Subduction beneath Alaska differs strongly from elsewhere in the North Pacific: North America’s largest mountains have arisen, and arc magmatism is absent. To better understand the relationship between subduction, magmatism, and orogenesis, we conducted in 1999-2001 the Broadband Experiment Across the Alaska Range (BEAAR), 36 PASSCAL broadband seismographs at 10-15 km spacing across the Alaska Range. These data have provided some of the best resolved images of subduction anywhere; we show two examples here. (A) Attenuation tomography (Stachnik et al., 2004) shows a high-attenuation, presumably hot mantle wedge underlying the Alaska Range. However, attenuation is small to the SE, above where the slab is less than 75 km depth, indicating that part of the mantle remains cold and isolated from large-scale flow. The Q values and their measured frequency dependence suggest sub-solidus conditions, 50-150 K cooler than temperatures inferred beneath active arcs elsewhere from similar measurements. (B) Prominent P-S conversions from the downgoing slab, in receiver functions (Ferris et al., 2003), show that the top of the slab is a low-velocity channel at depths less than 130 km, indicating that subducting crust has not converted to eclogites until this depth. Strong conversions are absent below 130 km depth, as are intraslab earthquakes. Subducted crust is seismically slow probably because hydrous minerals or free fluids are present, and it is the release of these fluids which embrittles the surrounding material, allowing earthquakes to occur. Deeper, the absence of fluids precludes seismogenesis. The images also show that subducting crust here is 2-3 times thicker than typical oceanic crust, and may indicate exotic terrane subduction to at least 130 km depth. Subduction of this buoyant crust could explain the shallow dip of the thrust zone beneath Alaska and the Neogene rise of the Alaska range.
