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Evaluation of chemical weathering and sediment flux for several drainages within the Yangtze River basin

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Chemical weathering is closely coupled with erosion and driving landscape evolution. Silicate weathering plays a major role of fixing atmospheric CO2 in the carbon cycle in time scales longer than 105 years. Therefore, quantitative estimation of chemical weathering rate and evaluation of its controlling factors are critical to understand its role on landscape evolution and controlling the carbon cycle on a long time scale. Researches on evaluating controlling factors of the weathering rates have been conducted using various methods and on various temporal and spatial scales, including theoretical approaches based on mineral dissolution experiments, empirical approaches based on analyses of river water, suspended material and sediments, and numerical modeling approaches to synthesize these data. Although empirical formulations of the chemical weathering and physical erosion rates specific to a certain river have been presented, processes of weathering and erosion should be considered together both from physical and chemical aspects in order to obtain more generalized formulas. Besides, in order to reconstruct the past processes of chemical weathering and erosion from the knowledge of the present processes, it is necessary to establish methods for reconstructing chemical vs physical weathering processes by using sediments which are the end products of weathering and erosion.

Toward the objective above, this study aims to explore the present processes of chemical weathering and erosion in the Yangtze River drainage as an example. Yangtze River is the longest river in Asia with the great water discharge and sediment flux. Hence, the river's role on material cycle on Earth's surface is significant. In addition, water and meteorological data are accumulated for long time period by many gauging stations and meteorological stations in the basin.

Mineral and chemical compositions of suspended particles and sediments as well as chemical composition of dissolved matter are analyzed for water samples and river bank sediments obtained from Yangtze River and its tributaries in the summer of 2011. Using these results, together with river discharge data and dissolved/suspended load concentrations, the fluxes for each element are calculated, and then the inputs from each watershed are obtained. Then, the relative contribution between chemical weathering and physical erosion is estimated. The calculation revealed that chemical weathering rate increases downstream but the relative contribution between chemical weathering and physical erosion in the uppermost part is the maximum in the upper, erosional part. In the lower, depositional part, dissolved carbonate is diluted after the main stream has merged with Poyang Lake, and then increased again toward the river mouth. The processes of chemical weathering and physical erosion in each watershed and their possible controlling factors will be discussed.