

# OBSIP Experiment Archive

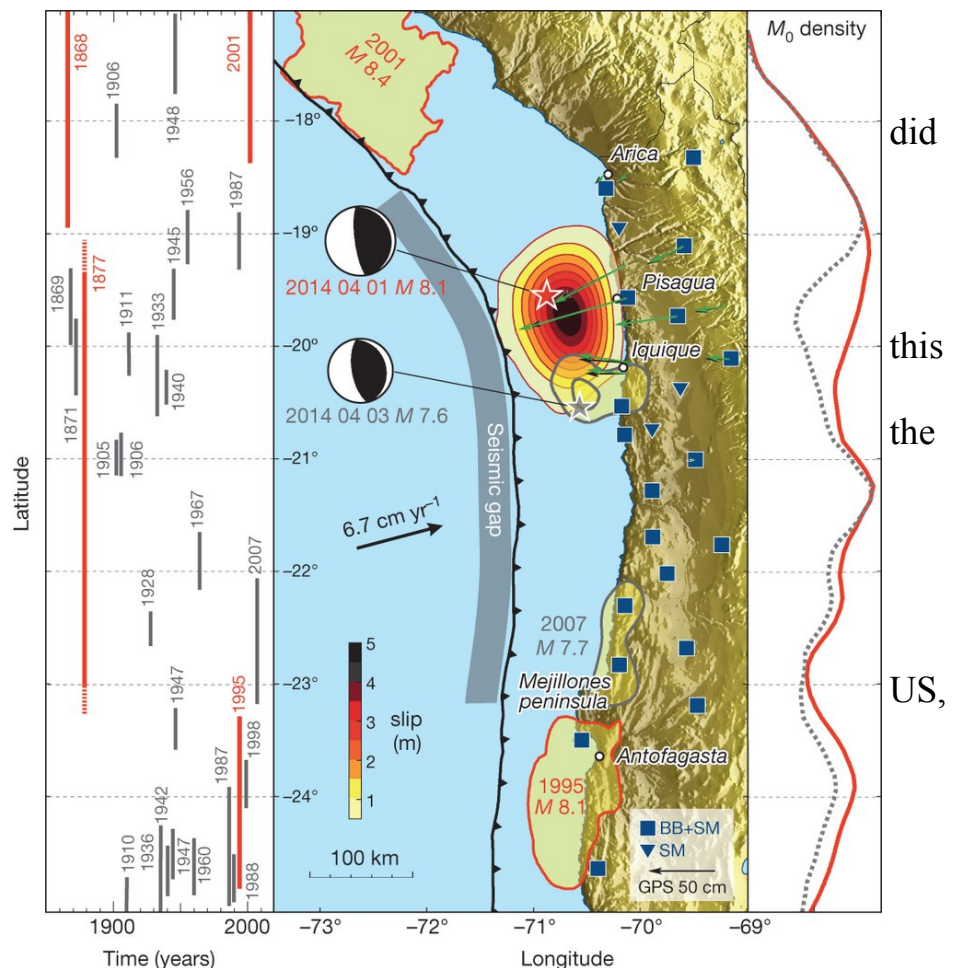
**Year:** 2016

**Experiment Name:** Pisagua/Iquique Crustal Tomography to Understand the Region of the Earthquake Source (PICTURES)

A high-resolution controlled-source seismic experiment to elucidate geologic controls on megathrust slip: the 2014 Pisagua, Chile earthquake sequence as a natural laboratory

**Principal Investigator(s):** Anne Trehu (OSU)

**Experiment Summary:** (Taken from the NSF Abstract Award #[1459368](#)): Subduction zones, where one tectonic plate plunges beneath another, are the birthplace of many of Earth's more destructive earthquakes and volcanoes. Numerous studies reveal patchiness in the distribution of slip during these earthquakes; patches with the greatest slip can occur in pattern that is the opposite of where patches characterized by aseismic deformation occur along the fault. On April 1, 2014, a magnitude 8.2 earthquake occurred offshore Chile near the town of Pisagua. This region was identified in 1991 as one of two major seismic gaps in Chile. ... The portion of the seismic 'gap' that not slip during the Pisagua quake is marked by a distinct density high, indicating an abrupt change in crustal structure. The objective [of] project is to collect marine geophysical data to elucidate geologic significance of this correlation between a crustal structure and earthquake slip. This project also has an important educational component. Students from the Chile, Germany will participate in an shipboard course in seismic reflection data processing.



Tectonic and seismic history of study area (Shurr et al., Nature, 2014).

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**Experiment Summary:** ...Advances in geodetic techniques and an increase in the number of high-resolution seismic networks have brought remarkable advances in documenting the

distribution of slip on subduction zone plate boundary faults prior to, during, and after great earthquakes. The main Pisagua shock was preceded by two distinct foreshock sequences that occurred in the month prior to the main shock, and it was followed by many aftershocks, the largest of which had Mw 7.8. The sequence only ruptured the northern half of the gap, leaving significant unreleased strain accumulation according to plate tectonic and geodetic locking models. This study will acquire and analyze marine seismic data to characterize the Pisagua earthquake source region. A large-volume tuned airgun array and multichannel streamer (MCS) and [50] short-period ocean bottom seismometers (OBS) operated by the US Ocean Bottom Seismometer Instrumentation Pool and the German marine research institute GEOMAR. A 3D tomographic P-wave velocity model and a grid of 2D deep-crustal seismic reflection profiles will be obtained. The velocity model and positions of reflective boundaries will be integrated with high-resolution bathymetric data to generate a geologic model of the crust that can be compared to the seismologically and geodetically-determined slip history prior to, during and after the earthquake. The program will be accomplished in two phases.

## Cruises:

10/26/2016 - 12/09/2016:

50 short period Scripps Institution of Oceanography and 19 GEOMAR ocean-bottom seismometers will be deployed on board the R/V Sonne. Active source and deep crustal multichannel seismic reflection data will be collected by the R/V Langseth. This experiment will also incorporate an onshore seismic deployment through IRIS PASSCAL.

## Data:

All data from the PICTURES experiment can be accessed under the virtual network [PICTURES](#). Data from all OBSIP instruments deployed is archived under temporary network code [XW](#) and assembled data set ID #[16-005](#) at the IRIS DMC. GEOMAR OBS data will be archived under network code [Z7](#).

## Downloads/Links:

[Experiment Blog](#)

[Nature](#)

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**Experiment Summary:** ...During phase 1, imaging will target the region that slipped during the 2014 earthquake and acquire reconnaissance data from the remaining gap to optimize the field program for phase 2. Earthquakes recorded by this and other OBS and onshore arrays will be incorporated into the data set for 3D tomography to increase the depth extent of imaging and improve determination of S-wave velocities and Poisson's ratio. Partners in this project include Oregon State University, GEOMAR, and the Universidad de Chile.



Proposed OBS deployment locations from cruise blog.