

10. Final conclusion and recommendations for further study

Quantification of natural gamma radiation on gold TDFs is only accurate when done in conjunction with 'some' sampling and analyses of U (using analytical methods that measure U directly like ICP-MS). Direct measurements of U can be used to calibrate natural gamma and to discount radionuclide disequilibrium as a source of error in natural gamma radiation measurements, which allows more accurate concentration measurements to be made. Only when disequilibrium has been accounted for a resource estimation of U can be done based on natural gamma spectrometry.

The effect of U migration is significant due to the oxidative and anionic nature of gold tailings, where pyrite oxidation decreases pH significantly and produces abundant sulphate anions to complex with the oxidised form of U (the Uranyl ion), thus increasing the transportability of U. Migration of U also effects the resource estimation since the same zones where lower grades are found were shown to have areas where U was transported away. Zones with high grades tend to be U accumulation regions.

Modelling of U concentration data will assist in the planning of the re-mining and processing of a TDF, since predictions can be made of the ore grade that can be expected at certain locations. To create these models, detailed elevation surveys as well as grid-based drilling is required at a proposed interval of 60 m. Lower intervals do not necessarily improve data accuracy significantly, although higher resolution is possible.

Further research needs to be done on the following:

- The chemical speciation of uranyl in these sulphate-rich, oxidized environments as well as the chemical speciation of other radionuclides that occur along with U;
- Profiles of the oxidation-reduction potential on New Machavie and other gold TDFs including the mobility of toxic metals relative to the different oxidation zones;
- The chemical speciation of U in the different oxidation zones of gold TDFs, this may lead to suggestions regarding the immobilisation of U within the TDFs and the prevention of environmental contamination;
- Correlation of radiometric data with other elements including trace metals and gold;
- The effects of particle size on the mobility of U; and
- The cause of decreased Th content in the un-oxidized zone.