

Processes of Forming Basic Water Quality of Springs in the Northwestern Part of Shimousa Upland, Central Japan.

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Deterioration in water quality of springs in the valleys dissecting the urbanized uplands in and around big cities like Tokyo is one of the serious environmental issues. Land use changes of uplands due to urbanization have resulted in deterioration in water quality of many springs and streams. It is estimated that the following two processes form ion composition of spring water in the urbanized uplands. One is the natural process of sediment-groundwater interaction, and the other is the human-induced process that means the artificial addition of loads to groundwater by human activities on uplands. In order to conserve and rehabilitate water quality, and to predict the change in water environment in urbanized areas, it needs to distinguish quantitatively the two processes. Therefore, the present research tried to deduce the water quality due to the natural process from the observed data on the basis of the relationships between water quality and the factors such as spring altitude, land use, and geology. Also, it tried to understand the natural process based on the understanding of chemical compositions of geological strata.

The study area is the northwestern part of the Simousa upland in the eastern part of the Tokyo Metropolitan Area. The Simousa upland was formed during the Last Interglacial Age and consists of many layers of marine, brackish and alluvial sand and clay beds, each of which is almost horizontal stratum. They are covered with volcanic ash layers with a maximum thickness of about 5m. Springs are located at various altitudes in the valleys dissecting the upland corresponding to the altitudes of aquifers in different strata. For 60 springs selected in the study area, water quality elements such as water temperature, electric conductivity, pH, alkalinity, silica concentration, and major inorganic ion concentrations were measured. Using waters extracted from the sediment samples of upland deposits taken from each stratum at outcrops, water quality elements were also measured. For every spring, relative height between spring point and upland surface was surveyed on the 1/2500 scale maps, and drainage basin land use in 1994 was analyzed on the basis of the detailed digital information of land use published by Geographical Survey Institute of Japan.

With an increase in relative height between spring point and upland surface, silica concentration increases. It indicates that the relative altitude is a parameter of the flow path length of groundwater in the upland deposits. On the basis of relationships between relative altitude and ion concentration for individual major ions, the observed ion compositions of individual springs were divided into the basic load and the additional load. The basic load line shows that the concentration of calcium increases along the increase of relative height, in comparison with other ions of cation such as sodium. Among anion, bicarbonate ion showed a tendency of increase.

On the other hand, the quality of waters extracted from the sediment samples shows a potential of strata to solve out ions, and it showed high proportions of sodium among cation, which is a different characteristic from spring waters.

The reason for the remarkable differences of quality between spring waters and extracted waters can be explained as follows:

The quality of extracted waters that is related to the chemical composition of stratums indicated that the upland deposits stably contain Kaolinite and sodium feldspar. The Kaolinite is considered to be generated by change of mineralogical composition of the mineral found in upper stratums; sodium-calcium feldspar. In the process of changing the mineralogical composition, it solves out sodium, calcium and bicarbonate. In addition to it, the carbonate minerals contained in upper stratums possibly dissolve calcium in groundwater. The accumulated processes along the flow of groundwater result in the increases of ion concentrations of spring waters.