Geophysical Research Abstracts
Vol. 20, EGU2018-15356, 2018
EGU General Assembly 2018

Subduction polarity reversal and its influence on mountain building – the Taiwan example and its application to the Alps

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Subduction zones are major drivers of plate motions, govern much of Earth's topography and influence the architecture of mountain belts. Seismic tomography and geologic evidence suggests that subduction zones can switch polarity, by having the overriding and subducting plates switch roles over time, with the polarity reversal propagating along strike of the plate boundary. Seismic tomography and geologic evidence suggest that subduction zones change polarity as the overriding and subducting plates switch their roles either in time (at a given location) or space, along the strike of a convergent plate boundary (at a given time). Polarity reversals have been suggested in the geological record at a number of locations, including the European Alps or Taiwan. However, the mechanism of polarity reversal remains debated, and different hypotheses have been put forward. Polarity reversals have been related to spontaneous flipping along a transform fault, propagating slab tear and breakoff, collision of two subduction zones, or propagating slab tear and rollback.

Plate tectonic reconstructions offer a tool to trace subduction polarity in time and space and test the different hypotheses. In this contribution we use the Taiwan orogen – a well-known example of past and present subduction polarity reversal that has been compared to the European Alps – to understand the influence of polarity reversal on the evolution of mountain building. We propose that the Mesozoic polarity reversal controls much of present day mountain building in Taiwan, including its foreland basin evolution. We compare this result with the foreland basin evolution of the European Alps, which we constrain by a compilation of new and published low-temperature thermochronology data. We argue that much of the Neogene uplift observed in the North Alpine Foreland Basin is the result of a mantle driver, possibly related to past subduction polarity reversal.