"High-effort" Seismic Acquisition: Improving Image Detail

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Abstract/Excerpt

In seismic exploration, there is always a trade-off between the quality of the seismic data acquired and the resources and "effort" committed to obtaining the data. For most routine seismic surveying, the acquisition geometry is designed to sample the anticipated subsurface features without spatially aliasing their structure, and to provide some amount of noise attenuation, while still allowing acceptable daily production rates. Noise attenuation is usually provided by horizontally summed geophone arrays whose antenna pattern preferentially admits vertically travelling reflection wavefronts, rather than non-vertical coherent noise wavefronts. Recent equipment advances, however, allow us to record individual geophones in sufficient numbers that we can eliminate arrays and reduce receiver station intervals dramatically. Doing this allows us to accomplish two objectives: the lateral resolution of a survey can be greatly improved, and various multi-channel processing tools, in addition to conventional horizontal summation, can be employed for noise attenuation. An earlier example of single phone acquisition relative to arrays is discussed for multi-component acquisition by Hoffe, et al (2002).

Although we describe the close-spaced, single geophone recording technique as "high effort", the actual number of geophones per survey does not necessarily increase from that used in a conventional survey. What does increase is the number of phone/cable connections that must be made and broken during layout and pickup of the survey, as well as the density of source stations, since we typically shoot every other station, at the reduced station interval.

There are three objectives for our proposed technique: improved lateral resolution of reflection events; increased stack fold for higher S/N; and proper spatial sampling, not only of reflection features, but of all coherent noises, so that these noises can be effectively attenuated using multichannel processes.