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Physics of the Earth and Planetary Interiors 150 (2005) 339–350
PHYSICS OF THE EARTH AND PLANETARY INTERIORS
www.elsevier.com/locate/pepi

The crust and upper mantle discontinuity structure beneath Alaska inferred from receiver functions

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Received 9 August 2004; received in revised form 29 November 2004; accepted 3 December 2004

Abstract

In this study, three receiver function stacking methods are used to study the detailed crust and upper mantle structure beneath south-central Alaska. We used teleseismic waveform data recorded by 36 stations in the Broadband Experiment Across the Alaska Range (BEAAR) and 4 permanent stations in Alaska. $H-\kappa$ stacking method using P-to-S converted wave and its multiply reflected waves between the Earth's surface and the Moho discontinuity is adopted to estimate the crustal thickness (H) and average crustal V_P/V_S ratio (κ) in this region. The receiver function results for 24 stations show that the crustal thickness under Alaska ranges from 26.0 to 42.6 km with an average value of 33.8 km, and the V_P/V_S ratio varies from 1.66 to 1.94 with an average value of 1.81 which corresponds to an average Poisson's ratio of 0.277 with a range from 0.216 to 0.320. High Poisson's ratios under some stations are possibly caused by partial melting in the crust and the uppermost mantle. Common converted point (CCP) stacking results of receiver functions along three lines show clear Moho and slab images under this subduction zone. The depths of the slab from our CCP stacking images are consistent with those estimated from the Wadati–Benioff Zone (WBZ). In the area between two stations DH2 (147.8°W, 63.3°N) and DH3 (147.1°W, 63.0°N), a Moho depth offset of about 10 km is found by both the $H-\kappa$ and CCP stacking techniques. Common depth point (CDP) stacking of receiver functions shows not only the 410-, 520- and 660-km discontinuities, but also significant variations (−30 to 15 km) in the transition zone thickness under the southwest and southeast parts of the study region. The transition zone becomes thinner by 20–30 km, indicating that the temperature there is 150–200 K higher than that of the normal mantle.
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Keywords: Receiver functions; Crustal thickness; Poisson's ratio; The upper mantle discontinuities; Alaska

1. Introduction

Receiver function methods have been widely used to study the interior structure of the Earth since they were first introduced to seismology about three

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doi:10.1016/j.pepi.2004.12.002