Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07489, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07489
EGU General Assembly 2008


# Conditions for growth of faceted spurs at normal-fault escarpments: insights from numerical modelling

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Faceted spurs are landforms frequently observed at normal fault escarpments. Footwall erosion is governed by fluvial incision, which generates fault-perpendicular valleys between the faceted spurs, whereas in situ diffusion smooths the scarp face. The rate at which the fault plane is exhumed and the amount of topography created depend on tectonic parameters such as fault velocity and dip angle. We developed a surface process model (SPM) that combines erosion and tectonic uplift to simulate the development of facted scarps under various tectonic and climatic conditions. For a chosen model grid spacing, we show that typical triangular facets exist for a large range of parameters that satisfy a simple relationship between fluvial erosion and diffusion. Within this range of parameters, the width/height (W/H) ratio of faceted spurs, as well as their mean slope appear strongly controlled by the diffusion coefficient, and by fault dip angle and velocity. The intensity of fluvial erosion, and hence controlling factors such as runoff and rainfall, does not appear to be critical in controlling facet morphology. This might explain why faceted scarps occur on all continents and in a wide range of climatic environments. Finally, with similar climatic and tectonic parameters, model grid spacing also influences the resulting facet shape: a tighter grid will produce a larger W/H ratio than a wider grid. We use these generic results to model the development of faceted spurs along the Wasatch fault, Basin and Range, USA, and test model outputs against appropriately scaled digital elevation grids of the mountain front area.