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# Onset of Slip Partitioning under Oblique-Convergence within Scaled Physical Experiments

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Oblique convergent margins host slip partitioned faults with simultaneously active strike-slip and reverse faults. Such systems defy energetic considerations that a single oblique-slip fault accommodates deformation more efficiently than multiple active faults. Previous experiments in dry sand demonstrate that strike-slip faults can develop after bi-vergent thrusting but the processes that foster two slipping faults rather than one remain elusive. Some slip partitioned systems may develop at margins that previously accommodated transform deformation; the vertical fault cannot accommodate contraction so that growth of a new thrust fault results in slip partitioning. We use scaled experiments within wet kaolin combined with digital image correlation techniques to map deformation at the onset of slip partitioning in low convergence (< 30˚) experiments with and without a pre-existing vertical weak plane.

The suite of experiments reveal three styles of slip partitioning development controlled by the convergence angle and presence of a pre-existing weakness. The first style (Type 1) observed in the low convergence angle experiments (5°) produce strike-slip faults prior to reverse faults regardless of whether the fault is precut or not. For higher convergence angle experiments 10°, 15°, 20°, 25°, 30° (precut and uncut), the presence of a pre-existing crustal weakness controls the sequence of slip partitioning. In these experiments, a primarily reverse fault forms first. Subsequent slip partitioning develops either with the initiation of strike-slip along the precut surface (Type 2) or with growth of a second dipping fault outboard and more shallowly dipping than the first fault where the slip on the first fault transitions to strike-slip (Type 3). Within both Type 2 and 3, slip on a new thrust fault produces extension within the hanging wall that facilitates strike-slip along the either precut or the older thrust fault. For experiments with convergence angle $\geq$ 10˚, the relative angle of convergence controls the relative timing of slip partitioning development (higher convergence angles partition earlier) but not the sequence of faulting leading up to slip partitioning.

The Type 1 and 2 both produce stable slip partitioned systems similar to crustal faults at oblique convergence subduction margins. In contrast, the slip partitioning of type 3 develops in limited areas, involves similarly vergent and closely-spaced faults within the thrust wedge (rather than one fault within the upper plate). Type 3 of these experiments resemble stage 2 deformation within previous dry sand experiments that show oblique slip within the thrust belt prior to strike-slip development. The new experimental results lend support to the model that slip partitioned fault systems in oblique convergence margins can develop from initially transform systems upon increasing obliquity of convergence. The experiments do not rule out the development of slip partitioning at margins with higher initial convergence where growth of a strike-slip fault may be facilitated by magmatic weakening of the upper plate. In fact, strain patterns in these experiments show abundant extension in the upper plate, that would facilitate strike-faulting if either weakening mechanisms representing magmatism had been simulated or greater strain applied.