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Chemical and mineralogical proxies of erosion episodes in the dried lake sediments (Amik Lake, Southern Turkey): paleoenvironmental implications

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The Amik Basin in the Eastern Mediterranean region has been continuously occupied since 6000-7000 BC. The landscape has sustained with highly variable anthropic pressure culminating during the Late Roman Period when the Antioch city reached its golden age. The basin also sustained a high seismic activity (M≥7) as it is a releasing step-over along the Dead Sea Fault. The study focuses on the sedimentary record of the Amik Lake occupying the central part of the Basin. Our objective is to constrain major paleo-environmental changes in the area over the last 4000 years and to unravel possible human impacts on the sedimentation. A diverse array of complementary methods was applied on the 6 m long record. High resolution of mineralogical (XRD) and geochemical (XRF) analyses were performed. Quantitative mineralogical phases of sediments by the Rietveld method were computed using Topaz software. The age of the record is constrained combining radionuclide and radiocarbon dating, and checked using the correlation between the earthquake history and rapidly deposited layer identified. A high sedimentation rate of 0.12 cm/yr was inferred at the coring site.

The 4000 years old record shows that significant fluctuations of the lake level and the riverine system inflow into the Amik Lake occurred. The Late Bronze lowstand leaded to punctual dryings of the lake at the end of the Bronze/Iron transition marked by the collapse of the Hittite Empire and during the Dark ages. At that time, the riverine was carrying a large terrigenous input linked to strong soil erosion related to deforestation, exploitation of mineral resources and the beginning of upland cultivation. During the Roman Period and in the later periods, upland soils were partly depleted and the riverine system completely transformed by channelization that leaded to a mashification of the Amik Basin.

Chemical and mineralogical composition of sediments is quite diversified reflecting the significant geological variation of drainage basins. Abundant calcareous minerals, especially calcite, aragonite, dolomite and small amount of wollastonite characterize the different sedimentary levels recorded in the lake. Levels relatively rich in fluorite, richerite, enstatite, and wollastonite are a result of the erosion of the ophiolitic rocks from the surrounding Amanos Mountains. These levels are interpreted as corresponding to relatively high erosive periods, while more humid periods lead to more intensive weathering and consequently to the dominance of kaolinite, muscovite/illite and talc more advanced in the relative stability scale, indicating a climate with contrasting seasons. During the most recent Period a marked increase in terrigeneous minerals associated with a rise in dolomite indicates ungoing erosion as well as the drying-out of the lake.