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Lake Geneva sediments: Archive for past environmental changes and human activity during the last 3000 years

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Lake sediments are excellent archives of environmental changes in the watershed and provide high-resolution records of regional paleohydrological variability. Lake Geneva is the largest peri-alpine lake in western Europe, with a maximal water depth of 309 m. It is part of the Rhone river system and was formed during the Pleistocene by glacial erosion. Our study focuses on the deepest part of the lake basin, where sedimentation is mainly controlled by fluvial input from the Rhone and Dranse rivers. These two river systems are sensitive to regional climate variations in the alpine realm and to human activity that affect the discharge regime and sediment delivery to the lake.

In Lake Geneva, high resolution seismic reflection profiles reveal two distinct units in the late Holocene sedimentation history. One unit (Unit 1) consists of a succession of five large lens-shaped seismic sub-units, characterized by transparent/chaotic seismic facies with irregular lower boundaries, interpreted as mass-movement deposits. These sub-units are interbedded within parallel, continuous, high-amplitude reflections, interpreted as the 'background' lake sediment. The second unit (Unit 2) consists of 5 m-thick 'background' seismic facies with parallel geometry. It displays alternating dm-thick chaotic/transparent and continuous, high amplitude reflections, which are interpreted as hemipelagic layers punctuated by turbidites. This turbidite layers, are interpreted as floods- and mass movement-related deposits.

Four 7- to 12-m long sediment cores were retrieved with a modified Kullenberg system from the deepest part of Lake Geneva. The sedimentary sequence spans the last 3000 years. Magnetic susceptibility and density were measured by Geotek Multisensor Core Logger at 0.5 cm resolution. X-ray fluorescence was carried out using an Avaatech core scanner from the University of Barcelona at 1-cm resolution. This technique provides semi-quantitative information of the sediment elemental composition. Clastic-related elements such as Ti, K or Si records extreme precipitation events in the lake watershed while the Fe/Mn ratio and Calcium in the sediment provides information about the redox conditions in the lake bottom and the calcite endogenic precipitation in the epilimnion respectively. The sedimentary record suggests a complex hydrological variability during the last two millennia during different climatic facies such as the Medieval Warm Period (MWP) and the Little Ice Age (LIA). However, the climate signals are certainly also overprinted by human activity during the last 3000 years, and particularly during last centuries with river regulation and dam building on the Rhone river and disentangle both forcing mechanisms is needed in order to achieve an adequate paleoclimatic reconstruction.

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