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Reply

Reply to the comment by J. Maley, P. Giresse, C. Favier & C. Doumengue on the paper "Geochronological arguments for a close relationship between surficial formation profiles and environmental crisis (c. 3000–2000 BP) in Gabon (Central Africa)", by D. Thiéblemont et al., 2013 [C.R. Geoscience 345, 272–283]

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First, we would like to sincerely thank J. Maley et al. for their interest for our paper and contribution to the debate.

We note that the comment of Maley et al. questioned at least three aspects of our work, i.e.:

- the timing of events—these latter include:
  - the Stone Line emplacement,
  - the forest cover regression—;
- the Stone Line dynamics;
- the Cover Horizon emplacement.

We will respond individually to each one of these questions.

1. Timing of events

Maley et al. indicate that they want only to discuss the *last stone line* (SL) event, that is the more recent of a series thought to have occurred at different periods during the Quaternary. As we wrote in the paper, *in Gabon* we never observed superimposed SL, so that we consider that the SL we see is always the most recent one (i.e. 'last SL'). This last SL is actually always located below a soft layer of clayey to sandy yellow material: the Cover Horizon (CH).

From the data referred to by Maley et al., this SL event could have occurred around 2600 BP. We must therefore consider that the CH should be younger than 2600 BP, which is actually consistent with most of the new data we present and also from the references we cite.

However, as noted by Maley et al., we consider that the forest cover regression and SL + CH emplacement were correlative events (i.e. SL + CH emplacement could not have been possible in the presence of a forest cover) that we assume to have occurred in a period of ~ 2000 years (~ 4000–2000 BP) from the available geochronological data on surficial formations (see our discussion).

The conclusion reported by Maley et al. (from the references they cite) that the maximum of regression could have taken place between c. 2600 and 2550 BP is based on ^{14}C-calibrated palynological profiles recovered from different lakes from Central Africa. ^{14}C dates obtained on organic matter (either bulk organic matter or plant remains) included in sediments (including surficial formations and lake sediments) are actually the most direct indication of the existence of vegetation in the source region at a given place. A revised (we include in it the data referred to by Maley et al.) version of Fig. 7 of our paper is presented (Fig. 1), which shows the variability of the ^{14}C dates obtained at

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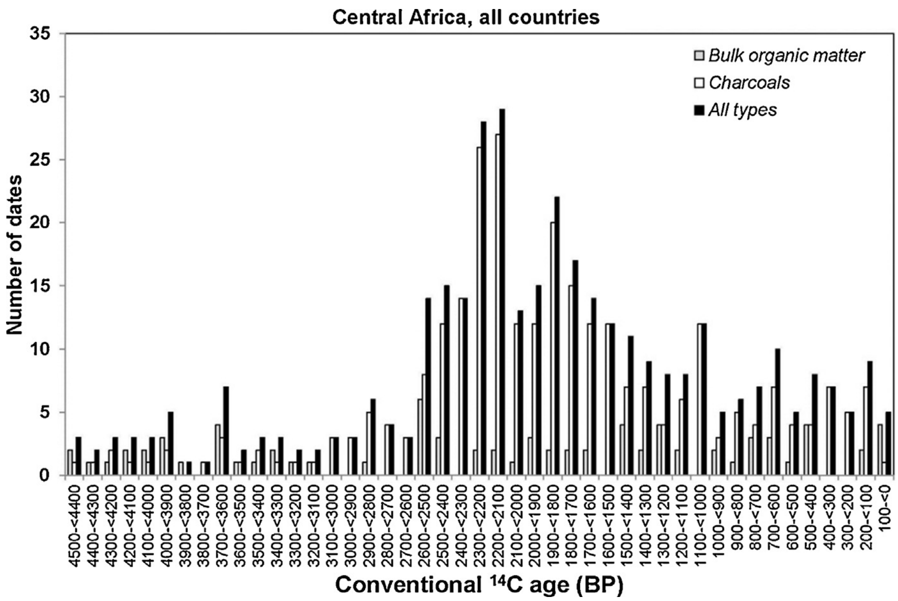

Fig. 1. Frequency diagram of ^{14}C dates obtained on vegetal remnants recovered form recent sediments (including surficial formations, lake and river sediments and anthropogenic deposits) of western Central Africa in the interval 4500–0 BP, based on the compilation used in Thiéblemont et al. (2013) completed by some references indicated on Fig. 2.

the scale of Central Africa in the 4500–0 BP interval. A sudden increase in the available dates is observed around ~ 2600–2500 BP and culminates around ~ 2100–2000 BP. Before 2600 BP, the number of available ^{14}C dates by 100-year step is always less than or equal to 7. If we consider profiles separately (Fig. 2), a more or less pronounced gap is always observed in the c. 3500–2500-BP interval. Considering all profiles together, a constant gap may be defined in the 3400–2800 BP interval, which is not inconsistent with the conclusion we drawn that "most of the landscape was free of forest c. 4000–2000 BP". Note however that a more precise definition of this gap should require the use of calibrated ^{14}C ages.

2. Stone line dynamics

As far as the SL is concerned, our observations *in Gabon* (Thiéblemont, 2013; Thiéblemont et al., 2009) show that the dynamic of the SL deposition evolved from debris flows along the hill slopes to torrential along the valley drainages.

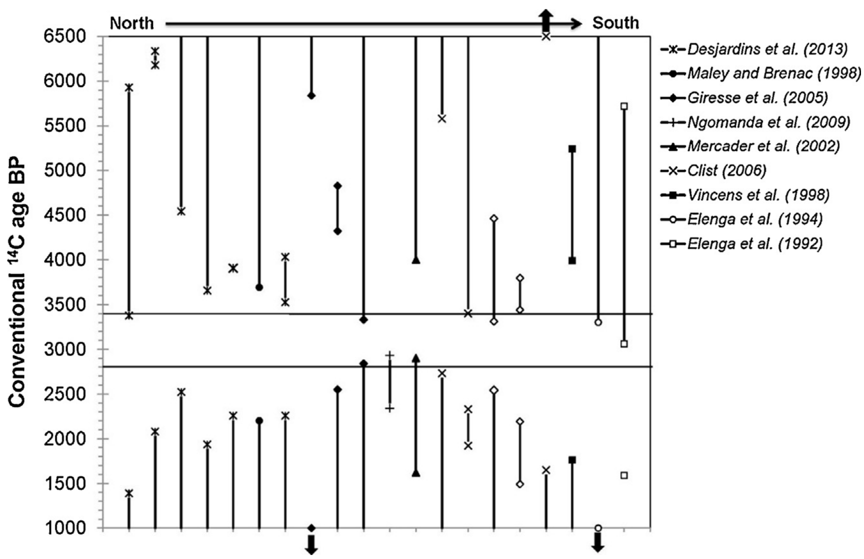

Fig. 2. Ranges of ^{14}C ages obtained on vegetal remnants from 20 profiles from western Central Africa with representation (bars) of the time-intervals of ages, below and above 3000 BP. Consistent data from Cameroonian rivers obtained by Sangen (2011) are not reported in this diagram (from Desjardins et al., 2013; Maley and Brenac, 1998; Giresse et al., 2005, 2009; Ngomanda et al., 2009; Mercader et al., 2002; Clist, 2006; Vincens et al., 1998; Elenga et al., 1992, 1994).

Fig. 3. A typical river in western Congo (Mayombe region) with bed covered by an accumulation of large and more or less rounded blocks of crystalline rocks of varied nature.

Moving from the top to the bottom of the watersheds, one can see an increasing proportion of rounded elements, sometimes one meter or more in diameter along the bed of some rivers. For us, this organization suggests a single sedimentological system, at least at the scale of the Gabonese territory, involving mass movements along the slopes and highly energetic (i.e. torrential) transport along the riverbeds (Fig. 3). Maley et al. argue that such a torrential dynamic is inconsistent with the low slopes of the rivers. Low slopes are indeed prevailing for the Gabonese rivers, so that it is actually an enigma how such torrential events could have occurred. Nevertheless, the organization we note above is clearly inconsistent with the SL as being the results of (multiple...) large landslides. Nevertheless, as mentioned earlier, we agree that the upper part of the system (i.e. hill slopes) evolved by debris flowing.

3. Cover Horizon emplacement

By reference to another paper (Thiéblemont, 2013), Maley et al. agree that aeolian processes could have been a major factor of CH genesis. Nevertheless, Maley et al. consider the 'ultimate' deposit (i.e. the CH as it is seen on the field) as a colluvium. One striking characteristics of the CH is its constant thickness over landscape (Fig. 4) and lack of any kind of stratigraphic organization. This suggests emplacement by homogeneous mass deposition. This is indeed a common characteristic of loesses. Nevertheless, we are aware that the granulometric patterns of the CH do not fit the conventional granulometric definition of loesses. Indeed, the CH is not a loess but a composite aeolian deposit involving variable proportions of distal (silt to clay) and local or sub-local (sand) components (Thiéblemont, 2013).

Fig. 4. A typical landscape of western Congo with the Cover Horizon forming a very homogeneous layer, about 2 meters thick, covering a steep hill.

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