

## EXECUTIVE SUMMARY

The principal aims to this contract were threefold:

- i. to investigate and model a sulphide chemistry in both the aqueous and gaseous phases,
- ii. to investigate and model the recovery of elemental sulphur through chemical oxidation of sulphide, and
- iii. to investigate and model the precipitation and recovery of metals.

With regard to sulphide chemistry, this is complex and governed by both weak acid and redox reactions.

In Acid Mine Drainage (AMD) waters, this is further complicated by the co-existence of both the carbonate, hydroxide and base systems. The only reasonable approach to understanding is via equilibrium chemistry. This is effected here in a clear and didactic fashion, using graphical approaches effected in so-called equilibrium diagrams. This approach is extended to examining interphase equilibrium, for example aqueous-solid phase chemistry of the redox and weak acid reactions of both metal sulphides and elemental sulphur.

Consideration is given to the feasibility of developing a unit process to effect elemental sulphur recovery using physico-chemical methods. Aspects investigated included measurement of hydrogen sulphide ( $H_2S$ ) stripping using  $CO_2$  or the stripping agent. The  $H_2S$  was then oxidized to elemental sulphur by passing the carrier gas through a ferric solution. The rapid kinetics of the various processes make this proposal worthy of further investigation.

With regard to precipitation and recovery of metals, two important findings were identified. First, the flocculation effect observed in the Rhodes BioSURE System was found to be caused by a ferric / ferrous / sulphate / hydroxide – better known as Green Rust which is a metastable precipitant. This flocc decomposes within a day to magnetite, haematite and other ferrous / ferric minerals. Further investigation into the decomposition process led us to a unique method of producing magnetite (ferrite) from AMD waters, a process effected at ambient temperature using air as oxidant. This aspect has been further investigated under a separate WRC contract and the process patented by the WRC.