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Validating hydraulic fracturing data from the Lansjärv postglacial fault, North Sweden

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The Swedish Nuclear Waste Company (SKB) conducted a major study on the Lansjärv postglacial fault in Northern Sweden about 20 years ago. The investigations included drilling four boreholes ranging from 50 m to over 500 m in length, trench digging, and a suite of measurements and borehole monitoring (e.g. hydraulic fracturing, extensometer measurements; SKB, 2008).

Four major and several minor fault scarps form the approximately 50 km long, SSW-NNE trending Lansjärv fault in north Sweden (Lagerbäck, 1990). The subvertical bedrock scarp was measured to vary from ∼3 to 7 m in the three trenches (e.g. SKB, 2008), but values up to about 20 m have been reported (Kuviamäki et al., 1998). Within the site investigation area, the fault was determined to have a strike of 20ºN and a dip of ∼80º from the horizontal.

Borehole KLJ01 was drilled and cored down to 500 m borehole length, and designed to cut the major postglacial fault at about 150 m depth, assuming that the fault dip was ∼85º from the horizontal. However, it was difficult to determine the exact depth of the fault. Stress measurements using the hydraulic fracturing method were made by Bjarnasson (see SKB, 2008), but highly fractured rock prevented measurements above 300 m borehole length. The result display a strongly non-linear stress field with respect to both magnitudes and orientations; hydrofractures display a 90° rotation between 350 and 500 m borehole length (from 330ºN to 60ºN).

After the completion of the Lansjärv investigation, reflection seismic data from other postglacial faults in Sweden show that at least two of the most active faults have a complex internal faults structure, and that their dip is more gentle than that measured at the Lansjärv fault. In addition, new data reveal that the postglacial faults in Sweden are active in terms of microseismicity (Lund et al, in prep,). This has lead to speculations that the KLJ01 borehole never penetrated the major postglacial fault. In this study, we revisit the raw data from hydraulic fracturing measurements with the primary objective to validate the data. The analysis results will be used to establish a plan for additional investigations at the Lansjärv site that may help answer the true orientation of the main fault.