Exhumation and deformation partitioning in an arc-continent collision during highly oblique plate convergence ~6 to ~2 Ma, Taiwan

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New low-temperature thermo-chronological and structural data from the Slate and Tailuko Belts integrated with previously published data suggest strain partitioning with contemporaneous exhumation during highly oblique plate convergence in Taiwan.

Deformation partitioning is recorded in the Slate and Tailuko Belts by the contemporaneous development of markedly different deformation histories. For example, the Slate Belt is characterized by regional-scale upright to overturned folds that typical verge northwest. Penetrative strain is marked by a well-developed cleavage (S1) with a down-dip stretching lineation (L1) and incremental strain markers record a top-to-the north-west sense of shear (Clark et al., 1992; Tillman and Byrne, 1995). In contrast, the Tailuko Belt is characterized by regional-scale isoclinal folds with a steep to moderately northwest dipping axial planar cleavage, S2, and a stretching lineation that plunges gently northeast. Asymmetric structures associated with S2 and S2-related mylonite zones consistently show a top-to-the left sense of shear. Contemporaneity of the deformation in the two belts is suggested by two geochronologic studies. A recent 40Ar/39Ar study of synkinematic mica porphyroblasts associated with develop to the Slate Belt in the Hsuehshan Range shows growth during a protracted period lasting from ~6.0 to ~2.5 Ma (Chen et al., 2016). In a separate 40Ar/39Ar study of an S2 mylonite zone in the Tailuko Belt, Wang et al. (1998) argued that recrystallized biotite in the mylonite grew below the closure temperature for biotite to argon. They proposed, therefore, that the plateau and isochron ages, ranging from 4.1 to 3.0 Ma, recorded the time of mylonite formation. The different strain patterns, and their apparent contemporaneity, argue for partitioning into orogen-normal (Slate Belt) and orogen-parallel (Tailuko Belt) components, consistent with proposed oblique convergence of the Philippine Sea (i.e., Luzon arc) wrt Eurasia in the Pliocene.

Age-elevation transects (AET) from the Slate and Tailuko Belts are also consistent with strain partitioning although the two belts record markedly different exhumation cooling histories. For example, new AETs from the Hsuehshan and southern Central Ranges, based on both new and previously published fission track and (U-Th)/He dates of completely reset detrital zircon grains, indicate moderate rates of cooling ~6 to 2 Ma (rates of ~1.1 to 1.5 mm/yr) and are consistent with a previously published AET from the Slate Belt exposed at Mt Yu (Hsu et al., 2016). In contrast, previously published AETs from the Tailuko Belt in the eastern Backbone Range indicate significantly slower rates of exhumation cooling (rates of ~0.1 mm/yr) during the same time period (Hsu et al., 2016).

We propose that the different rates of exhumation cooling reflect fundamentally different tectonic processes and that both regimes relate to deformation partitioning along the margin during oblique convergence in the Pliocene. That is, in the Tailuko Belt, where along-strike stretching argues for little change in crustal thickness, rates of exhumation cooling are extremely low. In contrast, in the Slate Belt, where down-dip stretching suggests crustal thickening, rates of exhumation cooling are significantly higher.

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