Mineral-specific attachment of sulphate-reducing bacterial consortia: combined experimental and xDLVO modelling approach

K. BAKER^{1,2}*, J. BRIDGE², D. BROWN², S. ROLFE^{2,3}, J. SCHOLES^{2,3}, R. EDYVEAN^{1,2} AND S. BANWART²

¹Chemical and Process Engineering, University of Sheffield, UK (*correspondence: k.m.baker@shef.ac.uk)

²Cell-Mineral Research Centre, Kroto Research Institute, University of Sheffield, UK

³Animal and Plant Sciences, University of Sheffield, UK

99% of all microbial life is attached to, or assocatied with, a surface [1]. The association of microogranisms with substrata (Fig. 1) is critical to understanding the role of biogeochemical processes in natural attenuation, but cellmineral interactions, and the formation of biofilms, may be highly variable and spatially heterogeneous over many scales within a geological ecosystem such as an aquifer [2].



Figure 1: Microbes (white) attached to quartz grain after *in situ* incubation.

In this work, we adopt a multi-faceted approach to investigate the mineral attachment characteristics of sulphatereducing bacteria (SRB) isolated from a deep sandstone aquifer contaminated with phenolic compounds. We assess the formation of biological conditioning films on the solid phase, substratal bio-weathering patterns, and the forces involved in anchoring a sessile community within microcosms containing various minerals. Extended (x)DLVO theory [3] is used to estimate the forces experienced by planktonic SRB approaching the different mineral surfaces and assess the role of physicochemical conditions in the initiation of mineral colonisation by SRB.

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High-pressure phase equilibria of K-rich silicate liquids: Implications for near-solidus peridotite melts

M.B. BAKER AND E.M. STOLPER

Caltech, CA 91125 USA (mikeb@gps.caltech.edu)

Near-solidus melts of anhydrous fertile peridotite are alkali-rich at P > -1 GPa, and they exhibit increasing K/Na with increasing P due to the increasing compatibility of Na in clinopyroxene (cpx) [1] and the highly incompatible nature of K (unless the liquid (liq) becomes so K-rich that a potassic phase is stabilized). There are, however, few data on the compositions of coexisting crystals and melt for anhydrous Krich liquids in equilibrium with lherzolitic or harzburgitic assemblages at high P, and thus the effects of K on peridotite melting relations just above the solidus in the Earth's mantle are not well known. Nevertheless, available data at 2-3 GPa [2, 3] suggest that these effects may be substantial.

We have begun high-P melting experiments on mixtures of basalt plus olivine (ol), orthopyroxene (opx), and microcline; bulk compositions have 4-5 wt. % K₂O, K₂O/Na₂O is 3-5 (by wt.), and Mg/(Mg+Fe_{tot}) is ~0.8 (atomic). Experiments to date have been done at 2 GPa, 1390-1450°C using a piston-cylinder device and graphite-Pt double capsules; run times were 9-15 hr. Observed phase assemblages are liq + opx + spinel (sp); liq + ol + opx + sp; liq + ol + opx + cpx + sp. The liquids are potassic (K₂O ~ 6-8 wt. %).

In the ol + opx + sp \pm cpx-saturated runs, liquid SiO₂ contents are ~50 wt. %. Compared to 2 GPa lherzolitesaturated melt compositions with lower alkali contents, our results and those of [2] suggest that SiO₂ contents decrease with increasing melting above the fertile peridotite solidus (although the silica-enrichment just above the solidus may not be as dramatic as at 1 GPa [4]). CaO contents of the cpxsaturated liquids are 6-7 wt. %, consistent with the limited published data at 2-3 GPa [2, 3]. This suggests that, like nearsolidus melts at 1 GPa [5], higher-P melts of fertile peridotite have relatively low CaO contents just above the solidus (although liquid CaO contents increase with further melting). Whether CaO contents of 3-4 GPa cpx-saturated melts of fertile peridotite are in the range of ~8-9 wt. % or are substantially higher has a direct bearing on the current debate concerning the importance of peridotitic vs. pyroxenitic sources for Hawaiian lavas [e.g., 6].

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