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Siderophore-enhanced extraction of Pt from oxidised PGE ores from the Great Dyke, Zimbabwe

D. Mohwinkel and M. Bau

Jacobs University Bremen, School of Engineering and Science, Earth and Space Sciences, 28759 Bremen, d.mohwinkel@jacobs-university.de

We are conducting selective leaching experiments on platinum-group-elements (PGE) ores of the oxidized main sulphide zone (MSZ) of the Great Dyke in Zimbabwe.
Being the second largest PGE deposit worldwide, mining operations at the Great Dyke currently focus on the recovery of PGE from disseminated sulfides in pyroxenites. The mineralization in the Great Dyke mafic/ultramafic layered intrusive complex occurs in the uppermost part of the ultramafic sequence in two major zones: the Main Sulfide Zone (MSZ) and the Lower Sulfide Zone (LSZ) (Locmelis et al., 2010).
The MSZ shows the highest PGE grades and thus is the major PGE resource of the Great Dyke. In addition to pristine ores that are currently mined, resource estimates suggest that there exist about 400Mt of oxidized, surficial MSZ material (Prendergast, 1988). Relative to the pristine ore, the oxidized PGE ore shows higher Pt/Pd ratios (due to depletion of Pd during weathering) and almost complete removal of sulfur (Locmelis et al., 2010). In the oxidized MSZ about 50% of Pt is hosted by PGM, 45% by hydroxides and 5% by relict sulfides (Oberthür & Melcher, 2005). The oxidized MSZ is currently not mined because of insufficient PGE recovery rates with conventional processing techniques, which renders mining sub-economic. The complex mineralogical distribution of the PGE in the oxidized MSZ aggravates to this fact.
In our study, batch leaching experiments on 'fresh' as well as pre-leached oxidized MSZ are used to quantify the amount of platinum that can be extracted from oxidized MSZ ore with biogenic chelators. The extraction agents utilized in this study are low-molecular weight organic chelating agents called siderophores. Siderophores are a group of organic molecules synthesized and exuded by various microorganisms and plants in environments with low iron bioavailability. These multi-dentate biogenic chelators are then utilized to acquire Fe in Fe-limited environments. However, it has been shown that other divalent and trivalent metals are complexed by siderophores as well.
Our siderophore experiments on untreated ('fresh') oxidized MSZ ores revealed considerably low Pt recovery rates of way less than 1% into solution.
However, by a combination of a pre-leaching step with conventional acids like HCl, drying of the solid residue and a subsequent leaching step with unbuffered siderophore solutions, we were able to raise the total (HCl+siderophore) recovery of Pt to 20-40%. In unbuffered experiments, however, we experienced significant pH drops to pH 3 as soon as the siderophore solution was mixed with the solid residue of the HCl leaching step; this drop markedly inhibits the complexation efficiency of the siderophores. In contrast to such unbuffered systems, Pt recovery rates in buffered experiments rose to a maximum of 78% of a bulk sample's Pt content; with a siderophore contribution in the mobilization of 48%, while most base metals were nearly completely omitted.
This not only implies that siderophores are effective Pt complexing agents as soon as the chemical and mineralogical settings are favorable, but that biological complexation and hence prospective bio-leaching of Pt from these supergene residual ore deposits, which occur e.g. at the Bushveld complex as well, is in fact a promising approach for further studies.
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