Estimate of residence time of groundwater in Mt. Fuji area, central Japan

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Many groundwater samples were collected from Mt. Fuji area, central Japan which is totally composed of basaltic materials. The samples were analyzed for Na^+, K^+, Ca^{2+}, Mg^{2+}, Si, Al^{3+}, Fe^{2+}, Fe^{3+}, TC (total dissolved carbon), Cl^-, $NO_3{}^-$, $SO_4{}^{2-}$. Analytical data plotted against altitude indicate that alkali and alkali earth element and Si concentrations increase with decreasing altitude, indicating that the dissolution of silicates in basaltic materials control the trends. Ca and Mg concentrations positively correlate with each other. This is consistent with CaO/MgO molal ratio of basalt which is 1.47. Therefore, it isi inferred that Ca and Mgi in groundwater were derived mainlyfrom the congruent dissolution of basalt. Ca/Si concentrationratio determined by the dissolution reactions of basalt accompanied by the precipitation of allophane is 0.29 that is lower than 0.48 estimated from the analytical data on groundwater. This lower value could be due to the precipitation of silica mineral (SiO_2). The agreement between theoretical and analytical results indicate that Ca, Mg and Si concentrations of groundwater are governed by dissolution and precipitation reactions. In order to interpret groundwater chemistry and estimate residence time of groundwater the simplified coupled dissolution kinetics-fluid flow model was used. Assuming reasonable values of parameters (reactive surface area, mass of groundwater, temperature etc) and usingr ate constant experimentally determined, residence time of groundwater in southeastern and northern part of Mt.Fuji area was estimated to be several years to 30years. This estimated residence time is consistent with isotope data (herium isotope, tritium concentration and CFCs). The calculation indicate that the reasonable residence time(10-30years) was obtained, if dissolution rate constant of Si for basaltic glass determined by fluid flow experiments but unreasonable one by closed system experiments. It is just conceivable that whether etch pit formed or not and/or heterogeneous dissolution occurred or not has significant impact on dissolution rate of basalt.

Dissolved gallium and gallium/aluminum ratios in the US GEOTRACES North Atlantic zonal section

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Gallium has a solution chemistry and geochemical behavior similar to aluminum; however, gallium appears to be less reactive than aluminum. Thus, fractionation of gallium from aluminum has the potential to shed light on aluminum input and removal processes with gallium beaving like a "super-heavy isotope" of aluminum. The 2010/2011 US GEOTRACES North Atlantic zonal section provided an opportunity to create a first detailed ocean section of dissolved gallium. Thirty-two profiles plus ancillary surface water samples were obtained and analyzed for dissolved gallium and aluminum.

In general, this new Ga section is consistent with previous observations: deep and bottom waters ranged between 30 and 35 pmol/kg; a distinct Ga minimum is observed in the Antarctic Intermediate Water; a slight maximum is found in Mediterranean Outflow Water; and, surface waters show a distinct north-westward increase. The surface water trend could be reflective of a residence time effect (i.e., accumulation of dust-derived Ga during North Atlantic gyral circulation) or of greater dust dissolution input. The biggest surprise is the observation of a ~20% increase in Ga in deep waters in the vicinity of the Mid-Atlantic Ridge.

The dissolved Ga/Al ratios are also instructive. Low (i.e., more rock-like) ratios in the Med water and hydrothermally-influenced waters are suggestive of recent inputs of these elements. In contrast, high Ga/Al ratios along the African margin are suggestive of preferential Al scavenging removal. Interestingly, high Ga/Al ratios in Labrador Sea Water along the western margin are actually lower than ratios in the Labrador Sea itself, suggesting accumulation of Al during transit. In surface waters of the eastern part of the section, where there is a significant gradient in chlorophyll fluorescence, the Ga/Al ratio increases with increasing fluorescence. This is consistent with preferential scvanging removal of Al from surface waters.