Experimental investigation of Cu-Fe-Zn isotope behavior during primary phase dissolution in basalt and andesite

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Based on elemental and isotopic data, the sizes of sinks and sources of Cu-Fe-Zn to the dissolved pool of oceans have been estimated. The Cu-Fe-Zn fluxes from mid-ocean ridge hydrothermal system to the open ocean could be significant, but these estimates are uncertain. The isotope composition of hydrothermal fluid is variable. For example, both heavy and light Zn isotope ratios have been reported in hydrothermal system. Most hydrothermal fluids from seafloor vents have high $\delta^{66}Zn$ values up to ~+1‰[1]. In contrast, Mid-Atlantic Ridge hydrothermal vent is supposed to have a very low $\delta^{66}Zn$ value (−0.5‰)[2]. We report elemental and isotopic data from a series of water-rock interaction experiments as a function of time and temperatures at acid pH condition, to assess the mechanism and magnitude of Cu-Fe-Zn isotope fractionation. The heavy Zn isotope ratios of leaching residues in experiments indicate that isotopically-light Zn are enriched in the fluids, which are consistent with observations in Mid-Atlantic Ridge hydrothermal vent. In addition, $\delta^{66}Zn$ is well correlated with Fe isotope variation. In the case of Cu isotopes, Cu isotope fractionation seemed to be controlled by starting materials. Different Cu isotope behaviors are observed in the experiments of seawater-basalt and seawater-andesite experiments. These results help to detail how the Cu-Fe-Zn isotope system behave in hydrothermal system and further in the study of metal flux into deep ocean.

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[2] Conway, T.M., John, S.G., 2014. The biogeochemical cycling of zinc and zinc isotopes in the North Atlantic Ocean. Global Biogeochemical Cycles, 28(10): 1111-1128.