Patterns and processes of recent anthropogenic impacts on lake sediment formation: multi-proxy evidence from two hard-water lakes in Estonia

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The study addresses possible links between recent changes in lithology of the sediment and anthropogenic impact on two lakes, Lake Verevi and Lake Nõmmejärv. Collected historical data shows that studied lakes and their catchment areas became in the 20th century significantly influenced by human activities. L. Verevi has been affected by sewage waters, while there has been direct hard-water inflow from oil-shale mine into L. Nõmmejärv. In both cases, lakes shifted toward more eutrophic state and there was a significant change in sediment composition from organic-rich to carbonate-rich sediment. The aim was to detect the main causes of changes in carbonate accumulation. Photosynthetic pigment markers, stable isotopes ($^{13}C_{CaCO_3}$ and $^{18}O_{CaCO_3}$), bulk geochemistry and pollen analysis were performed. The sediment was dated using the $^{210}Pb$ and $^{137}Cs$ method. Combined geochemical and isotopic evidence confirms authigenic origin of the carbonates. The change in stable isotopes profiles correlates with the increase in productivity proxies (photosynthetic pigments and Botryococcus remains). This indicates effect of eutrophication on precipitation of carbonates which are likely caused by intensive photosynthesis during the algal blooms.