The recent Bothnian Bay M4.1 earthquake: where, how and why?

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On 19 March 2016 a magnitude 4.1 earthquake occurred in the Bothnian Bay, between northern Sweden and Finland. The event was located approximately 59 km SE of Piteå and 80 km NE of Skellefteå in Sweden, while the distance to the nearest Finnish city, Raahe, was 100 km. The earthquake was widely felt in northern Sweden and Finland, the furthest reports come from some 250 km away, with intensities up to V. The main event was followed by 6 aftershocks within the first 8 hours, and two more events in the vicinity in the next two months. These aftershocks are interesting as aftershocks to M4+ events are not always observed in Sweden and Finland.

The Bothnian Bay is one of the most seismically active areas in continental Fennoscandia, but the cause of the seismicity is still not well known. Until recently, the offshore areas have been poorly monitored by the national seismic networks. The 2016 main shock, however, was well recorded on both shores (17 Swedish and 12 Finnish stations within 160km), and it provides a unique data set for joint seismological analysis.

We gather the available seismic data from Sweden and Finland and relocate the mainshock and aftershocks, comparing results with various velocity models and location software. The focal mechanism of the main event is estimated using a variety of methodologies, from a pure polarity solution via combined polarity and amplitude estimates to full waveform inversion in both time and frequency domains. The estimates show a strike-slip solution with nodal planes in approximate NW-SE and NE-SW. The events are located in an area of high microearthquake activity, forming a diffuse approximately north-south cloud off the Swedish coast. We combine seismic results with other geophysical data such as bathymetry, magnetics and deep seismic reflection (BABEL) data to speculate about the origin of the seismicity in general and the 2016 events in particular.