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揚子江の流量と懸濁物輸送との関係
Interrelationship between water discharge and suspension transport of the Yangtze River

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Water discharge and suspension load of a river are potentially recorded in sediments in the drainage and / or the river mouth. Isotope composition of fossil calcareous skeletons and detrital provenance and flux reconstructed from the sediment samples could provide us useful proxies for paleoclimatic study. Sediment load from the Yangtze River to the East China Sea (ECS) from the delta to the Okinawa Trough have been widely used to reconstruct the East Asian summer monsoon (EASM) in the past since the water discharge from the Yangtze would be highly affected by monsoon rain, which could deliver much fresh water and sediment to the ECS. The past impact of fresh water from the Yangtze could be reconstructed from stable oxygen isotope signal recorded in the fossil calcareous skeletons found in the ECS sediments, which has also been used as proxy for EASM.

Theoretically, sediment provenance and its yield could be changed from time to time depending on the distribution of precipitation which would control the balance of water discharges from the tributaries. Change in the precipitation distribution also affects the water isotopic composition of each tributary and then the main stream of the Yangtze. Although such variability could change the end-member composition and concentration of the fresh water and sediment load provided to the ECS, paleoceanographic studies in this region have not considered well about the potential change in the basic condition. Therefore, we need to know the water isotope and sediment budget along the Yangtze main stream with regards to the inputs from its major tributaries in order to understand the potential effects from the change in the distribution of the EASM precipitation.

For this purpose, we have started a systematic sampling of the Yangtze River water to determine the stable oxygen and hydrogen isotope ratios and suspension loads during summer in 2011 and winter in 2012. Water samples were taken at main junctions of the major tributaries. The amount of suspended solids (SS: mg/L) of water sample is determined from the weight of solid particles filtered out on nitrocellulose filter and the volume of water filtered. Hydrogen and oxygen isotope ratio of water sample was measured using ThermoFisher Scientific MAT253 Isotope Ratio Mass Spectormeter with GasBench II.

Water discharge of the Yangtze main stream is approximately 4 times higher in summer than in winter, and the summer discharge increases downstream from ~6,000 m3/s in the Sichuan Basin to ~40,000 m3/s at Nanjing. SS of mainstream is always higher than any other main branches and several to ten times higher in summer than winter. SS is diluted by the less turbid branch water and the summer SS decreases downstream from ~430 mg/L in the Sichuan Basin to ~85 mg/L in Nanjing. Though SS tends to be diluted at every junction with clean branch water, the total transported SS is maintained nearly constant along whole main stream path. Seasonal contrast of SS is significantly larger in the upstream than downstream, which suggests that the upstream responds more sensitively to a discharge event (e.g. heavy rain or flooding).

Summer oxygen isotope value in the upper Jinshajian is -14 permil VSMOW and the value is increased downstream to -8.2 permil VSMOW at Shanghai by the mixing of isotopically heavier water from branches. Slightly larger difference of isotope value between upstream and downstream in summer than in winter suggests the contribution of the EASM precipitation in the region close to the vapor source ocean and of lower altitude. However, summer isotope ratio and d-excess of the branches in the lower reach is higher than winter ones, which also suggests the effect of more active evaporation during summer.

キーワード: 揚子江, 流量, 懸濁物組成, 懸濁物輸送量
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