Geophysical Research Abstracts
Vol. 14, EGU2012-6539, 2012
EGU General Assembly 2012

Plate deformation at the transition between collision and subduction: insights from 3D thermo-mechanical laboratory experiments

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3-D thermo-mechanical laboratory experiments of arc-continent collision investigate plate deformation at the transition between collision and subduction. Deformation in the collision area propagates into the subduction-collision transition zone via along-strike coupling of the neighboring segments of the plate boundary. The largest along-strike gradient of trench-perpendicular compression produced by a passive margin turning by 90 degrees does not generate sufficiently localized shear strain in the transition zone to cause a strike-slip system. This is because of the fast propagation of lithosphere failure in the arc area. Deformation is thus continuous along-strike, but the deformation mechanism is three-dimensional and progressive structural variations arise because the coupling between neighboring segments induces either advanced or delayed failure of the arc lithosphere and passive margin. During the initial stage of collision, the accretionary wedge is partially subducted, the interplate zone is lubricated, and shear traction drops. Thus large convergence obliquity does not produce a migrating fore-arc sliver. Instead, the fore-arc motion is due to the pressure force generated by subduction of the buoyant continental crust. It follows that convergence obliquity does not yield trench-parallel deformation of the fore-arc and its influence on the collision process is limited. However, convergence obliquity may have shaped the active margin during the stage of oceanic subduction stage, prior to collision, and inherited structures may impact the propagation mechanism.