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Observations from Multibeam Bathymetry and Backscatter Data; Active Deepwater Fold Belts of East Indonesia

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Introduction

Eastern Indonesia is an extremely active tectonic region resulting in active mountain building and basin subsidence promoting vigorous depositional systems juxtaposed with actively deforming structural domains. East Indonesia is located on the eastern, leading edge of the Sunda micro-plate where it interacts with the Indo-Australia and Pacific plates in a complex distributed triple junction. The region is dominated by convergent and transform margins between shifting fragments of each of the plates. A recent marine hydrographic survey has provided a remarkable new data set imaging the interplay of structure and deposition in middle to ultra-deep water settings. With such outstanding imagery of both depositional and structural systems, we are afforded exceptional opportunities to observe the control of the structural systems on depositional patterns in situations that range from structure growth exceeding deposition, to the opposite where sedimentation outpaces deformation. Additionally we see a variety of structural styles in convergent systems, particularly at the leading edge, controlled by the pre-existing structural fabric of the converging sections, including inversion vs. virgin thrust propagation and variation in fold development related to thickness of deforming section.

Convergent Systems

We will review three convergent settings, one along the northern margin of the Indo-Australia plate where it is interacting with the Pacific, another in central eastern Indonesia in the Bird's Head of West Papua, and a third in the south where Australia converges with southeastern Indonesia.

Along the northern margin of the Indo-Australia plate a previously unknown active fold belt is crossed by several depositional systems. A variety of behaviors is apparent along the length of the fold belt. Where sediment input is low we see channels diverted and re-routed around uplifting anticlines. The general pattern is of fill and spill with channels incised at the spill point. There are also indications of drainage capture and one location where we see a mini-basin tilted by active structural growth. Moving along the fold belt, the structural style changes in part due to a thickened deforming section, and we find an area of rapid sedimentation burying the

fold belt. This behavior ranges from complete burial along the major axis of sedimentation to areas where deformation and sedimentation are more balanced away from the axis. Features along the margin include faulting of the depositional apron and uplift and abandonment of channel systems. Additionally there is an instance where a structure uplifted and diverted the main depositional axis.

In the central region of the Seram Trough a convergent zone between the Bird's Head and Seram Island is present. The resulting fold and thrust belt is imaged over about 650kilometers along the deformation front. The structural style varies considerable over the length from apparent orthogonal convergence to areas dominated be strike-slip faulting. Particular features of interest are oblique strike-slip faults crossing the fold belt, large angle changes in the orientations of fold structures over short distance along the fold belt as well as major textural variations believed to be related to changes in depth to the detachment faults or variations between thin and thick-skinned folding.

In the southern region, the convergence between Australia and the islands of Timor and Tanimbar is imaged. Here the convergence is relatively simple however the resulting structures still show considerable variance over the length of the imaged compressional zone. Inversion of northwest shelf Australian normal faults dominates in one region which is separated abruptly from an area of completely different structural character, a more chaotic disorganized compressional zone. Depositional features are minimal in this deformation zone, allowing un-impeded viewing of the structural orientations.

Discussion

Through presentation of a variety of deep-water fold belt morphologies across eastern Indonesia, we hope to explore the variable nature of deep-water fold systems with particular emphasis on the rapid lateral variability observed. Additionally, with focus on the northern fold belt, we hope to explore the patterns of observed relationships between active depositional systems and actively deforming fold belts. The concept of fill-spill-drain should be discussed as the patterns observed on the modern seafloor suggest a series of ponded deposition with adjustment of base level as mini-basins are filled to spill which results in incision of the previously filled basins. This concept will be supported by a brief look at a fourth fold belt in the Makassar Strait.