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Structural development of the North-Sumatran Accretionary Prism

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The accretionary prism of northern Sumatra differs from classical prism examples in a number of ways. It consists of an almost flat, up to 130 km wide plateau and a small but steep outer wedge. Along its entire width from the deformation front to the rear of the prism it is composed of multiple, up to 5 km thick undeformed blocks of layered sediments that are adjacent to seismically chaotic units. The intact thrust blocks are the same thickness as the 5 km thick incoming sediment section and are usually bounded on both sides by steep landward and seaward vergent faults. Similar sedimentary blocks, bounded by conjugate normal faults that relate to bending of the subducting oceanic plate, are also observed in the incoming section. Another striking structural feature is the occurrence of landward vergent (seaward dipping) thrust faults in the outer prism. These unusual deformation structures differ from the common fold-and-thrust belt model in the dip direction of the thrust sheets and have, to a similar extent, only been reported from the Cascadia margin. Seismic reflection data also image a series of high-amplitude negative-polarity reflective faults in the prism and the incoming sediment section that only produce minor displacements. These faults do not intersect the seafloor or the plate-boundary at depth and dip both landward and seaward at a lower angle than most prism thrust faults. We use a combination of reflection seismic and bathymetric data to investigate the parameters and processes that lead to the development of the unusual prism structure and morphology. In addition to detailed structural and morphologic descriptions we summarize and compare fault dips in the incoming section and the prism in order to analyse how proto-deformation of oceanic plate sediments influences the structural development of the prism. We present a conceptual model in line with our observations that could be transferable to accretionary margins with a similar geologic history, that is continuous accretion of thick sediment packages over tens of millions of years.