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Timing of saprolitisation in the Haute-Lesse area (Belgium).

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The dating and the timing of the paleoweathering processes are essential to integrate the paleosurfaces into their paleoclimatic, eustatic and geodynamic framework. This work deals with the timing of the saprolitisation in the Haute-Lesse area (Ardenne, Belgium).

In this area, the weathered mantle can reach 65 meters of depth, and is preserved in the highest plateaus only. The alternations of Lochkovian shales and sandstones experienced the Hercynian tectonic activity and were later affected by saprolitisation processes. The saprolitisation mainly resulted in (1) the oxidation of pyrite, (2) the destruction of local carbonates, chlorite, illite-smectite mixed-layers, part of illitic material, and (3) the correlative neoformation of kaolinite, iron (hydr)oxides and manganese oxides. Due to the relative maturity of the primary sediments (rare ion-rich minerals), the reactions were nevertheless limited: a main part of the primary minerals (quartz, muscovite, heavy minerals) were unaffected (or poorly affected) by the weathering.

The neoformed parageneses are the result of three phases of saprolitisation, probably in relation with both carbonic and sulphuric acid fluids. The various dating methods we used, such as K-Ar, Ar-Ar on hollandites, paleomagnetism on iron (hydr)oxides and isotopic geochemistry on kaolinite and (hydr)oxides, give consistent results. The upper part of the profile is early Early Cretaceous ($\sim$ 130 My) in age, the middle part early Late Cretaceous ($\sim$ 93 My), and the lowest part Early Miocene ($\sim$ 21 My). Another weathering process during the Late Permian-Early Triassic is also deciphered by using the Pb-Pb dating method on uranium-bearing phosphates located in fractures just below the transition between the weathered and the fresh rocks. These fractures

were probably closed (and remained closed) after the neoformation of the phosphates. When dating the saprolitisation processes, careful must therefore be paid to the detailed mineralogical and geochemical context of the dated samples, as well to their precise nature and position in the studied profile.

This study highlights the geodynamic relative stability of the studied area since the Late Permian-Early Triassic. Basically, weathering is only possible when rocks are in/near the atmosphere-lithosphere interface: this was the case during the Late Permian-Early Triassic, the early Early Cretaceous, the early Late Cretaceous and the Early Miocene, as deduced by the dating methods. Today also, these thick weathered mantles are still in the contact atmosphere-lithosphere. This study also indicates that the saprolitic landscapes in the Haute-Lesse area are relict and thus not in relation with the current climatic conditions. The results finally allow us to integrate the Haute-Lesse saprolite within the global context of paleoweatherings in Northwestern Europe where four major saprolitisation periods are identified: Late Permian/Triassic, Early Cretaceous, Paleocene/Eocene interval and Early Miocene.