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Geophysical cave detection with a portable Very Low Frequency (VLF) radio transmitter

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In the past few years several attempts have been made to delineate karstic features as caves with geophysical methods from the surface. Knowledge about the exact position of caves might be of interest for karst hydrogeology, hazard estimation or even touristy purposes. However, interpretation of data from indirect approaches as geophysics naturally always holds a certain degree of ambiguity.

A geophysical field experiment at the Swiss Jura Mountains is presented, which shows the possibility for precise lateral position delineation of an accessible cave at a depth varying from 10 to about 60 meters below surface in Mesozoic limestone. For this purpose, a portable Very Low Frequency radio transmitter prototype with a loop diameter of about one meter is placed along a 150 meter long profile at several positions inside the cave with vertical transmitter loop axis orientation. In order to delineate the transmitter locations from the surface, a Radio-Magnetotelluric (RMT) receiver prototype is used simply by triangulation of the zero-signal from the transmitter loop. The zero signal of the emitted EM field should coincide with the transmitter loop axis in case of an undistorted EM field. As in-situ proof, the transmitter positions additionally have been speleologically mapped.

The results of the experiment show that the lateral positions found from the surface by combined application of a VLF transmitter and RMT receiver coincide extremely well with the locations speleologically mapped. At the deepest part of the cave (about 60 meters below surface) lateral deviation between EM- and speleological results is only about one meter. Therefore, this technique for instance enables positioning of drilling locations aiming on entering cave galleries.