



Palaeohydrology and environmental changes during the Holocene in northern Spain: The sedimentary record of Lake Estanya.

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The Balsas de Estanya (42° 02' N, 0° 32' E, 670 m a.s.l.) is a karstic lake complex located at the foothills of the External Pyrenean Sierras and related to the hydrogeological system of the Estopiñán Synclinal. Runoff and surface inputs are small, and the lake is mainly fed by groundwaters from the surrounding local limestone aquifers. There is no surface outlet. The substrate, composed of non-permeable Upper Triassic Keuper facies, limits groundwater losses. Consequently, the lake is potentially an excellent archive of regional paleohydrology. The main lake basin is composed of two sinkholes with maximum depth of 12 and 20 m, separated by a sill. A seismic survey revealed a > 15 m thick lacustrine sequence. Four Kullenberg cores up to 4 m long were retrieved in 2004 from the deepest areas of both subbasins.

The longest core (1A-1K) from the deepest subbasin provides a detailed Holocene record of environmental, hydrological and climatic change for the transitional zone between the humid Pyrenees and the semi-arid Ebro River Basin (NE Spain). Five organic macro-remains dated by AMS ¹⁴C provide a chronological framework for the sequence. The basal age is 9498 ± 50 cal years BP. High-resolution magnetic susceptibility data and sedimentary facies identification (mineralogy, smear slides and SEM observations) together with Total Inorganic Carbon, Total Organic Carbon, Total Sulphur and Total Nitrogen analyses allowed the reconstruction of periods of increased

chemical water concentrations, fluctuating bottom anoxic conditions, and occurrence of periods of increased surface erosion and floods. Stable isotopes ($\delta^{13}\text{C}$, $\delta^{18}\text{O}$) in organic matter and carbonates are coherent with these interpretations showing large fluctuations in water salinity and water level during the Holocene that could be correlated with millennial-scale climatic fluctuations. Biogenic Opal content record shows 2 major peaks related to maximum algal productivity.

Comparison of the main arid and humid periods in Estanya with Northern European and African records allows evaluation of the singularity of the Iberian Peninsula climatic evolution during the Holocene.