Proxy Recognition of Volcanic Ash and Eolian Dust: Implications for Climate Records, Tectonics, and Nutrient Cycling

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Delivery of aluminosilicate material to the oceans in the form of eolian dust and volcanic ash is controlled by a number of geologic and climate mechanisms. This material can provide a record of physical processes (e.g., tectonics, climate, volcanology) and is also an important part of biogeochemical cycling (e.g., nutrient delivery). In the NW Pacific Ocean, large inputs of volcanic ash from convergent arc systems (e.g., Izu-Bonin, Marianas, Kamchatka) and eolian dust from China are related to the tectonic evolution of volcanic arcs and Cenozoic climate.

Differentiating eolian dust from altered and unaltered volcanic ash, and distinguishing both from primary authigenic phases, is difficult [1]. This is further complicated due to the presence of a large, relatively unrecognized component of volcanic ash that is mixed into the bulk sediment ("dispersed" ash). This dispersed ash is quantitatively significant and is an under-utilized source of critical geochemical and tectonic information [2]. For example, volcanic ash may provide as much bioavailable nutrients (e.g., Fe) to the surface water as does the eolian sources [3]. Because all these phases are aluminosilicates with a small compositional range, distinguishing between them to a precise degree is best achieved by a combination of chemical and quantitative multivariate statistical treatments [2].

We here extend our earlier study of ODP Site 1149 by presenting an enhanced data set that allows higher resolution study of volcanic input to the Izu-Bonin system. Our new expanded study confirms the presence of a significant dispersed ash component at Site 1149 [2]. The aluminosilicates are likely composed of four end members, i.e., loess and three other ash components. Geochemical signatures (e.g., K_2O, Fe_2O_3) of the dispersed ash can be exploited to provide insight into the clay mineralogy (i.e., smectite), which is involved in the hydrologic budget of subducting sediments. We will also present results from discrete ash layers as compared to the dispersed ash.

[1] Ziegler et al., (2007) *EPSL* **254,** 416-432. [2] Scudder et al., (2009) *EPSL* **284**, 639-648. [3] Olgun et al., (2001) *Global Biogeochem. Cycles* **25,** GB4001.

Hydrochemical analyses to evaluate groundwater system in Horonobe Area, Hokkaido, Japan

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For the safety assessment of a geological disposal of radioactive waste, it is important to establish validation method for estimating regional groundwater flow system.

In this study, first we collected more than 200 data of saline waters which were analyzed by JAEA and other organizations. And in order to indicate the mixing ratio of saline waters from different origins, the multivariate analyses were carried out based on the M3 (Multivariate, Mixing and Mass-balance) model developed by SKB (Laaksoharju et al., 1999) . We analyzed on these data in three cases where chemical components combinations are different. These combinations are as follows: 1.Cl^-, δ D, δ ^{18}O (the components which are not involved in water-rock reaction) 2. Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^- (the components involved in water-rock reaction) 3. Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, δ D, δ ^{18}O (all components) .

We tried to construct a hydrochemical model in the region where Neogene to Quaternary marine sedimentary rocks are deposited. The Wakkanai formation and the overlying Koetoi formation which consist of siliceous and diatomaceous mud-stones are the main targets of our study.

As the result of the multivariate analyses, four types of endmembers were extracted. They are: 1. surface water , 2. Cl-poor water (HDB-5） , 3. Cl-rich saline water (HDB-7), 4. Ca-rich saline water((HOKUSHIN R-1). Spatial plotting of these endmembers shows that high concentration part of HDB-5 water is distributed in deeper region where abnormal formation pressures were measured, and HDB-7 water is more rich in western site. This result suggests that in this area, there are some types of deep groundwaters which flow in different directions.

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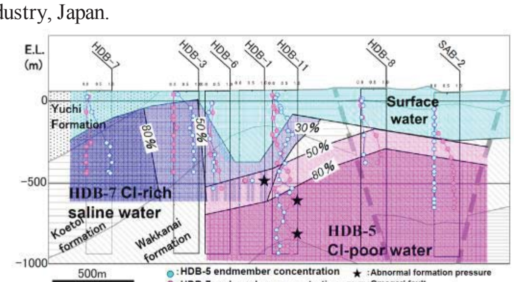

Figure 1: Projecting distribution of the endmenbers

[1] Laaksoharju et al., (1999) *Applied Geochemistry* **14#**, 861-871.