

# CAVE SYSTEM OF KITA GAČEŠINA – DRAŽENOVA PUHALJKA

## THE LONGEST CAVE IN THE DINARIC KARST

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The Croatian cavers have continued to explore the Crnopac Massif, the most northern, the highest and the most karstified part of the south-eastern Velebit mountain ridge known thanks to its underground karst phenomena. In more than 8 years of intensive research Cave system of Kita Gačešina – Draženova puhaljka reached the length of 23,334 m, depth of 737 m and became the Croatian and Dinaric karst longest cave. Speleologists have done some geomorphological research, microclimatic and radon concentration measurements, collecting and analysing some animal species. The whole area shows enormous speleological and tourism potential.

### 1. Introduction

The Dinaric karst form a mountain chain in the Southern Europe, spanning areas of Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Albania and Montenegro. They extend for 645 km along the coast of the Adriatic Sea (northwest-southeast), from the Julian Alps in the northwest down to the Šar-Korab Massif. The highest mountain of the Dinaric Karst is Mount Prokletije, located on the border of eastern Montenegro and northern Albania (2.692 m a.s.l.).

The Dinaric Karst is the fifth most rugged and extensively mountainous area of Europe after the Caucasus Mountains, Alps, Pyrenees and Scandinavian Mountains.

The Dinarides are known as a place of origin of term karst, the German name for Kras, a region in Slovenia partially extending into Italy, where the first scientific research of karst topography was made. This includes use of Croatian karst phenomena terms such as ponor, dolina, polje, jama, etc., in international geological vocabulary.

Dinaric karst is also the top of hotspots of world's subterranean biodiversity. The Postojnska Cave, described for the first time in 17<sup>th</sup> century is one of the famous and oldest tourist caves in the World. Since that time it was also known as the longest Dinaric cave.

In last few decades, number of speleological explorations in whole area grows. Hundreds of cavers in each country have found new caving attractive zones with deep and long caves.

The Crnopac Massif in Croatia is the most northern, the highest and the most karstified part of the south-eastern Velebit mountain ridge (part of Dinaric coastal mountainous karst). Numerous surface and underground karst phenomena are characteristic, including Cave system of Kita Gačešina – Draženova puhaljka, since 2011 – the Dinaric longest cave.

### 2. Crnopac Massif

The Crnopac Massif is situated between higher terrain of the Gračac Polje on the north and Zrmanja and Krupa river valleys on the South and East. The massif is built of thick upper Triassic, Jurassic and Cretaceous carbonate deposits. In higher parts of the massif, mentioned rocks

are covered with Oligocene to Lower Miocene carbonate breccias, probably deposited on the flanks of tectonically uplifted areas during older tectonic phase (Korbar 2009).

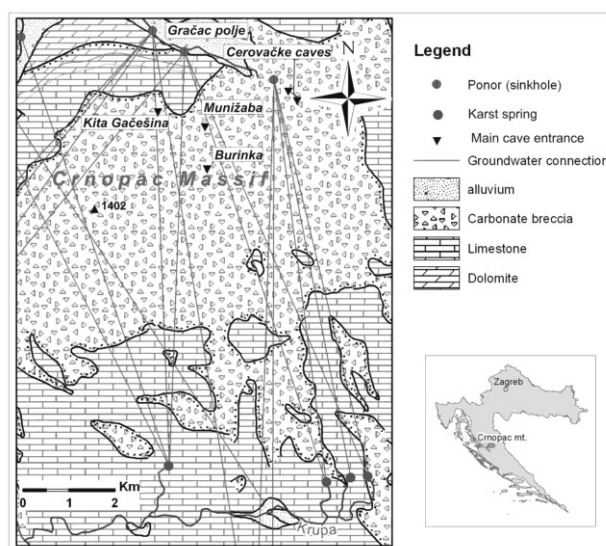


Figure 1. Geology of Crnopac massif.

Due to dominantly carbonate structure of this part of Velebit, waters flow subterraneous through the Crnopac Massif generally southwards. Underground waters get water from sinking streams that come from karst polje in Lika and Gračac areas and appear in springs on right side of Zrmanja and Krupa river valleys.

In such conditions, polygenetic multilevel caves have developed. Speleogenesis of the caves in the Crnopac Massif probably have lasted continuously from the beginning of the massif uplift (upper Miocene).

Mechanical properties of the Oligocene to Lower Miocene carbonate breccias (Jelar breccias) play a significant role in the cave morphology. Low frequency of cracks and joints in these massive breccias enables the preservation of underground passages and chambers of very large dimensions.

The most important caves of the Crnopac Massif are Munižaba (9.318 m, -510 m, volume 2.3 millions of m<sup>3</sup>). Cave system Kita Gačešina – Draženova puhaljka (23,334

m, -737 m, volume 1.3 millions of m<sup>3</sup>), Burinka (930 m, -290 m, volume 1.1 millions of m<sup>3</sup>), Gornja (Upper Cave) (1,292m) and Donja (Lower Cave) Cerovačka pećina

hydrologic system. In 2004, cavers from the SS St.Mihovil (Šibenik) found lower entrance of Cave system of Kita Gaćešina – Draženova puhaljka. Cavers from the SS PDS Velebit and SS Mosor (Split) join them and new

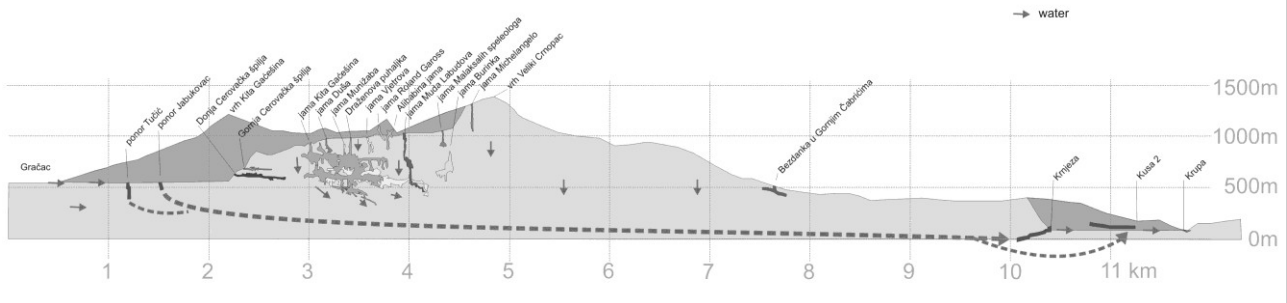


Figure 2. Projected section of large caves in Crnopac massif: N-S.

(2,779 m), and Muda Labudova (2,490 m, -680 m).

### 3. History of explorations

While the Upper Cerovačka Cave entrance was known to local people, Lower cave entrance was found during the railway building in 1913. New found cave brought large quantities of archaeological findings, sites of the cave bear, cave lion and amazing speleothem forms. Both caves in a total length of 4 km become most popular tourist cave site in Croatia.

Modern cave explorations with rope techniques started in late seventies. Year after year just a few cavers succeeded to rich summit plateau. Members of Speleological section (SS) Željezničar (Zagreb) in cooperation with others clubs have found impressive chambers in Burinka (160 x 90 x 90m), Munižaba (185 x 60 x 70m) and Veliko Grotlo pit (100 x 85 x 130m). War in Croatia stopped further caving activity.

Explorations continued few years after the end of the war. Members of SS Željezničar have found dozens of new pits and caves (Michelangelo pit -274 m, Alibabina jama -218 m, Muda Labudova pit -680 m). Today, there are more than 250 known caves on the Crnopac. The SS PDS Velebit (Zagreb) continued exploration of Munižaba channels with massive use of alpine techniques; drilling, bolting and spending a lot of time in underground camps what led to the total length of more than 9 km. Using the cave diving techniques, the DDISKF Dinaridi explored Kusa II Cave (3,010 m) and Krnježa spring (sump, -106m) in Zrmanja and Krupa river valleys – the outputs of

cave rapidly grew up. Draženova puhaljka pit was found in 2005 (the SS Željezničar), and 2009 connected to Kita Gaćešina. In 2010, the system became the longest cave in Croatia and 2011 the longest in Dinarides. Eighty-one explorations conducted by cavers of the almost every caving club in Croatia brought the total length of 23,334 m and placed system on the list of 200 World longest caves. Caving accidents in 2011 and 2012 caused two most complex cave rescue operations in Croatia ever with two blissfully happy ends.

### 4. Cave system Kita Gaćešina – Draženova puhaljka (KG–DP)

Cave system of KG–DP is a network of multiphase cave passages, remnants of various levels of paleodrainage systems that conducted waters from the higher terrain to the base level springs on the south and south-east. Older phreatic and epiphreatic channels are frequently crossed by younger invasion vadose shafts, which provide entrances and also connections between different levels. These are three main levels in the system. The highest one approximately at 800 m is developed in Jelar breccias. The middle one is approximately at 600 m, similar to Cerovačke caves and the Munižaba Cave. Even not in breccias, this level also characteristics large passages, result of simultaneous collapsing and removing of collapsed material by big underground water flows during the hydrologically active phase of their development. The lowest level (250–400 m) is inclined according to carbonate layer inclination (-20 to -35°, SW).

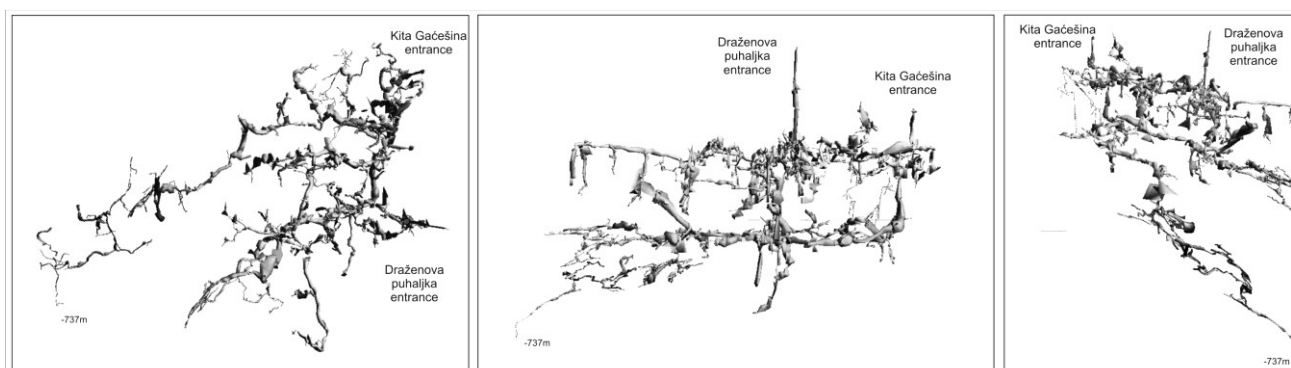


Figure 3. Cave system of Kita Gaćešina – Draženova puhaljka – 3D view.

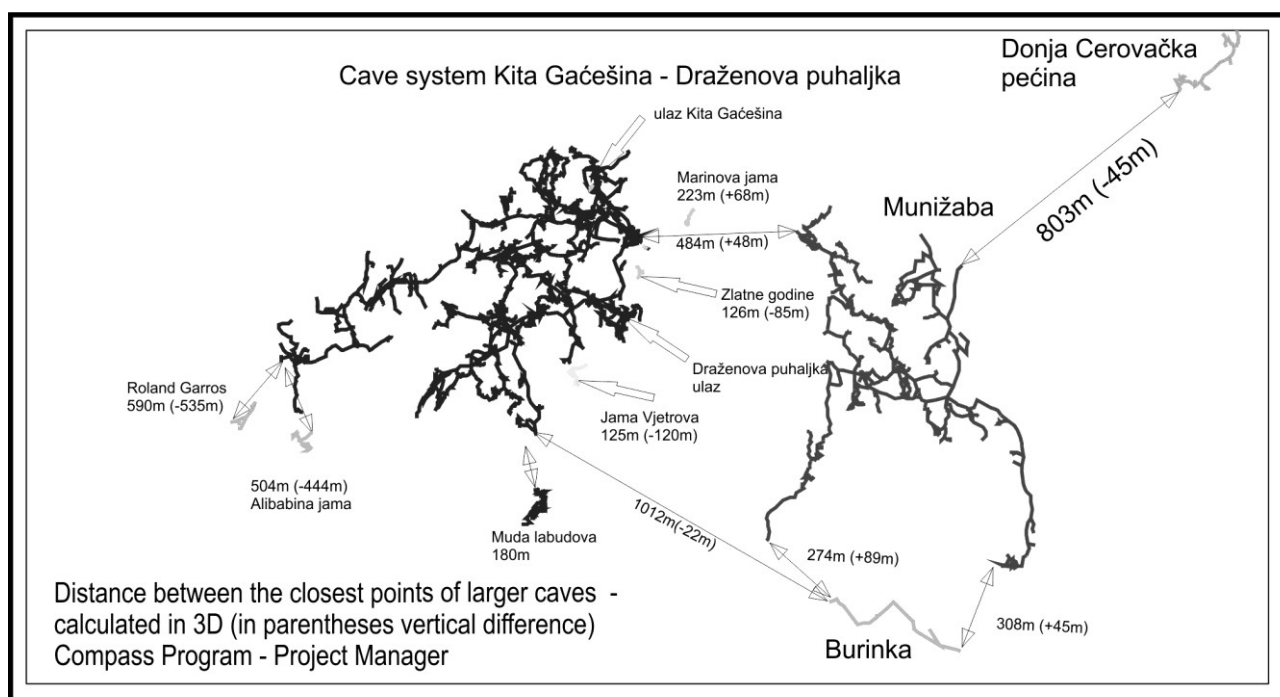


Figure 4. Plans of largest caves on Crnopac Mt.

Lower entrance (Kita Gaćešina) is at 920 m, and the higher one (Draženova puhaljka) at 985 m a.s.l. The lowest point (-737 m) is at 248 m a.s.l. what means almost 300 m lower than the Gračac Polje (545) and its sinkholes. All water in system is the rainwater or melted water from ice and snow caves in the Crnopac Massif. Permanent water stream – Gračac Polje drainage system haven't been found yet.

The KG–DP cave system in almost all parts and many surrounding caves characteristics strong air flow. In permanent air pressure during the summer it tends to come out from the entrances and during the winter its changes the direction. Cold air flows lowers the temperature and create ice speleothemes in areas close to the entrances. There must be some higher entrances placed close to the top of the Crnopac Massif (1,402 m a.s.l.) and connected to the lowest parts of the system. Measured temperatures in system vary from 3.7 to 5.4 °C.

## 5. Biospeleological research

Biospeleologists collected KG–DP cave system fauna material only twice and collected 20 different species. First interpretation of results showed that organisms are similar to surrounding caves that were visited much more times by the biospeleologists. Some data still wait to be explained and there are some indications that there must be at least one new speciae.

Cavers were collecting remains of cave bats and it is confirmed that at least 8 different bats lived in the cave system.

## 6. Measurements of radon concentration

Measurements of radon concentration were performed during 6 months in the upper level of the system at 7

locations. Concentration range, between 514 and 1,220 Bq.m<sup>-3</sup> and it is higher during summer. These values are comparable with the results of measurements in the deep pits of the northern Velebit (Paar et al. 2008) and significantly lower than the concentration of radon in Žumberak caves (Paar et al. 2005). In complex caves like Kita Gaćešina, there is no simple connection of radon concentration with ground surface climate conditions. Future investigations will try to connect radon dynamic with cave microclimate and geology.

## 7. Nature Protection and tourism potential

Existing known values, diversity of forest cover and extraordinary landscapes with existing near tourist centers makes exceptional tourism potential. Opening of the forest road construction has made the area more accessible but in karst areas hitherto untouched forests have been felled. Speleological research results presentation initiates idea of establishing a more nature protection zone – Speleological Park Crnopac what become one of the Zadar County goals (SPARC project). For now, cavers have succeed to stop intensive logging

## 8. Conclusion

Croatian cavers have found more than 250 caves, dozens kilometers of subterranean channels and impressive chambers showing Crnopac massif remarkable geomorphologic phenomena. In more than 8 years of intensive research Cave system of Kita Gaćešina – Drazenova puhaljka reached the length of 23,334 m, depth of -737 m and became longest cave in Croatia and Dinaric Karst. The whole area shows high speleological and tourism potential

Despite undertaken geomorphological research, microclimatic measurements, radon, physico-chemical

analysis of water, the collection and analysis of animal species, we can say that the systematic scientific investigation of the whole area is still in its infancy.

## Acknowledgments

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