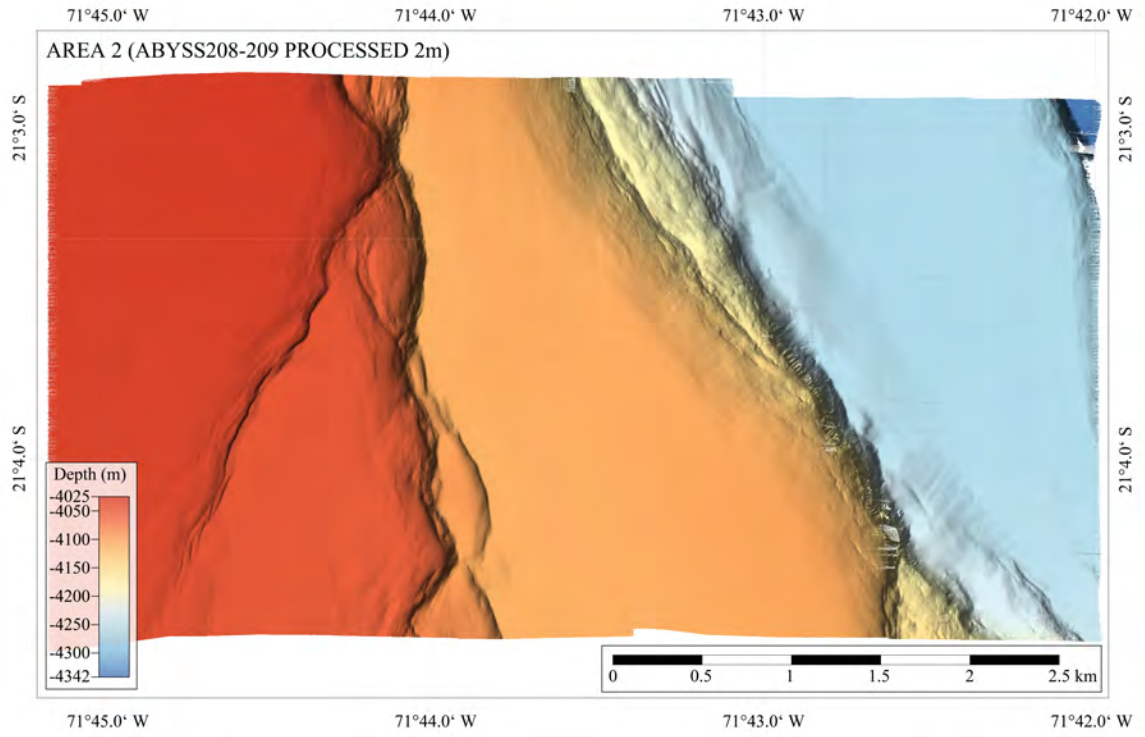
FS SONNE Reise SO244-II

Antofagasta – Antofagasta

27.11.15 – 13.12.15

2. Weekly Report, Dec. 6, 2015

Our second week on RV SONNE started with the deployment of the GeoSEA array in our westernmost working area on the outer rise of the oceanic Nazca plate. This region on the downthrusting plate is characterized by a distinct topography inherited from seafloor spreading. In addition to volcanic structures such as cones and calderas the original seafloor spreading fabric is recognized. These inherited structures in the vicinity of the deep sea trench is overprinted by recent plate-bending related normal faulting which trend parallel to the trench.



AUV map of working area 2 in water depth exceeding 4000 m. An approximately 100 m high scarp is recognized to the right trending in a NW-SE direction. This structure originates from the original seafloor spreading. The structures on the left near 71°44'W are active fault zones trending parallel to the deep sea trench. The deformation focused on these faults is the target of the second GeoSEA sub array.

The monitoring of extensional processes across these outer rise bending faults will yield an improved understanding of the fault processes and degree of extension as well as the physical properties of the fault zone and elastic parameters of the lithosphere. Furthermore, the occurrence of earthquake doublets around the globe indicates a strain transfer from the outer rise to the forearc (e.g. Samoa-Doublet, 2009) or vice versa (e.g. Kuriles Doublet, 2006/7).

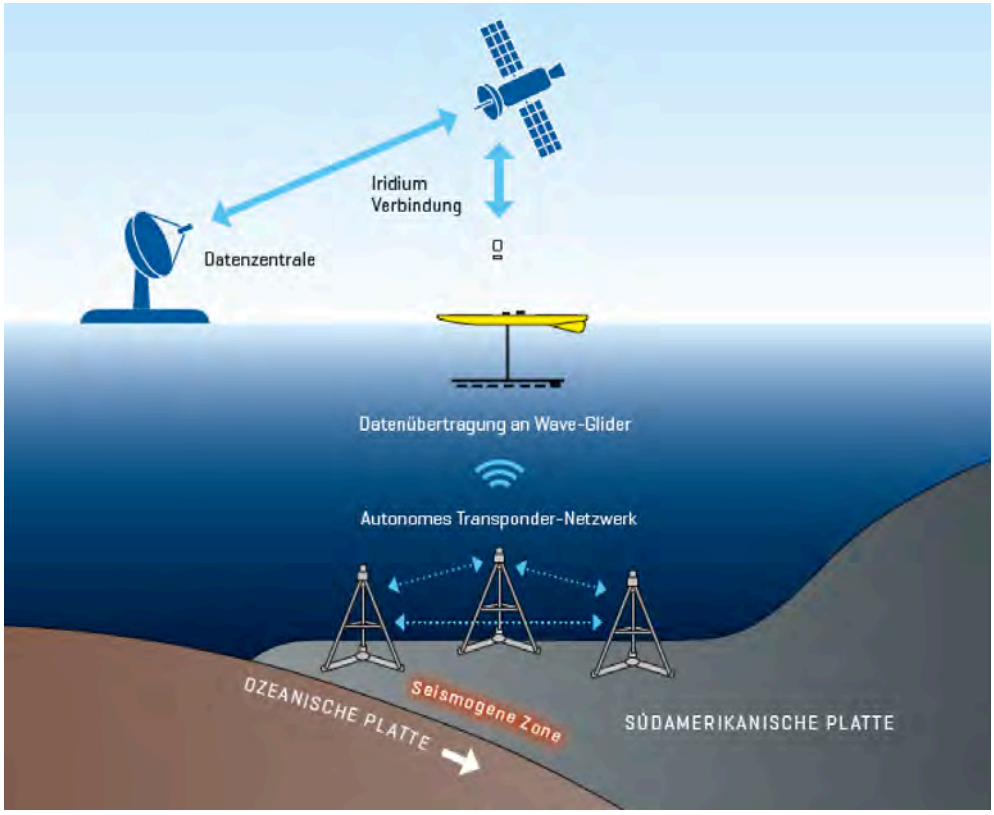
A total of five GeoSEA tripods (stations A201-A205) were installed in working area 2 between Nov. 30 and Dec. 1, 2015 in water depth ranging from 4034 m to 4105 m. Communication with the transponders proved very stable whereas the release of the tripod turned out to be troublesome. For the first two stations, the release unit did not respond and only after heaving the tripod we could recognize that the station indeed remained on the seafloor. The third station A203 however had to be heaved back to the deck of RV SONNE after not responding at all. After exchanging the release unit, this station was lowered to the seafloor again and could finally be released on its deployment position.

Simulatenously we deployed GeoSURF, a wave glider, which navigates autonomously above the installed stations at depth to retrieve data from the seafloor to the sea surface where it connects to a satellite and sends the data to our lab at GEOMAR.

Wave glider GeoSURF ready for deployment on the deck of RV SONNE.

The deployment of GeoSURF started at 7:30 and lasted until 19:30 when we had to recover GeoSURF using the rescue boat of RV SONNE. The successful test of navigation as well as data upload leaves us confident to use GeoSURF in the future to autonomously monitor system health and retrieve the data (see sketch below).

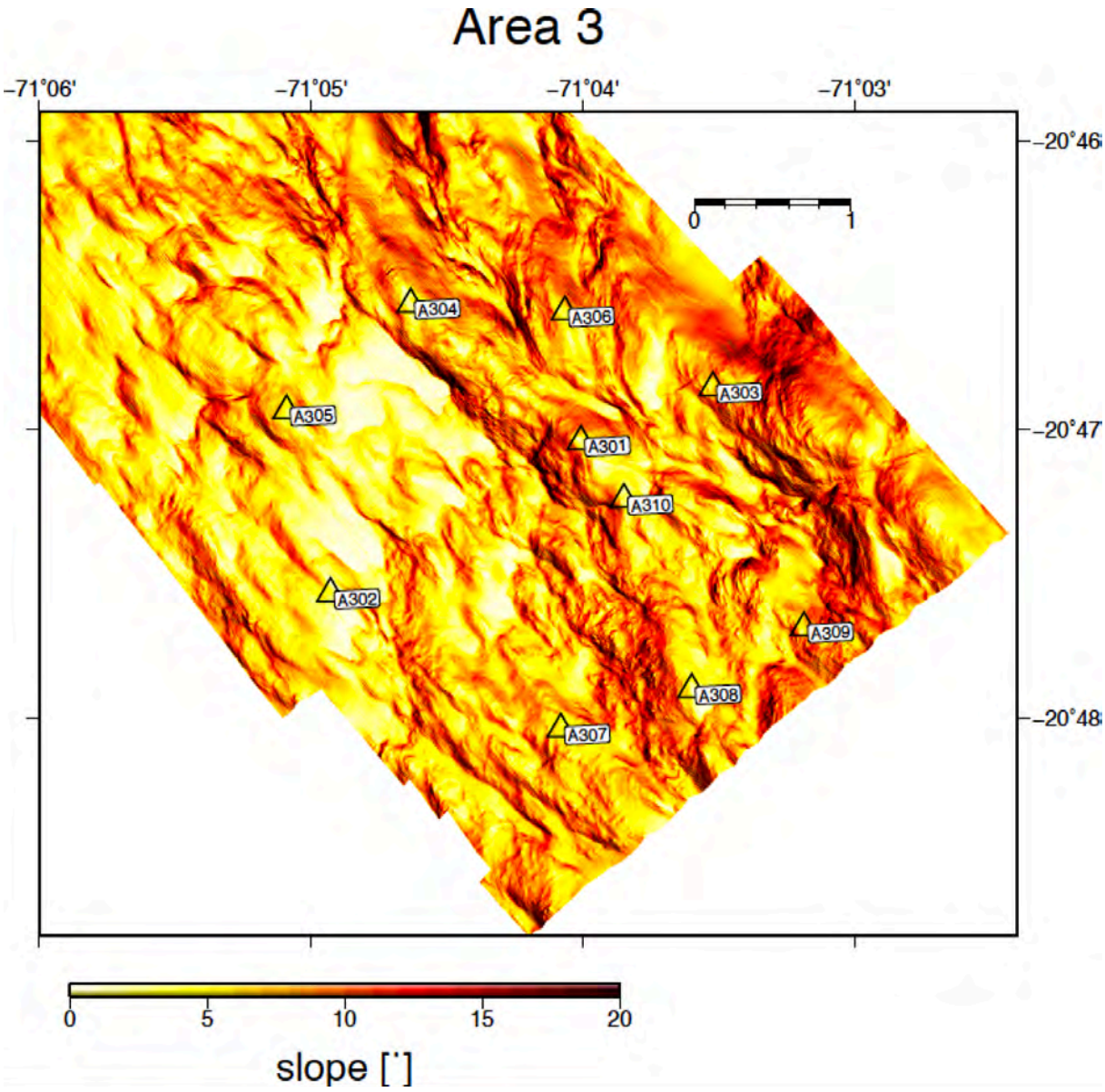
Recovery of GeoSURF using RV SONNE's rescue boat.



Sketch of the array set-up: The GeoSEA array installed on the seafloor communicates with GeoSURF, the wave glider at the surface that transfers the data via satellite to the lab (C. Kersten).

On December 2 we reached our third working area where a total of 10 stations was to be deployed in water depth between 5087 m and 5368 m. The working area is located on the lower slope of the continental margin about 10 km east of the deep sea trench and covers a region of 35 km^2. A suite of ridges and active fault zones

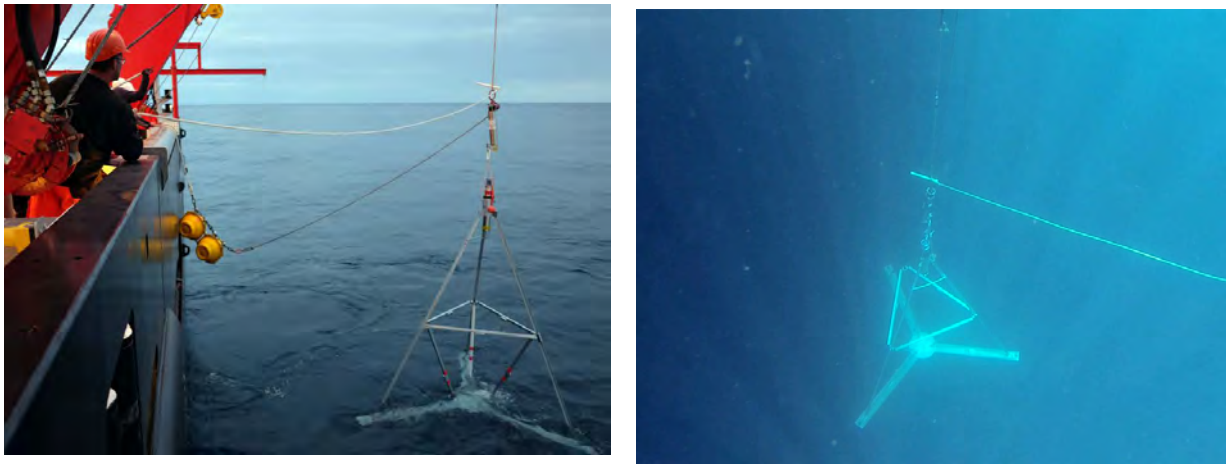
with relative heights of up to 500 m dominates the region, which is overall characterized by steep slopes.



Slope map of working area 3 in water depth > 5000 m. The distinct steep slopes are challenging for the installation of the GeoSEA tripods. A total of 10 GeoSEA stations was successfully installed on the seafloor to measure the diffuse strain build up in this region.

The tectonically complex region with its steep slopes and narrow ridge crests poses a particular challenge for the deployment of the instruments regarding line-of-sight. Based on our previous experiences with deep-water deployment sites we modified the tripod installation by adding a floatation above the tripod as well as on the connecting line between the releaser and the train wheel. Furthermore, we added about 15 m to the connecting line to ensure that there is enough tension between the tripod and the Benthos floatation spheres as any point of time. All 10 stations could be deployed successfully until December 5. Line-of-sight between the stations was

better than anticipated and the number of measured and retrieved baselines was accordingly higher than modeled or expected. Monitoring of the area in the upcoming years is targeted to measure the tectonic strain build-up. This information is crucial to understand the coupling between the downthrusting Nazca plate and South America and to better understand earthquake initiation and rupture.

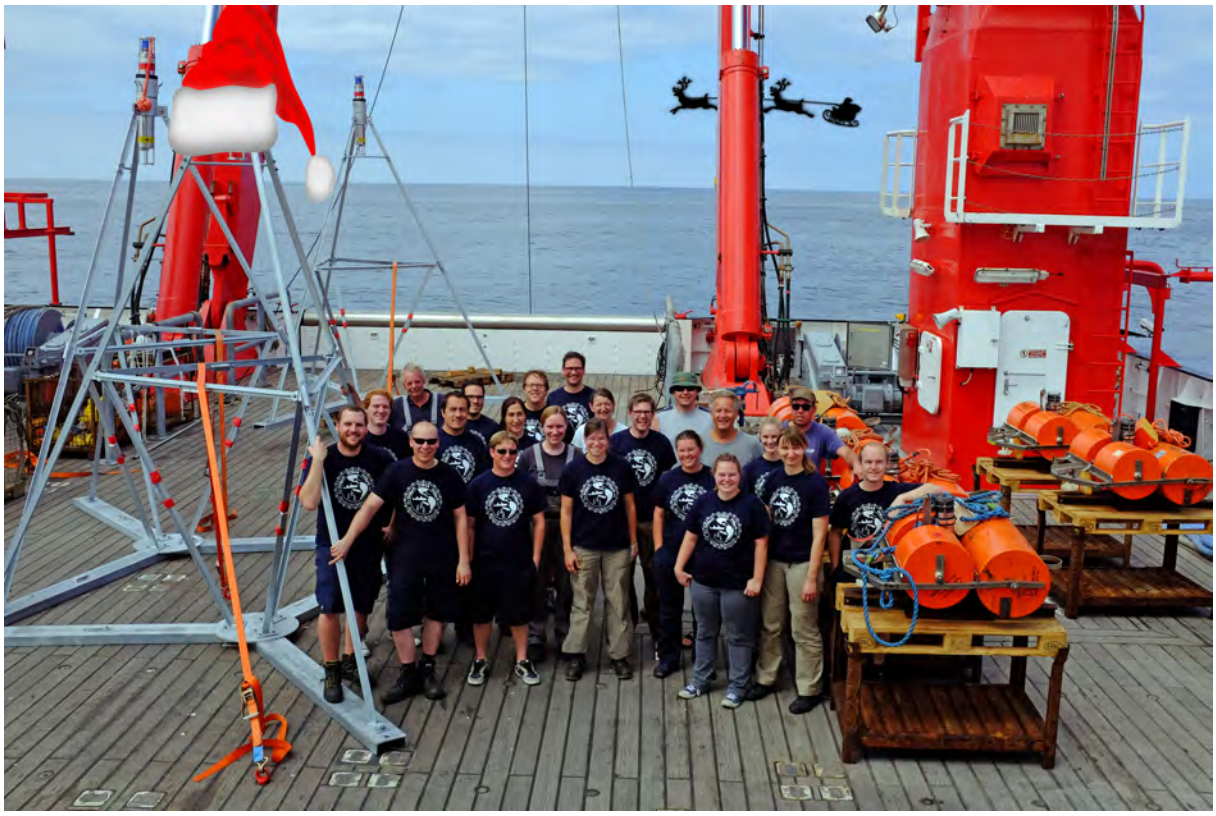


GeoSEA station A308 on the deep sea cable of RV SONNE: above and below the ocean surface....

During recovery of the releaser and train while of station A310 on the eve of December 5 the connecting line ripped apart above the Benthos spheres. Both floatation spheres as well as the heavy weight release unit got entangled in the portside propeller of RV SONNE, as could be verified by video. RV SONNE turned off the propellers as night fell and drifted slowly northwards carried by the Humboldt current.

On the morning of December 6 in the daylight we tried to free the propeller from the entangled material, however we did not succeed. We commenced our 12 nm long transit back to working area 1 to install the first of the remaining three stations (A106). This station immediately responded to the pings from the five stations already deployed in the network as well as to RV SONNE. This success was a vague consolation for the fact that one or both of the Benthos spheres must have imploded during transit. Fortunately the heavy-weight release unit pulled both spheres as well as the remaining line to depth, setting the portside propeller free so that it could be utilized unconditionally. In the afternoon of December 6 we successfully deployed station A107 and now look forward to the beginning of the upcoming week when we will hopefully complete the installation of the last of our 23 GeoSEA stations.

The weather as well as the Pacific swell prove very stable and everybody on board is doing well and enjoying the regular ‘visits’ by dolphins, whales, seals, Mahi Mahis and Humboldt squids to the vessel.



Kind greetings to everybody back home !

Heidrun Kopp

At sea, 20°47’S / 70°49’W