

C-3.2 Study on Hydrogeological Response to Acid Rain for Geology and Soil

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Abstract It is necessary for evaluation of effect to groundwater by acid rain to grasp hydrogeological characteristics such as infiltration capacity, grain size, water content and chemical and mineralogical ones of geology and soil properties in the basin where acid rain falls. In this report, the authors selected Shirasu and Kanto loam, which are the most common volcanic ash deposits in Japan, atypical soils and examined them through the batch and the infiltration experiments for about one month whether they are vulnerable for acid rain or not. Especially, the authors tried to draw a buffering capacity map of the Kanto loam for acid rain in the whole Kanto plain. Such kinds of map is valuable to prevent the acid rain problems to groundwater resources.

Key Words Soil, Infiltration, Buffering capacity, Shirasu, Kanto loam

1. Introduction:

In the countries such as Japan being unremarkably damaged by acid rain, it is necessary to confirm the place where the damage will first be found by the acid rain and give priority to take countermeasures in case of suffering damage by the acid rain. It is an urgent subject to make clear groundwater flow system considering soil properties and geomorphological features of the area on the assumption that the acid rain should fall in the area.

2. Research Objectives:

Physico-chemical evaluations of vulnerability of Kanto loam and pyroclastic deposits, so called "shirasu" distributed in the southern Kyushu, to acid water, are examined by the batch and the infiltration experiments using artificial acid water. The purpose of this study is to discuss spacial difference of vulnerability of geology and soil characteristics to acid rain in the study area and to be drawn a kind of vulnerability map to present one of materials considering countermeasures to pre-

vent acid rain problems to the groundwater resources.

3. Vulnerability of Shirasu to acid water:

The authors collected 3 samples of Shirasu (pyroclastic deposits) from the Yunono Onsen, Kagoshima Prefecture and Okamoto, Ebino City, Miyazaki Prefecture and 1 sample of weathered lava from volcano Mt. Sakurajima, Kagoshima Prefecture to make the batch and the infiltration experiments in the laboratory.

The following results were obtained through the experiments.

- 1) As the duration of the experiment was rather short (35 days), rapid reactions such as ion exchanges on the surface of minerals have only been found, whereas, slow reactions such as weathering and changing in quality of the mineral have rarely been found.
- 2) About 50 to 60 % of buffering mechanism of pH for the soil was cation exchange reactions.
- 3) When acid rain of pH 4 has continued to fall in the area having 2,000 mm of annual precipitation, the durations when 50 cm of soil can keep groundwater in over pH 5 are to be 45 years for Yunono and 20 years for upper and lower Okamoto. These are the values to be calculated only by rapid reactions. If slow reactions are considered in this calculation, they will be longer. On the other hand, volcanic ash from Sakurajima had no buffering ability keeping over pH 5.

4. Vulnerability of the Kanto loam to acid water:

The "Kanto loam" is widely distributed on the Kanto Plain. It is impossible to ignore the existence of the Kanto loam when the effect on groundwater by acid precipitation is considered, since acid precipitation must first percolate through the Kanto loam, deposited as the surface layer. The Kanto loam is classified into four different groups, based on geological deposition age, with Tama loam as the oldest in the bottom, followed by Simosueyoshi loam, Musashino loam, and Tachikawa loam at the top, as the youngest. The four groups are thought to have different physico-chemical features. Even the loam deposited in the same geologic age, has different physico-chemical features such as particle size and permeability, with the distance from the supplied volcano.

The authors made the batch and the infiltration experiments using acid water of pH 2 for the Kanto loam samples taken from 18 sites in the whole Kanto Plain. On the basis of the results of water quality analysis and mineral composition analyzed by XRD and TG-DTA methods for 18 samples of the Kanto loam, a map showing buffering capacity to acid rain in the Kanto Plain was drawn in Fig.1. The map shows the following two trends.

- 1) In general, buffering capacity of the Kanto loam to acid rain is higher in the western part of the Kanto Plain, and lower from northeastern to southeastern parts of it.
- 2) The area having high buffering capacity to acid rain is expanding like a belt

from west(SW) to east(ENE) of the Kanto Plain.

The areal distribution of buffering capacity of the Kanto loam to acid rain may be explained by distance from the source of the ash and areal difference of characteristics of the Kanto loam related to wind direction of the Westerly.

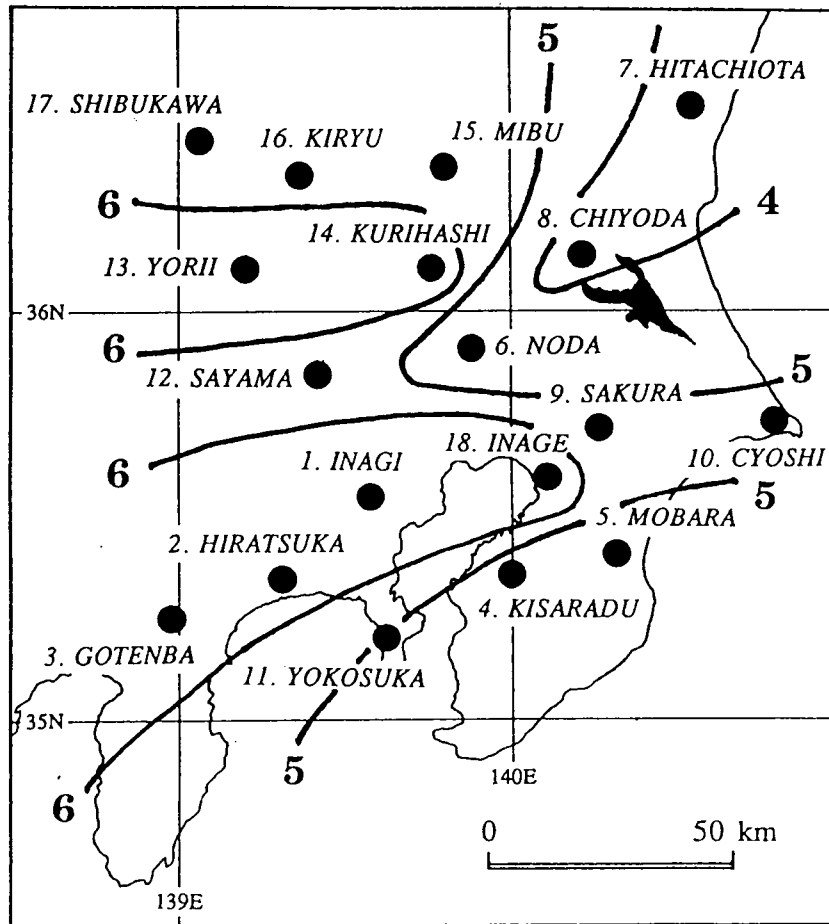


Fig.1 The areal distribution of buffering capacity(pH final values) of the Kanto loam to acid rain