Nature of crustal electrical conductivity anomalies in the Central Norwegian Caledonides and similarity to analogous anomalous conductivity features in the Alpine-Carpathians.

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SUMMARY

A dense network of broadband magnetotelluric data in the period range of 10^{-3}-10^{3}s was collected during two field campaigns in 2022-2023 covering the Trondelag area, central Norway as a part of the D-Rex project (Deposit to Regional-scale Exploration) to investigate the lithospheric structure of the central Norwegian Caledonides, and how they relate to the near-surface mineralization. 3D inverse modelling of the MT responses revealed complex three-dimensional electrical structure within and below the Caledonides. The study area lies within the Caledonian allochtonous nappes, which mark a detachment from the underlying Precambrian Svecokarelian and Sveconorwegian basement and has undergone tens to hundreds of km(s) of lateral transport. The conductivity distribution appears to be controlled by local morphology. Several smaller conductivity anomalies in the upper crust are located either within the Caledonian nappes or below. Few of them cross the base-nappe horizon that has been derived in previous geophysical studies. A pronounced conductivity anomaly is observed at the mid-crustal depths of the Precambrian basement. It underlies the nappe complex where this is thickest (ca 8-10 km) and is connected to near-surface conductive features by sub-vertical conduits intersecting the basement/thrust boundary. Where this mid-crustal anomaly has affected the tectonic evolution of the Caledonian orogen or its subsequent extension remains to be discussed. Similarly, the connection between deeper conductivity anomalies and the near-surface conductive features with known Cu-Zn deposits needs further investigation. However, the presented results fit into the mineral system concept with deep-seated relict sources, fossil mineral-bearing fluid pathways and ore deposits themselves. In this context, a similarity with crustal conductors in other, even much younger orogenic regions can be noticed. In the Carpathian branch of the European Alpine orogene, a similar chain of anomalous features appears in the crust beneath the system of nappes. This well-known Carpathian conductivity anomaly is associated with a shear zone that also functions as a channel for fluids migrating from the mantle and forming conductive mineral accumulations near the Earth's surface.

Keywords: Magnetotellurics, 3D inversion, mineral deposits, Norvegian Caledonides, Western Carpathians