Supporting Information

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SI Text

Sibudu is located ≈40 km north of Durban, South Africa, ≈15 km inland from the Indian Ocean, on a steep cliff overlooking the Tongati River. The shelter is 55 m long and ≈18 m in breadth. The excavation grid is in the northern part of the shelter at an altitude of ≈100 m above mean sea level. The present excavations, which are ongoing, began in 1998, and 21 m^2 of MSA deposit have been excavated by the Wadley team (1, 2).

Optically stimulated luminescence (OSL) dating of quartz grains has proved successful for dating the MSA deposits of Sibudu, and the OSL ages were obtained from single-grain analyses of sedimentary quartz (3–5) (Table S1). By examining a large number of individual grains, rigorous statistical procedures could be applied (3–5), resulting in final ages with good precision. The MSA occupation at Sibudu seems to have lasted from ≈77 ka to ≈38 ka. The 14 recent MSA age estimates are interesting because of the rarity of post-60 ka occupations at South African MSA sites.

The MSA cultural sequence is long and detailed, containing pre-Still Bay, Still Bay, Howiesons Poort, post-Howiesons Poort, and late and final MSA assemblages (1, 2, 6–11). The Sibudu pre-Still Bay is a flake-based industry with few formal tools. The Still Bay is also a flake-based industry, but it contains bifacial points, bifacial point fragments from double-pointed points, and bifacial tools (8). The tips of the points that were subjected to a use–trace analysis have clear animal residues, such as collagen, animal tissue, muscle tissue, fat, and bone (12). Some Still Bay points have traces of compound adhesives with mixtures of red ochre and plant gum on their bases where they would once have been hafted to shafts (12). Neither ochre nor plant gums are contaminants occurring in sediment samples from the immediate vicinities of the tools (12).

The Howiesons Poort above the Still Bay is a blade-based industry rich in backed tools, especially segments. These are shaped like the segment of an orange, with a sharp cutting edge on the straight lateral and a deliberately blunted, curved back. Many segments have ochre and plant adhesive traces on their curved backs where they would have been hafted to shafts or handles (13–15) (Fig. 1*A*); however, some segments lack ochre and instead have such products as fat mixed with plant material (Fig. 1*B*). The design of a segment with the cutting edge along its full length means that it may not have been possible to use twine as well as adhesive to attach the segments to their hafts. Thus, the adhesive would have needed to be especially robust. Quartz segments, which are much smaller than those made on other rocks (16), have simple plant gum on their ends more often than they have ochre (15), suggesting that they were hafted differently from the larger segments. At least some segments are likely to have functioned as arrowheads. Broken bone points are present in Howiesons Poort layers, and these seem to provide the earliest evidence for the use of bone arrowheads (17), which may have supplemented the use of stone arrowheads.

Backed tools were replaced by points after the Howiesons Poort. Points seem to have been consistently used as parts of weapons for hunting, most likely as the tips of spears (6, 7, 11). Use–trace analysis supports this interpretation because impact fractures and animal residues occur on the tips of the points. Many of the post-Howiesons Poort points have residues implying hafting with ochre-loaded adhesives (12, 13, 18–22), so the practice of using ochre-loaded adhesives is longstanding in the MSA. Furthermore, Sibudu is not alone in having MSA tools with ochre-loaded adhesives. A variety of ochred tools are present throughout the sequence at Rose Cottage Cave, Free State, South Africa (23). Segments from the Howiesons Poort of Rose Cottage have ochre traces (24), as do those from Umhlatuzana, KwaZulu-Natal, South Africa (14).

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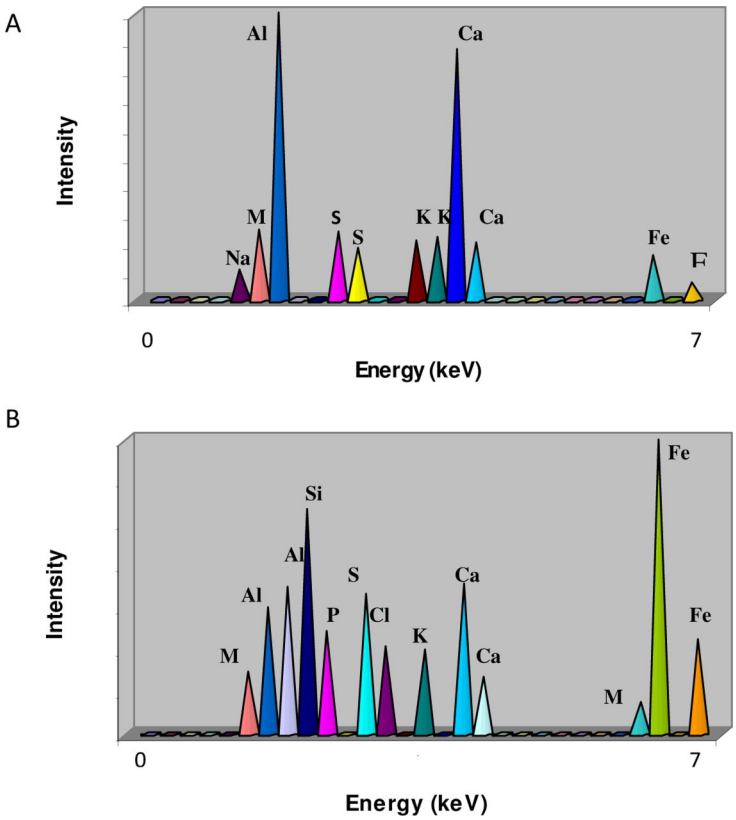

Fig. S1. Mineral intensities of adhesives under EDS X-rays. (*A*) Mineral intensities in yellow ochre no. 10 and *Acacia* gum adhesive under EDS X-rays. The highest peaks show the minerals with the highest intensity; i.e., the most abundant minerals in the sample. Some minerals have 2 peaks because most commonly occurring elements produce K X-rays, and when K_{α} are generated, so are K_{β} rays. The larger (and first) peak shows the intensity of the mineral. (*B*) Mineral intensities of red ochre no. 12 and *Acacia* gum adhesive under EDS X-rays.

Fig. S2. Grinding nodules of red ochre no. 15 on a sandstone slab. Note the quartz grains that stand proud on the slab; these became incorporated in the ochre powder as coarse particles (1,180 to $<$180 μm).

Fig. S3. Stone tool attached to its haft with adhesive made from red ochre no. 15 and *A. karroo* gum.

Other Supporting Information Files

Table S1 (PDF)
Table S2 (PDF)
Table S3 (PDF)