Moho Topography Beneath the Alaska Range: Results from BEAAR

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Tectonically south central Alaska overrides a shallow subduction zone. This is where the North American – Pacific plate boundary undergoes a transition from transform to convergent boundary type, a "closed corner transition zone" (Mann, Grindlay and Dolan, 1999). The Alaska Range forms the "corner" far inland of the Yakutat block. The Yakutat block is in the process of accreting to North America (Freymueller et al., 2002). The curvilinear Alaska Range is bisected by the Denali fault system, a 1200 km long dominantly right lateral strike slip fault system that arcs across southern Alaska. Active seismicity of the Aleutian Wadati-Benioff zone disappears to the east beneath the Alaska Range. Active arc volcanism, strongly correlated with the 100 km depth contour to the west, also disappears beneath the Alaska Range (Nye et al., 2002). The Broadband (seismic) Experiment Across the Alaska Range (BEAAR) was designed in part to examine continental margin convergence by providing data to determine crustal and upper mantle structure beneath the central Alaska Range.

BEAAR utilized thirty-six broadband seismometers on loan from the Program for the Array Seismic Studies of the Crustal Lithosphere (PASSCAL) of the Incorporated Research Institutions for Seismology (IRIS) to record local, regional, and teleseismic events between spring 1999 and fall 2001. Twenty-one stations formed the main line, located along the Parks Highway between Fairbanks and Anchorage. Eight stations were located roughly east west across the Denali Highway and the Denali National Park road. Two stations were deployed along Petersville Road for better coverage in the southwest. Of the 995 earthquakes with moment magnitude Mw>5.5 during the BEAAR deployment, 751 events are between 29° and 101° from centrally located station RND and considered teleseismic events. Approximately 15, 000 teleseismic P wave arrivals and each resulting receiver function were examined. Individual traces that survived quality control are grouped based on event clusters and trace similarity. Each group is stacked, and lateral offset of the Moho piercing point is determined. Receiver functions are inverted for the velocity profile beneath the station. A plane layered model with a crustal velocity of 6.5 km/s and a mantle velocity of 8.2 km/s is used to calculate a suite of synthetic receiver functions using different interface depths; each stack or representative trace provides a single crustal thickness.

The crustal thicknesses determined by modeling receiver functions calculated from BEAAR seismograms provide the first detailed look at the Moho topography beneath the Alaska Range. The main features include a shallow Moho north of the range, and a deep, irregular Moho in the central Alaska Range. Individual crustal thicknesses are reported in map view with a vector representing the lateral offset in the direction of the mean back-azimuth for each stack. In a further attempt to aid visualization of the data, these irregularly spaced Moho piercing points are gridded and contoured to provide a map of Moho topography.