



Chemical weathering in the Mekong River Basin: Clay mineralogy and element geochemistry of lower-reach river sediments

Pham Nhu Sang^{a,*}, Zhifei Liu^{a,**}, Yulong Zhao^a, Pham Trung Hieu^{b,c}, Sopheap Thav^d, Sopheap Den^{a,d}

^a State Key Laboratory of Marine Geology, Tongji University, 200092, Shanghai, China

^b Vietnam National University, 700000, Ho Chi Minh, Viet Nam

^c Faculty of Geology, University of Science, 700000, Ho Chi Minh, Viet Nam

^d Faculty of Forestry Science, Royal University of Agriculture, 120000, Cambodia

ARTICLE INFO

Editorial handling by Dr. Zimeng Wang

Keywords:

Clay minerals
Major elements
Trace elements
Chemical weathering
Mekong river

ABSTRACT

Chemical weathering of parent rocks in river basins plays a significant role in controlling the global geochemical cycle and climate change, especially in the world's largest river basins such as the Mekong River Basin in tropical regions. However, the chemical weathering process of the Mekong River Basin is still not well understood. In this study, clay mineralogy and major/trace-element geochemistry of fluvial sediments (clay, silt, and sand fractions) collected from the lower Mekong River Basin (Cambodia and Vietnam) were utilized to investigate the sediment provenance and chemical weathering process. The major-element compositions of the clay, silt, and sand fraction sediments from both the mainstream and tributaries consist of dominant SiO₂, Al₂O₃, and Fe₂O₃, (84 wt%, 89 wt %, and 95 wt%, respectively) and minor K₂O, Na₂O, MgO, CaO, TiO₂, P₂O₅, and MnO. The clay mineral assemblages in mainstream sediments are high in illite (36 wt%), moderate in kaolinite (28 wt%) and chlorite (26 wt%), and low in smectite (10 wt%), whereas those in tributary sediments are high in smectite (37 wt%), moderate in kaolinite (26 wt%) and chlorite (22 wt%), and low in illite (15 wt%). The different clay mineral assemblages between mainstream and tributary sediments can be significantly related to the parent rock lithology and/or the weathering process in the source region. On the basis of clay mineralogy and elemental geochemistry, river sediments of the mainstream in the lower reach may be derived mainly from felsic rocks in the lower part of the middle reach of this basin, with secondary contributions from the upper and lower reaches as well as the upper part of the middle reach. Sediments in the Kampi and Speu tributaries highly originate from felsic rocks, whereas sediments in the Srepok, Ter, and Chhiong tributaries can be mostly weathering products of mafic rocks. The clay mineral proxies (smectite/(illite + chlorite) and kaolinite/(illite + chlorite)) combined with the elemental geochemistry (CIA, α^{Al} values, and weathering trends) of the clay fraction sediments indicate intensive chemical weathering in the lower and middle reaches. The high-relief topography and cold and dry climatic conditions in the upper reach result in high illite and chlorite contents in the soil and moderate chemical weathering. The chemical weathering intensity increases from the upper to middle reaches and further to the lower reach. Tectonics in the middle and upper reaches of the Mekong River Basin play the most important role in controlling weathering and erosion processes, whereas East Asian-Indian monsoon climate conditions with warm temperature and predominant rainfall throughout the year and lithology are the main forcing factors for the intensity of chemical weathering in the lower reach.

1. Introduction

Chemical weathering of continental rocks is a significant Earth surface process, that strongly links the Earth's spheres, shapes the

landscape, and controls the source-to-sink dispersal of materials from land to sea as well as global geochemical cycles (Gaillardet et al., 1999; Conley, 2002). In addition, the chemical weathering of silicate rocks can largely consume atmospheric CO₂, which is significantly related to the

* Corresponding author.

** Corresponding author.

E-mail addresses: sang@tongji.edu.cn (P.N. Sang), lzhifei@tongji.edu.cn (Z. Liu).