geoconvention
Calgary • Canada • June 20-22 2022

Understanding the Effects of Mineralizing Fluids on Petrophysical Properties: A study of Magnetic Susceptibility and Spectral Gamma in a Cu-Au System at Upper Beaver, Canada

Brandon Hume, Université Laval, Department of Geology and Geological Engineering

Summary

The Upper Beaver Deposit (UB) is a Cu-Au hydrothermal system located within the Abitibi sub-province approximately 5 km north of the main Larder - Lake Cadillac break. The UB deposit was chosen for this study because it consists of three distinct intrusive phases namely: (1) a mafic syenite, (2) syenite porphyry and (3) a spotted porphyry. We know that veins and dikes exploit tensional stress vectors in the region to spread across the deposit. At UB the alteration profile is dominated by a pervasive early calc-alkalic alteration that is related to hydrothermal magnetite-chalcopyrite veins. This alteration profile can be locally replaced by sericite/carbonate alteration, expressed by the presence of quartz-ankerite-chlorite veins.

Geophysical interpretation of the deposit is complex because these successive intrusive and regional alteration events have altered the geophysical response we see today. The aim of this project is to identify and understand the signature of these alterations events from physical properties measured downhole. The study focuses on veins and the host-rock. Encouraging initial results have shown that it may be possible to use petrophysical relationships to classify different vein types and use this classification data as a proxy for maturity of the alteration fluids in a deposit.

Initial analysis of the data revealed that the magnetic susceptibility, density, and the spectral gamma-ray (SGR) response in mineralized sections can be used to denote three subcategories within lithology packages. 1) Zones of High K, U, Th, and magnetics (close to 1 Si) along with elevated density (3.2 – 3.7 G/cm3) are likely a form of skarn and are indicative of the most concentrated zones of alteration. 2) highly magnetic (100 -500 x 10-3 Si), low density (2.4 -2.7 g/cm3), Low K, high U relate well to zones of mixed chalco- magnetite-quartz veining. 3) Zones with nonmagnetic (< 1 - 10 x 10-3 Si), low density (2.4 -2.7 g/cm3), high K, U and Th correlate well with elevated gold content and are likely representative of the later-stage metalliferous zones, but also the barren quartz-carbonate-sericite veins. We can clearly see a relationship with the creation of hydrothermal magnetite in the copper rich early fluids which reaches its peak with the introduction of gold. Magnetite then disappears as the fluids grade from a Cu-Au mix to Au dominated then barren fluids.

As our work continues, we expect that the variations in physical properties will allow us to classify the 12 distinct phases of veining that have been identified at UB and use this information as a proxy for the maturity of the fluids in the system and eventually map this information in space with geophysical inversions.