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

An Appeal for an Up-To-Date Accurate Tectonic Map of the Red Sea Depression

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An appeal for an up-to-date accurate tectonic map of the Red Sea depression

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(Written contribution received before meeting)

One of the major problems confronting Earth scientists interested in the geology of the Red Sea depression is that there are almost as many versions of the fault pattern as publications.

In producing generalized geological maps and sections some Earth scientists have assumed that the marginal scarps, often wall-like when viewed from the sea, are mainly fault-line or fault scarps, and that faults can be plotted mainly by using topographic data. Drake & Girdler (1964, figure 14), Holmes (1965), Laughton (1965) and others all advocate a fault-bounded Red Sea depression. In doing this basic documents published by surveys and other official bodies, by oil companies, and by individuals familiar with the ground have been either ignored or modified; and as a result a chaotic situation has developed.

Certainly in some places the bounding features are faults, but in many places according to official geological maps, and internationally accepted descriptions, the depression is not completely fault bounded as some geologists and geophysicists would have us believe. The marginal scarps, often highly dissected, are located commonly on downwarps (monoclines) and have developed in response to a subsiding base level of erosion controlled by deep seated convection systems in the mantle which ultimately resulted in separation. In some places as much as 6 km of sediments have accumulated on the downsides, and separation has amounted to about 80 km, the approximate width of the axial trough.†

In the Sudan section of the depression, and at many other localities around the margin, Mesozoic, Tertiary and Quaternary sedimentary rocks rest *non-comformably* on the Basement complex group (Auden 1958; Whiteman 1965, 1968) Sudan; Said (1962), parts of Egypt; and U.S.G.S.–Aramco Geological Maps of Arabian Penninsula 1963, scale 1:2 000 000 and 1:500 000.

Seaward of this contact, both on the land and beneath the sea, there are many proven faults and folds (Said 1962; Mohr 1962, etc.; Carella & Scarpa 1962; Whiteman, in press, 1965*a*, 1968; Knott, Bunce & Chase 1965). Faults predominate, and their combined throws frequently amount to hundreds of metres. Many of the folds are drape structures.

The models advocated by Drake & Girdler (1964, figure 14), Girdler (1965), and Laughton (1965, 1966) in which faults are not shown in the sediments overlying the Basement complex: the Basement itself is shown in a series of fault blocks tilted away from the axial trough, and the sediments are shown as dipping landwards and down faulted against the Basement complex, are geologically unacceptable. The stratigraphic record does not support the sequences of events proposed (Whiteman 1968).

† Since this contribution was written Tramontini & Davies (1969) have suggested that separation at latitude 23° N is greater than 130 km.

Equally unacceptable are the versions of Red Sea geology printed on Geological Map of Africa published by the Association of African Geological Surveys (A.A.G.S.)–Unesco 1963, Scale 1:5 000 000 (Whiteman 1965*b*, pp. 80–86); and the new International Tectonic Map of Africa (I.T.M.A. 1968) published by A.A.G.S.–Unesco 1968, Scale 1:5 000 000 (Whiteman 1969).

I.T.M.A. (1968) now stands with another Unesco backed map 'The structural sketch map of part of the rift zone of Eastern Africa' Scale 1:5 000 000, published in Nairobi 1965 after the Upper Mantle Committee (U.M.C.)–Unesco Meeting, convened specifically for the study of the African rift system. The I.T.M.A. 1968 pattern is markedly different from the U.M.C./ Unesco pattern for the Ethiopian section of the Red Sea depression and students of rift geology find it hard to understand why the U.M.C.–Unesco Map was preferred to a more antiquated and arbitrary version.

Likewise at the northern end of the Red Sea the structural maps produced by Kostandi (1959), Said (1962), Picard (1965) and many other geologists who know the ground intimately have been ignored or modified and another version substituted on I.T.M.A. 1968. Some of the fold axes in northern Sinai, for instance, have been plotted at trends which diverge by as much as 30° from the previously published trends, and many of the Sinai and Suez faults have been left off when, even taking into consideration the scale, they could have been plotted easily.

Marginal to the central part of the depression some 65 % of the faults shown on I.T.M.A. 1968 for the Arabian section of the Afro–Arabian Swell enclosed by the sedimentary Palaeozoic boundary differ either in position, length, or direction from those faults plotted on the U.S.G.S.–Aramco Maps of the Arabian Penninsula 1963.

Much has been written on recent years about the nature and distribution of the Mozambiquian Belt, and other ancient fold systems in Africa, and attention has been drawn to both positive and negative correlations of rift trends and basement structures. I.T.M.A. 1968 shows a new interpretation for a large part of the Sudanese and Ethiopian sides of the Afro–Arabian Swell and the Red Sea Depression; and for Sudan Republic the Mozambiquian pattern has been plotted over about 780 000 km² of Basement Complex. Only two radiometric ages are available for the Sudanese Basement in this vast area (Whiteman 1965; Almond 1967); both were submitted to the coordinators of I.T.M.A. 1968. One of these dates is for the ring dike of the Sabaloka complex, near Khartoum, central Sudan (540 ± 25 Ma); and the other was obtained for a basic dyke at Jebel Hamashaweib, near Mohammed Qôl, Jubal el Bahr el Ahmer (740 ± 80 Ma). No mention of them is made on the map.

As Mozambiquian can only be defined radiometrically then it is misleading to attempt to delimit it without regional radiometric control. Rocks metamorphosed and folded during late Precambrian and early Palaezoic times almost certainly exist in Sudan Republic, but the boundary plotted on I.T.M.A. 1968 has little value, and was not plotted on documents submitted by the writer for Sudan.

If we are to arrive at a comprehensive view of the relations of the rift and fold systems, continental separation, convection systems for the continental plates of Africa and Arabia, then it is essential that data are plotted with as great an accuracy as possible.

I appeal for a new Red Sea structural map, acceptable by geologists, geophysicists and oceanographers, and my suggestions on procedure have been transmitted to the Commission for the Geological Map of the World through the International Union of Geological Scenes.

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