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Soil Geochemical Characteristics in Korea

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1. Introduction

The present study was carried out along the soil profile in different rock Hillslopes. The geochemical coefficients were used in order to consider the geochemical characteristics in soil and spatial variability of microelements within soils. The soil geochemistry has not been investigated entirely in Korea yet, so the present study can give a new information about the primary concentration of several microelements within soil and spatial transportation characteristics of these microelements which concentrated along the soil profile in different bedrock soils in Korea. The purpose of this study is (1) to consider the primary characteristics of the soil geochemistry in different rock Hillslopes (2) to determine the microelements which are leached by throughflow and overland flow, (3) to clarify the distribution behaviours of the microelements such as Cu, Zn, Pb and Ni along the lateral and vertical directions in Hillslopes.

2. Study areas and methods

Granite Hillslope (Gr) is located in north-west side in Sapae Mountain (552 m a.s.l) at longitudes of $127^0$02'E, and latitudes of $37^0$43.5' N. The bedrock is composed of Jurassic Daebo Intrusive Granite rocks (KIGAM, 1999). Gneiss Hillslope (Gn) is located in north-east side in Yebung Mountain (679 m a.s.l) at longitudes of $127^0$07'E and the latitudes of $37^0$33'N. This area is underlined by Pre-Cambrian banded Gneiss. Sedimentary rock Hillslope (Se) is located in north-west side in Kuemo Mountain (411 m a.s.l). The geological formation is occupied by the Cretaceous Sedimentary Rock.

In this study, soils were sampled from soil profiles along the upper and lower slopes in Gr, Gn and Se rock Hillslopes. The yellow sandy soil which has low organic matter and red-yellow soil were sampled in upper and lower slopes, respectively in Gr Hillslope. The Mountain forest brown soil and dark brown soil were sampled in upper and lower slopes in Gn Hillslope. Dark grey lighted brown lithosol with A/R layer and reddish brown silt clay loam soils were sampled in upper and lower slopes, respectively in Se Hillslope. The several microelements such as lead (Pb), zinc (Zn), nickel (Ni) and copper (Cu) were selected in order to consider the primary geochemical characteristics for Gr, Gn and Se rock Hillslopes and to compare with the average amounts of microelements, called by Clark within soils in the world which calculated by Kabata-Pendias and A.M Vinogradov (Table 1).

Table 1. The Clark concentration of the micro-elements within soil in the world

Microelements	Cu	Pb	Zn	Ni	Fe	Mn	Ti	Co	Sr	Cr	Sn	Mo	V
A.Kabata-Pendias	28	25	78	20	38000	545	3500	8.5	280	65	1.1	2	69
A.M.Vinogradov	47	16	83	58	-	-	-	18	340	83	-	-	-

Table 2. The average concentrations of microelements within soils in Gr, Gn and Se Hillslopes (mg/kg)

	Cu	Pb	Zn	Ni	Fe	Mn	Ti	Si	Al	Mg	Ca	Na	K
Gr soil	28.35	49.4	100.6	20.8	1.23	0.08	0.31	25.09	4.81	0.4	0.41	0.88	0.84
Gn soil	50.45	35	128.4	54.85	2.64	0.09	0.57	24.4	4.68	1.44	0.37	0.21	1.16
Se soil	29.4	23.75	77.85	15.85	1.12	0.05	0.52	34.29	2.71	0.51	0.23	0.56	0.64

3. Results

The soil geochemistry of different bedrock Hillslopes in Korea indicates the peculiar structure and feature due to environmental conditions, geomorphological features, soil properties and parent material characteristics. The migration intensity of elements by water within soil is high in Korea which has large annual average precipitation and high annual average temperature. The average concentrations of the most microelements in Gr, Gn and Se soils were relative larger comparing with Clark concentration in the world (Table 2)

The geochemical characteristics in Granite Hillslope

Comparing with Clark concentration, the average concentrations of elements within soil were relative larger in upper and lower slopes (Table 2). Especially, the concentrations of the Pb and Zn were larger than their average amounts in the world. The large concentrations of Zn and Pb in downslopes indicated that they have been transported via intensive eluvial processes from upslope. The accumulations of the Ca, Mg and Na were weak activity in upper slope. The mobile Fe of 0.72% in humus layer increased until 1.21% in illuvial layer (Bt) in upper slope. The large amounts of the Cu, Zn and Ni in lower slope indicates that intensive chemical weathering and active geochemical processes formed in upper slope, then deposited in Toeslope (Fig. 1). Whereas Pb increased 2 to 3 times larger in upper slope than lower slope related on no easily transportation by water.

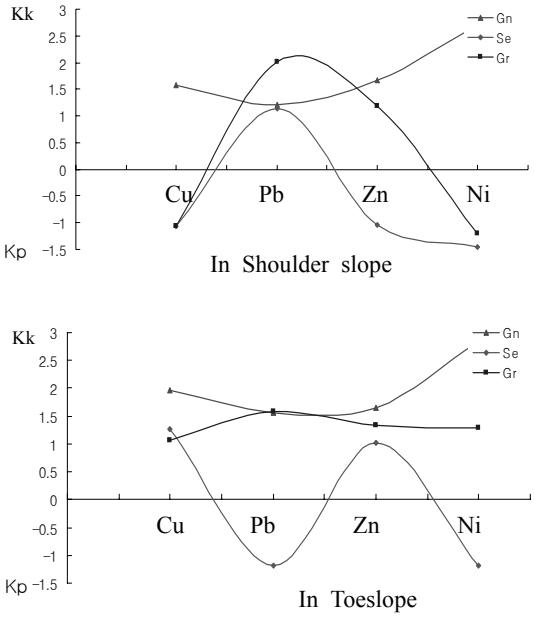

Fig. 1 The comparison of the Kk and Kp values of microelements within soils along Hillslopes

The geochemical characteristics in Gneiss Hillslope

For comparing with Clark concentration, the average concentrations of these elements within soils are relative large in Shoulder slope and Toeslope. The concentrations of Fe and Mn were high than in the Gr and Se rock soils. The concentrations of Zn and Ni in Shoulder slope decreased slightly to Toeslope, whereas the concentration of the Cu and Pb increased gradually to downslope soil (Fig. 1). *In Upper slope*, concentrations of Cu and Pb were low than Zn and Ni. They were caused by their amounts in the bedrock and biogenic adsorption. The

concentration of the Fe, Mn and Ti increased in down layers due to vertical transportation of throughflow. *In Lower slope*, the concentrations of Cu and Pb were high. It was explained by their vertical transportation through overland and infiltrated flow. Especially the largest amounts of Zn and Ni which related on their average concentration in parent material were revealed in there.

The geochemical characteristics in Sedimentary Hillslope

In upper slope, soil has weakly developed. The elements have transported from the A horizon to the underlying B horizon by water percolating through the soil. The correlation was used in order to compare the concentration of elements and soil properties. In the red brown clay soils containing much humus content in Toeslope, elements were accumulated largely. It indicated that geochemical process was actively promoted in upper slope than lower slope due to much rainfall amount in Shoulder slope. For comparing with Clark concentrations of the microelements within soils, the average concentrations within soil in Se rock Hillslope are relative approximate. However Cu, Zn and Ni are contained relative larger in Toeslope than Shoulder slope. That means the geochemical process was actively processed by water in Shoulder slope, consequently soil extremely eroded in Shoulder slope (Fig. 1).

4. Conclusions

The average concentrations of the most microelements in Gr, Gn and Se soils were relative larger comparing with Clark concentration in the world. Cu, Zn and Ni except of Pb were contained larger in there. Especially, Zn was actively transported by water for spatial scale. Their high value indicates that the soils in these different bedrock in Korea are more vulnerability for erosion by water, consequently geochemical process which generated by overland flow or throughflow has actively generated. The geochemical activity of these elements in Gn Hillslope was determined by large annual precipitation and high elevation landscape than other Gr and Se catchments. *Kk* coefficient showed that these elements were activity within brown soil in Shoulder slope and Toeslope in Gn Hillslope. *Kp* coefficient indicated that Cu and Ni were actively transported from Shoulder slope, and were deposited in Toeslope in Gr Hillsope. For Se soils, Cu, Zn and Ni were transported by water to downslope.

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