

Origin of skillful stone-tool-sharpening method pushed back more than 50,000 years

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Pictured is a Still Bay bifacial point from Blombos Cave in South Africa made of silcrete and finished by pressure flaking, primarily at the tip. Credit: Image courtesy Science/AAAS

A highly skillful and delicate method of sharpening and retouching stone artifacts by prehistoric people appears to have been developed at least 75,000 years ago, more than 50,000 years earlier than previously

thought, according to a new study led by the University of Colorado at Boulder.

The new findings show that the technique, known as pressure flaking, took place at Blombos Cave in South Africa during the Middle Stone Age by anatomically modern humans and involved the heating of silcrete -- quartz grains cemented by silica -- used to make tools. Pressure flaking takes place when implements previously shaped by hard stone hammer strikes followed by softer strikes with wood or bone hammers are carefully trimmed on the edges by directly pressing the point of a tool made of bone on the stone artifact.

The technique provides a better means of controlling the sharpness, thickness and overall shape of bifacial tools like spearheads and stone knives, said Paola Villa, a curator at the University of Colorado Museum of Natural History and a study co-author. Prior to the Blombos Cave discovery, the earliest evidence of pressure flaking was from the Upper Paleolithic Solutrean culture in France and Spain roughly 20,000 years ago.

"This finding is important because it shows that modern humans in South Africa had a sophisticated repertoire of tool-making techniques at a very early time," said Villa. "This innovation is a clear example of a tendency to develop new functional ideas and techniques widely viewed as symptomatic of advanced, or modern, behavior."

A paper on the subject was published in the Oct. 29 issue of *Science*. Other study co-authors included Vincent Mourre of the French National Institute for Preventive [Archaeological Research](#) in France and Christopher Henshilwood of the University of Bergen in Norway and director of the Blombos Cave excavation. The research was funded by the Wenner Gren Foundation of New York.

"Using the pressure flaking technique required strong hands and allowed toolmakers to exert a high degree of control on the final shape and thinness that cannot be achieved by percussion," Villa said. "This control helped to produce narrower and sharper tool tips." The bifacial points, known as Still Bay points, likely were spearheads, she said.

The authors speculated that the pressure flaking technique may have been invented in Africa and used sporadically before its later, widespread adoption in Europe, Australia and North America. North American archaeologists have shown that Paleoindians used the pressure flaking technique to fashion stone points likely used to hunt a menagerie of now-extinct mammals like mammoths, mastodons and ancient horses.

With the exception of obsidian, jasper and some high-quality flint, few stone materials can be pressure flaked without first heating them, Villa said. While there is evidence of silcrete heating some 164,000 years ago at the Pinnacle Point site in South Africa, the Blombos Cave artifacts are the first clear evidence of the skillful pressure flaking technique being used to carefully shape, refine and retouch tools, said Villa.

There are several ways to confirm whether silcrete has been heat-treated, Villa said. Archaeologists at Pinnacle Point used two common methods called thermoluminescence and archaeomagnetism that require the destruction of stone tool samples, as well as a non-destructive technique known as maximum gloss analysis.

Villa, Mourre and Henshilwood used a visual method for the Blombos Cave artifact analysis based on the contrast between heated and unheated tool surfaces observed microscopically at low magnification. While the removal of flakes from unheated silcrete produces scar surfaces with a rough, dull texture, heat-treated silcrete scar surfaces have a smooth, glossy appearance, said Villa.

The researchers analyzed 159 silcrete points and fragments, 179 other retouched pieces and more than 700 flakes from a layer in Blombos Cave linked to the so-called Still Bay industry, a Middle Stone Age tool manufacturing style that started roughly 76,000 years ago and which may have lasted until 72,000 years ago. The researchers concluded that at least half of the ancient, finished points at Blombos Cave were retouched by pressure flaking.

In addition to the microscopic analysis of the tools, the team also used experimental replication to show that pressure flaking was used in the final retouching phase of the points. The shaping of both heated and non-heated tools -- known as knapping -- was done by Mourre using silcrete chunks collected by Henshilwood from outcrops roughly 20 miles from Blombos Cave.

The silcrete samples used in the replication stage of the study were heated by Henshilwood in collaboration with Kyle Brown of Arizona State University, who published a 2009 paper in *Science* on the heat-treatment of silcrete in South Africa.

The team members compared attributes of points and flakes created for the experiments by percussion and pressure with points and flakes found in Blombos Cave, finding that unheated silcrete chunks first shaped with quartzite stone hammers and further worked on with wooden hammers known as billets could not be pressure flaked.

"Pressure flaking adds to the repertoire of technological advances during the Still Bay (period) and helps define it as a time when novel ideas were rapidly introduced," wrote the authors in *Science*. "This flexible approach to technology may have conferred an advantage to the groups of *Homo sapiens* who migrated out of Africa about 60,000 years ago."

Provided by University of Colorado at Boulder

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