Tectonic relaxation and the development of cross fold in the Singhbhum Proterozoic mobile belt: Insights from physical and numerical model experiments

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Mobile belts are generally characterized by deformational structures of multiple generations, indicating complex spatial and temporal evolution of the strain fields. These deformed terrains show interference patterns indicating superposition of structures striking transverse to the orogenic trend which leads to the development of cross folds in mobile belts. Despite significant work on cross-folding, it is still not well understood how horizontal shortening can develop regionally along the trend of an orthogonal convergent belts. Our present work deals with the spectacular cross-folds in the eastern flank of the Singhbhum Proterozoic mobile belt.

This study uses three-dimensional continuum models to address the long-standing question: what is the tectonics of regional scale cross-folds with axial planes transecting the orogenic trend? Physical experiments were conducted with PDMS (Poly dimethyl siloxane), a Newtonian viscous material under lower strain rate of deformation. We propose that the belt underwent orogen-parallel flow during tectonic relaxation, developing orogen-parallel shortening, as observed in analogue models. This gravity-driven flow appears to be potential factor for cross folding in orogenic belts. In order to substantiate the deformation of analogue models, the horizontal shear stress was mapped in FE models. This reveals a distinct zone of shear stress localization in the eastern flank. Model results suggest that the arcuate belt is likely to show deformations by large horizontal shear at the flank of the model. This prediction agrees to the observations from analogue models. In order to study the large scale three-dimensional flow pattern, velocity vectors are plotted in the model. The vector diagram shows that the material flow does not take place orthogonally to the orogenic trend, while at the NE margin the flow direction is parallel to orogenic trend, resulting in the development of cross folds in Singhbhum mobile belts.