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Linkages of fluvial terrace formation and geometry to Milankovitch-scale climate change revealed by the chronostratigraphy of the Colorado River above Moab, UT, and regional correlations

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Linkages of fluvial terrace formation and geometry to Milankovitch-scale climate change revealed by the chronostratigraphy of the Colorado River above Moab, UT, and regional correlations

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PROBLEMS AND PURPOSE

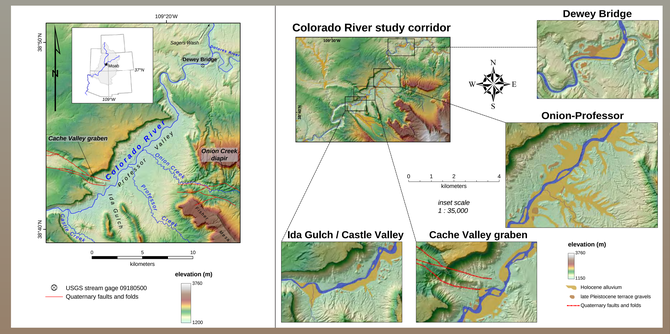
• The Colorado River flows from its Rocky Mountain headwaters to the Gulf of California, draining most of the Colorado Plateau. Although the river's hydrology is set in the Rockies, its sediment load is largely supplied by the plateau drylands of the lower drainage.

• Terrace genesis at Milankovitch timescales
  • Reflects changing dynamics between fluctuating hydrology and local sediment supply?
  • Relations to major late Pleistocene climate shifts?
  • Do study terraces correlate regionally? (i.e. are pulses of sedimentation transient or synchronous?)
  • What controls the formation of fill vs. strath terraces?

• Deformation of terraces
  • Is there a detectable influence of salt tectonism on terrace form and type?

• Our goal is to address these questions through detailed chronostratigraphy, correlation, surveying, and long-profile analysis.

STUDY AREA AND BACKGROUND

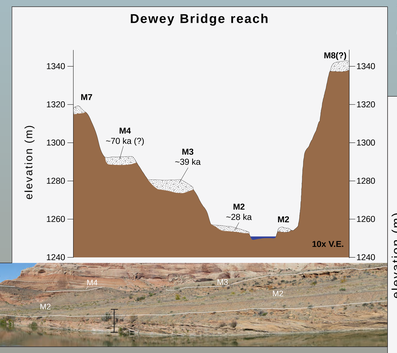


• Erosional, high relief landscape. Narrow upper bedrock canyon broadens into alluvial valley with classic monuments seen on the silver screen.

• Bedrock stratigraphy consists of Pennsylvanian evaporites, overlain by late Paleozoic and Mesozoic clastic sedimentary rocks.

• The field area includes salt-related anticlines, grabens, and diapirs with poorly constrained Quaternary activity.

TERRACE STRATIGRAPHY



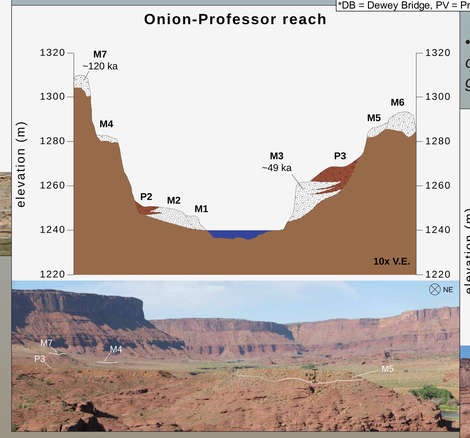
• *Preservation of six late Pleistocene terraces (M2-M7) in study area, generally more complex than in other areas of the Colorado Plateau.*

• *7 out of 16 eventual OSL dates allow preliminary correlation of terrace deposits from upstream to downstream.*

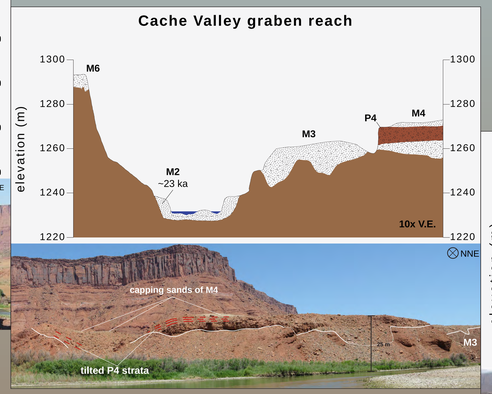
PRELIMINARY OSL AGE CONTROL FOR COLORADO RIVER TERRACE DEPOSITS

Deposit	Sample*	USU Sample #	Depth (m)	# Aliquots	Dose Rate, Gy/ka	De, Gy	Preliminary Age, ka
M2	AJ-DB-T2A	USU-1075	1.7	8	3.43 ± 0.15	96.20 ± 21.39	~28
M2	AJ-CVG-T2Au	USU-1073	2.5	7	2.81 ± 0.13	65.77 ± 24.23	~23
M3	AJ-IG-T3g	USU-1074	1.5	15	3.25 ± 0.14	132.05 ± 22.70	~41
M3	AJ-DB-T3	USU-1078	1.8	8	3.29 ± 0.15	127.55 ± 14.76	~39
M3	AJ-PV-T3uAu	USU-1076	3.0	12	3.21 ± 0.15	156.47 ± 26.09	~49
M6	AJ-IG-M5	USU-1279	1.5	6	2.64 ± 0.12	215.24 ± 40.99	~81
M7	AJ-PV-M4	USU-1197	2.3	3	2.65 ± 0.11	~200	~120

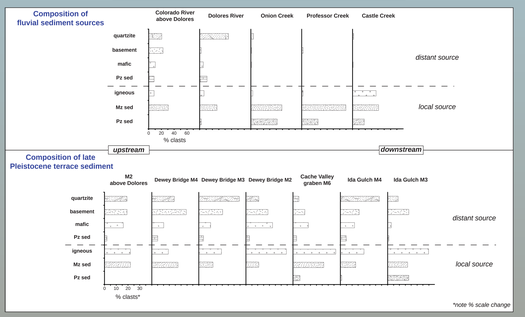
*DB = Dewey Bridge, PV = Professor Valley, CVG = Cache Valley graben, IG = Ida Gulch

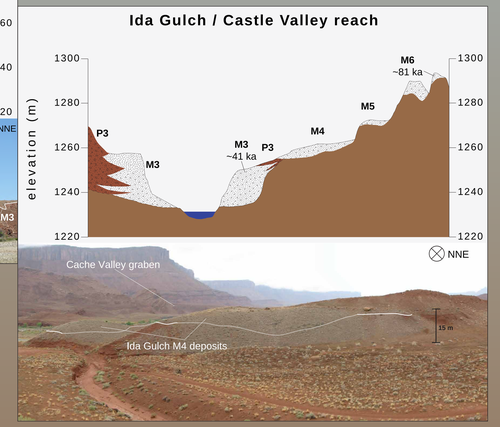


• *Terrace deposits thicken and straths become more irregular downstream in broad Professor Valley and Cache Valley graben.*

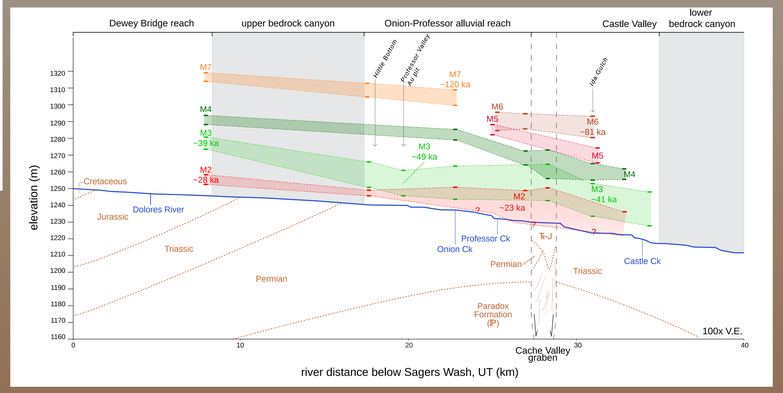


BEDLOAD PROVENANCE

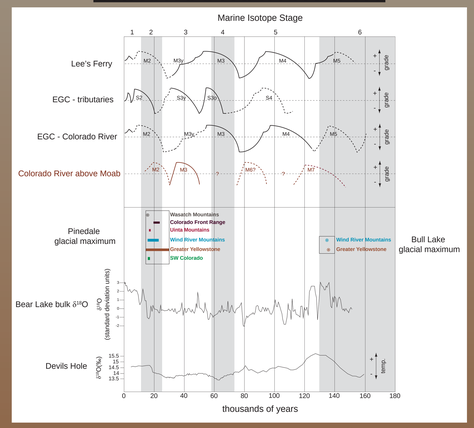




LONGITUDINAL PROFILE VARIATIONS



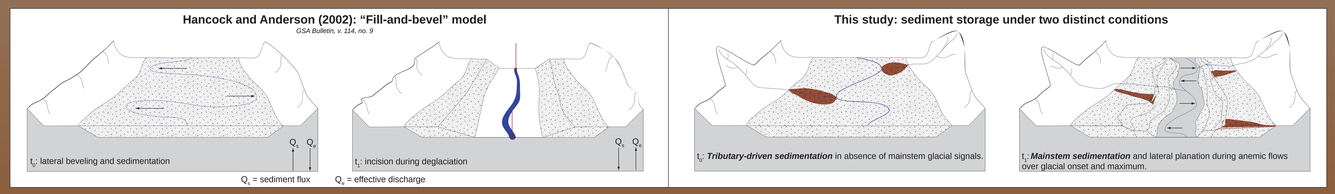
CHRONOSTRATIGRAPHY



• *We hypothesize that certain episodes of terrace sedimentation are linked to decreased peak flows during full glacial conditions (MIS 2, 4, 6).*

• *But also, other major terrace deposits are stored during pulses of dryland tributary sediment loading (MIS 3, 5), as suggested by previous work in Grand Canyon.*

CONCEPTUAL MODELS OF TERRACE FORMATION



CONCLUSIONS

• Climate correlations are not straightforward:
  • Sedimentation of M2, M5 (?) and M7 over the onset and height of glacial conditions (MIS 2, 4, 6).
  • M3, M4 (?) and M6 deposited during episodes of highly variable climate (MIS 3, 5), perhaps inspiring perturbations resulting in high sediment yields.

• Spatial patterns of terraces indicate controls by valley geometry and neotectonics. Fill terraces are found in wide valleys (in contrast to previous models), and salt tectonics have resulted in both broad subsidence and localized deformation.