

# **Time in the Rock: A Fluvial View toward Preservation of Time and Process in the Stratigraphic Record**

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## **Abstract**

The linkage of process to stratigraphic expression is based primarily upon the observation that modern depositional patterns replicate in the ancient. Uniformitarianism implies that this commonality in pattern translates to a commonality in causal mechanism. This is the founding logic of Geology. The stratigraphic record preserves rock for such a small fraction of any Earth-time interval, however, that it would seem inconceivable for rocks to record past events and depositional patterns with any fidelity. Rates of ancient sediment accumulation and rates of modern deposition also appear inconsistent in that ancient aggradation rates are too slow to accommodate the thicknesses accumulated by comparable modern processes. The signal of driving depositional causes further seems weak compared to depositional noise. Stratigraphic units do in fact though record modern patterns that are routinely attributable to common driving processes and long term depositional trends.

Explanations for these observations span the evident, the emergent, and the eventual, but some are presently available. First, the stratigraphic record includes "snap shots" of events rather than the continuum of events and is more the "statistical sampling machine" than the tape recorder of events. The rock record thus preserves little of the span of time and the fidelity of the record is contingent on the degree to which the sample taken is representative of the events that passed. Second, longer-term process will ultimately record as shifts in the population of snap shots preserving the shorter-term processes. Processes are thus best recorded by the elements in the part of the stratigraphic hierarchy which deposit over the time scale most characteristic to the time scale of the process. For instance, processes that operate over a few millennia are best preserved by stratigraphic units that form over millennia (e.g., channel belts, terrace units, etc.), whereas processes that occur over decades are poorly recorded by these units and are more likely recorded in shifts in elements that form over these time shorter periods (e.g., channel scours, bar forms, etc.). Thirdly, much of the volume of sediment deposited is accommodated laterally instead of vertically, providing the unaccounted space required to store more enduring units in apparently thinner vertical space. Errors in interpretation occur when processes and depositional products are not well matched in their stratal hierarchy, and/or the capacity for lateral storage of narrow sedimentary units is not accounted.