ARCHAEOLOGY AT RAS MUARI: SONARI, A BRONZE AGE FISHER-GATHERERS SETTLEMENT AT THE HAB RIVER MOUTH (KARACHI, PAKISTAN)

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This paper describes the results of the surveys carried out along Ras Muari (Cape Monze, Karachi, Sindh) by the Italian Archaeological Mission in Lower Sindh and Las Bela in 2013 and 2014. The surveyed area coincides with part of the mythical land of the Ichthyophagoi, *mentioned by the classical chroniclers. Many archaeological sites, mainly scatters and spots of fragmented marine and mangrove shells, were discovered and AMS dated along the northern part of the cape facing the Hab River mouth. The surveys have shown that fisher and shell gatherer communities temporarily settled in different parts of the headland. They began to exploit the sea resources during the Neolithic. However, the most important discovery consists of a unique fishers' settlement with rectangular stone-walled structures located on a limestone terrace near Sonari (SNR-1), the first ever found along the northern coast of the Arabian Sea. The AMS dates show that it was settled mainly during the first half of the third millennium cal BC when the Indus Civilisation flourished in the area. Considering the importance of the discovery, all the material culture remains from the Sonari sites have been described and analysed in detail and, whenever possible, framed into the different phases of environmental changes and human adaptation to the coastal environment that have been interpreted thanks to a good series of AMS dates from marine and mangrove shells.*

Keywords: Sindh; Balochistan; Arabian Sea; coastal archaeology; Bronze Age; fisher-gatherers; mangroves; Gadani chert; radiocarbon dating

INTRODUCTION
Paolo Biagi

This paper presents and discusses the research carried out in 2013 and 2014 by the Italian Archaeological Mission in Sindh and Las Bela (Balochistan, Pakistan), part of an archaeological project conducted in the region since 2000. More precisely it describes the results of the surveys conducted along the northern side of Ras Muari (Cape Monze, Karachi)[1]

between the present village of Sonari at the Hab mouth, in the north, and the Baloch coastal settlement of Mubarak, a few kilometres north of the cape, in the south (fig 1).[1]

This territory had never been studied in detail before the 2000s. Previous surveys were carried out by Professor A R Khan of the Institute of Geography, Karachi University, during the second half of the 1970s. His surveys led to the discovery of many archaeological sites of different ages, from the Palaeolithic to the Buddhist and Muslim periods,[2] among which is the prehistoric settlement of Sonari (SNR-1). Sonari is the only Bronze Age fisher-gatherer village ever discovered along the northern coast of the Arabian Sea with rectangular stone structures and net sinkers. The site is so far unique, and very important for the study of the Bronze Age of a region located at the south-western edge of the spread of the Indus Civilisation, where different archaeological aspects from the Indian subcontinent, the Arabian/Persian Gulf and the Gulf of Oman interacted.[3]

The scope of the 2013 and 2014 research was also to fill a chronological gap in the archaeology of the territory, which extends between Lake Siranda in the west and the Indus Delta in the east, by means of a systematic programme of accelerated mass spectrometry (AMS) dates. To date, more than 100 radiocarbon dates have been obtained from samples collected from the coastal region, mainly from shell middens and scatters of mangrove and marine shells recovered during the surveys conducted in the last twenty years.[4]

Our surveys were conducted on foot in August 2013 and January 2014 by two of the present authors (PB and RN). They were repeated systematically four different times following the same track: starting from the Hab mouth, where the present fishers' village of Sonari is located, walking from north-east to south-west across small fans and slope debris along the ridge that runs at the northern edge of the alluvial plain where the saddle inside which the prehistoric settlement of Sonari SNR-1 is located, and then south-west towards the village of Mubarak and the Arabian Sea coast.

The surveys led to the discovery of many archaeological sites, most of which consist of concentrations of shell fragments lying at the top of wind-borne sediments and distributed over an area of *c* 0.5km² at altitude 14–31m asl. The presence of scatters of marine and mangrove shells had already been reported by W T Blanford in the late 1800s[5] and O Schmieder in the 1950s.[6] It is important to note that the recorded shell features cannot be due to natural factors – they must be attributed to the human exploitation of past marine and mangrove environments during different ages. In fact, most shells have been intentionally fragmented by hard hammering to extract meat in a way that cannot be due to natural causes or animal predation. Moreover, the shell scatters consist of circular/oval concentrations, never alignments as would be the case if they had been deposited by sea wave/tide action.

Each archaeological site, irrespective of its age, was recorded by global positioning system (GPS) device and precisely positioned with the help of Soviet military maps and high magnification satellite photographs. One specimen of marine and mangrove shell species was collected from each site for identification. Whenever available, one single adult specimen of *Terebralia palustris* or *Telescopium telescopium* gastropod was selected for dating and defining where mangroves flourished around the cape. If mangrove shells were not

1. Khan 1973.
2. Khan 1979, map 1.
3. Prabhakar 2013; Laursen and Steinkeller 2017; Uesugi 2019.
4. Biagi *et al* 2016a.
5. Blanford 1880, 184.
6. In Siddiqi 1956, 30.

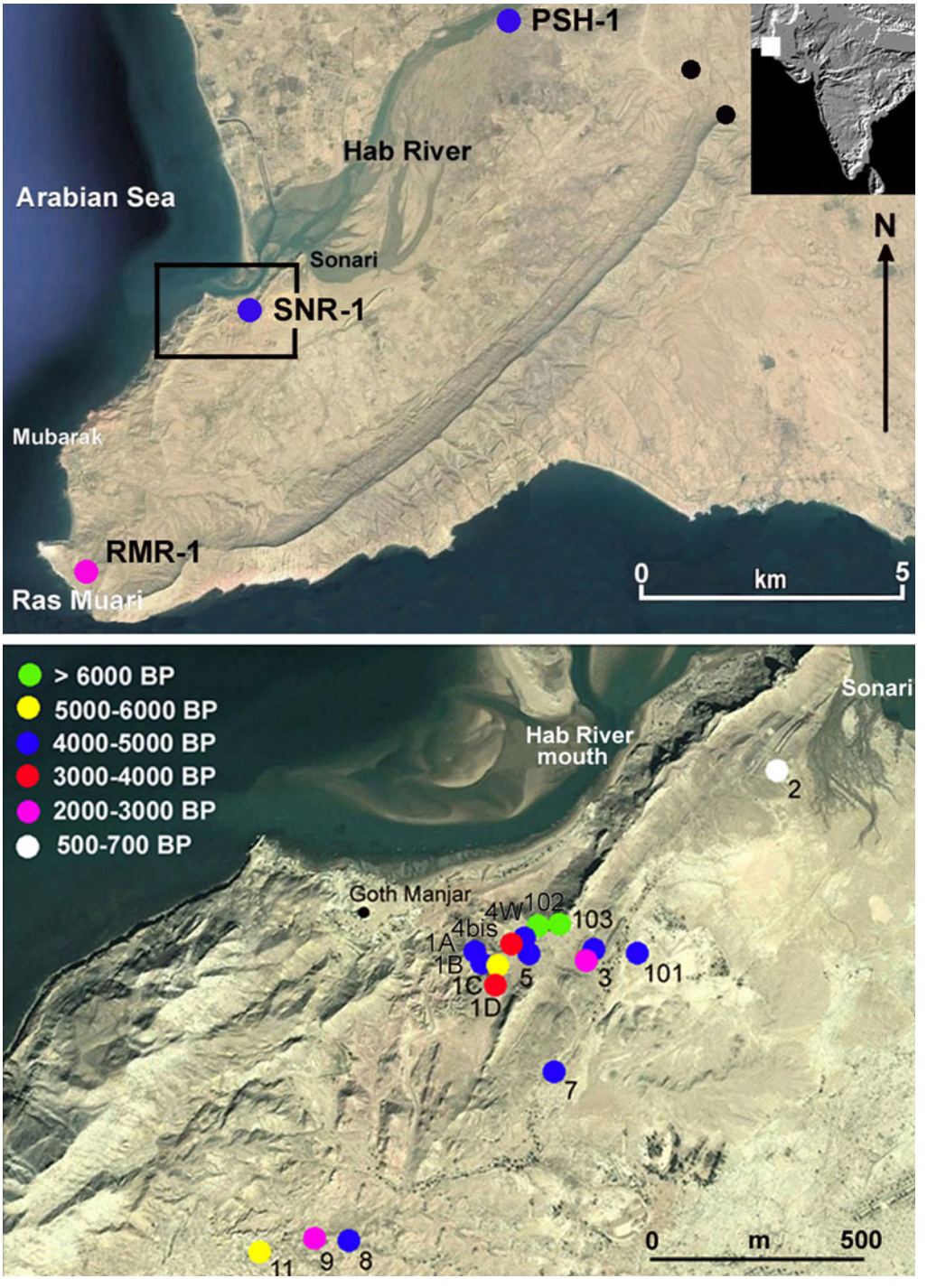

Fig 1. Sonari: (top) the area surveyed in 2013 and 2014 with the location of the radiocarbon-dated sites of Pir Shah Jurio (PSH-1), Sonari (SNR-1) and Ras Muari (RMR-1) and two Mesolithic sites discovered near Sona Pass by A R Khan in the late 1970s (black dots); (bottom) distribution and chronology of the Sonari sites. *Maps*: R Nisbet and P Biagi.

available, specimens of *Meretrix* sp, *Lunella coronata* and *Turbo bruneus* marine shells were sampled for dating. All the dated samples were collected from the central part of each site, and located by GPS (see table 2). A first preliminary report on Sonari was published in 2004,[7] and a short note regarding the preliminary results of the 2013 survey were published in 2014.[8]

ENVIRONMENTAL SETTING AND NATURAL RESOURCES

Renato Nisbet and Paolo Biagi

The peninsula protruding into the Arabian Sea towards Ras Muari (fig 1, top) is formed by two low rocky chains that shape its northern and southern coasts, and the shallow alluvial basin that opens between them. The scanty vegetation consists of halophytes close to the shore and a few spiny shrubs along the rocky slopes and gullies. All of the semi-arid region of south-western Sindh is relieved by the summer monsoon,[9] with a rainfall of 80–90mm that is nearly a half of the annual precipitation in the area.[10]

South of the Hab estuary, sedimentary rocks of Oligocene and Miocene age form the hilly chain facing the Arabian Sea that elongates south-west for 7km down to Cape Monze.[11] They are mostly composed of fine-grained to conglomeratic sandstone, inter-bedded with limestone and calcareous sandstone. The geology of the area strongly affects its morphology, as the succession of softer and harder rocks originated the characteristic local deflated mesas that are sometimes partly covered with aeolian deposits. The north-eastern segment of the range, facing the village of Goth Manjar, culminates at 45m. Its wide, almost flat, surface is easy to access from the south throughout a narrow passage (24°52′41.0″N–66°41′38.5″E) that leads to the saddle inside which the archaeological site SNR-1 is located.

South of the range, a large alluvial plain fills the area between the coasts. The plain is open towards the Hab, whose waters seasonally flow into it. Its surface gradually rises inland (westwards) for at least 1km, where isolated limestone outcrops, sand dunes and conglomerates reach 15–20m.

The whole Makran coast is subject to Quaternary and Holocene tectonic activities that shape the territory in multiple forms, among which are mud volcanoes, strong earthquakes, coastal uplift with raised beaches, faulting in younger sediments and river terraces.[12] An uplift of *c* 100m has been suggested for the western part of the Makran coast, gradually reducing to 2–3m in the Indus Delta.

R A Khan described the presence of a fault around Ras Muari,[13] which is part of the huge Karachi Arc generated by the motion between the Arabian and Asian plates.[14] Following Quaternary neotectonic processes, the cape has been formed by a strong uplift, as is shown by the occurrence of raised beaches close to the seashore. Just 300m from the

7. Biagi 2004, fig 6.
8. Biagi and Nisbet 2014.
9. Wilson 2000, 19.
10. Snead 2010a.
11. Vredenburg 1909; Khan 1973; Niamatullah *et al* 2011.
12. Snead and Frishman 1968; Snead 2010b.
13. Khan 1973.
14. Sarwarand and Alizai 2013.

present coastline, and *c* 0.5km south of the seasonal stream along which Mubarak village is located, a continuous horizontal layer of *Lunella coronata* marine shells was observed along natural erosion of a stream at *c* 2m of depth from the topsoil and 16m of altitude. One shell specimen was collected and dated to 2955±35 cal BP (RMR-1: GrA-62254) (fig 1, top). This is one of the most recent radiocarbon dates obtained from our Las Bela/Indus Delta survey. It deserves further investigation because of the absence of archaeological sites of this period in the cape that makes the presence of this shell horizon intriguing. Increasing evidence of eustatic/tectonic changes along the sea side that might have affected archaeological sites' visibility even in historic times has been demonstrated for the coast east of the Indus Delta, Gujarat in particular.[15]

Apart from unique geomorphologic characteristics, archaeological aspects should also be considered in their settings, as documented by G F Dales.[16] These include uplifted coastal and riverine Indus Civilisation ports such as Sutkagen-dor and Sotka-koh, at present located several kilometres from the coastline in the Gwadar-Ormara region of Makran, and Mai Gondrani Buddhist caves that open in vertical walls of faults in Las Bela Valley.[17] These geological conditions (crustal instability and strong uplift) should be taken into account when considering the changing past relationships between the archaeological sites of the area and the Hab mouth mangrove forest. Affecting Hab water discharge, together with climatic change, these movements might have caused the decline of mangrove environments and consequently the availability of its food and wood resources, until the very recent disappearance of this unique ecosystem (GrA-59834: 670±50 BP on *T telescopium*).

THE 2013 AND 2014 SURVEYS

Renato Nisbet and Paolo Biagi

The main scopes of the 2013 and 2014 surveys were to record and reconstruct the history of human presence and interference in an almost unknown territory of coastal Sindh and Las Bela. Therefore, the following strategy has been adopted: 1) record and precisely locate each archaeological site by GPS device;[18] 2) radiocarbon date the periods of human settlement by means of mangrove and marine shells recovered from the sites; 3) define the presence and death of mangroves at the Hab mouth and their different periods of human exploitation; and 4) study the Bronze Age fisher-gatherers village of Sonari (SNR-1) and its eventually related archaeological evidences.

The discovery of SNR-1 is very important since so far we do not have any evidence of other prehistoric fisher settlements along the northern coast of the Arabian Sea, despite great emphasis given to their presence in different periods.[19] The territory discussed in this paper is part of the mythical land of the *Ichthyophagoi* (fish-eaters) described by ancient Greek and Roman authors,[20] according to whom Las Bela was settled by groups of Oritae. However, we have scarce information regarding the locations and characteristics

15. Gupta 1972; Gaur and Vora 1999; Goyal *et al* 2013.
16. Dales 1962; Dales and Lipo 1992.
17. Minchin 1907, 39.
18. A Garmin 60CSx.
19. Ray 1999.
20. Schoff 1974; Ray 2003, 37 and n 9, 49–51.

of their villages[21] and their eventual relationship with other sites of the interior. This absence of evidence contrasts with that of the many Indus Civilisation and later port towns known from neighbouring Gujarat in India.[22] Moreover, the coast west of Karachi is considered to be one of the important north Arabian Sea sources from which large oceanic shells were exploited and traded to supply the artisan workshops of the Indus cities.[23]

Our surveys led to the discovery of many archaeological sites. They mainly consist of man-made heaps or scatters/spots of decoloured, fragmented marine and mangrove shells, samples of which were AMS dated from most sites (fig 1, bottom; tables 1 and 2).

The most recent AMS date (670±50 BP: GrA-59834) was obtained from a small scatter of *Meretrix* sp, *Cyprea* sp and *T telescopium* fragments (SNR-2 on *T telescopium*, see table 2). The result shows that a mangrove environment was still flourishing around the Hab's mouth during the seventeenth to nineteenth centuries AD, though we do not know exactly when it began to disappear.

Close to site SNR-2, along the foot of the ridge, five Islamic tombs were discovered *c* 100m from the south-westernmost limit reached by the Hab's floods (SNR-100: fig 2, top). The tombs are roughly rectangular, except for one that is almost oval and oriented east–west. They measure *c* 1.50 × 1.20m, and are delimited by medium-sized, limestone blocks (fig 2, bottom). They were numbered from 100A to 100E. Inside and around them a few grave goods were recovered. They consist of two conjoining sherds of one small Chinese porcelain cup painted in blue, probably attributable to the sixteenth century AD,[24] from graves 100A and 100C (fig 3, no. 2), a few ceramic potsherds (fig 3, nos 1, 3 and 5), and a few pieces of a glass necked flask (fig 3, no. 7) from the surface of graves 100B and 100C (fig 3, no. 8) (table 5).

A scatter composed exclusively of fragments of marine and mangrove shells was found *c* 500m south-west of the graveyard (SNR-101). A few pieces of *Turbinella pyrum*, a large oceanic shell often exploited in prehistoric and historic times for the manufacture of different types of artefacts,[25] were collected from its surface. The site was dated to 4690±35 BP (GrA-62252 on *T palustris*).

SNR-3 was discovered *c* 150m west of SNR-101 on the lower part of the slope that takes to the saddle inside which the settlement of SNR-1 was found (fig 4, top). The site consists of irregular spots of marine and mangrove shell fragments scattered over a surface *c* 25m in diameter. Two different dates suggest that the site was settled during different periods. In fact, one *Lunella coronata* specimen yielded the result of 4280±30 BP (GrA-67145), while one *T palustris* gastropod was dated to 2195±30 BP (GrA-62249). The assays show that while part of the midden accumulated around the end of the Bronze Age, a mangrove environment was still flourishing in the surroundings during the third to fifth centuries AD.

Another scatter of *T telescopium* and *T palustris* fragments recorded *c* 300m south-southwest of SNR-3, along the edge of the same ridge (SNR-7), was dated to 4560±60 BP (GrA-59832). It shows that a mangal environment was present in the area also during the Bronze Age.

Moving farther south-west, five more shell spots were discovered. Site SNR-8 is an eroded midden located *c* 650m from SNR-7 (fig 4, bottom). It is a *c* 40m long scatter

21. Siddiqi 1956, 26.
22. Rawat 2015; Sarkar *et al* 2020.
23. Ray 2003, 31; Gaur *et al* 2005.
24. S Rastelli, pers comm 2018.
25. Deshpande-Mukherjee 1998, 2008; Gaur *et al* 2005.

of marine and mangrove shells, dated to 4405±35 BP (GrA-66251 on *T palustris*). Some 80m west of the site, a heap of *Lunella coronata* shells (SNR-9), *c* 1.50m in diameter, was dated to 2190±50 BP (GrA-59831). It was found close to another scatter of *Lunella coronata* and *Meretrix* shells (SNR-10). SNR-11 is a spot of *Turbo bruneus* marine shells found on the surface of an eroded terrace. It was dated to 5650±60 BP (GrA-59830).

SNR-12 is a heap of marine gastropods, *c* 1.50m in diameter, while SNR-13 is another small spot of *Meretrix* marine shells dated to 3520±50 BP (GrA-59829).

Other sites were recorded inside the saddle, the most important of which is the prehistoric fisher-gatherer village of SNR-1 discovered by A R Khan in the late 1970s (fig 5). The settlement is a C-shaped feature made of collapsed limestone blocks well-sheltered inside the saddle that makes it invisible from both the sea and the Hab plain (fig 6). The site is *c* 30m long (north–south) and 35m wide (east–west). Its north, concave, side faces the Arabian Sea.

SNR-1 is composed of at least six rectangular rooms (or cabins) of different size delimited by limestone blocks. Their floors are covered with *Meretrix* and a few other shells that were sampled for radiocarbon dating (fig 7; tables 1 and 2). Most rooms are oriented east–west, only one is north–south (SNR-1B). The rooms SNR-1A, SNR-1A1 and SNR-1A2 are adjacent to each other. The larger feature SNR-1A was built west of SNR-1A1 and SNR-1A2, north of the previous one following the same orientation. Most probably, more rooms are buried in the eastern part of the village below the stone rubble.

Just in front of the concave side of the settlement, three shell heaps were recorded of different size and thickness, made of fragments of mangrove and marine shells, called SNR-1AC1, AC2 and AC3 (table 1). Regarding these features, it is important to note that around the end of the eighteenth century Lieutenant R Hughes-Buller reported the presence of small shell heaps along the coast of Makran, related to the production of lime from shells, whose scope was to lime cotton nets.[26] This process is accurately described by M I Siddiqi in his article on the fishers of West Pakistan, in which he points out that in Las Bela lime was obtained exclusively from *T telescopium* shells.[27] Therefore, we suggest that the SNR-1 shell heaps might be related to a similar activity that took place mostly during the Bronze Age.

SNR-4 is a wide triangular spot, *c* 75m long, sloping *c* 6m south-eastwards. It consists of colluvial shells, among which a few lithic artefacts were collected (fig 8). The site is very rich in mangrove and marine shell specimens, including fragments of *Turbinella pyrum*. The spot is delimited by the following coordinates: 24°52′39.4″N–66°41′35.7″E (SNR-4, central point), 24°52′39.4″N–66°41′35.2″E (SNR-4bis), 24°52′38.8″N–66°41′34.6″E (SNR-4W) and 24°52′38.7″N–66°41′36.5″E (SNR-4E). It is impossible to say whether SNR-4 is a single site or results from the erosion of more middens, as two different *T palustris* radiocarbon dates would suggest (SNR-4bis: GrA-62250: 4520±35 BP and SNR-4W: GrA-66633: 3995±35 BP) (fig 9).

Two more points were taken by GPS within site SNR-4. The first marks the presence of a microlithic backed point (SNR-5) surrounded by fragments of *T telescopium* shells, one specimen of which was dated to 4470±60 BP (GrA-59833). The second is a bladelet core made of dark reddish brown Gadani chert (SNR-6) (fig 8).

26. Hughes-Buller 1907, 203.
27. Siddiqi 1956, 66.

Table 1. Sonari: list of the archaeological sites and their main characteristics. Abbreviations: T.p. (*Terebralia palustris*), T.t. (*Telescopium telescopium*), A.r. (*Anadara rhombea*), Cy. (*Cypraea* sp), L.c. (*Lunella coronata*), M. (*Meretrix* sp), O. (*Ostrea* sp), T.b. (*Turbo bruneus*), T.py. (*Turbinella pyrum*).

Site no.	Coordinates	Altitude (m)	Survey date	Dimension (m)	Characteristics	Faunal species	Material culture remains	Structures (orientation)	Date/ attribution
SNR-1	24°52′37.8″N–66°41′31.6″E	24	07/08/2013	35 × 20	Settlement	M., L.c., T.b., T.t., T.p.	Chert artefacts, 4 potsherds, net weights, quern	Stone-walled features	GrN-27054
SNR-1bis	24°52′37.7″N–66°41′33.2″E	24	07/08/2013	-	Single point	T.t.	Gadani chert lithics, limestone tool, net weights	None	Undated
SNR-1Sud	24°52′39.1″N–66°41′34.9″E	23	07/08/2013	-	Single point	None	1 potsherd	None	Undated
SNR-1A	24°52′37.8″N–66°41′31.1″E	24	07/08/2013	3.00 × 2.50	Settlement structure	M.	3 potsherds	Stone feature (E-W)	GrA-59839
SNR-1A1	24°52′37.8″N–66°41′31.1″E	24	07/08/2013	1.80 × 1.40	Settlement structure	M.	None	Stone feature (E-W)	Undated
SNR-1A2	24°52′37.8″N–66°41′31.1″E	24	07/08/2013	1.80 × 1.70	Settlement structure	M.	2 potsherds	Stone feature (E-W)	Undated
SNR-1B	24°52′37.6″N–66°41′31.2″E	26	07/08/2013	3.00 × 1.90	Settlement structure	M.	Chert blade, net weight	Stone feature (N-S)	GrA-59837
SNR-1C	24°52′37.6″N–66°41′31.5″E	27	07/08/2013	2.60 × 1.95	Settlement structure	M., O.	None	Stone feature (E-W)	GrA-63867
SNR-1D	24°52′37.5″N–66°41′31.7″E	27	07/08/2013	2.75 × 1.90	Settlement structure	O., T.t., *Scylla serrata*	Potsherds	Stone feature (E-W)	GrA-59835
SNR-1AC1	24°52′38.4″N–66°41′32.1″E	27	10/01/2014	Ø 4.00	Shell heap	M. (very small fr.), T.t.	None	30cm thick	Undated
SNR-1AC2	24°52′38.3″N–66°41′32.2″E	27	10/01/2014	2.00 × 4.80	Shell heap 5 cm thick	M. (very small fr.)	None	5cm thick	Undated
SNR-1AC3	24°52′37.9″N–66°41′31.5″E	27	10/01/2014	Ø 3.00	Shell heap 15 cm thick	O., T.t., T.p.	None	15cm thick	Undated
SNR-2	24°52′58.9″N–66°42′02.6″E	3	07/08/2013	-	Single point	M., Cy., T.t.	None	None	GrA-59834
SNR-3/3bis	24°52′38.2″N–66°41′41.4″E	9	07/08/2013	Ø 25.00	Shell scatter	M., L.c., T.b., T.t., T.p.	None	None	GrA-62249

(*Continued*)

Table 1. (*Continued*)

Site no.	Coordinates	Altitude (m)	Survey date	Dimension (m)	Characteristics	Faunal species	Material culture remains	Structures (orientation)	Date/ attribution
SNR-4	24°52′39.4″N–66°41′35.7″E	24	07/08/2013	75 × 15	Eroded shell midden	T.py., M., L.c., T.b., T.t., T.p.	Gadani chert core and artefacts, net weights	None	Undated
SNR-4bis	24°52′39.4″N–66°41′35.2″E	19	07/08/2013	-	Eroded shell midden	T.t., T.p.	4 potsherds, net weight	None	GrA-62250
SNR-4W	24°52′38.8″N–66°41′34.6″E	29	07/08/2013	-	Single point	T.t., T.p.	None	None	GrA-66630
SNR-4E	24°52′38.7″N–66°41′36.5″E	23	07/08/2013	-	Single point	T.b., T.t, T.p.	None	None	Undated
SNR-5	24°52′38.8″N–66°41′34.3″E	27	07/08/2013	-	Single point	T.t.	Gadani chert point	None	GrA-59833
SNR-6	24°52′38.4″N–66°41′34.2″E	22	07/08/2013	-	Single point	None	Gadani chert core, net weight	None	Undated
SNR-7	24°52′27.7″N–66°41′37.8″E	14	07/08/2013	40 × 15	Shell scatter	T.t., T.p.	None	None	GrA-59832
SNR-8/8bis	24°52′13.5″N–66°41′18.4″E	23	08/08/2013	15 × 10	Shell scatter	M., L.c., T.b., T.t., T.p.	4 potsherds, net weights	None	GrA-62251
SNR-9	24°52′13.7″N–66°41′15.3″E	20	08/08/2013	-	Shell scatter	L.c.	None	None	GrA-59831
SNR-10	24°52′14.8″N–66°41′15.1″E	25	08/08/2013	*c* 20 × 10	Eroded shell scatter	M., L.c.	None	None	Undated
SNR-11	24°52′12.4″N–66°41′10.1″E	23	08/08/2013	-	Shell scatter	T.b.	None	None	GrA-59830
SNR-12	24°52′11.5″N–66°41′08.3″E	26	08/08/2013	Ø 1.50	Shell scatter	L.c., T.b.	None	None	Undated
SNR-13	24°51′45.2″N–66°40′59.3″E	31	08/08/2013	Ø 3.00	Shell scatter	M.	None	None	GrA-59829
SNR-100A	24°52′58.8″N–66°42′02.2″E	15	10/01/2014	*c* 1.50 × 1.20	Islamic tomb	None	Chinese painted porcelain	Stone grave (E–W)	16th century AD?
SNR-100B	24°52′59.3″N–66°42′02.5″E	14	10/01/2014	*c* 1.50 × 1.20	Islamic tomb	None	Glass	Stone grave (E–W)	16th century AD?

(*Continued*)

Table 1. (*Continued*)

Site no.	Coordinates	Altitude (m)	Survey date	Dimension (m)	Characteristics	Faunal species	Material culture remains	Structures (orientation)	Date/ attribution
SNR-100C	24°52′59.6″N–66°42′02.7″E	14	10/01/2014	*c* 1.50 × 1.20	Islamic tomb	None	Chinese painted porcelain, vase bottom, glass	Stone grave (E–W)	16th century AD?
SNR-100D	24°52′59.3″N–66°42′02.8″E	12	10/01/2014	*c* 1.50 × 1.20	Islamic tomb	Small bivalves	1 potsherd	Stone grave (E–W)	16th century AD?
SNR-100E	24°52′58.6″N–66°42′02.8″E	10	10/01/2014	*c* 1.50 × 1.20	Islamic tomb	None	White porcelain, 1 potsherd	Stone grave (E–W)	16th century AD?
SNR-101	24°52′38.7″N–66°41′46.7″E	12	10/01/2014	Sparse Ø *c* 5.00	Shell scatter	A.r., O., T.py., M., L.c., T.b., T.t., T.p.	None	None	GrA-62252
SNR-102	24°52′41.0″N–66°41′38.5″E	45	10/01/2014	Ø *c* 3.00	Shell spot	M., A.r.	None	None	GrA-62253
SNR-103	24°52′41.1″N–66°41′36.7″E	32	10/01/2014	Ø *c* 3.00	Shell spot	M.	None	None	GrA-59828
RMR-1	24°50′38.1″N–66°39′50.8″E	16	10/01/2014	*c* 10.00	Stream profile	L.c.	None	*c* 2m of depth	GrA-62254

Table 2. Sonari: date list of the radiocarbon-dated sites. Calibrations according to the marine curve of 229±27 ^{14}C years (see Reimer and Reimer 2001).

Site no.	Coordinates	Altitude (m)	Shell samples	Lab no.	Uncal BP date	Cal BC/AD date 1 σ	Cal BC/AD date 2 σ	$\delta^{13}C$
SNR-102	24°52′41.0″N–66°41′38.5″E	45	*Meretrix* sp. (Clam)	GrA-62253	6360±40	4677–4549	4733–4481	+0.50
SNR-103	24°52′41.1″N–66°41′36.7″E	32	*Meretrix* sp. (Clam)	GrA-59828	6180±50	4464–4345	4546–4306	+1.01
SNR-11	24°52′12.4″N–66°41′10.1″E	23	*Turbo bruneus* (Brown dwarf turban)	GrA-59830	5650±60	3928–3774	3978–3683	+2.18
SNR-1C	24°52′37.6″N–66°41′31.5″E	27	*Meretrix* sp. (Clam)	GrA-63867	5125±35	3345–3014	3366–3090	+0.13
SNR-1B	24°52′37.5″N–66°41′31.2″E	26	*Meretrix* sp. (Clam)	GrA-59837	4850±60	2999–2831	3079–2694	+1.30
SNR-1A	24°52′37.8″N–66°41′31.1″E	24	*Meretrix* sp. (Clam)	GrA-59839	4780±60	2886–2704	2963–2597	+1.30
SNR-101	24°52′38.7″N–66°41′46.7″E	12	*Terebralia palustris* (Giant mangrove whelk)	GrA-62252	4690±35	2817–2615	2845–2564	-4.20
SNR-7	24°52′27.7″N–66°41′37.8″E	14	*Terebralia palustris* (Giant mangrove whelk)	GrA–59832	4560±60	2614–2430	2734–2316	-2.36
SNR-4bis	24°52′39.4″N–66°41′35.2″E	19	*Terebralia palustris* (Giant mangrove whelk)	GrA-62250	4520±35	2542–2409	2586–2313	-3.79
SNR-5	24°52′38.3″N–66°41′34.9″E	27	*Telescopium telescopium* (Horn snail)	GrA-59833	4470±60	2476–2289	2567–2196	-5.14
SNR-8bis	24°52′13.5″N–66°41′18.4″E	23	*Lunella coronata* (Crowned turban shell)	GrA-67144	4450±35	2444–2309	2483–2212	+2.25
SNR-8	24°52′13.5″N–66°41′18.4″E	23	*Terebralia palustris* (Giant mangrove whelk)	GrA-62251	4405±35	2392–2238	2452–2177	-4.38
SNR-3bis	24°52′38.2″N–66°41′41.4″E	9	*Lunella coronata* (Crowned turban shell)	GrA-67145	4280±35	2193–2046	2276–1987	+3.42
SNR-1	24°52′38″N–66°41′31″E	24	*Terebralia palustris* (Giant mangrove whelk)	GrN-27054	4080±30	1923–1796	1986–1731	-4.43
SNR-4W	24°52′38.8″N–66°41′34.6″E	24	*Terebralia palustris* (Giant mangrove whelk)	GrA-66633	3995±35	1823–1682	1879–1617	-7.47

(*Continued*)

Table 2. (*Continued*)

Site no.	Coordinates	Altitude (m)	Shell samples	Lab no.	Uncal BP date	Cal BC/AD date 1 σ	Cal BC/AD date 2 σ	$\delta^{13}C$
SNR-1D	24°52′37.5″N–66°41′31.7″E	27	*Telescopium telescopium* (Horn snail)	GrA-59835	3660±50	1422–1278	1491–1204	-4.42
SNR-13	24°51′45.2″N–66°40′59.0″E	31	*Meretrix* sp. (Clam)	GrA-59829	3520±50	1262–1091	1354–1008	+0.38
SNR-3	24°52′38.2″N–66°41′41.4″E	9	*Terebralia palustris* (Giant mangrove whelk)	GrA-62249	2195±30	364AD–483AD	320AD–555AD	-4.74
SNR-9	24°52′13.7″N–66°41′15.3″E	20	*Lunella coronata* (Crowned turban shell)	GrA-59831	2190±50	364AD–518AD	280AD–576AD	+1.60
SNR-2	24°52′58.9″N–66°42′02.6″E	3	*Telescopium telescopium* (Horn snail)	GrA-59834	670±50	1839AD–...	1724AD–...	-5.10
RMR-1	24°50′38.1″N–66°39′50.8″E	16	*Lunella coronata* (Crowned turban shell)	GrA-62254	2955±35	542–392	690–368	+1.71
PSH-1	24°55′39.1″N–66°44′28.2″E	35	*Terebralia palustris* (Giant mangrove whelk)	GrN-26370	4130±20	1978–1872	2035–1806	-4.38
PSH-1bis	24°55′39.1″N–66°44′28.2″E	35	*Terebralia palustris* (Giant mangrove whelk)	GrA-66638	4270±35	2182–2039	2265–1974	-4.15

Fig 2. Sonari: (top) the Islamic graveyard SNR-100 from the south-west; (bottom) tomb SNR-100A. *Photographs*: R Nisbet.

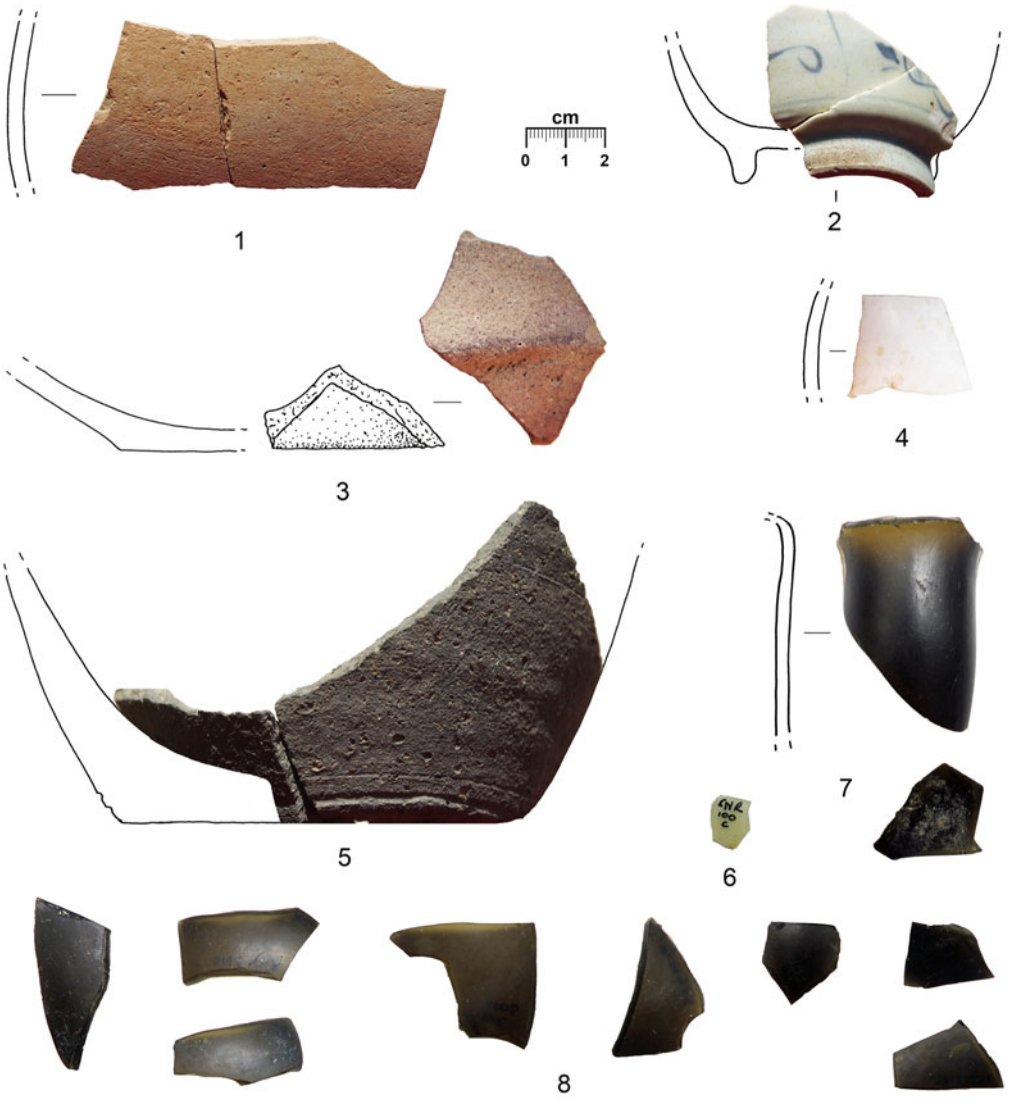

Fig 3. Sonari: potsherds and glass fragments from graveyard SNR-100. 1, 3 and 5: ceramic; 2 and 4: Chinese porcelain; 6–8: glass vessels (see table 5). *Photographs*: E Starnini.

THE STONE ASSEMBLAGE: FISHING EQUIPMENT

Elisabetta Starnini

Our current knowledge of the presence of prehistoric fishing communities along the south-western coast of Pakistan is still very scarce. This fact contrasts with the evidence available from the Sultanate of Oman and the south-eastern coast of the United Arab Emirates, where *c* fifty years of surveys and the excavations carried out in aceramic shell middens and other types of Bronze Age sites have yielded a great variety of fishing implements.

Fig 4. Sonari: (top) SNR-3 from south-west; (bottom) SNR-8 from west. *Photographs*: P Biagi.

Fig 5. Sonari: view of the terrace with the location of SNR-1 (rectangles), and the area covered by SNR-4 in the foreground. *Photographs*: P Biagi.

Fig 6. Sonari: (top) SNR-1, stone-walled structures filled with shells in the western part of the site; (bottom) stone rubble in the eastern part. *Photographs*: P Biagi.

Fig 7. Sonari: (top) SNR-1, stone-walled structure SNR-1A; (bottom) valves of *Meretrix* sp shells on its floor. *Photographs*: P Biagi.

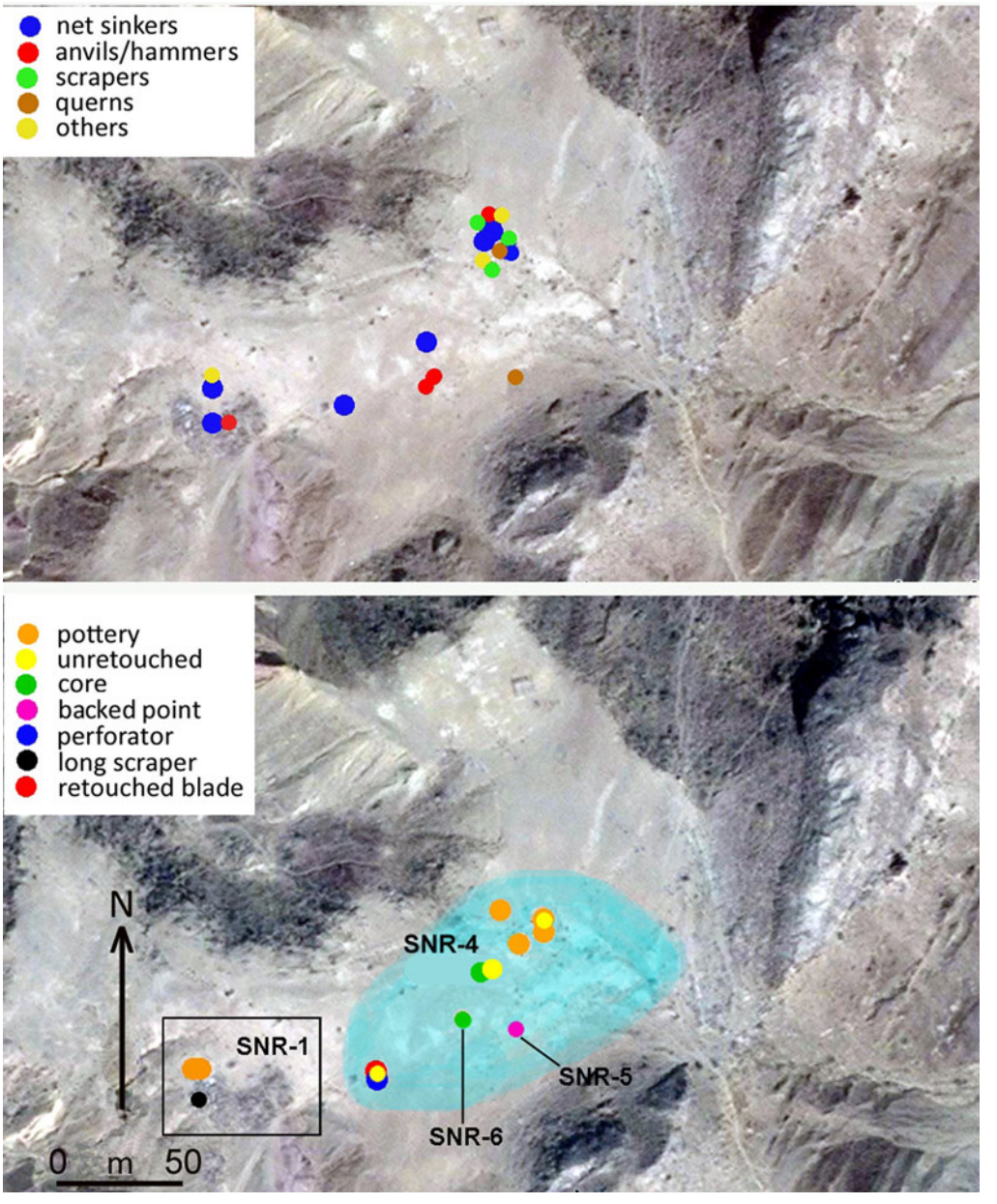

Fig 8. Sonari: distribution maps of the stone tools (top), knapped stones and ceramic potsherds (bottom). *Maps*: P Biagi and R Nisbet.

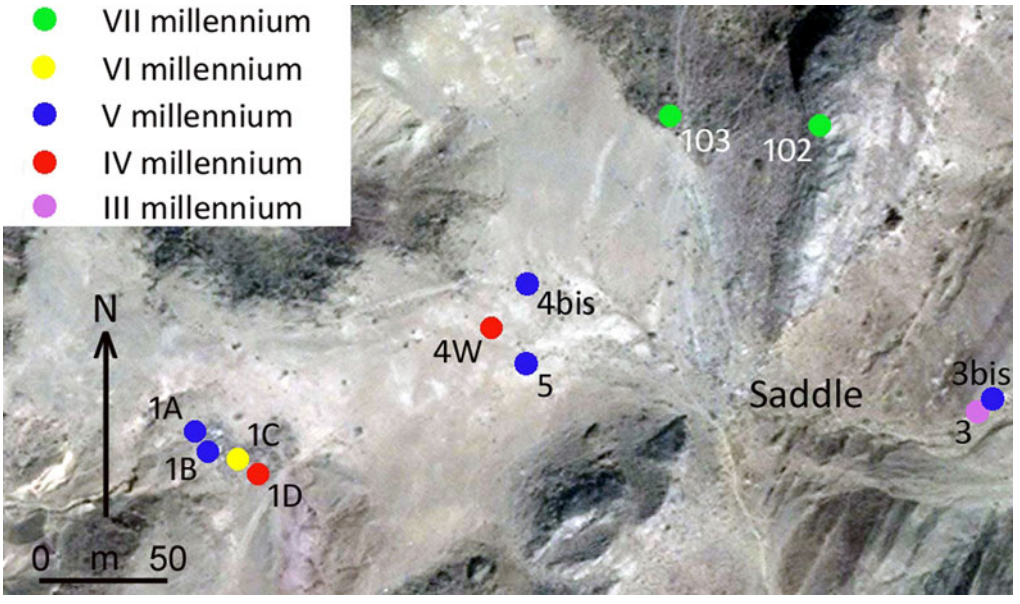

Fig 9. Sonari: distribution map of the radiocarbon-dated sites on the terrace. *Map*: P Biagi and R Nisbet.

Among these are different types of stone net sinkers[28] and fish hooks made from shell and copper,[29] though remains of nets are almost absent with the exception of one Bronze Age specimen from the interior of the Makran coast (fig 10).[30]

Simple, double-notched flat pebbles of various sizes are the commonest stone implement associated with fishing.[31] Their size variability has been related to different fishing techniques. The general impression is that small sized items and weight are associated with casting or 'beach seine net', while specimens of a larger size and weight belong to gill nets or large 'seine nets'. However, this simplistic subdivision makes problematic the attribution of medium size and weight specimens.[32]

Net sinkers, obtained from flat oval pebbles notched roughly in the middle of their long sides, are known from many Omani coastal sites of the Saruq and Bandar Jissah facies, dated between *c* 7000 and 5000 BP,[33] though they are known also from more recent Bronze Age sites.[34] Their form and weight variability is believed to show some chronological significance,[35] though some authors suggest that their different typology might derive from certain local traditions.[36]

28. Beech 2003, 290, 2004, 61–3; Marrast *et al* 2019.
29. Uerpmann and Uerpmann 2003; Beech 2004, 63–8.
30. Thomas *et al* 2012.
31. Cleyet-Merle 1990, 145 and 146; figs 3 and 5.
32. Beech 2003, 290.
33. Uerpmann 1992, 94.
34. Beech 2004, 61.
35. Ibid.
36. Uerpmann 1992, 94–6.

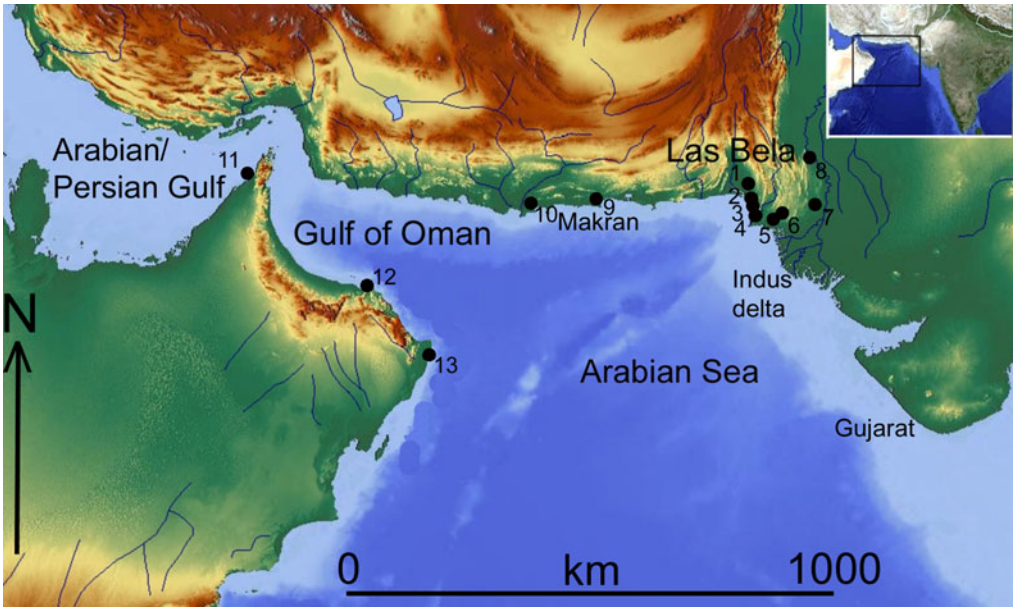

Fig 10. Distribution map of the most important sites of the Arabian Sea coasts mentioned in the text: 1) Lake Siranda, 2) Bay of Daun, 3) Ras Gadani, 4) Sonari, 5) Mulri Hills, 6) Kadeji Gorge, 7) Ongar, 8) Amri, 9) Pasni, 10) Sutkagen Kot, 11) Ras al-Khaimah, 12) Bandar Jissah, 13) Ra's al-Khabbah. *Drawing*: P Biagi.

Besides five specimens already published in a preliminary report in 2004,[37] ten more net sinkers were collected from some of the Sonari sites (fig 8, top; fig 11; fig 12, nos 2–5; fig 13, no. 3). Their weight varies from small types of 22g to heavier specimens up to 168g (table 3). Most artefacts are less than *c* 100g, ie lighter than those reported from the Arabian/Persian and Oman Gulfs, Bronze Age Umm an-Nar period.[38] They can be compared with a group of medium-sized sinkers from the Middle Holocene coastal site of Ra's al-Khabbah (KHB-1) in Oman.[39]

The Sonari net sinkers consist of flat pebbles with two opposed notches knapped in the middle of the long sides, around which a string can be firmly tied. These objects are often reported in the literature as 'net weights', 'notched pebbles', 'fishing weights' or 'notched weights'. Indeed, the blanks have been carefully selected among the limestone beach pebbles that abound along the shores of Cape Monze, the sole modification being represented by the two opposed, bifacial notches knapped by hard hammering.

The size variability of the Sonari net sinkers can be explained either as consequent to different, albeit contemporaneous, fishing strategies adopted by the same community or as a chronological proxy implying multiple frequentations of the site. Therefore, it is necessary to examine their significance in better detail.

These stone objects were illustrated and described for the first time by C Rau towards the end of the nineteenth century in his book devoted to prehistoric fishing, where he

37. Biagi 2004, fig 6, nos 6–10.
38. Beech 2004, 63 and fig 33.
39. Cavulli and Scaruffi 2011, 31.

Fig 11. Sonari: stone net sinkers. 1 and 2) SNR-4; 3) SNR-4bis; 4–6) SNR-1.
Photographs: E Starnini.

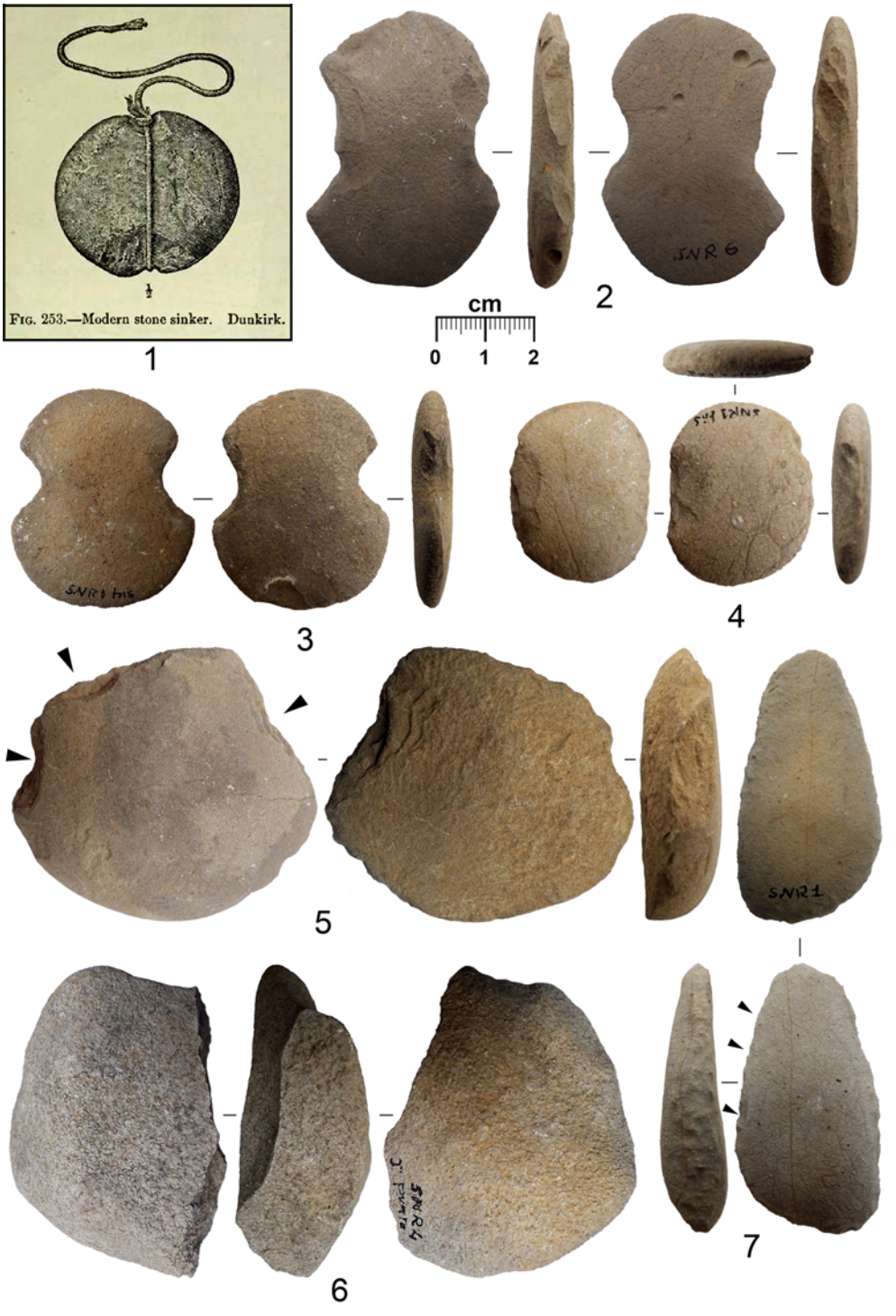

Fig 12. 1) Illustration from C Rau (1884, fig 253) showing a notched stone net sinker of the native fishers of the Great Lakes in North America; 2) stone net sinker from SNR-6; 3) net sinker from SNR-1bis; 4) net sinker from SNR-1bis; 5) net sinker on a pebble flake with chipped sides from SNR-4; 6) fragment of a grinding implement with one concave, worn working platform, from SNR-4; 7) weathered pebble flake with side retouch, from SNR-1. *Photographs*: E Starnini.

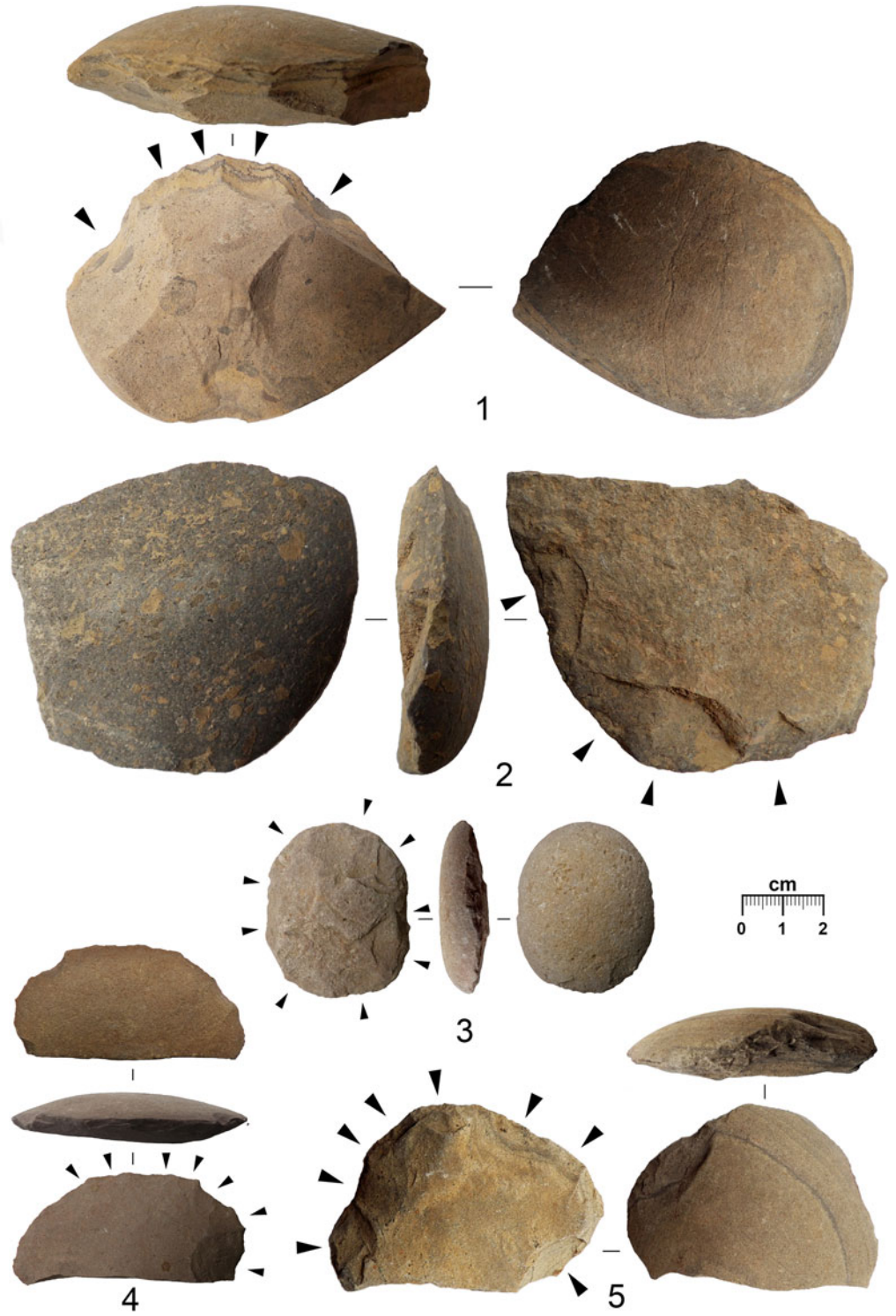

Fig 13. Sonari: stone artefacts from SNR-4. 1, 2, 4 and 5) pebble flakes with chipped margins; 3) net sinker from a small pebble with centripetal flaking on one face. *Photographs*: E Starnini.

Table 3. Sonari: list and description of the stone artefacts.

Site no.	Coordinates	Survey date	Description	Measures (L × W × T) (mm)	Weight (g)	Raw material	Figure
SNR-1	24°52′37.9″N–66°41′31.6″E	10/01/2014	Net sinker on oval, flat pebble, with two opposite notches	62.5 × 48 × 8	44	Quartzarenite?	11, no. 4
SNR-1	24°52′37.5″N–66°41′31.6″E	10/01/2014	Net sinker on oval, flat pebble, with two opposite notches	73 × 58 × 15	100	Quartzarenite?	11, no. 5
SNR-1	24°52′37.5″N–66°41′31.8″E	10/01/2014	Net sinker on oval, flat pebble, with two opposite notches	55 × 42.5 × 19	66	Calcareous sandstone or limestone	11, no. 6
SNR-1	24°52′38.0″N–66°41′31.6″E	10/01/2014	Very weathered pebble flake, retouch traces, side scraper?	68 × 37 × 16.5	52	Limestone	12, no. 7
SNR-1	24°52′38.0″N–66°41′31.6″E	10/01/2014	Flat, round pebble with flake detachments	45 × 41 × 13	38	Limestone	14, no. 2
SNR-1	24°52′37.5″N–66°41′31.8″E	10/01/2014	Anvil stone/hammerstone on oval pebble, with one flaked side from hard hammering, weathered surfaces due to aeolian erosion	81 × 58 × 27	170	Calcareous sandstone or limestone	15, no. 2
SNR-1 bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	Net sinker on oval, flat pebble, with two opposite notches	52 × 43 × 10	30	Calcareous sandstone or limestone	12, no. 3
SNR-1 bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	Net sinker on oval, flat pebble, with two opposite notches	44 × 34 × 9	22	Fossiliferous limestone	12, no. 4
SNR-4	24°52′39.5″N–66°41′34.9″E	10/01/2014	Net sinker on discoidal, flat pebble, with two opposite notches	86 × 82.5 × 15	168	Calcareous sandstone or limestone	11, no. 1
SNR-4	24°52′39.7″N–66°41′35.0″E	10/01/2014	Double notched pebble flake, net sinker?	69 × 74 × 18	118	Calcareous sandstone or limestone	12, no. 5
SNR-4	24°52′39.5″N–66°41′35.2″E	10/01/2014	Scraper on pebble flake, invasive retouch all around the edge	64 × 83.5 × 25	158	Calcareous sandstone or limestone	13, no. 1

(*Continued*)

Table 3. (*Continued*)

Site no.	Coordinates	Survey date	Description	Measures (L × W × T) (mm)	Weight (g)	Raw material	Figure
SNR-4	24°52′39.3″N–66°41′34.9″E	10/01/2014	Fragment of pebble flake, flaked all around the edge	86.5 × 70 × 26.5	226	Calcareous sandstone or limestone	13, no. 2
SNR-4	24°52′39.8″N–66°41′35.1″E	10/01/2014	Oval pebble flake with centripetal flaking on one face, net sinker?	46 × 37 × 13	30	Limestone	13, no. 3
SNR-4	24°52′39.2″N–66°41′35.0″E	10/01/2014	Fragment of scraper on pebble flake, invasive retouch all around the edge	62 × (28) × 14	30	Limestone	13, no. 4
SNR-4	24°52′39.7″N–66°41′34.9″E	10/01/2014	Fragment of scraper on pebble flake, invasive retouch all around the edge	68 × 44 × 28	76	Calcareous sandstone or limestone	13, no. 5
SNR-4	24°52′38.0″N–66°41′34.3″E	10/01/2014	Anvil stone/hammerstone on elongated, oval pebble, wear depression on both faces	111 × 76 × 47	575	Fossiliferous limestone	14, no. 1
SNR-4	24°52′39.8″N–66°41′35.0″E	10/01/2014	Anvil stone on flat, oval pebble, wear depression on both sides, fractured on one side	(71) × 71 × 25	214	Limestone	14, no. 3
SNR-4	24°52′37.9″N–66°41′34.2″E	10/01/2014	Anvil stone/hammerstone on elongated, oval pebble, wear depression on both faces	117 × 65.5 × 36.5	416	Quartzarenite?	15, no. 1
SRN-4	24°52′37.9″N–66°41′35.3″E	10/01/2014	Oval quern, left *in situ* (already published generically from SNR-1)	15 × 11 × 7	–	Sandstone?	Biagi and Nisbet 2014, fig 7
SNR-4 bis	24°52′39.4″N–66°41′35.2″E	07/08/2013	Net sinker on oval, flat pebble, with two opposite notches	47 × 35 × 10	26	Limestone	11, no. 2
SNR-4 bis	24°52′39.4″N–66°41′35.2″E	07/08/2013	Net sinker on oval, flat pebble, with two opposite notches	60 × 46 × 15	66	Limestone	11, no. 3
SNR-4 bis	24°52′39.4″N–66°41′35.2″E	07/08/2013	Fragment of grinding stone with one concave surface	64 × 82 × 41	218	Sandstone	12, no. 6
SNR-6	24°52′38.4″N–66°41′34.2″E	07/08/2013	Net sinker on oval, flat pebble, with two opposite notches	64.5 × 45 × 11	42	Limestone	12, no. 2

discussed the finds from some European lake sites.[40] He noticed that their production technology and shape are similar to those of the North American aboriginal net weights extensively used by native fishers for weighting gill nets along the shores of the Great Lakes (fig 12, no. 1). The ethnographic parallels provided by Rau are an undisputable proof of the function of these stone artefacts. The same author noticed another characteristic of the stone sinkers, ie their size variability, most probably related to their different use and fishing techniques.[41]

H-P Uerpmann and M Uerpmann, describing stone implements from the prehistoric fishers' sites of Oman,[42] distinguished two basic types according to their manufacture technology. They called them N-type ('Normal', ie made from oval pebbles notched on their longer sides) and R-type ('Retouched', ie with a retouch shaping the whole outline of the pebble on both faces and notches) respectively, assuming that their difference is related to two different functions and fishing techniques. All the Sonari specimens, regardless of their size, fit into the N-type category, except for one atypical item (fig 13, no. 3).

Similar artefacts are known from the Neolithic site of Sha'ar Hagolan, and many other sites in Israel, dated from the Upper Palaeolithic to the Early Bronze Age.[43] Here, stone net sinkers in the form of notched pebbles have been related to freshwater fishing with 'throwing nets' or fishing lines or rods. This fishing gear was apparently first used by Upper Palaeolithic and Epipalaeolithic hunters and gatherers, though their use was continued by sedentary Neolithic communities.[44] Moreover, it has been suggested that differences in the form of weights, size and the location and size of the notches may indicate different fishing methods, probably related to tying. Their occurrence within archaeological sites is considered to be consequent to the discard of the net.[45]

According to Siddiqi,[46] who studied the fishers' settlements of the south-western coast of Pakistan in the 1950s, 'the most promising fishing grounds are situated at the mouths of the rivers, where the small fish congregate and attract the larger ones'. The same author reports that stones equipped the gears at the fishers' settlements of Makran and Las Bela,[47] although he did not provide us with any description of the net weights.

Moreover, stone net sinkers are part of the material culture of the Jōmon hunter-gatherers of prehistoric Japan,[48] who were also skilled fishers since the Initial Jōmon period (ninth to seventh millennia BP). Ichthyologic studies have shown that the Jōmon fishers captured salmon and trout running upstream during the autumn, carp in the freshwater zone, black sea bream and sea bass in the estuarine water and, most interestingly, bonito and tuna in the off-shore zone.[49] Y Kondo provided a very interesting spatial analysis of the archaeological contexts (house, midden, pit, etc.) where Jōmon net sinkers have been recorded,[50] discovering that disposal loci can be classified into settlement (on-site) and non-settlement (off-site). The same author observed a significant correlation between

40. Rau 1884, 59.
41. Ibid, 157.
42. Uerpmann and Uerpmann 2003, 111–13 and fig 7.6.
43. Rosenberg *et al* 2016.
44. Ibid, 47.
45. Belcher 1994, 136.
46. Siddiqi 1956, 58.
47. Ibid, 64.
48. Naumann 2000; Kondo 2008, fig 1, nn 1–3.
49. Toizumi 1997; Uchiyama 1997; Kondo 2008.
50. Kondo 2008.

fishing potential and standardised weight of sinkers,[51] interpreting the variability of sinkers in function of fishing conditions such as water depth, target fish and expected fish catch. The variability of net fishing strategies is explained as a means to effectively exploit the aquatic resources available close to settlements in accordance with their population size and location.[52] Therefore, we can confidently interpret our net weight assemblage from Sonari as evidence of fishing most probably related to different fish catches.

Other Sonari stone objects consist of several pebble flakes with retouched sides or edges, resembling large scrapers (fig 12, no. 7; fig 13, nos 1, 2, 4 and 5). They have never been reported or described before from any other Pakistani Arabian Sea site, except for one limestone specimen from Daun-111 shell midden (Las Bela), AMS dated to the mid-seventh millennium BP.[53] These tools resemble the so-called 'heavy duty scraping tools' that are known from many Late Stone Age sites of Oman whose subsistence economy was based on the exploitation of marine and mangrove resources.[54]

Sonari also yielded some pebbles with traces of hammering and pitting in the form of shallow, rounded cup marks (fig 14, nos 1 and 3; fig 15), These tools have often been described as anvil stones and hammers, and have been retrieved from shell middens of both the Arabian Sea coasts.[55] Pebbles with pecked round grooves roughly in the centre of both surfaces from the Omani shell middens have been interpreted as crushing stones[56] for breaking the hard shell of mangrove gastropods to extract their meat.[57]

Finally, there are two stone tools on cobbles that can be interpreted as lower parts of grinding implements. They are made from sandstone and present one worn, concave working platform (fig 12, no. 6).

To sum up, the small assemblage of stone tools described above can be attributed to the activities of a community of fisher-gatherers that exploited sea and mangrove environments. On the basis of the typology of the associated potsherds and the radiocarbon dates it can be attributed to the Bronze Age (figs 8 and 9).

THE KNAPPED STONE ASSEMBLAGE

Paolo Biagi

A few knapped stone artefacts were collected from the sites located on the Sonari terrace. Most specimens come from a spot called SNR-1bis, *c* 30m east of SNR-1 (table 4). They consist mainly of fragments of bladelets and flakelets,[58] only one of which is retouched (fig 16, no. 2), and one straight perforator obtained from a small limestone flake (fig 16, no. 11). Most artefacts are made from a variety of dark reddish brown chert whose source is known at Ras Gadani (*c* 25km north of Sonari), from which we have traces of its exploitation, radiocarbon dated to the fifth millennium BP (GDN-0: GrN-26369: 4460±30 BP on *T palustris*).[59] One bladelet of high quality exogenous chert was found on the floor of room

51. Ibid, fig 4.
52. Ibid, 358.
53. Biagi *et al* 2012, fig 13, n 1.
54. Uerpmann and Uerpmann 2003, 55 fig 4.8, 8 and 82, fig 5.9.
55. Biagi 1998, fig 18; Biagi *et al* 2012, fig 13.
56. Uerpmann and Uerpmann 2003, 113.
57. Ibid, 114, n 26 and fig 7.8.
58. Bladelets and flakelets 2.5–5.0cm long; microbladelets and microflakelets 1.25–2.5cm long.
59. Biagi *et al* 2013a, table 1.

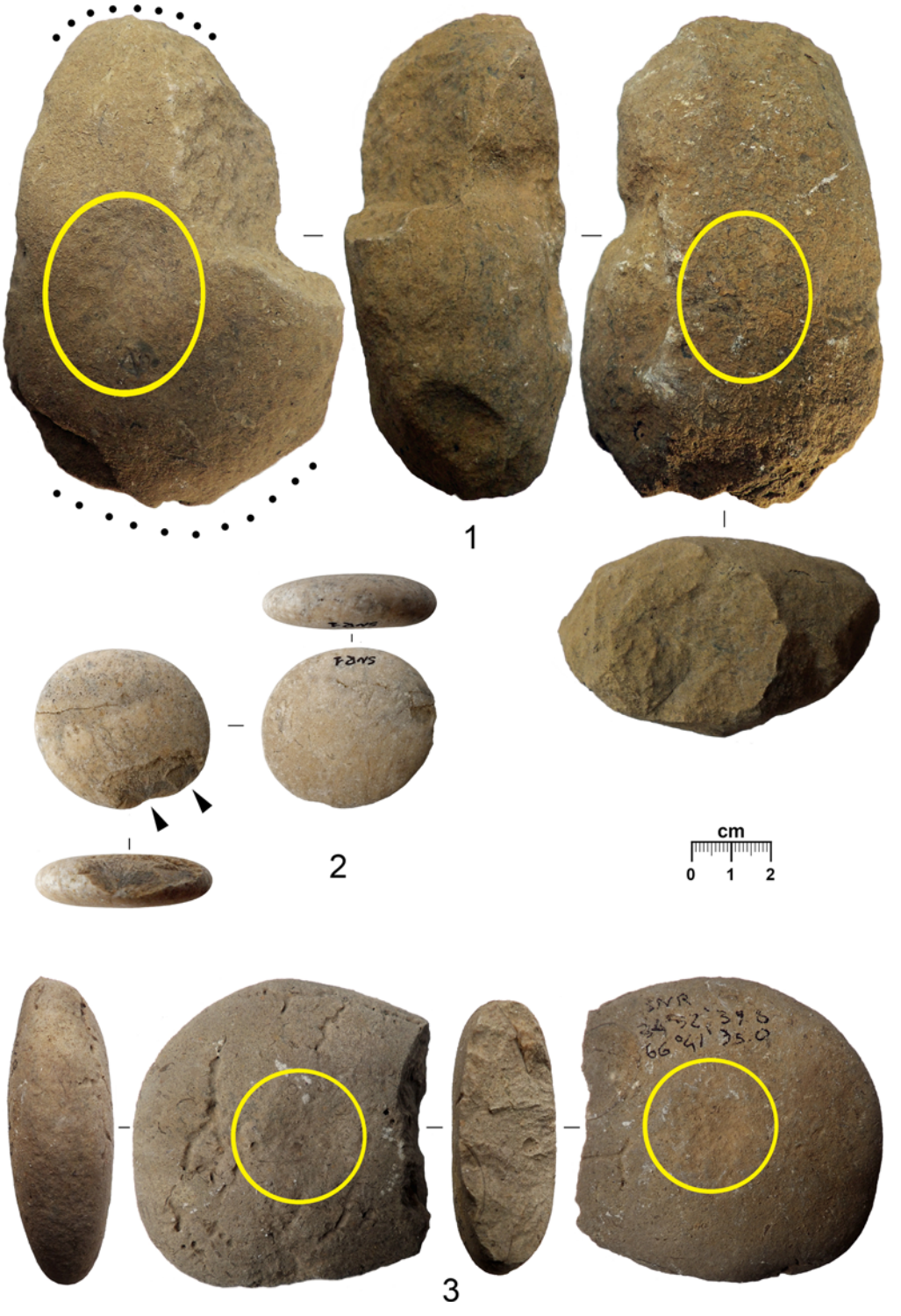

Fig 14. Sonari: stone artefacts. 1) anvil stone/hammerstone on pebble from SNR-4; 2) small, rounded flaked pebble, from SNR-1; 3) anvil stone on pebble, used on both sides, from SNR-4. *Photographs*: E Starnini.

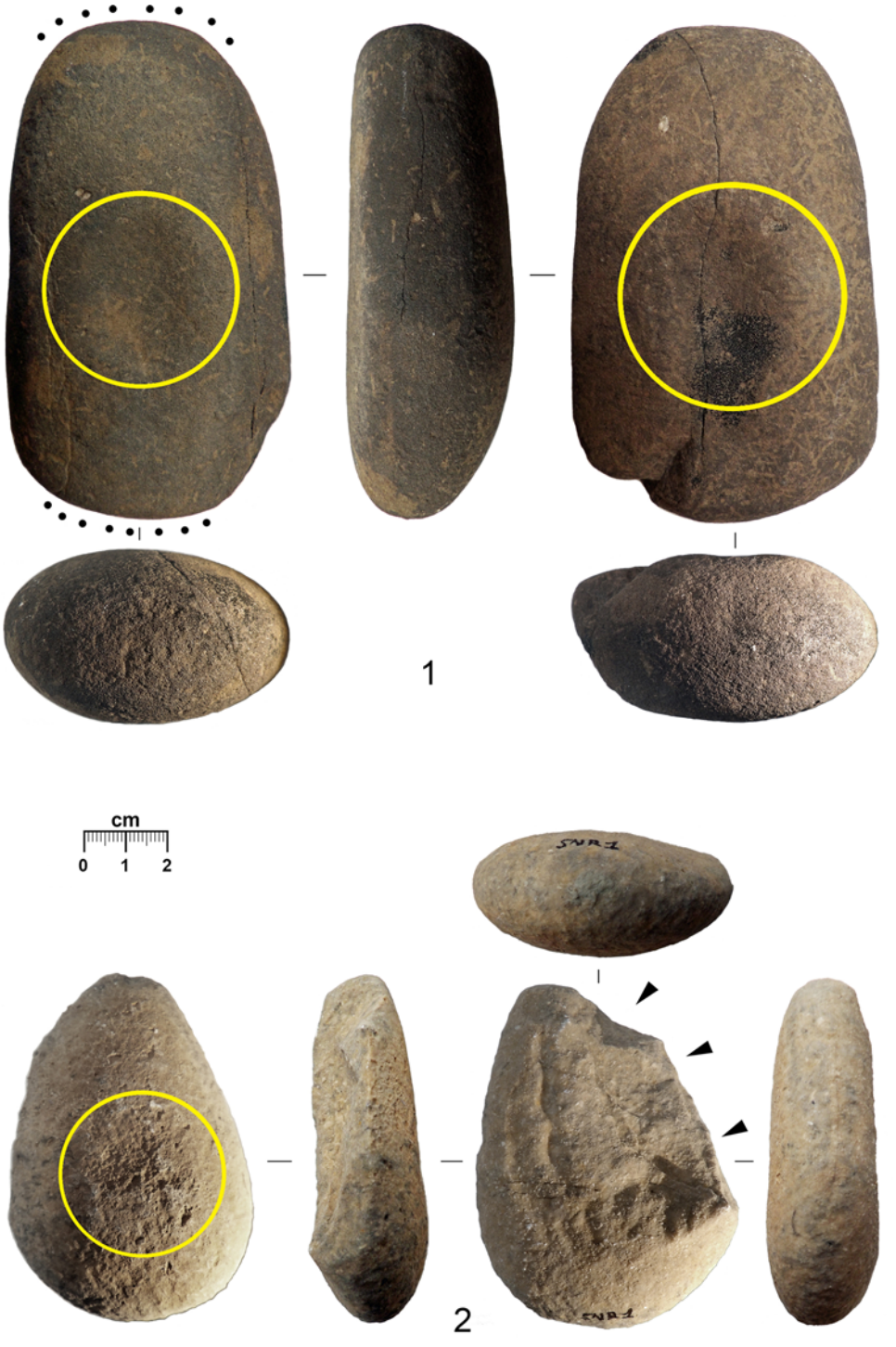

Fig 15. Sonari: stone artefacts. 1) anvil stone/hammerstone on pebble from SNR-4; 2) fragment of flat pebble, probable hammerstone, from SNR-1. *Photographs*: E Starnini.

Table 4. Sonari: list and description of the knapped stone artefacts. Colours of the Munsell Soil Color Charts 1992.

Site no.	Coordinates	Survey date	Typology (Laplace 1964)	Condition	Measures (L × W × T) (mm)	Cortex	Weight (g)	Use-wear	Raw material	Colour (Munsell)	Figure
SNR-1	24°52′37.8″N–66°41′31.6″E	07/08/2013	Unretouched flake	Complete	32 × 51 × 18.5	50%	31.60	None	Gadani chert	7.5YR5/6, Strong brown	-
SNR-1	24°52′37.8″N–66°41′31.6″E	07/08/2013	Small, tested block	Complete	22.5 × 21 × 11.5	75%	5.96	None	Gadani chert	5YR3/3, Dark reddish brown	-
SNR-1bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	LD2 dext [Amd], Backed bladelet	Proximal fragment	(21.5) × 11 × 4	No	1.31	None	Gadani chert	5YR3/3, Dark reddish brown	16, no. 2
SNR-1bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	Unretouched microbladelet	Mesial fragment	(11) × 10 × 2.5	No	0.38	None	Rohri? chert	5/27.5YR, Brown	16, no. 4
SNR-1bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	Unretouched bladelet	Mesial fragment	(11) × 15 × 3.5	No	0.78	None	Gadani chert	5YR3/3, Dark reddish brown	16, no. 5
SNR-1bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	Unretouched microbladelet	Proximal fragment	(17) × 8 × 3	No	0.48	None	Gadani chert	5YR3/3, Dark reddish brown	16, no. 7
SNR-1bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	Unretouched microbladelet	Distal fragment	(11.5) × 11 × 4	No	0.62	None	Gadani chert	5YR3/3, Dark reddish brown	16, no. 8
SNR-1bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	Bc2 dist [Apd conc+Apd conc], Borer on flakelet	Complete, weathered	48.5 × 30 × 12.5	No	19.54	None	Limestone	5Y7/2, Light grey	16, no. 11
SNR-1bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	Unretouched flakelet	Fragment, weathered	(21.5) × 15 × 6	No	2.16	None	Gadani chert	5YR3/3, Dark reddish brown	-
SNR-1bis	24°52′37.7″N–66°41′33.2″E	07/08/2013	Unretouched flakelet	Complete	27 × 28 × 15	20%	6.45	None	Rohri chert	5YR3/3, Dark reddish brown	-
SRN-1B	24°52′37.6″N–66°41′31.2″E	12/08/2013	LD2 [Smi dext]/.use wear, Backed bladelet	Mesial fragment	(42) × 13 × 3	No	2.93	Cut wood	Las Bela? chert	10YR3/6, Dark yellowish brown	16, no. 10
SNR-4	24°52′38.8″N–66°41′34.6″E	07/08/2013	Decortication flakelet	Distal fragment	(26) × 37 × 9.5	No	8.64	None	Granular chert	10YR6/3, Pale brown	-
SNR-4	24°52′38.8″N–66°41′34.6″E	07/08/2013	Microbladelet core	Fragment	18 × 21.5 × (11)	No	3.69	None	Gadani chert	5YR3/3, Dark reddish brown	16, no. 9
SNR-4	24°52′38.8″N–66°41′34.6″E	07/08/2013	Unretouched microflakelet	Complete	15 × 11 × 5.5	No	1.34	None	Gadani chert	5YR3/3, Dark reddish brown	-

(*Continued*)

Table 4. (*Continued*)

Site no.	Coordinates	Survey date	Typology (Laplace 1964)	Condition	Measures (L × W × T) (mm)	Cortex	Weight (g)	Use-wear	Raw material	Colour (Munsell)	Figure
SNR-4bis	24°52′39.4″N–66°41′35.2″E	07/08/2013	Unretouched microflakelet	Proximal fragment	(16) × 14 × 4	No	1.13	None	Rohri? Chert	6/410YR, Light yellowish brown	16, no. 6
SNR-5	24°52′38.3″N–66°41′34.9″E	07/08/2013	PD2 prox [Amd sen], Backed point bladelet	Complete	28 × 7.5 × 2	No	0.55	None	Gadani chert	5YR3/3, Dark reddish brown	16, no. 1
SNR-6	24°52′38.4″N–66°41′34.2″E	07/08/2013	Bladelet core, prepared platform	Prismatic, 1 face	32.5 × 30 × 14	75%	16.58	None	Gadani chert	5YR3/3, Dark reddish brown	16, no. 3

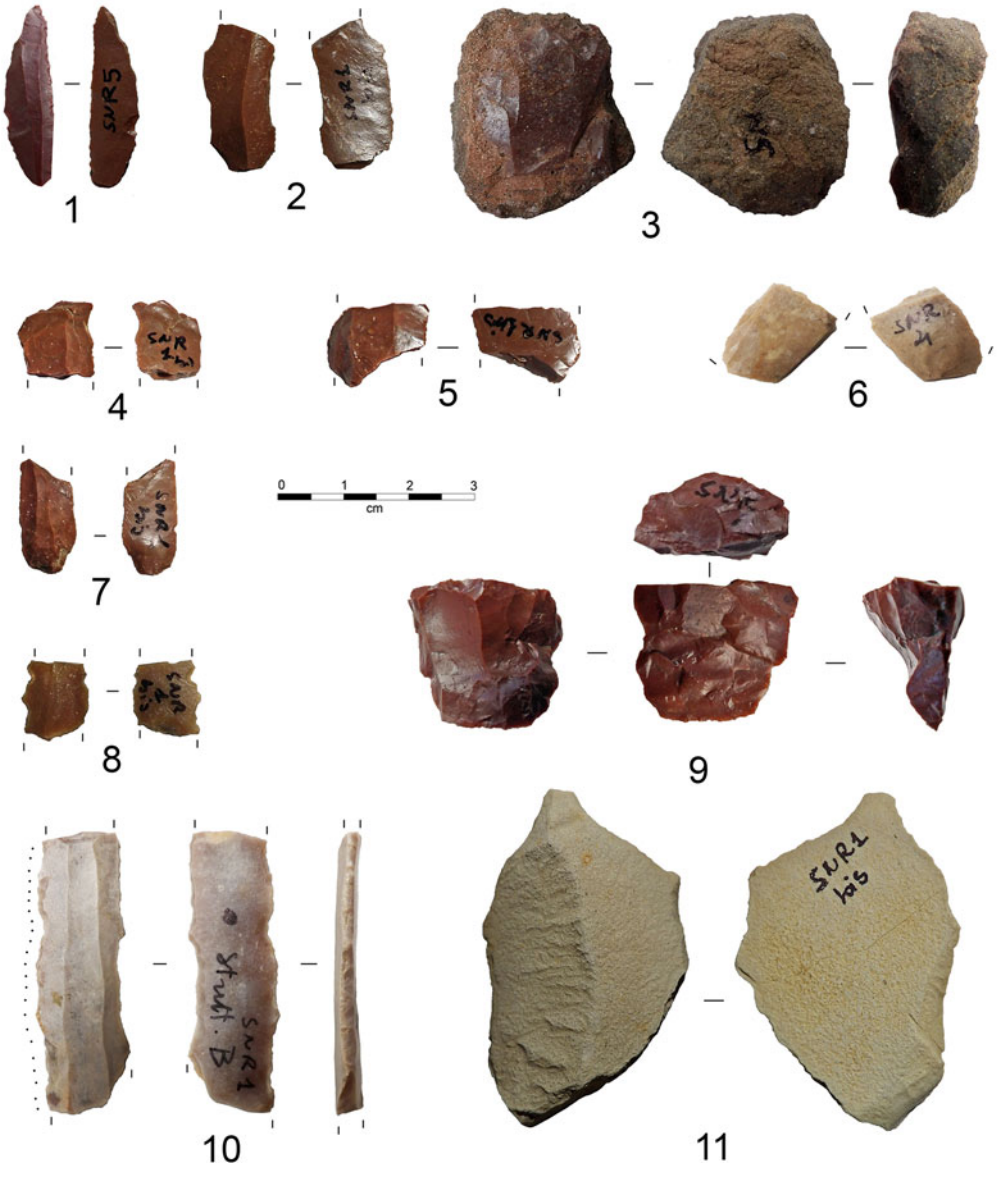

Fig 16. Sonari: knapped stone industry. 1) microlithic backed point from SNR-5; 2) retouched microbladelet fragment from SNR-1bis; 3) microbladelet core from SNR-6; 4) microbladelet fragment from SNR-1bis; 5) bladelet fragment from SNR-1bis; 6) microflakelets fragment from SNR-4bis; 7) microbladelet fragment from SNR-1bis; 8) microbladelet fragment from SNR-1bis; 9) microbladelet core from SNR-4; 10) used microbladelet fragment from SNR-1B; 11) perforator on limestone flakelet from SNR-1bis. *Photographs*: E Starnini.

SNR-1B. It has a trapezoidal cross-section, straight parallel sides, semi-abrupt, inverse retouch along the right side and cut wood use-wear traces along the left side (fig 16, no. 10).[60] This tool can be compared with four other bladelets recovered in 2002, two of which show the same type of semi-abrupt retouch.[61] One microbladelet backed point of Gadani chert with abrupt retouch along the left side was collected from SNR-5 (fig 16, no. 1). One exhausted, prismatic core with microbladelet detachments on one face obtained from a small, corticated pebble of Gadani chert comes from SNR-6 (fig 16, no. 3), while another fragment of Gadani chert core with one prepared platform and microbladelet detachments on one face comes from SNR-4.

The knapped stone assemblage from Sonari consists of very few artefacts. However, some considerations can be made on their typology, function and the raw material exploited to produce them. Most specimens are made from Gadani dark reddish brown chert,[62] though Rohri and Las Bela chert artefacts are also present. Gadani chert is easy to identify. It was exploited for making tools between the beginning of the Holocene[63] and most probably the Indus period, as is shown by a radiocarbon date obtained from Ras Gadani (GrN-26369, see above). However, during this latter period the exploitation of Gadani chert seems to have partly ceased and been substituted by that of exogenous, better quality raw material extracted from the chert mines of Lower and Upper Sindh.[64] As far as we know, the present distribution radius of Gadani artefacts[65] extends roughly from the Mulri Hills at the eastern outskirts of Karachi, in the east, to Lake Siranda (Las Bela), in the north-west.[66]

The presence of two cores, from SNR-4 (fig 6, no. 9) and SNR-6 (fig 6, no. 3) respectively, shows that at least some of the artefacts were produced on the spot. The backed point of no. 1 in fig 16 is atypical for a Bronze Age lithic assemblage, and might be better related to an earlier occupation, most probably of the seventh millennium BP. This attribution is suggested by the recovery of one comparable tool type, made from the same raw material, from the impressive Lake Siranda shell midden SRN-29, whose earliest occupation is radiocarbon dated between 7130±35 BP (GrM-18731)[67] and 6595±35 BP (GrA-54299), both on *T palustris*.[68] However, we have to consider that we know very little of the typology and technology of the knapped stone assemblages of the fisher-gatherers of this period, and most Gadani chert artefacts from the Sonari sites are indeed microlithic specimens. The presence of one regular bladelet of non-local chert from the surface of one of the SNR-1 structures is also important. Most probably it comes from Lower or Upper Sindh sources, among which are the Rohri Hills, Ongar and Jhimpir,[69] that undoubtedly supplied the Bronze Age Indus sites located around Sonari, including Pir Shah Jurio[70] and Balakot.[71]

60. Biagi and Nisbet 2014, fig 8.
61. Biagi 2004, fig 6, nn 1–4.
62. Naseem *et al* 1996–7.
63. Khan 1979, 12.
64. Biagi and Starnini 2018.
65. A few more Gadani chert flakelets were collected during the first visit in Jan 2000.
66. Biagi 2013, fig 6.
67. Samples collected and dated in 2019.
68. Biagi *et al* 2016a, 5.
69. Biagi *et al* 2016b.
70. Biagi 2004, fig 5.
71. Samples collected and dated in 2013.

The general impression, based on the study of the knapped stone artefacts at present underway from the Lake Siranda sites in Las Bela,[72] the Tharro Hills and Kot Raja Manjera, in Lower Sind,[73] suggests that important technological changes took place at the turn of the Chalcolithic in the study region, when pressure technique was introduced for the manufacture of regular blades and bladelets and new, exotic raw materials started to be exploited for the first time during the Amri Culture period.[74]

THE POTTERY

Michela Spataro

A few small potsherds come from the surface of three radiocarbon-dated sites (SNR-1, SNR-4 and SNR-8: tables 1 and 5; fig 8, bottom), two of which from structure SNR-1A2 (fig 17, nos 7 and 8).

Firing colour and paste characteristics show that most potsherds might be attributed to the Indus Civilisation or slightly earlier (SRN-1A2). Most fragments are undecorated body sherds of unidentifiable vessel shapes (fig 17, nos 1–8, 13–15), with the exception of a small rim of a probable plate (fig 17, no. 10), a lower body fragment close to the bottom from SNR-4bis (fig 17, no. 12), one sherd with narrow, horizontal, red-painted lines from SNR-8 (fig 17, no. 9) and with narrow, horizontal grooves from SNR-8 (fig 17, no. 11). A few pieces have wheel traces.

Besides fragments of two Chinese porcelain vessels (fig 3, nos 2 and 4) and undecorated potsherds (fig 3, nos 1 and 3), a few fragments of two glass vessels were found on the surface of graves 100B and 100C (fig 3, nos 6–8; table 5).

Seventeen ceramic potsherds from a maximum of sixteen vessels (table 6) and three porcelain samples were analysed.

All samples were sent for polished thin sectioning. The thin sections were analysed with a Zeiss Axiophot polarised microscope and by variable pressure scanning electron microscopy-energy dispersive X-ray spectrometry (SEM-EDX).[75] EDX analyses were carried out on four different areas of each sample at ×100 magnification (each covering an area of *c* 1.5 × 1.1mm). The SEM was used at a pressure of 30Pa with a 20kV accelerating voltage; the samples were analysed uncoated at a 10-mm working distance. Ten elements (Na, Mg, Al, Si, K, Ca, Ti, Mn, Fe and Pb) were detected and measured. The results were converted into oxide percentages, which were normalised (oxygen by stoichiometry) to take into account the fact that oxygen and carbon are not measured.

A variety of recipes and raw materials were used to make the seventeen ceramic samples, which were divided into eleven fabric groups (see table 6 for detailed descriptions). No fabric group appears at more than one site.

There are therefore significant differences between the ceramic fabrics, as expected from pottery made in different periods. Unfortunately, on the basis of the fragmented status and the weathered surfaces of the sherds, it is not possible to trace correlations between shape, surface treatments and paste used to make the ceramics. In some instances, ceramics were not tempered (Fabrics 1, 3 and 5, eg fig 18c), while others were probably

72. Unpublished data, material under study 2020.
73. Biagi 2005 and 2010.
74. Casal 1964.
75. See Spataro 2011, 256–7.

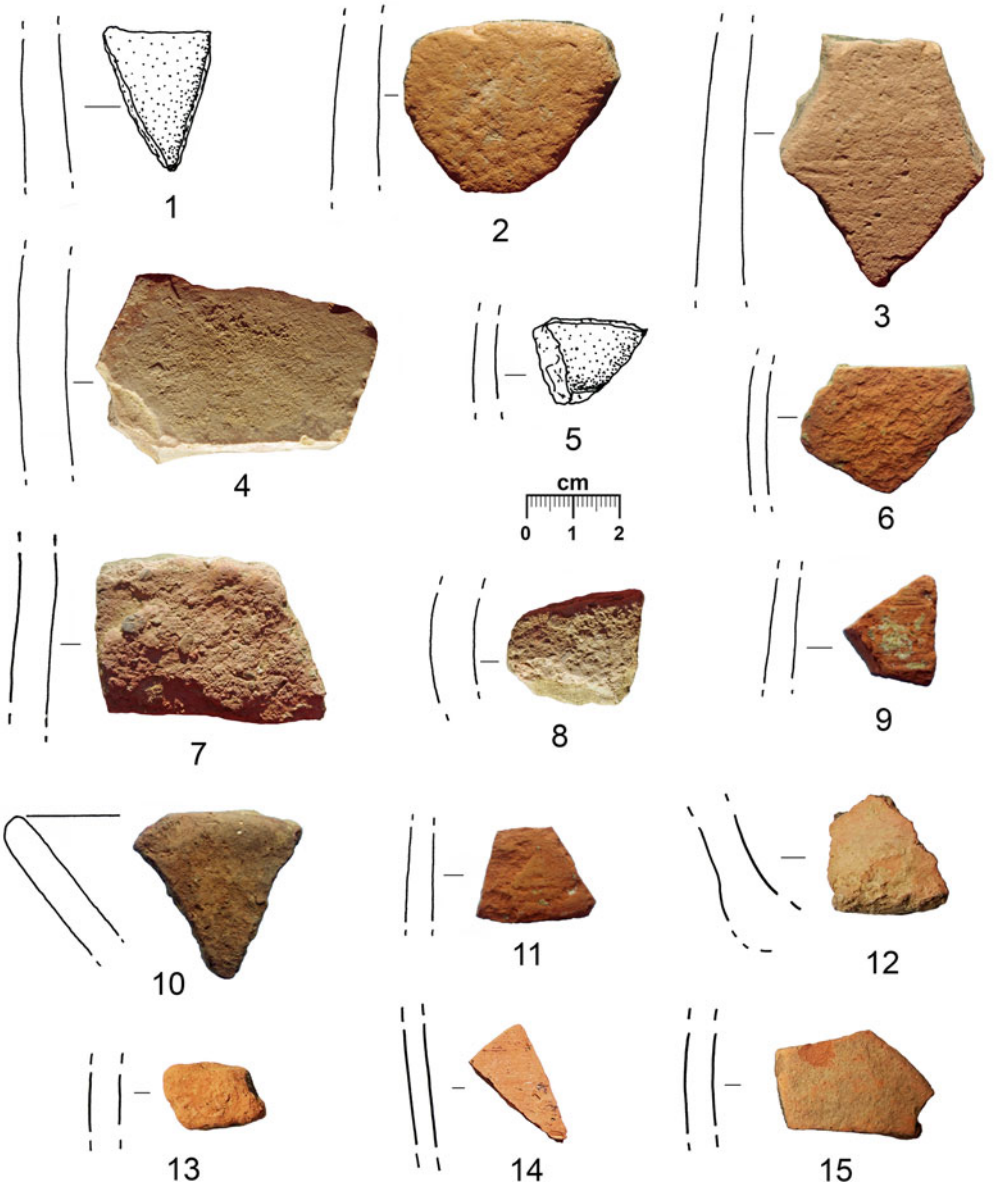

Fig 17. Sonari: prehistoric potsherds. 1 and 3–5) SNR-1; 2) SNR-1Sud; 7 and 8) SNR-1A2; 12–15) SNR-4bis; 6 and 9–11) SNR-8 (see table 5). *Photographs*: E Starnini.

tempered with sand (Fabrics 2, 6 and 7; eg fig 18a and d) and grog (Fabrics 8–10; see fig 18 e–f). Grog was added to a couple of Bronze Age sherds (SNR11 and 12) and to a body sherd with grooved decoration (SNR14). Grog inclusions varied, some were calcareous, others were not (eg in sample SNR14), some were more highly-fired than the matrix of the sherds to which they were added, some included scattered coarse and fine quartz. Sample SNR14 included second generation grog (grog in grog; see fig 18f),

Table 5. Sonari: list and description of the ceramic and glass sherds. * = same vessel; n.a. = not analysed.

Site no	Coordinates	Survey date	Material	Description	Colour (Munsell)	Measures (L × W × T) mm	Analysis no.	Figure
SNR-1	24°52′39.5″N–66°41′34.7″E	07/08/2013	Pottery*	Body sherd, smoothed surfaces	7.5YR6/4, Light brown	31 × 22 × 9	SNR4	17, no 1
SNR-1	24°52′39.5″N–66°41′34.7″E	07/08/2013	Pottery*	Body sherd, smoothed surfaces	7.5YR6/4, Light brown	55 × 42 × 9	SNR2	17, no 3
SNR-1	24°52′39.5″N–66°41′34.7″E	07/08/2013	Pottery	Body sherd, smoothed surfaces	7.5YR5/4, Brown	48 × 51 × 9	SNR5	17, no 4
SNR-1	24°52′39.5″N–66°41′34.7″E	07/08/2013	Pottery	Body sherd, weathered surfaces	7.5YR6/4, Light brown	12 × 23 × 4.5	SNR3	17, no 5
SNR-1Sud	24°52′39.1″N–66°41′34.9″E	07/08/2013	Pottery	Body sherd, weathered surfaces	5YR6/8, Reddish yellow	36 × 47 × 8.5	SNR10	17, no 2
SNR-1A2	24°52′37.8″N–66°41′31.1″E	07/08/2013	Pottery	Body sherd, visible inclusions	5YR6/6, Reddish yellow	35 × 47 × 7	SNR12	17, no 7
SNR-1A2	24°52′37.8″N–66°41′31.1″E	07/08/2013	Pottery	Body sherd, visible inclusions	7.5YR6/6, Reddish yellow	30 × 27.5 × 7.5	SNR11	17, no 8
SNR-4bis	24°52′39.4″N–66°41′35.2″E	07/08/2013	Pottery	Lower body sherd, rough surfaces	5YR6/6, Reddish yellow	25 × 21 × 11	n.a.	17, no 12
SNR-4bis	24°52′39.4″N–66°41′35.2″E	07/08/2013	Pottery	Body sherd, weathered surfaces	7.5YR5/4, Brown	19 × 15 × 7	n.a.	17, no. 13
SNR-4bis	24°52′39.4″N–66°41′35.2″E	07/08/2013	Pottery	Body sherd, smoothed surfaces	5YR5/6, Yellowish red	26 × 19 × 4	n.a.	17, no. 14
SNR-4bis	24°52′39.4″N–66°41′35.2″E	07/08/2013	Pottery	Body sherd, weathered surfaces	5YR5/6, Yellowish red	25 × 32 × 8	n.a.	17, no. 15
SNR-8	24°52′13.5″N–66°41′18.4″E	08/08/2013	Pottery	Body sherd, eroded surfaces	7.5YR6/6, Reddish yellow	29 × 37 × 4	SNR16	17, no. 6
SNR-8	24°52′13.5″N–66°41′18.4″E	08/08/2013	Pottery	Body sherd, narrow grooved lines	7.5YR6/6, Reddish yellow	24 × 21 × 6	SNR15	17, no. 9
SNR-8	24°52′13.5″N–66°41′18.4″E	08/08/2013	Pottery	Plate rim, weathered surfaces	10YR6/4, Light yellowish brown	35 × 33 × 6	SNR14	17, no. 10
SNR-8	24°52′13.5″N–66°41′18.4″E	08/08/2013	Pottery	Body sherd, red-painted narrow lines	7.5YR6/6, Reddish yellow	20 × 26 × 6	SNR13	17, no. 11

(*Continued*)

Table 5. (*Continued*)

Site no	Coordinates	Survey date	Material	Description	Colour (Munsell)	Measures (L × W × T) mm	Analysis no.	Figure
SNR-100A	24°52′58.8″N–66°42′02.2″E	10/01/2014	Blue painted Chinese porcelain*	Base sherd, pedestalled shape	–	25 × 44 × 5	SNR103	3, no. 2
SNR-100B	24°52′59.3″N–66°42′02.5″E	10/01/2014	Glass (8 pieces)*	Body sherds, spherical container	5Y3/2, Dark olive grey	-	n.a.	3, no. 8
SNR-100C	24°52′59.6″N–66°42′02.7″E	10/01/2014	Blue painted Chinese porcelain*	Base sherd, pedestalled shape	–	32 × 34 × 5	SNR102	3, no. 2
SNR-100C	24°52′59.6″N–66°42′02.7″E	10/01/2014	Glass	Body sherd?	5GY7/1, Light greenish grey	13 × 11 × 1	n.a.	3, no. 6
SNR-100C	24°52′59.6″N–66°42′02.7″E	10/01/2014	Glass (2 pieces)*	Neck sherds, flask or bottle?	5Y3/2 Dark olive grey	48 × 37 × 3.5	n.a.	3, no. 7
SNR-100D	24°52′59.3″N–66°42′02.8″E	10/01/2014	Pottery (3 pieces)	Body sherd, smoothed surfaces	5YR6/4, Light reddish brown	45 × 101 × 4	SNR6 & 8 (same pot), SNR7	3, no. 1
SNR-100D	24°52′59.3″N-66°42′02.8″E	10/01/2014	Ceramic vessel (2 pieces)	Base sherd, 2 narrow grooves	Gley 3/1, Dark bluish grey	74 × 119 × 17	SNR100	3, no. 5
SNR-100E	24°52′58.6″N-66°42′02.8″E	10/01/2014	Pottery	Plate base, weathered surfaces	5YR6/6, Reddish yellow	23 × 44 × 7	SNR1	3, no. 3
SNR-100E	24°52′58.6″N-66°42′02.8″E	10/01/2014	Chinese porcelain	Body sherd	White	27 × 32 × 3	SNR101	3, no. 4

Table 6. Sonari: description of ceramic fabric groups discussed in the text (analysis by M Spataro)

Fabric group and samples	Clay	Non-plastic inclusions	Notes/clay processing
Fabric 1 (sample SNR1)	Red, slightly micaceous, oriented and non-calcareous	Abundant: sub-angular and angular quartz (<20%; 0.2 × 0.15 and 0.04 × 0.03mm; few very fine quartz grains 0.01 × 0.01mm) Common: polycrystalline quartz (some with metamorphism), fine muscovite (<2%), opaques, ilmenite (?) Rare: plagioclase, thick lamellae of biotite mica, possible fine serpentine, hornblende, pyroxene, very occasional elongated void possibly left by burning out of plant matter (naturally present in the clay)	Not-tempered Post-depositional calcareous fragments infilling the voids of the fabric and on the surface
Fabric 2 (samples SNR2, 4)	Red and slightly calcareous	Abundant: fine and well-sorted mainly sub-angular quartz (>20%; ca 0.07 × 0.05mm), fine polycrystalline limestone pellets Common: fine muscovite mica (<2%), iron oxides, opaques Rare: amphibole, fine serpentine (?), polycrystalline quartz, fine igneous inclusions (ca. 0.08mm; made of fine feldspar; SNR2), possible microcline fragment (SNR2), fine clay pellets rich in fine quartz inclusions (mainly in sample SNR2)	Sand-tempered (?) Clay filaments starting to vitrify (SNR2, 4) Post-depositional calcareous fragments and sand infilling the voids of the fabric and on the surfaces
Fabric 3 (sample SNR3)	Fine red and slightly calcareous	Common: quartz inclusions (<5%; ca 0.1 × 0.08mm), polycrystalline limestone pellets (<5%; up to 0.38mm), iron oxides Rare: plagioclase, polycrystalline quartz, very fine muscovite mica	Not-tempered Clay filaments starting to vitrify Post-depositional calcareous fragments along the surface
Fabric 4 (sample SNR5)	Brownish-red, very fine, slightly micaceous and non-calcareous	Rare: fine quartz inclusions (ca 0.02 × 0.02mm), very fine muscovite and biotite, clay fragments, iron oxides, fine voids (probably left by the drying process)	Levigated
Fabric 5 (samples SNR6, 7, 8)	Brownish-red, micaceous and slightly calcareous	Common: fine quartz inclusions (>10%; 0.04 × 0.04mm, with scattered coarser grains, up to 0.1 × 0.08mm), very fine muscovite mica (>3%) Rare: biotite mica, scattered voids, iron oxides	Not-tempered Post-depositional calcareous fragments infilling the voids and the surfaces
Fabric 6 (samples SNR9, 10)	Reddish, very micaceous and highly-fired	Abundant: sub-angular quartz, muscovite mica with long lamellae (>5%) and biotite with thinker lamellae (ca 3%, up to 0.15mm long; present in clusters as well) Common: plagioclase Rare: polycrystalline quartz, flint, pyroxene, felsic rock fragments, iron oxides	Probably sand-tempered The sherds might belong to the same pot Some post-depositional calcareous fragments are present

(*Continued*)

Table 6. (*Continued*)

Fabric group and samples	Clay	Non-plastic inclusions	Notes/clay processing
Fabric 7 (samples SNR13, 15, 16)	Red, fine, micaceous and non-calcareous	Abundant: fine and very well-sorted quartz (20%; 0.04 × 0.03mm), very fine and long muscovite mica Common: pyroxene Rare: biotite mica, amphibole, opaques, iron oxides	Tempered with sieved sand (?) Clay filaments starting to vitrify A painted layer is visible on the surface of samples SNR13 and 15 Post-depositional calcareous fragments on the surface of SNR15 and 16
Fabric 8 (SNR11)	Brown and non-calcareous	Abundant: grog of various sizes (grog inclusions contain very few inclusions, like the main fabric of the sherd) Common: very fine quartz inclusions (>5%; 0.02 × 0.02mm), very fine muscovite mica Rare: limestone fragments, biotite mica, pyroxene, fine opaques, iron oxides	Grog-tempered
Fabric 9 (sample SNR12)	Brown, slightly vitrified, calcareous and micaceous	Abundant: fine quartz inclusions (15%; 0.02 × 0.02mm but with some scattered coarser quartz grains) Common: some grog inclusions (which are made of a similar paste to that of the surrounding clay matrix of sample SNR12, occasionally with slightly coarser quartz, or more calcareous), fine muscovite, coarse sub-rounded limestone pellets, opaques, iron oxides Rare: pyroxene, iron-rich clay pellets	Grog-tempered Post-depositional calcareous fragments are visible in the fabric and on the surface
Fabric 10 (sample SNR14) This sherd is much finer than the previous two grog-tempered.	Brown-reddish, non-calcareous, very micaceous and highly-fired in some regions	Abundant: mainly fine quartz inclusions (<10%; ca 0.04 × 0.04mm; with scattered coarser grains), grog inclusions (between 0.7 and 0.05mm long; occasionally more highly-fired than the present sherd. Some grogs are slightly calcareous) Rare: clay pellets, amphibole, plagioclase, polycrystalline quartz, calcite of secondary formation	Grog-tempered Well-fired but no vitrification of the clay
Fabric 11 (sample SNR100)	Dark brown	Common: fine quartz (<5%; 0.03mm), siltstone, coarse fragments of fine-grained pelitic fragments, similar in composition to the matrix, but richer in calcium oxide, some of which are vitrified, some are iron-rich (up to 18% iron oxide) Rare: serpentine (?), pyroxene	Post-depositional carbonates are visible infilling the voids of the sherd

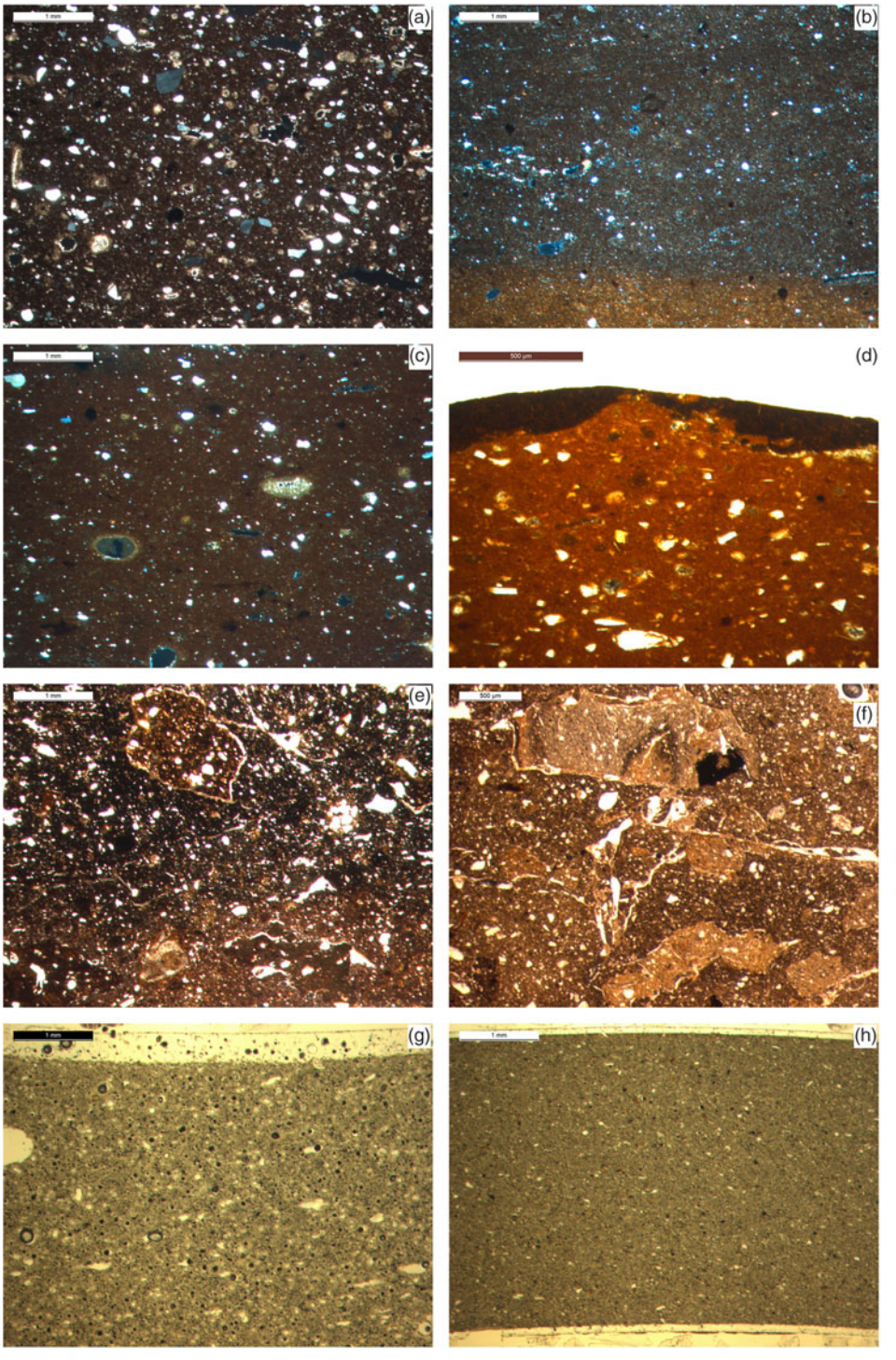

Fig 18. Sonari: photomicrographs of ceramic thin sections of samples. a) SNR4; b) SNR5; c) SNR8; d) SNR13; e) SNR12; f) SNR14; g) blue-on-white SNR102; h) SNR101 white porcelain samples. Photomicrographs a–c were taken in cross polarised light, and d–h in plane polarised light. *Photographs*: M Spataro.

suggesting that this technical choice was an ongoing tradition. In prehistory, the use of a specific temper type is often linked to cultural tradition rather than for functional reasons, so the presence of a grog fragment within another grog fragment suggests a tradition of grog-tempering within the same cultural group.

The only levigated pot (SNR5, Fabric 4) is a body sherd (fig 17, no. 4), which was also red-painted (fig 18d) with a paint made by mixing a fine clay and iron oxides (the paint is not visible to the naked eye).

The sands inclusions in the potsherd fabrics, some of which were deliberately added to the clay and others were naturally occurring in the raw materials, represent a variety of minerals that come from metamorphic and igneous settings. As they are fine-grained, they might have been transported over long distances from the original rock outcrops. The Sonari sites are located in proximity of the Hab mouth, whose lower reaches cross Alveolina limestone. The local geology also includes Nari and Gáj formations and Kojak shales.[76] The Nari (Oligocene to early Miocene) and Gáj (Miocene) formations are consolidated rocks that include igneous rocks (altered basalt, andesite, diorite and granite); metamorphism is also recorded.[77]

Amphibole and the igneous inclusions identified in the potsherds are too fine to be attributed to a specific rock formation; in addition, amphibole occurs in different igneous rock formations (eg granite, andesite, diorite, etc.). On these bases, the potsherds could be of local origin, but the geology is also homogenous for a long stretch of the Hab.[78]

The chemical compositions of the sherds confirm the mineralogical groupings (table 7). For example, four body sherds (samples SNR2, 3, 4 and 5) were found at the same spot (SNR-1), and they were attributed to three fabrics (table 6): they have three different chemical compositions, as seen in principal components analysis (PCA) (fig 19). Other sherds found together have a very similar chemical composition, suggesting that they were made from the same raw materials. The samples of Fabric 7 (SNR13, 15 and 16) could come from the same pot (fig 19), as suggested by the mineralogical analysis. Two pots (SNR9 and 10), which were made with a clay richer in muscovite and biotite micas than the other pots, are also chemically different from the others. Although mineralogically different, the dark bluish/grey vessel (SNR100), is chemically similar to samples attributed to Fabric 7, found at SNR-8.

Finally, the Chinese porcelain sherds are very different from each other; although they have both a fine paste, the small blue and white bowl (SNR102, 103) has a paste rich in fine quartz with recurrent voids. The glaze is 0.14–0.09mm thick and lime-alkaline (fig 18g). The white porcelain fragment (SNR101) has a finer paste, with few quartz inclusions, occasional iron oxides and no voids. It was glazed with a fine, *c* 0.05mm thick, lead glaze (fig 18h).

DISCUSSION

The surveys carried out by the Italian Archaeological Mission during the last twenty years in the territory stretching from Sonmiani and Siranda lagoons in Las Bela to the Indus Delta, in Lower Sindh, led to the discovery of many archaeological sites, most of which

76. Vredenburg 1909, pl 12.
77. Khan 1973, 17–23.
78. Vredenburg 1909, pl 12.

Table 7. Sonari: SEM-EDX compositional results of the fabrics of the Sonari sherds. Average of four bulk analyses in the grey rows, and standard deviation in the white rows; s.d. = standard deviation; – = below detection limit (analysis by M Spataro).

Sample no.	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	FeO	PbO
SNR1	1.8	3.4	17.6	60.7	3.0	6.7	0.7	-	5.9	
s.d.	0.2	0.3	0.4	0.7	0.1	0.1	0.1		0.2	
SNR2	1.1	3.1	14.3	63.2	2.2	9.7	0.8	-	5.6	
s.d.	0.1	0.2	0.5	1.0	0.1	0.3	0.1		0.2	
SNR3	0.9	4.0	19.4	58.0	1.9	6.4	1.2		8.1	
s.d.	0.1	0.1	0.5	0.2	0.2	1.2	0.1		0.7	
SNR4	1.1	3.2	15.1	61.8	2.2	9.8	0.8	0.2	5.8	
s.d.	0.1	0.1	0.5	0.9	0.1	0.4	0.0	0.0	0.3	
SNR5	1.5	4.3	19.5	56.6	3.4	6.9	0.8	-	6.9	
s.d.	0.1	0.1	0.1	0.3	0.1	0.3	0.0		0.1	
SNR6	1.7	3.5	17.9	59.8	2.9	7.5	0.8	-	6.0	
s.d.	0.1	0.1	0.3	0.5	0.1	0.2	0.0		0.1	
SNR7	1.7	3.7	17.8	59.5	3.0	7.2	0.8	0.0	6.2	
s.d.	0.1	0.1	0.2	0.6	0.1	0.4	0.0	0.0	0.1	
SNR8	1.7	3.5	17.7	59.4	2.9	7.7	0.8	-	6.2	
s.d.	0.1	0.1	0.1	0.4	0.1	0.3	0.0		0.1	
SNR9	1.3	2.0	17.2	68.5	3.2	1.6	0.7	0.0	5.5	
s.d.	0.1	0.1	0.9	1.3	0.1	0.0	0.0	0.0	0.2	
SNR10	1.3	3.5	16.1	63.5	3.1	6.9	0.7	-	5.0	
s.d.	0.1	0.2	0.2	1.5	0.1	1.1	0.1		0.2	
SNR11	1.5	3.0	19.6	61.0	3.7	4.6	0.9	0.0	5.8	
s.d.	0.3	0.2	0.3	1.6	0.2	1.5	0.1	0.0	0.3	
SNR12	1.1	2.3	18.1	62.7	2.6	6.0	1.0	0.0	6.0	
s.d.	0.1	0.1	0.3	1.0	0.1	0.7	0.1	0.0	0.1	
SNR13	1.5	3.5	19.5	59.8	3.1	5.2	0.8	-	6.6	
s.d.	0.1	0.1	0.5	0.5	0.2	0.3	0.0		0.2	
SNR14	1.0	2.7	18.4	65.4	3.1	2.4	0.9	-	6.0	
s.d.	0.2	0.2	0.3	0.4	0.5	0.9	0.1		0.1	
SNR15	1.4	3.5	19.7	59.9	3.3	4.6	0.8	-	6.7	
s.d.	0.1	0.1	0.2	0.4	0.1	0.1	0.0		0.1	
SNR16	1.5	3.5	19.5	60.0	3.3	4.9	0.8	-	6.6	
s.d.	0.1	0.1	0.3	0.1	0.1	0.2	0.0		0.1	
SNR100	1.1	3.7	20.4	61.3	3.4	2.8	0.8	0.0	6.7	
s.d.	0.0	0.3	0.9	1.3	0.2	1.6	0.1	0.0	0.3	
SNR101 paste	0.5	0.2	24.0	72.6	1.7	0.3	0.2	0.0	0.5	
s.d.	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	
SNR101 glaze	1.6	0.2	12.7	61.2	3.4	5.8	0.0	0.0	0.2	15.0
s.d.	0.0	0.0	0.2	0.8	0.2	0.5	0.0	0.0	0.0	0.7
SNR102 paste	0.0	0.8	20.7	72.4	2.0	2.5	0.1	0.0	1.4	
s.d.	0.1	0.0	0.2	0.3	0.0	0.1	0.1	0.0	0.2	
SNR102 glaze	0.1	3.0	14.6	67.0	1.9	12.4	0.0	-	0.9	
s.d.	0.1	0.4	0.1	1.2	0.1	0.8	0.1		0.0	
SNR103 paste	0.0	0.8	20.5	72.6	2.0	2.6	0.2	-	1.2	
s.d.	0.0	0.0	0.3	0.4	0.0	0.0	0.0		0.0	
SNR103 glaze	0.0	2.9	14.5	67.5	2.0	11.9	0.0	-	0.9	
s.d.	0.0	0.1	0.5	0.8	0.1	0.7	0.1		0.0	

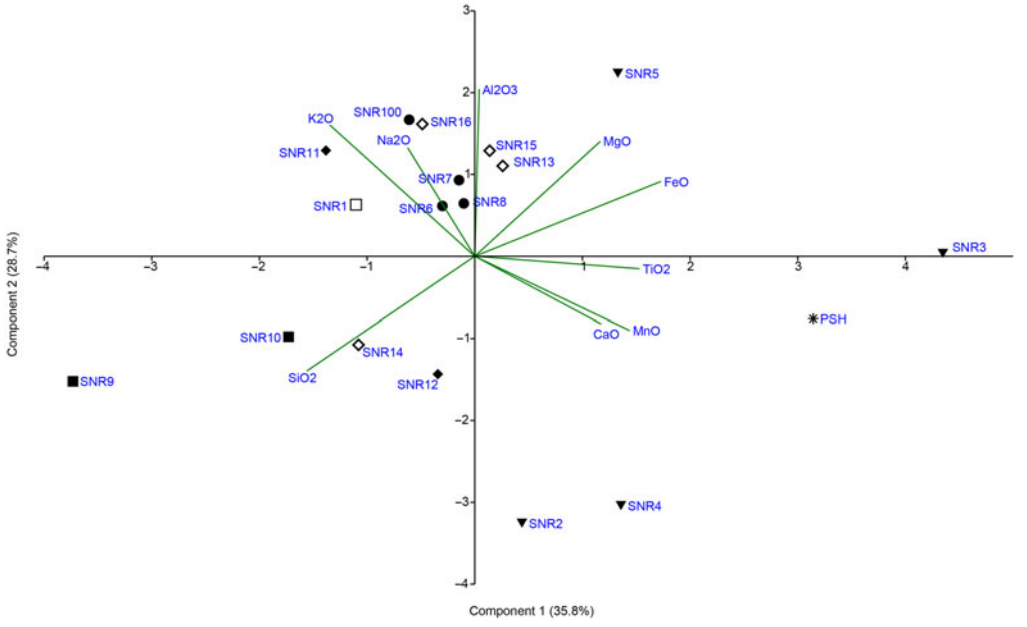

Fig 19. PCA output (Components 1 and 2), based on SEM-EDX compositional data for the sherds analysed from Sonari. PCA was carried out using Past v3.18 (Hammer *et al* 2001). Each point represents the average of four bulk analyses (table 7). The samples analysed represent the full range of variability in petro-fabrics. Symbols according to the find spot of the sherds (see table 5). Legend: symbols correspond to find-sites (filled triangle SNR-1; filled square: SNR-1Sud; filled diamond: SNR-1A2; diamond SNR-8; dot: SNR-100D; square SNR-100E; asterisk: Pir Shah Jurio). *PCA output*: M Spataro.

consist of shell middens and scatters/spots of mangrove and marine shells that have been systematically recorded and sampled for radiocarbon dating.

The project led to the first reconstruction of the time, pace and settlement pattern related mainly to the human exploitation of mangal and marine resources along this part of the north Arabian Sea coastline, an almost *terra incognita* from both archaeological and palaeoenvironmental points of view.

At present we have at our disposal more than 100 radiocarbon dates, most of which are from *T palustris* and *T telescopium* samples.[79] They show that mangroves flourished during the Holocene in virtually every estuary of freshwater courses in this part of the north Arabian Sea coast whenever suitable environmental conditions were available in term of salinity and temperature, attracting human groups that exploited their resources. Their late Holocene and sub-recent disappearance has been observed along the coasts of Sindh, Balochistan and the Persian/Arabian Gulf.[80] This fact is connected with the fractionation and later disappearance of the Bronze Age Indus Civilisation that was caused by monsoon weakening and the establishment of arid conditions that started to prevail around the end of the third millennium cal BC.[81]

79. Biagi and Starnini 2018.
80. Tengberg and Lombard 2001; Lézine *et al* 2002; Berger *et al* 2013.
81. Staubwasser *et al* 2003; Dixit *et al* 2014.

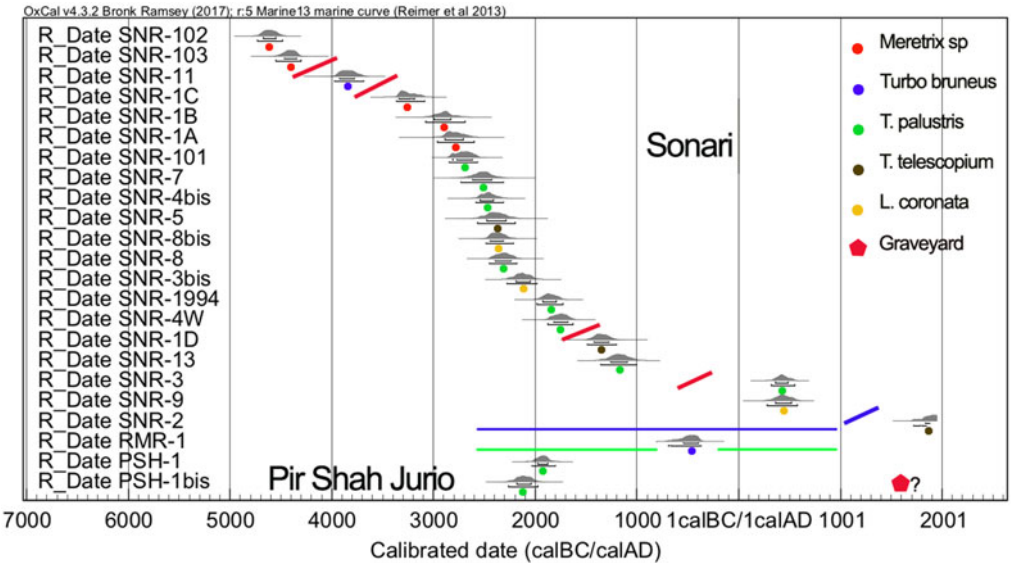

Fig 20. Plot of the calibrated dates from Sonari (SNR), Ras Muari (RMR-1) and Pir Shah Jurio (PSH) calibrated according to the marine curve of 229±27 ^{14}C years (see Reimer and Reimer 2001). *Graph*: T Fantuzzi.

The earliest indication of the presence of mangrove swamps comes from the Mulri Hills (MH-15: GrA-63863: 7320±40 BP on *T palustris*), a low limestone range located at the eastern outskirts of Karachi, at that time under direct influence of the Malir and some Indus channels, while a slightly more recent date comes from a shell midden discovered along the eastern shore of Lake Siranda (Las Bela) (SRN-43: GrA-54290: 7200±35 BP on *T palustris*). Both these dates are from single adult fragments of *T palustris* shell. However, it is important to remark that a piece of marine bivalve from KDJ-1, a site located along the southern bank of the Kadeji River at its confluence with the Mol, yielded a result *c* 1000 years earlier (KDJ-1: GrA-63862: 8275±45 BP). Though the date comes from a marine shell, its negative δ^{13}C value of −4.44 shows that it grew in a mangrove environment, suggesting that mangrove swamps were already flourishing at the Malir mouth, and more broadly the Karachi Gulf, around the end of the ninth millennium BP.[82]

The earliest evidence of human exploitation of the coastal resources at Sonari comes from two small scatters of *Meretrix* bivalves, radiocarbon dated to the second half of the seventh millennium BP (SNR-102: GrA: 62253: 6340±40 BP, and SNR-103: GrA-59828: 6180±50 BP). These results raise the question of the time mangroves made their first appearance around the Hab mouth (fig 20), given that the oldest *T palustris* dates available from the area fall between the middle of the fifth and the end of the fourth millennium BP (from SNR-101 to SNR-4W: see table 2). Moreover, the results show that mangroves were still present around Sonari when they were already disappearing from the coast of Las Bela, as suggested by the assays obtained from Lake Siranda and the Bay of Daun.[83] The SNR-101 date matches well with that obtained from the Chalcolithic/Bronze

82. Biagi 2018.
83. Biagi *et al* 2012.

Age mound of Balakot[84] (BLK-1: GrA-55828: 4660±40 BP on *T palustris*),[85] along the course of the Winder, suggesting the existence of a mangrove swamp exploited by its inhabitants most probably along the eastern coast of the Sonmiani Lagoon.

Two slightly later dates were obtained from the small Indus Civilisation settlement of Pir Shah Jurio (fig 17; table 2). The site is located on a protruding terrace surrounded by alluvium and the traces of an old riverbed, along the left, eastern, bank of the Hab, *c* 6.5km north-east of its mouth and 8km north of Sonari (fig 1, top).[86] Finally, two results from Sonari (SNR-3 and SNR-2: see table 2), one from Daun (Daun-117: GrN-31494: 1440±30 BP on *T palustris*) and one from the northern shore of Lake Siranda (SRN-10, GrA-54302: 975±25 BP on *T palustris*) are the only historical dates so far available from Pakistani palaeo-mangroves.

As reported above, the Sonari sites yielded a small number of stone artefacts related to fishing. They consist almost exclusively of net sinkers, while fish hooks, harpoons and fish bones are missing. Their absence is most probably due to the very arid climatic conditions of the cape and salinity that have destroyed both metal artefacts and bones. However, the presence of notched stone net sinkers is very important. These artefacts are very rare in Las Bela. So far, Bronze Age specimens are known only from two sites discovered along the shores of the Bay of Daun, namely Daun 3 and Daun 5,[87] where ten shell middens have been radiocarbon dated to the Mature Indus period, and two more to the end of the same civilisation.[88] They are not represented from the Chalcolithic and Bronze Age mound of Balakot, along the Winder course, in the northern part of the Kurkhera Plain, where fish bones and mangrove shells are numerous.[89] Stone net sinkers are also very rare from the shell middens discovered along the shores of the ancient Siranda lagoon, in which only four specimens have been recovered,[90] three of which from Neolithic sites and one dated to the beginning of the Chalcolithic (SRN-73).[91]

According to the available evidence, we can suggest that fishing was not the primary activity practised by Neolithic to Bronze Age groups that seasonally settled along the shores of Daun and Siranda. These sites show that their main subsistence economy was the collection of mangrove shells and, to a lesser extent, bivalves that live also in mangrove waters. Only at Sonari was a different pattern recognised. Here, fishing was undoubtedly practised as well as shellfish gathering. The location of the site and the material used for the constructions of the SNR-1 village stone structures are also important. The site is definitively well hidden inside a wide saddle *c* 150m from the present seashore. Moreover, the exposed features are made of local limestone blocks and not bricks, which are widely considered the commonest construction material used during the Indus Civilisation. Though of quite a different age, the only known parallels are the small, historical stone fishers' structures on the hills near Gwadar, along the coast of Makran. On their surface, Siddiqi reports the presence of potsherds, flints, grinding stones and lime fragments, as well as Greek and Bactrian coins associated with bones and shells.[92]

84. Dales 1974.
85. Biagi *et al* 2013b.
86. Fairservis 1993, fig 9.1.
87. Biagi *et al* 2012, table 2.
88. Ibid, fig 14.
89. Meadow 1979; Belcher 2005.
90. Biagi and Starnini 2020, fig 6 nos 1–4.
91. Biagi *et al* 2016a, table 1.
92. Siddiqi 1956, 26.

Our data would suggest that fishing started to be more intensively practised in the area during the Bronze Age. The Sonari net sinkers are all typologically the same, though their weight differs. They would suggest that coastal fishing took place during the winter months, at low-tide in shallow waters along a narrow zone of the rocky coastline of this part of the cape,[93] considering the great danger represented by the Arabian Sea waters, especially in the summer months when the seasonal monsoon blows from the south-east and fishing is not practised even today.

Finally, two conjoined fragments of ostrich egg from SNR-1 are also important to report.[94] This discovery is unique in the archaeology of the region, since we still know very little of the presence of ostriches along the Arabian Sea coasts during the Holocene, and our knowledge has not improved during the last thirty years.[95]

To conclude, SNR-1 is the only Bronze Age fisher-gatherer site with stone structures so far discovered along the northern coast of the Arabian Sea.[96] It was settled mainly between the last centuries of the fourth and the first centuries of the third millennium cal BC; that is, between the end of the Chalcolithic and the beginning of the Bronze Age. One radiocarbon result obtained from structure SNR-1D (GrA-59835: 3660±50 BP on *T telescopium*) shows that it was inhabited again a few centuries later. According to the radiocarbon chronology, SNR-1 is slightly older than the small Indus settlement of Pir Shah Jurio (PSH).

A ceramic bangle from the latter site is petrographically and chemically similar to the vessel found at SNR-1,[97] suggesting a similar provenance (fig 19). However, most probably the two sites were settled in different periods and were not complementary to each other. This evidence raises interesting questions regarding the origins of SNR-1's inhabitants, the radius of their seasonal movements along the north Arabian Sea coast and, more broadly, about their systems of production, of which fishing, gathering, farming and probably hunting were part.[98]

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93. Ibid, 57.
94. Biagi 2004, fig 6 no. 5.
95. Neumayer 1990.
96. Desse and Desse-Berset 2005, 90.
97. Spataro 2013, 137.
98. Durrenberger and Pálsson 1987, 509; Nadjmabadi 1992.

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