3D Seismic Reflection Imaging with Uncontrolled Sources using Large N Arrays

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Reflection seismology with controlled sources often provides the highest resolution of any seismic technique. However, the application of the reflection method to probe all but the shallowest of structures is often inhibited by the substantial cost of artificial sources as well as logistical barriers to their deployment. Here we describe how reflection processing can be applied to recordings of ambient energy sources, natural and artificial, to produce reflection imagery that approaches the quality of conventional controlled source (CMP) surveys. Such "passive" seismic reflection imaging has only recently become practical with the advent of large N nodal technology that can simultaneously record spatially dense arrays for substantial lengths of time. Three diverse approaches are considered: seismic interferometry of ambient "noise" (natural or artificial), redatuming of microearthquake subsets via interferometry (a subset of the previous methods), and VSP imaging of microearthquakes with known locations. Examples from Iceland, the eastern US and Alaska suggest that these methods represent a transformative approach to studying, and monitoring, deep structure in areas illuminated by ongoing microseismicity.

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