Geophysical Research Abstracts
Vol. 13, EGU2011-6609, 2011
EGU General Assembly 2011

Mechanics of formation and evolution of Forearc basins

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In this study, the mechanics of forearc basins will be the object of a numerical investigation to understand the relationships between the wedge deformation and forearc basin formation. The aim of this work is to gain insight into the dynamics of the formation of the forearc basin on top of a deforming accretionary wedge, including the mechanism of formation of accommodation space and preservation of basin stratigraphy. Our tool is a two-dimensional numerical model that includes the rheological properties of the rock, including effective internal friction angle, effective basal friction angle, thermally-activated viscosity and strain softening. We also simulate different sedimentation rates in the basin, to study the influence of underfilled and overfilled basin conditions on wedge deformation. The stratigraphy in the basin is simulated, because, as noted in earlier studies, underfilled conditions incourage tectonic deformation in the inner wedge. We compare the numerical model to basins along the Sunda-Java Trench and the Alaskan margin. The Sunda-Java Trench shows a variety of structural and basin styles including underfilled and overfilled basins and different wedge geometries along the same trench. We interprete and document these structural styles, using depth migrated seismic sections of the Sunda Trench, made available by the IFM-GEOMAR group in Kiel and the Bundesanstalt für Geowissenschaften and Rohsto[U+FB00]e (BGR) in Hannover. On the Alaska margin we focus on the Kenai Peninsula, Kodiak Island plateau. This segment of the margin has one of the largest accretionary wedge - forearc basin systems in the world. It also exhibits a double forearc basin system with an interior basin (Cook inlet) and an outer basin, outboard of Kodiak Island, which is a prime candidate for a negative-alpha basin, as described by Fuller et al., (Geology, 2006). A number of studies of the Alaska margin were conducted in the 1990s based out of GEOMAR. One important aspect of these margins is the presence of a dynamic backstop, characterized by older accreted material, that, although deformed during and after accretion, later becomes a stable part of the upper plate. We argue that, following critical wedge theory, it entered into the stability field of a wedge either by steepening or weakening of the underlying detachment. As a stable wedge, this older segment of the wedge acts as a mechanical backstop for the frontal deforming wedge. This dynamic backstop moves seaward in time, in response to isostatic loading by the growing wedge, or due to seaward retreat of the slab with a consequent steepening of the base of the wedge.