

Rare earth elements distribution in weathering profiles from Corumbataí Formation, São Paulo, Brazil

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In this study 32 clay samples from 10 mining fronts were analysed regarding the rare earth elements (REE) content and mineralogy. These materials are used for ceramic coatings in the Santa Gertrudes Ceramic Pole, São Paulo, Brazil, considered as the biggest ceramic pole in Latin America. The mines comprehend the Corumbataí Formation mudstones from Paraná Sedimentary Basin. The samples were analyzed as a whole and along each mine profile to evaluate the variation of REE concentration, mineralogy and weathering effects. The results show a differentiation into two main groups: 1) lower portion; and 2) upper portion. The samples from the lower portion of all mines present a fractionation pattern characterized by a continuous depletion in light REE from La to Sm ($La/Sm_N = 3.77 \pm 0.27$), followed by a negative anomaly in Eu ($Eu/Eu^* = 0.024 \pm 0.003$) and a regular decreased distribution of heavy REE from Gd to Yb ($Gd/Yb_N = 1.51 \pm 0.14$). The upper portion samples present a similar distribution pattern as described before and REE ratios $La/Sm_N = 3.50 \pm 0.58$, $Eu/Eu^* = 0.014 \pm 0.003$, $Gd/Yb_N = 1.72 \pm 0.19$, however, the concentration of REE in the upper portion ($\Sigma REE = 857 \text{ ppm} \pm 99$) is higher than in the lower portion ($\Sigma REE = 539 \text{ ppm} \pm 53$). After the analysis of each profile from lower to upper portions, seven mines front were identified featuring a REE concentration increase with progressive weathering, probably due to a rapid reprecipitation and loss of major elements that are easily remobilized. Two of the upper samples present the highest contents in REE, which is attributed to the presence of kaolinite and dehydrated layers of expansive clay minerals in Pieroni and Christofletti 2 Mines respectively, indicating the more advanced weathering state of these samples. In three mines front (Cruzeiro 1, Partezani 1 and Tute) no significant enrichment in REE was noticed along the profiles, so the fractionation pattern remains in the same order of magnitude, thus implying in a higher resistance of these rocks to the weathering, due to a higher amount of non clay minerals within the benches or depth of the bench within the profile.