

Tracing weathering and reverse weathering in floodplains using Si isotopes and Ge/Si ratios

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The role of high mountainous areas as the loci of the majority of chemical weathering (i.e. CO₂ consumption) is ambiguous due to their relatively minor surface area. Low relief areas, including floodplains, are increasingly recognised as important for river weathering flux formation, based on e.g. studies that consider longitudinal changes in water chemistry and/or suspended particulate matter composition as large rivers cross their floodplains. The integrated signals imply aging of sediment in floodplains. But in some cases, floodplains may alter weathering fluxes through chemical sedimentation, i.e. removal of elements from solution.

To directly investigate the processes occurring, we analysed material from field campaigns in two tropical floodplains – a cross-floodplain borehole survey of the upper Paraná in southern Brazil and a longitudinal survey of the terminal wetlands of the Okavango River in northern Botswana. We focus on tracing biological and weathering processes with the isotopes of Si and with Ge/Si ratios, interpreting Ge as a ‘pseudoisotope’ of Si. We analysed these, together with major and trace element concentrations, for surface water, groundwater/porewater, separated sediment fractions and aboveground vegetation.

In the Paraná, mobile elements are enriched downcore – the older sediments have accumulated e.g. K, Ca and Mg. $\delta^{30}\text{Si}$ of floodplain groundwaters is enriched by up to 1‰ relative to river water, implying in situ formation of a lighter phase. In the Okavango, observed changes in water chemistry and a $\delta^{30}\text{Si}$ decrease (~0.6‰) in dissolved Si can be interpreted as weathering of isotopically light primary and/or secondary minerals, or as intense biological recycling. Conversely, the surface water geochemistry suggests an elemental (K, Ca, Mg) sink via mineral authigenesis.

Our data suggest large floodplains are areas of both weathering and reverse weathering, adding complexity to our emerging understanding of floodplain weathering dynamics.

Mineralogical pathways involved in the formation of hydrous Mg/Ni silicate ores (New Caledonia)

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New Caledonia hosts one of the biggest Ni-laterite deposits in the world. Highest Ni grades are related to hydrous Mg/Ni silicate ores [1], which are best preserved at depth along serpentized faults in the saprock. Despite their importance, the mechanisms involved in the formation of the Ni silicate ores (garnierites) are still a matter of debate.

Series of fracture-controlled clay and silica infillings were investigated by optical and electron microscopy, Raman spectroscopy, X-ray diffraction and electron microprobe analyses. The first infilling stage consists of residual well-crystallized ophiolitic serpentines intimately mixed with poorly ordered serpentine-like and talc-like minerals. Talc-like minerals predominate in a second stage of infillings whereas quartz druses prevail in the ultimate infilling stage. Two crystal-chemistry pathways are attributed to the early redistribution of Ni and differentiation of white and greenish patches along the reactivated faults. In the white Ni-free deweylites, the compositional variation of clay minerals is distributed along a mixing line between Mg end-members of the serpentine-like (α -kerolite) and talc-like (β -kerolite) minerals. In the greenish patches of Ni-rich garnierites, it is distributed along a second mixing line between an Mg end-member of serpentine-like minerals and a Ni end-member of talc-like minerals (pimelite). Our results then evidence a multistage leaching of Mg and increase of the Ni and Si activities of the infilling solutions during post-obducted tectonic pulls, in agreement with a recent thermodynamic study [2].

[1] Freyssinet *et al* (2005) *Econ Geol*, 100th An Vol, 681-722.

[2] Gali *et al* (2012) *Clays Clay Miner*, **60**, 121-135.