Pedoanthracology reveals Holocene fire-vegetation-climate linkages in Central Africa

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Pedoanthracology can be used to reconstruct fire and vegetation dynamics which in turn explain or illustrate paleoclimatic and anthropogenic shifts (Di Pasquale et al. 2008; Tovar et al. 2014). Although charcoal analysis has proven worthwhile for vegetation reconstructions in temperate and arid ecosystems, it has only sporadically been applied in tropical contexts due to the lack of straightforward identification techniques coping with species-rich environments. Therefore, we recently developed a transparent charcoal identification procedure for Central Africa using large databases and well defined characters (Hubau et al. 2012). Moreover, we illustrated how combining imaging techniques can provide optimal visualization of charcoal anatomy, enabling evaluation of specific difficulties encountered during charcoal examination. This eventually leads to high level identification of charcoal taxa (Hubau et al. 2013). Here we present how these techniques resulted in charcoal records demonstrating a direct temporal link between Holocene droughts, palaeofire and vegetation change in the Democratic Republic of Congo (Hubau et al. 2015). We find three distinct periods of local palaeofire occurrence: 7.8 - 6.8 ka BP, 2.3 - 1.5 ka BP, 0.8 ka BP - present. These periods are linked to well-known Holocene drought anomalies: the 8.2 ka BP event, the 3rd millennium BP rainforest crisis and the Medieval Climate Anomaly. During and after these Holocene droughts the Central African rainforest landscape was characterised by a fragmented pattern with fire-prone open patches, especially near the forest boundary. Furthermore, the dominance of pioneer and woodland savanna taxa in younger charcoal assemblages indicates that rainforest regeneration was hampered by increasingly severe drought conditions after 0.8 ka BP. Finally, first results from the Central Congo basin indicate that disturbance through fire after 0.5 ka BP could be at the origin of present-day patchy distribution patterns of long-lived secondary forest stands. An example is a forest type dominated by the famous flagship species Pericopsis elata (wood known as afrormosia). These results support the notion of a dynamic forest ecosystem at multi-century time scales across the Central African rainforest.

Di Pasquale, G. et al. (2008). The Holocene tree line in the northern Andes (Ecuador): First evidence from soil charcoal. Palaeogeography, Palaeoclimatology, Palaeoecology 259: 17-34.

Hubau, W. et al. (2012). Charcoal identification in species-rich biomes: A protocol for Central Africa optimised for the Mayumbe forest. Review of Palaeobotany and Palynology 171: 164-178.

Hubau, W. et al. (2013). Complementary imaging techniques for charcoal examination and identification. IAWA Journal 34: 147-168.

Hubau, W. et al. (2015). Charcoal-inferred Holocene fire and vegetation history linked to drought periods in the Democratic Republic of Congo. Global Change Biology 21: 2296-2308.

Tovar, C. et al. (2014). Influence of 1100 years of burning on the Central African rainforest. Ecography 37: 1139-1148

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