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Identification and evaluation of post-depositional mechanical traces on quartz assemblages: An experimental investigation

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A B S T R A C T

The evaluation of the state of preservation of archaeological lithic artefacts is the first step before starting a functional analysis. If lithic artefacts show a variety of damage from many contact materials, they are also subject to modifications from "natural" causes, such as water transport, soil abrasion, trampling etc. Studying alteration features gives us information to reconstruct the life story of lithic tools after their abandonment and helps us to better understand formation processes of archaeological sites.

Prolonged movements under soil could be responsible for post depositional surface modifications that sometimes look like wear traces due to use. These alterations could have chemical and/or mechanical origin. Recognizing them is of paramount importance especially on quartz assemblages where usewear analysis requires a long and complex methodology that differs to a certain extent from the protocol applied to other artefacts produced with different raw materials such as flint, obsidian etc … For this reason, the use wear and post-depositional surface modification analysis on quartz and quartzite tools have been undertaken by very few researchers until now. The aim of this paper is to increase the experimental quartz field through the attempt to recreate mechanical contact between quartz flakes and sediments such as in archaeological contexts.

Through the use of a Polishing Machine MECAPOL P320 equipped with two counter-rotating platens, it was possible to wear out two experimental flakes in a sandy quartzite sediment coming from Sai Island (Sudan) for 240 h.

After the experimentation, the two flakes showed no edge damage or other visible modifications, but some micro traces on the crystal surface were present. Although long and demanding, this step sharply reduces possible errors in the recognition of use-wear during the experimental stage. The micro traces definable as abrasions on some parts of the crystal surface, have been analysed by a metallographic microscope and compared with the same crystal portion taken before the experiment. Even if it is difficult to reconstruct post depositional processes in a laboratory, this attempt shows that the contact between sediment and stone tools in a continuous movement can randomly abrade the crystal surface.

1. Introduction

Quartz is a common mineral in the earth and it exists both in an isolated state and as a constituent of sedimentary, metamorphic and intrusive rocks. Due to its vast availability, quartz was intensely exploited during prehistory and, as a consequence, chipped stone tools made of quartz can be a rich source of data for understanding human behaviour. In this sense, use-wear analysis may be an excellent instrument for achieving this goal. Nevertheless, this raw material has been rarely taken into consideration by researchers due to its irregular fracture pattern, surface texture, and high reflectivity.

In the field of use wear analysis, Sussman (1985, 1988) and Knuttson (1988a, 1988b) (Knutsson et al., 1988) were the earliest researchers who carried out functional analysis on quartz assemblages with optical microscopes and SEM. In particular, Knuttson focused on systematic and intensive experimental activities, relating tribology and formation processes of use wear (Knuttson, 1988a, 1988b; Ruff and Bayer, 1993; Ludger, 2009).

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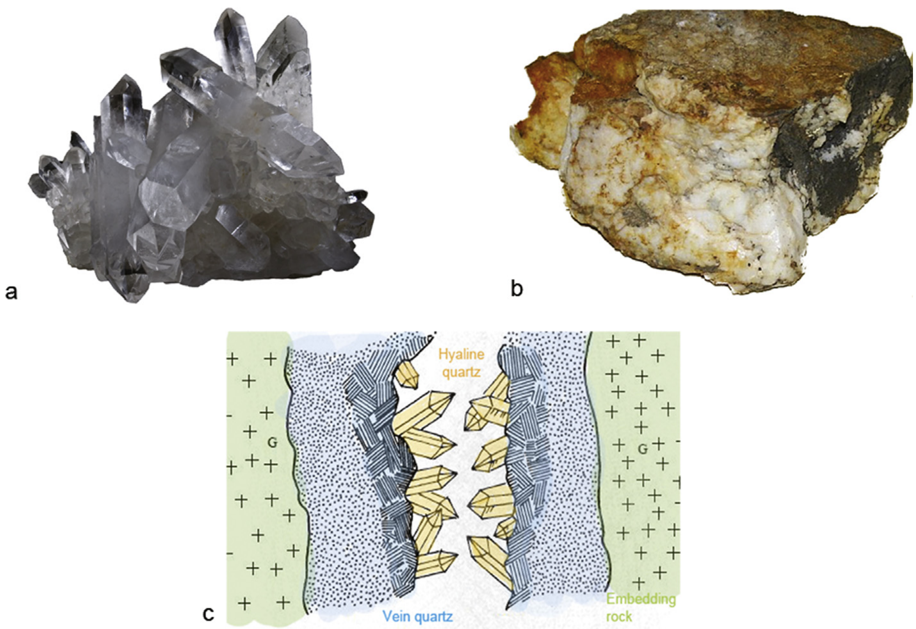

Fig. 1. (a) hyaline quartz crystal; (b) vein quartz; (c) Vein quartz and hyaline quartz crystal formation (from Collina-Girard, 1997, mod. Venditti).

After a period in which the studies of quartz assemblages were put apart in favour of flint assemblages, research turned to quartz for functional, technological and geological purposes. Derndarsky and Ocklind (2001) and Igreja Araujo (2009) tested the use of modern equipment including the Confocal laser Scanner, and Differential Interferential Contrast simplified microscopic observation, avoiding the high reflectivity of crystal quartz. Other use-wear studies based on functional analysis of quartz and quartzite industries include Clemente-Conte and Gibaja (2009), Gibaja et al. (2002), Ollé et al., (under review), Lombard (2011), Moncel et al. (2008), Mourre et al., (under review), and Lemorini et al. (2014).

Numerous studies on post-depositional processes have been carried out on flint objects. Levi Sala (1986) and Plisson and Mauger (1988) made experiments on chemical and mechanical post depositional surface modification (PDSM) and relative characterization of micro traces. Tringham et al. (1974), Shea and Klenck (1993) and Flenniken and Haggarty (1979) considered trampling evidence due to anthropic processes. Other research includes studies on thermal alteration by Clemente Conte (1997), and experiments by Hosfield and Chambers (2005, 2005a) and Hosfield (2011) based on surface modifications (fracture, abrasions, rounding) on flakes and bifaces in sandy and pebbly sediments exposed to the action of water flow.

However, investigations on post-depositional modifications of quartz industries are still uncommon.

Except for the pioneering work of Knuttson and Lindé (1990) on post depositional evidence and experimentation with aeolian abrasion, there are no other studies concerning mechanical effects on quartz industry. Studies on flint tools are not directly comparable with quartz due to the different internal structure and different use wear formation processes under the same conditions.

Some experimental studies were carried out in geology regarding quartz behaviour oriented to the reconstruction of the origins of loess deposits (Bullard et al., 2004; Jerolmack and

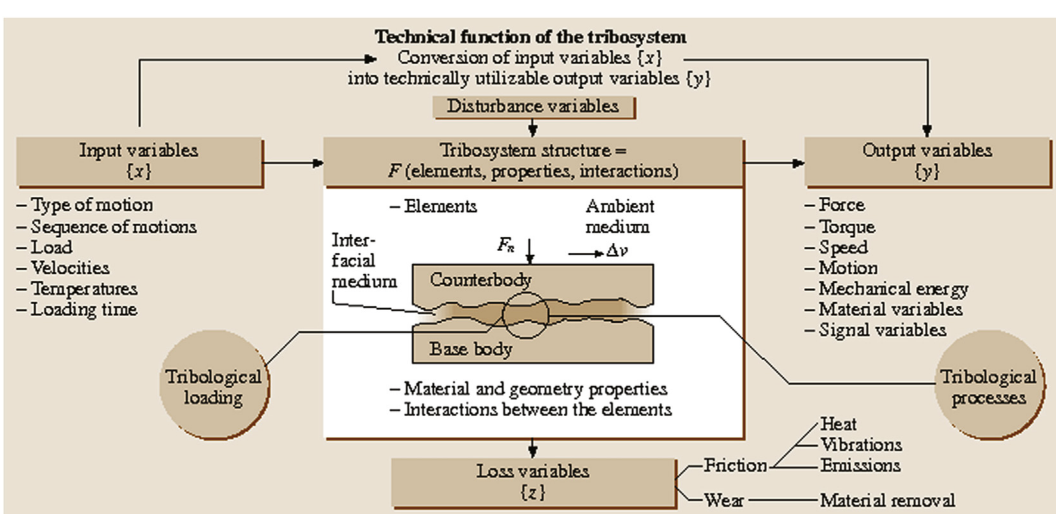

Fig. 2. Tribological system (from Ludger, 2009).