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High resolution fingerprinting of eutrophication in a large-hard water lake (Lake Bourget, NW French Alps)

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The uppermost sediments of Lake Bourget consist of organic-rich rhythmites which have been previously related to the recent onset of persistent anoxia in the hypolimnion. Radionuclide dating (137Cs and 241Am) confirms that these laminations are biochemical varves In order to characterise the sedimentary fingerprint of anoxia a multi-proxy investigation was initiated including the analysis of biotic and abiotic sediment proxies. Varve dating showed that anoxia has begun in 1948 AD. This new condition is marked by the appearance of large calcite crystals (15-30μm). Before 1948 AD, the carbonate fraction in the sediment showed a bimodal grainsize distribution: very fine grained calcite particles ($<1\mu$m) and calcite crystals within the fine silt fraction (4.5-8μm). The non-carbonated sediments are composed of diatoms (eutrophication marker), organic matter (anoxia marker) and detrital particles derived from the Rhône river. Flux variations of different particle types allow the reconstruction of the recent history of the lake. For 7200 years phosphorus was mainly brought by the Rhône into Lake Bourget. Since 1948, the increase of nutrient supplies (showed by the phosphorus enrichment factor) and the low hydrological activity of the Rhône are causing the anoxia appearance. Furthermore the Rhône floods have probably played an important role on the oxygenation of the hypolimnion and hence on the organic matter accumulation. Detrital particles brought into the lake during Rhône floods might also have the capacity to trap the phosphorus in the sediments. In conclusion, the anthropogenic eutrophication,, climate changes and the human impact on the Rhône river (hydroelectric dams) control the environmental conditions of the lake.