



Along-strike and along-dip segmentation of subduction zones: Control of plate structure and geometry on segmentation and seismicity

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Convergent plate boundaries around the globe show a high degree of structural complexity and variability in site-specific geometry and mass flux. The heterogeneity in the structural evolution, the interior regime as well as external architecture of individual margins is reflected in their seismic character, resulting in a segmentation along-strike as well as along-dip. Subduction zones generate more than 80 percent of global earthquakes above magnitude 8.0, but rupture characteristics are highly individual and linked to margin specific geometrical conditions. Major segments of subduction zones are commonly submerged in deep water and difficult to access at the majority of margins. Marine geophysical techniques, which are able to image the complex structures in these settings with sufficient coherency and depth penetration, have proven crucial to improve our knowledge on the geological framework of the different types of subduction zones. Field data from different margins around the globe deliver images of the seafloor and subsurface in unprecedented resolution, which show segmentation to be far more complex than previously inferred. Along-strike segmentation results in accretionary segments contiguous to erosive segments along a single margin. Modes of mass transfer must hence be viewed as transient processes dependent on sediment supply and lower plate structure. Along-strike segment boundaries commonly correlate with underthrusting lower plate relief that controls the deep deformation of a subduction zone and the spatial and temporal variation in slip behavior. Examples of underthrusting oceanic basement relief at different stages of subduction elucidate their impact on the inner geometry of the margin. Lower plate heterogeneities occur at subduction zones worldwide and thus pose a common phenomenon, whose role as barriers to seismic rupture constitute a central control on subduction zone seismicity and segmentation.