

Kinematic study of the North Alfeo Fault (East Sicilian margin) by seafloor marine geodesy

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This thesis project is part of the European FOCUS* project whose objective is to measure by laser reflectometry on an optical fiber the movements (1-2 cm/year) associated with the activity of a submarine fault off Sicily. To calibrate and measure independently these movements, a network of 8 acoustic seafloor beacons has been installed near the fiber and on both sides of the fault to characterize its relative displacements by direct-path acoustic ranging. In parallel, an absolute geodesy experiment will be conducted from a surface vehicle, combining surface positioning by GNSS and underwater positioning of the beacons by acoustic. The aim is to determine the "absolute" geographical position of a group of beacons to the nearest centimeter. By repeated measurements over time, for at least 3 years, of relative ranging and absolute positioning, we expect to characterize the relative and absolute movements of the fault. In parallel, and during the whole duration of the project, deformation measurements will be carried out regularly from land by laser reflectometry on the optical fiber to monitor the activity of the fault.

The study area is located at the foot of Mount Etna, off Catania in Sicily, where a major active strike-slip fault, the North Alfeo Fault, has recently been mapped. Eastern Sicily is a region of high seismic activity that has suffered many devastating historical earthquakes (1693 Catania, 1908 Messina).

The fiber optic cable and geodetic stations were deployed in October 2020 during the Focus-X1 oceanographic cruise on the RV *Pourquoi Pas?*. The new 6 km long cable is now connected to the termination of a submarine electro-optical cable, landing in Catania, and crosses the North Alfeo Fault in several locations. Geodetic stations were placed in close proximity to the new cable and the fault.

Other cruises are planned in 2021 (Focus-G1) and beyond to upload from the surface the data acquired by the acoustic beacons and to position the network. In a future cruise (Focus-X2), complementary geophysical data (seismicity and high-resolution seismic profiles) will be acquired to collect additional evidence of activity on the North Alfeo Fault, and to identify other active submarine faults in the study area.

The objective of the thesis project is mainly to process and analyze the data acquired by the 8 geodetic stations network, and finally, to compare the results with those of the fiber optic measurements from land, and to integrate them in the geodynamic context of the study area.

The ultimate goal of the FOCUS project is to demonstrate the feasibility of monitoring active seafloor structures with an optical fiber, in particular to improve seismic hazard assessment and warning devices before a major earthquake.

The FOCUS project is conducted in collaboration with the GEOMAR Institute (Kiel) and INGV (Catania).

NB: the start of this thesis is conditioned by the success of the Focus-G1 cruise, in August 2021, in the acquisition of marine geodetic data.

Expected profile: knowledge in geodesy, inversion methods, acoustics, programming (math-physics background).

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Information : <https://www.iuem.univ-brest.fr/lgo/les-chantiers/erc-focus/>

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