Uranium-series dating of travertine from Soda Dam, New Mexico: Constructing a history of deposition, with implications for landscape evolution, paleohydrology, and paleoclimatology


High precision uranium-series geochronology at Soda Dam, New Mexico provides a record of paleohydrology and incision history for the upper reaches of the Jemez River over the last 700 ka. Active travertine-depositing hot springs occur along the intersection of the Soda Dam fault, and the Jemez River; new dates on active and extinct deposits provide improved geochronologic and geologic context with respect to the timing of travertine accumulation. The largest volume-accumulation, Deposit A, yields ages ranging from >700 ka to 259.6 ± 14.5 ka. The oldest ancestral Jemez River gravels are preserved beneath Deposit A, at a maximum elevation of 132 m above the modern river; efforts to date pumice clasts are ongoing, but model ages of ~700 ka provide an estimate of 188 m/Ma over the last 700 ka. This agrees with longer term bedrock incision rates of 200 m/Ma, from the base of the 1.1 Ma Bandelier tuff. Inset into Deposit A, Deposit A1, contains travertine-coated Jemez River gravels with a strath 30 m above the modern river; these yield an age of 200.6 ± 2.1 ka, giving a bedrock incision rate of 150 m/Ma over the last 200 ka. A cross cutting vein, at the same elevation as the 200 ka sample, yields an age of 110.9 ± 1.5 ka, suggesting substantial artesian head during the 5e substage of the Eemian interglacial. Deposit B, at lower elevations, developed on a banded central fissure ridge; combined ages from the fissure and mound accumulation indicate the system was active from 138-78 ka, a 60,000 yr interval spanning the transitional period during termination II. Deposit C, at 23 and 16.5 m above the modern river, respectively, yielded ages of 103.2 ± 0.5 ka and 101.7 ± 0.5 ka, giving a river incision rate of 160 m/Ma over the last 100 ka. Our results suggest semi-steady bedrock river incision since ~1 Ma with episodic travertine deposition along the Soda Dam fault system at 400-700 ka, 260-360 ka, 134-96 ka, and < 5 ka; reflecting the changes in climate, regional volcanic processes and the existence of the Valles Caldera paleolakes. Stable isotope values of the dated travertines range from δ18O = -19 to -6.5 per mil (PDB), reflecting variations in local spring chemistry and temperature. Compared to global travertine data, Soda Dam travertines have relatively positive C isotope values of +1.4 to +11.7, suggesting degassing of CO2 in the hydrothermal system.

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geochronology, Quaternary geology, travertine, uranium-series, U-Pb, springs, paleoclimate, hydrology, landscape evolution, geomorphology

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