Investigating Crust and Mantle Structure with the Florida-to-Edmonton Broadband Array

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During the Florida to Edmonton Broadband Seismometer Experiment (FLED), 28 broadband IRIS/PASSCAL STS-2 seismometers were deployed (May, 2001 to October, 2002) from central Florida to Alberta, Canada (Figure 1). Together with adjacent permanent stations from the IRIS/GSN, USNSN, CNSN, and New Madrid Seismic Network, the roughly linear array crossed diverse tectonic provinces and features, including the rifted continental margin, the Appalachian orogen, the Proterozoic and Archaean provinces of the continental interior, the Mid-Continent Rift and the Williston Basin. Data quality was in general very good.One project involved constraining crustal structure beneath the array using Ps phases scattered from the Moho and crustal reverberations (Figure 2). Significant features include zones of thickened crust beneath the southern Appalachian mountains, the late-Proterozoic Mid-Continent Rift in Iowa, and the Williston Basin. Beneath FLED in the southern Appalachians, the ratio of surface topography to excess crustal thickness matches the value found in the northern Appalachians beneath the Missouri-to-Massachusetts Broadband Seismometer Array (MOMA). However, both Appalachian ratios are small when compared to topography/crustal root ratios in young orogens. These results are consistent with global trends in orogenic crustal thickness, mountain topography and gravity anomalies that suggest a systematic decrease with age in the buoyancy of crustal roots relative to the mantle. Such an increase in crustal root density can be explained by gradual metamorphic reactions over hundreds of millions of years.

Figure 1. The station locations of the Florida-to-Edmonton (FLED) broadband seismic array.

Other projects completed or underway involve examining the shear-wave splitting in SKS and related phases and their constraints on mantle anisotropy, transition zone discontinuity topography with scattered wave migration, lateral variations in upper mantle heterogeneity and anisotropy using Rayleigh and Love waves, ultra-low velocity zones at the core-mantle boundary using SPdKS phases, mantle attenuation structure beneath North America, lateral variations in the lowermost mantle using ScS-S waves, mantle discontinuities using SS precursors, and D″ thermal boundary layer structure (see later).

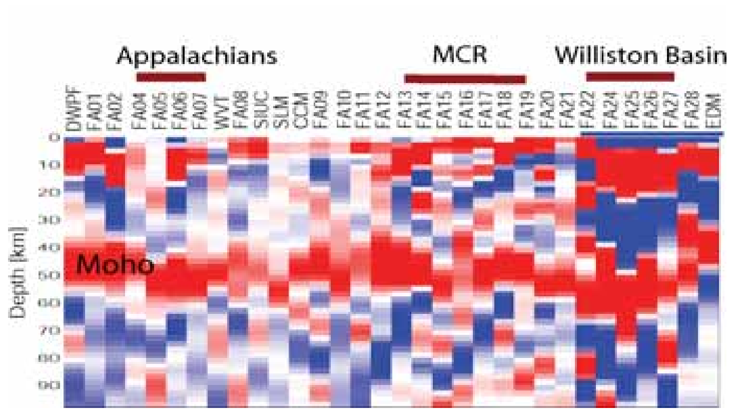

Figure 2. Image of the Moho beneath the FLED array from Ps phases (red or positive arrivals). Waveforms at each station were corrected with an inverse free surface transform, simultaneously deconvolved, and migrated to depth in 1D using a uniform velocity model. True crustal thicknesses (not shown) were modeled allowing for lateral variations in crustal velocities.

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