APPENDIX 5.2: MULTISPECTRAL IMAGING OF TEL MALḤATA OSTRACA

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Since ink on ostraca fades significantly over time, it is important for study and documentation to quickly acquire the most legible images of the inscriptions. We have recently demonstrated (Faigenbaum *et al*. 2012) that improved imaging can be achieved using multispectral imaging (MSI) rather than standard digital imaging.

We imaged many Tel Malḥata ostraca using a state-of-the-art commercial multispectral imager.[1] This system produces a set of images, each corresponding to a different wavelength range. We then carried out a detailed analysis to determine the optimal image (denoted as "M-image") from this set.

A significant improvement in legibility is observed when comparing the M-image and the standard color image (usually taken soon after excavation). In several cases, faded letters are considerably clearer and previously unrecognizable letters may be identified.

The readability of an ostracon in standard room conditions begins to degrade after excavation, due to fading of the ink. A standard color image taken long after excavation would therefore be much less legible than one taken soon after discovery. The multispectral images discussed here were taken in January 2011, while most of the ostraca were found and imaged during 1990–2000. It is noteworthy that in spite of ink degradation, MSI still yielded improved images. Therefore, one should aim to take MSI of ostraca soon after excavation.

Two examples illustrating the differences between regular color imaging and MSI are presented below (Figs. 5.21–5.22). Contrast and brightness of the images were adjusted with standard image processing software (Photoshop, ImageJ, GIMP, etc.).

Inscription No. 1 from Tel Malḥata (recovered during the first expedition, in 1971) is shown in Fig. 5.21. The left image shows the standard color image taken close to time of discovery (converted to grayscale), the right one shows the M-image. While several letters in the bottom lines are barely visible in the standard image, they appear more distinctly in the M-image. In addition, letters are more accentuated in the M-image (e.g., first and second lines).

Inscription No. 20 from Tel Malḥata (Fig. 5.22) shows a clear improvement for all letters in the M-image (right).

LOW-COST MULTISPECTRAL IMAGING SYSTEM

The above examples demonstrate clearly the advantages of MSI of ostraca. Fortunately, it is unnecessary to use expensive, state-of-the-art MSI systems to image ostraca. As we have demonstrated via our MSI studies of ostraca, a low-cost MSI system can give comparable images. The system comprises a modified digital camera along with nine bandpass filters (see Faigenbaum *et al*. 2012, for a detailed description of the construction and use of such a system).

1 CRI Nuance VariSpec SNIR-10 (short/near infrared) LCTF (liquid crystal tunable filter) multispectral imager, fitted with a CoastalOpt UV-VIS-IR 60mm apochromatic lens.

It is important to note that even without MSI, it may still be possible to improve the readability of old digital color images of ostraca. One should look at the different color channels separately, and compare the red (~600–700 nm), green (~500–600 nm), blue (~400–550 nm) and full-color images. The red channel may be the best choice between these possibilities, as previously observed (Bülow-Jacobsen 2008).

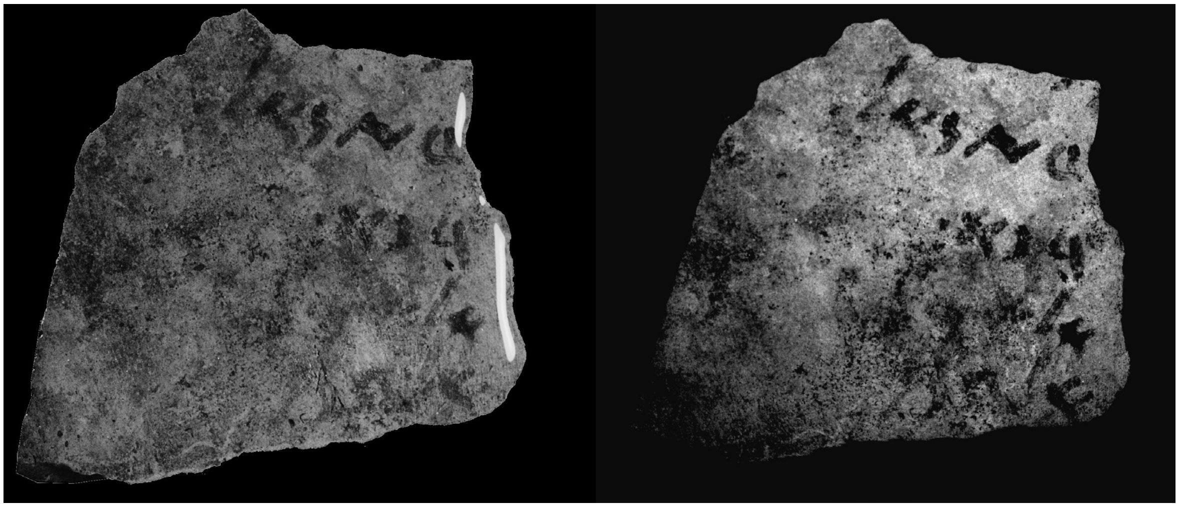

Fig. 5.21: Inscription No. 1. Left: original image converted to grayscale image; right: optimal multispectral image (M-image) taken at wavelength λ = 775 nm.

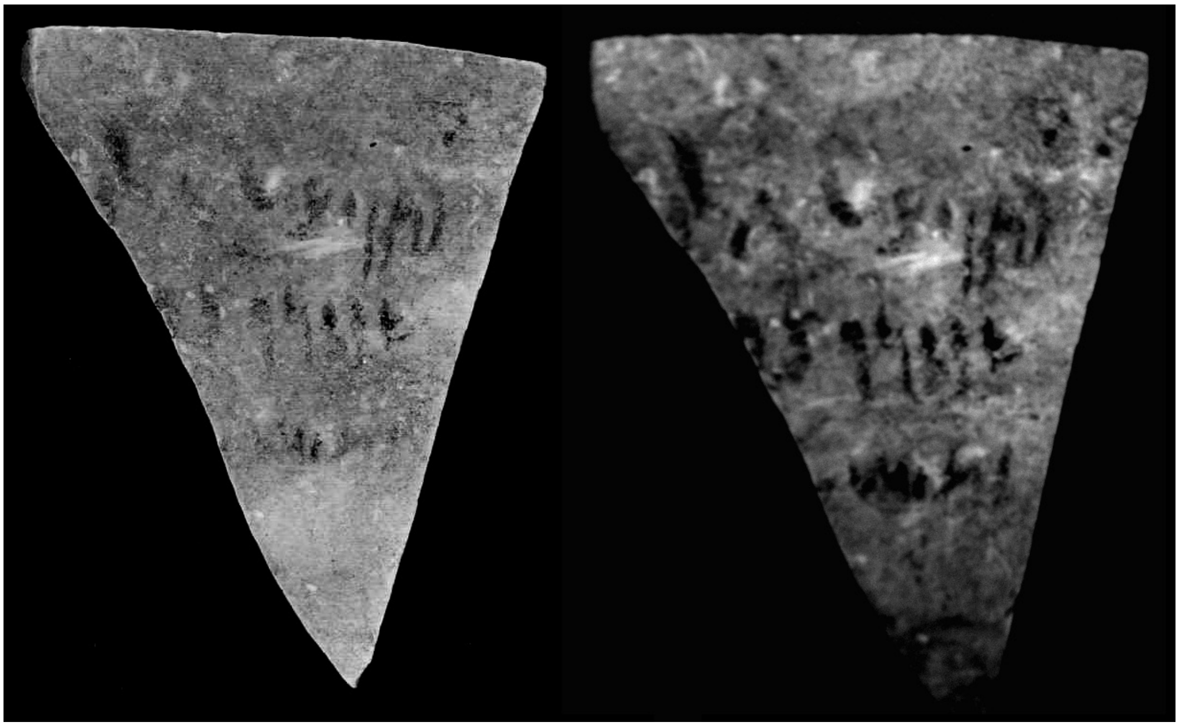

Fig. 5.22: Inscription No. 20. Left: original image converted to grayscale image; right: optimal multispectral image (M-image) taken at λ=720 nm.

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