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Relation between lineament and well productivity (지질구조선과 지하수 산출성간의 상관성 평가)

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요 약 문

Lineament maps are the important tools that may reveal points of groundwater recharge, flow and development. In particular, groundwater flows and yields in mountainous area, composed of crystalline rocks with many fractures, are governed mainly by the lineaments corresponding to fractures, joints and faults. Lineaments may give important information on the best distribution of wells and their management. For two districts; Pohang and Cheonan, the relationship between lineament and groundwater factors was analyzed. To compare groundwater productivity, storativity, and transmissivity of a well site along the distance to lineament, the distances to lineament was regrouped into five groups with an equal range, 100m, for the Pohang district and they are also divided into five groups with an equal range, 150m, for the Cheonan district. From the results of the Spearman Rank Correlation Analysis and Kendall Analysis for each group, the means of SPC and T of wells which are located near lineaments generally have large values. The means of SPC and T show a reverse linear relationship with a lineament distance, but the means of S shows a disperse distribution and no distinct linear relation. Result of the linear regression model between SPC and lineament length density shows that it will be effective to use the lineament length density map when finding the optimal well site on a regional scale.

key word : lineament, well productivity, linear regression model

1. Introduction

For a regional-scale analysis, available well investigation data, remotely sensed data, fracture data and hydrogeologic data are collected and compiled. Generally, high production areas in bedrock aquifers are especially and generally associated with conductive fracture zones characterized by high transmissivity. Detailed structural analysis and the understanding of the tectonic evolution of a given area can provide useful information in regional scale studies. Many studies for the analyses of bedrock aquifer yield have been done during the previous several decades (Mabee et al., 1994; Sander et al., 1996; Sami, 1996; Sander et al., 1997). Kim et al(2004) developed the lineament extraction

program using ArcView script and this study also uses the script.

To analyze the relation between groundwater productivity and lineament distribution, the followings are analyzed;

i) the relation between groundwater productivity of a well and the distance to the nearest lineament

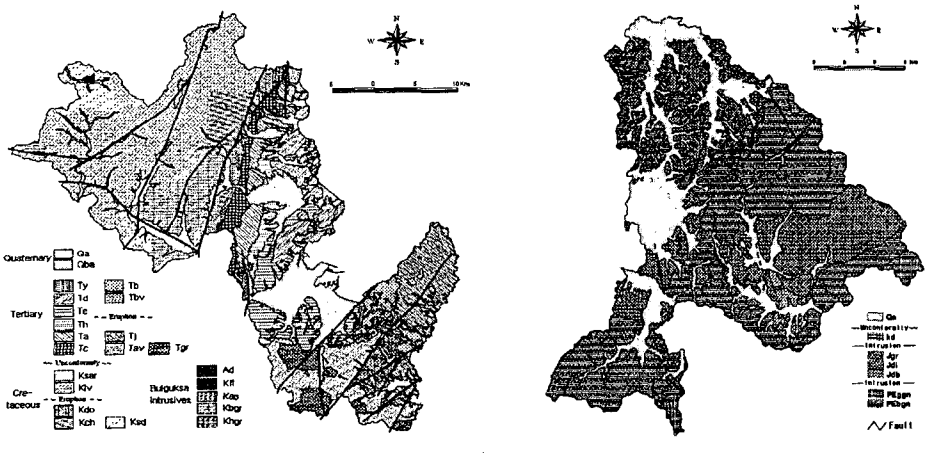
ii) the relation between groundwater productivity of a well and the distance to the nearest lineament cross-point

iii) the relation between groundwater productivity of a well and the lineament length density

iv) And, the relation between groundwater productivity of a well and the orientation of lineaments or the length of lineament.

2. Study area

The Pohang and Cheonan districts (Figure 1) were selected as the study areas because these areas have been investigated for several years to study the groundwater conditions and draw hydrogeologic maps based on the basic groundwater survey project planned by the MOCT (MOCT and KOWACO, 2003a, 2004b). Thus, they have abundant information on groundwater wells, geology, hydrogeology and lineaments. The Pohang district has been investigated from 2002 to 2003 by KOWACO, and the Cheonan district from 2000 to 2003.

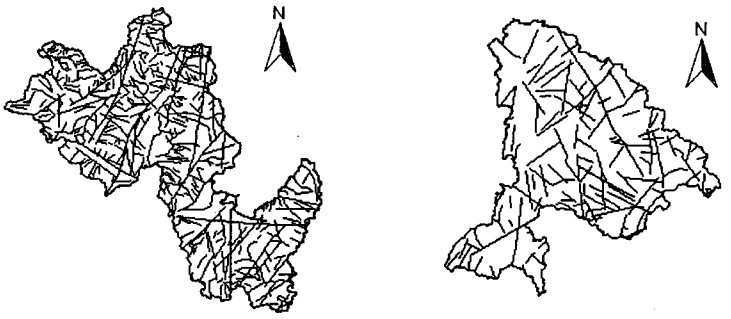


a) Pohang b) Cheonan

Figure 1 Regional geologic maps for the Pohang and Cheonan districts.

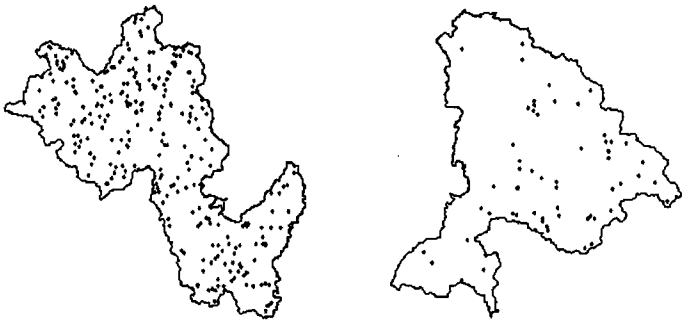
3. Data and Process

The total numbers of existing wells are 1,176 for Pohang and 16,494 for Cheonan. The Cheonan district has low topographic characteristics which are plains or lower hills, and these areas of the Cheonan district are wider than that of the Pohang district. These low elevations are relatively favorable for agriculture and dwellings.



a) Pohang b) Cheonan

Figure 2 Lineament distribution maps for the Pohang and Cheonan districts

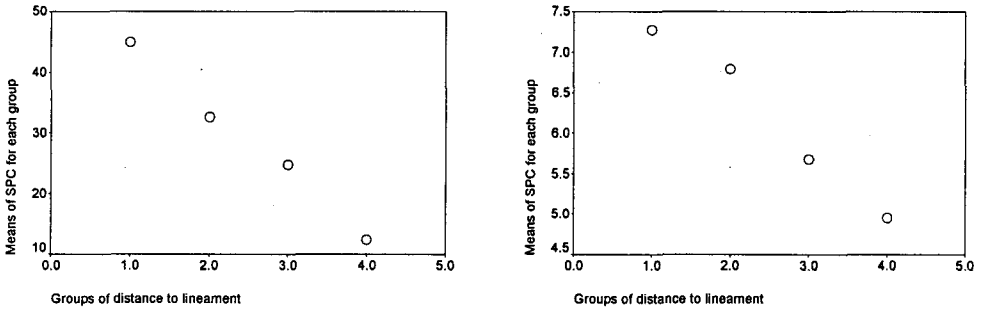


a) Pohang b) Cheonan

Figure 3 Lineament cross-point map for the Pohang and Cheonan districts.

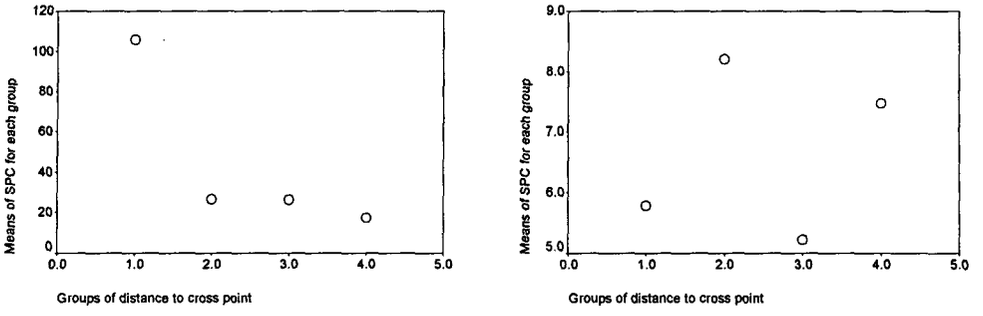
4. Result

The mean for SPC shows a reverse linear relationship with a lineament distance. The SPCs of the wells located near lineament are generally larger. This means that, on selecting the target area for pre-investigation before well construction, lineament analysis is essential and effective to protect from and minimize the failure of well development.



a) Pohang b) Cheonan

Figure 4 Scatter diagrams for the mean values of SPC and the distance to lineament for Spearman Rank Correlation Analysis for the Pohang and Cheonan districts.



a) Pohang b) Cheonan

Figure 5 Scatter diagrams for the mean values of SPC and the distance to lineament cross-point for Spearman Rank Correlation Analysis for the Pohang and Cheonan districts.

To reveal the linear relations between the SPC and lineament length density a linear regression model is used. Wells with a high productivity of over 10 m²/d/m only were selected for this analysis in the Pohang and Cheonan districts because those with a lower productivity were evenly distributed along the lineament length. For the Pohang district, Pearsons correlation coefficient is 0.670 and it is significant. The R square is 0.449. The linear regression model is expressed as;

$$y=-81.896+149.211x$$

where y is the mean of SPC and x is a lineament length density.

For the Cheonan district, Pearsons correlation coefficient is 0.756 and it is highly significant. The R square is 0.572. The linear regression model is;

$$y=7.567+13.305x$$

where y is the mean of SPC and x is a lineament length density.

5. Conclusion

For two districts; Pohang and Cheonan, the relationship between lineament and groundwater factors was analyzed. To compare groundwater productivity, storativity, and transmissivity of a well site along the distance to lineament, the distances to lineament was regrouped into five groups with an equal range, 100m, for the Pohang district and they are also divided into five groups with an equal range, 150m, for the Cheonan district. From the results of the Spearman Rank Correlation Analysis and Kendall Analysis for each group, the means of SPC and T of wells which are located near lineaments generally have large values. The means of SPC and T show a reverse linear relationship with a lineament distance, but the means of S shows a disperse distribution and no distinct linear relation.

For analyzing the effect of lineament cross points, the distances to the nearest lineament cross points are also divided into five groups with equal range, 400m, for the Pohang district and they are divided into five groups with 1,000m range for the Cheonan district. Groundwater productivity near the lineament cross-point increases rapidly, and in many wells far from the lineament cross-point it decreases slowly and gradually.

To reveal the linear relation between SPC and lineament length density, the wells with a high productivity with over 10 m²/d/m were selected in the Pohang and Cheonan districts. Pearsons

correlation coefficients between the two items are 0.670 and 0.756, and they are highly significant. Depending on the linear regression model between SPC and lineament length density, it will be effective to use the lineament length density map when finding the optimal well site on a regional scale.

6. References

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