

Structural controls on Ni-Cu-Co mineralisation in the Jotun-Valdres Nappe Complex, south-central Norway.

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The Espedalen Nickel-Copper-Cobalt deposits lie within the lower Jotun-Valdres Nappe Complex of the Caledonian Orogeny. Recent studies have focused on the geometrical and geochronological aspects of the regional geology (Corfu & Heim, 2019) or on the processes related to the genesis of the mineral deposits (Mansur et al., 2023). The mineralisation displays typical magmatic textural and compositional features, however, these have been overprinted by deformation. Yet, the extent and origin of the deformation has not been considered in previous studies. We provide new structural and kinematic observations which document the relationship between the sulphide deposits and two separate orogenic episodes and place the mineralisation within a regional tectonic framework.

On a map scale, the distribution and geometry of the deposits shows two main patterns: 1) Minor deposits oriented in NNW-SSE linear patterns. 2) Larger, more massive orthomagmatic sulphide deposits forming mappable bodies in ENE-WSW geometries. Detailed structural analysis reveals that type 1 geometries occur within steeply-dipping to vertical strike-slip mylonitic shear zones. The shear zones display mutual cross-cutting relationships with the Ni mineralisation: We observe undeformed mineralisation emplaced within ductile dilation zones in the shear zones, and mineralisation that is deformed within the shear zone fabric. These deposits are rather small (i.e. <1-5 meters) and define vertical, segmented geometries. Type 2 geometries are relatively large (i.e. 5-10s meters) flat-lying zones (20-30 degrees) to the NW that host massive sulphide bodies. These ubiquitously have tectonised margins with top-to SE kinematics which we interpret as tectonically transported during the Caledonian Orogeny.

Steep strike slip shear zones associated with Type 1 geometries are found as xenoliths within tectonically dissected blocks in the Type 2 massive sulphides geometries. Based on U-Pb zircon dating by Corfu & Heim, (2019) of the host rocks of the mineralisation the age of these steep strike-slip shear zones must be pre-1510Ma, which was interpreted as the crystallization age of the Espedalen Complex.

We present a map-based geometric/structural/metallogenic model for the formation and segmentation of these deposits on a regional scale.

Corfu, F., & Heim, M. (2019). Geochronology of Caledonian metamorphic allochthons in the Otta–Heidal region, South Norway; tectonostratigraphic and palaeogeographical implications. *Journal of the Geological Society*, 177(1), 66–81. <https://doi.org/10.1144/jgs2019-010>

Mansur, E. T., Slagstad, T., Dare, S. A. S., & Sandstad, J. S. (2023). Geology and sulphide geochemistry of the Ni-Cu-Co mineralisation of the Espedalen Complex, Norway: Constraints for the distribution of magmatic sulphides within a variably deformed anorthosite suite. *Ore Geology Reviews*, 161, 105666. <https://doi.org/10.1016/j.oregeorev.2023.105666>