Statistical interpretation of the relation between geochemical and mineralogical data obtained from lake and floodplain sediments (Amuq Valley / Turkey)

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Amuq Valley region, that includes Amuq Lake and floodplains of Orontes, Afrin, and Karasu River, and its surroundings have always been a focus of interest for scientists as they provide a unique data collection that preserves both geological and archaeological records of environmental and social turbulences experienced during the Holocene epoch. In the Amuq Valley region, mineralogical and elemental geochemical investigations were carried out along 149 samples from undisturbed sediment cores that were taken from the Amuq Lake and from the vicinity of the archaeological sites of Tell Kurdu, Tell Atchana, and Tell Tayinat. Mineralogical content of the sediments along these cores were examined by X-Ray Diffraction (XRD) and SEM-EDS. Inductively Coupled Plasma – Optical Emission Spectrometry / Mass Spectrometry (ICP-OES/MS) analyses were conducted on the samples to detect quantitative concentrations of major, minor and trace elements. A method was developed by MapInfo software to convert intensities of bulk powder and oriented air-dried clay fraction X-ray diffractogram peaks to numerical values. Numerical values obtained from XRD and ICP-OES/MS analyses were correlated by Correlation Matrix and Principal Component Analysis. Hence, mineral-element relationships were statistically identified. The main purpose of this study is to reveal statistical correlations between geochemical and mineralogical data obtained and characterized from the lake and floodplain sediments of Amuq Valley and uncovering the relationship between geochemistry and mineralogy of the lake and floodplain samples by providing some statistical evidences.

Statistical evaluation of the data revealed that quartz, serpentine, feldspar group minerals and clay minerals have higher correlation coefficients in t he floodplain samples wh ile ca lcite an d ar agonite ha ve higher correlation coefficients in the lake samples. A significant effect of environmental difference was determined on aragonite correlations. It was also examined that the clay mineral peaks before 20° 2θ on bulk powder X-ray diffractograms have stronger correlations with quartz, serpentine, and feldspar group minerals in contrast to the other clay mineral peaks. Moreover, element vs. mineral correlations revealed possible presence of impurities like rutile in quartz due to high correlation coefficients of Si, Al, Fe, Mn, Cu, Ti, Hf, Zr, and Nb, while other minerals generally correlate with their chemical constituents except clay minerals which also correlate with trace elements including rare earth elements such as Hf, ,YLa, Ce, Pr, Nd, Sm, Eu, Tb, Dy, Th, Ga, Er, Yb, Lu, Zr, and Nb. These results also showed that application of this statistical analysis technique is an efficient and timesaving approach on large data sets.

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