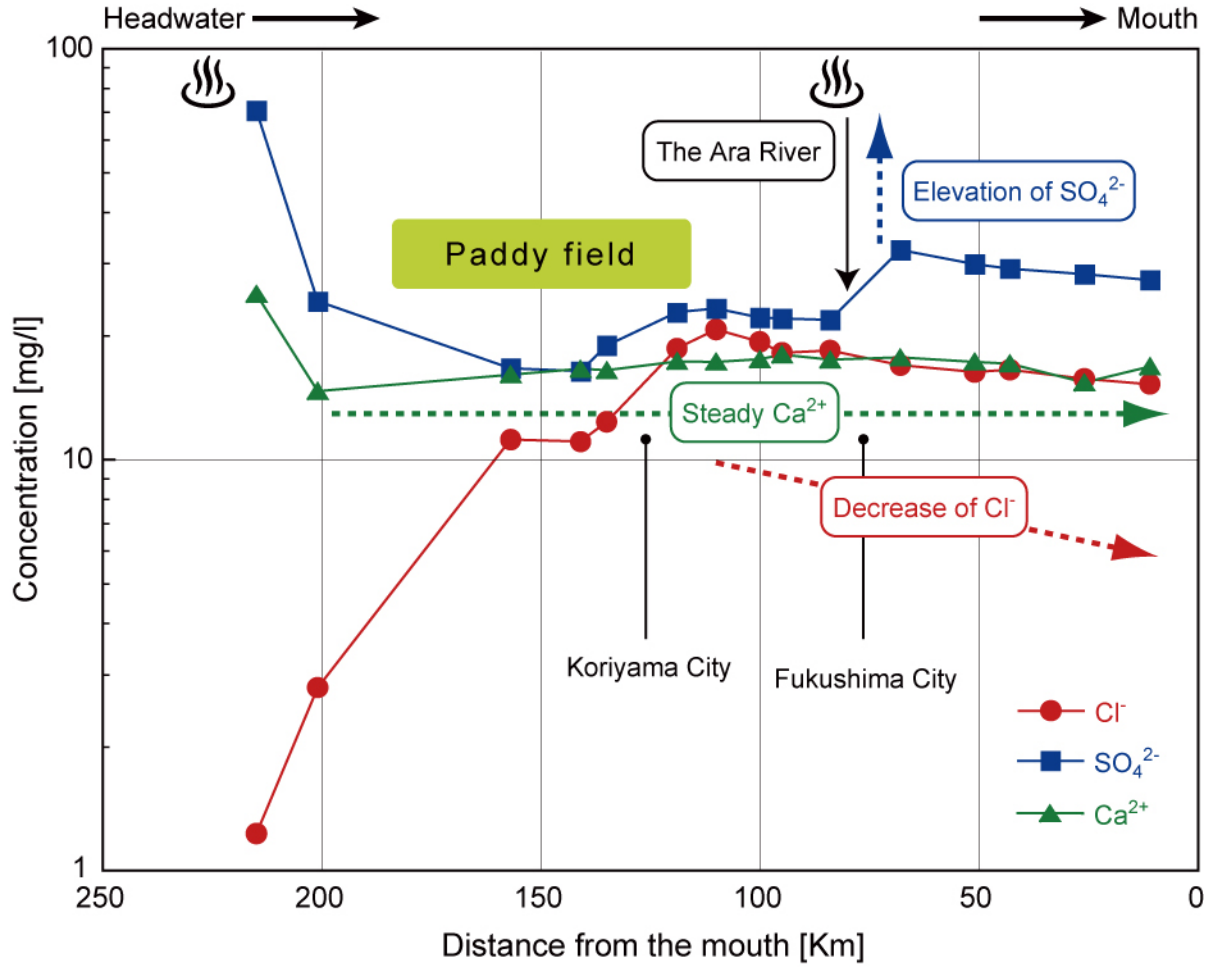
Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

AHW018-07 Room: Exibition hall 7 subroom 2 Time: May 28 10:45-11:00

Water quality formation in the Abukuma River system

Saitoh Yu[1*], Yoshihito Saitoh[2], Takanori Nakano[1]

[1]RIHN, [2]Motomiya Mayumi Elementary School



A hydrogeochemical case study about the Abukuma River system is reported. The Abukuma River of 238 km long, debouching to the Pacific Ocean, drains northeast Japan. Granitic rocks consist the east and Volcanic rocks do the west of the basin, and the alluvium fills the valley between them. Precipitation is large in the mountainous districts and low in the lowlands. The population within the watershed is 1.38 million. Farmland occupies 18 % of the basin area. Many other types of human impacts, such as dams, urban areas, and hot spring resorts, affect the river system.

TRIBUTARIES
Cl^- concentration ([Cl^-]) of the tributary water correlates well (r^2=0.70) with the areal average precipitation of the catchment. Although [Cl^-] correlates also well with the average elevation of the catchment (r^2=0.55), the lower coefficient suggests that the correlation is resulted from the

correlation between the elevation and precipitation (r^2=0.69).
Chemistry of the tributary water varies between the east and west side of the main river. Ion concentrations are generally higher in the east, except for [SO_4^{2-}]. Various factors, such as area, elevation, precipitation, may multiply cause the variation. Ratio between [Ca^{+}] and [SO_4^{2-}], both of which can be attributed to the geology, is significantly distinguishable between the east and west. [Ca^{2+}]/[SO_4^{2-}] is around 1.7 in the eastern tributaries, while 0.8 in the west. Lower [Ca^{2+}]/[SO_4^{2-}] in the west implies that H_2SO_4 derived from the pyrite within volcanic rocks have been used for the weathering of minerals. This is supported by the isotope ratio of dissoleved strontium, which is dependent on the geology of the catchment.
Ratio between the human-activity related ions, [NO_3^-] and [Cl^-], is also significantly distinguishable. [NO_3^-]/[Cl^-] is around 0.8 in the east, while 0.5 in the west. Although both precipitation and sewage are conceivable as the Cl^- source, the precipitation may take the main role because it correlates well with [Cl^-]. Thus, the higher [NO_3^-]/[Cl^-] in the eastern tributaries suggests agricultural contamination of NO_3^- derived from fertilizer. This fits well with the fact that agricultural use of the upland where the most tributary samples were taken is more active in the east than west.

MAIN RIVER
The electroconductivity is higher in the main Abukuma river than in tributaries. The chemistry gradually changes from Ca-SO_4type in the headwater, through Ca-HCO_3in the upper to middle course, Na-HCO_3in the middle, to Na-Ca-HCO_3in the lower.
[Cl^-] rises substantially in the upper 100 km course, and then gently declines in the lower 100 km course. [NO_3^-] and [Na^+] shows the similar trend. Broad paddy field lies west of the upper and middle course of the Abukuma river. Precipitation in this area is quite low (<1200mm). Inflow of wasted western tributary water, which has been subjected to strong evapotranspiration in flowing through the paddy field, is thought to responsible for the concentration increasing in the main river. In the lower 100 km course, along which large-scale paddies are few, tributary inflow of low concentration may dilute the main river water.
[SO_4^{2-}] shows sudden elevation in the lower middle course around the Fukushima City. Similar elevation is observed about [Mg^{2+}] and [F^-]. Obviously, the inflow of the Ara river originating from a hot spring area is responsible for the elevation. [Mg^{2+}], [Ca^{2+}], [SO_4^{2-}], and [F^-] of the Ara river water are significantly higher than that of the main Abukuma river. The increasing rate of [SO_4^{2-}] by mixing calculated from the discharge is 44 %. The value is well accorded with the actual rate of 48 %. The similar results are obtained about [Mg^{2+}]. However, as especially for [Ca^{2+}], calculation does not fit the actual increasing rate. [Ca^{2+}] in the main river varies little as opposed to the other ions. The river-bed sediment seems to buffer the change of [Ca^{2+}] due to the high adsorbability of Ca^{2+} to it.

Keywords: the Abukuma River, hydrogeochemistry, chloride ion concentration, human impact, mixing process, Strontium isotope