Microbially-driven remediation of bauxite residue (red mud)

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Bauxite residue, a byproduct of the Bayer process for alumina refining, is an alkaline, saline tailings material that is generally considered to be inhospitable to microbial life. Remediation and reuse strategies for bauxite residue typically aim to decrease pH and salinity through chemical and physical amendments such as gypsum and tillage. Microbial communities have been viewed to date as passive responders rather than as active agents of remediation. Here, we present a novel strategy for pH neutralisation in alkaline tailings based on microbial fermentation of organic carbon.

Laboratory-scale bioreactors containing bauxite residue plus a microbial inoculum were used in this study to identify key factors controlling the rates and extent of microbially-driven bioremediation. Initial tailings pH and organic carbon supply both significantly affected the rates and extent of bioremediation. Initial pH and salinity significantly influenced microbial community successional trajectories. Microbial community structure was related to markers of fermentation activity, with 2,3-butanediol fermentation was identified as the major mechanism of pH neutralisation. This study provides the first experimental demonstration of microbially-driven bioremediation in bauxite residue, and will enable future development of bioreactor treatment systems at full field scale.