THE DOLINES ABOVE THE COLLAPSE CHAMBERS OF POSTOJNSKA JAMA

VRTAČE NAD PODORNIMI DVORANAMI POSTOJNSKE JAME

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Stanka Šebela: Vrtače nad podornimi dvoranami Postojnske jame

Na površju nad Postojnsko jamo je 22 vrtač in dve udornici. Nekaj manj kot polovica (40,9 %) vrtač je oblikovanih nad podornimi dvoranami. Te so oblikovane v regionalno najmočneje izraženih prelomnih conah na terenu in so tako genetsko vezane na tektonsko pretrte cone. Podorne dvorane predstavljajo področja najmlajšega spreminjanja jamskih rovov. Vertikalno prenikanje v vadozni coni je na takih mestih običajno zelo dobro, kar dokazujejo tudi kamini v stropih podornih dvoran. Vrtače nad podornimi dvoranami najdemo nad Rovom brez imena, Pisanim rovom in Koncertno dvorano.

Ključne besede: vrtača, podorna dvorana, geološka struktura, Postojnska jama, Slovenija

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Stanka Šebela: The dolines above the collapse chambers of Postojnska Jama

On the surface above the passages of Postojnska Jama there are 22 dolines and two collapse dolines. Slightly less than half the dolines (40,9 %) developed above collapse chambers. These are formed in regionally the most significant tectonically fractured zones and are genetically related to tectonically crushed zones. Collapse chambers represent places of the youngest transformations of cave passages. Vertical percolation in the vadose zone is in these places normally very good, evidenced by chimneys on the ceilings of collapse chambers. The dolines above collapse chambers in Postojnska Jama are found above Rov Brez Imena, Pisani Rov and Koncertna Dvorana.

Key words: doline, collapse chamber, geological structure, Postojnska Jama, Slovenia

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INTRODUCTION

In recent years (Šebela, 1992 and 1994) I have been working in detailed geological investigations in Postojnska Jama (Fig. 1) which is the c. 13 km long part of the largest Slovene cave, the Postojna cave system, 20 km long. The cave was tectonico-lithologically mapped at the scale 1:1.000 (Šebela, 1994).

My doctorial thesis was financed by Ministry of Sciences and Technology of Slovene Republic from 1991 to 1994.

As a main method of my work I used prof. Čar's (1982) method of detailed tectonico-lithological mapping which divides tectonically fractured zones into:

- fissured (the least fractured, stratification still visible)
- broken (more fractured, rock often occurs as blocks, may be physically displaced)
- crushed (the most fractured, stratification has been destroyed, tectonic breccia often present).

For understanding the geology of cave passages it was necesarry to study the surface above the cave to place the data in regional geological conditions. The surface was mapped at the scale 1:2.500 (Šebela, 1994). Besides the geology I also observed karst phenomena like dolines and collapse dolines on the surface and I tried to find any connections with geological structure.

The highest density of dolines on the surface is north from the collapse doline Stara Apnenica (Fig. 1). These dolines developed in a fissured to broken zone more than 100 m wide, whose directions are N-S and cross Dinaric orientation NE-SW. Under these dolines there are no known cave passages; we can find just some little vertical shafts. In the dolines the stratification which dips towards SW is very visible. It forms the NE slope of the dolines.

Some other dolines developed in crushed zones and especially in the Dinaric crushed zones NW-SE.

All the dolines were marked on the morphological map. On the surface directly above the cave passages of Postojnska Jama there are 22 dolines (Fig. 1) and 9 of them are directly above the collapse chambers. All the collapse chambers in the cave developed in regionally the most significant tectonically crushed zones. This is important, because on the surface there is almost no morphological difference between 22 dolines above the cave passages.

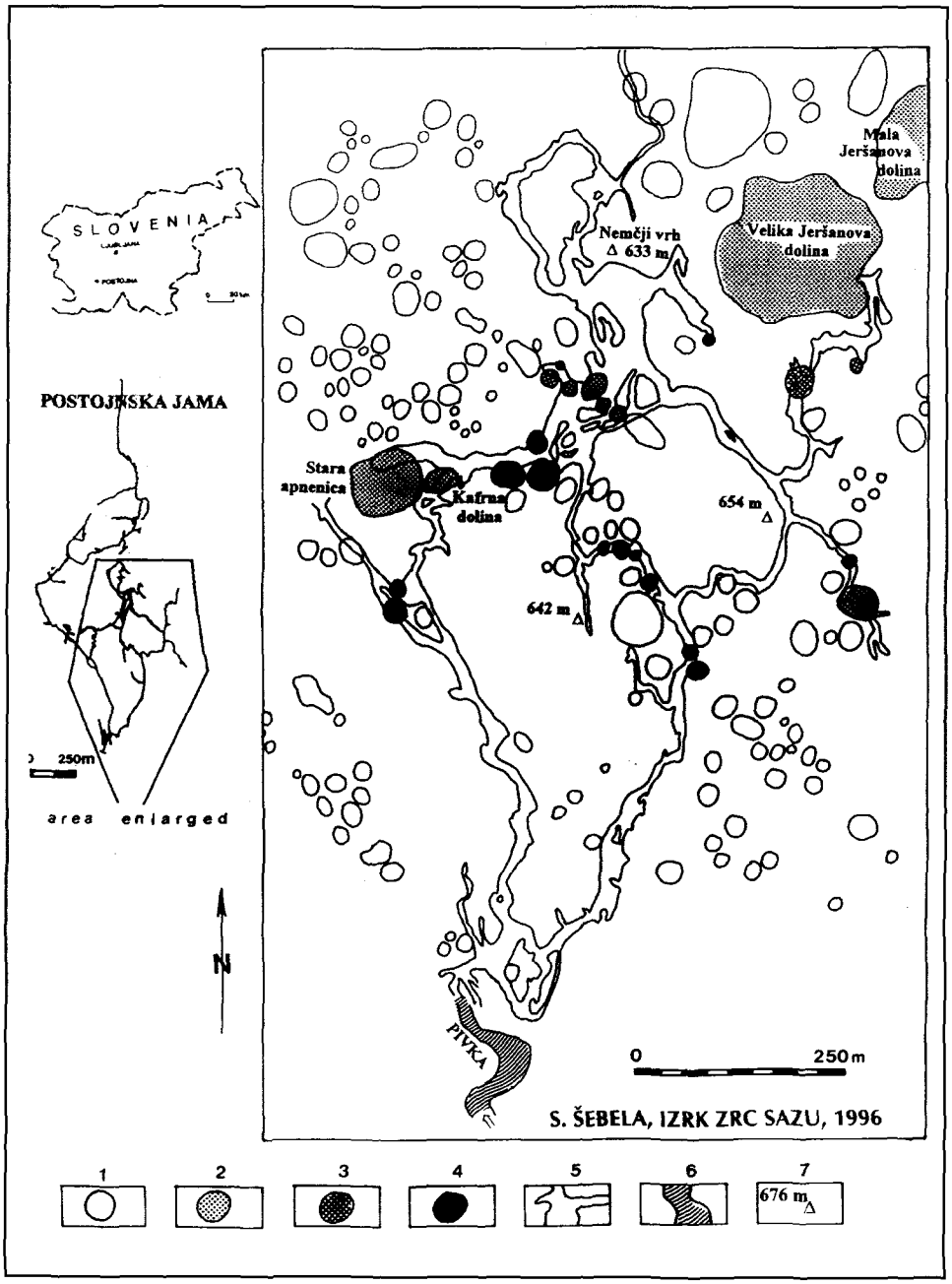
SLOVENIA
POSTOJNSKA JAMA
250m
area enlarged
N
Mala Jeršanova dolina
Nemčji vrh Δ 633 m
Velika Jeršanova dolina
Stara apnenica
Kafrna dolina
654 m Δ
642 m Δ
PIVKA
0 250m
S. ŠEBELA, IZRK ZRC SAZU, 1996
1
2
3
4
5
6
7
676 m Δ

Fig. 1: Cave passages of Postojnska Jama and dolines on the surface:
1 - doline
2 - collapse doline
3 - dolines above collapse chambers of Postojnska Jama
4 - dolines above passages of Postojnska Jama
5 - ground plan of cave passages
6 - river
7 - altitude a.s.l. of hills

Sl. 1: Rovi Postojnske jame in vrtače na površju:
1 - vrtača
2 - udornica
3 - vrtače nad podornimi dvoranami Postojnske jame
4 - vrtače nad rovi Postojnske jame
5 - tloris jamskih rovov
6 - reka
7 - nadmorska višina vzpetin

Gospodarič (1965, 1976) made an important geological investigation of the area above and near Postojnska Jama.

Čar & Gospodarič (1984) made a detailed tectonico-lithological mapping on the surface above Pivka and Črna Jama. They determined some types of dolines according to geological structure.

GEOLOGICAL CONDITIONS IN COLLAPSE CHAMBERS AND DOLINES ABOVE THEM

In Postojnska Jama the collapse chambers (Fig. 2) where we did not find signs of phreatic conditions after the last breakdown are:
- Rov Brez Imena
- Pisani Rov
- Velika Gora
- and Koncertna Dvorana.

Postojnska Jama developed in the Upper Cretaceous limestone $K_2^{2,3}$. Gospodarič (1965) determined old overthrusting and folding deformations. For development of cave passages the Postojna anticline (Gospodarič, 1965; 1976) is very important. The axis of anticline crosses Ruski Rov and Čarobni Vrt (Fig. 2). In Pisani Rov the intensity of axis decreases. Most of passages developed in the SW part of the Postojna anticline.

In "Javorniško-Snežniške Grude" tectonic unit (Pleničar, 1970) younger faulting deformations as Dinaric (NW-SE) and cross Dinaric (NE-SW) fault zones prevail.

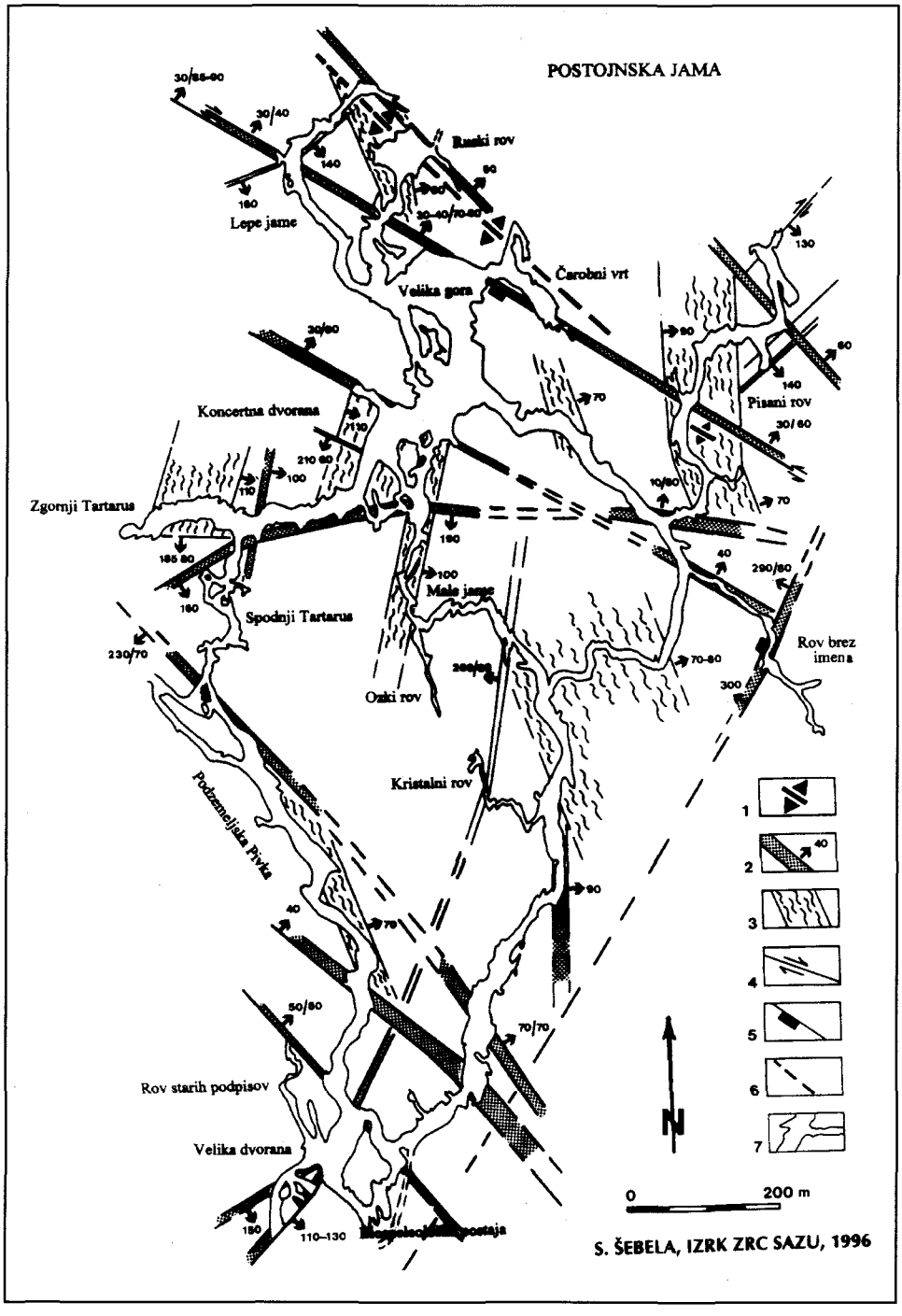
POSTOJNSKA JAMA
Ruski rov
Lepe jame
Velika gora
Čarobni vrt
Koncertna dvorana
Pisani rov
Zgornji Tartarus
Spodnji Tartarus
Mala jama
Ozki rov
Rov brez imena
Kristalni rov
Podzemeljska Pivka
Rov starih podpisov
Velika dvorana
1
2
3
4
5
6
7
N
0
200 m
S. ŠEBELA, IZRK ZRC SAZU, 1996

Fig. 2: Structural geology of Postojnska jama:
1 - anticline
2 - crushed zone with geological structural elements
3 - broken and fissured zone
4 - horizontal movement
5 - vertical movement
6 - supposed fault zone
7 - ground plan of cave passages

Sl. 2: Strukturna geologija Postojnske jame:
1 - antiklinala
2 - zdrobljena cona z geološkimi elementi
3 - porušena in razpoklinska cona
4 - horizontalni premik
5 - vertikalni premik
6 - domneven potek prelomne cone
7 - tloris jamskih rovov

The same situation is visible in Figure 2. From Spodnji Tartarus to the beginning of Pisani Rov we follow an important crushed zone with an almost E-W trend which is relatively older than the Dinaric crushed zones.

The collapse chamber in Rov Brez Imena developed in a crushed zone of cross Dinaric orientation 290-300/80-90 (Fig. 2). On the fault plane which limits the fault zone there are traces of vertical movements where the NW block is moved down and the SE block up. On the surface 67 metres above the colllapse chamber there is a doline with diameter at the top of 75 metres and a depth of 17,7 metres. Through the doline there is the same fault zone as may be observed in the cave 67 metres below the surface.

Pisani Rov has two collapse chambers. The northern one is very small and the chamber is closed with breakdown blocks. On the surface we have a little doline which is 10 metres in diameter and 2 metres deep. In the cave the collapse chamber is formed in crushed zone 140/90, but on the surface in the doline it is impossible to determine the same fault zone, because the terrain lies in the SE slope of Velika Jeršanova Dolina (Fig. 1), where processes of erosion changed the surface.

A better example in Pisani Rov is the collapse chamber in the middle of the channel 30 metres under the surface. It developed in Dinaric crushed zone 30/60 with horizontal movements left movement. The same fault zone, but with steeper dip (20/90), crosses the doline above the collapse chamber. The doline is 6,7 metres deep and 20 metres wide.

Above the biggest collapse chamber in Postojnska Jama called Velika Gora (Šebela, 1995) there are no dolines. Velika Gora developed under the southern slope of hill the Nemčji Vrh (Fig. 1).

30 metres above Koncertna Dvorana there are 6 dolines which are all genetically connected with the Dinaric crushed zone 30-40/80-90. In the cave we can observe vertical movements, where the NE block is moved up and SW block down.

The other 13 dolines are just above cave passages and not above collapse chambers.

I have to mention also two collapse dolines Kafrna Dolina and Stara Apnenica (Fig. 1) which are above cave passages and whose origin is closely connected with important crushed zone in the direction almost E-W (160-190/90). The collapse doline Velika Jeršanova Dolina lies a little away from Pisani Rov. But the bottom of the doline is at the same as Pisani Rov.

CONCLUSIONS

Directly above the passages of Postojnska Jama there are 22 dolines and two collapse dolines. If we observe 22 dolines it is not possible to find the differences between them to determine if they are overlying collapse chambers in the cave. It is easier if we know where collapse chambers in the cave are and then determine the dolines above the cave.

According to geological and especially tectonic conditions the important regional fault zones are the reasons for collapse chambers and also for dolines above them. Almost half of the dolines above the cave are tectonically controlled. The activity of the same fault zone resulted in formation of collapse chambers in the cave and the dolines on the surface.

In collapse chambers the vertical percolation is very good. In Pisani Rov and in Koncertna Dvorana at the top of collapse chamber there are chimneys.

40,9 % of dolines above passages of Postojnska Jama developed in tectonically crushed zones. Important tectonic zones influenced also underlying cave passages where collapse chambers developed.

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VRTAČE NAD PODORNIMI DVORANAMI POSTOJNSKE JAME

Povzetek

Postojnska jama je 13 km dolg del Postojnskega jamskega sistema (Sl. 1), ki je z 20 km najdaljši jamski sistem v Sloveniji. V obdobju od 1991 do 1994 sem v Postojnski jami in na površju nad njo, pod mentorstvom prof. dr. Jožeta Čarja, opravljala doktorsko nalogo, ki jo je financiralo Ministrstvo za znanost in tehnologijo RS.

Na površju nad rovi Postojnske jame je 22 vrtač (Sl. 1) in dve udornici (Kafrna dolina in Stara apnenica). Skoraj polovica vrtač, in sicer 9 primerov predstavlja vrtače, pod katerimi so podorne dvorane. Vrtače, ki so nad podornimi dvoranami, se od ostalih vrtač na terenu morfološko ne razlikujejo. Edino povezavo v nastanku med podornimi dvoranami in vrtačami nad njimi lahko najdemo v regionalno močneje izraženih prelomnih conah (Sl. 2).

Vrtače nad podornimi dvoranami najdemo nad Rovom brez imena, Pisanim rovom in Koncertno dvorano (Sl. 2).

V Rovu brez imena sta podorna dvorana in vrtača, ki je 67 m nad njo, oblikovani v prečno dinarski tektonski coni 290-300/80-90. Na zunanji prelomni ploskvi opazujemo sledove vertikalnega premikanja, kjer se je SZ blok glede na JV spustil.

Nad Pisanim rovom sta 2 vrtači nad podornima dvoranama. Severnejša podorna dvorana je manjših dimenzij, saj je zaprta s podornimi bloki. Razvita je v prelomni coni 140/90, ki ji na površju ne moremo slediti, saj leži teren v JV pobočju Velike Jeršanove doline in je morfološko precej spremenjen.

Boljši primer predstavlja druga vrtača v Pisanem rovu, ki se je oblikovala v dinarski prelomni coni 20/90. 30 m pod površjem lahko sledimo isti prelomni coni, ki pa ima nekoliko drugačno smer in vpad (30/60). Ob tej prelomni coni lahko določimo horizontalne premike, in sicer levi zmik.

Nad Koncertno dvorano je razdalja do površja 30 m. Nad podorno dvorano je 6 vrtač, ki so v genetski zvezi z dinarsko prelomno cono 30-40/80-90. V podorni dvorani lahko določimo vertikalno premikanje, kjer se je SV blok glede na JZ dvignil.

Ostalih 13 vrtač je le nad rovi Postojnske jame, ne pa tudi nad podornimi dvoranami.

Geološka zgradba terena kaže jasno sliko, ki kaže, da so podorne dvorane in vrtače nad njimi genetsko vezane na pomembnejše regionalne prelomne cone.

Nekaj manj kot polovica, in sicer 40,9 % vrtač, ki so nad rovi Postojnske jame je tektonsko pogojena. Močnejše tektonske cone so pomembno vplivale tudi na spodaj ležeče rove, saj so nastale podorne dvorane.

Seveda pa ne moremo posploševati trditve, da so pod skoraj polovico vrtač, in sicer tudi v predelih, kjer jamski rovi niso znani, razvite podorne dvorane.

Z gotovostjo lahko trdimo le, da se vrtače, oblikovane v istih tektonsko pretrtih conah kot spodaj ležeče podorne dvorane, morfološko ne razlikujejo od ostalih vrtač na tem terenu. Povezava med nekaterimi vrtačami in spodaj ležečimi jamskimi rovi ter predvsem podornimi dvoranami je na primeru Postojnske jame zelo očitna in predstavlja genetsko povezavo med vrtačami in podornimi dvoranami z istimi tektonsko pretrtimi conami.