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Geochemical compositions of the Changjiang and Huanghe river sediments and the weathering contrast in two drainage basins

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Abstract

The Changjiang (Yangtze River) has the forth-largest water discharge in the world, while the Huanghe (Yellow River) ranks second in terms of its huge sediment loads. Previous studies on geochemistry of both rivers primarily focused on comparisons of elemental concentrations and the controlling factors, element behaviors in the estuarine areas, and chemical fluxes to ocean. Dissolved components in river water were used to examine and compare weathering mechanisms in the drainage basins. Although strong physical denudation in the Huanghe drainage basin and chemical weathering in the Changjiang basin are widely accepted, few studies touched upon the degree of silicate weathering in the drainage basins and moreover, the relation between chemical and mineral compositions and weathering intensity has rarely been concerned as yet.

In this present study we attempt to reconstructs the histories of chemical weathering in the drainage basins of the Changjiang and Huanghe, based on the geochemical compositions of the river sediments. Based on the proxy indicators of chemical weathering such as elemental ratios of K/Na, Na/Ca, Sr/Ba, Rb/Sr, and CIA, the mechanisms of chemical weathering were discussed. The silicate weathering of the Changjiang basin is relatively strong and Na- and Ca- silicate minerals are considerably dissolved, while other silicate minerals are less attacked. In comparison, the Huanghe basin is characterized by very weak silicate weathering, and the weathering degree corresponds well with that of the loess in northwest China which is the predominant sediment source of

the Huanghe. Similar and uniform fractionation patterns of rare earth elements (REE) of both river sediments distinctly show that the chemical weathering played a minor role on REE compositions and the provenance background compositions exert a dominant control. Overall, the Changjiang and Huanghe basins constitute a consistent weathering spectrum from the early to intermediate stage. The similarity of chemical compositions between the upper continental crust (UCC) and the Huanghe sediments as well as the low degree of chemical weathering in the Huanghe basin imply that the river sediments can be considered to be the representative of UCC and are suitable for studying the evolution of weathered upper continental crust. We argue that climate is the predominant factor controlling silicate weathering in both river basins, while controls by source rocks and relief are subordinate. Highly erosive river basins such as the Huanghe produce poorly weathered materials, which casts doubt on the idea that strong physical weathering naturally contributes much to chemical weathering.