Chromaticity of Selin Co Lake Sediments in the Central Tibetan Plateau Reflects Regional Paleoclimate Evolution Since the Last Glacial Maximum (Postprint)

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Abstract

Selincuo Lake, located in the interior of the Tibetan Plateau, is the largest saline inland lake in Tibet. The study section was selected from the third lacustrine terrace of Selincuo Lake. Using chromaticity, a common climate proxy indicator, together with grain size, carbonate content [CaCO3(%)], mineral analysis, and total organic carbon (TOC) for comparative analysis, and simultaneously employing 14C dating methods for accurate chronological division of the section, this study preliminarily explores the variability of the chromaticity enhancement mechanism of Selincuo Lake sediments since the Last Glacial Maximum. The results indicate that: a* and b* exhibit good correlation with medium-coarse sand and magnetic susceptibility; lightness L* shows good correlation with CaCO3(%); thus, variations in sediment chromaticity can reflect regional paleoclimate changes. Additionally, mineral analysis of lake sediments reveals that the primary color-forming minerals influencing chromaticity variations are goethite, predominantly under reducing conditions. High values of redness a* and low values of lightness L* correspond to warm-humid climate conditions, characterized by coarser sediment grain size, low carbonate content, high organic matter content, and higher magnetic susceptibility values; conversely, low values of redness a*, high values of L*, finer grain size, high carbonate content, low organic matter content, and low magnetic susceptibility values correspond to dry-cold climate. During the 17.4~15.5 cal ka BP interval, it corresponds to dry-cold climate characteristics; during the 15.5~10.4 cal ka BP interval, it corresponds to warm-humid climate; during the 10.4~5.2 cal ka BP interval, the overall characteristics belong to warm-humid climate; among which, 9.7~9.4 cal ka BP and 8.75~8.5 cal ka BP represent two important cold events with dry-wet climate characteristics; during the 5.2~1.2 cal ka BP interval, it reflects

dry-cold climate characteristics; during 4.3~4.0 cal ka BP, 3.3~3.0 cal ka BP, and 2.4~1.75 cal ka BP, it reflects arid-warm climate characteristics; after 1.2 cal ka BP, the water level of Selincuo Lake declined rapidly.

Full Text

Preamble

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Abstract

Selin Co Lake is located in the central Qinghai-Tibetan Plateau, a region highly sensitive to climate change and minimally influenced by human activities. In recent years, this area has become a focal point for paleoenvironmental research. This study selected a profile from the lake’ s third terrace and collected 122 samples. Radiocarbon (^{1} C) dating provided precise age control for the profile. Multiple analytical methods—including total organic carbon (TOC), X-ray diffraction (XRD), calcium carbonate content (CaCO %), magnetic susceptibility, and grain size analysis—were employed to reconstruct the paleoenvironmental history.

The investigation focused on three color components: redness (a*), yellowness (b*)*, and brightness (L*). The a* and b* values are primarily associated with goethite content, with sedimentary a* serving as an effective indicator of warm-humid climate conditions. The L* parameter exhibits strong correlations with TOC and CaCO %, and moderate relationships with magnetic susceptibility and grain size.

Coarser grain size, elevated magnetic susceptibility, higher organic content, and decreased CaCO % collectively indicate warm-humid conditions, characterized by high a* and low L* values. Conversely, fine grain size, low magnetic susceptibility, reduced organic content, and increased CaCO % reflect cold-dry conditions, marked by low a* and high L* values.

Based on these proxies, paleoclimatic changes were delineated into five distinct stages: (1) a cold-dry period from 13.33–12.23 ka BP, (2) a pronounced cold-dry interval from 12.23–10.07 ka BP encompassing the Younger Dryas event, (3) a Holocene megathermal period from 10.68–8.70 ka BP featuring sustained high a* and b* values with declining L*, (4) a warm-humid phase from 8.70–3.93 ka BP, and (5) a cold-dry period from 3.93–0 ka BP. These results align closely with monsoon variability patterns documented across the Qinghai-Tibetan Plateau.

Keywords: Hue; grain size; paleoclimate and paleo-environment; Selin Co Lake

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Note: Figure translations are in progress. See original paper for figures.