

Prehistoric Pottery Production and Technology at Bukit Tengkorak, Sabah, Malaysia*

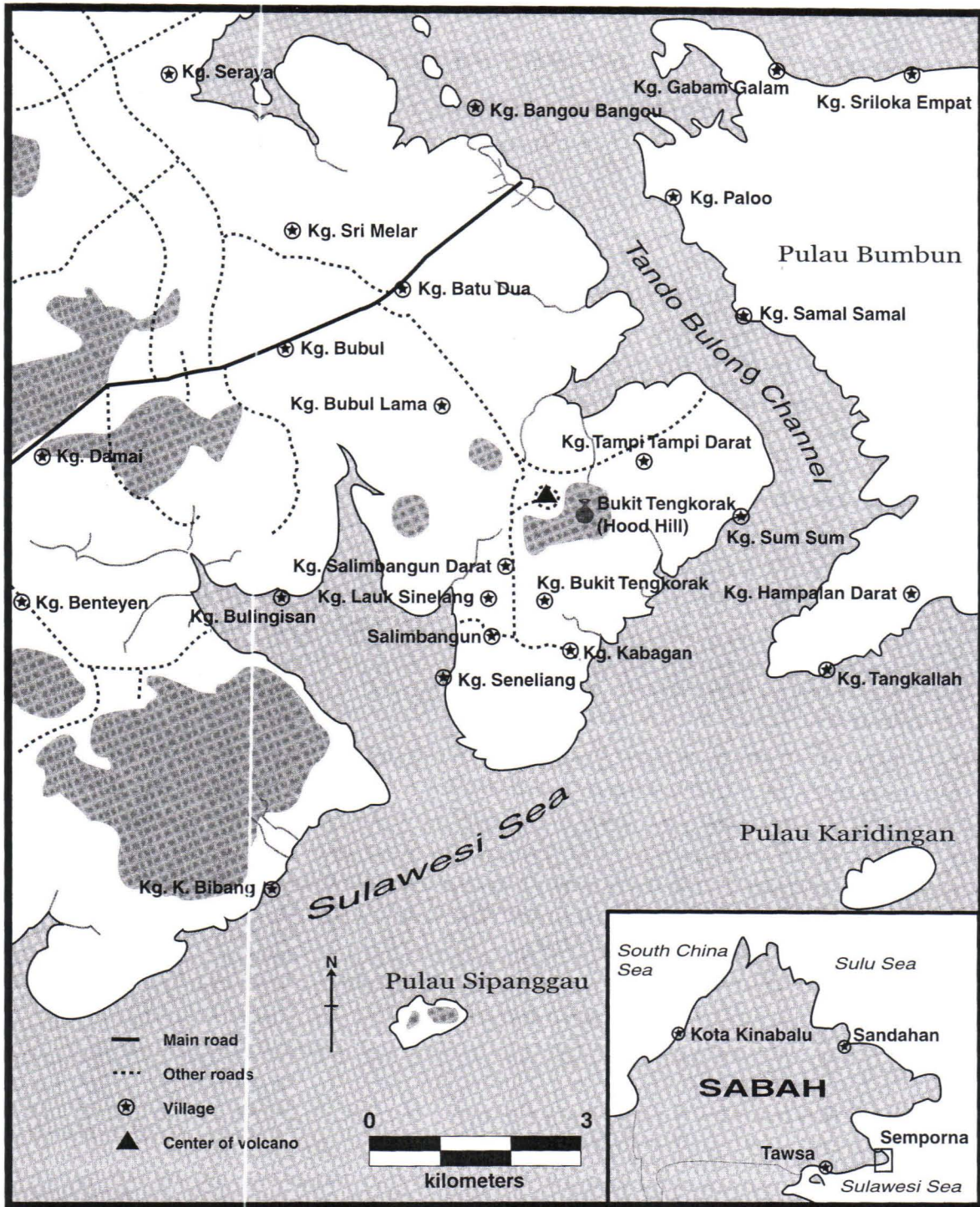
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Introduction

Bukit Tengkorak ("Skull Hill") is a Neolithic site, located at the top of a hill overlooking the Sulawesi sea and approximately 5 kilometers from Semporna in Sabah, Malaysia (Map 13.1). Archaeological research at Bukit Tengkorak was undertaken in 1994 and 1995 by a joint research team from the Centre for Archaeological Research Malaysia and Muzium Sabah. The Semporna Peninsula where Bukit Tengkorak is located consists largely of numerous isolated hills and mountains, most of them extinct volcanoes which may range from Pliocene to Quaternary in age (Kirk 1962, Lee 1970). Our geological survey in and around Bukit Tengkorak in 1996 concluded that Bukit Tengkorak is part of the rim of a 2-kilometer-wide volcanic crater (HD Tjia, personal communication, Figure 1). Surveys by the Geological Department of Kota Kinabalu revealed that Bukit Tengkorak was previously an island. However, the coral limestone terrace of the Semporna Peninsula is reported to have risen between 100 and 130 meters during the past 20,000 years (Tjia *et al.* 1972). It is therefore very likely that when Bukit Tengkorak was occupied at around 4,340 BC, it was not an island but a mountainous ridge near the coast.

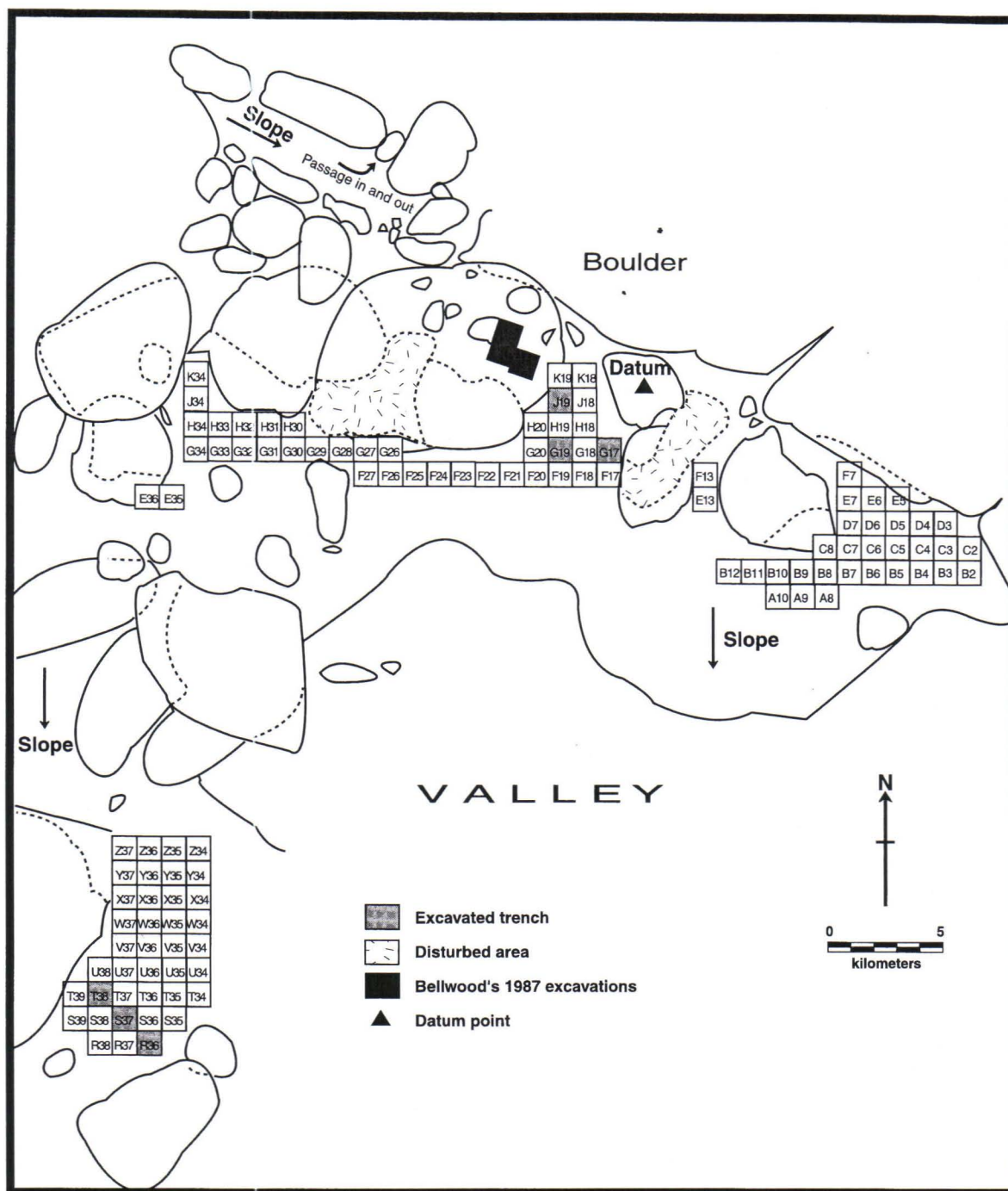
Two seasons of excavations, in July 1994 and April 1995, over a period of 5 weeks, were conducted at the top of Bukit Tengkorak. The excavations were carried out at two volcanic outcrops situated about 20 meters apart, at an altitude of about 600 feet above sea level and at GPS N4°27' 20.08" and E 118°37' 04.3". A total of 6 one-meter trenches or squares (G17, G19, J19, R36, S37, and T38), three in each volcanic outcrop, were excavated down to the base of undisturbed cultural deposits, about 150 centimeters in maximum depth (Map 13.2). The excavated area covered approximately 10% of the total area that could be excavated. The top layer (0–20 centimeters) of trenches G17, G19, and J19, however, appeared to be disturbed and was quickly removed. The subsequent layers contained undisturbed artifacts which were exposed in their *in-situ* positions using only trowels, brushes, and wooden skewers in arbitrary controlled spits 5 centimeters deep. The excavated soil was sieved through 1 millimeter and 0.2 millimeter meshes. A wide range of archaeological materials excavated from Bukit Tengkorak includes considerable quantities of pottery sherds, agate, chert and obsidian microliths as well as marine molluscs, fish and animal bones. The large quantities of marine remains are indicative of a maritime-oriented society. Pottery sherds formed the main type of artifact but no complete or restorable vessels were recovered.

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Map 13.1 Location of Bukit Tengkorak, Semporna, Sabah.

Radiocarbon dates of four charcoal samples and one *Anadara* shell sample from trench G17 yielded dates as early as 4,340 BC for Bukit Tengkorak (Table 13.1). One of the charcoal samples (Beta-83785) from the lowest level of the cultural deposits provided calibrated dates of 4,340 to 3,975 BC. The charcoal sample (Beta-74447) from the top layer is modern which confirmed our suspicion that most of the top layer (0–20 centimeters) of trenches G17, G19, and J19 was disturbed. As such no reliable dates can be obtained for the terminal use of Bukit Tengkorak but the absence of metals and stonewares can only suggest that it is likely to be older than 2,000 BP or about 50 BC.¹ On the basis of the radiocarbon



Map 13.2 Plan of Bukit Tengkorak and excavated trenches.

dates, soil stratigraphy, and the spatial and temporal distribution of artifact types, three phases of occupation at Bukit Tengkorak were defined: (1) Early Phase (4,340–1,285 BC), (2) Middle Phase (1,200–900 BC), and (3) Late Phase (900–50 BC).

The Pottery Industry of Bukit Tengkorak

Archaeological evidence for pottery production at Bukit Tengkorak includes 20,236 pieces of pottery sherds excavated mostly from thick layers of ash measuring 50–80 centimeters, suggesting that they were remnants of open kilns used for firing the pottery. Most of these sherds were low-fired, poor in quality, and were found with ash adhering to them. Some also had firecracks. Hence, it is very likely that these

Table 13.1 Radiocarbon dates from Bukit Tengkorak, Sabah.

LAB NUMBER	CONVENTIONAL AGE (BP)	CALIBRATED AGE (BC)*	MATERIAL	NOTES
Beta-74447	101.0 ± 0.9%M	-	charcoal	Trench G17, layer 1 spit 4, 15-20cm
Beta-74448	3190 ± 60	1190 to 860**	<i>Anadara</i> shells	Trench G17, layer 3 spit 11, 50-55cm
Beta-83783***	2940 ± 50	1285 to 990	charcoal	Trench G17, layer 4 spit 15, 70-75cm
Beta-83784	2650 ± 90	980 to 745; 700-530	charcoal	Trench G17, layer 5 spit 20, 95-100cm
Beta-83785	5330 ± 80	4340 to 3975	charcoal	Trench G17, layer 8 spit 26, 125-130cm

Notes: * Cal BC dates (2 sigma, 95% probability).

** This marine shell sample has been calibrated according to Stuiver & Braziunas (1993).

*** This sample was analyzed using AMS (Lawrence Livermore).

sherds are wasters damaged during firing and discarded. Moreover, the volcanic boulders at the top of Bukit Tengkorak formed a natural wind tunnel for the onshore sea breeze rising up Bukit Tengkorak and the inhabitants probably took advantage of this frequent breeze for firing the pottery.

A heap of clay, measuring about 70 centimeters in thickness, was also uncovered at trench T38 during the excavations. Near this clay heap, pottery sherds as well as agate, chert, and obsidian microliths, flakes, and debitage were found but no food remains were recovered, suggesting that this area was used as a craft working area for producing pottery and stone tools. The argument for pottery making is further supported by X-ray diffraction analysis and thin-section analysis of samples from the clay heap which revealed that it is kaolin-rich (good quality clays for making pottery) and contains mostly rounded and subrounded quartz grains indicating a riverine origin of the clays. In addition, the distinct boundary between the clay heap and the volcanic rocks as well as the discontinuities between the clay heap, the upper loam, and the basal volcanic layers do not seem to indicate that this clay heap occurred naturally at the site. Furthermore, basic and essential raw materials for making pottery such as clay, water, and fuel are readily available and easily accessible at the foot of Bukit Tengkorak. All these pieces of evidence, therefore, strongly support the conclusion that the heap of clay was brought to the site in order to make pottery at Bukit Tengkorak. It is also possible that the potmakers used the large clay sources which can still be found at the foot of Bukit Tengkorak.

The scale of pottery production may be deduced from an extrapolation of the number of sherds excavated from about 10% of the excavation area. A volume of about 6 cubic meters of soil yielded a total of 20,236 sherds. Assuming that the density of sherd is the same for the rest of the unexcavated area, it is therefore possible that about 2 million sherds could be present. This is not surprising because tens of thousands of sherds were strewn on the floor of the outcrops at the top as well as the slope and foot of Bukit Tengkorak due to recent disturbance.

Pottery Technology

Bukit Tengkorak pottery is formed using the hand molding and the paddle-and-anvil techniques. The surfaces of some sherds have impressions of anvil or finger marks as well as carved-paddle and bound-paddle marks or designs. Examination of the clay particles, inclusions, and voids using the scanning electron microscope and petrographic thin-section analysis of the sherds shows very little sintering and a clay matrix parallel to the surface of the sherds, a pattern closely associated with making pottery using

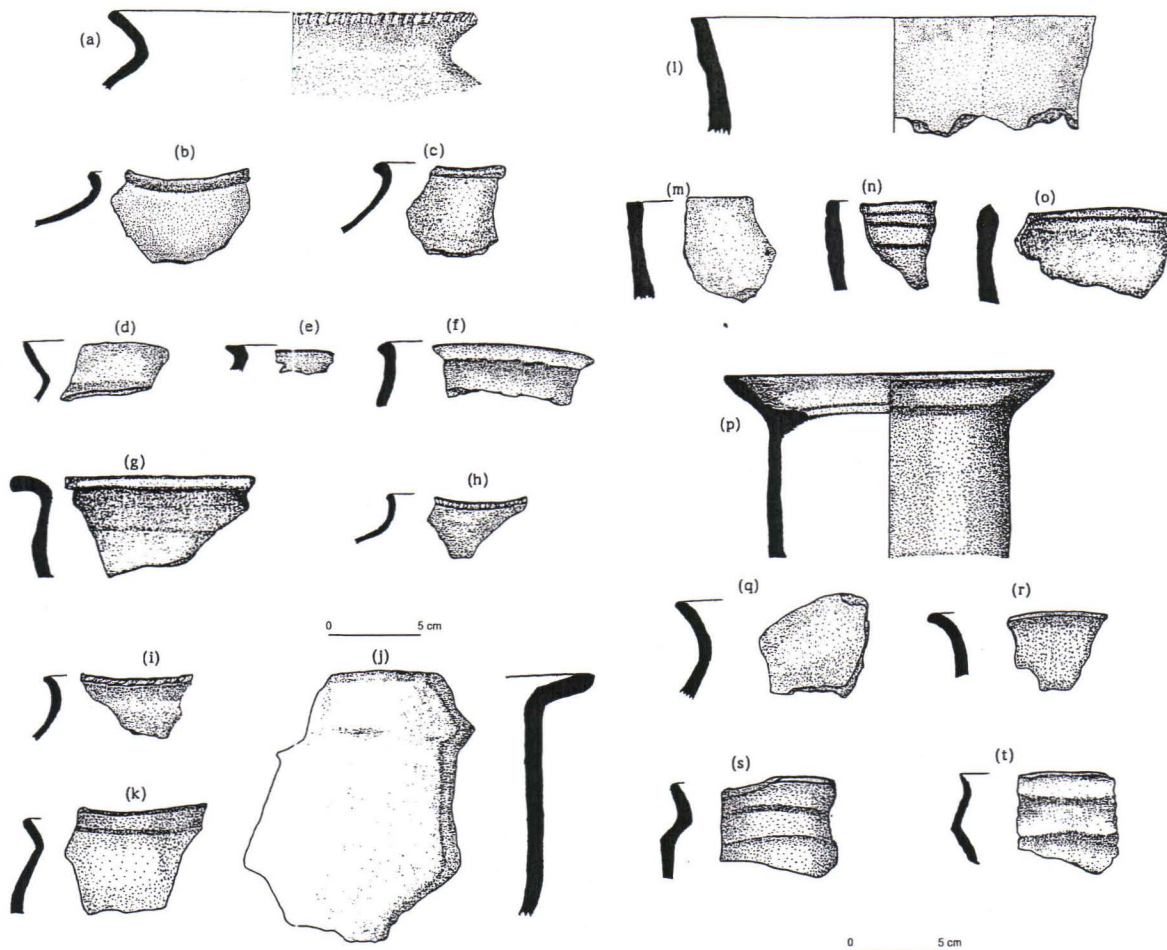


Fig. 13.1 Pottery types.

a wheel as well as the lump-and-paddle technique. The joining technique is evident in the lines of breakages of some sherds, particularly the stove fragments. Fifty sherds were radiographed using the Xerox Medical System 125 (run in positive mode at 55–60 KV, 5 mA and 1 minute with a 130 centimeters focal distance); the results showed even forming pressure and homogeneous distribution of porosity which is evidence for forming and finishing using the lump-and-paddle technique (Vandiver and Chia 1996).

Freshly-broken sherds examined under a binocular microscope at low magnification of 10x or 20x showed sand-tempered pottery. The sand grains are fairly coarse and angular, measuring 1.0 to 0.1 millimeters in size and often protrude at the surface giving the pottery a coarse appearance. Thin section analyses of 25 sherds revealed similar inclusions, consisting of mainly volcanic minerals such as quartz sand and plagioclase feldspars. There are also some volcanic rock fragments, volcanic glass, muscovite, biotite, iron nodules, shells, and some unidentifiable organic materials.

The majority of the sherds have dark gray cores which may be caused by firing in an atmosphere with insufficient oxygen, too short a firing period, low temperatures of firing, or a combination of all of these factors. Mohs hardness of the sherds measured between 2–3, suggesting low firing temperature. Refiring these sherds at 700°C, the gray and black cores became lighter, supporting the deduction that the pottery was fired for a short period of time, probably less than 45 minutes. Refiring tests also indicate a firing range of between 600°C and 700°C. Firing temperature of 800°C and above is rarely achieved probably because it would cause the calcareous inclusions (calcium carbonate) in these sherds to decompose into CaO and CO₂ and the pottery would be subjected to disintegration after firing due to the hydration of CaO.

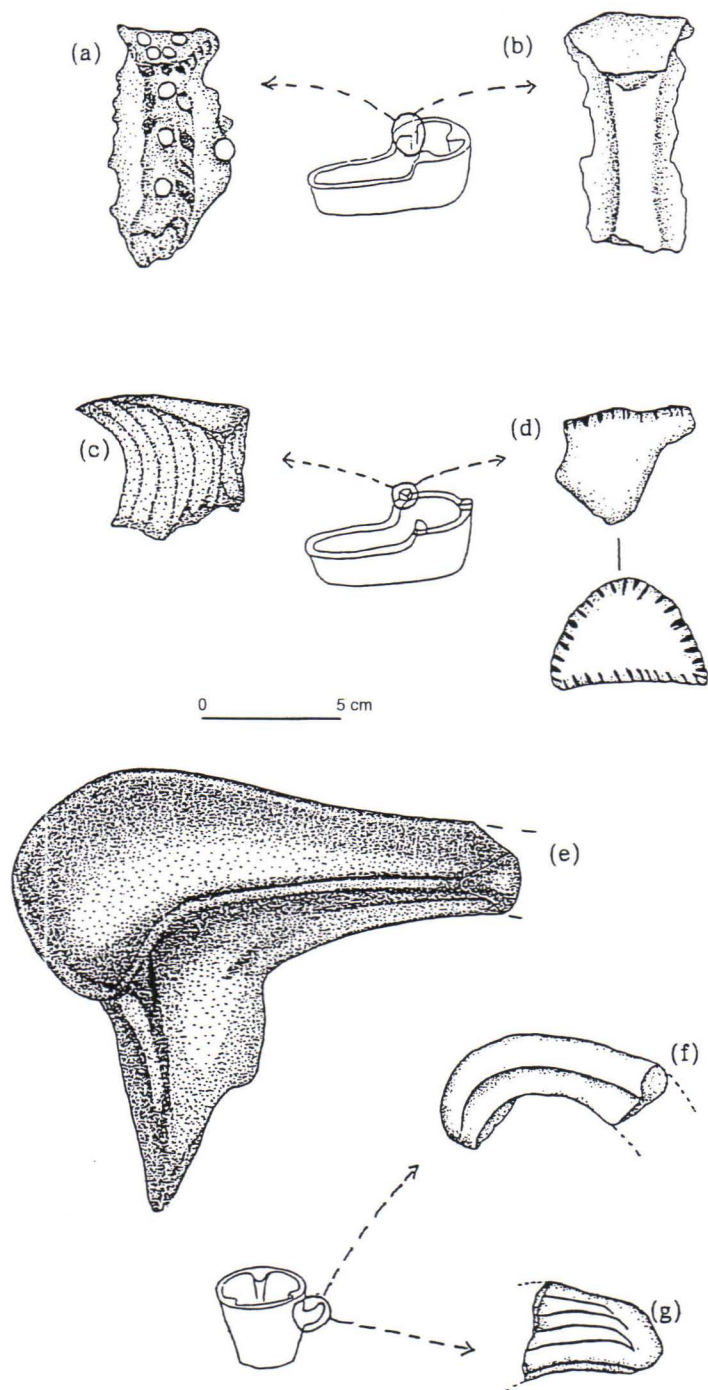


Fig. 13.2 Stove fragments.

Pottery Types

All pottery sherds excavated from Bukit Tengkorak were in the form of earthenware; no trade ceramics (stoneware and porcelain) were found. The earliest pottery types recovered from the excavations are red-slipped and plain, mostly in the form of restricted and unrestricted globular jars and bowls as well as pottery stoves (Figures 13.1–13.3). They generally represent utilitarian vessels for cooking and storing liquid or water. Red-slipped and plain pottery also dominated throughout the levels or cultural phases.

Impressed, incised, and perforated pottery as well as new forms of lidded and footed vessels began to appear in the middle and late phases, at around 1,200 BC (Figures 13.4–13.7, Tables 13.2 and 13.3).

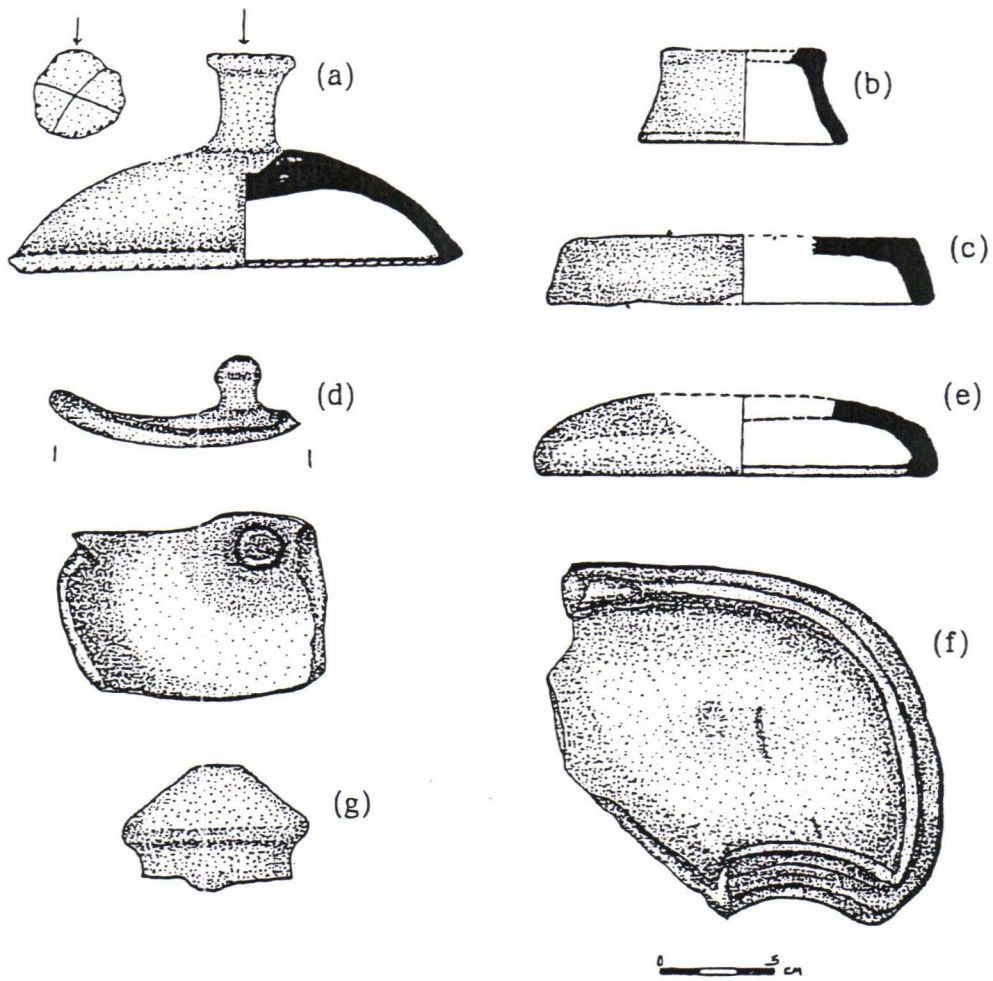


Fig. 13.3 Pottery lids.

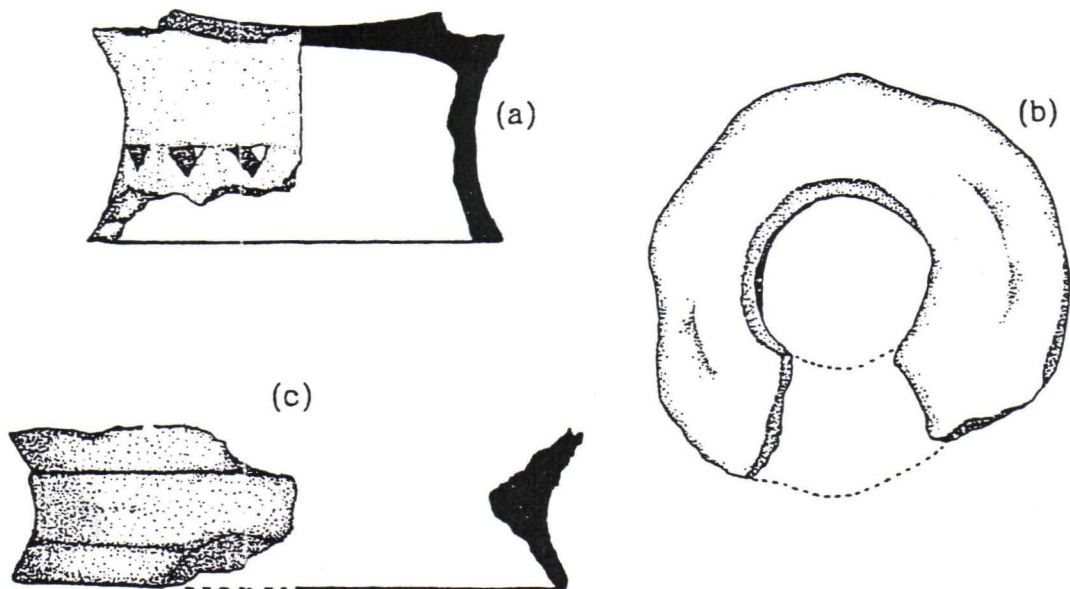


Fig. 13.4 Ring feet.

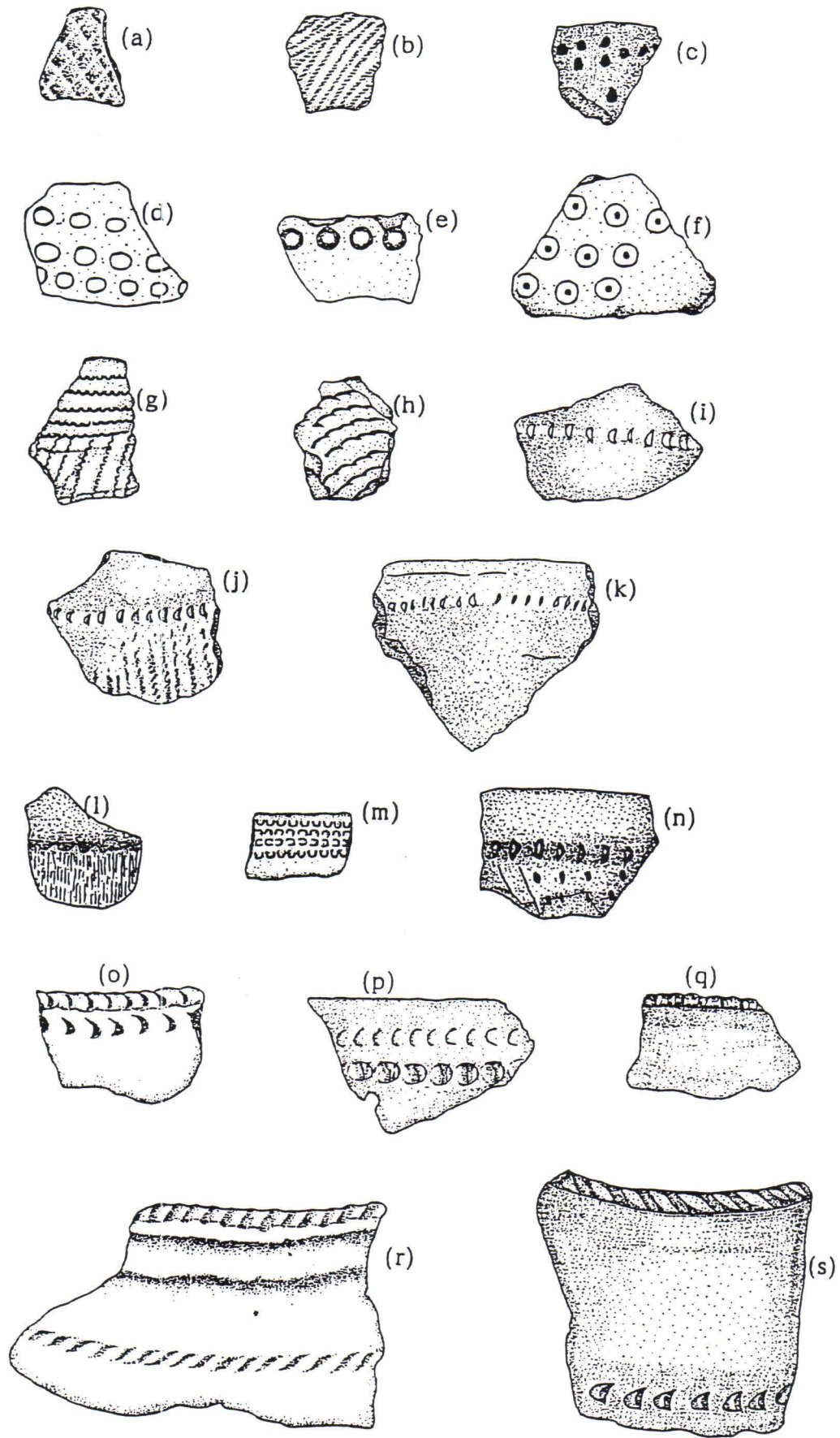


Fig. 13.5 Impressed pottery.

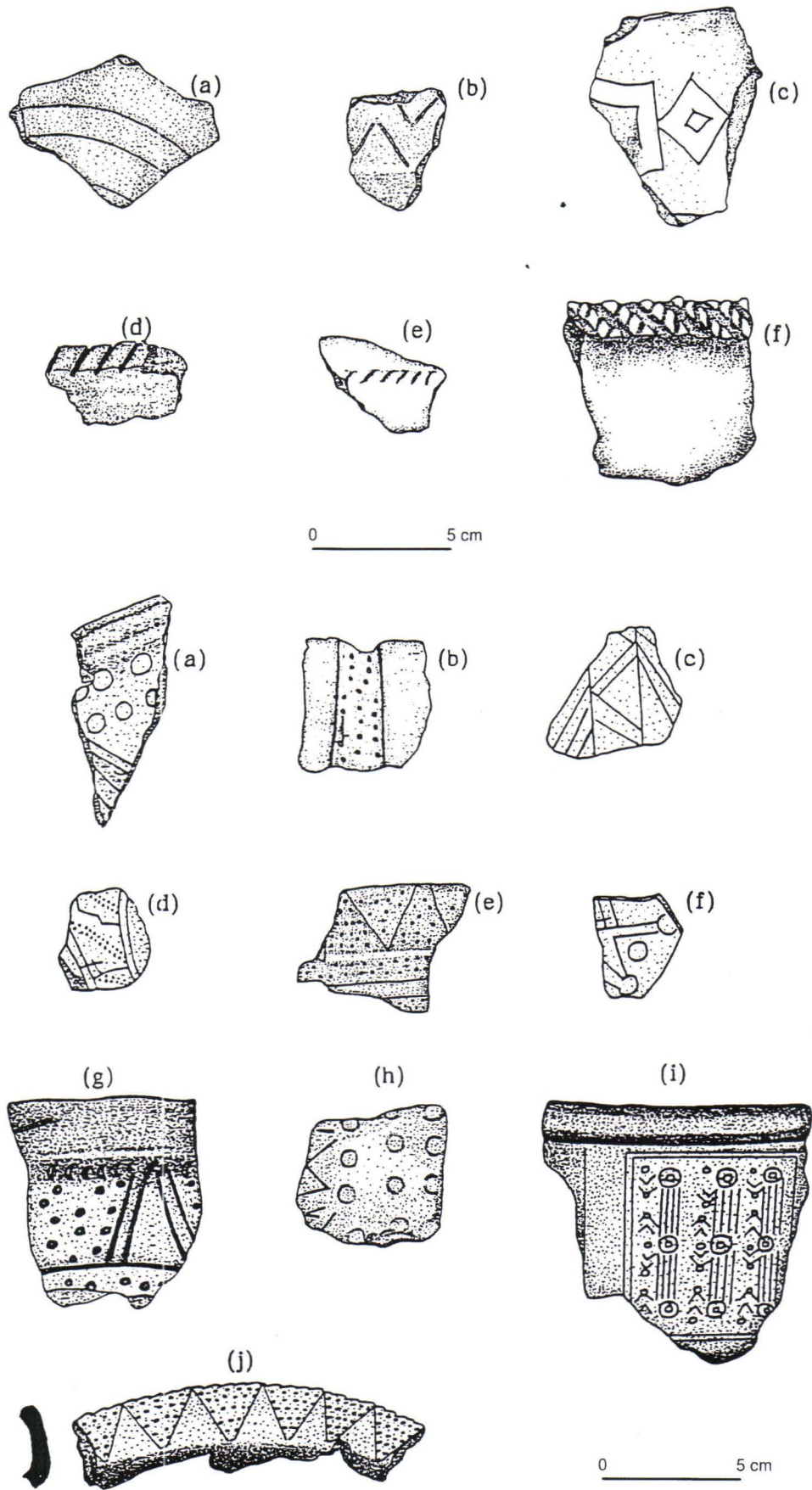


Fig. 13.6 Incised and impressed pottery.

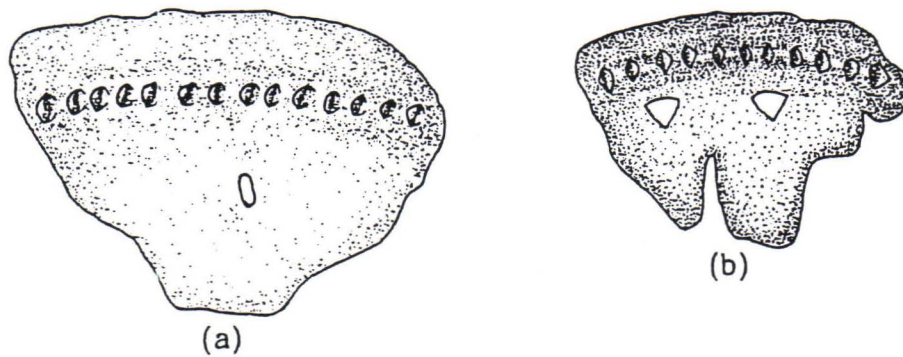


Fig. 13.7 Impressed/incised and perforated pottery.

However, pottery with impressed and incised designs formed only about 7% of the total sherd assemblage. The pottery is decorated with designs on the body and rim by incising, impressing and/or perforating with a variety of tools such as the carved-paddle, bound-paddle, finger nail, shell, and probably bamboo or hollow canes. Five main categories of impressed and incised designs may be found among the sherds. They include impressed; incised; impressed and incised; impressed or incised and perforated; and perforated. Within some of these categories, a considerable variety of types can be distinguished further,

Table 13.2 Vertical distribution of decoration types in trenches G17, G19 and J19.

SPIT (CM)	DECORATION TYPES							TOTAL	%	
	PLAIN	RED-SLIP	IMPRESSED (IMP)	INCISED (INC)	IMP + INC	IMP/LNC+PERFORATED	PERFORATED			
1(0-5)		799	10	1	1			1	812	5.09
2(5-10)		919	22		15	4			960	6.02
3(10-15)		691	7			5			703	4.41
4(15-20)	3	204	9		3				219	1.37
5(20-25)	19	1167	39		8	7			1240	7.78
6(25-30)	75	2041	35		7	3			2161	13.56
7(30-35)	37	421	19		21	13		8	519	3.26
8(35-40)	67	1860	48		11	3	2		2011	12.62
9(40-45)	88	630	42		17	7	1	1	786	4.93
10(45-50)	9	114	64		24	12		4	223	1.40
11(50-55)	159	1647	38		29	3			1876	11.77
12(55-60)	48	# 335	31		15	4		1	430	2.70
13(60-65)	141	644	89		23	6	1	1	905	5.68
14(65-70)			48		12	2	4	1	67	0.42
15(70-75)	92	331	23		45	5	1		497	3.12
16(75-80)	85	341	16		24	4		1	471	2.96
17(80-85)	138	885	18		23				1064	6.68
18(85-90)	19	211	5		10	1		1	247	1.55
19(90-95)	19	350	8		7				384	2.41
20(95-100)					3	3			6	0.04
21(100-105)					3	7			10	0.06
22(105-110)		33	7		2	1			43	0.27
23(110-115)		29				1			30	0.19
24(115-120)			2		6	1			11	0.07
25(120-125)	1	77	1		7				86	0.54
26(125-130)	6	53	1		1				61	0.38
27(130-135)									0	0.00
28(135-140)	8	108							116	0.73
29(140-145)									0	0.00
Total	1028	13890	588	321	83	9	19	15938	100	
%	6.45	87.15	3.69	2.01	0.52	0.06	0.12	100		

Table 13.3 Vertical distribution of decoration types in trenches R36, S37 and T38.

SPIT (CM)	DECORATION TYPES						TOTAL	%
	PLAIN	RED-SLIP	IMPRESSED (IMP)	INCISED (INC)	IMP/LNC+PERFORATED	PERFORATED		
1(0-5)		66	9				75	1.66
2(5-10)			29			4	36	0.80
3(10-15)							1	0.02
4(15-20)		93	2		7		102	2.26
5(20-25)			9	1	1		11	0.24
6(25-30)		38	9		2		49	1.09
7(30-35)		97	21		3	2	123	2.73
8(35-40)	1	327	26	3	2		359	7.96
9(40-45)		402	25	1	6	1	435	9.64
10(45-50)	2	294	31	2	11		340	7.54
11(50-55)	1	244	21	3	4		2732	6.05
12(55-60)	1	431	13	3	1	1	450	9.97
13(60-65)		783	45	7	5		840	18.62
14(65-70)	4	370	9	2	5		390	8.64
15(70-75)	1	458	11	3	3		476	10.55
16(75-80)	1	316	3	4	2		326	7.23
17(80-85)		101	8	18	1		128	2.84
18(85-90)		56	9	5			70	1.55
19(90-95)			6	6			12	0.27
20(95-100)			3				3	0.07
21(100-105)			1			1	2	0.04
22(105-110)				5			5	0.11
23(110-115)							0	0.00
24(115-120)				2	2		4	0.09
25(120-125)			1				1	0.02
26(125-130)							0	0.00
27(130-135)							0	0.00
28(135-140)							0	0.00
29(140-145)			1				1	0.02
Total	11	4076	292	65	59	9	4512	100
%	0.24	90.34	6.47	1.44	1.31	0.20	100	

for instance cord-marked, carved-paddled, and punctuated designs are found within the impressed pottery category.

Four main forms of rims were also observed: everted, vertical, flaring, and rim with two points of curvature where the second curve which is closer to the lip has an everted rim (Figures 13.1 and 13.2). The most common rim form is the everted rim, some with thickened or flattened lips. Rim diameters may vary from 8 to 30 millimeters but most fall within the 15 to 25 millimeters range. The earliest types of rim decoration are either plain or rim with notched lip which occurred in all the cultural phases. Plain rims, however, dominated (80%) throughout the cultural phases, followed by rims with notched lips (13%), and rims with fingernail-impressed lips (7%), while the remaining types of rim decoration comprised less than 1%. Impressed and incised rims appear to be well-defined chronologically, occurring predominantly in the middle and late phases, at around 1,200 BC or from spit 18 upwards (Tables 13.4 and 13.5).

Conclusion

Archaeological research at Bukit Tengkorak provides evidence for a large and localized pottery industry from 4,340 BC to perhaps 50 BC. The radiocarbon date of 4,340 BC identifies Bukit Tengkorak pottery as one of the earliest in island Southeast Asia. It is possible that the Bukit Tengkorak pottery tradition continued until today in Semporna as seen from similar pottery types produced by present pottery

Table 13.4 Vertical distribution of types of rim decoration in trenches G17, G19 and J19.

SPIT (CM)	RIM DECORATION TYPES*													TOTAL	%
	r	r-n	r-n(s)	r-n2	r-fn	r-fn(s)	r-fn2	r-i	r-x	r-xx	r-vv	r-d	r-p		
1(0-5)	10				1									11	0.54
2(5-10)	69	20		2			1	1			4			97	4.79
3(10-15)	3													3	0.15
4(15-20)					1									5	0.25
5(20-25)	105	19	1	2				1	3					131	6.46
6(25-30)	34	11		1				1	1					48	2.37
7(30-35)	83	6		1	1			4						95	4.69
8(35-40)	91	14						4	2					111	5.48
9(40-45)	56	6						2	1		1			66	3.26
10(45-50)	147	23		1		2	3	2	2	1		11		192	9.47
11(50-55)	140	33		1	4		1	4	2					185	9.13
12(55-60)	74	14		1	1		1	1				1		93	4.59
13(60-65)	174	50	2		2		2	2	2	3				237	11.69
14(65-70)	43	6	1	1			1							52	2.57
15(70-75)	84	12		1				1	1					99	4.88
16(75-80)	109	6	1	1						2				119	5.87
17(80-85)	106	12			1			2		2				123	6.07
18(85-90)	41	11							1					53	2.61
19(90-95)	39	7												46	2.27
20(95-100)	23	4												27	1.33
21(100-105)	60							1						61	3.01
22(105-110)	17	2			1									20	0.99
23(110-115)	20													20	0.99
24(115-120)	49	2										1		52	2.57
25(120-125)	41	2												43	2.12
26(125-130)	24													24	1.18
27(130-135)														0	0.00
28(135-140)	8													8	0.39
29(140-145)	4	1						1						6	0.30
Total	1658	261	5	12	12	2	9	27	15	8	5	12	1	2027	100
%	81.84	12.88	0.25	0.59	0.59	0.10	0.44	1.33	0.74	0.39	0.25	0.59	0.05	100	

Notes: * r = plain lip
 r-n = notched lip
 r-n(s) = side notched lip
 r-n2 = double notched lip

r-fn = finger-nail impressed lip
 r-fn(s) = side finger-nail impressed lip
 r-fn2 = double finger-nail impressed lip
 r-l = line incised lip

r-x = single cross incised lip
 r-xx = multiple cross incised lip
 r-vv = chevron incised lip
 r-d = punctated lip
 r-p = perforated lip

communities. Such a long duration of pottery making seems to reinforce the conclusion that Bukit Tengkorak was a suitable site for making pottery. In addition, Bukit Tengkorak is located in an ecologically favorable area (suitable climate and good raw materials) for pottery production. Bukit Tengkorak pottery was manufactured by hand molding and the lump-and-paddle technique. The pottery was tempered with mainly sand and feldspars of volcanic origin as well as some calcareous and organic materials. Firing was carried out for short periods of time at 600–700°C, temperatures associated elsewhere with open firing.

Red-slipped and plain pottery dated as early as 5,000–4,000 BC and similar to Bukit Tengkorak has been reported from elsewhere in island Southeast Asia, particularly in the North Borneo-Southern Philippines-Eastern Indonesia region. The site of Balobok in the Sulu Archipelago, for instance, has similar pottery dated around 5,000 BC (Spoehr 1973, Ronquillo *et al.* 1993). Other sites such as Leang Tuwo Mane'e in the Talaud islands and Paso in Minahasa (Bellwood 1976), Ulu Leang in Sulawesi and sites in Eastern Timor (Glover 1976), as well as sites in Madai and Baturong in Borneo (Bellwood 1988) also yielded closely similar pottery, dating back to 2,500 BC. Such similarities in pottery types seem to suggest that different groups in the North Borneo-Southern Philippines-Eastern Indonesia region

represents the introduction or importation of Lapita or other cultures or the migration(s) of people remains an open question. The implications of and factors leading to the migrations of people and the development of interregional contact or long-distance trade and exchange as well as socio-political complexity are definitely worth exploring in future research.

NOTE

- ¹ Despite the lack of a well-established date for the first use of metal in island Southeast Asia, a date of about 2,000 BP is generally accepted for the first use of bronze and iron artifacts, particularly in Sabah, the Talaud Islands, Bali and Java (Soejono 1979, Bronson and Glover 1984, Bellwood 1985).