

Field data from the South Yuba basin, California reveal spatial patterns of transport and storage of hydraulic mining sediment that are considerably different than patterns in the Bear River reported elsewhere. Mountainous trunk channels of the South Yuba are eroded to bedrock with little evidence of sediment storage. Explanations for this contrast with the Bear River basin, where long-term sediment storage has been overwhelming, include channel gradient, catchment area, and differences in geomorphic history.

The timing of sediment transport in the Bear River has been dramatically different than predicted by Gilbert's *symmetrical sediment wave model*. Lack of main channel storage in the South Yuba suggests a sediment wave more similar to Gilbert's concept, although sustained storage and mobility of sediment in some tributary channels suggest that a *skewed wave model* is also appropriate to that basin. Thus, even in the type locale of Gilbert's model, sediment deliveries are skewed in respect to time. This temporal relationship is more subtle in the steep gorges of the Yuba basin, but differences with the Bear River are in degree not kind.

H52A-2 1330H

Aggradation and Degradation in Redwood Creek, Northwestern California, Over Three Time Scales.

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Aggradation and degradation spanning three time scales have been studied in the Redwood Creek basin. Floodplain sediments several thousand years old and up to 7.7 m deep were sampled by backhoe trenches and soil cores. Results from stratigraphic analyses and C14 dating suggest one floodplain rose about 1.3 m in 810 years (+/- 50y), through a minimum of 5 major episodes of flood deposition. Individual fining-upward flood deposits laid down between 3520 and 810 ybp range from 40 to 120 cm thick and have weak soil (A horizon) development. Deposits younger than 810 ybp are less than 40 cm thick and show little to no soil development, suggesting episodes of overbank flooding occur more frequently, but deposit less sediment than prior to 810 ybp. Modern (post-1950) flood deposits are limited spatially and average <10 cm/event. In contrast, over several decades, a similar amount of channel filling (1-2 m) occurred in steep tributaries in one flood event, but >70% was then removed in 5 to 10 years. Likewise, in the 1954 flood the main channel of Redwood Creek (area = 720 km², gradient = 1.4%) aggraded several meters in headwater areas. Channel cross section surveys show that subsequent erosion and transport of upstream flood deposits caused aggradation downstream during the last 14 years. The locus of aggradation shifted 6 km downstream in 9 years. Finally, on the scale of one high flow season, detailed topographic surveys show that fine-grained gravel 'sheets' 0.2-1 m high were deposited on gravel bars, raising the mean channel-bed elevation. These gravel 'sheets' are only found in reaches displaying recent aggradation. Although floodplain deposits provide a long-term record of sedimentation, they may not document significant short-term fluctuations in sediment storage and channel morphology due to landuse.

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Hydrologic and Geomorphic Characteristics of Landslide/Dam-Break Floods in the Cascade Mountains of Washington

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Extreme floods which occur episodically in confined valleys in the Cascade Mountains of Washington due to rapid erosion of landslide or debris flow dams can lead to degradation and aggradation of channels and valley floors. Peak discharges associated with landslide/dam-break floods in these terrain can exceed those of even long-recurrence interval runoff floods by one to two orders of magnitude. Recurrence intervals of dam-break floods may range between 10¹ and 10² years, and are partly controlled by the number of potential landslide and debris flow sites adjacent to confined valleys. Incorporation of large volumes of vegetative debris, including entire trees, by the flood increases the frictional resistance of the flow and leads to increased flood heights. Periodic damming of the flood by the debris may lead to flood surges. Landslide dam-break floods may encompass entire valley floors and generate extremely high shear stresses up to 2500 N/m². Erosional and depositional features resulting from the flood wave are controlled primarily by the geometry of the valley floor rather than the geometry of the channel. Erosion of sediment by flood waves may expose bedrock along channels and valley floors. Massive deposition of sediment and vegetative debris leads to formation of terraces, logjams and flood levees, including boulder berms.

H52A-4 1400H

Recent Hydrologic Changes in Lower Las Vegas Wash, Clark County, Nevada.

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Las Vegas Wash drains about 1,600 mi², including metropolitan Las Vegas, to Lake Mead on the Colorado River. Radiocarbon dating of organic sediments indicates uninterrupted flood-plain aggradation during the last 3,000 years throughout the lowermost 6-1/4-mi reach of the wash. Several cycles of channel cutting and filling predate emplacement of the late-Holocene fill, which consists primarily of thin, upward-fining strata of fine-grained sediments that appear to have been deposited by infrequent, sluggish flows.

The lower wash was ephemeral before settlement; early historic evidence documents a dominantly sparse, xerophytic vegetation. Upstream population has grown from about 5,000 in 1930 to about 700,000 in 1989. Wastewater discharge through the lower wash has increased in parallel with population growth; flow became perennial in 1955, averaged 63 ft³/s by 1975, and may average more than 150 ft³/s in 1989. By 1965, increasing flows supported dense phreatophytic and halophytic growths, and marshlands were common.

Increasing streamflow progressively modified channel morphology, and channel degradation in the late-Holocene deposits was apparent by 1969, when average flow approached 40 ft³/s. Thereafter, erosion progressed because of both increasing wastewater flows and superimposed flood flows. Erosion, which climaxed during the flood-dominated summer of 1984, cumulatively removed about 4-1/4 million yd³, or 2,700 acre-ft, and redeposited most of it in Lake Mead; this volume is equivalent to a length of 33,000 ft, a width of 200 ft, and a depth of 17 ft. Extensive damage to roads, pipelines, and wetlands resulted, and erosion continues. A dam presently being constructed 2 mi upstream from the mouth of the wash will modify erosion and deposition trends along a several-mile reach.

H52A-5 1415H

Timing and Possible Causes of Late Holocene Erosion and Aggradation, Southwestern Colorado Plateau, U.S.A.

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Since about A.D. 1200, streams of the semiarid southwestern Colorado Plateau have undergone two episodes of aggradation and erosion on different spatial and temporal scales. The early erosional episode began between A.D. 1150-1250 and lasted until about A.D. 1400. This erosion caused widespread entrenchment of continuous channels and lowered water tables. Aggradation beginning about A.D. 1400 extended into first order basins and resulted in deposition of a valley-axis and a valley-margin alluvial facies. These deposits record the filling and overtopping of the entrenched channels with sediment wells. Perennial surface water was more abundant than at present, and few large floods occurred in the period A.D. 1400-1880. The cause of this widespread alluviation is probably related to climate anomalies of the Little Ice Age. Intensification of hillslope weathering may have created an oversupply of sediment to alluvial channels.

The recent erosional episode began about A.D. 1880, although the year varies among basins. The erosion was rapid, propagated into first order basins, and resulted in lowered water tables and deeply incised continuous channels. The channels remained wide and deep until the early 1940s, suggesting that sediment was primarily transported through the channel system. Although erosion closely followed human occupation of the area, erosion was probably caused by an increase of summer-early fall (warm-season) rainfall that in turn was associated with increased frequency of El Niño-Southern Oscillation (ENSO) conditions in the Pacific Ocean.

The present aggradational episode began in the early 1940s and resulted in partial filling of the earlier channel system through development of floodplains in second and higher order basins. After the early 1940s, the frequency of large floods, average daily discharge of tributary streams, and the sediment load of the Colorado River decreased substantially. The decrease in flood frequency and daily discharge is closely related to a 10-15 percent decrease of annual rainfall frequency during the warm season and to a possible 4-6 week shortening of the average rainy season. These rainfall changes are in turn linked to a decrease in the number of dissipating tropical cyclones over the Colorado Plateau and to a change in the frequency and effective season of ENSO conditions.

H52A-6 1430H

THE HILLSLOPE RECORD OF EROSION AND DEPOSITION CYCLES

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Two cycles of erosion and deposition are recorded in soil profile morphology and slope deposits in the eastern foothills of the Southern Alps of New Zealand. Both periods of instability occurred after fires (in 1300 and 1840 AD) had destroyed the pre-existing vegetation. A soil survey of a small drainage basin revealed a complex mosaic of soils. A conceptual model was developed which describes the changes in soil profile morphology within a cycle of erosion and deposition. Four morphogenetic soil profile classes form over one cycle of instability when maximum and minimum conditions of

erosion and deposition are considered. With second cycle of instability each of these morphogenetic classes becomes the starting point for a new sequence of soil profile forms. Over thirty soils were described and assigned to a morphogenetic class. The complete stratigraphic record was only found in selected parts of the landscape. Each successive cycle of instability increases the number of morphogenetic soil profile classes and decreases the area containing the complete stratigraphic record. The preservation of cycles of instability in soils depends on the type, rate and frequency, of erosion and deposition processes and the rate of pedogenesis.

H52A-7 1445H

AMS-C14 Evidence for Regional Aggradation Starting in the Early Holocene in Southeastern Brazil and for Degradation Due to Deforestation

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Extensive field studies in the hilly uplands of the Southeastern Brazilian Plateau has led to the recognition of at least four colluvial units and the terraces that appear to be of Holocene age and contain important clues about the relationships between climate fluctuations, base-level changes and cycles of aggradation and incision over a broad region. As a first step towards testing the hypothesis that the deposits record regionally synchronous events we collected small amounts of charcoal and leafy material from a number of sites in the Bananal area and dated them using accelerator mass spectrometry. A paleosol on the colluvial unit, Bom Retiro, for which one date, 9330 ± 160 BP had already been obtained was sampled from four different sites from widely varying topographic positions, yielding ages of 8750 ± 9950, 9565 (±200) and 9970 (±300) clearly defining onset of Holocene aggradation. Three ages of the basal exposure of the highest terrace on two different drainages gave 9430 ± 9330 and 8970 (±300) BP indicating that main valley aggradation began about the same time as the paleosol formed. Several dates within and near the top of the highest terrace and within the next highest terrace one valley show that incision of the highest surface formation of lower alluvial terraces occurred within the last 200 years. This surprising result suggests that early deforestation in parts of southeastern Brazil greatly destabilized river valleys and hillslopes leading to the current state of deeply incised valleys and gullied hillslope deposits.

H52A-8 1500H

Ensemble Stability Criterion for Drainage Patterns Developed on Hillslopes

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A simple model is presented which connects the cyclic aggradation and degradation of hillslope drainage networks to intense rainfall temporal variability. It represents drainage formation and degradation on a plane slope by a two dimensional mathematical model in which mass and momentum are conserved. According to the mechanism of the movement of sediment on a slope, it is assumed as the active source of channel differentiation on a conical surface at the hillslope scale. Analyzing network sensitivity to geometry, soil characteristics, and rainfall intensity, 80 controlled experiments of drainage network formation have been carried out, by means of the model, for different parameter sets.

The results are summarized with reference to two measures of network organization on the slope: length of the total network system that develops under exam, L_n , and runoff concentration at the downstream plane, R_n . Both are presented in a non dimensional form with the same characteristics for a Peano network that develops on the slope and as functions of τ_n , the ratio between actual bottom shear stress and critical value.

They show that, increasing τ_n , first the developing of a drainage network can be detected, both in terms of L_n and R_n , with a value around $\tau_{n,c1}$ followed by a quasi-exponential decrease. For very large τ_n , no network formation is observed in terms of L_n and also the ability to concentrate runoff on the surface decreases with the increase of shear stress and sediment transport rate controlled by water and sediments and no stable drainage pattern can be developed.

The results obtained from the simulation of the erosional and depositional patterns can be used to give a physical interpretation of the evolution of a network which develops on a hillslope of given soil characteristics excited by a rainfall field non uniform in the function of rainfall intensity only, i.e. $r_n = r_n(t)$, and the surface is subjected to storms of random duration and intensity, randomly distributed rainfall event can be classified as:

- *non active* - the rainfall intensity of the storm is less than the critical value for which $\tau_n = 1$. The pattern of the surface, i.e. the present organization on the hillslope, is not changed, irrespective of the storm;
- *active* - the storm intensity is able to develop a drainage network on the surface, improving the drainage organization of the hillslope; a storm duration greater than the characteristic time for the organization on the slope, t_n , is needed;
- *catastrophic* - the storm intensity gives a τ_n value for which the surface is washed out by sediments, and if the duration of this storm is