

# KAVOUSI

## The Results of the Excavations at Kavousi in Eastern Crete

*Directed by*

Geraldine C. Gesell, Leslie Preston Day,  
and William D.E. Coulson

*Sponsored by*

The University of Tennessee

*Under the auspices of*

The American School of Classical Studies at Athens





Frontispiece. Large pedestaled krater (GR27 P4), Early Orientalizing. Watercolor D. Faulmann.

PREHISTORY MONOGRAPHS 71

# KAVOUSI IV

## The Early Iron Age Cemeteries at Vronda

*Part 1*

TEXT

*By*

Leslie Preston Day and Maria A. Liston

*Contributions by*

Kimberly Flint-Hamilton, Kevin T. Glowacki, Eleni Nodarou,  
Effie Photos-Jones, David S. Reese, Lynn M. Snyder, and Julie Unruh

*Edited by*

Geraldine C. Gesell and Leslie Preston Day



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## Preface

This volume is the fifth in the final report of the cleaning and excavations at Kavousi Vronda, which were conducted between 1981 and 1992 by Geraldine C. Gesell, Leslie Preston Day, and the late William D.E. Coulson. The volume includes two distinct cemeteries: the tholos tombs at Vronda, which were uncovered by Harriet Boyd or local landowners and cleaned as part of the Kavousi project between 1900 and 1990; and the cremation enclosures excavated by members of the Kavousi project from 1984 through 1992. Preliminary analysis of the material from the tholos tombs was carried out by Geraldine Gesell (architecture), William Coulson† (pottery), and Leslie Day (objects), and it formed the basis for preliminary reports (Gesell, Day, and Coulson 1983; Day 1984; Gesell 1985). Preliminary reports on the cremation enclosures also have appeared (Day, Coulson, and Gesell 1986; Gesell, Coulson, and Day 1991; Day 1995, 2011a; Gesell, Day, and Coulson 1988, 1995). The skeletal remains from all of the tombs in the Kavousi area were studied and written up by Maria Liston (1993, 2007; Liston and Day 2009). This volume supersedes all of these earlier works.

The reports on the houses of the earlier LM IIIC settlement can be found in three previous volumes. *Kavousi* IIA (Day, Klein, and Turner 2009) describes the buildings on top of the Vronda ridge: Building A-B; Building Complexes C-D and J-K; and Buildings P, Q, and R. *Kavousi* IIB (Day and Glowacki 2012) presents the buildings on the slopes of the Vronda ridge: Building Complexes E, I-O-N, and L-M; Building F; the pottery kiln; and areas

excavated on the periphery that did not belong to any of these buildings. *Kavousi IIC* (Day et al. 2016) contains detailed analyses of the architecture, pottery, other finds (including figurines and stone tools), and botanical and faunal remains, along with a complete history of the site and a reconstruction of the social, political, and religious organization of the LM IIIC settlement. *Kavousi III: The Late Minoan IIIC Shrine* presents the architecture and ritual equipment of the shrine in the settlement (Gesell, Glowacki, and Klein, in prep.). For building and room designations, the reader should consult earlier volumes.

The Kavousi series also will include volumes on the excavations at the Kastro, a site high on the mountain above and to the east of Vronda. The Kastro report will include volumes on the pottery, stratigraphy, architecture, and finds from the settlement on the peak, as well as the material from the tombs on the slopes surrounding the Kastro that were recovered by earlier archaeologists.

A detailed history of excavations at Kavousi can be found in *Kavousi I* (Haggis 2005, xvii–xix) and *Kavousi IIA* (Day, Klein, and Turner 2009, xxv–xxviii, 3–5). It thus will not be repeated here.

The complete list of acknowledgments for the work at Kavousi was provided in *Kavousi IIA* (Day, Klein, and Turner 2009, xxix–xxxv), but since that time others have contributed to the study and publication of the Vronda material. The work has been done with the support of the 24th Ephorate of Prehistoric and Classical Antiquities (now the Ephorate of Antiquities of Lasithi) and especially its directors, Vili Apostolakou and Chrysa Sofianou. We are most grateful for the continuing support of the Institute for Aegean Prehistory (INSTAP). The INSTAP Study Center for East Crete (INSTAP SCEC) has facilitated the studies and has provided the use of publication teams to complete drawings and photography; we are especially grateful to the director, Thomas Brogan, who personally has done so much to support our work. We wish to thank the American School of Classical Studies at Athens (ASCSA) for its support, and in particular the Blegen Library, the facilities of which were a major source of information for our research. We also greatly appreciate the financial support that came from our associated institutions: Wabash College, the University of Tennessee, and Texas A&M University.

The University of Tennessee supported the preliminary studies of the human remains from the graves, and the Wiener Laboratory (ASCSA) and its former and current directors, Sherry Fox and Panagiotis Karkanias, have provided resources and advice for the human bone studies. The data on crania were shared with an undergraduate student, Sarah Swinger, who initially analyzed them for her undergraduate honors thesis and identified some of the patterns in the data.

Others have been generous with their time and expertise. The pottery studies were informed by discussions with a number of individuals, including Antonios Kotsonas, Margaret Mook, Penelope Mountjoy, Metaxia Tsipopoulou, and the late Nicolas Coldstream. The petrographic analysis was conducted at the INSTAP SCEC. Ryan Collier, Matthew Hurley, Shireen Kanakri, Matthew Miller, Megan Oehrlein, and Mark Willingham helped with the estimation of vessel capacities. Analysis of the few stone tools found in the graves was carried out by Heidi Dierckx, who also wrote the catalog entries. Harriet Blitzer and Tristan Carter provided the identification of stones used in objects that were not tools. Initial faunal analysis of the material from the tholos tombs was provided by Sheilagh Wall-Crowther. Walter Klippel collaborated with Lynn Snyder in the species identification of the animal bones from all of the graves, and Dimitra Mylona was enormously helpful in pulling material for analysis and photography. The marine shells were studied by David Reese; an overall discussion of these shells can be found in *Kavousi IIC* (Day et al. 2016). The botanical remains from the graves have been analyzed by Kimberly Flint-Hamilton, and the overall results have been presented in *Kavousi IIC* (Day et al. 2016).

The metallurgical analysis of the iron artifacts from Vronda and the Kastro was carried out by Effie Photos-Jones, of the University of Glasgow and Scottish Analytical Services for Art and Archaeology (Ltd.), Glasgow. The study took place in the 1990s, and it reflects the state of research at that time. There has been no serious opportunity to discuss these results in the context of more recent research on the topic of Early Iron Age metallurgy in Greece. Bloomery iron (early or late) is not a glamorous material, and yet it has been pivotal in the development of the Greek world. Its full story, on its own and vis-a-vis bronze, remains largely unwritten. Unfortunately, it has not been possible to update it with respect to recent comparable work elsewhere other than to acknowledge the analytical study by Eleni Filippaki, Yannis Bassiakos, and Barbara Hayden (2014) on mainly Late Roman to Byzantine iron slag from Priniatikos Pyrgos near Hagios Nikolaos in East Crete.

The following individuals worked specifically on the graves, and their contributions are much appreciated. The cleaning of Tholos Tombs I, II, IV–VI, IX, and X was carried out by William Coulson, Leslie Day, and Geraldine Gesell. Tholos VIII was uncovered again by Pedar Foss, and Tholos XI was cleaned by Jane Carter. Trench supervisors of the enclosure graves included Kevin Baldwin (Grave 11), Thomas Brogan (Grave 19), Jane Carter (Grave 34), William Coulson (Grave 1), Leslie Day (Graves 1 and 2), Deanne Dicer (Grave 36), Pedar Foss (Grave 13), Kevin Glowacki (Graves 6–8, 15, 23, 24, 28, 30, 33, 35), James Higginbotham (Grave 16), Nancy Klein (Grave 31), Mark Lawall (Grave 19), Heidi Mittelstadt (Grave 20), Jonathan Reynolds (Grave 20), Julia Shear (Graves 9, 14), Jeffrey Soles (Grave 3), Susan Springer (Graves 4, 5), Lee Ann Turner (Graves 10, 12, 17, 21, 22, 25–27, 32), Benjamin Venable (Grave 29), and Catherine Woolfit (Grave 29). Maria Liston and anthropological assistants (Melinda Carter, Jonathan Reynolds, and Susan Kirkpatrick Smith) worked together with the trench supervisors in excavating the enclosures, overseeing the plotting and removal of the bones and the grave goods.

Plans and sections of the tholos tombs were drawn by William Coulson, Leslie Day, Jeffrey Soles, Pedar Foss, and Konstantinos Chalikias. Charles L. Hall, Douglas H. Pierce, Faye C. Polillo, James Rehard, and Vanessa A. Rousseau drew the state plans of the enclosures. Plans of the tholoi and enclosures were inked by Roxana Docsan.

The difficult task of conservation of the pottery and objects from the enclosure burials was undertaken over the years by a number of conservators, including Jane Allison, Richard Barden, Ann Brysbaert, Nancy Buschimi, Stefania Chlouveraki, Matthew Crawford, Kathy Hall, Barbara Hamman, Katherine Holbrow, Helen Kingsley, Linda Landry, Catherine Magee, Katherine Nightingale, Albert Nyboer, Noël Siver, Kirsten Svenson-Taylor, Christine Thede, Katerina Triandafyllou, Katherine Untch, and Gayle Wever. The pottery and objects from the tholos tombs were drawn by William Coulson, Leslie Day, Geraldine Gesell, and Roxana Docsan; drawings were inked by Roxana Docsan. Pottery from the enclosure burials was drawn primarily by Roxana Docsan and Leslie Day, but also by David Cummins, Stephen T. Moody, and Christopher White; while most of the pottery was inked by Roxana Docsan, a few vessels were done by Doug Faulmann and Elizabeth Safran. The metal artifacts were drawn and inked by Lyla Pinch Brock. Terry Faulkner drew and inked the figures of the semi-articulated skeletons based on the field drawings. Kathy Hall provided testing, X-ray analysis, and perceptive observations about the metal artifacts, including the textile impressions.

Photography was carried out by Kavousi project staff photographers from 1981–1996: Duane Bingham, Steven Hamilton, Karen Moukheiber, Christina Paterakis, Joanne Polley, Julie Smith, and John Zimmerman. From 1997 to the present, photography has been carried out at the INSTAP SCEC by Kathy May and Chronis Papanikolopoulos. William Coulson, Leslie Day, Geraldine Gesell, Kevin Glowacki, Nancy Klein, and Melissa Eaby were responsible for additional site photography. The photographs of the material excavated by Boyd

were taken by Geraldine Gesell. Theodora Kopestonsky kindly helped with the digitization of many of the photographs.

Quentin Dodd worked on a digital reconstruction of the contents of Grave 9 for his senior undergraduate thesis at Wabash College. Because this occurred early in the use of computers in archaeology, it was not entirely successful. Nevertheless, he was instrumental in determining the stratigraphy of this complicated enclosure.

Kevin Glowacki estimated the capacities of vessel types from the enclosure burials found in Appendix A. The iron artifacts formed the basis for a metallurgical study by Effie Photos-Jones, a report on which is included as Appendix B. Additional information about the metal objects came from X-ray analysis by Kathy Hall at the INSTAP SCEC.

The material from the Vronda cemeteries is to be found in several museums and storerooms in Crete at the time of publication. Pottery and objects from Boyd's excavation of the tholos tombs are in the Herakleion Archaeological Museum (inventory numbers prefaced by HM). The majority of the material from the cleaning and excavation by the Kavousi project can be found in the storerooms of the INSTAP SCEC. Some vessels are on display or in the storerooms of the Archaeological Collection of Ierapetra (IM), while others (including some that had been inventoried in the Ierapetra museum) have been taken to the Archaeological Museum of Hagios Nikolaos (HNM).



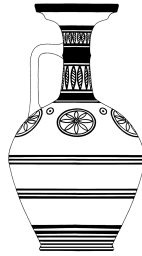
## List of Abbreviations

The following chronological abbreviations are used (Bronze Age dates are based on Warren and Hankey 1989; Early Iron Age dates are based on Coldstream 2001 and Kotsonas 2008).

FN	Final Neolithic (ca. 4500–3200 B.C.)	LG	Late Geometric (ca. 745–710/700 B.C.)
EM	Early Minoan (ca. 3200–2100 B.C.)	CA I	Cypro-Archaic I (ca. 750–600 B.C.)
MM	Middle Minoan (ca. 2100–1600 B.C.)	SubG	Subgeometric (ca. 680–650 B.C.)
LM	Late Minoan (ca. 1600–1050 B.C.)	SubLG	Sub-Late Geometric (ca. 680–650 B.C.)
SM	Subminoan (ca. 1050–1000/970 B.C.)	O	Orientalizing (ca. 700–600 B.C.)
EIA	Early Iron Age (ca. 1100–700 B.C.)	EO	Early Orientalizing (ca. 710/700–670 B.C.)
CG	Cypro-Geometric (ca. 1050–750 B.C.)	MO	Middle Orientalizing (ca. 670–640 B.C.)
PG	Protogeometric (ca. 970–810 B.C.)	LO	Late Orientalizing (ca. 640–600 B.C.)
EPG	Early Protogeometric (ca. 970–920 B.C.)	EPAR	Early Protoarchaic (ca. 710/700–640 B.C.)
MPG	Middle Protogeometric (ca. 920–875 B.C.)	LPAR	Late Protoarchaic (ca. 640–600/570 B.C.)
LPG	Late Protogeometric (ca. 875–845 B.C.)	A	Archaic (ca. 600–480 B.C.)
SubPG	Sub-Protogeometric (ca. 850–800 B.C.)	C	Classical (ca. 480–331 B.C.)
PGB	Protogeometric B (ca. 845–810 B.C.)	V	Venetian (13th–17th century A.D.)
G	Geometric (810–700 B.C.)	Ott.	Ottoman (17th century–1900 A.D.)
EG	Early Geometric (ca. 810–790 B.C.)	Mod.	Modern (1900 A.D.–present)
MG	Middle Geometric (ca. 790–745 B.C.)		

The following additional abbreviations are also used in this volume.

AutoCAD	computer-aided design software	<b>M</b>	metal
avg.	average	m	meter(s)
<b>B</b>	bone or ivory	m asl	meters above sea level
brec	breccia	m <sup>2</sup>	square meter(s)
ca.	approximately	m <sup>3</sup>	cubic meter(s)
cf.	comparable to (in faunal analyses)	max.	maximum
cm	centimeter(s)	mm	millimeter(s)
d.	diameter	MNI	minimum number of individuals
EDM	electronic distance measurement	µm	micron(s)/micrometer(s)
esp.	especially	nm	not measured
est.	estimated	no(s).	number(s)
ext.	exterior	<b>P</b>	pottery
<b>G</b>	glass	para	parallel
G.	Grave	PB	polished block
g	gram(s)	perp	perpendicular
GPS	Global Positioning System	pers. comm.	personal communication
h.	height	pl.	plural
H/DR	ratio of height of an open vessel to the diameter of the rim	PMD	petrography sample by Peter M. Day
HM	Herakleion Archaeological Museum catalog number	pres.	preserved
HNM	Archaeological Museum of Hagios Nikolaos catalog number	<b>S</b>	stone
H <sub>v</sub>	Vickers hardness (test for measuring microhardness)	SEM-BS	back-scattered mode scanning electron microscopy
IM	Archaeological Collection of Ierapetra catalog number	SEM-EDX	scanning electron microscopy with energy-dispersive X-ray analysis
INSTAP	Institute for Aegean Prehistory	SEM-SE	secondary emission mode scanning electron microscopy
INSTAP SCEC	Institute for Aegean Prehistory Study Center for East Crete	SHB	smithing hearth bottom
int.	interior	<b>ST</b>	stone tool
KAV	prefix (Kavousi) for petrograph- ic and metallurgical samples	<b>TC</b>	terracotta
kcal	kilocalorie(s)	th.	thickness
kg	kilogram(s)	TMJ	temporo-mandibular joint
km	kilometer(s)	VE	Vronda East
L	liter(s)	VN	Vronda North
L.	length	VS	Vronda South
LCH	Langerhans cell histiocytosis	VW	Vronda West
lime	limestone	w.	width
LEH	linear enamel hypoplasia	wh	whole
		wt.	weight
		XPL	cross-polarized light



## Glossary

The text uses the following terms, which are specialized terminology or do not have exact English equivalents.

dromos	passage leading to the entrance of a tholos tomb, often just a pit in front of the stomion
enclosure grave	a stone-lined enclosure containing multiple cremation burials that were burned on the pyre and left in place; formerly called a cist grave
jift	solid and semisolid residue from olive pressing
pseudo-dromos	area in front of a tholos tomb that is not lined with stones and is often merely a pit
stomion	doorway for entering a tholos tomb
tholos	type of tomb that is generally round in plan and covered with a corbeled vault (pl. tholoi)
<i>tsakali</i>	soft marl bedrock that can be cut easily; also called <i>kouskouras</i>
<i>zembili</i>	large rubber basket with two handles used for carrying dirt and stones; approximate capacity of 25.00 L (pl. <i>zembilia</i> ).

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# KAVOUSI IV

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*Part 2*

TABLES, CHARTS, FIGURES, AND PLATES

*By*

Leslie Preston Day and Maria A. Liston

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- Plate 76B. Metallographic section 1 of KAV4 (object K 20014.2; x50) showing uniform and intense carburization with areas of pearlite (dark) and grains of ferrite (light) at the boundaries between pearlites.
- Plate 76C. SEM-BS image of KAV4 showing lamellar pearlite (b) amid ferrite grains (a) traversed by elongated slag inclusions (c).
- Plate 77A. Metallographic section 2 of KAV10 (object K 20014.2 ; x50) showing uneven carburization across the section with pearlite (dark) and grains of ferrite (light), and a gradual increase of carburization from bottom to top of image.
- Plate 77B. SEM-BS image of KAV10 showing area of lamellar pearlite (b) with ferrite (a).
- Plate 78A. SEM-BS image of KAV14 showing globular wustite (FeO, bright), needles of fayalite (gray and appearing below wustite), and (weathered) interstitial glass (darker shade of gray).
- Plate 78B. SEM-BS image of KAV14 showing remnants of a fragment of charcoal (arrow) trapped within the matrix of partially reduced iron oxide.
- Plate 79A. SEM-BS image of KAV16 showing an unreacted iron ore inclusion (a) trapped within fayalite phase slag (b) and metallic iron (c); pores (d), dendrites of wustite (e), and globular iron oxide evolving from fine dendrites (f) are also visible.
- Plate 79B. SEM-BS image of KAV17 showing large dendrites of globular wustite (a) and fine dendrites of fayalite growing out of interstitial glass (grayish black).
- Plate 80A. SEM-BS image of KAV11 showing ferrite (a), fine and well-developed needles of iron nitride (b), cementite (c), and small slag inclusions (d).
- Plate 80B. Metallographic section of KAV 26 (x50) showing ferrite with multiple slag inclusions following the line of working or hammering (composite of three images).
- Plate 81A. Metallographic section of KAV33 (x50) showing ferrite with multiple slag inclusions lining up along the line of working or hammering.
- Plate 81B. SEM-BS image of KAV33 showing slag inclusions (a) of various sizes trapped within the ferrite matrix, with cementite growing within the grain boundaries.
- Plate 81C. Metallographic section of KAV35 (x50) showing ferrite matrix with many elongated slag inclusions drawn along the direction of the line of working.

- Plate 82A. SEM-BS image of KAV21 showing a section of the copper alloy consisting of tin bronze with lead inclusions.
- Plate 82B. SEM-BS image of upper section of KAV15 showing the metallic iron envelope having completely weathered to iron oxide (a), small islands of remaining low carbon iron (b), and angular grains of Cu-Sn alloy (c) separated by corrosion (light gray).
- Plate 82C. SEM-BS image of KAV21 showing lead metal inclusion (a) at the grain boundaries of a copper-tin alloy (b) and, with volume expanded (looking puffed up), tin chloride corrosion growing at the grain boundaries (c).
- Plate 82D. SEM-BS image of KAV15 showing the interface between the copper alloy and iron part of the fibula.
- Plate 83A. Metallographic section of KAV29 (x50) showing a largely ferrite matrix with areas of angular pearlite.
- Plate 83B. SEM-SE image of KAV29 showing lamellar pearlite (bright), a long “island” of ferrite (light gray), and a small teardrop-shaped slag inclusion near the center.