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Technological organization and lithic microwear analysis: An alternative methodology

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ABSTRACT

The paper investigates Binford's concept of "organization of technology" in the context of lithic microwear analysis. A theoretical approach to technological organization will alleviate the current focus of use-wear analyses upon reconstruction of individual activities. Use-wear traces must be recognized as palimpsests, rather than traces from separate episodes, to address changes in cultural systems. When conventional methods of use-wear analysis are combined with spatial analysis of "living floors" (e.g., French "Paleo-ethnology") the data tend to orient toward spatial goals, making it difficult to evaluate organizational aspects of lithic utilization. An alternative strategy based on Binford's organizational approach is proposed. Microwear analysis on artifacts from the Paleoindian Mill Iron site in Montana, and case studies from Japanese prehistory, examine methods to evaluate lithic organization from use-wear data. These include curation versus expediency, local versus nonlocal dichotomy of raw materials, "multiple stage surface alteration," "multiple stage edge rounding," and accumulation of use-wear traces upon stone surface. The organizational approach to microwear also addresses the gap between wear patterns observed experimentally versus those observed on archaeological tools.

1. Introduction

General interest in the function of ancient tools dates back to the earliest scientific studies of lithic artifacts. Ever since John Evans constructed a classification scheme based on tool function (1872), function, technology, and typology have all been interrelated parts of lithic analysis. Since the 1970s, microwear analysis opened a new research arena for the Palaeolithic period. It is now applicable to a wider field of study, not only for use-wear, but also to study production techniques with the same methods of microscopy. This was the original direction that the Russian pioneer of traceology, Sergei Semenov, proposed in his landmark study, *Prehistoric Technology* (Semenov, 1964): the study of technological evolution of man on the basis of microscopic traces.

Use-wear is direct evidence of tool-using activity that has occurred at different localities on the landscape where prehistoric human groups conducted various subsistence and domestic activities. Analysis with high power microscopy has been in use for 30 years in Japan (e.g., Serizawa et al., 1982), a country where "Archaeology is National History" and inductive reasoning has been a key archaeological principle. This experimental framework of meaning assignment has required a theoretical background including the concept of "Middle Range Theory" (Binford, 1981:21–30; Akoshima, 1983). Microwear studies in Japan have since revealed functions of stone tools from the Palaeolithic to the Kofun (Burial mound) Period (Akoshima, 1989, 2008; Midoshima, 2005 for references).

This paper investigates one of Binford's wide-ranging concepts, "organization of technology" (Binford, 1979), in the context of lithic microwear analysis. A theoretical approach to technological organization will alleviate some of the current inadequacies in use-wear analyses, which have aimed at the reconstruction of individual use episodes since the 1970s. Instead, observed use-wear traces should be recognized as "palimpsest" phenomena that can shed light on certain aspects of cultural systems.

Microwear analysts tend to select data that would better serve their goals of reconstruction of specific human activities conducted at the site. As a result, it has become difficult to evaluate organizational aspects of lithic utilization. Binford's organizational approach has broad applicability to use-wear studies, and an alternative strategy needs to be developed to retain the integrity of the archaeological record. Microwear data are inevitably characterized by their nature as "palimpsests," in that various traces have accumulated, and sometimes effaced others, on tool working edges.

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Traces remain, in some form, from all use activities performed throughout the life history of a specific tool. However, these use-wear traces were produced during organized and discrete occasions rather than from homogeneous, continuous activity. Binford (1982) pointed out variability in function of places in Nunamiut patterns of land use, and he thus expected assemblages to vary according to place. Similarly – although on a much smaller scale – microwear variability is expected to occur on the surface of various classes of tools as the result of organized activities by prehistoric people.

2. Use-wear analysis as middle range research

Microwear traces are static facts in the present that imperfectly document dynamic processes in the past. Robust linkage between traces and activities is obtained through actualistic situations of controlled experiments in the present world. Thus, use-wear analysis can be defined unambiguously as a field of "Middle Range Research" (Binford, 1981). However, the principle of meaning assignment requires us to re-think the relationship between the "archaeological record" and "behavior." What is the fundamental unit of analysis in the scientific discipline? A similar problem was also once viewed in a different context as a "generation gap" in processual archaeology (Binford, 1983: 157–167). In the field of microwear analysis, archaeological facts of use-wear traces do not speak themselves. Therefore replicative experiments of activities are carried out to develop interpretive criteria, as most use-wear analysts would agree.

However, an important issue can arise in recognizing the correct unit of analysis when working with reference experiments versus archaeological specimens. Traces exist as contemporary facts of already accumulated wear on the tool surface in the form of micro-scale "palimpsests" resulting from repeated use within the given system of technological organization. A wide range of variability exists in the use of each tool, depending on situations under which the users carried out activities. Activities are organized, therefore resultant use wear traces do not accumulate randomly. They are not regular accumulations of similar wear traces, either.

This is an important problem of experimental strategy. Replicative experiments presume situations of similar ways of use for a tool, or a type of tool, through their use life. Generally, inferences are attempted for separate use activities such as "the right edge was used for whittling soft wood". A use episode or repetition of similar use episodes for each tool is reconstructed on the basis of controlled experiments. The linkage between statics and dynamics is sought at the level of a discrete tool use activity. In this strategy, inferred activities are then often connected with spatial distribution data. However, actual uses of most tools are systematically organized. Traces may overlap, but are not randomly accumulated. Accordingly, complex archaeological patterns of microwear traces on specimens as groups need to be classified first as clues to their organization, rather than seeking simple identification criteria for a single type of use inferred from a simple experiment.

Actually, the applicability of the so-called "high power" microwear technique is limited to a certain population of artifacts due to such factors as surface conditions, as long as the reconstruction of concrete activity episode is the aim. Research trends of microwear analysis since the 1970s require methodological revision in order to expand coverage to ordinary and abundant specimens, for which conventional analysis techniques may not be useful.

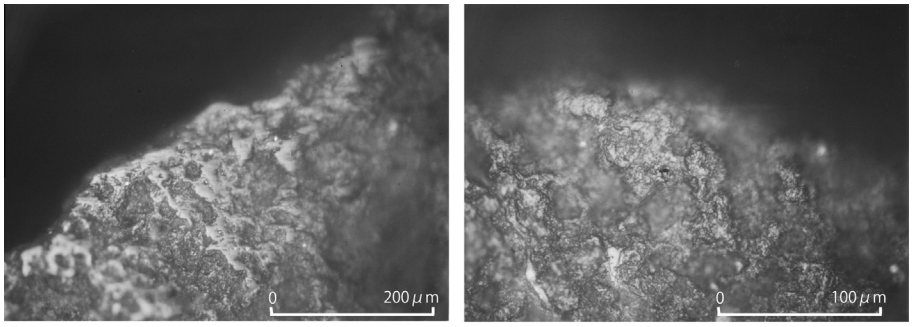
3. Tohoku University team framework

The method of lithic microwear analysis in Japan was established by the late Professor Chosuke Serizawa. He organized the Tohoku University Microwear Research Team in 1976, which continues up to the present (e.g., Akoshima, 2010). The experimental reference collection comprises more than 650 specimens and the database is currently the largest in the country (Akoshima, 2008).

The team developed and proposed a classification scheme of microwear polishe types (Kajiwara and Akoshima, 1981). The polished surface on siliceous hard shale was microscopically classified into 11 types, namely, A, B, C, D1, D2, E1, E2, F1, F2, X, Y (see Akoshima and Frison, 1996 for English description). Polish types on shale are very similar to microwear on European flint (Fig. 3.1). The polish types on shale are so close in appearance to polish on flint that the Tohoku classification can be applied to Keeley's microphotographs (Keeley, 1980), thus a reference table between the two was created (see Table 4.3 in Akoshima, 1993). The relationship of polish types with worked materials was evaluated, with the result that the correlation between polish types and worked materials was not necessarily exclusive, but rather, probabilistic. Keeley's original recognition that polish types indicate the materials worked (Keeley, 1980) was not fully supported. Namely, our method discovered and described collective patterns in archaeological samples first, then assigned meaning using experimental framework (e.g., Serizawa et al., 1982). These results were published mostly in Japanese, and the method has since been applied nationwide.

4. Organizational approach to microwear traces

Use wear analysis was combined with the "organizational approach" to lithic artifacts in general. The relational approach to use wear that employs the framework of technological organization was conducted for case studies on the Mill Iron site, a Paleoindian kill and camping location in southeastern Montana



1. B type polish (hard wood, cut, 4,000st) 2. E2 type polish (raw hide, scrape, 10,000st)

Fig. 3.1. Use wear polish type, by Tohoku Research Team.