Introduction

During an ocean bottom node (OBN) survey, we used two types of nodes and two types of seismic source in a survey. The two sources were an array of conventional Airguns (CAG) and a Tuned Pulse Source (TPS). The data were recorded by co-located OBNs of two types. One OBN type had conventional geophones (Benchmark). The other type had QuietSeis Micro Electronic Mechanical Systems (MEMS). In this paper we present phase ring analysis as indicator of low frequency content and transverse component analysis as indicator of vector fidelity.

Source Comparison

The sources were deployed from the same vessel. The CAGs were deployed in staggers flip-flop configuration. Each array with two sub-arrays. 50m across between port and starboard. The port array was 16.67 meters ahead of the starboard array. The TPS was deployed in the middle, behind the boat. Each CAG array was shot twice per each single TPS shot, so four CAG shots for each TPS shot. There was 25 meters on the vessel sail line between CAG shots, and 100 meters between TPS shots. The staggered flip-flop was done to produce square shot carpet. The sail line separation was 100m. This resulted in a woven carpet of 50x50 meter CAG shots and 100x100 meters TPS shots. Figure 1 shows the geometry, continuous common receiver gather data, and phase rings. Phase rings are produced by Fourier Transforming the data, calculating the phase as the arctangent of the real and imaginary components, and then taking frequency slices. The phase rings show that the TPS has much stronger low frequency signal compared to the CAG.

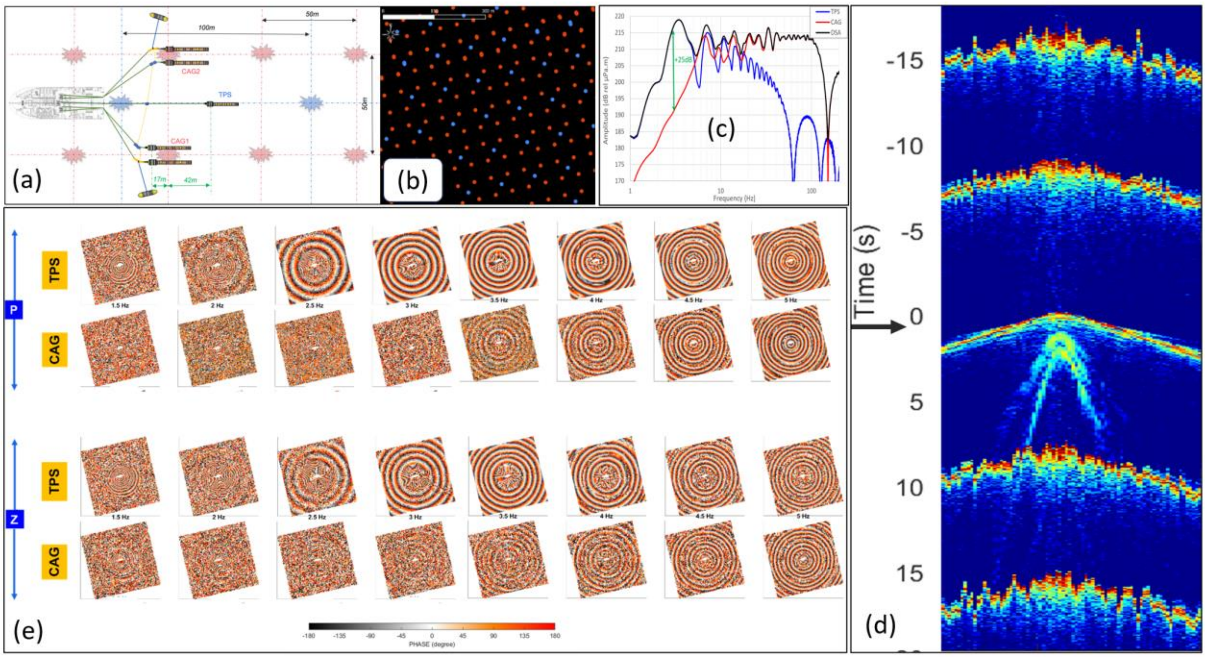

Figure 1 *(a) Source boat configuration. (b) Woven shot carpet. (c) Spectra. (d) Blended data chunked on the TPS.. Note the saturation overdrive (darker than red) affecting the Airguns more than the TPS. (e) Phase rings show better low frequency signal from TPS than from conventional Airguns (CAG).*

Receiver Comparison

We use the transverse component of the direct arrival as an attribute indicative of vector fidelity. The direct arrival wave through the water is radial. Direct arrival energy recorded on the transverse component is an indication of vector infidelity that might be due to spurious sensor response to waves arriving from an orthogonal direction to the sensor, and/or either residual tilt that was not recorded accurately, and/or components that were not exactly orthogonal. Figure 2 shows the results of transverse component analysis. The time window was narrow on the direct arrivals. Only the direct arrivals traveling only through water are purely radial. Surface waves and refractions can come from the side and contain non radial waves. Low cut filter was used to attenuate surface waves. The QuietSeis MEMS had much less energy on the transverse component.

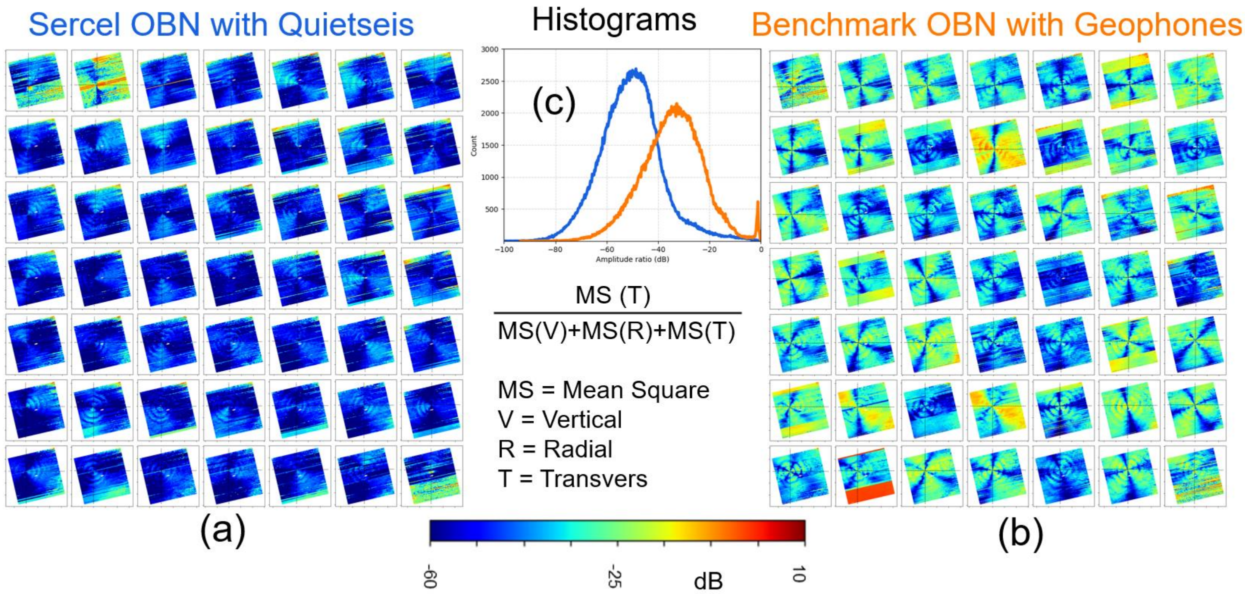

Figure 2 *Maps of the ratio between the mean square amplitude of the transverse component of the direct arrival and the mean square amplitude of all three components. (a) Sercel GPR nodes with QuietSeis MEMS. (b) Benchmark OBNs with Geophones (c) Histograms with QuietSeis in blue and Geophones in orange. There is a 20dB between the peaks of the histograms.*

Conclusions

We found that the Tuned Pulse Source has much stronger low frequency signal compared to conventional Airguns, and that QuietSeis MEMS have a much higher vector fidelity compared to benchmark geophones. This paper demonstrates how the improved vector fidelity plays a key role in maximising the value of broadband seismic data.