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Past changes of weathering regime in laterites recorded in Fe isotope signal preserved in Fe oxyhydroxides.

ZUZANA FEKIACOVA[1], BEATRIX HELLER[2,3], DAMIEN GUINOISEAU[2], JULIEN BOUCHEZ[4], ADRIEN DUVIVIER[1], SOPHIE CORNU[1], ABEL GUIHOU[5], CÉCILE QUANTIN[2], THIERRY ALLARD[3], PIERRE DESCHAMPS[1] AND CÉCILE E GAUTHERON[2,6]

[1]Aix Marseille Univ, CNRS, IRD, INRAE, CEREGE
[2]GEOPS, Université Paris Saclay, CNRS
[3]IMPMC, UMR 7590, CNRS, Sorbonne Université, MNHN
[4]Université Paris-Cité, Institut de physique du globe de Paris, CNRS
[5]Aix Marseille Univ, CNRS, IRD, INRAE, Coll France, CEREGE UMR 7330
[6]Université Grenoble Alpes

Deep lateritic profiles result from tropical weathering and represent valuable climatic and paleo-environmental terrestrial archives. These profiles can preserve information over millions of years [e. g., 1, 2] although unravelling the signals recorded in various geochemical proxies remains challenging. Iron oxides and oxyhydroxides (i.e., oxides s. l.) are redox-sensitive minerals evolving rapidly in response to redox fluctuations. Yet, recent studies showed that secondary Fe oxides can yield information documenting the environmental conditions at the time of their formation [3]. In this work we studied Fe isotope fractionation associated with (re)generation of secondary Fe oxides during the lifetime of a ferruginous duricrust, located in a profile at Kaw Mountain Ridge, French Guiana. We used (U-Th)/He age and mineralogical data [3] to constrain a Fe isotope mass balance model, with the aim of examining the Fe cycling in response to changing weathering conditions.

The $d^{56}Fe$ values increase with decreasing age of Fe oxides, ranging from 0.15 ±0.02‰ at 25 Ma to 1.24 ±0.09‰ at 2 Ma. We observe a significant shift at around 7 Ma, concomitant with changing mineralogy and with the onset of increasing Al substitution in Fe oxides. We interpret this radical shift in the Fe isotope fractionation factor as reflecting the change from a lateritization regime to a bauxitisation regime identified by [3] in response to an intense climatic change in Guiana Shield region, during Late Neogene. Mass balance model results support this interpretation by suggesting (i) Fe cycling within a closed system during the ferruginous lateritic weathering stage (older than Late Neogene), producing low and homogeneous $d^{56}Fe$ values in Fe minerals and, in contrast (ii) large Fe isotope fractionation explained by Fe cycling operating as an open system with significant Fe loss, consistent with intensified weathering and improved drainage conditions during the bauxitization phase.

References

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