Photo 4: Karren surface round Otlica (Trnovski Gozd) (Photo by P. Habič).

during the frequent summer storms with heavy rain. Intensive karstification and modest soil cover on the limestones enable the precipitation to drain underground quickly and feed abundant karst springs at the border of the High Karst.

Geomorphological processes and karst and other geomorphologic features are studied in detail in geomorphologic and speleological treatises by MELIK (1959, 1963), RADINJA (1972), GAMS (1974), HABIČ (1968, 1974, 1992) and others.

2.5. SPELEOLOGICAL PROPERTIES OF THE AREA

(A. MIHEVC)

There are 489 caves known and registered on the area of Trnovski Gozd and Banjšice plateau. The longest cave is the Predjama cave, the 7571 m long ponor cave of Lokva stream. The deepest caves are Velika Ledena Jama v Paradani, Jazben, Habečkov Brezen and Strmadna on Nanos plateau. There are 17 caves longer than 200 m and 18 deeper than 100 m.

The majority of the pothole entrances lies at 800 m a.s.l. where the average annual temperature is about 4° - 6° C. Frequently, the entrance parts of the potholes compared to the interior parts are widened. Numerous potholes are blocked by ice, snow or break-down blocks. The basic shapes of the potholes not yet spoiled by the superficial influence may be observed in inner avens only. The accessible caves are of different types: simple potholes or shafts of different depths systems of shafts and inclined or horizontal passages, ponor caves on the contact limestone with flysch or dolomite on the plateau and spring caves of different types on its foot. Most of the caves, about 70% are simple potholes and other smaller corrosive caverns formed by rain and snow waters. Most of caves are not very deep, 262 less than 20 m and only 7 are deeper than 200 m.

Depth and number of caves

more than 300 m	3
200 - 299 m	4
100 - 199 m	10
50 - 99 m	49
20 - 94 m	119
1 - 19 m	262

The following caves, briefly described, partly with a cave plan, are assumed as the important caves of the area under investigations:

Vipavska jama

Situated at the foot of Nanos at the springs of Vipava, the cave consists until recently of an artificial tunnel, which reached two natural cavities, so it acts as a spring during high discharge of the Vipava. Recently, through one of the cavities cavers entered in a about 1 km long maize of epiphreatic galleries developed along fractures. The survey is in progress but a plan doesn't exists yet. There are great discharges through some of the galleries, and water oscillates, according to sediments for about 25 m only 400 m inside the Nanos karst massif.

Veliki Hubelj

The cave entrance is in an altitude of 249 m, and forms the high water spring of the Hubelj river. The cave is 440 m long and is about 50 m above the permanent spring which is 219 m a.s.l. The cave is a maze of passages developed along joints and fractures in non bedded limestone. A cave plan is given in Fig. 2.15.

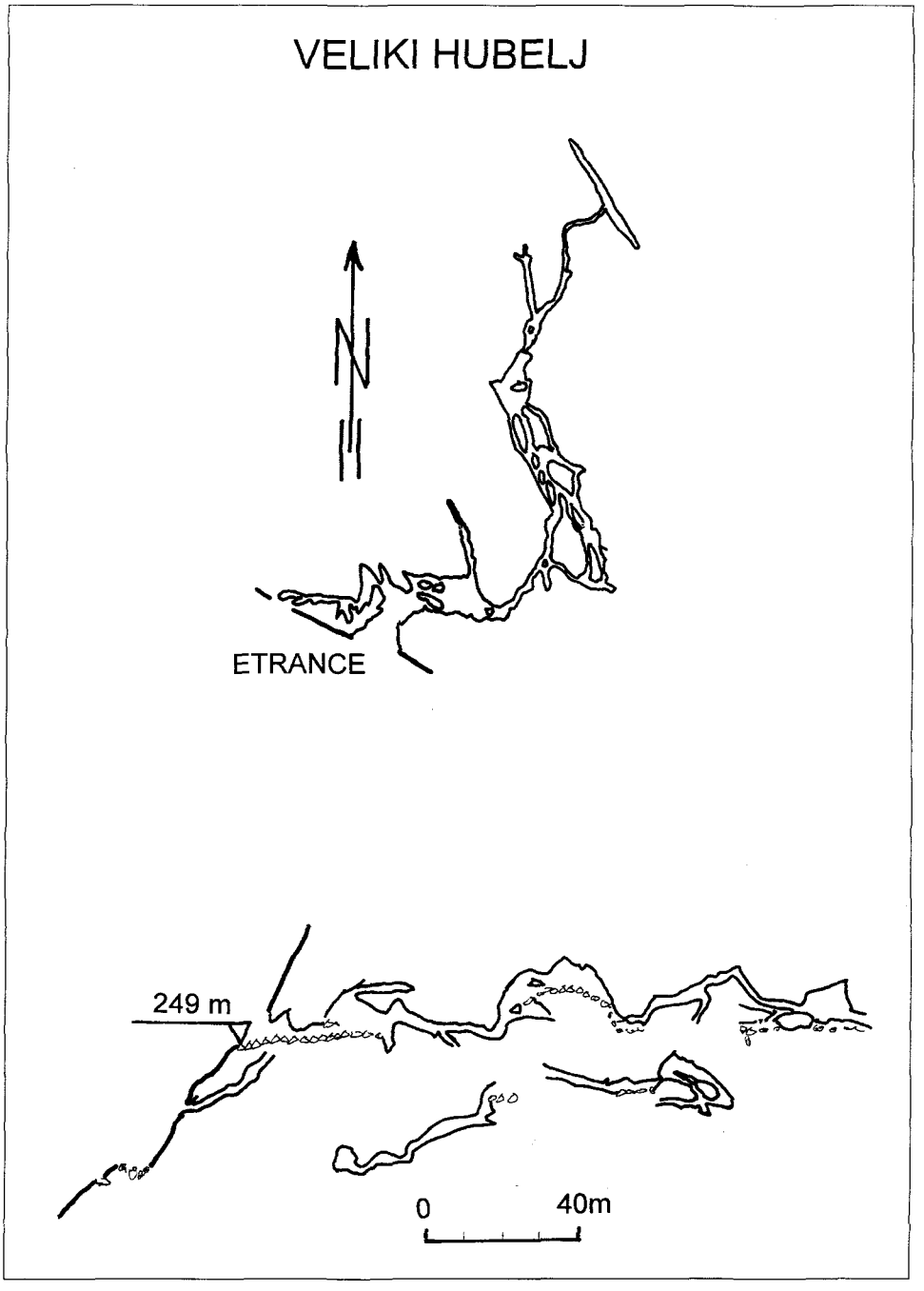

Fig. 2.15: Cave plan of the Veliki Hubelj.

Ledenica na Dolu

With an entrance in 995 m a.s.l., a length of 50 m and a depth of 80 m, this cave is developed in Jurassic limestones (Fig. 2.16). In the bottom part percolating water can be observed with a discharge up to 30 l/s after heavy rain. Its big entrance allows cooling of the cave during winter, but winter ice melts later in the year.

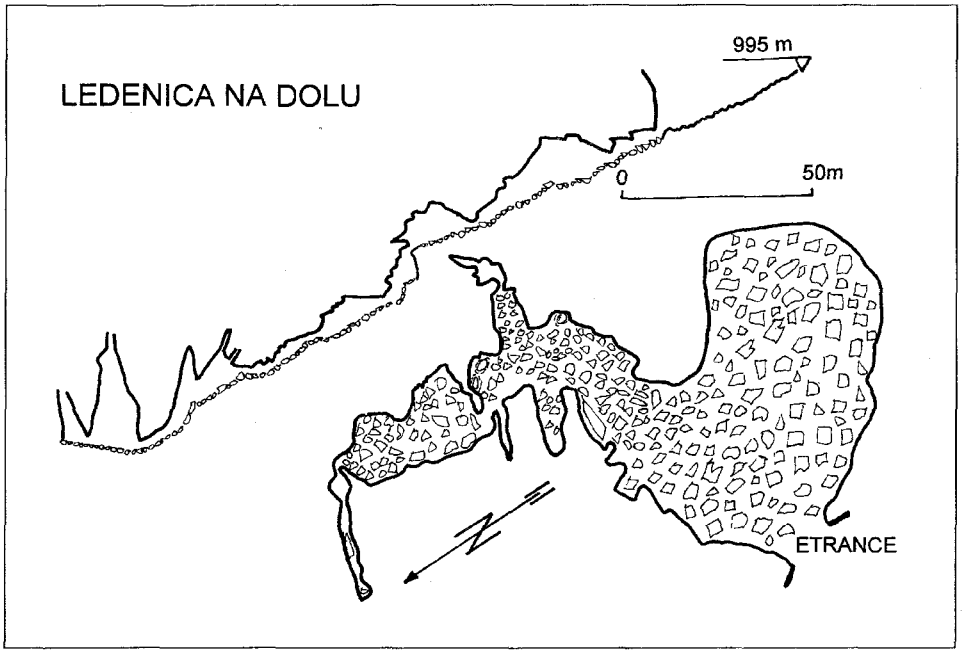

Fig. 2.16: Cave plan of the Ledenica Na Dolu.

Belo Brezno

The entrance to this simple 40 m deep shaft is in an altitude of 1240 m. The cave consists of vertical shaft which is filled with rocks and snow in the depth of about 35 m (Fig. 2.17). Short narrow rift continues to depth of about 40 m, where further passage is blocked by gravel. The cave Belo Brezno was one of the main injection points for the tracing experiments carried out in the framework of the project (compare Chapter 6).

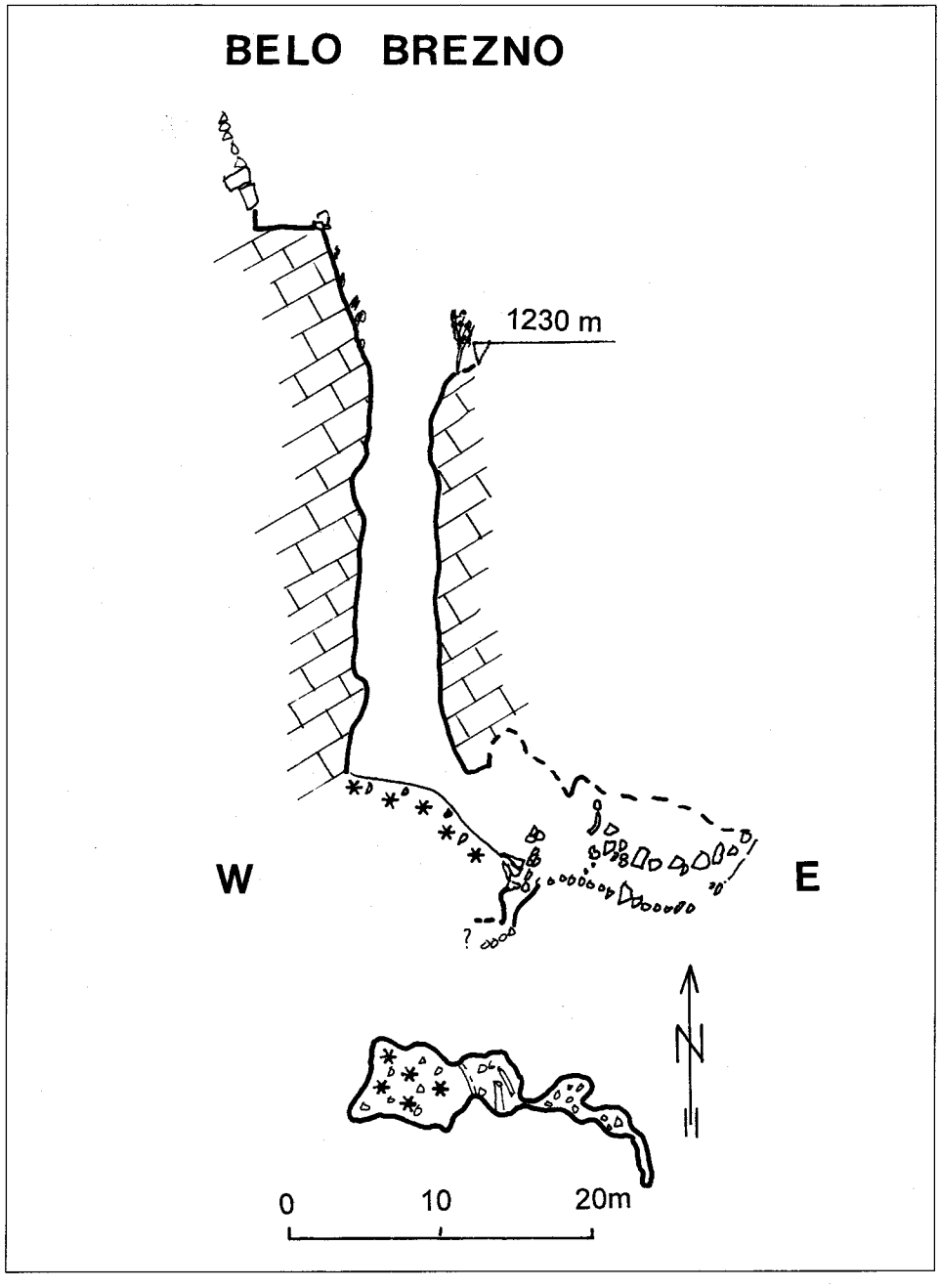

Fig. 2.17: Cave plan of the Belo Brezno, injection place for the repeated tracer injections in 1993, 1994, 1995 (see Chapter 6).

Ledenica V Kozji steni

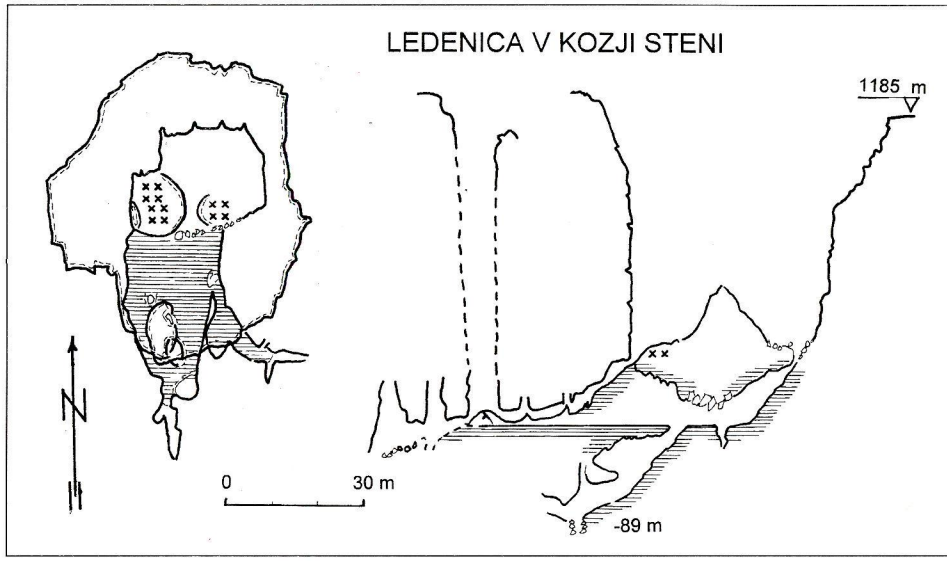

Fig. 2.18: Cave plan of the Ledenica V Kozji Steni.

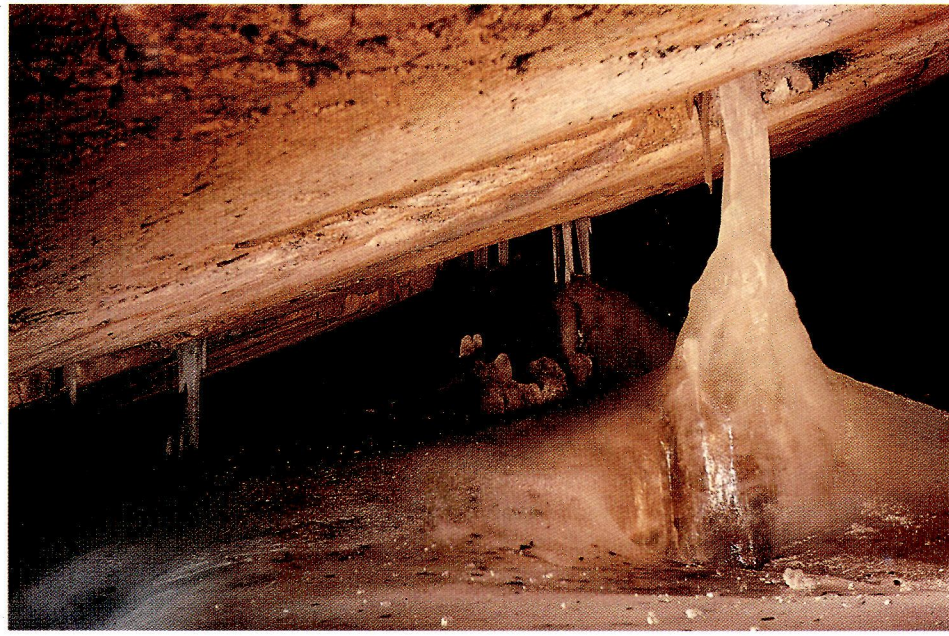

Photo 5: Ice cave Ledenica V Kozji Steni (Photo by A. Mihevc).

This ice cave in Kozja Stena is a 89 m deep pothole with a large permanent cave glacier and resembles regarding its shape and dimensions to a large collapse doline (Fig. 2.18, Photo 5). The entrance lies in an altitude of 1200 m. The 60 m deep entrance vertical drop having the dimensions at the top of 50 x 60 m, about 50 m deep the pothole narrows to 30 x 25 m. The bottom of the entrance pitch has a double depression leading downwards into common chamber where a large ice lake closes the cave continuation. The entrance pitch is developed in Jurassic limestone and dolomitic limestone in a strong fissure zone in N-S direction. By linkage of parallel potholes developed within this zone an ice volume of about 86.000 m^3 can be assumed.

Velika Ledena Jama V Paradani

Velika Ledena Jama V Paradani (Great ice cave in Paradana) is the deepest and also one of the biggest ice caves of the whole karst plateau (Fig. 2.19). It consists of series of shafts, connected by short fossil or active meanders or collapsed rooms. The depth of its surveyed part is 385 m, but in August 1996 new parts were discovered. The cave is estimated to be about 700 m deep now, but no plan of newly discovered parts exist yet, as explorations are still in progress. The cave is developed in stratified Triassic limestone and dolomitic limestone. Entrance of the cave is situated in altitude 1100 m a. s. l., in the bottom of larger, 60 m deep closed depression. This enables cold air to descent and flow into the cave during the cold period of year, forming ice to depth of about 200 m. At the bottom, even in summer, temperature does not exceed + 3° C.

The entrance part consists of three halls with permanent ice, it quantity estimated to 3000 m3 and was used as a natural source of ice. The volume of ice oscillates due to climatic changes and self controlling mechanism of filling in and reopening the narrowness at the entrance. This permits the cooling of the inner parts of the cave and so freezing the percolating water. Permanent ice is situated in the entrance part of the cave (Photo 6), in parallel shafts and in some chambers. This are three separated ice bodies, which are formed by freezing of percolated water in cooled cave. Ice level or better quantity is changing, records exist for last 25 years. In dry winters of the past years only little new ice was formed.

The inner part of the cave consists of short galleries and shafts, all situated on a very small area of 150 x 150 m. There are 38 inner avens within the cave. The deepest is 240 m deep followed by 98, 55, 40 and 35 m deep avens, the others are smaller, all together about 2000 m, and thus they represent the main building element of the cave, which was formed by percolating water. Three morphological different types of shafts are evident in the cave:

- shafts developed in steep meanders following the dip
- shafts developed in fissured zones. They originate along vertical joints one

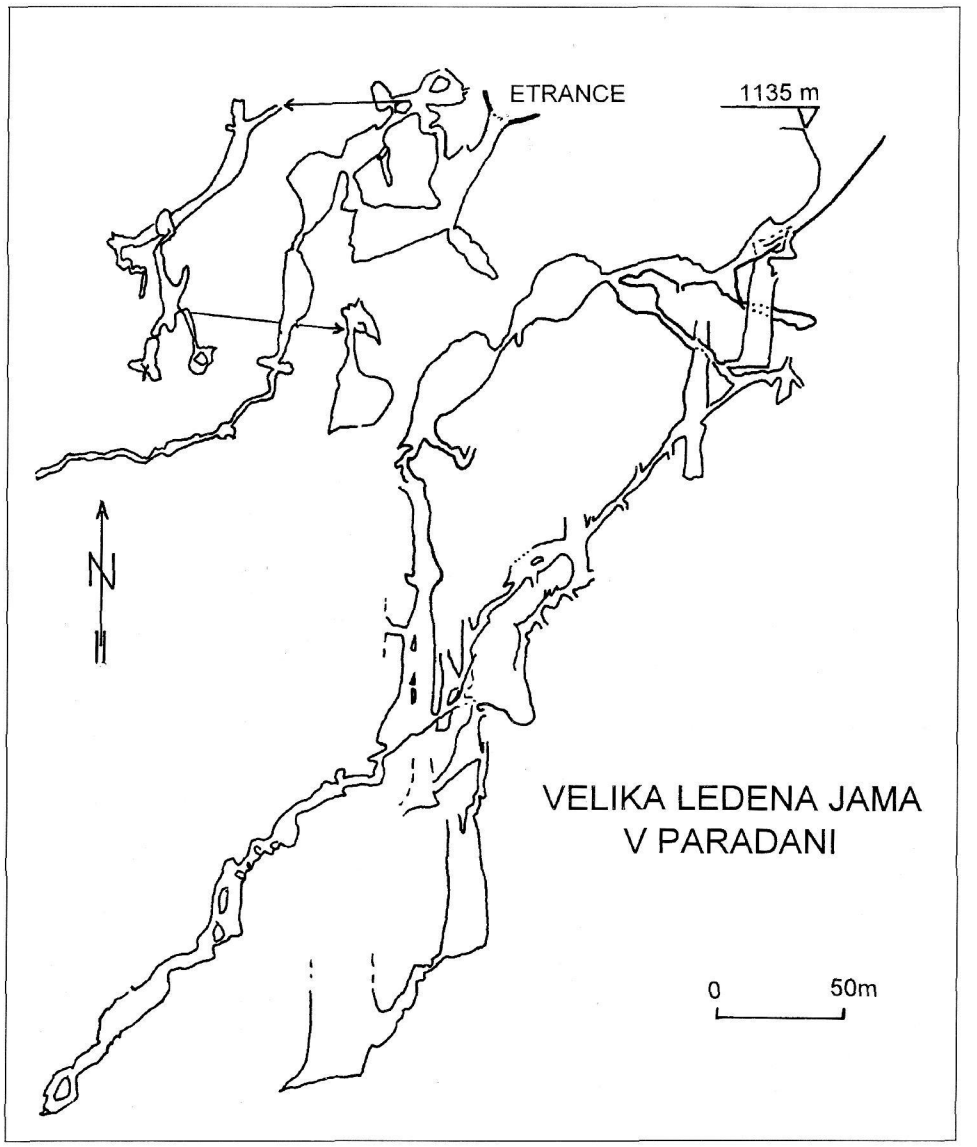

Fig. 2.19: Cave plan of the Velika Ledena Jama V Paradani.

above another, or are parallel, formed along one or along parallel joints
- third type doesn't follow the structure. In parts, which are accessible they just drill their way down, having a stable point recharge and well drained bottom.

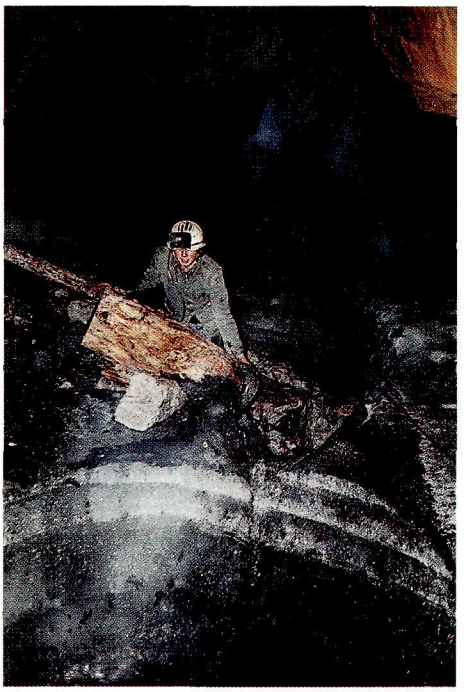

Photo 6: The cave Velika Ledena Jama V Paradani (Photo by A. Mihevc).

All three morphological types may also mean three different types of water percolation trough the vadose zone of karst.

Jazben

Entrance to cave Jazben is situated near Kanalski Vrh village in 574 m a.s.l. The cave is 334 m deep, formed near the contact of permeable upper Cretaceous limestone and flysch marls. The cave consists mostly of a series of shafts. Entrance part of a cave is dry, but in depth of about 120 m water appears. The cave than follows a NW - SE fault, along which it cascades to depth about 300 m. This part is developed in massive limestone. Below that point cave changes into a narrow meander which follows the dip of marly, thin bedded limestone with chert.

Habečkov brezen

The 336 m deep cave is developed near the contact of Triassic dolomite and Cretaceous limestone. It consist of series of potholes, which can be followed to a narrow rift at the bottom part and which terminates in a sump

at elevation of 332 m. This sump is only 3,6 km apart from the springs of Divje Jezero at the Idrijca river.

Divje Jezero spring

Divje Jezero is a karst spring of Vauclusian type. The level of the lake in which the water flows is in altitude 320 m. The submerged gallery that supply it with water is explored to the depth of 122 m (Fig. 2.20). The first part of cave to depth about 95 m is steep and reaches with a lower angle the terminal depth. Beyond the gallery it still continues.

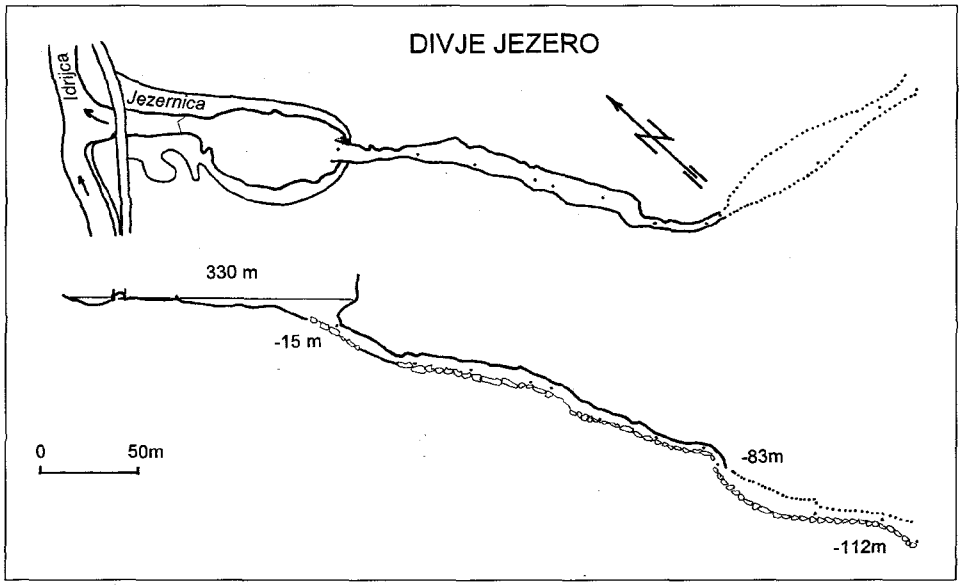

Fig. 2.20: Cave plan of the Divje Jezero.

Slapenski ledenik

Slapenski ledenik ice cave is located in the bottom of a small doline in an altitude of 1010 m on the plateau of Nanos. Under the entrance, a 30 m deep shaft, a large room is developed, partly filled with ice and snow (Fig. 2.21). Both were used for water supply too. On the side of this chamber a second shaft reaches the lowest part of the cave at -112 m. During the tracing experiment in 1995 (compare chapter 6.) the tracer was injected in the first room at the depth of about 30 m in between boulders and the wall of the cave.

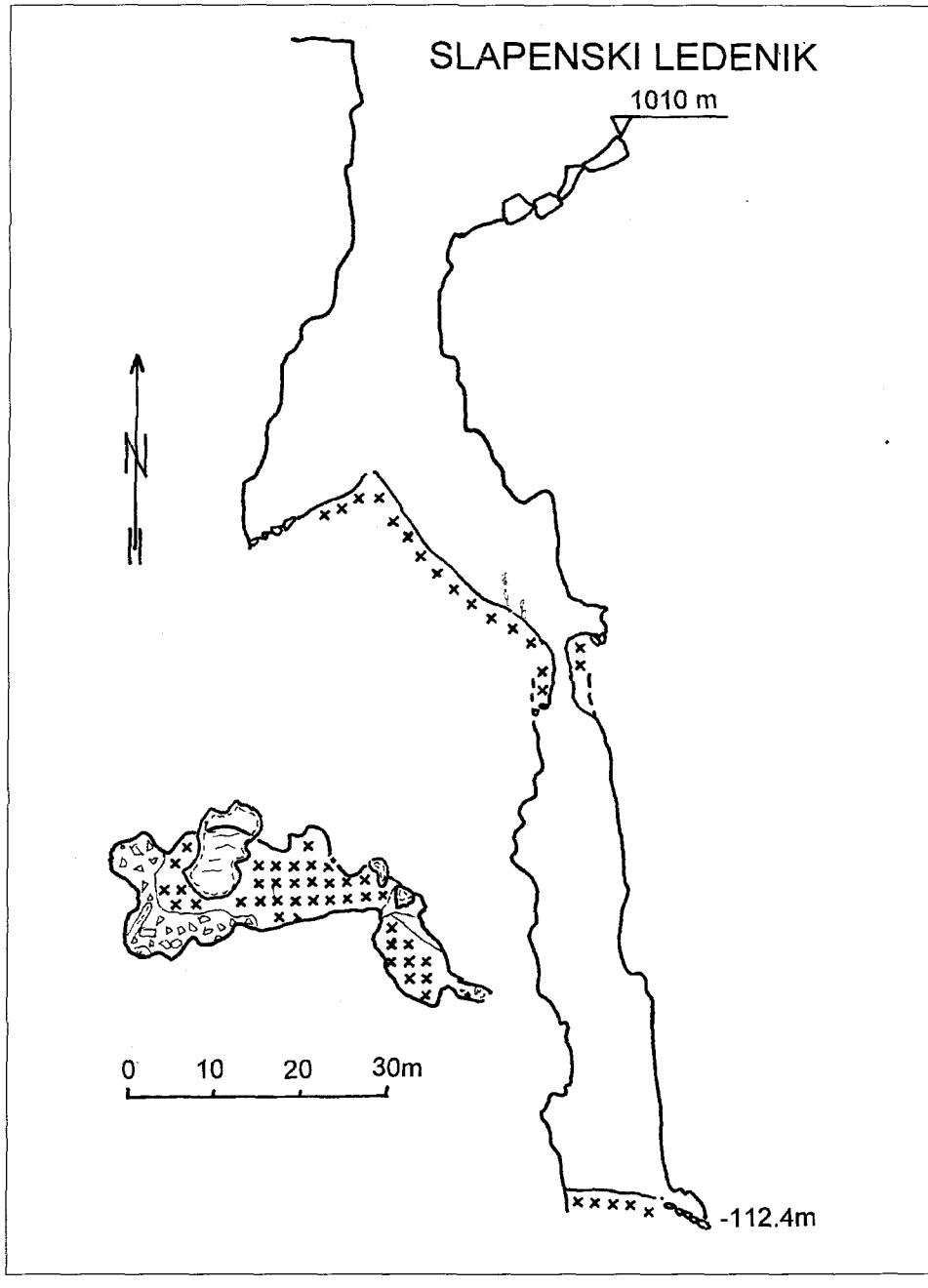

Fig. 2.21: Cave plan of the Slapenski Ledenik, injection place for the experiment in 1995 (see Chapter 6).

Strmadna

Strmadna cave is the deepest cave of the Nanos plateau. It entrance is in altitude of 1060 m a.s.l., and it is 218 m deep. The cave is a system of shafts mostly controlled by fractures in direction NW - SE.

2.6. GEOLOGY AND HYDROGEOLOGY

2.6.1. Geological Description (J. ČAR)

The geological description covers the territory limited by the valleys of the Vipava, Soča, Idrijca, Trebuša, Belca and Zala rivers from the southwest, west and northeast, respectively. To the southeast the border of this territory runs along Hotenjsko podolje (Hotenja lowland) across Planinsko polje (Planina polje) through Postojnska Vrata (Postojna gate) and embraces the Pivka basin and Nanos (Mt. Nanos).

The basic data on the geological conditions on Banjška Planota (Banjščica plateau), the Trnovski Gozd (Trnovo forest), Črni Vrh plateau, Hrušica, Pivka basin and Nanos can be found on the geological maps of Gorica (BUSER 1968), Postojna (BUSER et al. 1967) and Tolmin (BUSER 1987) and in the corresponding descriptive notes and legends. More details and particularities about the geological structure of the regions may also be found in the works of BUSER (1965), MLAKAR (1969), PLACER & ČAR (1974), PLACER (1981), ČAR & GOSPODARIČ (1988) AND JANEŽ & ČAR (1990). Reviews of geological discussions of older authors are also included in the listed works. Based on the above mentioned literature, the official maps and own mapping a general geological sketchmap of the investigation area is given in Fig. 2.22.

Fig. 2.22: Geological sketchmap of Banjšice, Trnovski Gozd, Nanos and Hrušica: 1 - periglacial breccia and rubble, 2 - flysch rocks of the Upper Cretaceous, Palaeocene and Eocene age, 3 - Upper Cretaceous organogenic limestone, 4 - Lower Cretaceous bituminous limestone with inliers of dolomite, 5 - limestones and dolomites of the Jurassic age, 6 - Norian-Rhaetian limestone (Dachstein), 7 - Norian-Rhaetian dolomite, 8 - Carnian granular dolomite, alternation of silt and sandstone, 9 - normal geological boundary, 10 - erosion discordance, 11 - thrust line, 12 - fault, 13 - dip and strike of strata, 14 - dip and strike of inverse strata, 15 - karst spring.