California State University-Fresno

Environmental Sciences Seminar Series
Presents:

4D Evolution of step-overs along strike-slip faults: Migration with respect to affected deposits, local versus far-field tectonic inversion and other implications

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Thursday, December 1st at 1 p.m in McLane 277A

Abstract

Traditionally geologists have viewed step-over regions as progressively increasing in structural relief with increasing slip along the principal displacement zones (PDZs). In contrast, some step-over regions appear to migrate along the strike of the PDZs with respect to deposits affected by them, leaving a "wake" of formerly affected deposits trailing the active step-over region. Such step-overs generate comparatively little structural relief at any given location. For restraining bends of this type, little exhumation and erosion takes place at any given location. Another characteristic of migrating step-overs is local tectonic inversion that may migrate along the strike of the PDZs. This is most easily observed for migrating releasing bends where the wake is composed of former pull-apart basin deposits that have been subject to shortening and uplift. This type of basin inversion occurs along the San Andreas fault wherein the wake is affected by regional transpression. Along a neutral transform margin, similar basin inversion may occur as a result of the interaction of a migrating restraining bend with the wake of a releasing bend, or simply as a result of 4D crustal accommodation of the migrating releasing step-over. This type of inversion contrasts markedly with "traditional" inversion that has been ascribed to far field changes in tectonic regime. Migrating step-overs may evolve by propagation of the PDZ on one side of the step-over and shut off of the PDZ on the other side. This process is the progressive asymmetric development of a strike-slip duplex. Examples of migrating step-overs are present along the northern San Andreas fault system at scales from meters (sag ponds and pressure ridges) to tens of km (large basins and transpressional uplifts). Migrating step-overs and the "traditional" step-overs may be end members of step-over evolutionary types, and ratio of wake length to the amount of slip along the PDZs during step-over development measure the "migrating step-over component" of a given step-over. Thus, for a "pure" migrating type, the wake length would be equal to or greater than the slip, whereas for a "pure" traditional type, there would be no wake length.