Hydrochemistry at a volcanic summit area, Norikura, central Japan

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Norikura volcano in the Chubusangaku National Park is located in the central mountainous area of the Japan Archipelago. This area provides ideal water samples to understand the chemical behaviors of the natural surface water. In this work, chemical compositions of spring and pond water samples from summit and mountainside area of the Norikura volcano were determined. The results were subjected to multivariate statistical techniques to classify the water samples and to extract geochemical potential factors affecting the chemical composition of waters. The purpose of this research work is to clarify the geochemical process of water formation from a water source unpolluted by seawater nor anthropogenic activity.

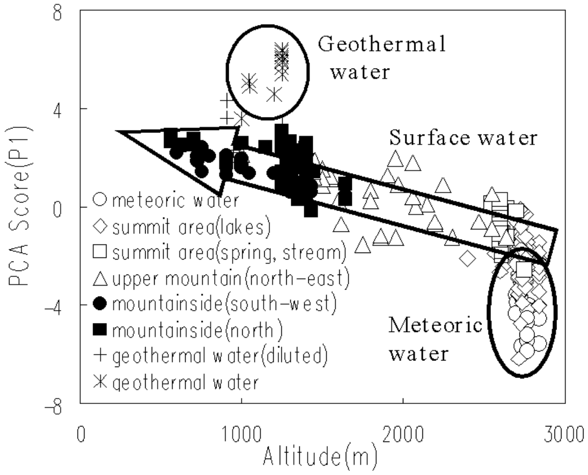

Figure 1: The scatter plots of altitudes of the sampling points vs PCA(P1) scores based on the major chemicals (Na, K, Mg, Ca, Si, Cl, NO_3, SO_4) of the water samples from Norikura volcanic area. The chemical data set was log-transformed and standardized prior to the statistical calculation.

The meteoric and geothermal waters were clearly distinguished from non-geothermal surface waters by PCA plots. The first component, which accounts for approximately 70% of the variance, showed high correlation with geographical information, e.g. altitude.

The further statistical and geochemical study showed that the factor which control the major solute in this area is exclusively rock-water interaction, i.e., rock dissolution (70%) and ion-exchange (20%). The geothermal or the anthropogenic contribution is negligible in this area.

Oxyanion stable isotopes and ocean paleoredox

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The ~1.5‰ offset in Mo isotope composition ($\delta^{97/95}$Mo) observed between seawater and the presumed composition of the continental crust has been interpreted as resulting from preferential adsorption of light Mo isotopes to sedimentary Mn-oxides (Barling *et al.,* 2001). This hypothesis is supported by experimental adsorption studies (Barling *et al.,* 2003). Seawater $\delta^{97/95}$Mo may therefore be sensitive to the extent of Mn-oxide deposition, and hence $\delta^{97/95}$Mo variations in authigenic phases may reflect variations in deep sea oxygenation.

While this model is likely to be qualitatively correct, quantitative interpretation of $\delta^{97/95}$Mo variations requires good constraints on the effects of all significant Mo removal processes on the ocean Mo isotope budget. Removal of Mo to euxinic sediments appears to have little overall effect because removal in such settings approaches 100%. However, the role of suboxic sediments is not so clear. For example, McManus *et al.* (2002) reported systematic $\delta^{97/95}$Mo variations in suboxic sediment porewaters which reflect preferential removal of lighter isotopes. Such sediments probably account for < 10% of Mo removal today, but this quantity may have varied in the past. Paleoredox reconstuction would benefit from multiple isotopic tracers with different redox sensitivities.

Cr and Se isotope measurements are being explored as paleoredox indicators that could be sensitive to less strongly reducing conditions. Soluble Cr(VI) converts to insoluble Cr(III) under mildly reducing conditions. This abiotic reaction induces fractionation of ~3.4‰ shift in ^{53}Cr/^{52}Cr. The marine Cr cycle, and presumably Cr isotope ratios, should be sensitive to suboxic conditions. Se is also highly soluble when oxidized, and sorption-prone or insoluble under mild to moderately reducing conditions, with isotopic fractionation accompanying reduction. The next step for both elements is to identify removal pathways and measure modern seawater and sediments.

References

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