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Water-quality diagnosis of Sabanakett district in central Laos

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ater cycle in the Indochinese peninsula is strongly affected by Asian monsoon, and people strongly depend on the water in rainy season. Rain in this tropical area accelerates chemical weathering to have formed lateritic soil, which is deficient of base cations and is enriched in iron and aluminum. Lao People's Democratic Republic is a landlocked country in the peninsula and its water resource receives high demands as electric power from the surrounding countries. Development of industrial system and growth of population in Laos, although they are not so rapid, become concerned with pollution and other human impacts on the aquatic ecosystemr. Nevertheless, there is few geochemical study on the fresh water in Laos. Water stable isotopes and dissolved components in surface water and shallow groundwater, as they are of meteoric water origin, provide basic information on the water cycle, material behavior in ecosystem, and human health. In RIHN, project focusing on infectious disease such as Malariya and Clonorchis sinensis disease have been implemented at Xepon and Lahanam areas in Savannakhet district of southern Laos. These areas are located in the watershed of the Banhyang River, which is one large tributary of the Mekong River. Here we report the compositions of stable isotopes and dissolved components for surface and ground waters at about 200 sites in this area. All analyses were done for water using 0.2 um acetate-cellulose filter.

The d18O values and dD values of all waters are plotted along the meteoric water line. It is notable that the water isotope ratios of surface waters show a large areal variation (d18O values; -11.4 - -7.4 permill) and dD values, whereas those of most ground water (<50m from the surface) fall in a relatively narrow range (d18O; -8.1 - -6.5 permill). This isotope value of groundwater is close to the annual average of rain water at Luang Phabang in northern Laos (d18O; -7.4 permil), suggesting that the groundwater and surface water in small streams are derived largely from precipitation in Lao Heights. In contrast, the Banhyang River and some tributaries had low water isotope ratios. This result is also consistent with that this river flows from the Annamite Mountains where the precipitation would have low isotope ratios due to elevation effect.

Dissolved components are divided into three groups (A, B, and C) based on the water type and the water isotope ratio. Regardless of the water type, the concentration of dissolved component in the water with high d18O value (-8.1 - -6.5 permil) showed a large variation. On the other hand, for waters with d18O values less than -8.1 permill, Group-A and Group-B components are characterized by low concentrations and high ones, respectively. Component of Group-C is intermediate between the two groups. Cl, SO4, and alkali and alkali-earth elements are classified into the Group-A, and are considered to be dissolved as ions in the water. The Group-A components are very high in the groundwater of Lahanam area, which is derived from the dissolution of evaporate minerals. In contrast, Group-B is composed of Al, Ti, Fe, Mn, Y, and REEs, which are the major constituent of minerals resistant to chemical weathering. It is likely that the Group-B elements are present as small mineral and/or colloidal particles in the water. The widespread distribution of surface water with high Fe and Mn contents suggest a contribution of lateritic soil. This result is also consistent with the comparison of Sr isotope data between water and rock, suggesting that the water is affected by rainwater input rather than the dissolution of primary minerals. Group-C is composed of NO3, Zn, and K. These components are affected by human activities in addition to atmospheric precipitation and mineral dissolution, which are the major source of group-A and ?B components. Indeed, NO3 tended to be high in populated area. Zn was also high in groundwater pumped through Zn-coated steel pipe.

Keywords: Laos, water circulation, water isotope, material behavior, strontium isotope, trace element