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Groundwater system Investigation of the Cheonggyecheon Watershed Area

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Abstract

The groundwater system of the Cheonggyecheon watershed is very complicated because it is influenced by many factors such as pumping out, groundwater leakages into subway stations, civil use of groundwater, and leaking water from water supply and sewage lines. So the characterization and evaluation of the groundwater flow and contaminant transport in the Cheonggyecheon water system is quite a difficult task. The purpose of this study is to analyze the influence on the 'groundwater' below the Cheonggyecheon watershed by the 'maintenance water' on the Cheonggyecheon stream after the restoration. We have so far collected groundwater quality data, hydrogeologic aquifer parameters, and the amount of leakages into subway stations and its influence on the groundwater system. Results show that groundwater level was influenced by the direction and depth of subway tunnel. This study will continue to monitor groundwater quality, a water level fluctuation relation between rainfall and groundwater recharge for further investigation of the groundwater flow system in the Cheonggyecheon watershed.

key words : Cheonggyecheon watershed, groundwater, restoration construction

1. Site description

In the study site, there are three construction sectors, and total 21 wells had been installed in 2003. Some wells are in the stream bed, another wells are on the stream bank(Fig.1). The first sector is undertaken by the Daelim construction company between Cheonggye 1st street and Cheonggye 4th street. There are 5 observation wells in the bottom of Cheonggyecheon stream.

The second sector is between Cheonggye 4th street and Cheonggye 8th street. There are also 5 observation wells. Nowadays, however, the first and the second stage have no observation wells left because of destruction during restoration processes.

The third sector, Hyundai stage, is between Cheonggye 8th street and the point of joining with Jungrang-cheon, where observation wells are not in the stream bed, but on the stream bank. So,

unlike Daelim and LG stages we can access to the wells to investigate the water level fluctuation and water sampling. This stage has 11 observation wells which are in left and right side on the bank of the Cheonggyecheon.

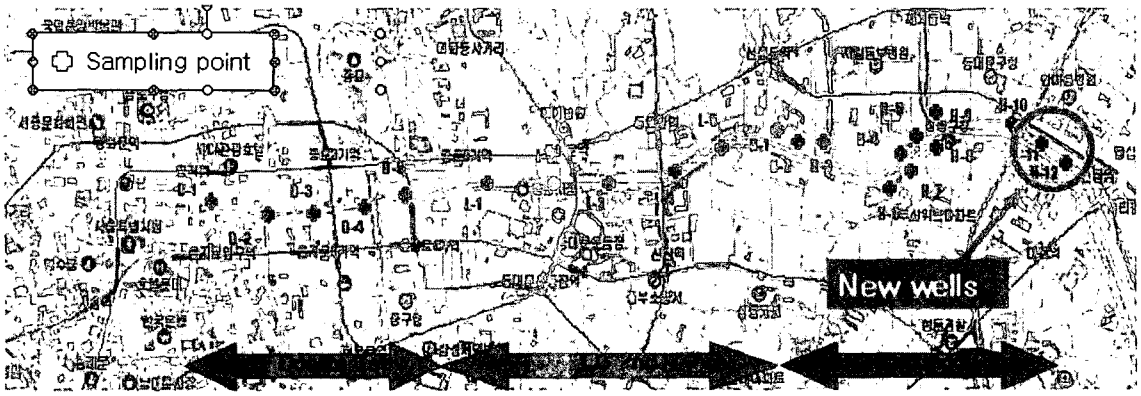

Figure 1. Location of observation wells in the study site

2. Monitoring of the water quality

The result of water quality analysis will be a basis for comparison of the change of a water quality after the restoration of the Cheonggyecheon. So, we detected inflow contaminant water like sewage to Cheonggyecheon stream. The water was sampled once in a month from October to December 2003, to analyze the quality of the water(Fig. 2). In October, the groundwater, leaking water from subway lines, and stream water in the Cheonggye watershed were collected.

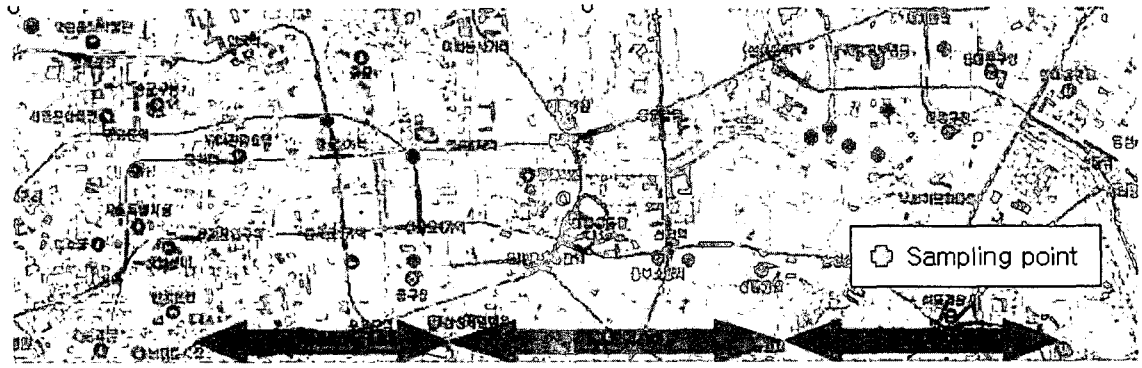

Figure 1. Location of groundwater sampling

3. Analysis of the water quality

The result of analysis for the samples on October gives us that the cation displays a trend like Ca > Na > K > Si > Mg, and the anion shows that of HCO_3 > SO_4 > Cl. The wells have two depth levels: deep(> 10m depth) and shallow(<10m depth). Deep wells have much nitrate contents, while there are low dissolved constituents in shallow wells. The piper diagram shows the major elements.

Most water samples show the major ion water type of Ca-HCO_3 (Fig. 3).

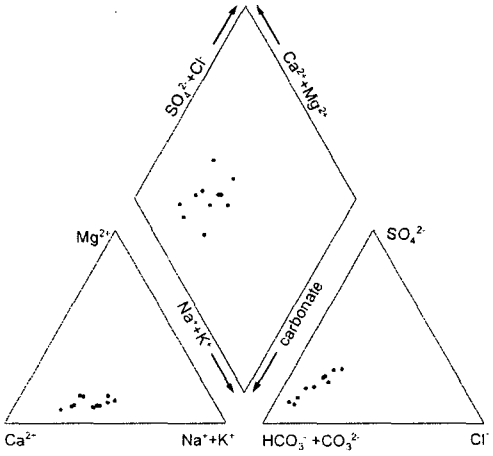

Fig. 3 Piper diagram on October

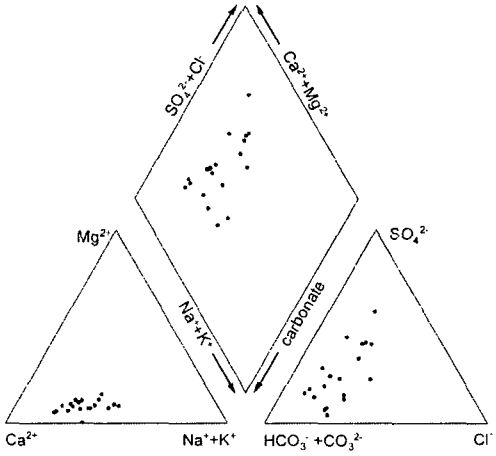

Fig. 4 Piper diagram on November

Results of 'Principle Component Analysis (PCA)'were shown in Table. 1-a. In hydrogeologcal study, the PCA helps to understand the chemical relationship in study site, and find out a groundwater flow patterns based on the geochemical factors.

From the result of this method, the component 1 shows a high value of Cl, NO_3, and Na presumably affected by anthropogenic sources such as sewage. The component 2 shows the high value of HCO_3, K, Mg, and Ca. It seems that the water quality is some what related to cement structure around the Cheonggyecheon.

The water samples from observation wells in work site on November was analyzed. The wells are located on Cheonggyecheon streambed, the wells on the streambed are from D-1 to D-5 and from L-1 to L-5. The wells from H-1 to H-12 are ,on the other hand, located the stream bank (Fig. 1). The piper diagram shows the major constituents in the water samples of the wells on the streambed (Fig. 4). The water samples from the Daelim 1st sector has high value of NO_3, and that from the LG 2nd sector has high Na, Cl, and HCO_3 contents. It seems that the groundwater in these sectors is influenced by household and industrial sewage. The groundwater in Hyundai 3rd sector does not have a regular trend. The result of PCA is shown in Table 1-b.

Table 1-a

	component	
	1	2
CL	.917	.300
NO3	.907	-.318
NA	.891	.346
SO4	.748	.506
SI	.747	.364
HCO3	.166	.967
K	.014	.801
MG	.533	.772
CA	.578	.748

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

Table 1-b

	component		
	1	2	3
HCO3	,893	-,120	-,330
CL	,860	,209	-,041
NA	,828	,446	,232
MG	,710	,558	,159
CA	,577	,724	-,012
SI	,607	,719	,181
SO4	,051	,952	-,069
K	-,020	,270	-,754
NO3	-,055	,298	,689

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

Table 1. The Principal Component Analysis of the groundwater samples: Table 1-a is shown that the water samples were collected in the Cheonggyecheon stream, subway lines, and a used groundwater nearby Cheonggyecheon watershed. Table 1-b is shown that the water samples were collected to the observation wells in the sector of the Cheonggyecheon restoration.

4. Reference

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