Geophysical Research Abstracts,
Vol. 11, EGU2009-3633, 2009
EGU General Assembly 2009
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To what extent can regional grain-size trends be decoded to gain information about tectonic subsidence rates and sediment flux? Case studies from the Eocene Pobla Basin, Spanish Pyrenees

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Regional grain-size trends preserved in sedimentary deposits theoretically embed important information on the dynamics of sediment routing systems and their sensitivity to external forcing mechanisms**.** In simple terms, downstream sediment fining is driven primarily by selective deposition of sediment, and mediated by abrasion of the clasts during transport. However, the relative efficiency of this process is determined by (1) the physical characteristics of the input sediment supply; (2) the spatial distribution of subsidence rate, which generates the accommodation necessary for sediment preservation; (3) the detailed mechanics of sediment transport and deposition. A key challenge is therefore to determine how these first two factors control the calibre and spatial distribution of deposits over timescales of 10^4-10^6 years without incorporating the details of hydraulics and sediment transport which are largely unknowable for time-averaged stratigraphy in the geological past. One method to solve this problem is to assume self similarity between the long-term, longitudinal grain-size distribution of the substrate and the dimensionless relative mobility function for gravel, using only the local mean and standard deviation of grain-sizes in transport as scaling parameters[1]. In principle, this approach offers a simple means to explore the controls on downstream fining in fluvial deposits, but until now there have been few attempts to test this methodology using fluvial sedimentary successions where we have clear and independently derived constraints on the rates and volumes of sediment deposition through time. We address this challenge using detailed grain-size data from the Eocene Pobla Basin, Spanish Pyrenees, where the timing of sediment deposition is known from palaeomagnetic and palaeontological dating, the system is closed so mass is conserved, and where good exposure enables time-lines within stratigraphy to be picked out unambiguously. For successive stratigraphic horizons, we derive downstream trends in coarse-fraction grain-size for two basin-filling sediment routing systems with maximum length scales of 5 and 30 km respectively, using Wolman and photographic point counts, and palaeocurrent data from pebble imbrications and gutter casts. Our data show that the rate of grain-size fining varies over time and with system length, and cannot be explained by abrasion alone. We use this detailed data set to test the selective deposition model and we evaluate the extent to which regional grain-size trends can be decoded for sediment flux and subsidence variables over timescales of $>10^4$years.

[1]Fedele, J. J., and Paola, C., 2007, Similarity solutions for fluvial sediment fining by selective deposition, Journal of Geophysical Research, 112, F02308, doi10.1029/2005JF000409.