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Sr and O isotopic compositions and water chemistry in Salton Basin, California: implications for changes in water source and paleoclimate

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Salton Basin is located in the arid southeastern California where scanty knowledge on late Pleistocene-Holocene climate changes exists due to a general dearth of climatic archives in the desert environment. The basin is occupied by Salton Sea, a closed marine-like lake belonging to the Colorado River (CR) drainage system. Through Alamo River and New River to the south, Salton Sea presently receives 85% of its water from the CR in the form of agricultural, municipal and industrial wastewaters. The remaining inputs are from Whitewater River at the Sea's northern end (7%), surface precipitation (∼3%) and groundwater (∼4%). During the past, lakes with fluctuating levels occupied the basin. For instance, shoreline features show that Lake Cahuilla of late Pleistocene-Holocene age left more than 600 m-thick lacustrine deposits including abundant tufas. The paleoclimatic signals of the paleolake records based on geomorphic features, however, were often obscured by the Colorado River inflow to the basin. In order to reconstruct past changes of climate and input from CR in the Salton Basin, we have explored the use of isotopic and chemical proxies. We investigated oxygen and strontium isotopic compositions and concentrations of Na, K, Ca, Mg, Sr, Rb, Cs, Ba, Al, Pb, U, and Li in waters collected from rivers, creeks and Salton Sea in the Salton Basin and its surrounding areas. Three saline water samples from the north, northwest and southwest beaches of Salton Sea have δ^{18}O values of -1.0 to 0.6 permil (SMOW), and ^{87}Sr/^{86}Sr ratios of 0.710101 to 0.710108 (with analytical er-

rors about $\pm$0.000005). Samples from Alamo River and New River have δ^{18}O values of -10.9 and -10.7 permil (SMOW), and ^{87}Sr/^{86}Sr ratios of 0.710230 and 0.709848, respectively. The CR near Salton Basin has δ^{18}O of -11.9 permil and ^{87}Sr/^{86}Sr of 0.710429, whereas Whitewater River near Salton Basin has δ^{18}O of -10.6 permil and ^{87}Sr/^{86}Sr of 0.715960. Waters from three creeks around Salton Sea have δ^{18}O values ranging from -10.3 to -3.6 permil and ^{87}Sr/^{86}Sr ratios from 0.708830 to 0.711112. The concentrations of the afore-mentioned elements provide constraints on the chemical characteristics for each of the water sources to the Salton Sea. Our isotope and chemical analyses indicate the following: (1) The CR water has an ^{87}Sr/^{86}Sr ratio distinguished from that of Whitewater River. As the ^{87}Sr/^{86}Sr ratio of Salton Sea is identical to that of the CR water, it implies that regardless of evaporation and mixing, the ratio of the lake water has remained relatively unchanged since 1905 when Salton Sea formed. If so, one may use the ^{87}Sr/^{86}Sr ratio in lacustrine deposits to identify the time and duration of the CR input. (2) That the δ^{18}O of Salton Sea is much heavier than that of its input waters reflects the evaporation effect on the δ^{18}O of a closed-basin lake. We may thus use the δ^{18}O record of the lake sediments to re-trace the hydrological changes, hence the paleoclimatic history, of the Salton Basin.