The Eastern North American Margin (ENAM) Community Seismic Experiment

ENAM CSE team:

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Science goals for an ENAM CSE:

- To understand the roles of inheritance and magmatism on rifting and rupture.
- To understand margin evolution from rifting to surface processes and active tectonics today.

Other goals of the ENAM CSE:

- Provide an open-access dataset that will be open and useful for a variety of science targets.
- Enlarge the number of people taking advantage of marine seismic data through broad training program.
GeoPRISMS ENAM objectives

• How was deformation distributed throughout the lithosphere on the Atlantic Margins, and how was it influenced by magmatism and preexisting structural and compositional heterogeneity?

• How does rift structure and magmatism vary within and between segments along the ENAM?

• How do mantle dynamics influence the syn- and post-rift evolution of the margin?

• What processes accompanied the transition from late-stage rifting to mature seafloor spreading?

• How has the margin been influenced by post-rift tectonics?

• What controls the large-scale form of the passive margin?

• What are the magnitudes, mechanisms, and timescales of elemental fluxes between the Earth, oceans, and atmosphere along a passive margin during and after rifting?

• Is post-rift passive margin morphology self-regulating? What are the scales and frequency of submarine landslides, and what preconditions and triggers landslides?
History

• Community experiment idea for ENAM born at GeoPRISMS ENAM meeting in Allentown, PA in Oct 2011

• Community feedback sought for area of ENAM study – poll used to choose area off North Carolina

• Proposal submitted in July 2012 and funded

• Further community feedback sought on experiment design
Data acquisition

- Deployment of BB OBS in April 2014 aboard the R/V Endeavor (planned recovery: April 2015)
- Deployment of BB onshore stations in May 2014 (planned recovery: May 2015)
- Onshore/offshore active source seismic program on R/V Langseth, R/V Endeavor, and onland in Sept-Oct 2014
- Onshore active-source experiment planned for summer 2015
Science applications of the community data

Slides and salt diapirs
Participants

26 scientists and students involved in addition to PI’s
On the *Langseth*...

- Training and participation in data acquisition and processing
- Every person processed at least one line
- Science discussions
On the Endeavor...
On land… Short period stations in NC and VA

Kara Jones

Bix Magnani
On land… Broadband stations on the Outer Banks

Natalie Accardo and Celia Eddy servicing Outer Banks stations

M6.0 Napa valley earthquake recorded on ENAM stations
Outreach

• Presentations to schools and other groups during onshore seismic station deployment and servicing

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

• Field work blog during fall field programs http://enamseismic.blogspot.com/

• A few media interviews
Data distribution and future activities

- Data products that are or will very shortly be available for download:
  - Continuous data from onshore/offshore stations
  - Receiver gathers from OBS and onshore stations
  - Raw MCS data from Langseth
  - Initial, time migrated reflection sections from the Langseth
- Workshops also planned for training and to coordinate science with the data
Challenges....
Blake Spur thought to represent a ridge jump and/or a change in the direction and speed of early seafloor spreading.

Along-strike structure of oceanic crust important for comparison with along-strike variations in synrim magma intrusion.

Profile along the Blake Spur magnetic anomaly.
Deep, rough basement
Thick, smooth basement
Moho
Margin crossing line from close to shore to ~80 km past the Blake Spur magnetic anomaly to capture full rifting and early seafloor spreading history
Science opportunities recognized in MCS data at sea:

- Change in basement character at the Blake Spur Magnetic Anomaly – insights on early spreading history?
- Anomalously thick oceanic crust with deep reflectivity beneath Blake Spur Magnetic Anomaly
- Complex patterns in BSR, faulting and other features in Cape Fear area
- Salt diapirism and associated sediment deformation and slope stability
- Intriguing faults and blocks inside and outside of the Currituck slide; a strong BSR is also imaged in this region.
- An intriguing, very thick sediment section with highly variable seismic characteristics is observed in all data
- Seismic Oceanography in area of Gulf Stream
Other science datasets acquired in fall 2014

• Onshore recordings of offshore experiment
• Underway data from R/V Langseth
• Oceanographic data – dense XBT’s
Independent study by Duke and NOAA of marine mammals and seismic work
What’s next

• Finish uploading all existing ENAM data and send out email blast about its availability

• Finish acquisition
  – recover broadband OBS and onshore instruments in April/May 2015
  – onshore active source program in summer 2015

• Training and science workshops in May/June 2015

• Proposals to NSF and lots of science with the data
Want to see more?

• T53A-4683: ENAM: A community seismic experiment targeting rifiting processes and post-rift evolution of the Mid Atlantic US Margin. Van Avendonk et al

• OS43B-1277: Seismic Images of the Gulf Stream Front off the Coast of North Carolina from the 2014 ENAM Community Seismic Experiment
Thank you...

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• Captains, Scientific Staffs and Crews of the R/V Langseth, R/V Endeavor
• Scripps and WHOI OBS groups
• LDEO Marine Office and NSF for planning/permitting efforts
• People in NC and VA for hosting seismic stations