



442

Raw materials of the Aeneolithic polished tools from the cave Vindija (NW Croatia)

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Despite the fact that the Neolithic, Bronze-age, Roman and Middle-age remains were found at the site, the cave Vindija (Hrvatsko Zagorje, NW Croatia) is well known mostly because of Neandertals, their culture and associated Upper Pleistocene faunal assemblages. Thus, while in the frame of previous project (101711 "Paleolithic and Mesolithic of Croatia") the analysis of the Paleolithic industry from the cave Vindija was made, the investigation is recently focused to the analysis of the industry deriving from geologically youngest deposits of the cave.

The cave Vindija is situated on the slopes of the peak Križnjakov vrh (Mt. Ravna Gora) in semimountainous region of northwestern Croatia (46°18'12"N, 16°14'38"E), 20 km from the town Varaždin and approximately 55 km from Zagreb. Its semicircular vaulted entrance opens at 275m/sl. The cave consists of a single large chambre measuring 50 meters in length, 28 meters in breadth, and over 20 meters in height.

The genesis of the cave is connected with the Middle Pliocene tectonic pattern of the area, when the north-south movements generated the NW-SE transcurrent dextral fault, as well as with the Upper Pliocene and Pleistocene rising of Mt. Ravna Gora that caused formation of a brook valley, as well as the recent morphology of the cave. The sedimentation of Quaternary deposits has started in the Middle Pleistocene.

Approximately 15 meters of investigated deposits were divided into 13 distinct stratigraphic units and designed with letters from M (oldest) to A (youngest). The levels M and L appear to date to the Riss Glacial (OIS 6), unit K is correlated with the Eemian (OIS 5e), while the levels J - D encompass the Last Glacial (OIS 5d - 2). The uppermost levels A, B, C, and partly D were dated to the Holocene (OIS 1), and their lithostratigraphy is defined as follows:

- level A - black humus - 15 cm - subrecent
- level B - brown humus-like soil - 60 cm - Subboreal-Subatlantic
- level C - speleothem - 20-50 cm - Atlantic
- level D - greyish silty sediment - 50-150 cm - Early Holocene-Early Dryas

Only the speleothem, i.e. level C, was dated radiometrically. The estimated radiocarbon age of the sample Z-1856 is 1.7 +/- 0.6 pMC, i.e. 4.929 years B.P.

The Lasinja and Retz-Gajary Culture (Aeneolithic), as well as Litzen-type ceramic (Bronze-age), and probably Kisapostag-culture were found in the described levels.

The polished stone artifacts from the cave Vindija are stored as separate collection at the Archaeological department of the Museum of the town Varaždin. The collection consists of 20 polished tools/weapons and 2 plugs found in the uppermost levels of the cave interior or in the sediments excavated in front of the cave (levels A, B) together with the mentioned Aeneolithic and Bronze-age cultural remains. The excavations were performed by teacher and curator at the Museum Stjepan Vuković in the period from 1934 till 1949 and documented in attendant protocols.

Following the method of typological analysis established for the stone industry of northeastern Slovenia the stone tools from the cave Vindija are divided into two main categories: perforated polished tools (14 specimens) and polished tools/weapons without perforation (6 specimens).

In the category of tools without perforation, to the type D 2 i.e. to the cylindrical axes belong the specimens Inv. Nr. 379, 512 and 381. The artifact Inv. Nr. 513 is ascribed to the type G2 i.e. in the group of maces and grinders. Peculiar are two stone tools which resemble the so called foreign-shaped axes registered also on the territory of Slovenia and in Koprivnica region. One of them, i.e. specimen nr. 6277 is extremely well formed, with well polished lower part and with a cross-like incision in the middle of upper elongated part. Similar characteristics could be seen on the specimen Inv. Nr. 394. Most probably they belong to the new subcategory of the type B. The fragmentary axe Inv. Nr. 378 found in the level with a ceramics of Litzen-type belongs to the type B 2.

Perforated stone artifacts belong to the variants of the types A, B, and C: specimens 501 and 514 to the variant A4, tool 1335 as well as specimens 384 and 382 to the variant A3. One fragment of axe-hammer Inv. Nr. 370 belongs probably to the same variant. The fragment 391

is probably one axe of the variant A 9. The perforated hoes are ascribed to the type C: the specimen 392 to the variant C1, the fragment 374 to the variant C2. The fragments 504 and 503 are typologically not defined.

The miniature axe Inv.Nr. 377 is exceptional because of its fine chiseling and decoration in the shape of double-cross incision on both sides and probably with cult assignment.

Two plugs in collection indicate a local tool production and possibly greater quantity of perforated tools.

The performed petrographical analysis showed that among the raw materials used for production of above described tools, basalt is represented with 36%, diabase with 23%, serpentinite with 23%, andesite with 9% and sandstone with 9%. These raw materials possessed physical and technical properties which met the expectations of their users, and the choice of stone raw materials was not accidental but intentional and depended on the function of the final product.

From above 22 described stone artifacts from the cave Vindija, 14 were determined only macroscopically with binocular lens by using non-destructive optical methods: with exception of 4 specimens (Inv.Nr. 514, 380, 382, 513), they have been made from andesite (2 specimens), serpentinite (5 specimens) and sandstone (2 specimens).

The thin sections were made of 8 broken or fragmented specimens (Inv.Nr.: 370, 384, 391, 503, 374, 379, 501, 504) and determined by polarizing microscope. While the determined diabase samples represent a hypabyssal rocks of basaltic composition consisting mainly of pyroxene and feldspar and with larger crystals of clinopyroxene enclosing the lath-shaped crystals of plagioclase feldspars, the fine-grained rocks with phenocrysts of pyroxene in a groundmass of plagioclase together with some crystals of opaque minerals (probably magnetite) were determined as basalt.

Only one specimen (Inv.Nr. 374) comprises patches of rhomboedral calcite crystals in a microcrystalline matrix. Also, on the surface of some artifacts, the calcite could be found as a thin micritic crust.

Tectonic pattern of the area of Hrvatsko Zagorje is one of the most complicated in north Croatia, and the result of tectonic activities is Middle Triassic basalt-spilite magmatic group of Hrvatsko Zagorje and Cretaceous volcanogenic-sedimentary complex. Petrologically, the magmatic group is composed of basalts, largely transformed into spilites with some andesites and pyroclastic rocks, while the volcanogenic-sedimentary complex consists of the tuffs, tuffites, spilitized diabases, and gabbros.

Thus, considering the results of recently analysed Vindija's polished stone tools, it is obvious that the used raw material is of local origin, because the following rocks were registered in the area: basalts, andesitic basalts and spilitized basalts (Mts. Ivanščica and Strahinščica), spilites (Mt. Kalnik), gabbros (Mt. Kalnik), andesites (Mt. Ravna Gora) diabases (Mts. Ivanščica and Kalnik), and serpentinite (Mt. Kalnik).

It must be noted that some of the bigger outcrops of mentioned volcanic rocks were used from the Roman times until today in the quarries of technical stone in Lepoglava (Mt. Ivanščica), Ljubeščica (Mt. Kalnik), etc. At the same time, the volcanic rocks could be found as pebbles (or cobbles) of Alpine provenience in alluvial beds of the river Drava. Thus, the selection of raw material was made functionally in relation to the available assortment showing that the Aeneolithic inhabitants of Vindija cave had a practical knowledge of raw material in the area of NW Croatia. But, to find out the exact origin (i.e. locality = quarry) of different raw materials used at Vindija, the analyses of the tool samples must be extended to the stone samples originating directly from the outcrops of volcanic and/or metamorphic rocks of the investigated area.

