Diversity of use of grinding implements in late hunter-gathering and early Pastoral communities of Fazzan, Libyan Sahara

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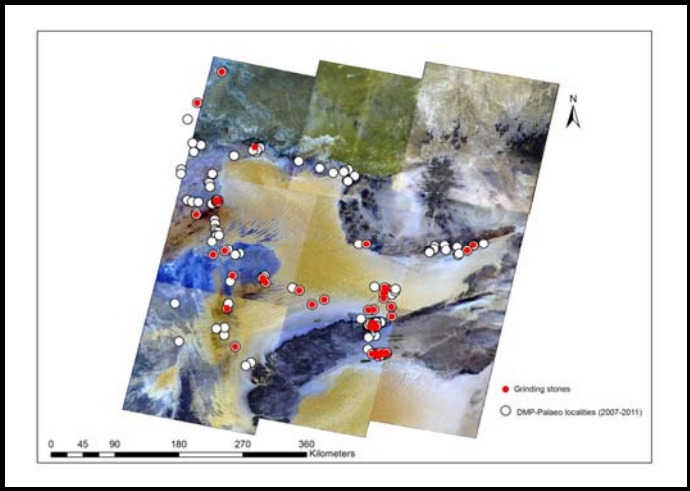
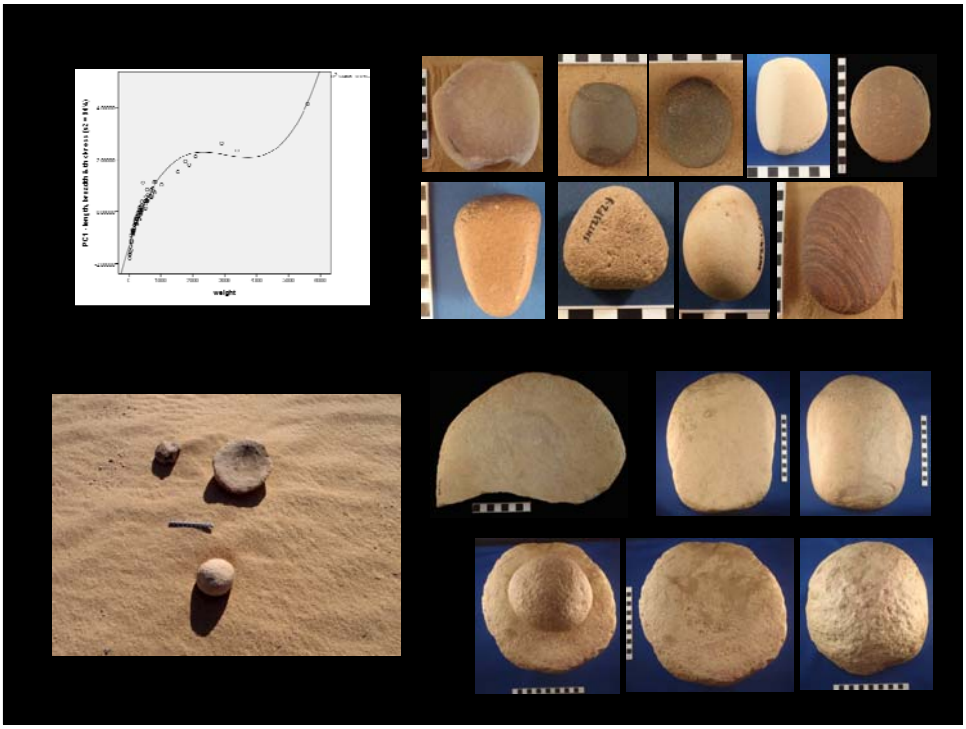
	Locality of occupation	Pottery/Grinding	Lithics	Economy
Early Acacus (9,800-8,900 yrs)	* base camps with stone structures in Acacus mountains * use of interdune lakes * small occupation sites	* NO pottery * very very rare grinding tools * beads: very rare	* microliths, backed pcs, high blade/flake ratio * mainly quartz	* specialised hunting of Barbary sheep * very little plant processing
DRY				
Late Acacus (8,900-7,400 yrs)	* concentrated in highland (Acacus) sites * rare use of interdunes * larger sites	* Pottery: Dotted wavy-line, rocker decoration * Grinding tools: very frequent * beads: frequent * decorated ostrich eggshell	* high macro/microlith ratio * decreased % of blades and bladelets * increased % of geometric microliths * range of raw materials	* broader hunting range (small + large mammals, fish, birds) * significant exploitation of wild cereals * enclosures of Barbary sheep? * storage
WET				
Early Pastoral (7,400-6,400 yrs)	* dense occupation of Acacus mts and Messak – larger sites * dense occupation of interdunes	* Pottery: rocker decoration, but no wavy-line		* economy based on cattle, ovicaprids?, and exploitation of wild cereals
DRY: NO SITES (6,400-6,100 yrs)				
Middle Pastoral (6,100-5,000 yrs)	* occupation of Acacus mts, with smaller sites * quarries on Messak * intense use of interdunes – semi-sedentary camps	* Pottery: 'alternatively pivoting stamp' decoration	* crude lithics * wide range of arrowheads * polished tools (but rare)	* ?Nile influence – EW * economy based on cattle, with seasonal use of highlands * increased population * cattle burials
Late Pastoral (5,000-3,500 yrs)	* discontinuous use of shelters in Acacus * wadis of Messak * no occupation of inter-dunes	* Pottery: undecorated	* crudish tools, almost all quartzite * increase use of exotic raw materials * pre-dynastic tools	* economy based on ovicaprids – almost NO cattle * high mobility * human burials

Adapted from: Cremaschi & Di Lernia 1999; Garcea 1998; Garcea 2004

Desert Migrations Project - PALAEO





Searching for residues

Sampling for residues:

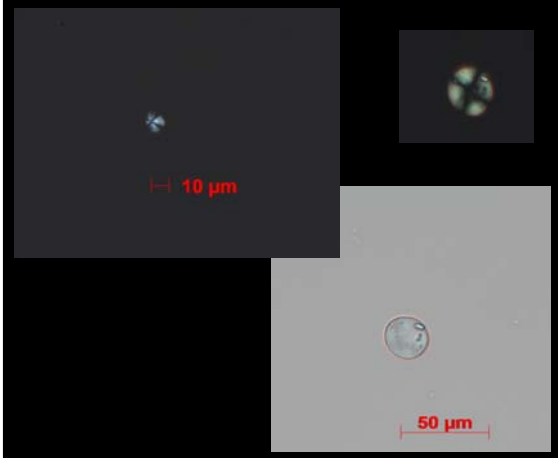
- 148 samples were collected from 15 grinding slabs and 56 mullers
- Both dry and wet samples – targeting fissures and cracks where residues could have better preserved
- *7 samples of sediment and plant remains found underneath the slabs when collected

Microscope analysis at different magnification: 200x, 400x and under oil immersion 630x.

Starch granules

- Starch granules were recovered from several mullers and only one slab so far, but in low quantity, often less then 3 granules/sample
- According to morphological characteristics, for example shape, average size and hilum morphology, we have described 4 types of starches, ranging from 2 to 50 microns in size

•All starch granules recovered show damage consistent with grinding (broken granules), dry conditions (cracks) and exposure to high temperatures (reduced brightness or loss of the extinction cross)

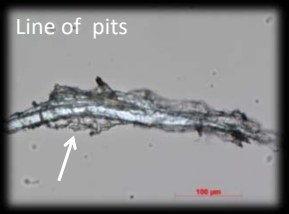


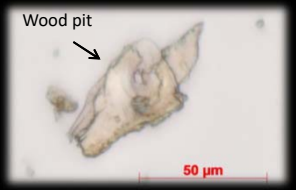
Phytoliths

- Phytoliths are also common among the samples
- Cataloguing of phytolith typology is ongoing, but preliminary identification shows:
  - grass species
  - trees and bushes (wood and bark)
- Phytoliths also show damage related to grinding, such as broken "extremities"

Wood and root fibres

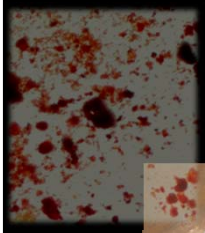
- A variety of plant fibers were also identified, including fibers from roots and soft wood (often found twisted)
- Possible small flakes of resins were recovered from several implements, consistent with the processing of wood/bark from Acacia and Tamarisk, which produce large quantities of resin





Ochre

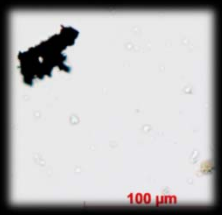
- Ochre was found in many grinding implements as a red residue adhering to the tools, and deep into cracks and cervices.
- It appeared in distinct lumps.
- It was also found associated with resins, starches and phytoliths, suggesting dietary and non-dietary uses of the same tools



Garamantian burial with lump of ochre – Mattingly et al. 2010

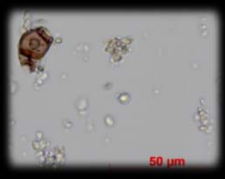
Charcoal

- Micro-charcoal was found often as a silvery/grey residue on the tools
- The margins were often irregular probably due to grinding



Other finds

- Pollen, fungal spores and insect remains (such as small scales) were found in very low quantity



- Possible evidence of fine ostrich eggshell 'dust'

Dietary use

- Processing of 'starchy foods' such as seeds and tubers


- Grasses and seeds

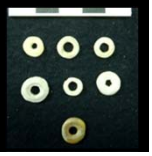
Non-dietary use

- Preparation of plant fibres for 'basketry' items

- Wooden tools
- Production of pigments

- Extraction of resins from the bark for utensils


- Ostrich eggshell bead production



Conclusions

1.Grinding tools: key avenue for exploring changing patterns in social and economic behaviour

2.Diversity of use of grinding implements

3.Holocene Central Sahara – complex population history, very diverse economies

4.Diversity of grinding tools in space and time

5.Technically: recovery of residues from exposed artefacts from desert

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