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Trans-Himalaya weathering under monsoon climate: What is the impact of South Tibetan mountain weathering on Paleogene climate cooling?

XIAOBAI RUAN[1], ALBERT GALY[2] AND YIBO YANG[3]

[1]CRPG CNRS University of Lorraine

[2]CRPG-CNRS-Université de Lorraine

[3]Institute of Tibetan Plateau Research, Chinese Academy of Sciences

Presenting Author: xiaobai.ruan@univ-lorraine.fr

Global climate cooling during the Cenozoic has often been related to the draw down of atmospheric pCO_2 by enhanced chemical weathering of crustal materials in the Tibetan Plateau and orogenic edges. The modern system is primarily controlled by the burial of organic matter because the chemistry of the crustal material in the Himalaya is dominated by alkali-rich silicate that is inefficient in the long-term atmospheric CO_2 consumption. However the chemical weathering in the Eocene or early Oligocene would more correspond to the erosion of the Trans-Himalaya, dominated by subduction-related granitoid Gangdese batholith arc, which are richer in alkali-earth, more susceptible to lower the atmospheric pCO_2 by chemical weathering under a monsoon-like climate. Therefore, in this study, we turn to the Chayu catchment as a modern analogue, with subduction-related granitoids weathered under the monsoon climate. Water chemistry allowed to resolve the proportion of carbonate versus silicate weathering and sulfuric acid versus carbonic acid weathering in this catchment. In particular, secondary calcite precipitation can reduce the Ca dissolved flux by up to 80%. Correcting for this effect, the results suggest that the chemical weathering in the modern Chayu catchment is a net carbon source to the atmosphere. Discharge of each main tributary was estimated by water $\delta^{18}O$ mixing, in order to investigate possible relationship between the weathering rates with the local mean annual temperature (MAT) and runoff. Silicate weathering rates are positively correlated with MAT, suggesting that silicate weathering was more important than today during the Paleogene. The $^{87}Sr/^{86}Sr$ of the Chayu river water are between 0.730 to 0.735, being similar to Himalayan rivers. This suggests that the chemical weathering of the edges of the Tibetan Plateau could have had a strong impact on the marine $^{87}Sr/^{86}Sr$ very soon after exhumed relief were formed by the India-Eurasia collision.