I. Summary

We present a new seismological model of the lithosphere/asthenosphere boundaries determining the Pacific ocean to a depth of about 600 km that is consistent with a global seismic tomography model of the upper mantle. The model is based on a combination of surface wave and body wave data and is used to study the effects of thermal and mechanical anisotropy on the seismic velocities and on the thermal structure of the oceanic lithosphere. The model provides a rigorous test of the hypothesis that the seismic velocities and the thermal structure of the lithosphere are controlled by the temperature and density distribution, and that the anisotropy of the seismic velocities is related to the mechanical anisotropy of the lithosphere.

II. Data and surface wave tomography

Figure 1. Image of the Earth's surface taken from a satellite, showing the Pacific Ocean and surrounding continents.

III. Seismic model

Model Construction

The model is constructed using a 3D finite-difference scheme that solves the wave equation in a 3D grid. The grid is constructed to match the resolution of the seismic data, and the equations are solved using a 6th-order finite-difference scheme. The model is solved for different periods of oceanic and continental earthquakes, and the results are used to infer the seismic velocities and the thermal structure of the Pacific Ocean.

Model Validation

The model is validated by comparing the predicted seismic velocities and thermal structure with the observed data. The model is able to reproduce the observed seismic velocities and thermal structure with high accuracy, indicating that the model is able to accurately represent the oceanic and continental lithosphere.

IV. Seismic velocities versus lithospheric age

Figure 2. Seismic velocities versus lithospheric age for the Pacific Ocean.

V. Converting Vs to temperature and density

Figure 3. Conversion of seismic velocities to temperature and density for different lithospheric ages.

VI. Thermal age

Figure 4. Thermal age map of the Pacific Ocean.

VII. Seafloor topography

Figure 5. Seafloor topography map of the Pacific Ocean.

References