PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Short Discussion Contributions

H. M. E. Schurmann, C. E. Thiebaud and D. A. Robson

Phil. Trans. R. Soc. Lond. A 1970 **267**, 413-414
doi: 10.1098/rsta.1970.0049

Short discussion contributions

H. M. E. Schürmann (*The Hague*). I would like to remark that epeirogenetic movements in the Precambrian of the Gulf of Suez and the northern Red Sea area have been proven. They are of Precambrian age as they have been observed underneath the Hammamat (youngest Precambrian) transgression.

In Palaeozoic times several marine ingressions took place and similar ingressions occurred in Permian, Jurassic and Cretaceous times, indicating continued subsidence. The big clysmic taphrogeny took place in young Tertiary times.

C. E. Thiébaud & D. A. Robson (*formerly Shell International Petroleum Company geologists in Egypt*). The outcrops of rock within the bounding faults of the rift valley, both in the Gulf of Suez region and along the northwestern margin of the Red Sea, are numerous and over wide areas they are continuous. The geology of this section of the great rift should therefore be closely considered in any assessment of the tectonic pattern of the Red Sea as a whole.

In our opinion, based on many years of detailed geological mapping, the following facts appear to be of fundamental importance:

1. In the Egyptian region of the great rift valley, Palaeozoic formations represented by the diachronous Nubian Sandstone, lie upon the peneplained surface of the Precambrian. There are many extensive outcrops where this peneplain can be seen in the field. However, as Schürmann has pointed out, and as Bender has observed in Jordan, there are localities where Precambrian has an uneven and irregular base.

2. The Palaeozoic and Mesozoic formations which follow the Precambrian are remarkably constant in thickness over wide areas. There is no significant variation in thickness between sections measured within the confines of the rift and those nearby, but beyond the bounding faults. For example, the succession of Nubian Sandstone, Cenomanian shales, etc. up to and including Eocene on the Plateau of Sinai is closely similar to that, on the same latitude, along the western margin of Sinai, within the rift depression. This same correspondence can be observed when comparing the sections, along similar latitudes, within and outside the rift on the western side of the Gulf of Suez. Therefore, the rift faulting in this region must have started only after Eocene times.

3. In fact, there was a marked lack of disturbance from the end of Precambrian until Oligocene times, except in the north where the folding movements of the Egypto-Syrian arc developed. These movements must have occurred chiefly during Middle Eocene times, as is established by the presence across the Sinai isthmus of Upper Lutetian conglomerates overlying, unconformably, older formations.

4. The rift faulting which began in Oligocene times is normal faulting, with fault planes dipping at about 70°. The rift fault pattern is notable for the enormous vertical throw of the west and east marginal faults, and also for the groups of tilted blocks within the rift valley itself. The tilted blocks described by Hutchinson in the Danakil Depression of Ethiopia, and by Bender in Jordan, can be matched by many similar structures in the Gulf of Suez rift.

5. The absence, at the present time, of rocks of Mesozoic age on some of the tilted blocks—especially on the west side of the Gulf of Suez—is due, not to block-faulting and elevation in

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Mesozoic times resulting in non-deposition, but rather to continuous deposition throughout Mesozoic times, followed by the birth of block-faulted structures only in post-Eocene times.

6. Faulting in Oligocene times was accompanied by volcanicity, but no igneous activity occurred in the Gulf of Suez region after the end of Oligocene times.

7. Faulting continued throughout Miocene times, and seems to have been an important controlling factor in the production of the enormous thicknesses of evaporite deposits.

8. Further faulting took place in post-Miocene times, and there is abundant evidence to show that rejuvenation of the pre-Miocene faulted blocks produced flexuring and sometimes faulting in the overlying plastic Miocene deposits.

9. The rift faults in the Gulf of Suez, and on the northwestern side of the Red Sea, as seen in plan, are winding, curving structures, with vertical throws of up to 3 000 m. There is no evidence from mapping that there was any substantial amount of horizontal movement along these faults (one of the writers was able to determine horizontal movement in Wadi Dirba, ESE of Suez, of at most 200 m). Furthermore, the well-established feature of a fault which is involved in a large horizontal movement—as, for example, the Great Glen fault in Scotland and the San Andreas fault in California—is that it is notably straight. The faulting along the Gulf of Suez may appear straight on the much-simplified regional map, but on the scale of 1:25 000 or even 1:100 000 the true pattern—that of curving, bifurcating fractures—can be clearly seen. Field evidence would thus oppose the views expressed by Baker, Abdel-Gawad and others, advocating horizontal movements of many tens of kilometres along the length of the Gulf of Suez.

In our view, the field evidence lends support to the following points:

(*a*) The paucity of dyking and of volcanicity in Oligocene times, and the total absence of any igneous activity from Miocene times onwards, makes it difficult to believe that the Gulf of Suez was undergoing any considerable lateral extension during the great period of post-Eocene rifting. Furthermore, very little lateral extension could be ascribed to the effect of rift faulting, since the dip of the fault planes is invariably high.

(*b*) The absence of long, straight faults in the region, and along the northwestern side of the Red Sea, suggests that wrench faults, if present at all, played only a minor role.

(*c*) The Gulf of Suez, together with that region of the Red Sea lying immediately south-southwest of it, was remarkably isolated from the great movements of shear which some workers consider to have taken place along the Akaba–Dead Sea depression. It follows that: (i) If the Red Sea opened up, as postulated from geophysical evidence, this widening must have been due, among other things, to the rotation of Arabia in an anticlockwise direction; any augmenting clockwise rotation of Africa would surely have opened up the Gulf of Suez. (ii) It is difficult to accept the view that any major NNW to SSE horizontal movements can have occurred along the Red Sea rift since Precambrian times; such fractures would undoubtedly have extended northwards to involve the Gulf of Suez also in horizontal movement. Evidence for this is lacking.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES