GC12-FibreOptic-50, updated on 21 Nov 2024
https://doi.org/10.5194/egusphere-gc12-fibreoptic-50
Galileo conference: Fibre Optic Sensing in Geosciences

High resolution seismometers and strainmeters at the termination of plurikilometric fibers : a new brand of fiber optic sensors for harsh environment

Pascal Bernard[1], Guy Plantier[2], Philippe Ménard[2], Mathieu Feuilloy[2], Guillaume Savaton[2], Romain Feron[2], Francesco Biagioli[1,3], Marie-Paule Bouin[1], Maurizio Ripepe[3], Eleonore Stutzmann[1], Jean-Philippe Metaxian[1], Yann Hello[4], Roberto Moretti[1], and Jean-Bernard DeChabalier[1]

[1]IPGP, Institut de Physique du Globe de Paris, France (bernard@ipgp.fr)

[2]ESEO, Ecole Supérieure d'Electricité de l'Ouest, France (plantier@ipgp.fr)

[3]Department of Earth Science, University of Florence, Firenze, Italy (maurizio.ripepe@unifi.it)

[4]Université Côte d’Azur, IRD, CNRS, Observatoire de la Côte d’Azur, Géoazur, Valbonne, France (yann.hello@geoazur.unice.fr)

We have recently qualified *in situ* innovative high resolution optical seismometers and strainmeters. Designed and constructed by ESEO, they consist of a purely mechanical sensors, depleted from electronics, connected through a plurikilometric fiber to an optical interrogator based on Fabry-Perot interferometry. For the seismometer, the optical cavity is the centimetric gap between the collimator at the termination of the fiber and the mirror fixed on the mobile mass, which reflects the laser beam into the fiber towards the interrogator. The latter interferes with the primary laser beam reflected on the collimator interface. For the strainmeter, the optical cavity is a simple monomode fiber, of plurimetric size. The large distance between these sensors and their interrogator allows to install the former under harsh environmental conditions, as on active volcanos, on ocean bottom, in deep borehole, keeping the interrogator in a safe, accessible place providing facilities for powering (6 W for 4 channels), real-time telemetry, and easier maintenance. Such monitoring would be a difficult if not impossible task in the long run for most commercial instruments, due to much higher cost and/or risk for the installation and for the maintenance for the latter. These instruments may also prove usefull in (geo)-industrial contexts with high temperature or high radiation conditions. Here we present the basic features and overall performance of two prototype sensors: an optical ocean bottom seismometer installed 5 km offshore Les Saintes, Guadeloupe, and optical strainmeters installed on the slope of the Stromboli volcano, since 2021. For the Stromboli, we will describe its specific installation modality, with 5 m long sensing fibers buried in trenches, and compare the strain records of ordinary explosions to those of colocated instruments: a broadband seismometer, an optical fiber interrogated by DAS, and a borehole tiltmeter. Focussing on the strain records of several major explosions, we will show the potential of this strainmeter to better characterize the pressure source at the origin of these events and to contribute to improve the short term alert of major and paroxysmal explosions. We will finally present our projects of new installations of this optical strainmeter, with the objective or recording slow slip transients within tectonic fault systems, in the context of induced and natural seismicity.