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Earliest Eruptions of the Yemen Volcanics

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Abstract. A basaltic lava flow is recorded in the upper part of the Cretaceous Ghiras Sandstone Member in the Ta'iz area, south-western Yemen Arab Republic. This basalt indicates that the eruptions of the Yemen volcanics and the Red Sea rifting had begun in the Late Cretaceous.

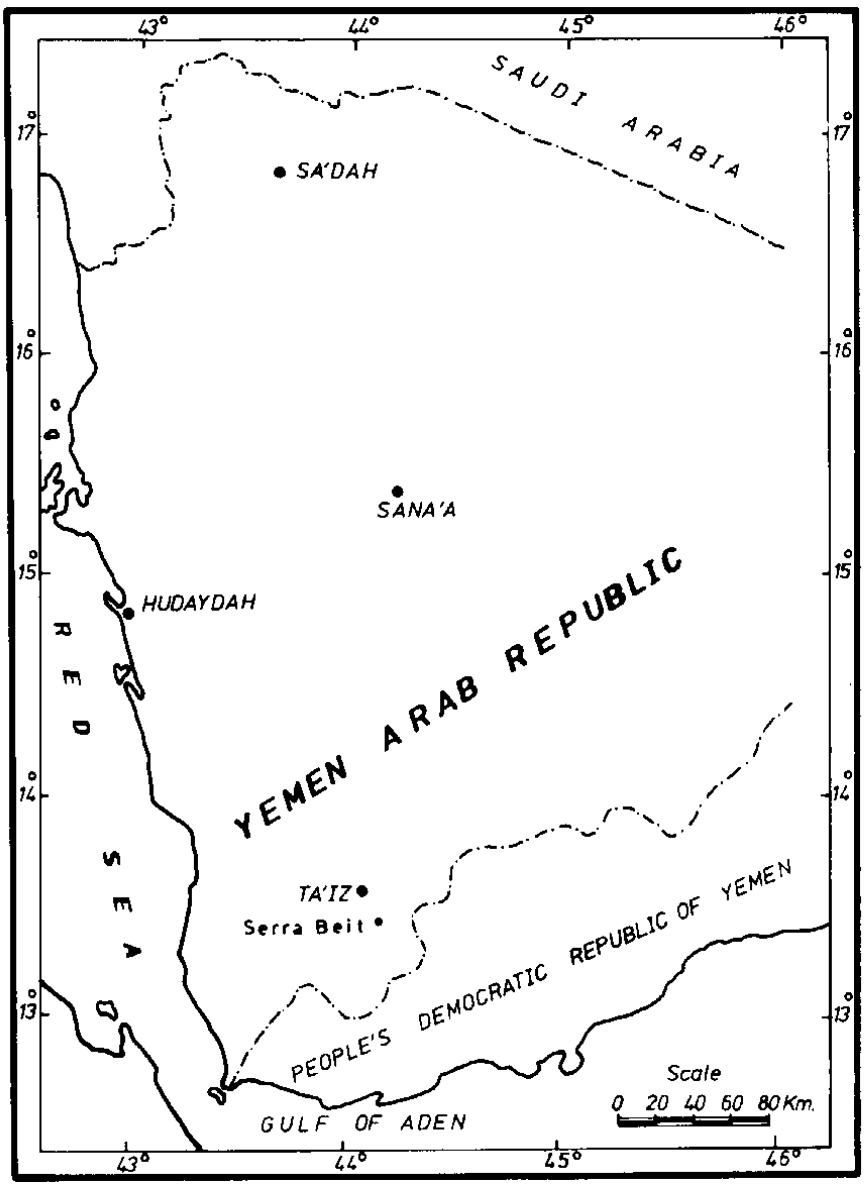
Introduction

On the basis of their stratigraphical position, radiometric dating, and the fossils recorded in the intercalated sediments, the Yemen Volcanics (= Trap Series) were assigned to the Tertiary. Some authors [1,2, D. Bosence, and M. Menzies of London University, written communications], mentioned that the volcanic activity in the Yemen Arab Republic had begun in the Late Cretaceous. However, precise evidence referring to the beginning of this volcanism has not been provided. In the present study, a basalt layer is recorded in the upper part of the Cretaceous Ghiras Sandstone Member in the Ta'iz area, southwestern Yemen Arab Republic (Text-Fig. 1). This layer represents one of the earliest stages of the volcanism related to the Red Sea rifting and therefore, it is very useful in dating these important geologic events in Arabia.

The present study aims to describe the recorded basalt layer and to discuss its stratigraphic significance.

Characteristics of the recorded layer

This layer consists of black, compact basalt with vesicular upper surface. It is almost horizontal with a thickness of about 10 m, and extends laterally with two nearly parallel surfaces, for several hundreds of meters. It is characterised by plagioclase and olivine phenocrysts in a fine grained groundmass [3] which makes it



Text-Fig. 1. Yemen Arab Republic, location map of the study area.

similar to and correlative with the basal part of the Yemen Volcanics that consists of black-greenish black, dense basalt [4]. No effects of metamorphism have been observed at the upper contact with the overlying sandstone. The lack of effects of metamorphism accompanied by the occurrence of vesicles in the upper surface, indicates that this layer represents a basaltic lava flow rather than a sill.

Occurrence

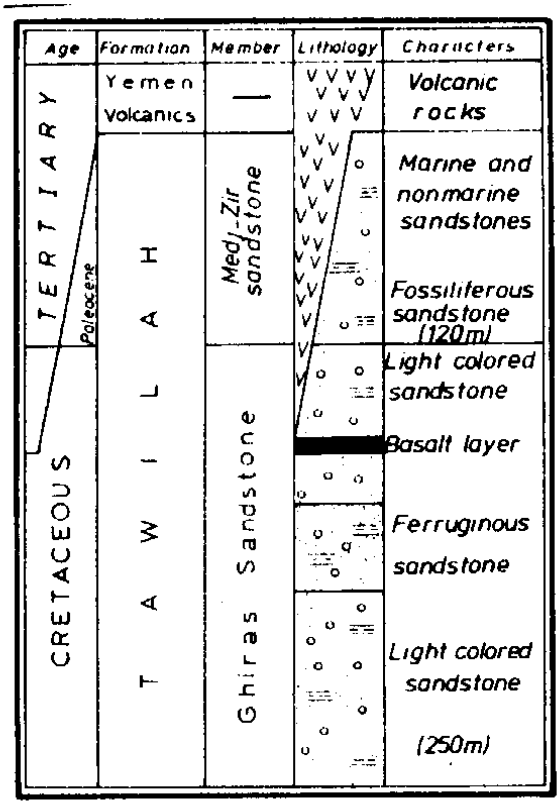
The basalt flow is interlayered in the upper quarter of the Ghiras Sandstone Member (Cretaceous) of the Tawilah Formation (Cretaceous-Paleocene), (Text-Fig. 2). The Ghiras Member was assigned to the Cretaceous on the basis of its stratigraphical position [2]. It is conformably underlain by the Sabatain / Madbi Formations which bear fossils of Kimmeridgian age (Late Jurassic), (Table 1), and conformably overlain by the Medj-Zir Sandstone Member which contains Paleocene fossils (Table 2).

Table 1. Fossils recorded in the Madbi Formation in the Yemen Arab Republic, and the People's Democratic Republic of Yemen [6,7,8].

Astarte (Coelastrte) scytalis Holdaus
Ataxiceras sp. cf. *A. desmoides* Wegele
Belemnopsis tangenensis (Futterer)
Ceratomya sp. cf. *C. plicata* (Agassiz)
Daghanirhynchia macfadyeni
Exogyra fourtaui Stefanini
Gryphaea balli ? (Stefanini)
Idoceras sp. cf. *I. farquharsoni* Spath
Inoceramus sp. cf. *I. suprajurensis* Thurmann
Laevaptychus latus (Parkinson)
Lima (Plagiostoma) harronis (Dacque)
Lopha marshi (Sowerby)
Lopha solitaria (Sowerby)
Modiolus imbricatus (Sowerby)
Modiolus jurensis Roemer
Ostrea (Liostrea) sp. cf. *O. (L.) moreana* Buvignier
Ostrea (Liostrea) wagurensis Cox
Paleotrix form *X*
Perisphinctes mombassanua Dacque
Perisphinctes (Divisosphynctes) sp. cf. *P. (D.) inaequalis* (Spath)
Perisphinctes (Pachyspinctes) robustus Spath
Posidonia somaliensis Cox
Proconulus ambalensis (Weir)
Rhopalo teuthis somaliensis Spath
Somalirhynchia africana
Somalirhynchia sp. cf. *S. jordanica*
Terebratula sp. cf. *T. terebratula*
Trocalia sp. cf. *T. yemenesis* (Basse)
Valvulinella (= *Kurnubia*) *jurassica Henson*

Table 2. Fossils recorded in the Medj-Zir Sandstone Member in the Yemen Arab Republic [1,2,6,9].

Ammobaculites sp.
Ammodiscus glabratus Cushman and Jarvis
Bigenerina burri Finlay
Brasiliella sp. cf. *B. variabilis* Troelsen
Calyptrea sp.
Campanile sp.
Haplophragmoides hawardense Stelck and Wall
Karreria sp.
Melonis sp.
Nerinea sp.
Protelphidium sp.
Pulsiphonina prima (Plummer)
Rectoeponides sp.
Rzehakina epigona minima Cushman and Renz
Spirotecta sp.
Usbekistania mubarekensis Suleymanov



Text-Fig. 2. Stratigraphic section of the Tawilah Formation and the lower part of the Yemen Volcanics, showing the stratigraphic position of the recorded basaltic layer.

Location

The basalt is well exposed on the slopes of the southern side of Wadi Serra Beit which lie about 1 km to the east of Serra Beit Village at an elevation of about 1800 m above sea level. These slopes also lie about 25 km southeast of Ta'iz City (Text-Fig. 1).

Approx. lat. (of the exposure) 13° 23′ N
Approx. long. (of the exposure) 44° 09′ E

Stratigraphic significance

The occurrence of this basaltic layer which represents one of the earliest lava flows in the Yemen Arab Republic, in the upper part of the Ghiras Sandstone Member, indicates that both the eruptions of the Yemen Volcanics and the rifting of the Afro-Arabian shield which led to the formation of the Red Sea graben, had begun in the Late Cretaceous. Also, this occurrence indicates that the stratigraphic relation between the Tawilah Formation and the overlying Yemen Volcanics is conformable and not unconformable as it has been believed by the previous workers [e.g. 2,4,5]. As this layer extends adjacent to one of the Tertiary granitic bodies on which the Serra Beit Village lies, it cannot be used in estimating the accurate isotopic age of these important geologic events due to the effects of that granitic body. Using the K-Ar dating methods, the present layer is dated as 23.8 million years. This date means that it belongs to the Late Oligocene, but its stratigraphical position indicates that it has a Late Cretaceous age. The difference in the interpreted age is attributed to the resetting of the K-Ar date by the neighboring Tertiary granitic body. Accordingly, the estimated isotopic age (23.8 m.y) is considered as representing a Cretaceous age reset by the Tertiary granite. It is therefore, rejected in the present study.

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أولى تدفقات بركانيات اليمن

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ملخص البحث. تم تسجيل تدفق حمم بازلتية في الأجزاء العلوية من فرد الغراس الرملي (العصر الطباشيري) في منطقة تعز، جنوب غربي الجمهورية العربية اليمنية، وهذا يدل على أن تدفقات بركانيات اليمن وإنخساف البحر الأحمر، قد بدأت في العصر الطباشيري المتأخر.