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Brittle reactivation of ductile precursor structures: The role of incomplete structural transposition at a nuclear waste disposal site, Olkiluoto, Finland

Pietari Skyttä, Taija Torvela

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Brittle reactivation of ductile precursor structures: the role of incomplete structural transposition at a nuclear waste disposal site, Olkiluoto, Finland

Pietari Skyttä, University of Turku, Department of Geography and Geology, FI-20014 University of Turku, Finland

Taija Torvela, University of Leeds, Earth and Environment, Leeds LS2 9JT, UK

Abstract

Reactivation of discrete deformation zones that are orientated favourably with respect to the stress field is a well-known phenomenon. What is less clear is the role of other structural features and heterogeneities in localizing deformation. In this paper we describe how brittle deformation structures are localized into zones of incomplete structural transposition inherited from earlier ductile deformation phases. In our example, these zones of incomplete structural transposition are characterised by localised high-strain structures of the latest ductile deformation stage, including short limbs of strongly asymmetric folds and anastomosing networks of minor shear fabrics. When such zones are systematically organized, and orientated favourable with respect to the stress field, they can be very efficient in localizing deformation and forming new fault zones. Applied to the site of the planned geological repository of nuclear waste in Olkiluoto, Finland, the recognized structural inheritance provides tools to understand the geometries, networks and kinematics of the brittle fault zones and the related secondary fracturing which together define the rock mechanical and hydrogeological framework for the repository.

Keywords: Structural inheritance; Fault linkage; Transposition; Nuclear waste disposal; Palaeoproterozoic; Fennoscandian Shield

1. Introduction