Geophysical Research Abstracts, Vol. 9, 03222, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03222

Diffusive fractionation of trace elements by chaotic mixing of magmas

D. Perugini, M. Petrelli and G. Poli

Department of Earth Sciences, University of Perugia, Piazza Università 1, 06100 Perugia, Italy (diegop@unipg.it)

Recent research on magma mixing systems has shown that the mixing process is governed by chaotic dynamics and that this process is responsible for the generation of fractal structures that propagate within the magmatic mass from the meter to the micrometer length-scale.

Laser Ablation ICPMS trace element analyses have been performed on rock samples with evidence of chaotic mixing phenomena. Results indicate that trace elements with similar values of diffusion coefficient display good correlations in interelemental plots whereas, as the difference between diffusion coefficients increases, the correlation is progressively lost. In addition, a large variability of REE patterns is observed, with the remarkable feature of the presence of positive and negative Eu anomalies occurring at short length scale, of the order of few mm.

Given the chaotic nature of magma mixing structures, the mixing process has been simulated by coupling a chaotic advection and a chemical diffusion numerical scheme by considering several trace elements with variable diffusivities. Simulations indicate that such a model explains with good approximation the variable correlations among trace elements observed in natural samples. In addition, the same patterns of REE observed in natural samples, including the occurrence of positive and negative Eu anomalies at short length scale, are observed indicating that a chaotic advection/diffusion dynamic system is a suitable model to explain natural data.

Results presented in this contribution indicate that at the micrometric length-scale small volumes of magmas are strongly influenced by the coupled action of chemical diffusion and chaotic flow fields and, hence, they do not represent magmas *de facto* present in the magmatic system because their compositions may have experienced a ‘diffusive fractionation’ process. These results may have important petrogenetic implications. For instance, if such melts were trapped as melt inclusions, they would provide misleading information about melt compositions. It is suggested that the approach of studying the degree of correlation among trace elements may be a possible method to test if melt inclusion compositions, commonly used as petrogenetic indicators, display evidence of such a ‘diffusive fractionation’ process.