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Change of climate, geodynamic and biogeographical barriers recorded in supergene minerals of the tropical critical zone

CÉCILE E GAUTHERON[1], BEATRIX HELLER[2,3], CLAIRE ANSART[1], CAROLINE SANCHEZ[2] AND THIERRY ALLARD[3]

[1]GEOPS, Universiy Paris Saclay, CNRS, France
[2]University Paris Saclay, CNRS, France
[3]Sorbonne University, CNRS, IRD, MNHN

Presenting Author: cecile.gautheron@univ-grenoble-alpes.fr

The continental surface evolves under the action of erosion and weathering, that themselves depend on geodynamic/tectonic and climatic processes. For mountain ranges, massive erosion episodes over the Cenozoic have been recorded in response to tectonics and/or climate change. However, for most of the tectonically quiescent, flat areas located in tropical regions, less is known due to few geological markers or adapted tools. In quiescence areas, laterite will form through intense weathering associated with high mean annual temperature and precipitation. While soluble elements including nutriments are leached from the basement rocks during weathering, insoluble elements such as Fe and Al are accumulated forming supergene minerals. With millions of years, thick lateritic profiles form, with a kaolinite-rich saprolite covered with a ferruginous duricrust containing mostly hematite and goethite. Under more intense weathering conditions (i.e. higher temperature and/or precipitation), kaolinite is leached and gibbsite and boehmite form bauxite with an Al-rich duricrust. Consequently, laterites and bauxites are formed and preserved only in low erosion areas and will evolve in association with the water table fluctuations.

In this contribution, we will show how the use of hematite and goethite (U-Th)/He geochronology coupled with mineralogical and geochemical analysis of different laterite and bauxite samples can be related with the change of climatic and geodynamic conditions over the Cenozoic. Examples from the Guiana Shield in the northern part of the South American continent allow the identification of different weathering regimes through time related to climatic changes. Along the coast of Suriname and French Guiana a strong Miocene to Pliocene weathering event resetting older episodes is detected (Ansart et al., 2022; Heller et al., 2022), whereas along the Amazon or Rio Negro discrete weathering episodes during Eocene, Oligocene, Miocene and Pliocene are highlighted (Allard et al., 2018; Gautheron et al., 2022). In addition, in Central Amazonia, laterite also reflects geodynamic changes in paleofluvial dynamics and the formation of biogeographic barriers that correspond to bird speciation since the Pliocene (Gautheron et al., 2022). Thus, supergene products constitute an increasingly studied archive that sheds light on past processes in the evolution of the critical zone of tropical areas.