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Intraplate earthquake swarm in Kouvola, south-eastern Finland

I. Smedberg, M. Uski, T. Tiira, K. Komminaho, and A. Korja

Institute of Seismology, Department of Geosciences and Geography, University of Helsinki, Finland
(ilmari.smedberg@helsinki.fi)

The Vyborg rapakivi batholith comprises an area of more than 20 000 km3 in south-eastern Finland and Russian Karelia. The 1.65-1.63 Ga old batholith intrudes Paleoproterozoic bedrock that was formed in the Svecofennian orogeny between 1.9 and 1.8 Ga. The batholiths area is known for shallow swarm type earthquake activity. The latest swarm has been occurring since December 1, 2011 in and around the town of Kouvola. More than 70 earthquakes, with magnitudes ranging from ML 0.4-2.8, have been recorded so far by the Finnish permanent seismic network. The swarm has been widely felt and reports on explosion- or thunder-like sounds accompanied by shaking of the ground are common. The felt effects and a strong Rg phase recorded by the nearest stations, at epicentral distances of 60-70 km, constrain the earthquake foci within the uppermost few kilometres of the crust. The events are concentrated around a major sub-vertical fault and contact zone traversing the batholith in NE- SW direction.

Inspired by the ongoing activity, four off-line seismic stations have been installed in the source area on December 19-20, 2011. The central station is located close to the active fault segment, while the others are deployed within a radius of 9 km from it. The stations are equipped with three-component Trillium 120 PA broadband seismometers. The sampling rate is set to 250 Hz. The response to ground velocity is flat in the frequency band of 0.01-100 Hz.

In this study, waveform data recorded by the off-line stations are used to improve the detection capability and hypocentre locations of the swarm events. Preliminary locations of the events are reanalysed using synthetic waveform-modelling of depth sensitive Rg phases and a high-precision relative location method. The relocated hypocentres are correlated with magnetic anomalies associated with tectonized lithological contacts within the batholiths. A composite fault plane solution is computed to constrain the source mechanism and the governing process behind the shallow swarm-type intraplate earthquake activity is discussed. Furthermore, peak values of ground motion displacement, velocity and acceleration are measured for the 22.12.2012 ML 2.6 earthquake. Combined with recordings from permanent stations, the spectral decay of ground motion acceleration is estimated.