

Annexes

Annexe 1. Location of Saruq al-Hadid within the Arabian Peninsula



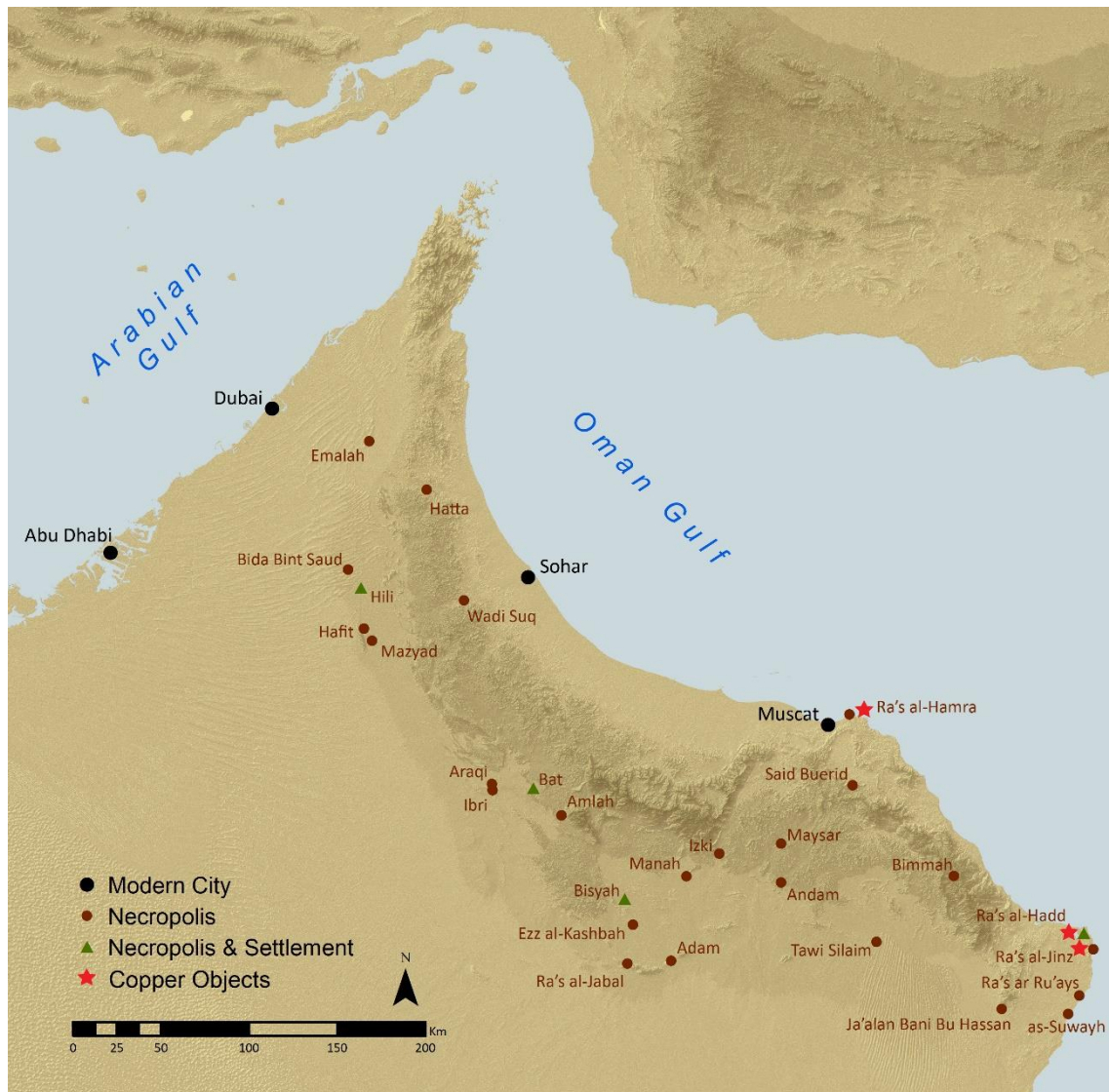
Scale 1:8.000.000, oriented North.

Annexe 2. SE Arabia settlement pattern evolution

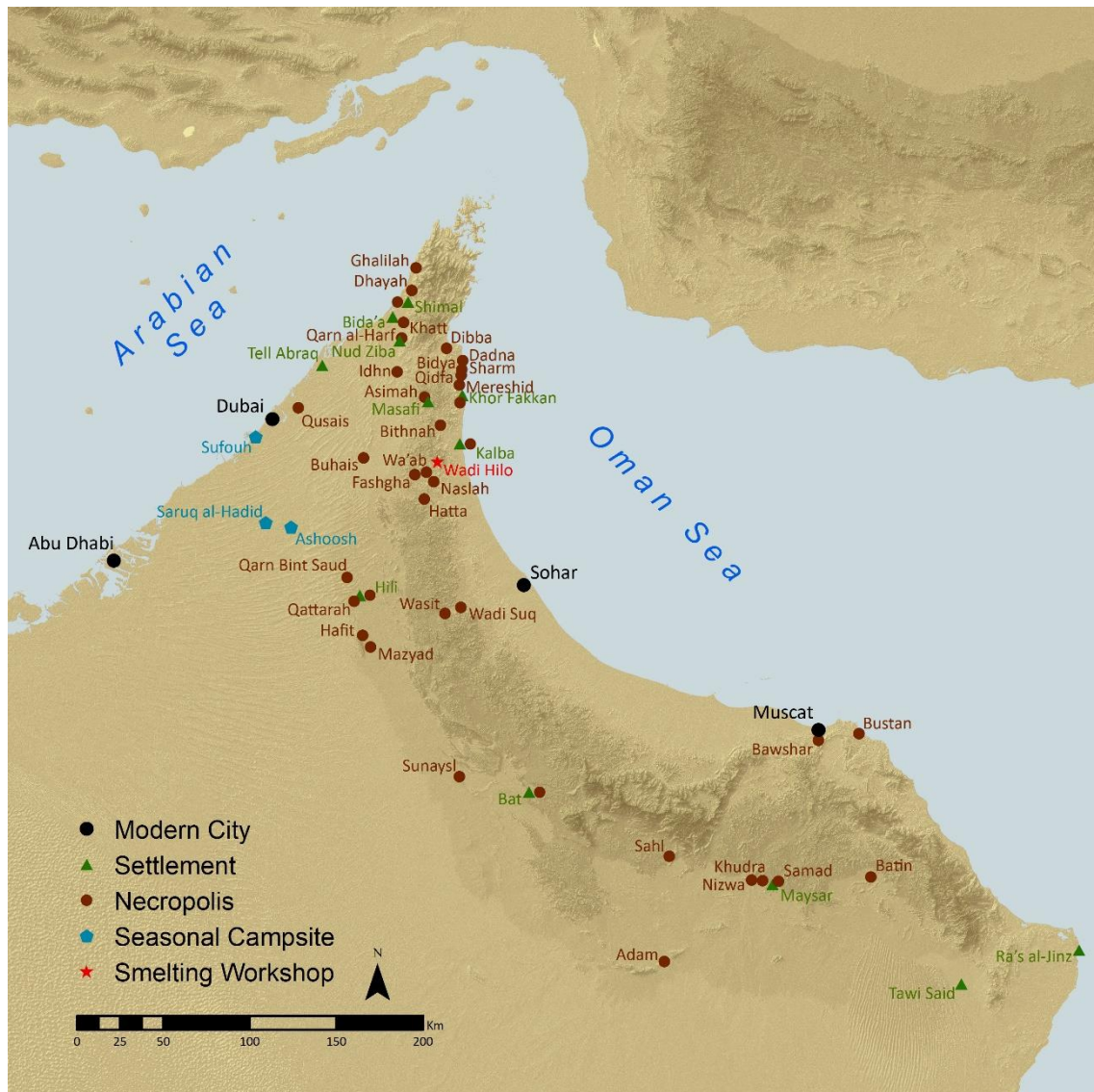
c. 3000 – 2500 BC	Hafit	- first evidence of copper production - first evidence of settled life - subsistence strategies of pastoralism, coastal resources and agriculture (mountain oasis) - proliferation of communal burial, in cairns, perched upon the mountains - evidence of contacts with Mesopotamia
c. 2500 – 2000 BC	Umm an-Nar	- proliferation of metallurgical production near extraction areas - metallurgical production for export - import of tin?/tin-bronzes - proliferation of sedentary occupation to piedmont areas - collective (monumental) circular tombs within settlements - construction of monumental circular towers (territory? hydrographic? resources? control) - expansion of ceramic and soft stone local productions - subsistence strategies of pastoralism, coastal resources and agriculture
c. 2000 – 1300 BC	Wadi Suq	- contraction? of metallurgical extraction (supplanted by recycling?) - cessation? of metallurgical export/import - increased variability in copper type objects - settlement contraction? change to mobile subsistence strategies? occurrence of hunting seasonal sites - variability in architectural burial practices, still communal - regionalism in ceramic and soft stone productions - first evidence of camel domestication

c. 1300 – 300 BC	Iron Age	- expansion of copper extraction and production - increased variability in copper type objects - evidence of import/export of metals (including iron) and other prestige objects with nearby regions (particularly Iran) - Existence of production centres in ceramic, soft stone, copper, etc. - introduction of the falaj system - settlement proliferation (in all ecosystems) - extensive use of camel for transportation - ritual practices associated to a snake deity and existence of cultic sites/buildings - evidence of social complexity and elites - existence of administrative/communal buildings - fortification of settlements (ditches/walls) - variability in subsistence strategies (coastal, mountain, desert and piedmont resources), with specialization? - variability in burial practices (occupation of older communal tombs and first evidence of individual burials)
c. 300 BC – 300 AD	Recent Pre-Islamic	- contraction? of copper extraction (replaced by recycling?) - progressive substitution of copper weaponry by iron options - evidence of iron production - contraction? of settlement pattern - extended contacts with nearby regions - individual (or limited to kin) burial practices, with occasional architectural styles of Nabatean influence - evidence of social complexity. Some king? references - existence of administrative buildings and production centres

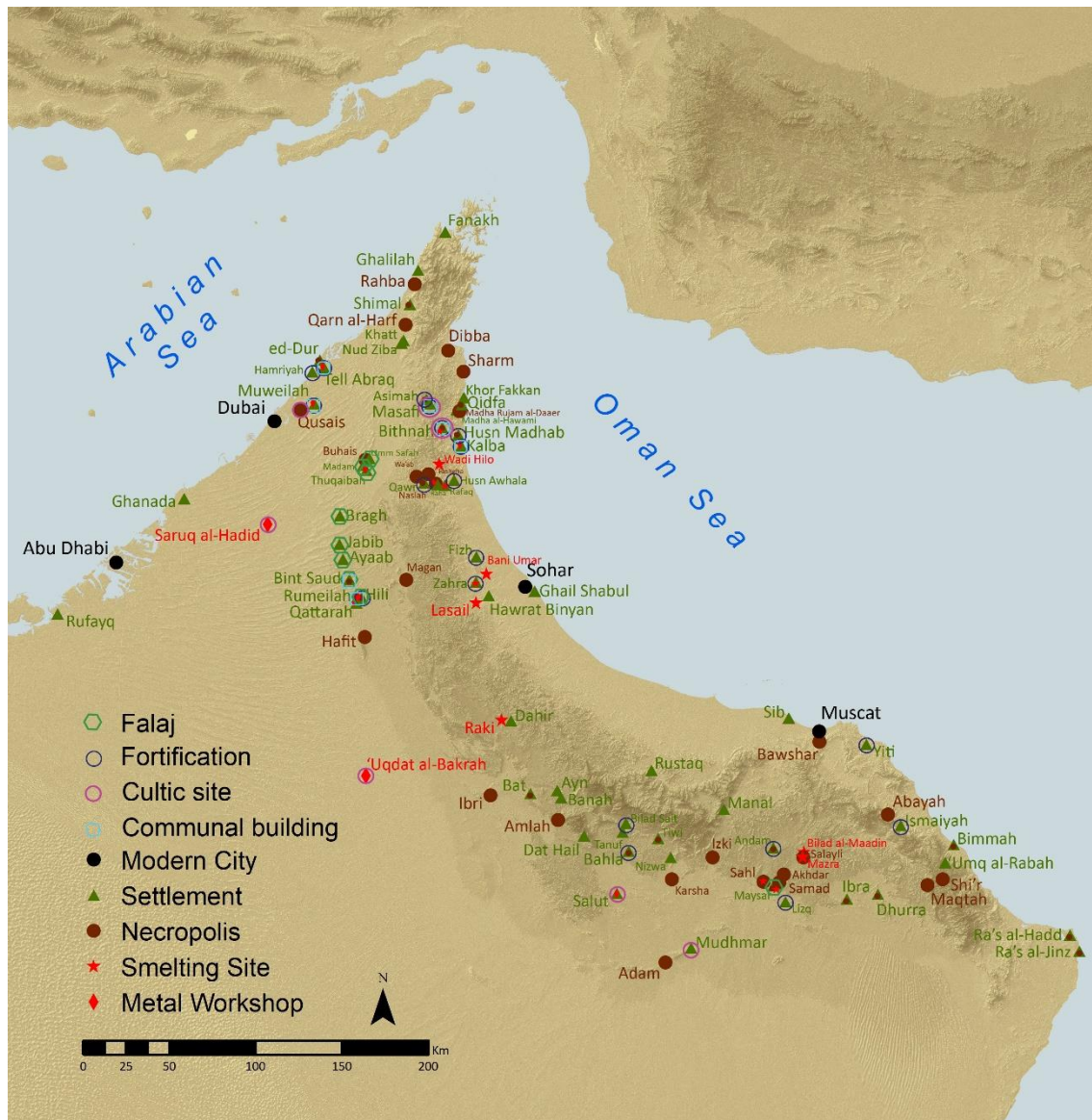
- a. Table of Southeast Arabia chronological periods and main characteristics (GOY, 2019; WEEKS, 2003; DELRUE, 2008; FRIFELT, 1976; ORCHARD, 1995; CLABLE, 2012; UERPMANN *et al.*, 2012; MAGEE, 2014; BENOIST, 2010; CLEUZIOW, 2002; CLEUZIOW, 2003; POTTS, 1991; RIGHETTI, 2015; OVERLAET, 2018)



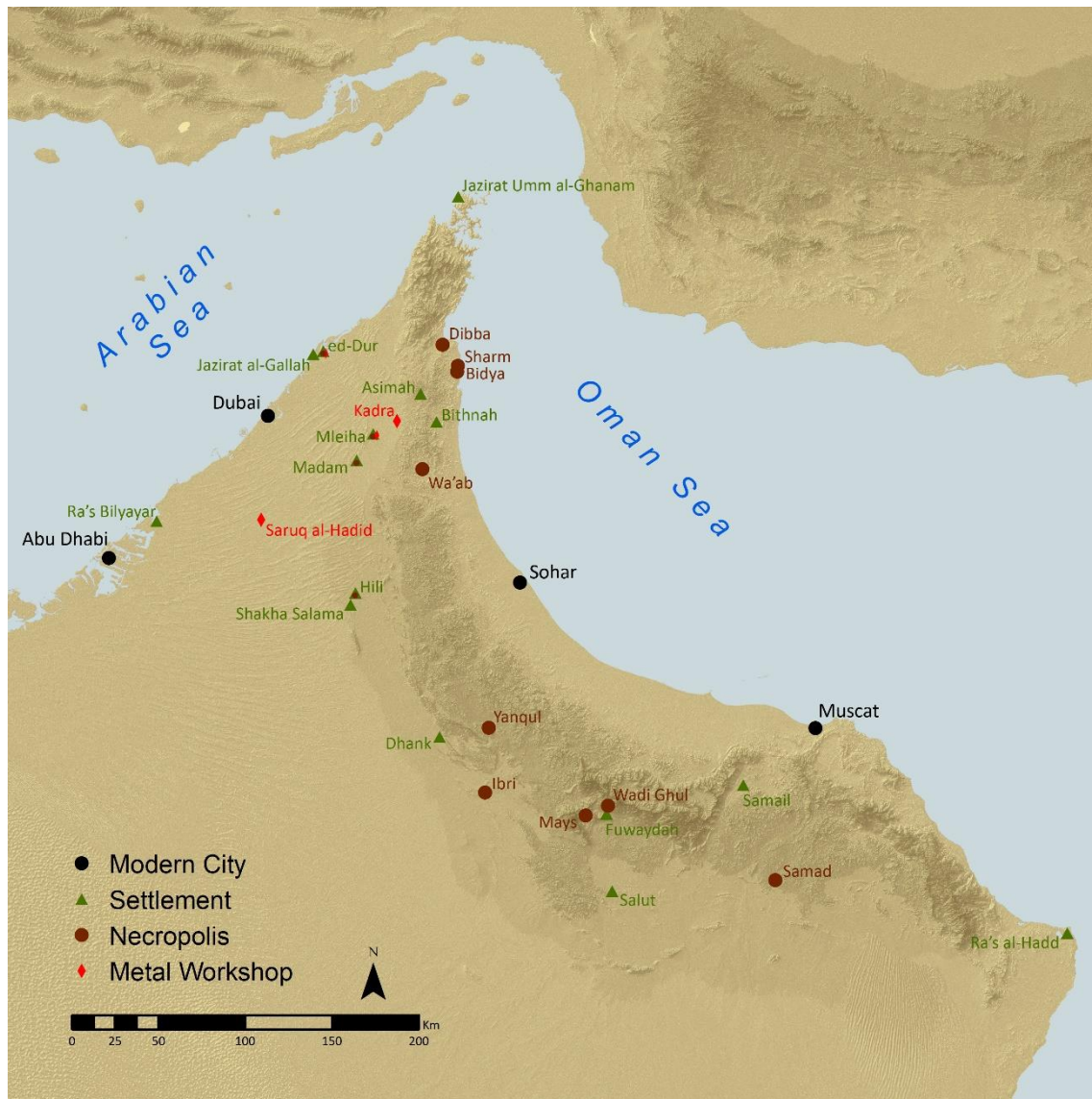
b. Hafit period settlement pattern, including sites where the first evidence of copper objects appear (GOY, 2019; RIGHETTI, 2015).



d. Wadi Suq period settlement pattern, including sites with smelting evidence (GOY, 2019; RIGHETTI, 2015; KUTTERER, 2020; CONTRERAS *et al.*, 2016; WEEKS *et al.*, 2019a; VON DER DRIESCH *et al.*, 2008).

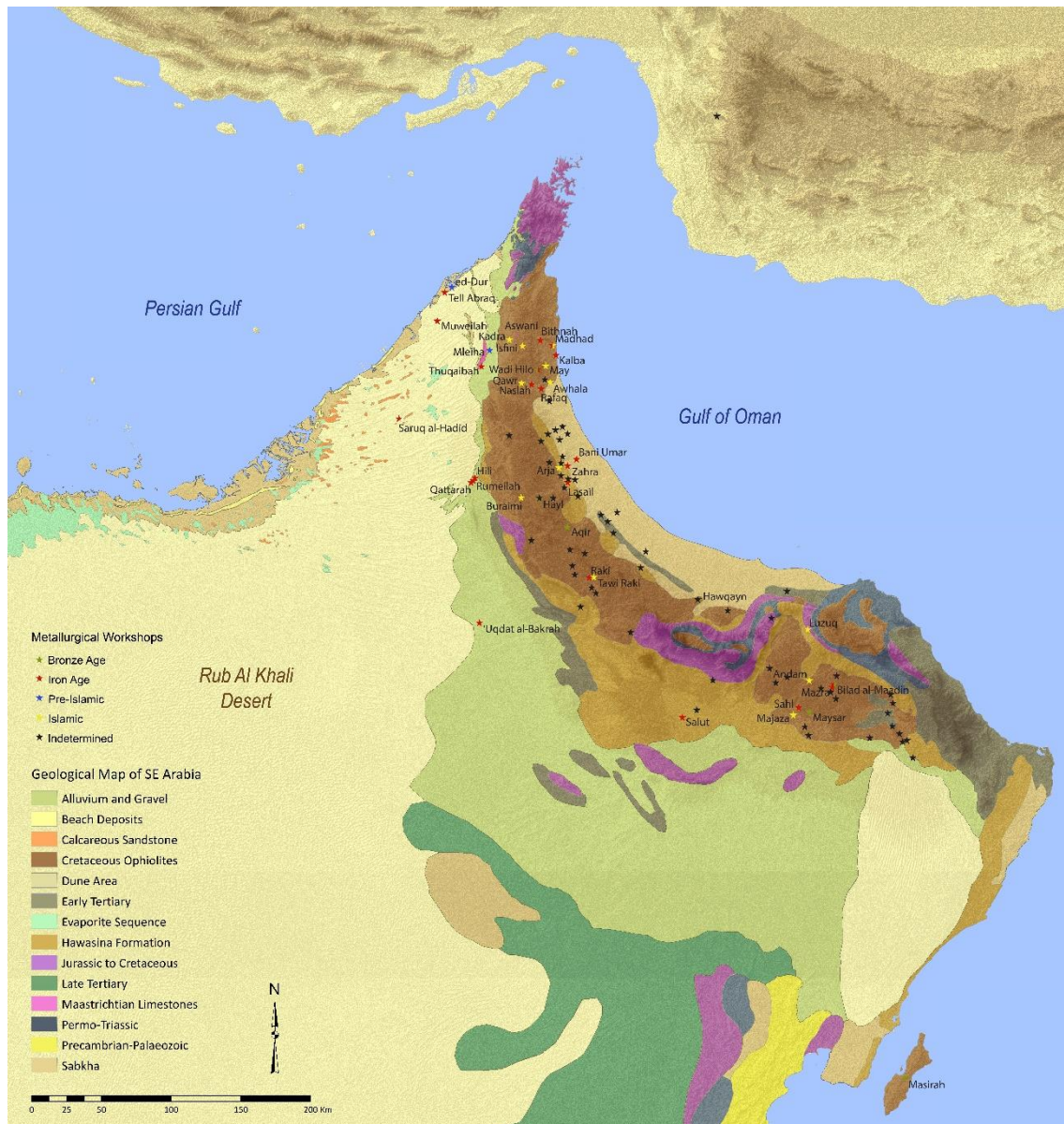


- e. Iron Age settlement pattern, including sites with smelting and/or smithing evidence only. Sites evidencing communal or cultic buildings were also signaled, as well as those where falaj irrigation systems or fortifications were identified (GOY, 2019 ; WEEKS, 2003; KROLL, 2013; BENOIST, 2010).



f. Pre-Islamic period settlement pattern, including sites with smelting/smithing evidence (GOY, 2019; YULE, 2019; WEEKS *et al.*, 2019a).

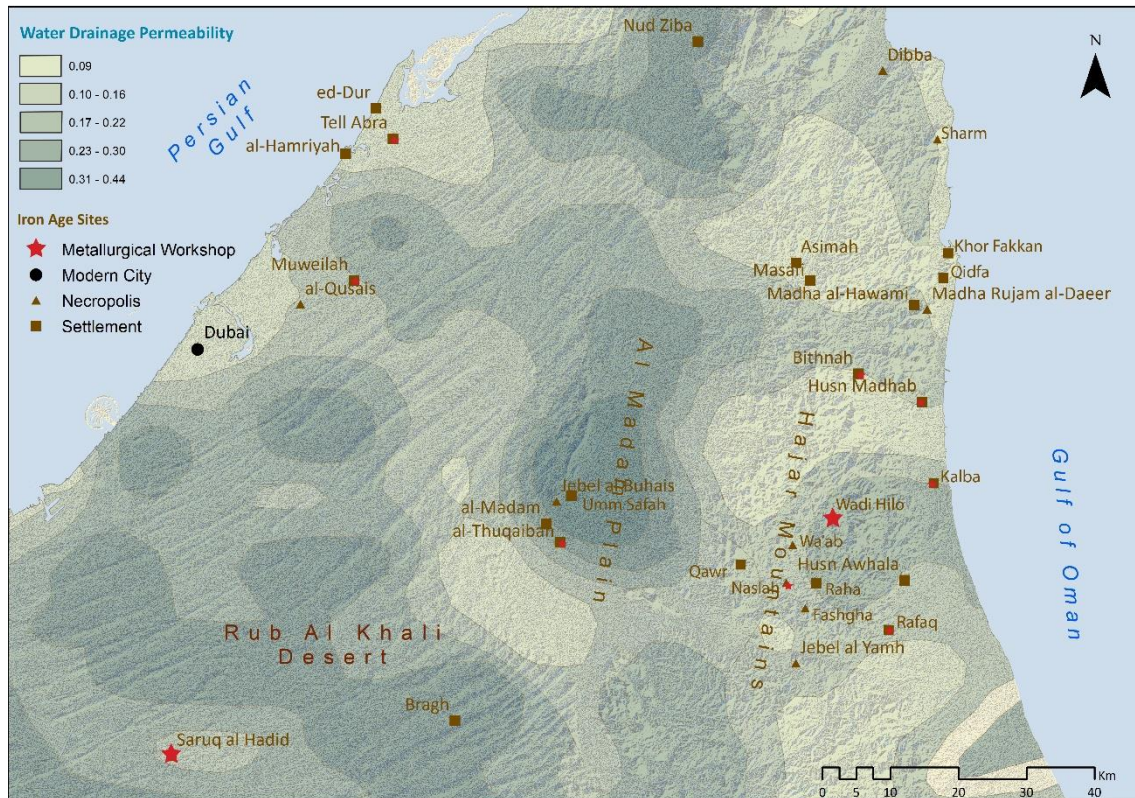
Annexe 3. Geological and environmental setting of SE Arabia



- a. Geological map of SE Arabia including known smelting sites (GOY, 2019; KROLL, 2013; GLENNIE, 1995). Those that have been assessed chronologically were mapped here, although only a few samples of slag were collected and dated. Most still require thorough excavation and assessment to be properly understood and dated.



b. Southeast Arabi ecosystems, including Iron Age settlement pattern and evidence of fajag irrigation system circled in blue (KROLL, 2013; GLENNIE, 1995)



c. Water drainage permeability of northern SE Arabia (including Iron Age sites)
(RIZK *et al.*, 2003)



Acacia



Prosopis



Tamarix



Panicum turgidum



Pennisetum divisum



Leptadenia pyrotechnica



Periploca aphylla



Calotropis procera



Citrullus colocynthis



Eremobium aegyptiacum



Silene villosa



Avicennia marina



Chenopodiaceae



Tephrosia apollinea



Cocculus pendulus



Ziziphus spina-christi



Moringa peregrina



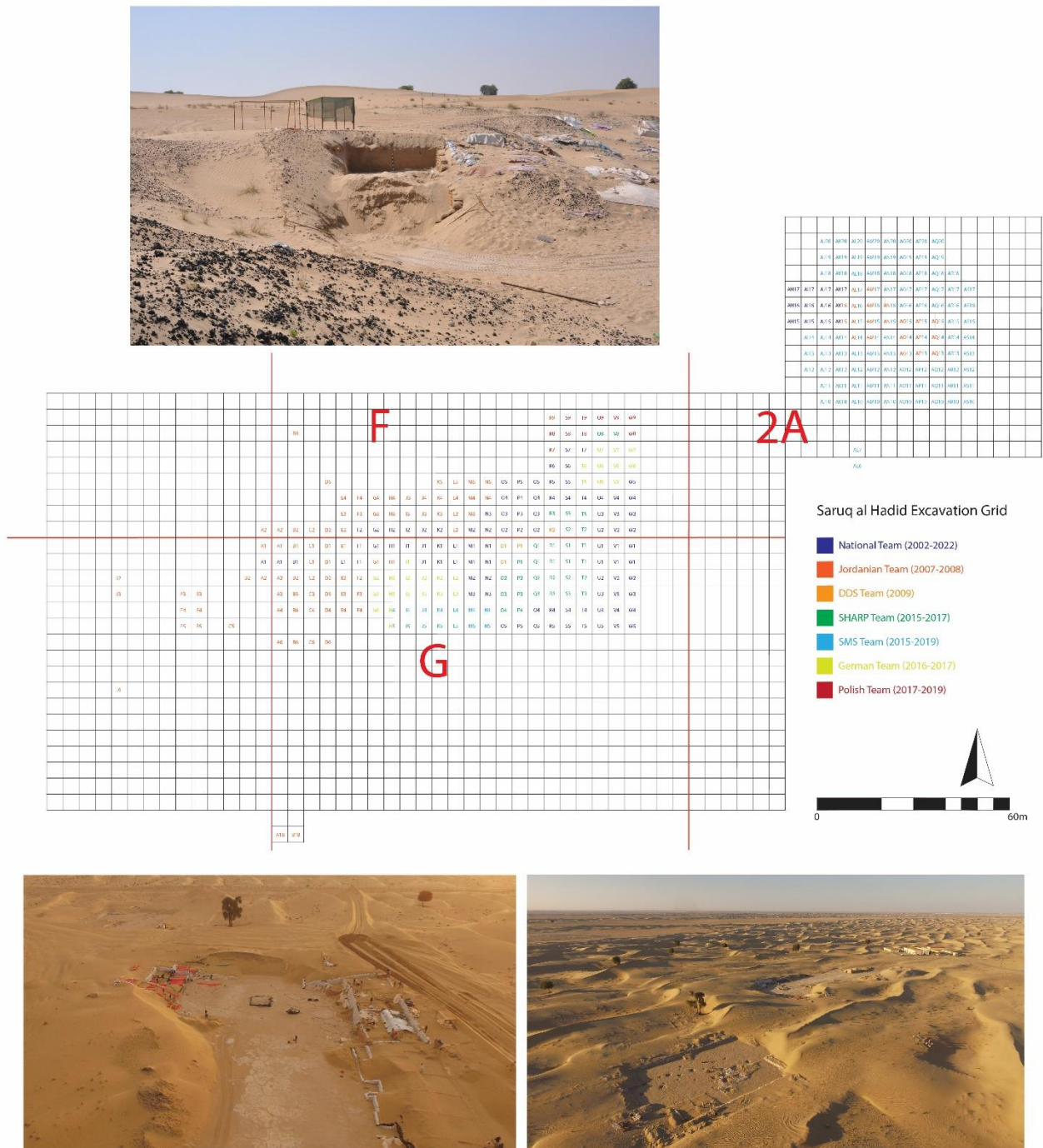
Ficus salicifolia

d. Compilation of flora from southeast Arabia.

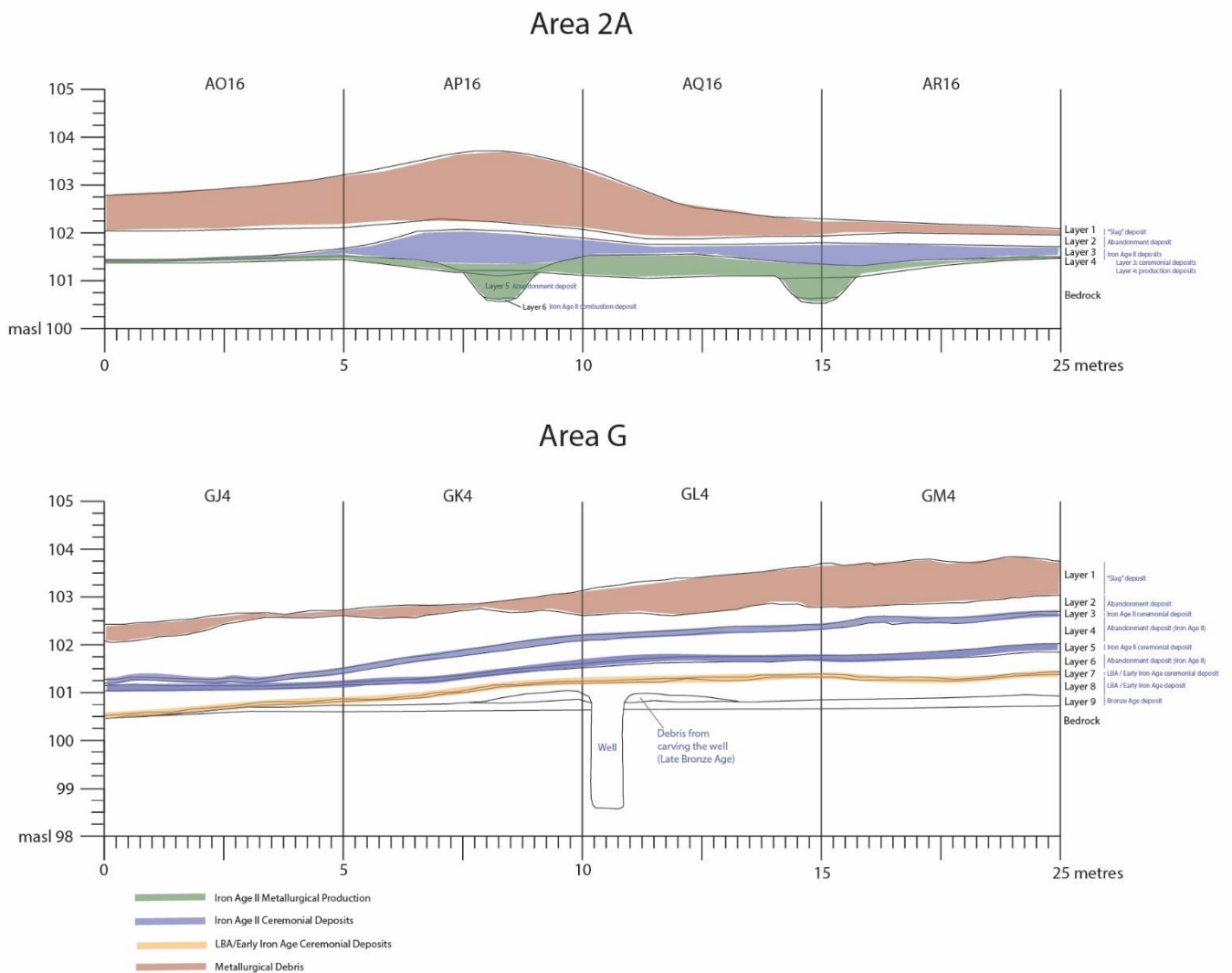
Annexe 4. Saruq al-Hadid excavation Areas and stratigraphic sequence

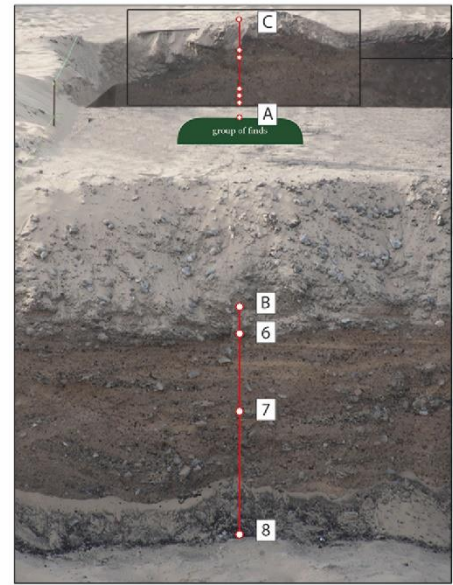


- a. Aerial view of Saruq al-Hadid archaeological site (above); wells identified in Area G (left-middle); excavation of combustion pits in Area 2A (2019) (right-middle); general view of Saruq al-Hadid with *ghaf* trees (left-below); excavation of Area G (2018) (right-below). © Qutaiba al-Dasouqi (Dubai Municipality)



b. Excavation grid of Saruq al-Hadid, including images of slag cap in Area G (above) and aerial views of the site (2018) (below). Images © Qutaiba al-Dasouqi (Dubai Municipality)

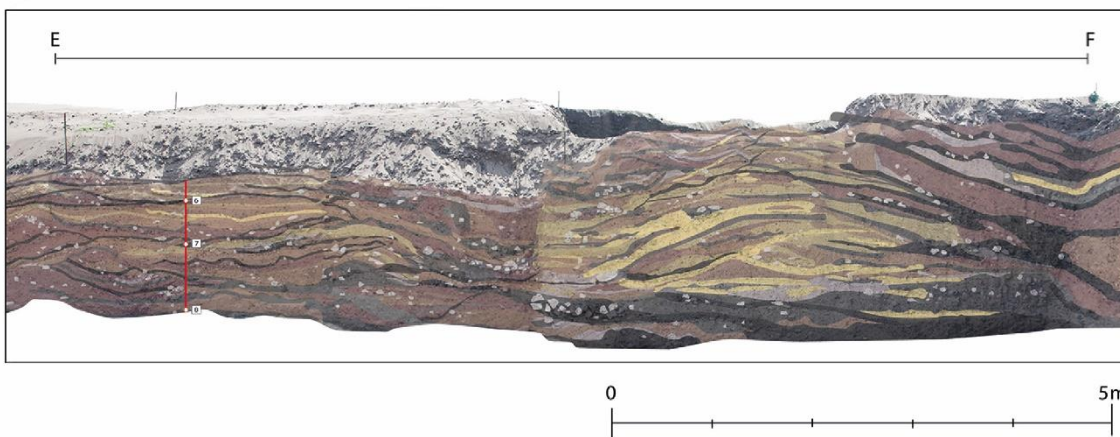




	X	Y	Z
A	322473.8537	2729015.1508	103.8658
B	322473.850	2729020.4179	-
C	322473.850	2729010.0617	-



Charcoal samples	X	Y	Z	INTCAL 13 BetaCal 3.21 Calibrated results
1	322473.850	2729010.0617	104.09	(95.4%) 799-736 cal BC (68.2%) 795-751 cal BC
2	322473.850	2729010.0617	103.96	
3	322473.850	2729010.0617	103.47	
4	322473.850	2729010.0617	103.42	
5	322473.850	2729010.0617	103.02	
6	322473.850	279020.4179	103.02	(95.4%) 708-470 cal BC (68.2%) 753-682 cal BC
7	322473.850	279020.4179	102.56	(95.4%) 799-736 cal BC (68.2%) 795-751 cal BC
8	322473.850	279020.4179	102.07	(95.4%) 801-743 cal BC (68.2%) 799-753 cal BC
9	322470.9033	2729011.1672	103.8405	(95.4%) 831-775 cal BC (68.2%) 814-792 cal BC
10	322475.4833	2729025.5515	101.3138	(95.4%) 845-788 cal BC (68.2%) 823-797 cal BC



d. Stratigraphic sequence of Area 53. © Anna Zuber & Júlia Coso (Sanisera Archaeology Institute)

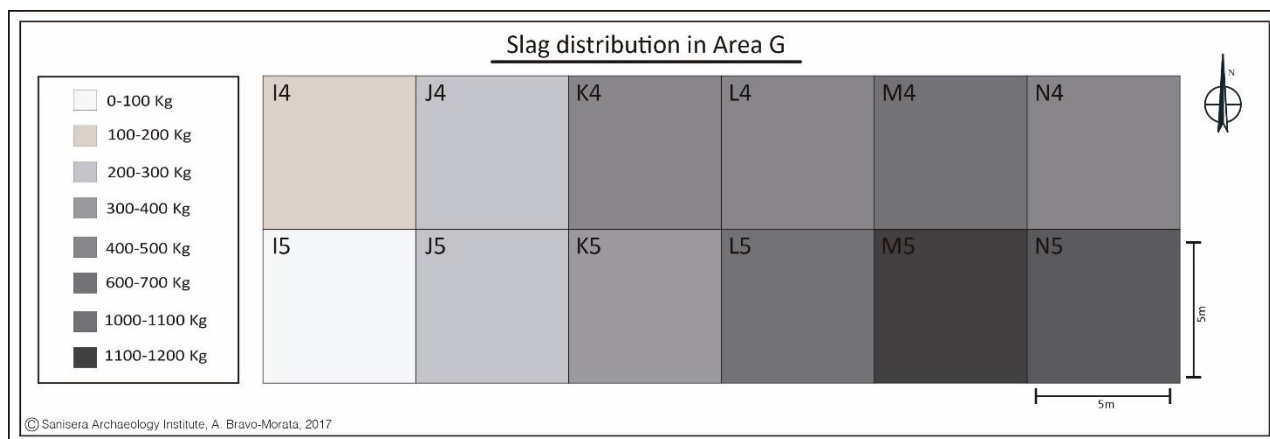
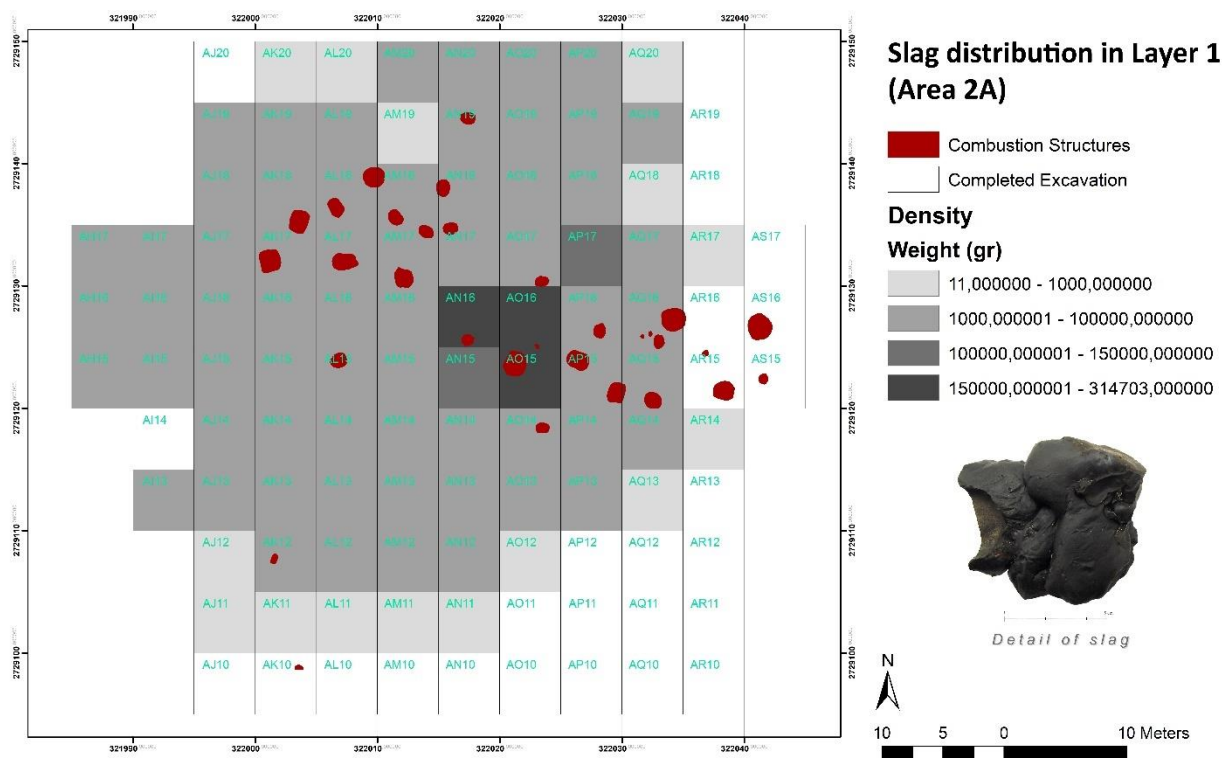
Annexe 5. Smelting evidence at Saruq al-Hadid



- a. View of slag capping Saruq al-Hadid (above (WEEKS *et al.*, 2015)). Different types of slag, 'slangots' and ingots from 'slag' layer. © Anna Zuber (Sanisera Archaeology Institute)

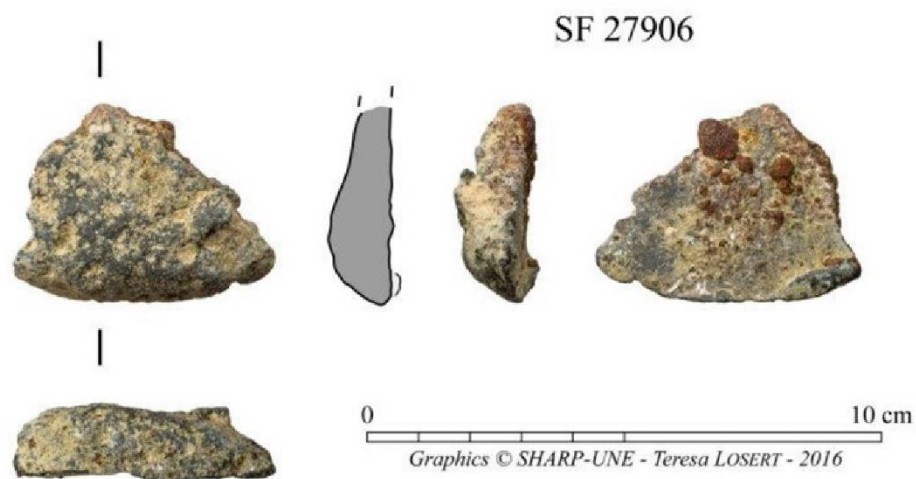
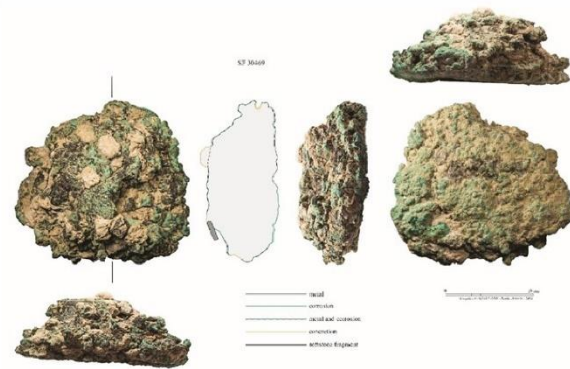


b. Technical ceramic fragments identified in Saruq al-Hadid (right © H  l  ne David-Cuny (SHARP); left    Anna Zuber (SAI)). Note the tuyere hole in the bottom-right photo.



c. Slag distribution in Layer 1 of Area 2A (above © Marta del Mastro (SAI)) and Area G (below © Alberto Bravo-Morate (SAI)). Note that in Area 2A the slag concentrates in 4 squares, while in Area G it distributes randomly. The slag has also no direct connection with the combustion structures identified in Area 2A (Layer 4).

Annexe 6. Refining and recycling evidence at Saruq al-Hadid

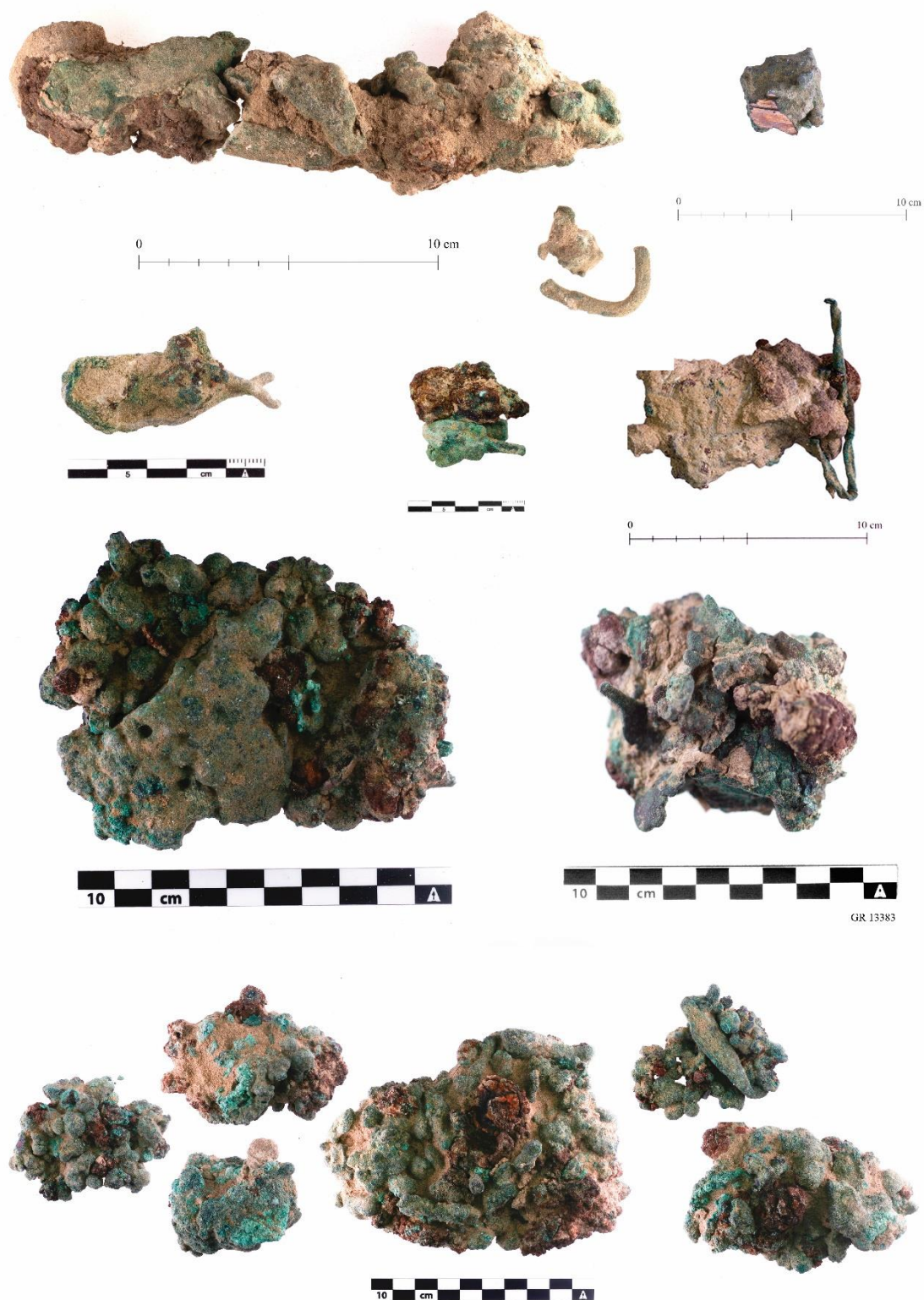


- a. Ingot and 'Slangots' found in Areas F/G by the SHARP team (© Hélène David-Cuny). The furnace bottom SF 21468 that was found with the 'slangot' SF 21467. Note that the ingot SF 27906 was cut into a smaller portion, likely for easier melting.



b. Examples of 'slangot', ingots and copper prills identified accumulated in Area 2A (Layer 4). Many were identified next to the smaller combustion pits (structures 25 and 31), hypothesised to be for the refining of copper 'slangots'.

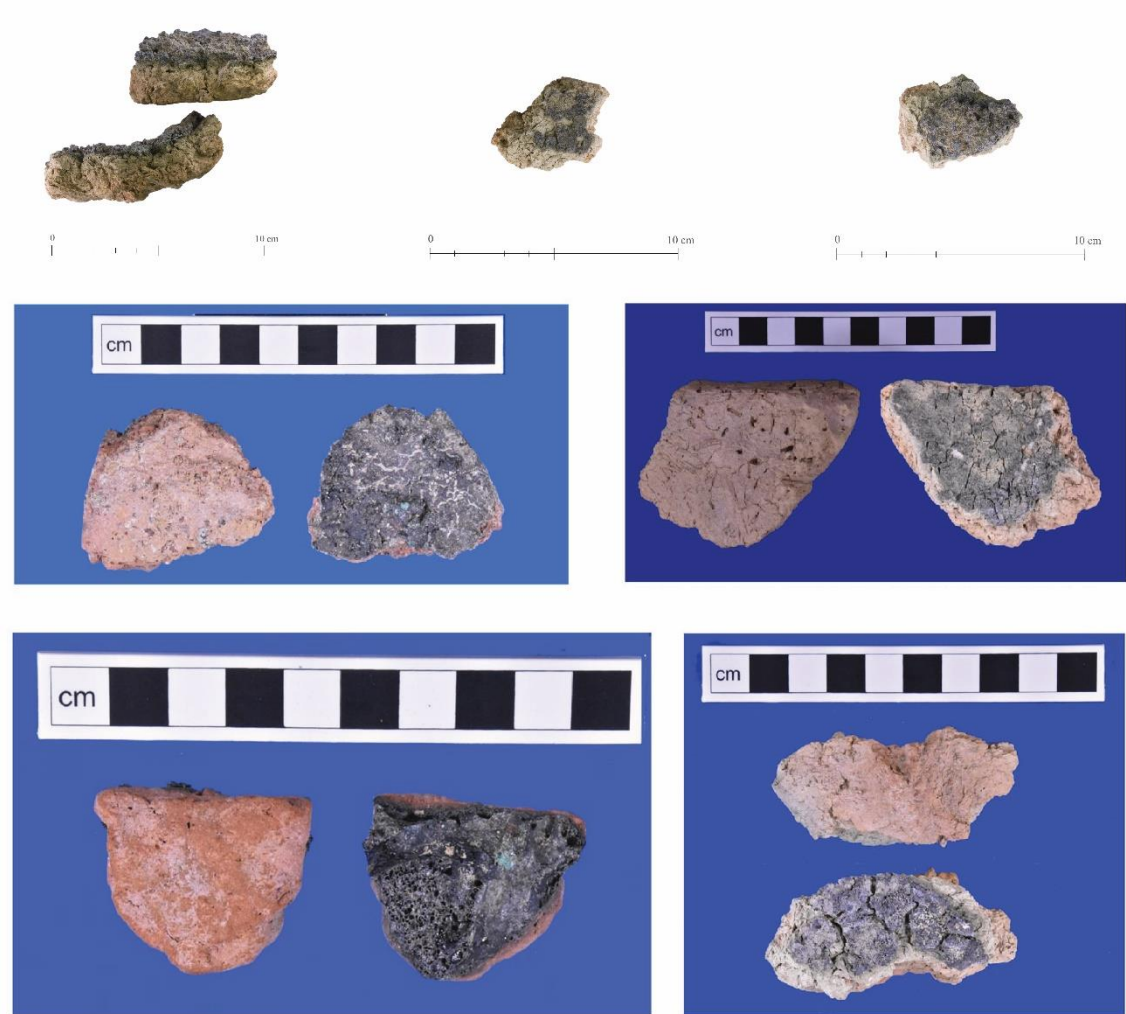
© Anna Zuber (SAI)



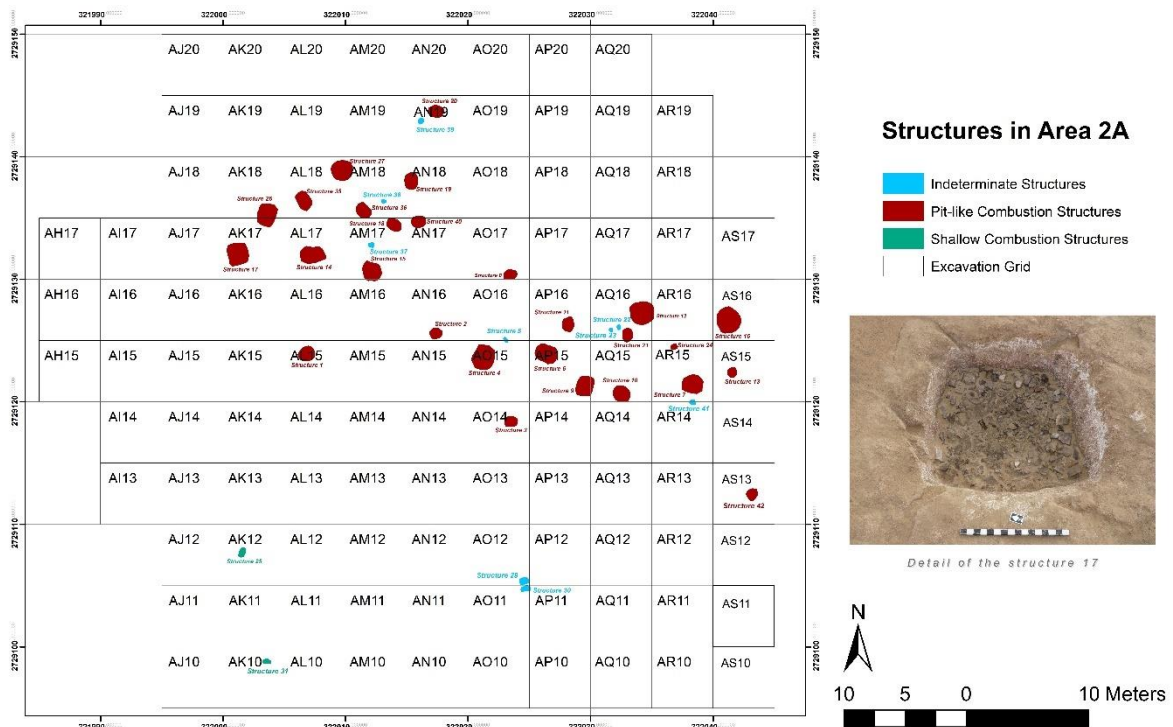
c. Examples of copper ingots, prills, spills and recycled material found in Layer 4 of Area 2A. © Anna Zuber (SAI)



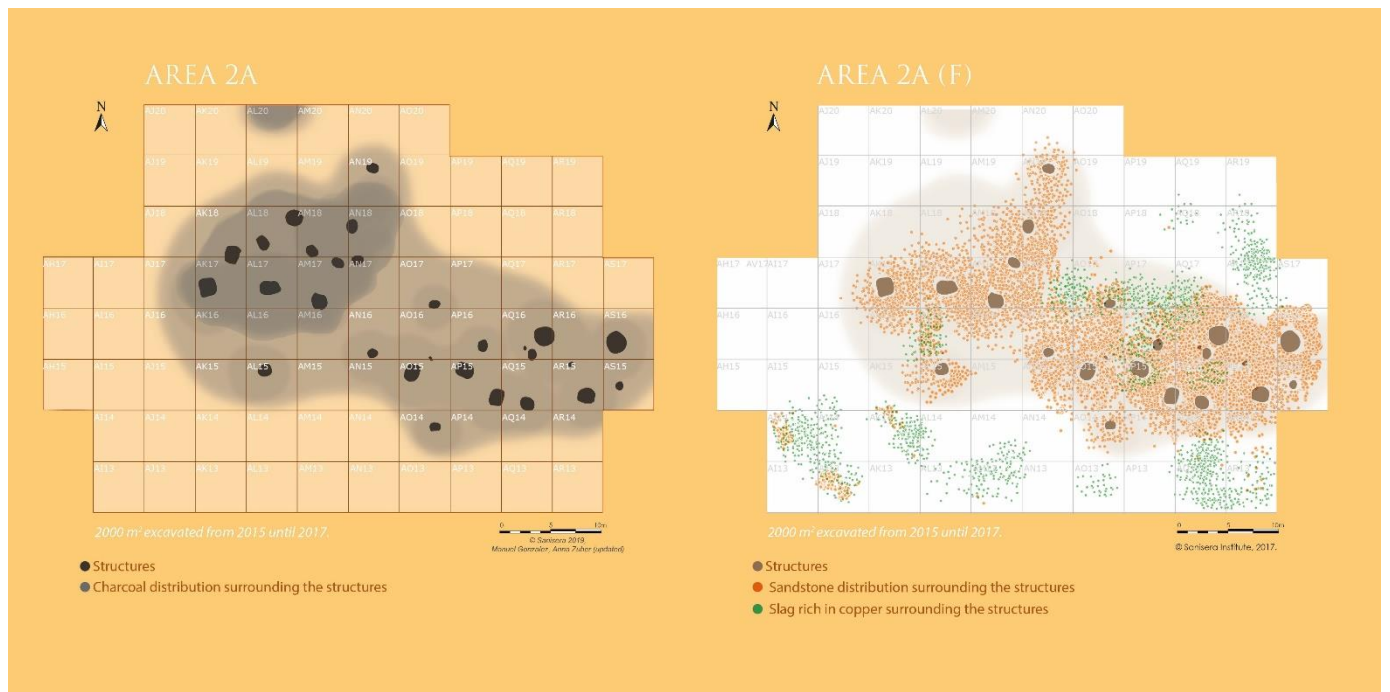
e. Examples of unfinished (bracelets and arrowheads) objects, discarded material (unfinished/deformed snake, spatula and razor), and copper wires found in Layer 4 of Area 2A. © Anna Zuber (SAI)



f. Examples of crucibles found in Area 2A (Layer 4) (© Anna Zuber (SAI)) above and in Areas F/G middle-below © H    ne David  Cuny (SHARP).



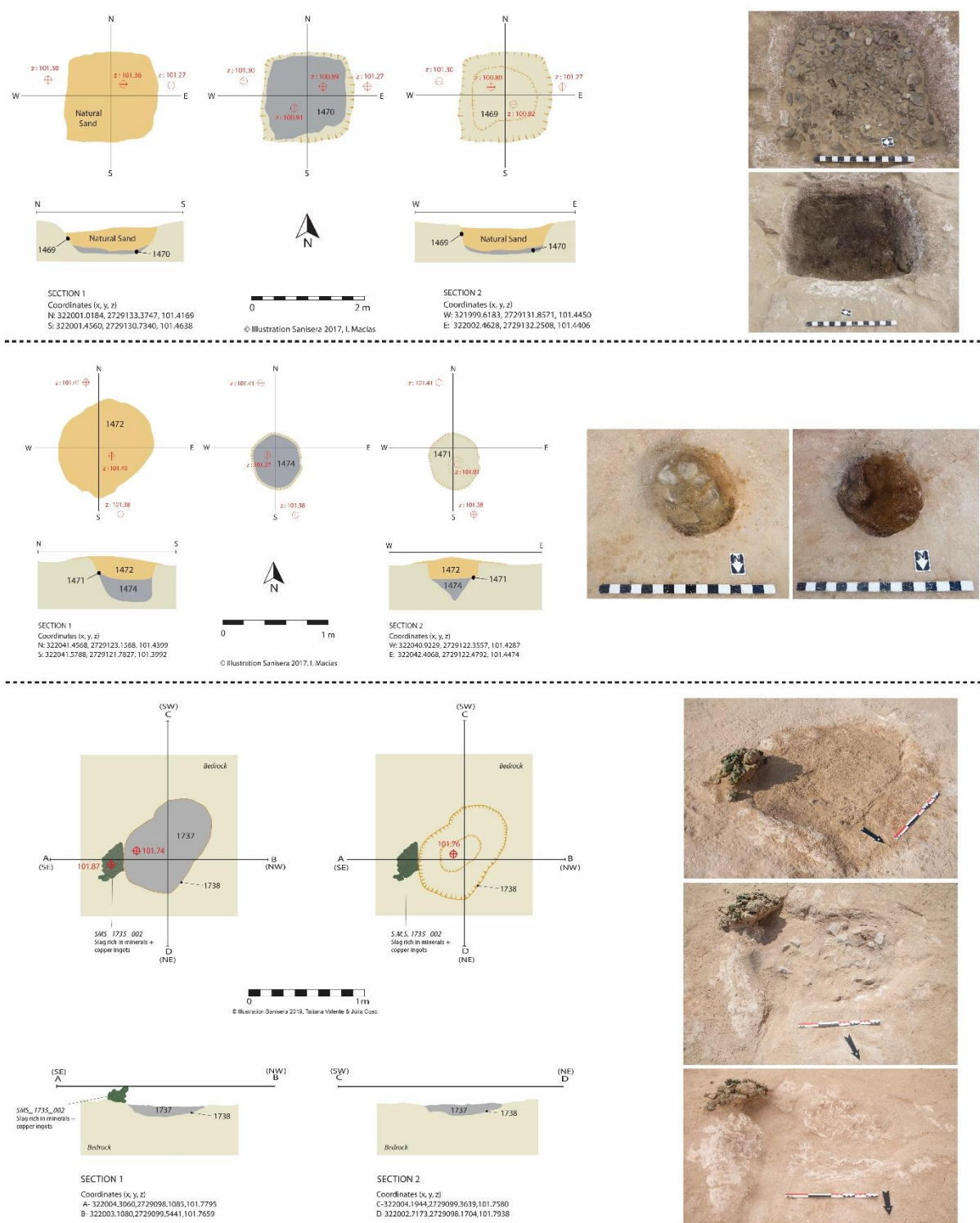
g. Combustion structures distribution in Area 2A. The indeterminate structures refer to shallow depressions in the gypsum floor that were hypothesised to have contained large water jars or working tables. © Marta del Mastro (SAI)



h. Distribution of charcoal, sandstone and unrefined slag around the structures in Area 2A. © Manuel Gonz  les (SAI)



- i. Excavation of combustion structures in Area 2A. Below-left note the intervals of combustion debris intertwined by gypsum debris and abandonment deposits.
In the images at the centre-right note the 'slagots', ingots and prills accumulated next to the structures.



- j. Different types of combustion structures identified in Area 2A. Above, structure 17, hypothesised for melting and annealing phases; middle, structure 13, hypothesised for melting/alloying phases; below, structure 31, hypothesised for refining phases.

Annexe 7. Compilation of production tools from Saruq al-Hadid



- a. Compilation of stone tools from Area 2A and small soft stone tools identified in both metallurgical deposits of Area 2A and ritual deposits of the site (below).

© Hélène David'Cuny (SHARP) and Anna Zuber (SAI)



© Graphics Sanisera 2019, Anna Zuber

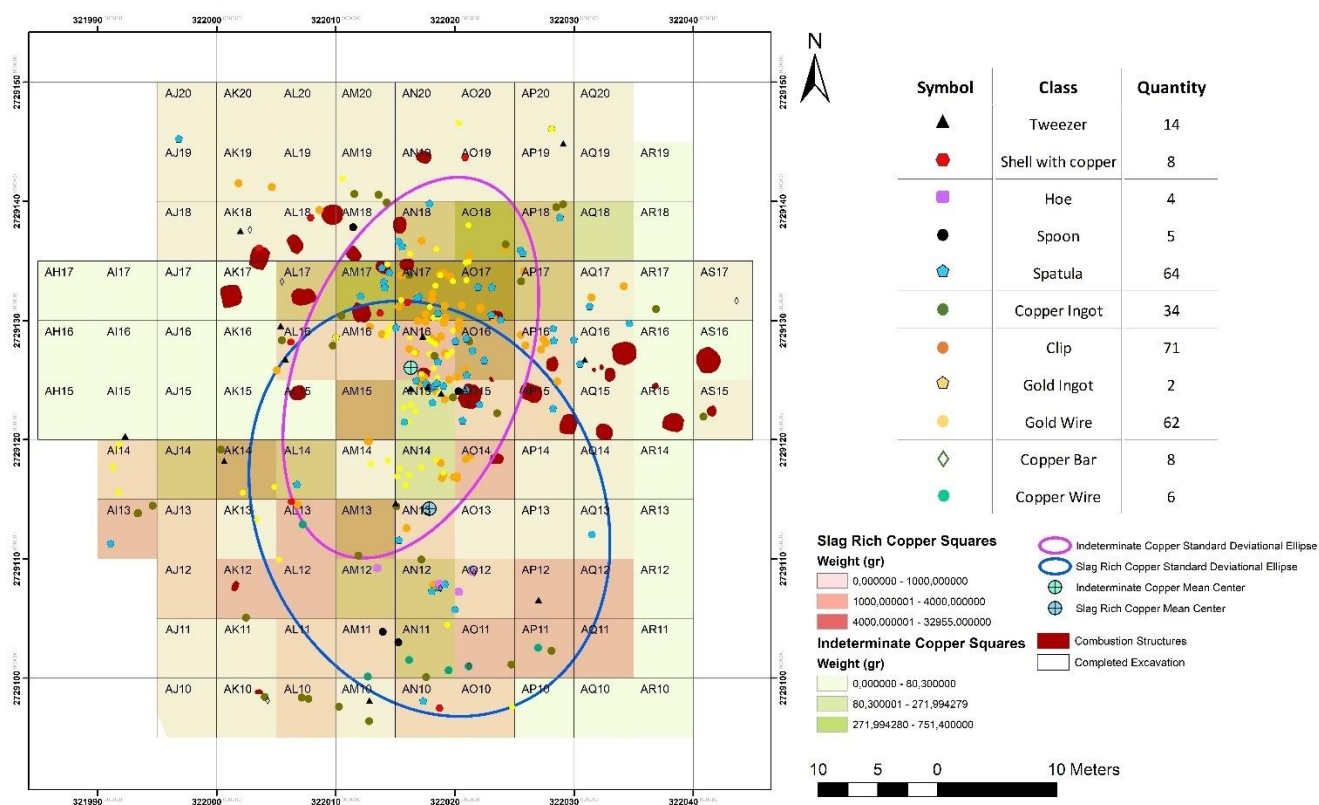


© Graphics Sanisera 2019, Anna Zuber



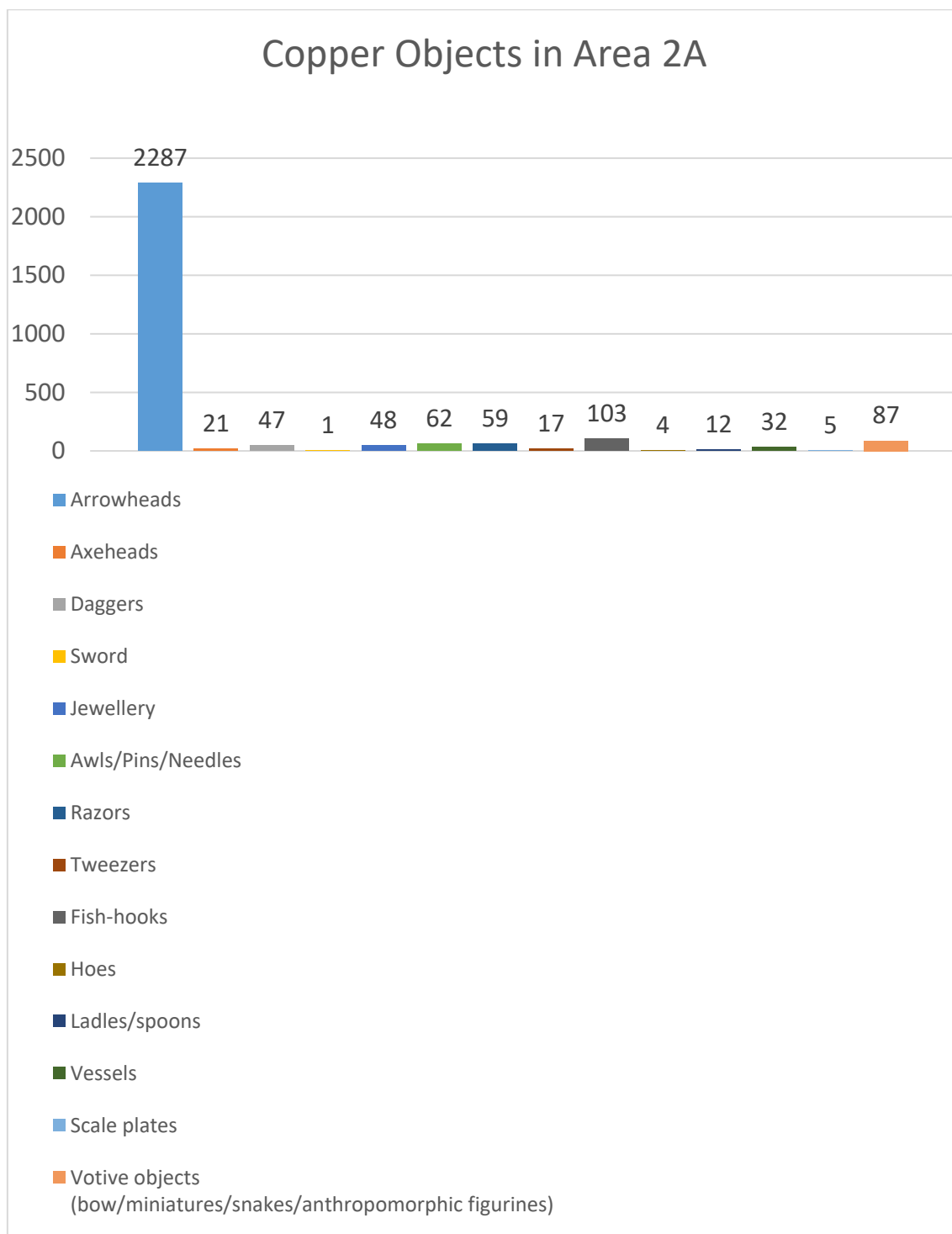
© Graphics Sanisera 2019, Anna Zuber

- b. Compilation of production tools from Area 2A, including chisels, spoons, clips, shells with copper, and disc billets. © Anna Zuber (SAI)

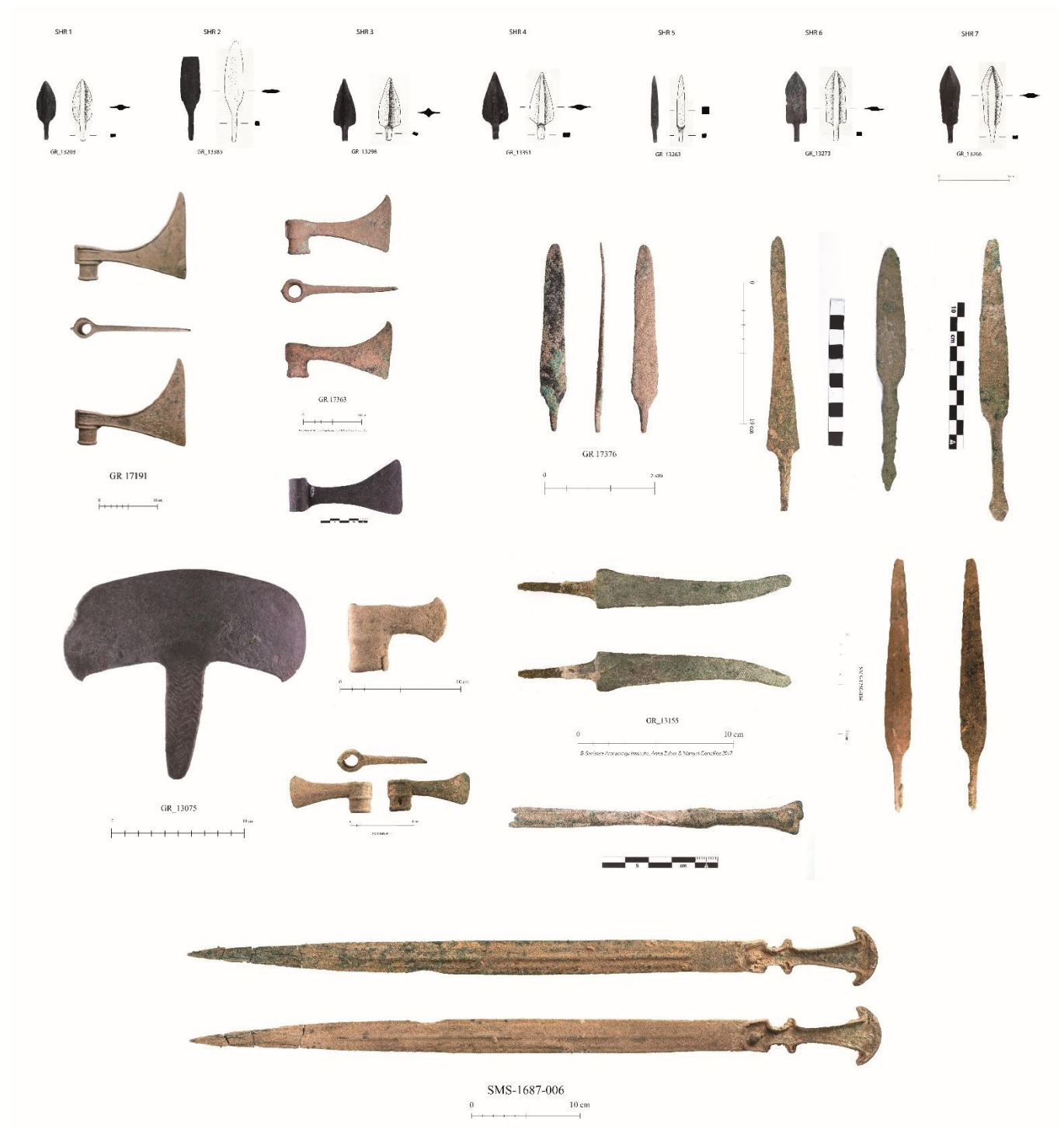


- a. Distribution of production tools in Area 2A such as copper wires, spoons, shells with copper, clips and ingots. There is a clear preponderance of copper clips near the structures which lead to the hypothesis of being used to clip the moulds together. Copper wires, bars and ingots, in turn, predominate in the southern zone of the Area. In this distribution map we can also have a perception of where do slangots (pink) and copper fragments accumulate (green). © Marta del Mastro (SAI)

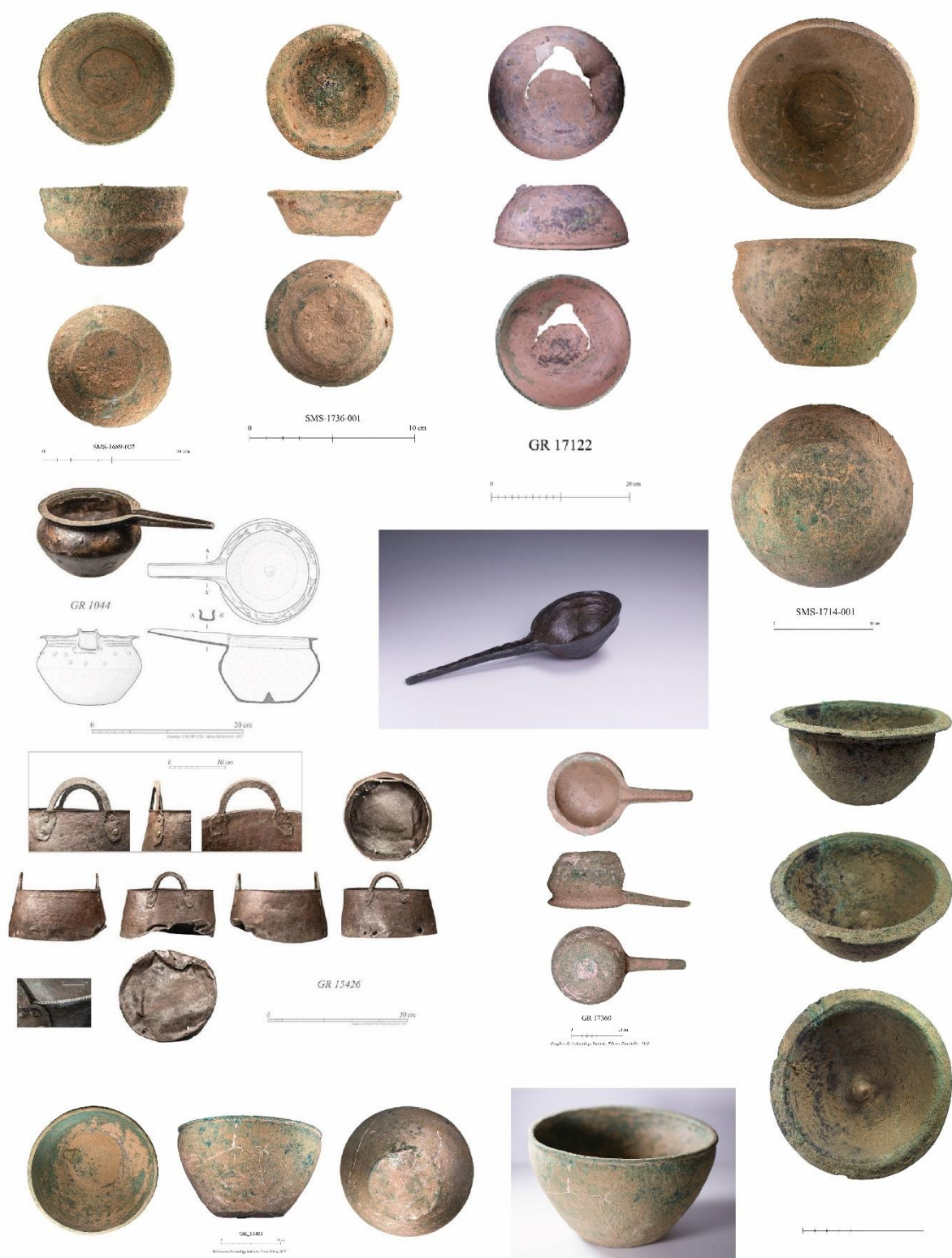
Annexe 8. Compilation of copper objects from Saruq al-Hadid



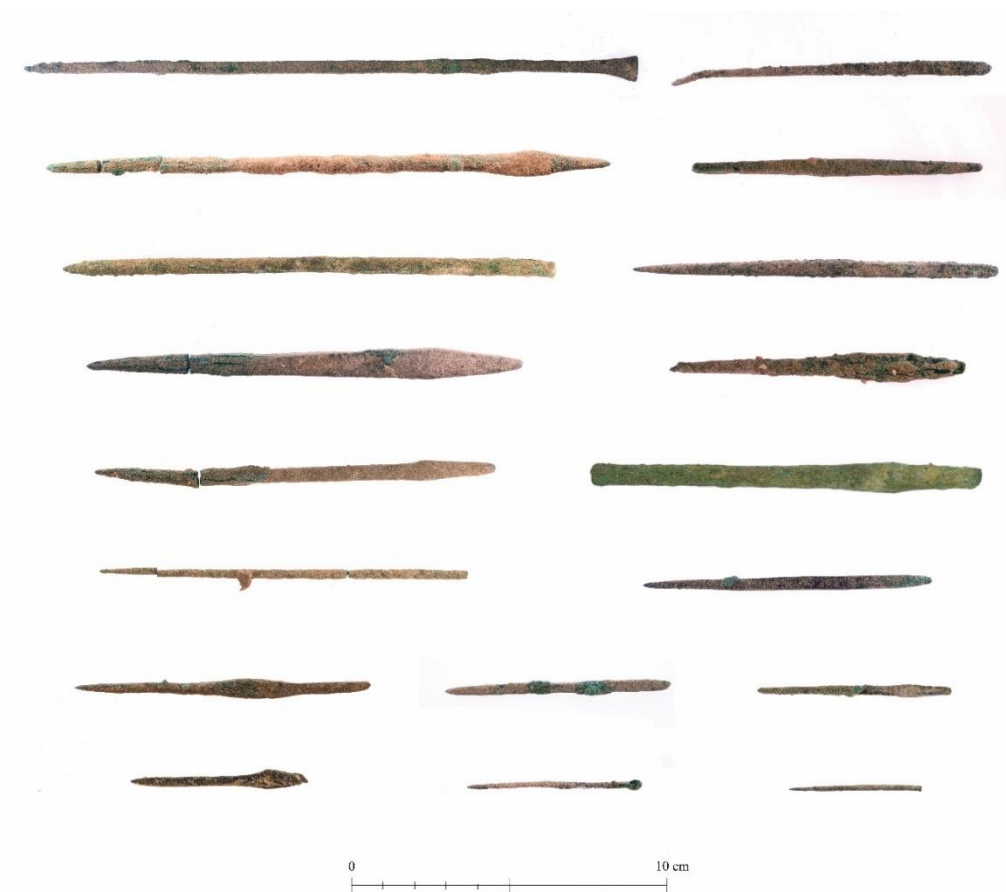
- a. Copper objects identified in Area 2A alone. Note the preponderance of weaponry, in particular arrowheads.



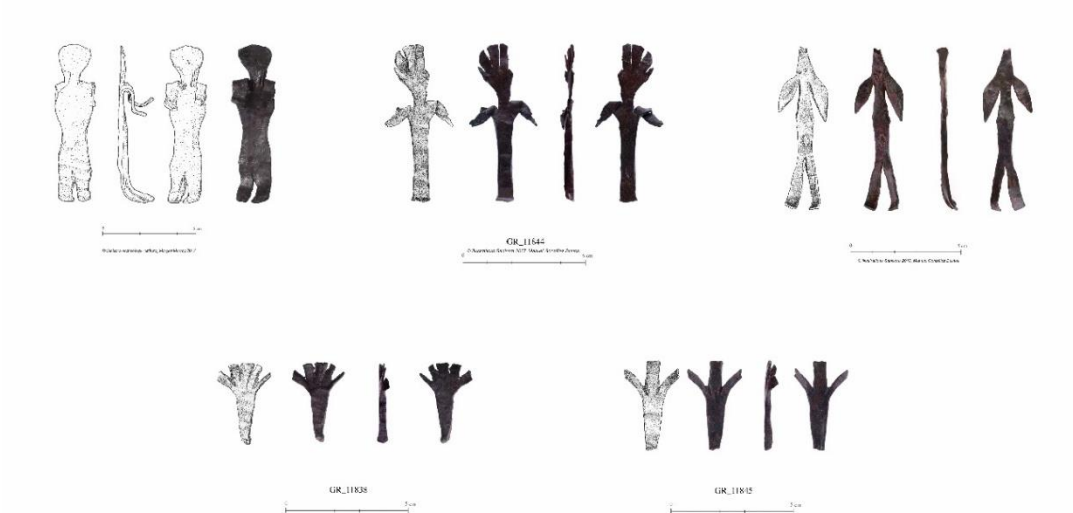
b. Compilation of arrowheads, axeheads, daggers and swords from Area 2A. ©
Anna Zuber, Edurne Fernández and Ismael Macías (SAI)



c. Compilation of copper vessels found in Areas F/G and 2A. © Anna Zuber and Edurne Fernández (SAI) and H       David-Cuny (SHARP).



e. Compilation of copper awls/chisels, pins and needles. © Anna Zuber and Edurne Fernández (SAI)



f. Compilation of copper anthropomorphic figurines from Area 2A. © Anna Zuber and Manuel González (SAI)



g. Compilation of votive objects such as copper and gold snakes and miniaturized weaponry. © Anna Zuber and Manuel González (SAI)

Annexe 9. Compilation of jewellery from Saruq al-Hadid



Compilation of jewellery found in Areas F/G and 2A such as copper bracelets, and beads of copper, gold, silver and numerous stones, shells and bone. © Hélène David-Cuny (SHARP) (above) and Anna Zuber (SAI) (below)

Annexe 10. Compilation of ritual material from Areas F/G



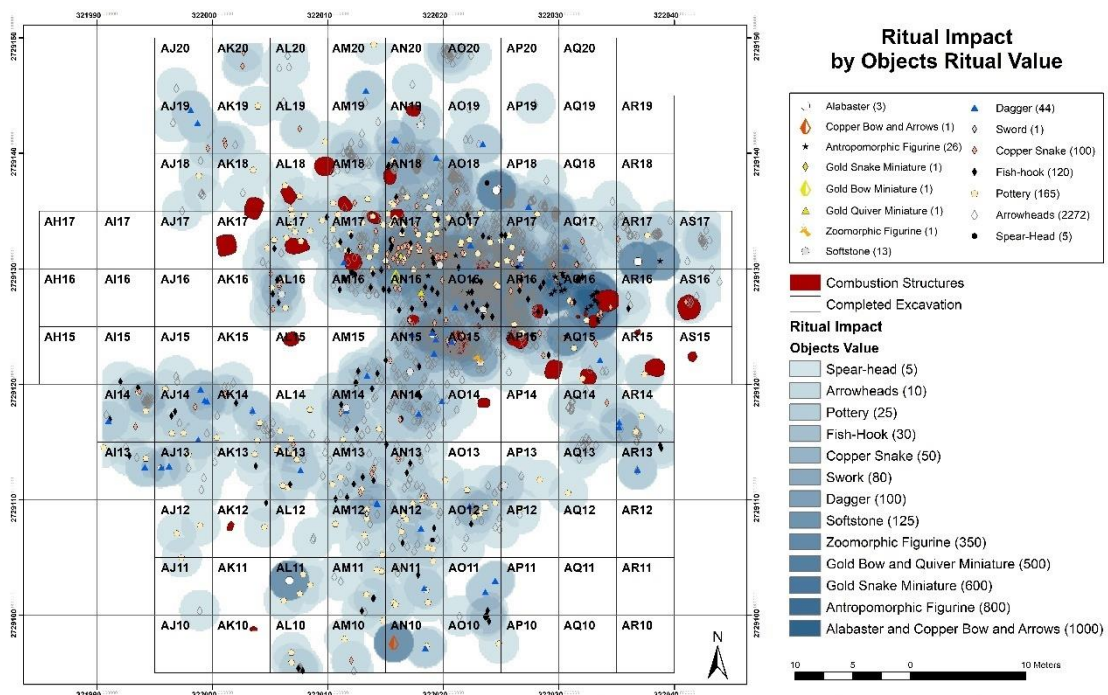
Compilation of material from the ritual deposits of Areas F/G. © H       David-Cuny (SHARP), Anna Zuber and Edurne Fern             (SAI)

Annexe 11. Compilation of ritual/communal material from Area 2A

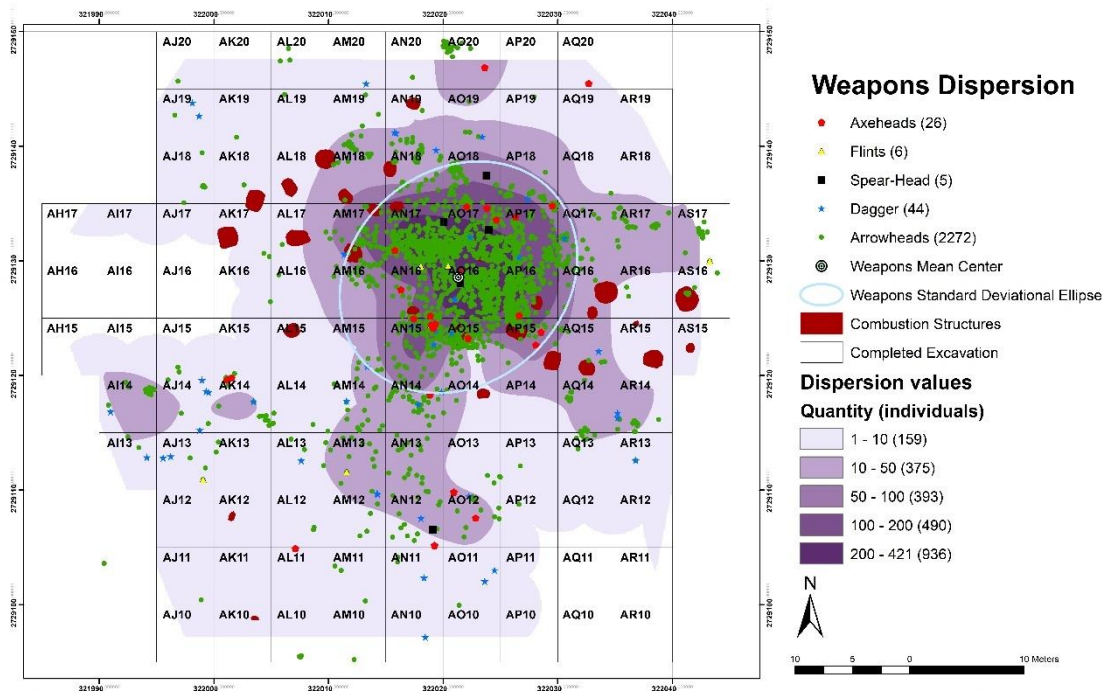


a. Compilation of materials from the ritual/communal deposits of Area 2A. ©

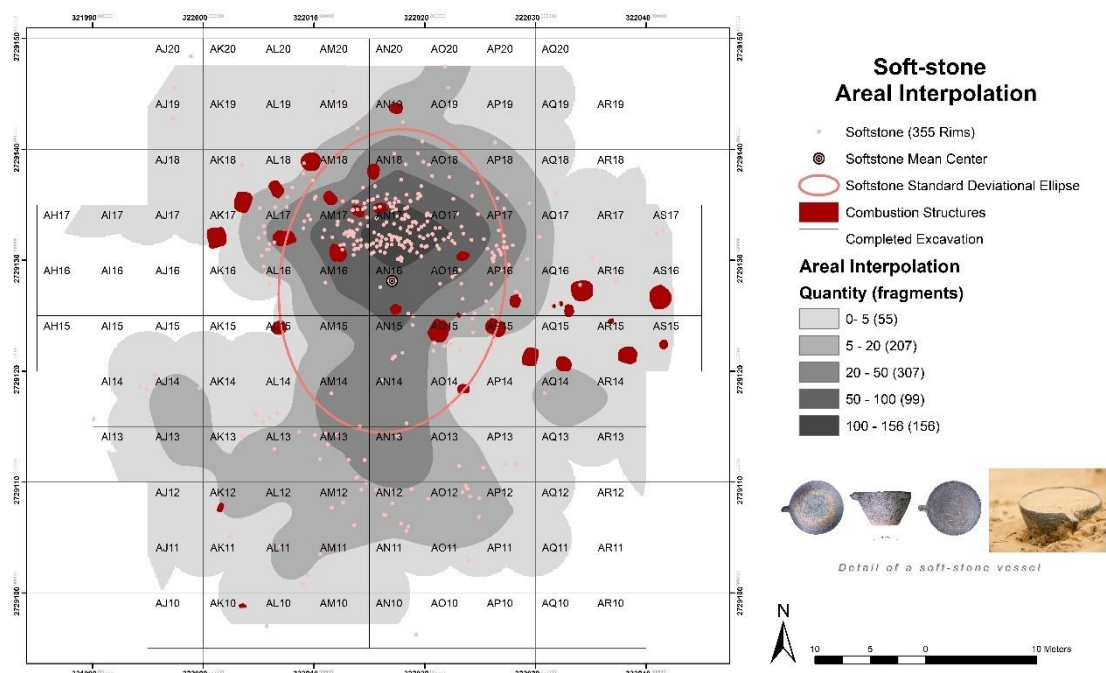
Anna Zuber, Manuel González and Edurne Fernández (SAI)



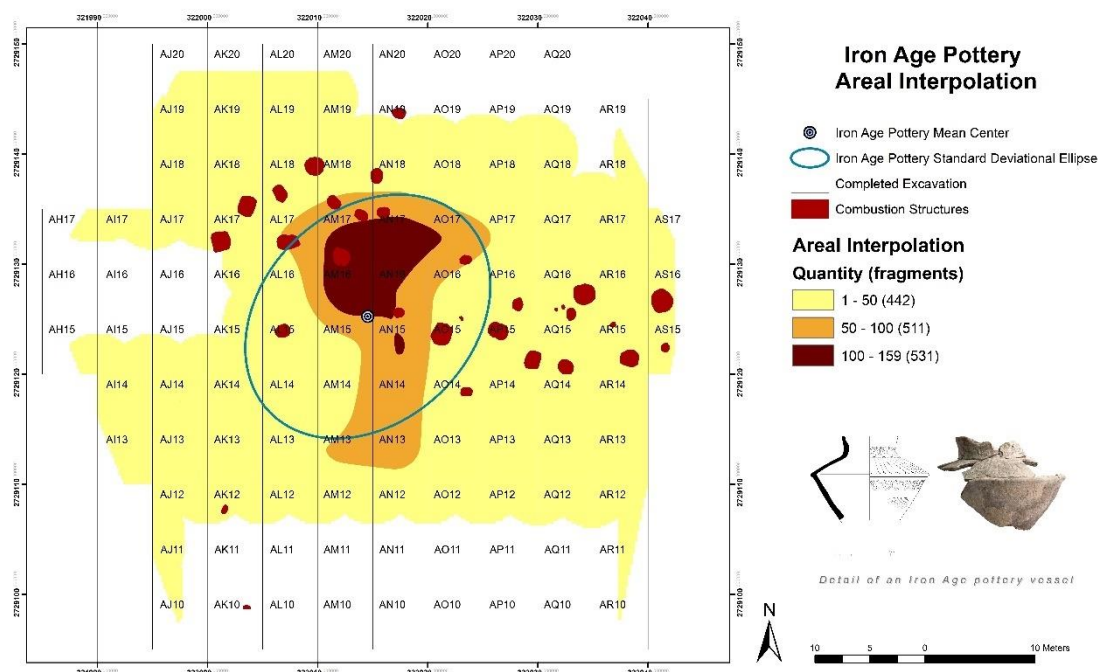
b. Distribution of artefacts in Area 2A from ritual deposits. There is a clear centralization of ritual/communal performances in squares AN17, AO17, AP17, AN16, AO16 and AR16. © Marta del Mastro (SAI)



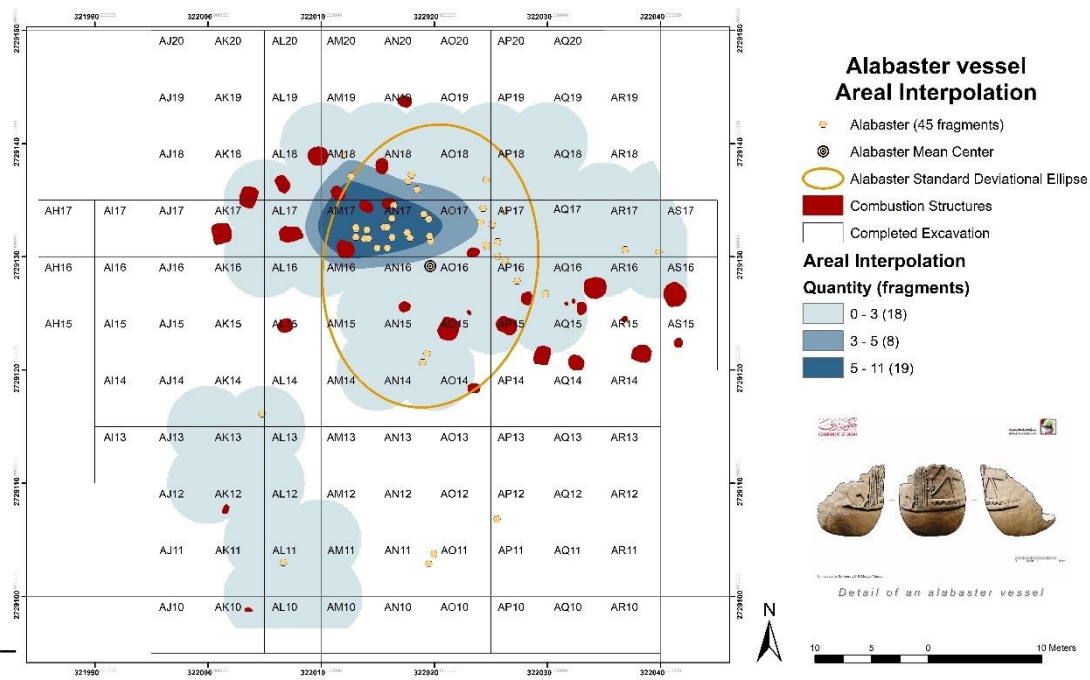
c. Distribution of weaponry in Area 2A. Weaponry epicentre dispersion matches the centre of ritual/communal performances. © Marta del Mastro (SAI)



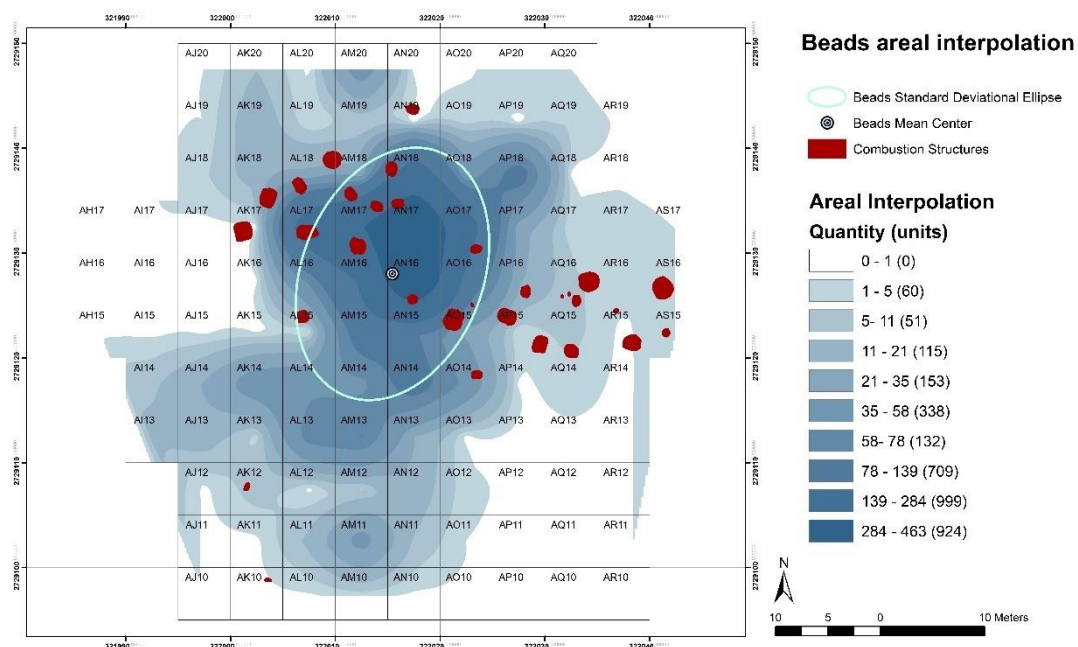
d. The epicentre of dispersion of soft-stone vessels in Area 2A also matches the centre of ritual/communal performances. However, a great number of vessels was also found in the southern squares. © Marta del Mastro (SAI)



e. The Iron Age pottery found in Area 2A also matches the centre of ritual/communal performances. © Marta del Mastro



e. Alabaster vessels, although found in small number, are only present in either burial or cultic/communal contexts. In Area 2A, again, they were mostly found in the centre of ritual/communal performances. © Marta del Mastro



f. Bead jewellery, although found all over Area 2A, concentrated in the centre of ritual/communal performances, but many were also found in the southern portion of the Area, including in the metallurgical deposits. © Marta del Mastro