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Obsidians from the Melka-Konture Prehistoric Site, Ethiopia

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(with chemical analyses by J. H. Scoon[a])

Obsidian artifacts from the Melka-Konture site about 50 km south of Addis Ababa span the period from Oldowan to Late Stone age. A number of specimens from different levels have been examined petrographically and for their chemical compositions. All prove to be alkali rhyolite obsidians of virtually identical composition and petrographic character, differing only in degree of devitrification and hydration. They belong to Group 1g of Renfrew *et al.* (1966) and it is almost certain that their source is the nearby obsidian quarry at Baltchit. This seems to have been opened in a short flow which appears to be unrelated to the large extinct Recent volcano, Wachacha, which lies to the north-west.

Introduction

The prehistoric site of Melka-Konture (Figure 1) lies on the banks of the river Awash about 50 km south of Addis Ababa. It spans the period from the Oldowan to the Late Stone Age and extends for some 12 km in length and up to 4 km in width. A continuous sequence of stone industries has been found at sites in this region. In the earlier levels materials used are mainly basalt with some obsidian, but in later sites the artifacts are nearly all made from obsidian. The obsidian samples whose petrographic features and major trace element compositions are reported here come from all the principal types of site mentioned below where excavations have been carried out.

Geology of the Area

The Upper Awash valley lies at an altitude of some 2000 m and it is separated from the Middle valley by deep gorges. Melka-Konture is located between the Upper and Middle valleys and an important fault limits the site in its south-eastern part. This fault brings into juxtaposition Quaternary sediments with a Tertiary trachybasalt volcanic series (Trap series) which is well exposed in the gorges. In the graben of Melka-Konture which is situated at the western margin of the Ethiopian rift, four main Quaternary sedimentary cycles have been recognized by Taieb (1974). From oldest to youngest these are: Gomborian, Garbian, Tabellian and the fourth is Holocene. The three earlier cycles are named from the gullies where they are exposed. The deposits of these cycles are of three kinds: (a) fluviolacustrine; sands and clays deposited by the Awash river;

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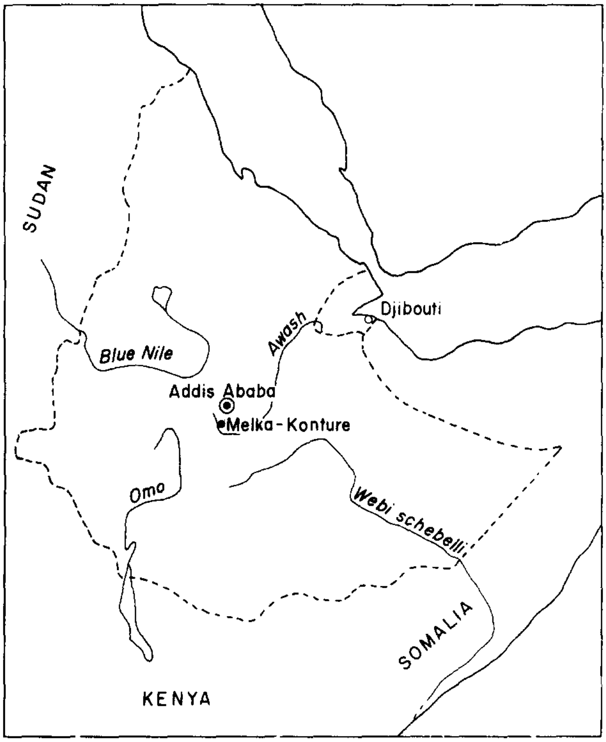

Figure 1. Sketch map showing the location of Melka-Konture.

(b) volcanic; mainly cinderitic tuffs deposited in calm water and mixed with clays, ignimbrites and pumices, all testifying to continuing volcanic activity during different periods of the Quaternary:
(c) slope deposits; these are very common during the latter part of the Pleistocene. A brown or black "cotton soil" covers most of these deposits. Chavaillon (1973) who has directed the excavations at Melka-Konture since 1965 has recognized seven periods which correspond to the main stratigraphical phases. Period 1 is represented by base formations that continue beneath the present river level. These contain four archaeological layers, the type site of which is *Gombore I–B*. Period 2 is heralded by erosion affecting formations of period 1. The clay layers were cut and covered by sand and gravel alluvial deposits. Four archaeological horizons are recognized. Period 3 is marked by further erosion which partly destroyed previous deposits and the geological formations of this period are interlocked with those of period 2. A tuff layer marks the top of this period which contains six archaeological layers. Period 4 is marked by erosion of the tuff and underlying sands. Then follow several sedimentary phases separated by volcanic episodes. Six archaeological layers belong to this period: *Gombore II* is the type site for the beginning and *Garba I–B* that for the end of this period. Period 5 is one beginning with further erosion which removed some of the latest strata of period 4 with which period 5 deposits are interlocked. Five occupation layers are recognized and the type site is *Wofi III*. Period 6 is marked not by further erosion but by the major Melka-Konture fault whose throw is more than 20 m. Three archaeological layers belong to this period. Period 7 is marked by further erosion which produced gullies in the upper strata of period 6; these were succeeded by the deposition of a vertisol or "black cotton soil" which contains two archaeological layers and *Kella* is the type site. At the end of this

period a further gully-cutting erosional phase occurs (15–20 m) producing the present topography. Belonging to this period is the site at *Baltchit.*

Prehistory—the Archaeological Sites (Figure 2)

Gombore I–B

This is an Oldowan living-floor on which the principal characteristic artifacts are intentionally broken pebbles, pebble tools, choppers, polyhedrons and thick scrapers. A structure has been found that might represent a wind shelter. The natural materials used are mainly basalt with minor obsidian.

Gombore II

This appears to be an early phase of the Acheulean. Obsidian as a raw material is found more frequently, and the main tools present are handaxes and a few cleavers as well as end-scrapers, borers and notched tools.

Garba I–B

This belongs to the Upper Acheulean; it contains evolved forms of handaxes, a great number of cleavers and numerous bolas, while choppers and polyhedrons are almost non-existent. The proportion of obsidian used is greater than in the two previous sites.

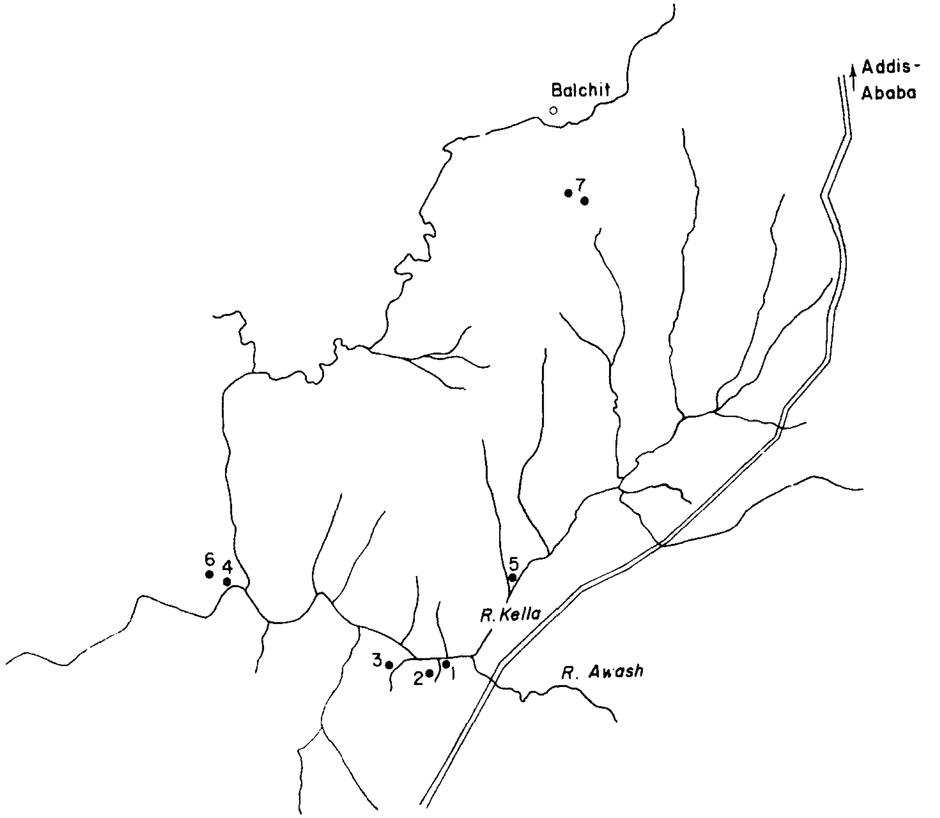

Figure 2. Archaeological sites in the area of Melka-Konture.
1. Gombore I–B; 2. Gombore II; 3. Garba I–B; 4. Wofi II; 5. Kella; 6. Wofi III; 7. Baltchit.

Wofi II

This is a Middle Stone Age site, characterized by the use of obsidian as the predominant raw material. The industry is mainly of flakes and is complex and evolved, with beautiful points, side scrapers and little bifacial pieces. There are also some very well made hand-axes and a few cleavers (Hours, 1971).

Kella

Kella is a Late Stone Age site where the artifacts are made entirely of obsidian. The most characteristic tools are end-scrapers, burins, backed blades, notches and truncated pieces. No geometric microliths have been found but a few potsherds, mainly plain, have been recovered (Hivernel-Guerre, 1971). An artifact of this layer has been analysed as well as a pebble of obsidian coming from a layer immediately below the archaeological layer.

Wofi III

Wofi III is also a Late Stone Age site but no archaeological layer *in situ* has yet been found. The artifacts come from erosion of the black cotton soil in which they were embedded. The industry, probably later than that at Kella, is characterized by beautiful pyramidal cores, blades and scrapers. Grinding equipment and pottery are associated.

Baltchit

This site has not yet been studied in detail but it is striking because of the presence of mounds of obsidian debitage up to 30 m in diameter and a metre high. Some of the blades recovered measure up to 25 cm in length; tools represented are limited to end-scrapers and notched and denticulated pieces. It is likely that this site is very recent for up to a few years ago local inhabitants were trading this obsidian to scrape hides. Close to this site an obsidian quarry has been found.

Petrology of the Obsidians

These sections were cut from ten of the specimens, two were analysed chemically and trace element determinations were carried out on nine to check whether they form a homogeneous group which would identify the presumed source as the quarry at Baltchit. All the specimens examined proved to be very similar petrographically; they are pale grey glasses in the thinnest chips and all are high quality obsidians. The freshest material comes from the Baltchit quarry but even this shows some signs of the earliest stages of devitrification and hydration. This obsidian contains much less than 1% of crystalline material nearly all of which is in the form of microlites of anorthoclase.

The refractive index of the glass varies slightly within the range $n = 1{\cdot}482$–$1{\cdot}488$ presumably due to slightly differing degrees of hydration. Most of the anorthoclase occurs as curved strings of traichytes arranged along perlitic cracks that converge on individual centres of devitrification spaced at intervals of some 100 μm. There are in addition some larger microlites which appear to represent early-formed crystals elongated parallel to the direction of flow. This suggests that the quarry was opened in a short flow. Also present are a few microphenocrysts of anorthoclase with characteristic twinning, a few of an iron-rich, greenish-brown amphibole and a few minute octahedra of magnetite.

The other specimens sectioned reveal somewhat more advanced stages of devitrification; that from Kella has a well banded structure and in its more devitrified parts cristobalite can be identified in places. There are a few vesicles also in this specimen as well as signs of slight oxidation, visible as a local reddening of the glass. In all specimens except that from Wofi the refractive index of the glass lies in the range $n = 1{\cdot}475$–$1{\cdot}485$, presumably due to slightly higher degrees of hydration compared with that of the fresh

Table 1. Analyses and CIPW norms of obsidians from Melka-Konture

	Analyses 1.	Analyses 2.		Norms 1.	Norms 2.
SiO_2	74·95	75·07	Qz	29·68	29·77
Al_2O_3	13·21	13·22	Or	29·51	29·51
Fe_2O_3	0·53	0·51	Ab	35·68	35·68
FeO	0·78	0·86	An	2·24	2·24
MnO	0·04	0·04	Di	0·86	0·89
MgO	0·15	0·16	Hy	0·36	0·42
CaO	0·63	0·66	Mt	0·70	0·70
Na_2O	4·23	4·23	Il	0·46	0·48
K_2O	4·93	4·93	*Rest*	0·14	0·11
H_2O+	0·11	0·09			
H_2O-	nil	nil		99·63	99·80
TiO_2	0·19	0·20			
P_2O_5	0·03	0·02			
	99·78	99·99			

1. Alkali rhyolite obsidian, quarry Baltchit.
2. Alkali rhyolite obsidian, artifact Wofi III, Middle Stone Age site.
Analyst J. H. Scoon.

glass at Baltchit quarry. Many of the specimens display flow structures, most contain the amphibole and all exhibit the characteristic early devitrification structure described in the Baltchit quarry specimen.

To identify the chemical characters of the obsidians, Mr J. H. Scoon very kindly carried out wet chemical analyses of two specimens. One came from Baltchit quarry, the other was the artifact from Wofi III. Analyses and CIPW norms are set down in Table 1. The two analyses are virtually duplicates and show that the obsidians are hypersthene-normative alkali rhyolites with nearly 30% of normative quartz (Nockolds, 1954).

Renfrew *et al.* (1966) have demonstrated that obsidian types and their Middle East sources can be most readily identified by trace element analysis and that a Ba–Zr plot is particularly distinctive. Trace element contents of nine specimens, including the two reported in Table 1, were kindly determined by Mr R. S. Allen with the Hilger-Littrow

Table 2. Trace element data on Ethiopian obsidians

BAG	1	2		3		4		5	
Spec. No.		68	69	68	65	69	HOF III	69	1727
Ba	600	550	570	600	620	570	600	620	600
Ga	15	15	18	15	18	18	15	18	15
La	80	95	80	80	80	80	80	80	80
Li	45	40	45	45	35	45	40	45	45
Mo	12	10	10	12	12	12	10	12	12
Nb	55	60	60	55	55	60	65	60	60
Pb	20	20	18	20	20	20	18	20	20
Rb	150	150	150	135	150	135	135	150	150
Sr	80	80	80	80	70	80	80	80	80
Y	40	40	40	35	40	40	40	40	40
Zr	250	230	230	270	230	250	230	250	230
V	7	7	10	7	7	7	7	7	7

All values parts/million.
1. Baltchit quarry (Table 1, no. 1); 2. Kella; 3. Kella; 4. Wofi III (Table 1 no. 2); 5. Gombore Ib.

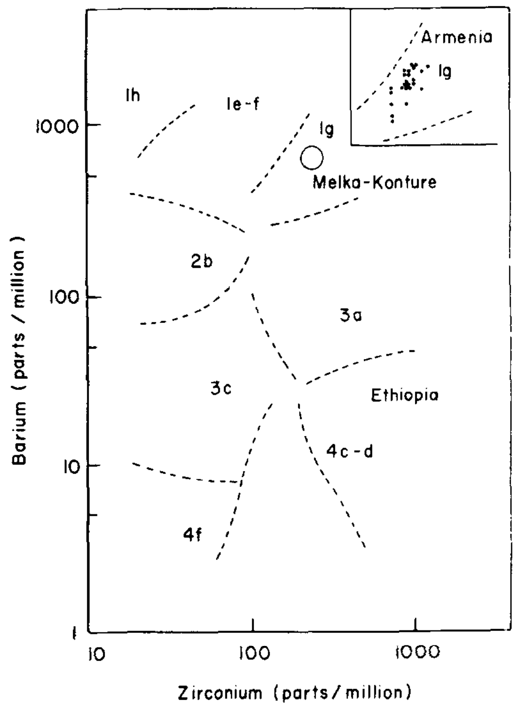

Figure 3. Renfrew, Dixon & Cann's (1966) classification of Mediterranean and Middle East obsidian types on the basis of their barium and zirconium contents. Note that the Melka-Konture obsidians plot in field 1g. All the points represented by analyses in Table 2 plot within the encircled field. Inset (for comparison) scatter field of Armenian presumed single-source type 1g obsidians. All previously analysed Ethiopian obsidian artifacts belong to type 4d.

optical spectrograph in the Department of Mineralogy and Petrology, Cambridge. These analyses are set down in Table 2. Again all are very similar within the limits of error and the results show that the obsidians belong to Group 1g of Renfrew *et al.* (1966) on the basis of the Ba–Zr plot (Figure 3). They also have the low Sr and high Fe/Mg ratios which are characteristic of this group. However, it should be noted that all the Group 1 obsidians described by these authors are calc-alkaline in character, and that those of Group 1g are restricted to widely distributed artifacts found in the Levant and southern Turkey. They form a coherent geochemical group and are believed to be derived from a single presently unidentified source in Armenia. The Melka-Konture obsidians however are alkaline obsidians; they cannot be distinguished from calc-alkaline types by their refractive index but they can be recognized by the presence of anorthoclase and by their much lower total iron, calcium and magnesium contents. At the present time the Melka-Konture obsidian seems to represent a unique Ethiopian source, for all previously reported Ethiopian obsidians belong to Group 4d (Cann & Renfrew, 1964).

At one stage it was thought that the Melka-Konture obsidians might be derived from the Mt. Wachacha volcanic centre which lies about 25 km north of Melka-Konture and 12 km north of Baltchit. This volcano has been dated as 4·5 my. (Miller & Mohr, 1966) but no obsidians have been reported from it. The volcano seems to be built predominantly of porphyritic sanidine trachyte, abundant breccias and crystal tuffs of trachytic composition, and minor carbonatite. Subsequent examination of the trachyte specimens investigated by Miller & Mohr reveals them to have a per-alkaline character. Hence it would appear that the Late Quarternary volcanic activity at Baltchit that produced the obsidians found at Melka-Konture is likely to have been independent of the Wachacha centre.

We believe that all the artifacts were derived from the Baltchit quarry source although it is possible that some may have come from other small but related outcrops of obsidian that have been found in the beds of some of the tributaries of the river Awash. Unfortunately no specimens from these sources were available to us for examination.

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