IDENTIFICATION OF PUMICE AND VOLCANIC ASH FROM ARCHAEOLOGICAL SITES IN THE EASTERN MEDITERRANEAN REGION USING CHEMICAL FINGERPRINTING

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Introduction

The volcanic layer of the "Minoan" eruption of the Thera volcano between 1450 and 1650 B.C. is a clear time marker in the stratigraphy of the surrounding area. Therefore, the general idea of this study was to settle the volcanic products of this major eruption, which lasted only a few days, within the relative archaeological chronologies of the Eastern Mediterranean region in correlation to its different time frames. Although the date of the eruption is still object of intense debates,[1] the eruption products can be used as tangible evidence for contemporaneity or at least post-eruption dating of the respective strata wherever found within well-defined stratigraphies of an archaeological site.

The majority of the erupted material consists of chemically rather homogeneous pumice and pumiceous flow deposits, the so-called "Minoan tuff" or "Oberer Bimsstein" (Bo, upper pumice[2]). Generally, the term tephra designates all fragmental volcanic ejecta produced during an eruption. The volume estimations for the tephra output of the Minoan eruption range from 16 to 35 km^3 of dense rock equivalent.[3] The impact on the contemporary civilizations is evident and alluvial pumice as well as direct fallout from the eruption cloud is reported from several sites on Greek islands and Asia Minor (see e.g.,[4] and references therein). The fallout formed a synchronous layer of volcanic ash (tephra with grain size ≤ 2 mm) that can be used directly as a datum line. Provided a reliable identification, it can be used for chronology wherever found in primary deposits. Pumice, on the contrary, floats on water and was transported over large distances all over the Eastern Mediterranean region due to marine currents and wind.[5] It can be assumed that within weeks after the eruption large amounts of pumice were accumulated along the shorelines. Pumice is a quite useful abrasive which has been collected and traded

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[1] Manning S.W. (1999), *A Test of Time – The Volcano of Thera and the chronology and history of the Aegean and east Mediterranean in the mid second millennium BC,* Oxbow books, Oxford and Oakville.

[2] Vitaliano C.J., Fout J.S., Vitaliano D.B. (1978), Petrochemical study of the Tephra sequence exposed in the Phira Quarry, Thera, in: C. Doumas (ed.), *Thera and the Aegaean World* 1, London, 203–215; Vitaliano C.J. Taylor S.R., Norman M.D., McCulloch M.T., Nicholls I.A. (1990), Ash layers of the Thera Volcanic Series: Stratigraphy, Petrology and Geochemistry, in: Hardy D.A., Renfrew A.C. (eds.), *Thera and the Aegean World* III, London, 53–78; Francaviglia V., Di Sabatino B. (1990), Statistical Study on Santorini Pumicefalls, in: Hardy D.A., Renfrew A.C. (eds.), *Thera and the Aegean World* III, London, 29–52; Druitt T.H., Edwards L., Mellors R.M., Pyle D.M., Sparks R.S.J., Lanphere M., Davies M., Barriero B. (1999), *Santorini Volcano* Geological Society Special Publications, *Geological Society of London* 19, 165 pp; Sparks R., Wilson C. (1990), The Minoan deposits: a review of their characteristics and interpretation, in: Hardy D.A., Renfrew A.C. (eds.), *Thera and the Aegean World* III, London, 89–99.

[3] Sigurdsson H., Carey S., Devine J.D. (1990), Assessment of Mass, Dynamics and Environmental Effects of the Minoan eruption of Santorini volcano, in: Hardy D.A., Renfrew A.C. (eds.), *Thera and the Aegean World* III, London, 100–112; Pyle D.M. (1990) New estimates for the volume of the Minoan eruption, in: Hardy D.A., Renfrew A.C. (eds.), *Thera and the Aegean World* II, London, 113–120.

[4] Peltz C., Schmid P., Bichler M. (1999), INAA of Aegean pumices for the classification of archaeological findings, *Journal of Radioanalytical and Nuclear Chemistry* 242/2, 361; Pearce N.J.G., Eastwood W.J., Westgate J.A., Perkins W.T. (2002), Trace-element composition of single glass shards in distal Minoan tephra from SW Turkey, *Journal of the Geological Society London* 159, 545–556.

[5] Bichler M., Egger H., Preisinger A., Ritter D., Stastny P. (1997), NAA of the 'Minoan pumice' at Thera and comparsion to alluvial pumice deposits in the Eastern Mediterranean region, *Journal of Radioanalytical and Nuclear Chemistry* 224, 7–14; Warren P.M., Puchelt H. (1990), Stratified Pumice from Bronze Age Knossos, in: Hardy D.A., Renfrew A.C. (eds.) *Thera and the Aegean World III,* 3, 71–81.

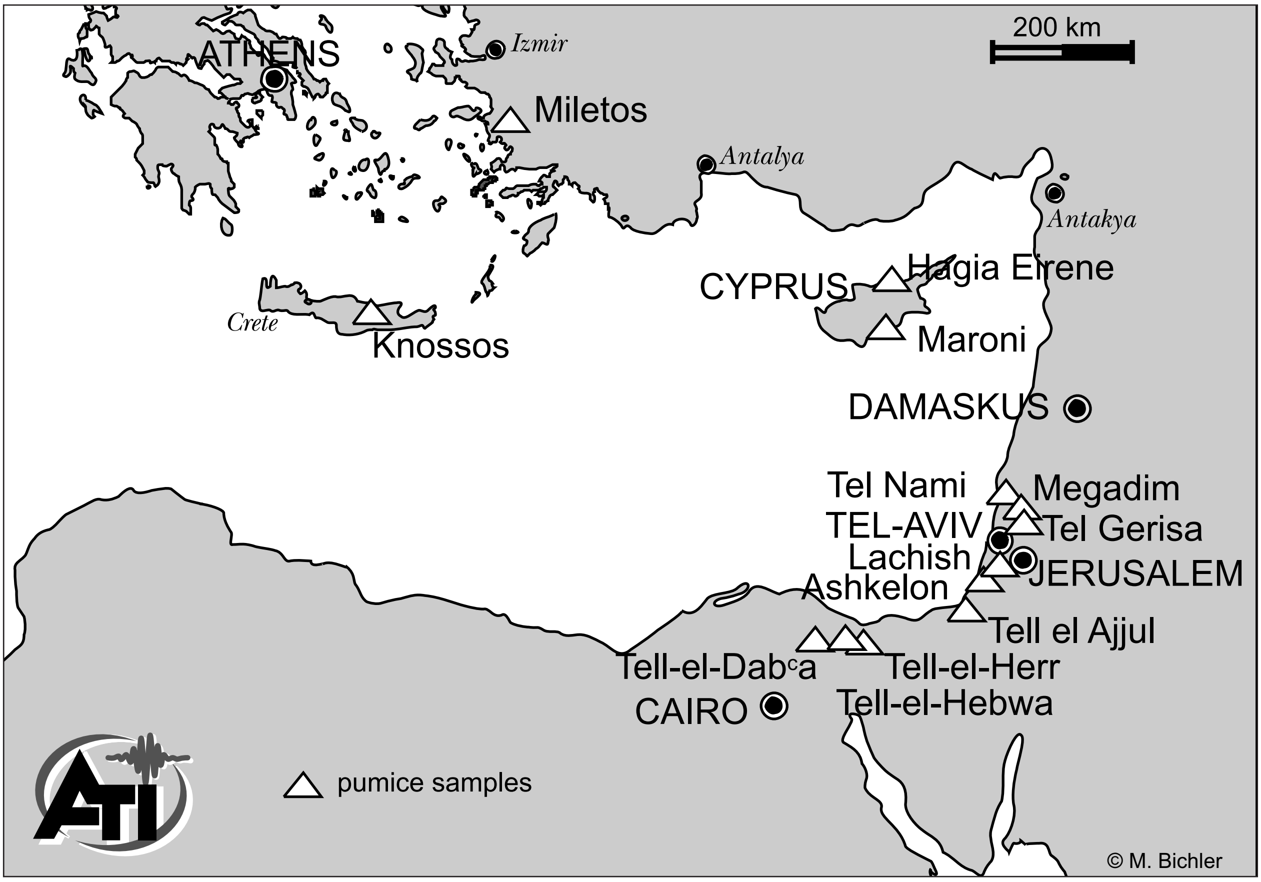

Fig. 1 Geographical distribution of pumice samples found in archaeological excavations of the Eastern Mediterranean that were included in this study

since prehistoric times. The applicability for chronological purposes has been checked in earlier studies by demonstrating that the "Minoan" pumice is sufficiently homogeneous and can be distinguished from the numerous other Aegean pumice sources by comparing normalized trace element distribution patterns ("chemical fingerprinting").[6] Additionally, these studies have shown that instrumental neutron activation analysis (INAA) is a perfectly suitable technique to identify such material.

Nevertheless, for the identification of tephra deposits in greater distance to the volcano a chemically relevant effect has to be considered. The erupted material consists mainly of highly vesicular silicate glass (pumice) with a certain percentage of crystals having formed during melt ascent (e.g., pyroxene, quartz, feldspar, titanomagnetite). Several elements are enriched in these mostly sub-mm sized crystals, which numerically decrease with growing distance from the volcano due to separation by gravity.[7] Previous studies from our working group[8] showed significant differences in the compositions between bulk pumice and the pure glass fraction. The occurrence of Minoan tephra deposited direct-

[6] Bichler M., Egger H., Preisinger A., Ritter D., Stastny P. (1997), NAA of the 'Minoan pumice' at Thera and comparsion to alluvial pumice deposits in the Eastern Mediterranean region, *Journal of Radioanalytical and Nuclear Chemistry* 224, 7–14; Bichler M., Peltz C., Saminger S., Exler M. (2003), Aegean Tephra – an analytical approach to a controversy about chronology, *Egypt and the Levant* 12, 55–70.

[7] Williams H., McBirney A.R. (1979), *Volcanology*, Freeman, Cooper &Co, San Francisco, USA, 138ff.

[8] Schmid P., Peltz C., Hammer V.M.F., Halwax E., Ntaflos T., Nagl P., Bichler M. (2000), Separation and Analysis of Theran Volcanic Glass by INAA, XRF and EPMA, *Mikrochimica Acta* 133, 143–149.

ly from the eruption cloud is not restricted to the Aegean region. It has also been found in lake sediments from Köycegiz, Gölcük Gölü, Gölhisar Gölü (Turkey) and even in deep-sea cores from the Black Sea.[9] The estimated orientation and extent of the tephra layer differs greatly depending which types of deposits (e.g. lacustrine and continental deposits, deep-sea drill cores) are considered. This is due to the difficulty to decide whether deep-sea tephra layers have been produced by fallout from the eruption cloud or if there is a major contribution by sunken, fragmented, and compacted pumice. The amount of this contribution is governed by the direction of the marine currents and the time span until the pumice starts to sink. Experiments and observations have shown that this can last for months[10] and therefore a significant amount can be expected even in areas where actually no eruption cloud fallout has been deposited.

Samples and Analytical Techniques

In this study 286 samples of archaeologically stratified pumice collected in excavations at Tell el-Dab^ca (Egypt), Sinai, Tel Nami, Tel Gerisa, Ashkelon, and Megadim (all Israel), Miletos (Turkey), and Knossos (Crete) were identified due to their mineralogical composition and by chemical fingerprinting. For an overview on the geographical situation see Fig. 1. The pumice pieces vary in size between one and 15 cm in diameter, and are whitish to brown in color mostly with abundant crystals of feldspar, biotite, quartz, or ore minerals. The tephra layer found in the excavation site of Iasos, Turkey (Fig. 2) was analyzed on the elemental distribution within the layer.

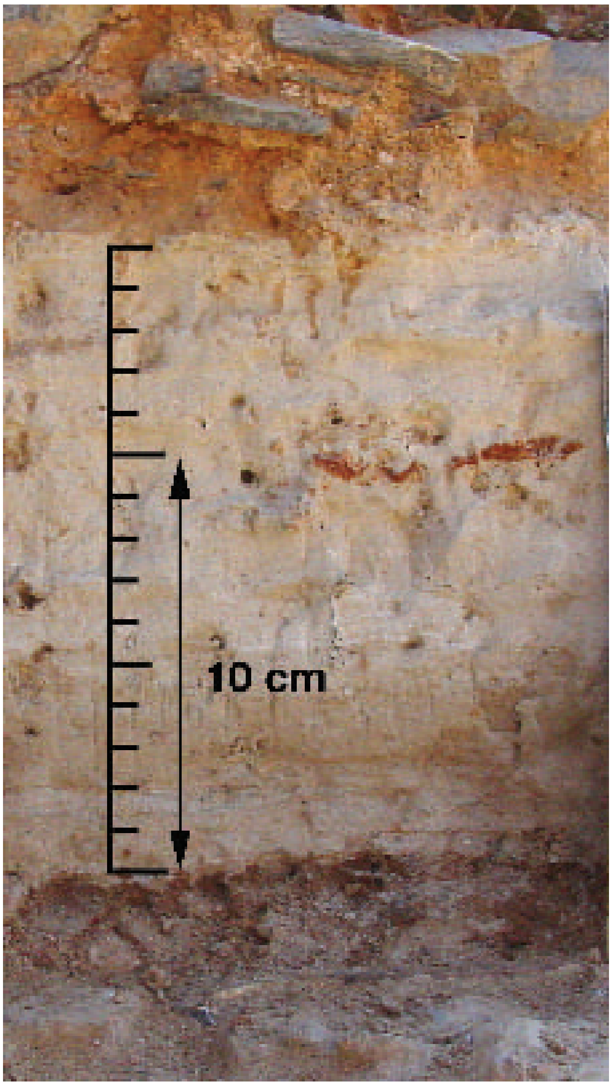

Fig. 2 Overview of the tephra layer at Iasos, Turkey. This layer was found below a roman pavement

Sample preparation

Each archaeological sample was treated as follows: after thorough surface cleaning with distilled water in an ultrasonic bath and the microscopical investigation, about 1g (or more, if available) of each sample was crushed exclusively with polyethylene (PE) tools and transferred to polypropylene (PP) beakers to avoid any contamination. Drying for about 90

[9] Van Zeist V., Woldring H., Stapert D. (1975), Late Quaternary vegetation and climate of southwestern Turkey, *Palaeohistoria* 17 55–143; Sullivan D.G. (1988), Discovery of Santorini Minoan Tephra in Western Turkey, *Nature* 333, 552–554; Guichard F., Carey S., Arthur M.A., Sigurdsson H., Arnold M. (1993), Tephra from the Minoan eruption of Santorini in sediments of the Black Sea, *Nature* 363, 610–612; Keller J. (1980), Prehistoric pumice tephra on Aegean islands, in: C. Doumas (ed.), *Thera and the Aegean World* II, 49–56; Vinci A. (1985), Distribution and chemical composition of tephra layers from Eastern Mediterranean abyssal sediments, *Marine Geology* 64, 143–155; Watkins N.D., Sparks R.S.J., Sigurdsson H., Huang T.C., Federman A., Carey S., Ninkovich D. (1978), Volume and extent of the Minoan tephra layer from Santorini volcano: new evidence from deep-sea sediment cores, *Nature* 271, 122–126; Soles J.S., Davaras C. (1990), Theran ash in Minoan Crete: New excavations in Mochlos, in: Hardy D.A., Renfrew A.C. (eds.), *Thera and the Aegean World III*, 89–95.

[10] Sutherland F.L. (1965), Dispersal of pumice supposedly from the 1962 South Sandwich Islands eruption on Southern Australian shores, *Nature* 207, 1332–1335.

hours and homogenization by grinding in an agate mortar to grain sizes < 3 micrometers were followed by additional drying to constant weight at 110°C.

The tephra-layer from the excavation site at Iasos has an average thickness of about 16cm over an accesible length of several meters. It was sampled in eight units of 2 cm each (see Fig. 2). To prepare the samples for instrumental neutron activation analysis (INAA) they were first dried for 12 h at 110°C then weighed and decarbonatized. To remove the carbonaceous compounds, 20 ml $HNO_{3\ conc.}$ diluted with 80 ml triple-distilled water were added to about 25g of each dried sample in PP-beakers. A reduction of the fine-grained fraction (< 5 micrometers) containing clay minerals was achieved by decanting the supernatant after one hour. This procedure was repeated at least three times until the solution was clear. Five reiterations were needed for the uppermost section of the layer because of its high contamination by organic material from the overlying soil. The residual solid fractions were dried in conical cups made of Teflon™ at 110°C. The decanted fine-grained fractions were rinsed with tri-distilled water and acetone, and dried in Teflon™ cups, too. All fractions were re-weighed to determine the total amount of volatilized components. The fractions were named from bottom (Iasos 1) to top (Iasos 8) in the stratigraphic sequence.

Optical microscopy

The pumice samples were thoroughly examined under the binocular microscope to determine the amount and size of crystals (especially biotite) as well as the vesicularity and the texture of the glassy matrix.

The volcanic glass shards separated from the layer at Iasos were studied with a ZEISS Axiolab polarization-microscope with variable magnification up to 1000. From the separated material about 1 mm^3 (~ 5000 particles) was investigated by optical microscopy. These glass shards show characteristic shapes and appear as single grains as well as transparent aggregates. They are are optically isotropic, single shards clear, the aggregates with a more whitish appearance.

Chemical fingerprinting

For INAA about 150 mg of each sample were sealed into Suprasil™ quartz glass vials. The samples were irradiated together with certified reference material for 100 hours in the KFKI-reactor of the Atomic Energy Research Institute, Budapest, Hungary, at a thermal neutron flux of 7×10^{13} $cm^{-2}s^{-1}$. The multi-element standards used for the quantitative analysis were the CANMET reference soil SO1, NIST SRM 1633b Coal fly ash, BCR No. 142 light sandy soil, and MC rhyolite GBW 07113. The quartz sample vials were decontaminated and packed into polyethylene vials fitting the automatic sample changer facilities of the Atominstitut. After a decay time of 5 days, a first gamma-spectrum was measured to obtain the activities of the short and medium-lived activation products As-76, K-42, La-140, Lu-177, Na-24, Np-239 (U), and Sm-153. Three weeks later, a second measurement was started to detect the long-lived activation products Ba-131, Ce-141, Co-60, Cr-51, Cs-134, Eu-152, Fe-59, Hf-181, Lu-177, Nd-147, Pa-233 (Th), Rb-86, Sb-124, Sc-46, Ta-182, Tb-160, Yb-169, Zn-65, and Zr-95. The measuring times were 1800 s and 10000 s, respectively. All samples were measured using an automatic sample changer with a fixed distance of 2 cm beside the detector. The whole analysis was performed with a 151 cm^3 HPGe-detector (1.8 keV resolution at the 1332 keV ^{60}Co peak), connected to a PC-based multichannel analyzer with preloaded filter and loss-free-counting system.[11] Possible contributions by fission products to the Ce and Nd abundances were checked with the coal-fly-ash standard having a high U-content of 8.79 mg/kg resulting in no detectable influences.

Results and Discussion

Pumice

The results of the chemical analysis are presented in Table 1. Normalizing these abundances to the average elemental abundances of Santorini Bo ("Minoan") pumice, a clear identification of the volcanic sources can be achieved (see Table 2). The results indicate that in the excavations pumice from the Southern Hellenic island arc (including Milos,

[11] Westphal G.P. (1995), Digital Implementation of the Preloaded Filter Pulse Processor, *Journal of Radioanalytical and Nuclear Chemistry* 193, 81–88; Westphal G.P. (1982), Real-time correction of counting losses in nuclear pulse spectroscopy, *Journal of Radioanalytical and Nuclear Chemistry* 70, 387–410.

Santorini, Nisyros, Giali, Kos), from the Aeolian islands (Lipari, Italy), and from Central Anatolia was found. The associated volcanic eruption ages are given in Table 3. The elemental concentrations of some pumice samples (Tel Nami, Megadim) have been published[12] previously, for a better overview they are added to Table 1.

The conformity of all elemental concentration data related to chemical fingerprinting is demonstrated for the pumice samples from Tell el Dabᶜa, Series L in Fig. 3 a–f. The shaded areas represent the natural variation of the element concentrations found in the respective deposits (data from [13]). The samples can be clearly identified as "Minoan", from the greek islands Nisyros and Giali, or from Pre-Minoan eruptions of Santorini called Bu 2 and Cape Riva. Nevertheless, two samples could not be identified with the database actually available. Sample L-2 shows the same distribution pattern as three of the samples from Ashkelon (E-80, E-146, E-174), but all of them can be distinguished from the Santorini Bo pumice.

Generally the patterns agree quite well with the natural variation ranges, nevertheless some exceptions have to be explained. The slight deviations are due to the very small quantities taken from the original pumice. The virtual enrichments in Cr and Co are most probably due to contamination during excavation work with steel tools, whereas the differences in Sb and As are due to the geochemical behavior (volatility) of these elements. Another possibility is the virtual dilution due to quartz grains in the samples. On the other hand only minor changes in composition due to leaching effects are found although glass hydration effects and strongly weathered rock surfaces were observed especially in the water-saturated sedimentary environment of Tell el Dabᶜa. All these effects lead to misinterpretations in statistical programs, since they cannot consider the "robustness" of elements under all possible geochemical and environmental influences during pumice storage in the various archaeological sites. To confirm the identifications, binary trace element ratio plots represent a good means,[13] such as the Eu versus Ta or Eu/Ta versus Ba/Th graph (Fig. 4). This graph is one example of an entire series of element ratio graphs especially designed to distinguish the different pumice-producing eruptions of the Santorini volcano. The samples from Tell el Dabᶜa Series L plot very clear in the fields of Santorini Bo (Minoan Tuff), Bu (Lower pumice), and Cape Riva.

Iasos tephra layer

In Fig. 5 the trace element pattern normalized to Santorini Minoan Tuff (Bo, "oberer Bimsstein") is presented. The layer can be identified as Santorini Bo and shows a rather homogeneous composition. For the majority of the elements, depletions by a factor of 0.9 on the average can be observed. Exceptions are the elements As (mean enrichment factor 1.31), Cr (6.8), Co (1.18), Sb (1.44), and K (1.16). These enrichments are due to environmental contamination and were found at even higher levels in the separated fine-grained fraction containing the samples' clay mineral content (see Table 4; sample Iasos 1f).

Nevertheless, comparing the elements throughout the different layers (Fig. 6 a–d) the variations for most of the elements add up to the same trend. The layers with lowest carbonate abundances (e.g., 3 & 7) show the highest contents in all other elements determined and vice versa. Iasos 4, the unit with 2nd-highest carbonate content is depleted in Na, K, Fe, and most of the trace elements. The same phenomenon is found in layers 1 and 8, which are highly contaminated by the over- and underlying soil, leading to depletions in all elements determined. In layer 4, a contamination with carbonaceous muddy material mixed with silica could be the reason for the observed depletion of all elements determined.

On the contrary, layer 3 seems to be a very pure tephra-layer, such as layer 7. Since these two layers are separated by the carbonate-rich layer 4, the scenario seems to be as follows: Layer 1–3 represent the original tephra sequence, layer 4 shows the first intake of carbonaceous material from the environment, layer 5–7 is slumped material washed in either during the deposition process or shortly afterwards.

Another possible explanation would be to assume that the minima of carbonaceous contamination (samples 1–3, 5 and 7) represent the first

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[12] Huber H., Bichler M. (2003), Geochemical correlation of archaeological sites using tephra from the Minoan eruption, *Czechoslovak Journal of Physics* 52, A47–A60.

[13] Peltz C., Schmid P., Bichler M. (1999), INAA of Aegean pumices for the classification of archaeological findings, *Journal of Radioanalytical and Nuclear Chemistry* 242, 361–377.

three phases of the Minoan eruption. However, this can be ruled out, since the chemical signature is typically for the first (Plinian) phase of this eruption, and the variations within all sub-units of the sequence are negligible compared to those found for the different phases of the Santorini eruption.

Conclusions

Pumice samples from diverse excavation sites throughout the whole Eastern Mediterranean region (Turkey to Egypt) have been identified using chemical fingerprinting and mineralogical investigations. Those samples that could not yet be identified can be clearly differentiated from Santorini Bo pumice and from all other sources already investigated in our research group. Samples taken during an excursion to Cappadocia (Central Anatolia, Turkey) in summer 2003 will significantly enlarge the analytical database and enhance our ability to identify pumice findings accordingly.

The tephra layer at Iasos is a good example for studying geochemical changes by post-depositional effects on such tephra falls. The modification started with the deposition and slumping of different sequences within the layer and was carried on by the infiltration of solutions bearing carbonate, silica, and other agents related to soil and even anthropogenic deposits. This process leads to a progressive alteration of the layer ending up in the decomposition of the vitric particles and ingrowth of clay minerals such as Kaolinite and Montmorillonite. Further research on possible chemical changes during transport in the stratosphere is presently being carried out.

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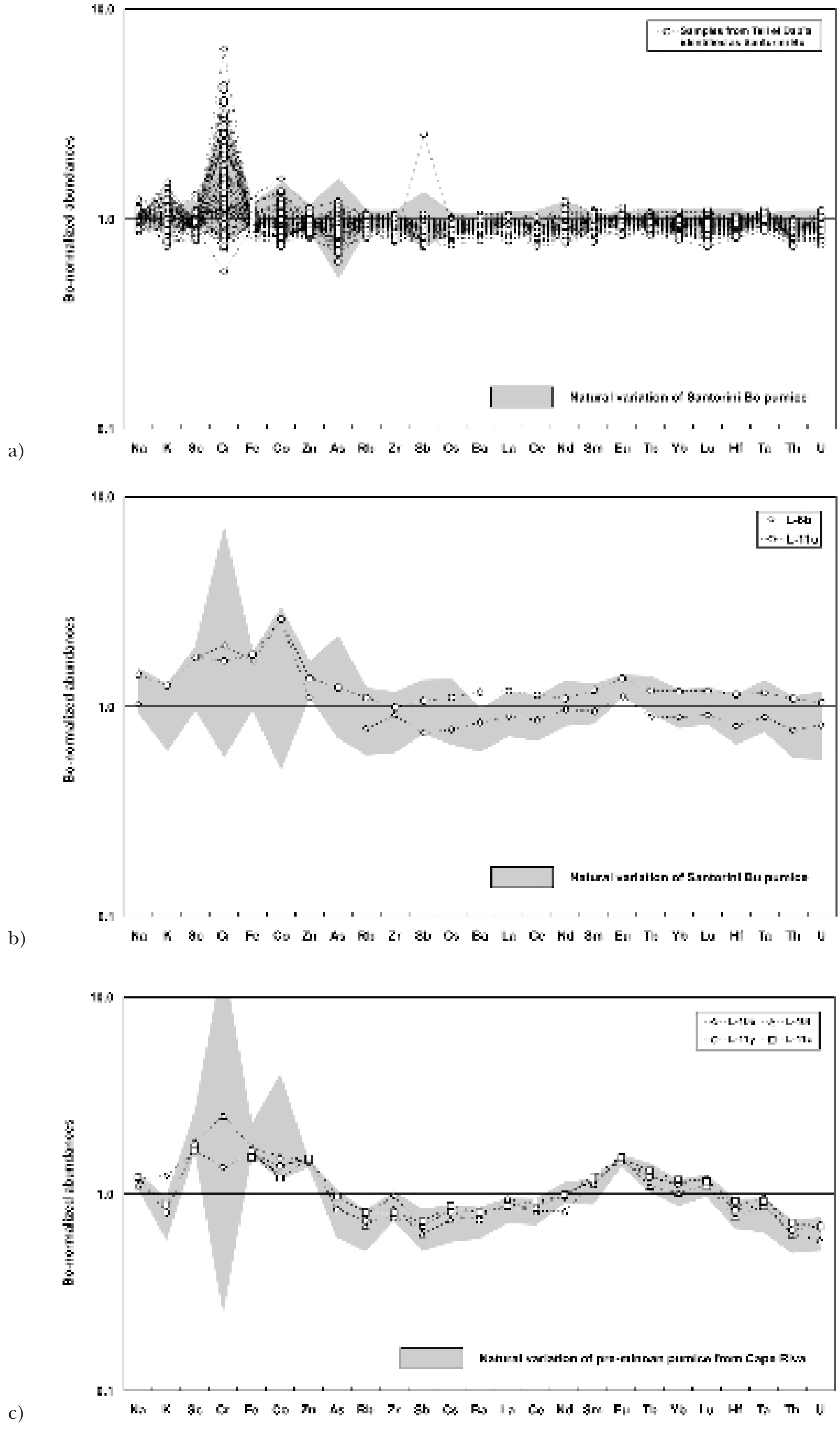
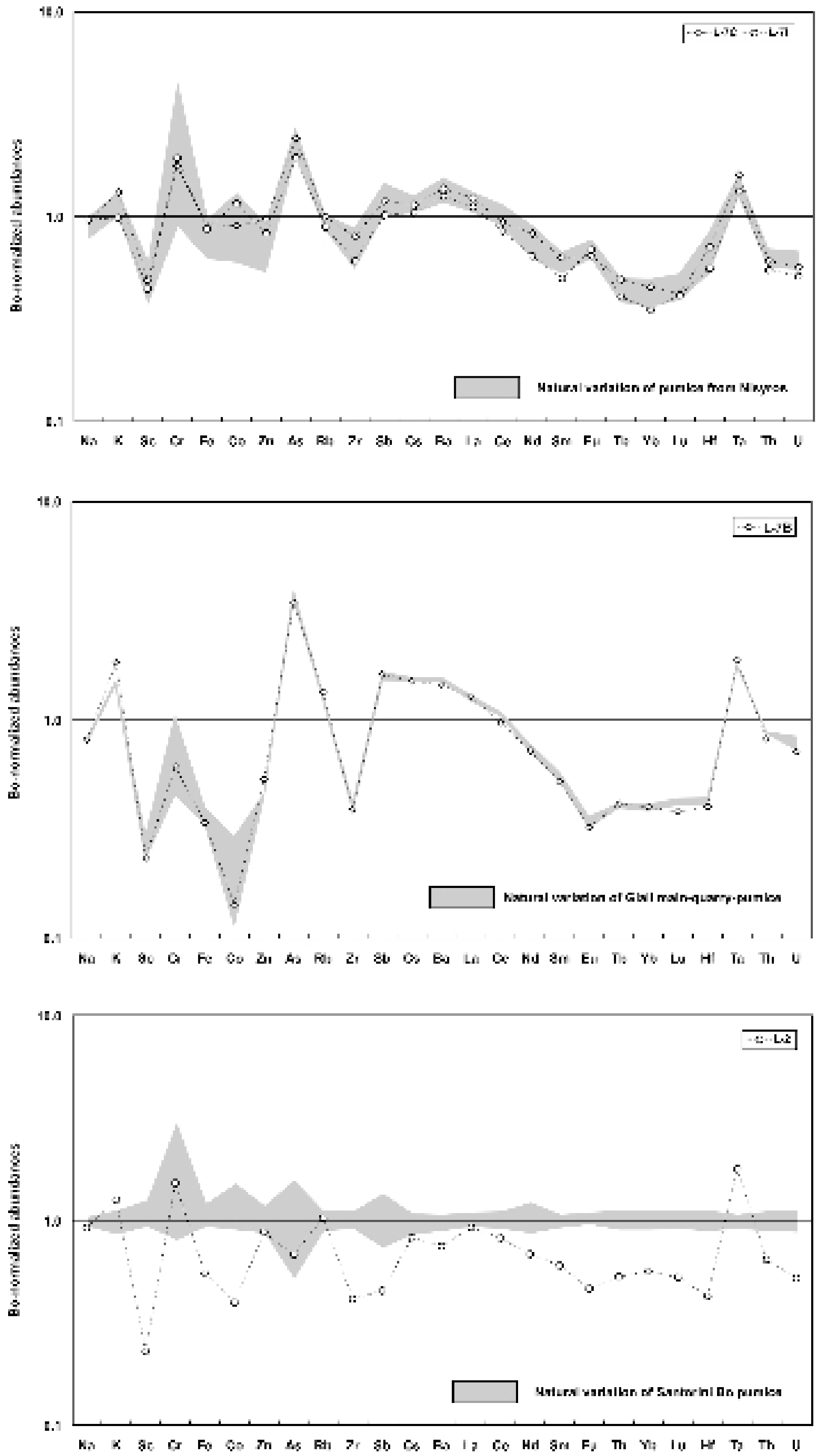


Fig. 3a–c Distribution of elements in pumice samples from Tell el Dab^ca, Series L. All values are normalized to the average Santorini Bo concentrations, see footnote 13. Shaded areas show the natural variation range of the original deposits – data from footnote 13 for a), from Duma B. (2002), *Aktivierungsanalytische Untersuchung präminoischer Eruptivgesteine der Insel Thera (Santorini),* Dipl. Thesis, Vienna Univ. of Technology, 194pp. for b) and c).



d) e) f)

Fig. 3d–f Distribution of elements in pumice samples from Tell el Dab^{c}a, Series L. All values are normalized to the average Santorini Bo concentrations, see footnote 13. Shaded areas show the natural variation range of the original deposits – data from footnote 13 for d), e) and f).

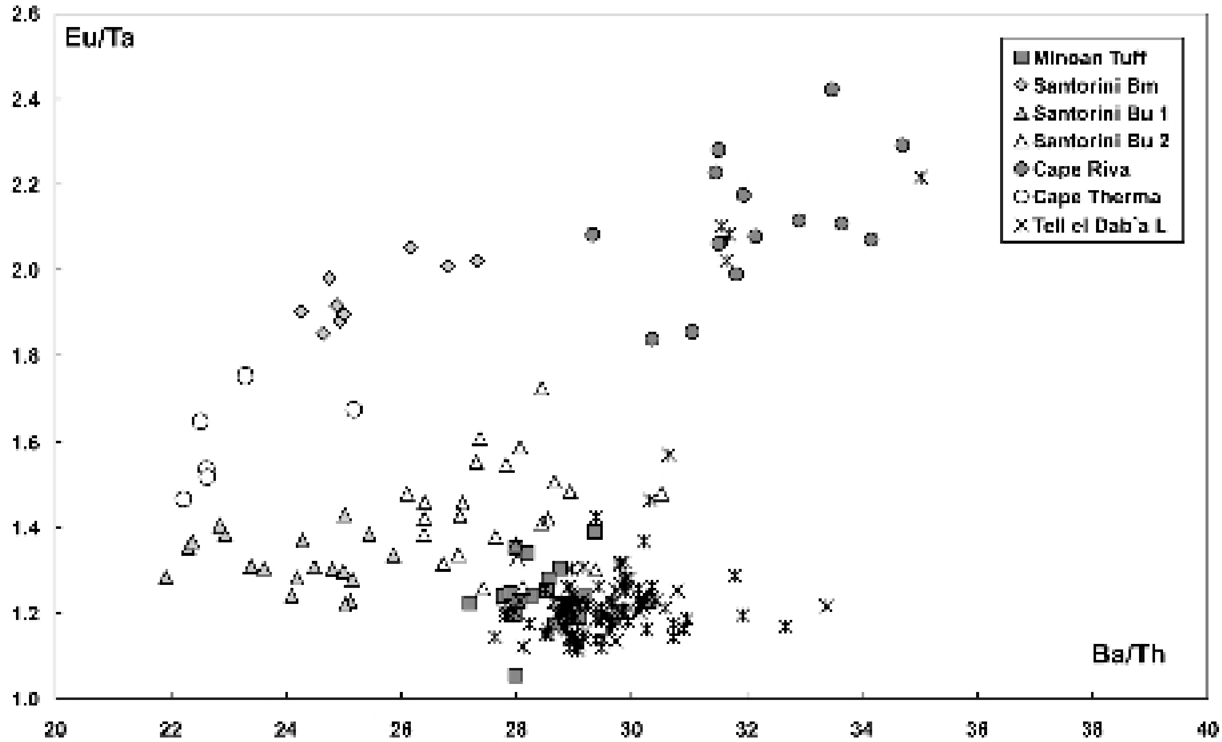


Fig. 4 Binary of trace element ratios for the differentiation of a pumice source within the Santorini volcanic complex

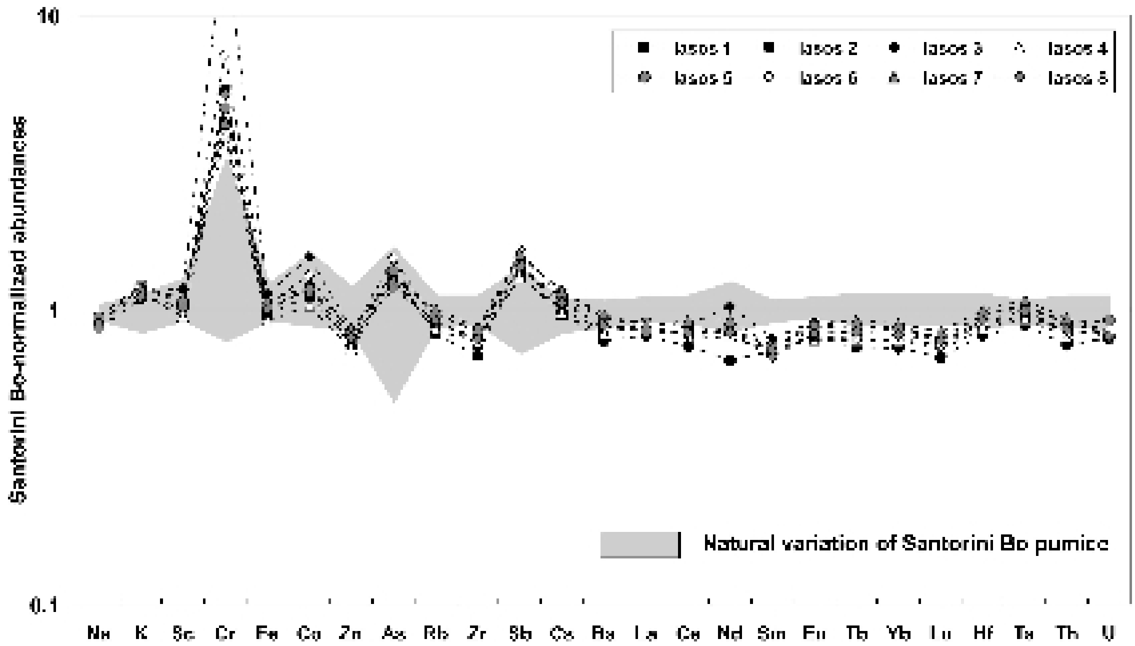


Fig. 5 Element distribution pattern for the tephra layer from Iasos.
Normalization factors and natural variations from Footnote 13

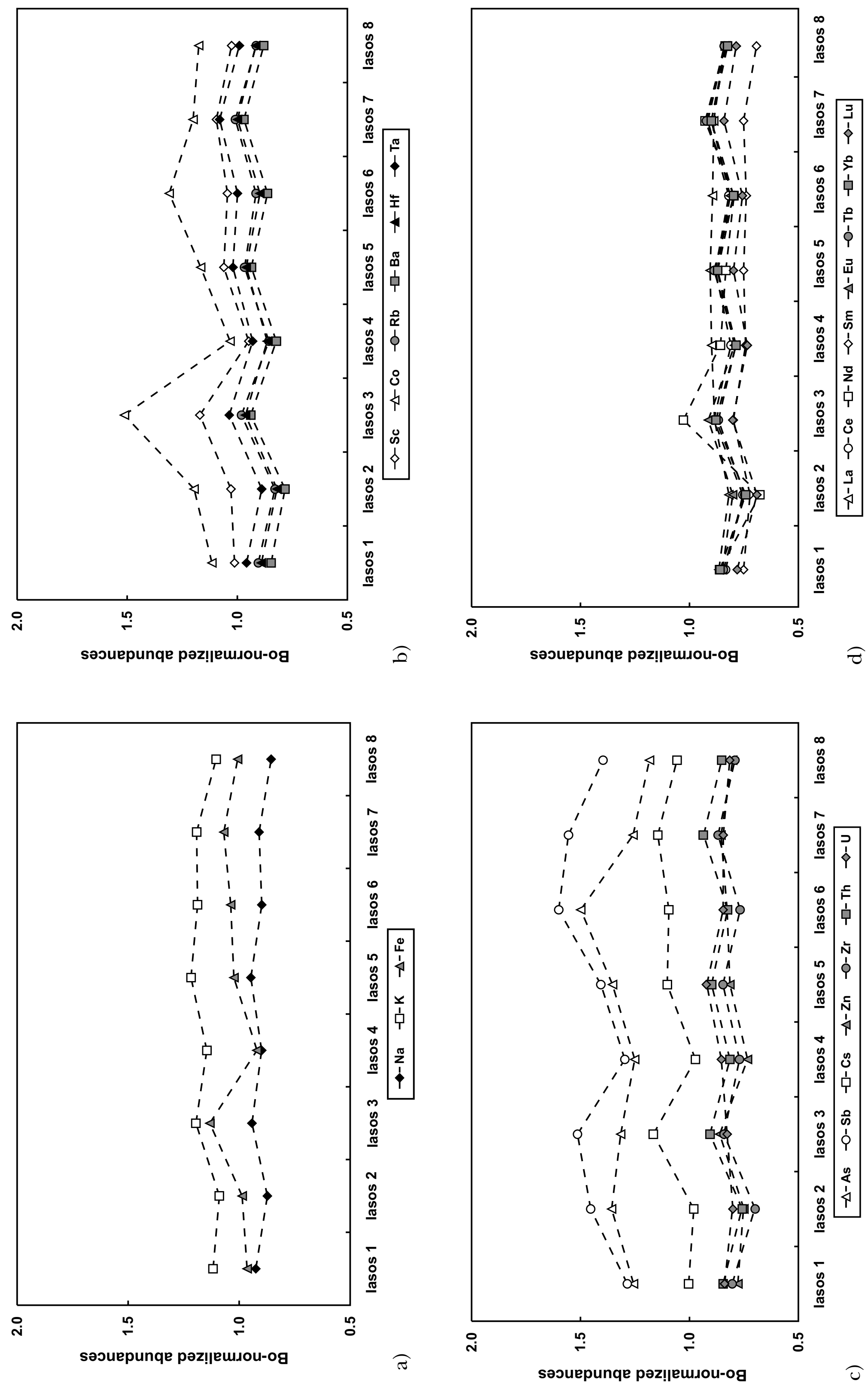


Fig. 6 a–d Major and trace element distribution patterns for the tephra layer at Iasos, Turkey identified as "Minoan" eruption. Normalization factors see footnote 13

Tell el Dabʿa	Age	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																										
L-1a	Tuthmosis III	3.40	2.20	2.00	7.73	1.11	3.41	50.6	2.72	100	273	0.24	2.54	483	27.7	53.2	22.1	5.60	0.94	0.95	4.44	0.67	6.94	0.77	16.8	5.05
L-1b	Tuthmosis III	3.84	3.12	2.16	8.50	-	3.72	55.7	2.62	107	285	0.26	2.78	538	29.9	57.0	25.3	5.98	1.06	1.04	4.78	0.70	7.43	0.83	18.0	5.63
L-1c	Tuthmosis III	3.29	2.39	1.99	7.71	7.19	3.59	54.4	2.78	98.7	285	0.25	2.51	508	27.8	54.9	24.7	5.89	0.95	0.98	4.61	0.68	7.43	0.78	16.8	5.30
L-1d	Tuthmosis III	3.40	2.30	2.60	9.35	5.59	5.19	60.7	2.75	95.1	267	0.22	2.44	484	27.8	54.2	21.6	5.68	1.04	1.01	4.47	0.69	7.03	0.82	16.2	4.75
L-3	Tuthmosis III	3.84	2.82	1.82	7.39	3.11	3.13	50.2	3.08	99.5	237	1.09	2.66	519	32.5	56.6	24.9	6.03	0.94	0.96	4.65	0.74	7.39	0.77	17.8	6.38
L-4a	Tuthmosis III	3.60	2.36	2.15	8.23	2.95	3.80	55.3	2.94	104	286	0.27	2.68	523	29.4	55.8	22.5	6.04	1.05	1.01	4.65	0.70	7.46	0.82	17.5	5.17
L-4b	Tuthmosis III	3.35	2.31	1.81	7.09	1.59	2.91	50.2	2.05	102	273	0.24	2.61	492	28.2	54.0	23.2	5.63	0.92	0.95	4.51	0.67	7.15	0.79	17.2	5.36
L-4c	Tuthmosis III	3.33	1.87	2.09	8.17	1.59	3.86	53.5	2.43	97.4	260	0.24	2.47	479	27.7	52.1	24.0	5.42	0.93	0.96	4.32	0.64	6.80	0.76	16.4	4.77
L-4d	Tuthmosis III	3.34	1.85	2.19	8.61	1.41	4.34	53.9	2.89	93.6	254	0.23	2.41	470	27.0	50.3	19.7	5.43	0.95	0.89	4.30	0.65	6.53	0.74	15.7	4.83
L-4e	Tuthmosis III	3.43	2.23	2.27	8.90	4.33	4.66	56.1	2.54	101	279	0.25	2.60	517	28.9	55.7	24.1	5.99	0.99	1.00	4.61	0.69	7.21	0.81	17.1	5.21
L-4f	Tuthmosis III	3.52	3.08	2.00	7.91	1.61	3.20	53.2	2.94	110	297	0.28	2.88	541	30.0	58.4	24.3	5.99	0.99	1.00	4.91	0.73	7.91	0.85	18.7	5.45
L-4g	Tuthmosis III	3.23	2.44	1.97	7.59	2.32	3.52	48.7	2.26	96.3	269	0.25	2.46	477	27.0	50.9	21.9	5.40	0.92	0.91	4.28	0.64	6.70	0.76	16.1	5.12
L-4h	Tuthmosis III	4.09	2.85	2.82	10.7	1.83	6.11	65.1	3.35	111	266	0.30	2.94	596	33.3	64.0	26.6	6.77	1.14	1.09	5.22	0.81	8.16	0.86	19.9	6.17
L-5a	Tuthmosis III	3.38	2.24	2.01	7.74	2.16	3.49	51.9	2.62	100	269	0.25	2.58	551	28.3	54.9	23.1	5.66	0.93	0.95	4.54	0.69	7.15	0.78	17.3	5.23
L-5b	Tuthmosis III	3.25	1.79	1.99	7.68	2.28	3.59	51.3	3.20	94.9	264	0.22	2.46	511	27.3	52.0	22.3	5.68	0.94	0.92	4.26	0.65	6.82	0.73	16.1	5.33
L-5c	Tuthmosis III	2.90	2.48	1.81	6.73	2.27	3.22	48.6	2.00	89.3	247	0.22	2.31	462	24.9	48.7	20.6	5.46	0.83	0.85	4.03	0.60	6.25	0.71	15.0	5.87
L-5d	Tuthmosis III	3.61	2.78	2.25	8.80	1.73	3.92	60.2	2.23	113	295	0.27	2.90	547	30.8	59.7	28.9	6.20	1.01	1.07	4.99	0.74	7.86	0.89	18.9	5.82
L-5e	Tuthmosis III	3.38	2.67	1.89	7.43	3.15	3.25	51.6	3.07	106	285	0.27	2.73	524	29.3	56.8	23.3	5.98	0.93	0.92	4.67	0.70	7.47	0.82	18.0	5.34
L-5f	Tuthmosis III	3.14	2.46	2.32	9.22	4.27	4.65	57.7	2.54	99.0	286	0.27	2.58	489	27.7	54.1	23.2	5.65	0.89	0.96	4.52	0.69	7.39	0.79	16.9	5.18
L-5g	Tuthmosis III	3.55	2.62	1.97	7.90	2.53	3.33	51.9	2.91	108	294	0.26	2.80	541	30.4	57.3	22.7	6.33	0.95	1.02	4.79	0.72	7.61	0.84	18.3	5.69
L-5h	Tuthmosis III	3.66	2.35	2.10	8.12	1.74	3.56	54.7	2.39	111	290	0.28	2.83	546	30.6	58.4	25.3	6.05	1.04	1.07	4.85	0.73	7.73	0.86	18.6	5.56
L-5i	Tuthmosis III	3.57	2.92	2.12	8.24	2.07	3.57	55.5	2.52	111	297	0.26	2.85	545	30.4	59.0	27.1	6.05	0.99	1.02	4.88	0.73	7.80	0.87	18.8	5.66
L-5j	Tuthmosis III	3.57	2.76	2.17	8.34	4.60	4.12	55.5	2.59	107	293	0.27	2.81	531	30.4	57.4	25.4	5.94	1.00	1.00	4.71	0.72	7.61	0.84	18.1	5.20
L-5k	Tuthmosis III	3.34	2.03	2.08	7.93	1.64	3.76	52.6	2.62	100	271	0.27	2.57	502	28.1	53.5	23.4	5.82	0.94	0.95	4.46	0.67	7.02	0.78	16.8	5.35
L-5l	Tuthmosis III	3.43	2.85	2.21	8.45	7.26	4.32	57.8	2.73	106	297	0.27	2.73	517	29.6	57.2	23.9	6.00	0.98	0.99	4.84	0.71	7.77	0.85	17.9	5.29
L-5m	Tuthmosis III	3.60	2.77	2.19	8.34	5.24	3.98	56.3	2.81	111	308	0.29	2.90	552	30.9	59.7	26.1	6.23	1.02	1.07	4.90	0.74	7.86	0.89	18.8	5.63
L-5n	Tuthmosis III	3.55	2.85	2.19	8.53	2.22	3.77	59.5	3.05	113	295	0.28	2.87	543	30.8	58.6	23.1	6.32	0.96	1.07	4.88	0.76	7.75	0.86	18.8	5.73
L-5o	Tuthmosis III	3.77	2.02	2.15	8.27	1.65	3.74	53.7	2.16	111	303	0.27	2.85	561	30.9	58.6	22.7	6.12	1.02	1.02	4.95	0.72	7.81	0.86	18.7	5.60
L-5p	Tuthmosis III	3.40	1.98	1.98	7.52	-	3.34	52.0	2.32	101	271	0.23	2.57	510	27.7	53.4	21.7	5.71	0.96	0.93	4.45	0.69	7.01	0.79	17.0	5.27
L-5q	Tuthmosis III	3.37	2.45	1.93	7.54	1.55	3.25	52.4	2.56	104	280	0.25	2.64	518	28.3	54.7	23.8	5.85	0.94	1.00	4.54	0.70	7.34	0.81	17.5	5.19
L-6a	Tuthmosis III	3.53	2.45	2.07	7.99	3.36	3.67	53.1	2.81	107	293	0.27	2.75	539	30.2	57.3	26.5	5.94	0.99	0.98	4.77	0.71	7.62	0.85	18.1	5.41

Table 1 Analytical results of elemental concentrations in pumice from various excavation sites, all values in mg/kg, except Na, K, and Fe in weight %. The analytical error due to counting statistics is less than 10 rel.% for the elements Cr, As, Nd, Sm, Yb, and U, less than 5 rel.% for all others

Tell el Dabʿa	Age	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																										
L-6c	Tuthmosis III	3.59	2.13	2.24	8.58	2.26	3.94	55.1	2.79	110	302	0.27	2.86	560	30.6	58.7	25.1	5.98	1.04	1.04	4.84	0.70	7.71	0.87	18.6	5.79
L-6d	Tuthmosis III	3.30	2.37	1.91	7.27	2.93	3.27	50.2	2.65	101	278	0.26	2.58	505	28.0	53.4	21.8	5.76	0.90	0.96	4.45	0.69	7.10	0.79	17.0	5.19
L-6e	Tuthmosis III	3.28	2.53	2.07	8.20	3.17	3.82	51.1	0.00	100	258	0.27	2.59	493	28.0	53.3	25.6	5.64	0.93	0.91	4.33	0.67	6.97	0.79	16.7	4.77
L-6f	Tuthmosis III	3.72	2.27	2.37	9.41	2.05	4.40	56.9	2.16	104	289	0.27	2.71	531	30.0	57.6	22.4	6.23	1.08	0.97	4.62	0.72	7.42	0.82	17.8	5.50
L-6g	Tuthmosis III	3.59	2.82	2.07	8.06	–	3.51	56.1	2.58	111	300	0.27	2.82	566	30.5	57.7	24.0	6.10	1.03	1.03	4.89	0.75	7.68	0.85	18.5	5.50
L-6h	Tuthmosis III	3.04	1.90	1.75	6.85	3.35	3.05	47.7	1.91	94.3	271	0.24	2.43	485	26.0	49.2	20.8	5.18	0.84	0.88	4.18	0.63	7.04	0.74	15.8	4.64
L-6i	Tuthmosis III	3.29	2.44	1.88	7.11	1.88	3.29	50.7	2.09	101	258	0.28	2.54	505	27.4	52.2	23.4	5.51	0.91	0.91	4.44	0.65	7.03	0.79	16.7	4.95
L-7a	Tuthmosis III	3.39	2.58	2.04	7.85	5.90	3.62	53.1	2.63	103	262	0.28	2.59	502	30.5	53.4	22.1	5.69	0.95	0.95	4.18	0.67	6.85	0.79	17.4	5.88
L-7b	Tuthmosis III	2.96	2.38	1.80	6.85	5.03	3.26	46.9	2.18	93.4	250	0.24	2.35	454	30.4	53.4	22.8	5.46	0.84	0.88	3.85	0.61	6.50	0.74	16.4	5.20
L-7c	Tuthmosis III	3.16	2.72	1.98	7.90	6.03	3.83	51.4	2.88	97.7	286	0.26	2.48	499	29.3	52.6	21.1	5.58	0.96	0.90	4.11	0.67	7.39	0.79	16.5	5.11
L-7d	Tuthmosis III	3.37	2.85	2.00	7.61	4.43	3.59	53.3	2.80	104	266	0.29	2.59	498	31.0	54.6	23.1	5.95	0.96	0.99	4.23	0.66	7.00	0.82	17.7	5.43
L-7e	Tuthmosis III	3.52	2.57	2.07	7.85	3.97	3.66	54.7	2.61	108	289	0.27	2.70	520	31.7	55.3	24.9	6.02	0.99	0.98	4.44	0.70	7.11	0.83	18.1	5.44
L-7f	Tuthmosis III	3.43	2.67	2.12	8.28	2.42	3.73	56.0	2.64	108	273	0.29	2.65	503	31.4	55.6	24.4	6.27	0.99	0.98	4.37	0.69	7.18	0.82	18.1	5.28
L-7g	Tuthmosis III	3.40	2.96	2.11	8.38	1.99	3.59	54.5	2.37	106	272	0.27	2.70	511	31.1	56.0	24.0	5.97	0.98	0.97	4.49	0.69	7.21	0.82	18.3	5.58
L-7h	Tuthmosis III	3.37	2.27	1.92	7.68	2.79	3.27	51.9	2.63	106	270	0.26	2.63	523	30.7	54.5	22.4	5.78	0.93	0.97	4.30	0.69	7.01	0.80	17.9	5.67
L-7i	Tuthmosis III	3.52	2.93	2.09	7.76	4.53	3.92	54.5	2.83	106	272	0.28	2.69	502	31.3	55.3	23.3	5.95	1.03	0.94	4.26	0.67	7.08	0.84	17.9	5.27
L-7j	Tuthmosis III	3.45	2.65	1.95	7.40	3.45	3.30	53.4	2.50	103	270	0.28	2.58	508	30.8	54.4	23.3	5.80	1.01	0.98	4.26	0.68	6.98	0.78	17.5	5.30
L-7k	Tuthmosis III	3.58	2.58	1.97	7.93	2.32	3.20	53.4	2.71	112	294	0.29	2.77	540	31.9	56.6	25.8	6.07	0.99	1.01	4.54	0.70	7.50	0.83	18.8	5.66
L-7l	Tuthmosis III	3.57	2.48	1.98	7.68	2.60	3.31	52.7	2.79	109	283	0.27	2.73	514	31.7	56.0	22.2	6.13	0.98	0.99	4.47	0.71	7.30	0.82	18.5	5.71
L-7m	Tuthmosis III	3.03	2.13	1.92	7.38	8.61	4.68	49.2	2.69	94.8	274	0.24	2.40	530	28.5	51.3	23.2	5.61	0.91	0.90	4.02	0.62	6.89	0.78	16.2	5.21
L-7n	Tuthmosis III	3.43	2.63	2.00	7.58	2.26	3.43	53.4	2.78	106	275	0.28	2.67	516	30.9	54.4	20.3	5.95	0.96	0.96	4.33	0.67	7.05	0.81	17.9	6.04
L-7o	Tuthmosis III	3.14	2.64	2.22	8.64	5.92	4.80	52.6	2.83	95.8	264	0.24	2.39	547	28.7	50.8	20.6	5.41	0.96	0.92	4.12	0.63	6.63	0.79	16.4	4.72
L-7p	Tuthmosis III	3.52	3.14	2.01	7.64	2.81	3.56	52.5	2.40	104	256	0.27	2.61	501	30.3	53.4	24.1	5.82	1.00	0.94	4.38	0.67	6.98	0.80	17.6	5.37
L-7q	Tuthmosis III	3.33	2.50	2.05	8.08	4.58	3.74	52.5	2.54	105	287	0.27	2.63	520	30.7	55.2	25.1	6.01	0.99	0.99	4.44	0.65	7.18	0.82	17.9	5.61
L-7r	Tuthmosis III	3.43	2.68	2.13	8.11	2.27	3.66	55.5	2.75	109	285	0.29	2.75	538	31.8	56.5	23.1	6.22	0.97	1.01	4.61	0.69	7.41	0.83	18.7	5.37
L-7s	Tuthmosis III	3.33	2.97	2.05	7.51	2.23	3.63	52.7	2.34	100	254	0.25	2.50	493	29.7	51.7	21.2	5.64	0.97	0.91	4.23	0.62	6.78	0.79	17.1	5.11
L-7t	Tuthmosis III	3.56	2.78	1.95	7.89	2.65	3.11	51.1	3.11	112	286	0.29	2.80	530	32.5	57.8	23.2	6.21	1.01	1.01	4.70	0.69	7.55	0.84	19.0	5.62
L-7u	Tuthmosis III	3.40	2.62	2.12	7.69	2.98	3.65	54.6	2.57	104	286	0.27	2.55	522	30.4	54.2	24.3	5.85	0.99	0.99	4.44	0.67	6.91	0.78	17.5	5.15
L-7v	Tuthmosis III	3.16	2.62	1.83	7.18	3.85	3.24	49.2	2.47	100	256	0.28	2.49	492	29.1	51.6	20.9	5.95	0.90	0.90	4.16	0.60	6.70	0.78	16.9	5.61
L-7w	Tuthmosis III	3.10	2.42	2.13	9.13	4.94	4.15	54.3	2.35	99.2	258	0.29	2.47	527	29.4	53.6	24.7	6.25	0.93	1.02	4.31	0.63	6.76	0.78	17.0	6.29
L-7x	Tuthmosis III	3.21	2.85	1.96	7.89	6.19	3.90	49.3	2.28	96.2	251	0.24	2.41	503	28.9	51.2	20.4	5.61	0.96	0.87	4.06	0.59	6.56	0.77	16.3	5.13

Table 1 continued

Tell el Dabᶜa	Age	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																										
L-7y	Tuthmosis III	2.89	2.27	1.89	7.37	7.00	3.82	48.4	2.68	87.8	241	0.23	2.18	447	26.4	46.7	19.7	5.15	0.90	0.84	3.81	0.56	6.30	0.71	14.7	4.44
L-7z	Tuthmosis III	3.43	2.79	2.13	7.86	3.99	3.78	56.4	2.44	104	278	0.29	2.63	513	31.0	55.5	24.5	6.45	1.00	0.99	4.48	0.65	7.04	0.82	17.8	5.52
L-7A	Tuthmosis III	3.29	3.15	2.27	8.46	8.09	4.92	55.7	3.00	101	267	0.27	2.56	493	30.9	54.5	24.1	5.94	1.04	0.94	4.29	0.64	7.06	0.85	17.2	5.15
L-7D	Tuthmosis III	3.57	2.82	1.98	7.72	–	3.14	54.6	2.43	114	302	0.28	2.89	558	32.3	58.7	23.3	6.21	0.99	1.05	4.80	0.67	7.74	0.86	19.6	5.63
L-7E	Tuthmosis III	3.50	2.39	2.23	8.61	–	4.09	55.0	2.86	104	265	0.27	2.60	541	30.9	54.5	20.0	5.89	1.00	0.96	4.30	0.71	6.96	0.81	17.8	5.28
L-7F	Tuthmosis III	3.48	3.07	2.13	7.91	–	3.56	56.2	2.85	109	290	0.30	2.74	557	32.0	56.6	24.4	6.14	1.00	1.00	4.36	0.75	7.28	0.85	18.8	6.12
L-7G	Tuthmosis III	3.33	2.58	2.11	8.01	5.01	3.93	57.1	2.22	105	277	0.28	2.64	534	30.6	56.6	23.8	6.29	1.00	1.00	4.37	0.77	7.13	0.84	18.0	5.30
L-7H	Tuthmosis III	3.43	3.38	2.25	8.24	3.21	3.85	61.2	2.14	111	294	0.28	2.84	553	31.7	58.8	24.2	6.50	1.01	1.04	4.61	0.80	7.48	0.85	19.0	5.37
L-7J	Tuthmosis III	3.46	2.60	2.06	7.85	3.29	3.48	56.1	3.08	106	278	0.28	2.63	547	30.8	56.5	19.6	5.94	1.03	1.00	4.47	0.77	7.13	0.82	18.2	5.37
L-7K	Tuthmosis III	3.58	2.64	1.95	7.51	3.19	3.43	52.8	2.64	104	272	0.27	2.56	509	30.0	53.6	22.2	6.08	1.03	0.94	4.32	0.77	6.85	0.79	17.4	5.13
L-8a	Tuthmosis III	3.53	3.17	2.13	8.35	3.48	3.72	56.8	2.86	109	268	0.28	2.81	545	31.9	58.2	23.4	6.21	1.00	1.02	4.60	0.81	7.41	0.84	18.9	5.34
L-8b	Tuthmosis III	3.56	2.45	1.99	7.70	–	3.24	53.0	2.53	107	278	0.26	2.73	543	31.3	55.8	22.4	5.96	0.98	0.99	4.48	0.78	7.26	0.82	18.4	5.27
L-9	Tuthmosis III	3.48	2.25	2.16	8.03	–	3.80	56.8	1.97	103	283	0.27	2.60	533	30.2	54.8	20.1	5.85	0.98	0.97	4.32	0.74	6.98	0.78	17.8	5.30
L-10a	Tuthmosis III	3.53	2.86	2.00	7.76	3.06	3.30	54.1	2.61	107	277	0.26	2.69	529	31.3	56.5	21.2	6.40	1.02	1.00	4.54	0.74	7.28	0.84	18.3	5.22
L-10c	Tuthmosis III	3.54	3.46	2.14	8.28	2.20	3.85	54.9	2.11	104	270	0.29	2.63	538	30.7	55.0	21.4	5.98	1.00	0.97	4.37	0.76	7.06	0.81	17.8	5.31
L-10d	Tuthmosis III	3.60	2.75	2.48	8.71	2.24	4.60	61.5	1.74	108	292	0.26	2.66	532	31.5	57.1	28.5	6.06	1.04	1.00	4.55	0.80	7.25	0.83	18.4	5.21
L-10g	Tuthmosis III	3.58	2.98	2.36	8.57	1.65	4.35	56.9	2.31	104	279	0.27	2.64	529	31.3	56.1	27.6	6.48	1.03	0.96	4.44	0.79	7.09	0.81	18.0	5.12
L-10h	Tuthmosis III	3.51	3.24	1.98	7.96	2.35	3.14	55.3	2.42	113	284	0.26	2.83	569	32.4	57.4	22.9	6.11	0.95	1.01	4.60	0.81	7.62	0.85	19.3	5.10
L-10i	Tuthmosis III	3.73	2.71	2.14	8.26	–	3.58	54.3	2.71	111	293	0.27	2.75	560	31.7	57.6	26.6	6.51	1.04	1.02	4.61	0.81	7.45	0.83	18.8	5.25
L-10j	Tuthmosis III	3.53	2.37	2.02	8.03	1.80	3.47	52.5	2.74	106	283	0.27	2.67	523	30.9	55.5	24.4	5.88	0.98	0.99	4.39	0.77	7.16	0.81	18.1	5.18
L-10k	Tuthmosis III	3.46	2.34	2.42	9.26	3.34	5.17	57.9	2.49	103	271	0.25	2.60	521	30.8	55.5	26.7	6.32	0.99	0.96	4.34	0.75	7.10	0.81	17.7	5.13
L-10l	Tuthmosis III	3.58	2.56	1.96	7.65	1.64	3.18	54.2	2.60	108	282	0.27	2.71	551	31.4	56.4	24.6	5.95	1.02	1.00	4.59	0.80	7.34	0.84	18.6	5.29
L-10m	Tuthmosis III	3.60	2.25	1.94	7.81	1.46	3.02	53.2	3.22	115	300	0.29	2.85	570	32.8	58.9	22.4	6.75	0.96	1.01	4.66	0.81	7.68	0.86	19.6	5.83
L-10n	Tuthmosis III	3.49	3.61	1.95	7.67	–	3.14	54.2	2.62	–	277	0.28	2.75	540	31.8	57.3	28.6	6.47	0.94	1.03	4.55	0.75	7.45	0.82	18.9	5.78
L-10o	Tuthmosis III	3.49	2.14	1.91	7.33	2.52	3.05	52.2	2.44	106	286	0.28	2.67	542	30.7	54.5	24.1	5.80	1.02	0.97	4.43	0.76	7.35	0.83	18.0	5.43
L-10p	Tuthmosis III	3.57	3.22	2.18	8.04	2.03	3.91	55.3	2.57	105	282	0.27	2.68	519	30.8	55.8	24.1	5.91	1.03	0.99	4.46	0.73	7.09	0.82	18.0	5.22
L-10q	Tuthmosis III	3.57	3.18	2.01	7.81	1.56	3.24	55.2	2.46	114	292	0.29	2.84	542	32.2	58.6	31.1	6.64	0.97	1.00	4.66	0.84	7.57	0.87	19.3	5.62
L-11r	Tuthmosis III	3.55	2.56	2.06	8.01	1.98	3.88	52.4	2.78	95.1	233	0.28	2.59	514	29.6	54.8	22.4	5.25	0.97	0.95	4.51	0.71	7.21	0.74	17.2	6.07
L-11s	Tuthmosis III	3.70	2.75	2.25	8.30	1.87	4.25	57.2	2.78	102	243	0.31	2.74	554	29.1	58.3	23.3	5.94	1.08	0.99	4.71	0.75	7.57	0.79	18.3	5.30
L-11t	Tuthmosis III	3.01	2.35	1.84	6.92	2.47	3.19	48.7	2.40	95.9	226	0.26	2.57	500	25.7	54.2	23.6	5.26	0.90	0.91	4.42	0.70	7.06	0.73	17.2	5.06
L-11v	Tuthmosis III	3.63	2.42	2.60	11.20	4.38	5.33	54.4	2.65	91.7	226	0.25	2.42	500	28.0	54.1	21.3	5.36	1.05	0.97	4.56	0.69	7.12	0.74	17.0	4.92

Table 1 continued

Tell el Dabʿa	Age	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																										
L-11w	Tuthmosis III	2.98	2.29	1.81	7.59	2.60	3.01	49.2	2.52	96.0	230	0.28	2.57	502	25.1	54.7	24.1	4.81	0.92	0.95	4.52	0.70	7.31	0.73	17.4	5.19
L-11x	Tuthmosis III	3.74	2.99	1.97	7.44	12.7	4.23	54.0	3.22	101	251	0.31	2.74	577	32.6	57.5	23.7	5.74	0.92	0.98	4.77	0.74	7.79	0.80	18.7	6.47
Santorini Bu																										
L-6b	Tuthmosis III	3.43	0.00	3.60	14.6	3.86	10.05	63.4	0.00	85	263	0.22	2.25	474	28.3	54.4	24.9	5.86	1.12	0.91	4.26	0.69	6.29	0.71	15.5	4.82
L-11u	Tuthmosis III	4.72	3.06	3.86	14.7	3.27	10.2	79.1	3.41	120	288	0.32	3.20	661	37.6	71.6	28.0	7.40	1.37	1.20	5.70	0.90	8.85	0.93	21.8	6.20
Cape Riva																										
L-10e	Tuthmosis III	3.97	3.01	3.51	14.2	2.71	4.91	83.6	–	84.4	284	0.20	2.44	446	29.7	56.2	24.7	7.51	1.56	1.24	5.40	0.90	6.71	0.77	14.1	3.97
L-10f	Tuthmosis III	3.67	–	3.75	15.7	4.94	6.09	85.8	–	74.8	242	0.19	2.14	436	27.4	51.4	20.8	6.91	1.54	1.11	4.88	0.83	5.95	0.69	12.5	3.44
L-11y	Tuthmosis III	4.04	1.96	3.50	15.2	–	5.47	87.9	2.32	79.3	218	0.21	2.34	414	27.8	53.1	25.4	7.21	1.47	1.22	5.37	0.85	6.44	0.71	13.1	4.08
L-11z	Tuthmosis III	4.03	2.14	3.35	14.3	–	4.72	87.7	2.70	87.2	232	0.22	2.52	451	27.7	57.1	25.4	7.60	1.55	1.32	5.69	0.87	7.13	0.74	14.3	4.02
Non-Bo																										
L-2	1550-1500 BC	3.05	3.06	1.20	1.96	3.00	1.55	50.6	1.88	111	119	0.14	2.38	420	29.3	51.5	17.5	3.71	0.46	0.54	2.71	0.40	3.29	1.44	12.8	3.07
Giali main quarry																										
L-7B	Tuthmosis III	2.71	4.45	0.74	2.00	1.21	0.56	31.0	9.63	145	113	0.48	4.36	815	40.7	61.3	18.5	3.23	0.32	0.42	1.92	0.29	3.11	1.51	16.4	4.21
Nisyros caldera																										
L-7C	Tuthmosis III	3.20	3.19	1.94	4.19	3.49	3.56	56.0	6.69	108	231	0.36	3.30	771	39.0	59.0	21.1	3.90	0.65	0.50	2.18	0.32	5.49	1.29	12.1	3.34
L-7I	Tuthmosis III	3.26	2.42	1.93	3.86	3.84	4.63	48.7	5.46	97.4	179	0.31	3.07	717	35.7	54.0	16.7	3.14	0.70	0.42	1.71	0.32	4.38	1.08	11.1	3.06

Ashkelon	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																											
MC 19586	LB I	E 33	3.28	2.71	1.97	7.25	2.36	3.41	59.7	3.09	101	265	0.28	2.57	501	29.6	53.6	23.2	5.76	0.91	0.94	4.45	0.75	7.10	0.77	17.0	5.41
MC 20231	LB I	E 38a	3.40	n.d	2.15	8.20	2.94	3.85	69.5	3.08	101	227	0.30	2.64	582	30.5	62.0	22.9	6.16	0.99	1.05	5.13	0.80	7.93	0.81	18.8	5.22
MC 20231	LB I	E 38b	3.27	2.80	2.08	7.47	3.67	3.53	77.6	2.65	114	292	0.41	2.89	832	30.7	60.5	23.6	6.31	0.89	1.10	4.92	0.79	7.95	0.88	19.3	5.57
MC 20231	LB I	E 38c	3.45	3.28	2.14	7.89	5.23	3.80	60.3	3.41	108	263	0.30	2.76	520	31.0	57.7	24.5	6.14	0.97	1.07	5.00	0.85	7.96	0.90	18.2	5.38
MC 20231	LB I	E 38d	3.14	2.87	2.00	8.52	2.57	3.74	60.8	2.69	106	289	0.27	2.68	719	29.2	56.7	27.3	5.65	0.89	0.95	4.66	0.73	7.50	0.81	18.0	5.38
MC 20231	LB I	E 38e	3.45	3.24	2.08	8.09	1.69	3.38	59.9	3.17	109	245	0.30	2.84	530	30.7	58.1	24.2	5.92	0.96	1.08	4.85	0.85	7.68	0.90	18.6	5.46
MC 20231	LB I	E 38f	3.21	2.95	2.34	8.80	5.43	5.01	67.4	3.00	96.8	231	0.25	2.45	486	29.3	53.0	22.2	5.62	0.92	1.03	4.36	0.69	7.25	0.81	16.6	4.97
MC 20231	LB I	E 38g	3.41	2.76	1.76	7.48	n.d	2.82	53.9	3.06	112	296	0.30	2.84	528	31.3	57.8	23.7	6.28	0.89	0.98	4.79	0.80	7.87	0.84	18.9	6.11
MC 20236	LB I	E 39a	3.47	3.48	2.04	7.78	5.81	3.70	63.9	3.22	112	269	0.30	2.87	557	31.6	60.9	24.3	5.97	0.99	1.09	5.04	0.80	7.88	0.94	19.2	5.36

Table 1 continued

Ashkelon	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																											
MC 20236	LB I	E 39b	4.44	3.63	1.70	7.03	n.d	2.63	59.7	2.38	113	315	0.26	2.79	568	31.4	59.2	23.6	5.43	0.90	1.01	4.87	0.80	8.15	0.85	19.1	5.94
MC 26614	LB I	E 57	3.90	3.51	1.89	7.59	3.29	3.34	59.2	3.12	109	293	0.28	2.70	519	31.5	56.3	22.3	6.32	0.90	0.99	4.66	0.80	7.63	0.86	18.1	6.95
MC 26626	?	E 58	3.31	2.79	1.76	6.81	3.46	2.88	56.9	3.14	104	231	0.27	2.60	491	29.4	54.6	24.9	5.84	0.90	0.99	4.45	0.73	7.22	0.86	17.5	5.29
MC 31163	Iron I	E 66	3.46	2.65	1.65	6.52	2.23	2.39	55.7	2.59	103	221	0.29	2.60	488	29.6	52.6	22.5	5.60	0.88	1.01	4.40	0.74	7.05	0.80	17.2	5.10
MC 31216	?	E 67	3.32	2.57	1.84	7.19	2.70	3.17	53.9	2.79	102	270	0.26	2.56	498	29.6	53.6	23.6	5.72	0.91	0.89	4.39	0.71	7.15	0.78	17.1	4.74
MC 31306	Iron I	E 68	3.66	3.08	2.17	7.98	2.43	3.56	61.9	3.27	108	249	0.28	2.83	538	31.8	58.5	26.4	5.98	0.99	1.09	4.87	0.77	7.57	0.89	18.7	5.68
MC 31345	Persian	E 69a	4.03	3.51	1.98	7.72	3.05	3.08	61.1	3.57	109	258	0.32	2.81	532	32.5	57.5	26.0	6.18	0.91	1.04	4.74	0.75	8.08	0.89	18.8	5.73
MC 31345	Persian	E 69b	3.25	2.72	1.83	7.22	2.18	2.68	63.0	3.60	116	316	0.27	2.91	562	31.3	59.8	22.2	6.10	0.89	1.02	4.92	0.80	8.08	0.86	19.4	6.14
MC 31345	Persian	E 69c	3.34	2.72	2.06	7.57	2.35	3.64	63.2	2.64	103	274	0.25	2.56	539	29.2	56.4	22.0	5.73	1.00	0.98	4.51	0.78	7.26	0.79	17.5	4.79
MC 31345	Persian	E 69d	3.63	2.81	2.07	8.06	3.43	3.36	63.7	2.85	110	249	0.30	2.85	542	31.4	59.3	24.5	5.99	1.00	1.09	4.83	0.77	7.69	0.88	18.9	5.69
MC 31345	Persian	E 69e	3.46	2.87	2.08	7.38	1.86	3.54	65.8	3.09	111	289	0.31	2.76	545	31.3	57.9	24.7	5.74	0.92	1.02	4.75	0.81	7.54	0.83	18.5	5.84
MC 31799	Persian	E 70	3.38	2.15	1.95	7.48	2.74	3.35	62.4	2.73	100	232	0.27	2.59	511	28.9	53.2	22.3	5.47	0.89	1.00	4.40	0.72	7.08	0.85	17.0	5.02
MC 32287	LB	E 73a	3.23	3.13	1.75	7.14	2.12	2.65	55.9	2.77	106	229	0.26	2.72	573	29.4	55.3	23.6	5.74	0.89	1.03	4.67	0.81	7.43	0.89	18.0	5.49
MC 32287	LB	E 73b	3.50	2.91	1.82	7.06	2.40	2.99	59.0	2.63	106	288	0.26	2.69	684	29.9	56.5	22.9	5.85	0.91	0.98	4.58	0.75	7.65	0.82	18.1	4.88
MC 32287	LB	E 73c	3.43	3.37	2.13	8.05	2.12	4.16	60.4	2.96	100	288	0.27	2.53	526	29.9	54.6	21.6	5.37	0.99	0.97	4.42	0.76	7.04	0.78	17.0	4.92
MC 32287	LB	E 73d	3.06	2.91	2.35	8.30	2.67	4.13	69.7	2.49	109	297	0.30	2.83	609	30.1	59.3	n.d	5.28	0.89	1.02	4.84	0.70	7.62	0.95	18.8	5.68
MC 32287	LB	E 73e	3.22	3.02	1.63	6.36	2.12	2.41	57.1	2.70	99.5	218	0.28	2.55	617	28.7	51.7	21.8	5.38	0.87	0.98	4.34	0.73	6.77	0.80	16.8	5.32
MC 32471	LB	E 77a	3.48	3.35	1.62	7.07	2.37	2.46	54.3	3.20	103	228	0.28	2.58	498	28.5	53.0	24.3	5.72	0.86	1.02	4.44	0.72	7.19	0.82	17.1	5.18
MC 32471	LB	E 77b	3.71	4.19	1.78	7.20	6.17	2.89	59.0	3.16	112	256	0.31	2.89	555	30.9	60.5	26.9	6.01	0.93	1.10	5.01	0.87	7.88	0.95	19.3	5.70
MC 45336	Iron I	E 113	3.47	2.97	2.00	7.87	2.64	3.40	62.2	2.32	107	244	0.30	2.82	671	30.6	57.3	24.0	5.87	0.99	1.04	4.75	0.79	7.44	0.87	18.2	5.35
MC 45516	Iron II	E 114	3.38	2.66	1.87	7.38	2.17	3.24	56.2	2.96	107	288	0.35	2.70	515	30.1	57.0	24.6	5.20	0.91	0.94	4.65	0.81	7.50	0.82	18.1	4.78
MC 45671	Iron II	E 117	3.26	2.91	1.75	6.98	2.12	2.70	56.6	2.93	105	232	0.27	2.67	503	28.7	54.2	23.5	5.66	0.90	1.03	4.50	0.00	7.13	0.83	17.6	5.21
MC 47677	Iron	E 140a	3.51	2.76	2.00	7.94	1.92	3.35	65.2	n.d	110	239	0.30	2.82	528	30.6	58.0	23.5	5.76	0.96	1.10	4.82	0.84	7.73	0.89	18.5	5.60
MC 47677	Iron	E 140b	3.56	2.93	1.97	7.78	n.d	3.01	59.7	2.60	114	253	0.28	2.92	552	31.0	59.7	26.7	6.07	1.01	1.05	5.06	0.80	7.87	0.93	19.3	5.58
MC 47702	?	E 141	3.19	2.88	1.88	7.18	2.08	3.04	60.9	3.39	106	245	0.27	2.71	522	29.4	57.5	24.2	5.61	0.93	1.05	4.74	0.78	7.56	0.88	18.5	5.43
MC 48001	Iron	E 144	3.50	3.50	2.14	8.17	3.81	3.88	64.6	5.09	111	252	0.32	2.84	580	31.2	59.2	25.2	5.85	1.02	1.08	4.85	0.81	7.92	0.95	18.7	5.85
MC 48240	?	E 145	3.53	3.54	1.81	7.27	1.69	2.76	66.0	3.37	113	259	0.29	2.92	579	31.1	59.5	24.2	5.73	0.96	1.07	4.92	0.75	8.07	0.93	19.4	5.60
MC 48359	MB2-LB	E 147	3.88	3.29	2.05	7.73	4.31	4.01	57.6	2.76	95.5	225	0.25	2.46	483	28.8	53.3	22.5	5.45	0.91	0.97	4.32	0.75	7.27	0.85	16.8	4.68
MC 48382	MB2B/C	E 148	3.49	2.85	1.97	7.57	6.71	3.82	66.8	3.93	107	294	0.32	2.67	526	31.3	57.0	21.6	5.69	0.93	0.98	4.59	0.72	7.87	0.85	17.8	5.52
MC 49373	LBI-tomb	E 152	3.55	2.97	1.97	7.56	2.11	3.03	60.4	8.20	112	259	0.30	2.91	609	31.0	59.5	24.1	5.65	0.96	1.06	4.94	0.82	7.94	0.94	19.3	5.56
MC 50799	Iron I	E 158	3.36	2.51	2.24	8.43	3.44	4.45	59.6	3.06	102	283	0.27	2.66	510	29.6	56.1	23.1	5.18	0.95	0.97	4.61	0.74	7.33	0.82	17.3	5.14

Table 1 continued

Ashkelon	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																											
MC 51139	LB-tomb	E 160a	3.58	n.d	1.86	7.24	5.12	2.76	57.8	2.90	106	251	0.31	2.73	526	31.0	57.2	23.4	5.91	0.97	1.00	4.62	0.77	7.73	0.89	18.1	5.32
MC 51139	LB-tomb	E 160b	3.36	4.11	2.02	7.67	4.06	3.08	66.9	3.89	111	253	0.29	2.82	575	32.4	60.0	27.2	6.19	0.88	1.09	4.95	0.82	7.77	0.91	19.1	6.03
MC 51985	MB2 B/C	E 161	3.36	n.d	2.07	8.00	3.58	3.49	76.7	5.62	98.1	226	0.27	2.57	496	29.1	54.7	21.8	5.46	0.94	1.03	4.47	0.78	7.03	0.80	16.8	5.00
MC 52012	Iron I	E 162	3.41	n.d	2.11	8.23	2.21	3.56	64.1	3.27	111	259	0.33	2.87	566	31.6	59.6	23.7	6.02	0.98	1.10	4.89	0.77	7.82	0.92	19.0	5.70
MC 52014	Persian ?	E 163	3.51	2.60	2.37	9.24	1.89	4.66	64.9	3.76	105	246	0.27	2.73	582	29.8	58.5	26.2	5.46	1.00	1.02	4.75	0.83	7.32	0.86	18.3	4.99
MC 52654	?	E 167	3.33	2.62	2.05	7.90	n.d	3.92	58.5	2.64	106	299	0.27	2.67	538	29.1	57.2	20.7	5.04	0.95	0.99	4.68	0.74	7.40	0.80	18.0	5.24
MC 53128	?	E 169	3.26	2.77	1.90	7.29	16.4	3.58	62.7	3.84	100	322	0.28	2.51	518	29.4	53.5	23.5	5.19	0.91	0.95	4.42	0.72	8.21	0.82	16.9	5.75
MC 53278	Iron I	E 170	3.40	2.66	2.91	11.9	2.22	8.37	62.6	2.32	91.0	243	0.21	2.32	509	27.9	51.9	22.2	5.43	0.94	0.88	4.17	0.73	6.36	0.72	16.0	5.04
MC 53685	LB II ?	E 171	3.21	3.35	1.91	7.45	2.34	3.40	57.3	4.00	104	282	0.27	2.67	605	29.4	56.0	23.2	5.21	0.95	1.00	4.61	0.73	7.37	0.84	17.7	5.35
MC 54765	LB I ?	E 172a	3.30	3.06	1.80	7.17	1.81	2.78	58.3	2.85	108	288	0.29	2.80	542	29.7	57.5	24.9	5.15	0.91	0.99	4.80	0.84	7.60	0.83	18.5	5.47
MC 32891	?	E 172b	3.49	n.d	2.14	7.98	1.78	3.60	65.2	3.04	109	254	0.31	2.80	560	31.0	58.6	26.5	5.82	0.98	1.08	4.79	0.75	7.66	0.94	18.7	5.73
MC 32891	?	E 176	4.17	n.d	2.00	7.93	4.61	3.24	59.8	3.24	106	256	0.27	2.75	534	30.3	56.7	24.9	5.74	0.95	1.07	4.70	0.75	8.09	0.85	18.1	5.18
Santorini Bm																											
MC 32844	MB2 A/B	E 81a	3.82	n.d	3.14	13.3	5.68	4.35	100	2.90	90.1	236	0.21	2.55	456	29.1	59.1	26.4	7.06	1.45	1.38	5.72	0.90	7.21	0.89	14.7	4.06
MC 32844	MB2 A/B	E 81b	3.97	2.35	3.36	13.4	3.80	4.94	87.5	2.16	86.6	290	0.29	2.49	465	29.3	56.6	27.1	7.51	1.42	1.16	5.58	0.93	7.10	0.79	14.2	3.92
MC 32844	MB2 A/B	E 81c	3.70	2.16	3.34	13.6	3.15	4.91	89.9	1.18	83.8	284	0.19	2.34	432	28.1	55.4	27.3	7.27	1.42	1.15	5.31	0.76	6.73	0.78	13.5	3.74
MC 47650	?	E 139b	3.84	n.d	3.23	12.3	1.91	5.03	91.3	n.d	69.0	180	0.20	1.84	389	24.4	48.5	21.6	5.78	1.37	1.08	4.78	0.69	5.76	0.63	12.6	3.46
MC 47650	?	E 139c	3.82	n.d	3.15	12.0	2.51	4.32	88.7	n.d	66.8	204	0.22	1.78	369	24.6	47.3	21.3	5.95	1.36	1.11	4.68	0.72	6.01	0.66	12.4	3.62
MC 47650	?	E 139d	4.19	1.86	3.31	12.7	2.32	4.64	87.6	2.46	71.9	230	0.19	1.92	411	26.6	50.3	23.5	5.40	1.44	1.00	4.77	0.83	5.98	0.65	13.1	3.89
MC 49813	LB I-tomb	E 155	3.84	n.d	3.71	14.36	3.34	4.69	98.4	2.21	96.3	245	0.21	2.75	514	33.4	65.2	32.5	7.48	1.59	1.37	5.68	0.83	7.48	0.93	16.2	4.33
Santorini Bu																											
MC 47650	?	E 139a	3.66	2.34	1.91	7.79	3.90	1.58	73.5	3.38	92.6	236	0.29	2.38	471	29.0	53.9	25.9	6.40	1.10	1.21	5.20	0.76	7.25	0.75	16.3	5.01

Table 1 continued

Ashkelon	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Giali main quarry																											
MC 49376	?	E 153	2.66	4.51	0.83	2.12	18.1	1.25	37.4	12.9	143	104	0.54	4.42	844	39.8	63.7	20.4	3.28	0.34	0.46	2.05	0.30	3.36	1.61	16.4	4.37
MC 50600	LB?burial	E 157	2.51	4.37	0.74	1.94	2.78	0.76	41.9	9.96	129	92	0.46	4.03	781	36.7	57.9	19.6	3.14	0.31	0.41	1.86	0.32	3.03	1.52	14.9	4.14
MC 52208	Iron I	E 164	2.53	4.40	0.82	2.23	4.38	1.47	39.3	10.4	143	100	0.48	4.39	859	38.8	64.2	20.2	3.37	0.34	0.46	2.03	0.32	3.26	1.65	16.5	4.40
MC 52338	Iron I	E 165	2.67	4.01	0.79	2.08	3.09	0.74	38.9	14.1	143	103	0.52	4.44	857	39.4	65.0	20.3	3.28	0.33	0.46	2.09	0.36	3.45	1.63	16.6	4.44
MC 52555	Iron I	E 166	2.54	3.91	0.78	2.09	2.79	1.32	35.8	9.60	140	118	0.46	4.26	810	39.1	62.2	19.8	2.98	0.34	0.42	1.99	0.31	3.31	1.50	15.8	4.42
Kos Plateau Tuff																											
MC 45305	?	E 175	2.96	3.70	1.01	2.54	1.60	1.51	27.4	7.00	132	103	0.52	4.28	645	32.1	51.0	14.4	2.62	0.37	0.36	1.68	0.27	3.00	1.89	16.0	4.86
Nisyros																											
MC 45818	Iron II	E 120	2.70	2.62	1.79	5.34	6.58	5.04	53.2	5.29	86.6	147	0.34	2.79	685	33.8	50.8	19.5	3.49	0.69	0.47	1.86	0.32	4.43	1.07	10.2	2.70
MC 45952	?	E 122	3.41	3.22	1.74	3.57	3.96	3.69	47.5	6.37	105	168	0.36	3.35	774	35.9	56.0	18.8	3.38	0.69	0.41	1.85	0.29	4.73	1.24	11.9	3.32
MC 47466	?	E 138a	3.25	2.28	1.77	4.43	3.30	4.33	48.6	5.94	95.4	161	0.33	3.08	731	33.6	53.5	15.7	3.14	0.66	0.40	1.77	0.31	4.62	1.12	11.0	2.94
MC 47466	?	E 138b	3.08	2.78	1.81	4.08	3.01	4.12	48.7	5.85	91.3	153	0.31	2.96	688	32.9	51.7	17.7	3.19	0.64	0.42	1.72	0.27	4.42	1.10	10.5	3.02
MC 47466	?	E 138c	3.08	2.78	1.81	3.94	4.39	4.21	49.7	5.50	87.7	162	0.30	2.84	715	31.4	50.7	16.8	2.90	0.64	0.39	1.69	0.29	4.69	1.09	10.2	2.74

Tel Gerisa	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																											
11157	Unstrat.	D1a	3.29	3.22	1.77	7.08	2.45	2.96	49.9	3.51	96.9	260	0.27	2.66	522	29.4	56.9	23.1	6.61	0.94	0.94	4.55	0.76	6.99	0.78	17.4	5.03
11363	Arabic	D2b	2.62	2.20	2.23	8.26	13.0	4.99	62.8	3.60	103	310	0.37	2.85	565	26.6	65.0	25.1	5.49	1.07	1.02	4.91	0.81	8.16	0.99	18.6	4.01
11363	Arabic	D3a	3.05	3.04	1.95	7.77	6.83	4.17	52.2	3.73	91.3	273	0.30	2.49	503	30.4	57.2	23.6	6.04	0.91	0.91	4.38	0.76	7.13	0.79	17.0	4.94
11363	Arabic	D3d	2.94	2.33	2.00	7.62	3.24	6.44	55.6	3.01	106	300	0.32	2.84	565	26.6	62.5	25.2	5.39	1.06	1.02	4.90	0.83	7.78	0.86	19.0	4.90
11369	Arabic	D4a	3.20	2.49	1.78	6.62	2.02	3.09	48.2	3.03	89.4	245	0.25	2.44	490	28.2	52.8	22.9	5.72	0.91	0.88	4.25	0.72	6.54	0.73	16.2	5.15
11369	Arabic	D4b	3.10	2.64	2.12	7.89	2.95	4.05	56.5	2.84	100	277	0.31	2.74	535	28.0	60.0	23.5	5.94	1.00	0.98	4.76	0.76	7.31	0.82	18.3	4.66
11369	Arabic	D4c	3.50	2.69	1.64	6.40	1.44	2.43	46.4	2.75	94.7	266	0.24	2.55	522	31.1	55.7	20.6	6.22	0.99	0.90	4.40	0.75	6.86	0.75	17.1	5.00
11638	Iron I	D6	3.29	2.69	1.75	6.83	6.87	3.49	49.4	3.73	87.9	256	0.26	2.42	480	30.7	53.2	21.7	6.68	0.87	0.86	4.20	0.70	6.56	0.75	15.9	5.39
11299	Iron I	D7a	2.95	2.65	1.84	7.01	2.95	3.26	53.6	2.82	97.9	280	0.27	2.67	528	26.8	60.0	22.8	5.82	0.97	0.95	4.74	0.79	7.24	0.80	18.1	4.98
11299	Iron I	D7b	3.20	2.83	1.59	6.27	2.26	2.68	45.8	3.18	89.0	247	0.25	2.38	485	28.8	52.7	18.9	6.11	0.90	0.86	4.19	0.74	6.52	0.73	16.1	5.22
11299	Iron I	D7c	2.54	2.42	1.93	7.63	5.45	3.73	56.5	2.83	102	287	0.29	2.79	549	24.8	62.1	25.6	5.15	1.00	0.98	4.89	0.83	7.78	0.87	18.6	4.46
11299	Iron I	D7d	3.09	2.86	1.77	7.09	2.24	3.15	49.8	3.07	91.1	251	0.27	2.48	473	29.5	54.4	22.5	6.40	0.88	0.88	4.41	0.73	6.65	0.74	16.5	5.40
11309	Iron I	D8a	2.80	2.23	2.15	8.11	11.2	4.69	64.9	3.06	105	303	0.31	2.87	575	26.5	65.3	29.4	5.63	1.09	1.04	5.06	0.83	8.11	0.89	19.0	4.52

Table 1 continued

Tel Gerisa	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																											
10395	9A LB II B	D9a	2.73	2.34	2.15	8.14	9.12	4.73	61.5	3.45	98.3	282	0.31	2.75	545	26.7	61.0	24.0	5.81	1.03	0.99	4.73	0.79	7.33	0.85	17.9	4.43
10395	9A LB II B	D9b	2.88	2.42	2.07	7.72	5.81	4.14	58.1	2.93	96.1	280	0.28	2.69	540	27.0	60.4	22.0	5.93	0.99	0.95	4.64	0.79	7.33	0.82	17.9	4.72
10395	9A LB II B	D9c	2.85	2.39	2.37	9.00	7.18	5.10	64.4	3.13	100	293	0.30	2.71	564	27.6	62.1	23.4	5.86	1.03	1.01	4.84	0.80	7.51	0.87	17.9	4.82
10395	9A LB II B	D9e	2.82	2.27	2.00	7.47	2.90	3.67	54.1	2.66	96.0	272	0.25	2.61	542	25.1	58.0	24.5	5.21	0.99	0.93	4.63	0.75	7.00	0.77	17.4	4.36
10395	9ALB II B	D9f	3.09	2.59	2.10	8.50	5.31	4.25	57.6	3.36	96.6	269	0.31	2.67	545	28.9	60.1	25.2	6.41	1.01	0.97	4.77	0.82	7.19	0.82	17.7	4.94
11725	9B LB II B	D13a	3.18	3.28	2.01	7.63	2.25	3.82	56.8	3.27	97.1	265	0.27	2.63	546	31.0	58.1	22.3	6.87	0.96	0.94	4.64	0.82	7.05	0.78	17.5	5.76
11725	9B LB II B	D13b	2.97	2.86	2.16	8.43	2.88	4.09	66.0	3.00	113	319	0.33	3.07	640	27.1	66.2	23.6	5.84	1.13	1.07	5.22	0.93	8.09	0.91	20.3	5.18
12033	9B LB II B	D14a	2.85	2.51	1.61	6.22	6.09	3.53	45.0	3.53	77	218	0.22	2.08	433	27.6	47.0	21.5	5.91	0.83	0.76	3.70	0.64	5.83	0.66	13.7	4.76
12033	9B LB II B	D14b	2.45	1.95	2.19	7.97	9.97	5.45	57.0	2.79	84.7	256	0.24	2.32	480	25.0	54.6	23.2	5.35	0.94	0.85	4.19	0.70	6.92	0.77	15.4	4.07
12033	9B LB II B	D14c	2.49	2.13	1.75	6.58	8.07	4.02	49.1	3.88	84.4	249	0.26	2.31	462	24.8	52.2	19.7	5.34	0.87	0.82	4.05	0.70	6.66	0.73	15.2	4.28
Giali main quarry																											
11363	Arabic	D2a	2.36	3.41	0.90	2.54	12.7	2.04	35.4	8.70	110	119	0.46	3.68	697	36.1	58.9	17.0	3.65	0.40	0.40	1.91	0.31	3.43	1.30	13.7	3.77
11363	Arabic	D3b	2.36	3.58	0.83	2.23	5.63	1.13	33.2	9.59	127	126	0.78	4.25	816	35.4	66.4	18.5	3.36	0.36	0.42	2.08	0.36	3.47	1.47	16.1	3.86
11513	Arabic	D5	2.23	3.50	0.94	2.57	6.44	1.63	39.2	8.62	135	131	0.52	4.49	865	34.8	72.5	20.1	3.38	0.42	0.47	2.30	0.37	3.73	1.57	17.2	3.68
10395	9A LB II B	D9d	2.44	4.11	0.90	2.56	11.3	1.67	36.5	9.61	123	137	0.47	4.13	780	40.4	64.7	19.7	4.07	0.39	0.42	2.04	0.35	3.69	1.44	15.6	4.33
10395	9A LB II B	D9g	2.25	3.47	1.13	3.11	12.0	2.33	43.8	8.50	139	153	0.53	4.61	866	36.4	75.0	22.1	3.72	0.50	0.49	2.33	0.39	4.16	1.63	17.6	3.83
12034	9B LB II B	D15	2.20	3.98	0.86	2.25	4.54	1.43	37.0	9.50	129	130	0.49	4.28	832	36.5	67.3	18.6	3.53	0.37	0.42	2.10	0.36	3.65	1.47	16.1	4.00
Nisyros caldera																											
11363	Arabic	D3c	2.58	2.91	1.69	3.55	3.95	3.02	46.0	6.67	92.4	216	0.33	3.03	707	35.8	59.6	20.4	3.89	0.64	0.42	2.10	0.35	5.20	1.16	11.2	3.17
11045	9B LB II B	D11a	2.96	2.63	1.71	3.66	3.02	3.99	42.4	5.42	93.0	201	0.32	3.17	728	31.8	58.4	18.6	3.23	0.69	0.40	1.91	0.33	4.88	1.11	11.5	2.90
11045	9B LB II B	D11b	3.20	2.74	1.55	3.70	5.61	3.71	38.8	6.12	87.4	159	0.32	3.00	677	34.5	53.1	16.1	3.60	0.65	0.38	1.66	0.30	3.88	1.01	10.7	2.87

Tel Nami	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																										
TN 13-87	MB?	C-1	3.56	2.50	1.84	7.11	1.78	3.02	56.4	2.58	94.3	217	0.29	2.43	476	30.7	52.2	20.9	5.99	0.90	4.23	0.66	6.76	0.75	16.6	4.73
TN 13-87	LBII?	C-3	3.69	2.95	2.08	7.89	3.99	3.40	58.8	8.51	98.4	253	0.35	2.56	482	33.5	58.7	25.4	6.46	1.03	4.79	0.74	7.56	0.84	18.6	6.02
TN 36-89	LBII?	C-4	3.75	2.77	2.13	7.78	5.10	3.50	59.2	6.02	100	251	0.35	2.61	504	34.3	62.6	28.3	6.52	1.08	5.02	0.76	7.91	0.89	19.7	4.84
TN 36-89	LBII?	C-7	3.44	2.49	2.01	7.38	2.94	3.65	60.8	3.49	91.2	212	0.30	2.40	465	29.0	51.3	22.2	5.48	0.95	4.14	0.66	6.72	0.75	16.0	4.46
TN 13-88	LBII?	C-11	3.31	2.53	2.70	7.77	4.99	4.36	61.9	20.3	94.6	271	0.35	2.47	497	31.3	63.6	27.9	6.16	1.01	4.97	0.77	8.99	1.03	22.5	5.30

Table 1 continued

Tel Nami	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																										
TN 100-97	LBIIb	C-21	3.26	2.42	2.55	8.81	7.94	4.14	73.4	16.6	101	287	0.38	2.66	517	35.3	71.1	29.7	6.64	1.11	5.70	0.86	9.01	1.04	22.6	6.23
TN 100-97	LBIIb	C-22	3.60	2.63	2.26	8.41	4.10	4.18	62.5	4.33	98.4	238	0.36	2.59	501	31.4	59.3	24.9	6.06	1.01	4.68	0.72	7.78	0.87	18.6	5.68
TN 100-97	LBII?	C-23	3.62	3.00	2.05	7.56	3.16	3.45	59.3	2.92	102	223	0.33	2.64	515	32.0	58.0	26.3	5.91	0.97	4.60	0.71	7.43	0.80	18.1	5.47
TN 36-89	LBIIb	C-28a	3.48	2.92	2.31	8.26	4.67	3.56	59.9	20.7	98.6	271	0.35	2.58	502	34.2	64.5	25.3	6.59	1.01	5.00	0.78	8.99	1.00	22.0	5.66
TN 13-88	LBII?	C-9	3.28	2.62	1.80	6.90	2.50	3.29	58.2	2.88	91.2	217	0.28	2.40	460	28.2	50.8	20.6	5.13	0.88	4.20	0.65	6.68	0.73	15.8	5.24
TN 36-89	LBII?	C-10	3.44	2.63	1.99	7.52	1.99	3.01	56.7	5.42	103	243	0.32	2.67	509	31.3	58.0	23.3	5.96	0.97	4.73	0.72	7.63	0.84	18.7	6.35
TN 36-89	LBIIb	C-12	3.60	2.66	2.11	7.65	3.13	3.49	58.3	3.58	100	231	0.29	2.62	490	30.8	56.3	23.7	5.64	0.97	4.60	0.71	7.51	0.83	17.9	5.14
TN 36-89	LBIIb	C-13	3.72	2.70	1.97	7.80	n.d.	3.02	57.6	2.78	108	249	0.32	2.78	527	32.3	58.0	23.6	5.97	0.93	4.71	0.74	7.58	0.81	18.5	5.78
TN 36-89	LBIIb	C-14	3.55	2.42	1.95	7.54	1.87	3.17	56.8	3.01	101	227	0.32	2.66	504	29.9	56.2	24.8	5.44	0.97	4.58	0.72	7.28	0.81	17.8	5.85
TN 36-89	LBII?	C-15	3.47	2.67	2.01	7.58	2.21	3.30	56.8	3.70	97.7	227	0.31	2.54	497	30.0	54.5	22.5	5.57	0.96	4.45	0.68	7.10	0.77	17.4	5.40
TN 13-88	LBII?	C-16	3.42	2.68	2.04	7.81	1.80	3.42	60.4	2.79	104	249	0.29	2.69	511	29.8	57.5	25.1	5.42	0.97	4.70	0.73	7.44	0.81	18.0	5.38
TN 36-89	LBIIb	C-17	3.44	2.57	1.83	7.25	1.82	2.87	56.7	2.67	103	229	0.30	2.65	505	29.7	55.0	20.9	5.53	0.92	4.57	0.71	7.19	0.80	17.6	4.96
TN 100-97	LBIIb	C-19	3.53	2.63	2.29	8.10	4.18	3.63	61.8	14.6	98.3	257	0.33	2.52	509	34.1	61.4	25.9	6.55	1.09	5.00	0.77	8.17	0.91	19.7	5.44
TN 13-88	LBII?	C-20	3.42	2.98	2.09	7.86	2.97	3.68	59.8	3.06	103	241	0.31	2.73	518	31.0	58.4	23.6	5.66	1.01	4.77	0.74	7.49	0.85	18.3	5.66
TN 36-89	LBII?	C-24	3.24	2.28	2.14	8.00	3.69	3.77	61.9	7.12	93.3	232	0.30	2.45	509	28.3	57.5	26.4	5.11	1.02	4.60	0.72	7.51	0.85	18.4	4.15
TN 36-89	LBIIb	C-25	3.46	2.52	2.29	8.15	2.29	3.71	62.7	10.3	94.9	260	0.33	2.49	491	30.7	59.0	25.4	5.69	1.05	4.74	0.76	7.76	0.85	19.3	5.03
TN 36-89	LBIIb	C-26	3.45	2.67	2.10	7.94	2.48	3.39	60.6	7.71	101	260	0.31	2.60	514	31.1	59.6	26.2	5.78	1.02	4.85	0.76	7.84	0.86	19.2	5.25
TN 36-89	LBIIb	C-27	3.51	2.55	2.07	7.73	2.18	3.31	58.8	7.16	102	242	0.31	2.62	515	30.6	59.3	24.4	5.63	1.00	4.81	0.74	7.81	0.83	18.9	4.99
TN 65-92	LBII?	C-29	3.53	2.71	1.95	7.54	n.d.	3.12	57.4	2.49	101	242	0.32	2.66	511	29.7	55.8	24.6	5.35	0.95	4.63	0.71	7.40	0.80	17.7	5.29
TN 36-89	?	C-31	3.36	2.58	2.25	8.32	2.35	3.65	63.8	7.95	100	252	0.40	2.66	538	30.6	62.2	21.1	5.66	1.02	4.95	0.78	8.31	0.88	20.1	5.65
Nisyros caldera																										
TN 65-92	LBIIb	C-30	3.42	2.92	1.68	3.44	2.28	2.77	48.6	6.01	95.6	180	0.37	3.02	719	35.8	55.0	18.1	3.32	0.63	1.92	0.32	5.10	1.16	10.9	3.45
TN 13-87	LBII?	C-2	3.49	3.01	1.73	3.80	4.41	3.04	49.4	6.43	94.3	182	0.39	3.03	740	38.8	58.1	21.3	4.10	0.72	2.13	0.33	5.44	1.17	11.4	2.75
TN 37-86	LBII?	C-8	3.11	n.d.	1.88	4.32	11.3	4.25	49.3	5.31	95.4	178	0.37	3.16	719	33.2	56.4	18.3	3.68	0.71	1.82	0.31	5.03	1.08	11.3	2.84
Giali main quarry																										
TN 36-89	LBII?	C-5	2.75	3.80	0.77	2.02	3.18	0.72	33.3	11.6	132	100	0.55	4.17	782	40.9	63.5	20.2	3.34	0.36	2.00	0.31	3.17	1.53	16.3	4.23
TN 13-87	LBIIb	C-6	1.81	n.d.	0.82	2.22	4.36	0.98	35.6	7.32	133	101	0.54	4.21	786	37.3	63.6	19.9	3.65	0.36	1.98	0.31	3.30	1.48	16.0	4.46
TN 36-89	LBIIb	C-28b	2.70	3.84	0.81	2.07	29.2	1.16	39.8	12.8	130	98.2	0.55	4.18	791	40.0	64.2	19.1	3.05	0.33	1.93	0.32	3.35	1.50	16.7	4.57
TN 13-88	MB?	C-18	3.11	3.73	0.81	2.35	3.63	1.39	24.9	4.62	126	80.5	0.55	4.14	778	34.3	52.3	14.1	2.26	0.41	1.53	0.25	2.43	1.66	15.9	4.94

Table 1 continued

Miletos	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Santorini Bo																											
98151	LM 1	M6	3.34	2.71	2.17	8.54	20.6	4.62	62.3	3.89	110	259	0.37	3.18	538	31.0	61.5	25.9	5.83	0.91	1.03	4.96	0.79	7.59	0.86	19.8	5.49
98399	LM 1	M11	3.52	2.51	2.30	8.48	38.3	5.01	68.3	4.03	107	251	0.37	3.23	527	29.7	59.9	24.9	5.54	0.98	0.99	4.79	0.76	7.25	0.84	19.0	5.25
9981	LM 1	M14	3.34	2.59	2.54	10.1	8.54	5.49	65.3	3.41	103	242	0.32	3.01	518	29.6	58.1	23.9	5.59	1.00	0.99	4.75	0.77	7.17	0.82	18.2	5.13
97164	LM 1	M15b	3.48	2.64	2.37	9.09	6.68	5.38	61.4	3.80	98.6	242	0.31	2.88	500	29.5	56.9	22.8	6.12	0.96	0.95	4.53	0.73	6.92	0.78	17.8	4.99
Non-Bo																											
95164	LM 1	M1	3.04	3.67	1.47	3.20	13.2	4.38	35.9	6.19	119	122	0.49	4.04	1500	31.8	51.1	14.6	2.44	0.47	0.33	1.57	0.26	3.30	1.45	15.0	4.12
96286	≥ LM 1	M4	2.88	3.46	0.56	2.04	7.48	1.20	20.4	5.89	104	78.2	0.46	3.71	465	21.3	31.3	9.47	2.09	0.34	0.28	1.37	0.22	2.05	1.45	11.5	4.73
97297	LM 1	M7a	2.12	3.14	1.41	4.16	64.0	6.08	51.8	10.2	129	122	0.75	5.27	643	35.5	60.3	20.4	3.72	0.52	0.50	2.11	0.34	3.70	1.23	15.4	3.54
97297	LM 1	M7b	2.39	3.09	1.81	5.66	25.2	6.63	52.9	8.64	119	143	0.60	4.54	696	35.4	63.6	20.6	3.68	0.59	0.52	2.18	0.35	4.01	1.31	14.8	3.67
97399	LM 1	M8b	3.33	3.44	0.92	2.61	17.0	1.84	25.0	6.07	119	97.2	0.50	4.26	510	37.1	57.6	16.4	2.99	0.44	0.35	1.57	0.27	2.53	1.63	16.9	4.74
98103	LM1A	M10a	2.28	4.34	1.03	3.29	15.0	2.98	31.5	7.97	151	139	0.63	5.29	607	31.3	52.8	15.8	3.07	0.36	0.42	2.15	0.36	4.11	1.98	17.7	5.72
98103	LM 1A	M10c	2.62	4.35	0.99	3.07	8.03	2.42	29.0	7.19	135	101	0.54	4.49	1260	44.8	67.3	18.0	3.11	0.39	0.37	1.66	0.28	2.62	1.73	19.6	5.02
98299	LM1	M13	2.51	4.50	0.98	2.62	20.8	2.37	27.3	36.7	128	103	0.56	4.15	1850	22.2	37.5	11.1	2.47	0.40	0.31	1.53	0.25	2.68	1.54	13.0	5.11
9999	EB–MB	M16	2.82	3.58	1.09	2.63	7.13	1.96	27.1	6.72	127	106	0.53	4.61	510	23.8	40.1	11.7	2.43	0.36	0.35	1.74	0.29	2.93	1.71	14.2	5.02
99265	MB	M17	3.03	3.43	1.27	2.95	21.8	2.50	30.9	6.34	117	119	0.49	4.21	1140	35.7	57.9	14.8	3.44	0.46	0.35	1.72	0.27	3.39	1.52	16.8	4.62
99356	LM 1A	M19	3.41	4.16	0.66	2.01	16.0	1.43	18.7	4.84	111	71.1	0.38	4.34	2690	24.6	38.0	10.1	1.93	0.58	0.24	1.14	0.19	1.82	1.18	11.3	3.30
99746	LM 1	M20	3.02	3.60	0.79	2.67	4.89	1.63	23.6	6.31	124	94.0	0.50	4.26	1130	57.0	81.8	21.3	3.48	0.42	0.38	1.59	0.27	2.45	1.69	22.7	4.92
Giali top layer																											
96275	MB–LM 1	M3	3.00	3.13	1.44	3.51	10.5	2.73	40.5	6.71	112	145	0.52	3.90	599	35.2	51.9	17.7	4.07	0.63	0.45	1.84	0.30	3.91	1.34	12.8	3.73
Giali main quarry																											
97399	LM 1	M8a	2.57	3.74	0.81	2.22	11.0	1.57	35.5	10.3	130	104	0.51	4.45	783	37.6	61.2	17.8	3.20	0.35	0.42	2.01	0.32	3.24	1.37	15.8	4.22
9981	LM 1	M15a	2.47	3.91	0.77	2.08	12.3	1.34	33.0	10.4	124	97.6	0.47	4.24	749	37.6	57.4	16.9	3.24	0.34	0.40	1.89	0.31	2.95	1.32	15.0	4.31
00189	MB	M21	2.58	3.93	0.84	2.31	10.0	1.58	34.7	9.56	136	113	0.50	4.56	822	38.5	64.7	19.2	3.36	0.37	0.44	2.07	0.35	3.43	1.44	16.5	4.46
Nisyros caldera																											
95320	LM 1	M2	2.94	3.34	1.62	3.77	13.4	4.55	53.8	8.11	109	197	0.47	3.79	712	37.8	59.2	19.0	3.70	0.55	0.48	2.17	0.36	5.41	1.22	12.8	3.46
97151	MB	M5	2.99	2.58	1.85	4.10	10.4	5.06	47.6	6.00	90.7	181	0.34	3.16	675	32.2	53.3	17.4	3.30	0.65	0.41	1.80	0.30	4.86	0.99	11.0	2.94
9898	EB–LM 1	M9	2.91	3.48	2.13	4.50	8.10	4.43	58.8	7.63	107	218	0.37	3.62	744	38.1	63.7	21.4	3.73	0.59	0.50	2.36	0.39	5.84	1.28	13.0	3.38
98103	LM 1A	M10b	3.52	2.56	2.08	4.01	7.43	5.23	54.8	6.43	89.1	192	0.35	3.03	712	34.2	56.2	19.9	3.63	0.76	0.45	2.00	0.33	4.93	1.10	10.7	2.76
98179	MB	M12	3.39	2.63	1.62	3.33	10.0	4.17	40.7	6.14	85.7	169	0.32	2.98	688	33.1	51.6	16.0	3.47	0.73	0.38	1.68	0.28	4.51	0.92	10.5	2.78
99344	LM 1A	M18	3.28	2.65	2.01	4.35	9.13	5.34	50.2	6.47	96.0	186	0.37	3.43	724	34.0	57.3	17.2	3.19	0.71	0.41	1.87	0.31	4.85	1.11	11.8	2.76
00325	LM 1	M22	3.18	2.68	1.73	3.65	16.7	3.95	47.5	6.35	89.9	189	0.38	3.38	661	33.4	52.9	17.5	3.28	0.67	0.43	1.93	0.32	4.99	1.07	10.9	2.89

Table 1 continued

Miletos	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Nisyros caldera																											
00331	LM 1	M23a	3.00	3.23	1.60	3.76	14.4	3.33	48.7	7.38	107	214	0.47	3.72	770	36.3	62.1	19.5	3.54	0.61	0.47	2.24	0.36	5.83	1.30	13.2	3.26
00331	LM 1	M23b	3.15	3.17	1.63	3.74	13.8	4.46	47.7	7.38	106	196	0.44	3.65	748	36.9	61.0	20.0	3.65	0.67	0.49	2.23	0.37	5.33	1.22	12.8	3.15

Megadim	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Yb	Lu	Hf	Ta	Th	U
Santorini Bm																										
L961B5992	EBI	G4	3.62	n.d.	3.36	14.7	3.66	4.94	97.8	n.d.	76.5	203	0.21	2.28	410	25.7	51.3	26.3	6.57	1.42	5.13	0.79	6.09	0.74	12.8	3.45
Kos Plateau Tuff																										
L152B847	Persian	G1	2.77	n.d.	0.78	2.50	6.85	1.69	31.2	5.35	114	90.9	0.46	3.80	421	29.3	46.2	13.9	2.50	0.42	1.54	0.26	2.64	1.57	14.3	4.06
L2267B3723	EBI	G8	2.83	3.16	0.80	2.65	4.60	1.73	29.0	5.02	128	89.8	0.46	3.88	939	28.2	44.0	12.1	2.46	0.39	1.54	0.27	2.56	1.65	14.2	4.70
Giali main quarry																										
L70B376	Persian	G5	2.34	4.09	0.81	2.18	5.52	1.61	47.5	9.01	126	100	0.45	4.01	741	35.6	58.0	17.9	3.25	0.34	1.91	0.31	3.10	1.41	15.2	4.12
L2070B3158	MBII	G10	2.18	3.79	0.81	2.12	4.87	1.51	50.5	10.7	129	98.1	0.48	4.37	675	36.0	57.1	18.2	3.45	0.32	1.95	0.32	3.19	1.36	16.2	4.39
Lipari																										
L138B822	Persian	G2	2.63	3.64	1.23	1.66	6.69	1.33	61.9	19.9	295	194	0.97	14.3	184	51.5	101.3	39.6	8.60	0.20	4.26	0.66	5.91	2.30	47.2	13.5
Nisyros																										
L1086B2356	MBII	G3	3.04	n.d.	1.80	3.88	4.37	4.18	49.5	5.74	92.8	165	0.31	2.95	706	32.0	53.4	17.5	2.97	0.67	1.79	0.29	4.64	1.08	11.0	2.84

North Sinai	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Yb	Lu	Hf	Ta	Th	U
Unidentified		A 289	13.7	35.2	11.5	1.98	8.53	3.7	47.8	8.94	160	150	1.23	10.1	636	61.3	121	37.8	6.82	1.52	2.33	0.33	3.13	1.24	31.1	5.69
Santorini Bo		A 345	33.4	23.7	22.7	8.71	1.60	5.69	51.4	2.77	85.4	210	0.19	2.25	463	27.8	50.9	20.5	4.72	0.87	3.99	0.60	6.31	0.67	15.4	5.44

Knossos	Age	Sample	Na	K	Fe	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs	Ba	La	Ce	Nd	Sm	Eu	Yb	Lu	Hf	Ta	Th	U
Santorini Bu			3.56	3.00.	2.92	11.8	84.8	4.08	91.2	11.2	117	271	0.38	3.85	483	35.4	64.4	28.6	7.94	1.33	5.20	0.72	9.05	1.02	19.9	6.64

Table 1 continued

Excavation site	Number	Provenance
Tell el Dab^ca	105	101 Santorini (95 Bo, 2 Bu, 4 Cape Riva), 2 Nisyros, 1 Giali, 1 non-Bo
Ashkelon	78	60 Santorini (52 Bo, 1 Bu, 7 Bm), 8 Giali, 1 Kos, 5 Nisyros, 4 non-Bo
Tel Gerisa	32	23 Santorini Bo, 6 Giali, 3 Nisyros
Tel Nami	32	25 Santorini Bo, 3 Nisyros, 1 Kos, 3 Giali
Miletos	29	4 Santorini Bo, 4 Giali, 9 Nisyros, 12 non-Bo
Megadim	7	1 Santorini Bm, 1 Nisyros, 2 Kos, 2 Giali, 1 Lipari
North Sinai	2	1 Santorini Bo, 1 non-Bo
Knossos	1	1 Santorini Bu

Table 2 Compilation of identified pumice samples. The unidentified samples are most likely of Anatolian origin Bo ... oberer Bimsstein (Minoan Tuff), Bm... Middle Tuff Sequence, Bu … unterer Bimsstein (Lower Pumice Tuff); non-Bo … unidentified, but definetly of non-Minoan origin

Eruption	Age [ky]	Reference
Santorini Cape Therma	257 ± 31	DRUITT *et al* (1999)
Santorini Lower Pumice (Bu)	180 – 205	DRUITT *et al* (1999)
Kos Plateau Tuff	145	KELLER *et al* (1990)
Santorini Middle Tuff (Bm)	100	DRUITT *et al* (1999)
Santorini Cape Riva	21	DRUITT *et al* (1999)
Giali main quarry	≥ age of Nisyros	KELLER *et al* (1990)
Nisyros caldera	> 12.5	KELLER *et al* (1990)
Giali top layer	< age of Nisyros	KELLER *et al* (1990)
Lipari Mt. Pilato	~5	PICHLER (1981)
Santorini Minoan Tuff (Bo)	~3.6	FRIEDRICH *et al* (1990)

Table 3 Compilation of volcanic eruption ages associated with pumiceous deposits

DRUITT T.H., EDWARDS L., MELLORS R.M., PYLE D.M., SPARKS R.S.J., LANPHERE M., DAVIES M., BARRIERO B. (1999), Santorini volcano. Geological Society Special Publication, *Geological Society of London* 19, 165 pp.
KELLER J., REHREN TH., STADLBAUER E. (1990), Explosive Volcanism in the Hellenic arc: a summary and a review, in: HARDY D.A., RENFREW A.C. (eds.), *Thera and the Aegean World III*, Vol. 2, 13–26.
PICHLER H. (1981), *Italienische Vulkan-Gebiete III,* Gebr. Bornträger, Berlin-Stuttgart, 20 pp.
FRIEDRICH W.L., WAGNER P., TAUBER H. (1990), Radiocarbon dated plant remains from the Akrotiri excavation on Santorini, Greece, in: HARDY D.A., RENFREW A.C. (eds.), *Thera and the Aegean World III*, Vol. 3, 188–196.

Sample	Na [wt.%]	K [wt.%]	Fe [wt.%]	Decarb [wt.%]	Sc	Cr	Co	Zn	As	Rb	Zr	Sb	Cs
Iasos 1	3.079	2.715	2.106	6.27	8.68	8.38	4.38	54.0	3.48	97.9	233	0.38	2.90
Iasos 2	2.906	2.646	2.155	5.72	8.82	11.1	4.71	52.2	3.76	89.7	203	0.43	2.84
Iasos 3	3.136	2.903	2.473	4.71	10.0	37.2	5.95	59.9	3.65	106	244	0.45	3.37
Iasos 4	2.992	2.783	2.009	9.86	8.13	7.77	4.06	51.0	3.47	92.8	224	0.39	2.81
Iasos 5	3.153	2.956	2.236	6.13	9.10	9.60	4.59	56.6	3.75	105	246	0.42	3.19
Iasos 6	2.989	2.885	2.267	9.24	8.96	14.5	5.15	57.5	4.16	99.0	223	0.48	3.17
Iasos 7	3.030	2.894	2.335	7.02	9.39	8.55	4.72	59.5	3.49	109.2	252	0.46	3.31
Iasos 8	2.849	2.681	2.199	11.6	8.80	10.6	4.62	55.8	3.28	99.0	230	0.42	3.06
Iasos 1f	1.749	3.169	2.329	43.6	12.2	15.8	4.92	56.8	7.12	95.7	227	1.18	4.15

All concentrations in mg/kg, except as noted

Sample	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	Th	U
Iasos 1	477	27.4	52.5	22.1	4.64	0.85	0.85	4.35	0.65	6.90	0.77	16.9	4.96
Iasos 2	442	26.0	47.5	17.4	4.46	0.80	0.76	3.75	0.57	6.35	0.71	15.2	4.74
Iasos 3	529	28.1	55.9	26.4	4.93	0.92	0.88	4.44	0.66	7.46	0.83	18.1	4.90
Iasos 4	464	28.5	51.0	22.0	4.59	0.79	0.80	3.98	0.61	6.69	0.75	16.3	5.05
Iasos 5	527	28.7	55.5	21.4	4.64	0.87	0.90	4.40	0.66	7.43	0.82	18.0	5.45
Iasos 6	486	28.4	51.6	20.4	4.56	0.81	0.81	4.03	0.63	6.95	0.80	16.5	5.01
Iasos 7	547	28.2	57.7	23.8	4.64	0.90	0.93	4.55	0.70	7.74	0.87	18.7	5.00
Iasos 8	496	26.6	52.7	21.4	4.28	0.83	0.85	4.17	0.65	7.10	0.80	17.0	4.83
Iasos 1f	128	24.8	46.4	16.7	4.74	0.66	0.72	3.77	0.59	7.26	0.82	19.5	5.00

All concentrations in mg/kg

Table 4 Major and trace element contents of eight sub-units from the tephra-layer at Iasos. "Decarb" designates the amount removed by the decarbonization and purification process