PALEURAFRICA

Origin of the European modern faunas through Palaeogene Central Africa collections

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SUMMARY OF THE FINAL REPORT

Context

Recent advances in the study of vertebrate evolution suggest that the earliest modern mammals such as primates, perissodactyls (odd-toed ungulates) and artiodactyls (even-toed ungulates), which appeared suddenly with other vertebrate groups in all three Northern hemisphere continents at the Paleocene-Eocene Thermal Maximum, 56 myr ago, likely originated during the late Paleocene in tropical habitats farther south. Interestingly, there is a unique collection of Paleocene vertebrates from Central Africa in the federal heritage resulting from Belgian expeditions of the Royal Museum for Central Africa (RMCA) by Edmond Dartevelle in the Democratic Republic of Congo and Angola.

Objectives

The aim of this project was to identify the Paleogene vertebrate faunas of Central Africa and to look for ancestors of modern vertebrates from Europe and elsewhere. This required the study of historic archives and digitization/cataloguing of specimens at RMCA and Royal Belgian Institute of Natural Sciences (RBINS), the relocation and excavations of fossil sites in Central Africa, India and Europe, and analysis of vertebrate specimens, with a focus on their relevance for reconstructing climate and faunal evolution in the Paleogene.

Research methodology

Relevant early Paleogene specimens from the Dartevelle collection, and archival data related to them have been located, evaluated and catalogued. Historic entries have been refine and update to enrich them with additional metadata. Selected sedimentary rock samples were divided in two: one for analysis in University of Namur (isotope analysis) and one for analysis in Ghent University (palynologic analysis). Eight field excavations have been done, two of them in Democratic Republic of Congo (Bas Congo and Bandundu) and six in India (Gujarat). Meetings of the partners were held on a regular basis, including with Duke University Lemur Center and Ohio university, as well as the follow-up committee, to evaluate the research strategy.

Results

In total, our team produced 67 full articles during the six years of the project (four funding years plus two years extension). Among them, 65 articles were published in impact factor journals and one as a chapter of a book. The results of the studies were regularly presented during diverse international congresses. In total, 72 abstracts (29 published and 43 unpublished abstracts) have been presented at congresses, all related to Paleogene vertebrate faunas and their environments. Numerous new species and genera and even families new to science have been made. The project produced extraordinary and unexpected results, such as the almost complete absence of Danian-aged rocks in the famous Landana section on the marine margin of the Congo Basin, contrary to prevailing interpretations over the last half a century; the first latest Paleocene mammal age of Europe; new tracks for primate origins; and the notion that perissodactyl origins involved India. New paleobiogeographic and phylogenetic results were obtain for a large spectrum of Paleogene vertebrates, including fish, snakes, turtles, crocodilians, birds and mammals. The age of some debated fossil localities have been solved thanks to isotope analysis and/or palynomorph analysis.

An important discovery is that some faunal exchanges between Europe and Africa involved the Indian subcontinent as it drifted towards Asia. Indeed, results on Paleogene vertebrates from India (several expeditions funded by grants from the National Geographic Society before 2015 and by the Leakey Foundation since 2015) have revealed a strong link with European and African faunas respectively. This hypothesis has been supported by the discovery of the early Eocene vertebrate assemblage from Tadkeshwar Lignite Mine, India. These important results supported our decision to include our studies on Indian vertebrates in the general results of PalEurAfrica.

In the framework of the ending of the PalEurAfrica project (see http://www.paleurafrica.be), we received from September 10th to 13th 2019, 62 experts from 14 countries of four different continents at the RBINS for an international symposium related to the *Evolution and paleoenvironment of early modern vertebrates during the Paleogene*. This international meeting also celebrated the memory of one of our PalEurAfrica partners, Gregg Gunnell (1954 – 2017), who died tragically and unexpectedly during the project. In total, 51 abstracts have been presented (38 talks in technical sessions, 10 posters, and 3 keynote lectures). The congress finished with a one-day fieldtrip in three famous Belgian vertebrate localities (Dormaal, Hoogbutsel, and Maret) that were reopen for the meeting thanks to the support of the mayors of Zoutleeuw, Boutersem and Orp-Jauche respectively. A special double issue of the international journal *Geobios* gathers 15 articles presented following the congress.

Conclusions and recommendations

The six partners and collaborators of the PalEurAfrica research project have created a network of 146 researchers during the six years of the project. Partners at different institutions worked on different subjects at the same time in small groups of 2 or 3 partners. We also regularly engaged collaborators from outside PalEurAfrica. Importantly, some topics involved all partners together for more complex integrative works dealing with the

paleontology and sedimentology of DRC and Angola. This system allowed our team to produce more publications and to broadly address the general theme of PalEurAfrica. We anticipate that collaborations with the Centre de Recherches Géologiques et Minières (CRGM) in DRC, the HNB Garhwal University (Srinagar) and Wadia Institute of Himalayan Geology (Dehradun) in India will continue and that new joint projects will be proposed to continue collaborative and complementary research in these countries.

The starting point of this successful project is thanks to Belspo's choice to make a relatively open topic that corresponded perfectly with the historical missions of several Belgian federal institutions. This would have not been possible with a specific topic that would certainly have restricted the size of the scientific network.

Keywords

Paleogene, Vertebrates, Africa, India, Europe