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New upper mantle model for North America: no longer a pyrolite composition?

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We compare the traveltimes data for P and S waves from the long range seismic profiles and from the earthquakes recorded to the offset of 3000 km with theoretical traveltimes predicted by standard seismological models: PREM, IASP- 91, AK-135 and especially by seismo-petrological model PREF (Cammarano and Romanowicz - 2007). For our analysis we are used data from north American array also. Our analysis suggests that for several events in the distance range 2000-3000 km, the first-arrivals are characterized by a relatively high velocity of 8.7–8.9 km/s. It is about 2.5% higher than P-wave velocity of the Lehmann phases, observed in the nearest offset and about 3% smaller than velocity below 410 km discontinuity. S waves model suggested significant differences in Vp/Vs ratio. We suggest that this is a new first-order seismological boundary which can be interpreted as a top of the mantle transition zone. Seismological arguments for the existence of such a boundary are as follows: refracted waves with velocity 8.7-8.9 km/s and reflected waves find by Warren at al. (1967) and by Thybo and Perchuc (1997b). Several new publications suggested existence of a low velocity zone above the 410-km discontinuity. We also see this feature in our studies. Important suggestion is existence of 300 km discontinuity below cold areas and it is also difficult to exclude this boundary below "cold" areas however phases from this boundary are in secondary impulses. Depth of this boundary strongly depends on the thermal state of the mantle in particular regions. In conclusion we can say that the mantle transition zone starts much earlier and the lower part of the upper mantle is much faster than predicted by purely pyrolitic mantle model. Several petrological studies suggest influences of fluids (especially H2O) on the character of the 410 km discontinuity and of the transition zone. All the differences in experimental data can be explained by the effect of temperature on the phase transformations within the olivine-wadsleyite system.