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Slabs Known and Unknown - Investigating the Upper Mantle Under Kamchatka With Teleseismic Receiver Functions

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The southern part of the Kamchatka peninsula in the northwestern corner of the Pacific is underlain by a well developed subduction zone which terminates at the intersection of the peninsula with the Aleutian arc. The northern part of the peninsula shows evidence of recent subduction, but no contemporary activity, seismic or volcanic. The character of the subduction zone changes as it approaches the junction, with a shallowing of the Benioff zone at the corner, and intense volcanism. Broad band seismic data from a portable network of stations sampling the entire length of Kamchatka is used to constrain seismic impedance properties of the lithosphere and upper mantle under the Kamchatka peninsula. Mode-converted phases in the coda of teleseismic P waves identify and delineate interfaces within the upper mantle under the peninsula. We utilize both standard tools of receiver function analysis and a new source equalization technique based on multiple-taper correlation (MTC) spectrum estimates. The MTC technique has superior noise-handling properties, and can process more protracted source time functions, increasing the usable dataset. The overall geometry of the subducting slab under Kamchatka, known from its earthquake distribution, identifies time windows for converted phases associated with the top of the slab. We find clearly identifiable converted phases in the expected time window - around 10 sec behind the direct P on the eastern coast of Kamchatka, around 15 sec behind direct P in the central part of the peninsula. As a rule, both SV and SH polarized energy are present. The complicated nature of the observed mode-converted phases, and variations of their amplitude between stations imply a laterally variable structure of the interface between the subducting slab and the supra-slab mantle. Near the coast we also find mode-converted energy much later (about 20 sec behind direct P) than would be expected for conversion from the subducting slab surface. The large SH-polarized components of these phases, coupled with weak Moho conversions, suggest that they may be associated with features within the lithosphere, as opposed to being crustal multiples. Receiver functions obtained in the regions where we do not expect to see the slab - on the western coast as well as north of the junction - yielded a number of surprises. At most sites we find significant mode-converted energy between 10 and 20 sec after the direct P, implying strong impedance contrasts within sublithospheric upper mantle. A possible explanation is a remnant of the relatively short-lived subduction zone north of the Kamchatka-Aleutian junction. The western coast of Kamchatka is believed to contain a number of distinct terranes accreted together, with zones of contact likely to extend at depth.

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