Geophysical Research Abstracts, Vol. 9, 06688, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06688

Petrographic composition of sediments vs. grain size: a statistical model

R. Tolosana-Delgado, H. von Eynatten

Sedimentologie/Umweltgeologie, Geowissenschaftliches Zentrum der Universität Göttingen (raimon.tolosana@geo.uni-goettingen.de)

Blatt, Middleton and Murray (1972, *Origin of sedimentary rocks*; p. 301) published a plot where they conveyed "*the probable relationship between grain size and detrital fragment composition, based on the limited data currently available*", representing a summary of all sediments at a global scale. The plot gives, for the range of grain sizes occurring in nature, the composition of five variables (Rf=rock fragments, Qp=polycrystalline quartz, Qm=mono-crystalline quartz, F=feldspar and M=phyllosilicates, including micas and clay minerals), and it summarizes a wide set of processes, mainly comminution, alteration and dissolution. Our goal here is to describe this system by means of regression of a composition on grain size, in ϕ scale.

In order to perform a rigorous statistical treatment, we chose the following set of log-ratios to represent the composition: Rf/Qp (capturing the distribution within polycrystalline grains), F/Qm and M/Qm (capturing the distribution within monocrystalline grains), and Qp/Qm. Each one of these log-ratios is expressed as a linear function of ϕ, attaining coefficients of determination R^2 of 0.45, 0.78, 0.998 and 0.98 respectively. Jointly back-transforming the results, one obtains an initial sand composition (for ϕ=0, corresponding to the ordinates at the origin) of approx. [Rf,Qp,Qm,F,M]=[55, 23, 19, 3, 0]%, and a multiplicative gradient (corresponding to the slope of the regression) showing that, decreasing grain size in one ϕ unit, the sediment becomes 6 times more enriched in phyllosilicates than in monocrystalline quartz, while being relatively depleted of 20% of its feldspar and 85% of its polycrystalline grains with respect to monocrystalline quartz. In this model, the process is independent on the grain size.

If the obtained predictions are back-transformed and represented together with the original data, a surprisingly good fit of our statistical model to the conceptual model of

Blatt et al. (1972) is obtained, much better than what raw linear statistics might offer. This fit suggests that the multiplicative process fitted here succesfully summarizes the *relative intensities* of all physico-chemical processes involved in the relationship composition-grain size, and that the independence of process on grain size is not an over-simplification.