Oxygen and Carbon Isotope Study of Natural and Synthetic Azurite

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Abstract

Slow precipitation experiments were used to determine the oxygen isotope fractionation between azurite$_{(CO_3)}$ and water. This temperature-dependent fractionation is $1000 \ln \alpha = 2.67 (10^6/T^2) + 4.75$, where T is in kelvins, azurite$_{(CO_3)}$ denotes the CO_2 liberated by acidification of azurite and corrected to calcite standards.

Oxygen isotope data for 46 azurite samples from 44 localities around the world suggest formation from meteoric waters. Both carbon and oxygen isotope delta values for natural azurites are consistent with values recorded for speleothems, soil carbonates, and malachite, suggesting that azurite commonly derives much of its carbon from isotopically light soil CO_2.

The new oxygen isotope thermometer indicates that most natural azurites form within ±10°C of modern local air temperatures. A few azurite samples from deposits of massive sulfides yield apparent temperatures up to 48°C, which are significantly higher than modern air temperatures. We suggest that the higher apparent temperatures record the heat produced during oxidation of concentrated sulfides. Our results indicate that exothermic oxidation of massive sulfide deposits can produce shallow subsurface temperatures up to 25°C higher than mean local air temperatures.