Geophysical Research Abstracts
Vol. 13, EGU2011-10381, 2011
EGU General Assembly 2011

Detrital geochronology, mineral fertility and short-term erosion patterns

Marco Giovanni Malusà and Eduardo Garzanti

University of Milano-Bicocca, Dipartimento di Scienze Geologiche e Geotecnologie, Milano, Italy (marco.malusa@unimib.it, +39 02 6448 2073)

Quantitative sediment budgets based on detrital geochronology, when coupled with determination of mineral content in diverse sediment sources (mineral fertility - e.g. Moecher and Samson, 2006), are a powerful tool to constrain erosion patterns in orogenic belts on short-term timescales (10e2-10e4 a).
Starting from well-sorted sediment samples, standard separation techniques are applied to size windows chosen on the basis of mean grain-size and expected size-shifts of selected minerals relative to quartz (Garzanti et al., 2009). Geochronological analyses performed on single mineral grains yield grain-age distributions that are decomposed in distinct populations, characterized by specific age and size (e.g. Bernet et al., 2004; Malusà et al., 2009). The size of each population, if not affected by hydraulic effects, is a function of (i) the relative size of diverse detrital sources, (ii) their short-term erosion rates, and (iii) their mean mineral fertility. When age signatures allow reliable discriminations of different sources, and the size of specific sub-basins is known, determination of short-term erosion patterns still requires to reliably assess mineral fertility.
Mineral fertility in source-rocks can be determined by measuring the mineral content in the sediments they produce, provided that sediment mineralogy is not significantly modified in the sedimentary cycle, and specifically by hydrodynamic processes (e.g., selective entrainment for bedload sands). Sorting during transport and deposition, or inaccurate sampling and treatment in the laboratory, can and commonly do alter the original provenance signature. Placer deposits, although routinely sampled because they provide a mineral pre-concentration, should instead be carefully avoided. Comparison between grain density and source-rock density is an effective tool to check for anomalous concentration of dense and particularly ultradense minerals. Fundamental complementary information is provided by sediment geochemistry. The lack of concentration anomalies for elements largely hosted in minerals such as monazite, zircon and apatite (e.g. REE, Th, Zr, Hf, P) provide a proof that source-rocks fingerprints were not altered by hydrodynamic processes (Garzanti et al., 2010).
Our methodological approach for assessing short-term erosion rates can be applied to any geochronological system, including U-Pb on zircon and fission tracks on apatite. Application to apatite fission-track dating was tested in well-constrained drainage basins of the Western Alps, and validated by independent estimates based on petrographic analyses of bulk sediment (Resentini and Malusà, submitted). In this latter case, single detrital fission-track samples constrain the erosion pattern both on short-term (10e2-10e4 a) and long-term (10e6-10e7 a) timescales.

Bernet, M., Brandon, M.T., Garver, J.I., and Molitor, B., 2004. Fundamentals of detrital zircon fission-track analysis for provenance and exhumation studies with examples from the European Alps. Geol. Soc. Am. Special Paper, v. 378, p. 25-36.
Garzanti, E., Andò, S., and Vezzoli, G., 2009. Grain-size dependence of sediment composition and environmental bias in provenance studies. Earth Planet. Sci. Lett., v. 277, p. 422-432.
Garzanti, E., Andò, S., France-Lanord, C., Vezzoli, G., Censi, P., Galy, V., and Najman, Y., 2010. Mineralogical and chemical variability of fluvial sediments. 1. Bedload sand (Ganga-Brahmaputra, Bangladesh). Earth Planet. Sci. Lett., v. 220, p. 157-174.
Malusà, M.G., Zattin, M., Andò, S., Garzanti, E., and Vezzoli, G., 2009. Focused erosion in the Alps constrained by fission-track ages on detrital apatites. Geol. Soc. London Spec. Publ., v. 324, p. 141-152.
Moecher, D.P., and Samson, S.D., 2006. Differential zircon fertility of source terranes and natural bias in the detrital zircon record: Implications for sedimentary provenance analysis. Earth Planet. Sci. Lett, v. 247, p. 252-262.
Resentini, A., and Malusà M.G., submitted. Sediment budgets by detrital apatite fission tracks (Rivers Dora Baltea and Arc, Western Alps). Geol. Soc. Am. Special Paper.