
MINERALOGY OF A URANIUM-COPPER BRECCIA PIPE

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In northern Arizona, uranium-rich breccia pipes are common, however, these deposits are rarely found to contain 36% copper. Energy Fuels sent fifteen drill-core samples from their Canyon mine to Montana Tech. These samples contain varying amounts of copper and uranium from different areas of the deposit. The samples were cut, trimmed, placed into epoxy, and polished. A total of 36 polished “plugs” were made. The plugs were scanned using an X-Ray Fluorescence (XRF) device to determine rough estimates of element composition. Each plug was then carefully observed under a reflected-light microscope. The mineralogy and estimated amounts of minerals were noted. Plugs that were seen to have interesting features, high amounts of unusual elements, or unknown minerals were placed in a scanning electron microscope (SEM). The SEM uses electron dispersive spectroscopy (EDS) to obtain a chemical analysis of a specific point on the plugs which aids in mineral identification. Some specimens were also examined by Raman spectroscopy and X-ray diffraction (XRD). The most abundant mineral found in our samples was tennantite ($\text{Cu}_6[\text{Cu}_4(\text{Fe},\text{Zn})_2]\text{As}_4\text{S}_{13}$) followed by chalcopyrite (CuFeS_2). We also found the minerals uraninite (UO_2), pyrite (FeS_2), bornite (Cu_5FeS_4), galena (PbS), sphalerite (ZnS), chalcocite (Cu_2S), covellite (CuS), and rammelsbergite (NiAs_2). These minerals were deposited by hydrothermal fluids into a quartz grain matrix, in which they act as a cement holding the grains together. The discovery of rammelsbergite, a nickel mineral, was an unexpected find. The results of this project will be sent to Energy Fuels where they will use the data to help in milling and metallurgy. This mineralogy study may also help the mine understand potential sources of metal contamination for future mining wastes. One of our recommendations to Energy Fuels will be to assay their ore for recoverable nickel in addition to the other metals (Cu, U, Pb).