ENAM 2015 Land Seismic Experiment

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Shot point operations along the ENAM profiles
By Steve Harder and Beatrice Magnani

The 1440 seismometers and sensors deployed along the two ENAM profiles will record seismic waves produced by 11 detonations located along the trace of the profiles. To ensure that most of the energy will travel in the subsurface rather than being lost at the surface, the explosives are detonated at a depth of about 70 feet. Each shot point location is carefully selected to match strict safety requirements and then permitted with state and local authorities. Once permits are authorized, drilling of the boreholes and loading of the explosives can begin. The seismic source team has been working ahead of the deployment team to prep all the shot points along the two lines.

Near surface geology along most of the ENAM lines consists of unconsolidated sands and plastic clays. These require mud rotary drilling techniques and some method to hold the borehole open (i.e., casing) so the liquid explosive (called emulsion) is not squeezed from the hole. In the ENAM project we case only the explosive, a much more economical method than casing the entire borehole. The white tubes in the photo below are filled with emulsion and have been primed with detonators (orange wires) and boosters (inside the tubes). They are ready to be loaded into the hole.

Two charges ready for loading into the borehole. Charges contain 200 lb. each of emulsion and are 5 feet long and 10 inches in diameter.

A charge being lifted by the drill before loading into the borehole. Note the two large piles of sand produced from drilling the borehole.

Program, deploy, shoot, pick up, download, repeat.
By Beatrice Magnani

For the next three weeks the experiment pace is going to be a planned sequence of events with very little wiggle room (although two contingency days are built in the schedule). In essence our schedule consists of five fundamental steps repeated for each profile: 1) seismometer programming, 2) instrument deployment, 3) shooting, 4) instrument pick up, 5) data download. Like clockwork, everything seems easy when coordination and collaboration of all the people in the science team is efficient and these steps follow each other seamlessly. So far we are on schedule and everything is going well.

1) Seismometer programming

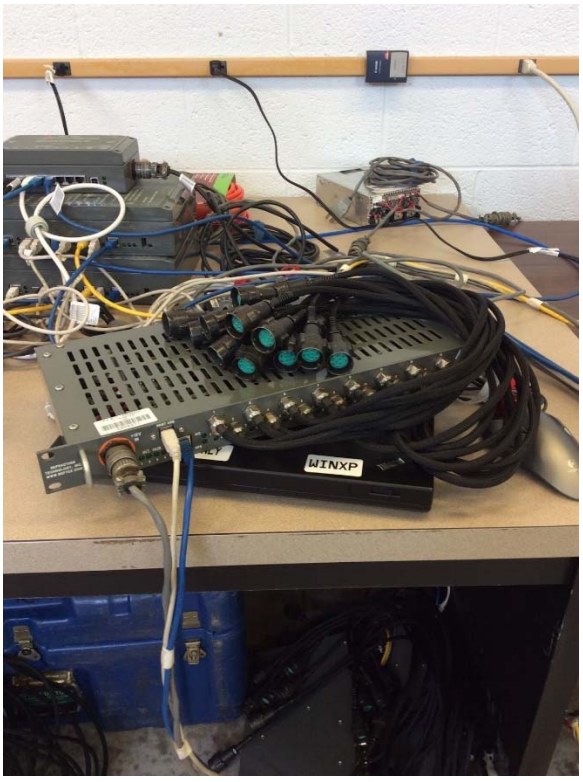
The instruments (RefTek 125 a.k.a. "the Texans", https://www.passcal.nmt.edu/content/instrumentation/dataloggers/1-channel-texan-dataloggers) are cable-less single-channel dataloggers that can be deployed for three to five days, recording continuously.


Casey holding a "Texan"

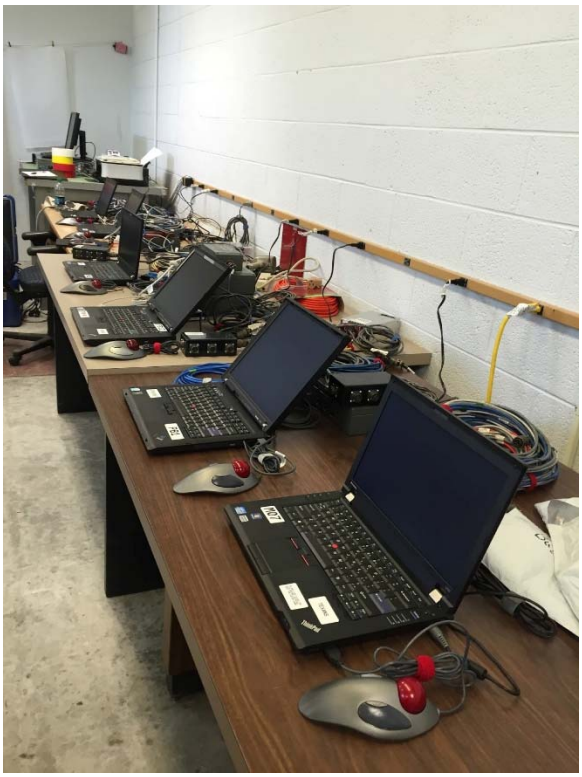
Before we can start working with the instruments, we need to power them. So we sat down and loaded each of the 720 of them with 2 D-cell alkaline batteries.

Loading batteries in the 720 Texans. Now we can start testing/programming the instruments.

The recording parameters (window length, sample rate, etc) are programmed before the Texans are deployed through "bridges" that allow to work on multiple instruments at the same time.



One of the PASSCAL bridges used to program, download and connect with the RT125 Texans seismometers. Each bridge (hub) can simultaneously connect with 15 instruments. We have 15 bridges, so during operations we could program/download 225 instruments simultaneously.



Laptops ready to program the instruments that will go in the ground

Bridget working on 45 instruments. Note the bridge inserted
on the back side of the box. These instruments are getting ready to be deployed.

2) Instrument deployment

The ENAM land active-source experiment will acquire data along two profiles, Line 1 (to the north) and Line 2 (to the south). We will start deploying and recording Line 2, which has 705 stations. The seismometers along this profile will be deployed by 8 teams, each consisting of 2 people (a driver and a navigator), armed with seismometers, sensors, GPS, shovel, authorized permits, electric tape, deployment/recovering sheets, leveling bubbles, flags, cleaning rags, plastic bags, cutters, bug spray, gallons of drinking water and a bucket of resilience.

Deployers kits

Before the teams head out to the field, Bridget and Eric have been training them on how to correctly deploy the seismic instruments.

Bridget and Eric, showing how to correctly deploy an RT125

Each team will deploy ~ 85 instruments over a time window of 2 days. All instruments will have to be in the ground by June 22, 11:00PM, when the first land shot will be fired.

Hannah, Ryan and Casey pondering how it will feel doing this 85 times (or more!) in a 105F weather.

After all details are explained and questions answered, the teams head out to the field to survey their stations. This will be their opportunity to familiarize with their section of the profile, select the location for each station and flag it and enter it in the handheld GPS, so that the following day (deployment day) there will be no need to spend time making decisions about the locations and time can be efficiently spent deploying the instruments.

On deployment day, everybody gets a pretty early start. Teams show up at the instrument center around 5AM to pick up a bit over half of their instruments (in the blue boxes - each box contains 15 Texans), and the head out to the field. Dan, Bridget, Eric and I head out to the instrument center around 4:45AM to make sure they get all they need to do their job and see them off. By 7:30AM all teams have loaded and are off to their tasks.

Seismometers and sensors divided up by deployment team ready to be picked up

Deployment teams arrive at the instrument center to load at the crack of dawn.

More loading

Siwen and James checking equipment before loading it in their vehicles

One last load to go!

The last station went into the ground in the evening of June 22. That same night we will shoot 6 points along Line 2. Shooting will start at 11PM if all goes well, and will take most of the night. More on that tomorrow morning!