Direct determination of the heating temperature of heat-treated lithic artefacts at Diepkloof Rock Shelter

The appearance of heat treatment of silcrete for the production of stone tools in the South African Middle Stone Age is one of the major arguments that have been brought forward to understand the advent of culturally modern behaviour (Brown et al., 2009). The current debate around the technical investment of silcrete heat treatment (Brown and Marean, 2010; Schmidt et al., 2013) illustrates the need for understanding this process in terms of investment of resources and time. Two concurrent models of heat treatment during the MSA are being discussed at the moment. [1] A slow heating process in a sand bath, on top of which a fire burned over long time periods, would plead for a rather cost intensive and time consume process. [2] If heat treatment was realised in the direct environment of fires that can simultaneously be used for other fire related activities, the whole process would not necessarily require extra resources or time. From experimental studies, we know that South African silcretes can be heated in both these ways (Schmidt et al., 2013). However, the process that was actually used by MSA hunter-gatherers remains unknown and only the direct determination of appropriate proxies on lithic artefacts from the MSA can settle the debate and allow understanding this earliest occurrence of heat treatment of raw materials for stone tool production. One such proxy is heating temperature. From previous experimental studies, it is known that both discussed processes produce different heating temperatures in the archaeological materials. Slow heating in a sand bath produces heating temperatures around 350°C (Brown et al., 2009; Eriksen, 2006) whereas heating in direct contact with embers produces heating temperatures around 550°C (Eriksen, 2006; Schmidt et al., 2013). The direct determination of heating temperatures will allow understanding which process was used.

Thermodynamic analysis of burned and deliberately heated archaeological materials has yielded valuable information about the firing temperature of ancient ceramics and lithic artefacts (Drebushchak et al., 2005; Schmidt et al., In Press). The main assumption at the base of these techniques is that the chemical reaction taking place during heating can only be triggered when an artefact is reheated to a higher temperature than it was originally heated to during the archaeological heating event. The chemical reaction in silcrete and other silica rocks is well known to be the loss of chemically bound water (Schmidt et al., 2011; Schmidt et al., 2012) and a new method for determining precise heating temperatures of heat treated silica rocks (Schmidt et al., In Press) is based on the study of this reaction of water loss. We have obtained excellent results using a thermo balance for determining actual heating temperatures of burned archaeological flint and silcrete samples from the European Neolithic and the Middle Palaeolithic. Applying this technique to heat treated lithic artefacts from the South African MSA will allow for precisely understanding the process used for heat treatment and hence determine the investment of the process in terms of energy, time and resources.

This is why we propose to apply this new method to a set of 11 unplotted silcrete artefacts (coming from a small collapse of the section) and 1 plotted silcrete artefact (layer “Frans”) from the Howiesons Poort of Diepkloof Rock Shelter. The Howiesons Poort material of this horizon shows clear signs of heat treatment for the production of standardised blades and bladelets and presents therefore a perfect framework for the study of the technical knowledge of Middle Stone Age hunter gatherer communities. This analysis, while destructive, will yield precious information about the advent of behavioural modernity in South Africa during the MSA and aims in producing data for upcoming high grade publications on the subject.

The analysis will be performed by P. Schmidt, postdoctoral fellow at the University of Tuebingen (Germany). The material will be transported by plane and returned to the University of Cape Town by the 31/12/2014.

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