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Editorial

Standardization, calibration and innovation: a special issue on lithic microwear method

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A B S T R A C T

This paper introduces a special issue of the Journal of Archaeological Science that considers the current state and future directions in lithic microwear analysis. There is considerable potential for lithic microwear analysis to reconstruct past human behaviour as it can provide direct insight into past activities. Consequently, it is a technique worthy of significant additional investment and continued development. To further the cause of methodological maturation within microwear analysis and to promote standardization, calibration, and innovation, the following collection of papers present various approaches and perspectives on how greater methodological refinement and increased reliability of results can and should be achieved. Many of these papers were part of a session held at the 2011 Society for American Archaeology Meeting (SAA) in Sacramento, California, while others were selected from the 2012 International Conference on Use-Wear Analysis in Faro, Portugal. The purpose of the SAA session and this special themed issue is essentially two-fold. The first is to promote awareness of the need for methodological standardization, calibration, and continuing innovation. The second is to open a serious dialogue about how these aims could be pursued and achieved.

1. Introduction

Lithic microwear analysis is a technique primarily used to understand stone tool function, allowing researchers to identify past behaviours through microscopic traces left on lithic material culture. Although data collection is often qualitative, decades of rigorous research have resulted in sophisticated interpretations of prehistoric behaviours and actions. However, as a result of the subjective, nature of 'traditional' microwear analysis, interpretations made from wear traces have been met with some scepticism in the wider archaeological community. Similar scepticism has been directed towards other comparable analytical techniques, e.g. the taxonomic identification of plant microfossils (MacLeod et al., 2010). One often cited problem is that becoming a specialist is seen, inaccurately, as a fairly easy process that requires relatively little investment in time and training. While there are some established laboratories where training can be provided and some books are available that can serve as useful guides, there are as yet no widely recognized and accepted standards of practice or accredited practice guides. Although most specialists have developed their techniques of microwear analysis from a shared corpus of knowledge and many common methodological fundamentals, often passed down from experienced mentor to student, each practitioner has tended to develop his or her own way of conducting analyses.

Current practice in microwear analysis can trace its origins to the work of Semenov (1964) and other traceologists at the Leningrad Academy of Science (Levitt, 1979). Continued development of techniques by many researchers (e.g. Anderson, 1980; Grace, 1989; Keeley, 1980; Odell, 1979; Odell and Odell-Vereecken, 1980; Serizawa et al., 1982; Tringham et al., 1974) not only clarified and improved upon earlier microwear methods, but also introduced greater variability in terms of how analysts observe, identify and document wear. Despite early attempts to establish a common nomenclature (Hayden, 1979) and numerous microwear meetings and conferences over the years (e.g. Anderson et al., 1993; Beyries, 1988; Cahen, 1982; de G. Sieveking and Newcomer, 2012; Longo and Skakun, 2008; Owen and Unrath, 1986), analysis still lacks universally recognized standardization with regards to terminology and practice. Today, there remains considerable variability in many aspects of microwear research, including recording techniques and identification criteria that often lead to difficulties and inconsistencies in the presentation and evaluation of individual interpretations.

The field of microwear analysis also lacks a consistent framework for understanding wear processes. There has been progress in the ability to measure tribological interaction between the surface of the tool and that of the worked material (e.g. Anderson et al., 2006; Astruc et al., 2003; Vargiolu et al., 2007), however this work is still ongoing. Similarly, there are no consistent guidelines or criteria for identifying if lithic material is analysable based on degree of post-depositional wear. Some work has been done to clarify the issue of post-depositional wear (Burroni et al., 2002; Mansur-Franchomme, 1986) and some labs have protocols in place (e.g. Donahue and Evans, 2012) but there is no global standard or agreed upon framework for assessing assemblages prior to functional analysis. The lack of certainty surrounding the precision and accuracy of current methodologies that underlie many

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interpretative frameworks (see Evans, 2014) is also a source of tension. Some of these issues may be overcome by clarifying what constitutes best practice and agreeing on protocols which can be globalized within standardized analytical frameworks.

The contributions to this special issue offer a variety of suggestions as to how wider standardization could be realized. These papers were originally presented at two different international conferences; first was the 2011 Society for American Archaeology Meeting in Sacramento, California and second was the 2012 Conference in Use-Wear Analysis in Faro, Portugal. These presentations, the resulting papers, and this special themed issue serve two basic purposes: first to increase awareness of the need for greater standardization, reliable calibration, and innovation, and second to fuel an open and serious dialogue regarding how these aims could be pursued and achieved. Standardization is a means for effective intra- and inter-disciplinary communication and leads to greater comparability of both data and results. In tandem, a reliable means of calibrating individual datasets to an accepted standard would provide a common language to facilitate the exchange of information between researchers. This would then serve to broaden and deepen contexts for interpretation making it possible to move beyond methodological variability and enhance our collective understanding of past human behaviours. Additionally, innovation in the form of new techniques and technologies will increasingly demand the development of widely recognized standards within the field. Consistency and openness regarding all stages of the process, including recovery, artefact preparation, microscopy, data analysis, and interpretation is needed to move the discipline forward.

2. Contributions

The papers in this special issue cover a wide range of topics relating to the theory and practice of lithic microwear analysis. The papers explore microwear through reflective self-evaluation, experimentation, archaeological application, or a combination of these three complementary approaches. The authors also present an array of perspectives, including some conflicting opinions about the future of the discipline. The purpose in organizing the original SAA conference session and the resulting journal issue was not to collate the ideas and work of solely like-minded researchers, but rather to bring together a truly diverse set of analysts who approach the same series of long-standing issues from a wide range of perspectives. It is this sort of intellectual diversity that fuels meaningful dialogue and drives disciplinary progress. As with microwear literature in general, the papers in this issue employ a number of different conceptual frameworks and analytical methodologies. Some papers use traditional qualitative methods of microwear analysis to address methodological issues or archaeological problems, while other papers explore newer quantitative methods of microwear analysis.

Several papers in this issue employ quantitative methods of analysis to interpret microwear traces. Evans (2014), Stemp (2014), Macdonald (2014), and Ibáñez al. (2014) use a variety of instrumentation developed for the engineering field of surface metrology for the quantification of wear traces. Evans (2014) uses laser scanning confocal microscope data as an example of how high end methods could compliment an existing standardized framework to improve accuracy. Stemp (2014) provides a comprehensive review of the use of laser profilometry as a means to quantify worn surfaces. This paper outlines the strengths and weaknesses of the method, providing suggestions for future research. Macdonald's paper (Macdonald, 2014) explores the use of focus variation microscopy for microwear analysis. This relies on the same principle as focus stacking macro photography and z-stack microscopy; however, focus variation microscopy differs in that it is a calibrated system designed for surface measurement and, as such, can provide reliable results. In their contribution, Ibáñez et al. (2014) use a laser-scanning confocal microscope to differentiate between wild and domesticated cereal harvesting tools. Other techniques with a similar theme are Lerner's contribution (Lerner, 2014), which explores the potential of image analysis to systematically quantify use-related microwear using incident light microscopy. This study is the latest contribution in an ongoing program of research into lithic raw material variability and the role it plays in microwear development. This follows from pioneering work by others (e.g. González-Urquijo and Ibáñez-Estévez, 2003; Grace, 1989) and, if successful, may provide a more widely applicable technique for assessing this microwear development. Using GIS software, Schoville (2014) maps fractures on tool edges to understand assemblage level patterns of microfractures, allowing the analyst to incorporate larger sample sizes than traditional microwear analysis. As mentioned above, these papers all strive to move microwear analysis towards a more quantifiable method, although they use a range of techniques from surface metrology microscopes to image analysis software, in an attempt to standardize worn surface descriptions through mathematical means.

Two further papers review aspects of commonly used microwear methods to gain a deeper understanding of these technologies. Borel et al. (2014) compare the relative utilities of incident light and scanning electron microscopy in terms of their respective strengths and weaknesses. They assess how each can be applied in pursuit of a clearer understanding of archaeological microwear evidence. Ollé and Vergès (2014) advocate for cumulative experimental design where the same set of experimental tools are repeatedly used and analysed over several set periods of time. This allows the authors to closely and directly monitor the development of microwear on the same surfaces during the course of extended use.

Using more traditional qualitative methods of analysis, other papers present archaeological case studies to illustrate the importance of standardized methodological paradigms and showcase the capability that microwear analysis has to offer as an interpretative tool. These include the contribution by Wiederhold and Pevny (2014), who outline their own best practice through the integration of rigorous experimentation, site context, and microwear analysis to understand Paleoindian assemblages in North America. Yerkes et al. (2014) present a case study of Neolithic bifacial axes, showing how microwear analysis can result in elegant interpretations of past behaviours. These papers clearly present their methods of analysis and highlight the importance of explicit reporting of analytical steps to bolster interpretation.

Two papers tackle methodological standardization for ground stone tools. Adams (2014) reviews microwear methodology as applied to ground stone technology and discusses how the field of tribology can contribute to our methodological development. Dubreuil and Savage (2014) offer another perspective on analysing wear traces on ground stone tools.

Other papers offer more reflective narratives on the state of the discipline. Evans (2014) amalgamates published blind test data, the analysis of which highlights where current methods may be failing. This contribution will allow researchers to target contact materials that are more problematic to identify and develop new methods for identification. Iovita carries out highly controlled experiments with cast glass projectile points to assess the nature of diagnostic impact fractures as a means of identifying stone-tipped projectile use in prehistory. In another paper, Rots and Plisson (2014) offer reflections on the current state of projectile impact research and provide suggestions for where further development is needed. To conclude the issue, Van Gijn (2014) provides a timely reminder that

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