# Evaluating $\delta^{15}N$ as a high pH proxy for closed-basin lacustrine systems

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The pH-dependent nature of reduced nitrogen species allows for stable isotope investigations of high-pH, closed-basin lacustrine rock records. Exploring the range of environments in which such a proxy is valid could have major implications for future $\delta^{15}N$ interpretations of crater paleolakes on Earth and Mars. As pH increases, a greater proportion of gaseous $NH_3$ volatilizes out of solution ($pK_a$ = 9.25); this imparts a fractionation favoring the volatilization of $^{14}N$, leaving behind an $NH_4^+$ pool enriched in $^{15}N$ [1].

Two data sets from the rock record have been generated to explore this effect. The first comes from the 15-Ma-old Nördlinger Ries impact crater in southern Germany, a Mars analog of the highest order because—like craters on Mars—it possesses a well-preserved, dual-layer ejecta (DLE) blanket composed of materials that resettled after impact [2]. $\delta^{15}N$ values from a sedimentary drill-core sequence range from 3.82‰ to 17.47‰. The second data set is from the Green River Formation (GRF) of west-central USA. $\delta^{15}N$ values range from 5.97‰ to 21.44‰, with a net $\delta^{15}N$ increase covering a 6-million-year period (54-48 Ma). This timespan includes the Early Eocene Climatic Optimum (52.6-50.3 Ma), an event hypothesized to favor an increase in lake pH [3].

While both data sets help to establish the value of using $\delta^{15}N$ to track high-pH shifts, calibration in modern systems is requisite to refining this proxy. Samples were collected from five alkaline lakes in Coorong National Park, South Australia. Beyond pH, it appears that other factors also contribute to the $\delta^{15}N$ trends of each lake. We hypothesize that the largest additional controls include salinity, anoxia, and evaporation. These data may represent a first step toward developing a comprehensive understanding of ammonia volatilization with the goal of bridging a notable gap between experimental predictions and field results. [1] Li et al. (2009), *GCA* 73, 6282-6297. [2] Sturm et al. (2013), *Geology* 41, 531-534. [3] Lowenstein et al. (2017), *Earth-Sci. Rev.* 173, 295-306.