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Comment on "Intensifying Weathering and Land Use in Iron Age Central Africa"

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Abstract

Bayon *et al.* (Reports, 9 March 2012, p. 1219) interpreted unusually high aluminum-potassium ratio values in an Atlantic sediment core as indicating anthropogenic deforestation around 2500 years before the present (B.P.). We argue that there is no terrestrial evidence for forest destruction by humans and that the third millennium B.P. rainforest crisis can be clearly attributed mostly to climatic change.

Bayon *et al.* (*1*) reported geochemical results of a marine sediment record recovered in the Atlantic off the mouth of the Congo River. They interpreted aluminum-potassium ratio (Al/K) values in terms of weathering intensity in the Congo watershed and regional climatic developments. For most of the 20,000 years for which relevant data are presented, high Al/K values correlate with high rates of soil weathering during periods of increased precipitation, and low Al/K values correspond to low weathering rates under dryer conditions. The exception is a period of unusually high Al/K ratios in three samples, with inferred dates of 2444 to 2106 years before the present (yr B.P.), which led Bayon *et al.* to suggest that Bantu-speaking farmers were responsible for a major deforestation event during this period, with intensive land use and iron smelting resulting in soil denudation and increased weathering. The authors present interesting new data on the late Holocene palaeoenvironment of Central Africa. However, we strongly question their conclusion about the role of human impact in deforestation during this period because their interpretation

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contradicts palaeoecological and archaeological evidence from terrestrial sites with-in, or adjacent to, the Congo drainage basin.

The hypothesis that a rainforest crisis resulting from climatic change in the third millennium B.P. facilitated the spread of agricultural communities throughout Central Africa (*2*, *3*) has found broad acceptance by palaeoecologists and archaeologists. Numerous studies have modified the original model and suggest that a major vegetation change occurred in two phases. The first, around 4000 yr B.P., mainly affected the periphery of the central African forest block and can be attributed to decreasing rainfall. The second, caused by increasing seasonality of rainfall between 2500 and 2100 yr B.P., also was noticeable in the interior. The appearance of a marked dry season due to an abnormal southward shift of the intertropical convergence zone is corroborated by Saharan diatoms in dust deposited as far south as 4°N and the savanna crop *Pennisetum glaucum* in contemporaneous archaeological sites (*4*, *5*). Although at the periphery savannas were spreading, the rainforest crisis of the third millennium B.P. was not a general “deforestation event,” as Bayon *et al*. argue. In southern Cameroon, Gabon and the inner Congo Basin, a mosaic of mature and secondary forests with light-demanding trees developed (*4*, *6*). None of the palynological archives indicated in figure 1 of Bayon *et al*. shows any sign of human impact for this period; instead, rainforest disturbance can be readily attributed to increasing aridity and/or stronger seasonality.

Archaeological sites containing pottery, and in some cases also iron, with radiocarbon dates clustering in the second half of the third millennium B.P., attest to a major immigration into the central African rainforest. Insofar as the available calibrated dates (2 SD) allow a judgment, one might discern a slight tendency toward a north-to-south movement. However, many more dates are needed to affirm this. As yet, the oldest sites are located in southern Cameroon and date to around 3000 yr B.P.; later ones occur in Gabon and on the coast of the Republic of Congo (Congo-Brazzaville) (around 2600 yr B.P.) and in the Democratic Republic of Congo (Congo-Kinshasa) (around 2400 yr B.P.) (*7*–*9*). The discrepancy between the timing of the localization of settlements and large-scale vegetation changes strongly suggests that human impact was not the major causal factor for forest disturbance.

Despite repeated claims, especially in the secondary literature (*10*), that the immigrants were farmers, direct data on their economies are scarce. Available evidence suggests a mixed subsistence system with hunting, fishing, collecting, animal husbandry, and, limited to southern Cameroon, some small-scale plant cultivation. People collected fruits and firewood near settlements and changed the species composition of the forest through some form of management. Archaeobotanical samples indicate a mosaic of mature and secondary forests, comprised of shade-tolerant and light-demanding trees, around the settlements (*5*, *7*, *11*). If agricultural plots were present, they must have been small. Common oil palm fruits do not prove intensified plant cultivation, as Bayon *et al*. state, but may have been collected from natural stands, as is done today. Pollen data clearly show that expansion of this pioneer species always followed climatically induced openings of the rainforest (*4*, *12*). Linguistic, archaeological, and archaeobotanical data are consistent with the hypothesis that the settlers took advantage of the secondary forest plant communities, which can be easily cleared and contain numerous useful tree species.

Vegetation degradation due to metallurgy also is undocumented. The earliest evidence of iron production in the rainforest is dated around 2500 yr B.P., but such evidence is not voluminous. In Bas-Congo of the Democratic Republic of Congo and the Sangha region of the Republic of Congo, iron production appears even later, around 2000 yr B.P. (*7*, *8*, *13*), thus excluding any temporal correlation between increased Al/K values in the Atlantic around 2400 yr B.P. and potential deforestation for metallurgy on the continent. Even after

the intensification of iron production in Central Africa after 2000 yr B.P., its influence on the vegetation remained negligible (*14*).

We do not deny that the first ceramic- and iron-producing immigrants had an impact on the rainforest and acted as potential amplifiers of environmental change. As in other parts of the world, the central African rainforest has been subject to human manipulation and is by no means “virgin.” Current debates regard tropical rainforests as cultural landscapes where prehistoric people developed special adaptations and management practices, thus influencing plant succession and species composition (*15*). So far, all available terrestrial evidence points to climate change as the major factor for vegetation transformation in the central African rainforest during the third millennium B.P., potentially facilitating the introduction of small-scale farming and iron production. Testing this hypothesis will require more firm data from archaeological sites, coupled with regional palaeoecological studies. Three geochemical samples from one marine core clearly are not sufficient to confirm large-scale anthropogenic forest destruction on the African continent as an alternative hypothesis.

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