



UNIVERSITY OF ALBERTA 2019 SEG FIELD TRIP REPORT

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The objective of this field trip was to expose participants to the magmatic-hydrothermal systems that characterize the American Southwest. We wanted students to better understand the geotechnical and metallurgical aspects of mining as they often control whether a deposit is economic. To accomplish this goal, the University of Alberta SEG student chapter toured the operations of the following mines: 1) Bagdad, Freeport McMoran's copper and molybdenite porphyry in Arizona; 2) Castle Mountain, Equinox Gold's low sulfidation epithermal gold deposit and 3) Mountain Pass, MP Mineral's rare earth element (REE) mine in California. During these tours, students were familiarized with the local structures that controlled the emplacement of these deposits and the alteration used to help vector towards ore bodies. Emphasis was placed on rock description using textural and mineralogical evidence as clues to the formation of each deposit and making links to regional story of the Laramide orogeny. Days not spent at mine operations were dedicated to exploring the vast landscape of the basin and range province by visiting the cinder cones, the Kelso dunes, and a skarnoid magnetite deposit all within the Mojave and Sonoran deserts.

DAY 1: Day one was spent travelling and getting everyone ready to spend a week in the desert. Our preparation began at the airport where we packed everyone and their gear into our full size SUV. Afterwards, we went to Winco to shop for food and supplies that would last for the duration of the trip. Our day ended at Circus Circus in Las Vegas to regroup and get ready for the days ahead.

DAY 2: Our group left early in the morning to arrive in the Hualapai Mountain in Arizona. We started of the day with our safety induction, and an overview of the classic porphyry model before we set out on our

hike. We then ventured to different outcrops identifying the different veining styles (A,B, & D veins) and alteration associated with the root zone of porphyry systems. We discussed the features of each vein type while trying to sort out the timing relationship of mineralization relative to the different vein types. Afterwards, we began our traverse through the system looking at potassic alteration. Students got to see rocks with greisen and K-rich alteration within a stockwork of quartz veins. The day concluded with stops at some historic mine adits to see the structures and mineralization.

Hualapai Mountains Porphyry System, Arizona



Figure 1) Overview of Porphyry emplacement and textures



Figure 3) Supergene copper



Figure 2) B-type vein with potassic alteration



Figure 4) Historic Mine Adit

DAY 3: Day three was our first mine tour at Bagdad, a copper-moly porphyry. Upon arrival we met with the senior geologist Jim Bussman where we talked about mine safety and completed an overview of the geology. Students were then taken to the open pit outlook where we got to talk with the geology team about the large-scale open pit operations and take some photos. Next we were taken down into the open pit to look at the bench face discussing mineralogy, deleterious elements, and watch an active drill site. We then proceeded to the mill where students were exposed to methods of crushing the rock to the appropriate size to maximize recovery during floatation. This was followed by an overview of the flotation process and discussions of how pH can be used to selectively extract different minerals. Lastly, we got tour the mechanics shop which was followed by an overview of the heap-leach operation to see the solvent extraction and electrowinning processes (SX-EW). Fortunately, we arrived in time to watch them harvest the copper sheets. Our day concluded and we drove to camp at the Kelso Dunes.

Bagdad Copper-Molybdenite Porphyry



Figure 5) Open Pit Lookout



Figure 7) Tour of the Mill



Figure 6) Production Drilling Operations



Figure 8) Mechanics Shop

DAY 4: The focus of day 4 was to expose the participants to detailed mapping. We drove to the Vulcan mine (an old abandoned iron mine) to conduct an anaconda style mapping exercise where students could learn how to map structure, alteration, mineralogy and note taking in a concise and organized manner. In addition to mapping, students got to observe a skarnoid deposit with massive and strata bound magnetite hosted within limestone. Discussions were tailored around replacement textures and how skarn deposits fit in the overall magmatic-hydrothermal deposit continuum. Also discussed was the controversial topic of how Fe is mobilized and deposited in these types of systems. We concluded our day by driving back to our camp at the Kelso Dunes.

Anaconda Style Mapping at the Vulcan Mine

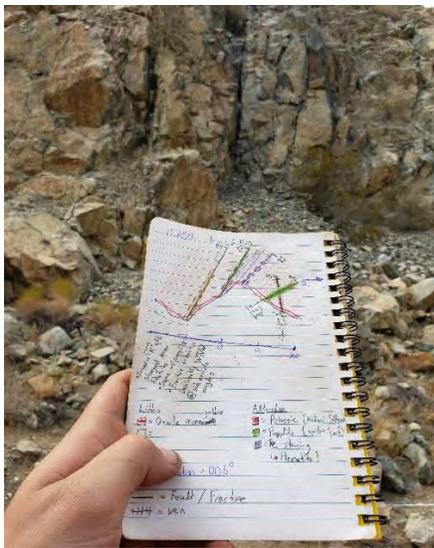


Figure 10) Mapping Exercise



Figure 11) Magnetite hosted in limestone



Figure 9) Students Pondering Fe-mineralization



Figure 12) Pit overview of the Vulcan Mine

DAY 5: On day five we made our way Castle Mountain, a low sulfidation epithermal gold deposit. We started our day in the office looking over maps with a basic introduction to the geology and history of the mine. At the open pit outlook, we discussed the importance of the fault intersections and breccia zones as fluid conduits which hosts the bulk of the gold mineralization. Having the opportunity to see a mine in the preliminary stages, we learned the importance of doing an environmental assessment by collecting water samples, seeds, and wildlife surveys. Following the tour of the mine, we were invited to visit one of the drill prospects which was host to textbook epithermal textures like bladed quartz after calcite and colloform quartz. We concluded our afternoon by setting up camp and hiking the Cima Dome cinder cones within the Mojave national preserve.

Castle Mountain, Low Sulfidation Epithermal Deposit



Figure 13) Castle Mountain Pit Overview

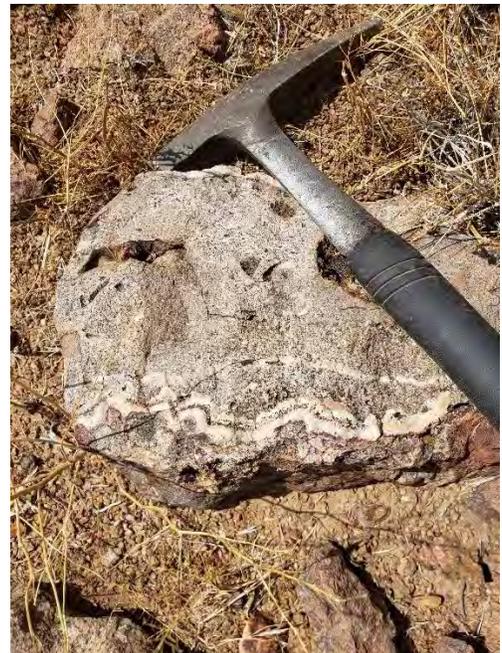


Figure 14) Vein Exhibiting Bladed Quartz After Calcite

DAY 6: To conclude our trip we had the opportunity to tour Mountain Pass, MP Mineral's REE mine. Our morning started off with a mine safety orientation and general deposit overview. Here, student learned the importance of the extensional history of this region bringing rise to the ultra-potassic intrusions believed to deposit the extremely high grades of REE that characterize this mine. Discussions were focused on nationalizing this strategic resource against a world where China holds the monopoly on REE and their refinement. Students were taken to the open pit overview and given the opportunity to see the discovery outcrop known as the Birthday vein, host to crystals of Bastnasite, Ce carbonate mineral, that are an impressive centimeter or greater! Our day concluded with a hike around the Bowl of Fire in Lake Mead National Recreation Area to see the large meter scale dunes preserved.

Mountain Pass, REE deposit



Figure 15) Mountain Pass Pit Overview

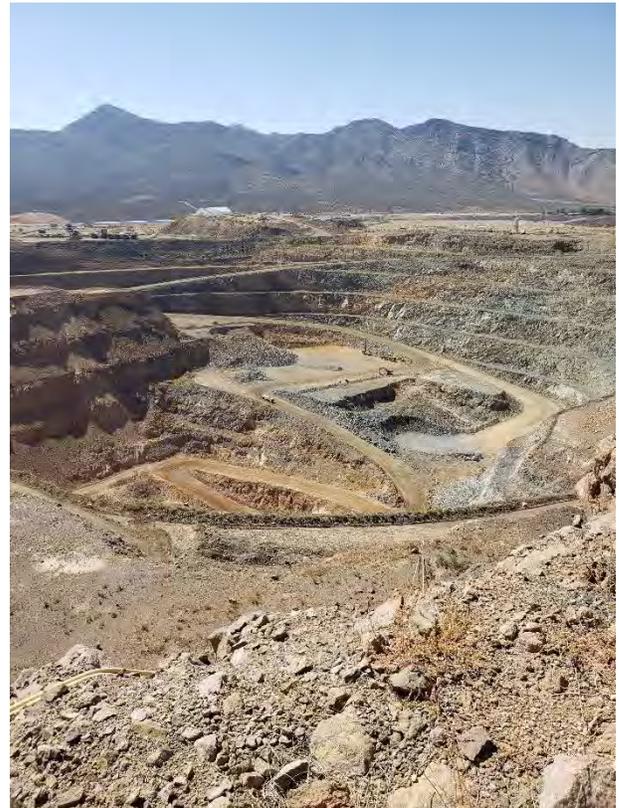


Figure 17) Mountain Pass Open Pit Operations



Figure 16) Large Bastnasite Crystals at the Birthday Vein

SEG Trip Funding Breakdown

| Funding Amount & Source | Column1 | Column2 | Grant & Funding Allocation | Column3 | Column4 | Column5 |
|--------------------------------|---------|----------|----------------------------|----------------|------------|--|
| Fund | Amount | Currency | Item | Cost | Currency | Notes |
| SEG Stewart R. Wallace Grant | 1500 | USD | Vehicle Rental | 672.94 | USD | Ford Expedition |
| | | | Fuel | 204.48 | USD | Gas |
| | | | Hotel + Fees | 195.74 | USD | Circus Circus 2019/09/22 |
| | | | Hotel + Fees | 364.35 | USD | Ellis Island 2019/09/28 |
| | | | TOTAL | 1437.51 | USD | |
| Dahrouge Geological Consulting | 754.84 | USD | Groceries | 554.86 | USD | Groceries and meals for the duration of the trip |
| | | | General Camp Supplies | 113.29 | USD | |
| | | | TOTAL | 668.15 | USD | |
| APEX Geoscience | 1509.67 | USD | Flight Subsidy | 1509.67 | USD | \$301.93 USD flight subsidy for the 5 participants |
| | | | TOTAL | 1509.67 | USD | |

This field trip was made possible from the support of the SEG Stewart R. Wallace funding award, Dahrouge Geological Consulting, APEX Geoscience, The SEG University of Alberta Student Chapter and, lastly, all our SEG field trip participants.

University of Alberta SEG Student Chapter Field Trip Our Sponsors

