Water and carbon cycles in the Han River Basin, Korea constrained from δD and $\delta^{18}O$ of the river water

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During photosynthesis, terrestrial plants transpire ~10^2 moles of water molecules per every mole of CO_2 fixed and this quantitative relation is known as water use efficiency. Therefore, the water cycle (especially its transpiration component) of an area can be used as a defining parameter of the ecosystem productivity. Constraining water and carbon cycles in the Han River basin may have an implication for the role of highly populated and disturbed terrestrial environments on the atmospheric carbon cycling. The precipitation in the basin amounts to 33.2 km^3/y and of this amount, 16.0 km^3/y is being discharged by the river. On the basis of a simple water balance relation, the evapotranspiration flux is estimated to be 17.2 km^3 or 51.8 % of the total precipitation. δD and $\delta^{18}O$ values of the precipitation and the river water produce the Local Meteoric Water Line (LMWL) of $\delta D = 8.16\ \delta^{18}O + 15.5$ and the Local Evaporation Line (LEL) of $\delta D = 6.33\ \delta^{18}O - 4.72$. Using an isotope mass balance relation, the evaporation flux in the basin is calculated as 18.1 % of the precipitation, i.e., 6.0 km^3/y. The interception flux, estimated from the relative distribution of needleleaf, broadleaf and grass vegetation in the area, is 20.8 % of the precipitation, i.e., 6.9 km^3. After the evaporation and the interception accounted for, the remaining water flux of 4.3 km^3 (12.9 % of the precipitation) constitutes the transpiration flux in the area. With the representative water use efficiency of 800.5 ~ 899.6 moles H_2O/moles CO_2 for the study area, the transpiration flux is translated into the Net Primary Productivity (NPP) of 3.2 X 10^{12} ~ 3.6 X 10^{12} g Carbon/y (121.5 ~ 136.5 g Carbon/m^2). Using the relation by Raich and Potter (1995), heterotrophic soil respiration in the basin is estimated as 7.9 X 10^{12} g Carbon/y (303.1 g Carbon/m^2) indicating that the basin acts as a significant source for the atmospheric CO_2. The low NPP in the basin may be interpreted as a common character of areas with disturbed ecosystems. However, it is also likely that the uncertainties in the water budget of the basin, especially the discharge estimate, may have produced an erroneous estimate of NPP. This work was supported by a grant (code 3-2-1) from the 21st Century Frontier Research Program.

Neoproterozoic alkaline magmatism in the northwestern Gyeonggi massif, South Korea, and its tectonic implications

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Alkaline meta-granitoids, ranging in composition from syenite to alkali granite, occur in the northwestern Gyeonggi massif. Ion microprobe U–Pb zircon analyses indicate that the granitoids were emplaced at 742 ± 13 Ma, and are corroborated by a Rb–Sr whole rock age of 770 ± 40 Ma. Major and trace element characteristics, together with Sr and Nd isotopic data, suggest that the granitoid magma was derived from ancient (T_{DM} = 2.6 – 2.2 Ga) continental crust with addition (ca. 30 – 45 vol.%) of juvenile mantle-derived basaltic magma. The generation of the alkaline granitoid is attributed to crustal thinning induced by deep-seated thermal activity such as mantle upwelling or mafic magma influx.

Alkaline igneous activity at 742 Ma is coeval with Neoproterozoic (ca. 0.85 – 0.75 Ga) rift-related magmatism prevalent in South Korea (Lee et al., 2003). This magmatic activity indicates that large-scale extensional tectonic activity triggered by upwelling plume-like mantle are prevalent in the South Korea. The Neoproterozoic rifit-related magmatism has been well known in the South China Block, possibly caused by conductive heating above a mantle plume beneath South China at ~825 Ma (Li et al., 1999, 2003), but lacks in the North China Block. Thus, it is suggested that the Gyeonggi massif is correlative with the South China Block and has experienced a rifting event during the Rodinia breakup.

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