The influence of upper plate tectonic inheritance in the southern Taiwan arc-continent collision

*Jonathan C Lewis[1]

1.Indiana Univ Pennsylvania

Seismogenic strain inversions offshore SE Taiwan suggest that the Luzon forearc is detached from the Philippine Sea Plate (PSP) creating a forearc sliver. Both the origin and the fate of the forearc sliver remain unresolved, although tomographic work suggests that it exists at depth in the suture zone of the Taiwan orogen. I suggest this forearc material might play a role in the geodynamics of the collision. Recent studies of seismogenic strain, metamorphic fabrics and brittle deformation in the southern Taiwan mountains reveal non-recoverable strain patterns that are difficult to understand in the context of the ongoing collision. In spite NW motion of the Luzon volcanic arc at ~80 mm/yr relative to the Eurasian passive margin, the dominant expression of seismogenic strain and brittle faults is NE-SW maximum principal stretching. Extension is at a high angle to the PSP convergence vector and at a low angle to the strike of the slate and schist that dominates the southern Central Range. The stretching is expressed in inversions of focal mechanisms as preferred nodal planes with steep WSW and ENE dips accommodating normal motion, and as near vertical preferred nodal planes accommodating strike slip motion. These structural geometries are focused where peak temperature proxies reveal maximum temperatures, and leveling data reveal short-term uplift rates at their highest. To date, nearly all studies of the southern Central Range have sought to explain the uplift history and thermal structure in profiles constructed normal to the strike of the range. The predominance of structures accommodating NE-SW stretching suggests the possibility that crustal thinning and strike slip are playing a role in bringing metamorphic rocks to the surface. If this is correct, the rocks very clearly record non-plane finite strain and it is important to examine profiles constructed at high angles to the dominant strike of these structures (~N15W). Recent unpublished Ar-Ar ages suggest that these kinematics may be relatively young. In the Yuli belt, just west of the Longitudinal Valley, and in the easternmost slate belt the youngest metamorphic foliations generally dip shallowly and are marked by stretching lineations that plunge gently NE to NNE. Preliminary crystallization ages for minerals defining these fabrics are ~1 Ma. Importantly, the Yuli belt includes mantle-derived, high-pressure metamorphic blocks that tomographic, seismic and petrophysical data suggest are connected to their source at ~40-50 km by an east-dipping seismic (high) velocity anomaly. Exhumation of mantle-derived, high-pressure metamorphic rocks from such depths in a subduction channel would not necessarily predict shallow plunging stretching lineations. The relation between the shallow plunging stretching direction and the recrystallization depths for these rocks therefore remains an important question. It is possible that the shallow fabrics are a relatively recent transpressional overprint superimposed on a longer history of updip subduction channel flow. The influence of a tectonically buried forearc sliver is also important. The rocks of the forearc sliver may in effect form the leading edge of the Luzon volcanic arc backstop, making them a viable source for the high-pressure mantle rocks now at the surface in the Yuli belt. In addition to hosting a putative subduction channel marked by a coherent seismic velocity anomaly, this part of the collision is noteworthy for a voluminous aseismic zone that appears to reach the Earth surface in the Central Range east of the Yuli belt. Seismogenic strain in the rocks that span this enigmatic shoaling of the brittle-ductile transition varies systematically, suggesting a relatively strong contrast in rheology. Establishing the nature and origin of this aseismic volume will likely shed light on the geodynamics of the Taiwan arc-continent collision.

Keywords: Taiwan, seismogenic strain, collision, exhumation, normal fault

