University of South Australia

Applied Centre for Structural & Synchrotron Studies (ACeSSS)

Australian Postgraduate Award Industry (APAI): PhD student

To study

Silicate reactions in passivation mechanisms for pyrite oxidation control in acid mine drainage

The management of acid and toxic metal drainage from sulfide-containing mining waste, mainly stored as rock dumps (i.e. acid rock drainage, ARD), is of fundamental importance to the continuing social acceptance of mining industries and to the environmental management costs of current, exhausted and abandoned mine sites. In Australia alone, it is estimated that current ARD waste management costs of operating mines exceed $120M p.a. at >100 sites, or $1800M over the next 15 years, plus >$650M in inherited liability at abandoned sites. In the last decade, this has elevated assessment and management of acid rock drainage to one of the highest priorities in mining and minerals processing management.

The first level of ARD management is control of sulfide (principally pyrite) oxidation to reduce acid and metal generation rates so that secondary controls (e.g. covers, effluent treatment, rehabilitation) are effective. Our previous work has produced four case studies **in which pyrite oxidation rates have been reduced by 10-100 times in test durations up to 10 years**. We have identified several different mechanisms contributing to this pyrite passivation.

An Australian Postgraduate Scholarship (Industry) is available in ACeSSS (Applied Centre for Structural and Synchtrotron Studies) at the University of South Australia. This project, as a part of a Australian Research Council -Linkage project “Mechanisms for pyrite oxidation control in acid mine drainage” is supported by AMIRA International representing several sponsoring minerals processing companies. It will involve collaboration between the research group of ACeSSS and Levay & Co. Environmental Services.

The Linkage project consists of basic research accompanying the applied, industry-supported component, aiming to reduce ARD . The applied component is focused on control optimisation of limestone and reactive silicates in maintaining neutral pH, long-term silicate neutralisation matching acid generation and verification of low-dose phosphate (apatite) additions in biofilm control of pyrite oxidation. The basic research focuses on the understanding, development and exploitation of the pyrite passivation mechanisms occurring and the stability of the products. It is only through this fundamental understanding that effective long-term ARD amelioration management strategies can be put in place.

The PhD project is focussed on the basic research component of the ARC Linkage Project and the fundamental mechanisms governing ARD reactions. It will specifically investigate the silicate-related mechanisms of pyrite oxidation rate control offering the most innovative additions to current practice. This will include i) study of structure of the passivating layer formed on pyrite surface, particularly the function of silicates in stabilising the layer from

pyrite/calcite/silicate/phosphate model systems. ii) solution speciation modelling (static and kinetic) of the sequence of formation of precipitates (goethite, aluminosilicates, etc) in solution for correlation with the secondary layer formation; iii) addition of fine aluminosilicate particles to the standard ARD system and the pyrite/limestone systems with detailed characterisation of pyrite oxidation rates and induced cementing and secondary armouring formation; and iv) study of additive solutions with reactive silicates to produce neutral pH addition to standard ARD with and without calcite addition. Kinetic net acid generation (NAG), column leaching and sulfide oxidation cell tests, in conjunction with solution speciation modelling (IC-S speciation, ICP, ICPMS and PHREEQ program) and solid surface/bulk analysis (XPS, SEM, TEM, ToF-SIMS, synchrotron XED/XRF microprobe, synchrotron XRD/glancing angle XRD), will be carried out in the study.

Applicants should have an Honours degree or Bachelors degree with relevant experience in geochemistry, chemistry, chemical engineering, materials science or a related field. Australian or New Zealand citizenship or Permanent Residents of Australia is essential for the applicants.

Stipend: Tax-free $26,140 p.a. Allowances are also available for relocation and thesis preparation. There will be opportunities to attend national and international conferences relevant to the research.

The application deadline is the 30th of September 2009. For application information please contact Dr. Jun Li (Ph 61-8-83025032, e-mail Jun.li@unisa.edu.au), Dr. Russell Schumann (Ph 61-8-83023718, e-mail Russell.schumann@unisa.edu.au) and Professor Roger Smart (Ph 61-8-83023353, e-mail Roger.smart@unisa.edu.au).