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Neotectonics of Taiwan: insight from 2D and 3D sandbox experiments

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In Taiwan today, the subduction of the Chinese continental margin under the Luzon arc results in the progressive growth of an active orogenic wedge. It is one of the best places to study the complex relationships that occurs between the tectonic processes controlling deformation (plate rheology and kinematics, metamorphism and magmatism) and surface processes (erosion and sedimentation). In the Central Range of Taiwan, foliation and lineation traces outline the shape of both, the foreland structure and relative backstop of the orogenic wedge. The foliation dip and the strain ellipsoids distribution show the fan shape of a large pop-up structure characterizing the effects of plate convergence. On the eastern flank, regionally developed penetrative cleavage dips gently toward the east. Stretching lineations defined by phyllosilicates lie approximately parallel to the axes of regional folds with varying trends from northeast to east. Geometry of strain shadows indicates that (a) extension directions changed from along-strike toward down-dip and (b) top-to-the southwest or west shearing occurred in the direction of along-strike. The orogen-parallel shearing determined in the hinterland side, which is different from the orogen-perpendicular thrusting observed in the western flank of the Central Range (the foreland side), has to be related with strain partitioning induced by the oblique plate-convergence. In order to study the kinematics of the present day convergence of Philippine Sea plate to the Asian continent around Taiwan, we perform 2D and 3D sandbox modeling and we analyzed the models with PIV (Particle Image Velocimetry) software. In 2D experiments, a model Coulomb wedge is submitted to erosion and sedimentation under topography and flux steady state conditions. The 3D experiments are mainly used to study the escape tectonics occurring in the middle west and southwest Taiwan. A wedge shaped indenter and a basement relief were used to simulate the mechanical plate boundary between

Philippine Sea plate and Eurasia plate and the basement topography to the west of Taiwan respectively. We examine the exhumation patterns, the mode of fault propagation and displacement patterns by strain partitioning of vertical vs. horizontal displacement and convergent parallel vs. orogen parallel components. The preliminary conclusions are: 1. The interactions between tectonics, erosion and sedimentation control geometry and kinematics of the doubly vergent transpressional orogen. 2. Exhumation processes are controlled by the balance between erosion, frontal accretion and underplating in different structural domains of the wedge. 3. Retrowedge erosion favorites backfolding and backthrusting, induces flower structures and fan shaped cleavage distribution. 4. Sedimentation promotes underplating and out-of sequences thrusting. 5. Structural heritage (normal faults or topographic relief) controls inversion of sedimentary basins during wedge growth.