

Proactive Prospect Advancement: Discovery, Permitting, Pilot Drilling, and Community Outreach of the Clementine Prospect in the Northern Pioneer Mountains of Southwest Montana.

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Our exploration strategy combines a new regional ore-forming model constrained by an overlay of regional environmental sensitivity limiting target selection to prospective areas with lower likelihood of inviting environmental opposition. Modeling began in 2011 and after four field seasons of GPS-assisted digital geological mapping in a steep remote terrain covered by dense forest canopy an oxidized breccia vein system was discovered in 2014 in the northern Pioneer Mountains of Montana. Our field work was guided by a new regional structural and tectonic ore-forming model in the Cordilleran fold and thrust belt. We proposed earlier at the SEG Keystone Conference in 2014 that both giant porphyry Cu-Mo deposits at Butte and Bingham and the linear belt of smaller deposits running southward from Butte through the Pioneer Mountains to Bannack formed during or soon after thrusting in the hanging wall of the frontal Sevier-age thrust above basement. Here, regularly-spaced igneous plutons ascended fault ramps within the anticlinal hinge of the frontal fold forming a regional anticlinorium manifest as a linear north-south belt of mines and related plutonic centers including a host of smaller deposits spaced about 7 km apart. We termed this pattern a syntectonic frontal thrust fault-bend anticlinal mineral belt exposed in a nappe window into the Lewis Over-Thrust. We interpret the regular spacing of deposits to be due to Rayleigh-Taylor magmatic instabilities and recognized a gap in the sequence between the Quartz Hill and Beal Mountain deposits. This location is advantageous as it is situated well away from the proposed Forest Jobs and Recreations Act areas farther south which includes possible new wilderness areas. We mapped within the most prospective corridors on Fleecer Ridge where we expected focused magma ascent, hydrothermal activity, and mineralization. Ultimately the field work revealed the mineralized breccia vein system at the apical anticlinal hinge predicted from our model where intrusions and related hydrothermal fluids ascend and be trapped. We interpret the exposed vein breccias at Clementine as the possible top of a deeply buried Butte style cordilleran copper, silver, tungsten, rare metal (metalloid) system perhaps amenable to 21<sup>st</sup> Century underground mining minimizing surficial disturbance.

The Clementine prospect is located within the Deerlodge-Beaverhead National Forest and hence pilot drilling required securing a permit from the US Forest Service besides earning the exploration permit from the Montana Department of Environmental Quality necessary for filing an environmental restoration bond satisfying the USFS specifications. In permitting, we welcomed scientific input from the US Forest Service and Montana DEQ. Multiple site visitations by the USFS scientific team included specialists in minerals and mining, botany, hydrology, and archeology and site visits by DEQ geologists all proved helpful in designing and implementing a satisfactory plan of operations. Special care was taken to not cause harm to certain tree species, especially, the white bark or limber pine trees that occur rarely in the area.

Pilot drilling commenced in 2016 after running 4,500 feet of ½ inch polyline plastic pipe from a water tank through the woods out to the drill site to storage tanks. While only 146 feet of drilling was accomplished, some useful core confirmed the presence of relict sulfides containing silver, copper, arsenic, and antimony using SEM techniques consistent with our possible target of a deep Butte porphyry copper deposit rather than a stibnite-cinnabar gold deposit. Stream water sampling was done to establish geochemical baselines and found no detectable As or Sb at the ppb level but illuminated a discernible sulfate anomaly around the zone of mineralization.

Rather than relying on transparency as the main vehicle for communicating exploration activities with the community, Brimhall developed a multi-year, open education program with lectures and field trips providing sufficient geology for attendees to understand ore deposits in a scientific, environmental, historical, and economic context. The program is now hosted annually by the Wise River Community Foundation with four all-day Saturday events. Augmenting the practical geology lectures are narrated historical slide shows by Alta Miller and afternoon field trips. We call the program: EarthBook Montana (<http://www.earthresourcesmt.org>). Included in the program is learning to read the geological map of Montana published by the Montana Bureau of Mines and Geology, appreciating the geological time scale, the stratigraphic column in terms of its development involving global marine regressions and transgressions, global temperature change, glacial epochs, mass extinctions, plate tectonics, and magmatic history. Credentialed K-12 teachers earn up to 28 Professional development renewal units. Engagement in science education in “EarthBook Montana” provides the content, time, and field excursions necessary for attendees to see ore deposits as an integral part of natural processes that have shaped the crust of the earth and molded the landscape of the Rocky Mountains. Alta Miller’s historical photo essays build links between the Wise River community and their pioneer roots in Bannack, Hecla, Quartz Hill, and Butte.