# Budget analysis on groundwater and river water interaction in Kherlen River basin, eastern Mongolia

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## I Introduction

Based on the stable isotope and solute concentrations analysis, the main stream river water would be mostly recharged by the precipitation fallen in the headwater region of the Kherlen River basin (Abe, 2004). Also, the solute concentration data shows that the interaction between the river water and groundwater might not be predominant except for the riverside regions along the Kherlen River. The present study focuses on the interaction between the groundwater and Kherlen River water considering the stream runoff and stable isotope data.

## II Methods

During RAISE Project IOP (Intensive Observation Period) 2003, we surveyed and took samples for groundwater, river water, lake water and spring water in Kherlen River Basin (Mongenmorit to Underhaan) from July to October. The stable isotopic compositions and major solute concentrations were determined on these water samples (more than 200). We performed the stream discharge measurement of base flow in main stream of Kherlen River and tributaries flowing into the main stream from June 9th to 14th 2004 (Fig. 1). This period was relatively dry and did not have any rain fall events, so the observed discharge would represent a value in base flow. Also, we measured at every tributaries flowing into main stream of Kherlen River from headwater region up to Underhaan.

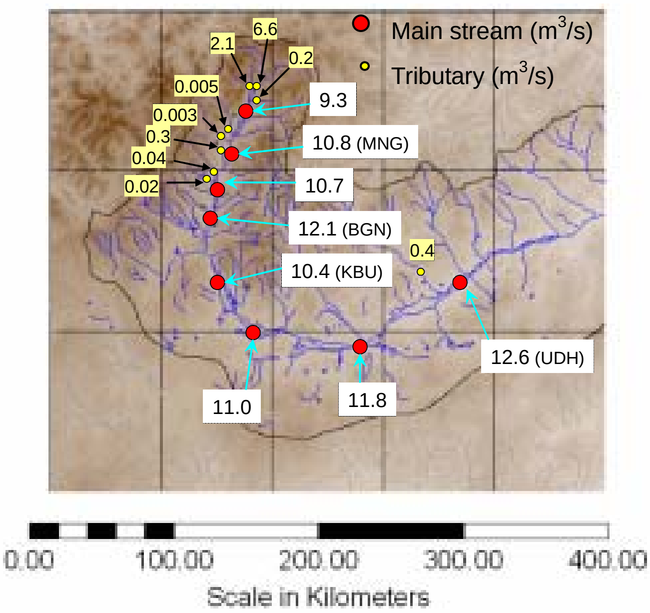


**Fig. 1 The locations of stream discharge measurements and observed discharge rate (m³/s) from June 9th to 14th, 2004.**

## III Results and discussion

The runoff rate increased a little at almost every interval of the main stream in Kherlen River (Fig. 1). The oxygen-18 increased along the main stream from the headwater to Underhaan, whereas d-excess value decreased (Fig. 2). This suggests that the river water would be affected by evaporation effect. Also, the groundwater should discharge into the main stream for compensation of the evaporation loss from the river.

The water budget at an interval along the stream is shown in Fig. 3 and as followings.

$$Q_{in} - E + G_{in} + q_{in} = Q_{in} \quad (1)$$

The water and isotope budget is described as,

$$Q_{in}\delta_{in} - E\delta_v + G_{in}\delta_g + q_{in}\delta_{qin} = Q_{out}\delta_{out} \quad (2)$$

where $\delta_{in}$: isotope ratio of inflow; $\delta_v$: isotope ratio of evaporated vapor; $\delta_g$: isotope ratio of groundwater; $\delta_{out}$: isotope ratio of outflow; $\delta_{qin}$: isotope ratio of tributary.

The evaporation loss and groundwater discharge rate are estimated at the intervals from Mongenmorit (MNG) to Baganuur (BGN) and from BGN to Underhaan (UDH) using eqs. (1) and (2). The parameters used calculation and estimated values are listed in Table 1. The groundwater in the magnitude of 1.0 m³/s might discharge into the Kherlen River from MNG to BGN, and also the discharge rate is estimated to be 2.6 m³/s from BGN to UDH Abe (2004) mentioned that the interaction between groundwater and river water could take place within a width of approximately 2 to 10 km from the main stream in the regions of BGN, KBU, DH

**Table 1　The parameters and calculation results of the water and isotope budget at two intervals from MNG to UDH.**

| · MNG → BGN | · BGN → UDH |
|---|---|
| — Elevation: 1390 ～ 1290 m | — Elevation: 1290 ～ 1020 m |
| — Horizontal distance: 58 km | — Horizontal distance: 247 km |
| — $Q_{in}$: 10.8 $m^3/s$ | — $Q_{in}$: 12.1 $m^3/s$ |
| — $Q_{out}$: 12.1 $m^3/s$ | — $Q_{out}$: 12.6 $m^3/s$ |
| — $\delta_{in}$: -16.0 ‰ | — $\delta_{in}$: -15.0 ‰ |
| — $\delta_{out}$: -15.0 ‰ | — $\delta_{out}$: -12.6 ‰ |
| — $\delta_g$: -11.2 ‰ | — $\delta_g$: -12.9 ‰ |
| — $\delta_v$: -29.0 ‰ | — $\delta_v$: -24.6 ‰ |
| — $\delta_{qin}$: -11.4, -10.2, -9.3 ‰ | — $\delta_{qin}$: -11.5 ‰ |
| — $q_{in}$: 0.003, 0.04, 0.02 $m^3/s$ | — $q_{in}$: 0.4 $m^3/s$ |
| ➢ $E$: 0.1 $m^3/s$ (4 mm/d) | ➢ $E$: 2.4 $m^3/s$ (16 mm/d) |
| ➢ $G_{in}$: 1.0 $m^3/s$ | ➢ $G_{in}$: 2.6 $m^3/s$ |

and UDH. The estimated values should need more quantitative and complemented discussion, however those are reasonable as a preliminary analysis.

## References

Abe, Y. (2004): Study on groundwater flow system in the Kherlen River basin, Mongolia. *Master of Science Thesis, Graduate School of Life and Environmental Sciences, University of Tsukuba*, 63p.

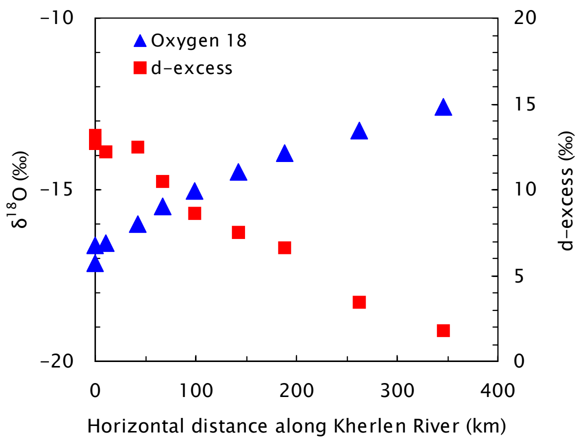


**Fig. 2　The oxygen-18 and d-excess distribution along the main stream of Kherlen River in June 2004.**

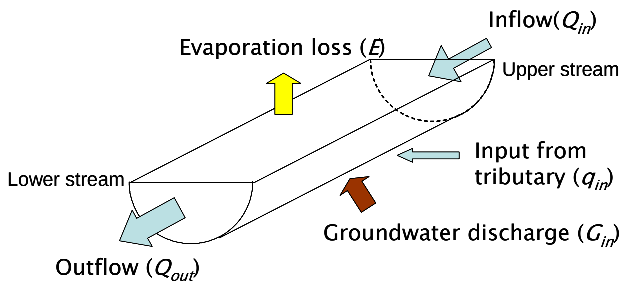


**Fig. 3　Water budget in an interval along the main stream of the Kherlen River.**