Radiocarbon, Vol 63, Nr 2, 2021, p 461–471 DOI:10.1017/RDC.2020.123

THE NEW RADIOCARBON DATASET FOR TRILITH MONUMENTS OF SOUTHEASTERN ARABIA

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ABSTRACT. Triliths are megalithic monuments scattered across the coastal plains of southern and southeastern Arabia. They consist of aligned standing stones with a parallel row of large hearths and form a space, the meaning of which is undoubtedly significant but nonetheless still unknown. This paper presents a new radiocarbon (^{14}C) dataset acquired during the two field seasons 2018–2019 of the TSMO (Trilith Stone Monuments of Oman) project which investigated the spatial and temporal patterns of the triliths. The excavation and sampling of trilith hearths across Oman yielded a dataset of 30 new ^{14}C dates, extending the use of trilith monuments to as early as the Iron Age III period (600–300 BC). The earlier dates are linked to two-phase trilith sites in south-central Oman. The three ^{14}C pairs collected from the two-phase trilith sites indicated gaps between the trilith construction phases from 35 to 475 years (2 σ). The preliminary spatio-temporal analysis shows the geographical expansion of populations using trilith monuments during the 5th to 1st century BC and a later pull back in the 1st and 2nd century AD. The new ^{14}C dataset for trilith sites will help towards a better understanding of Iron Age communities in southeastern Arabia.

KEYWORDS: Arabia, Late Iron Age, Oman, radiocarbon dating, trilith monuments.

INTRODUCTION

Trilith monuments are ritual spaces found across the coastal plains from Ḥaḍramawt in eastern Yemen to Ra᾿s al-Ḥādd in Oman. They consist of three flat pyramidal standing stones which lean against each other. The triliths are aligned in a row on a low platform filled with small pebbles. They are accompanied by an arrangement of square-shaped boulders and a row of large circular hearths to form a recognizable spatial configuration of trilith cluster (Figure 1). Together these items form a "trilith cluster," the basic unit of trilith nomenclature (Garba 2019: 149). Trilith clusters sometimes occur together with various ancillary stone structures such as cairn tombs, stone circles or boulders with engravings. Triliths have been archaeologically recorded in Ḥaḍramawt and the al-Mahra Governorates of Yemen (Dostal 1968; Rougeulle 1999; Bin ʻAqil and McCorriston 2009; McCorriston et al. 2011), and in the Ẓufār Governorate (Thomas 1929a, 1929b; Thesiger 1946; al-Shahri 1991; Zarins 2001; Newton and Zarins 2010; Harrower et al. 2014; McCorriston et al. 2014), al-Wusṭā Governorate (Jagher and Pümpin 2010; Jagher et al. 2011; Genchi et al. 2016, 2017; Garba et al. 2019, 2020), and Ash Sharqiyah Governorates of Oman (de Cardi et al. 1977: 26–32; Doe 1977; al-Jahwari 2013, 2018). Attempts to map their distribution have also been made (Dostal 1968: 54–55; de Cardi et al. 1977: 30–31, fig.7; Yule 2013: 25, fig. 14, 2014: 75; Garba 2017: 46–48, 2018: 503–504, 2019: 153; al-Jahwari 2018: 68; Yule 2018: 462–466, figs. 16 and 19). This study and the question of who built the triliths are the subject of first author Garba's dissertation.

The Italian-Czech "Trilith Stone Monuments of Oman" (TSMO) archaeological expedition began field research of the trilith monuments in Oman in 2018. The main objective of the first two field seasons was to test and verify the trilith chronology and distribution by means of a more representative dataset of radiocarbon (^{14}C) dates and to build a consolidated database of trilith sites. The investigation of the spatio-temporal patterning

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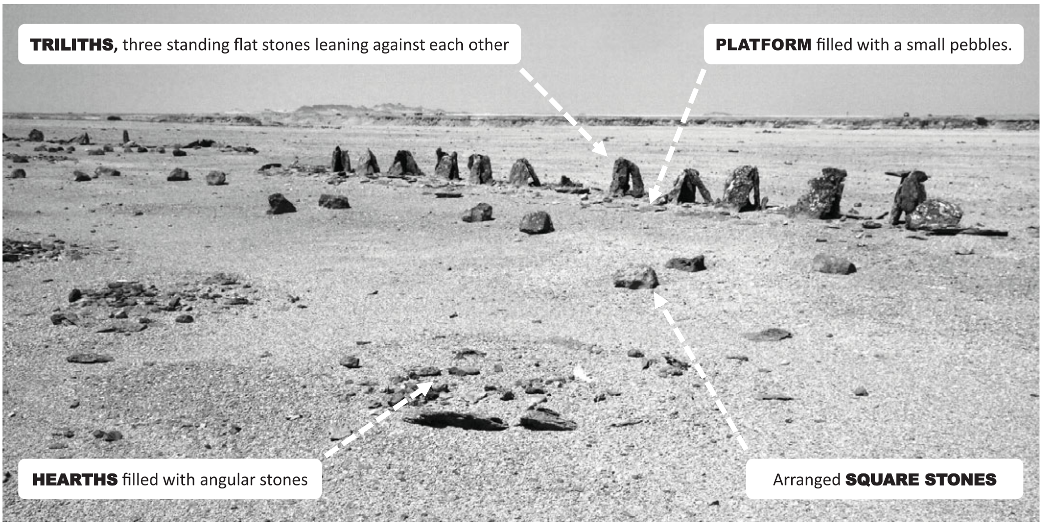

Figure 1 Typical configuration of a trilith cluster, Wādī Ṣayy, Duqm. Photo: R. Garba 2010.

across a wider and more coherent geographical area sought to discover which people or peoples might have built them and to disentangle their function and meaning.

DATA COLLECTION AND METHODS

The sampling strategy focused on badly preserved trilith sites and large trilith complexes with six and more trilith clusters and sought to uncover the patterns behind such extensive installations. The sampling was conducted during the ground verification of trilith sites across the whole trilith distribution area in Oman. Through a combination of remote sensing, the TSMO ground surveys, and linking data from various archaeological sources, the trilith distribution dataset grew from an initial 231 trilith sites with 647 clusters (Garba 2017, 2018) to 692 trilith sites with 2844 clusters across an area from eastern Yemen to north-central Oman (Figure 2). During the first field campaign in 2018, seven trilith hearths were stratigraphically excavated but yielded just three charcoal samples. The scarcity of charcoal from the excavation of the trilith hearths led to more effective sondage of the centre of the hearths. This helped to preserve the remaining hearth material, and thus future data collection, and to maintain the visual integrity of the hearth. The reason for the lack of charcoal (irregular or one-time use, ritual removal, environmental conditions, etc.) is under investigation. In addition to the main large hearths, there were other ("secondary") hearths located randomly around the trilith clusters. Across four field campaigns, we investigated 73 hearths, and this yielded 43 samples of charcoal or other organic material from 34 hearths (6 in the north-central Oman, 16 in south-central Oman, and 12 in southern Oman). Figure 2 shows the distribution of trilith sites and the location of sites which yielded organic material.

In addition to the small amount of charcoal, the trilith hearths yielded "pseudo-charcoal" material that quantitatively dissolved in NaOH during the ABA pretreatment process (four from the total of 34 samples). Pretreatment was carried out at the CRL ^{14}C laboratory in Prague (Czech Republic). The samples in termoblok (at 90ºC) were leached repeatedly with

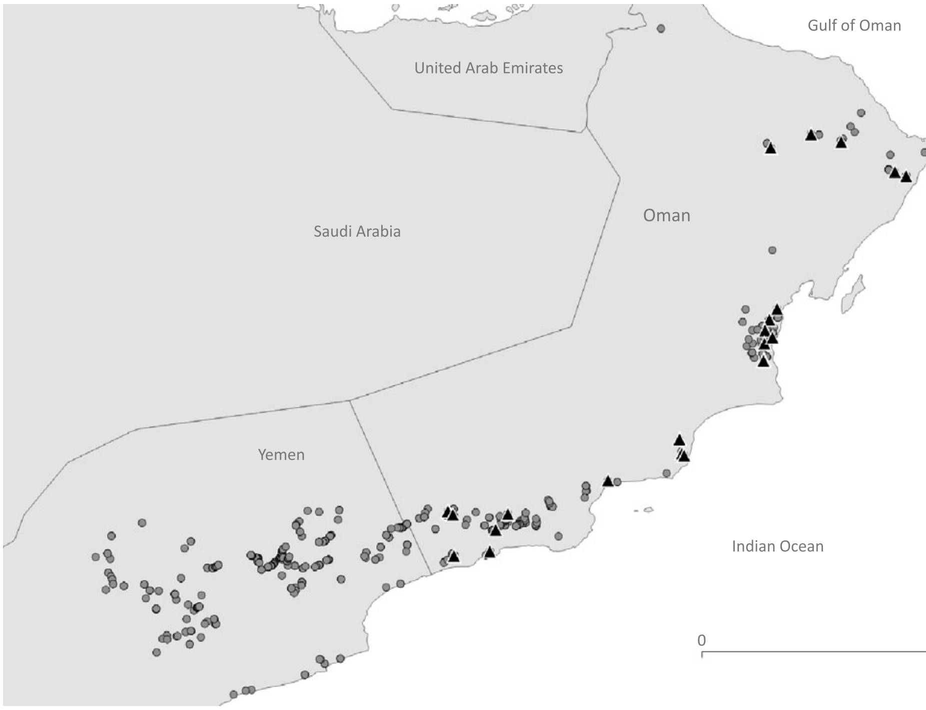

Figure 2 Distribution of trilith sites (dots) and locations which yielded organic samples (triangles). Source: trilith dB v14.8 (2.6.2020), TSMO sample dB v.19.6. (23.5.2020).

0.5 M HCl followed by 0.1 M NaOH and finally 0.01 M HCl. Before and after the alkaline extraction, the samples were rinsed with distilled water in order to adjust the pH of the extract to 6–8 (Gupta and Polach 1985; Jull et al. 2006; Simek et al. 2019). The samples were dried at 60°C to reach constant weight. After pretreatment, the dry samples, together with CuO, were torch sealed under a dynamic vacuum into quartz glass tubes and combusted at 900°C for at least 8 hours. The resulting carbon dioxide was dried and transferred into the graphitization reactor. The batch method of graphitization with pure Zn as a sole reduction agent was derived from routines described by Rinyu et al. (2015) and by Orsovszki and Rinyu (2015). The 30 pretreated charcoal samples were combusted, graphitized, sealed in vacuum, and sent for AMS measurements to the ICER laboratory in Debrecen (Hungary) with the international code "DeA-" (Molnár et al. 2013a, 2013b; Handlos et al. 2018). The calibration software chosen was the OxCal 4.3.2 tool by Bronk Ramsey (2017) with the curve IntCal13 for atmospheric samples from the northern hemisphere (Reimer et al. 2013).

RESULTS AND DISCUSSION

Triliths are generally assumed to date from the Samad Late Iron Age 200 BC–AD 300 (Yule 2016: 65, fig. 31). An overview of the nine previous trilith dates from Yemen and Oman (de Cardi, Doe and Roskams 1977: 28; al-Shahri 1991: 193, 2000: 57; Cremaschi and Negrino 2002: 342; Bin 'Aqil and McCorriston 2009: 608; McCorriston et al. 2011: 4, 2014: 135–136) was provided recently by Garba (2019: 149). The new trilith ^{14}C dataset from Oman provides a significant increase in the number of trilith dates. Table 1 summarizes the new trilith ^{14}C dataset.

Table 1 Results of ^{14}C analysis. OxCal v4.3.2 Bronk Ramsey (2017), IntCal13 (Reimer et al. 2013).

Sample ID	Lab code	Context ID	Z_L1* (cm)	Z_L2* (cm)	^{14}C age (yr BP, 1 σ)	Calibrated age (yr, 2 σ)
TSMO18-1A-004	CRL19004	OM. WU. 086. FP2	8	8	1972 ± 27	41 BC–AD 78
TSMO18-1A-008	CRL19098	OM. WU. 090. FP9.A	15	15	1969 ± 16	21 BC–AD 71
TSMO18-1A-009	CRL19280	OM. WU. 090. FP9. B	12	20	1974 ± 16	34 BC–AD 70
TSMO18-1A-010	CRL19003	OM. WU. 090. FP9. C	35	35	2034 ± 28	157 BC–AD 50
TSMO18-1A-018	CRL19099	OM. WU. 016. FP4	7	10	2170 ± 61	379–56 BC
TSMO19-1B-060	CRL19214	OM.DA.008.FP14	18	18	2079 ± 16	166–47 BC
TSMO19-1B-064	CRL19215	OM.DA.005.FP6	18	22	2060 ± 17	163–2 BC
TSMO19-1B-069	CRL19217	OM.WU.008.FP1	20	20	2130 ± 17	342–93 BC
TSMO19-1B-077	CRL19210	OM.WU.093.FP3	20	20	2177 ± 17	356–173 BC
TSMO19-1B-079	CRL19209	OM.WU.093.FP6	5	8	1910 ± 29	AD 21–209
TSMO19-1B-088	CRL19213	OM.ZU.002.FP1	18	18	1911 ± 16	AD 60–129
TSMO19-1B-090	CRL19223	OM.ZU.074.FP11	10	10	108 ± 29	AD 1803–1938
TSMO19-1B-091	CRL19211	OM.WU.075.FP2	9	14	2267 ± 16	395–234 BC
TSMO19-1B-092	CRL19207	OM.ZU.115.FP9.A	5	5	1929 ± 16	AD 27–125
TSMO19-1B-093	CRL19212	OM.ZU.115.FP9.B	10	10	1964 ± 16	AD 1–76
TSMO19-2A_111	CRL19787	OM.SS.029.FP6	20	25	2046 ± 25	161 BC–AD 20
TSMO19-2A_112	CRL19788	OM.WU.076.FP3	15	25	2271 ± 28	401–210 BC
TSMO19-2A_113	CRL19789	OM.WU.076.FP4.A	15	20	2040 ± 25	160 BC–AD 25
TSMO19-2A_115	CRL19790	OM.WU.084.FP1.A	8	8	2108 ± 25	196–54 BC
TSMO19-2A_117	CRL19792	OM.WU.084.FP6.A	8	8	113 ± 22	AD 1682–1935
TSMO19-2A_118	CRL19793	OM.WU.084.FP6.B	18	18	2281 ± 28	402–231 BC
TSMO19-2A_174	CRL19925	OM.ZU.190.FP4.A	1	3	1904 ± 20	AD 54–134
TSMO19-2A_175.A	CRL19926	OM.ZU.190.FP4.B	5	11	2036 ± 19	101 BC–AD 22
TSMO19-2A_178.A	CRL19928	OM.ZU.191.FP10.B	28	28	2143 ± 20	351–101 BC
TSMO19-2A_179	CRL19929	OM.ZU.210.FP2	25	30	2048 ± 20	161 BC–AD 5
TSMO19-2A_185.A	CRL19930	OM.ZU.196.FP2	28	30	1987 ± 19	41 BC–AD 60
TSMO19-2A_186	CRL19931	OM.ZU.207.FP3	40	45	2068 ± 20	166–40 BC
TSMO19-2A_188	CRL19932	OM.ZU.066.FP1	25	27	2160 ± 21	356–117 BC
TSMO19-2A_192.A	CRL19933	OM.ZU.184.FP4	40	45	2192 ± 19	360–196 BC
TSMO19-2A_193	CRL19934	OM.ZU.211.FP4	40	45	2115 ± 20	199–57 BC

*Depth below the surface Level 1, Level 2.

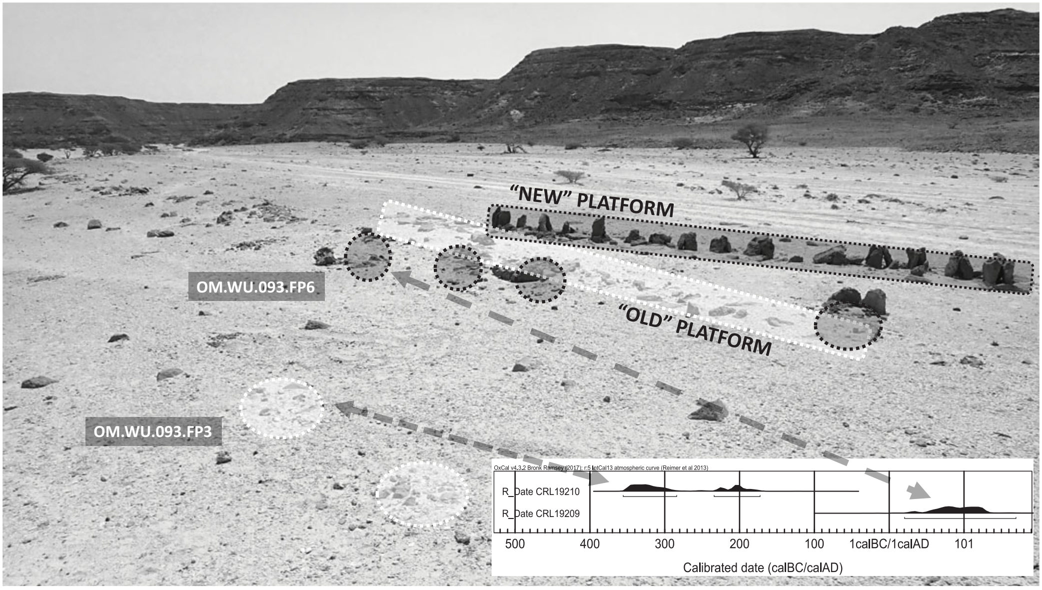

Figure 3 Wādī Wāṭif two-phase trilith site with respective calibrated ^{14}C dates. Source: TSMO project, ^{14}C analyses OxCal v4.3.2 Bronk Ramsey (2017), IntCal13 (Reimer et al. 2013).

Two samples (CRL19223 and CRL19792) show evidence of much later re-use of the trilith hearths in the 17th to early 20th century but still prior to the bomb peak. The samples are from different locations (Wādī ʿAīnain in al-Wusṭā and Wādī Shaʿath near the Salalah port in Ẓufār) and suggest that the ancient pre-Islamic rituals assumed to be connected with the triliths might have continued among local tribes up to more modern times.

The key discovery with respect to the chronological tracing of trilith monuments was the OM.WU.093 trilith site at Wādī Wāṭif, which represents the overlay of two horizontally offset trilith clusters. The platforms and hearths show different levels of preservation (Figure 3), which suggests chronologically distinct construction phases or events. The two ^{14}C dates (the first from hearth OM.WU.093.FP3 associated with the "earlier platform" TSMO19-1B-077, CRL19210, 2177 ± 17 BP, or cal BC 356–173 [2 σ]; the second from hearth OM.WU.093.FP6 associated with the "later platform" TSMO19-1B-079, CRL19209, 1910 ± 29 BP, or cal AD 21–209 [2 σ]) give a gap between the phases of between 227 and 475 years (2 σ). The absence of trilith standing stones on the "earlier" platform indicates re-use of the old standing stones during construction of the "later" platform. The layout and dating of the site suggest that the people who built and used the triliths might have returned to the same place after some 4 to 9 generations.

The trilith chronology was studied in two domains: temporal intra-trilith site chronology within a single trilith space; and spatio-temporal inter-trilith site chronology across Oman. For the intra-trilith chronology, the ^{14}C dates from different strata of the same trilith hearth and two-phase trilith sites were analyzed. Calculations for the duration of use and the gap between phases of activity at individual trilith sites are presented in Table 2.

Because of the small number of dated samples per site (no more than 3), the maximum values show the uncertainty of the dating method. Only the minimum values, if they are non-negative,

Table 2 Calculations for the duration of use and the gap between phases of activity at individual trilith sites. OxCal v4.3.2 Bronk Ramsey (2017), IntCal13 (Reimer et al. 2013).

Site ID	Chronology	N	Duration of use (years)			Gap between phases (years)		
			Min	Max	%	Min	Max	%
OM.WU.076	Horizontal offset	2	149	1756	95.4	105	390	95.4
OM.WU.084	Horizontal offset	2	3	1638	95.4	35	323	95.4
OM.WU.093	Horizontal offset	2	306	2004	95.4	227	475	95.4
OM.WU.090	Hearth layers	3	40	961	95.4	–119	706	95.4
OM.ZU.115	Hearth layers	2	–2	758	95.3	–24	87	95.4
OM.ZU.190	Hearth layers	2	76	1221	95.4	47	209	95.4

provide useful information on the lower limit of duration of the sites. The two longest minimum figures for duration of use are from the two-phase sites OM.WU.093 at Wādī Wāṭif at 306 years and OM.WU.076 at Wādī ʿAīnain at 149 years. Both are in the al-Wusṭā/Ẓufār borderland area. The intra-hearth ^{14}C dates (samples CRL19925 and CRL199266) from site OM.ZU.190.FP4 at Aydim (Ẓufār) show repeated use of the hearth for a minimum duration of 76 years (2 σ) between level –1 to –3 cm and –5 to –11 cm layers. Three ^{14}C dates (samples CRL19098, CRL19280 and CRL19003) from the OM.WU.090.FP9 hearth layers of the trilith site at Nafūn (al-Wusṭā) show a minimum duration of use of 40 years (2 σ). The OM.ZU.115.FP9 intra-hearth ^{14}C dates (CRL19207 and CRL19212) from Ḥanūn (Ẓufār) show a minimum duration of negative 2 years (2 σ), thus no chronological events. Apart from the two-phase trilith site OM.WU.093, an additional two ^{14}C pairs from two-phase trilith sites in nearby Wādī ʿAīnain were obtained from OM.WU.076 (samples CRL19788 and CRL19789) and OM.WU.084 (samples CRL19790 and CRL 19793). The data for the trilith site OM.WU.076 show a gap between the phases of 105–390 years (2 σ) and for OM.WU.084 a gap of 35–323 years (2 σ). These results can be independently reproduced using the OxCal model to calculate the duration of use and the gap between phases of activity at the trilith sites (see supplementary data: script file *triliths_intra_site.oxcal* and output file *triliths_intra_site.pdf*).

For the second investigation, the spatio-temporal inter-trilith regional chronology, hierarchical chronological cluster analysis (HCA) of the calibrated dates was calculated in order to estimate the chronological clusters. The distance between two dates was calculated as the inverse probability that they represent the same event (Dreslerová et al. 2020; Demján and Pavúk in press). The probability that two calibrated ^{14}C dates i and j, defined by mean ^{14}C ages t_i, t_j and standard deviations σ_i, σ_j, represent the same event can be expressed as the ratio

$$P_{ij} = \frac{4\sum_{t\in I} f_{Calib}(t, t_i, \sigma_i) f_{Calib}(t, t_j, \sigma_j)}{\left(\sum_{t\in I} f_{Calib}(t, t_i, \sigma_i) + \sum_{t\in I} f_{Calib}(t, t_j, \sigma_j)\right)^2} \quad (1)$$

where I is the set of dates from the IntCal13 (Reimer et al. 2013) and f_{Calib} is the calibration function by Bronk Ramsey (2008). For every number of clusters that can be formed based on the HCA, the mean silhouette coefficient was calculated to quantify the consistency of the results of the clustering (Rousseeuw 1987) together with the p-value (Figure 4).

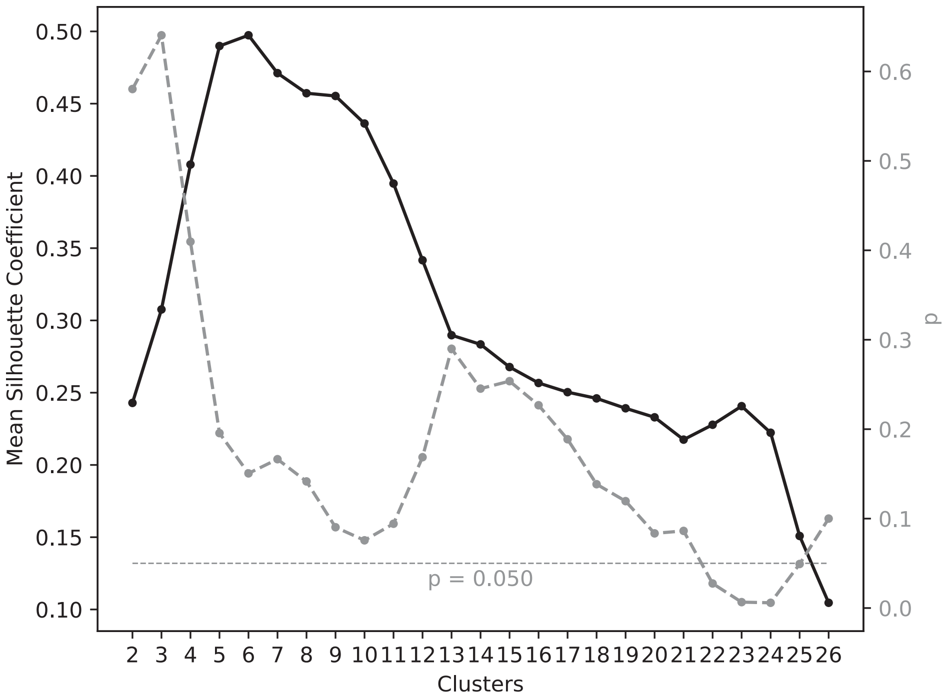

Figure 4 Mean silhouette coefficient (solid line) and p-value (dashed grey line) as a function of the number of modeled clusters.

The results of HCA analysis on all ^{14}C dates across Oman shows limited chronological clustering ($p \leq 0.05$, 22 to 25 clusters from $N = 30$), which suggests something approaching the continuous use of trilith monuments in the region. The temporal extent of the use of a trilith hearth gives the earliest activity from cal BC 417 to 242 (2 σ) and the latest activity from cal AD 72 to 160 (2 σ). These dates represent the beginning and end termini of all available ^{14}C dates modeled in OxCal as a single phase (see supplementary data: script file *triliths_earliest_latest.oxcal* and output file *triliths_earliest_latest.pdf*).

The spatio-temporal modeling was carried out in two steps: first, the dated sites were clustered into the same region if the distance between them was less than 150 km; secondly, the calibrated dates from each region were summed and normalized so that each resulting distribution had a sum of one. This eliminates a possible distortion due to uneven sampling. The results of the spatio-temporal modeling are shown in Figure 5 and could indicate the regional spatial dynamics of the people or peoples culturally associated with the use of trilith monuments. The preliminary spatio-temporal analysis indicates a southwest-to-northeast expansion of occupation from southern Oman (Ẓufār and al-Wusṭā/Ẓufār borderland) to north-central Oman (al-Dāḫilīyah, aš-Šarqīyah) during the 5th to 1st centuries BC, followed by a reverse northeast-southwest trajectory in the first two centuries of the Common Era. The existing dataset is still not sufficiently representative to provide a comprehensive interpretation of the pattern across the whole area of trilith distribution. Some 336 of the 692 registered trilith monuments are located in eastern Yemen which means valuable ground data were not available as a result of the conflict in the region. This is the first attempt, we hope of

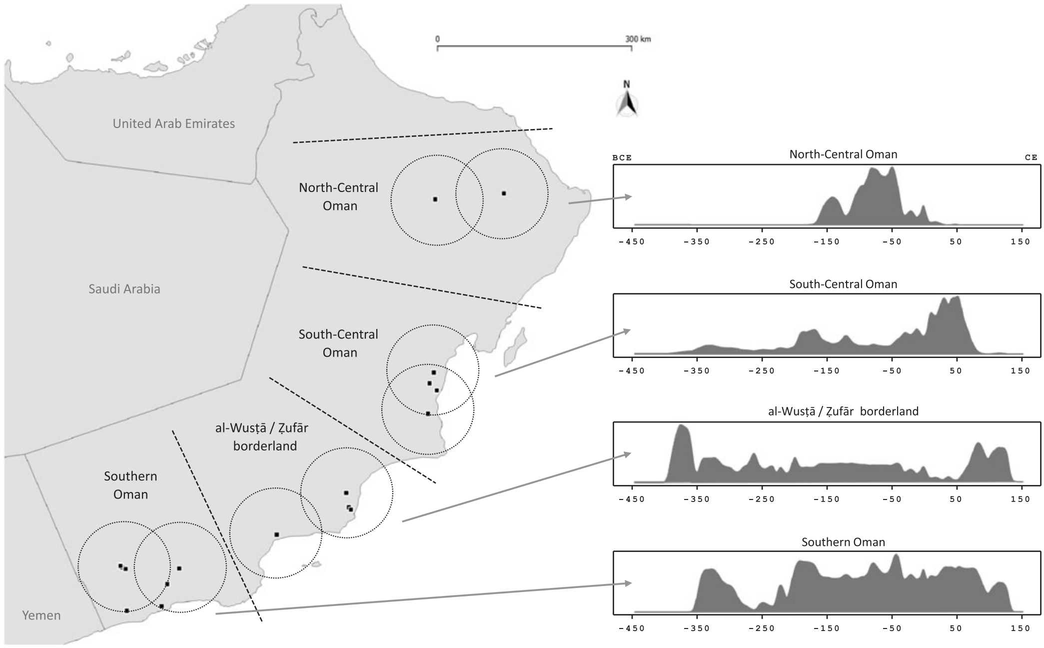

Figure 5 Summed probability distributions of calibrated ^{14}C dates from the examined regions.

many, to study the spatial and temporal patterns of occupation by the people or peoples associated with trilith monuments.

CONCLUSIONS

The samples collected during the TSMO fieldwork showed evidence of intra-hearth events and provided data regarding the duration of use of the trilith hearths. The discovery of two-phase trilith sites brought valuable data into the trilith chronology and resulted in a revised range with respect to the use of trilith hearths in Oman, now believed to be from 410 BC to AD 158 (cal 2 σ). Three ^{14}C dates from south-central Oman provided new evidence of the use of trilith monuments as early as the Iron Age III (600–300 BC) period, and the expansion of existing trilith affiliation with the Samad Late Iron Age (300 BC–AD 300) period. Two limitations should be mentioned with respect to trilith chronology. First, the dates obtained from the hearths represent a *terminus ante quem* (latest possible date) of use, not necessarily the first use of the hearths. Secondly, we assume that the hearths were built and used at the same time that the trilith stone arrangements were erected as the two features are part of a single ritual space. Means of mitigating these limitations include taking samples from the lower strata of the hearths and finding a trilith site with a lateral stratigraphy (two-phase sites with an overlay of horizontally offset trilith clusters built at different times). Both means were partially addressed in the new ^{14}C dataset. The contemporary nature of the construction of the trilith stones and the use of hearths could be tested by OSL dating of sediments beneath trilith platform stones to obtain the time of construction (*terminus post quem*) of the trilith monument. Combining the new ^{14}C dataset from the trilith hearths and the new trilith distribution database allowed, for the first time, the spatio-temporal analysis of the use of trilith monuments in Oman. The results allowed us to study the occupation patterns of tribal populations culturally associated with trilith monuments. The preliminary results show the use of trilith monuments in southern Oman in the 5th to 3rd century BC, an expansion into south-central Oman (Duqm/al-Wusṭā) in the 2nd century BC, followed by further expansion into east-central Oman in the 1st century BC resulting in the furthest geographical extent of the use of trilith monuments. In the 1st and 2nd centuries AD, we see a gradual retreat into south-central Oman and later to southern Oman. The new ^{14}C dataset for trilith monuments contributes to our understanding of the distribution patterns and chronology of trilith monuments and their possible connection to the pastoralists, foragers and sedentary oasis populations of southeastern Arabia during the Iron Age.

ACKNOWLEDGMENTS

We thank the Ministry of Heritage and Tourism for permission to conduct fieldwork in Oman. We are grateful to the TSMO team in supporting the sample collection during the field seasons 2018–19. This publication was supported by OP RDE, MEYS, under the project "Ultra-trace isotope research in social and environmental studies using accelerator mass spectrometry", Reg. No. CZ.02.1.01/0.0/0.0/16_019/0000728, by institutional funding of the Nuclear Physics Institute of the Czech Academy of Sciences (RVO61389005).

SUPPLEMENTARY MATERIAL

To view supplementary material for this article, please visit https://doi.org/10.1017/RDC.2020.123

REFERENCES

al-Jahwari N. 2013. The Early Bronze Age funerary archaeological landscape of western Ja'alan: Results of three seasons of investigation. Arabian Archaeology and Epigraphy 24(2):151–173.

al-Jahwari N. 2018. Al-Aḥǧār aṯ-ṯalāṯīya fī manṭiqat Ǧaʿlān Banī Bū Ḥasan, al-Manṭiqaaš-Šarqīya bi-Salṭanat ʿUmān. Adumatu 38:63–90.

al-Shahri A. 1991. Grave-types and 'triliths' in Dhofar. Arabian Archaeology and Epigraphy 2/3:182–195.

al-Shahri A. 2000. The language of Aad [privately printed].

Bin 'Aqil AJ, McCorriston J. 2009. Prehistoric small-scale monument types in Hadramawt (southern Arabia). Antiquity 83:602–618.

Bronk Ramsey C. 2008. Radiocarbon dating: revolutions in understanding. Archaeometry 50:249–275.

Bronk Ramsey C. 2017. Methods for summarizing radiocarbon datasets. Radiocarbon 59(6):1809–1833. doi: 10.1017/RDC.2017.108.

Cremaschi M, Negrino F. 2002. The frankincense road of Sumhuram: Palaeoenvironmental and prehistorical background. In: Avanzini A, editor. Khor Rori Report 1. (Arabia Antica, 1). Pisa: Edizioni Plus. p. 325–364.

Curie LA. 1995. Nomenclature in evaluation of analytical methods including detection and quantification capabilities (IUPAC Recommendation 1995). Pure & Appl. Chem. 67(10):1699–1723.

de Cardi B, Doe B, Roskams P. 1977. Excavation and survey in the Sharqiyah, Oman, 1976. Journal of Oman Studies 3(1):17–33.

Demján P, Pavúk P. In press. Clustering of calibrated radiocarbon dates: site-specific chronological sequences identified by dense radiocarbon sampling. Radiocarbon.

Doe B. 1977. Gazetteer of sites in Oman, 1976. Journal of Oman Studies 3(1):35–57.

Dostal W. 1968. Zur Megalithfrage in Südarabien. Festschrift Werner Caskel. Leiden: Brill.

Dreslerová D, Kozáková R, Metlička M, Brychová V, Bobek P, Čišecký Č, Demján P, Lisá L, Pokorná A, Michálek J, Strouhalová B, Trubač J. 2020. Seeking the meaning of a unique mountain site through a multidisciplinary approach. The Late La Tène site at Sklářské Valley, Šumava Mountains, Czech Republic. Quaternary International 542:88–108.

Garba R. 2017. Triliths, the stone monuments of southern Arabia—study. Internal report to the Ministry of Heritage and Culture, Sultanate of Oman [unpublished circulated report].

Garba R. 2018. Triliths. Hinterland monuments of ancient nomads. In: Cleuziou S, Tosi M. In the shadow of the ancestors: the prehistoric foundations of the early Arabian civilization in

Oman. Edited by Frenez D, Garba R. Chapter 48. 2nd edition. Ministry of Heritage and Culture, Sultanate of Oman.
Garba R. 2019. Triliths, the stone monuments of Southern Arabia: preliminary results and path towards the interpretation. Proceedings of the Seminar for Arabian Studies 49:147–158. Archaeopress, Oxford, UK.
Garba R, Maiorano MP, Stefanisko D, Chlachula D, Al-Ghafri W. 2019. Trilith stone monuments of Oman (TSMO): final report of the 1st season 2018–2019 (Field missions TSMO 1A & 1B). Release: June 2019. Ministry of Heritage and Culture, Sultanate of Oman [unpublished circulated report].
Garba R, Danielisová A, Maiorano MP, Abbas M, Chlachula D, Daněček D, Al-Ghafri W, Neuhuber S, Štefanisko D, Trubač J. 2020. TSMO research project. Report of the 2nd season 2019–2020. Ministry of Heritage and Culture, Sultanate of Oman [unpublished circulated report].
Genchi F, Garba R, Martino G, Maiorano MP, Al-Ghafri W. 2016. Final report from Duqm Survey Project 2015. Ministry of Heritage and Culture, Sultanate of Oman [unpublished circulated report].
Genchi F, Garba R, Martino G, Maiorano MP, Al-Ghafri W. 2017. An archaeological overview on the landscape of the Duqm development area, Sultanate of Oman (poster). Proceedings of the Seminar for Arabian Studies 47:93–100.
Gupta S, Polach H. 1985. Radiocarbon dating practices at ANU. Canberra: ANU.
Handlos P, Svetlik I, Horáčková L, Fejgl M, Kotik L, Brychova V, Megisova N, Marecova K. 2018. Bomb peak: radiocarbon dating of skeletal remains in routine forensic medical practice. Radiocarbon 60(4):1017–1028
Harrower M, Senn M, McCorriston J. 2014. Tombs, triliths and oases: the Arabian Human Social Dynamics Project (AHSD) archaeological survey 2009–2010. Journal of Oman Studies 18: 145–151.
Heaton TJ, Blaauw M, Blackwell PG, Bronk Ramsey C, Reimer PJ, Scott EM. 2020. The IntCal20 approach to radiocarbon calibration curve construction: a new methodology using Bayesian splines and errors-in-variables. Radiocarbon 62(4):821–863. doi: 10.1017/RDC.2020.46.
Jagher R, Pümpin Ch. 2010. A new approach to central Omani prehistory. Proceedings of the Seminar for Arabian Studies 40: 185–200.
Jagher R, Pümpin Ch, Wegmuller F, Winet I. 2011. Central Oman Palaeolithic survey report: 2007 season. Journal of Oman Studies 17:15–50.
Jull A, Burr G, Beck J, Hodgins G, Biddulph D, Gann J, Hatheway A, Lange T, Lifton N. 2006. Application of accelerator mass spectrometry to environmental and paleoclimate studies at the University of Arizona. Radioactivity in the Environment 8:3–23.
McCorriston J, Steimer-Herbet T, Harrower M, Williams K, Saliège J, Bin'Aqil A. 2011. Gazetteer of small-scale monuments in prehistoric Hadramawt, Yemen: a radiocarbon chronology from RASA-AHSD project research 1996–2008. Arabian Archaeology and Epigraphy 22(1):1–22.
McCorriston J, Harrower M, Steimer T, Williams K, Senn M, Al Hādhari M, Al Kathīrī M, Al Kathīrī A, Saliège J, Everhart J. 2014. Monuments and landscape of mobile pastoralists in Dhofar: the Arabian Human Social Dynamics (AHSD) Project, 2009–2011. Journal of Oman Studies 12: 117–144.
Molnár M, Janovics R, Major I, Orsovszki J, Gönczi R, Veres M, Leonard A, Castle S, Lange T, Wacker L, Hajdas I, Jull A. 2013a. Status report of the new AMS ^{14}C sample preparation lab of the Hertelendi Laboratory of Environmental Studies (Debrecen, Hungary). Radiocarbon 55(2–3):665–676.
Molnár M, Rinyu L, Veres M, Seiler M, Wacker L, Synal H-A. 2013b. EnvironMICADAS: a mini ^{14}C-AMS with enhanced gas ion source interface in the Hertelendi Laboratory of Environmental Studies (HEKAL), Hungary. Radiocarbon 55(2–3):338–344.
Newton L, Zarins J. 2010. Preliminary results of the Dhofar archaeological survey. Proceedings of the Seminar for Arabian Studies 40:247–266.
Orsovszki G, Rinyu L. 2015. Flame-sealed tube graphitization using zinc as the sole reduction agent: Precision improvement of Environ MICADAS ^{14}C measurements on graphite targets. Radiocarbon 57(5):979–990.
Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Ramsey CB, Buck CE, Cheng H, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Haflidason H, Hajdas I, Hatté C, Heaton TJ, Hoffmann DL, Hogg AG, Hughen KA, Kaiser KF, Kromer B, Manning SW, Niu M, Reimer RW, Richards DA, Scott EM, Southon JR, Staff RA, Turney CSM, van der Plicht J. 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55(4):1869–1887.
Rinyu L, Orsovszki G, Futó I, Veres M, Molnár M. 2015. Application of zinc sealed tube graphitization on sub-milligram samples using Environ MICADAS. Nuclear Instruments and Methods in Physics Research 361:406–413.
Rougeulle A. 1999. Coastal settlements in southern Yemen: The 1996–1997 survey expeditions on the Ḥaḍramawt and Mahra coasts. Proceedings of the Seminar for Arabian Studies 29:123–136.
Rousseeuw PJ. 1987. Silhouettes: a graphical aid to the interpretation and validation of cluster analysis. Journal of Computational and Applied Mathematics 20:53–65.

Simek P, Megisová N, Bemš J. 2019. Preparation of wood, charcoal and bone collagen micro samples using automat for AMS radiocarbon dating. Radiation Protection Dosimetry 186(2–3):433–436.
Thesiger W. 1946. A new journey in Southern Arabia. The Geographical Journal 108(4/6):129–145.
Thomas B. 1929a. Among some unknown tribes of South Arabia. The Journal of the Royal Anthropological Institute of Great Britain and Ireland 59:97–111.
Thomas B. 1929b. The south-eastern borderlands of Rub' al Khali. The Geographical Journal 73(3):193–212.
Yule P. 2013. Late pre-Islamic Oman: the inner evidence, the outside view. In: Hoffman-Ruf M, Salami A, editors. Studies on Ibadism and Oman: Oman and overseas. ii. Hildesheim: Georg Olms. p. 13–33.
Yule P. 2014. Cross-roads: Early and Late Iron Age south-eastern Arabia. Wiesbaden: Harrassowitz.
Yule P. 2016. Valorising the Samad Late Iron Age. Arabian Archaeology and Epigraphy 27:31–71. doi: 10.1111/aae.12060.
Yule P. 2018. Toward an identity for the Samad period population (Sultanate of Oman). Zeitschrift für Orient-Archäologie 11:438–486.
Zarins J. 2001. The land of incense: archaeological work in the Governorate of Dhofar, Sultanate of Oman, 1990–1995. Muscat: Sultan Qaboos University Publications.