DEPTH EXTENT OF THE FAULT ZONE SEISMIC WAVEGUIDE: EFFECTS OF FAULT INCREASING VELOCITY WITH DEPTH

WU, Jiedi, Dept. of Geosciences, Virginia Tech, Blacksburg, VA 24061

Deformation in major fault zones creates a low-velocity zone that can trap or guide seismic waves. Previous studies have disputed whether this low-velocity seismic waveguide is associated with fault zones extends to seismogenic depths or is restricted to the shallowest few kilometers; and earlier computer modeling had usually assumed a homogenous fault. However, pressure-induced closure of porosity causes seismic velocity both outside and inside the fault to increase substantially with depth. This velocity increase will cause the dominant frequency of the waveguide to increase. The trapping efficiency for a fault zone that contains a realistic velocity increase with depth was investigated using three-dimensional finite-difference simulations. Sources within the deep fault generate guided waves that are dispersive over a broad range of frequencies. Sources adjacent to the deep fault generate strong guided waves at the surface, even though the waveguide extends continuously to greater depth than the source. For both the deep and shallow waveguide, sources outside the fault generate similar guided waves that are strongly dispersive at low frequencies but weak at high frequencies. For deep sources inside or outside the fault, low frequencies propagate as body waves at depth and are guided only by the shallow fault zone. Travel time delays of guided waves don't grow with increasing source depth at low frequencies. Detection of the fault zone waveguide at seismogenic depth requires careful analysis of trapping and dispersion at higher frequency than has usually been investigated.

Advisor: Dr. J. A. Hole