

**Supplementary Information – Thermal history geological and geomorphological constraints (c.f. SI-Table 2).**

Three different types of information have been used to obtain prior constraints for thermal history inversions: (1) Stratigraphic age. This information is obtained from the sedimentary environment and stratigraphic age of clastic sediment samples or the intrusion age of an igneous rock. Information on sediment(s)/basin(s) can be used to constrain samples in close proximity by providing information on the timing of exposure/burial of the sample; (2) Geomorphic constraints. These constraints are based on the geomorphic position of the sample with respect to known landform/regolith remnants of the West African morphoclimatic sequence (e.g., Beauvais & Chardon, 2013). These constraints are significant as they are pertinent only for the Cenozoic (i.e., since the end of the formation of the bauxite in the Eocene); (3) Miscellaneous (i.e. loose stratigraphic constraints and constraints whose age is debatable). This includes information on nearby basin(s)/sediment(s) whose age is disputable or not well constrained, but that could still provide information on the denudation/burial history of a sample, information on nearby intrusions and information regarding the sedimentary cover that has likely been removed.

All pre-Mesozoic rock samples are currently exposed in erosional landscapes that have undergone denudation since at least the formation of the bauxites (55 – 45 Ma), which cap all the highest reliefs (remnants of the “African Surface”). This denudation may vary from 0 to up to 600 m and roughly equates to the regional relief above the considered sample. Pre-Eocene burial is not precluded for the pre-Mesozoic samples, especially those found along the margins of Mesozoic sediments bearing basins (Iullemmeden Basin and coastal basins) and near the coast.

The main N-S transect follows two main river valleys (the long Ouémé, flowing south and the short Mékrou, flowing North, with a divide located ca. 10°N). Along that transect, bauxitic and

Intermediate surfaces remnants have all been dissected, except approaching the coastal sedimentary basin (northern edge capped by the Intermediate ferricrete) and the Iullemeden Basin (ferricrete Intermediate plateaux of the northernmost part of the section). Away from the transect, bauxite remnants are very scarce and may be preserved in the Atacora range (ca. 550 m). The regional N-S cross-section of the country suggests that the current envelope of the topography coincides with that of the Intermediate ferricrete (abandoned ca. 30 Ma ago).

The occurrence of Lower Paleozoic fluvial and shallow marine clastic sediments in the Kandi basin suggests that most of the material eroded over Benin prior to the Late Paleogene was made of such platform sediments. This is reinforced by the occurrence of Paleozoic sediments on offshore seismic lines.