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3D thermal model of rock outcrop and it verification made by simultaneous geophysical measurement

Abstract

Interdisciplinary research on geological, geophysical and thermal conditions is becoming more and more important. All, different data can be bind together by up to data survey methods – 3D laser scanning. This method provides a point cloud, discreet spatial information on scanned objects. Point cloud consists of a large number of points measured on the surface of the object. Besides XYZ coordinates a point cloud caries information on intensity (strength of the laser signal coming back to the instrument) and RGB colour at the measured point. It is possible to cover obtained model with data from a thermal camera. A series of thermal images was taken and then projected on to a 3D model creating a 3D thermal model. This survey allowed distinguish differed rock layers forming the object. This was done remotely, with almost no need to access any dangerous (due to its shape) parts of the object. Geophysical survey was done simultaneously for distinguishing the mechanical properties of rock, which could be compared with thermal image. For this purpose a one of the seismic methods was used. Seismic refraction tomography studies are mainly based on analysing the travel times of waves refracted under the critical angle. After applying proper algorithms the observed travel time – distance function is converted into cross-section of the subsurface presenting the seismic velocity distribution comprising the depth of seismic boundaries and the velocity inside layers. Seismic refraction tomography allows to determine vertically and laterally heterogeneous velocity fields of the subsurface. Its application requires a dense multi-fold coverage of subsurface segments. In order to guarantee high structural resolution, the seismic field configuration has to ensure that each relevant underground segment is sounded under different ray directions.