Iron Oxide Rock Artefacts in Mesopotamia *c.* 2600-1200 BC

An interdisciplinary study of hematite, goethite and magnetite objects

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Archaeopress Archaeology

Archaeopress Publishing Ltd
Summertown Pavilion
18-24 Middle Way
Summertown
Oxford OX2 7LG

www.archaeopress.com

ISBN 978 1 78491 964 1
ISBN 978 1 78491 965 8 (e-Pdf)

Cover illustration: Stamp seal and cylinder seals from the De Liagre Böhl Collection, Leiden.

Printed in England by Oxuniprint, Oxford

This book is available direct from Archaeopress or from our website www.archaeopress.com

Contents

List of Figures

Figures made by: B. Brouwestijn: 3.2, 3.10, 4.2-4.12; B. Einwag: 2.6; J. Fokkema: 1.1, 2.3, 2.7, 3.1, 4.1; M.M. Melein: 2.4, 2.5, 3.3, 3.4, 3.7, 3.17; H.G. de Vries: 1, 2.1, 3.5, 3.8, 3.11

List of tables

Acknowledgements

For many years, more than even I myself had expected, I've spend part of my time writing this PhD-thesis. When, in 2002, I asked Marten Stol for advice about what to do after studying Mesopotamian Archaeology with Govert van Driel († 2002), he suggested writing a book. The book became a thesis, and because of the rocky subject, Henk Kars became my promotor. Although it was pretty difficult to find time to study, next to raising a family and working, I tremendously enjoyed the intellectual challenge. And while I secretly think iron oxide rocks are not the prettiest stones in the world, the stories the archaeological artefacts tell us are fascinating.

I would like to thank Marten Stol for his initial ideas and support, as well as for his inspired guidance with the cuneiform sources, and Henk Kars for taking me aboard the Institute for Geo- and Bioarchaeology as a 'buitenpromovendus' and at some point as co-ordinator of the BSc and MSc of Geoarchaeology. When I asked Adelheid Otto as my supervisor and second promotor, I couldn't have hoped for all the great comments and advice she would give, as well as her shared enthusiasm for the subject.

Special thanks go to Judith Mulder, for her work as a student under my supervision. For her BSc-thesis she surveyed the geological sources and during her MSc she analysed materials from the Dutch collections, at an internship with Luc Megens at ICN. Dirk Visser made the chapter on archaeometrical analyses possible with his knowledge of and access to neutron-based analytical facilities. Current and previous staff of the NINO library: thank you for a quiet place to sit, read and work amidst a fantastic collection of books on Assyriology and Mesopotamian archaeology. Jaap Fokkema and Bert Brouwestijn from the VU drawing room kept cool over endless alterations and prepared beautiful maps and graphs.

One of the things that keeps puzzling me is why Mesopotamian weights are sometimes shaped like ducks. That they are duck, not geese is explained in Chapter 5. I've looked for explanations and parallels, but the closest I come to an answer is the scene from Monty Python's 'The Holy Grail' (17:03 minute; 1975), where a real duck is used as a balance weight to weigh a witch....

I've met so many great people over these years, some of whom have read all or part of the work in progress: Diny Boas († 2016), Erika Guttman-Bond, Lisette Kootker, Judie Visser, Lex van Eijk, Marjolijn Engelhard, Dick Tiernego, Lorenz Rahmstorf. Erik van Beers helped me get my head round statistics and Roderik Overmars patiently corrected typo's in numeric tables. AM, many thanks for going over the many pages to improve my English. For reasons not always entirely clear to me there are many friends and acquaintances who never lost faith that someday I would indeed finish the book: Suzanne Vanhouten, Karin van Beers, Linda Mbeki, Juliëtte Eichholz, Mariëlla Eringa, David Engelhard, Tante Joke, Lianne Plantinga, Frank Meijers (my vital study buddy during the final months), Dominicus Kamsma, friends at Tafelronde, my three folk-dancing clubs, Vrije School Utrecht, (ex-)colleagues from IGBA, colleagues at UCGB, your support and faith in me made all the difference.

Special thanks to my ex-husband Rik, who made it possible for many years for me to work part-time on this research. And loads of love for Valentijn and Lumen, who grew up learning more about hematite than most. Thanks to them for helping type parts of the database, too.

I would like to dedicate this book to my beloved grandfather Henk Egberts († 2009), who, in hindsight, put me on the path to archaeology when I was still very young. He was my greatest fan and I'm proud to be his granddaughter.

1. General introduction

1.1 Background

This research, written as a PhD thesis at the Institute for Geo- and Bioarchaeology at Vrije Universiteit Amsterdam, focusses on objects of iron oxide rock, found in Mesopotamia in archaeological contexts dating to ca. 2600-1200 BC. The area under study is Larger Mesopotamia, from the Eastern Mediterranean coast to the Zagros mountains and from the Taurus mountains to the Gulf (see Fig. 1.1). This area, featuring the Euphrates and Tigris rivers, was not so much a political entity, as well as a region with comparable religious beliefs, shared languages and common cultural traits. Throughout the area, there was a shared pantheon, although local variations and deities existed. At first, Sumerian was spoken and written in Southern Mesopotamia. After 2000 BC Sumerian had become extinct as a living language and its role was taken over by Akkadian, a Semitic language probably understood by most, even if their mother tongues may have differed. The cuneiform writing system was slightly adapted.

Writing was done mainly on clay tablets, with cylinder seals being used to seal the tablet with a personal identification mark, or that of officials from an institution.

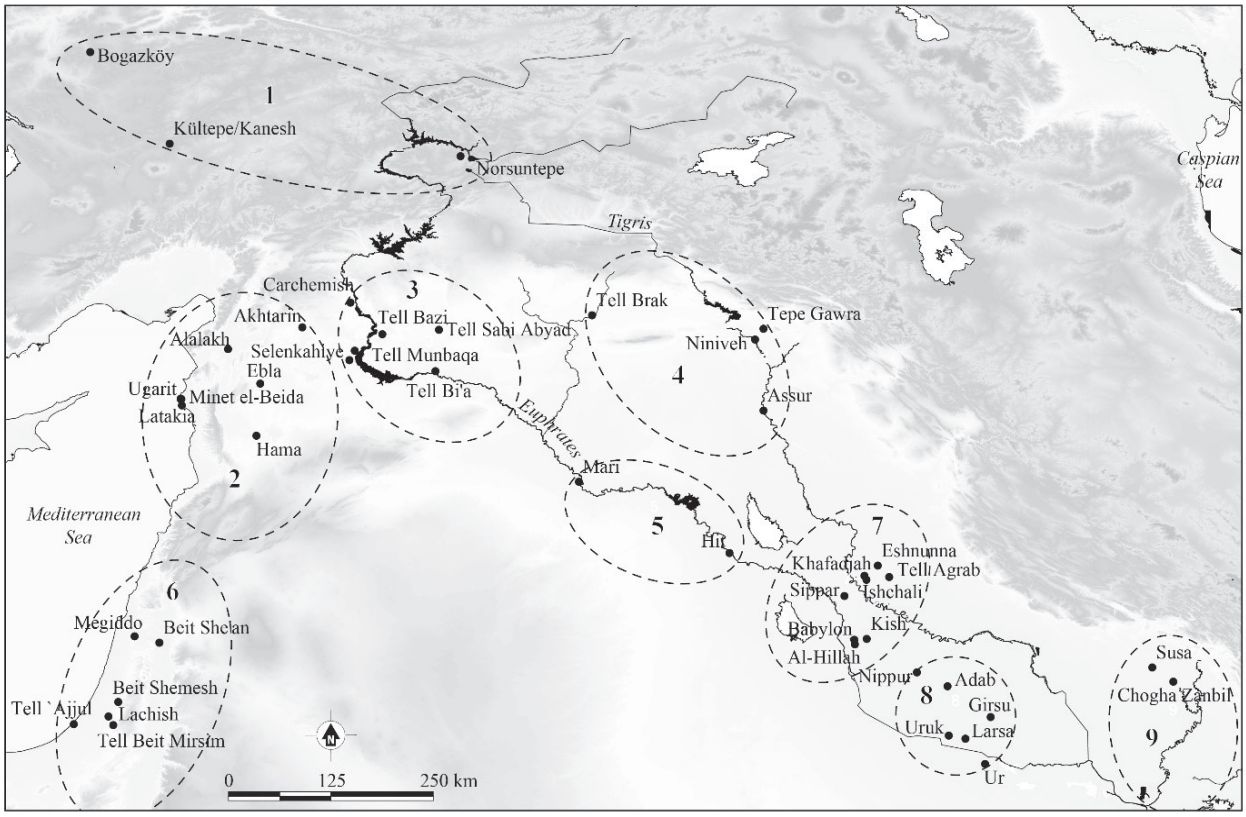

Figure 1.1: Area under study, with sites where iron oxide rock artefacts were found.

Only rarely was this area united under one ruler. Instead, during most times there were various, ever changing complex societies such as city states and kingdoms, interspersed with non-sedentary groups.

Trade relations interconnected the area and extended to neighbouring regions. As the area is vast, divided into multiple states and fractions, with cultural zones shifting over time throughout the area, it is a study in itself to describe and fully understand Larger Mesopotamia's history in detail. It is impossible to divide the centuries under discussion into cultural or historical periods that apply to the entire area. A visual representation of some of the important periods, movements and events in Syria and in Mesopotamia, together forming Larger Mesopotamia is given in Appendix I, which is based on Akkermans and Schwartz (2003) and Roaf (1990).

Most of the iron oxide rock artefacts studied are cylinder seals. Cylinder seal styles are important dating criteria. An overview of cylinder seal styles is therefore given in the lower section of the representation given in Appendix I.

Mesopotamia is very poor in natural resources, apart from fertile soil, some gypsum and limestone, agricultural produce and livestock. Timber, metals, precious stones, all these building blocks of developed societies, had to be imported by the states, kingdoms and non-sedentary groups. The complex interplay of processes related to these imports is an essential area of study within Mesopotamian and Near Eastern archaeology.

Within this area of research three important approaches can be discerned: archaeological, archaeometric and text-based. To illustrate this an example of each approach is given:

Archaeological approach

A famous example of research based on archaeological sources is the study on the Uruk World System (Algaze 1993). Algaze revealed the expansion of Uruk culture from Southern Mesopotamia to the Syro-Mesopotamian plains in the North and the Zagros mountains and Khuzestan in the East in the second half of the fourth millennium BC, driven by a demand for commodities. By identifying settlement patterns and typical Uruk cultural artefacts, Algaze was able to map an extensive distribution network that revealed the implementation of a bureaucratic society in faraway regions aimed at securing resources.

Archaeometric approach

Archaeometric analyses were the basis of Kohl's study of chlorite vessels from Iran (1976) that exposed a long-distance trade with multiple production centres of high quality stone vessels in the mid-third millennium BC. Kohl's 'intercultural style' vessels are found from Palmyra to Mohenjo-Daro and from Uzbekistan to the Arabian peninsula. He analysed them with several archaeometric techniques such as neutron activation and X-ray fluorescence. Using X-ray diffraction, five different production centres and distribution networks could be identified. Similar artefacts were being made in production centres at great distances, of different materials, which then found their way to royal graves and large buildings all over the Middle East.

Text-based approach

The highly organized trade between Assur and the kārums (trading centres) in Anatolia in the early second millennium BC, where woollen textiles were traded against metals such as copper and tin, was documented in cuneiform archives. Without these archives it would have been impossible to understand the mechanisms of exchange (Veenhof 1972, Dercksen 1996). The cuneiform texts, administrative documents as well as letters, give insight into the composition of caravans, the trade items that were bought and sold, the going rates of goods, qualities and kinds of traded items, organisation of the trade and identities of the trading partners.

While each of these three approaches can be a useful way of studying mechanisms of exchange, as illustrated above, combining techniques and methods from archaeology, archaeometry and textual studies often yields even more insight into the mechanisms of import and export. The study of iron oxide rock artefacts provided an excellent opportunity to combine archaeology, archaeometry and cuneiform sources. Although the study of non-indigenous materials has a long tradition within Mesopotamian and Near Eastern archaeology, the iron oxide rocks were never researched before, even though these materials are very resistant to degradation processes in the soil, are fairly well recognized in excavations (but see Chapter 3 for some remaining issues) and their cuneiform names were identified as early as in the 1920s. Hematite, goethite and magnetite were used during a relatively short time span, mainly between *ca.* 2200-1600 BC. Before and after this period these materials hardly occur in the archaeological record. This relatively short period of use makes it possible to focus on the factors that influenced the introduction as well as the abandonment of these non-indigenous materials in Mesopotamia. Furthermore the development of the kinds of artefacts and of ideas and beliefs concerning iron oxide rock materials could be identified, as the cuneiform sources could be included in the research.

1.2 Aim and outline of the research

As stated above, one of the essential areas of Near Eastern archaeology is to understand the complex interplay of processes that influenced the import of foreign materials. The aim of this multi-disciplinary study is to identify such processes for a single material, iron oxide rock. In order to do so, the following research question was defined: *What are the temporal and spatial patterns of use of iron oxide artefacts and how can these be explained?*

The research questions to be answered by studying the archaeological material are:

- What kinds of artefacts were made of iron oxide rocks?
- How were these made?
- When and where were they produced?
- When and where were they used?

An archaeometric approach is used to answer the following questions:

- What are the material properties of iron oxide rocks used for artefacts?
- How can these properties be determined?
- What was the geological formation of these materials?
- Where did the raw material come from?

Textual sources are used to investigate:

- What connotations and beliefs are associated with these materials?
- What were these materials used for, are there applications of these materials mentioned in the texts that are not known from the archaeological sources?

Although iron oxide rock can be a source of iron for metal production, this aspect lies beyond the scope of this research, as well as the application of ground iron oxide rock for pigments.

In order to answer the research questions, the mineralogical properties of hematite, magnetite and goethite are explored in Chapter 2. These properties are then assessed in order to define the suitability of rocks from different geological origins to make small artefacts from. A literature survey was made to identify possible natural sources.

In Chapter 3 an overview of the kinds of artefacts made of iron oxide rocks is given with examples from archaeological literature. Through the combination of evidence from several excavations with results

from experimental archaeology, a chaîne opératoire is suggested for the fabrication of iron oxide rock artefacts.

A database (Appendix II) of over 3,000 descriptions of iron oxide rock artefacts from archaeological literature is the basis for Chapter 4: an analysis of the use of iron oxide rock artefacts over the centuries. The spatial and temporal distribution of iron oxide rock artefacts and information about sizes of artefacts and half fabricates also provide further insight into the possible origins of the materials.

In Chapter 5 the cuneiform textual sources dealing with *šadānu* or ^{NA4}KA.GI.NA are discussed. Examples from medical-magical texts as well as from other sources give an insight into the application and the connotations of iron oxide rock materials.

The results of the archaeometric analyses of iron oxide rock artefacts from three Dutch collections (RMO, APM and NINO) are presented in Chapter 6. The experiences gained from the non-destructive measuring also led to some recommendations on the manner of analysis of these materials.

The results and insights gained from this archaeological, archaeometric and text-based research are presented, compared and combined in the conclusion and synthesis, Chapter 7, in an attempt to better understand what interplay of processes influenced the use of these non-indigenous materials.

1.3 Dissemination of the results

Parts of this research have been published previously:

S. Imberti, W. Kockelmann, M. Celli, F. Grazzi, M. Zoppi, A. Botti, A. Sodo, M. Leo Imperiale, **M. de Vries-Melein**, D. Visser and H. Postma 2008: Neutron diffractometer INES for quantitative phase analysis of archaeological objects. in *Measurement Science and Technology* 19: 1-8, doi:10.1088/0957-0233/19/3/034003.

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