Journal of Archaeological Science 37 (2010) 2061–2065

Contents lists available at ScienceDirect

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

Fracture markings from flake splitting

Are Tsirk

Fractography Consultant, Upper Montclair, NJ 07043, USA

ARTICLE INFO

Article history:
Received 26 January 2010
Received in revised form
15 March 2010
Accepted 17 March 2010

Keywords:
Fracture markings
Fractography
Flintknapping
Edge chipping
Split flakes

ABSTRACT

When a flake is split longitudinally during its detachment, it can leave several kinds of fracture markings, termed here split marks, on the flake scar. Observations from contemporary knapping are considered together with mechanics and fractography for understanding the formation of the split marks. These markings on a negative flake scar can indicate the splitting of a flake during its detachment. Recognition of flake splitting is of archaeological interest especially for technologies where the flakes were utilized.

1. Introduction

In lithic analysis it is obviously of interest to use all the evidence from lithic remains that is relevant for particular archaeological goals. To do that, it is necessary to identify the relevant data. Understanding what the lithic products mean and how they were produced is useful for this purpose.

Fracture markings are the basic tools of fractography, the field that deals with interpretation of fractures (Fréchette, 1990; Hull, 1999; Quinn, 2007). Every archaeologist involved with lithic analysis is in fact engaged in fractography, usually at an intuitive level.

The frequently encountered markings known as ripples and twist hackles (Fréchette, 1990: 21), for example, have been used in archaeology for a long time. Fracture markings were introduced formally to archaeology by Kerkhof and Müller-Beck (1969) and in English by Faulkner (1972). Since then, they have been utilized in various applications (e.g. Hutchings, 1999; Tsirk, 1981; Tsirk and Parry, 2000) and new markings have been discovered (Michalske, 1979; Tsirk, 2007).

Fracture markings on flake scars that can serve as evidence for the lengthwise splitting of a flake during its detachment are introduced here. A flake may be split lengthwise in several ways. Complete splitting of a flake may start by the proximal end of a flake or, less often, away from it. Partial splitting of a flake may be initiated at some irregularity in a region of a flake away from its edges. Such partial splitting usually extends from the irregularity to the flake edge in its distal region. The partially split flakes are, in fact, partly cracked flakes. All of these cases often lead to the manifestation of characteristic fracture markings on the negative flake scars.

Observations from contemporary knapping are considered together with mechanics and fractography for understanding the processes of flake splitting and the formation of the split marks. Observations and analytical expectations are considered to ask whether such fracture markings can be used as evidence that the flake was split during its detachment. Recognition of flake splitting from flake scars is of archaeological interest especially for technologies in which the flakes were utilized. Clovis biface technology is an example.

In French lithic technology literature, “Siret (accident)” (Inizan et al., 1999) and “pseudo-burin of Siret” (Bordes, 1981) have been used for a thick split flake thought to be a burin by Siret (1933).

2. Observations

All contemporary knappers have encountered many split flakes. For this study, flakes produced by direct and indirect percussion by the writer were used. Hammerstones and moose antler billets were used for direct percussion; antler punches, for indirect percussion. The 48 flakes used included chert or jasper (28), obsidian (17), novaculite (2) and industrial plate glass (1). The study included 8 flakes with partial splits and 40 with complete splits, which separate a flake into two “halves”. Of the latter, 29 flakes were with the split starting by the proximal end of the flake and 11 away from it. Most of the split flakes were associated with fracture markings termed **split marks** here.

E-mail address: aretsirk@yahoo.com

0305-4403/$ – see front matter
doi:10.1016/j.jas.2010.03.011

Three basic kinds of split marks were observed. A characteristic **split ridge** and a **split step** are seen on the negative flake scars in Figs. 1 and 2, respectively. An enlarged view of the flake scar in Fig. 2 is shown in Fig. 3. A split ridge manifested downstream of the split step is seen here. For comparison, a split ridge on a Clovis point cast can be seen in Fig. 4. A **split ripple pattern**, as well as a split ridge, is seen on the flake in Fig. 5. Both of these fracture features were of course manifested on the negative flake scar as well. In a split ripple pattern, the ripples on the two sides of the split are often dissimilar, sometimes terminating at the split line or having an irregularity in the smooth curves of the ripples. Split ripple patterns may be recognized by the ripples being offset or almost kinked in fracture plan at the split location. Also, the spacing and other characteristics of the ripples sometimes differ at the two sides of the split. In addition to Fig. 4, a split ridge can also be seen on another Clovis biface illustrated in Frison and Bradley (1999:54–55).

The split marks were detected either by refitting the two "halves" of the split flake, by observation of the negative flake scar or both. Observations were made only by naked eye and with a 12X hand lens. It was not always clear whether or not any of the split marks noted were in fact manifested. In such uncertain cases, it was documented that the markings were not observed.

The split marks observed in this study are indicated in Table 1. The markings were usually manifested in the distal portion of a flake. For the complete splits starting at the proximal end, the split markings extended from the distal end for about 8–93 percent, averaging 41 percent of the split length. For the partial splits in the table, the corresponding range was about 11–36 percent, averaging 27 percent.

In all of the complete splits starting at the flake proximal end (Table 1), the split fracture initiated at the outer and propagated to the inner flake surface, with the splitting fracture progressing in the flake distal direction. The situation was usually similar for the complete splits starting away from the proximal end. However, they also included three cases with the fracture propagating from the inner to the outer surface, and four cases where the splitting fracture progressed in the "reverse" direction, towards the flake proximal end.

Fig. 1. A split ridge on a negative flake scar, from direct percussion with a hammerstone on Normanskill chert.

Fig. 2. A split step seen on a negative flake scar, from direct percussion with a hammerstone on Esopus chert.

The complete splits starting away from the proximal end included one case in which the surface roughness known as mist (Quinn, 2007, pages 5–8 to 5–14) was manifested. The mist was followed by fracture branching (Quinn, 2007, pages 4–3 to 4–6) at first to one and then also the other side. The complete splits starting at the proximal end included two cases with manifestation of mist, but none with branching. Although branching can occur at only slightly higher fracture velocity than mist, it is associated with significantly greater energy consumption (Schönert et al., 1969; Richter, 2006, personal communication).

The observations excluded data deemed to have little practical interest for archaeology. Thus tiny slivers from flake edges were not included among the split flakes. Very small split flakes were excluded as well, as was one secondary flake associated with a split bulbar scar.

3. Formation of split marks

The causes of flake splitting, though of great interest in itself, is not the focus here. But still, to understand the formation of split marks, it is necessary to know how the splitting of flakes occurs.