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Tension zones of deep-seated rockslides revealed by thermal anomalies and airborne laser scan data

Ivo Baroň (1), David Bečkovský (2), Juraj Gajdošík (3), Filip Opálka (4), Lukas Plan (1), and Gerhard Winkler (5)

(1) Karst and Cave Research Group, Department of Geology and Paleontology, Natural History Museum, Burgring 7, 1010 Vienna, Austria (ivo.baron@nhm-wien.ac.at), (2) Institute of Building Structures, Faculty of Civil Engineering, Brno University of Technology, Veveří 331/95,602 00 Brno, Czech Republic, (3) Geospol Košice, s.r.o., Urbánková 64, 040 01 Košice, Slovak Republic, (4) Department of Geological Sciences, Faculty of Science, Masaryk University, Kotlářská 267/2, 611 37 Brno, Czech Republic, (5) Speleological Society of Vienna and Lower Austria, Obere Donaustraße 97/1/61, A-1020 Vienna, Austria

Open cracks, tension fractures and crevice caves are important diagnostic features of gravitationally deformed slopes. When the cracks on the upper part of the slope open to the ground surface, they transfer relatively warm and buoyant air from the underground in cold seasons and thus could be detected by the infrared thermography (IRT) as warmer anomalies. Here we present two IRT surveys of deep-seated rockslides in Austria and the Czech Republic. We used thermal imaging cameras Flir and Optris, manipulated manually from the ground surface and also from unmanned aerial vehicle and piloted ultralight-plane platforms. The surveys were conducted during cold days of winter 2014/2015 and early in the morning to avoid the negative effect of direct sunshine. The first study site is the Bad Fischau rockslide in the southern part of the Vienna Basin (Austria). It was firstly identified by the morphostructural analysis of 1-m digital terrain model from the airborne laser scan data. The rockslide is superimposed on, and closely related to the active marginal faults of the Vienna basin, which is a pull apart structure. There is the 80-m-deep Eisenstein Show Cave situated in the southern lateral margin of the rockslide. The cave was originally considered to be purely of hydrothermal (hypogene) karstification; however its specific morphology and position within the detachment zone of the rockslide suggests its relation to gravitational slope-failure. The IRT survey revealed the Eisenstein Cave at the ground surface and also several other open cracks and possible cleft caves along the margins, headscarp, and also within the body of the rockslide. The second surveyed site was the Kněhyně rockslide in the flysch belt of the Outer Western Carpathians in the eastern Czech Republic. This deep-seated translational rockslide formed about eight known pseudokarst crevice caves, which reach up to 57 m in depth. The IRT survey recognized several warm anomalies indicating very deep deformation of the slope. When compared to digital terain model, some of these thermal anomalies suggest large unexplored crack systems deep in the rock-slope failure. As a conclusion we notice that especially when compared to topographic structures visualized on high accuracy digital terrain models, detecting the thermal anomalies could significantly contribute to understanding the subsurface occurrence of the tension fractures and voids within deep-seated rockslide bodies.