Aftershock Imaging with Dense Arrays (AIDA)

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The Mw 5.8 Virginia earthquake of August 23, 2011, provided an opportunity to explore the feasibility of deploying large numbers of portable seismographs at close spacing to record aftershocks and the value of their recordings for improved characterization of the rupture process and structure in the hypocentral region. On August 27, 2011, four days after the main shock, we deployed 103 portable "Texan" one component, short-period recorders along two linear profiles over the hypocentral zone. An additional 105 "Texan" instruments were added six days later to extend the array more directly over the aftershock zone and along a regional NE-SW profile. The latter employed three component sensors to quantify regional attenuation characteristics of both P and S waves. Our initial analyses has focused on the contribution of the dense arrays to a) lowering the threshold for detecting/locating aftershocks b) improving hypocentral locations , c) computing more detailed velocity models (e.g. via tomography), and d) imaging crustal structure within and below the hypocenters using reflection P and S phases. A second pilot experiment was carried out after the M 4.0 Maine earthquake of October 16, 2012, results from which have confirmed the value of dense array recording. Here we focus on our efforts to use the aftershocks as sources for 3D reflection imaging of crustal structure near the rupture zone. Although reflection methods often provide the highest resolution of any geophysical technique for structural imaging, the high cost of conventional surface surveys (especially 3D) inhibits its application. Here we show how a novel application of well-known Vertical Seismic Profiling (VSP) methodology, coupled with seismic interferometry, may be applied to dense aftershock recordings to produce detailed, 3D images of reflective structures near the rupture, and could perhaps be used to monitor post-seismic temporal variations of physical properties at depth.