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Exhumation process and extension during collision initiation: Taiwan

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Rapid exhumation of mountain ranges (typically 10-15 km of crust exhumed in 1-2 Myrs) is usually attributed to a combination of factors including feedbacks between modes of accretion in the crust, e.g. localized accretion of high metamorphic grade units by underplating, off-sequence thrust faults and/or ductile flow in the deep crust, and high erosion rates boosted by climate and morphological processes. Syn-orogenic (orogen-parallel or orogen-perpendicular) extension is often associated with such fast exhumation processes. However, the relative of role of plate kinematics versus the architecture of the deformed continent is generally obscured by poorly-resolved spatial and temporal orogenic evolution. Here we study the case of the Taiwan orogen where the overall collisional processes from immature offshore submarine accretion of the South China Sea margin to post-collisional extensional collapse of high mountains is ongoing and can be studied onshore. Taiwan results from the collision between the Philippine volcanic arc and the Eurasian rifted margin.

The study focuses on low-grade metamorphic (T < 350°C) syn-/post-rift metasedimentary cover outcropping in the Backbone Range schist belt (originally Eocene and Miocene sandstones and shales deposited in shallow to deep marine environments on hyperextended rift domain) in contact with high-grade metamorphic basement (T > 550°C) of the Tailuko belt and Yuli belt in the Central Range. Miocene metasediments of the eastern Backbone Range near the contact with higher grade rocks show dominant simple shear deformations that contrast with stratigraphically younger Miocene units of the western and southern Backbone Range showing dominant pure shear deformation. The measurements of foliation-bearing lineations indicate a systematic top-to-the-SW shear. In addition to ductile deformation, faulting is also observed next to the contact area that indicates strike-slip movements associated with normal top-to-the-SW shearing. In order to best constrain the nature of the contact in the eastern Central Range, an RSCM study was used to obtain maximum temperature (Tmax) values. The cover units in this transtensional deformation zone reached Tmax of 320-400°C, whereas they are below 320°C in the remainder of the cover metasediments. In this transtensional area, chlorine-mica pairs crystallized in chemical equilibrium parallel to the NE-SW lineation. From thermodynamic modeling of chlorite-mica equilibriums we resolve a the first P,T estimates for the Miocene unit at 5 $\pm$ 1 kbar and 320-400°C.

Results are then integrated in a three-dimensional geological model of this area showing relationships between the deformation pattern and exhumation of the higher-grade metamorphic units. We emphasize that the rapid exhumation of the Central Range occurred, and is still ongoing, as a result of the strain partitioning in a regional-scale sinistral strike-slip domain along the suture zone between the Philippine volcanic arc and the Eurasian margin. Extension reflect accommodation of a NE-SW stretching parallel to the chain and a predominantly top-to-the-SW kinematic, accommodating part of the rapid exhumation of high-grade units from below the Miocene cover, in the last 1-2 Ma.