Geophysical Research Abstracts
Vol. 17, EGU2015-8014, 2015
EGU General Assembly 2015

The role of tropical cyclones on landscape dynamics in southern Baja California, Mexico based on Late Pleistocene-Holocene alluvial stratigraphy

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Region-wide alluvial records provide evidence that time-transgressive changes in climate can be a major driver of landscape evolution. Historically, landfall of eastern Pacific tropical cyclones in southwestern North America during the late summer and early fall provide the strongest storms that have demonstrated geomorphic impact on the landscape. The alluvial fan record of the southern portion of Baja California (Mexico) was investigated to determine if linkages exist between region-wide fluvial deposits and tropical cyclones. The regional distribution and Pleistocene to Holocene morphostratigraphy of alluvial fans has been established for the southern portion of Baja California with primary focus on the La Paz and San José del Cabo basins. Six discrete morphopedosedimentary alluvial units (Qt1 through Qt6) were differentiated across the region using a combination of geomorphologic mapping, sedimentological analysis, and soil development further reinforced with geochronology using radiocarbon, optically stimulated luminescence and cosmogenic depth-profiles. A first phase of regional aggradation began before $\sim$ 100 ka (Qt1) and culminated $\sim$10 ka (Qt4). After deposition of Qt4, increasing regional incision of older units and the progressive development of a channelized alluvial landscape coincide with deposition of Qt5 and Qt6 units in a second, incisional phase. All units are conformed of multiple 1-3 m thick alluvial packages deposited in upper-flow regime and representing individual storms. Aggradational units (Qt1-Qt4) covered broad (>2 km) channels in the form of sheetflood deposition while incisional stage deposits are mostly confined to channels of $\sim$0.5-2 km width. Continuous deposition of the thicker sequences is demonstrated by closely spaced luminescence dates in vertical profiles. In a few places disconformities between major units are evident and indicated by partly eroded buried soils. Analysis of historical terraces as part of the younger units incised into older fans show that deposition was accomplished by large tropical cyclone events. Older units feature the same sedimentological traits as these historical deposits. We interpret the whole sequence as indicating discrete periods during the Late Pleistocene and Holocene when climatic conditions allowed large tropical cyclone events that today are not expressed. These discrete periods can be associated with specific periods when (a) insolation at the Equator was at peaks determined by precessional cycles and (b) the Tropical Pacific might have shown a state similar to that currently displayed during El Niño events.