ST.232

Stable Isotopic Study of the Drake Goldfield, Northeastern NSW, Australia

Hongyan Quan[1], Ian Graham[1], Rohan Worland[2], Lewis Adler[3], Christian Dietz[4]
1. School of Biological, Earth and Environmental Sciences, UNSW Sydney, Kensington, NSW, Australia, 2. White Rock Minerals Ltd., Ballarat, VIC, Australia, 3. Bioanalytical Mass Spectrometry Facility, UNSW Sydney, Kensington, NSW, Australia, 4. Central Science Laboratory, University of Tasmania, Hobart, TAS, Australia

The Drake Goldfield is located in the southern New England Fold Belt of northeastern New South Wales, Australia. It contains a number of low-sulfidation epithermal precious metal deposits including those at Mt. Carrington, White Rock, and Red Rock, with a current mineral resource containing 23.2 Moz Ag and 341 koz Au. These deposits occur exclusively within the Drake Volcanics, a 60- × 20-km NW-SE-trending sequence of Late Permian shallow volcanics and related epiclastics, which drilling suggests are at least 600 meters thick. The Drake Volcanics are centered on a circular magnetic feature, the Drake Quiet Zone, which mapping confirmed to be a collapsed volcanic caldera structure. Although known and mined for over 100 years, there have been few detailed studies on deposits associated with the Drake Volcanics, the only comprehensive study being that on the Red Rock Field, one of the smallest within the larger Drake Goldfield.

A total of 92 fresh carbonate vein samples were microdrilled from diamond drillcores from across the field and at various depths, and pXRD analysis of these identified five species: ankerite, calcite, dolomite, magnesite, and siderite. Overall, the $\delta^{13}C_{PDB}$ varies little in comparison to the $\delta^{18}O_{smow}$, which is highly variable. Carbon and oxygen isotope analysis show that the range of C and O compositions are I) ankerite: $\delta^{13}C_{PDB}$ from -9.33 to -5.92‰ and $\delta^{18}O_{smow}$ from +5.81 to +7.99 ‰; II) calcite: $\delta^{13}C_{PDB}$ from -21.32 to -1.42‰ and $\delta^{18}O_{smow}$ from -0.92 to +17.94 ‰; III) dolomite: $\delta^{13}C_{PDB}$ from -13.02 to -5.15‰ and $\delta^{18}O_{smow}$ from +3.40 to +10.59‰; IV) magnesite: $\delta^{13}C_{PDB}$ from –8.94 to -5.37‰ and $\delta^{18}O_{smow}$ from +8.15 to +15.84‰; and V) siderite: $\delta^{13}C_{PDB}$ from -13.71 to -10.44‰ and $\delta^{18}O_{smow}$ from +14.12 to +17.11‰. In addition, a total of 36 sulfide samples (primarily sphalerite and pyrite) from diamond drillcores from across the Drake Goldfield were microdrilled for S isotope analysis. Overall, these have a wide range in $\delta^{34}S_{CDT}$ values from -16.54 to 2.10‰.

The carbon and oxygen isotope results indicate that the carbon is mainly of magmatic origin and little affected by the widespread and pervasive low-temperature alteration and atmospheric precipitation. Calcite shows a widespread near-horizontal distribution in oxygen isotope values, suggesting derivation of oxygen from a large range of sources including meteoric, low-temperature hydrothermal, and possibly magmatic. For magnesite, the spread in oxygen isotope values once again forms a linear array towards more positive $\delta^{18}O$ values, suggesting derivation from low-temperature alteration fluids. Dolomite and ankerite have similar trends, both opposite to that for magnesite, trending towards more negative oxygen isotope values and with much less variation. Sulfur isotope ratios of sulfide minerals indicate that the sulfur was most likely derived from at least two different sources—sedimentary and magmatic—the relative importance of each varying from one deposit to another.