A Holocene palaeoenvironmental reconstruction of Lake Albert, South Australia: an isotopic, geochemical and palynological interpretation

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Abstract

Lake Albert, situated at the terminus of the River Murray, forms part of the diverse and ecologically important Lower Lakes system of shallow lakes and wetlands. Past and current environmental change within Lake Albert and surrounding areas is currently a topical issue in political and public debate, centering on the heavy regulation of River Murray flows and other anthropogenic impacts, as well as future sustainability and remediation. This study presents the first detailed palaeoenvironmental reconstruction of Lake Albert, based on stable isotope and palynological analysis. Two main cores were analysed, one from the middle of the lake (Site 1) and the other close to the Narrows (Site 2). The sedimentary records from these cores date to 7195 ± 35 yr BP and 7305 ± 35 yr BP respectively, indicating a complete record of lacustrine sedimentation at both sites. Lacustrine clayey-mud facies show an upward decreasing trend in total organic carbon values and increasing carbonate content, indicating general decreases in water depth and productivity with lake evolution, as well as increasing lake isolation. Palynological analysis indicates predominantly freshwater eutrophic conditions, supported by C/N ratios. However, $\delta^{13}C$ concentrations are heavier than typical lake organic matter dominated by algae (range = -18.3 to -26.9‰). This is most likely explained by an increasingly heavy $\delta^{13}C$ composition of dissolved inorganic carbonate input into Lake Albert. Heavy sources of $\delta^{13}C$ in DIC in Lake Albert are most likely as a result of higher input of carbon from remineralised C_4 plants, supported by the significant presence of C_4 grasses within the lake catchment and little variation in C/N

ratios from algal sources. The presence of freshwater pollen and algae, and the absence of dinoflagellates in pollen assemblages indicate that Lake Albert has never been directly connected to the Coorong Lagoon. Major depositional and geochemical changes have occurred within the upper sediments of Lake Albert as a result of anthropogenic impacts, associated with greatly increased sedimentation rates. Increased knowledge in the natural palaeoenvironmental evolution of Lake Albert indicates that, of the three major remediation options proposed by the Federal Senate in 2008, the current remediation program within Lake Albert, which allows it to dry out and become an ephemeral system, is the most sustainable solution currently available.

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