



Wavelets - Seismic, Sonar, and Sunshine: The 2014 UH Geophysics Field Camp at Galveston

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Figure 1: Students and equipment at boreholes located at the UH La Marque Geophysical Observatory.

The University of Houston Geophysics Field Camp came back from its traditional Montana site to more fully explore the areas around Houston this summer 2014. While we sorely missed the cool mountain air and vistas of the Beartooth Ranges, we had the opportunity to combine a land geophysics program with a marine component (the only such school of which we know in the US). Proximity to Houston also helped students' travel budgets! As part of the Camp, we undertook a number of surveys at our La Marque Geophysical Observatory (**Figure 1**), Dickinson Salt Dome, Galveston Harbor, and Brazos River. The nine days of field activity (including GPS, ground-penetrating radar, total station surveying, LIDAR, gravity, magnetics, and sonar) were completed successfully with no injuries. Whew! We greatly enjoyed staying at the Texas A&M – Galveston facilities (even with some tinges of rivalry).

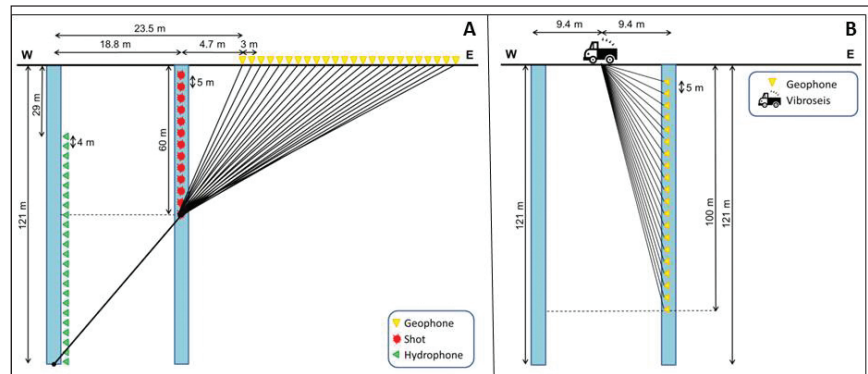


Figure 3: Schematic diagrams of survey geometry using the downhole source (A) and the Vibroseis truck (B).



Figure 2: The UH Vibroseis truck and downhole source used for VSP acquisition.

We also tested a new downhole seismic source, at La Marque, to create reverse VSP and crosswell survey geometries (**Figure 2**). The La Marque test facility hosts two shallow wells, approximately 140 m deep and 19 m apart. The borehole acquisition geometries, using both types of sources, are shown in **Figure 3**. In the case of the downhole source, we used an array of 24 hydrophones (**Figure 3A**) in the west well and a spread of 24 vertical geophones on the surface to record 12 shots from the east well. In addition, we employed an IVI T15000 vibroseis source, with 3C downhole geophones in the east well, to

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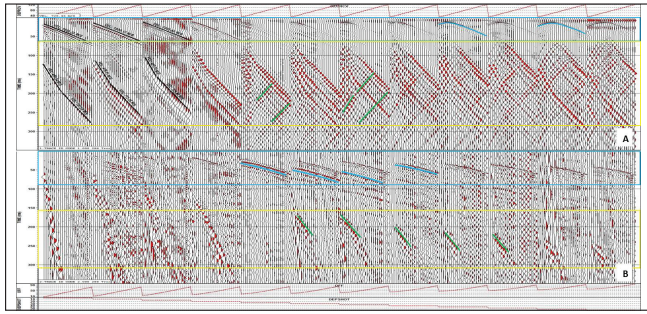


Figure 4: Seismic gathers showing the downhole shots recorded by the downhole hydrophones (A) and the surface geophones (B). Blue and yellow boxes highlight the P and S first arrivals respectively.

record 20 shots given at the midpoint between the wells (**Figure 3B**).

Some data examples are shown in **Figure 4**. We can see in **Figure 4A** the 12 shots given by the downhole source and recorded by the hydrophone array. Using first breaks, we calculate velocities for the P (blue box) and S waves (yellow box). The velocity for P wave events varies from 1800m/s to 1900m/s, while for S waves there is more variability - 450 m/s to 700 m/s. In some of the shots, it is possible to see some reflections mainly for S waves (green lines). **Figure 4B** shows the same 12 shots acquired by the vertical geophones on the surface. We can see the first arrivals of P wave events with hyperbolic shape (blue box) and some S wave events more visible in the shallowest shots (yellow box).

Figure 5 displays a comparison between P wave events acquired using the downhole source at 5 and 10 m depth (**Figure 5A**) and the vibroseis (**Figure 5B**). **Figure 5B** shows the upgoing wave field in field recorded time (FRT) and after the re-datuming process from time zero to 100ms. In both data sets, we can see a P reflection around 90

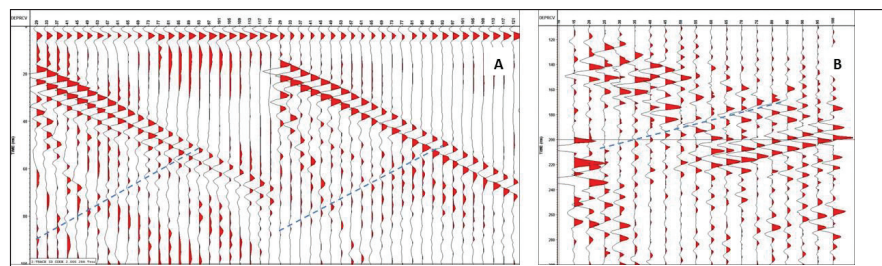


Figure 5: Shot records using the downhole (A) and the Vibroseis (B) sources showing a P reflection around 90 m (blue dotted lines).

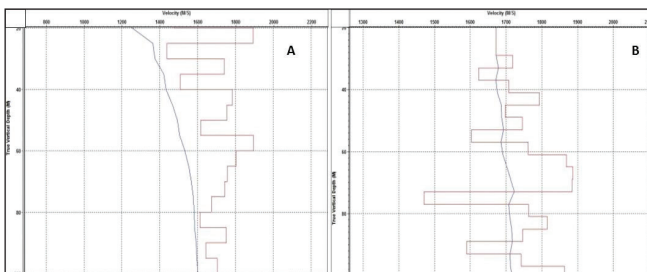


Figure 6: Comparison between P velocities calculated from VSP data acquired with downhole source (A) and acquired using the Vibroseis (B). Both show a trend between 1700m/s and 1800m/s. The blue lines are the RMS velocities and purple lines are interval velocities.

meters depth (blue dotted line). Full processing of the VSP, RVSP, and crosswell data is underway. **Figure 6** shows a comparison between P velocities calculated with vibroseis and downhole sources.

We were thrilled this year with the results of our 2014 Geophysics Field Camp. The introduction of a marine component with sonar and boomer seismic was very popular with the participants (and instructors) – to be discussed in a later report. We were also delighted with learnings from the new downhole source and LIDAR scanning. We would like to express our appreciation to the SEG Foundation who supported the School, the Allied Geophysical Lab who supplied much of the equipment and staff, and the TAMU-G dining staff who fed us so well! We look forward to next year's School scheduled for the Gulf Coast.

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