

GEOLOGICAL MAPPING IN EAST AFRICA

P. H. TEMPLE

Introduction

The aim of the present paper is to provide an up-to-date appraisal of the present position of East African geological mapping. Such an exercise may be justified upon a number of grounds. Firstly, there is no cover diagram of East African geological mapping as a whole, and although the various national geological survey departments produce annual status diagrams these are not directly comparable with one another and the total East African picture is lost. Secondly, the rate of production of maps and reports and the progress of basic mapping have been so rapid in the last few years, particularly as a result of the application of aerial survey, that it becomes increasingly difficult to keep abreast of the changes. Thirdly, it is considered that if the present availability of data is made more widely known, more use will be made of, and greater benefit obtained from, the products of the various geological survey departments. This may be most evident in teaching and research work, but may also be important in the wider field of development planning. With these points in mind it has been thought necessary to deal with both primary or basic mapping and with regional compilations. Figure 1 gives an indication of the nature, extent and availability of basic mapping at the present time (April 1965); the paper is concerned with a discussion of the information presented on the map, and with various regional compilations of lesser detail and broader generalisation. No attempt is made to summarize the present state of our geological knowledge of East Africa.

Basic or primary mapping.

Figure 1 shows strong internal contrasts in detailed mapping within the individual East African countries, as well as contrasts between the three countries taken as a whole. These contrasts are presented statistically in Table 1.

It will be seen that Tanzania, with the largest area to map, has also the largest area and the largest proportion of its territory unmapped geologically; Tanzania has, however, carried out more basic mapping than either of the other two countries (approximately 188,400 square miles, more than three times the area covered in Uganda). Kenya is nearest to a complete national coverage and has the largest area of standard-scale mapping. A further feature worthy of note is the large proportion of the area of Uganda with no basic map coverage, although this position is at present rapidly being remedied. Tanzania depends most heavily upon old, non-standard mapping. Although the table is misleading in certain respects, it does thus outline the broad comparisons. The regional differences spring partly from the problems involved, partly from the histories of the various survey departments and their level of financing and staffing at any given time, and partly from the contrasting stimuli of mineral exploitation and government support. These factors raise complex issues which cannot be considered in detail here.

National and regional compilations.

Figure 1 fails to show the availability and range of less detailed geological maps, a field in which all parts of East Africa are well served. The general

TABLE I
 Comparison of regional primary geological mapping
 (All area figures in square miles)

	642,261 Total land area	Unmapped geologically		Standard scale mapping		Unpublished mapping		Older mapping	
		Area	%	Area	%	Area	%	Area	%
Kenya	219,790	48,365	22	79,458	36	82,392	38	9,975	4
Tanzania	342,170	153,736	45	77,177	22.5	87,522	25.5	23,735	7
Uganda	80,301	32,851	41	24,557	30	21,370	27	1,523	2
E. Africa		234,952	37	181,192	28	191,284	30	34,833	5

Source: Areas from *Stateman's Yearbook*, 1964; proportions and areas (approximate) calculated from Figure 1.

GEOLOGICAL MAPPING IN EAST AFRICA

geological map of East Africa (1:2,000,000), produced on behalf of the International Conference in 1952, has recently been superseded by a new map representing the state of knowledge in 1961. This sheet (1:4,000,000), together with an accompanying text, was compiled by E. P. Saggerson of the Kenya Survey Department, and information supplied by the other survey departments for the Eighth Commonwealth Forestry Conference (Russell, 1962). Its most significant departures from the earlier map lie in a clearer representation of the major faults, the recognition in East Tanzania of the Dodoman system, and a vastly improved understanding of the older Pre-Cambrian relationships. Much more detail is shown on eastern Kenya, both in the north and in the south.

On a national level the most adequate map of Kenya is to be found in the *Atlas of Kenya* (2nd. edition, 1962), where a feature of major significance is the distinction between Tertiary and Quaternary volcanics. Tanzania is covered by a 1:2,000,000 sheet published as Part 2 of Memoir 1 (*Summary of the Geology of Tanganyika*, 1960). This map represents a major advance on that published in the *Atlas of Tanganyika* (3rd. edition, 1956) which is essentially a reprint of the 1952 territorial map (*op.cit.*). The Tanzania map is accompanied by a comprehensive and scholarly account (Quennell, McKinlay and Aitken, 1956). Uganda is covered on a scale of 1:1,250,000 (Geological Survey, 1961); the map shows Bouguer gravity contours and an explanation of these is given. Contribution from the respective survey departments have aided the compilation of recent all-Africa maps in addition to the national productions mentioned above, (*Esquisse structurale provisoire de l'Afrique*, 1958. 1:10,000,000).

Maps of special interest.

This category, as it appears in Figure 1, represents a subjective assessment based upon a number of diverse considerations. Attention has been paid not only to mapped areas of special geological or geomorphological interest, but also to the representation of the range of geological conditions existing in East Africa. Only modern maps are included, and the quality and significance of the accompanying information, generally in the form of a report, was taken into consideration. The economic significance and the comparative ease of access were amongst other factors considered in the selection of sheets.

The available maps provide an intriguing introduction to the broad landscape contrasts which East Africa presents. From coastal plain to interior plateau, from volcanic mountain to rifted trough, from arid semi-desert to lacustrine margin, the scenic types are fully represented. In Kenya, attention is drawn to the Malindi area as an example of the coastal sedimentary sequences, which are especially interesting at this point in view of the raised beach deposits; to the Gregory rift around Naivasha and Magadi; and to the Miocene volcanic and sedimentary areas of the Lake Victoria margins south of Kavirondo Gulf. In Tanzania several sheets represent the plateau areas that form most of the country. The Morogoro area is to some degree typical of the eastern zone, with its meridional structural trend, extensive erosion surfaces and inselbergs and old faults. The Geita gold-mining area represents the pediment and tor aspect of the eroded granites of Kilimanjaro. The Mahenge sheet shows the superbly-defined faulted junction of the Pre-Cambrian rocks with a weaker, continental basin of Karroo sediments. Fault structures are also clearly shown on the Lushoto and Lake Jupe sheets, where they have defined

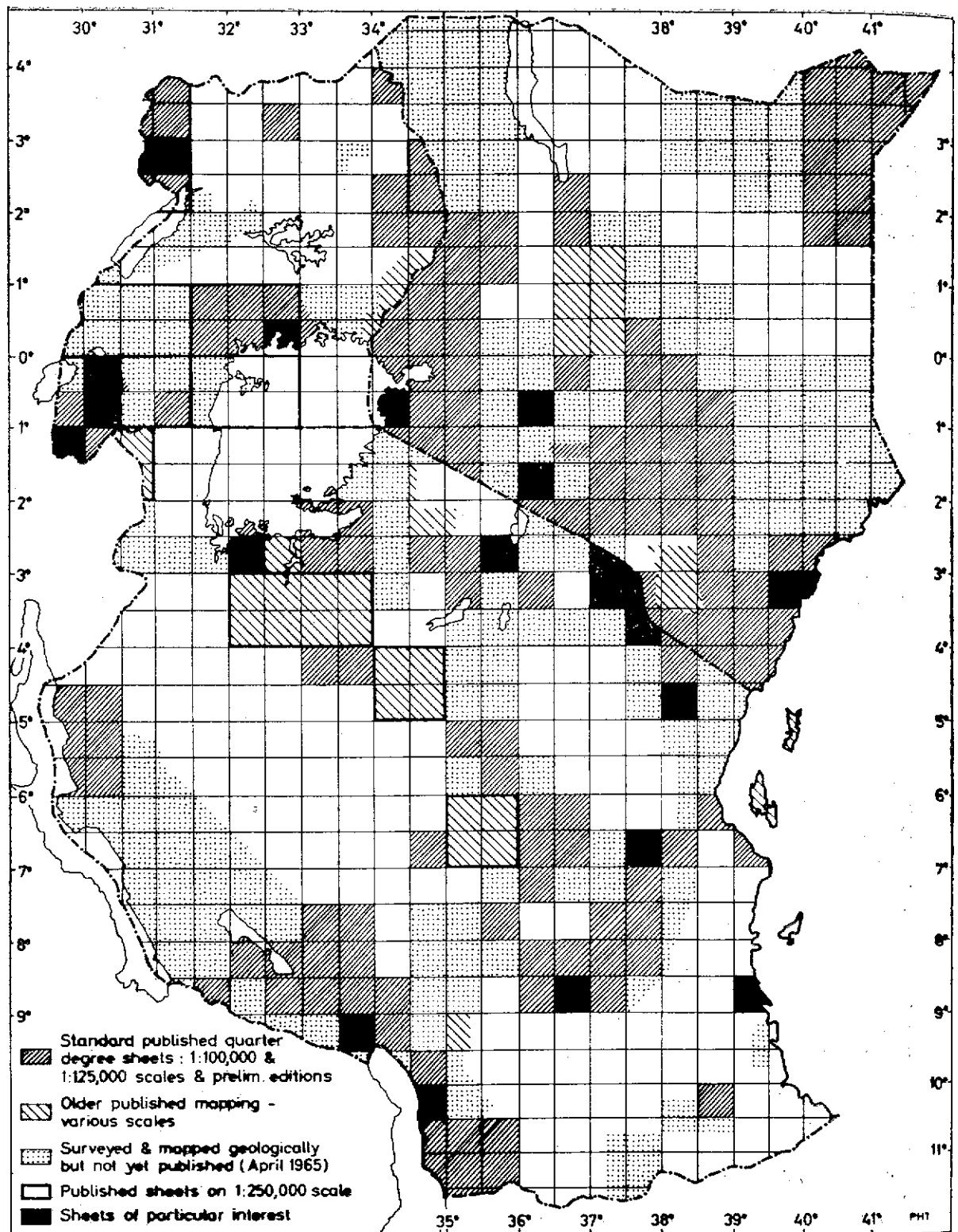


Figure 1. A status map of East African primary or basic mapping at April 1965. (Information supplied by the national Geological Survey Departments, Note: Tanzania standard scale mapping is made up of both Preliminary and Standard productions).

GEOLOGICAL MAPPING IN EAST AFRICA

and initiated block mountains. The Karroo sedimentary rocks are most important economically in the Manda area which incorporates East Africa's most important coalfields. The break-down from the plateau to the coast is indicated on the Kilwa sheet, and the later volcanic history of the eastern rift is exemplified on three magnificent sheets: the Tukuyu sheet covers the Rungwe and Poroto volcanics north of Lake Nyasa (Harkin, 1960); the Angata Salei sheet shows the southern end of Lake Natron, the Embagai caldera, Kerimasi and the still active Oldoinyo Lengai; and the Kilimanjaro sheet, covering the highest point in the African continent. From Uganda, the inverted relief of coastal Buganda is chosen (the Kampala — South Kyagwe area); whilst the northern Congo watershed, with its partly-faulted, partly-warped surfaces, and the fault-controlled Albert Nile represent landscapes of great contrast. The south-west of Uganda is well-represented: the Bushenyi area includes part of the arena country of Ankole, with its unroofed granite domes intruded into Karagwe-Ankolean phyllites; and the Buhweju area shows the breakdown of this plateau surface, across a large area of explosion craters, to the Lake George flats of the western rift. The far south-west of Uganda, an area of high warped plateaus, lakes dammed by volcanic activity, reversed rivers and the volcanic mountains of the Mufumbiro completes the series of selected sheets, full details of which are listed below.

Conclusion.

The state of geological mapping as described above represents to some degree the achievement of the national geological survey departments. It is a story of great scientific and economic interest. Although it is difficult to agree unreservedly with Dixey's attestation that "the status and effectiveness of a geological survey, and of the importance attached to it by the administration, is at once revealed by the rate of issue of geological sheets and the total extent of country covered by them" (1963, 55), it must nevertheless be said that in East Africa the effectiveness of the surveys can be readily appreciated from their mapping. This is not only a question of extent and speed of production; it is also a question of high quality. In view of this final consideration, the more widely the products of the surveys are used, the better.

Acknowledgement. The author wishes to acknowledge his indebtedness to the Geological Survey Departments of Kenya, Tanzania and Uganda who kindly provided most of the information incorporated in this paper. Any errors or misrepresentations which may remain are, however, entirely the responsibility of the author.

References.

- Dixey, F., 1963 'Geology, applied geology (mineral resources) and geophysics in Africa', in *A review of the natural resources of the African continent*, U.N.E.S.C.O., 51-100. (Includes a full bibliography of local work, regional maps and general surveys).
- Harkin, D. A., 1960. *The Rungwe volcanics at the northern end of Lake Nyasa*. Geol. Surv. Tanganyika, Memoir No. 2.
- Saggerson, E. P., 1962. 'The geology of East Africa', in Russell, E.W., (Ed.) *The natural resources of East Africa*, 52-66.
- Quennell, A. M., McKinlay, A. C. M., & Aitken, W. G., 1956. *Summary of the geology of Tanganyika*. (Part 1, Introduction and Stratigraphy). Geol. Surv. Tanganyika, Memoir No. 1.

*Maps discussed.**General*

- Esquisse structurale provisoire de l'Afrique, 1958. 1:10,000,000. Coloured. Association des Services Géologiques Africains, Int. Geol. Congr. Paris: Michaud.

EAST AFRICAN GEOGRAPHICAL REVIEW

Geological map of East Africa, 1952. 1:2,000,000. Coloured. Geol. Surv. Tanganyika. Prepared on behalf of the Interterritorial Conference, 1952. Dar es Salaam: Govt. Printer, 1954.

Geological map of East Africa, 1961. 1:4,000,000. Coloured. Directorate of Overseas Surveys. Accompanying *The natural resources of East Africa*, handbook produced for the Eighth Commonwealth Forestry Conference, 1962. Nairobi: East African Literature Bureau.

Kenya

Geological map of Kenya, 1961. 1:3,000,000. Coloured Geol. Surv. Kenya. In *Atlas of Kenya*, 2nd. edition, 1962.

Basic mapping on the scale of 1:125,000. Sheets of special interest: *Malindi*, 1956 (Report No. 36); *Magadi*, 1958 (Report No. 42); *Gwasi*, 1958 (Report No. 45); *Naivasha*, 1963 (Report No. 55).

Tanzania

Geological map of Tanganyika, 1959. 1:2,000,000. Coloured. Geol. Surv. Tanganyika. Memoir No. 1, *Summary of the geology of Tanganyika*, 1960, pt. 2.

Basic mapping on the scale of 1:125,000. Sheets of special interest: *Geita*, 1961 (Quarter degree sheet No. 32); *Angata Salei*, 1961 (39); *Kilimanjaro*, 1965 (42, 56 and 57); *North Pare*, 1962 (73); *Lushoto*, 1963 (109); *Morogoro*, 1961 (183); *Mahenge*, 1962 (251); *Kilwa*, 1963 (256); *Tukuyu*, 1957 (259); *Manda*, 1957 (285).

Uganda

Geological map of Uganda, 1961. 1:1,250,000. Coloured. (Also with Bouguer gravity contours and explanation). Geol. Surv. Uganda.

Basic mapping on the scales of 1:100,000 and 1:250,000. Sheets of special interest: *Okollo*, 1964 (Quarter degree sheet Nos. 19 & 20); *Kampala*, 1958 (71); *Buhweju*, 1959 (76); *Bushenyi*, 1963 (85); *Kabale*, 1965 (93).

The above maps are obtainable as follows: Ministry of Industries, Mineral Resources and Power, Geological Survey Division, P.O. Box 903, Dodoma, Tanzania (for Tanzania sheets); Ministry of Natural Resources, Mines and Geological Department, P.O. Box 30009, Nairobi (for Kenya sheets); The Commissioner, Geological Survey Department, P.O. Box 9, Entebbe, Uganda (for Uganda sheets).