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Joint geophysical investigation of a small scale magnetic anomaly near Gotha, Germany

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In the framework of the multidisciplinary project INFLUINS (INtegrated FLUid Dynamics IN Sedimentary Basins) several airborne surveys using a full tensor magnetic gradiometer (FTMG) system were conducted in and around the Thuringian basin (central Germany). These sensors are based on highly sensitive superconducting quantum interference devices (SQUIDs) with a planar-type gradiometer setup. One of the main goals was to map magnetic anomalies along major fault zones in this sedimentary basin. In most survey areas low signal amplitudes were observed caused by very low magnetization of subsurface rocks. Due to the high lateral resolution of a magnetic gradiometer system and a flight line spacing of only 50m, however, we were able to detect even small magnetic lineaments.

Especially close to Gotha a NW-SE striking strong magnetic anomaly with a length of 1.5 km was detected, which cannot be explained by the structure of the Eichenberg-Gotha-Saalfeld (EGS) fault zone and the rock-physical properties (low susceptibilities). Therefore, we hypothesize that the source of the anomaly must be related to an anomalous magnetization in the fault plane.

To test this hypothesis, here we focus on the results of the 3D inversion of the airborne magnetic data set and compare them with existing structural geological models. In addition, we conducted several ground based measurements such as electrical resistivity tomography (ERT) and frequency domain electromagnetics (FDEM) to locate the fault. Especially, the geoelectrical measurements were able to image the fault zone. The result of the 2D electrical resistivity tomography shows a lower resistivity in the fault zone. Joint interpretation of airborne magnetics, geoelectrical and geological information let us propose that the source of the magnetization may be a fluid-flow induced impregnation with iron-oxide bearing minerals in the vicinity of the EGS fault plane.