



Late Holocene subalpine lake sediments record a multi-proxy shift to increased aridity at 3.65 kyr BP, following a millennial-scale neopluvial interval in the Lake Tahoe watershed and western Great Basin, USA

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A mid Holocene dry period has been reported from lake records in the Great Basin and Sierra Nevada, yet the spatial and temporal extent of this interval is not well understood. We present evidence for a millennial-scale interval of high winter precipitation (neopluvial) at the end of the mid Holocene in the Lake Tahoe-Pyramid Lake watershed in the northern Sierra Nevada that reached its peak ~ 3.7 kcal yr BP. A transect of 4 cores recovered from Fallen Leaf Lake in the Tahoe Basin were dated using AMS¹⁴C on plant macrofossils, and analyzed using scanning XRF, C and N elemental and stable isotope measurements, and diatoms as paleoclimate proxies. Fallen Leaf Lake is a deep glacially-derived lake situated in the Glen Alpine Valley at an elevation of 1942m, ~ 45 m above the level of Lake Tahoe. In Fallen Leaf Lake, the end of the neopluvial is dated at 3.65 ± 0.09 kcal yr BP, and is the largest post-glacial signal in the cores. The neopluvial interval is interpreted to be a period of increased snowpack in the upper watershed, supported by depleted $\delta^{13}\text{C}_{org}$ (-27.5%) values, negative baseline shifts in TOC and TN, lower C:N, and high abundances of *Aulacoseira subarctica*, a winter-early spring diatom. Collectively, these proxies indicate cooler temperatures, enhanced mixing, and/or shortened summer stratification resulting in increased algal productivity relative to terrestrial inputs. The neopluvial interval ends abruptly at 3.65 ka, with a change from mottled darker opaline clay to a homogeneous olive clay with decreased *A. subarctica* and opal, and followed by a 50% reduction in accumulation rates. After this transition $\delta^{13}\text{C}_{org}$ becomes enriched by 2‰ and TOC, TN, and C:N all show the start of positive trends that continue through the Holocene. Pyramid Lake is an endorheic basin situated at the terminal end of the watershed, and inflow arrives from the Lake Tahoe basin via the Truckee River. At Pyramid Lake, existing ages on paleo-shorelines indicate a significant lake-level rise beginning at some point after 5 kcal yr BP and reaching a highstand of about 1186 m between 3.8 – 4.1 kcal yr BP (Briggs et al., 2005), but new OSL ages on Holocene shorelines are pending. In the Walker, Mono, and Owens lake basins, the neopluvial shorelines represent the highest late Holocene shorelines (Stine, 1990; Adams et al., 2014). Collectively, these studies indicate that the neopluvial and subsequent aridification intervals preserved in Fallen Leaf Lake sediments were at least regional in scale, affecting the watersheds in the northern Sierra Nevada-western Great Basin