A Theory of Fire-cracked Rock

Douglas C. Wilson, Portland State University
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by

Douglas C. Wilson, Ph.D.
Archaeology consulting
435 NE Floral Place
Portland, Oregon 97232
Phone: (503) 238-6861
Email: dcwilson@aol.com

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ABSTRACT

Fundamental shifts in prehistoric subsistence, settlement patterns, demographic characteristics, and socioeconomic complexity have been documented for the Pacific Northwest. These shifts undoubtedly resulted in dramatic changes in the systems used to obtain, use, and maintain rocks used to transfer thermic energy in hearths and roasting ovens. Changes to "thermal rock" systems undoubtedly also have conditioned the characteristics of the fire-cracked and otherwise thermally-altered rocks found at archaeological sites. The frequency and regularity of use of facilities using thermal rocks are seen as fundamental behavioral processes that temper the stages of reduction of rocks found at sites and the location and density of deposition of rock fragment wastes. A stage-model is proposed to explain the evolution of thermal rock systems in the Pacific Northwest and a research design for future thermal rock studies presented.

INTRODUCTION

*We ought not cast rocks aside with reckless abandon in archaeological emulation of that mythic character who, blinded by the profusion of trees, could not see the forest.*

John R. White 1980

What is the meaning of thermal rocks in archaeological context? These most humble of artifacts, often identified as fire-cracked, fire-altered, or "hot" rocks, are ubiquitous at archaeological sites in the Pacific Northwest, and in many cases, are the most abundant artifacts found. Thermal rocks are those that were used in hearths, roasting ovens, sweat lodges, drying ovens, and other mundane domestic facilities, usually to retain and transfer heat from open wood fires for the purposes of cooking foods, producing steam, generating heat for warmth, and other uses. Certainly through counting thermal rocks, and weighing them, and knowing the density of them in cultural deposits, archaeologists are provided with hard numbers with which they can better characterize and compare archaeological facts. Cook and Treganza (1950) conducted such basic composition studies as far back as the 1940s and 50s. For example, they calculated that the 49 metric tons (30 cubic meters) that comprised the Peterson III site of Solano County, California, contained 40.28% rock, whereas the estimated 713 metric tons that comprised the Brazil Mound in Sacramento County contained only 5.68% rock. The differences in rock composition between these and other California sites were largely attributed by Cook and Treganza to proximity to available rock sources. Beyond such basic compositional and gross
economic studies, however, what specific analytical value do thermal rocks have?

In 1997, thermal rocks have become popular. Two entire sessions at the April meetings of the Society for American Archaeology in Nashville were devoted to thermal rocks and new ideas are surfacing. A Binghamton student recently sent me a copy of her term paper titled “Fire Cracked Feminism” that dealt with gender issues surrounding the interpretation of fire-cracked rock (Thompson 1996). The recent surge in interest in thermal rocks probably has many archaeologists’ scratching their heads. How can these misshapen lumps of rock compare with the elegant lines and geometric perfection of the projectile point or the groundstone artifact? Thermal rocks are artifacts devoid of style. There is no manufacturing stage for a fire-cracked rock. Their shapes are purely the result of modification through use. So why should we study them?

DeLyria’s and my experiments (Wilson and DeLyria 1996) add to the few others that suggest that different types of rock used in hearths and roasting ovens fracture differently and at different rates. Given the labor needed to procure the often large numbers of thermal rocks found at archaeological sites, the selection of rocks and the stockpiling of rocks were undoubtedly major concerns of prehistoric peoples.

A central question of this paper is: What elements of human behavior and characteristics of human populations went into the selection and use and reuse of rocks and how is this likely to have changed through time? In short, how does a theory of fire-cracked rock improve the analytical potential of archaeological sites in the Pacific Northwest? In building a theory of thermal rocks, I am attempting to extract some expectations based on the present archaeological understanding of wide-spread and general changes in subsistence and settlement in the region.

That there are important ties between the use of thermal rocks and major economic and social changes in Plateau and Northwest Coast subsistence and settlement has been suggested by a number of authors, including Ames and Marshall (1980-81) and Thoms (1989). Thoms, in particular, makes the crucial link between the archaeological record of thermal rocks and the intensification of production of camas. Through detailing the system for the extraction and processing of camas, he underscores that thermal rocks are the key to understanding camas root intensification in the Pacific Northwest.

A crucial starting point in theorizing about thermal rocks is what I call the first principal of
household resource use and waste (Wilson et al. 1991). In brief, this principal suggests that the more frequently a resource is used, the more efficiently it is used and, as a consequence, the less waste is discarded or still-usable resource abandoned in storage. For example, products in use everyday, such as toothpaste, are rarely discarded as waste, while less frequently used resources, such as lawn fertilizer, often are. While there are other confounding factors, such as tool durability and variability in product shelf-life, generally, frequency of use is believed to be causally related to waste. For thermal rocks, waste represents incomplete use. An efficiently-used rock is one that is used until the rock is too damaged, in too many fragments, and too small in size to retain heat or one that cannot be easily manipulated in thermal rock facilities. The most efficiently-used rocks, *ceteris paribus*, are those that are used until they are a pile of small blocky fragments and thermal spalls. In this sense, thermal rock features found in the archaeological record are a measure of resource waste, as the facility was abandoned as *de facto* refuse, with its constituent elements not completely used up. Why such facilities are left in the archaeological record is a question for abandonment studies. They do, however, provide valuable information on the nature of thermal rock characteristics prior to deposition.

A stage-model of use of thermal rocks is a second important consideration in building a theory of thermal rocks. At the procurement stage, rocks are chosen on the basis of technological factors, such as heat retention characteristics, resistance to thermal shock, and availability. The identification of whole rocks in abandoned features can provide one measure of the baseline technological characteristics for rocks selected by the users of the features. During the use stage, rocks are degraded within thermal rock facilities, such as hearths or roasting ovens, usually through thermal shock, often associated with high and highly fluctuating temperatures generated by open wood fires. At a certain intensity of use, the management of thermal rock facilities involves cleaning, replacement of highly-fragmented rocks, and sometimes the reconstruction of the facility. For example, after roasting camas in an earth oven, large quantities of charcoal, ash, and small fragments of fire-cracked rock are generated. After three firings of a replicated oven, the original 266 cobbles procured for the experiments had become nearly 1,000 pieces of thermal rock, most of which fell below 15 grams in weight (Wilson and DeLyria 1996). During the maintenance stage, certain rocks that are deemed no longer useful, are discarded. Depending on
the intensity of use of thermal rock facilities, the amount of debris generated, and the perception of repeated use of a facility, formal refuse disposal facilities (e.g., middens), will be created from the debris from thermal rock facilities. Studies of sites in the Willamette Valley have documented midden deposits with thermal rock that exceeds 500 fragments per cubic meter but where the average size of rocks were less than 40 grams (Wilson 1995). Such deposits that contain many small-sized fragments of rock are clear evidence for the intentional and redundant maintenance of hearths and earth ovens.

While abandoned facilities, such as hearths and ovens, are important indicators of the components of a still-functioning facility, it is the small fragments and isolated larger-sized thermal rocks in refuse deposits and sheet trash that are perhaps most indicative of efficiency of use. The build-up of middens composed of many small fragments of thermal rock spalls and small blocky rock fragments are probably the direct result of the maintenance of ovens, hearths, and other thermal rock facilities, and the sizes and condition of the rocks in these deposits are probably representative of the intensity of maintenance of such facilities.

In sum, the degree to which thermal rocks are used up in hearths, ovens, and other thermal rock facilities, represents one measure of how frequently the facilities were used. It is hypothesized that hearths and ovens that were used on a daily basis are more likely to contain rocks that have been carefully selected for their thermal shock resistance and other technological characteristics. Further, the management of rocks in these frequently-used facilities should have resulted in a greater efficiency of rock use, with maintenance optimized to provide the best trade off between technological performance characteristics and artifact handling constraints. Hearths and ovens that are used only infrequently will exhibit less care in the selection of rock materials and sizes and the maintenance of such facilities will be non-existent or much reduced. The longer the interval between reuse of facilities, the less efficiently will thermal rocks be managed. At the far end of the spectrum, facilities that are used only once will exhibit the least care and no evidence for maintenance.

With these theoretical notes in mind, expectations regarding temporal trends in the Pacific Northwest can be generated. The prehistory of the Pacific Northwest is generally divided into PaleoIndian, Archaic, and the Pacific periods. The PaleoIndian and Archaic periods (11,500-
5500 B.P.) are generally identified as a time of small-sized social groups (bands), exhibiting a high mobility pattern, and employing a broad spectrum subsistence base. In contrast, during the Pacific period (5500-historic contact), there is widespread evidence for increased populations, increased winter sedentism, including the construction of houses and winter villages, storage-based subsistence economies, a heavier reliance on roots and salmon, and, in general, an elaboration of material culture. The last 2,000 years of the Pacific period is often seen as a culmination of social and economic development, with evidence for widespread exchange networks, population increase, and increased focus on the acquisition of wealth and prestige items.

Applying these general trends to the principles generated for thermal rock systems, discussed above, a number of temporal expectations for thermal rock systems are suggested. First, given the low populations and high mobility of the foraging, hunter-gatherer-fisher bands of the PaleoIndian and Archaic periods, specific resource procurement areas might have been subject to much less frequent visitation. This may have afforded less of an opportunity for the construction and consistent management of thermal rock facilities. There would also have been fewer facilities overall, reflecting lower population sizes. Facilities would be smaller in size, reflecting both the smaller sizes of the corporate households and the smaller quantities of food resources prepared, usually just for immediate consumption. Since there would be less of an expectation of regular reoccupation of camps, thermal rock facilities might be constructed for a single use or for a short period of use, with little perceived need for maintenance. Given high mobility, it is possible that information on the best rock types available at each camp site might be deficient and those rocks that were technologically superior for a particular task might not be the ones that were selected for the task. It is possible that simply the closest rocks, regardless of composition and other technological characteristics, might be selected for use.

The PaleoIndian and Archaic periods were probably dominated by use of thermal rock facilities that were used at low frequencies and for short durations. The thermal rocks associated with these systems should reflect the greater inefficiency of the system in terms of rock selection and the management of the facilities. Demographic and group-size patterns should be reflected in relatively small thermal rock facilities and in small quantities of rock debris in informal discard locations.
With the onset of the Pacific period, with larger population sizes, larger corporate household sizes, increased sedentism, intensification on root and nut crops, possibly increased requirements for other heating and food-drying facilities, and the increasingly frequent reoccupation of resource procurement sites, there may have been an increase in local knowledge of rock types for particular resource procurement areas. Better knowledge of rock resources could have translated into increasingly efficient rock use. The more specialized the subsistence system, the more circumscribed the territory, and the more densely packed the population, the more intensive the use of thermal rock resources.

These characteristics for the Pacific period suggest that thermal rock facilities would have been used at increasingly high frequencies. The perceptions that these facilities would be reused would lead to increasingly efficient use and maintenance of the features. Intensification on root and nut crops and processing for winter storage would result in larger facilities and increasingly more formal distinctions between activity areas and areas for the discard of unusable rock wastes in secondary refuse aggregates. In general, the rock systems should have become more formalized and efficient through time.

While general trends in the complexity and efficiency of thermal rock systems though time have been hypothesized above, synchronic patterns could be addressed to further test theories of thermal rocks. For example, the identification of rock use systems for camas roasting facilities could be compared with base-camp hearths, and house-pit hearths. The proximity of a site to rock sources and the technological characteristics of the rocks could also be examined within the framework of measuring and interpreting thermal rock systems.

Unfortunately, comparative analyses of thermal rocks in the Pacific Northwest are hampered by incomplete and sporadic recording of thermal rocks at archaeological sites. In a sense, this paper is a call for the routine and improved recording of thermal rocks. Often rocks are simply noted as present or absent in an excavation unit. In better cases, the counts and sizes of rocks are recorded and in only a few cases are thermal rocks recorded in sufficient detail to adequately compare them for the purposes of interpreting the thermal rock systems that formed such a crucial element of the domestic routine of prehistoric cultures.

In recording thermal rocks, the size and condition of the rocks are, of course, important
variables. Minimally, in addition to general counts and weights, ranges of rock sizes, and counts of spalls versus blocky-cracked fragments should be routinely recorded. Information on whole cobbles in features and deposits should be collected to gather base-line data on variability in rock size selection. Documentation of thermal rocks within formalized refuse disposal locations, such as middens, is also clearly important. One goal of thermal rock studies should be to build comparative databases for thermal rock use at sites across the Pacific Northwest. This will provide a means to compare sites and to test theories regarding thermal rock use and the complexity of cultural systems in the past.

As John White (1980) noted nearly 20 years ago, *We ought not cast rocks aside with reckless abandon.*
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