

LDEO Climate Center Proposal: Mono Lake CO₂ Exchange Rate

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Abstract

Based on measurements of ¹⁴C commencing in the late-1950's, the ¹⁴C inventory of Mono Lake has increased about ten-fold faster than expected. A whole lake SF₆ tracer experiment conducted in the late-1980's confirmed that air-water gas exchange of inert gases was close to canonical estimates based on wind speed over the lake. The most plausible hypothesis for the rapidly increasing ¹⁴C values is that air-water CO₂ exchange is enhanced due to either the high pH of the lake (≈ 9.8) or the very high biological productivity measured in the lake. In particular, carbonic anhydrase released by the abundant brine shrimp and/or algae might be the culprit. Preliminary experiments were conducted in Mono Lake in August 2006 to determine the enhancement rate of air-water CO₂ exchange over inert gases (N₂O and O₂) in both Mono Lake (at low winds) and in a circular wind-wave tank shipped to the site and filled with Mono Lake water. These preliminary experiments yielded an enhancement factor of 3 to 4 at low and medium wind speeds. While the enhancements at low wind speeds are in accord with theory of chemical enhancement due to hydration reactions of CO₂ with OH⁻, the enhancement at intermediate winds is surprising and might point to biologically mediated processes. In November 2006, we will return to Mono Lake to conduct further experiments to cover a range of wind speeds. A total of nine experiments will be conducted in a three-day period. In each experiment, the CO₂ exchange rate will be compared with other gases (N₂O and O₂), while SF₆ will be used to leak test the apparatus. Also, by carrying out measurements at a different time of year, the roles of high pH and carbonic anhydrase may be determined.