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# Application of MRI and X-ray CT for the study of the solid and liquid phases during the leaching of low grade ores

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Heap bioleaching is gaining importance as a technique for the recovery of valuable metals (such as copper) from low grade ores. In this process iron and/or sulfur oxidising microorganisms are used to aid the oxidation of base metal sulfides in the ore, thereby liberating the metal ions into solution. The heaps are highly heterogeneous systems, both with respect to heap structure and the ore particle size and composition. This has a significant effect on the liquid distribution because the flow is variably dominated by gravitational and capillary forces, making it highly non-uniform. Therefore typical 'black-box' type experiments are non-ideal for the accurate description of the leaching processes. It is therefore desirable to use non-invasive tomographic techniques to study these systems.

The mineral particles within the solid ore can be identified using X-ray CT as their absorption of the X-rays is greater than that of the surrounding gangue rock. X-ray CT may therefore be used to study the selective leaching of minerals as a function of their position in the ore (proximity to the surface) and potentially their composition.

The liquid distribution within representative leaching systems is better examined using magnetic resonance imaging (MRI). Specialist acquisition protocols have been developed for this as the para- and ferromagnetic species within the ore have the potential to cause significant magnetic susceptibility distortions in the images (Fagan et al 2012). The accuracy of the MRI method is confirmed through comparison of the MRI acquisition of a saturated ore sample with an equivalent X-ray CT acquisition.

Through the eventual combination of the information from the two imaging techniques, the effect of liquid flow and degree of wetting on the mineral leaching can be quantified. This is critical new information which may be used to further optimise the operating conditions of a heap leach.

References

Fagan, M.A., Sederman, A.J., Johns, M.L. (2012) 'MR imaging of ore for heap bioleaching studies using pure phase encode acquisition methods', J. Magn. Reson. 216, 121-127

## Submit a paper<br>for peer review<br>(SA Journal of Science)?<br>(Yes / No / Maybe)

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