Oblique convergence, indentation and bivergent tectonics in Taiwan: insights from field observations and analog models

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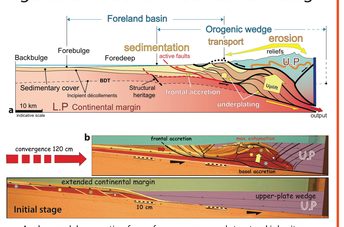
abstract

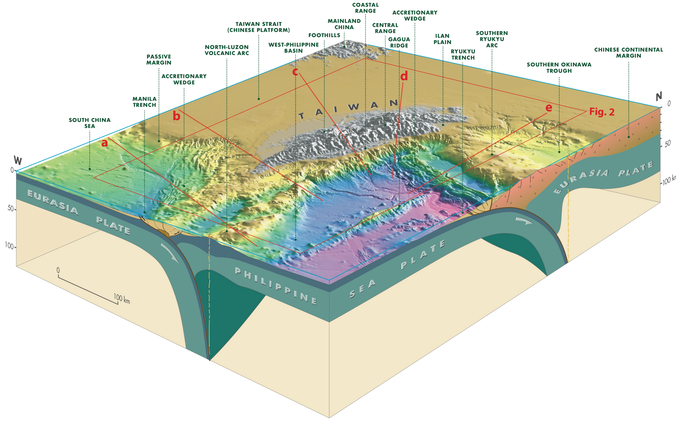
In Taiwan today, the subduction of the Chinese continental margin under the Philippine Sea plate results in the progressive growth of an active orogenic wedge. It is one of the best places to study the complex relationships that occur between the tectono-metamorphic processes controlling deformation (plate rheology and kinematics) and surface processes (erosion and sedimentation). In the Central Range of Taiwan, foliation and lineation traces outline the geometry and kinematics of deformation in both, the foreland and hinterland of the orogenic wedge. The foliation dip and the strain ellipsoids distribution show the fan shape of a large pop-up structure characterizing the 3D effects of oblique convergence, indentation and roll-back tectonics. On the eastern flank of the mountain range, regionally developed penetrative cleavage dips, isotope data and sedimentary structures demonstrate regional rollback structures. Two mélange units, the Kenting and Lichi mélange are exposed at the south and east of the Central Range respectively. We present the results of 2D and 3D sandbox models designed to investigate the complex deformation characterizing the active Taiwan orogenic wedge. Experiments allow the study of interactions between tectonics and surface processes, accounting for various boundary conditions and parameters such as sedimentation, erosion, basal friction, and décollement level. They account for the development of those mélanges and bivergent structures. We then characterize the exhumation patterns, the rotation of foliation and stretching lineation and the displacement patterns induced by strain partitioning in the orogen.

A generic model for Mountain building

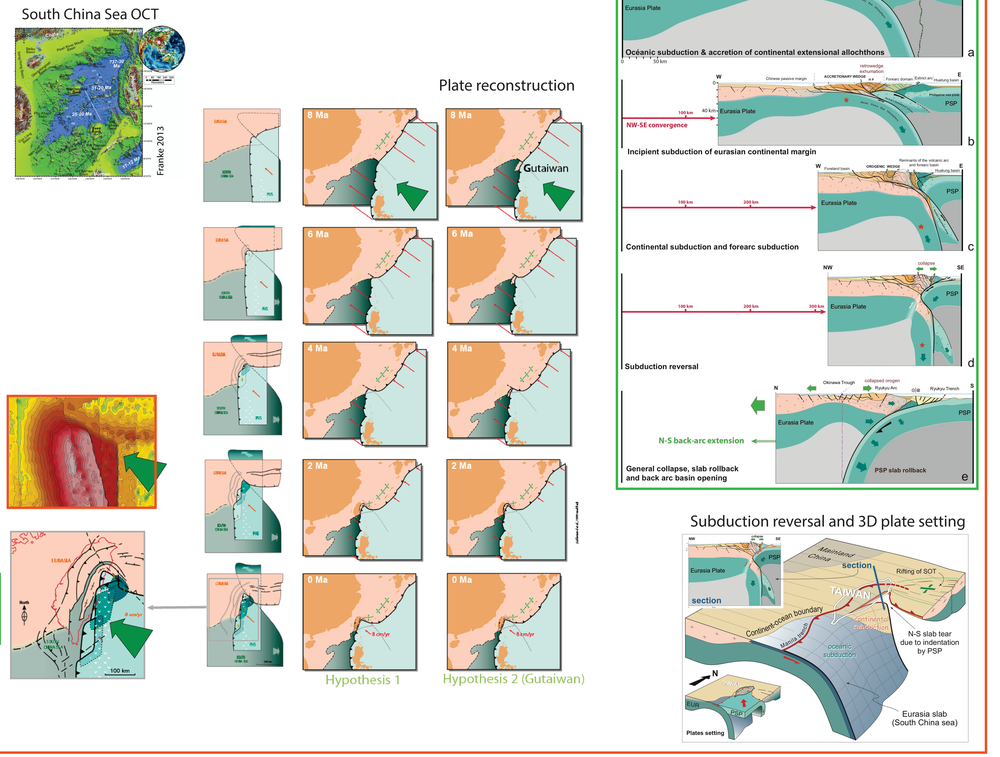


Analog model accounting for surface processes and structural inheritance

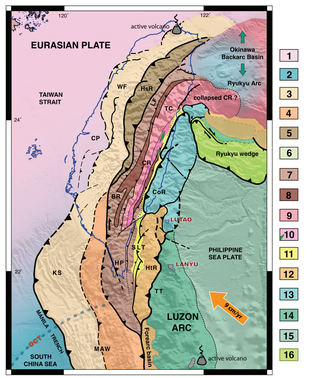
Geodynamic setting of the Taiwan orogenic belt

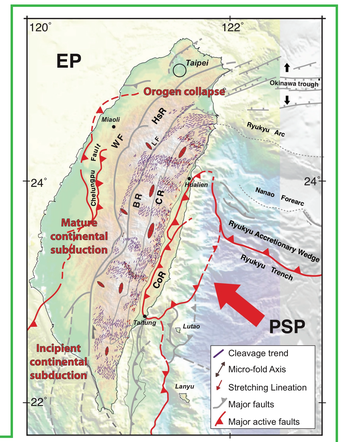


Evolution of the Taiwan orogen during indentation by the Philippine sea plate

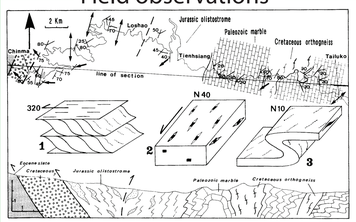


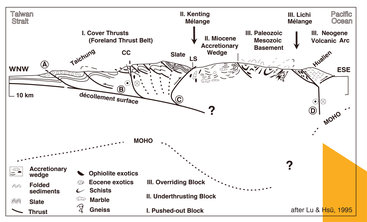
The main tectonic units



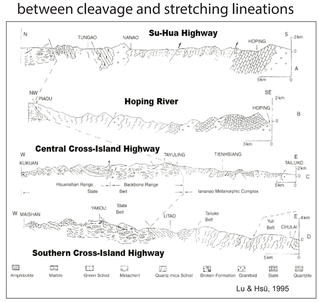


Field observations

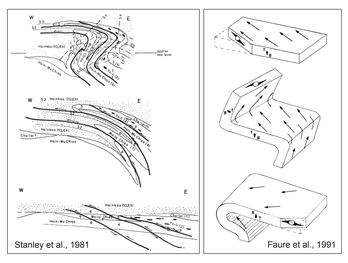




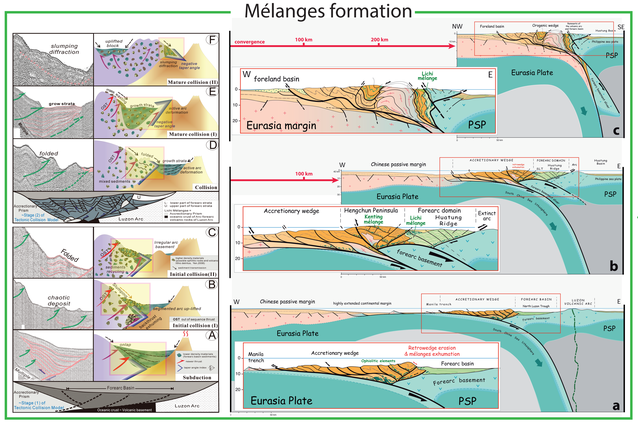
Cross sections showing the relationships between cleavage and stretching lineations



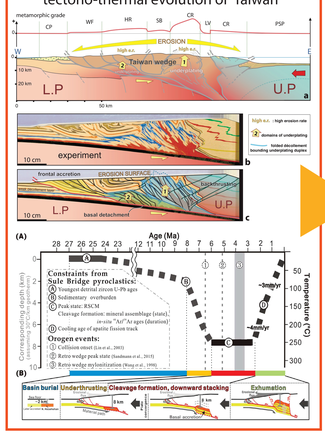
Two models for the shape and evolution of strain



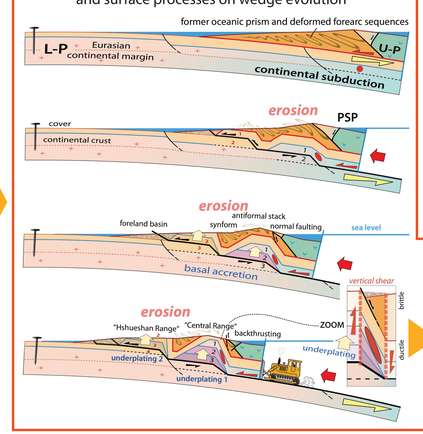
Mélanges formation



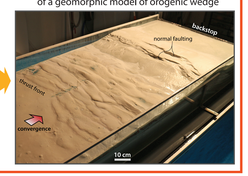
Impact of underplating on the tecto-thermal evolution of Taiwan



Impact of crustal rheologic layering and surface processes on wedge evolution



Synconvergence normal faults in the hinterland of a geomorphic model of orogenic wedge



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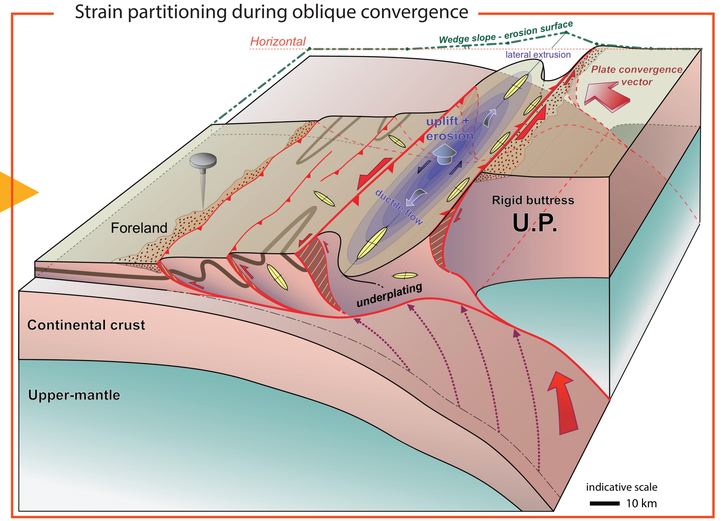
Strain partitioning during oblique convergence