Geophysical Research Abstracts
Vol. 19, EGU2017-10823, 2017
EGU General Assembly 2017

Modelling Forearc Basin Formation and Stratigraphy

Utsav Mannu (1), Kosuke Ueda (2), Sean Willett (1), Taras Gerya (2), and Michael Strasser (3)

(1) Geological Institute, ETH Zürich, 8092 Zürich, Switzerland, (2) Institute of Geophysics, ETH Zürich, 8092 Zürich, Switzerland, (3) Institute of Geology, University of Innsbruck, A-6020 Innsbruck, Austria

Comparison of synthetic stratigraphy of forearc basins as generated in coupled plate subduction and accretionary wedge models to the stratal patterns observed for forearc basins in nature, could be used to ascertain the dynamic consistency of the interpreted deformational history of the wedge. Additionally, it could help us understand the emergence of stratigraphic patterns in forearc basins as an interplay between sedimentary flux and wedge dynamics. Here we present a simple methodology to generate synthetic stratigraphy by emplacing isochronal surfaces during the evolution of the wedge.

We use a dynamic 2D, high-resolution, thermo-mechanical, subduction model coupled to an adaptive irregular surface grid to model the free surface. In this model, we track basin stratigraphy developing in the wedge top basins atop the accretionary prism by emplacing lines of Lagrangian markers at discrete times along the upper surface of the model, which subsequently are buried, transported, and deformed according to the velocity field generated in the model. We conduct numerical experiments to identify the stratigraphic signatures of different forearc basin formation mechanisms. We also study the impact of hinterland and trench sedimentation on the wedge evolution and its impact on forearc basin formation.

Forearc basins that form on top of the overriding plate remain passive to the deformation history of the wedge. Forearc basins formed as negative alpha basins remain mostly undeformed. Forearc basins that form due to wedge stabilization exhibit landward tilting of strata with time. We also find that trench sedimentation enhances the landward tilting of the basin by shifting deformation landwards and potentially triggering out-of-sequence-thrust emergence/reactivation. Predicted stratigraphic features in our numerical models agree well with stratigraphic patterns observed in different types of forearc basins in the Nankai Trough, Sunda Strait and Lombok Basin offshore Japan, Java and Bali, respectively.