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Stable isotopes as an exploration tool: Tracking cryptic alteration surrounding the Iscaycruz Zn (Pb-Cu-Ag) skarn-CRD deposit, central Peru

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The Iscaycruz Zn-(Pb-Cu-Ag) skarn-carbonate replacement deposit (CRD) is located within a sequence of Early Cretaceous layered carbonate and siliciclastic rocks in central Peru. The deposit is located on the western flank of a tightly compressed anticline, within a larger northwest-trending thrust-fold belt in the western Peruvian Cordillera. Proximal stable isotope haloes have been identified surrounding the Antamina Zn-Cu skarn, Uchucchacua Ag-base metal vein, and Iscaycruz Zn-Pb-Cu-Ag skarn-CRD in central Peru. Studies analyzing stable isotope data surrounding mineral deposits consistently exhibit alteration haloes in carbonate rocks with relatively depleted δO18 and δC13 values proximal to the center of mineralization, as well as areas of higher degrees of fluid:rock interaction. Prior work in the Iscaycruz district identified several stable isotope anomalies; however, an investigation between these anomalies and various stratigraphic units, orebodies, or sulfide accumulations has not been conducted. The primary goal of this study is to integrate visible and cryptic alteration around a known orebody and utilize the resulting identified relationships as an exploration tool for regional targets. A complementary study of ultraviolet fluorescent response of carbonate rocks and minerals will be incorporated into the stable isotope study to investigate any linkages between isotopic depletions and easily identified fluorescent characteristics. Prior work at the nearby Uchuchaccua deposit identified a strong correlation between a distinct orange-red fluorescent calcite and proximity to mineralization, and preliminary results in this study indicate a similar phenomenon surrounding the Chupa deposit at Mina Iscaycruz.

A secondary goal of this study is to evaluate various sampling strategies and analytical methods to inform industry of best practices. The initial sampling survey collected representative samples from contacts, structural intersections, and mineralized zones to assess the interactions between fluids and carbonate ore host rocks. The second sampling survey focused on regional sampling, lead isotopes, and prospective contacts north of the Santa Este pit. Both surveys collected samples from transects centered on key features, however the second survey also collected individual samples across hundreds of meters to assist sampling strategy comparisons. Upon the evaluation of all isotope results, both types of sampling strategies will be compared to the identified isotopic patterns to determine if dense sampling of features is required for future studies of carbonate deposits. The two surveys accumulated ~1,600 samples for stable isotope analysis from surface and subsurface locations surrounding Mina Iscaycruz, and from surface locations in the Palpas region located 12 km west of the mine. The final component of this study involves the use of lead isotopes to track fluid sources at Mina Iscaycruz, where the age of mineralization is currently unknown. The mineralization at Iscaycruz has not been linked to a causative intrusion, however lead isotopes can help separate mineralized zones into discrete groups based on their isotopic composition. These groups will be characterized and can inform geologic models, and can date mineralization by proxy if one of the deposits within the group relates to an intrusion with a known age.