

## Travertines: An end product of rising mantle fluids

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Travertines are a common surface product from mantle derived waters rich in CO<sub>2</sub> (e.g., Rio Grande Rift in New Mexico and Arizona, basins of the Brazilian Atlantic margin, etc.). Travertine deposits range from subaerial to subaqueous and include extensive lacustrine accumulations (e.g., Bagni di Tivoli, Italy) and large terraced mounds (e.g., Yellowstone) to somewhat smaller fluvial, sloping fans, and fissure ridges. The deposits are predominantly calcite and aragonite and individual constituents range from abiotic to bacterially induced precipitates. Sampling surface waters and precipitates unfortunately commonly does not accurately reflect the rising mantle water composition. Oxygen and carbon isotopic values of the waters change markedly in short distances due to degassing, e.g.,  $\delta^{13}\text{C}$  increases of 5‰ in 25m downflow from a vent. Precipitates commonly display seasonal laminae millimeters thick and generally summer carbon isotopic values are lower whereas oxygen values as well as Mg, Sr, and Mn are higher than in immediately vertically adjacent winter laminae, consequently individual laminae must be sampled to obtain meaningful analyses. Different types of carbonate grains (e.g., rafts vs encrusted algae) that formed at the same time and within centimeters of each other display different stable isotopic values. Additionally, due to high concentrations of the reactants, some measured in excess of 50 I<sub>sat</sub>, disequilibrium precipitation is common and also biotic fractionation presents additional complications.