New Zealand coal mine drainage: Downstream chemical evolution and aqueous speciation

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Water rock interactions in areas disturbed by mining can lead impacts on water quality downstream of the mine. The reactive minerals and geochemistry of the processes that lead to mine drainage impact have been studied for the last 30-40 years and are well understood. However, mine drainage management, remediation as well as secondary minerals and long term geochemical processes are active fields of research. Changes in chemistry of mine drainage from the zone where AMD forms into the receiving environment is controlled by secondary minerals and aqueous chemistry related to these minerals has implications for management and treatment of mine drainage.

In New Zealand's acidic coal mine drainages, several common and predictable changes in mine drainage chemistry occur between the zone where oxidation of sulphide minerals takes place and the downstream environment. Roughly from upstream to downstream, these processes include oxidation of Fe(II)to Fe(III), partial neutralisation by alumino-silicate minerals, precipitation of a series of Fe minerals, partial adsorption of trace elements, substitution of Al for Fe as the dominant Lewis acid, precipitation of Al minerals, and complexation of trace elements. These processes can take place over a relatively short distance (~100 m) at an active mine site or several kilometres at legacy mine sites and the degree to which they occur define an evolution process for mine drainage chemistry.

Data used to identify mine drainage chemical evolution comes from laboratory based leach testing, field analyses at mine seeps, laboratory based mine drainage neutralisation tests, field observations in downstream environments and aqueous speciation modelling studies. Thorough understanding of the chemical evolution processes for mine drainage chemistry is used to:

- identify most appropriate mine drainage management options;
- improve the efficiency and effectiveness of active treatment;
- optimise the selection and performance of passive mine drainage treatment systems; and
- better understand the environmental impacts of mine drainages.

Ant nest geochemistry used to locate silver-lead-zinc mineralisation buried beneath 40+ metres of barren rock

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In the 6th century, Varaha Mihira, an Indian astronomer, mathematician, and astrologer described the importance of termite mounds as indicators of both groundwater and gold mineralisation. However, only during the last few years have termite and ant nests been actively investigated as geochemical indicators of buried mineralisation.

This paper describes the geochemistry of meat ant nests (Iridomyrmex purpureus) and termite nests located in a semi-arid climate of mixed eucalypt forest with barren sandstone cover rocks (<1 ppm Ag, 10 ppm Pb, <25 ppm Zn, and <44 ppm As) overlying (40-60 m) epithermal silver-lead-zinc mineralisation of the Bowdens Silver Deposit (NSW, Australia).