$\delta^{15}N$ as a pH proxy for the Miocene Ries Impact Crater lake

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The 15-Ma-old Nördlinger Ries impact crater in southern Germany is 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. An ancient lake was housed in the crater, and successive erosion of the DLE blanket may have caused multiple shifts in that lake's ion concentrations and pH value [1]. Models suggest that the first of these shifts led to the formation of a stratified brackish eutrophic soda lake that later transitioned towards less alkaline saline conditions. Prior to this study, no information was available on the nitrogen and sulfur isotope compositions of the sediments that filled the impact crater. Here we present new $\delta^{15}N$ data that strongly support the pH trends suggested from autigenic minerals and hydrochemical modeling, as well as $\delta^{34}S$ values that are reshaping previous assumptions regarding the lake's initial sulfur inputs.

At pH 9.25, NH_3 and NH_4^+ are at equal parts in solution (pK_a = 9.25). Therefore, as pH increases, a greater proportion of gaseous NH_3 volitilizes out of solution. This process imparts an isotopic fractionation favoring the volitilization of ^{14}N, leaving behind an NH_4^+ pool enriched in ^{15}N [2]. Our $\delta^{15}N$ data display not only the heavy values diagnostic of this effect, but also a trend that matches favorably with previous pH modeling. Our bulk $\delta^{34}S$ data contain values that are significantly heavier than those of the surrounding Mesozoic target rocks and their underlying groundwaters. A second stage of research is underway to determine if impact events can significantly alter the sulfur isotope compositions of their associated melts and breccias. Our ultimate goal is a refined understanding of the environments and expressions of life in the lake after impact, with the hope of identifying the conditions and potential for preservable biosignatures in analogous ancient crater lakes on Mars.

[1] Arp *et al.* (2013) *GSA Bulletin* **125** (7-8), 1125–1145.
[2] Li *et al.* (2009) *GCA* **73**, 6282-6297.