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The role of swamp zones in the characterization and quantification of weathering processes in a humid-tropical environment (Nsimi site, Southern Cameroon)
Rôles des bas fonds marécageux dans l'altération et l'érosion en milieu tropical humide (cas du bassin de Nsimi, sud Cameroun)

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The Nsimi basin, located in southern Cameroon, is a pilot site of the PEGI program (programme d'Environnement de la Géosphère Intertropicale, ORSTOM-CNRS) for the study of modern weathering processes in a tropical environment. The first results obtained from this program (Viers et al., 1997) show strong chemical differences between waters located in slope zones (depleted in organic matter) and those ponded in swamp zones (enriched in organic matter). These swamp zones represent 20% of the basin surface. In order to understand the weathering mechanisms responsible for the geochemical variations in the basin, we have studied water chemistry, and characterized the mineralogy and chemistry of the soil profile. However, the focus of the present study is on water samples taken from: 1) piezometric wells and springs in slope areas, and 2) piezometric wells and marsh waters in the swamp zones. Soil samples analyzed in this study were only taken from the swamp zones. The study was carried on 23 water samples from slope areas and swamp zones, and 4 soil samples obtained during piezometric drilling (October 1996). Water samples were analyzed by high pressure liquid chromatography (HPLC ; major cations and anions) and inductively-coupled plasma mass spectrometry (ICP-MS ; trace elements). Dissolved organic carbon was measured by low temperature chemical oxidation (LTCO). Soil mineralogy was characterized by x-ray diffraction (XRD), infrared spectroscopy (IR), scanning electron microscopy (SEM), electron microprobe analysis (EMPA), and ICP-MS. Our observations on the chemical/spatial heterogeneity of waters in the basin corroborate those of Viers et al. (1997). Moreover, the results from the present study shows the existence of highly reduced (iron-rich) sections at the interface between the slope and swamp zones in the soil profiles. Large quantities of NH_4 and NO_3 measured in these zones suggest that the reduction process is governed by the decomposition of organic matter. In general, the soil profile in the swamp zone can be divided in three major horizons: 1) a top horizon rich in organic matter, 2) an intermediate sandy horizon, and 3) a bottom clay-rich horizon. The most abundant minerals found in the whole soil profile are quartz, kaolinite, and goethite. Oxide minerals such as zircon and rutile are also found along the profile. All these minerals, including the oxide phases which are

highly resistant to low temperature alteration, are affected by the weathering process. SEM observations in coexisting kaolinite crystals show evidence for secondary recrystallyzation in the upper part of the bottom clay-rich horizon.
A qualitative model describing both geochemical and mineralogical changes in the basin has been elaborated. This model is based on the important role of organic acids during mineral dissolution and subsequent release of insoluble elements (e.g., Fe, Al, and Zr). Kaolinite recrystallization suggest a partial recycling of Al and Si within the weathered profile. Also, the marked presence of Fe can be explained by dissolution of iron-rich phases under reducing conditions in an organic-rich anoxic environment. We also demonstrate quantitatively that chemical weathering, which is predominant in swamp zones, is responsible for 80% of chemical erosion of the basin.

Keywords : weathering processes, tropical environnement, swamp zones, water chemistry, soil analyses
Mots clés : processus d'altération, environnement tropical, zones marécageuses, chimie de l'eau, analyses de sols

* VIERS, J.,DUPRE, B., POLVE, M., SCHOTT, J., DANDURAND, J.-L. et BRAUN, J.-J., 1997 : « Chemical weathering in the drainage of a tropical watershed (Nsimi-Zoetele site, Cameroon) : comparison between organic-poor and oganic-rich water », Chemical Geology 140, 181-206.