Geophysical Research Abstracts,
Vol. 10, EGU2008-A-11321, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-11321
EGU General Assembly 2008

An integrated numerical-statistical modelling approach to characterisation of compositional and textural heterogeneity of siliciclastic basin fills

G.J. Weltje (1), M.B. Brommer (2), M.A. Prins (3), J.B. W. Stuut (4) and M. Zabel (4)

(1) Delft University of Technology, Faculty of Civil Engineering and Geosciences, Delft, The Netherlands (g.j.weltje@tudelft.nl), (2) Royal Haskoning, Peterborough, United Kingdom, (3) Vrije Universiteit, Faculty of Earth and Life Sciences, Amsterdam, The Netherlands, (4) MARUM – Centre for Marine Environmental Sciences, Bremen, Germany

The initial conditions for sediment property models are determined by the sediment feeder systems contributing to a basin fill, and the compositional/textural characteristics of their sediments (provenance). Subsequent fractionation during selective entrainment, transport, and deposition control the spatial variation in composition and texture of locally deposited grain assemblages (dispersal). Hence, spatial heterogeneity of siliciclastic sediments primarily reflects the intrinsic coupling of grain size and mineral composition. This multivariate sedimentary fingerprint is most easily studied in unconsolidated modern sediments, which permit compositional variability to be factorised into local and regional controls. The concept of transport invariance of narrow grain-size fractions (corresponding to grain assemblages unaffected by selective transport), allows the distinction of variation induced by selective transport from other mechanisms, such as weathering, diagenesis, or mixing of sediments from multiple sources. The compositional and textural heterogeneity of a basin fill may be summarised in a 3-D array (cube) that contains the spatial variation of transport-invariant petrographic compositions corresponding to multiple grain-size ranges. Two types of compositional variability can be distinguished that correspond to differently oriented slices through this cube: (1) Fractionation (unmixing) into transport-invariant subpopulations, the dominant source of compositional heterogeneity on the lamina scale;

(2) Mixing of sediments from different feeder systems within each transport-invariant subpopulation, the dominant source of compositional heterogeneity on the dispersal-system scale. The variability attributable to both processes can be described, quantified, and explained in terms of multivariate linear (un)mixing. The mathematical model developed for this purpose, EMMA, is briefly discussed. An extension of the method, developed to investigate the problem of compositional variability at different spatial scales, permits the length scales of compositionally homogeneous zones (petrofacies) to be characterised in a probabilistic way.