Environmental controls on silica sinter formation revealed by radiocarbon dating

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Silica sinter deposits overlying geothermal fields are reliable records of environmental, geochemical, and biological changes through time. Therefore, determining the absolute ages of formation of these deposits is fundamental to constrain the timing and evolution of processes that have shaped silica precipitation on the Earth's surface. We performed 14C dating of organic matter trapped within silica sinter deposits from the high-altitude El Tatio geyser field in the Chilean Altiplano. Radiocarbon ages of stratigraphically controlled samples retrieved from four well-preserved paleosinter mounds range from 10,840 ± 30 to 230 ± 35 yr B.P., indicating that the El Tatio system has had active discharge of silica-rich chloride springs over at least the past 10,000 years that has resulted in the formation of extensive sinter deposits. These ages are used to determine the silica precipitation rate at El Tatio, which was calculated to be between 0.14 and 2.57 kg/yr/m2. These values are among the highest precipitation rates in geothermal systems for which data are available, and are consistent with in situ silica precipitation experiments at El Tatio (0.84-2.92 kg/yr/m2). Our results indicate that the extreme environmental conditions of the arid Chilean Altiplano, i.e., high evaporation and cooling rate of thermal waters and significant daily temperature oscillations, play a key role in the construction and preservation of silica sinter deposits.