Journal of Archaeological Science: Reports 21 (2018) 667–678

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep

A powder preparation kit from the Middle Bronze Age at Megiddo, Israel: Tools and raw materials

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ARTICLE INFO

Keywords:
Megiddo
Middle Bronze
Stone tools
Grinding
Burials
Pigments
Red kaolinite

ABSTRACT

A unique assemblage of tools dating to the Middle Bronze Age was uncovered at Megiddo (Israel). The assemblage included pestles, pounding stones, many worked stones and various colored materials. We used mainly Fourier Transform Infrared Spectroscopy (FTIR) in order to identify the bulk materials of the artifacts, as well as the materials adhering to the surfaces of the artifacts. An unusual kaolinite, quartz, calcite and hematite containing compound was used for producing red powder, charcoal for black powder and chalk, shells and bone for white powders. We conclude that the assemblage was a kit used to produce relatively small amounts of colored powders. The possible uses of the kit are discussed, including for decoration of intramural burials found in the immediate vicinity.

1. Introduction

An assemblage of stone, shell, bone and ceramic items was found in the 2014 excavation season at Megiddo, northern Israel (Fig. 1), in a Middle Bronze II–III (17th–16th century BCE) domestic context. The assemblage includes stone pestles, pounders and pebbles, a few shells, several bone objects, a ceramic lamp and lumps of red sediment, all found concentrated in a circular arrangement. A grinding stone and a perforated stone object were retrieved in the immediate vicinity and may be an integral part of the assemblage. Here we study this most unusual assemblage in order to understand what the artifacts were used for.

Middle Bronze Megiddo covered an area of ca. 12 ha. It was the urban hub of a city-state that ruled over the western Jezreel Valley – the bread-basket of Canaan – and guarded the most important international road in the Levant that led from Egypt to Syria, Anatolia and Mesopotamia. The city was well-fortified by a massive brick-wall and an earthen rampart, and was equipped with monumental gate, palace and temple. For a summary of the site and its finds, see (Ussishkin, 1992: 171–199). The assemblage discussed here was found in Level K-11 in Area K, located in the southeastern sector of the city (Fig. 2), which features remains of a domestic quarter (Fig. 3). Typical to this period, burials were found under the houses (Martin et al., in press-a, b).

The significance of the assemblage was recognized immediately after exposure of the uppermost components (Fig. 4). These included a conspicuous lump of red material. Using an FTIR operated on-site, we immediately identified this red material as containing among other minerals the clay mineral kaolinite (Fig. 5). Kaolinite is a minor clay mineral in the southern Levant, and when present in soils it comprises between 15 and 25% of the clays, with the dominant clay being montmorillonite (Gal et al., 1974). This observation, as well as the red color of the material, highlighted the fact that it was a most unusual find. With this in mind, the assemblage was meticulously excavated and the objects were handled carefully and not washed. This enabled us to obtain invaluable information on the materials adhering to many of the artifacts' surfaces. This mode of discovery and excavation underlies the importance of operating an on-site laboratory.

Here we analyze the materials of the tools themselves, as well as the materials adhering to the tools in order to establish the use of this unique assemblage.

2. Materials and methods

Once detected, the excavation of the assemblage was carried out delicately with small tools, the artifacts were photographed and the precise locations were documented with reference to the national grid using a total station. The artifacts were deliberately not washed once we realized that this was a major cache of associated objects. Only the large grinding stone and the perforated object were washed, as these were the first to be exposed.

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https://doi.org/10.1016/j.jasrep.2018.08.024
Received 1 February 2018; Received in revised form 13 August 2018; Accepted 13 August 2018

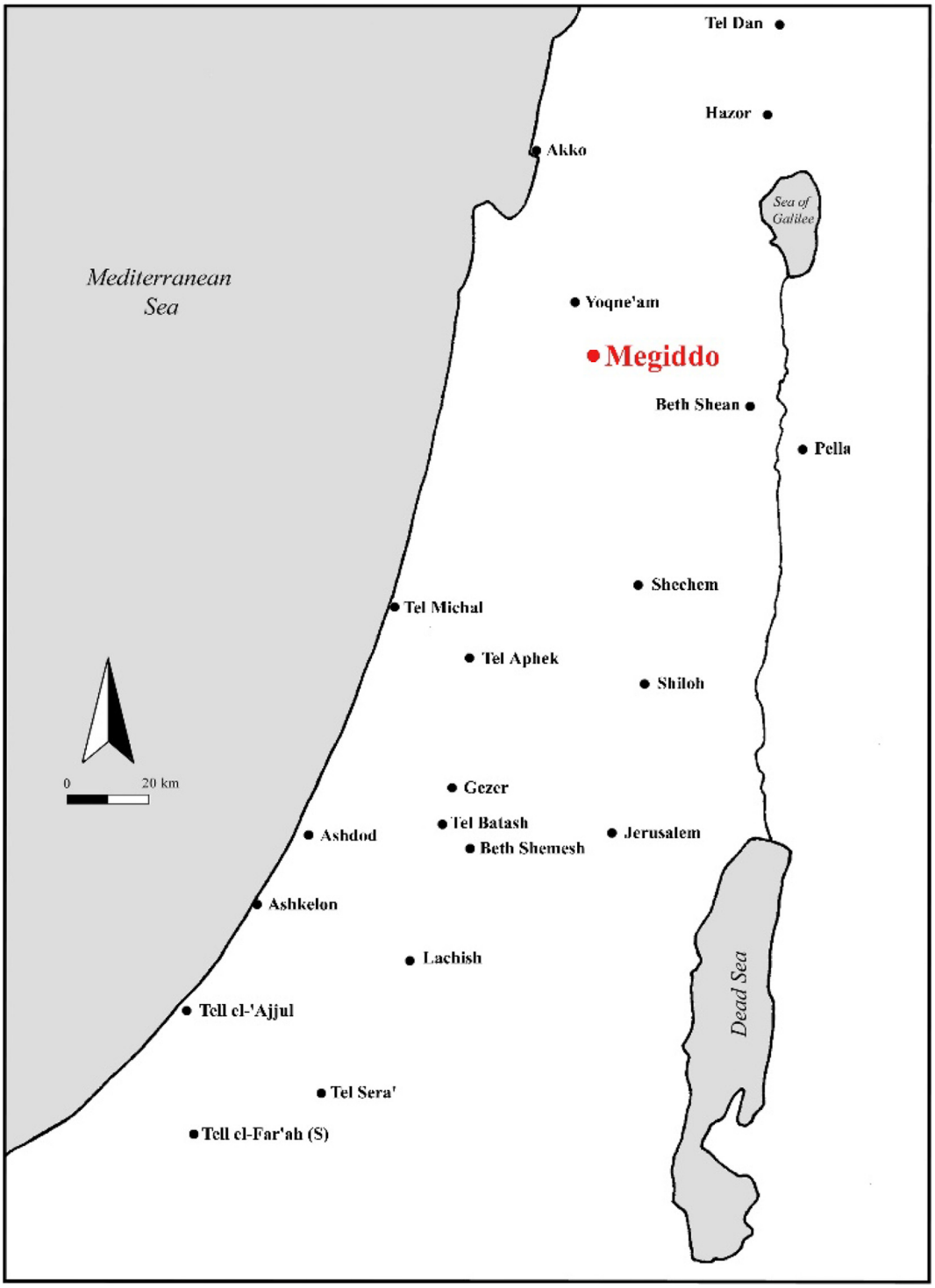

Fig. 1. Map showing important sites in the Middle Bronze southern Levant and the location of Megiddo.

Some of the initially exposed materials were analyzed on-site using Fourier Transform Infrared Spectroscopy (FTIR) (Weiner, 2010). The remaining analyses of the finds and adhering materials were carried out in the laboratory using FTIR and optical microscopes. All together 300 FTIR analyses were performed, using an iS5 Thermo FTIR. Less than a milligram of each sample was first homogenized by grinding in an agate mortar, and then about 10 mg of KBr was added. The sample and the KBr were well mixed and a transparent pellet was produced using a hand-held Pike Press. The samples were analyzed at 4 cm^{-1} resolution. The spectra were compared to a library of over 300 standard spectra that can be downloaded from the Kimmel Center of Archaeological Science (Weizmann Institute of Science) web site (http://www.weizmann.ac.il/kimmel-arch/infrared-spectra-library).

Powder diffraction measurements were carried out in reflection geometry using an Ultima III (Rigaku, Japan) diffractometer equipped with a sealed Cu anode X-ray tube operating at 40 kV and 40 mA. A bent graphite monochromator and a scintillation detector were aligned in the diffracted beam. $\theta/2\theta$ scans were performed under specular conditions in the Bragg-Brentano mode with variable slits. The 2θ scanning range was 6–90° with step size 0.025° and collection time of 9 s per step.