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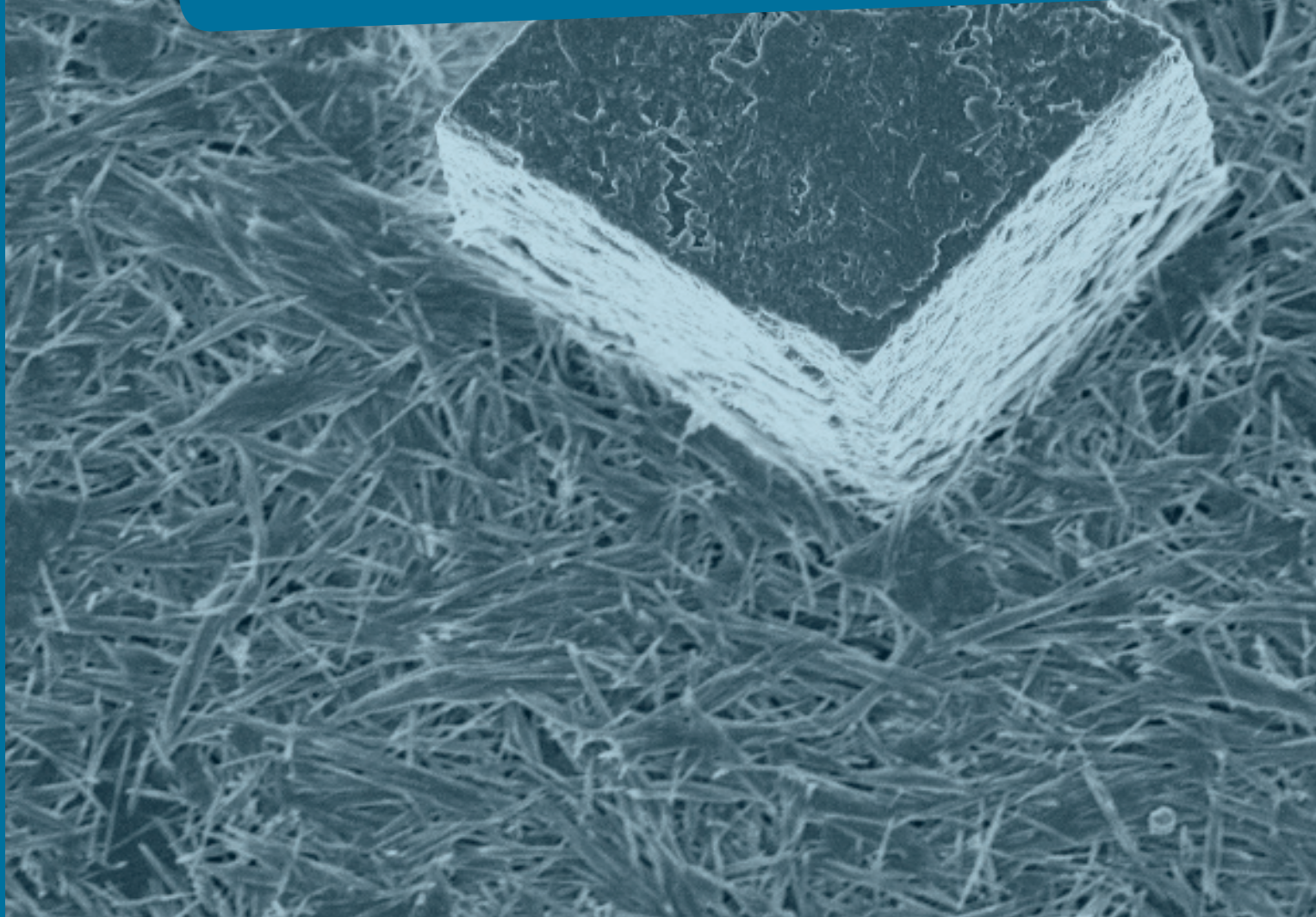

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THE SEDIMENTS OF INLE LAKE (SOUTHERN SHAN STATE, MYANMAR): MINERALOGICAL AND GEOCHEMICAL CHARACTERISATION TO TACKLE ORIGIN AND DEPOSITIONAL PROCESSES

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Inle Lake is the second largest lake in Myanmar and the most important, for its economic, touristic, agricultural and environmental value. Previous studies report that Inle lake is seriously threatened by anthropic activities on the lake sides and in its drainage basin, leading to a decrease in the open water surface, estimated to as much as 32.4% between 1935 and 2000. This is attributed to an increase in sedimentation caused by accelerated soil erosion, as a consequence of deforestation in the watershed, and to the expansion of agriculture in the form of floating gardens. [1]

Ten sediment cores, ranging from 40 to 85 cm in length, were collected in March 2014 (hot dry season). Cores were cut in 5 cm slices, wrapped in polythene foil to prevent oxidation, and transported to the Department of Earth and Environment Sciences in Pavia (Italy). In the laboratory, sediment samples were dried at room temperature for 2-3 days in order to maintain the crystal structures, and ground to fine powder in an agate mortar. The mineralogical composition was determined by X-ray powder diffraction (XRPD), while the topography of some crystal structures and the elemental composition were analysed using scanning electron microscopy (SEM). Major and trace element contents were determined by Total Digestion ICP/MS.

In the bulk sediment, the most abundant mineral is calcite (27 to 100%), followed by quartz (0 to 54%). Other less abundant minerals are: mica/illite (0 to 33%), kaolinite (0 to 14%), aragonite (0 to 15%) and hematite (0 to 9%). The clay fraction is mostly composed by kaolinite with lower mica/illite and chlorite, and traces of smectite. Calcite is not evenly distributed in the lake area: samples collected at or near the main inflow and at the outflow show an abundance of about 50%, generally increasing with depth, whereas within the lake calcite rises up to more than 90%. Endogenic calcite precipitation is known to occur in the warmer months, triggered by photosynthetic activity and evaporation of the water body [2], but detrital calcite is also likely present in the sediments.

SEM observations showed a variety of grain morphologies and surface textures. Grains are medium to coarse in size (4-500 μm), and are commonly constituted by calcite and quartz. Sediments collected near the inflow show the abundance of detrital minerals such as feldspar, calcite and quartz, which can be attributed to soil erosion. In addition, coarse grains are dominated by mineral aggregates, also probably formed in the soil, in which calcite is associated with organic matter. Sediments from the centre of the lake, accounting for 90% of calcite, show both detrital and endogenic calcite grains, characterized by a rounded shape and by superposed layers, respectively. An apatite grain was detected in sediments from the agricultural zone, and attributed to the use of phosphate fertilizers in the floating gardens.

Chemical analyses indicate that Ca is the most abundant element, in agreement with the abundance of calcite, followed by Al, Na and K, all elements contained in detrital minerals and associated heavy metals. The comparison between the elemental compositions of lake sediment with that of the rocks outcropping in the watershed confirmed that accelerated soil erosion, and the consequent detrital input to the lake, constituted a major source of potentially toxic elements to the lake.

[1] Sidle R.C., Ziegler A.D., Vogler J.B. (2007). Contemporary changes in open water surface area of Lake Inle, Myanmar. Sustainability Science, 2, 55-65.

[2] Thin M. M., Sacchi E., Setti M. (2016). Hydrological processes at Inle Lake (Southern Shan State, Myanmar) inferred from hydrochemical, mineralogical and isotopic data. Isotopes in Environmental and Health Studies, 52 (4-5), 455-467.