Overcoming Near-Surface Challenges

VectorSeis, Single-point Recording Delivers High Bandwidth Data

SEGMENT	**Land acquisition and processing**
REGION	**Colombia, South America**
TECHNOLOGIES	**Scorpion, VectorSeis® multicomponent sensor**

THE CHALLENGE

Higher resolution data is required to continue to effectively explore for new resources

Land seismic data has traditionally been limited by the complexities of the near surface. This complex layer has a great deal of variation. It can range from unconsolidated sediments to extremely hard bed rock from recording station to recording station. This layer is known to cause large static shifts in the data and can also tend to absorb high frequencies in data due to array summing and direct frequency absorption. Tectonic activity in Columbia has produced an extremely complex near-surface challenge.

THE SOLUTION

VectorSeis, single-point recording

Three-component digital sensors provide an opportunity to make some fundamental changes to acquisition. While we can't change the absorption rate of the near surface, we can improve the data results by using multicomponent, single-point sensors.

Geophones have long been the standard of the seismic industry. Commonly deployed in a surface array to form a mechanical filter, geophones are subject to small time delays in the array elements due to the near surface that cause the array-summed data to degrade. The most common impact of this degradation is the attenuation of the high frequencies.

Even when the Earth is not directly limiting the frequency response and ultimately the bandwidth of the data, the arrays we deploy can often times attenuate the frequencies above 70Hz and limit the resolving power of our data.

The solution for broader bandwidth data is deploying a high fidelity, three-component sensor, like VectorSeis. VectorSeis is designed to be deployed as a single-point unit. This eliminates the high frequency attenuation effects of the array. The VectorSeis technology also provides undistorted frequency recording to as low as 2-3 Hz. Combined with the single-point deployment, this will generally record 10-15 Hz broader bandwidth data and ultimately translate to better resolution and better images.

The single-point VectorSeis sensors do not suffer the directional bias, signal smear and frequency loss effects of a geophone array and therefore more accurately sample the true seismic wavefield with a broader bandwidth.

THE RESULTS

Colombia offers many challenges for land seismic, VectorSeis and single-point technology show great promise for better bandwidth data

The opportunity to compare single-point VectorSeis technology directly with geophone technology deployed in an array came in 2005 in Colombia. In a region of Colombia known for near surface complications and intense structure, a seismic survey was recorded with VectorSeis and geophone arrays located in coincident locations. This data provides an unparalleled opportunity to examine the characteristics of the two technologies and methods side-by-side. Figure 1 shows field records from a common source fired into VectorSeis and coincident geophone arrays. Since group intervals have gotten closer in recent years due to high channel count systems, deployed geophone arrays have become less effective. In some cases group intervals can become so close that deployed arrays can sum source-generated noises like ground roll. This is the case with the Colombia data.

This data also illustrates a clear case for broader bandwidth. The single-point VectorSeis data shows better signal response as high as 160 Hz where the geophone data shows a high degree of attenuation. Surface wave interference and limitations of the array deployed geophones has limited the frequency response in this range (Figure 2). This impact will show on stacked data and ultimately impact the imaging capability of the final result. Stack traces from the VectorSeis sensors delivered stable trace and signal response above 140Hz while the geophone data was dramatically attenuated. In the Colombia area, this data demonstrates VectorSeis single-point technology and its advantages over traditional geophone arrays and holds the promise of better resolution images and more effective exploration methods.

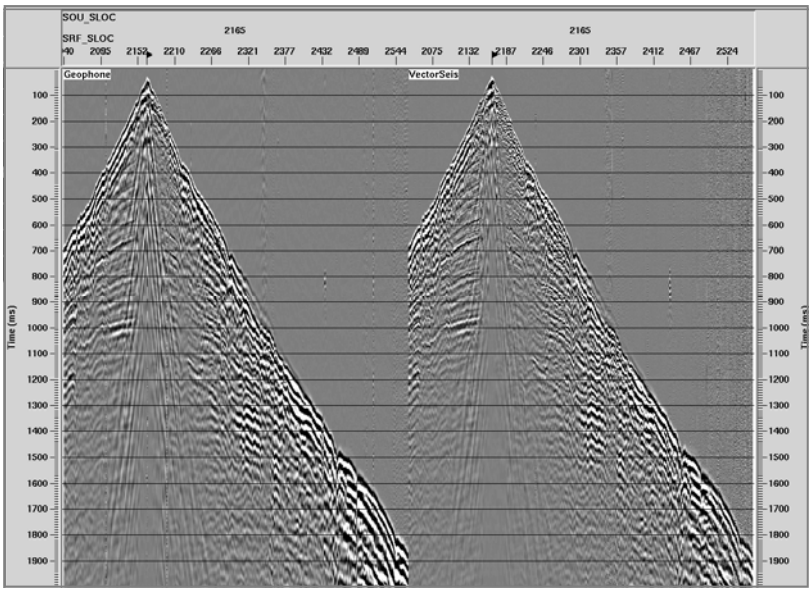

Figure 1:
Geophone left, VectorSeis right.
This picture provides a direct comparison between VectorSeis data and array based geophone data from the Colombia area. In the 90-100 Hz range, there is a distinct signal advantage in the VectorSeis data on the right. This 5-10 db advantage at this frequency range is due to single-point digital geophones and requires no more effort in the field.

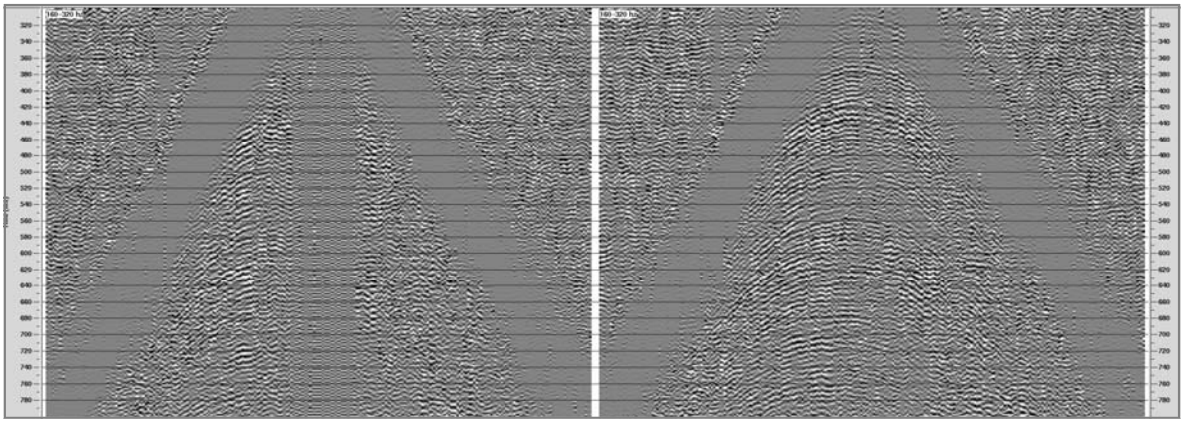

Figure 2:
Geophone left, VectorSeis on the right. Above 160 Hz there is a very dramatic difference in the recorded signal. VectorSeis shows a coherent response while the geophone data is nearly totally attenuated.

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