Is it possible to overcome microscopic contamination affecting the interpretation of the archaeological record?

Archaeology is a subfield of anthropology, the study of all human culture. This discipline often resorts to several scientific techniques to analyse the archaeological record. For instance, microscopy is intensively used to analyse different materials, such as ceramics, stone tools, pollens, samples of sediment, etc.

Stone artefacts, made by prehistoric hominins worldwide, are frequently observed with different microscopes to understand their function. On the one hand, use-wear analysis aims at analysing the modifications of the surface of the artefacts. On the other hand, residue analysis has as a major aim the identification of micro-fragments of the material which was cut with prehistoric tools.

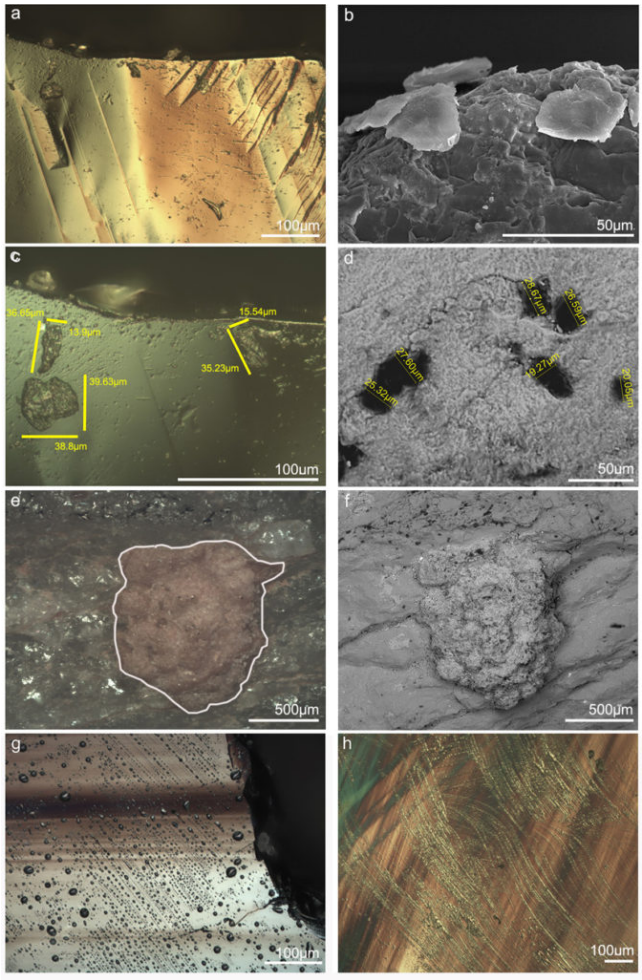

Fig. 1. Handling residues on different lithic raw materials. Skin flakes imaged with OLM (a, c) appear as circular whitish transparent particles, while in SEM micrographs they are dark when using backscattered electron detectors (d) and light grey exhibiting topographical details with

secondary electron detectors (b). Sometimes skin flakes are not visible under the OLM: all over the sediment concretion found on archaeological pieces (surrounded in white) (e), skin flakes do not appear, while under the SEM-backscattered electron detector they are in the form of small black particles (f). Grease on rock crystal in the form of circular spots (g) or lines (h). a, g) orig. mag.: 200×; b) orig. mag.: 1000×; c) orig. mag.: 500×; d) orig. mag.: 1250×; e) orig. mag.: 50×; f) orig. mag.: 135×; h) orig. mag.: 100×.

The main problem when observing particles on the stone tools is modern contamination. Wrong attestations of these substances to ancient residues lead to false interpretations of the data and therefore, to misleading reconstructions of the behaviour of our ancestors.

After stone tools are removed from the earth during archaeological excavations, they are subjected to several analyses, all of them involving hand contact. Because of that, dried particles of human skin, called skin flakes, are the most recurring modern residue on stone tools (Fig. 1).

This specific modern contaminant and others, such as modelling clay's particles, were microscopically characterised using both optical light microscopy (OLM) and scanning electron microscopy (SEM). By using SEM-EDAX (energy-dispersive x-ray spectroscopy) the elemental composition of each contaminant was provided.

This is the first systematic study focused on laboratory contamination of the archaeological stone tools. The main objective is to learn how to remove the background noise due to handling during microscopic analyses of the artefacts.

The combined imaging of the same substances with both OLM and SEM allows to improve the analysts' capacities to recognise them. Thanks to our experiments, we showed that sometimes even after relatively intense cleaning procedures, modern skin flakes can survive

As it is extremely difficult to clean the surfaces by only removing the modern contaminants and not affecting the ancient residues, archaeologists should start to differently treat the archaeological record after excavation. For instance, the careful sampling of the artefacts to be microscopically analysed (possibly done in the field) may reduce the incidence of modern contaminants. The selected artefacts would not be washed nor drawn and contact with hands or modelling clay would be avoided.

The best option is always to minimise the post-excavation handling of the artefacts meant to undergo microscopic residue analysis. Nevertheless, the application of different microscopic techniques and the analysis of the elemental composition of the samples (with SEM-EDAX) proved to be suitable to discriminate between contaminants and ancient residues.

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