The North Bullion deposit is located five miles south of the Rain Mine, currently recognized as the southern end of the Carlin Trend. The goal of this project is to contribute to the geologic knowledge base of the North Bullion deposit and establish that the Carlin trend, which contains the second largest concentration of gold in the world, extends further south than now recognized.

Typical host rocks in most Carlin-type gold deposits (CTGD) are miogeoclinal carbonate shelf-slope rocks containing thin-bedded pyritic and carbonaceous silty dolomitic limestone and marl, and primary porosity from turbidite sequences. The North Bullion deposit, however, contains two distinct zones of gold mineralization hosted in mixed siliciclastic-carbonate rocks within the foreland basin overlap sequence, similar to some other Carlin trend deposits. The upper gold zone is hosted within Mississippian flysch facies sandstone, silty mudstone, mudstone, micrite, and multi-lithic breccia, and the lower gold zone formed within Devonian slope facies carbonate and multi-lithic collapse breccia. Although these host rocks have a high siliciclastic component, the North Bullion deposit exhibits ore and alteration minerals, mineralization style, pyrite geochemistries, and paragenetic sequences that are similar to typical CTGD. As the North Bullion deposit is located on strike of the Carlin Trend, does the Carlin Trend extend further south than previously recognized?

The objectives for this study are: 1) determine the mineralogy and paragenesis of ore and alteration minerals, 2) identify the size and intensity of alteration haloes of both visible alteration minerals and stable isotopes, and 3) identify and characterize fluid pathways and assess the intensity of fluid and rock interactions associated with mineralization. Data collected from this study show: 1) the North Bullion deposit displays ore pyrite chemistry, textures, and alteration minerals similar to known CTGD; 2) the ore pyrites have discontinuous sub-micrometer Au-bearing rims and the same trace element chemistry - As, Hg, Tl, and Sb - as known CTGD; 3) the host rocks of the deposit have been locally decarbonatized, argillized, and silicified, exhibiting alteration typical of CTGD; and 4) highest grades occur primarily in mudstone and silty mudstone along any lithologic contacts in the upper zone between mudstone, silty mudstone, limestone and multi-lithic breccia, and within the lower collapse breccia zone.

Other characteristics of the North Bullion deposit include dolomite alteration of host rocks prior to introduction of gold mineralization, and locally high silver grades from stephanite (Ag₅SbS₄), which based on cross-cutting relationships, likely precipitated during a pre-Au event. Petrography shows that tectonic breccias within the area formed during the pre-, syn-, and post-ore stages, and collapse breccias formed during the ore stage. The presence of discrete Au and Ag mineralization events and multiple breccia generations demonstrates that multi-stage brecciation was related to several episodes of fault movement and/or hydrothermal activity along the North Bullion Fault corridor and related structures in the area.