

WATER CONTENT OF OPAL-A: IMPLICATIONS FOR THE ORIGIN OF LAMINAE IN GEYSERITE AND SINTER

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ABSTRACT: Sinter and geysерite, formed largely of amorphous opaline silica (opal-A), precipitate at many hot-spring and geyser systems like those found on the North Island of New Zealand. Opal-A is a hydrated silicon dioxide ($\text{SiO}_2 \cdot n\text{H}_2\text{O}$) that may contain silanols, trapped water, and/or absorbed water. Little is known about the factors that control the distribution of water ($\text{H}_2\text{O} + \text{OH}$) in sinter and geysерite.

Backscattered electron images (BSEI) of geysерite and sinter commonly reveal sectors and/or alternating laminae that are characterized by differences in their average atomic weights. Electron microprobe (EMP) and scanning electron microscope (SEM) analyses, however, show that differences in the average atomic weights cannot be attributed to the presence of other elements (e.g., Au, Ag) or minerals (e.g., sulfur, kaolinite, jarosite). The compositional heterogeneity in the opal-A, as highlighted by BSEI, must reflect variation in the water content of the opal-A. Integration of BSEI and EMP analyses for Si and O shows that opal-A contains “excess” O that must be bound into the H_2O and OH. The excess O can be used a proxy for the total water ($\text{H}_2\text{O} + \text{OH}$) content of the opal-A that forms geysерite and sinter.

Geysерite and sinter from the Whakarewarewa geothermal area is formed of “dry” opal (average 5--6 wt % $\text{H}_2\text{O} + \text{OH}$) and “wet” opal (average 12--13 wt % $\text{H}_2\text{O} + \text{OH}$). Interpretation, based largely on the distribution of these different types of opal in the geysерite and sinter, suggests that the “wet” opal forms as a result of rapid precipitation whereas the “dry” opal forms as a result of slower precipitation. Such information must be integrated into any model that attempts to explain the evolution of geysерite and sinter deposits.