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Three-Dimensional Oxygen Isotope Imaging of Convective Fluid Flow around the Big Bonanza, Comstock Lode Mining District, Nevada

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Abstract

Oxygen isotope analyses of propylitized andesites from the Con Virginia and California mines allow construction of a detailed, three-dimensional image of the isotopic surfaces produced by the convective fluid flows that deposited the famous Big Bonanza orebody. On a set of intersecting maps and sections, the $\delta^{18}O$ isopleths clearly show the intricate and conformable relationship of the orebody to a deep, ~500 m gyre of meteoric-hydrothermal fluid that circulated along and above the Comstock fault, near the contact of the Davidson Granodiorite. The core of this gyre ($\delta^{18}O$ = 0 to 3.8‰) encompasses the bonanza and is almost totally surrounded by rocks having much lower $\delta^{18}O$ values (–1.0 to –4.4‰). This deep gyre may represent a convective longitudinal roll superimposed on a large unicellular meteoric-hydrothermal system, producing a complex flow field with both radial and longitudinal components that is consistent with experimentally observed patterns of fluid convection in permeable media.