Nitrogen Isotopes

Messy, messy, messy!

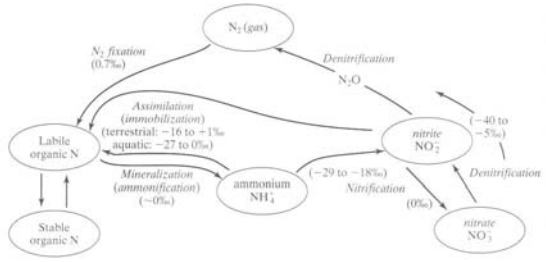


FIGURE 9.1: Simplified diagram of the nitrogen cycle. Note that nitrification is generally thought of as the conversion of ammonium to nitrate, with nitrite an intermediate step. Likewise, denitrification is the conversion of nitrate to N_2 and/or N_2O gas, but nitrite is an intermediate phase. Numbers in parentheses indicate average fractionations ($\delta^{15}N_{product} - \delta^{15}N_{source}$) associated with each process.

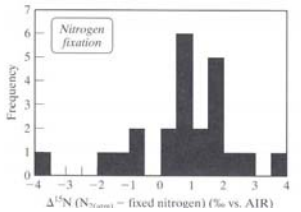


FIGURE 9.2: Fractionation associated with N_2 fixation. The average value is 0.72‰ (meaning that the organisms have $\delta^{15}N$ values less than 0‰). (Data from Hübner, 1986.)

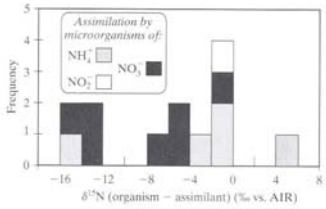


FIGURE 9.3: **Nitrogen isotope fractionation during assimilation by microorganisms.** On the basis of limited data, the fractionation is similar, regardless of whether ammonium, nitrate, or nitrite is the assimilant. (Data from Hübner, 1986.)

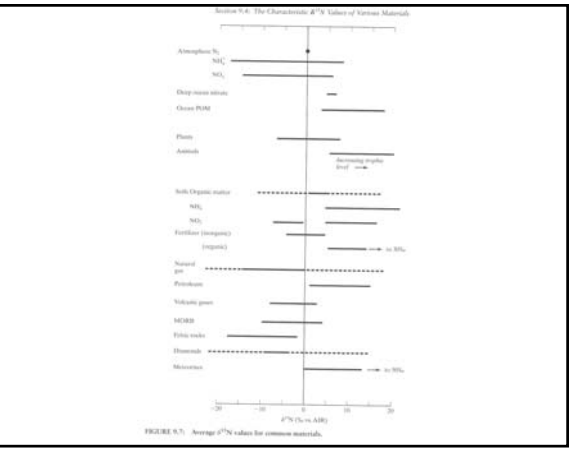


FIGURE 9.7: Average $\delta^{15}N$ values for common materials.

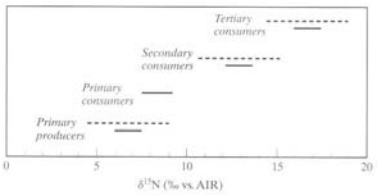


FIGURE 9.8: **Nitrogen isotope compositions of marine plants and animals as a function of trophic level.** There is a regular increase of approximately 3‰ per trophic level. (Data from Minagawa and Wada, 1984 (solid); Schoeninger and DeNiro, 1984 (dashed).)

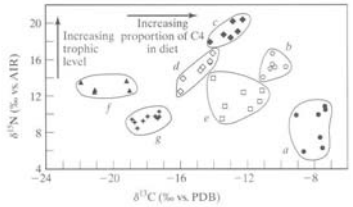


FIGURE 9.9: δ^{13}C and δ^{15}N values of bone collagen from Native American communities:
a. Western Anasazi, Southern Utah (A.D. 1–1300)
b. Nantucket Island, Massachusetts (A.D. 1000–1600)
c. Northwest coast Haida and Tlingit salmon fishers (historic)
d. Southern California coastal (A.D. 1400–1800)
e. Plains Arikara, South Dakota (A.D. 1650–1733)
f. Southern Ontario, Middle Woodland period (A.D. 1–400)
g. Modern Chicago, United States.
See text for details. Compilation and references from Martin (1999) and Schoeller et al. (1986).

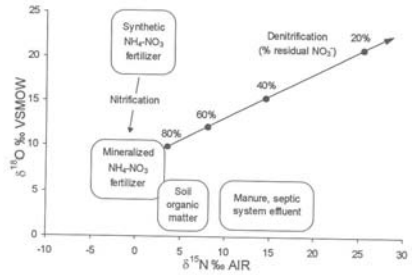


Fig. 6-12 The isotopic composition of various sources of NO_3^-. The enrichment trend for NO_3^- during denitrification is shown with % of original concentration remaining. δ^{18}O values for nitrate vary according to the δ^{18}O of local groundwaters. Ranges are for groundwaters with $\delta^{18}O_{H_2O}$ ~ –10‰ VSMOW.

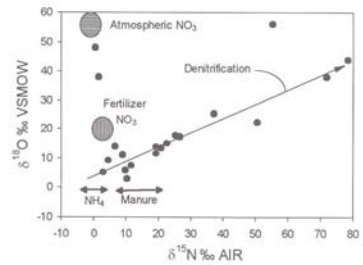
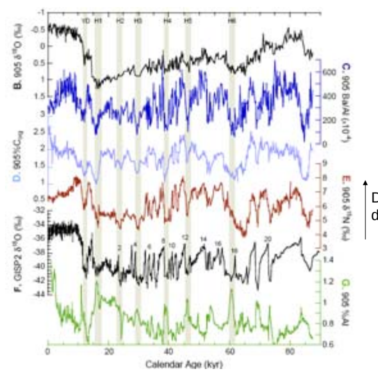


Fig. 6-15 Denitrification in the Fuhrberg aquifer shown by increases in δ^{15}N and δ^{18}O values (Böttcher et al., 1990).



Variations in tropical convection as an amplifier of global climate change at the millennial scale

Impacts of Climatic Change and Fishing on Pacific Salmon Abundance Over the Past 300 Years

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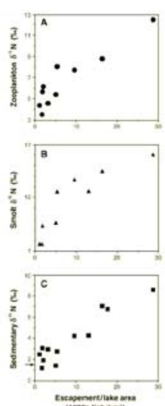
Fig. 1. Locations of seven Alaskan lakes discussed in this study: 1, Karluk; 2, Frazer; 3, Red; 4, Akalura; 5, Ugashik; 6, Becharof; and 7, Tazimina.



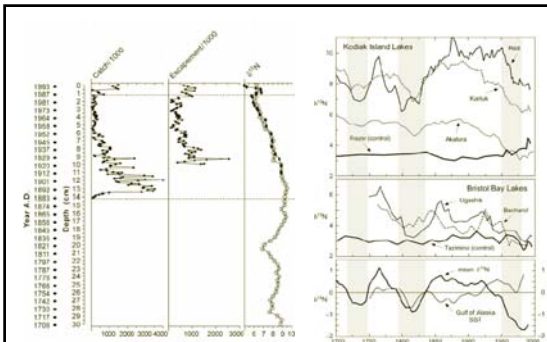


Fig. 3. Historical and paleolimnological evidence of sockeye salmon variation in Karluk Lake over the past ~300 years. The historical information for Karluk sockeye salmon includes commercial catch data beginning in 1882 and escapement counts from a weir on the Karluk River beginning in 1921. The paleolimnological data consist of $\delta^{15}N$ profiles from two replicated cores collected at the same sampling station showing the excellent reproducibility of the coring, isotope and dating techniques, concentrations of cladoceran *Bosmina longirostris* microfossils, relative abundances of dominant diatom taxa (greater than 10% in at least one interval), and the relative abundance sum of all benthic diatoms. The data are divided into three different zones (from top to bottom): the fertilization period, the commercial fishing period, and the precommercial fishing period.