VALIDATION OF SEQUENTIAL LEACHING TESTS TO PREDICT POTENTIAL IMPACTS OF LOW SULFUR IRON ORE WASTE ON SURFACE AND GROUNDWATER QUALITY

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Introduction

- Metalliferous mobility and drainage occurs in acidic conditions but can also occur in circum-neutral and alkaline conditions, depending on the mineralogy of the waste rocks assessed.
- Sequential leaching methodologies involve the leaching of waste rocks with a sequence of aggressive extractants. They are rapid tests taking only weeks to complete compared with kinetic column leaching that can take up to 2-3 years.
- Sequential leaching can be used as a screening tool to predict the likely order of species mobilisation and extent of dissolution of metal ions and metalloids (metal oxyanions) and the potential impact on ground and surface water quality.

Aim

To develop and validate a sequential leaching method customised for variably weathered, low sulfur and/or complex mineralogy iron ore waste rock from BHP's operations in the Pilbara Region of Western Australia.

Materials and Methods

- A Sequential leaching procedure (Fig. 1) was developed by ChemCentre in collaboration with MBS Environmental.
- Seven waste rock samples considered representative of Western Australian iron ore deposits were analysed using the optimal sequential leaching method.
- The predictive value (metal/rock type risk identification) of this test, complemented by results from static waste rock characterisation tests and mineral characterisation by XRD/SEM, was compared against longer term (up to two years) kinetic column testing (Fig. 2).

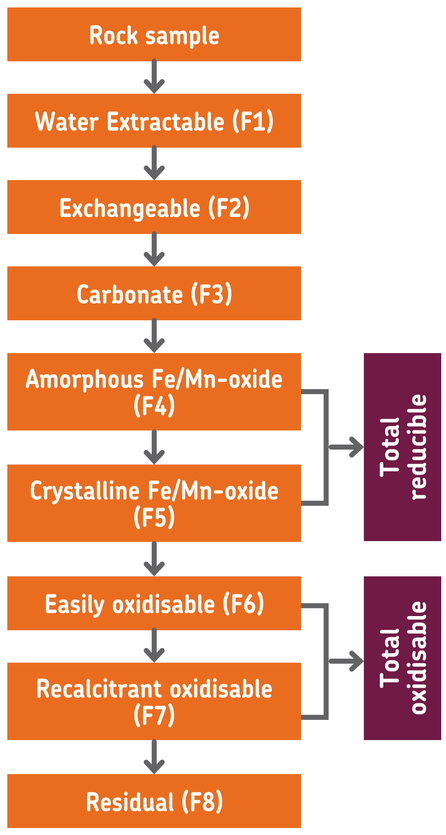

Fig.1. Sequential Extraction Procedure

Fig.2. Kinetic Leaching Study over 24 months

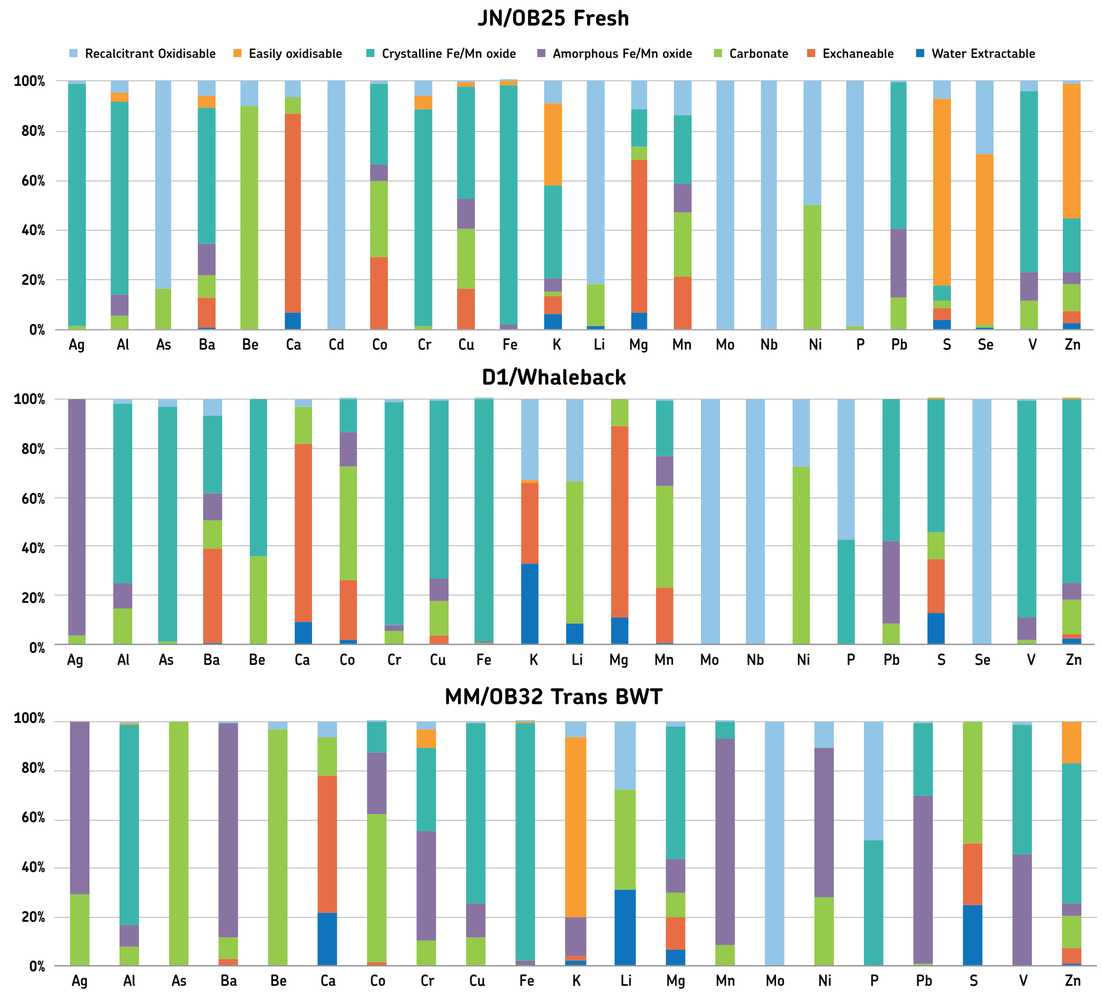

Fig.3. Distribution of metals in the several phases of three rock samples according to the optimised sequential leaching method

Result and Discussion

- Conventional AMD characterisation of one of the 7 test materials classified as non-acid forming (NAF) on the basis of acid formation potential calculated from the Total Oxidisable sulfur (TOS) concentration being less than the measured Acid Neutralising Capacity (ANC) value. Under typical circumstances, samples of this nature would not normally be selected for kinetic leach testing. The sequential leaching protocol correctly predicted that this sample (sample JN/0B25 Fresh) would give rise to copper leachate concentrations of concern, which was confirmed by the subsequent long-term kinetic leaching study.
- Results suggested that the proposed sequential extraction method can be used as an effective tool to assess the metal-phase association compared to other methods in the literature[1-4].

Summary

- An optimised sequential leaching procedure was developed, validated and assessed against longer term kinetic leaching studies on 7 waste rock types representative of Western Australian iron ore deposits.
- A decision support tool was developed for the application of the optimised sequential leaching test as a screening tool for early identification of risks that can be used to direct and prioritise longer term kinetic studies and to better inform waste management plans, Environmental Impact Assessment, and mine-site closure planning and approval.

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