Heat-Treating Experiments With Onondaga Chert: Preliminary Results*

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Heat-treatment in lithic technology refers to the controlled heating of quartz-rich, brittle, elastic lithic materials in order to reduce fracture toughness and improve knapping qualities. Successful heat-treatment reduces the point-tensile strength of many varieties of micro-crystalline quartz, including chert, without perceptibly altering any of the other properties with regard to fracture. This reduction in fracture toughness has tangible benefits to the knapper in terms of the relative ease with which fracture can be accomplished and controlled.

Heat-treated materials require the application of less force to produce flakes. Longer and, frequently, thinner flakes can be detached from heat-treated stone than can be removed with equivalent force from unheat-treated stone (Crabtree and Butler 1964; Flenniken and Garrison 1975; Mandeville and Flenniken 1974; Rick 1978). The increased ease of flake fracture significantly enhances the knapper's control over the material. Failure rates in the production of chipped stone tools may be diminished. Greater latitude and flexibility may be possible in both the choice of retouching techniques, and in the variety of functional products that may be produced from a given lithic unit.

Heat-treatment is not, however, a necessary technological step in the stone tool manufacturing process. Many of the better quality lithic materials can be successfully knapped without thermal alteration. Heat-treatment is therefore an optional technological process in the manufacture of stone tools. It is a process which involves definite labor and time costs, and often certain risks, as well as variable potential benefits.

It is thus of interest to archaeologists to be able to recognize the use and effects of heat-treatment. When archaeologists are investigating the use of lithic materials for which heat-treatment is possible, technologically useful and analytically identifiable, the recognition of heat-treatment may allow us to ask interesting questions concerning prehistoric technological decision-making processes. Such decisions may have involved a considered balance of costs and benefits of heat-treatment with respect to various kinds and grades of raw material, with respect to the products (and by-products) of manufacture, and with respect to circumstances of raw material availability (distribution across the landscape), or logistical considerations (bulk- or weight-carrying capacities, reuse capabilities, etc.) (eg., Goodyear 1979).

The primary purpose of this investigation is to determine whether heat-treating procedures can appreciably improve the flaking qualities of Onondaga chert, and whether heat-treating effects can be recognized in Onondaga chert. If these questions can be answered affirmatively, we are in the position to determine whether the aboriginal tool-makers of western New York employed this technological process, for what purposes, and under what conditions it was viewed as beneficial and worthwhile.

It should be noted at the outset that there is no clearcut archaeological or ethnographic evidence that deliberate thermal alteration was prehistorically employed with Onondaga chert. This study is therefore exploratory in nature. The only published consideration of heat-treating effects on this chert type (Lavin 1983) was concerned only with documenting what color changes might be produced in New York cherts by heat-treating. Lavin concluded that heat-treating could produce some subtle color changes in Onondaga chert, but that the resulting colors were still within the natural range of variation for this quite variable material. Significantly, Lavin does not seem to have examined the appearance of the chert on fresh fracture surfaces produced after heat-treatment, which is the variable of interest to archaeologists interested in recognizing the use of heat-treatment. Nor did she examine the properties of interest to the knapper: changes in texture or tensile strength which would signal potentially improved flaking qualities.