Geophysical Research Abstracts,
Vol. 11, EGU2009-5947, 2009
EGU General Assembly 2009

Real and apparent changes in sediment accumulation rates over time

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Field estimates of sediment deposition rate tend to decreases as a power law function of the length of time over which the estimate is made grows. This apparent decrease in sediment deposition has been attributed completeness of the sedimentary record; the effect arises due to the incorporation of longer hiatuses in deposition as averaging time is increased. We demonstrate that a heavy-tailed distribution of periods of non-deposition (hiatuses) produces this phenomenon and that observed accumulation rate decreases as $t^{\gamma-1}$ over multiple orders of magnitude, where $0 < \gamma \leq 1$ is the parameter describing the tail of the distribution of quiescent periods. By using continuous time random walks and limit theory, we can estimate the actual average deposition rate from observations of the surface location over time. Geologic and geometric constraints place an upper limit on the length of hiatuses implying the use of a truncated or tempered power-law distribution. The result is that average accumulation rates approach a constant value at very long times. The stochastic nature of sediment deposition provides an alternative explanation for the apparent increase in global sediment accumulation rates over the last 5 million years.