SEG 2017 Conference

Preliminary investigation of fluid and melt inclusions in unidirectional solidification textures in the Saginaw Hill hydrothermal system, Arizona

Wyatt Moyer Bain* and Matthew Steele-MacInnis

University of Arizona, Tucson, AZ, USA, *e-mail, bain@email.arizona.edu

Most models for the formation of magmatic-hydrothermal ore deposits describe how magmatic systems at depth transition into hydrothermal systems in the shallow crust. This process is commonly referred to as magmatic-hydrothermal transition and is a major control on heat and mass transport in the shallow crust. However, much of what we know about magmatic-hydrothermal transition is not from direct sampling of early hydrothermal fluids in the context of their magmatic source, but is inferred by analyzing fluids trapped in late stage fractionation products, such as veins and miarolitic cavities. As a result, questions remain regarding the nature of early fluids in magmatic hydrothermal systems, especially those related to porphyry Cu systems. In order to better understand how magmatic-hydrothermal systems form and evolve, more data are needed from localities which preserve early magmatic-hydrothermal fluids prior to their circulation through a hydrothermal system.

In this study, we report new data on magmatic-hydrothermal fluids by analyzing fluid inclusion assemblages (FIAs) preserved in unidirectional solidification textures (USTs) from Saginaw Hill, AZ. Saginaw Hill is located in the western flanks of the southernmost Tucson Mountains and hosts moderate amounts of hydrothermal mineralization (i.e. copper sulfide) and abundant USTs associated with a quartz monzonite stock. USTs are of interest because they record episodic and sequential release of hydrothermal fluids exsoved from a melt and contain fluid inclusions which likely preserve minimally evolving hydrothermal fluids prior to their circulation through a hydrothermal system. The abundance of well-preserved UST layers at Saginaw Hill, and the fact that they are associated with a quartz monzonite stock, make this area ideal for studying magmatic-hydrothermal transition. By analyzing fluid inclusions from Saginaw Hill USTs, we aim to 1) characterize the chemical and physical conditions of early, minimally evolving hydrothermal fluids, 2) explore the nature of fluids generated by intermediate melts, and 3) determine if systematic differences exist between early fluids generated in the barren and mineralized hydrothermal systems.

Preliminary petrographic investigation shows that UST layers from Saginaw Hill include abundant primary and secondary FIAs. Most primary and secondary inclusion groups contain H_2O_{liquid} and H_2O_{vapor}, having one to two daughter salts (halite and sylvite) with salinities in excess of 65 wt% NaCl equiv. Many inclusions also contain round or triangular opaque sulfide daughter crystals (i.e. chalcopyrite) and an unidentified prismatic birefringent daughter crystal. In addition to the highly saline inclusions, sparse amount of silicate melt inclusions occur in the cores of euhedral crystals, and are commonly associated with inclusions which contain a prismatic birefringent daughter crystal. LA-ICP-MS analysis shows that many primary and secondary FIAs have high contents of Na, K, Mg, Cu, Fe, and Zn. These data provide new constraints on the composition of fluid at magmatic-hydrothermal transition.