



GMPE-SG: Sesión General Geomorfología y Procesos Exógenos

Change of reactive areas of rock-forming minerals due to natural weathering: a case of Paraná basalts

Wladimir Octavio Acevedo¹, Alexey Novoselov^{3,2}.

(1) Ciencias de la Tierra, Ciencias Químicas, Universidad de Concepción

(2)

(3) Instituto de Geología Económica Aplicada (GEA), Universidad de Concepción, Concepción, Chile

Dissolution of rock-forming minerals, is the main factor limiting the kinetics of a number of geochemical processes at near-surface conditions. Basing on the Transition state theory, the portion of any mineral (Δx_i) dissolved during time interval (Δt) can be calculated as follows: $\Delta x_i = r_i S_i \Delta t$ Whereas there are a few extended databases and many distinct algorithms for estimation of dissolution rates (r_i), the change of reactive areas of minerals (S_i) with fluid, is poorly understood. Traditionally, researchers use the values for pure minerals quoted in literature or recalculate this parameter using the BET specific surface area (S_{BET}), measured for whole rock, by the equation: $S_i = \varphi_i S_{BET}$ Where φ_i is a volume fraction of the i -th mineral in the bulk volume of rock. Both approaches do not consider the possible change of reactive area due to dissolution of mineral grains. This may cause the serious ambiguity in the duration of chemical transformations. In this context, this is strictly important to reveal the typical patterns of change of reactive areas of main rock-forming minerals. Basalts are common and highly reactive rocks, able to transform at a scale of few thousand years to completely altered regolith. Because their alterations are driven exclusively by chemical weathering under tropical climatic conditions, Paraná basalts, covering vast areas in Brazil and Northern Argentina, represent a best suited object for this research. In order to characterize the change of reactive areas of typical rock-forming minerals, we took the high-resolution SEM images of plagioclase, pyroxene, k-feldspar, olivine, ilmenite and magnetite. Those images represent minerals at different dissolution stages from absolutely fresh to almost dissolved grains. Then, those photos were handled with ImageJ software. To reveal the general trends, we analyzed obtained data on the grains perimeter with statistical methods. We found that the reactive areas of all minerals are not constant and change due to weathering by different laws. Those values quickly rise and increase up to a factor of 8 at dissolution of 50-60% of mineral grains. However, later reactive areas start to decrease. Also, we reveal the correlation of mineral surface areas obtained from SEM images with BET measurements. The model fitting the change of reactive areas can improve the accuracy of geochemical calculations and can be widely applied for simulations of weathering and hydrothermal alterations.