Integrating multivariate statistical analysis for geochemical assessment of groundwater quality in Gümüşhacıköy Plain (Amasya, Turkey)

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Groundwater is the main source for drinking water, agricultural and the industrial sector, the demand for water has increased over the years and led to water scarcity in all over the world. In the Gümüşhacıköy Basement, in the mid-northern part of the Turkey, agriculture is the most important mainstay and this area includes the most important agricultural areas of Turkey. The groundwater is extracted by wells drilled in the alluvium of the Gümüşhacıköy Plain to meet municipal, industrial and especially agricultural requirements. Factor analyses technique is useful in the analysis of groundwater data corresponding to large number of variables. Principal Component Analysis (PCA) performed on correlation matrix of the raw data in which a water sample is described by 15 physical and chemical parameters for 38 samples. The PCA produced 4 for significant component that explained 78 % of the cumulative variance. Piper and Chadha graphical methods were used to identify geochemical facies of groundwater samples and geochemical processes occurring in the study area. The water is mainly of Ca-Na-HCO_3 type.

Retention of colloids at rough rock surfaces

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The retention of colloidal particles at mineral and rock surfaces is of fundamental importance for numerous processes, including trace metal and contaminant mobility, wastewater treatment, or diagenetic and weathering reactions. In nature, particle attachment conditions are often electrostatically unfavourable due to the pH-dependent mineral surface charge. In such cases, surface roughness of the collector surfaces may play an important role in governing the retention efficiency.

In this study, we compare the retention of colloids (polystyrene latex colloids [d = 1 μm] and hematite colloids [d = 0.95 μm]) at rough single mineral surfaces (quartz, albite, K-feldspar, biotite) and surfaces of mineral aggregates (Granodiorite from Grimsel test site, Switzerland). Surface roughness variations are in a range of 0.05 to 3 μm. Experiments were repeated under defined ionic strength variations. Particle retention experiments were performed at pH = 5.

Vertical Scanning Interferometry (VSI) was applied for characterization of surface topography, quantification of surface roughness, as well as quantification of colloid deposition. This method provides a large field-of-view that is sufficient to detect common inhomogeneities at mineral surfaces and to quantify their lateral extent. Application of so-called *converged* roughness parameters enabled the quantification of roughness differences at irregular surfaces.

A positive correlation between colloidal deposition flux (*Sh*) and surface roughness (*Rq*) of single mineral samples was observed for retention under unfavourable consitions. For granodiorite surface samples, however, the observed particle retention was tenfold higher. The experiments showed the quantitative and predictable impact of intergranular porosity as well as roughness variations caused by mineral aggregates on the retention of colloids.