Chapter – III

METHODS OF STUDY

You know my method.
It is founded upon the observation of trifles.
Sherlock Holmes (Doyle 1988: 214)

This chapter discusses different methods employed during the research to understand various features of regional Chalcolithic cultures in Gujarat. It incorporates details of selection of representative sites and type sites, exploration techniques, data collection methods, macroscopic studies and techniques of data analysis. Ceramics is the important characteristic feature of regional Chalcolithic cultures/traditions of Gujarat and thus formed the major artifact of analyses. Artifacts of metal, stone, terracotta, faience, shell and bone were also given due importance. The study also focuses on architectural features and burials excavated at selected sites in relation with other excavated Harappan sites in Gujarat. For comparison and correlation of archaeological data, final excavation reports, preliminary excavation reports, reviews and different articles in books and other published materials referred to. Many a times, these reports and articles were however found biased towards excavator’s or author’s objectives and views; the drawings, photographs and descriptions still form a reliable and major source of information as it is almost impossible to access the artifacts recovered from many sites as they were excavated by various organizations or institutions in different time periods. The methods used for the classification and periodization of sites are also described in this chapter.

Stages of Research

The research was carried out in eleven stages. The first stage dealt with the survey of published literature. It helped in the selection of the topic, understanding the basic concepts, status of Harappan and Chalcolithic research in India and Pakistan,
along with its draw backs, other contemporary cultures in different parts of the world, nature and trend of archaeological research in the global scenario, artifact analysis and interpretation. After the initial literature survey, representative sites of the study were selected and from them four type sites were identified. This stage was followed by the designing of sampling strategies of excavated artifacts, cleaning of samples and its documentation. Participation in excavations of Harappan and Chalcolithic sites in Gujarat and outside India enhanced the understanding of nature of various sites. This was followed by describing various field survey strategies and collection of information regarding the sites and artifacts. This stage was followed by the classification of ceramics obtained from the field survey.

In the following section, periodization of the explored sites using ceramics and the other data from excavated sites was done. In the next stage, database/list and separate maps of all the reported Harappan and regional Chalcolithic sites in Gujarat were prepared chronologically. Preparation of chronological sequence and stratigraphy of sub-regions of Gujarat was the next step. It was followed by the preparation of a database and graphs of antiquities from all the available excavated sites. The final stage of the research was the compilation of all the relevant data and analysing the same towards interpreting them.

**Literature Survey**

For comparison and correlation of artifact data, excavation reports of Bet Dwarka (Gaur et al. 2005), Dhatva (Mehta et al. 1975), Jokha (Mehta et al. 1971), Kanewal (Mehta et al. 1980), Kuntasi (Dhavalikar et al. 1996), Langhnaj (Sankalia 1965; Clutton-Brock 1965; Ehrhardt and Kennedy 1965), Lothal (Rao 1979; 1985), Malvan (Allchin et al. 1995), Nageswar (Hegde et al. 1990), Oriyo Timbo (Rissman and Chitalwala 1990), Rangpur (Rao 1963), Rojdi (Possehl and Raval 1989), Somnath (Nanavati et al. 1971) and Surkotada (Joshi 1990) were referred to.
Selection of Representative Sites and Type Site Identification

In order to achieve the research goals, Datrana IV (Ajithprasad 2002) in north Gujarat and Prabhas Patan/Somnath (Dhavalikar and Possehl 1992) in Saurashtra were selected as representative sites of Pre-Prabhas Assemblage. Ratanapura (IAR 1984–85; Bhan 1989) in north Gujarat, Kanewal (Mehta et al. 1980) in central/south Gujarat, Rojdi (Possehl and Raval 1989), Rangpur (Rao 1963), Lothal (Rao 1979; 9185), Vagad (Sonawane and Mehta 1985) and Nageshwar (Hegde et al. 1990) in Saurashtra and Desalpur (IAR 1963–1964) in Kachchh were selected as representative sites of Micaceous Red Ware. Padri Ware was represented by Padri (Shinde and Kar 1992) in Saurashtra and Anarta tradition by Loteshwar (IAR 1990–91; Bhan 1994), Datrana (IAR 1993–1994; 1994–1995), Moti Pipli (Majumdar and Sonawane 1996–1997), Nagwada (Hegde et al. 1988) and Zekhda (Momin 1983) in north Gujarat, Bagasra (Sonawane et al. 2003; Bhan et al. 2004) in Saurashtra and Shikarpur (IAR 1987–88; 1988–89; 1989–90) and Surkotada (Joshi 1990) in Kachchh. From these representative sites, Loteshwar, Datrana IV, Vagad and Padri were selected as type sites. Among these, Loteshwar, Datrana IV and Vagad were explored and excavated by The Maharaja Sayajirao University of Baroda and Padri by Deccan College Post Graduate and Research Institute, Pune. The excavations of these sites revealed evidences for the existence of regional Chalcolithic cultures/traditions namely Anarta tradition, Pre-Prabhas assemblage, Micaceous Red Ware and Padri Ware in these sites.

Loteshwar

Though the ceramic types belonging to Anarta tradition were noticed during the excavations at sites like Surkotada (Joshi 1990) and Nagwada (Hegde et al. 1988), its nature as a distinct regional Chalcolithic tradition of Gujarat was identified only after the excavation at Loteshwar (Khari-no-Timbo) in 1990–91 by the Maharaja Sayajirao University of Baroda. At Loteshwar, Anarta ceramics (Ajithprasad 2002; Yadav 2005) were initially thought as belonging to the later
stage of Mature Harappan or Late Harappan period. But the series of conventional and AMS radio carbon dates from the site proved its Early Harappan origin and date of its Chalcolithic phase as 3700-2200 BC. The Chalcolithic period was preceded by the microliths using community (100 cm deposit) datable from c. 7300 BC (Sample No. CAMS-55902). No structural remains were unearthed from the Chalcolithic level but few pits of various sizes (50 cm to 200 cm) having a somewhat plastered effect on its walls, filled with ash, bones and ceramics were excavated. Among the two skeletons unearthed from the site one belongs to the Chalcolithic period (Ajithprasad 2009). Grinding/palette stones are available from Microlithic and Chalcolithic levels; which can be viewed as an indication of the beginning of food processing by the aceramic microlithic using communities which continued in the succeeding levels (Ajithprasad and Madella Personal Communication). Though geometric and non-geometric tools were recovered from both periods, one of the interesting features of the site is the absence of the use of the crested ridge technique (Brahmbhatt 2000: 75) which was commonly used by the Harappan folks.

From the presence of skeletal remains of both wild and domestic varieties of cattle, it has been interpreted as one of the probable centres of local domestication of zebu cattle (*Bos indicus*) (Patel 2009: 181). Patel (2009:181) further observes that wild sheep and goat are completely absent in both levels and its domestic varieties are available at the site in the later Chalcolithic levels. Based on these she proposes that these might have been brought into the site probably from areas to the Northwest (Patel 2009: 181). Long span of Chalcolithic phase at Loteshwar and ephemeral nature of the settlement can be interpreted as representation of periodic visits by mobile pastoralists who travelled to the area seasonally (Patel 2009: 184). Thus, from the above discussion it appears that Loteshwar has potentials to understand the processes of Early Food Production, Regionalization and Integration.
Datrana

Pre-Prabhas level was first noticed at the excavations at Somnath/Prabhas Patan in 1955-56 and 1956-57 and this phase of the site was designated as Period IA (Subbarao 1958). Although, in the subsequent excavation report (Nanavati et al. 1971) there is no mention of the same as its significance was not recognized at that time. Re-excavation of the site in 1971-72, 1975-76 and 1976-77 by the Deccan College Post Graduate and Research Institute, Pune and Department of Archaeology, Government of Saurashtra revealed the Pre-Prabhas levels, which extended roughly over 75 square meters at the lowest level of the mound and was resting on a sterile deposit of marine sand at about 3 meters below from the modern surface level. Two radio carbon dates from the Pre-Prabhas level gave a consistent calibrated date of 2900 BC (Dhavalikar and Possehl 1992) and due to the notion that the Harappan sites in Saurashtra are Late Harappan in nature (Possehl 2007) it created some confusions and the data remained unpublished for a long time. As other Pre-Harappan regional Chalcolithic cultures were reported in the beginning of 1990s a preliminary article on the Pre-Prabhas level at Somnath was published (Dhavalikar and Possehl 1992). Apart from the ceramics, crested ridge blades, faience and steatite beads (some are segmented), and fragment of a wall plaster with reed impressions indicating wattle and daub architecture were also reported.

During 1993-94 and 1994-95, The Maharaja Sayajirao University of Baroda carried out excavations at Datrana, mound IV locally known as Hadkawala Khetar which revealed habitation deposit of 75-90 cm incorporating two cultural periods, Period I Mesolithic and Period II Chalcolithic (Ajithprasad 2002). The Chalcolithic period was represented by long crested ridge blades, prismatic blade cores, stone beads and roughouts, copper punch point and ceramics similar to those from the Pre-Prabhas level at Somnath/Prabhas Patan. At the upper level of the deposit, this ceramic was found associated with ceramics of Anarta tradition and Early
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Harappan Burial pottery indicating that Pre-Prabhas pottery using communities were the earliest Chalcolithic inhabitants at the site who later came into contact with the above mentioned traditions/cultures. No structural remains were unearthed from the site. Pre-Prabhas nature of the ceramics from Datrana was first identified by G. L. Possehl (Ajithprasad 2002). An important feature of Datrana and Somnath is the use of crested ridge technique for blade production. Both the sites are located in distant localities and they are the only sites which revealed Pre-Prabhas pottery till date. Coarse corrugated pottery similar to the Pre-Prabhas level was reported from Rojdi and Modhera and the evidences from Rojdi suggests that it might be the Sorath Harappan ceramics rather than the Pre-Prabhas pottery (Ajithprasad 2010). As the ceramics from Somnath were not available, Datrana is conceived as the type site which can provide important information regarding Pre-Prabhas assemblage.

Vagad

Micaceous Red Ware was first reported during the excavations at Lothal (IAR 1954, Rao 1979; 1985) where it was found to increase in quantity towards the lower levels and due to water logging, the excavator could not reach the natural soil. Published burial pottery from Lothal also shows that majority of them are of Micaceous Red Ware and in some burials both Harappan and Micaceous Red Ware were found together (Rao 1985; Ajithprasad 2009). Although, this ceramic ware's main concentration is in Bhal region, it is also reported from Kachchh, North Gujarat and Saurashtra and not a single site showed its independent existence till date. This pottery was found in the excavated sites like Rangpur (Rao 1963), Desalpur (IAR 1963-64), Kanewal (Mehta et al. 1980), Ratanpura (IAR 1984-85), Vagad (Sonawane and Mehta 1985), Rojdi (Possehl and Raval 1989) and Nageswar (Hegde et al. 1990) and in sites like Rojdi and Kanewal it is not reported as Micaceous Red Ware but under other terminologies. Though, Lothal yielded large amounts of Micaceous Red Ware, its stratigraphic context and 'cultural
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identity could not be established due to limitations in excavations (Herman and Krishnan 1994)

Therefore, Vagad (located in Bhal region) excavated by The Maharaja Sayajirao University of Baroda (Sonawane and Mehta 1985) was selected as the type site for the study where Micaceous Red Ware was reported along with the Classical Harappan and Sorath Harappan ceramics. Vagad covers an area measuring 450x300 m and rises to a height of 2 m from the ground level. The single cultural period of the site is divided into three sub-periods (IA, IB & IC) based on structural levels and c14 date of Vagad IA is 2190-2080 BC, IB is 1800-1600 BC and Vagad IC must be later in date. Six circular hut remains and yajnavedikas(?) represent the architecture of the site. Terracotta and stone weights, terracotta ear ornaments, beads of various materials, shell bangles with chevron motif, spindle whorls, toy cart wheels, terracotta discs, crucibles, copper objects, saddle querns, pestles, rubber stones and sling balls were also recovered from the site. Though, the Micaceous Red Ware from the site is limited in number, it has chronometric dates, all trenches were excavated up to the natural soil and the excavated materials are easily accessible. Therefore Vagad was selected as one of the type sites for the study.

Padri

Padri Ware was reported from the excavations at Padri in 1990s (Shinde and Kar 1992; Bhagat 2001) and 11 explored sites in lower reaches of Shetrunji River (Paul et al. 1997; Shirvalkar 2008). The four fold cultural sequence at the site is represented by the Pre Urban Harappan (Padri culture), Urban Harappan (Phase I and II), Post Urban Harappan and Early Historic periods. Padri Ware is represented by thick and thin varieties of Coarse Red Ware, Pink Slipped Painted Ware, White Lustrous Ware, Bichrome Ware, Red Painted Ware, Plain Hand Made Ware and White Painted Ware. Red Painted pottery of Padri is akin to Sorath Harappan pottery and occurs from the lowest levels (Bhagat 2001). Padri
ware also shows similarities to Anarta pottery in some decorative patterns and shapes (Shinde and Kar 1992, Bhagat 2001, Shirvalkar 2008). Steatite beads were also reported from the earliest level. Padri is the only regional Chalcolithic site in Gujarat which revealed clear cut evidence for the existence of architectural structure during the regionalization era. The site revealed a mud structural complex of pressed clay having nine rectangular or squarish interconnected rooms measuring 12.5x12.5 m (IAR 1995-96, Shirvalkar 2008, Shinde et al in press). The C14 dates for the Pre-Harappan phase at Padri goes back to fourth millennium BC (3636 BC). Padri ware also occurs in the Mature Harappan level at the site. All the ceramics and antiquities from Padri and other explored sites are preserved in the Deccan College Post-Graduate and Research Institute, Pune. The complex nature of the site showing the features of Padri, Anarta and Sorath Harappan cultures is an interesting example to understand the similarities and differences between the three cultures/traditions. Above all, being the only one excavated site and representative site of Padri Ware, Padri was selected as a type site for research.

Cleaning and Documentation of Artifacts
Almost all the ceramics from Loteshwar, Datrana and some ceramics from Vagad were heavily encrusted with salt. No chemicals were used to remove the encrustation as it will affect the ceramics which were very fragile in nature. The ceramics were soaked in the water for 3-4 days, rubbed by a soft brush, most of the encrustations were removed and dried them in natural condition. While cleaning, sherds of same vessels were noticed and they were joined using quick fix or B 72. Subsequently, all the ceramics were numbered in serial order (R1, R2, R3, etc.) and stored.

In the next stage all the ceramics were recorded in a typological description chart prepared based on the ideas derived from various ceramic studies. Works of Dales and Kenoyer (1986), Vidale (2000), Miller (2007), Manchanda (1972), Rice (1987), Shepard (1985 reprint), Orton et al. (1993), Adams and Adams (1991), March
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Macroscopic details recorded include serial number, trench name, layer, depth, maximum size of the sherd, vessel part, vessel shape, diameter of the vessel, presence of carination/projected shoulder, probable manufacturing technique, number and position of perforations, nature of perforation, texture of the sherd, feel of the sherd, presence and position of decoration, type of decoration, surface treatment, surface condition, nature of fracture/breakage, colour of the core, surface, presence of slip and paint on the sherd, condition of the preservation of painting, finishing technique, presence of marks, core condition, presence of graffiti, mica, sand particles, organic inclusions, ware, chronology, remarks and drawing of representative sherds (Appendix 1). Most of the sherds from Loteshwar and Datrana IV are very small in size. Due to this reason, sometimes it was difficult to distinguish certain rim sherds into pot/basin or bowl/basin. Hence, for clarity, maximum size of a sherd is given as supporting evidence.

Generally, there is no uniformity in the description of ceramic wares in excavation reports and they were determined on the basis of colour, surface treatment, texture, decoration, firing technique, thickness of ceramics, heating technique and perforations. In this thesis main categorization of the wares is based on colour of the sherd. Therefore, to maintain the uniformity in the results of analysis, colour of the core, surface, slip and paint of the pottery were recorded using Munsell Soil Colour Chart (1954).

As the sections of the sherds from Loteshwar were encrusted with salt, it was difficult to understand the texture of the sherds. So, one side of all the sherds from
Loteshwar were scraped/cut using ceramic cutting machine/electric saw. This made the sections very clear and at the same time not leading to any significant change in the shape of the sherds.

Texture of all the sherds was recorded in a standardized manner using sand paper chart prepared by the researcher. Various grades of sand papers of Jawan Company were used to categorize the texture of ceramics into fine, medium and coarse. The denominations of the sand papers used were 36, 50, 60, 80, 100 and 120 (fig. 3.1). As the grades of sand papers increases from 36 to 120, particle size become smaller and finer. All sherds irrespective of coarse, medium and fine texture contained particles smaller than 120. Following pattern was used to define the texture of the balls.

<table>
<thead>
<tr>
<th>Texture</th>
<th>Denominations of Flint/Sand Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine</td>
<td>100/120 and 120+</td>
</tr>
<tr>
<td>Medium</td>
<td>60/80 and 120+</td>
</tr>
<tr>
<td>Coarse</td>
<td>-36, 36/50 and 120+</td>
</tr>
</tbody>
</table>

General observation of most of the artifacts other than the ceramics from type sites has not shown any visual difference from those of the Classical Harappan sites. The common artifacts recovered from the sites include pottery discs, steatite beads, faience beads, stone beads, terracotta beads, stone blades, cores and copper objects. In case of the artifacts, the records in antiquity register formed the basic data for analysis.

Chronology of Loteshwar, Padri and Vagad were assessed on the basis of conventional and AMS radio carbon dates and Datrana on the basis of relative dates of ceramics like Pre-Prabhas Pottery, Anarta Pottery and Early Harappan Burial Pottery.
Fig. 3.1: Jawan Flint/Sand Paper Chart

36 = Coarse

50 = Coarse

60 = Medium

80 = Medium

100 = Fine

120 = Fine

Courtesy: Flint Papers, Jawan Brand
Participation in Excavations

The type sites considered for this research were excavated long time before the beginning of the study. Hence, the investigator did not get an opportunity to participate in the excavations to understand the nature of these Chalcolithic sites located in various regions of Gujarat. Therefore, the researcher participated in the excavations of various Harappan associated and regional Chalcolithic sites in Gujarat and outside to understand the architectural features, ceramics and other associated finds stratigraphically. The researcher participated in the excavations of the sites like Bagasra/Gola Dhoro (Anarta, Classical Harappan, Sorath Harappan and Late Sorath Harappan) (Sonawane et al. 2003; Bhan et al. 2004), Jaidak/Pithad (Sorath Harappan and Late Sorath Harappan) (Ajithprasad 2008), Shikarpur (Anarta, Classical Harappan, Sorath Harappan and Late Sorath Harappan) (IAR 1987-88; 1988-89; 1989-90) and Loteshwar (Anarta) (IAR 1990-91); Ajithprasad in Gujarat and Ra's al-Jinz (Local, Classical Harappan and Mesopotamian) (Cleuziou and Tosi. 2000)in Oman. All the excavations in Gujarat were vertical in nature and at Oman it was horizontal. For the convenience of excavation and control of the context all these sites in Gujarat were divided into grids of 5x5m. At Bagasra, conventional stratigraphic method was followed while at Jaidak, Shikarpur and Loteshwar lot (each dig as separate entity) and feature systems (one dig may contain various features and they were treated separately) incorporated to have better control of the archaeological data. The re-excavation at Loteshwar in 2009 was highly precise and samples for various scientific studies and dating were collected from each lot, feature and sub square of the trench. The excavation also helped to understand the nature of one of the type sites, its pits and artifacts.

Field Survey/Exploration

Field surveys were carried out in selected regions with an aim to locate and record settlements belonging to regional Chalcolithic cultures, to understand the nature of the sites, identify the distribution of similar artifacts in a particular region,
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periodize the explored sites based on excavated sites in the survey region and to re-examine the sites that were already reported. Pre-exploration research in relation to present study helped in understanding the geology, geography, geomorphology, soil types, drainage pattern, rainfall, location of modern settlements and its subsistence pattern. Field survey included systematic surface survey to locate archaeological sites, recording features of the sites and collection of artifacts. 1:250,000 scale map prepared by the Army Map Service (LD), Corps of Engineers, U. S. Army, Washington, D. C. in 1954, Naksha-ma-Gujarat (Gujarati language), Google Earth and relevant literature were used for locating villages, understanding the drainage pattern and geological features of the study area. Global Positioning System (GPS) was used to record the co-ordinates of the sites, probable boundary of the sites, height of the mounds and sometimes to register the waypoints.

Methods of Exploration

Full coverage survey/transect survey was almost impractical for the single investigator as the survey region was vast and due to the restraints on resources and funding. Apart from this, some regions are highly exploited for agricultural purposes, some are marshy areas and in some places the ideas of private properties are very high. These stood as great obstacles for full coverage/transect survey. Though the study area incorporates whole Gujarat, the target area of exploration had to be reduced as it was impossible to explore the whole state in limited time period. So, different small pockets in various regions were selected for village to village surveys. The exploration was conducted with the help of an archaeologist and a vehicle to reach the village, followed by walking down to the archaeological mound. Most of the villages in the survey regions were connected by stone paved roads and small lines. While, some places it was difficult to approach the villages due to the highly damaged nature of roads or due to the absence of a proper line.
Road maps and topo-sheets were used to locate the villages and great care was taken to avoid missing any site. The sites were located by using traditional archaeological survey methods such as their proximity to noticeable geomorphologic features, proximity to water sources, soil/agricultural potentials and raw material resources. The region around most of the sites were under cultivation, hence, the help of the villagers were essential to locate them. Sometimes, there was a tendency by the local people to misguide the investigator to exaggerate the importance of the village or due to their ignorance. Regardless of these drawbacks, this method was very helpful as it led to the location of many sites of archaeological interest. Above all, the surveys were carried out in the summer season which gave more visibility of fields.

The shortcoming of the village to village survey is the missing out of small sites, small or low artifact scatters, activity areas and sites without a prominent mound. It was also impossible to relocate some of the sites reported by the previous explorers as the co-ordinates were incorrect, mounds destroyed for agricultural purposes or construction of roads, earth removed for domestic activities and unawareness of the local people about the sites. These problems showed light to the necessity to conduct full coverage surveys in the future to have more reliable data regarding the distribution pattern of sites. In spite of all these shortcomings, the survey presents representative and accurate data.

Intensive village to village surveys were carried out to understand the nature of the Chalcolithic settlements around Lothal and Padri along with participating in the explorations in the area around Somnath/Prabhas Patan, coastal regions of South Gujarat, Maliya and Dhrangadhra talukas of Rajkot district and Halvad and Dasada-Patdi talukas of Surendranagar district and re-examined selected excavated Chalcolithic sites in north-Gujarat, Kachchh, Saurashtra and South Gujarat. Explorations were carried out within a radius of 25km of the excavated sites of Padri and Lothal. The survey in Padri covered parts of Talaja, Gogha, Palitana and...
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Bhavnagar talukas of Bhavnagar district. At Lothal, the field reconnaissance covered parts of the districts of Ahmedabad (Dholka and Dhandhuka talukas), Anand (Kambhat taluka) and Surendranagar (Limbdi taluka).

Explorations in Mangrol and Veraval talukas of Junagadh district under the direction of Ajithprasad yielded sites having Early Harappan Burial pottery, Prabhas Ware and Sorath Harappan pottery. Explorations in coastal regions of Gujarat under V. H. Sonawane and Ajithprasad yielded sites having Classical Harappan, Sorath Harappan and Late Sorath Harappan Ceramics. Explorations in Maliya and Dhrangadhra talukas of Rajkot district and Halvad and Dasada-Patdi talukas of Surendranagar district under Arun Malik revealed Sorath Harappan and Late Sorath Harappan pottery. None of the explored sites in the above mentioned regions revealed evidences for the existence of Anarta pottery, Micaceous Red Ware, Padri Ware and Pre-Prabhas Pottery.

Various excavated sites located in different regions of Gujarat were surveyed/visited to understand the features of them. The excavated sites visited by the investigator include Malvan (Allchin et al. 1995), Bhagatrav (Rao 1963), Lothal (Rao 1979; 1985), Rangpur (Rao 1963), Padri (Shinde and Kar 1992), Somnath (Nanavati et al. 1971); Dhavaliakr and Possehl 1992), Kuntasi (Dhavaliakr et al. 1996), Bagasra (Gola Dhorro) (Sonawane et al. 2003; Bhan et al. 2004), Pithad (Jaidak) (Ajithprasad 2008), Loteshwar (AR 1990-91), Datrana (Ajithprasad 2002), Moti Pipli (Majumdar and Sonawane 1996-97), Santhli (Ajithprasad 2002; 2009), Ratanpura (Bhan 1989), Nagwada (Hegde et al. 1988), Mathutra (Majumdar 1999), Shikarpur (IAR 1987-88; 1988-89; 1989-90), Kanmer (Kharakwal et al. 2005; 2009) and Dholavira (Bisht 1989a; 1989b; 1991; 1994; 1998-99; 2004).

Among these, Lothal, Kuntasi and Dholavira are preserved for the visitors, Kanmer was visited during the excavation and it provided information regarding the architectural features of these sites. Lothal and Dholavira have site museums and
many of the antiquities recovered from the excavations kept in these museums also furnished first hand information regarding the artifact assemblage from these sites.

The exploitation of resources is directly related to the distance from the site. Hence, the abundance of raw material should fall off with the increase in distance from its source (Wilson 2007: 392) and Renfrew (1977: 71–90) called it as monotonic decrement. In the earliest times of human history, people selected sites where basic conditions of life such as natural shelter, food resources, and raw material sources were present and consequently, settlements tended to be located where all of these conditions were met, or where the basic raw material sources were not further than a day’s walking distance from the settlement (Katalin 1998: 2). Based on these observations, it was assumed that Chalcolithic communities exploited the raw material sources closer to their habitation area for the subsistence and the maximum area they covered by foot in a day as 25km through and fro probably. It was also necessary to understand the nature of neighbouring sites, water bodies, soil types and grass lands around the type site which might have played a major role in the life of the people in the site. Thus an area of 25 km radius was selected, divided into five successive circles of 5km each with the excavated sites (Lothal and Padri) at centre and each circles covered 0-5km, 5-10km, 10-15km, 15-20km and 20-25km respectively.

To identify the distribution of Padri Ware, the first survey was carried out at excavated site in Padri Gohilini in Talaja taluka and then covered all the villages in the taluka. A number of sites of Chalcolithic and succeeding cultural periods were also located in this region. The area was earlier surveyed by Paul, Tripathy and Shinde (Paul et al. 1997; Paul 1999) and Shirvalkar (2008). Though, some villages in Gogha, Palitana and Bhavnagar talukas were in the purview of the survey region, none of them yielded Chalcolithic sites. The survey covered cultivated lands, barren lands, grass lands, small streams and rocky terrains. Minor variations
were noticed in geomorphology and soil types of the region. Though, the exploration yielded number of Chalcolithic (Rangpur IIA, IIB & IIC), Early Historic and Medieval sites none of them yielded Padri Ware except the excavated site at Padri Gohilini. The excavated site at Padri is almost completely destroyed by removing earth for domestic purposes and the mound is levelled into the surrounding ground level.

The second survey was carried out in the area around Lothal. Different parts of the Bhal region was earlier surveyed by Rao (1963), Momin (1979), Dimri (1999) and Krishnan and Dimri (2005). This was followed by the explorations in parts of Dholka, Dhandhuka, Khambhat and Limbdi talukas and this yielded number of Chalcolithic, Early Historic and Medieval sites in various land forms. This exploration yielded number of sites having Micaceous Red Ware and none of the sites showed independent existence of this ceramic type.

The boundary and size of the sites were very difficult to assess due to the agricultural practices, disturbed nature of these sites and low density of artifacts. The site size was determined on the basis of artifact scatter and its boundary was estimated by pacing. GPS (Garmin eTrex Vista) was also used to get the rough shape of the site and its size. The comparison of the data derived from pacing and GPS were used to address the methodological problems involved in traditional techniques. Length, breadth and height of the sites were recorded in meters and from this size of the total mound was calculated in hectares. Some sites showed evidences for the Chalcolithic and Early Historic occupation in a single mound and due to this it was also difficult to determine the distribution of artifacts belonging to each cultural phases in different parts of the mound. Apart from the excavated sites, none of the Chalcolithic sites in the explored region showed evidence of structural remains. Most of the sites were represented by very low mounds with occasional occurrence of sites levelled to the surrounding ground level for agricultural purposes. This also led to the loss of the original context of
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artifacts. In some sites antiquities are highly weathered due to their prolonged exposure to natural agencies and some are highly encrusted with salts.

Site details were recorded on site recording sheet (Appendix 2) prepared with researcher's objectives and requirements. This helped the investigator to systematically record the comparable parallel primary set of data regarding each site. All the mounds are named based on their local names and sometimes the names of the owners of the fields used. Both complete name of the sites and its abbreviations were filled in the recording sheet along with names of village and taluka. Other data filled in the form for primary analysis include condition of the site, its shape, size, water sources, soil types, landforms, co-ordinates, distance from the village, major artifacts and chronological position. As photographs can provide a lot of information for later studies, digital colour photographs of the sites and its all relevant features were taken.

Special care was taken to avoid any bias during sampling and recording artifact information. The artifacts were more visible in ploughed fields than the cropped ones. Samples were collected randomly in pottery bags from all over the archaeological mounds to obtain accurate information about spatial distribution of artifacts and the bags labelled with date, site name and village name. As some archaeological sites showed different cultural phases it was difficult to determine visible differences in the artifact scatter in various parts of the same. From the sites with higher density of artifacts representative samples of different wares and from the sites with very low density of artifacts all the available specimens were collected. Major artifacts recovered from the sites include diagnostic sherds of pottery, stone objects, shell objects and some faunal remains. The classification and periodization of all the artifacts were undertaken at a later stage. The ceramics were cleaned, labelled and documented in the pottery recording sheet. Details like object, material, colour, size (using digital calliper) and other features of the artifacts other than ceramics were also recorded in separate sheets. Selected
samples were drawn, photographed and compared with other excavated ceramics from the study area.

Classification of Ceramics

Ceramics from the explored sites were classified based on typology for relative dating and periodization of settlements. The sherds were separated into diagnostic and undiagnostic forms and further divided into regional Chalcolithic, Harappan, Early Historic and Medieval types. Chalcolithic ceramic group from the survey regions included Sorath Harappan pottery, Classical Harappan pottery and Micaceous Red Ware at Lothal area. Padri Ware was completely absent in the explored regions. All macroscopic details of the ceramics were recorded in the pottery description chart (Appendix 1) as in the case of the excavated ceramics. Based on probable functional aspects of the vessels they were classified and defined. These ceramics were compared with those of the excavated sites in the survey region. Periodization of the explored sites was done through the relative dates of ceramics and chronometric dates of excavated sites.

Periodization of Sites

Relative chronology and classification of sites into various periods were done on the basis of comparative analysis of the ceramics from explored sites with various excavated sites in Gujarat. Excavation reports of the sites like Rangpur (Rao 1963), Lothal (Rao 1979; 1985), Surkotada (Joshi 1990), Rojdi (Possehl and Raval 1989), Oriyo Timbo (Rissman and Chitalwala 1990), Bet Dwarka (Gaur et al. 2005), Dhatva (Mehta et al. 1975), Jokha (Mehta et al. 1971), Kanewal (Mehta et al. 1980), Kuntasi (Dhavalikar et al. 1996), Malvan (Allchin et al. 1995), Nageswar (Hegde et al. 1990), Somnath (Nanavati et al. 1971), Padri (Shinde and Kar 1992; Shinde 1992a; 1992b), Bagasra (Sonawane et al. 2003; Bhan et al. 2004), Nagwada (Hegde et al. 1988), Langhnaj (Sankalia 1965; Clutton-Brock 1965; Ehrhardt and Kennedy 1965) and Vagad (Sonawane and Mehta 1985) were used for this purpose. Based on the results of the analysis the sites from the explored areas were
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placed in Mature/Urban Harappan and Late/Post Urban Harappan phases. Though Micaceous Red Ware was recovered from some of the explored sites in Lothal area, it is impossible to prove the Early/Pre Urban Harappan nature of the sites based on surface finds and in the absence of other Early Harappan Ceramics. The ceramics from the survey regions can be fit into the Rangpur and Rojdi sequences.

Preparation of Site Data Base and Maps

In order to understand the broad distribution pattern of Harappan and other regional Chalcolithic cultures/traditions in Gujarat a data base of reported explored sites was prepared. This data base was prepared by combining the data from various excavation reports, Indian Archaeology- A Review, books, articles in journals and Ph.D. theses. As this database is based on secondary data, there are all possibilities of using secondary references. In Gujarat, many areas were repeatedly explored by various researchers in different time periods; hence many sites were reported more than once by different explorers or by the same explorer(s) with the same name or different names. Geo-coordinates of many sites are not given and in most of the cases they are not accurate. In Gujarat, with in a district there are many villages having the same name. Hence, in the absence of co-ordinates, sometimes it is impossible to locate the sites. In the earlier times, the co-ordinates were calculated from the topo-sheets and location of the villages was given instead of sites. Hence, there are all possibilities of error of at least half a kilometre. Till 2000, there was a default error of approximately half kilometre in GPS data and by the end of 2000 this error was rectified. Therefore, the co-ordinates of almost all sites reported till 2000 are incorrect. Size of the sites are not given in many reports and it also prevents the possibilities of further studies like rank size analysis. All the sites are dated based on the ceramics and there is no uniformity in the same and many regional Chalcolithic ceramics were considered as Harappan ones. It also prevents the accurate representation of site distribution in various regions. Many districts were created dividing the existing ones; hence the sites reported
prior to the partition of districts may bear the wrong district name. This data does not represent the original distribution of sites as many sites were destroyed by the vagaries of human and nature, some are not discovered till date and many discovered sites are not reported. Some areas are very intensively explored while others are not at all explored. In Gujarat, village to village survey is the common exploration technique and it is mainly based on the information provided by the villagers, therefore, there is a chance of missing hundred of small sites, raw material sources and artifact scatters.

Thus, it is imperative to conduct a full coverage survey in Gujarat by a centrally organized team, recording the measurements of the sites, its co-ordinates and approach roads, preparation of contour plans using total station, GIS and Google Earth aided photography and collection of various artifacts to fix the chronology of various sites and distribution of various cultures/cultural phases within the site. This will immensely help to understand the distribution of various sites in different regions of Gujarat. One can compare this data with the previous ones and address various methodological issues.

In spite of all these drawbacks, various maps prepared based on these data base can provide broad distribution pattern of various cultures/traditions in different regions of Gujarat. In an A4 size map, the difference of half or one kilometre will not make much difference. Maps showing the distribution pattern of all the explored Chalcolithic sites, all the sites of Regionalization Era, Integration Era, Localization Era, sites of Anarta tradition, Padri culture, Pre-Prabhas Assemblage, Micaceous Red Ware Tradition, Prabhas Assemblage, Early Harappan Burial Pottery, Classical Harappan, Sorath Harappan, Late Sorath Harappan, Lustrous Red Ware and Malwa Ware in Gujarat were plotted in separate maps. Various softwares like Adobe Photoshop, Corel Draw, Global Mapper, Map Info Professional, Google Earth and Microsoft Office were used for the preparation of distribution maps.
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Preparation of Chronological Sequence and Regional Stratigraphy

Based on chronometric dates (conventional radio carbon, EMS, and thermoluminescence dates), relative chronology (stratigraphy and seriation) and other material remains from the excavated sites, cultural sequence and regional stratigraphy of Gujarat was prepared to understand the distribution of various cultures/traditions in different regions of Gujarat in different time periods.

Preparation of Database of Antiquities and Graphs

In order to understand the site wise and region wise variability in the use of raw materials and artifacts, database and graphs of artifacts from available excavated Chalcolithic sites were prepared. The sites of Gujarat were excavated in various degrees. Some sites were excavated widely while trial trenches or limited number of trenches were dug in others. Some of the sites are very huge (above ten to hundred hectare) in nature while some are medium size (above one to ten hectare) or very small (less than one hectare). The distribution of artifacts is high in some sites while others have moderate or very low number. So, there is a chance of huge variation in the number of artifacts from different size. But, variation in materials and artifacts can be considered as indicators of variation in cultures/traditions, differences in raw material sources, trade contacts and site function.

Compilation of Data and Thesis Writing

Final stage of the research was the compilation of all the relevant information and drafting of the thesis. Thesis was structured into six chapters that incorporated, introduction, review of Chalcolithic studies in Gujarat, methods of study, results of survey and reanalysis of artifacts, discussion on chronology and construction of regional stratigraphy, conclusion, bibliography and appendices. Necessary maps, figures, tables and graphs were also placed in appropriate sections. Various softwares were used during the final drafting of the thesis and they include
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