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| A red circle with a white letterDescription automatically generated | Supplementary material for  Smogorzewska, A. 2025. **The first pottery in the Arabian Gulf: origin, production and distribution.** *Antiquity* 99.  Author for correspondence ✉ a.smogorzewska@uw.edu.pl |

**Materials and methods (ICP-MS analysis)**

Forty ceramic samples from Bahra 1, half of the Ubaid Ware and the other half, the Coarse Red Ware (CRW), were analyzed (Table S3). The samples were selected to present the greatest possible diversity in terms of fabrics within both ceramic groups. The samples represent all technological groups, i.e., fine ware, common ware, and coarse ware, with varying types and amounts of temper. Additionally, one clay sample was taken from the unfired vessel (P2), while six geological samples from the al-Subiyah region provided reference materials (P1, P3, P4, P5, P6, P7).

Their elemental composition was determined by inductively coupled plasma mass spectrometry (ICP-MS). The results were analyzed using principal component analysis (PCA). The following elements were included in the study: Li, Na, Mg, Si, P, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Rb, Sr, Y, Zr, Nb, Ba, La, Ce, and Pb (Table S4). The concentrations obtained in µg/l were converted to mg/kg (ppm) taking into account the sample weights and dilutions. The analyses were conducted at the University of Warsaw Biological and Chemical Research Centre by Dr. Anna Ruszczyńska.

Before the ICP-MS analysis, the samples were prepared following the proper procedure: ceramic fragments, weighing between 0.2 g and 1 g were ground in an agate mortar, which was washed with deionized Milli-Q water (18 MΩcm, Millipore, USA) and rinsed with high-purity ethanol (Merck, Germany). The samples were always ground in a dry mortar. The ground samples were placed in closed Eppendorf tubes and stored at room temperature for further analysis.

Each ground sample was weighed into Teflon containers in amounts of approximately 0.06 g and subjected to wet digestion in a mixture of concentrated acids (Sigma Aldrich/Merck, Germany) in the following proportions: 65% HNO3:50% HBF4:30% HCl=3:2:1, under conditions of elevated temperature and pressure in a closed system assisted by microwave energy (UltraWAVE mineralizer, Milestone, USA). In each of the three mineralization cycles, in addition to the samples, the reference material NIST SRM 679 and two blank samples (containing only the acid mixture) were also mineralized. After each mineralization cycle, the containers were washed and cleaned with acids. The cleaning conditions were replicated from the mineralization conditions (temperature, time, acids). After rinsing with Milli-Q water, the containers were reused for mineralization. Containers for the blank samples were selected randomly.

The mineralization conditions were optimized using the reference material (NIST SRM 679 Brick Clay, USA) to ensure complete mineralization. After each round of mineralization, the samples were cooled to room temperature, then analytically transferred to measurement vessels and diluted with Milli-Q water. The samples underwent complete mineralization. The mineralizates were stored in single-use, sealed plastic containers at approximately 4°C until elemental analysis.

Elemental composition measurements were conducted on the solutions using the ICP-MS method (Nexion 300D, Perkin Elmer, USA) with a system equipped with a liquid sample introduction system (quartz nebulizer and cyclonic spray chamber) and a quadrupole mass analyzer. The TotalQuant screening method was applied to determine the elemental composition. The principle of the method is based on mathematical algorithms that allow for the recording of spectra over a wide mass-to-charge ratio range. The screening method also involves the analysis of characteristic atomic interferences and the correction of signals when such interferences are detected. The accuracy of the results obtained using this method was verified by comparing the results for the reference material (SPS SW1 and SPS SW2, Spectrapure Standards, Norway) with the actual values provided in the certificate, achieving recoveries in the range of 60% to 150%, depending on the concentrations of the determined elements. This method was used for comparing elemental composition between samples or identifying elemental contaminants.

**Radiocarbon dates from Bahra 1**

A total of 34 radiocarbon dates (C14) were obtained from the Bahra 1 site (Table S2). With theexception of one sample, the dates were derived from marine shells (primarily *Conomurex persicus*). All dates were calibrated using the OxCal software (OxCal v. 4.2.3 Bronk Ramsey 2013) at the Poznań Radiocarbon Laboratory. Dates obtained from shells were calibrated using the Marine13 calibration curve, while those from charcoal were calibrated using the IntCal13 atmospheric curve (Reimer *et al.* 2013). The reservoir effect for the marine samples was calculated with a marine Delta\_R value of 230 ± 65. The maximum range of C14 dates for Bahra 1 spans from 5742 to 4890 BC.

**Table S1. C14 dates from Ubaid-related sites in the Gulf included in the text.**

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| **Site** | **Material** | **Conventional age BP (R\_Date)** | **Calibrated BC**  **(95,4% probability)** | **References** |
| H3 | Ashy fill of a shallow fireplace | 4570 ± 40 BP | 3500–3100 BC | Carter & Crawford 2010: table IV: 1 |
| H3 | Ashy fill of a shallow fireplace | 4110 ± 40 BP | 2880–2500 BC | Carter & Crawford 2010: table IV: 1 |
| H3 | Dump of dark ashy material in Chamber 7 | 6135 ± 50 BP | 5220–4940 BC | Carter & Crawford 2010: table IV: 1 |
| H3 | Ashy fill of a firepit | 6160 ± 40 BP | 5220–4990 BC | Carter & Crawford 2010: table IV: 1 |
| H3 | Ashy fill of a firepit | 6480 ± 45 BP | 5530–5340 BC | Carter & Crawford 2010: table IV: 1 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6405 ± 40 BP | 4891–4546 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6435 ± 30 BP | 4921–4601 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6330 ± 35 BP | 4786–4476 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6360 ± 40 BP | 4828–4498 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6500 ± 40 BP | 5003–4677 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6430 ± 35 BP | 4921–4589 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6340 ± 35 BP | 4796–4483 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6540 ± 35 BP | 5040–4716 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6450 ± 35 BP | 4940–4612 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6385 ± 35 BP | 4854–4527 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6430 ± 40 BP | 4927–4581 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6545 ± 40 BP | 5054–4712 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6465 ± 45 BP | 4973–4619 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6490 ± 40 BP | 4994–4666 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6525 ± 35 BP | 5023–4705 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6490 ± 35 BP | 4987–4674 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6520 ± 35 BP | 5017–4701 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dosariyah | Marine shell (*Pinctada radiata*) | 6395 ± 35 BP | 4873–4541 BC  ΔR = 180 ± 53 | Drechsler 2018: 172-282 |
| Dalma | Ashy sand/charcoal | 6395 ± 60 BP | 5479–5295 ВС (0.964)  5259–5228 ВС (0.036) | Beech & Glover 2005: table 1 |
| Dalma | Ashy sand, small bits of charcoal | 6230 ± 45 BP | 5308–5191 ВС (0.535) 5183–5057 ВС (0.465) | Beech & Glover 2005: table 1 |
| Dalma | Charcoal fragments humified organic remains | 6220 ± 45 BP | 5303–5055 ВС (1.000) | Beech & Glover 2005: table 1 |
| Dalma | Carbonised date stone (Phoenix  dactylifera) | 6165 ± 55 BP | 5292–5251 BC (0.041)  5228–4961 BC (0.959) | Beech & Glover 2005: table 1 |
| Dalma | carbonised date stone (*Phoenix*  *dactylifera*) | 5830 ± 55 BP | 4826–4816 BC (0.009)  4801–4545 BC (0.991) | Beech & Glover 2005: table 1 |
| Dalma | Charcoal fragments : humified  organic remains | 5830 ± 45 BP | 4790–4578 BC (0.966)  4574–4554 BC (0.034) | Beech & Glover 2005: table 1 |
| Abu Khamis | Charcoal | 5565 ± 255 BP | – | Masry 1997: 92 |
| Abu Khamis | Shell | 5660 ± 250 BP | – | Masry 1997: 92 |
| Ain as -Sayh, Site F | Shell | – | 4320 ± 80 BC  (uncalibrated conventional) | McClure & al-Shaikh 1993: 110 |
| Ain as -Sayh, Site F | Shell | – | 4380 ± 70 BC  (uncalibrated conventional) | McClure & al-Shaikh 1993: 110 |
| Ain as -Sayh, Site F | Shell (barnacle) | – | 4430 ± 90 BC  (uncalibrated conventional) | McClure & al-Shaikh 1993: 110 |
| Umm al- Quwain | Shell | 5890 ± 170 BP | – | Boucharlat *et al.* 1991: 67 |
| Khursaniyah | Shell | 6157 ± 238 BP | – | Masry 1997: 84 |

**Table S2. Radiocarbon dates from Bahra 1.**

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| **Sample** | **Material** | **Lab number** | **Conventional age BP (R\_Date)** | **Calibrated BC**  **(95,4% probability)** |
| SBH35\_0555 | Marine shell | Poz-112630 | 6750 ± 40 BP | 5271–4890 BC |
| SBH35\_0558 | Marine shell | Poz-112632 | 6765 ± 35 BP | 5278–4916 BC |
| SBH35\_0585 | Marine shell | Poz-112633 | 6840 ± 40 BP | 5346–4986 BC |
| SBH38\_0219 | Marine shell (*Conomurex Persicus*) | Poz-112634 | 6730 ± 40 BP | 5240–4849 BC |
| SBH38\_0272 | Marine shell (*Conomurex Persicus*) | Poz-112636 | 6860 ± 40 BP | 5364–5004 BC |
| SBH38\_0342 | Marine shell (*Conomurex Persicus*) | Poz-112637 | 6860 ± 40 BP | 5364–5004 BC |
| SBH38\_0389 | Marine shell (*Conomurex Persicus*) | Poz-112638 | 6825 ± 35 BP | 5322–4976 BC |
| SBH38\_0445 | Marine shell (*Conomurex Persicus*) | Poz-112639 | 6820 ± 40 BP | 5321–4963 BC |
| SBH38\_0492 | Marine shell (*Conomurex Persicus*) | Poz-112640 | 6770 ± 35 BP | 5282–4922 BC |
| SBH38\_1048 | Marine shell (*Conomurex Persicus*) | Poz-112641 | 6800 ± 40 BP | 5303–4946 BC |
| SBH38\_1055 | Marine shell (*Lunella coronata*) | Poz-112814 | 7165 ± 50 BP | 5628–5333 BC |
| SBH38\_1321 | Marine shell | Poz-112643 | 6820 ± 30 BP | 5313–4978 BC |
| SBH38\_1438 | Marine shell | Poz-112644 | 6950 ± 40 BP | 5462–5133 BC |
| SBH38\_1746 | Marine shell (*Conomurex Persicus*) | Poz-112646 | 6835 ± 35 BP | 5333–4987 BC |
| SBH38\_1713 | Marine shell (*Conomurex Persicus*) | Poz-112873 | 7000 ± 40 BP | 5481–5199 BC |
| SBH38\_0996 | Marine shell (*Conomurex Persicus*) | Poz-112647 | 6920 ± 40 BP | 5438–5080 BC |
| SBH38\_1727 | Marine shell | Poz-112734 | 6890 ± 40 BP | 5406–5041 BC |
| SBH38\_1729 | Marine shell | Poz-112732 | 6830 ± 40 BP | 5335–4976 BC |
| SBH38\_1673 | Charcoal | Poz-112305 | 6240 ± 40 BP  1.1%C TOC | 5311–5198 BC (63.9%)  5178–5066 BC (31.5%) |
| SBH38\_1206 | Marine shell (*Conomurex Persicus*) | Poz-112731 | 6830 ± 40 BP | 5474–5314 BC |
| SBH38\_1261 | Marine shell (*Conomurex Persicus*) | Poz-112730 | 6795 ± 35 BP | 5455–5299 BC |
| SBH38\_1420 | Marine shell (*Conomurex Persicus*) | Poz-112729 | 7140 ± 40 BP | 5742–5581 BC |
| SBH38\_1444 | Marine shell (*Conomurex Persicus*) | Poz-112728 | 6780 ± 40 BP | 5456–5280 BC |
| SBH38\_1514 | Marine shell (*Conomurex Persicus*) | Poz-112727 | 6930 ± 40 BP | 5586–5407 BC |
| SBH38\_0971 | Marine shell (*Conomurex Persicus*) | Poz-112726 | 6790 ± 40 BP | 5459–5290 BC |
| SBH38\_0777 | Marine shell (*Conomurex Persicus*) | Poz-112725 | 6840 ± 40 BP | 5481–5317 BC |
| SBH38\_0778 | Marine shell (*Conomurex Persicus*) | Poz-112724 | 6870 ± 40 BP | 5516–5344 BC |
| SBH38\_1699 | Marine shell (*Conomurex Persicus*) | Poz-112735 | 6945 ± 35 BP | 5590–5440 BC |
| SBH38\_1723 | Marine shell (*Conomurex Persicus*) | Poz-112736 | 7000 ± 40 BP | 5616–5471 BC |
| SBH38\_1750 | Marine shell (*Conomurex Persicus*) | Poz-112737 | 6935 ± 35 BP | 5576–5421 BC |
| SBH38\_0765 | Marine shell | Poz-113738 | 6765 ± 35 BP | 5445–5266 BC |
| SBH38\_0857 | Marine shell | Poz-112739 | 6860 ± 40 BP | 5505–5334 BC |
| SBH38\_1759 | Marine shell | Poz-112740 | 6770 ± 40 BP | 5452–5267 BC |
| SBH38\_1047 | Marine shell | Poz-112741 | 6860 ± 35 BP | 5499–5343 BC |

**Table S3. List of pottery samples.**

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| **No** | **Sample number** | **Pottery category** | **Description** |
| 1 | U42 | Ubaid Ware | Common ware: many medium sand particles, some red particles |
| 2 | U39 | Ubaid Ware | Coarse ware: moderate chaff, many fine dark grains |
| 3 | U6 | Ubaid Ware | Common ware: many fine sand particles, sparse medium white particles |
| 4 | U33 | Ubaid Ware | Coarse Ware: abundant coarse chaff, sparse fine red and white particles |
| 5 | U16 | Ubaid Ware | Common ware: abundant fine sand grits, sparse medium red particles, sparse pores |
| 6 | U2 | Ubaid Ware | Common ware: many fine sand (red, dark grey, white and translucent grains), voids visible on the surface, single medium pores |
| 7 | U41 | Ubaid Ware | Common ware: abundant fine and medium red particles |
| 8 | U1 | Ubaid Ware | Common ware: fine mineral inclusions (dark and red), sparse fine pores, dense fabric |
| 9 | U9 | Ubaid Ware | Common ware: moderate medium grains, many fine sand, single pores |
| 10 | U17 | Ubaid Ware | Common ware: medium and coarse white particles (lime?), moderate; medium sand grains, fine and medium chaff, mica |
| 11 | U46 | Ubaid Ware | Common ware: fine mineral inclusions, sparse pores |
| 12 | U1C | Ubaid Ware | Common ware: many fine sand (white, dark grey, red grains) |
| 13 | U27 | Ubaid Ware | Common ware: many sand particles |
| 14 | U5 | Ubaid Ware | Fine ware: fine particles, dense |
| 15 | U7 | Ubaid Ware | Fine ware: fine particles, porous |
| 16 | U13 | Ubaid Ware | Common ware: medium and fine mineral inclusions (translucent, dark and white), overfired |
| 17 | U4 | Ubaid Ware | Coarse ware: moderate chaff, dark and red grains |
| 18 | U18 | Ubaid Ware | Common ware: medium-coarse sand (dark grey and red grains), moderate quantity, single pores, sparse mica |
| 19 | U15 | Ubaid Ware | Fine ware: fine particles, dense fabric |
| 20 | U10 | Ubaid Ware | Common ware: many fine sand particles, sparse mica, single pores |
| 21 | L19 | Coarse Red Ware | Abundant chaff, moderate sand |
| 22 | L24 | Coarse Red Ware | Abundant chaff, sparse mineral particles, sparse mica |
| 23 | L5 | Coarse Red Ware | Abundant sand grains |
| 24 | L4 | Coarse Red Ware | Many medium sand grains with single coarse grains, moderate chaff, single medium and coarse white particles |
| 25 | L32 | Coarse Red Ware | Many medium sand grains, moderate chaff |
| 26 | L33 | Coarse Red Ware | Many medium sand grains with single coarse grains, moderate chaff |
| 27 | L3 | Coarse Red Ware | Moderate chaff, moderate medium white particles |
| 28 | L11 | Coarse Red Ware | Many medium sand, moderate chaff, moderate fine mica |
| 29 | L9 | Coarse Red Ware | Moderate medium sand with single coarse grains, moderate chaff |
| 30 | L42 | Coarse Red Ware | Moderate chaff, sparse sand |
| 31 | L29 | Coarse Red Ware | Moderate chaff, moderate medium mineral particles |
| 32 | L10 | Coarse Red Ware | Moderate medium sand grains, sparse chaff, fine mica |
| 33 | L1 | Coarse Red Ware | Moderate medium and coarse white particles, sparse sand, moderate chaff |
| 34 | L12 | Coarse Red Ware | Moderate chaff, white particles |
| 35 | L17 | Coarse Red Ware | Abundant chaff, moderate medium and coarse mineral particles, mica |
| 36 | L2 | Coarse Red Ware | Moderate medium and coarse sand, moderate chaff, single coarse red grains |
| 37 | L7 | Coarse Red Ware | Many coarse sand temper with single very coarse grains, moderate chaff, sparse fine mica |
| 38 | L6 | Coarse Red Ware | Moderate chaff, moderate medium white particles, single medium red grains |
| 39 | L26 | Coarse Red Ware | Moderate chaff, sparse sand, many fine white and red grains with single coarse particles |
| 40 | L16 | Coarse Red Ware | Abundant chaff temper, sparse white inclusions |

**Table S4. Results of ICP-MS analysis**

See OSM\_Table S4 accompanying pdf.

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