A field-based geochemical and petrographic study of the fluids preserved within the Harrison Pass pluton with implications for the fluid origin of Carlin-type gold deposits*

Corresponding author: Christopher H. Gates, Colorado State University, christopherhgates@gmail.com

The origin and evolution of the ore-bearing hydrothermal fluids responsible for the formation of CTD's in NE Nevada have not been conclusively determined. In fact, the origin of CTD's remains one of the largest unresolved debates in economic geology. An inclusive, well-accepted model for the origin and evolution of the fluids responsible for such massive gold endowments as those along the Carlin Trend will be vital in global exploration. Many studies have attempted to characterize the fluids that precipitated gold at the deposits on the Carlin Trend, producing many generalized theories for their origin. The results, while largely being inconclusive, indicate a complex, open-system evolution with multiple fluid inputs and require different genetic models to be used for different deposits. However, few studies have directly investigated potential sources for these fluids. The Harrison Pass Pluton (HPP) is a ~36 Ma, multi-phase, calc-alkaline, granitoid intrusive body in the southern Ruby Mountains. It is ~80 km southeast along strike with the temporally associated gold deposits along the Carlin Trend. The uplifted and exposed HPP serves as a viable analog for plutons of similar age, size, and style of emplacement that have been geophysically imaged beneath the Carlin Trend.

This work builds on previous characterizations of fluids circulating around the HPP during intrusion and studies of the petrological and geochemical history of pluton emplacement and subsequent tilting. This field-based study defines the spatial and geochemical parameters of fluid exsolution and migration within the HPP during intrusion. Preliminary results indicate a potential genetic link with spatially and temporally associated Carlin-type gold mineralization along the Carlin Trend. Mapping the relationships between vein systems, miarolitic cavities, and different alteration facies on the exposed oblique section of the tilted pluton has helped to constrain the nature, distribution, and conditions of fluid activity within the HPP. Multiple generations of quartz veins throughout the pluton, (the oldest of which lack alteration haloes), miarolitic cavities, and zones of alteration are found throughout the HPP, particularly near its roof. Field mapping, portable X-ray fluorescence, fluid inclusion microthermometry, stable isotope investigations, and lithogeochemical analysis, have been used to characterize these fluids. Microthermometry and petrography of fluid inclusions within vein material and altered rocks have defined the compositions, densities, salinities, and estimates of pressure and temperature conditions of the fluids within the HPP during emplacement. Comparison between these data and existing geochemical characterizations of CTD's provides insights into the degree and nature of meteoric inputs due to subsequent mixing. Thus, this study provides an important component in understanding the role of regional plutonism as a source for primitive CTD ore fluids, and may ultimately support the proposed mixing of magmatic and meteoric fluids as a mechanism for Carlin-type ore-fluid evolution.