**Project Summary: Collaborative Research: Imaging Science Workshops for USArray**

The seismology community is in the midst of the second phase of a data acquisition revolution. The first stage of this revolution was development of portable broadband seismographs and their deployment in what have become known as PASSCAL experiments. The second is an equally important breakthrough: We are now fielding broadband seismic arrays with station density great enough to make scattered wave, high-resolution, impedance fluctuation images of the mantle. These images are analogous to active source seismic reflection images of the crust in that they provide very high resolution but of structures from the lower crust through the mantle transition zone. The Bigfoot and Flexible array components of USArray will provide data suitable for scattered wave imaging of the lithosphere and deeper mantle.

Direct imaging, wavefield imaging, scattered wave imaging, and coherent imaging describe a general approach to remote sensing utilizing propagating waves. The most common scattered wave images in seismology now are reflection seismograms. Scattered wave imaging techniques back-extrapolate a recorded wavefield to make an image of material perturbations; these material perturbations appear as the coefficients in the governing partial differential equations. It is well known that scattered wave imaging can provide about an order of magnitude greater resolution than conventional traveltime tomography. To achieve this resolution requires both the high station density data promised by USArray, a large array aperture, and a reasonably close starting velocity model of the imaging region. A significant component of wavefield imaging techniques is development of the migration velocity fields used during back-extrapolation. These velocity fields can be provided by tomographic methods, and therefore tomography and wavefield imaging are complementary imaging schemes.

We are proposing a series of 3 workshops to be held over three years focusing on the subject of scattered wave imaging using earthquakes recorded by densely spaced broadband seismograph arrays, and particularly using the USArray data. The workshops will be organized by a steering committee, and developed in cooperation with the participating scientists as the series progresses. The workshops will be advertised broadly and will be open to anyone interested in attending.

The workshops will be designed to accelerate the development of scattered wave imaging techniques by creating a *virtual center of scientists and students*. The *virtual center* will actively engage scientists and students involved in this research in a working forum for exchange of ideas, joint development of software, and exchange of field and synthetic datasets. Workshop and study topics will include 1) investigation of the effects of the approximations used in formulating imaging algorithms on the final images, 2) testing and validation of different imaging methods using field and synthetic data, 3) experiment design criteria, 4) seismic velocity analysis, and 5) relating the images to composition and physical state of the Earth.

*Broader Impacts:* The workshops will be designed to include working classes for graduate students (and senior scientists) involved in this research area. This will build community in the new generation of young scientists who are emerging as the next group of theoretical leaders in seismology, and who will reap the benefits of the Earthscope endeavor. The synergy of bringing people from academic and industrial backgrounds will advance the field more rapidly than is possible otherwise. This improved communication will help advance knowledge in both the academic and industrial research communities and enhance cross-fertilization between these groups.