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Microearthquake activity on the Pärvie endglacial fault system, northern Sweden

Eva Lindblom (1), Björn Lund (1), Christopher Juhlin (1), Reynir Bödvarsson (1), Ari Tryggvason (1), Marja Uski (2), and Tormod Kvaerna (3)

(1) Department of Earth Sciences, Uppsala University, Uppsala, Sweden, (2) Institute of Seismology, University of Helsinki, Helsinki, Finland, (3) NORSAR, Kjeller, Norway

The Pärvie fault is one of the largest known endglacial faults in the world. It is situated in northernmost Sweden and extends for over 150 km with a northeastward direction. The fault exhibits reverse faulting throw of more than 10 m and based on studies of Quaternary deposits, landslides and liquefaction structures it is inferred to have ruptured as a one-step event at the time the ice sheet disappeared from the area. An earthquake of this size would have had a magnitude of approximately 8. The mechanisms driving the endglacial faults are still not well understood. However, knowledge of the fault geometry at depth would significantly contribute to the understanding. In a seismological study of the Pärvie fault we have both acquired a 23 km long seismic reflection profile across the center of the fault and deployed eight temporary seismic stations in the vicinity of the fault. The results of the reflection seismic processing images the fault system from the near surface down to about 2-3 km depth. The profile crosses three surface mapped faults where the westernmost, main fault strand, is dipping about 50 degrees to the east, the middle fault dipping 75 degrees east and the easternmost fault dipping 60 degrees to the west. The eight temporary seismic stations have recorded microearthquakes together with the six permanent northernmost stations of the Swedish National Seismic Network and a collaborating Finnish station. The seismic stations have recorded numerous small events, most of which are mining induced microearthquakes from the nearby Kiruna and Malmberget iron ore mines. About 500 microearthquakes are detected from the vicinity of the Pärvie fault system. Based on velocity structures estimated using both traditional 1D inversion and 3D local earthquake tomography we will present locations, magnitudes and focal mechanisms of the events. The events are concentrated to the east side of the surface trace of the main Pärvie fault and spread along its whole north-south extension ($\sim$150 km), implying few events with similar waveforms. There are, however, a few clusters of events, including a group of more than 40 events at the center of the fault. Waveform cross-correlation of these clustered events shows how they are aligned along the fault and help in giving better control of the depth estimates. We also use modeling of depth phases in order to constrain the depth locations. Focal mechanisms are calculated for all events using a spectral amplitude method.