr. 1.
- Pfafiuss S., 1886: Opis t. zw. "anamezytu wołyńskiego" znajdującego się koło miasta Równego, w gub. Wołyńskiej. Pamiętnik Fizjograficzny. T. VI Warszawa
- Polonska-Vayslenko N., 1995: Istoria Ukrainy.
- Poprawa P., Šliaupa S., Stephenson R., Lazauskiene J., 1999: Late Vendian-Early Paleozoic tectonic evolution of the Baltic Basin: regional tectonic implications from subsidence analysis. Tectonophysics, 314, p. 219-239.
- Siemiradzki J., 1909: Geologia Ziemi Polskich. T II, p. 123-124. Lwów Słownik Geograficzny Królestwa Polskiego.
- Subtelny O., 1991: Istoria Ukrainy.
- Tokarski J., 1928: O sanidynie w Berestowcu na Wołyniu Kosmos Ser. A T.53, Z. IV, p. 904-909.
- Tutkowski P., 1912: Miastorozdienje strietlnych kamniej w Łuckom uj. Wołyńskiej gub. Zytomir.
- Tutkowskij P., 1903: Jugo-zapadnaja cz. 16-go lista obszczej 10-ti-wierst. karty Jewrop. Rossi. Izwestja Geol. Kom., T. 22.
- Tyszeckij A.K., 1862: Nieskolko zamieczanij o bazaltach Wołyńskiej gub. Uniwersiteckija Izwestija Nr. 8, Kijów.
- Volovnik B.J., 1975: Trappovaya formacija Volhyno-Podoli. Tektonika i stratigrafia. Naukova Dumka, 8: 28-33 Kiev.