Understanding of Groundwater flow system and Nitrogen cycle in volcanic aquifer of pyroclastic flow

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Study area is well-known agriculture area in Southern Kyushu, Japan and highly depends on groundwater resources for their everyday use.

Local unconfined groundwater aquifer is widely polluted by Nitrate-Nitrogen originated from agriculture and cattle farming. It will become serious problem if this unconfined Nitrate pollution enlarges into the confined aquifer system which is used for local city water source. The detailed three dimensional groundwater flow system study has been done by using existing wells in the basin to understand the three dimensional distribution pattern of Nitrate-Nitrogen in the aquifer. However, the detailed groundwater age analysis by using Tritium for unconfined and confined groundwater has not been succeeded because of present low atmosphere tritium concentration. Thus we applied to challenge the CFCs dating method. Although the CFCs method has been widely used for dating the young groundwater instead of tritium in many countries, in Japan CFCs has been used only by Oceanographic study and has not been used in the field of Hydrology.

The history and fate of Nitrate contamination have been shown in multidisciplinary local transect studies in areas with agricultural sources (Bohlke and Denver 1995). However, resolution of Nitrogen sources can be difficult in larger regional studies because of co-occurrence of multiple anthropogenic Nitrogen sources and uncertainty in Nitrogen transformation pathways. Thus, the characterization of N geochemistry remains challenging, particularly in aquifer-scale assessments (Stephen 2006). In this study, the evidence of the shallow groundwater flowing towards deep aquifer was verified by the groundwater dating and the detailed Nitrogen reduction process was confirmed along the groundwater flow.

The field sampling groundwater was done in July, 2007 for about 50 wells by all using existing wells to analyze inorganic water chemistry, hydrogen / oxygen stable isotopes and CFC's.

The precipitation in summer mainly recharges the flow of shallow groundwater and flows from upland down toward river. Shallow groundwater in lowland is longer residence time than them in upland.
It is suggested that the high concentrations of nitrate introduced into groundwater by Fertilizers applied and cattle farming.

It is also suggested that occur Nitrate reduction, because nitrate ion concentration decreases and reduction product increases with flow.

It is thought possibly to occurs dissimilatory nitrate reduction(reduction to ammonium) with denitrification, as ammonium and Nitrite are a little detected in the groundwater when nitrate decrease. It poses a serious threat to the quality of public drinking water supplies and urgent countermeasures are required because this area is highly depends on groundwater resources for their everyday use.