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Journal of Archaeological Science 31 (2004) 1185–1189

Journal of Archaeological SCIENCE

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Authenticity examination of the inscription on the ossuary attributed to James, brother of Jesus

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Received 16 July 2003; received in revised form 26 February 2004

Abstract

A First Century CE ossuary belonging to a private collector, bearing engraved Aramaic inscription "Ya'akov bar Yosef achui de Yeshua" (James son of Joseph his brother of Jesus), has been attributed to James, Jesus' brother, first head of the Jerusalem church. The ossuary was reportedly found around Jerusalem. Previous examination suggested that the ossuary and the inscription were genuine.

Our research focuses on the authenticity of the patina that covers the inscription ("letters patina"), based on its petrography and oxygen isotopic composition ($\delta^{18}O$). We compared the $\delta^{18}O$ values of the letters patina from the James Ossuary, with the patina sampled from the uninscribed surfaces of the same item ("surface patina"), and with surface and letters patinas from legally excavated ossuaries from Jerusalem. In addition, the results were compared with $\delta^{18}O$ values of carbonates formed naturally from groundwater in the Judean Mountains. Our results show that the petrography and the $\delta^{18}O$ values of the letters patina of the James Ossuary differ significantly from the other patinas. The oxygen isotopic composition of the letters patina could not have formed under natural temperature and water oxygen isotope composition that prevailed in Judea during the last 3000 years. The patina was most likely artificially formed from powdered chalk immersed in hot water. These observations clearly call into question the authenticity of the inscription on "James Ossuary".

Keywords: Ossuary; Authenticity; Petrography; Oxygen isotopes; $\delta^{18}O$; Speleothems

1. Introduction

A First Century CE chalk ossuary belonging to a private collector (Fig. 1), bearing the engraved Aramaic inscription "Ya'akov bar Yosef achui de Yeshua" (=James son of Joseph his brother of Jesus), has been attributed to James, the brother of Jesus, first head of the Jerusalem church [19]. The burial box, (hence, "James Ossuary") was reportedly found at Silwan in Jerusalem. While previous mineralogical and geochemical examinations have proven the authenticity of the ossuary [12,19], doubts still remain as to the authenticity of the inscription on it, which drew the interest of numerous scientists from various disciplines.

This study focuses on the oxygen isotopic composition ($\delta^{18}O$) together with the petrography of the patina, which forms as a natural incrustation on the surfaces of rocks in the surface or sub-surface due to their exposure to rain and groundwater. In the Judean Mountains of Israel where the artifact was reportedly found, the host rock is almost entirely dolomite and limestone [1], and the patina that forms on such rocks is composed mainly of secondary calcium carbonate [8]. Our study compares the oxygen isotope composition ($\delta^{18}O$) and the petrography of patina that is deposited over the inscription letters of the James Ossuary (i.e., "letters patina"), with the patina developed on the surface of the same ossuary ("surface patina") and with letters and surface patinas

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doi:10.1016/j.jas.2004.03.001

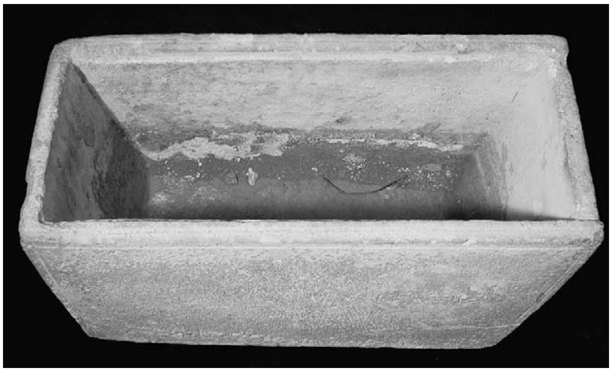

Fig. 1. The James Ossuary (courtesy the Israel Antiquities Authority).

of ossuaries found in legal excavations in Jerusalem. The latter are kept in the archaeological state collection of the Rockefeller Museum in Jerusalem [18]. The sampling locations from the James Ossuary are shown in Fig. 2 and the results are summarized in Table 1 and Fig. 3.

2. Method

Seven samples were collected from the letters patina i.e., the inscription from the James Ossuary and eight samples were collected from the surface patina in various locations using dental tools and a stereomicroscope (Fig. 2). Caution was taken while sampling in order to avoid contaminating the sampled patina with the underlying chalk. Samples were collected also from "surface" and "letters" patina of authentic ossuaries (Israel Antiquities Authority [IAA] numbers: 36.913, 36.2175, 42.127) found in Jerusalem area, and kept in the Rockefeller Museum collection [18].

Surface investigation was first made under a stereomicroscope at magnifications up to ×40 and under a Wild incident light (metallographic) microscope at magnifications of ×40–×400. Patina samples were examined in thin sections under a Zeiss Axiolab polarizing microscope at magnifications of ×40–×400.

The oxygen isotopic composition of the carbonate powder was analyzed using a VG Isocarb system attached to a SIRA-II mass spectrometer at the Geological Survey of Israel. All $\delta^{18}O$ values were calibrated against the international standard NBS-19, and are reported in permil, relative to the Pee Dee Belemnite (PDB) standard.

3. Results

Detailed petrographic examination of James Ossuary revealed that it is made of Senonian foraminiferous chalk of the Menuha Formation, containing ∼30% planktonic foraminifera (*Globigerinelloides* spp., *Heterohelix* spp.) and calcareous nannoplankton devoid of any signs of local metamorphism. This rock type is widespread in the Jerusalem vicinity [1] and was commonly used for the production of ossuaries during the First Century CE [18].

In a previous study, the inscription was observed as being "freshly cleaned", but coated in places with calcitic patina [12]. Detailed surface examination performed in this study under the stereomicroscope reveals that three types of secondary patina cover the James

Fig. 2. The inscription on James Ossuary, and the sampling locations of the letters and the surface patinas.

Table 1
$\delta^{18}O$ and $\delta^{13}C$ values of various patina types, James Ossuary and calcites deposited in the Judean Mountains during the last 3000 years

Sample description	$\delta^{18}O$ (‰ PDB)	$\delta^{13}C$ (‰ PDB)
Letters patina from the James Ossuary[a]		
Sample 1	−10.10	−4.70
Sample 2	−9.68	−1.20
Sample 3	−7.48	−5.70
Sample 4	−8.06	−7.71
Sample 5	−10.20	−3.33
Sample 6	−7.74	−4.08
Sample 7	−5.82	−5.14
Surface patina from the James Ossuary		
	−5.90	−3.54
	−5.87	−2.33
	−6.68	−7.45
	−5.10	−1.90
	−4.90	−3.48
	−5.83	−1.17
	−4.07	−5.67
	−5.21	−6.39
Surface patina from legally excavated ossuaries		
41.127—surface	−4.04	−2.80
236.913—surface	−4.02	−0.43
36.2175—surface	−5.22	−5.36
Letters patina from legally excavated ossuaries		
41.127—letters	−3.92	−1.40
36.2175—letters	−4.41	−6.16
236.913—letters	−4.26	−0.82
James Ossuary rock		
	−4.61	−0.40
	−4.40	−0.10
	−4.10	0.01
	−3.91	0.04
	−4.40	−0.15
	−3.85	0.20
Secondary calcite (speleothems) deposited during the last 3000 years [2,10,5]	−6.5‰ to −4.3‰	−10.0 to −11.5

[a] The location of the sample site is shown in Fig. 2.

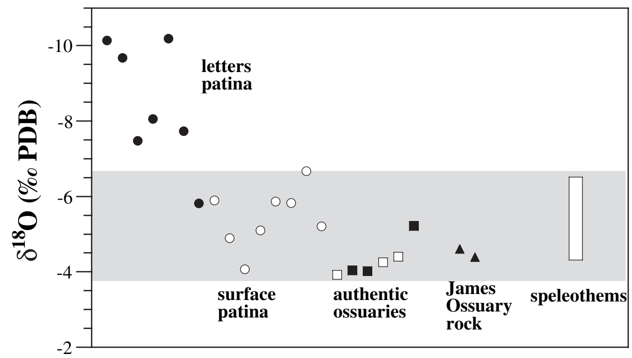

Fig. 3. Oxygen isotopic composition of the different patina types and secondary carbonates (speleothems) deposited inside caves in the Judean Mountains. Solid circles mark the letters patina; open circles mark the surface patina from the James Ossuary. Solid and open squares are letters and surface patinas from legally excavated ossuaries, respectively. Solid triangles mark the James Ossuary rock. Open rectangles mark the range of speleothems from the Judean Mountains [2,10,5]. The shaded gray area marks the overall range of naturally formed calcites in the Judea Mountains.

Ossuary. The first is a thin clay veneer of ochre biologically originated coating, or varnish, a matter often thought to be the result of microbial activity [8]. This varnish is superimposed in places by calcitic patina of gray color exhibiting sub-millimeter crystals, often displaying cauliflower shaped intergrowth. The letters cut through the varnish (Fig. 4), hence the entire inscription postdates it, or it has been cleaned by a sharp tool after its deposition. The inscription area, especially the words ‘‘his brother of Yeshua’’, are coated by fine textured to finely gritty, grayish matter. This matter is found only in and around the inscription. Micromorphologic study of the letters patina from James Ossuary show that it contains marine microfossils of nannoplankton (coccoliths), unlike all other surface and letter patinas, which do not contain any microfossils.

$\delta^{18}O$ values of the surface patina from James Ossuary, as well as the patinas of the other (legally excavated) ossuaries, have similar range of values, which are also similar to the range of values typical of the well-dated secondary calcite (speleothems) deposited inside caves in the Jerusalem area during the last 3000 years [10,11] (Fig. 3). Their $\delta^{18}O$ values are in agreement with the expected range of naturally formed secondary carbonates in the climatic conditions that prevailed in the Judean Mountains during the last 2000 years ($\delta^{18}O$ water −6‰ to −4‰ (SMOW) and mean annual temperatures of 18–19 °C [2,4,6]. These values are also similar to the range of diagenetically altered limestones from the Judea Mountains [13]. In contrast, significantly lower $\delta^{18}O$ values were measured for six samples taken from the letters patina (inscription) from the James Ossuary, ranging between −10.2‰ and −7.5‰. Only one sample taken from the last letter of the inscription (Figs. 2, 3 #No. 7) has a value of −5.8‰, and most likely arises from contamination with the host rock with $\delta^{18}O$ ~−4.5‰ (Table 1), which underlies the letters patina. Thus, the marked difference between the $\delta^{18}O$ values of the letters patina taken from the inscription and the surface patina from James Ossuary and patina from other authentic ossuaries, and secondary calcite from the Judea Mountains, makes it clear that the letters patina from James Ossuary has a different origin. No limestones from outcrops in Israel have compositions overlapping these low $\delta^{18}O$ values [13].

4. Discussion

The relationships between calcite $\delta^{18}O$ values and the possible combinations of water $\delta^{18}O$ and temperature are calculated using the equation: $1000 \ln \alpha$ calcite $- H_2O = 2.78(10^6)T^{-2} - 2.89$ [9,17], and plotted in Fig. 5. It can

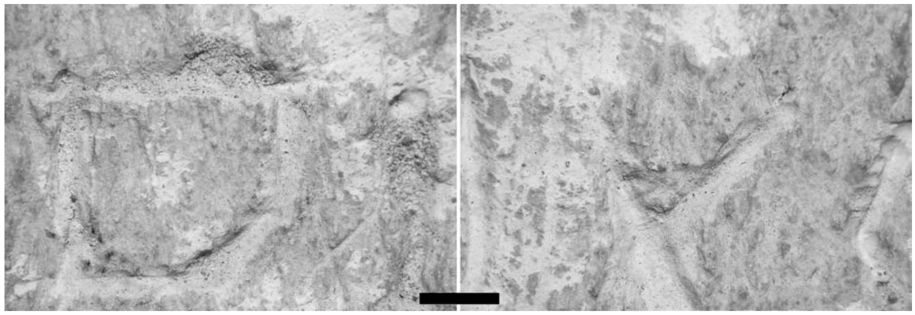

Fig. 4. Microscopic view of letters from the words "Joseph" and "brother", demonstrating post-varnish engraving of the writing, later coated by the letters patina (powdery material coating the depressions).

be seen that patina with $\delta^{18}O$ values typical to the letters patina from James Ossuary (−10.2‰ to −7.5‰), could have formed in two possible conditions. It could either be formed at surface temperatures (18 °C–19 °C) but with water $\delta^{18}O$ −10‰ to −7‰ (SMOW) or it could be formed from water with $\delta^{18}O$ values typical of Judean Mountains groundwater (−6‰ to −4‰) but at formation temperatures ranging between 40–50 °C. The former possibility is very unlikely, as there is no evidence for the existence of water with such low $\delta^{18}O$ values in the area during this time span. The range of rain and groundwater $\delta^{18}O$ values in the Judean Mountains region during the last 3000 years could not have been lower than ~−6‰ (SMOW) [2,3]. Water with values of −10‰ is typical to high elevations and high-latitudes [7,20,16]. The second possibility can be ruled out since ground temperatures of 40–50 °C did not exist in the region during the last 3000 years and the maximum land temperatures in the area reached only 22 °C whereas the present-day average land temperatures is 18–19 °C [3,14,15]. Hence, the isotopic composition of the letters patina from the James Ossuary differs from all other measured natural patinas. The fact that it could not be formed in the natural conditions that prevailed in the Judean Mountains during the last 3000 years, indicates

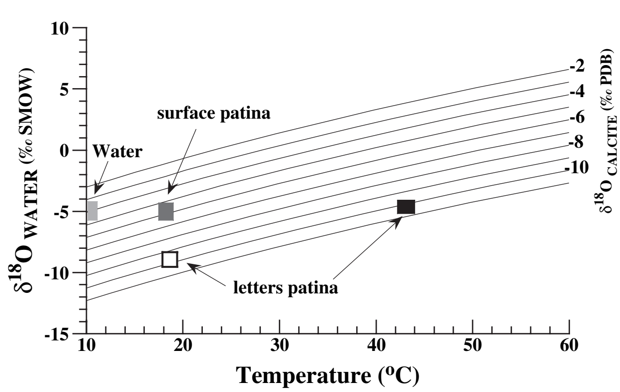

Fig. 5. The calculated relationships between calcite $\delta^{18}O$ values and the possible combinations of water $\delta^{18}O$ and temperature using the equation: $1000 \ln \alpha \text{calcite} - H_2O = 2.78(10^6)T^{-2} - 2.89$ [9,17], where α calcite–H_2O is the fractionation factor defined as the ratio ($^{18}O/^{16}O$ calcite)/($^{18}O/^{16}O$ water).

that the patina covering the letters was artificially prepared, most probably with hot water, and deposited onto the underlying letters.

Moreover, the fact that only the letters patina from the James Ossuary contain microfossils of marine origin, suggests that it was artificially deposited, after it was made by grinding marine carbonate sediments (possibly chalk from the same burial box) and dissolving them in warm water. The calcite precipitated from this solution obtained the very low $\delta^{18}O$ values.

It may be even logical to assume that the water temperature was considerably higher, but the $\delta^{18}O$ values were slightly brought up to their measured values due to the presence of the coccoliths (the latter having higher $\delta^{18}O$ values of ~−4.5‰). Hence, it may be assumed that originally, the powdered chalk was immersed in boiling water and applied over the freshly cut inscription. These observations clearly call into question the authenticity of the inscription on James Ossuary.

The method described here has never been applied for authenticity tests of archaeological artifacts. It may serve to establish the authenticity of other controversial archaeological items (including petroglyphs and inscriptions) in every location where a database of $\delta^{18}O$ values of calcite exists. Advisedly, the analytical data should be correlated with the archeological evidence. The combination of the two disciplines is the key to a successful research of this type.

Acknowledgements

This study was carried-out at the laboratories of the Geological Survey of Israel and the Laboratory for Comparative Microarchaeology of the Institute of Archaeology, Tel-Aviv University. We thank S. Dorfman, Director of the Israel Antiquities Authority, and A. Bein, Director of the Geological Survey of Israel, for appointing two of us (A.A. and Y.G.) as members of the special research committee studying the authenticity of the inscription on the James Ossuary and the Jehoash inscription, under which this research was done. U. Dahari from the Israel Antiquities Authority, whose help and support were substantial, chaired the committee. We thank Yehoshua Kolodny, Amos Bein, and Ittai Gavrielli for the fruitful discussion and Alan Matthews for his critical comments of the manuscript.

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