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An extensive swath of stagnant flat slab tomographic anomalies have been documented within the 410 to 660 km mantle transition zone under Japan, Korea and NE China, downdip of the northwest Pacific trench Benioff zones (e.g. Fukao et al., 1992; Zhao et al., 2015). In this study we mapped these slab anomalies in 3D from MITP08 global seismic tomography (Li et al., 2008) and used these slabs to constrain a new regional NW Pacific plate tectonic reconstruction in the Cenozoic.

Our mapped slabs included the Izu-Bonin, Kuril, and Kamchatka slabs, their associated stagnant flat slabs, and other regional slabs. The mapped slabs were then unfolded (i.e. structurally restored) to a spherical Earth surface to assess their pre-subduction geometries. The unfolded slab constraints were input into plate tectonic reconstructions using Gplates software.

When unfolded the western Pacific stagnant slabs have a minimum 2000 km east-west length. The mapped northern stagnant slab edge near the western Aleutians and the southern edge at the southernmost Izu-Bonin trench are roughly east-west and consistent with transform directions predicted by mean Pacific motions since 47.5 Ma.

Using the slab constraints in a quantitative plate reconstruction, we show it is unlikely the stagnant slabs were subducted by simple eastward retreat of Eurasia in the Cenozoic relative to a mantle reference. Instead, we show that the stagnant slabs were formed by ~3500 km of Eocene to present-day fast western Pacific subduction at the eastern margin of a slow-moving Eurasia. After subduction, the Pacific slabs advanced westward >2000 km under NE Asia within the mantle, pushed westward along the mantle transition zone by the fast Pacific subduction. We discuss the fit of this plate reconstruction against the timings of Japan Sea, Kuril Basin and Okhotsk Sea opening and NE China intraplate volcanism. We show possible reasons why the stagnant flat slabs did not penetrate the lower mantle. Today the western Pacific stagnant flat slabs form a barrier that has prevented other NE Asia slabs from penetrating the lower mantle.

キーワード: western Pacific, plate tectonic reconstruction, stagnant slab, Izu-Bonin, Kuril-Kamchatka, seismic tomography
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