STUDY OF SEISMIC SHEAR WAVES AND UPPER MANTLE STRUCTURE IN THE WESTERN UNITED STATES

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The western United States is marked by an upper mantle of abnormally low seismic velocities, high seismic wave attenuation and high heat flow relative to other continental areas. Both P and S arrivals are systematically late with respect to those in the central and eastern United States. In as much as late arrivals are associated in general with high heat flow, the regional differences in travel time probably are correlated with regional variations of upper mantle temperature. A partially-melted mantle of the western United States has been inferred by other investigators from studies of travel-time delays, magnetotelluric surveys, geomagnetic deep sounding and surface-wave phase velocities.

Although the existence of the low-velocity channel in the western United States is well established, quantitative information concerning the S-wave velocity structure in this zone and its lateral variation in the whole of the western United States is deficient.

This dissertation concerns the velocity structure of the mantle low-velocity channel and its variations in the western United States by using the azimuth-dependent S-delay times relative to Albuquerque, New Mexico.

Velocity models to fit the relative delay times are generated

from the model of Ibrahim and Nuttli (1967). The adapted S-wave velocity for the channel is 3.85 km/sec. The bottom of the low-velocity channel is kept at a depth of 201 km, and that of the top of the channel is allowed to vary to match the observed relative residuals.

Some of the results of this dissertation are:

1. The low-velocity channel in the western United States varies in thickness and is thickest, 160 km, under southern Utah and central Arizona.

2. Travel-time arrivals are early at two central United States stations FLO, Missouri and OXF, Mississippi.

3. The ratio of S station residuals to P station residuals is highest, 3.14, for South American earthquake data.

4. Partial melting in the LVC of approximately 15% by volume would result in S-wave delay time comparable to those found in this study.