

$^{88}\text{Sr}/^{86}\text{Sr}$ fractionation and calcite accumulation rate in the Sea of Galilee

NOA FRUCHTER ^{1,2}; BOAZ LAZAR ¹; AMINADAV NISHRI ³; AHUVA ALMOGI-LABIN ²; ANTON EISENHAUER ⁴; YARON BEERI-SHLEVIN ³; MORDECHAI STEIN ^{1,2}

¹Institute of Earth Sciences, The Hebrew University, Jerusalem, Givat Ram, Israel

²Geological Survey of Israel, 30 Malkhe Israel St., Jerusalem, 95501, Israel

³Israel Oceanographic and Limnological Research, Yigal Allon Kinneret Limnological Laboratory, P.O. Box 447, Migdal 14950, Israel

⁴GEOMAR, Helmholtz-Zentrum für Ozeanforschung Kiel, Wischhofstr. 1-3, 24148 Kiel, Germany

This study uses Lake Kinneret (Sea of Galilee, northern Israel) as a natural laboratory to investigate the fractionation of the stable Sr isotope ratio ($^{88}\text{Sr}/^{86}\text{Sr}$) during precipitation of authigenic calcite in the water column, and evaluates the dependence of the fractionation on $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{88}\text{Sr}/^{86}\text{Sr}$ ratios in the freshwater and brines that enter the lake are used to calculate the relative contributions of these sources to the Sr budget of the modern lake. The $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{88}\text{Sr}/^{86}\text{Sr}$ ratios were measured in authigenic calcite, living *Melanopsis* shells, lake water and various water sources to the lake. While the lake $^{87}\text{Sr}/^{86}\text{Sr}$ ratios are determined by the mixture of freshwater supplied mainly by the Jordan River and saline springs, the $^{88}\text{Sr}/^{86}\text{Sr}$ ratios of the lake reflect a more complex mass balance that includes the effect of isotopic fractionation during the precipitation of authigenic calcite. The data show a significant long-term effect of calcite accumulation on the stable Sr isotope ratio of the lake, increasing the $^{88}\text{Sr}/^{86}\text{Sr}$ of the water by 0.04 ‰. In contrast to the authigenic calcite, biogenic aragonite shells are shown to have a rather constant $^{88}\text{Sr}/^{86}\text{Sr}$ water- CaCO_3 fractionation of precipitation of coralline and chemical aragonite from seawater and the precipitation of authigenic calcite from various continental waters. The field data of the present study suggests that the fractionation of $^{88}\text{Sr}/^{86}\text{Sr}$ in authigenic calcite represents a kinetic fractionation that varies with precipitation rate, in addition to the constant thermodynamic property. Massive precipitation of authigenic calcite occurs in Lake Kinneret during the spring phytoplankton bloom as the latter increases considerably the degree of calcite saturation. The correlation between accumulation rate can be therefore used as a tool to reconstruct paleo-environmental variations by analyzing the $^{88}\text{Sr}/^{86}\text{Sr}$ ratio in authigenic CaCO_3 in core sections.