



McDONALD INSTITUTE MONOGRAPHS

Temple landscapes

Fragility, change and resilience of Holocene environments in the Maltese Islands

By Charles French, Chris O. Hunt, Reuben Grima,
Rowan McLaughlin, Simon Stoddart & Caroline Malone



Volume 1 of Fragility and Sustainability – Studies on Early Malta,
the ERC-funded *FRAGSUS Project*

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With contributions by

Gianmarco Alberti, Jeremy Bennett, Maarten Blaauw, Petros Chatzimpaloglou,
Lisa Coyle McClung, Alan J. Cresswell, Nathaniel Cutajar, Michelle Farrell,
Katrin Fenech, Rory P. Flood, Timothy C. Kinnaird, Steve McCarron,
Rowan McLaughlin, John Meneely, Anthony Pace, Sean D.F. Pyne-O'Donnell,
Paula J. Reimer, Alastair Ruffell, George A. Said-Zammit, David C.W. Sanderson,
Patrick J. Schembri, Sean Taylor, David Trumpf, Jonathan Turner, Nicholas C. Vella
& Nathan Wright

Illustrations by

Gianmarco Alberti, Jeremy Bennett, Sara Boyle, Petros Chatzimpaloglou,
Lisa Coyle McClung, Rory P. Flood, Charles French, Chris O. Hunt, Michelle Farrell,
Katrin Fenech, Rowan McLaughlin, John Meneely, Anthony Pace, David Redhouse,
Alastair Ruffell, George A. Said-Zammit & Simon Stoddart



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McDonald Institute for Archaeological Research
University of Cambridge
Downing Street
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CB2 3ER
(0)(1223) 339327
eaj31@cam.ac.uk
www.mcdonald.cam.ac.uk



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On the cover: *View towards Nadur lighthouse and Ghajnsielem church
with the Gozo Channel to Malta beyond, from In-Nuffara (Caroline Malone).*

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CONTRIBUTORS

DR GIANMARCO ALBERTI

Department of Criminology, Faculty for Social
Wellbeing, University of Malta, Msida, Malta
Email: gianmarco.alberti@um.edu.mt

JEREMY BENNETT

Department of Archaeology, University of
Cambridge, Cambridge, UK
Email: jmb241@cam.ac.uk

DR MAARTEN BLAAUW

School of Natural and Built Environment, Queen's
University, University Road, Belfast, Northern
Ireland
Email: marten.blaauw@qub.ac.uk

DR PETROS CHATZIMPALOGLOU

Department of Archaeology, University of
Cambridge, Cambridge, UK
Email: pc529@cam.ac.uk

DR LISA COYLE MCCLUNG

School of Natural and Built Environment, Queen's
University, University Road, Belfast, Northern
Ireland
Email: l.coylemcclung@qub.ac.uk

DR ALAN J. CRESSWELL

SUERC, University of Glasgow, East Kilbride,
University of Glasgow, Glasgow, Scotland
Email: alan.cresswell@glasgow.ac.uk

NATHANIEL CUTAJAR

Deputy Superintendent of Cultural Heritage,
Heritage Malta, Valletta, Malta
Email: nathaniel.cutajar@gov.mt

DR MICHELLE FARRELL

Centre for Agroecology, Water and Resilience,
School of Energy, Construction and Environment,
Coventry University, Coventry, UK
Email: ac5086@coventry.ac.uk

DR KATRIN FENECH

Department of Classics & Archaeology, University
of Malta, Msida, Malta
Email: katrin.fenech@um.edu.mt

DR RORY P. FLOOD

School of Natural and Built Environment, Queen's
University, University Road, Belfast, Northern
Ireland
Email: r.flood@qub.ac.uk

PROF. CHARLES FRENCH

Department of Archaeology, University of
Cambridge, Cambridge, UK
Email: caif2@cam.ac.uk

DR REUBEN GRIMA

Department of Conservation and Built Heritage,
University of Malta, Msida, Malta
Email: reuben.grima@um.edu.mt

DR EVAN A. HILL

School of Natural and Built Environment, Queen's
University, University Road, Belfast, Northern
Ireland
Email: ehill08@qub.ac.uk

PROF. CHRIS O. HUNT

Faculty of Science, Liverpool John Moores
University, Liverpool, UK
Email: c.o.hunt@ljmu.ac.uk

DR TIMOTHY C. KINNAIRD

School of Earth and Environmental Sciences,
University of St Andrews, St. Andrews, Scotland
Email: tk17@st-andrews.ac.uk

PROF. CAROLINE MALONE

School of Natural and Built Environment, Queen's
University, University Road, Belfast, BT7 1NN,
Northern Ireland
Email: c.malone@qub.ac.uk

DR STEVE MCCARRON

Department of Geography, National University of
Ireland, Maynooth, Ireland
Email: stephen.mccarron@mu.ie

DR ROWAN McLAUGHLIN

School of Natural and Built Environment, Queen's
University, University Road, Belfast, Northern
Ireland
Email: r.mclaughlin@qub.ac.uk

JOHN MENEELY
School of Natural and Built Environment, Queen's
University, University Road, Belfast, Northern
Ireland
Email: j.meneely@qub.ac.uk

DR ANTHONY PACE
UNESCO Cultural Heritage, Valletta, Malta
Email: anthonypace@cantab.net

DR SEAN D.F. PYNE-O'DONNELL
Earth Observatory of Singapore, Nanyang
Technological University, Singapore
Email: sean.1000@hotmail.co.uk

PROF. PAULA J. REIMER
School of Natural and Built Environment, Queen's
University, University Road, Belfast, Northern
Ireland
Email: p.j.reimer@qub.ac.uk

DR ALASTAIR RUFFELL
School of Natural and Built Environment, Queen's
University, University Road, Belfast, Northern
Ireland
Email: a.ruffell@qub.ac.uk

GEORGE A. SAID-ZAMMIT
Department of Examinations, Ministry for
Education and Employment, Government of Malta,
Malta
Email: george.said-zammit@gov.mt

PROF. DAVID C.W. SANDERSON
SUERC, University of Glasgow, East Kilbride,
University of Glasgow, Glasgow, Scotland
Email: david.sanderson@glasgow.ac.uk

PROF. PATRICK J. SCHEMBRI
Department of Biology, University of Malta,
Msida, Malta
Email: patrick.j.schembri@um.edu.mt

DR SIMON STODDART
Department of Archaeology, University of
Cambridge, Cambridge, UK
Email: ss16@cam.ac.uk

DR SEAN TAYLOR
Department of Archaeology, University of
Cambridge, Cambridge, UK
Email: st435@cam.ac.uk

DR DAVID TRUMPT

DR JONATHAN TURNER
Department of Geography, National University
of Ireland, University College, Dublin, Ireland
Email: jonathan.turner@ucd.ie

PROF. NICHOLAS C. VELLA
Department of Classics and Archaeology, Faculty
of Arts, University of Malta, Msida, Malta
Email: nicholas.vella@um.edu.mt

DR NATHAN WRIGHT
School of Social Science, The University of
Queensland, Brisbane, Australia
Email: n.wright@uq.edu.au

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Preface and dedication

Caroline Malone

The *FRAGSUS Project* emerged as the direct result of an invitation to undertake new archaeological fieldwork in Malta in 1985. Anthony Bonanno of the University of Malta organized a conference on ‘The Mother Goddess of the Mediterranean’ in which Colin Renfrew was a participant. The discussions that resulted prompted an invitation that made its way to David Trump (Tutor in Continuing Education, Cambridge University), Caroline Malone (then Curator of the Avebury Keiller Museum) and Simon Stoddart (then a post-graduate researcher in Cambridge). We eagerly took up the invitation to devise a new collaborative, scientifically based programme of research on prehistoric Malta.

What resulted was the original Cambridge Gozo Project (1987–94) and the excavations of the Xagħra Brochtorff Circle and the Ġhajnsielem Road Neolithic house. Both those sites had been found by local antiquarian, Joseph Attard-Tabone, a long-established figure in the island for his work on conservation and site identification.

As this and the two other volumes in this series report, the original Cambridge Gozo Project was the germ of a rich and fruitful academic collaboration that has had international impact, and has influenced successive generations of young archaeologists in Malta and beyond.

As the Principal Investigator of the *FRAGSUS Project*, on behalf of the very extensive *FRAGSUS* team I want to dedicate this the first volume of the series to the enlightened scholars who set up this now 35 year-long collaboration of prehistoric inquiry with our heartfelt thanks for their role in our studies.

We dedicate this volume to:

Joseph Attard Tabone
Professor Anthony Bonanno
Professor Lord Colin Renfrew

and offer our profound thanks for their continuing role in promoting the prehistory of Malta.

Acknowledgements

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Foreword

Anthony Pace

Sustainability, as applied in archaeological research and heritage management, provides a useful perspective for understanding the past as well as the modern conditions of archaeological sites themselves. As often happens in archaeological thought, the idea of sustainability was borrowed from other areas of concern, particularly from the modern construct of development and its bearing on the environment and resource exploitation. The term sustainability entered common usage as a result of the unstoppable surge in resource exploitation, economic development, demographic growth and the human impacts on the environment that has gripped the World since 1500. Irrespective of scale and technology, most human activity of an economic nature has not spared resources from impacts, transformations or loss irrespective of historical and geographic contexts. Theories of sustainability may provide new narratives on the archaeology of Malta and Gozo, but they are equally important and of central relevance to contemporary issues of cultural heritage conservation and care. Though the archaeological resources of the Maltese islands can throw light on the past, one has to recognize that such resources are limited, finite and non-renewable. The sense of urgency with which these resources have to be identified, listed, studied, archived and valued is akin to that same urgency with which objects of value and all fragile forms of natural and cultural resources require constant stewardship and protection. The idea of sustainability therefore, follows a common thread across millennia.

It is all the more reason why cultural resource management requires particular attention through research, valorization and protection. The *FRAGSUS Project* (Fragility and sustainability in small island environments: adaptation, cultural change and collapse in prehistory) was intended to further explore and enhance existing knowledge on the prehistory of Malta and Gozo. The objective of the project as

designed by the participating institutional partners and scholars, was to explore untapped field resources and archived archaeological material from a number of sites and their landscape to answer questions that could be approached with new techniques and methods. The results of the *FRAGSUS Project* will serve to advance our knowledge of certain areas of Maltese prehistory and to better contextualize the archipelago's importance as a model for understanding island archaeology in the central Mediterranean. The work that has been invested in *FRAGSUS* lays the foundation for future research.

Malta and Gozo are among the Mediterranean islands whose prehistoric archaeology has been intensely studied over a number of decades. This factor is important, yet more needs to be done in the field of Maltese archaeology and its valorization. Research is not the preserve of academic specialists. It serves to enhance not only what we know about the Maltese islands, but more importantly, why the archipelago's cultural landscape and its contents deserve care and protection especially at a time of extensive construction development. Strict rules and guidelines established by the Superintendence of Cultural Heritage have meant that during the last two decades more archaeological sites and deposits have been protected in situ or rescue-excavated through a statutory watching regime. This supervision has been applied successfully in a wide range of sites located in urban areas, rural locations and the landscape, as well as at the World Heritage Sites of Valletta, Ġgantija, Haġar Qim and Mnajdra and Tarxien. This activity has been instrumental in understanding ancient and historical land use, and the making of the Maltese historic centres and landscape.

Though the cumulative effect of archaeological research is being felt more strongly, new areas of interest still need to be addressed. Most pressing are those areas of landscape studies which often become

peripheral to the attention that is garnered by prominent megalithic monuments. *FRAGSUS* has once again confirmed that there is a great deal of value in studying field systems, terraces and geological settings which, after all, were the material media in which modern Malta and Gozo ultimately developed. There is, therefore, an interplay in the use of the term sustainability, an interplay between what we can learn from the way ancient communities tested and used the very same island landscape which we occupy today, and the manner in which this landscape is treated in contested economic realities. If we are to seek factors of sustainability in the past, we must first protect its relics and study them using the best available methods in our times. On the other hand, the study of the past using the materiality of ancient peoples requires strong research agendas and thoughtful stewardship. The *FRAGSUS Project* has shown us how even small fragile deposits, nursed through protective legislation and guardianship, can yield significant information which the methods of pioneering scholars of Maltese archaeology would not have enabled access to. As already outlined by the Superintendence of Cultural Heritage, a national research agenda for cultural heritage and the humanities is a desideratum. Such a framework, reflected in the institutional partnership of the

FRAGSUS Project, will bear valuable results that will only advance Malta's interests especially in today's world of instant e-knowledge that was not available on such a global scale a mere two decades ago.

FRAGSUS also underlines the relevance of studying the achievements and predicaments of past societies to understand certain, though not all, aspects of present environmental challenges. The twentieth century saw unprecedented environmental changes as a result of modern political-economic constructs. Admittedly, twentieth century developments cannot be equated with those of antiquity in terms of demography, technology, food production and consumption or the use of natural resources including the uptake of land. However, there are certain aspects, such as climate change, changing sea levels, significant environmental degradation, soil erosion, the exploitation and abandonment of land resources, the building and maintenance of field terraces, the rate and scale of human demographic growth, movement of peoples, access to scarce resources, which to a certain extent reflect impacts that seem to recur in time, irrespectively of scale and historic context.

Anthony Pace
Superintendent of Cultural Heritage (2003–18).

Appendix 7

The detailed soil micromorphological descriptions from the buried soils and Ramla and Marsalforn valleys

Charles French

A7.1. Santa Verna

Transect L:

Sample 39, BH115, 30–40 cm

Structure: weak small columnar blocky peds, <3 cm, with pellety, <250 µm, to aggregated, sub-rounded to irregular, <5 mm, micro-structure; *Porosity:* <5% vughs, sub-rounded, <200 µm; <5% fine channels, <3 cm long, <250 µm wide, vertical, accommodated, weakly serrated; *Mineral components:* <2% fine limestone pebbles, 2–5 mm; c/f ratio: 25/75; coarse fraction: 5% coarse sand-size limestone, 1–2 mm, sub-rounded; 10% medium and 10% fine quartz sand, sub-rounded, 200–750 µm; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 30% micro-sparite; 35% dusty clay; reddish brown (CPL/PPL); *Organic components:* 5–10% organic punctuations, <50 µm; *Pedofeatures:* *Amorphous:* very strong amorphous sesquioxide impregnation of whole groundmass; abundant (40%) aggregates of strongly amorphous sesquioxide impregnated clay, sub-rounded, <2 mm, no birefringence.

Trench B:

Sample 1/1, 42–52 cm

Structure: pellety, <500 µm, to aggregated, <1.5 cm, sub-rounded to irregular; *Porosity:* 10% vughs, sub-rounded to irregular to interconnected, <1 mm; <2% fine channels, <3 cm long, <1.5 mm wide, accommodated, smooth to weakly serrated; <1% cracks, <1 cm long, <50 µm wide; *Mineral components:* 10–20% fine limestone pebbles, <1.5 and 2–5 cm, sub-rounded to sub-angular, unsorted; c/f ratio: 5/95; coarse fraction: 5% fine quartz sand, sub-rounded, 100–500 µm; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 10–20% micro-sparite; 65% dusty clay, non-birefringent, gold to golden brown (CPL/PPL); reddish/orangey brown (CPL/PPL); *Organic components:* 10–20% organic/charred punctuations, <50 µm; 2% fine charcoal, <75 µm; *Pedofeatures:* *Amorphous:* common to abundant (10–20%) impregnative sesquioxide nodules, sub-rounded, sometimes with soil fabric coatings around them, <2 mm, no birefringence, strong red/orangey-red (CPL), reddish brown to dark brown (PPL).

Sample 1/2, 53–66 cm

Two fabric units: Upper fabric unit 1: as for sample 1/1 above; irregular but distinct boundary with Lower fabric unit 2: *Structure:* pellety, <500 µm; *Porosity:* 10–20% vughs, sub-rounded to irregular to interconnected, <2 mm; *Mineral components:* 5% fine limestone

pebbles, 2–5 mm and <3 cm, sub-rounded to sub-angular, unsorted; 70% micro-sparite; 5% fine-medium quartz sand, sub-rounded, 100–500 µm; 10% very fine quartz sand, 50–100 µm, sub-rounded; 15% aggregates of silty clay, speckled to short striated, moderate birefringence, golden brown (CPL), orange (PPL); pale grey/brown (CPL), pale brown/orangey brown (PPL); *Organic components:* 10–20% organic/charred punctuations throughout groundmass, <50 µm; *Pedofeatures:* *Amorphous:* strong amorphous sesquioxide impregnation of silty clay aggregates, strong red/orangey-red (CPL), reddish brown to dark brown (PPL).

Sample 1/3, 66–73 cm

Structure: weakly to moderately well developed small blocky, <1.5 cm, with pellety fabric in some voids, <500 µm; *Porosity:* 5–10% vughs, sub-rounded to elongated, <750 µm; 2% fine channels, <1.5 cm long, <500 µm wide, accommodated, smooth to weakly serrated; *Mineral components:* all fine fraction: 5% very fine quartz sand, 50–100 µm, sub-rounded; 95% silty clay, pure to dusty in groundmass, moderate birefringence, orangey red (CPL); reddish brown (PPL); *Organic components:* <1% organic/charred punctuations, <50 µm; *Pedofeatures:* *Amorphous:* few discontinuous linings/infills of voids/channels with micro-sparite.

Sample 1/4, 74–87 cm

Structure: well developed small blocky, <2 cm, with pellety micro-structure, <1 mm, sub-rounded to irregular; *Porosity:* <5% vughs, sub-rounded, <250 µm; 2% fine channels, <2 cm long, <250 µm wide, accommodated, smooth to weakly serrated; *Mineral components:* all fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 90% silty clay, pure to dusty in groundmass, short striated to weakly reticulate, moderate to strong birefringence, gold (CPL); strong to moderate reddish orange (CPL/PPL); *Organic components:* 5% organic/charred punctuations, <50 µm; *Pedofeatures:* *Amorphous:* all strongly reddened with amorphous sesquioxides; towards base of slide, few to common (up to 25% of groundmass), discontinuous linings/infills of voids/channels with micro-sparite and as irregular aggregates/zones in groundmass.

Ashby Sondage:

Sample 28, 65–70 cm

Structure: dense, sub-angular blocky, <4 cm; *Porosity:* <1% fine cracks, <4 cm long, <200 µm wide, accommodated, smooth to weakly serrated; *Mineral Components:* 25% fine gravel, <1 cm, sub-rounded to sub-angular, mainly limestone; 75% micro-sparitic silt;

grey/yellowish brown (CPL), pale brown (PPL); c. 2% aggregates of clay, <1 mm, sub-rounded, reddish brown to reddish orange (CPL); *Organic components*: 25% very fine organic punctuations, <50 µm.

Sample 2/1, 95–105 cm (context 30)

Structure: two, heterogeneous mixed fabrics; pellety, <2 mm, to aggregates, <2 cm; all sub-rounded; *Porosity*: c. 5–10% interconnected vughy; *Mineral components*: Main fabric 1: 50–80% of groundmass; pellety, <2 mm; 10% very fine quartz, 50–100 µm, sub-rounded; 90% silty clay, with weak birefringence, dark golden brown (CPL), orangey brown (PPL); Secondary fabric 2: 20–50% of groundmass; pellety to irregular zones, 100 µm to 4 mm; 5% very fine to fine quartz sand, 100–250 µm, sub-rounded; 10% medium quartz sand, 500–750 µm; 85% micro-sparite; pale grey/yellowish grey (CPL/PPL); *Organic components*: in both fabrics: common to abundant (10–20%) fine charcoal, 100–500 µm; abundant (10–20%) organic punctuations, <50 µm; rare (<1%) bone fragments, <500 µm; rare (<1%) pottery fragment, <1 cm.

Sample 2/2, 105–115 cm (context 51)

Structure: two, heterogeneous mixed fabrics; pellety, <2 mm, to aggregates, <2 cm, to small blocky, <3 cm; sub-rounded to irregular; *Porosity*: 10–20% interconnected vughy; <5% fine channels, <3 cm long, <1 mm wide, accommodated, serrated; *Mineral components*: 5% limestone gravel, 2–4 mm; sub-rounded; Main fabric 1: 90% of groundmass; pellety, <2 mm, to blocky peds; 5% very fine quartz, 50–100 µm, sub-rounded; 95% silty clay, striated, with weak to moderate birefringence, gold to dark golden brown (CPL), orangey brown (PPL); Secondary fabric 2: <10% of groundmass; pellety to irregular zones, 100 µm to 4 mm; 5% very fine to fine quartz sand, 100–250 µm, sub-rounded; 10% medium quartz sand, 500–750 µm; 85% micro-sparite; pale grey/yellowish grey (CPL/PPL); *Organic components*: in both fabrics: common to abundant (10–20%) fine charcoal, 100–500 µm; abundant (10–20%) organic punctuations, <50 µm; *Amorphous*: all strongly reddened with amorphous sesquioxides.

Sample 2/3, 115–125 cm (context 51 continued)

As for Sample 2/2 above

Trump Cut 55:

Sample 78, 'torba' floor

Structure: small blocky to aggregated to pellety, 2 cm to <500 µm; *Porosity*: 10% interconnected vughy; 10–15% large channels, <2 cm long, <4 mm wide, smooth, accommodated; *Mineral components*: 10% coarse sand-size limestone pebbles, 1–2 mm, sub-rounded to sub-angular, unsorted; 10% medium and 10% fine quartz sand, 100–750 µm, sub-rounded to sub-angular; 30% micro-sparite; 30% silty clay, speckled to short striated, weak birefringence; golden brown (CPL), brown (PPL); *Organic components*: 10–20% organic/charred punctuations throughout groundmass, <50 µm; 5% fine charcoal, <75 µm; few (2%) bone fragments, <1 mm; rare (1%) dung aggregate, <1.5 mm, black (CPL/PPL); *Pedofeatures*: *Amorphous*: strong amorphous sesquioxide impregnation of silty clay aggregates, strong red/orangey-red (CPL), reddish brown to dark brown (PPL); *Fabric*: few (2%) clay aggregates, <1 mm, sub-rounded, orangey red (CPL).

Sample 3/1, 100–120 cm

Structure: well developed columnar blocky, <6 cm, with some pellety fabric within, <500 µm; *Porosity*: 5% vughs, sub-rounded to elongated, <750 µm; 10% large channels, <6 cm long, <2.5 mm wide, accommodated, smooth to weakly serrated; *Mineral components*: 5%

fine quartz sand, 100–250 µm, sub-rounded; 10% very fine quartz sand, 50–100 µm, sub-rounded; 10% micrite; 75% silty clay, dusty clay as groundmass, weak birefringence; golden reddish brown (CPL/PPL); *Organic components*: 10% organic/charred punctuations, <50 µm; *Pedofeatures*: *Amorphous*: 10% amorphous sesquioxide nodules, <750 µm, sub-rounded.

Sample 3/2, 120–140 cm

Structure: weakly developed columnar blocky, <10 cm, with pellety microstructure, <500 µm, sub-rounded; *Porosity*: 5% vughs, sub-rounded, <750 µm; 5% channels, <8 cm long, <1 mm wide, accommodated, smooth to weakly serrated; *Mineral components*: 10% fine quartz sand, 100–250 µm, sub-rounded; 5% very fine quartz sand, 50–100 µm, sub-rounded; 85% silty clay, dusty clay as groundmass, speckled, weak to moderate birefringence; reddish/orangey brown (CPL), orangey brown (PPL); *Organic components*: <2% organic/charred punctuations, <50 µm; *Pedofeatures*: *Amorphous*: 10% amorphous sesquioxide nodules, <750 µm, sub-rounded.

Sample 3/3, c. 114–127 cm

Three fabric units: Upper and lower fabric units: *Structure*: pellety, <500 µm, to aggregated, <1 cm, sub-rounded; *Porosity*: 10% vughs, sub-rounded to irregular to interconnected, <1 mm; <2% fine channels, <5 mm long, <500 µm wide, accommodated, smooth to weakly serrated; *Mineral components*: <5% fine limestone pebbles, <5 mm, sub-rounded to sub-angular, unsorted; c/f ratio: 5/95; coarse fraction: 5% fine quartz sand, sub-rounded, 100–500 µm; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 10–20% micro-sparite; 65% dusty clay, non-birefringent, gold to golden brown (CPL/PPL); reddish/orangey brown (CPL/PPL); *Organic components*: 10–20% organic/charred punctuations, <50 µm; 2% fine charcoal, <75 µm; rare (<1%) burnt bone fragment, <500 µm; *Pedofeatures*: *Amorphous*: common to abundant (10–20%) impregnative sesquioxide nodules, sub-rounded, <2 mm, no birefringence, strong red/orangey-red (CPL), reddish brown to dark brown (PPL); distinct upper/lower boundaries with Middle fabric unit 2: repeated/alternating fine (c. 15) and coarser (c. 14) crust laminae over 7 cm horizon, composed of silt (80–90%) and very fine charcoal/organic punctuations, <50 µm (10–20%); planar voids inbetween crusts and vertical cracks within crust laminae; fine crust components: 45% micro-sparite, 55% silt, 5% clay, 10% organic dust; coarser crust components: 10% very fine quartz sand, 45% micro-sparite, 40% silt, 5% clay, 5–10% very fine charcoal, <75 µm, 10% organic punctuations, <50 µm; generally laminae/crusts fining up-profile.

Sample 3/4, 130–160 cm

Structure: pellety, <500 µm, to aggregated, <600 mm, sub-rounded; *Porosity*: up to 40% open vughy; <2% fine channels, <2 cm long, <500 µm wide, short, irregular, smooth to weakly serrated; *Mineral components*: 10% fine limestone pebbles, <8 mm, sub-rounded to sub-angular, unsorted; c/f ratio: 5/95; coarse fraction: 5% fine quartz sand, sub-rounded, 100–500 µm; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 35% micro-sparite; 50% dusty clay, non-birefringent; golden brown (CPL), brown (PPL); *Organic components*: 30% organic/charred punctuations, <50 µm; 2% fine charcoal, <75 µm; rare (<1%) bone fragment, <500 µm; rare (1%) shell fragments; rare (1%) plant tissue fragments.

Trench E:

Sample 4/1, 40–44 cm

Structure: dense, apedal; *Porosity*: <2% vughs, sub-rounded to elongated, <500 µm; <2% short horizontal channels, <1 cm long, <750 µm

wide, accommodated, smooth to weakly serrated; *Mineral components*: 5% fine quartz sand, 100–250 µm, sub-rounded; 10% very fine quartz sand, 50–100 µm, sub-rounded; 10% micro-sparite; 75% silty clay, dusty clay as groundmass, weak birefringence; brown (CPL/PPL); *Organic components*: <5% organic/charred punctuations, <50 µm; 2% shell fragments; 2% bone fragments, <4 mm.

Sample 4/2, 68–75 cm

Two fabric units: **Upper fabric unit 1**: 95% limestone, <5 mm, sub-rounded to irregular, with <5% as pellety aggregates of fabric unit 2 material as below, <2 mm; irregular but distinct contact with **Lower fabric unit 2**: *Structure*: dense, apedal; *Porosity*: <2% vughs, sub-rounded to elongated, <500 µm; <2% short horizontal channels, <1 cm long, <750 µm wide, accommodated, smooth to weakly serrated; *Mineral components*: 5% fine quartz sand, 100–250 µm, sub-rounded; 10% very fine quartz sand, 50–100 µm, sub-rounded; 10% micro-sparite; 75% silty clay, dusty clay as groundmass, weak birefringence; brown (CPL/PPL); *Organic components*: <5% organic/charred punctuations, <50 µm; 2% shell fragments; 2% bone fragments, <4 mm.

Sample 4/3, 83–93 cm

Structure: pellety, <500 µm, to aggregated, <1 cm, sub-rounded; *Porosity*: 10% vughs, sub-rounded to irregular to interconnected, <1 mm; <2% fine channels, <5 mm long, <500 µm wide, accommodated, smooth to weakly serrated; *Mineral components*: <5% fine limestone pebbles, <5 mm, sub-rounded to sub-angular, unsorted; c/f ratio: 5/95; coarse fraction: 5% fine quartz sand, sub-rounded, 100–500 µm; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 10–20% micro-sparite; 65% dusty clay, non-birefringent, gold to golden brown (CPL/PPL); reddish/orangey brown (CPL/PPL); *Organic components*: 10–20% organic/charred punctuations, <50 µm; 2% fine charcoal, <75 µm; rare (<1%) burnt bone fragment, <500 µm; *Pedofeatures*: *Amorphous*: common to abundant (10–20%) impregnative sesquioxide nodules, sub-rounded, <2 mm, no birefringence, strong red/orangey-red (CPL), reddish brown to dark brown (PPL).

Sample 4/4, 65–70 cm context 80 (wall plaster?)

Structure: dense, apedal; *Porosity*: <2% vughs, sub-rounded to elongated, <500 µm; *Mineral components*: 40–50% fine limestone, 2–5 mm, sub-rounded, evenly distributed; 10% very fine quartz sand, 50–100 µm, sub-rounded; 50% micro-sparitic silt; greyish/yellowish brown (CPL), pale brown (PPL); *Organic components*: 25% organic/charred punctuations, <50 µm; 1% bone fragments, <2 mm; 2% degraded plant tissue remains.

A7.2. Ġgantija Test Pit 1

Sample 28, 40–47 cm

Structure: pellety, <250 µm, to irregular/sub-rounded aggregated, 500 µm to 4 mm; well sorted; *Porosity*: 20–25% open vughy; <5% fine channels, <1 cm long, <100 µm wide, partly accommodated, weakly serrated; *Mineral components*: 20% small limestone/carbonate gravel, <1 cm, sub-rounded to sub-angular; coarse/fine ratio: 42/58; coarse fraction: 2% coarse, 10% medium and 30% fine quartz sand, 100–1000 µm, sub-rounded; fine fraction: 20% very fine quartz sand, 50–100 µm, sub-rounded; 5% micro-sparite; c. 32% dusty clay in groundmass, weak to non-birefringent, gold/golden brown (CPL); brown (CPL), reddish brown to very dark brown (PPL); *Organic component*: very strong brown staining of whole groundmass; 5% shell fragments, <2 mm; <2% bone fragments, burnt and unburnt, <1.5 mm; <1% very fine charcoal fragments, <500 µm; *Pedofeatures*:

Textural: see above; *Fabric*: few (5%) aggregates of silty clay and clay (Bt material), strong birefringence, sub-rounded, <750 µm, gold (CPL); *Amorphous*: weak to moderate amorphous sesquioxide impregnation of whole groundmass; few (5%) sesquioxide nodules, <750 µm, sub-rounded.

Sample 27, 50–67 cm

As for Sample 28 above, except for:

Pedofeatures: *Excrements*: rare (<1%) dung fragment, sub-rounded, <1 mm; *Amorphous*: rare (<1%) rolled clay (Bt material) aggregate, sub-rounded, gold (CPL), strong birefringence, <1 mm.

Sample 26, 60–77 cm

Structure: weak irregular small blocky, <2 cm; pellety, <500 µm, to sub-rounded aggregated micro-structure, 1–5 mm; *Porosity*: 10–20% interconnected vughy; <5% fine channels, <2 cm long, <500 µm wide, accommodated, smooth; *Mineral components*: <5% small limestone gravel, <1 cm, sub-rounded to sub-angular; coarse/fine ratio: 15/85; coarse fraction: 5% medium and 10% fine quartz sand, 100–500 µm, sub-rounded; fine fraction: 20% very fine quartz sand, 50–100 µm, sub-rounded; 10% micro-sparite; 45% dusty clay in groundmass, weak to non-birefringent, gold/golden brown (CPL); dark brown (CPL), brown to reddish brown (PPL); *Organic component*: very strong brown staining of whole groundmass; <5% shell fragments, <2 mm; 10% bone fragments, burnt and unburnt, <500 µm; <5% very fine charcoal/organic punctuations, <50 µm; *Pedofeatures*: *Textural*: see above; *Fabric*: few (5%) aggregates of silty clay (Bt material), strong birefringence, sub-rounded, <750 µm, gold (CPL); *Amorphous*: moderate amorphous sesquioxide impregnation of whole groundmass.

Sample 25, 88–100 cm

Structure: finely aggregated micro-structure, <2 mm; close porphyritic; *Porosity*: 5% vughs, sub-rounded to irregular, <500 µm; 5–10% fine channels, <1 cm long, <250 µm wide, accommodated, smooth; *Mineral components*: <5% small limestone/carbonate gravel, <1 cm, sub-rounded to sub-angular; coarse/fine ratio: 20/80; coarse fraction: 10% medium to coarse sand size limestone, 500–1000 µm, sub-rounded; 10% fine quartz sand, 100–250 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 40% micro-sparite; 30% dusty clay in groundmass, weak to non-birefringent, gold (CPL); gold (CPL), golden brown (PPL); *Organic component*: 5% bone fragments, <1000 µm; <5% very fine charcoal, <50 µm; 2% coarse charcoal, 1–2 mm; 10% organic punctuations, <50 µm; *Pedofeatures*: *Textural*: see above; *Fabric*: few (2%) clay aggregates (Bt material), <500 µm, strong birefringence, sub-rounded, reddish brown (CPL/PPL); *Amorphous*: few to common (<10%) calcitic hypo-coatings.

Sample 24, 100–111 cm

Structure: weakly developed sub-angular blocky, <2 cm; pellety, <500 µm, to sub-rounded aggregated, 2–4 mm, micro-structure in zones; *Porosity*: 10–15% open interconnected vughy and sub-rounded, <1 mm; 10% fine channels, <5 cm long, <2 mm wide, accommodated, weakly serrated; *Mineral components*: <5% small limestone/carbonate gavel, <5 mm, sub-rounded to sub-angular; coarse/fine ratio: 15/85; coarse fraction: 5% coarse, 5% medium and 5% fine quartz sand, 100–500 µm, sub-rounded; fine fraction: 20% very fine quartz sand, 50–100 µm, sub-rounded; 25% micro-sparite; 40% dusty clay in groundmass, weak birefringence, gold to yellowish brown (CPL); brown to reddish/yellowish brown (CPL), brown to reddish brown (PPL); *Organic component*: 10% organic/charred punctuations in groundmass; <10% shell fragments, <2 mm; <2% bone fragments, <1 mm; *Pedofeatures*: *Textural*: see above; *Fabric*: one large aggregate, <1 cm, sub-rounded, of organic fabric of Sample 26 incorporated from above; common (5–10%) aggregates of silty

clay (Bt material), strong birefringence, sub-rounded, <750 µm, gold (CPL); *Amorphous*: c. 40–60% of groundmass with stronger staining with amorphous sesquioxides in irregular zones; common (c. 20% of groundmass) partial void infills with amorphous to micro-sparitic calcium carbonate.

Sample 23, 111–125 cm

Structure: weakly developed sub-angular blocky, <2 cm; pellety, <500 µm, to sub-rounded aggregated, 2–4 mm, micro-structure in zones; *Porosity*: 10–15% open interconnected vughy and sub-rounded, <1 mm; 10% fine channels, <5 cm long, <2 mm wide, accommodated, weakly serrated; *Mineral components*: <5% small limestone gavel, <5 mm, sub-rounded to sub-angular; coarse/fine ratio: 15/85; coarse fraction: 5% coarse, 5% medium and 5% fine quartz sand, 100–500 µm, sub-rounded; fine fraction: 20% very fine quartz sand, 50–100 µm, sub-rounded; 25% micro-sparite; 40% dusty clay in groundmass, weak birefringence, gold to yellowish brown (CPL); brown to reddish/yellowish brown (CPL), brown to reddish brown (PPL); *Organic component*: 10% organic/charred punctuations in groundmass; <10% shell fragments, <2 mm; <2% bone fragments, <1 mm; *Pedofeatures*: *Textural*: see above; few (2%) aggregates of clay (Bt material), strong birefringence, sub-rounded, <750 µm, gold (CPL); *Amorphous*: up to 20% of groundmass with irregular/sub-rounded aggregates of strongly amorphous sesquioxide impregnated silty clay, <1 mm; c. 40–60% of groundmass with stronger staining with amorphous sesquioxides in irregular zones.

A7.3. Ġgantija WC Trench 1

Sample 3/2, 60–63 cm

Structure: apedal, homogeneous; *Porosity*: <10% vughs, <250 µm, sub-rounded to irregular; <2% channels, <1 cm long, <750 µm wide, accommodated, smooth to weakly serrated; *Mineral components*: 100% silt-sized calcium carbonate; greyish yellow (CPL), pale greyish brown (PPL).

Sample 3/9, context 1015, 45–56 cm

Structure: fine aggregated, <2 mm to weak to moderately well developed small blocky, <1.5 cm, with pellety micro-structure, <500 µm; *Porosity*: 10% open vughy; <10% channels, <1.5 cm long, <750 µm wide, partly accommodated, weakly serrated; *Mineral components*: 10–20% small limestone gravel towards base of slide, <1.5 cm, sub-rounded to sub-angular; coarse/fine ratio: 40–50/50–60; coarse fraction: 10% coarse sand size limestone, 1–2 mm, sub-rounded; 20% medium and 10–20% fine quartz sand, 100–1000 µm, sub-rounded; fine fraction: 5–10% very fine quartz sand, 50–100 µm, sub-rounded; 20–25% micro-sparite; 20–25% dusty clay in groundmass, weak to non-birefringent, gold/golden brown (CPL); brown (CPL), pale brown to brown (PPL); *Organic component*: <10% organic punctuations, <50 µm; <1% very fine charcoal fragments, <500 µm; *Pedofeatures*: *Textural*: see above; *Amorphous*: weak to moderate amorphous sesquioxide impregnation of whole groundmass.

Sample 3/10, context 1016, 70–80 cm

Structure: fine aggregated, <2 mm to weak to moderately well developed small to columnar blocky, <3 cm, with pellety micro-structure, <500 µm; *Porosity*: 10% open vughy; <10% channels, <1.5 cm long, <750 µm wide, partly accommodated, weakly serrated; *Mineral components*: 20–30% small limestone gravel towards base of slide, 2–4 cm, sub-rounded to sub-angular; coarse/fine ratio: 40/60; coarse fraction: 10% coarse sand size limestone, 1–2 mm, sub-rounded; 20% medium and 10% fine quartz sand, 100–1000 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 25%

micro-sparite; 25% dusty clay in groundmass, weak to non-birefringent, gold/golden brown (CPL); brown (CPL), pale brown to brown (PPL); *Organic component*: 10–20% organic punctuations, <50 µm; <1% very fine charcoal fragments, <500 µm; <2% fine bone fragments, <1 mm, sub-rounded; *Pedofeatures*: *Textural*: see above; *Amorphous*: weak to moderate amorphous sesquioxide impregnation of whole groundmass; common strong humic/amorphous sesquioxide staining of groundmass around void spaces.

Sample 3/1/1, context 1016, 68–77.5 cm

Lower fabric unit: *Structure*: fine aggregated to pellety, <500 µm; *Porosity*: 10–15% open vughy, <1 mm; two fabric units: *Mineral components*: 20% small limestone gravel, <2 cm, sub-rounded to sub-angular; coarse/fine ratio: 50/50; coarse fraction: 20% coarse sand size limestone, 1–2 mm, sub-rounded; 10% medium and 20% fine quartz sand, 100–1000 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 30–40% micro-sparite; 20–25% dusty clay in groundmass, weak to non-birefringent, gold/golden brown (CPL); brown (CPL), pale brown to brown (PPL); *Organic component*: 10–50% of groundmass as humified organic/charred fragments and punctuations, <250 µm and <50 µm; few (<2%) bone fragments, <500 µm; few (2%) fine charcoal, 250–500 µm; *Amorphous*: weak to moderate amorphous sesquioxide impregnation of whole groundmass; merging over <1 mm with *Upper fabric unit*: same as below, except 20% fine limestone gravel, <8 mm, sub-rounded; and <10% humified organics/punctuations.

Sample 3/1/2, context 1016, 78–85 cm

As for the lower fabric unit of Sample 3/1/1 above, except for: *Mineral components*: up to 40% fine limestone gravel, <1 cm, sub-rounded; *Fabric*: rare (<1%) silty clay soil aggregate, sub-rounded, <500 µm, with short clay striae, orange (CPL), moderate birefringence.

Sample 3/3, context transition of 1004/1019, 84–94 cm

Structure: well developed small blocky, <2.5 cm, to columnar blocky, <5 cm, with fine aggregated to pellety microstructure, <1 mm; *Porosity*: 10% channels, <7 cm long, <2 mm wide, accommodated, smooth to weakly serrated; 10% open vughy, <1 mm; two fabric units: *Mineral components*: 20% small limestone gravel, <2 cm, sub-rounded to sub-angular; coarse/fine ratio: 50/50; coarse fraction: 20% coarse sand size limestone, 1–2 mm, sub-rounded; 10% medium and 20% fine quartz sand, 100–1000 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 30–40% micro-sparite; 20–25% dusty clay in groundmass, weak to non-birefringent, gold/golden brown (CPL); brown (CPL), pale brown to brown (PPL); one large pottery fragment, <1.5 cm, sub-angular; *Organic component*: 10% of groundmass as humified organic/charred fragments and punctuations, <250 µm and <50 µm; few (<2%) bone fragments, <500 µm; few (2%) fine charcoal, 250–500 µm; *Amorphous*: weak to moderate amorphous sesquioxide impregnation of whole groundmass.

Sample 3/4, contexts 1016/1040 transition, 80–85 cm

Lower fabric unit: *Structure*: fine aggregated to pellety, <500 µm; *Porosity*: 10–15% open vughy, <1 mm; two fabric units: *Mineral components*: 75–80% small limestone gravel, <1 cm, sub-rounded to sub-angular; with 20–25% soil fabric in between: coarse/fine ratio: 50/50; coarse fraction: 20% coarse sand size limestone, 1–2 mm, sub-rounded; 10% medium and 20% fine quartz sand, 100–1000 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 30–40% micro-sparite; 20–25% dusty clay in groundmass, weak to non-birefringent, gold/golden brown (CPL); brown (CPL), pale brown to brown (PPL); *Organic component*: 10–30% organic/charred punctuations, <50 µm; few (<2%) bone fragments, <500 µm; few (2%) fine charcoal, 250–500 µm; *Amorphous*: weak to

moderate amorphous sesquioxide impregnation of whole groundmass; with dispersed horizontal zone of red soil aggregates above, sub-rounded, <4 mm, with strong amorphous sesquioxide reddening; same as lower B horizon of Santa Verna Trench B; associated with c. 1.5–2 cm thick zone of fine limestone gravel above; then Upper fabric unit: as for lower unit.

Sample 3/5, context 1004, 85–96 cm

As for Sample 3/1/1 above

Sample 3/6, context 1016, 96–104 cm

As for Sample 3/1/1 above, except:

Upper fabric unit: *Structure*: fine aggregated to pellety, <500 µm; *Porosity*: 10–15% open vughy, <1 mm; two fabric units: *Mineral components*: 20% small limestone gravel, <2 cm, sub-rounded to sub-angular; coarse/fine ratio: 50/50; coarse fraction: 20% coarse sand size limestone, 1–2 mm, sub-rounded; 10% medium and 20% fine quartz sand, 100–1000 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 30–40% micro-sparite; 20–25% dusty clay in groundmass, weak to non-birefringent, gold/golden brown (CPL); brown (CPL), pale brown to brown (PPL); *Organic component*: 20% organic/charred punctuations, <250 µm and <50 µm; few (<2%) bone fragments, <500 µm; common (10%) fine charcoal, <75 µm; *Amorphous*: weak amorphous sesquioxide impregnation of whole groundmass; merging/undulating boundary with Lower fabric unit: as above except for: *Amorphous*: strongly reddened with amorphous sesquioxides.

Sample 3/7, context 1019, 104–113 cm

As for Sample 3/6, lower fabric unit (above).

Sample 3/8, context 1019, 113–124 cm

Structure: fine aggregated, 1–2 mm, to pellety, <100 µm; *Porosity*: 25% open, interconnected vughy, <1 mm; *Mineral components*: 30% small limestone gravel, <2.5 cm, sub-rounded to sub-angular, all orientations; coarse/fine ratio: 10/90; coarse fraction: 20% coarse sand size limestone, 1–2 mm, sub-rounded; 5% coarse and 5% medium quartz sand, 500–1000 µm, sub-rounded; fine fraction: 15% very fine quartz sand, 50–100 µm, sub-rounded; 10% micro-sparite; 40% dusty clay in groundmass, weak to non-birefringent, golden brown (CPL); brown to golden brown (CPL), orangey/reddish brown (PPL); *Organic component*: 10–15% organic/charred punctuations, <50 µm; *Fabric*: rare (1%) fine sandy/silty clay soil aggregate, <1 mm, sub-rounded, dark orangey red (CPL/PPL); *Amorphous*: moderate amorphous sesquioxide impregnation of whole groundmass.

A7.4. Ġgantija olive grove and environs

Sample 35, Test Pit 5, 75–80 cm

Structure: pellety to fine aggregated, <2 mm; *Porosity*: 10–20% interconnected vughy; *Mineral components*: 50–75% fine limestone gravel, <1 cm, sub-rounded; c/f ratio: 50/50; coarse fraction: 15% coarse sand size limestone, 1–2 mm; 20% medium and 15% fine quartz, 100–750 µm, sub-rounded to sub-angular; fine fraction: 15% fine quartz sand, 50–100 µm; 25% dusty clay, non-birefringent, orangey brown (CPL); greyish brown (CPL/PPL); *Organic component*: few charcoal, <1 mm; <5% organic punctuations.

Sample 41, BH54, 70–80 cm

Structure: pellety to fine aggregated, <5 mm; *Porosity*: 10–20% interconnected vughy; *Mineral components*: 20% fine limestone gravel,

<1 cm, sub-rounded; c/f ratio: 30/70; coarse fraction: 10% coarse, 10% medium and 10% fine quartz, 100–750 µm, sub-rounded to sub-angular; fine fraction: 20% fine quartz sand, 50–100 µm; 20% micro-sparite; 30% dusty clay, non-birefringent, orangey brown (CPL); golden brown (CPL), pale reddish brown (PPL); *Organic component*: few charcoal, <1 mm; <5% organic punctuations; c. 2 cm thick zone of plant cell tissue at base of slide, with abundant excrements within; *Amorphous*: weak to moderate sesquioxide impregnation of groundmass.

A7.5. Skorba

Trench A, section 1:

Sample 11, 70–82 cm

Two fabric units: Upper fabric unit 1: *Structure*: pellety, <2 mm; *Mineral components*: as for lower fabric 2 below; Lower fabric unit 2: *Structure*: well developed sub-angular blocky, <4 cm; pellety micro-structure, <500 µm; *Porosity*: 10% channels, <4 cm, <1 mm wide, accommodated, weakly serrated, vertical/horizontal, all lined with micro-sparite and with up to 50% discontinuous infills of same fabric; 5–10% vughs, <250 µm, irregular to sub-rounded; both contain discontinuous pellety fabric within; *Mineral components*: 10% fine limestone, <2 cm, sub-rounded; coarse/fine ratio: 25/75; coarse fraction: 5% coarse and 10% medium sand-size limestone, 250–1500 µm, sub-rounded; 10% fine quartz sand, 100–250 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 20–40% micro-sparite; 25–45% dusty clay, weak to moderate birefringence; golden/reddish brown (CPL/PPL); *Organic components*: 5–10% fine charcoal, <250 µm; 5% organic/charred punctuations, <50 µm; rare (<1%) amorphous sesquioxide replaced plant tissue fragment; rare (<1%) shell fragments; *Amorphous*: rare (<1%) sesquioxide nodule, sub-rounded, <500 µm.

Sample 20, 85–97 cm

Mixture of two fabric units as for Sample 28: Fabric 1: 60% of groundmass; Fabric 2: 40% of groundmass; *Amorphous*: moderate amorphous sesquioxide staining of whole fabric.

Sample 24, 105–114 cm

Structure: aggregated micro-structure, <5 mm; *Porosity*: up to 20% interconnected vughy; *Mineral components*: coarse/fine ratio: 40/60; coarse fraction: 20% medium sand-size limestone, 500–1000 µm, sub-rounded; 20% fine quartz sand, 250–750 µm, sub-rounded; fine fraction: 10% very fine quartz, 100–250 µm, sub-rounded; 20% micro-sparite; 30% dusty clay, weak birefringence; towards base of slide are rare aggregates of dusty clay, <500 µm, sub-rounded, weak birefringence, golden brown (CPL); golden brown (CPL), brown (PPL); *Organic components*: 2–5% fine charcoal, <250 µm; 2% shell fragments; 2% bone fragments, <50 µm; rare (<1%) plant tissue fragments.

Sample 28, 120–131 cm

Main fabric 1: >90% of total groundmass; *Structure*: pellety, <250 µm; *Porosity*: up to 20% vughs, interconnected, irregular to sub-rounded, <3 mm; *Mineral components*: 3% of total groundmass; *Structure*: pellety micro-structure, <500 µm; 30–40% fine limestone pebbles, <5 cm, sub-rounded; slight horizontal orientation; coarse/fine ratio: 25/75; coarse fraction: 10% coarse and 10% medium sand-size limestone, 250–1500 µm, sub-rounded; 5% fine quartz sand, 100–250 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 25% micro-sparite; 40% dusty clay, pellety, weak to moderate birefringence, golden brown (CPL); whitish/golden brown

(CPL), pale grey/golden brown (PPL); *Organic components*: 2% very fine charcoal, <250 µm; 5% organic/charred punctuations, <50 µm; *Anthropogenic inclusions*: rare (<1%) bone fragments, <250 µm; *Minor fabric 2*: <10% of total groundmass; *Structure*: aggregated micro-structure, <1 cm; *Porosity*: <2% vughs, <200 µm; *Mineral components*: coarse/fine ratio: 40/60; coarse fraction: 20% medium sand-size limestone, 500–1000 µm, sub-rounded; 20% fine quartz sand, 250–750 µm, sub-rounded; fine fraction: 10% very fine quartz, 100–250 µm, sub-rounded; 20% micro-sparite; 30% dusty clay, weak birefringence; dark golden brown (CPL), golden brown (PPL); *Organic components*: 2–5% fine charcoal, <250 µm.

Trench A, section 2:

Sample 26, 70–80 cm

Two fabric units: *Upper fabric unit 1*: *Structure*: pellety, <250 µm; *Porosity*: up to 20% vughs, interconnected, irregular to sub-rounded, <3 mm; *Mineral components*: 3% of total groundmass; *Structure*: pellety micro-structure, <500 µm; 30–40% fine limestone pebbles, <5 cm, sub-rounded; slight horizontal orientation; coarse/fine ratio: 25/75; coarse fraction: 10% coarse and 10% medium sand-size limestone, 250–1500 µm, sub-rounded; 5% fine quartz sand, 100–250 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 25% micro-sparite; 40% dusty clay, pellety, weak to moderate birefringence, golden brown (CPL); whitish/golden brown (CPL), pale grey/golden brown (PPL); *Organic components*: 2% very fine charcoal, <250 µm; 5% organic/charred punctuations, <50 µm; *Anthropogenic inclusions*: rare (<1%) bone fragments, <250 µm; distinct horizontal boundary with *Lower fabric unit 2*: *Structure*: dense, apedal; *Porosity*: none; *Mineral components*: <2% fine limestone fragments, <1 cm, sub-rounded; 98% calcitic amorphous ‘slurry’; 10% calcitic soil fabric aggregates, <1 cm, irregular, same fabric as for Sample 78; *Organic components*: 5–10% charred organic punctuations, <50 µm; 5% fine charcoal, <3 mm, sub-rounded; 5% burnt and amorphous sesquioxide replaced plant fragments, <3 mm.

‘Floor’ spot sample, upper sample 26, 75–82 cm

Two well mixed fabrics: *Main fabric 1*: 60% of groundmass; *Structure*: dense, apedal; *Porosity*: none; *Mineral components*: <2% fine limestone fragments, <1 cm, sub-rounded; 98% calcitic amorphous ‘slurry’; 10% micritic soil fabric aggregates, <1 cm, irregular, same fabric as for Sample 78; *Organic components*: 5–10% charred organic punctuations, <50 µm; 5% fine charcoal, <3 mm, sub-rounded; 5% burnt and amorphous sesquioxide replaced plant fragments, <3 mm; *Fabric*: rare (<1%) burnt soil aggregate, reddish/crimson brown (CPL), <2 mm; *Minor fabric 2*: 40% of groundmass; *Structure*: pellety, <2 mm; *Porosity*: 15% interconnected vughy; *Mineral components*: same as Sample 20.

Sample 75, 91–100 cm

Structure: pellety, <5 mm; *Porosity*: 20% interconnected vughy; *Mineral components*: mixture of three main components: 1) 40–50% of groundmass: 40% fine sand-size limestone, 100–200 µm, sub-rounded; 10% fine quartz, 100–200 µm, sub-rounded; fine fraction: 50% micro-sparite; 2) 10–20% aggregates of calcitic ash, <1 mm, sub-rounded, grey (CPL/PPL); 3) 20–30% aggregates of dusty clay, non- to weak birefringence, <5 mm, sub-rounded to sub-angular, golden brown (CPL), sometimes coated with birefringent dusty clay; *Organic components*: 5% charred organic punctuations, <50 µm.

Sample 78, 107–120 cm

Structure: weakly developed columnar blocky, <5 cm; pellety micro-structure, <500 µm; *Porosity*: 5% channels, <5 cm, <1 mm wide, accommodated, smooth to weakly serrated, mainly vertical; 10%

vughs, <2 mm, irregular to sub-rounded; both contain discontinuous pellety fabric within; *Mineral components*: 5% fine limestone, <5 mm, sub-rounded; coarse/fine ratio: 25/75; coarse fraction: 10% coarse and 10% medium sand-size limestone, 250–1500 µm, sub-rounded; 5% fine quartz sand, 100–250 µm, sub-rounded; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 25% micro-sparite; 40% dusty clay, pellety, weak to moderate birefringence, golden brown (CPL); golden brown (CPL), pale grey/golden brown/brown (PPL); *Organic components*: 2–5% fine charcoal, <500 µm; 5% organic/charred punctuations, <50 µm; *Anthropogenic inclusions*: few (<2%) pot and burnt/unburnt bone fragments, <8 mm; rare (<1%) calcitic ash fragment, <1 mm, sub-rounded; *Amorphous*: rare (<1%) sesquioxide nodule, <500 µm, rounded.

Plaster spot sample

Structure: dense, apedal; *Mineral components*: <1% fine limestone fragments, <1 cm, sub-rounded; 70–80% calcitic amorphous ‘slurry’; 10% calcitic soil fabric aggregates, <1 cm, irregular, same fabric as for Sample 78; *Organic components*: 5% charred organic punctuations, <50 µm; 2% very fine charcoal, <200 µm.

A7.6. Xaghra town

Sample 5: Abandoned stone quarry on northeast side of town on road to Ramla Bay

Structure: very well developed sub-angular blocky, <6 cm; *Porosity*: 10% channels, <5 cm long, <750 µm wide, accommodated, smooth; 5% vughs, sub-rounded, <500 µm; *Mineral components*: all fine fraction: 15–20% very fine quartz, 50–100 µm, sub-rounded; 80–85% dusty clay in groundmass, speckled to striated to reticulate striated in places, gold to orange (CPL), moderate to strong birefringence; orangey brown (CPL), reddish orange (PPL); *Organic components*: <1% fine charcoal, <100 µm; 5% organic punctuations in groundmass; rare (<1%) silicified/clay replaced plant tissue fragments; *Amorphous*: 90% of the groundmass strongly impregnated with amorphous sesquioxides.

Sample 11: Modern house construction site 2

Structure: very well developed sub-angular blocky; *Porosity*: <5% vughs, sub-rounded, <500 µm; *Mineral components*: c/f ratio: 5/95; coarse fraction: 5% fine quartz, 100–250 µm; fine fraction: 15% very fine quartz, 50–100 µm, sub-rounded; 80% dusty clay in groundmass, striated to weakly reticulate striated in places, gold to orange (CPL), moderate to strong birefringence; orangey brown (CPL), reddish orange (PPL); *Organic components*: <1% fine charcoal, <100 µm; 5% organic punctuations in groundmass, <50 µm; *Amorphous*: 90% of the groundmass strongly impregnated with amorphous sesquioxides; *Fabric*: occasional aggregate of humic, fine sandy/silty clay loam, sub-rounded, <2 mm.

Sample 12: Modern house construction site 3: upper red soil

Structure: pellety, <500 µm, to sub-rounded aggregated, 2–4 mm; *Porosity*: 15–20% open interconnected vughy, sub-rounded to elongate, <3 mm; *Mineral components*: <5% small limestone gavel, <5 mm, sub-rounded to sub-angular; coarse/fine ratio: 15/85; coarse fraction: 5% coarse, 5% medium and 5% fine quartz sand, 100–500 µm, sub-rounded; fine fraction: 20% very fine quartz sand, 50–100 µm, sub-rounded; 25% micro-sparite; 40% dusty clay in groundmass, weak birefringence, gold to yellowish brown (CPL); dark brown to reddish brown (CPL/PPL); *Organic component*: brown to dark brown humic staining of whole groundmass; rare (<2%) charcoal fragments, <500 µm; 10% organic/charred punctuations in groundmass; rare (1%) bone fragments, <1 mm; *Pedofeatures*: *Textural*: see above; *Fabric*:

one aggregate of humic silt Ah material, <5 mm, sub-rounded, dark brown to black (CPL/PPL); *Amorphous*: strong to very strong staining with amorphous sesquioxides throughout groundmass.

Sample 14: Modern house construction site 3: lower red soil

Structure: very well developed, small irregular/sub-angular blocky, <3 cm; *Porosity*: 10% channels, <5 cm long, <750 µm wide, accommodated, smooth; 5% vughs, sub-rounded, <500 µm; *Mineral components*: 20% fine limestone gravel, <1.5 cm, sub-rounded; c/f ratio: 20/80; coarse fraction: 10% medium and 10% fine quartz sand, 100–500 µm, sub-rounded; fine fraction: 20% very fine quartz, 50–100 µm, sub-rounded; 60% dusty clay in groundmass, mainly speckled, gold to orange to reddish brown (CPL), moderate to strong birefringence; brown (CPL), reddish brown (PPL); *Organic components*: <1% fine charcoal, <100 µm; 5% organic punctuations in groundmass; *Amorphous*: groundmass moderately impregnated with amorphous sesquioxides.

A7.7. Tač-Cawla

Sample 9

Structure: dense, well developed small blocky, <3 cm; irregular aggregated to pellet micro-structure, <2 mm; *Porosity*: 5% vughs <250 µm, sub-rounded to irregular; 2% fine channels, <3 cm long, <750 µm wide, accommodated, smooth to weakly serrated; *Mineral components*: 25% very fine quartz sand, 50–100 µm, sub-rounded; 75% silty clay, stipple speckled and short striae, moderate to strong birefringence, red/reddish orange (CPL); very strong red (CPL/PPL); *Amorphous*: very severe amorphous sesquioxide impregnation of whole groundmass.

Sample 14

Structure: dense, moderately well developed blocky, <6 cm; irregular aggregated to pellet micro-structure, <2 mm; *Porosity*: 5% vughs, <500 µm, sub-rounded to irregular; 5% fine channels, <3 cm long, <500 µm wide, accommodated, smooth to weakly serrated; *Mineral components*: <2% fine limestone gravel, 2–4 mm, sub-angular; 20–25% very fine quartz sand, 50–100 µm, sub-rounded; 75–80% silty clay, striated to weakly reticulate striated, moderate to strong birefringence, red/reddish orange (CPL); very strong red (CPL/PPL); *Amorphous*: very severe amorphous sesquioxide impregnation of whole groundmass; 5–15% amorphous sesquioxide nodules, <250 µm, sub-rounded, orangey red (CPL/PPL).

Sample 139

Structure: aggregated, sub-rounded to irregular, <4 mm; *Porosity*: 5% channels, <5 mm long, <250 µm wide; 5% vughs, sub-rounded to irregular, <500 µm; *Mineral components*: 5% fine stone, <2 cm, sub-rounded to sub-angular; c/f ratio: 15/85; coarse fraction: 10% medium and 5% fine quartz sand, sub-rounded, 200–750 µm; fine fraction: 20% very fine quartz sand, 50–100 µm, sub-rounded; 20% micro-sparite; 10% silt; 25% dusty clay; golden brown (CPL), yellowish brown (PPL); *Organic components*: very few (1%) charcoal fragments, <5 mm; few (2%) micro-charcoal, <75 µm; 5–10% organic punctuations, <50 µm; *Pedofeatures*: *Amorphous*: weak to moderate amorphous sesquioxide impregnation of whole groundmass with few zones of greater impregnation; common partial infills and linings of voids with micritic to amorphous calcium carbonate.

Sample 261

Structure: aggregated, 100 µm to <2 mm; *Porosity*: up to 20% vughs, sub-rounded to irregular, <1 mm; most with calcitic coatings; *Mineral*

components: c/f ratio: 15/85; coarse fraction: 10% medium and 5% fine quartz sand, sub-rounded, 200–750 µm; fine fraction: 5% very fine quartz sand, 50–100 µm, sub-rounded; 75% micro-sparite; 20% dusty clay; pale golden/greyish brown (CPL), pale yellowish brown (PPL); *Excremental*: few (<5%) dung aggregates, <4 mm, sub-rounded; *Organic components*: 5–10% organic/charred fragments, <500 µm.

Sample 301

Two fabric units; *Upper fabric unit 1*: *Structure*: dense, aggregated, <5 mm; *Porosity*: 10% vughs, <500 µm, sub-rounded; <5% channels, <5 cm long, <500 µm wide, partly accommodated; *Mineral components*: <10% very fine quartz sand, 50–100 µm, sub-rounded; 80–90% dusty clay, weak to non-birefringent; aggregate of silt crust in upper right hand corner of slide, <1 cm; reddish brown (CPL), golden brown (PPL); *Organic components*: 10–20% organic/charcoal dust, <50 µm; *Lower fabric unit 2*: 50–75% limestone pebbles, <1.5 cm, sub-rounded in matrix of fabric as above; orangey red (CPL/PPL); very strong amorphous sesquioxide impregnation.

A7.8. In-Nuffara

Sample 17

Structure: aggregated, 500 µm to 4 mm, sub-rounded to irregular; *Porosity*: 20–50% interconnected vughy; 10% horizontal channels, <2 mm wide, weakly serrated, partly accommodated; *Mineral components*: 10% large limestone pebbles, <3 cm, sub-rounded to sub-angular; 10% fine limestone gravel, <5 mm, sub-rounded to sub-angular; c/f ratio = 10–20/80–90; coarse fraction: 10–20% fine sand-size limestone, sub-rounded to sub-angular, 100–250 µm; fine fraction: 10% very fine sand-size limestone, sub-rounded to sub-angular, 50–100 µm; 10% micro-sparite; 40% silty clay, in groundmass, weak birefringence; golden brown to brown (CPL); dark greyish brown (PPL); *Organic components*: <1% charcoal, <5 mm; 5–10% charred 'dust' in groundmass, <50 µm; <1% shell fragments.

Sample 40

As for Sample 17, except for:

Mineral components: 20% micro-sparite; occasional zone of amorphous calcium carbonate; *Organic components*: <1% bone fragments, <2 cm; <1% pot fragments, <1 cm; <1% fired clay fragments, <6 mm; *Fabric pedofeatures*: few silt crust fragments, with micro-lamination, <4 mm.

Sample 503

Structure: weakly developed sub-angular blocky, <3 cm; *Porosity*: 10–20% vughs, sub-rounded to irregular, <2 mm; 5% channels, irregular, <3 mm long, <500 µm wide, weakly serrated to smooth, partly accommodated; *Mineral components*: c/f ratio = 10/90; coarse fraction: 10% fine quartz sand, sub-rounded to sub-angular, 100–250 µm; fine fraction: 20% very fine quartz sand, sub-rounded to sub-angular, 50–100 µm; 70% silty clay, in groundmass and coating grains and voids, weak birefringence; golden brown (CPL); brown (PPL); *Organic components*: <1% charcoal, <500 µm; 5% charred 'dust' in groundmass, <50 µm; <1% bone fragments, <2 mm; <1% pot fragments, <4 mm; *Amorphous pedofeatures*: 10% of groundmass with irregular zones of sesquioxide formation.

Sample 509

As for Sample 503, except for:

Structure: very weakly developed sub-angular blocky, <5 cm; *Organic components*: whole groundmass is stained dark brown to brown.

A7.9. Marsalforn Valley Profile 626

Sample 626/1, 175–185 cm

Structure: weakly developed, sub-angular to columnar blocky, <1.5 cm; *Porosity*: <5% vughs, sub-rounded to irregular, <1 mm; 5% channels, <1.5 cm long, <500 µm wide, smooth to weakly serrated, accommodated; *Mineral components*: 5–10% fine limestone, sub-rounded, <5 mm; c/f ratio: 50/50; coarse fraction: 10% shell fragments; 2–5% coarse, 5% medium and 20% fine sand-size limestone, sub-rounded, 100–1000 µm; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 20% micro-sparite; 20% dusty clay; golden brown (CPL), greyish/yellowish brown (PPL); *Organic components*: rare (<1%) fragments of amorphous iron replaced humified organic matter and/or vegetal voids; *Fabric*: rare void infill of weakly reticulate, very fine sandy clay loam, golden brown/yellow (CPL), moderate birefringence, with 5% charred punctuations; *Amorphous*: rare (<1%) sesquioxide nodule, sub-rounded, <750 µm.

Sample 627/2, 200–210 cm

Structure: moderately well developed, sub-angular blocky, <4 cm; *Porosity*: <5% vughs, sub-rounded to irregular, <750 µm; 5% channels, <4 cm long, <750 µm wide, smooth to weakly serrated, accommodated; *Mineral components*: 5–10% fine limestone, sub-rounded, <5 mm; c/f ratio: 50/50; coarse fraction: 10% shell fragments; 2–5% coarse, 5% medium and 20% fine sand-size limestone, sub-rounded, 100–1000 µm; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 20% micro-sparite; 20% dusty clay; golden brown (CPL), greyish/yellowish brown (PPL); *Organic components*: rare (<1%) fragments of amorphous iron replaced humified organic matter and/or vegetal voids; *Amorphous*: rare (<1%) sesquioxide nodule, sub-rounded, <750 µm.

Sample 627/3, 275–285 cm

Structure: weakly developed, sub-angular blocky, <4 cm; *Porosity*: <5% vughs, sub-rounded to irregular, <750 µm; 5% channels, <4 cm long, <750 µm wide, smooth to weakly serrated, accommodated; *Mineral components*: 5–10% fine limestone, sub-rounded, <5 mm; c/f ratio: 50/50; coarse fraction: 10% shell fragments; 2–5% coarse, 5% medium and 20% fine sand-size limestone, sub-rounded, 100–1000 µm; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 20% micro-sparite; 20% dusty clay; golden brown (CPL), greyish/yellowish brown (PPL); *Organic components*: rare (<1%) fragments of amorphous iron replaced humified organic matter and/or vegetal voids; *Fabric*: few (<5%) silt and silty clay crust fragments, <2 mm; *Amorphous*: rare (<1%) sesquioxide nodule, sub-rounded, <750 µm.

A7.10. Ramla Valley Profile 627

Sample 627/1, 4–14 cm

Structure: moderately well developed, large sub-angular to columnar blocky, <5 cm; *Porosity*: <5% vughs, sub-rounded, <500 µm; 5%

channels, <5 cm long, <1 mm wide, smooth to weakly serrated, accommodated; *Mineral components*: 10–15% fine limestone, sub-rounded, <6 mm; c/f ratio: 40/60; coarse fraction: 10–15% shell fragments; 10% coarse, <5% medium and 10% fine sand-size limestone, sub-rounded, 100–1000 µm; fine fraction: 20% very fine quartz sand, 50–100 µm, sub-rounded; 40% micro-sparite; 20% dusty clay; yellowish brown (CPL), pale yellowish brown (PPL); *Organic components*: rare (<1%) bone fragment, <500 µm; few (<2%) irregular zones of humified organic matter.

Sample 627/2, 75–85 cm

Structure: 50% of groundmass is small, irregular, sub-angular blocky, <1 cm; 50% of groundmass is granular to small aggregated, <500 µm; *Porosity*: 50–75% open vughy in latter fabric; usually infilled with micrite; *Mineral components*: up to 50% fine limestone, sub-rounded, <1 cm, all orientations, occasionally weakly laminar; c/f ratio: 60/40; coarse fraction: 20% shell fragments; 10% coarse, 20% medium and 10% fine sand-size limestone, sub-rounded, 100–1000 µm; fine fraction: 5% very fine quartz sand, 50–100 µm, sub-rounded; 25% micro-sparite; 10% dusty clay; greyish brown (CPL/PPL); *Organic components*: rare (<1%) bone fragment, <250 µm.

Sample 626/3, 103–113 cm

Two fabric units: Upper fabric unit (0–3/4 cm): as for Pr 626/2 above; undulating, merging boundary over 1 mm with Lower fabric unit (3/4–8.5 cm): *Structure*: aggregated, <500 µm; *Porosity*: <5% vughs, sub-rounded, <500 µm; 5% channels, <5 cm long, <1 mm wide, smooth to weakly serrated, accommodated; *Mineral components*: <5% fine limestone, <4 mm; c/f ratio: 30/70; coarse fraction: 10% shell fragments; 5% coarse, <5% medium and 10% fine sand-size limestone, sub-rounded, 100–1000 µm; fine fraction: 15% very fine quartz sand, 50–100 µm, sub-rounded; 50% micro-sparite; 20–25% dusty clay, aggregated, <500 µm; brown (CPL/PPL); *Organic components*: few (<2%) irregular zones of humified organic matter; *Fabric*: occasional (2%) silty clay aggregate, <1 mm, sub-rounded, yellowish brown (CPL).

A7.11. Dwerja

Sample 616: 2.25–2.35 m

Structure: weakly developed, small irregular to sub-angular blocky, <5 cm; *Porosity*: <5% vughs, sub-rounded, <250 µm; 2% channels, <1 cm long, <500 µm wide, weakly serrated, partly accommodated; *Mineral components*: <5% fine limestone, sub-rounded, <8 mm; c/f ratio: 35/65; coarse fraction: 10% shell fragments; 5% coarse, 10% medium and 10% fine sand-size limestone, sub-rounded, 100–1000 µm; fine fraction: 10% very fine quartz sand, 50–100 µm, sub-rounded; 35% micro-sparite; 10% coarse calcitic, <50 µm; 10% dusty clay; brown (CPL), yellowish brown (PPL).

(Note: PPL = plane polarized light; CPL = cross polarized light; µm = microns; mm = millimetres; cm = centimeters)

Temple landscapes

The ERC-funded *FRAGSUS Project* (*Fragility and sustainability in small island environments: adaptation, cultural change and collapse in prehistory, 2013–18*), led by Caroline Malone (Queens University Belfast) has explored issues of environmental fragility and Neolithic social resilience and sustainability during the Holocene period in the Maltese Islands. This, the first volume of three, presents the palaeo-environmental story of early Maltese landscapes.

The project employed a programme of high-resolution chronological and stratigraphic investigations of the valley systems on Malta and Gozo. Buried deposits extracted through coring and geoarchaeological study yielded rich and chronologically controlled data that allow an important new understanding of environmental change in the islands. The study combined AMS radiocarbon and OSL chronologies with detailed palynological, molluscan and geoarchaeological analyses. These enable environmental reconstruction of prehistoric landscapes and the changing resources exploited by the islanders between the seventh and second millennia BC. The interdisciplinary studies combined with excavated economic and environmental materials from archaeological sites allows *Temple landscapes* to examine the dramatic and damaging impacts made by the first farming communities on the islands' soil and resources. The project reveals the remarkable resilience of the soil-vegetational system of the island landscapes, as well as the adaptations made by Neolithic communities to harness their productivity, in the face of climatic change and inexorable soil erosion. Neolithic people evidently understood how to maintain soil fertility and cope with the inherently unstable changing landscapes of Malta. In contrast, second millennium BC Bronze Age societies failed to adapt effectively to the long-term aridifying trend so clearly highlighted in the soil and vegetation record. This failure led to severe and irreversible erosion and very different and short-lived socio-economic systems across the Maltese islands.

Editors:

Charles French is Professor of Geoarchaeology in the Department of Archaeology, University of Cambridge. *Chris O. Hunt* is a Professor in the School of Biological and Environmental Sciences, Liverpool John Moores University, Liverpool.

Reuben Grima is a Senior Lecturer in the Department of Conservation and Built Heritage, University of Malta.

Rowan McLaughlin is Senior Researcher in the Department of Scientific Research at the British Museum and honorary research scholar at Queen's University Belfast.

Caroline Malone is a Professor in the School of Natural and Built Environment, Queen's University Belfast.

Simon Stoddart is Reader in Prehistory in the Department of Archaeology, University of Cambridge.

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