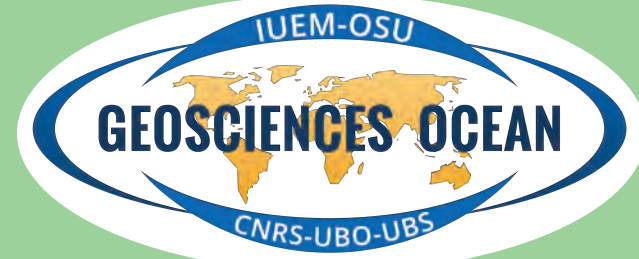


The FOCUS project offshore Catania, Sicily

(FOCUS = Fiber Optic Cable Use for Seafloor studies of earthquake hazard and deformation)



Gutscher, M.-A., Royer, J.-Y., Graindorge, D., Murphy, S., Klingelhoefer, F., Aiken, C., Cattaneo, A., Barreca, G., Quétel, L., Riccobene, G., Petersen, F., Urlaub, M., Krastel, S., Gross, F., Kopp, H.



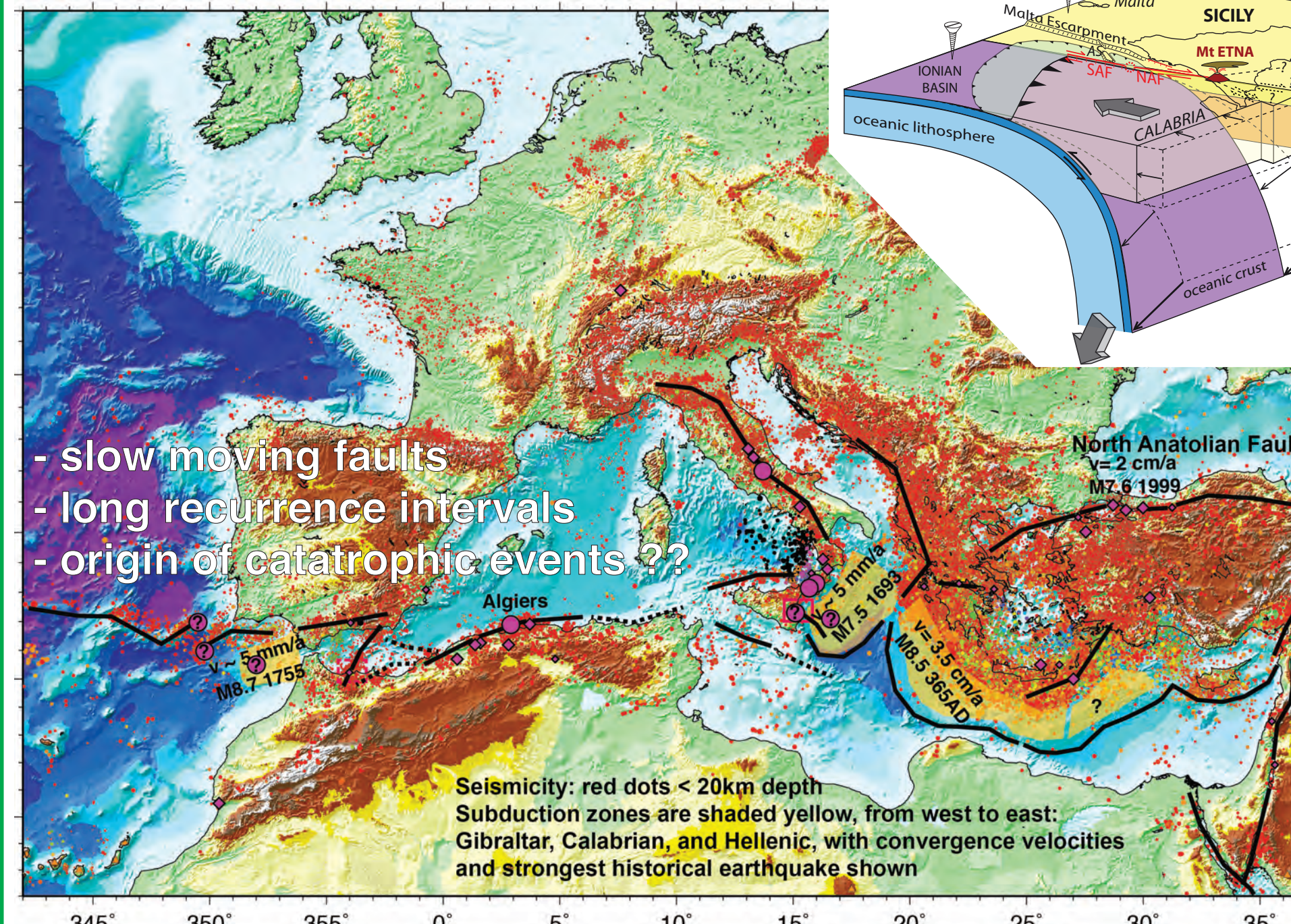
Abstract / Summary

Two-thirds of the earth's surface is covered by water and thus largely inaccessible to modern networks of seismological instruments. The global network of submarine telecommunication cables, if properly adapted, offers tremendous possibilities as a large-scale seismological monitoring tool for the future. Application of laser reflectometry in fiber optic cables can potentially be used to detect movement across active submarine faults in real time. This is the objective of the ERC (European Research Council) funded project - FOCUS. BOTDR (Brillouin Optical Time Domain Reflectometry) is commonly used for structural health monitoring of large-scale engineering structures (e.g. - bridges, dams, pipelines, etc.) and can measure very small strains (< 1 mm/m) at very large distances (10 - 200 km). However, this technique has never been used to study faults and deformation on the seafloor.

During the 5-year FOCUS project we aim to detect small (1 - 2 cm) displacements across the recently mapped North Alfeo Fault about 20 km offshore Catania, an urban area of 1 million people. Here, the Catania EMSO (European Multidisciplinary water-column and Seafloor Observatory) station is located in 2100 m depth and connected to land by a 25 km long electro-optical cable. BOTDR observations will have to be calibrated by other independent measurements. Therefore, targeted marine geophysical surveys of the seafloor along the trace of the cable and faults are planned, with the use of seafloor geodetic instruments to quantify relative displacement across the fault. The first step will be to connect a 6-km long fiber optic cable to the seafloor observatory TSS (Test Site South) and then deploy the cable using a deep-water cable-laying system with an integrated plow to bury the cable 20 cm in the soft sediments in order to increase coupling between the cable and the seafloor. The targeted track for the cable will cross the North Alfeo Fault at three locations.

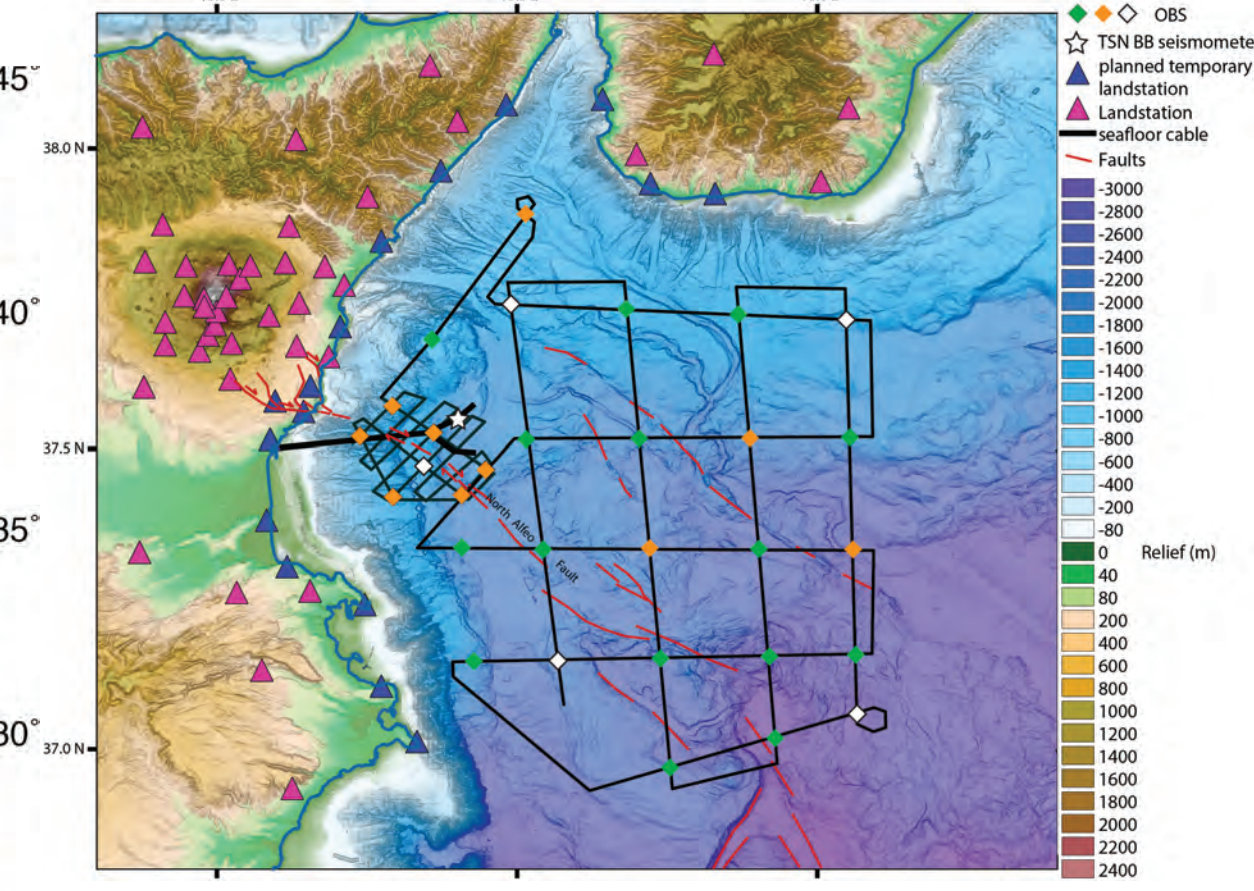
A further goal of the FOCUS project is to develop dual-use cables with standard telecommunication fibers in the protected core, and additional strain-sensor fibers towards the exterior, which could eventually replace (pure) telecom cables and become the new standard. This would provide a breakthrough in seismology, tectonics and natural hazard early warning technology.

Mediterranean Region: seismicity, faults and catastrophic earthquakes

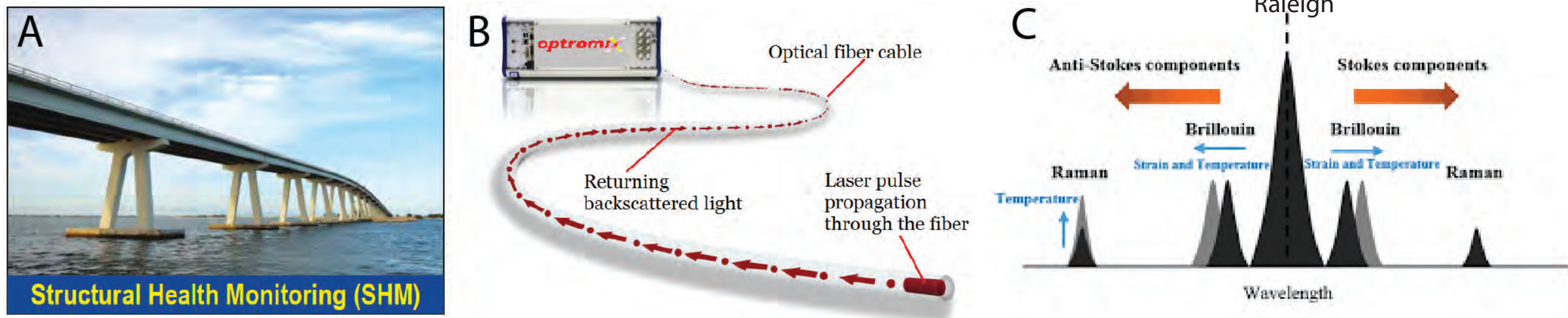


Sicily - Calabria: subduction, roll-back and lateral slab tear fault (location uncertain/debated)

FocusX2 marine expedition (requested for 2021)
Planned seismological experiment
- 30 ocean-bottom seismometers
- landstations (permanent & temporary)
- HR seismic profiles (580 Nm)



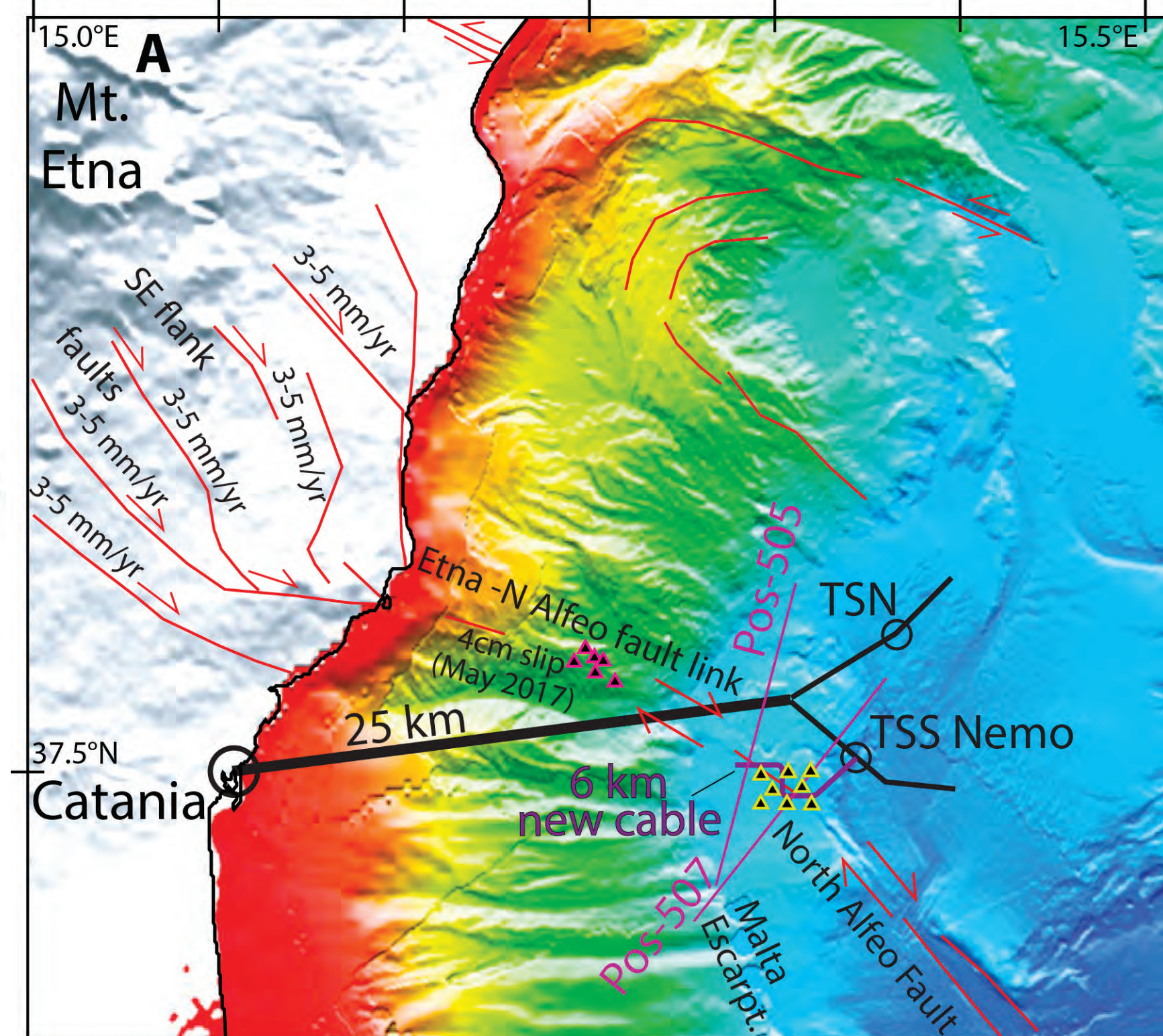
BOTDR (Brillouin Optical Time Domain Reflectometry)



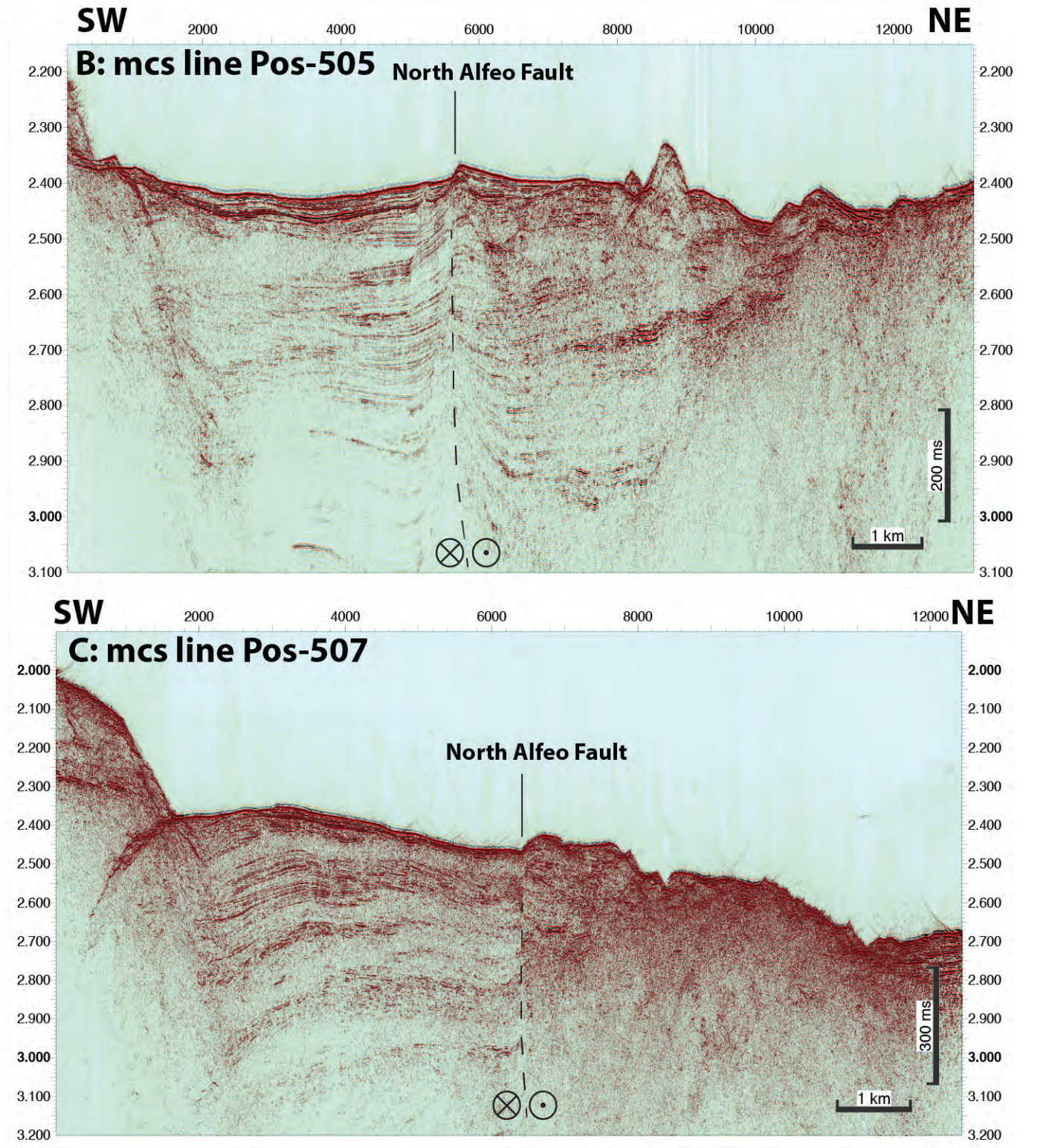
preliminary BOTDR tests on EMSO cable (July 2017)



Etna - Catania region: cable, seafloor observatory and N Alfeo Fault

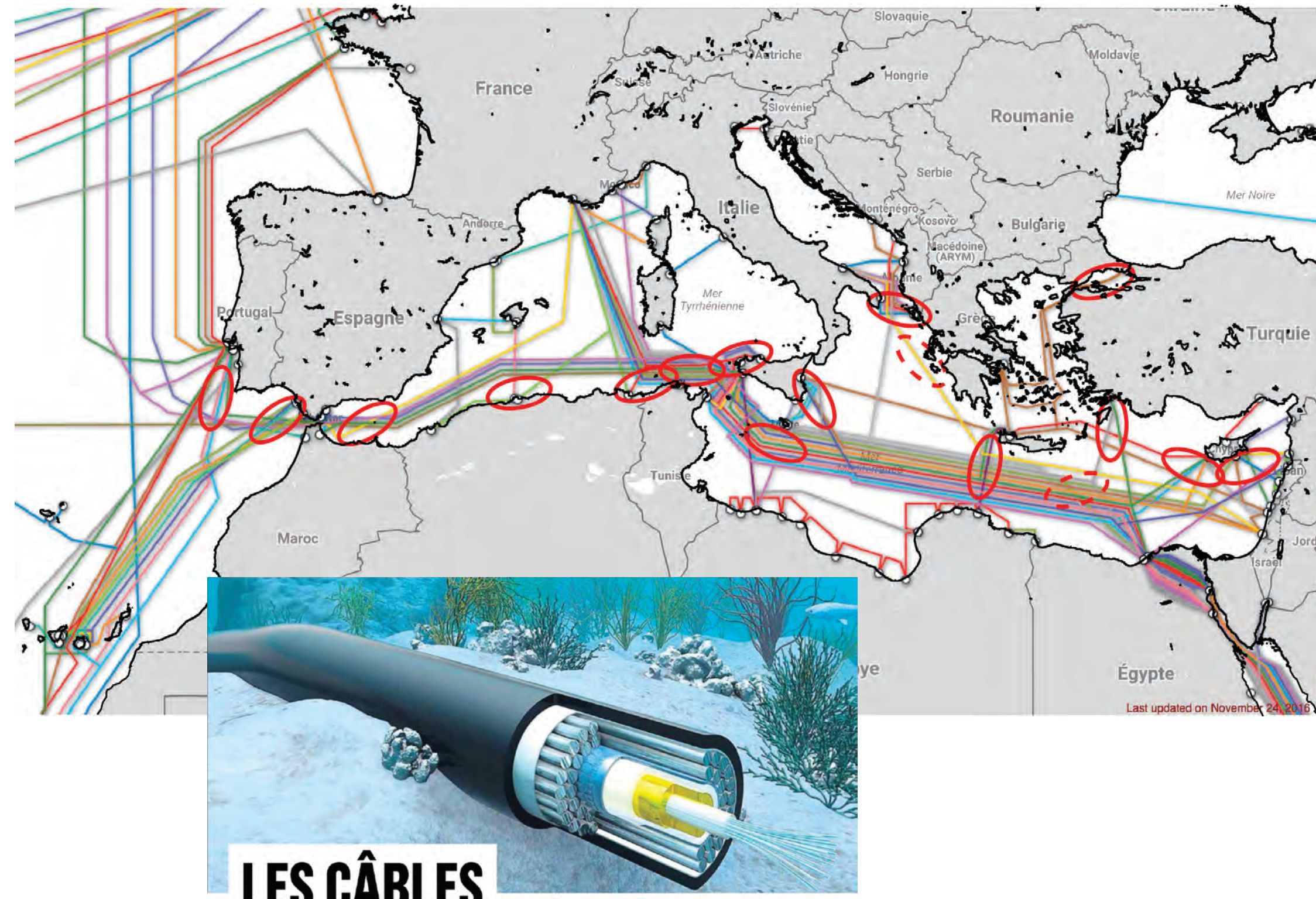


Bathymetry and planned seafloor experiment



seismic profiles (F. Gross, S. Krastel, Univ. Kiel - unpubl. data)

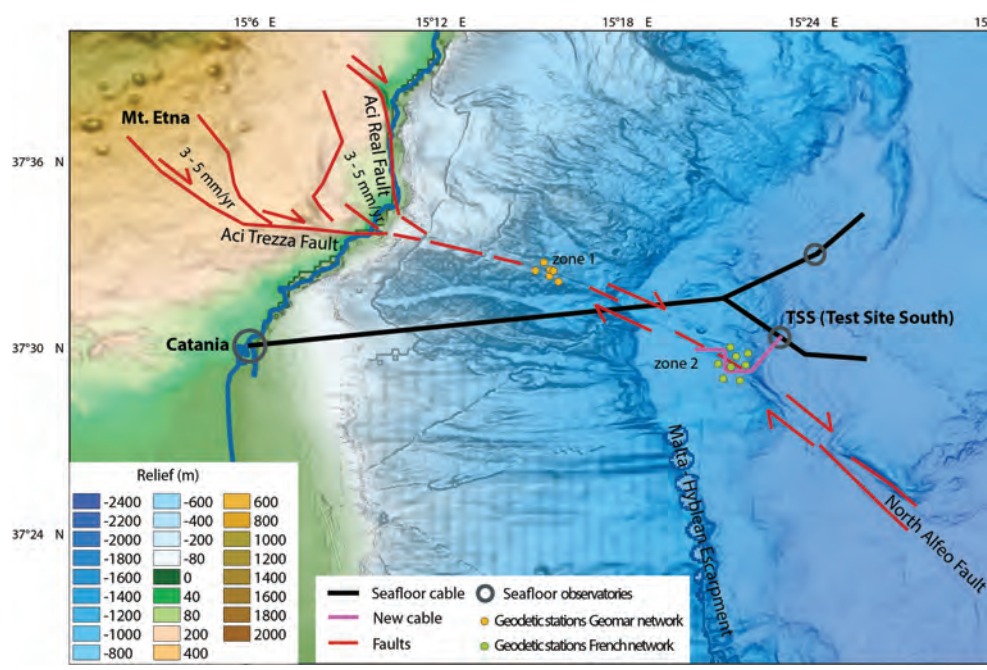
Telecom cables (cross Euro - African plate boundary)



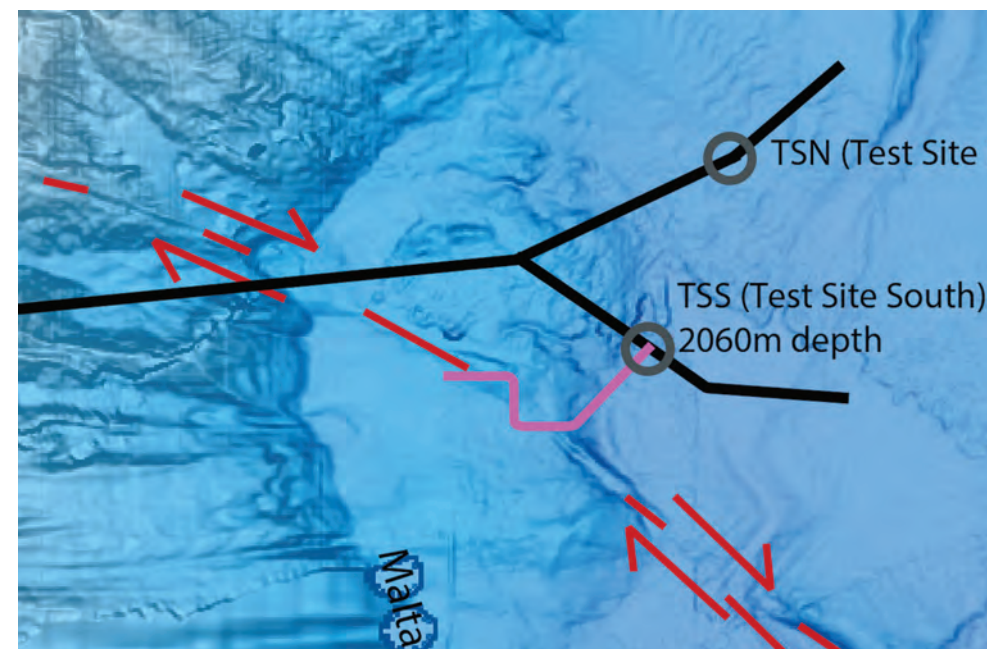
Marine expedition FocusX1 (10 days planned April 2020)

planned seafloor geodesy
6 German, 8 French stations

cable deployment plan (ROV + plow to bury cable)



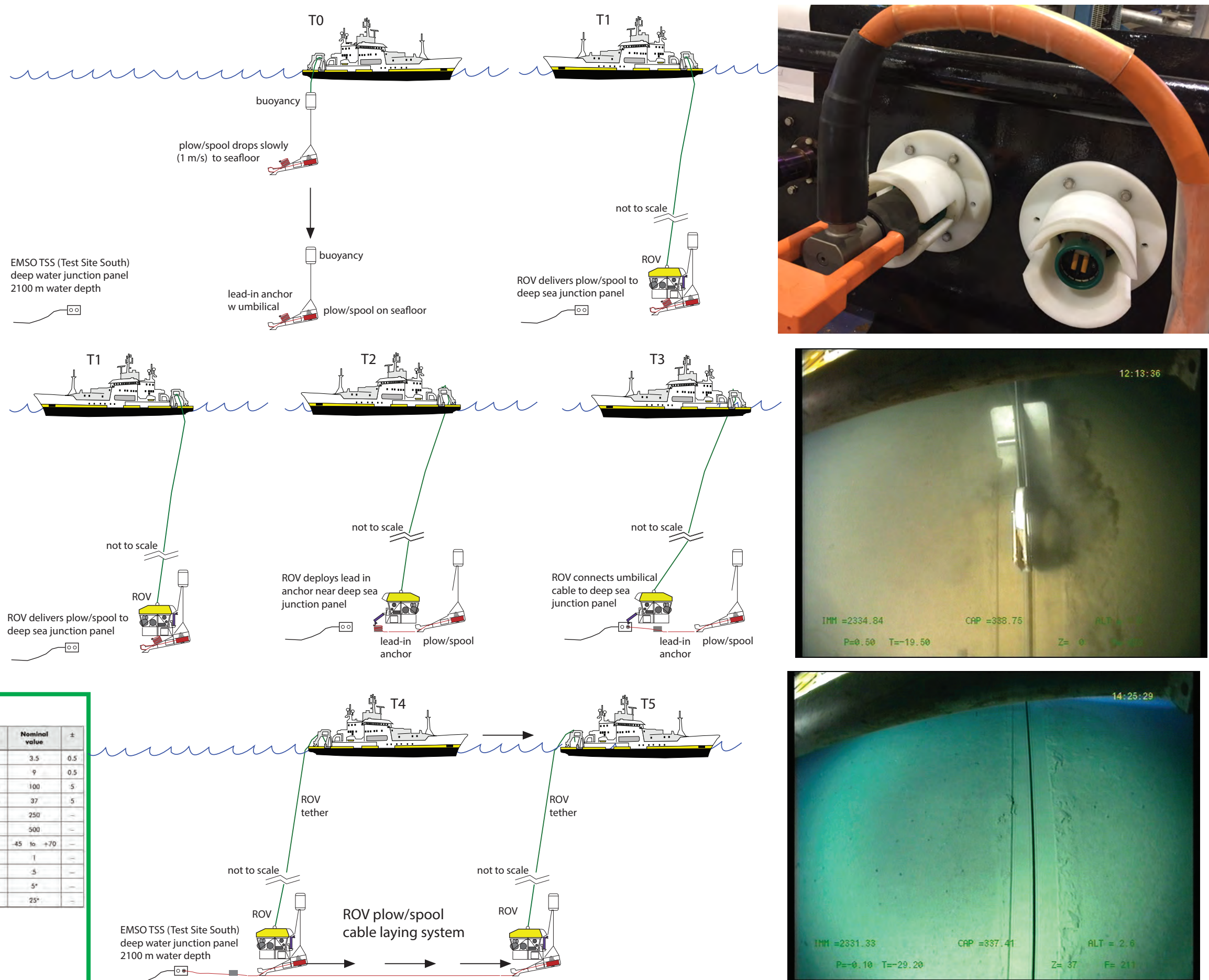
proposed path, 6-km long cable



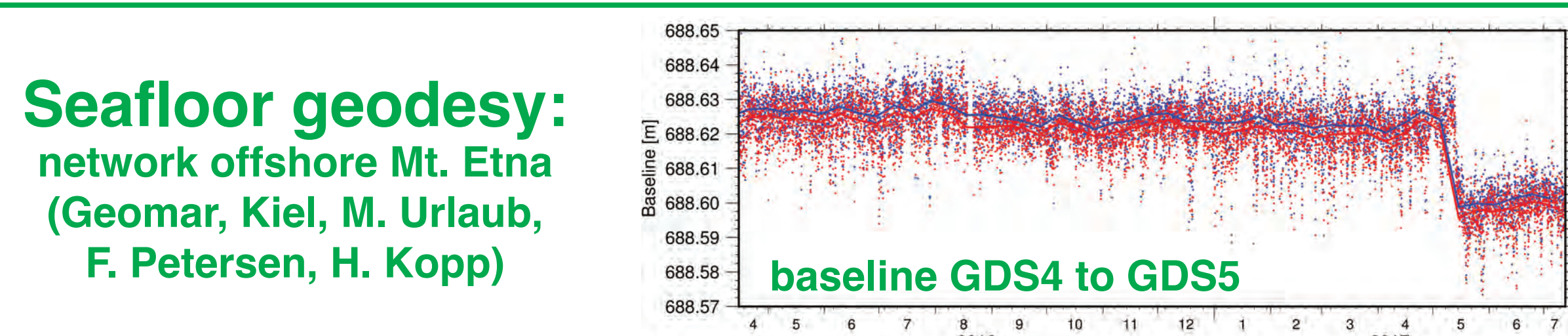
6-km long, 9mm diam. fiber optic cable



ROV operations (cable laying)



Seafloor geodesy: network offshore Mt. Etna (Geomar, Kiel, M. Urlaub, F. Petersen, H. Kopp)



Apr. 2016 - July 2017
4 cm slow-slip event (unpubl. data)

active fault 20 km offshore Catania!
(urban popul. 1 million)

Technical Description
FO Sensor Cable



Drawing No: D-11150 Issue 5