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New human teeth from Middle Stone Age deposits at Klasies River, South Africa

Since 1984, the main site at Klasies River has been re-investigated. Human remains, animal bones and stone artefacts have been collected from the LBS, SAS and other stratigraphic members, and these discoveries help to establish the antiquity of anatomically nearmodern populations practicing a Middle Stone Age way of life on the southern coast of Africa. Several teeth found in the lower SAS levels in 1989–1991 can be matched in recent South African populations. Two complete upper molars representing one individual have crowns that are relatively short mesiodistally. These specimens are small in comparison to black South African homologues, but MD and BL dimensions fall close to the averages for San burials. This evidence confirms that several of the Klasies individuals have very small molars, while others have cheek teeth that are close to the upper limits for size variation in recent Africans. The new material is in keeping with the view that sex dimorphism within this Middle Stone Age population may be pronounced.

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The Klasies River main site is situated on the southern coast of South Africa, between Plettenberg Bay and Cape St Francis (Figure 1). In 1967-1968, over two field seasons, deposits associated with these caves were investigated initially by Singer & (1982). Through Wymer large-scale excavations, they established that human occupation had begun early in the Late Pleistocene. They were able to outline the stratigraphy and Middle Stone Age cultural succession, and they discussed the significance of shell and animal bones, human remains and artefact assemblages. Since 1984 and following extensive collapse of the standing sections, a program of rehabilitation and re-investigation of the site has continued under the direction of H. J. Deacon. New excavations, purposely on a limited scale, have been designed to obtain additional samples for dating, to clarify the context of the human and other remains, and to improve understanding of the behavior of the Middle Stone Age inhabitants (Deacon, 1995, 2001; Deacon & Wurz, 2001). As a result, there is now more precision in the dating of the deposits (Deacon et al., 1988), the sedimentology of the site is better known (Deacon & Geleijnse, 1988), and the culture history has been clarified (Wurz, 2000). It has been established that the main site is a single depository in the lee of a cliff rather than the result of a series of occupations in different caves and shelters. The named caves like 1, 1A, 1B and 2 are simply different areas within the same depository. Occupation began with the regression of sea levels after the maximum transgression of the Last Interglacial (marine isotope stage 5e). This puts a terminus post quem on the age of the material. The infilling of the site took place





Figure 1. Outline map of South Africa, showing the locations of sites mentioned in the text.

in a number of pulses, and the deposits have been divided into a sequence of members. The oldest (LBS) levels, dating to some 110,000 years and containing hearths, shell and bone food waste and artefacts, have yielded two fragmentary human maxillae. The overlying (SAS) member, from which most of the other human bones have been recovered, is associated with dates in excess of 90,000 years (Grün *et al.*, 1990; Deacon, 1995). The RF and Upper members complete the sequence. The depository was effectively full about 60,000 years ago.

Human remains collected during the 1967–1968 excavations at main site have been described by Singer & Wymer (1982), who suggest that the material (particularly mandibles and teeth) can be sorted into two groups by size. One group is characterized as rather "primitive" or "rugged" in appearance, while the other, relatively "gracile" people are said to be more akin to recent Africans. However, consideration of all the

evidence now indicates that a single sexually dimorphic population, rather than two different groups, inhabited the caves episodically over thousands of years (Rightmire & Deacon, 1991; Bräuer et al., 1992). A key finding is that bones of essentially modern aspect are associated with early Late Pleistocene Middle Stone Age artefacts. The morphology of the Klasies inhabitants can be documented from teeth, several partial mandibles along with one more complete lower jaw (Lam et al., 1996), cranial fragments (Smith, 1992; Grine et al., 1998), the proximal portion of an ulna (Churchill et al., 1996) and the few other postcranial remains unearthed as of 1989. In the course of more recent excavations, several additional teeth have been recovered, along with postcranial bones. In view of the scarcity and importance of human material found unequivocally in Middle Stone Age contexts, attributes of the teeth are put on record here. The postcranial specimens will be detailed separately.



Figure 2. Stratigraphy of Klasies River main site, witness baulk west face section. Numbers in brackets are the approximate equivalents of the layers recognized by Singer & Wymer (1982). The teeth described in this report, along with other human remains, were recovered from the lower part of the SAS U sub-member.

Stratigraphy of cave 1 and provenience of the new finds

Almost all of the 1967-1968 human material was collected from the large excavations in cave 1. These finds were recorded as coming from different stratigraphic layers, although they cluster towards the front of the excavated area (Singer & Wymer, 1982: Figures 3.20-3.24). Some of the relevant layers (Layers 15 and 14) are talus slope deposits that eventually led to the blocking off of the entrance to cave 1. The strata underlying these layers are primary occupation deposits as evidenced by the preservation of hearths (Figure 2). It is improbable that spatial clustering of a low frequency class of finds like human remains would be apparent if they accumulated in such very different depositional environments. Clustering is a more likely result of the remains occurring instead within the same layer, perhaps as a consequence of a single depositional event. On this reasoning, the stratigraphic positioning of the 1967-1968 finds has been reassessed.

There are grounds to suggest that some facies changes between clast-supported and

matrix-supported sediments, the product of the elutriation of fines by ground waters draining through the deposit, were originally given unwarranted stratigraphic significance. An example can be seen in a published section (Singer & Wymer, 1982: Figure 3.3) that shows Layer 14, a clastsupported rubble, as both overlying and underlying Layer 15 and as the lateral equivalent of Layer 17. Thus, although the gross stratigraphic divisions recognized in cave 1 have validity, in detail anomalies have arisen through correlation of some clastsupported facies with Layer 14 when they are not related to that layer. The implication of not adequately resolving the details of facies changes in an admittedly complex condensed sequence is that some of the stratigraphic designations given to the 1967-1968 human remains in cave 1 can be encourages questioned. This thinking that the specimens came from one rather than several different layers. In effect, this reassessment would make the finds about the same age.

The 1967–1968 excavations removed most of the deposits from cave 1 but left in

place a central witness baulk. The more recent recovery of an ulna in the SAS deposits on the upslope side of cave 1 in a stratigraphic position that is correlated with the SAS U sub-member of the witness baulk section (the approximate equivalent of Layer 16 of Singer & Wymer, 1982) suggested that this might be the horizon from which most, if not all, the earlier finds came. However, in another cutting of the original cave 1 excavation, it was established that there is a midden horizon at the base of the underlying LBS member that includes human remains. To accommodate this observation, it is now postulated that there were a number of discrete episodes during which human bones accumulated and that these relics are not randomly dispersed through the deposits.

An excavation 1.5 m by 1.5 m in extent inthe witness baulk was designed to test whether the 1967-1968 sample of human remains might have come from the SAS U sub-member. In the course of this 1989-1991 excavation, a partial tooth crown, an anterior tooth and two upper molars were collected from the SMB (shell-middenbase) unit of the SAS U sub-member. It is probable that the adult anterior tooth belongs with the permanent molars, which represent one individual. These materials were found in close proximity. Only a single human phalanx was recovered from the considerable volume of the overlying SAS W (Layer 15) talus deposits intersected by the excavation, and this bone relates to an horizon higher in the sequence. Deposits of the SAS R sub-member (Layer 14), the main clast-supported rubble horizon of Singer & Wymer (1982), were absent in the excavated area and could not be sampled. The provenience of the human finds is thus beyond question, and dating of the lower SAS deposits is well established at ca. 100,000 years. From a taphonomic perspective, it is significant that the teeth occur with other human bones in the same part of the SAS U

horizon, as it is around this area that the 1967–1968 finds were clustered. These fragmentary earlier specimens include the broken and cut-marked frontal (KRM 16425), the temporal fragment described by Grine *et al.* (1998), several partial jaws, and postcranial elements. The new excavation provides strong evidence that, apart from the older remains in the LBS member, the majority of the cave 1 finds have come from the SAS U horizon and may be drawn from a small number of individuals, dismembered and scattered as a result of an episode of cannibalism (White, 1987; Deacon, 1993; Deacon & Wurz, 2001).

Anatomical descriptions

Square 01/C1, sub-member SAS U, unit SMB

This fragment of tooth crown retains a small portion of the root, broken just below the cervix. Only about one third of the crown itself is preserved. The occlusal aspect is worn, and some dentine is exposed inside the enamel margin. Surface details are mostly obliterated, but one wall presents a clear interproximal contact facet. The specimen is probably a lower molar and is likely on size considerations to be deciduous. It is viewed here as a dm_2 from the right side.

Square A2/1, sub-member SAS U, unit SMB The crown of this anterior tooth is worn almost to the level of the arches of the enamel line. The root is complete. It is slightly inclined lingually, and both its mesial and distal surfaces carry faint longitudinal grooves. The apex of the root is tilted (distally) relative to its long axis. Any identification of this specimen must be considered tentative, but overall proportions of the root and other features are in keeping with the morphology expected in a permanent upper lateral incisor. Although occlusal wear is extreme, the tooth may belong to the



Figure 3. Occlusal views of the 1989–1991 Klasies River left upper molar teeth. The crown of the M^2 (to the left) is ovoid in form, and much dentine is exposed on its mesial half. Interproximal contact facets are strongly developed. For the M^3 , more of the enamel cap is present, and the fissure pattern is partially preserved. Scale in cm.

same individual as is represented by the two upper molars.

Square A2/3, sub-member SAS U, unit SMB This M^2 from the left side makes secure contact distally with the M³ (described below), and it is clear that both are drawn from the same tooth row. The crown is compressed, so that in occlusal view it takes the shape of an oval, elongated buccolingually (Figure 3). This outline is irregular because of interproximal contact facets. The mesial facet is the larger of the two, and here the enamel is especially thin. The occlusal surface is heavily worn, and height of the crown has been substantially reduced. Dentine is exposed at the mesiobuccal cusp and also at the position of the mesiolingual protocone, where the surface is more deeply excavated. Distally, more of the enamel cap is present, and a little of the enamel covering the metacone remains. This cusp is flattened and displays a small perforation just inside the occlussal margin, at the distobuccal corner of the crown. Only a trace of the buccal groove can be followed centrally, and the trigon basin is not preserved. The roots are short and stout, and little separation of the





Figure 4. Mesial (upper) and distal (lower) views of the Klasies River left upper molar teeth. The roots of the M^2 (to the left) are relatively short, and the root complex tapers to a single apex. In the case of the M^3 , divisions of the root system are marked only by shallow vertical grooves. Scale in cm.

buccal and lingual elements is apparent (Figure 4). The entire root complex is flattened mesiodistally and tapers to a single apex, tipped slightly posteriorly. Length as measured distally from the cervix to the common apex is 13.7 mm.

On the mesial aspect of this tooth, a distinct groove is present just above the contact facet. This groove is parallel to the occlusal plane. Under low magnification, fine striations can be discerned along the length of its floor. These marks suggest abrasion caused by probing and/or cleaning of the interproximal space with a pick, or stripping through the teeth of some flexible material such as sinew. Examples of interproximal grooving thought to be a consequence of such activities have been reported for various populations including North American Indians (Ubelaker et al., 1969), Upper Paleolithic remains European (Formicola, 1988) and pre-contemporary Australian Aboriginals (Brown & Molnar, 1990). A similar structure, located a bit more superiorly, occurs also in the case of one of the upper molars from Equus Cave, South Africa (Grine & Klein, 1985). Recently, Grine et al. (2000) have described fine horizontal interproximal scratches, but no grooves, on two upper premolars from Blombos Cave, situated on the Cape coast west of Klasies River.

Square A1/4, sub-member SAS U, unit SMB This M^3 is intact, and the crown exhibits moderate attrition. Its occlusal aspect, rather mesiodistally compressed, is ovoid in form. Enough of the fissure system is present to outline a large (mesiolingual) protocone, a prominent mesiobuccal cusp, and a smaller metacone. The hypocone is much reduced in size, and no Carabelli's trait is expressed. Cusp surfaces are flattened, and the enamel of the paracone shows a tiny perforation to the dentine below. The buccal groove can be traced from the occlusal margin to the trigon basin, but this feature, like the lingual groove, has been reduced by wear to a faint incision.

There is a small facet on the mesial face of the crown, resulting from interproximal contact with the M^2 . Here the enamel has been thinned. The roots are relatively short. Two buccal elements can be distinguished, but these are fused throughout their lengths. This (buccal) complex is closely applied to the large lingual root. Divisions of the root system are marked only by shallow vertical Table 1 Length and breadth dimensions (mm) for the M^2 from Klasies River and modern African populations

	n	Ā	S.D.	Range
MD length				
KRM A2/3		(7.8)*		_
SA black males ⁺	303	10.3	0.71	8.6-12.6
SA black females ⁺	99	10.0	0.62	8.6-11.9
San (unsexed)‡	30	9.7	_	—
BL width				
KRM A2/3	_	11.7		
SA black males ⁺	303	11.9	0.69	10.2 - 14.6
SA black females ⁺	99	11.5	0.67	9.8–13.9
San (unsexed)‡	30	10.6	_	

*() indicates that only an estimate can be provided, as the tooth shows extensive interproximal wear. A precise measurement of MD length cannot be obtained.

†Averages and measures of variation for South African blacks are taken from Jacobson (1982).

‡Averages for San burials from Colesburg are taken from Drennan (1929).

grooves, and all three elements end superiorly at a common apex. Length measured distally is 13.6 mm.

Comparisons

The crowns of the two upper molar teeth can be measured, and dimensions are given in Tables 1 and 2. It is apparent that the Klasies M² is small mesiodistally in relation to its breadth. This is partly a function of interproximal wear, which is quite pronounced. As much as 0.5 mm should be added to the value for MD length, but even this "corrected" figure of 8.3 mm is low in comparison to the means for modern South African populations. The BL diameter of 11.7 mm falls between the averages for black males and females reported by Jacobson (1982). The Klasies crown is thus relatively short (rather than small in both dimensions), and this compression is not due entirely to interproximal attrition. These size relationships are illustrated in Figure 5, where sample means and ranges $(\bar{X} \pm 2 s)$ estimated for the modern blacks are plotted.

Ā S.D. n Range MD length 7.6**KRM A1/4** 9.2 0.736.3-11.0 SA black males* 265 0.96 SA black females* 8.8 $4 \cdot 4 - 10 \cdot 3$ 81 San (unsexed)[†] 26 8.2 BL width **KRM A1/4** 10.50.789.1-14.3 SA black males* 265 11.6SA black females* $4 \cdot 7 - 12 \cdot 7$ 81 10.81.13San (unsexed)† 26 10.3

*Averages and measures of variation for South African blacks are taken from Jacobson (1982).

†Averages for San burials from Colesburg are taken from Drennan (1929).

KRM A2/3 lies below the 95% limits expected for MD length but well within the ranges established for BL breadth.

The M^3 crown shows less severe interproximal wear but is again reduced in length. Its MD diameter is below the averages for blacks of both sexes but is included in the range calculated for females. Buccolingual breadth is close to the mean for females, and in this dimension the specimen also lies within the 95% limits estimated for the males. The Klasies tooth is rather small, but not exceptional, in its proportions in comparison to modern black South Africans.

Much the same conclusion holds when the fossils are compared to recent San. The dentitions of individuals "reputed to be Bushmen" recovered from a cemetery at the Karoo town of Colesberg have been described by Drennan (1929). There is some doubt concerning the ethnic identification of these burials, and in fact skeletons reliably documented as San or Khoi are very scarce (see discussion in Morris, 1986). Despite this uncertainty, Drennan's measurements are given in the Tables. In its MD diameter, the Klasies M^2 is small in

respect to the San average, but the difference is less than in the case of blacks. Buccolingual breadth exceeds the mean reported for 30 Colesberg individuals. KRM A1/4 is quite similar to an average San M^3 , as both length and breadth are within a few tenths of a mm of Drennan's figures. So, with the possible exception of the MD diameter of M^2 , it is clear that the measurements taken on the Klasies specimens would fall well within the range of San variation.

Teeth excavated previously from the SAS levels at the main site can also be matched to those of recent humans. Some, like the three molars associated with the KRM 16424 hemimandible, are exceptionally small, even in comparison to those of female black South Africans. It is possible that the 1989-1991 teeth represent another female, although of course sex cannot be determined accurately on the basis of so little information. Other individuals are larger, and the KRM 13400 mandible carries a premolar and two molars that approach the high ends of the size ranges for recent Africans. This specimen is likely to be male, and dental measurements coupled with other observations suggest a rather high level of sex dimorphism in the Klasies population (Rightmire & Deacon, 1991). The new evidence is in keeping with this conclusion.

The 1989–1991 individual from Klasies River main site can be compared directly to only a few hominids from other African Middle Stone Age localities. Deposits at Die Kelders (DK1), located on the coast 500 km to the west in the Western Cape Province, have produced a number of teeth, but many of the specimens described so far are deciduous (Grine *et al.*, 1991; Avery *et al.*, 1997). These materials along with two permanent upper premolars and one permanent lower molar generally fall within the ranges expected from modern Africans, but in several cases the lengths or breadths of the DK1 teeth exceed these limits. Here, there is

Table 2 Length and breadth dimensions (mm) for the M^3 from Klasies River and modern African populations

MAXILLARY SECOND MOLAR



Figure 5. Comparisons of the Klasies River molars with South African black homologues. Data for the recent population are from Jacobson (1982). Vertical bars and boxes represent the mean ± 2 s.D. units.

an approach to the dimensions characteristic of Neanderthals. However, Grine *et al.* (1991) comment that large size is not surprising for Late Pleistocene people and note that discrete morphological traits displayed in the Die Kelders dentitions occur frequently in recent San and black South Africans.

The site of Sea Harvest at Saldanha Bay in the Western Cape Province north of Cape Town has also yielded a human tooth, in deposits apparently dating to one of the cooler phases within the Last Interglacial (Grine & Klein, 1993). This upper premolar is large in comparison to modern African homologues. Another locality of interest is Equus Cave near Taung. The lower levels in the cave are of uncertain antiquity but are possibly older than 30,000 years. Along with abundant faunal remains, excavations in these levels have turned up eight isolated teeth and a fragmentary mandible (Grine & Klein, 1985). Three of the teeth are M³s. Relative to the Klasies M^3 , all have somewhat greater MD diameters but are roughly similar in BL breadth. Most recently, Blombos Cave situated in the Southern Cape between Die Kelders and Klasies River has produced several broken teeth in Middle Stone Age horizons. Grine *et al.* (2000) report that a deciduous upper incisor is noticeably larger in MD and BL dimensions than living South Africans and within the ranges observed for Neanderthals. A second deciduous tooth is smaller than most Neanderthal homologues.

Conclusions

New evidence is presented here to suggest that the Middle Stone Age inhabitants of South Africa were generally like living people in their tooth crown dimensions. Certainly this is true of the population at Klasies River main site, although a few individuals from other caves such as Die Kelders and Blombos fall close to or slightly exceed the upper limits for variation in modern Africans. At DK1, the Middle Stone Age occupation may mostly postdate the SAS deposits at Klasies, and there is a possibility that an increase in tooth size will be documented in groups of Last Glacial age. It is difficult to establish such a trend from the small samples presently available. In any case, the 1989-1991 Klasies River main site specimens help to demonstrate that some (probable females) from the lower SAS member are clearly small in comparison to South African blacks and close to the averages recorded from San burials. Sex dimorphism in Middle Stone Age groups was probably substantial, but the picture provided by the teeth is one of essentially modern features, present in a population living some 100,000 years ago.

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