The Upper Mantle Structure of the Straits of Sicily and the Southern Tyrrhenian Sea

by

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Abstract

Rayleigh wave phase velocities have been measured for the paths Sidi Bou Said (Tunisia) - Palermo (SBS - PLR) and Sidi Bou Said - Napoli (SBS - NPL) in the period range 27-76 sec and 14-50 sec, respectively. Inversion of the data has been performed by the " hedgehog " method.

For the path SBS - NPL we have taken into account recent estimates that the crustal thickness in the Tyrrhenian Sea is about 10 km. Keeping this crustal thickness fixed, the S-wave velocity for the mantle lid, as obtained in the inversion, is the same as the S-wave velocity in the asthenosphere channel, namely about 4.20 km/sec. Thus in this model, the lid is absent, or at least we cannot resolve a perceptible lid to the low-velocity channel. If we allow the crust to be 15 km thick and take the channel velocity to be 4.08 km/sec, we get acceptable solutions to the inversion with a very thin high-velocity lid to the low-velocity channel.

In the case of the profile SBS - PLR we have no data on crustal thickness. Thus we have been obliged to insert crustal thickness as an additional parameter in the inversion. Our result is that crustal thicknesses from 16 to 36 km are compatible with the dispersion data. We, therefore, cannot resolve between an oceanic and a continental structure.

In a new technical development we have attempted to restrict the slopes of the inverse solutions by measuring and subsequently inverting group velocities and phase velocities simultaneously. In this case the crustal thickness is between 20 and 32 km, the S-wave velocity in the lid is between 4.52 and 4.72 km/sec, and the channel velocity is about 4.32 km/sec. If the lid velocity is at the upper extreme, as found in other relatively stable regions, the lid thickness is only about 30-50 km. Hence the channel is quite shallow and starts around 60 to 80 km below the surface.

For neither of these two paths can we resolve the bottom of the low-velocity channel with the presently available data.

Interventions

K. Hsü — There are two models for the genesis of the Tyrrhenian Basin : 1. Oceanization of continental crust, 2. Spreading in marginal basins behind island arcs. Does your statement concerning the similarity of Tyrrhenian and Mariana basin imply a support of the second hypothesis?

Réponse — Seismic results only give a picture of the earth's interior today. To make an inference regarding the process leading to the present state requires a model. What we can say is that the Philippine and Tyrrhenian Seas are structurally similar today. It is very likely that these two regions were produced by similar processes. We believe that the model of spreading in marginal basins is consistent with sea-floor spreading and plate tectonics, but as indicated above, our evidence does not bear on this point.

E. Zarudzki — What was the L.V. channel thickness estimates?

Réponse — With phase velocity data only to periods of 76 sec at the longest we are unable to resolve the location of the bottom of the low-velocity channel. To do this we would need signal power at periods up to 150-200 sec.

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