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Middle Eocene vertebrates from the sabkha of Gueran, Atlantic coastal basin, Saharan Morocco, and their peri-African correlations

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ABSTRACT

The sabkha of Gueran in the Southwest Moroccan Sahara has yielded a rich and diverse fauna of late middle Eocene vertebrates that include the world's richest Bartonian age archaeocete assemblage. Archeocete remains were described previously and here we report on the rest of the vertebrate fauna. The Gueran fauna includes abundant chondrichthyan species belonging to Lamniformes, Carcharhiniformes and Rhinopristiformes, and actinopterygian assemblage consisting of *Cylindracanthus*, of a siluriform, and of Perciformes. Turtles are represented by at least two marine taxa referred to as Cheloniidae and Dermochelyidae. Crocodylian remains belong to at least two longirostrine species, including gavialoid remains. Snakes are represented by *Pterosphenus* cf. *schweinfurthi* (Palaeophiidae). Seabirds are represented by a pseudo-toothed bird (Pelagornithidae). The avian fossil belonged to a gigantic soaring bird and constitutes the earliest occurrence of the genus *Pelagornis*. The presence of proboscideans is attested by dental fragments. This fossil assemblage from Gueran shows affinities with those of the Eocene beds of Egypt and Libya. The numerous shared taxa support a close biogeographical connection between faunas from southeastern and southwestern coasts of the Mediterranean Sea.

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1. Introduction

The sabkha of Gueran is an internally salty drained depression in the Sahara located 125 km southeast of the

Atlantic coastal city of Boujdour, in southern Morocco (Fig. 1). The site was discovered in 2014, and dozens of skulls and partially articulated skeletons of late middle Eocene archaeocetes have been collected by local prospectors. During four successive field missions realized between 2014 and 2016, with the financial support of the National Geographic Society, hundreds of isolated remains

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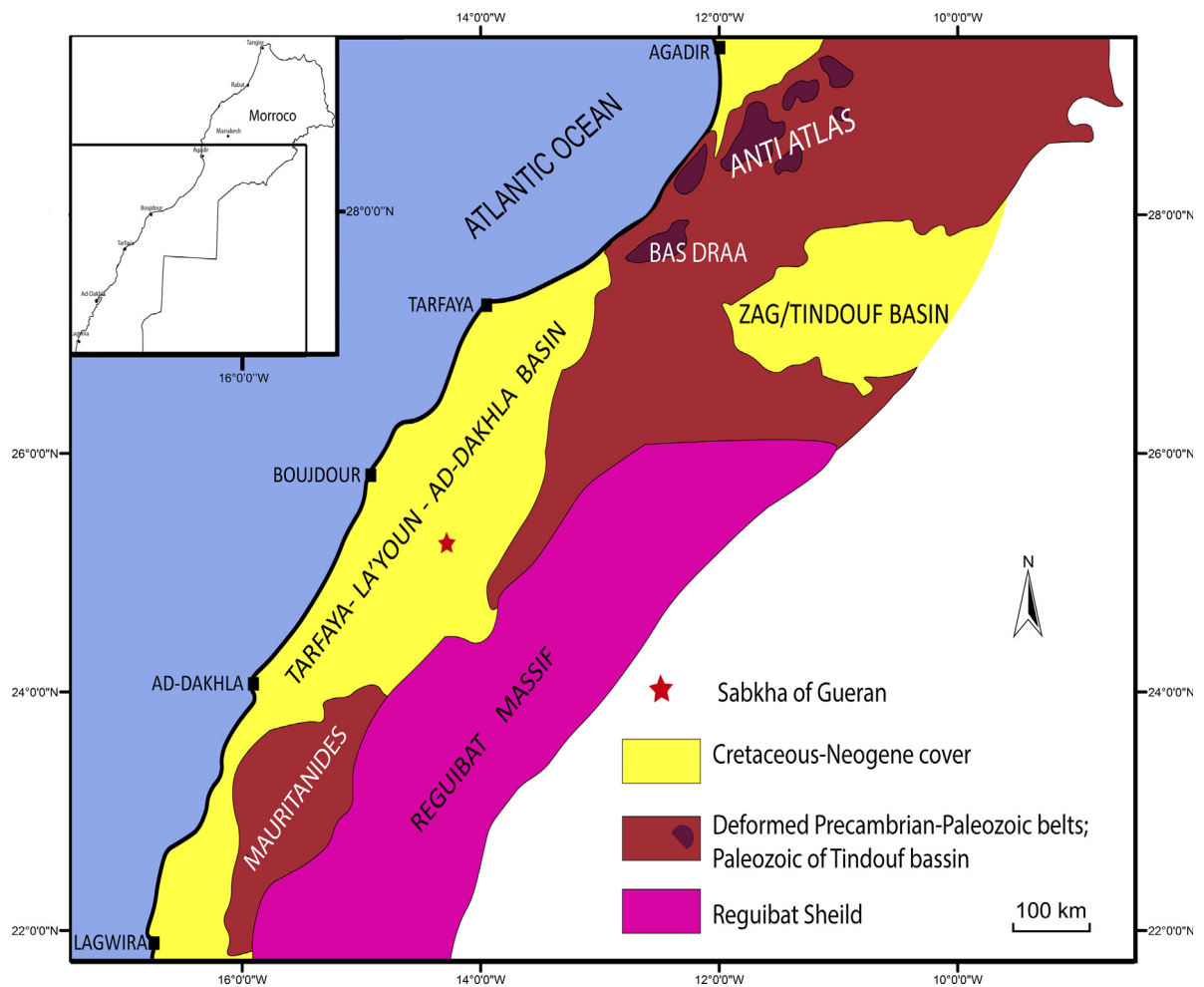


Fig. 1. Simplified structural map of southern Morocco showing the location of the sabkha of Gueran. Modified from [Hollard et al., 1985](#).

of marine vertebrates have been collected by Zouhri, Gingerich, and Khalloufi in a unique fossiliferous bed that extends over 20 km.

The interest of the Gueran locality lays in the rarity of late middle Eocene faunas in northwestern Africa. The late Eocene fossil record documents the impact of global climate changes at the Eocene–Oligocene transition on the evolutionary and biogeographical history of biodiversity. Bartonian archaeocetes previously described by [Gingerich and Zouhri \(2015\)](#) are among the most diverse archaeocete faunas of this age in the world. The extraordinary richness and excellent state of preservation of Bartonian archaeocetes document a crucial period in the evolution of cetaceans. Gueran archaeocetes include both protocetids and basilosaurids and are dated to the Bartonian because basilosaurids are not known from the Lutetian, and a single protocetid is known to have extended into the earliest Priabonian. The discovery of new archaeocete specimens makes it possible to strengthen the previous study. Other vertebrate taxa are also well represented at Gueran and contribute to a better understanding of the evolutionary

history of taxa still poorly documented in the Eocene, like proboscideans and pelagornithid seabirds.

This paper aims to provide a more complete picture of the fossil assemblage of Gueran and to refine the dating of this fauna by comparison with contemporaneous faunas of the Fayum Depression in Egypt, Dur At-Talah in Libya, and Eocene localities on the Atlantic coast of western Africa (Nigeria, Togo, Senegal, and Morocco). Additionally, we discuss the biostratigraphical, palaeobiogeographical, and palaeoenvironmental significances of this diverse marine fauna from the upper middle Eocene strata of northwestern Africa.

2. Geological setting

The marine fauna described herein comes from the Aridal Formation in the Gueran Depression ([Fig. 1](#)). Geologically, this formation belongs to the sub-basin of Boujdour, which constitutes, along with the sub-basin of Dakhla, the Atlantic basin of Tarfaya-La'Youn-Ad-Dakhla ([Davison and Dailly, 2010; Ranke et al., 1982](#)). This basin is

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