

PETROGRAPHIC ANALYSIS OF TWO BALLAST STONES FROM TEL MIKHAL (TEL MICHAL)

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Two ballast stones were recovered during the 1996 IAA excavation at Tel Mikhal (Fig. 1).¹ Both stones were found in Area C1, close to the ridge of the northern hill, reused in a Persian-period installation (W805). Samples were taken from these two stones, thin sections were prepared and then examined under a polarizing microscope at $\times 40$ magnification. The results of this examination were compared with regional geology and lithology datasets.

Ballast stones were widely used in ancient times as heavy material loaded low in a vessel to improve stability at sea. Ballast could consist of stone anchors, pebbles, beachrocks, clay and even sand.² Soft materials (dunnage) were usually placed underneath the ballast to protect the vessel's structure. Cargo was then carefully loaded on top. Heavy goods, such as ingots, were loaded first, and amphorae could be stowed in one or more layers and eventually extra ballast stones completed the cargo up to the necessary weight to assure the ship's manoeuvrability. Spare weight seems to have been collected fresh from the shore when needed, rather than loaded from a ready-prepared ballast pile. Thus,

analysis of these stones can help shed light on tracing the trade routes followed by ancient ships.

Petrographic analyses of stone anchors and ballast stones have been carried out in the last several years with mixed results (Porat 1996:95). Tel Mikhal is a case in point. Since merely two ballast stones were found in secondary use as part of a wall, an attempt to trace a sailing route on the basis of these stones would be contrived. Another possibility is that the stones were collected at some shore along the vessel's route. To complicate matters, this process could have happened several times. The provenance of these particular ballast stones would then reflect the route of the vessel that used them, and not necessarily the last one. Furthermore, it is impossible to gauge what time gap occurred between each use, since using ballast as a sailing technique was known as early as the Bronze Age (Parker 1992:30).

Analysis

Fig. 1a (B7133, weight: 21.5 kg).— Several major minerals were observed in the sample:

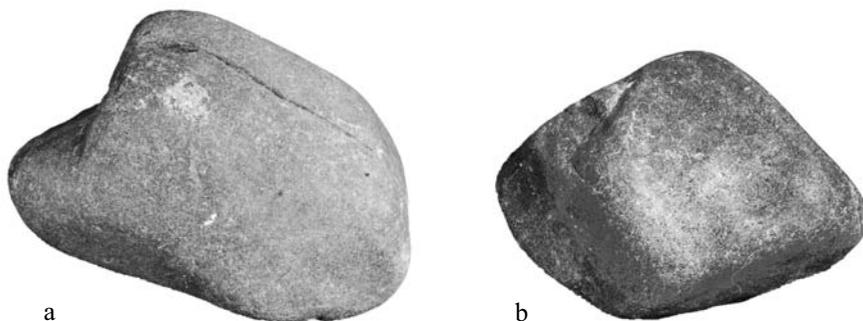


Fig. 1. Two ballast stones, found in secondary use.

quartz with characteristic wavy extinction, amphibolite showing poor two-directional cleavage and mica (biotite and muscovite). Pyroxene was noted as well, showing a 90 degree cleavage and a small quantity of ore (magnetite) with zircon as inclusion. Feldspar minerals appear as orthoclase and plagioclase, the latter with polysynthetic twins bearing an average extinction angle of 15–20 degrees, which allows us to define it as andesine. This stone can be defined as a medium grained monzo-diorite or quartz-monzonite.

Fig. 1b (B7134, weight: 18.5 kg).— The major minerals observed in this sample include quartz, mica (pleochroism in biotite), apatite and small amounts of orthoclase. Two other minerals appear in tiny amounts: plagioclase shows an average extinction angle of 40 degrees, which defines it as bytownite and pyroxene (appears as augite). The stone sample seems to be some kind of basic plutonic rock, perhaps gabbro.

DISCUSSION

The sampled stones cannot be assigned a local provenance from any location in Israel, since they are not characteristic of its geology (Bakler 1978; 1989; Horowitz 1979, Gifford, Rapp and Hill 1989). Such plutonic material is more likely to be found in the Cyprus area (Geological Map of Cyprus 1995).

A distant provenance is suggested for both analyzed stones. Both were probably loaded on a merchant ship on its way from the eastern Mediterranean basin to the Tel Mikhal anchorage. When the ship was loaded with local goods and heavy enough, the ballast stones were not required any longer, unloaded at the sea shore, and eventually collected and used as building stones. Because of the objective difficulties enumerated above, it would be unwise to reach any conclusion regarding the vessel's route. Hopefully, future excavations including shipwrecks and analysis of ballast stones found *in situ* in quantity will shed light on this matter.

On the one hand, the fact that such a distinctive seafaring device assigned to a distant origin was found at Tel Mikhal seems to reinforce the opinion that some kind of anchorage facilities were available in the area, perhaps north of Tel Mikhal (Grossman 1990:46). On the other hand, recent research shows that extended maritime and intensive nautical activities took place all along the coast of Israel. Underwater surveys and salvage excavations discovered port installations, prehistoric settlements and wrecked ships (Galili, Dahari and Sharvit 1993; Galili and Sharvit 1994). These activities were carried out during most of the historical periods, including the Persian period.

NOTES

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² Shown by the Procchio wreck excavation (Parker 1992:30).

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