

Movements and polygonal ground formation monitoring with terrestrial laser scanning in the cave Skednena jama

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Seasonal freezing and formation of the seasonal ice in middle latitude and altitude caves where mean annual temperature of the surface is above 0 °C requires adequate climate on the surface and suitable cave morphology, which enables ventilation and cooling of the cave or part of the cave in winter time only. Seasonal freezing has morphological effects on cave walls and cause creeping of cave sediments and formation of polygonal ground. Formed underground these features are not disturbed by rain or vegetation. They are important indicator of the present or past climatic conditions and enable easy measurements and study of the periglacial phenomena.

For such study we choose Skednena jama, 206 m long, 10 m wide and mostly about 5 m high cave (45°52'32.34"N, 14°14'26.67"E). The cave has three entrances, which are disposed at different altitudes between 496 and 460 m. The mean annual temperature of the area is about 8 °C. The coldest month is January (-1 °C) and the warmest July (+18 °C). During the winter there is a strong air draft through the cave, temperature is for several months below 0 °C and cave floor is frozen. Temperatures in the warm part of the year do not exceed the temperature of the rock (about 8 °C) because of temperature inversion.

Cave floor form clastic sediments, some collapse rock boulders but mostly coarse and fine gravel mixed with sand and silt. Most of the cave floor is levelled to an even inclination of 7-10° and is horizontal in cross section to the passage, which we can attribute to recent cryoturbation. On this levelled surface smaller features like sorted stone circles, stripes, clay hummocks and arrays of pebbles along the cave walls formed.

For several seasons we measured the seasonal movements of the selected stones, using marks on the stones and the walls of the cave. The upward movements from 5 – 10 cm were recorded.

For more detailed measurements we start with terrestrial laser scanning. The technology of the terrestrial laser scanning was used because it enables fast measurement of large amount of 3-D points with sufficient accuracy. From April 2018 to January 2019, we executed 9 scanning with Riegl VZ-400. Point clouds of several epochs were georeferenced into the same coordinate system with 13 wall stabilized control points. In December 2018 the temperatures dropped below 0 °C. That allowed the detection of the upward ground movements, which were calculated with cloud-cloud distance method. The maximum detected cloud distance between 9th November 2018 and 5th January 2019 was 15 cm. For larger areas of clay hummocks, the average altitude movement was over 5 cm.