Decadal diagenetic effects on d13C and d15N studied in varved lake sediment

Gälman, Veronika, Johan Rydberg, Christian Bigler

Limnol. Oceanogr., 54(3), 2009, 917-924 | DOI: 10.4319/lo.2009.54.3.0917

ABSTRACT: To assess the long-term (27 yr) effects of sediment aging on stable carbon and nitrogen isotope values ($\delta^{13}C$ and $\delta^{15}N$), we used a collection of eight freeze cores of annually laminated (varved) lake sediment collected from 1979 to 2007 in Nylandssjon (northern Sweden). Previous research has shown that 20-23% of carbon and 35% of nitrogen is lost in 27 yr. Material from specific years was compared in the cores, e.g., $\delta^{13}C$ and $\delta^{15}N$ of the surface varve of the 1979 core was followed in cores retrieved in 1980, 1989, 1993, 2002, 2004, and 2006. $\delta^{13}C$ increased by 0.4-1.5% during the first 5 yr. After this initial increase, only minor fluctuations were recorded. There is a good correlation between the magnitude in $\delta^{13}C$ changes and the initial carbon and nitrogen concentrations, indicating that the initial sediment composition is important for the ^{13}C fractionation. $\delta^{15}N$ gradually decreased by 0.3-0.7% over the entire 27-yr period. The lack of correlation with the initial sediment composition and the gradual decrease in $\delta^{15}N$ indicates a microbial control on $\delta^{15}N$ change. The diagenetic changes in the stable isotope values that occur in Nylandssjon are small, but of the same magnitude as the down-core variation in the varves deposited 1950-2006. Diagenetic effects should be considered when $\delta^{13}C$ and $\delta^{15}N$ are used to study organic matter sources or paleoproductivity, especially when dealing with recent trends or small changes. Based on our findings, diagenetic effects for $\delta^{13}C$ are observed during the first 5-10 yr, whereas no delimitation can be recommended for $\delta^{15}N$.