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**Reference: Fischer, K.M., A. Li, M.J. Fouch, and M.E. Wysession, Targets for USArray in eastern North America, *Eos Trans. AGU Suppl.*, 81, S319, 2000. (invited)**

## **Targets for USArray in Eastern North America** (invited)

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As USArray rolls across eastern North America, it will traverse Archean and Proterozoic craton, the Paleozoic Appalachian and Ouachita orogens, and the passive margins of the Gulf and Atlantic coasts. This range of tectonic environments will allow us to study how crustal and mantle structures created by episodes of continental collision and break-up have evolved over several hundred million years, and, in an environment uncomplicated by active tectonism, the thermal, chemical and dynamic properties of the thick (> 200 km) sub-cratonic lithosphere. Results from the 1995-1996 Missouri to Massachusetts Broadband Seismometer Experiment (MOMA) and the 1997-1999 NOMAD array in New York and Connecticut (both of which used IRIS/PASSCAL facilities) suggest a number of hypotheses to be addressed by USArray. These models will also be tested using data from the Florida to Edmonton Broadband Seismometer Experiment (FLED), an array scheduled for deployment in 2001.

Moho Ps conversions and reverberations reveal that the thickest crust beneath the MOMA array occurs under the western Appalachian province where Paleozoic sequences cover the Grenville basement of North America. The crust abruptly thins by roughly 5 km at the western limit of the cover rocks, and this Moho topography coincides with a region of dipping reflectors in the Grenville basement, suggesting an episode of deformation that extended through the entire crust. Later-arriving Ps conversions reveal a discontinuity at roughly 280 km in the mantle outside the sub-cratonic lithospheric keel and a discontinuity at 320 km beneath the keel, both of which may represent the base of a low velocity zone. No significant long wavelength topography exists on the 410 km velocity discontinuity across the keel's eastern margin. This result indicates that broad thermal anomalies of more than 100°C-150°C, either cold keel material or sub-keel downwelling, do not impinge on the transition zone. Data from USArray will be able to resolve whether a low velocity zone and an absence of significant vertical downwelling below the lithospheric keel are general characteristics of the North American mantle.

While a fast velocity anomaly associated with the subducted Farallon plate has been clearly observed in the lower mantle by tomographic inversions, its location in the transition zone remains ambiguous. A depression of the 660 discontinuity imaged by Ps conversions to the south of the western MOMA stations may represent a local intersection of the Farallon slab with the deep transition zone, but transition zone discontinuity topography obtained by USArray should more clearly resolve the slab's position.

To obtain better constraints on the distribution of azimuthal anisotropy with depth, we have combined the unique vertical resolution provided by surface waves with the excellent lateral resolution afforded by SKS

shear-wave splitting measurements. Specifically, variations in Rayleigh wave phase and amplitude data between array stations are used to solve for wavefield parameters and azimuthally varying phase velocities, and phase velocities are then jointly interpreted with SKS splitting observations. Application of this method to broadband stations in the northeastern United States and southeastern Canada requires the presence of significant anisotropy at depths of 200 km or more. The 50-70 km station spacing and 1000-1400 km aperture proposed for USArray is ideal for this technique and should yield unprecedented resolution of lithospheric deformation and deeper mantle flow across the continent.