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Supply-limited weathering regime in a tropical shields basin (Ogooué River basin, Gabon)

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At the global scale and on geological time scales, mechanical erosion and chemical weathering budgets are linked. Together, these processes contribute to the formation and the degradation of the Earth's critical zone and to the biogeochemical cycles of elements. While the weathering of hot and humid shields areas exhibit low weathering rates because of the depth of the mature depleted soil mantle there, shields areas dominate the continents areas over intertropical regions and, therefore, represent a significant proportion of the global delivery of dissolved matter to the oceans. In addition, these environments are under supply-limited conditions (the weathering rate is limited by the low rates of the erosion) and thus particularly sensitive to long-term variability erosion rates. Despite this importance, weathering-erosion budgets and rates estimation in these environments is sparse, and generally performed at a local scale (soil profiles) or, when performed at a larger catchment scale, the intra cratonic characteristics variabilities (e. g. the diversity of mechanical erosional regimes) are usually not singled out.

In the present study, we explored the variability of the weathering intensity of the Ogooué sub-basins (Western central Africa, Gabon) as a function of their geomorphologic, tectonic and lithological setting variability. We analyzed major and trace elements concentration and the strontium and neodymium isotopes of water, suspended matter sediments and bedload sampled in 24 Ogooué tributaries (September 2017 campaign). Our results show that shield areas exhibit a high variability of chemical weathering intensity, which follows the erosional regime characteristics of the studied sub-basins, likely related to their tectonic activity. Three regions can be distinguished: The Bateke plateau (East sub-basins - PB), is composed of pure sandstones (quartz)

and is inert in term of tectonic activity and therefore in term of erosion and weathering budget; the northern sub-basins (NB) are subjected to low tectonic activity and exhibit slightly higher erosion and weathering intensity than PB region and, by comparison, southern sub-basins (SB) exhibits uplift activity which is traduced by more intensive erosion and weathering processes.

The annual dissolved solid budget of the Ogooué basin is ~2.52 $t.yr^{-1}$ for a rate of 11.7 $t.km^{-2}.yr^{-1}$. According to the source discrimination method performed based on the geochemical analysis, the atmospheric inputs contributes to around 20% to the TDS, the silicate weathering contribution dominates the dissolved exports throughout 70% of its production while the carbonates weathering lowly contributes to the TDS production.

By comparison to the other large shields rivers, this basin exhibit a lower range of chemical silicate weathering rate than most of the world's large rivers, with values similar to those of the Congo River. This new dataset provides a key information to complete the World River chemistry database, which is limited for inter-tropical regions, especially in tectonically quiescent environments. Moreover, this study provides new data for tropical shields contexts allowing for the exploration of the interactions between erosion rates and climate in the control of continental weathering rates, and their relationships with long-term carbon cycle and short-term biogeochemical cycles.