

Acidophiles in neutral drainage and their impact to chemistry and flow

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A neutral drainage site with a robust microbial community was investigated for acidophile metabolic processes and viability. Two acidophilic species, cultured from site material, were viable at site-specific conditions in the presence of added nutrients but did not grow in conditions that relied on the provision of nutrients from waste rock. These results suggested a secondary, abiotically catalyzed process was necessary to initiate acidophile colonization and growth. In viable conditions, bacteria promoted the precipitation of ferric hydroxides and hydroxysulfates. The effect of bacteria metabolism on effluent chemistry at the micropore scale was observed with column studies. Biotic columns showed decreased pH values, elevated electrical conductivity, and increased total iron and sulphate concentrations. Precipitates were observed following a 2-week inoculation. The effect of biomineralization on material properties was investigated using the Brunauer-Emmett-Teller (BET) method. BET results indicated ferric and sulphate precipitates increased and decreased surface area, respectively. Barret-Joyner-Halenda (BJH) adsorption analyses of pore volumes in void spaces ($r < 10^3$ Angstroms) showed acidophile-inoculated materials were significantly different than abiotic material. Dissimilar BJH results from acidophiles indicated a species-specific influence on pore volume. The synthesis of results indicated acidophiles accelerate metal dissolution and induce a species-specific alteration of pore structure, which may affect reactivity and flow through the micro-porespace.

Resolving organic carbon of differing diagenetic/catagenetic states in riverine and marine sediments

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Organic matter in surface environments is a mixture with components that often possess ages ranging from the contemporary to thousands and even millions of years. Though it is well established that age influences reactivity, it is not clear how organic component age will impact responses to perturbations such as climate change. The ability to resolve and quantify the different pools of organic carbon is an essential step towards understanding the potential responses.

Simple two component mixtures are resolvable by determining the end-member isotopic signatures ($^{13}\text{C}/^{12}\text{C}$, $^{14}\text{C}/^{12}\text{C}$) and solving the appropriate mass balance equations simultaneously. More complex mixtures require a different approach. Here we report the use of pyrolytic signatures to resolve contemporary material, millennial aged soil C and sedimentary rock organic matter ($>10^6$ years old) in the riverine and marine sediments of the Waipaoa River margin of New Zealand.

The pyrolytic yield (pyrolysis product quantity normalized to total organic C content) decreases with increasing diagenetic and catagenetic alteration. The ratio of alkane to aromatic hydrocarbon pyrolytic products also decreases as does the O-containing compound/aromatic hydrocarbon ratio.

Pyrolytic parameters indicate riverine sediments are composed primarily of sedimentary rock and aged soil C, an observation consistent with ^{14}C -content. Mid-shelf sediments accumulate contemporary marine organic C whereas outer shelf and slope sediments appear to have more diagenetically altered and aged material. Sediment generation and storage processes within the sedimentary system play roles in creating the observed organic C mixtures.