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RMT Field Campaign at Laacher See (Eifel): Imaging of CO2-rich fluids rising near the surface

Since the last eruption of the Laacher See volcano (LSV) in the East Eifel volcanic field (EEVF) around 12.9 kyr ago, the volcanic activity beneath the LSV can still be traced by several gas emissions in the lake and its surroundings. This continuous gas flux is related to CO2 originating from the magmatic system in the upper mantle to the shallow crust at about 10 - 30 km depth, from where CO2 ascends to the surface along preferential fault pathways and leaks out at dry and wet (mixed with iron-rich water) CO2 springs, known as mofettes.

Here, we focus on the CO2 degassing sites of the EEVF on the east shore of the LSV and near the small town of Wassenach north of the LSV with the aim of identifying the CO2-enriched fluid pathways in the first ten to one hundred meters of depth. For this purpose, we have carried out Radio-Magnetotelluric (RMT) measurements in a frequency range of 1 - 256 kHz along six profiles that follow and cross the visible mofettes on the surface, thus indicating the directions of the faults and fluid pathways at depth. RMT is a powerful electromagnetic (EM) method to determine the near-surface electrical conductivity distribution, as this parameter is very sensitive to fluids and volatile compounds.

The associated electrical conductivity models resulting from a 2D inversion of the measured RMT data support the hypotheses of distinct vertical and horizontal CO2 migration pathways, which are represented as conductive reservoirs and channels in contrast to the more resistive carbonate rocks in the upper 30 m. These findings underscore that the RMT method is a useful tool to further constrain the complex fluid and CO2 pathways underneath mofettes in more detail.

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