MANTLE DYNAMICS AND SLAB RHEOLOGY CONSTRAINED BY NUMERICAL MODELING, STRUCTURAL AND SOURCE SEISMOLOGY

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Abstract

Subducting lithospheric slabs coupled to surface plates exert a pull force that contributes to plate motions. In the upper mantle, flow induced by slab density exerts tractions on the base of plates that further contribute to surface motions. Together, these forces act to make subducting slabs the main driving force for plate tectonics. However, our fundamental understanding of the fate of subducted slabs once they enter the upper mantle at convergent plate margins is limited by the scarce observational signatures of the process. Laboratory and numerical modeling of subduction dynamics have significantly advanced our understanding of deep earth processes. The key for validating geodynamic models is the comparison of synthetic results to observations. Our goal is to use observations to generate quantitative constraints on the rheology of subducting lithosphere and the upper mantle and to understand how the interaction between the two may be reflected in surface tectonics.

As deformation within subducting slabs in the upper mantle is accommodated by seismic strain release, seismicity has become the main observational tool in understanding subduction dynamics. Seismic tomography, shear wave splitting, geodetic observations, and surface tectonics also provide additional observations with which we can constrain our geodynamic models. Our goal is to utilize a variety of observations to construct a global geodynamic model that most closely accounts for the observations. We then adapt our general model for regional applications.

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