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Exhumation and Shortening during the Taiwan mountain building: insight from 2D thermomechanical modeling

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Taiwan orogen has long been regarded as a case example for studying exhumation and erosion processes in association with mountain building. We present here a new fully-thermo-mechanically and thermo-dynamically coupled model for cooling and exhumation of rocks in Taiwan, in which the shortening of the underthrusted Chinese margin produces an upward flow of lower crustal material below the upper crust. Our model, based on a realistic viscous-elastic-plastic rheology, satisfactorily reproduces available thermo-chronometric data, long-term and short-term deformation patterns, heat flux, erosion/sedimentation distribution as well as geological observations over the past 5 Myr evolution of the Taiwan mountain belt.

The crustal flow model allows the decoupling between the upper and the lower crust within the orogenic wedge itself. As such it is successful in reproducing FT ages in the Backbone Range older than in the adjacent Tananao Schist and Hsuehshan Range, long-term exhumation of the Tananao Schist and decoupling with the Backbone Range or recent concentration of shortening, uplift and propagation of deformation in the Western thrust belt in the past 1 Ma. Our interpretation of the results of modelling of P-T conditions illustrates that the rocks of the Central Range mainly inherited their peak temperatures and pressures in the stable Chinese margin. Moreover, we show that a fast plate convergence associated with high erosion rates and the presence of

a weak lower crust are both required to reproduce the deformation and exhumation patterns. Our model supports the earlier thick-skinned deformation hypotheses, for which the whole crust, at least its the upper 24 km, should be involved in the collision process. As such the model provides a reliable thick-skinned alternative to the thin-skinned duplexing model. Finally, our thermomechanical model further agrees with the idea that the hot/young and buoyant Chinese continental margin should be hardly subducted beneath the cold/old and dense oceanic plate of the Philippine Sea.