Geochemistry of crustal samples from the Atlantis Bank Platform, SWIR

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This aims of this project are to determine (i) the nature of the relationship between basalts, dolerites and gabbros across the 12 Ma old Atlantis Bank Platform, (ii) the spatial relationship between magmatic and tectonic features and (iii) to compare samples from this study to those from ODP Hole 735B. To this end, major element, trace element, Sr- and Nd-isotope and O-isotope ratios have been determined on a range of basalts, gabbros and mineral separates from samples across the platform.

The $^{87}Sr/^{86}Sr$ ratios of leached basalts range from (0.7028 – 0.7033) whereas the leached gabbros define a narrower range in $^{87}Sr/^{86}Sr$ (0.7027 – 0.7028). This is comparable with the $^{87}Sr/^{86}Sr$ ratios of gabbros from Hole 735B which range from 0.7028 – 0.7031 (Hart et al., 1999). $^{143}Nd/^{144}Nd$ ratios are not significantly different in the basalts and gabbros, ranging from 0.51312 – 0.51317.

Oxygen isotope ratios relative to V-SMOW range from 2.8 – 6.8 ‰ in the basalts and 3.4 - 6.6‰ in the gabbros. These vary from the expected Indian Ocean N-MORB value of 5.75‰ and can be attributed to different periods of high and low temperature alteration.

Geochemically the basalts are similar to N-MORB, whereas the gabbros show very distinctive major and trace element signatures. The REEs indicate that the gabbros are cumulates and apart from EU, are more depleted than the basalts in REEs. The gabbros show a positive Eu anomaly while the basalts have a slightly negative anomaly. The major element data indicate that the gabbros have accumulated olivine and plagioclase. The data indicate that the gabbros and basalts were not formed by fractionation of a single parental magma, but were formed from different magmas. Reasons for the geochemical differences between basalts and gabbros will be discussed at this meeting.

Reference

Hart, S., Blusztajn, J., Dick, H., Meyer, P., Muehlenbachs, K. (1999). “The fingerprint of seawater circulation in a 500-meter section of ocean crust gabbros.” Geochemica et Cosmochimica Acta **63**(23/24): 4059- 4080.

Comparison of sulfide oxidation in unweathered pyritic mine tailings

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Introduction

Oxidation of pyrite in sulfide-rich mining waste is a major source of metal pollution in mining areas. This oxidation reaction depends on oxygen content, water accessibility, ferric iron concentration, temperature, pH and microbial activity. To prevent air and water intrusion into mining wastes, abandoned deposits are commonly covered with soil or water covers.

The aim of this study was to investigate and compare weathering rates and the precipitation of secondary minerals in two unweathered pyrite-rich tailings materials sampled from a soil-covered impoundment.

Materials and methods

Coarse- (silty sand) and fine-grained (silt) unweathered tailings (pyrite content 17 and 22 vol%, respectively) were sampled from the interior at two different sites in an old deposit. The deposit has been covered since 1996 with glacial till, and is located in Kristineberg (65ºN 19ºE), northern Sweden.

Column experiments with these samples were run for 333 days at room temperature in two water saturated columns. Aerated distilled water was pumped into the bottom of the column at a rate of 45 mL/day.

The columns were frequently sampled for pH, redox potential, anions and cations. Mineral equilibria modeling of the leachate solutions was performed with PHREEQC2 to predict the potential precipitation of secondary minerals in the columns.

Results and conclusions

Overall, the leachate from the fine tailings showed higher metal, sulfate and acidity content compared with the coarse tailings. At the start of the experimental period, pyrite oxidation rates were high (7×10^{-10} mol s^{-1} for the coarse material and 2×10^{-9} mol s^{-1} for the fine), but decreased by one order of magnitude towards the end of the period. The faster oxidation rate in the fine tailings is probably a result of the greater specific surface area and the higher pyrite content in this material.

Mineral equilibria modeling showed that alunite, gibbsite, ferrihydrite and kaolinite might have precipitated in the coarse material, while chalcedony, jarosite-K and kaolinite may have precipitated in the fine. The reason for this difference is primarily the lower pH level in the fine material, and differences in the silicate mineral content in the tailings samples.