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Fibre-optic strain sensing – review and future

Philippe Jousset (1), Thomas Reinsch (1), Trond Ryberg (1), Hanna Blanck (2), Andy Clarke (3), Rufat Aghayev (3), Gylfi Pàll Hersir (2), Michael Weber (1,4), Charlotte Krawczyk (1,5)

(1) GFZ Potsdam, Potsdam, Germany (pjousset@gfz-potsdam.de), (2) ÍSOR Iceland Geosurvey, Reykjavik, Iceland, (3) Silixa Ltd, Elstree, Borehamwood, UK, (4) University of Potsdam, Institute of Earth and Environmental Science, Potsdam, Germany, (5) Technical University of Berlin, Germany

Natural hazard prediction and efficient crust exploration require dense seismic observations in time and space. Seismological techniques provide ground-motion data, whose accuracy depends on sensor capacity and distribution. More and denser networks are being deployed on volcanoes, sedimentary areas in order improve of capability to image and monitor the crust. It has been suggested for some months that fibre optic cable technology is able to record strain and is useful in industry related exploration and may be useful for seismology. We review the distributed Sensing technologies for such applications.

In this study, we demonstrate that direct strain determination is now possible with conventional fibre-optic cables deployed for telecommunication and is a new tool for earthquake location, for crustal exploration using unexpected sources and provides key records for understanding earthquake and fault structure and behaviour. Extending recently distributed acoustic sensing (DAS) studies, we provide spatially un-aliased broadband nano-strain data. We record seismic signals from natural and man-made sources with 4-m spacing along a 15-km-long fibre-optic cable layout on Reykjanes Peninsula, SW Iceland. We identify with unprecedented resolution structural features like normal faults and dykes in the Reykjanes Oblique Rift, allowing to infer new fault dynamic processes. Comparison with conventional seismometer recordings corroborates dynamic and stable spectral amplitudes between 0.1-100 Hz bandwidth. The networks of fibre-optic telecommunication lines worldwide may be used as seismometers opening a new window for Earth hazard monitoring and exploration.