

Metamorphic peak-temperatures and orogenic exhumation of an inverted passive margin: preservation of pre-orogenic peak-metamorphic conditions in Taiwan and Palawan islands (The Philippines)

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We present new zircon fission-track age and RSCM peak-metamorphic temperature estimates from the northern Taiwan slate-belt and northern Palawan. The two regions represent the conjugate margins of the South China Sea that have undergone inversion during two separate collisional episodes, from the latest Miocene until present-day (Taiwan) and in the Middle Miocene (Palawan). In both regions the slate/phyllite and (meta-) sandstone stratigraphic successions have undergone sub-green-schist to green-schist facies peak metamorphic temperatures with a consistent positive correlation between stratigraphic age and metamorphic grade. A similar pattern is observed in the resetting degree of ZFT-ages, with shallow stratigraphic levels displaying unreset to partially-reset ZFT ages, while older strata exposed at the core of regional anticlines are fully reset. Importantly, ZFT young-peak ages (i.e. pooled age of the youngest ZFT grain-age population) and fully reset ZFT-ages are consistent within error, and constrain the initiation of rock cooling and exhumation to 5.9 ± 1.5 Ma (weighted mean of 6 pooled ages) in the section studied in the Northern Hsuehshan Range (Taiwan), and to 14.7 ± 0.5 Ma (weighted mean of 7 pooled ages) in Northern Palawan. Taken together our data indicates that peak-metamorphic conditions in both regions were reached before the main exhumation event and precede thrust-stacking and topographic growth. Metamorphism is possibly related to basinal evolution (“burial metamorphism”) during the opening of the South China Sea or to some other tectonothermal events likely unrelated to the late Cenozoic mountain building processes. Our findings have important implications for the commonly assumed orogenic origin of low-grade metamorphic belts, as this assumption is implicitly included in the tectonic evolutionary models of orogenic development and in models of orogenic gold deposits typically found in slate belts, to name a few.

Keywords: Slate belt; Hsuehshan Range; Palawan collision; burial metamorphism; passive-margin inversion; thermochronology; ZFT-young peak age; RSCM peak-metamorphic temperatures