AGIA VARVARA-*ALMYRAS*
AN IRON AGE COPPER SMELTING SITE IN CYPRUS

edited by Christina Peege

in collaboration with Philippe Della Casa and Walter Fasnacht

Part I – Archaeological Situation, Stratigraphy, and Chronology

by Christina Peege

with a foreword by Philippe Della Casa

Part II – Materials and Processes

by Iphigenia Gavriel, Robert Morris, Anne Carey,
Aleksandra Mistireki, Walter Fasnacht, Martina Renzi,
Myrto Georgakopoulou, Christina Peege and Thilo Rehren

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Part II – Materials and Processes

Foreword:
Agia Varvara-Almyras, an Exceptional Case Study

Philippe Della Casa

There is in mediterranean, continental and insular Europe a long tradition of fieldwork, analytical investigation and archaeometallurgical experiment around the topic of early copper production, starting with the pioneering works of Much, Klose and Kyrle on the Mitterberg and Kelchalm in Austria already in the mid-19th century, and up to recent compound projects in the Eastern Mediterranean, the Alps, the British Isles, France, Italy, Spain and Portugal, and the Arabian Peninsula. Though archaeometallurgy, and in particular mining archaeology, has gained new grounds in various regions of Europe over the last generation of researchers, some main focus areas have remained the same from the onset: This holds in particular true for the Alps, the Iberian Peninsula, Sardinia, and Cyprus, the Copper Island par excellence.

One of the key topic that interlinks all these areas is the concept of *chaîne opératoire* – the production chain, process workflow, or operational web – i.e. the question of how and through which technical stages ores were treated, smelted and transformed into raw copper. The issue is a complex one, since it encompasses a broad spectrum of sciences and approaches. To name the most important: geology and mineralogy with regard to ores; analytical archaeology in identification and interpretation of structural features and tools relating to ore mining, beneficiation and smelting; inorganic chemistry with respect to smelting processes, as well as structural analysis on semi-finished, finished, and waste products; furthermore spatial, organizational and social understanding of all processes involved.

Not many archaeometallurgical sites of the prehistoric periods have been excavated and documented in such a way as to offer the opportunity of studying the full chaîne opératoire of copper production. Agia Varvara-*Almyras* now is such an outstanding case. Several factors contributed to this exceptional situation, from the chance discovery of the site in an agricultural low-impact environment, to the favourable conservation status and modest spatial extension of the structures including the nearby mining pit, and the perseverance of the excavation team under the lead of Walter Fasnacht, who from 1988 onwards uncovered, documented and presented in altogether 20 field seasons the remains of the smelting site.

However, such a long duration of activity and research inevitably comes along with a number of problems, the most important probably being that of documentation: started in a fully analogous research environment where structured excavation and recording of features, in particular micro-features such as furnace linings or slag deposits, was still hands-on, the project's final publication has to cope with today's demands of widely digitized analytical processes, and a state of research that has greatly evolved since the onset of fieldwork at Almyras. Christina Peege has remarkably mastered this challenge, insisting on a stratigraphic analysis as much as possible conforming to a Harris-matrix approach, and performing an almost comprehensive retro-digitalization of the – sometimes desperately inhomogenous – excavation documentation. Even if maybe not all expectations could be met, it is her great merit that the Almyras smelting site can be convincingly presented here in its structural, stratigraphic, and chronological complexity.

Due to the long lapse of time between excavation and publication, and the new perspectives and approaches integrated by Christina Peege in her PhD thesis, many of the assessments and results discussed in this publication diverge from views expressed in earlier, preliminary reports. This holds true both for technological and historical aspects of the research, from the process flow on the site, around and in the furnaces, to the economic importance and socio-political setting of the Almyras copper smelting workshop. Thanks to a critical and careful evaluation of geographical and historical components, it becomes evident that this workshop (many other, similar sites must have existed) cannot be fully understood if looked at as an individual phenomenon, i.e. without taking into consideration a situation within a landscape of settlements and socio-economic centers, such as e.g. Idalion. The term *operational web* assesses also this situation fairly well; our present knowledge of such a landscape, however, still is at most sketchy. The three scenarios proposed here for the three main phases of copper production at the Almyras site should thus serve as starting points for more extended, landscape-archaeological approaches to the history of copper mining and production in the 1st millenium BCE. The integration of the Early Iron Age copper workflow into a broader, socio-economic framework is a research question that interests not

only Cyprus and the Near East, but also e.g. the Alpine regions with ample comparative perspectives.

As for the process flow, or chaîne opératoire in a more *stricto sensu*, Almyras again offers many new insights thanks to the excellent quality of findings and finds. Additional contributions by Iphigenia Gavriel, Robert Morris, Anne Carey, Aleksandra Mistireki and Walter Fasnacht complete the set of data and information necessary for a full understanding of the functioning of the workshop and the various technical processes involved in the production of copper, from the crushing of the ore, to its roasting, pelleting, and finally smelting in the furnace. It seems evident that raw metal was the final product aimed for, even if – as in many other cases – only scant traces of it were found on the site. If the operational sequence can be described fairly well from the archaeological situation, and by comparison to similar smelting sites documented and analyzed in the Near East or the Alps over the last generation of researchers, not all the questions pertaining to the different stages of the copper process could be answered by archaeological observation solely.

It must be valued as a very fortunate circumstance that an extended analytical chapter on ores, slags, and copper metal by Martina Renzi, Myrto Georgakopoulou and Thilo Rehren could be integrated to this site monograph. Some of the points raised in their chapter – e.g. the question of ore beneficiation, and whether the copper was obtained in a single- or multi-step process (as suggested for the so-called *Mitterberg* process) – are widely debated, but still lack secure and in particular empirical confirmation. Renzi *et al.* present an essentially analytical approach, Anfinset has recently opened up yet another path, that of ethnographic comparison by introducing the *Nepal* process into the discussion. With these new perspectives, ancient copper pyrotechnology is bound to remain a hot topic in the next years.

It is thus a source of great satisfaction that now, 30 years after the discovery of the *Almyras* site, its features, finds, and contexts can be presented here in a comprehensive manner to the scientific community and the public.

Readings

Fasnacht W. *et al.* 1989 to 2000 Preliminary reports on the Almyras excavations, published in the Report of the Department of Antiquities, Cyprus.

Anfinset N. 2011. Social and Technological Aspects of Mining, Smelting and Casting Copper: An Ethnoarchaeological Study from Nepal. Bochum: Deutsches Bergbau-Museum.

O'Brien W. 2015. Prehistoric Copper Mining in Europe 5500–500 BC. Oxford: University Press.

Roberts B.W: and Thornton C.P. (eds) 2014. Archaeometallurgy in Global Perspective. Methods and Syntheses. New York: Springer.

Turck R., Goldenberg G., Py-Saragaglia V., Silvestri E., Stöllner Th. (eds) (in press 2018) Alpine Copper II. Proceedings of the International Workshop ‚Alpine Copper II', Innsbruck (A), 21–25 September 2016. Der Anschnitt – Beiheft. Bochum: Deutsches Bergbau-Museum.

Preface and Acknowledgements

This Part is a revised version of my PhD thesis 'Agia Varvara-*Almyras*, an Iron Age Copper Smelting Site in Cyprus. Archaeological Situation, Stratigraphy, and Chronology', submitted in December 2016 to the University of Zurich for the title of Doctor of Philosophy. This publication also presents results of detailed studies on specific materials. These contributions are annexed to the revised PhD text. The PhD together with the specific contributios made by various authors aims to present a comprehensive analysis of the copper smelting site of Agia Varvara-*Almyras*.

I owe a dept of gratitude to my tutors and mentors. While I presumably will miss some of the people who provided me with their support for the completion of this project, the ones mentioned below are worthy of special gratitude.

A large number of scientifically qualified employees as well as highly motivated volunteers contributed considerably to the success of the excavations. Their participation in the fieldwork was often associated with substantial financial and time expenditure. My warmest thanks go for their great commitment. The list given below is based on the personal journals of the Director of the Excavation, Walter Fasnacht. To all the volunteers and supporters who are not mentioned here either because they were too modest to highlight their achievements, or because the personal record is incomplete, I would like to express my sincerest thanks because without their support this PhD would have never ventured beyond project status. Walter Fasnacht deserves thanks because he entrusted me with the analysis of the archaeological data. He also organized the volunteers from Earthwatch, a non-profit environmental organization that contributed manpower, common sense and a substantial financial contribution to the costs of the excavation.

In Cyprus I also would like to highlight the important role of the CAARI, the Cyprus American Archaeological Research Institute in Nicosia. The hospitality it provided to me when I had to do research in their wonderful library, as well as its generosity to provide the team with excavation equipment, will be fondly remembered.

I also have to thank my doctoral supervisor Professor Dr Philippe Della Casa, Head of the Department of Prehistoric Archaeology at the University of Zurich. He not only directed my research in the right direction, he also facilitated access to the technical resources and financial resources of the Department of Prehistoric Archaeology. The technical attendant and scientific illustrator of the Department sacrificed a considerable amount of time to enhance the photographic record of the excavation.

I also would like to express my deepest gratitude to Professor Dr Thilo Rehren, Director of UCL Qatar, and Dr Martina Renzi, Research Fellow at the UCL Qatar. They integrated the Excavation of Agia Varvara-*Almyras*, and especially the early smelting activities on the site, into the wider context of the Iron Age Metal Production in the Arabian Peninsula. The methods applied by Renzi and Rehren and their results represent a considerable enhancement of the methods already applied while analysing the materials from the excavation.

For Dr Adrian Mebold, a retired Professor for English Language and Literature in Winterthur, and for the Historian Dr Mark Furner, it was an enormous challenge to read my texts and to revise and improve my English. With their engagement and always with favourable critique regarding my argumentation they considerably contributed to my determination to finish this book.

Given the amount of data and their structure it was an enormous challenge for Thomas Erdin from Ikonaut GmbH in Brugg AG Switzerland, to find a way and method to fulfil my need for a scientific reconstruction and visualization. Their inventive talent and readiness to explore and apply computer programmes off the beaten track was crucial for the result presented in this Part.

Dr Kate Leonard kindly revised and improved the manuscript during her archaeological research stay at the University of Zurich. Her benevolent yet critical perusal and her sagacious suggestions how to accentuate the arguments were equally inspiring as well as utterly needed in order to prepare this publication.

My parents Klaus Peege and Franziska Peege-Rosselet and my sister Nicole Peege I owe for the great motivation and decisive support in sometimes difficult and frustrating moments. Their readiness to support me whenever I needed it, were of inestimable value for my work.

I am very grateful for all the support and advice, nevertheless: mistakes are mine.

The Team 1987–2001

1987 Summer

Land surveying
Fasnacht, Walter
Schaar, Kenneth

1988 Spring season

Fasnacht, Walter
Leckebusch, Jürg
Morris, Robert
Schenk, Monika
†Stefani, Olympia
Flüeler, Gaby
Eberli, Ueli
Wunderli, Marlise
Zubler, Kurt
Gerbothé, Daniel

1989 Spring season

See 1988

1990 Autumn season

Fasnacht, Walter
Eberli, Ueli
Flüeler, Gaby
Gerbothé, Daniel
Kunz, Johanna
Morris, Robert
Schenk, Monika
Wunderli, Marlise
Zubler, Kurt
Pardalis, Gregoris
Isidorou, Sophronis
Souroupis, Giorgos
Adamou, Makis

1991 Spring season

Fasnacht, Walter
Gerbothé, Daniel
Hartmann, Daniel
Kassianidou, Vasiliki
Kunz, Johanna
Zubler, Kurt
Van den Post, Jeannette

1992 Autumn season

Fasnacht, Walter
Deslex, Carine
Gerbothé, Daniel
Kunz, Johanna
Morris, Robert
Zubler, Kurt
Regula Hosp

1993 Spring season

Fasnacht, Walter
Bachmann, Ingrid
Deslex, Carine
Flüeler, Gaby
Hensel, Hannes
Kassianidou, Vasiliki
Schenk, Monika
Zehnder, Maya
Pardalis, Gregoris
Souroupis, Giorgos

1993 Autumn season

Fasnacht, Walter
Deslex, Carine
Flüeler, Gaby
Haralambieva Athanassova, Anna
Kassianidou, Vasiliki
Larssen, Hanna
Leuthard, Markus
Maradi, Tünde
Morris, Robert
Reisacher, Anton
Wunderli, Marlise
Zollinger, Beat
Isidorou, Sophronis
Pardalis, Gregoris
Souroupis, Giorgos

1994 Autumn season

Fasnacht, Walter
Connolly, Anne
Larssen, Hanne
Maradi, Tünde
Morris, Robert
Pfeifer, Hansruedi
Reisacher, Anton
Souroupis, Giorgos
Pardalis, Gregoris
1995 Spring season
Fasnacht, Walter
Connolly, Anne
Deslex, Carine
Chrysomalis, Aya

Maradi, Tünde
Reisacher, Anton
Widmann, Albert
Zubler, Kurt and his family

1995 Autumn season

Fasnacht, Walter with his family Anne Hofer, Julian Hofer, Luzius Hofer
†Boll, Peter and his wife †Boll, Marianne
Chrysomalis, Aya
Deslex, Carine
Maradi, Tünde

1996 Autumn season

Fasnacht, Walter and his sons Julian Hofer and Luzius Hofer
Reisacher, Anton
Schenk, Monika
Schwarzländer, Silke
Fasnacht, Walter and his sons Julian Hofer and Luzius Hofer
Reisacher, Anton
Schenk, Monika
Schwarzländer, Silke
Zubler, Kurt, Zubler, Heidi, and their sons Nino Zubler and Tieni Zubler

1997 Spring

Team

Fasnacht, Walter and Travis, Kim
Connolly, Anne
Hedley, Ian

Earthwatch Team I

Kirby, Frank, Kirby, Emily
Andrews, June and Gill, Keith
Davies, Deborah, Lowenstein, Marc
Lynch, Lynda
Graner, Eve

Earthwatch Team II

Freeman, DeRon
Chatzinakis, Maria
Ashton, Barbara
Hall, Gabrielle
Obuhanych, Vikki, Robert Obuhanych
Tanigawa, Kiyoshi
Delong, Jack

Earthwatch Team III

Hoff, Kathy
Titus, Theresa
Hing, Amy
Casper, Sandy
Cook, Richard
Full, Jerry
Phillipp, John

1998 Autumn

Team

Fasnacht, Walter, Travis, Kim
Barbieri, Viviane
Connolly, Anne
Kohler, Eva
Peege, Christina
Pušek, Vladimir
Reisacher, Anton
Schenk, Monika

Earthwatch Team IV

Jones, Amie Lee
Knapp, Susan
Osborne, Jo

1999 Spring

Fasnacht, Walter and Travis, Kim
Carey, Hugh
Connolly, Anne (now Anne Carey)
Hedley, Ian
Peege, Christina

1999 Autumn

Team

Fasnacht, Walter and Travis, Kim
Barbieri, Viviane
Carey, Hugh
Connolly, Anne
Fawkes, Glynnis
Saviides, Niki
Seaman, Anna

Earthwatch Team V

Corrigan, Ben
Davis, Malcolm
Green, Norma
Locke, James
Mahmood, Khalid
Thai, Tina

2000 Spring

Fasnacht, Walter, Julian Hofer and Luzius Hofer
Kotai, Silvia
Peege, Christina

2000 May-June, TV-Season ZDF

Team

Fasnacht, Walter
Huber, Renata
Kunz, Johanna
Paraschiv, Florin

TV-Team

Calim Constantin
Coller, Viorel
Papirowski, Martin

2000 Summer

Fasnacht, Walter

2000 Autumn Study Season

Connolly, Anne (Anne Carey)
Connolly, Elizabeth
Gerbothé, Daniel and Gerbothé, Beatrix

2001 Spring, Reconstruction of furnace 8

Fasnacht, Walter
Barbieri, Viviane
Ferroni, Elisa
Künzler Wagner, Nina

2009 Summer, Study Season

Mistireki, Aleksandra
Liechti, Eva
Gavriel, Iphigenia

The Team in Alphabetical Order

Fasnacht, Walter
Kenneth Schaar
Bachmann, Ingrid
Barbieri, Viviane
Boll, Peter
Boll, Marianne
Calim, Constantin (TV-Team)
Chrysomalis, Aya
Coller, Viorel (TV-Team)
Anne Connolly and Hugh Carey
Eberli, Ueli
Deslex, Carine
Fawkes, Glynnis
Ferroni, Elisa
Flüeler, Gaby
Gavriel, Ifigenia
Gerbothé, Daniel
Haralambieva Athanassova, Anna
Hedley, Ian
Hensel, Hannes
Hosp, Regula
Huber, Renata (TV-Team)
Kassianidou, Vasiliki
Klemm, Susanne
Kotai, Silvia
Künzler Wagner, Nina
Kunz, Johanna
Larssen, Hanna
Leckebusch, Jürg
Leuthard, Markus
Liechti, Eva
Maradi, Tünde
Mistireki, Aleksandra
Morris, Robert
Nikolaides, Michael (Translator)
Paraschiv, Florin (TV-Team)
Papirowski, Martin (TV-Team)
Peege, Christina
Pfeifer, Hansruedi
Reisacher, Anton
Saviides, Niki
Schenk, Monika
Schwarzländer, Silke
Seaman, Anna
Stefani, Olympia
Van den Post, Jeannette
Widmann, Albert
Wunderli, Marlise
Zehnder, Maya
Zollinger, Beat
Zubler, Kurt
Kim Travis &Sullivan Fasnacht Travis

Part I – Archaeological Situation, Stratigraphy, and Chronology

by Christina Peege
with a foreword by Philippe Della Casa

This work was accepted as a PhD thesis by the Faculty of Arts and Social Sciences, University of Zurich
in the autumn semester 2016 on the recommendation of the Doctoral Committee:
Prof Dr Philippe Della Casa, University of Zurich (main supervisor),
and Prof Dr Elena Mango, University of Berne.

1. Introduction

'Set up stratigraphy!' When the author of the present study was issued with the handwritten record sheets and notebooks of the excavation carried out in Agia Varvara-*Almyras*, it was far from clear how far reaching the consequences of the author's enthusiastic reaction to Walter Fasnacht's assignment cited above would be. At first sight, to 'set up stratigraphy' seemed to be rather an aside in the far more complex task to publish the only copper smelting sites where, for the first time in the history of archaeometallurgical research, the full operational chain could be reconstructed. But more on that later.

While working through the record–a meta-archaeological investigation on pages and pages of paper–it became clear that to 'set up stratigraphy' was far from being an aside. On the contrary, it was revealed to be the key task of the post-excavation analyses because 'the stratigraphy' would lay the very foundation for a deeper understanding of the technological processes on the site. Given the sheer amount of data, from today's perspective, the venture to 'set up stratigraphy' was pure hubris of youth and coupled with pure lack of experience. The author was involved four times in the excavation as Trenchmaster, at the last four digging seasons on the site.

The key task of 'setting up stratigraphy' on a place like Almyras then can be seen as the construction of a scaffold onto which future scientific analyses of materials can be located spatially and chronologically. The scaffold as a metaphor also helps to understand that there are several levels for understanding sets of archaeological data. First, there are the horizontal levels, which give access to descriptive approaches–for example of single features, and they give access to contemporaneous aspects–for example the linking of the single features mentioned in copper processing workshops. Second, there are vertical elements in the scaffold which link the levels by means of causal relationships. Here the questions how and why have to be answered. All in all, what is built by the support of the scaffold is a construct, something which allows approaches from different sides and levels, while allowing us to constantly re-think the proposed construct from different perspectives.

This Part then has the aim to build the interpretive grid into which scientific analyses can be integrated. While analyses remain descriptive, the 'horizontal' and 'vertical' elements provide the analyses with spatial and temporal dimensions. They set in motion an interpretive approach that seeks to enhance a multifaceted understanding of the site.

Without diving into discussions about New, Processual and all the aspects of 'Post'archaeologies, the intellectual framework of this investigation is rooted in a tradition of interpreting environmental or technological determinism, the lack of human agency or the neglected impact of society, to provide further context. As an example, the widely-accepted metaphor of the operational chain or 'chaîne opératoire' as it can be also found in English scholarly literature gives a good example. The chain as an object is tear-proof when the single smaller rings are impeccably interlocked. A chain as an object is timeless and characterized by its specific shape. The operational chain is a helpful model or metaphor of structuring information from a site like Agia Varvara-*Almyras*, but it is also an intellectual trap because it focuses on technical processes leaving, not to a full but to a certain extent, aside the human agency: the social position of the people working there and the things going on which could have had an impact on the decision to start metallurgy on a remote site.

It seems to be logical then to focus first on the spatial rather than the technological aspect of the site and to ask, where the places are and how the places were shaped where the chain of operation was put into operation. More generally speaking, an approach was chosen which gives the opportunity to understand copper smelting not only as an abstract process based on universal rules or laws, but an approach which first reconstructs the specific place where the copper processing is allocated. An operational chain only makes sense when applied to a given place. The discussion of materials, as for example slag or furnace lining, without regard to the specific chain where they belong, does not lead to meaningful results. As an example: to analyse and compare trace minerals of slag fragments or the tempering of refractory ceramics without bearing in mind that these materials could belong to spatially as well as temporally separated chains of operation, does not end in meaningful results. A cultural-historical approach where a place is interpreted as an environment suitable for handicraft and adapted to the specific needs of the craftsmen also gives the opportunity to structure scientific results in meaningful (spatial and temporal) interpretations.

This publication aims to integrate all the features found on the site–not only the single rings believed to belong to the chain of operation, like furnaces–in order

to broaden the discussion towards the concept of a smelting site put in its historical context. It will also ask why a small place like Almyras was founded and run as a workplace next to much more profitable copper mines. The scientific and typological analyses of the materials, namely the furnace lining, the various types of slag and the tuyeres, as well as the geological setting of the site will be published in an appendix.