CHAPTER THREE
Micro-Residues on Stone Tools: The Bigger Picture from a South African Middle Stone Age Perspective
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Our stone tool micro-residue analysis was developed within the bigger framework of Middle Stone Age research in South Africa. Progress in our methodology was partly influenced by addressing the problems encountered during a series of four blind tests, two of which were entirely field-based. This resulted in a more secure strategy for distinguishing plant and animal residues, and we have made advances in the identification of incidental as opposed to use-related residues. A multi-stranded approach improved our chances of correctly identifying and interpreting residues on archaeological stone tools. Focused micro-residue analyses and the interpretation of results can now be used to gain detailed knowledge of Middle Stone Age human behavior regarding hunting and butchery activities, as well as variations in hafting technologies and the functional application of ochre. Micro-residue analyses applied to tools from the post-Howiesons Poort, Howiesons Poort and Still Bay technocomplexes contribute towards global research that investigates human behavioral evolution. This chapter aims to contextualize the development of our micro-residue research.

The scope of this chapter cannot facilitate an in-depth discussion. By highlighting some aspects that influenced the direction of our research we hope to create an impression of our current framework. The first South African Ph.D. thesis on stone tool residue studies was completed in 2000 (Williamson 2000a) under the direction of Lyn Wadley and the late Tom Loy. This study introduced the basic principles as well as the potential of residue analysis for the analysis of the Stone Age in the sub-continent where an approximately 2.5 million year old tool making tradition is recognized. Sub-Saharan Africa is a region with biological and cultural continuity, so the African record is indispensable for human behavioural evolution (Kuhn and Hovers 2006). It is against this background that Lyn Wadley began general Middle Stone Age research, while Marlize Lombard started exploring questions about Middle Stone Age hunting and hafting behavior. These explorations, and associated research questions and projects, resulted in our approach to micro-residue analysis gaining its distinctive direction and momentum. Experimentation, modern replication and blind testing became integral parts of our research design (Lombard et al. 2004; Lombard and Wadley 2007; Rots and Williamson 2004; Wadley 2005a; b; 2006; Wadley and Lombard, in press; Wadley et al. 2004a), without losing sight of the main goal: to improve our understanding of past human behavior.

The micro-residue work is deeply embedded in archaeological questions that have arisen during the course of excavations first at Rose Cottage Cave, Free State, and at Sibudu Cave, KwaZulu-Natal (Gibson et al. 2004; Lombard 2004; 2005a; Wadley et al. 2004b; Williamson 1996; 1997; 2000b; 2004; 2005). For over a decade, stone tools have been collected from these sites with the specific intention of subjecting them to residue analysis. Rose Cottage Cave appears to have been occupied, perhaps intermittently, over a period of about 90 ka (Pienaar 2006; Valladas et al. 2005) and Sibudu Cave has many finely separated post-Howiesons Poort Middle Stone Age layers that have been dated to between about 37 ka and 60 ka old by optically stimulated luminescence (OSL) (Jacobs 2004; Wadley 2005c; Wadley and Jacobs 2004).[1] Below the post-Howiesons Poort layers, dating to about 60 ka ago, there are two meters of Sibudu Cave deposits with Howiesons Poort and Still Bay technocomplexes, for which OSL dates are not yet available. Both sites have yielded hundreds of thousands stone tools from long sequences containing multiple industries (Clark 1997a; b; 1999; Harper 1997; Villa et al. 2005; Wadley 1992; 1996;

[1] One ka (kilo-annum) is 1000 years, 1000 ka (1000,000 years) equals one Ma (Mega-annum), which replaces the previously used mya (million years ago).

1997; 2000a; b; 2001a; b; 2005c). These stone tools occur in varying contexts over time. At both sites, but particularly at Sibudu Cave, we have extraordinary evidence for environmental change and for change in the use of features such as hearths. It is important to take a holistic view and position micro-residue analysis within the broader framework of data such as fauna, plant and geological sediments (Allott 2004; Cain 2004; Plug 2004, in press; Schiegl et al. 2004; Wadley 2004). The micro-residue research on stone tools is closely linked to our multi-disciplinary approach of the other archaeological material and is intended to complement it. Within this context we are consistently attempting to improve our methodology and are exploring the potential uses of stone tools and investigating whether these were composite, hafted tools.

How Blind Tests improved our Method

Blind testing was the impetus for the Society for American Archaeology (SAA) Symposium (Salt Lake City, 31 March 2005) of which this publication is an outcome (Barnard et al. 2007). Even though our tests, based on the morphological identification of residues on stone tools using light microscopy, are essentially different from the other tests presented at this Symposium, they adequately illustrate how blind testing can be used to strengthen analytical methodology. In 2004 we published the protocols and results of our first two blind tests (Wadley et al. 2004a). The original aim of the tests was to assess the ability, of Marlize Lombard, to identify a variety of plant and animal residues using light microscopy. Problems arising during the testing process made it clear that greater value might be gained from the lessons learnt about the methodology and the direction for future micro-residue research. Addressing the problems identified during our first tests stimulated new research, and subsequently two more tests were conducted, this time totally field-based (Lombard and Wadley 2007). The series of four blind tests have facilitated the development of a multi-stranded approach that provides a cautious, but secure strategy for the interpretation of archaeological residues.

Our first test highlighted the problems of a morphological distinction of certain plant and animal residues. Most mistakes in the identification during the test were made on faunal material and this suggested that some archaeological faunal residues might in the past have been erroneously interpreted as plant material (Lombard and Wadley 2007). This issue is of particular interest in our broader archaeological investigations because Sibudu Cave has large faunal assemblages but, prior to 2003, we found relatively few animal residues on stone tools and this seemed counter-intuitive. Errors in identification could have contributed to the perception that plant materials were more often processed than animal materials, or that animal residues did not preserve as well. The research of Marlize Lombard continued with the recognition of animal residue types and comparison of these with a variety of plant residues. An important outcome was the confirmation that birefringence (the double refraction of incident light) is not an exclusive characteristic of cellulose plant residues; certain faunal tissues are also highly birefringent when viewed with cross-polarized incident light.[2] Another outcome was the recognition that there are morphological similarities between certain plant and animal residues, such as ordered cell structures, cell shapes, the characteristics of fibers and the color and translucency of residues (see the color plate for some examples of ancient and modern micro-residues). Degradation, such as expected on archaeological tools, can make the distinction between plant and animal residues even more difficult.

The tests have also confirmed that not all residues on stone tools are associated with the use of the tool. Contaminants collect easily as a result of mistakes or unintentional coincidences (Wadley et al. 2004a) and during deliberate field-based replications and exposure to dust (Lombard and Wadley 2007). In our opinion the residue analysts need to give as much attention to the recognition of potential contaminants as to other residues. In addition to inclusions from ancient dust, archaeologically recovered tools may have accumulated other kinds of contaminating residues post-depositionally, prior to excavation. Microscope slides with dust samples, or soil samples from archaeological contexts, may help to establish records of the microscopic morphological appearance of such contaminants and they can be compared with putative use-related residues on stone tools (Lombard, 2006b; Lombard and Wadley 2007).

[2] We do not use a standard polarizing microscope, but a metallurgical microscope with incident light, which does not pass through the sample but is reflected, and rotating analyzer and polarizer filters to cross-polarize the light. Cross-polarization of light is obtained when the analyzer filter, between the sample and the eyepiece, is at a right angle with the polarizer filter, between the light source and the sample. This situation is sometimes referred to as 'crossed Nicols' or XPL. Many materials affect the plane of polarized light and will therefore light up when viewed in such light. Their specific behavior may assist the identification of such materials, including some organic residues. This technique is based on the field of optical mineralogy (Nesse 2003).