EarthScope Idaho-Oregon (IDOR) Controlled-Source Seismic Refraction Project

Collaborative Research: Deformation and magmatic modification of a steep continental margin, western Idaho-eastern Oregon (IDOR)

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Field acquisition: 10-18 August 2012

EarthScope IDOR, Controlled-Source Seismic

The EarthScope Idaho-Oregon project (IDOR) is an integrated, multidisciplinary geologic investigation of the growth and modification of an archetypal steep continental margin of the North American Cordillera. The project area centers on the Western Idaho shear zone (WISZ), where the relatively juvenile island arc terranes of eastern Oregon are juxtaposed against the Idaho batholith and older Precambrian craton in Idaho. The aim of the IDOR project is to study how this unusually steep accretionary edge modified and was modified by subsequent deformation and magmatism, and the tectonic implications for evolving lithospheric strength. The controlled-source seismic project will contribute to the overarching goals of IDOR by characterizing the geometry of the major boundaries and geologic units at depth within the crust and uppermost mantle, and providing insight about lithospheric structures and how they correlate to the surface geology in the region. In addition to layered composition and structure of the crust and Moho traditionally illuminated by this type of survey, the analysis will focus on the geometry of the WISZ in the crust and upper mantle, and the contrasts between continental- and oceanic-affinity crust and uppermost mantle across the WISZ.

The IDOR controlled-source seismic survey consisted of a 430-km long high-resolution refraction and wide-angle reflection line extending from eastern Oregon to eastern Idaho. 2555 single-component Texan stations recorded 8 explosive shots in August 2012. These data will be analyzed using standard 2-D refraction and wide-angle reflection travel-time methods and single or very low-fold, low frequency (<20 Hz) seismic reflection stacks to produce 2-D seismic P-wave and S-wave velocity models (Vp and Vs) of the entire crust and uppermost mantle. The controlled-source seismic line will be complimented by a passive-source broadband array (P.I. Russo) consisting of 85 stations in a 150 x 460 km swath centered on the controlled-source line. The controlled-source seismic will provide higher-frequency, higher-resolution images and the broadband will provide lower-frequency, deeper, 3-D constraints. Combined, these data sets will delineate the geometry of the edge of the continental lithosphere from the surface to the asthenosphere. The seismic data will be integrated with the other phases of the project to produce a series of well-constrained models representing the timing and deformation history of the WISZ and associated structures, and the impact of this lithospheric-scale feature on subsequent deformation and magmatism in the region.

Instrument Operations

Field acquisition for the IDOR controlled-source seismic refraction/wide-angle reflection project took place in August 2012. 2555 stations recorded 8 explosive shots over the course of 3 nights. Each station consisted of a Reftek RT125A Texan recorder with single component 4.5 Hz geophone (Geospace part number GS-11D). Sources were ~900 kg of explosive slurry buried to a center depth of ~21 m and plugged to the surface with cuttings, gravel, and bentonite clay. Stations recorded continuously for 7 hours each night in 10 minute event windows, beginning at 05:00 UTC (11:00 pm local time). The sampling rate was 250 sps with a programmed instrument gain of 32 and an overall sensitivity of 5.7x10^8 C/m/s.

The Texan stations were deployed in a 430 km east-west line from eastern Oregon near Prairie City to eastern Idaho in Pahsimeroi Valley. Stations followed county, state, and forest service roads, farm tracks, and hiking trails. Nominal spacing was 100-200 m for locations accessed by vehicle and 500 m for locations accessed on foot. Explosive sources were at a nominal 40 km spacing, with a ~120 km gap across National Forest lands due to permit restrictions. Station and shot locations were surveyed prior to deployment using Trimble GeoXT-RNT 2008 series hand-held GPS units running TerraSync Professional software v4.12. Differential correction was applied to the locations in post-processing with Pathfinder Office 5.0. Station and shot location coordinates are based on a WGS84 reference frame, and elevation is based on EGM 96 relative to mean sea level.

Deployment schedule:

Deployment of the Texan stations took place over 3 days from August 10 to August 12, 2012. The deployment crew consisted of 53 volunteers from 22 colleges and universities. Instruments were deployed from two base camps, located in Ontario, OR and Stanley, ID. Programming and data offloading were conducted at the primary base in Ontario, OR.

Deployment day 1, 10 August:

782 programmed instruments were sent to the base in Stanley, ID; 288 of these stations were deployed on day 1.

592 stations were deployed from Ontario, OR.

Deployment day2, 11 August:

558 stations were deployed from the Ontario base camp; 20 of these were deployed on foot by a hiking team.

329 stations were deployed from the Stanley base camp.

Deployment day 3, 12 August:

642 stations were deployed from the Ontario base camp.

146 stations were deployed from the Stanley base camp; 25 of these were deployed on foot by a hiking team.

2555 stations were deployed in total. 42 additional Texans were present in the field but not deployed due to malfunction or location cancellation. 19 of these were at the Stanley camp and 23 were at the Ontario camp.

Recording schedule:

Stations were live during three time windows from 12 August to 15 August, totaling 43 hours of recording. The recording programs were divided into 10 minute event windows, recording at 250 sps. Shots were recorded on the nights of 12 and 13 August. Additional recording times were utilized to capture local seismicity, mine blasts, and ambient noise.

Recording times in UTC (local MDT):
04:55, Aug 13 - 12:05, Aug 13 (10:55 pm, Aug 12 - 6:05 am, Aug 13) – 7 hours
17:55, Aug 13 - 12:05, Aug 14 (11:55 am, Aug 13 - 6:05 am, Aug 14) – 18 hours
17:55, Aug 14 - 12:05, Aug 15 (11:55 am, Aug 14 - 6:05 am, Aug 15) – 18 hours

Shot	UTC time	Julian day	Local Time	Local Date
1	5:05	226	11:05 pm	12 August
2	7:05	226	1:05 am	13 August
3	9:45	226	3:45 am	13 August
4*	7:35	227	1:35 am	14 August
5	5:05	227	11:05 pm	13 August
7	5:20	227	11:20 pm	13 August
8	9:00	226	3:00 am	13 August
9	7:20	226	1:20 am	13 August
10	5:01	226	11:01 pm	12 August

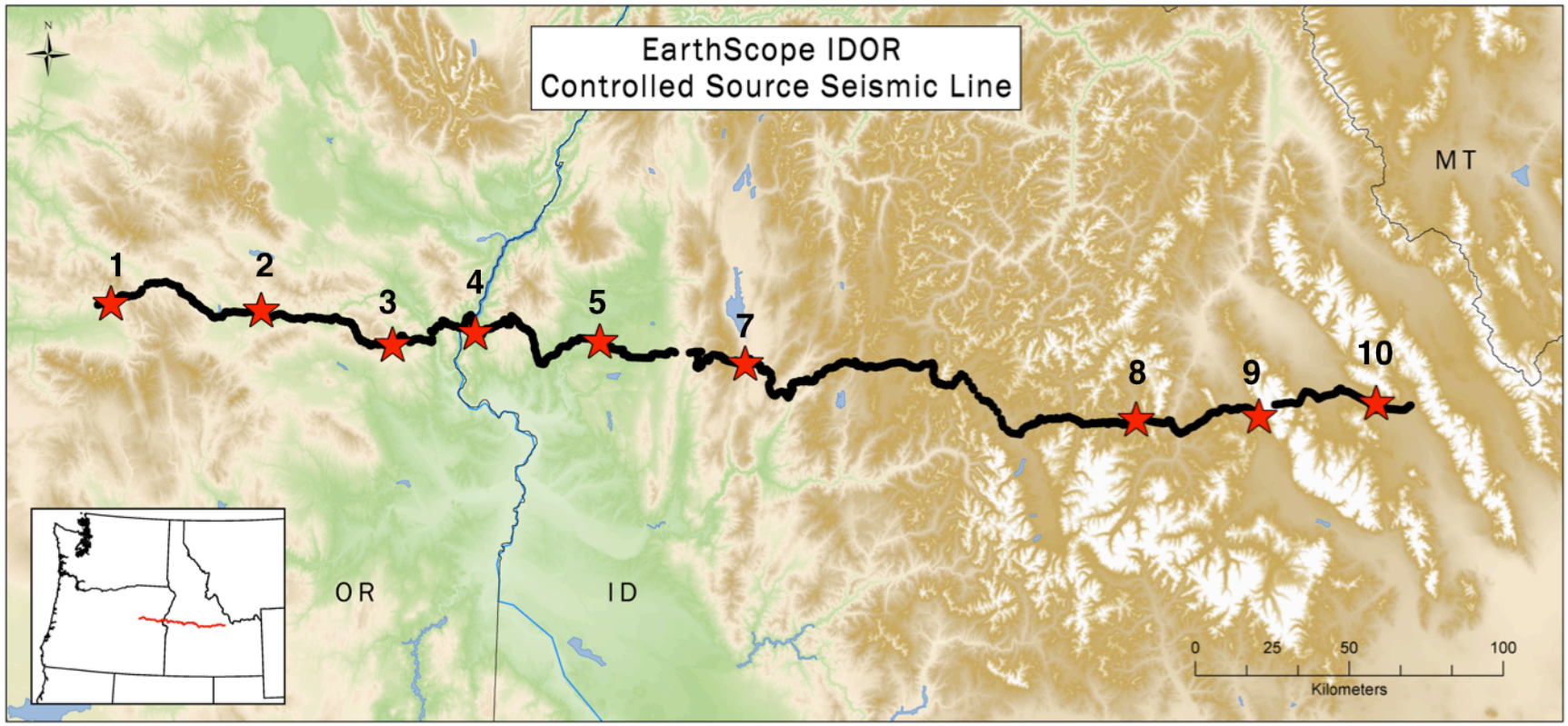
* Shot 4 failed to detonate due to problems with the explosives.

Retrieval schedule:

Retrieval day 0, 13 August:
53 instruments were retrieved earlier than planned due to increasingly unsafe conditions and road closures near Stanley, ID as a result of widespread, uncontained wild fires in the area. No instruments were damaged by the fires.
Retrieval day 1, 15 August:
1047 stations were retrieved.
Retrieval day 2, 16 August:
640 stations were retrieved; 20 of these by hiking teams.
Retrieval day 3, 17 August:
783 stations were retrieved; 25 of these by hiking teams.
Retrieval day 4, 18 August:
31 stations were retrieved.

2555 instruments were retrieved in total. Upon retrieval 2395 of the Texans had a green status light, 4 had a red status light, and 33 had no light. The remaining 123 Texans did not have a status recorded in the field logs. Data offloading was performed as instruments returned to base.

The final SEG-Y files were received at Virginia Tech on September 6, 2012.


EarthScope IDOR
Controlled Source Seismic Line
1
2
3
4
5
7
8
9
10
MT
OR
ID
0
25
50
100
Kilometers