EGU24-3882, updated on 29 May 2024
https://doi.org/10.5194/egusphere-egu24-3882
EGU General Assembly 2024

The delineation of graphite deposits in Lower Austria using the Transient Electromagnetic method

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The European Commission classifies graphite as a critical raw material, given its importance in refractory and high-tech applications, including the production of lithium-ion batteries. Many of Austrias graphite deposits are situated in and around the so-called “Drosendorf-Deckensystem” in Lower Austria. As those sites have been extensively mined out in the near-surface and are heavily weathered, the current interest of the potential assessment primarily focuses on the spatial extent of the graphite deposits, with particular interest in the deep continuation of these graphite deposits. Geological cross-sections are a standard approach for understanding subsurface graphite distribution, relying on available structural, geochemical, and/or lithological data. However, such information is primarily derived from surface observations, limited to exposed surfaces or outcrops. Geophysical methods can play a crucial role in extending the interpretation of geological cross-sections both horizontally and vertically. Due to the high electrical conductivity of graphite, electromagnetic and electrical methods like the Transient Electromagnetic (TEM) and the Induced Polarization (IP) are commonly applied for exploration. The IP method complements traditional electrical resistivity methods by measuring not only subsurface conductivity but also variations in the electrical capacitive properties (polarization) at low frequencies. In this study, we explore the feasibility of integrating the interpretation of IP and TEM measurements. The latter is known for its cost-effective coverage of large areas with high resolution and depth of investigation, compared to other geophysical methods. For that purpose, multiple TEM soundings were acquired in a ca. 4 km long profile between Berging and Kochholz in Lower Austria, situated in the geological section called “Drosendorf-Deckensystem”. The inversion of TEM data revealed distinct high-conductivity anomalies (100 – 200 mS/m) at approximately 40 m depth, attributed to the presence of graphite. A parallel comparison with two 160 m – 250 m long Time-Domain IP profiles confirms the graphite presence, attributed by high conductivity and high polarization ($\sigma' > 200$ mS/m, $\sigma'' > 20$ mS/m). Integrating these results along a geological cross-section improved the delineation and understanding of graphite deposits at depth and their correlation with lithological features in Lower Austria. Furthermore, these findings confirm that acquiring physical property models related to TEM and IP surveys has the potential to enhance mineral exploration.
This research work was co-financed by the Federal Ministry of education, science and research and supervised by the Federal Mining Authority of Austria within the framework of the VLG83 project (Raw Material research initiative).