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Snow and ice in speleological features of Dinaric Mountains in Croatia

Nenad Buzjak (1,2), Dalibor Paar (3,4), Darko Bakšić (3,5)

(1) University of Zagreb, Faculty of Science, Department of Geography, Croatia (nbuzjak@geog.pmf.hr), (2) Caving club Samobor, Croatia, (3) Speleological section Velebit, Croatia, (4) Faculty of Science, Department of Physics, University of Zagreb, Croatia (dpaar@phy.hr), (5) Faculty of Forestry, University of Zagreb, Croatia (baksic@gmail.com)

The caves and pits with perennial ice and snow in Croatia are situated in Dinaric Karst Mountain belt. The mountains parts higher than 1500 m a.s.l. have a humid boreal climate (Köppen's type Df) and the lower parts have a temperate humid climate (Cfb) highly modified by the relief. Mean annual temperature in the area up to 1000 m a.s.l. is about 5.5°C and in the highest parts around 3.5°C. The coldest months are January and February (MAT between -2 and -5°C) and the warmest one is July (MAT 12-16°C). Due to the position near Adriatic Sea there are important climate modifications. The most important one is high amount of precipitation that varies from 2000 to 3900 mm/year. In combination with higher altitude and larger depressions with intense temperature inversion there are good conditions for the accumulation of ice and snow in karst depressions like deep mountain dolines and caves and pits. The most impressive were discovered in northern Velebit karst. It is an area known for deep pits, three of which are deeper than 1000 m: Lukina Jama - Trojama pit system (-1421 m), Slovačka Jama (-1320 m) and the Velebita Pit system (-1026 m). So far, more than 280 pits have been discovered in an area of 25 km2. The area is composed of carbonate lithostratigraphic units ranging from the Middle Triassic to the Paleogene. Most of the pits have vertical entrances with temperatures close to 0°C down to about 100 m, so in many of them there is ice and snow. The depth of perennial ice and snow varies from 50 m to almost 560 m below entrance level. On the other hand, in some of deep pits in the same area there is no ice and snow, most likely because the entrance is not vertical. In the upper parts of these pits there is also a negative temperature gradient, but the minimum temperature is a few degrees above 0°.