Layer 2A structure and evolution along the Juan de Fuca ridge flanks

Kori Newman[1], Mladen Nedimovic[1], Suzanne Carbotte[1] , John Diebold[1], Jeffrey Babcock[2], Alistair Harding[2], Graham Kent[2], Pablo Canales[3] and Robert Detrick[3]

[1]LDEO, 61 Route 9W, Palisades, NY 10964, USA, [2]Scripps, 9500 Gilman Drive, La Jolla, CA 92093, USA [3]WHOI, 360 Woods Hole Rd., Woods Hole, MA 02543, USA

Approximate doubling of seismic velocities within layer 2A is the primary known change in the seismic structure of oceanic crust with age (Purdy and Ewing, 1986). This velocity change is commonly attributed to precipitation of low-temperature alteration minerals within the extrusive rocks associated with ridge flank hydrothermal circulation (Jacobson, 1992). Numerical simulations (Fisher and Becker, 1995; Wang et al., 1997) and observational studies (e.g. Langseth et al., 1989; Johnson et al., 1993) further indicate a close relationship between hydrothermal upflow zones and basement relief. Recent compilations indicate that layer 2A doubles in velocity within 5 Myr of crustal formation (Grevemeyer and Weigel, 1996; Carlson, 1998). From stacking velocity analysis, Rohr (1994) found that layer 2A velocities increase even more rapidly at the Endeavour segment and that there is a direct relationship between hydrothermal systems, sedimentary history and layer 2A evolution. We carried out 1D travel time modeling of super CMP gathers from our 2002 Juan de Fuca ridge and ridge flank MCS data to determine upper crustal velocities at ~3 km interval along hundreds of km of our profiles. Our results indicate a clear regional correlation between sediment burial and increase in upper crustal velocities. We attribute this correlation to more rapid precipitation of alteration minerals in the porous upper crust as the hydrothermal regime evolves from one dominated by open exchange with the water column to a regime effectively closed to seawater exchange due to the sealing sedimentary blanket. Interestingly, the very rapid increase in 2A stacking velocities reported by Rohr from 20-35 km off axis appears to be a local effect associated with the propagator wake crossed at this location. Our results also appear to show correlation between the change in 2A thickness/velocity and the location of propagator wakes, perhaps indicating that some propagator wakes may represent zones of focused fluid flow and enhanced precipitation of alteration minerals.