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Bridge over Olduvai Gorge: Capacity building and conservation of lithics and fossils

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ABSTRACT

This paper explores decision-making processes involved in the conservation of lithics and fossils excavated at Olduvai Gorge, Tanzania. The site is renowned for discoveries of early humans from the Palaeolithic period, lithics and fossils that document the evolutionary history of humans, vertebrate fauna and their environment over the last two million years. Excavated specimens are treated in situ, at the field laboratory and at the UCL Institute of Archaeology in London. Factors such as accessibility, ease of transportation and preparation, disposal, Tg and toxicity of resins, and ease of re-treatability are considered to decide what can be used in treatments and how. Frequently used materials include Paraloid B-44 and cyclododecane for temporary consolidation and Paraloid B-44 for adhesion and gap-filling. We have found that, in such complex contexts, the more one engages with colleagues across the disciplines and local community groups, the smoother, stronger and more sustainable one's efforts become.

INTRODUCTION

The Olduvai Geochronology Archaeology Project (OGAP) brings together an international team of palaeoanthropologists, geologists and conservators whose main goal is to study the mechanisms of human evolution at Olduvai Gorge, Tanzania. The work of conservators is fundamental for the effectiveness of these activities as some specimens come out of the ground in conditions that do not allow studies to be carried out.

This paper explores decision-making processes involved in the conservation of lithics and fossils excavated by OGAP. For this, we introduce the context and discuss the excavations, the finds and how to respond to some of the challenges encountered by considering both in-situ and laboratory conservation. We also discuss our efforts to make the project sustainable by building capacities of local and international partners and strengthening our relationships with local communities.

CONTEXT

Olduvai Gorge, a UNESCO World Heritage site located in the Ngorongoro Conservation Area in Tanzania (UNESCO 2016), is essential for the study of human evolution and is internationally renowned for important discoveries of early humans from the Palaeolithic period. It also yields lithics and fossils that document the evolutionary history of humans, vertebrate fauna and their environment over the last two million years, and offers abundant insight into the long sequence of events that comprise human evolution. For example, Olduvai Gorge was the first place where traces of the Oldowan culture (an early stone tool culture) were discovered. It was also one of the first sites in Africa where the earliest Acheulean was discovered, and where the traditional view of the Oldowan-Acheulean transition was established (de la Torre et al. 2012).

For the past 10 years, OGAP has worked at Olduvai in order to enlighten the mechanisms that led to the origins of the Acheulean (de la Torre et al. 2012 and 2015). Team members work across disciplines, focus on the effects of their activities, and engage in efforts to maximise benefits for the site and its local population. Conservation takes place both in London and in Tanzania, but was only incorporated into the project in 2013.

EXCAVATIONS

OGAP activities include archaeological excavations, surveys and stratigraphic and geochemical studies. Fieldwork aims to fulfil diachronic goals by sampling different time intervals and palaeoecological purposes by targeting variable environmental settings. The work is focused around four key sites: Henrietta Wilfrida Korongo East East, Sir Evelyn Fuchs and Professor Hans Reck, Mary Nicol Korong, and Fuch's Cliff.

OGAP hires and trains Tanzanian and local Maasai to work on the excavations and other related activities. The tools used in the excavations vary according to the type and density of archaeological material, geological context, expected closeness to the archaeological unit and other factors. Finds are not immediately removed but remain in the sediment in their original positions until they are adequately documented and allocated a sequential number. At the end of daily work, the finds are taken to the laboratory at the campsite for processing of excavation inventory and/or conservation, and all information is entered on the project's database (de la Torre et al. 2015) (Figure 1).

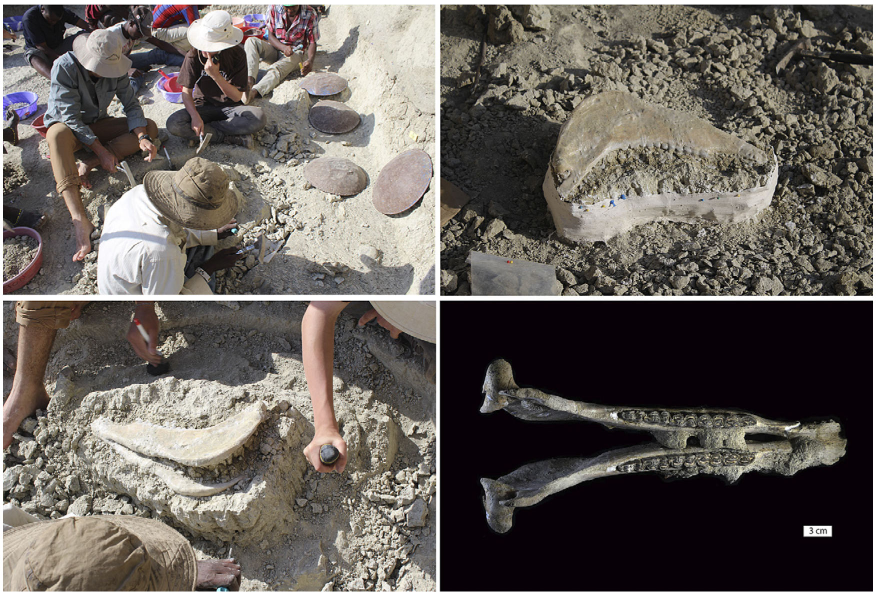

Figure 1. Excavation and conservation processes of specimen HWK L10 0223001575, identified as the mandible of an *Equus* cf. *oldowayensis*. Images show the busy trench after the specimen was revealed in the ground; specimen being prepared for block-lifting after being consolidated with Paraloid B-44, CDD and plaster; and specimen after conservation. Images by the authors and Dr Michael Pante (July 2014)

In 2013, OGAP built a new building in the Leakey campsite to process and store archaeological material. After the finds are brought to the building, each find is cleaned, labelled and entered on the database. After preparatory cleaning or conservation, specialists carry preliminary examination: techno-typological classification for stone tools, and taphonomic analysis for fossil finds. The finds are then individually packed in plastic bags and stored in padded trays of custom-made metal cabinets which are locally manufactured until further analysis and imaging are undertaken (de la Torre et al. 2015).

Selected specimens are transferred to the Institute of Archaeology (IoA) in London to be studied and/or conserved, with the authorisation of the Tanzania Commission for Science and Technology and the Department of Antiquities, Tanzania. All specimens are later returned to Tanzania.

Finds

Olduvai Gorge's finds include a high number of Palaeolithic artefacts (ranging from approximately one to two million years of age), amounting to thousands of pieces each season. They usually entail a range of hand axes, flakes and cores made from local lavas (basalt, trachyte or phonolite), quartzite, and fossilised bones. Different disciplines represented in the project look at the finds in different ways so as to extract information and form cohesive and comprehensive theories. For example, archaeologists may look at lithics to try to establish where raw material was obtained, how it was transported, or the technical features used to produce them (such as impact points or knapping platforms). Zooarchaeologists may look at fossilised bones to understand taxonomy, or signs of human activities such as cut marks, butchering techniques, or even tooth marks made by animals (de la Torre et al. 2012, de la Torre et al. 2015, Pante et al. 2016).

THE MISSION OF CONSERVATION IN OLDUVAI GORGE

OGAP conservators aim to ensure that specimens are excavated safely, that fragile or fragmented material does not suffer unnecessary damage or losses during the studies, and that they can be re-treated in the future. Pristine finds that have been long protected by the volcanic environment of Olduvai Gorge may also need attention. That is, while the surrounding matrix may serve as a support to the physical integration of buried stone tools and fossilised bones, it also obscures their surfaces and hinders examination. Moreover, because of the great pressure surrounding them, some finds may have become crushed, cracked or deformed by the very layers of sediment that protected them. Specimens often need to be stabilised by temporary consolidation before being lifted and transported to the campsite (Figure 2).

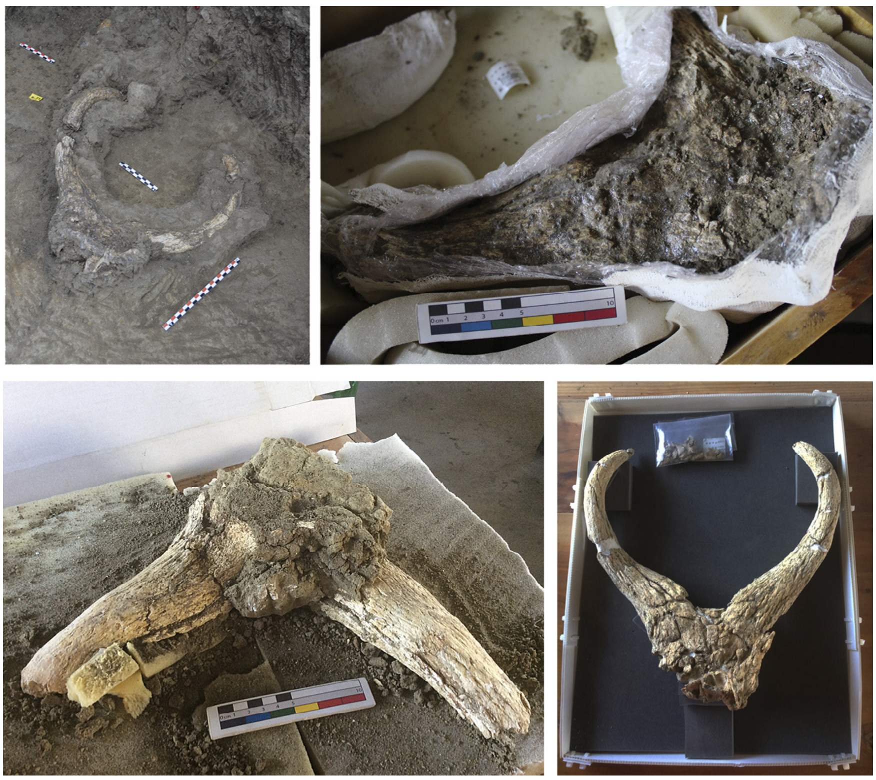

Figure 2. Excavation and conservation processes of specimen FLK T69L26-21. Images show the specimen just after being revealed in the ground; after consolidation with Paraloid B-44; during treatment; and after treatment (January 2016)

Figure 3. Archaeology students Trevor Keevil and Gabriela de la Torre, and conservator Eri Ohara-Anderson prepare a recently excavated specimen for transportation with improvised packing materials (July 2014)

Field and laboratory work

Conservators go to the trenches when especially fragile or unique artefacts start to surface. In these cases, we help with the excavation, consolidation of vulnerable areas of the specimen, lifting, packaging and transportation to the conservation laboratory.

Further conservation work may be conducted at the Laetoli Lab, an historic building at the campsite in Olduvai Gorge built in the 1970s to store material associated with the famous Laetoli footprints (Leakey et al. 1976).

CONSERVATION APPROACHES

Olduvai Gorge is far from any commercial areas, and rough terrain makes transportation of goods challenging, including water, food and any tools and materials for excavation and/or conservation. Although it is possible to find some basic supplies at Marty Chemicals, a small shop in Arusha (capital city of the Arusha region), conservation material is also imported. Imports, however, are limited by international legislation and transportation safety regulations. Moreover, importing may not be sustainable for the local colleagues who will be continuing these efforts in the future.

Importing conservation quality packing material, such as Correx or Plastazote, is also kept to a minimum. This calls for creative use of locally available materials. For example, to transfer large specimens from the excavations to the Laetoli Lab, we use metal shipping trunks padded with layers of cardboard and foams bought locally. Cardboard boxes of bottled drinking water can be flattened, cut into sheets, folded into different shapes to be used as mats, protective paddings or space fillers (Figure 3). Empty plastic water bottles also become useful lab tools.

The Laetoli Lab is an improvised conservation space with basic equipment. There is no electricity available other than what comes from two generators, or running water, besides what is supplied weekly by water trucks. Nor are there provisions for the disposal of chemical waste, which means that use and types of solvents have to be minimised. Other aspects influencing our choices include local climate conditions. Daily temperatures oscillating between 8 and 38°C limit the choice of consolidants and adhesives to those with higher glass transition temperatures (Tg).

In summary, factors such as accessibility, ease of transportation and preparation, disposal, Tg and toxicity of resins, and ease of re-treatability are used to help inform decisions on what can be used and how. A few materials have been tested along the last four years and this paper discusses the ones that are used more frequently.

Cyclododecane

Cyclododecane (CDD) is at the top of our list as a temporary consolidant for various reasons: it can be melted with heat; it sublimes at room temperature thus avoiding the need for solvents to remove it from the excavated material; it does not produce much waste (Rowe & Rozeik 2008, Peters & Ohara-Anderson 2015).

Because CDD has a melting range of 58°C–61°C and cools down and hardens quickly, the field conservator has to be able to apply it swiftly. Due to the remote location of the trenches, we use an inexpensive camping cook set on an open fire protected by a stone ring to heat CDD. As the excavation trenches regularly have three people working per square metre, the fire is placed several metres away from where the material is to be consolidated. To transfer the molten CDD from the fire to the excavated material, and to keep it in good working conditions, insulated boxes are made using locally available materials such as cardboard, aluminium foil and cotton wadding (Figure 4). CDD is used as little as possible so as to minimise costs and need to import, but also to reduce the sublimation time.

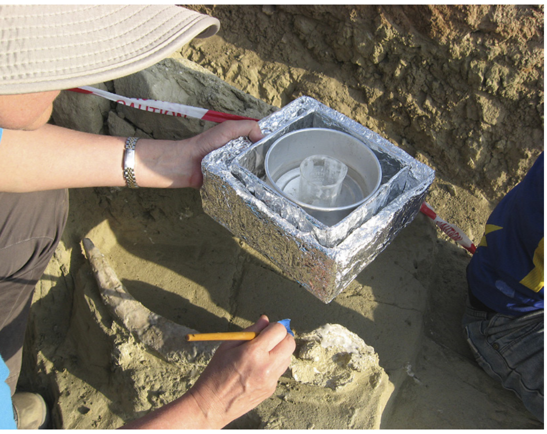

Figure 4. Specimen being consolidated with CDD in preparation for block-lifting (July 2014)

Other consolidants used

Applying CDD may not always be the most appropriate form of temporary consolidation, both due to the high number of excavated specimens and the fact that it does not always penetrate into hairline cracks. Thus, lead excavators are trained on how to use Paraloid B-72 or B-44 for consolidation or quick repairs to avoid further damage or loss of broken pieces. Although Paraloid B-72 has good working properties, its lower Tg does not allow it to solidify completely in situ. Thus, we prefer Paraloid B-44, which forms a harder film after setting but has a higher Tg. As long as the resins are applied with caution and parsimony, there is no significant difference between the two in terms of reversibility with acetone, the solvent readily available locally.

CONSERVATION AT THE LAETOLI LABORATORY

The Laetoli Lab is a busy workspace as work is carried out with the assistance of local Maasai and Tanzanian excavators, international and Tanzanian archaeology students, and IoA conservation students who may have joined us for the season.

Specimens that need conservation are singled out during the excavation or at its arrival at the Leaky Camp, either by the lead excavators or one of the conservators. Every piece that enters the Laetoli Lab is photographed, entered on the conservation database, and assigned to a conservator or apprentice. The conservation treatments are then discussed and carried out in consultation with the archaeologists, who aid in the identification of materials and may have specific views on what needs to be revealed by the treatments.

The most common treatment is the removal of sedimentary concretions, usually carried out mechanically with a variety of dental tools and scalpels. When the sediments are harder and the condition of the specimen allows it, rotary tools are also used to pare down the compact accretions impenetrable by hand tools.

The finds that are consolidated or repaired in situ may require further treatment because the resins used in the trenches may have enclosed soil, or because alignment of broken pieces needs to be corrected. After the resin is reduced or removed, the finds may need to be repaired and/or gap-filled. In these cases, Paraloid B-44 is applied with glass capillary tubes, micro spatulas or brushes, while gap-fills are usually done with a paste made of Paraloid B-44, acetone and glass microballoons.

Specimen FLK T69L26-21 can exemplify some of these procedures (Figure 2). This horn core, identified as of *Megalotragus* sp., was excavated from the FLK site in Olduvai Gorge in extremely fragile condition. It was brittle, friable, had numerous breaks, was misshapen and had been crushed, probably by the movements and weight of the surrounding sediment. A pedestal was carved and stabilised with plaster-impregnated bandages, and the horn core surfaces and cracks were temporarily consolidated with a Paraloid B-44 solution. This was enough to secure block lifting and transportation to the Laetoli Lab. Removing the sediment and consolidant without disrupting the countless fragments was challenging, but was accomplished by repeatedly dabbing the affected areas with Kimwipes (cellulose fibre wipes) impregnated with acetone. At the same time, cracks and breaks were repaired with Paraloid B-44, and gaps were filled or reconstructed with the glass microballoons mixture mentioned above.

Figure 5. Tanzanian and Maasai conservation apprentices working at the Laetoli Lab: Jackson Mukare, Kerio Zebedayo, Isack Faustin Lyimo, Elia Bura and Singira Oleseina confer to decide how to reconstruct a hippo pelvis (January 2016)

LABORATORY WORK IN LONDON

Some pieces are selected to be taken to the IoA for further studies and/or conservation, where they usually receive similar treatments to those described above.

The main difference is that the lithics that are covered by heavy sedimentary accretions and need to be treated with acids are only treated at the IoA, as the Laetoli Lab does not have all the necessary provisions for these treatments. Only quartzite can be treated with acids, as phonolite, basalt and trachyte react to most acids. We start by reducing the sedimentary accretions mechanically. If necessary, this is followed by repeated applications of or immersion in hydrochloric acid (HCL), and neutralisation with sodium hydroxide (NaOH). The HCL solution, application method and number of repetitions vary according to thickness and hardness of the accretions.

KNOWLEDGE TRANSFER, CAPACITY BUILDING AND SUSTAINABILITY

We work closely with Tanzanian colleagues, international and Tanzanian students from different disciplines, and the local Maasai population so as to make sure that knowledge transfer is effective and our efforts are relevant and sustainable. Conservation is included in the syllabus of the archaeology field school that is run along the summer and is attended by international and Tanzanian archaeology students, and hands-on training both in the trenches and at the Laetoli Lab is provided. Every season we reinforce capacities by training new apprentices and helping others to refine their knowledge and skills (Figure 5).

In order to engage directly with more members of the local Maasai community, beadwork workshops that are taught by local Maasai women are organised. Raw materials are procured locally or brought from London, and local Maasai women are hired as teachers. This allows us to learn more about raw materials, manufacturing techniques and Maasai culture. It also reverses our roles as researchers and knowledge holders, and encourages stronger and more democratic relationships to occur. Moreover, the workshops provide financial gains to the Maasai women, who also have better chances to sell their products or receive commissions from workshop participants. These activities maximise the financial benefits of our season for local people, as not only the Maasai hired to work on the excavations are paid, but they also valorise the hardworking Maasai women (Figure 6).

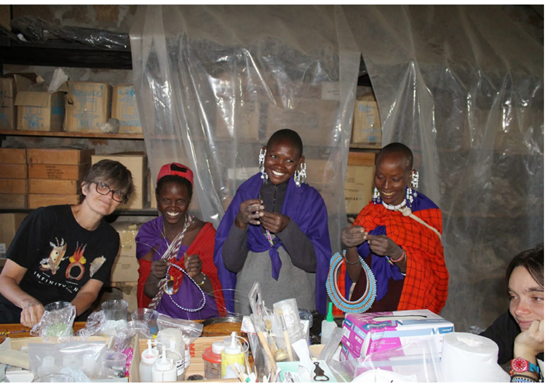

Figure 6. Beadwork classes being conducted by local Maasai Pendo Melau, Sekwai Babai and Nairoshi Zebeday at the Laetoli Lab at the Leakey Camp (August 2014)

CONCLUSION

Working across disciplines, with professionals and students of different nationalities, communicating in different languages and in a context of limited resources has posed complex challenges to OGAP conservators. Nonetheless, these challenges have been handled by carefully considering the context and conservators have managed to have a beneficial impact on the scientific studies carried out by OGAP. We have found that, in such complex contexts, the more one engages with colleagues across the disciplines and local community groups, the smoother, stronger and more sustainable one's efforts become. There is still a lot to be learned and improved, but every year we come back, our relationships with colleagues and local people become stronger, and this has reflected on the effectiveness of our work.

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MATERIALS LIST

Acetone (2-propanone)
UK: Tiranti
www.tiranti.co.uk/
Tanzania: Marty Chemicals (E.A.) Ltd.
Arusha, Tanzania
www.martyenterprises.co.ke/

Correx (polypropylene copolymer board)
Conservation by Design
www.conservation-by-design.com/

Cotton bandages impregnated with plaster of Paris
Tiranti
www.tiranti.co.uk/

Glass microballoons (microscopic glass spheres used as fillers due to its lightweight)
Conservation by Design
www.conservation-by-design.com/

87100 Kremer Cyclododecane solid (a white, waxy cyclic alkane)
AP Fitzpatrick
shop.apfitzpatrick.co.uk

Hydrochloric acid (HCl)
Fisher Scientific
www.fishersci.com/

Kimwipes (disposable cellulose fibre wipes)
Fisher Scientific
www.fishersci.com/

Laponite RD (synthetic clay composed of sodium magnesium lithium silicate that turns into a gel when mixed with water)
Conservation Resources
www.conservation-resources.co.uk/

Paraloid B-44 (methylmethacrylate/ ethylacrylate) and Paraloid B-72 (ethyl methacrylate/methyl acrylate co-polymer)
Conservation Resources
www.conservation-resources.co.uk/

Plastazote (polyethylene form sheet)
Conservation Resources
www.conservation-resources.co.uk/

Sodium hydroxide (NaOH)
VWR
uk.vwr.com/store/

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