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The scope of this paper is to illustrate and discuss the Mesolithic sites discovered during recent surveys carried out by the 'Joint Rohri Hills Project' (Biagi & Shaikh 1994) in the Thari District of Upper Sindh. Until a few years ago nothing was known of the Mesolithic period in the region, even though several sites had already been discovered in the suburbs of Karachi and along the coast of Las Bela. In effect, Commander K.R.U. Todd described a flint assemblage with geometric, trapezoidal microliths collected along the banks of the Lyari River in the Karachi County Golf Club (Todd & Paterson 1947); and Professor A. Rauf Khan (1979) published many Late Palaeolithic and Mesolithic sites, characterised by microlithic tools, just south of the Karachi University Campus and along the coast of Las Bela, in Baluchistan.

Preface

The first Mesolithic site of Upper Sindh was discovered in March 1995, east of the town of Thari, during a preliminary survey of the area. It was located on the top of a stabilised sand dune, west of the lake of Sāin Sim (Biagi & Kazi 1995). Other flint scatters attributable to the same age, characterised by the presence of geometric microliths, were discovered, the following year, at Duhbi, north of the lake of Khat Sim (Shar, Negrino & Starnini 1996). A few years later other Mesolithic flint assemblages were collected on the top of two other fossil dunes bordering the lakes of Lunwāro Sim and Pir Nago (Biagi 2004). Even though the Mesolithic flint industry had never been recorded from this region before, sites of this age were already known from neighbouring Rajastan (Misra 1977) where they are distributed in almost identical geographic locations.

Apart from the above-mentioned sites, important discoveries were made during the winter 2000-2001 in the Thari region. The survey, centred on the dunes around the lakes of Ganero (GNR) and Jamāl Shāh Sim (JS), led to the discovery of 18 sites, 11 of which yielded abrupt retouched microliths and/or geometric flint artefacts obtained from Rohri Hills flint, whose southernmost outcrops lie some 5 km east of the lakes. The approximate position of these sites is provided in Fig. 1. They are all located on stabilised sand dunes close or rather close to the above-mentioned salt-water basins.

The flint assemblages

The Mesolithic sites were discovered during a survey carried out between February 1st and 5th, 2001. They were all characterised by scatters of flints distributed over the surface of the fossil sand dunes. No particular concentration of artefacts, indicating possible buried structures such as fireplaces or artificial pits, has been noticed at any of the surveyed sites. The flints were normally lying in a horizontal position indicating that weathering had not greatly disturbed the original artefact distribution. The tools were collected by four people who worked on each site for about 1 hour.

All the artefacts are made of homogeneous pale brown flint whose original outcrops lie along the southern fringes of the Rohri Hills. Some of the tools are slightly patinated and look paler than the others.

Following Bagolini's (1968) method, the complete unretouched artefacts from seven sites with more than 100 such tools have been measured to develop the length: width and length-width : thickness diagrams whose results are shown in Table 1.

The results are quite homogeneous. The elongation indexes indicate that flakes (always over 30%) always prevail over blade-like flakes (*ca.* 20-26%). They are followed by wide flakes (*ca.* 15-23%) or blades (*ca.* 11-20%) according to the different assemblages, by very wide flakes (*ca.* 2-9%) and narrow blades (*ca.* 1-5%). The number of very narrow blades and extremely wide flakes is irrelevant (always less than 1%).

The dimension indexes are also similar with the exception of those of sites JS1 and JS4. The assemblages are mainly composed of normoliths (*ca.* 36-46%), followed by microliths and macroliths and by a much lower percentage of hypermacroliths and hypermicroliths. The exceptions are the assemblages from site JS1 and JS4. The unretouched flint industry of JS1 is mainly represented by microliths (44.56%) followed by normoliths (36.15%) and by macroliths (12.39%), while that of JS4 is characterised by normolithis (36.49%); the percentages of microliths (27.03%) and macroliths (25.01%) are almost identical.

The carination index shows quite a standardized production technique. The flat artefacts (*ca.* 40-48%) always prevail over very flat (*ca.* 26-40%) and thick products (*ca.* 9-13%). The other classes are represented by much lower

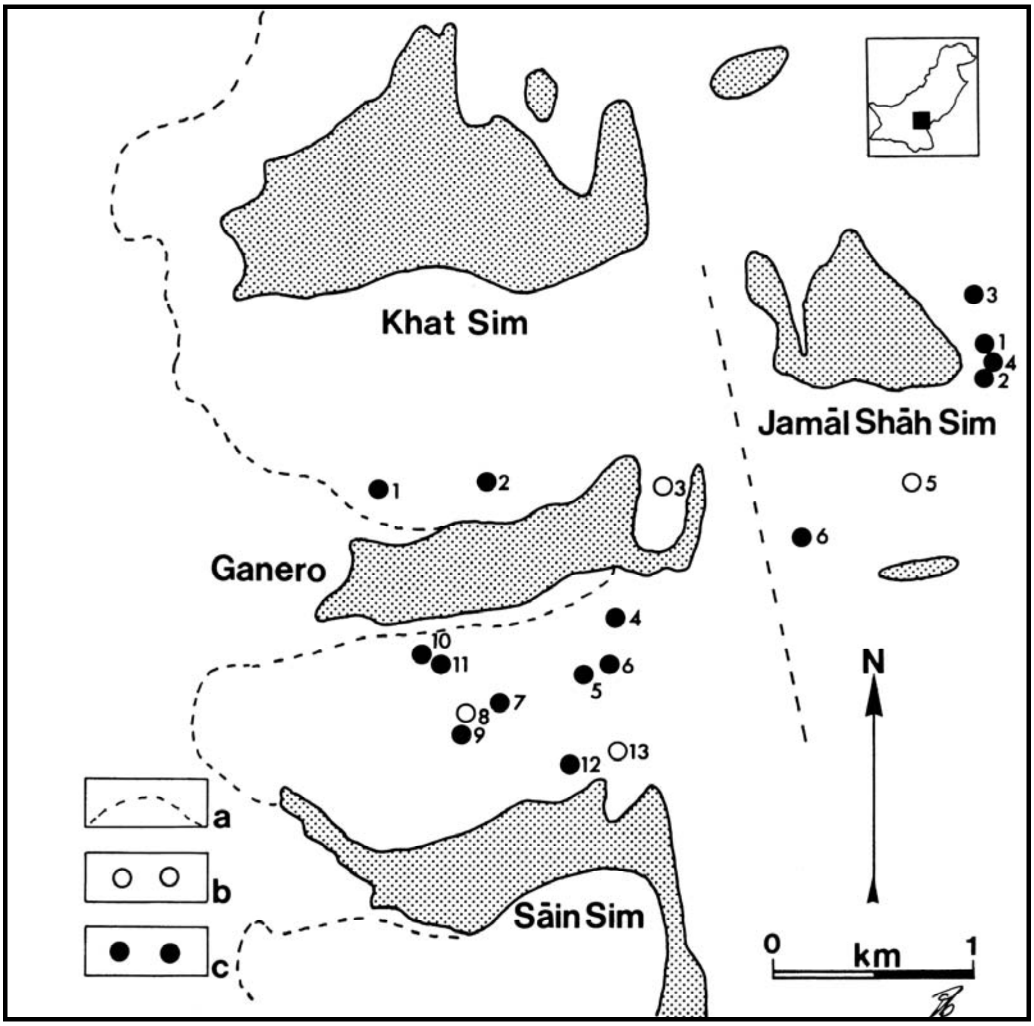

Fig. 1: Distribution map of the archaeological sites around the salt lakes of Ganero and Jamāl Shāh Sim discovered in February 2001. A = westernmost limit of the Thar Desert sand dunes; B = other sites; C = Mesolithic sites (drawn by P. Biagi).

percentages of tools: carinated (*ca.* 4-8%), very carinated (*ca.* 1-3%), hyperflat (*ca.* 0-4%) and hypercarinated (*ca.* 0-1%).

The results indicate that the manufacturing technique of the Ganero and Jamāl Shāh Sim Mesolithic flint industries was mainly oriented towards the production of flat or very flat, normal or small-sized flakes and blade-like flakes.

The blade indices are rather homogeneous ranging from 14.09 at JS3 to 22.94 at GNR4. Nevertheless, it is to be pointed out that these indices might be slightly underestimated because blade artefacts are easier to break and because they have often been transformed into instruments such as trapezoidal geometrics and microlithic, abrupt retouched tools.

The general composition of the flint industries is given in Table 2.

Description of the flint tools

Cores. They are rather small, mainly prismatic or of short, subconical type, more rarely polyhedral. They are generally characterised by one single, flat platform [Fig. 2.1-7, 11-12]. The prepared platforms are rather uncommon. They occur with one or more specimens at JS2, JS3, JS4, GNR7, GNR9 and GNR13. Two cores from JS2 and one from GNR7 have a dihedral platform [Fig. 2.8-9]. Discoid cores are known from JS2 (2x), GNR1 (2x) [Fig. 2.10], GNR7 (1x) and GNR9 (1x).

Crested blades. These technological pieces are represented only from JS1 (1x), JS2 (1x), GNR4 (2x), and GNR9 (2x).

Burins. This type of tools is very rare. Three lateral, simple burins and one on a fracture come from JS2; one lateral simple specimen, from JS3; one, with opposed, lateral detachments and one simple, transversal type come from JS4. Only one lateral burin on a fracture was collected at GNR9.

Isosceles trapezes. They are all of very similar shape and size, obtained from bladelets 7-12 mm wide [Fig. 3]. They are characterised by straight, oblique, completely retouched, abrupt truncations. They were collected at JS1 (6x) [Fig. 4.1-7], JS4 (1x) [Fig. 4.26], JS6 (1x), GNR4 (9x) [Fig. 4.33-40] and GNR9 (3x) [Fig. 4.43-45]. Some of the broken truncations might belong to these instruments.

Scalene triangles. They are of different shape due to the

Table 1: Length : width and length-width : thickness diagrams for the complete, unretouched artefacts															
		JS1		JS2		JS3		JS4		GNR4		GNR7		GNR9	
category	*limits*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Elongation indices															
Very narrow blades	>6	0	0.00	1	0.40	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Narrow blades	6-3	2	0.99	9	3.60	7	2.41	10	5.41	4	2.35	5	3.38	9	3.86
Blades	3-2	38	18.81	45	18.00	34	11.68	29	15.68	35	20.59	16	10.81	34	14.59
Blade-like flakes	2-1.5	50	24.75	67	26.80	72	24.74	46	24.86	41	24.12	30	20.27	51	21.89
Flakes	1.5-1	72	35.64	72	28.80	102	35.05	62	33.51	57	33.53	47	31.76	72	30.90
Wide flakes	1-0.75	30	14.85	41	16.40	52	17.87	30	16.22	28	16.47	35	23.65	43	18.45
Very wide flakes	0.75-0.50	10	4.95	14	5.60	22	7.56	7	3.78	4	2.35	14	9.46	23	9.78
Extremely wide flakes	<0.50	0	0.00	1	0.40	2	0.69	1	0.54	1	0.59	1	0.68	1	0.43
(blade indexes)			19.80		22.00		14.09		21.09		22.94		14.19		18.45
Dimension indices															
Hypermacroliths	>8	9	4.47	23	9.20	21	7.28	12	6.48	11	6.47	16	10.81	9	3.87
Macroliths	8-6	25	12.39	51	20.40	68	23.36	52	28.11	39	22.93	37	25.01	41	17.59
Normoliths	6-4	73	36.15	113	45.20	112	43.99	86	46.49	65	38.24	54	36.49	102	42.07
Microliths	4-2	90	44.56	62	24.80	74	25.43	29	15.66	53	30.58	40	27.03	84	36.06
Hypermicroliths	<2	5	2.48	1	0.40	0	0.00	6	3.24	2	1.18	1	0.68	1	0.43
Carination indices															
Hyperflat	>8	5	2.48	2	0.80	3	1.03	0	0.00	5	2.94	6	4.05	4	1.72
Very flat	8-4	71	35.15	65	26.00	102	35.05	63	34.05	68	40.00	54	36.49	86	36.91
Flat	4-2.5	95	47.03	121	48.40	134	46.05	78	42.16	68	40.00	62	41.89	109	46.87
Thick	2.5-2	20	9.90	34	13.60	31	10.65	22	11.89	16	9.41	16	10.81	23	9.87
Carinated	2-1.5	9	4.46	20	8.00	15	5.15	15	8.11	10	5.88	8	5.41	9	3.86
Very carinated	1.5-1	2	0.99	6	2.40	4	1.37	5	2.70	3	1.76	2	1.35	1	0.43
Hypercarinated	<1	0	0.00	2	0.80	2	0.69	2	1.08	0	0.00	0	0.00	1	0.43

Table 2: General composition of the flint industries										
	JS1	JS2	JS3	JS4	GNR1	GNR2	GNR4	GNR7	GNR9	GNR10
Unretouched artifacts	1131	923	1112	681	51	244	537	613	913	105
(complete)	(202)	(250)	(291)	(185)	(31)	(59)	(170)	(148)	(233)	(52)
Cores	18	12	8	5	1	2	2	6	5	-
(fragments)	(4)	(-)	(-)	(-)	(-)	(1)	(-)	(1)	(1)	(-)
Crested blades/flakes	1	1	-	-	-	-	2	-	2	-
Burins	-	4	1	2	1	-	-	-	1	-
Isosceles trapezes	6	-	-	1	-	-	9	-	3	-
(truncations)	(3)	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(-)	(-)
Scalene triangles	2	1	-	1	-	1	2	-	-	2
Backed points	5	6	1	2	-	-	-	-	1	1
Backed blades and truncation	-	2	-	-	-	-	-	-	-	-
Backed points and truncation	-	1	1	-	1	-	-	-	-	-
(fragments of backed tools)	(7)	(8)	(3)	(5)	(-)	(-)	(-)	(1)	(6)	(-)
Microburins	1	-	1	1	-	-	-	-	-	-
Retouched bladelets	3	3	-	1	-	3 (f)	1 (f)	1 (f)	6 (f)	-
Straight points	-	1	-	-	-	-	-	-	-	-
Side scrapers	-	2 (f)	-	-	-	-	-	-	8 (7f)	1
Abrupt retouched flakes	1	1	-	1	-	-	3	-	2	-

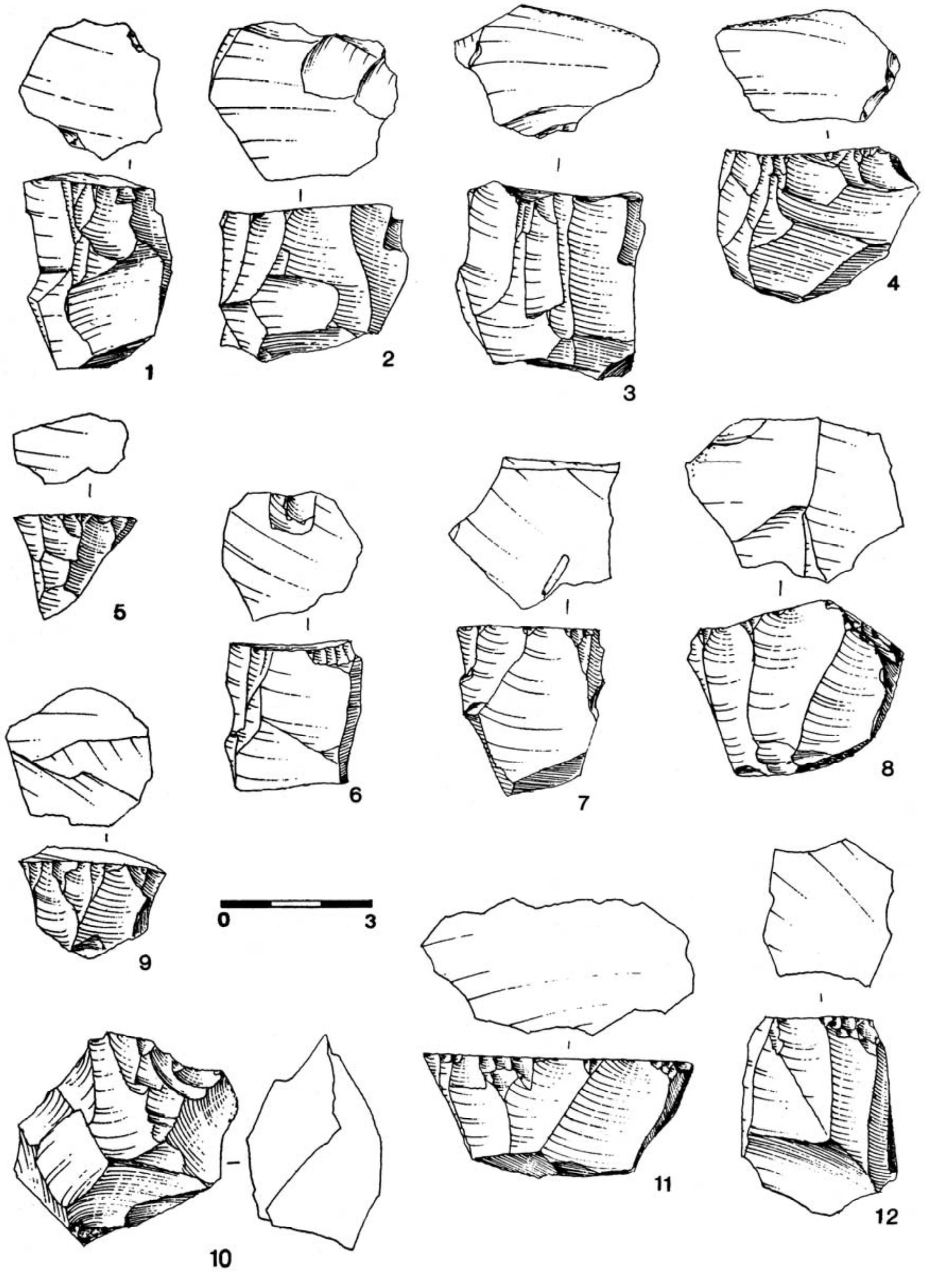

Fig. 2: Flint cores from JS1 (1-4), JS2 (5-9), GNR1 (10), GNR2 (11) and GNR4 (12). Flat platform cores (1-7, 11-12), dihedral platform cores (8-9) and discoid core (10) (drawn by G. Almerigogna and P. Biagi).

variability of the width of the narrow bladelets from which they have been obtained. Two fragments come from JS1 and one from JS2 [Fig. 4.11]. One complete specimen, with short truncation obtained with the microburin technique, as indicated by the presence of a *piquant trièdre*, was collected at JS4 [Fig. 4.27]. One almost isosceles specimen comes from GNR2 and two from GNR4 [Fig. 4.41-42]. One of these latter has the apex of the long point obtained with the microburin technique (*piquant trièdre*). Two more scalene triangles were found at GNR10. The first has the small truncation obtained with the microburin technique and the opposite point characterised by a short, oblique truncation [Fig. 4.52]; the second is a rather short and wide specimen with *piquant trièdre*

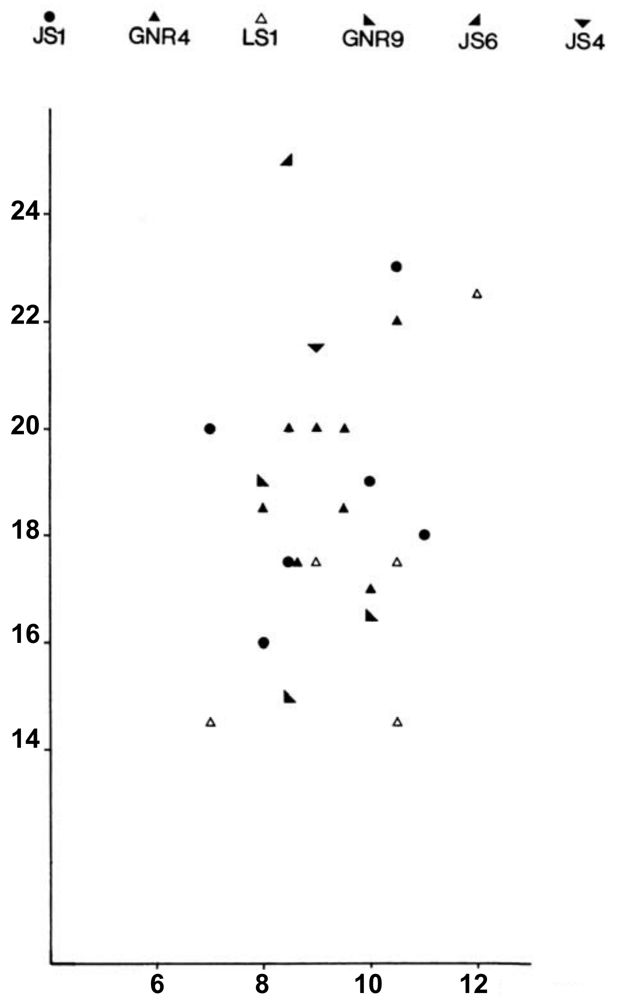

Fig. 3: Length : width diagram of the trapezoidal microlith, scale in mm (drawn by P. Biagi).

point [Fig. 4.51].

Backed points. They are of variable shape, length and width. One double pointed specimen obtained with deep, abrupt, unilateral retouch comes from JS1 [Fig. 4.8]. The samples from JS2 include a few wider specimens with curved point obtained with deep, abrupt unilateral retouch [Fig. 4.15-16]. One shoulder backed point is represented among the finds of JS3 [Fig. 4.23]; two wider, shouldered specimens come from JS4 [Fig. 4.29]. GNR9 yielded one broken, shouldered backed point [Fig. 4.46], while the specimen from GNR10 shows a very worn, rounded point at the proximal edge [Fig. 4.53].

Backed blades and truncation. To this class of tools have been attributed two instruments from JS2 [Fig. 4.13-14] and one from JS3 [Fig. 4.24] with very diverse typological characteristics.

Backed points and truncation. One example is from JS2 [Fig. 4.12] and one from GNR1 [Fig. 4.32]. The first is on an elongated, narrow bladelet with marginal, abrupt retouch along the right side, with oblique, slightly concave truncation. The complementary, marginal, abrupt retouch is at the distal edge. The second is a shouldered point obtained with deep, bipolar, abrupt retouch along the left side, with oblique, straight, short truncation.

Fragments of backed tools. They are mainly represented by fragments of abrupt retouched bladelets [Fig. 4.17-21]. Some are obtained with marginal or deep retouch along one side, while in a few cases the retouch is bipolar. One specimen from GNR9 shows a marginal, bilateral, sinuous retouch [Fig. 4.50].

Microburins. These are represented by very few specimens. The distal microburins from JS1 and JS3 are of an abrupt retouch type [Fig. 4.10, 25]. A strange, wide proximal microburin comes from JS4 [Fig. 4.31].

Retouched bladelets. They are often fragmented; obtained with marginal, simple, unilateral retouch, sometimes on parallel-sided microbladelets.

Straight points. Only one specimen: a straight, carinated, shouldered point obtained with deep, simple, bilateral convergent retouch. The complementary retouch is deep, simple, proximal, inverse on the right side [Fig. 4.22].

Side scrapers. They are mainly represented by fragments of flakelets and microflakelets with marginal, simple retouch along one side.

Abrupt retouched flakes. These consist of flakelets or micro-flakelets with marginal or deep, abrupt retouch along one or two sides. Two peculiar specimens are those of GNR9 that have a deep, abrupt bipolar retouch along the right side [Fig. 4.47-48].

Considerations on the flint assemblages

Dissimilarities in the composition of the flint assemblages from the different sites can be noted in the variable number of tool classes, as for instance, the presence/absence of typical tools such as trapezoidal geometrics or other types of abrupt retouched instruments. The importance of the isosceles trapezoidal microliths at GNR4, where they represent 60% of the tools, is noteworthy. On the contrary, there are sites where the number of abrupt retouched tools is very high. At JS2 and JS4, they represent 62% and 57% of the instruments.

The microburin technique seems to have been employed only in the manufacture of triangles (and possibly of backed points), but not of trapezes. The industrial variability of these sites might indicate that they are not all contemporary. The presence of trapezes seems to characterise the more recent sites. The industries of JS2, JS3 and JS4, represented by abrupt retouched instruments, are most probably slightly older than those with a great number of trapezoidal microliths. They also yielded a few burins, mainly obtained from flakes.

Other flint assemblages from the same region were collected from the dunes surrounding Lunwāro Sim (LS2), Sāin Sim (LS1) and Pir Nago (PN1) (Biagi 2004). The richest site is that of LS1 that yielded several trapezoidal geometrics obtained from bladelets, very similar to those of JS1, GNR4 and GNR9; while the flint assemblages from LS2 and PN1 are more poor. The first includes one backed blade and truncation, one crescent and three microburins; the second is represented by two microlithic backed points and one small subconical core.

Conclusions

The discovery of Mesolithic sites in the Pakistani Thar Desert is of major importance because it fills a gap in our

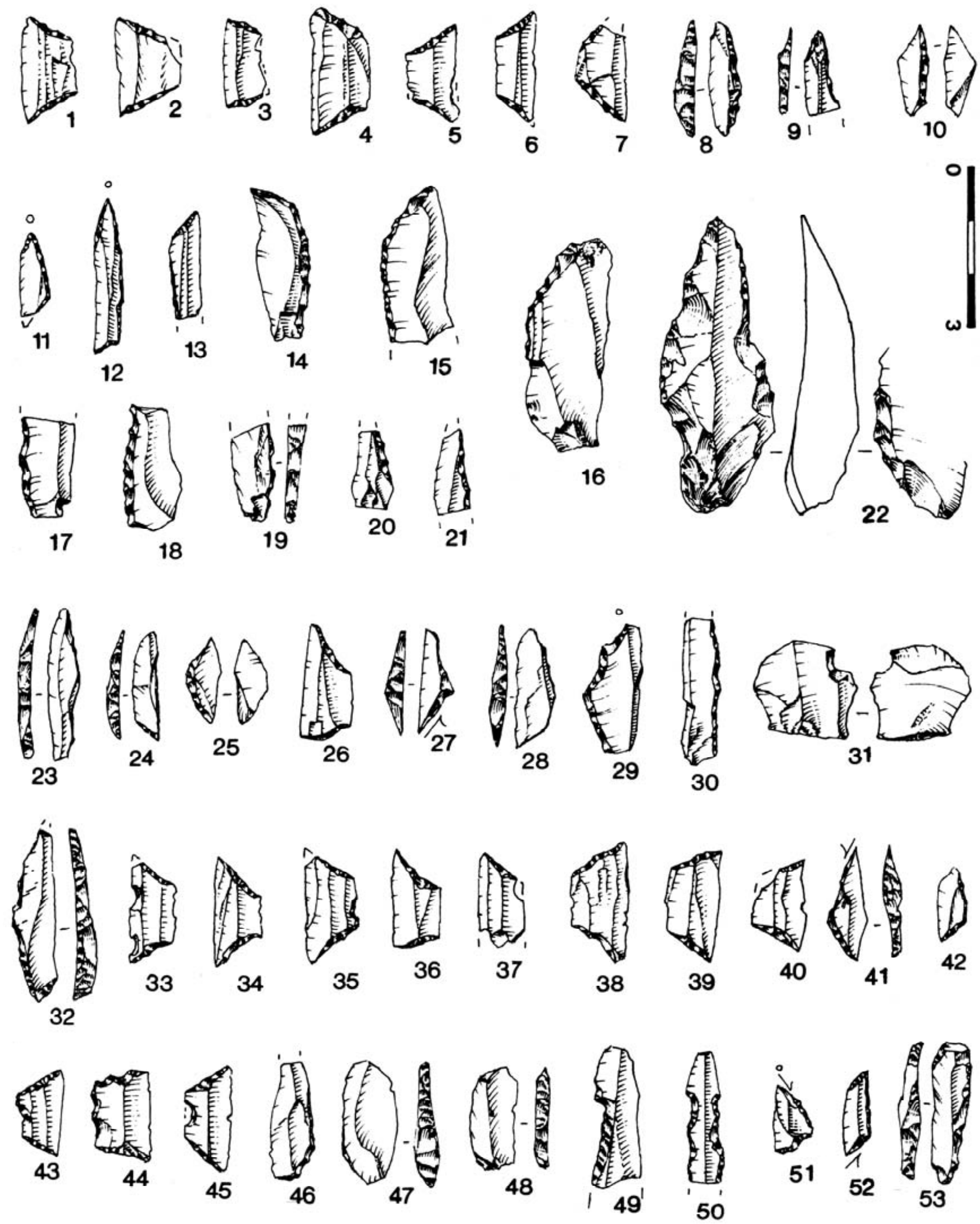

Fig. 4: Flint tools from JS1 (1-10), JS2 (11-21), JS3 (22-24), JS4 (25-30), GNR4 (32-34), GNR9 (43-50) and GNR10 (51-53). Isosceles trapezes (1-7, 26, 33-40, 43-45), backed points (8-9, 15-16, 23, 28-29, 32, 46, 53), triangles (11, 27, 41-42, 51-52), backed points and truncation (12, 32), backed blade and truncation (13-14, 24), fragments of backed tools (17-21, 30, 49-50), microburins (10, 25, 31), abrupt retouched flakes (47-48). The small circle indicates the proximal edge (drawn by G. Almerigogna).

knowledge on the last hunter-gatherers of the region at the beginning of the Holocene. Sites of this age are well known in the neighbouring Rajastan. Also the Rajastani Mesolithic sites are distributed on the top of sand dunes often facing saltwater and freshwater basins or river courses. This is the case for Bagor (Misra 1977), Budha Pushkar (Allchin & Goudie 1973), Tilwara (Misra 1971) and Didwana (Misra & Rajaguru 1986). Their absolute chronology is still very uncertain as for many Indian Mesolithic sites, most of which have yielded contrasting radiocarbon dates (Chakrabarti 1999: 99).

The Mesolithic flint assemblages of Rajastan are almost identical to those of Upper Sindh. At Bagor and Tilwara (Misra 1977) they are represented by different types of microliths including backed points and blades, backed blades/points and truncations as well as triangular and trapezoidal geometrics. Very similar assemblages come from Langhnaj in Gujarat (Sankalia 1956) and from Patne

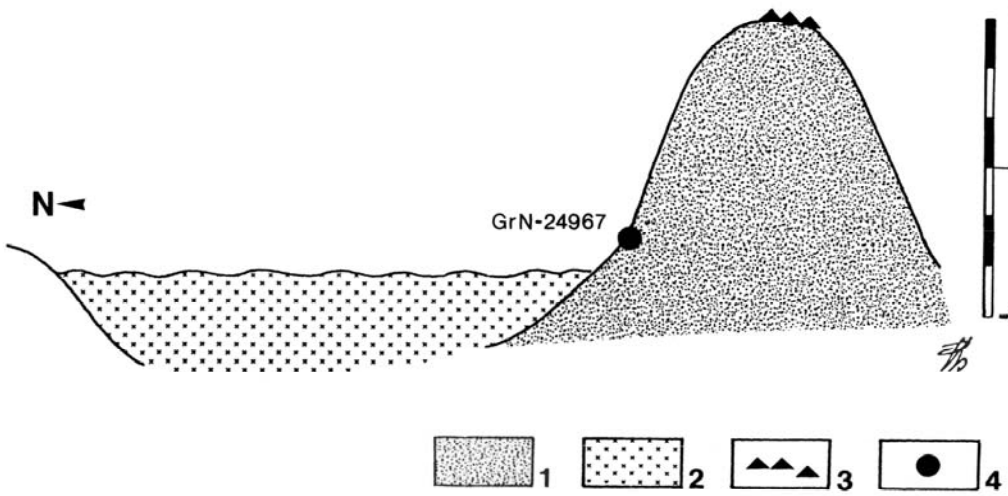

Fig. 5: Location of site LS2 on the top of a fossil dune facing the lake of Lunwāro Sim. 1 = fossil dune; 2 = salt-water basin; 3 = flint scatter; 4 = radiocarbon dated ancient shoreline. Altitudes are above sea level (drawn by P. Biagi).

in Maharastra (Sali 1989). This latter is the only site so far excavated from which a detailed sequence of final Late Palaeolithic and Mesolithic assemblages has been described. Here the Mesolithic seems to represent a technological continuation of the Late Palaeolithic industries, marked by the appearance of new types of geometric microliths.

Another problem that makes the age of the Thar Desert sites difficult to define is the typology of these sites. It must be remembered that they all are surface scatters of flints that did not produce any other archaeological evidence such as man-made features, hearth or discards of bone remains. They lie on the top of sand dunes often facing lake basins that formed around the beginning of the Holocene and turned saline in post-Harappan times (Singh 1971: 188).

The extension of Mesolithic palaeoshores of these lakes is unknown even though a certain oscillation of the water table has been demonstrated by the finds of Lunwāro Sim. Here a sample of *Parreysia triembolus* (det. K. Thomas, 1999), freshwater molluscs from a palaeoshore some 2 m above the present one, has been dated to 2460 ± 50 BP (GrN-24967) [Fig. 5]. Even though the date is difficult to calibrate because the average reservoir effect of the area is absolutely unknown, it demonstrates that the lakes water-table fluctuated through the time.

The pollen cores made by Singh (1971) at three salt lakes of Rajastan have shown that these basins began to form just before the start of the Holocene when the sand dunes were still active. The lacustrine deposits filled around the beginning of the Holocene. This has been demonstrated by two radiocarbon dates obtained from the lower deposits of Lakes Sambhar (TF-887: 9250 ± 50 BP) and Lukaransar (WIS-405: 9260 ± 115 BP). They mark a rapid increase in rainfall and a far more humid climatic phase that led to an increase in the vegetation cover and, consequently, to the stabilisation of the sand dunes. This climatic amelioration took place around the beginning of the Holocene (Hedge 1977: 176).

The discovery of many Mesolithic sites on the top of the Thar Desert dunes of Upper Sindh reinforces these environmental data. There is no doubt that the dunes were already stabilised by the beginning of the Holocene when the last hunter-gatherers settled, as indicated by the abundant traces of Mesolithic flint industries left on their peaks.

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