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Evidence of a slab of subducted lithosphere beneath central Taiwan from seismic waveforms and travel times

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Abstract

Knowing whether there is a slab of subducted lithosphere beneath central Taiwan is important for our understanding of the regional tectonic evolution. In this study, we aim at resolving this issue by investigating the seismic effects of a potential near-receiver slab, using data from a local broadband array. Rays from deep and intermediate-depth earthquakes in the Tonga–Kermadec subduction zone to central Taiwan stations exhibit reduced amplitudes and travel times relative to KMNB in the 0.1–0.4 Hz band, with a correlation between the degree of reduction and earthquake latitudes. The overall amplitude reduction observed at central Taiwan stations is not observed for earthquakes from the Hindu Kush. Our analysis suggests that the observations are not caused by crustal structure but by receiver-side heterogeneous mantle or, more specifically, an eastern dipping aseismic slab beneath central Taiwan. The extent of the slab is determined by jointly modeling amplitude and travel time observations at SSLB and TPUB using a 2-D pseudospectral method.

Keywords: Tonga–Kermadec; subduction zone; seismic wave

1. Introduction

Whether or not a slab of subducted lithosphere exits between 23°N and 24°N beneath central Taiwan remains an open question. Subduction zone seismicity does not provide conclusive answers because no earthquakes occur beyond ~80-km depth. Models published thus far adopt different views on the issue. For instance, in terms of tectonic evolution, the model of arc–continent collision [1–4] supports the presence of a slab, whereas that of arc–arc collision [5] favors its absence. In terms of orogenic processes, the model of skinned collision [6] or crustal exhumation [7] assumes its presence, whereas that of lithospheric collision [8] advocates its absence. Therefore, the resolution of the debate is crucial to a better understanding of the tectonic evolution and orogeny in the

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