



Differences in travel time curves for ‘cold’ and ‘hot’ models of the upper mantle

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In order to examine upper mantle structure beneath ‘cold’, tectonically stable regions, in comparison with ‘hot’, tectonically active regions, we have checked the differences between earthquake travel times for ray paths that pass beneath both types of domain. We find a clear distinction between ‘cold’ and ‘hot’ upper mantle in North America and Central Europe.

We have focused on travel times in the offset range between about 700 km and 3000 km. There is a significant delay for phases sampling the upper mantle low velocity zone (LVZ) below a depth of about 100 km. The delay depends on the thickness of the LVZ and appears to correlate with the tectonic state of the region. For ‘hot’ regions there is a large delay for phases that have crossed the LVZ, which corresponds to a thick LVZ; whereas the delay is smaller for phases that have propagated in ‘cold’ regions. For three events from Texas we identify some delay from the LVZ for recordings in the eastern US and a much larger delay for recordings in the western US in the offset range of 800-1600 km. The difference between these delays amounts to 3-5 s. The same observation has been made for two events in northern Algeria for recordings in Europe between raypaths that traverse the ‘hot’ Alpine region versus those outside. For all five events the situation is reversed at offsets beyond ~1600 km where phases from around the Mantle Transition Zone are observed. At these large offsets seismic phases which have velocities that are characteristic of those that have travelled below the ‘410-km’ discontinuity and have sampled the ‘cold’ regions, are recorded 2-3 seconds earlier than those that have sampled the ‘hot’ regions. Our observations indicate that the ‘410-km’ discontinuity is located at a significantly shallower depth below ‘hot’ rather than ‘cold’ tectonic domains.