

THE GLOBAL CONTROL OF CHEMICAL SILICATE WEATHERING RATES BY PHYSICAL DENUDATION OF CONTINENT

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At a geological time scale, chemical weathering of silicates acts as a sink of atmospheric CO₂ and is probably one of the main processes controlling its concentration, and hence climate. Compared to small rivers, large rivers have the property to integrate large surface areas and climates. The geochemistry of large rivers can therefore lead to global informations about the weathering rates of rocks and associated atmospheric CO₂ consumption, even if, lithology being the most important controlling factor of river chemistry, the dissolution of carbonates and evaporites often makes it difficult to isolate the pure silicate weathering component. We will present two attempts to quantify present day silicate weathering rates and CO₂ consumption rates using the largest rivers. - The first issue is based on the chemistry of the dissolved load and aims at correcting each large river dissolved load from the dissolution of non-silicate lithologies. The control of the calculated silicate weathering rates and CO₂ consumption rates appears to be a combination of climate and physical denudation. The regions of the world producing the highest chemical yields (derived from silicate weathering) to the oceans are those producing the largest amount of sediments. - As river suspended sediments are only derived from the incongruent weathering of silicates, their use as a proxy of chemical weathering intensity has been addressed. Based on a newly constituted data base on the geochemistry of suspended sediment of the largest rivers, we show that, except in the low lying tropical areas, the intensity of silicate weathering does not fluctuate very much among the different river basins. As the flux of chemical elements released to solution during chemical weathering is the product of suspended sediment concentration (varying over several orders of magnitude for the different rivers) by its weathering intensity (varying over one order of magnitude), we conclude that the flux of silicate weathering (and associated CO₂ consumption) is imposed by the physical erosion flux. In terms of chemical weathering of silicates, it is more efficient for a river to produce a lot of poorly weathered sediments rather than a small amount of highly weathered sediments. In addition, there is a global anti-correlation between the weathering intensity of suspended sediment and its concentration per liter of river water. The information given by the dissolved and suspended load of large rivers thus leads to a coherent picture of present day chemical weathering of silicates. For the evolution of the CO₂ concentration in the atmosphere, our study highlights the need to know the evolution of the total mass of sediments produced.