Effect of ionic strength on aluminum and dissolved silica under red soil-seawater interaction

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Red soil contamination to coastal area of Okinawa is environmental problem that has aroused the attention of many researchers. The soil is acidic, dominated by Al and low base-forming cations. This study was conducted to investigate behavior of the soil upon encountering seawater. Two red soil samples were fractionated into bulk soil, coarse sand and silt+clay. Different weights (1, 3, 5, 10, 15, 20, 30, and 40 g) of each fraction were shook with 100 mL of seawater and 1000 times diluted seawater. The pH, concentrations of Na^+, K^+, Ca^{2+}, Mg^{2+}, Al^{3+}, and SiO_2 were measured from extracts.

Results and Discussion

The ion exchange increased with increasing salinity, and the trend in both samples was silt+clay > bulk soil > coarse sand. The pH of the seawater was 8.25and the salinity was 34.40‰ while pH values of the soil were 4.65 and 5.04. The pH in soil-seawater extracts decreased up to 3.89 while Al increased from ~ 0 (seawater) to 53.94 mgL^{-1} in silt+clay fraction. The concentrations of Na^+, $Ca^{2+}$and Mg^{2+} and particularly K^+ decreased from the seawater. The K^+ decreased from 368 mgL^{-1} to 237 mgL^{-1} in the silt+clay fraction. The dissolved SiO_2 increased from 0.42 mgL^{-1} (seawater) to 34.23 mgL^{-1} in the coarse sand. The increasing Al that was accompanied by decreasing of the cations suggests the ion exchange reactions, but the SiO_2 trend was likely due to dissolution of the soil minerals. Maximum concentration of Al in 1000 times diluted seawater was 0.368mgL^{-1} in silt+clay, the maximum dissolved SiO_2 was 1.55 mgL^{-1} in coarse sand and the K^+ contents were < 1 mgL^{-1}.

Conclusions

Upon the red soil-seawater interaction, the salt effect in the seawater increased Al concentration through the exchange with Na^+, K^+, Ca^{2+} and Mg^2 and consequently decreases the pH of the extracts which in turn results in dissolution of silica.

Hydrocarbon biomarkers in near-surface sediments from Nankai Trough off central and southwest Japan

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In methane-rich marine sediments, e.g., at cold seeps and mud-volcanoes, a syntrophic consortium of archaea and sulfate-reducing bacteria is thought to perform anaerobic methane oxidation (AMO). This process is geochemically important as a sink of methane and as a factor affecting the carbon isotopic composition of methane. Here, we measured the composition of hydrocarbons in marine near-surface sediments where AMO seems to prevail according to the data of pore-water methane, and examined if we can find any molecular signature related to the process.

Near-surface core samples were collected from Nankai Trough off Tokai and Shikoku, where occurrence of gas hydrates has been expected from the results of previous seismic surveys and ocean drillings. The samples were freeze-dried, pulverized, and extracted ultrasonically with organic solvents of different polarity. The non-polar hydrocarbon fractions were separated from the total lipid extracts by column chromatography on silica gel, treated with activated copper to remove sulfur, and injected into GC-MS and GC-FID for identification and quantification of specific molecules.

N-alkanes were the major components for all the samples. A strong predominance of odd over even carbon-number compounds in the range over twenty-four indicated a significant organic input from land plants. High concentrations of PMI (2,6,10,15,19-pentamethylicosane), crocetane (2,6,11,15-tetramethyl-hexadecane), and their unsaturated homologues were detected from the samples off Tokai. Total concentrations of the PMIs and crocetanes were in good correlation with each other, suggesting a common origin. From the samples off Shikoku, in contrast, only PMI was detected at low concentrations. The presence or absence of crocetanes in the samples seems to reflect the major activity of archaea in the sediments being either methane-consumption or methanogenesis. This possibility needs to be further examined by stable carbon isotopic compositions of the biomarkers.