Expanding the user base with the ENAM community marine seismic experiment

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Goals of the ENAM CSE:

- Gather a seismic data set on the eastern US margin to help address science goals of the NSF/GeoPRISMS program.

- Engage young scientists and graduate students in the acquisition and processing of seismic data.
Why eastern U.S?

- One of two focus sites of GeoPRISMS (Rift Initiation and Evolution Initiative). The other site is East African Rift System.
- Relationship between major magnetic anomalies and early opening of the Atlantic Ocean not well understood.
- Need for a data set that links shallow and deep processes.
Non-PI science participation

- Broadband OBS deployment on R/V Endeavor (April 2014): 4
- R/V Marcus Langseth (marine seismics) cruise (Sep/Oct 2014): 9
- R/V Endeavor short-period OBS (Sep/Oct 2014): 6
- Land seismic team onshore-offshore recording: 7
- Broadband OBS recovery (Mar/Apr 2015): 4
- Explosion seismic project (July 2015): 27
- OBS seismic processing workshop, UTIG (May 2015): 20
- MCS seismic processing workshop, LDEO (June 2015): 12
ENAM Broadband OBS array

- Deployed April 2014
- Recovered March/April 2015
- R/V Endeavor
- WHOI broadband OBSIP OBS with Guralp T3 seismometers (sampling at 100 Hz) and DPG (sampling at 20 Hz).
- 30 OBS instruments deployed and recovered.
- BB OBS also recorded airgun shots from active-source seismic study (Sep/Oct 2014).
ENAM Broadband OBS array

- ENAM BB OBS array complements the Earthscope TA deployment, eastern US.
- Twenty OBS in grid near Cape Hatteras, 3 additional stations at the coast, and 10 stations farther offshore.
- Data distributed through IRIS/DMC.
ENAM Active-source seismic study offshore North Carolina, Sep/Oct 2014
Two-ship experiment

Endeavor:

Langseth:
R/V Langseth shipboard party

Norfolk-Norfolk
September 16-October 18, 2014

Co-chief scientists: Donna Shillington, Matt Hornbach, Anne Becel

Nine additional shipboard scientists, of which three junior faculty, and six graduate students

LDEO team, marine mammal observers
36-airgun array, 6600 cu.in., towed at 9m depth.

Shot spacing 225 meters for OBS data, 50 m for MCS data.

Deployment of the 8 km streamer for MCS imaging.

4816 km total length of seismic lines (includes 2 400-km dip lines)
Short-period OBS operation

- North Kingstown (RI)-North Kingstown (RI).
- Co-chief scientists: Harm van Avendonk, Brandon Dugan.
- Six additional graduate students.
- Two deployments of 47 short-period instruments.
- Four linear arrays, 15 km OBS spacing on dip lines, 22 km spacing on continental shelf.
Short-period OBS operation

- WHOI brought 23 D2 OBS; SIO brought 24 LC4X4 OBS.
- All have 3-component 4.5 Hz geophones and a hydrophone.
- 200 Hz sample rate.
- One OBS was lost at sea.
Land seismic team:

- Onshore-offshore data: Recording Langseth shots on land with 80 Reftek 130 stations in Sep/Oct 2018.
- Explosion seismic data: Array of Reftek Texans in June 2015.
- Responsible PIs: Beatrice Magnani, Dan Lizarralde, Steven Harder.
Communications

Project URLs:

http://www.ig.utexas.edu/enam/

http://enamseismic.blogspot.com/

http://geoprisms.org/initiatives-sites/rie/enam/

ENAM seismic data set

Open-access in IRIS/DMC, academic seismic portals at LDEO/UTIG
Example of Seismic reflection data

- Along Blake Spur Magnetic Anomaly
- Thicker than ocean crust.
- Structure in lower crust and upper mantle

Processed by Anne Bécel
Example of OBS seismic refraction data

- Seismic refractions recorded over very long offsets
- OBS 307 on Blake Spur Magnetic Anomaly
Example of OBS seismic refraction data

OBS data from two major dip lines on the same scale
ENAM OBS and MCS processing workshops

- In both case a five days intensive workshop.
- Participation by application for travel support from ENAM project. Number of applications exceeded capacity by 100%.
- We chose a strong group of attendants, who would benefit from seismic processing training.
- Format: Some class-room instruction, mostly hands-on experience in teams of two, discussion.
- OBS processing workshop in Austin TX, May 2015. MCS processing workshop at LDEO, June 2015.
OBS Processing workshop

• May 18-22, 2015 in Austin, TX

• 20 participants, mostly (not all) graduate students
OBS Processing workshop

- Supporting lectures
- Analysis of active-source OBS data
- Discussion
Purpose of OBS refraction processing class: Interpret
Traveltime tomography

- Identifying and picking phases, reciprocity checks, traveltime inversion. Suitable for 5-day course.
Example of Vp structure from dip line (south of Cape Hatteras):

Example of structure parallel to Blake Spur Magnetic Anomaly
Summary/Conclusions:

- ENAM Community Seismic Experiment set produced a unique combination of earthquake and active-source seismic data. These data will help the GeoPRISMS community reach its goals.
- The open-access seismic data set is now available. Science projects focusing on eastern US margin evolution will use the new data.
- The analysis of high-quality marine seismic reflection and refraction data is a rewarding experience for graduate students.
- By creating opportunities for students and young scientists to participate in geophysical studies, we strengthen our research community.