Geophysical Research Abstracts
Vol. 19, EGU2017-8661, 2017
EGU General Assembly 2017

Seafloor geodesy: Measuring surface deformation and strain-build up

Heidrun Kopp, Dietrich Lange, Katrin Hannemann, and Florian Petersen
GEOMAR, FB 4, Kiel, Germany (hkopp@geomar.de)

Seafloor deformation is intrinsically related to tectonic processes, which potentially may evolve into geohazards, including earthquakes and tsunamis. The nascent scientific field of seafloor geodesy provides a way to monitor crustal deformation at high resolution comparable to the satellite-based GPS technique upon which terrestrial geodesy is largely based. The measurements extract information on stress and elastic strain stored in the oceanic crust. Horizontal seafloor displacement can be obtained by acoustic/GPS combination to provide absolute positioning or by long-term acoustic telemetry between different beacons fixed on the seafloor. The GeoSEA (Geodetic Earthquake Observatory on the SEAfloor) array uses acoustic telemetry for relative positioning at mm-scale resolution. The transponders within an array intercommunicate via acoustic signals for a period of up to 3.5 years. The seafloor acoustic transponders are mounted on $\sim$4 m high tripod steel frames to ensure clear line-of-sight between the stations. The transponders also include high-precision pressure sensors to monitor vertical movements and dual-axis inclinometers in order to measure their level as well as any tilt of the seafloor. Sound velocity sensor measurements are used to correct for water sound speed variations. A further component of the network is GeoSURF, a self-steering autonomous surface vehicle (Wave Glider), which monitors system health and is able to upload the seafloor data to the sea surface and to transfer it via satellite. The GeoSEA array is capable of both continuously monitoring horizontal and vertical ground displacement rates along submarine fault zones and characterizing their behavior (locked or aseismically creeping).

Seafloor transponders are currently installed along the Siliviri segment of the North Anatolian Fault offshore Istanbul for measurements of strain build-up along the fault. The first 18 month of baseline ranging were analyzed by a joint-least square inversion and forward modeling for across-fault baseline changes. The initial results of the long-term observation period preclude fault-displacement at rates larger than a few millimeters-per-year, suggesting a locked state for the Istanbul-Siliviri segment, indicating that this portion of the fault is accumulating stress rather than continuously creeping at a slip-rate higher than 10 mm/yr during the observation period.

In addition, three arrays are currently deployed on the marine forearc and outer rise of the South American subduction system around 21°S. This segment of the Nazca-South American plate boundary has last ruptured in an earthquake in 1877 and was identified as a seismic gap prior to the 2014 Iquique/Pisagua earthquake (Mw=8.1). The southern portion of the segment remains unbroken by a recent earthquake.