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Micrometric measurements of the corrosion rate on the cave wall inscription in a swallet-cave of Odolina (Slovenia)

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Abstract
The inscriptions on cave walls are usually treated for preservation, because of their historical value. In the Ponikva cave, in Odolina, the old signatures were made of oil paint on the scalloped wall and thus the paint protected the rock surface against corrosion; that is why this rock surface juts out. The corrosion rate of the unprotected rock was measured by microerosion meter and this corrosion activity could then be compared respectively with laboratory tests and with similar activity in other caves .

Résumé
On a trouvé dans la grotte-perte Ponikva, en Odolina (Slovénie), les restes d'une inscription murale datant d'août 1929. La peinture employée sur le mur a protégé la roche contre la corrosion; c'est pourquoi à cet endroit la surface de la roche est convexe, en relief. En fonction de l'âge de l'inscription et de la convexité mesurée des lettres, on suppose que la vitesse de corrosion est de 1,05 à 1,98 mm par siècle.

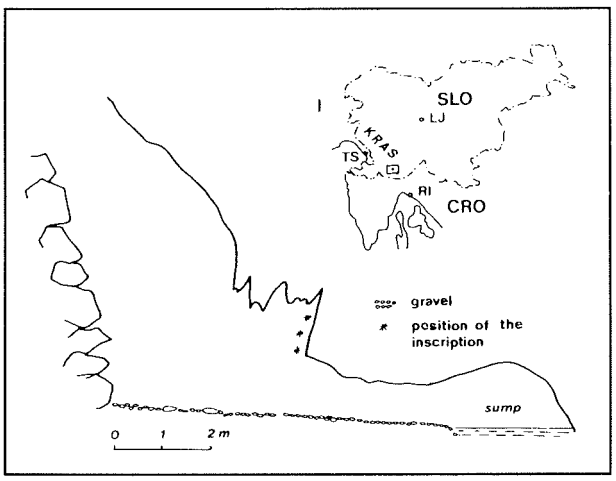

Figure 1 : Cross-section of the lower part of the Ponikva cave in Odolina. The position of the inscription is marked.

I. DESCRIPTION OF THE CAVE AND OF THE OLD INSCRIPTION

The ponor in Odolina is a 117 m deep cavent where the shafts alternate with short meander channels and bigger collapse chambers, developed along the tectonic zones. It developed in thick bedded Cretaceous rudist limestones.

The entrance to the cave is situated at the bottom of a Blind valley, widened by corrosion, named Odolina, which is one of the classical blind valleys on Kras. The cave is a swallow-hole of the brook, draining a 4,5 km^2 large basin built in Eocene flysch rocks.

Close to the final siphon, the channel lowers over a 6 m hight step into a small chamber. The chamber is closed by a vertical wall and, below it, a passage, 3,5 to 0,8 m high, leads to the siphon, some metres distant. During normal, low water level, there is no water flow in this part, as the brook already sinks in front of the cave. During high water level, the brook flows into the cave which becomes inaccessible; the conditions in the final part are thus unknown.

The frontal chamber wall and the passage to the siphon are covered by scallops, 4 to 10 cm long. Over the scallops, the cavers wrote the inscription with red paint (Fig. 1). The paint mostly peeled off, and the inscription is unreadable. But with the same paint, on some other places in die cave, the members of caving club G.S. Pasubio (BERTARELLI & BOEGAN, 1929)

Figure 2 : Picture of the wall with marked places where the rests of inscription are preserved. On the passage, floor gravel and sand are deposited

have made another inscription on August 25, 1929. We may infer that botte inscriptions were made on the same day during research and survey of the cave.

Everywhere the paint protects the rock against the corrosion; it is convex in relief. The colour of the inscription is preserved on some 10 cm^2 only; on some places where the paint is washed off, the letters are however jutting out (Fig. 2 & 3).

The inscription is placed over a net of current markings; dimension and shape are changing within short distance, in vertical direction in particular. On the upper part of the wall, more than 170 cm above the floor, the scallops are langer than 10 cm and the transitions among them are rounded. On the lower part of the wall, and also in the passage leading towards the siphon, the scallops are smaller; the longer axis between them is 4 to 6,5 cm long; and the transitions among them are sharp and conspicuous. All the current marks point the flow direction towards the siphon. Due to irregularities of the walls in the chamber and in the passage, the differences among the scallops are considerably influencing the degree of accuracy of the measurements and increasing the possibility of errors.

II. MEASUREMENTS OF CONVEX LETTERS AND CORROSION RATE

The coat of paint of the inscriptions, which protects the rock, is now about 0,03 mm thick; and even more in the places where small drops splashed. It is easy to peel off the paint from the rock surface; in some places it is well seen how small patches of paint successively scaled off and left behind traces of jutted out letters. It shows that abrasion practically did not act on this surface, although gravel and sand are deposited on the floor.

In some particular places, using a knife's edge, I have removed a small piece of the peeled off paint and, with a microerosion meter, have measured the difference between the protected old surface and neighbouring unpainted, unprotected surfaces. The microerosion meter was moved on a flat slat and the distance to the rock surface was measured. Due to curved surfaces, scallops for example, the measurements were possible only where the transition between the two measured surfaces was quick. That

is why the differences are precisely measured in eight places of the inscription only, on variously big scallops and on different parts of the same scallop. The device accuracy is 0,01 mm.

Figure 3 : Typical remains of the old signature on the net of current marks. The inscription with red oil paint originated in 1929. The rock surface protected - by paint - against corrosion is convex. The paint slowly peels off to pieces, and more or less convex parts appear in the rock microrelief.

III. RESULTS OF MICROMETRIC MEASUREMENTS AND EVALUATION OF THESE RESULTS

The biggest measured difference between the exposed and protected rock reaches 1,14 mm and the smallest 0,47 mm. Among specific measurements, differences were considerable; due to the small number of measurements, the bard conditions and thus the related errors, the measurements do not infer for sure the varions intensity of corrosion in different parts of the same scallop or within the net of variously big scallops.

The letters protected by paint have been stepping out in relief sine 1929, therefore during 63 years. The wall retreated at the rates of 1,83 mm/100 years and 1,05 mm/100 years. As the scallops are about 1,2 cm deep, it is also possible to calculate their age, which is 655 to 1142 years.

Simular values were obtained by LAURITZEN for phreatic passages of the Glomdalsvatn cave in northern Norway (LAURITZEN, 1981, 1985). The calculated corrosional retreat of the wall amounts, in his case, to 0,025 mm/year and the scallops needed for their development are roughly 800 years old . He compared the scallops according to discharge and to duration curve of water flow respectively. In those passages, the scallops originated during high water discharges which last less than 5% of the entire flow and the size of the scallops corresponds to the discharge which is even less than 2% of the flow. In this time, most of the annual corrosion takes place.

Brsnica brook, sinking into Ponikva in Odolina, is a small Stream. We haven't got any hydrological data about it and thus we do not know for how long in a year the painted wall is flooded. By some extent, we can use the calculation of flow velocity thanks to the

scallops size in the passage below the wall with inscription (LISMONDE, B. & LIGMANI, A. , 1987). Scallops originated during the flow velocity of about 0,5 m/s, this discharge in the channel is at such velocity about 1 m^3/s. According to estimation such discharges occur in Brsnica during only 20 days a year. On this base, one can calculate that the wall retreat rate would be 0,13 to 0,32 mm/year if such a flow would always sink in the cave .

IV. REFERENCES

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