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Using hydrogeochemistry to test mineral potential under transported cover in the Kunene Region of Namibia

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Mineral exploration in regions with substantial transported cover is difficult using traditional geochemical methods unless costly grid drilling is undertaken. Recent advances in ICP-MS technology allow detection levels in the ppb range for a large suite of elements, these low detection limits give explorers the opportunity to use sample media (water, vegetation, grain surfaces) that carry much lower levels of metals than residual soils. Groundwater is one of these sample media that has been used for reconnaissance by First Quantum Minerals in a number of countries looking for a variety of deposit types. Hydrogeochemistry has been used in the Kunene Region of Namibia in conjunction with Kunene Resources to test a large package of ground with multiple transported cover types.

Hydrogeochemical samples were collected from 105 locations, dominantly from community water sources. The procedure used was based on that of Noble et al. [1] for hydrogeochemical sampling in mineral exploration. Samples and associated quality control samples (blanks, duplicates and standards) were analysed at ALS, Vancouver environmental laboratory where detection levels are some of the lowest currently commercially available. The data collected, both field parameters and laboratory analyses, although collected for mineral exploration, provides information which can be used for the evaluation of water resources.

The water samples were measured for pH, Eh, conductivity, total dissolved solids and temperature at the point of sampling. The samples had a range of pH from 6.62 to 9.15, Eh from -12.25 to 423.72 mV and conductivity from 222µS/cm to 13800µS/cm. The conductivity of 39 % of the samples exceeded the guideline value for drinking water of the World Health Organisation of 1500µS/cm. High conductivities are particularly pronounced in water sources within and proximal to a gypsum pan due to distinctly higher SO_4^{2-} content. The high salinity of the gypsum associated ground waters has resulted in higher background metal concentrations distinctly different to the regional aquifer and, thus, required both aquifers to be examined separately. The influence of gypsum on more distal waters is also suggested due to most waters conforming to the 1:1 Ca, SO_4 line.

Water samples proximal to known copper mineralisations were used to identify specific indicator elements that would be seen proximal to mineralisation in samples from covered areas. The water associated with the Cu mineralisation were found to have high SO_4^{2-} (above the 1:1 SO4 line) suggesting the oxidation of sulphides. The samples also had a distinctly low Eh in comparison to other regional samples, along with high relative concentrations of Al, Sr, W, and Zr. There was no elevation in Cu concentration above background in the water proximal to copper mineralisation but four regional samples had Cu values well above background (<8.6ppb), 2 adjacent to each other (35.7ppb and 15.7ppb). The transport of Cu in neutral waters is restricted (Leybourne and Cameron [2]) suggesting that the source of Cu anomalism in groundwater is proximal to sample location. The identification of anomalies with sampling on a 5 to 10km spacing suggests that groundwater can be used as a regional

greenfields tool to identify areas of interest in a region as well as providing useful water quality information.

References:

[1] Noble R et al. (2011) CSIRO Earth Science and Resource Engineering

[2] Leybourne M and Cameron E (2008)Chem Geol 247: 208-228