Archaeological Explorations at the Harappan Site of Kotada in Lodrani, Bela Bet, Gujarat

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Abstract

The significance of the Harappan site of Kotada in Lodrani, Gujarat, lies in its fortified settlement and is located around 50 km from the famous Harappan site of Dholavira towards its east. Initially documented between 2014 and 2016, it gained prominence in 2024 through media coverage. This study examines its fortifications, material culture, and environmental setting. The ceramic assemblage indicates cultural interactions and trade networks. Additional finds, including lithic tools, terracotta artefacts, copper objects, and faunal remains, suggest economic diversity. Radiocarbon dating confirms occupation during the Early and Mature Harappan phases, while the ceramic assemblage also suggests a brief medieval reoccupation. Modern disturbances such as looting and agricultural activities threaten its integrity. This study highlights the need for systematic excavations, scientific research, and conservation efforts to protect Kotada's archaeological significance.

Introduction

The Harappan site of Kotada in Lodrani (23° 54' 49.5720" N; 70° 39'00.8892" E; 62 m AMSL), Bela Bet, Gujarat, represents a significant fortified settlement that provides valuable insights into the regional manifestations of the Indus Civilization (Fig. 1). First documented by Bhudia (2014) and Rajesh (2016), the site gained popularity in 2024 after being reported in a series of newspapers and on social media (Yadav 2024). This study presents a comprehensive review of the site's archaeology, examining its fortification, architectural elements, and material culture, including pottery, lithic artefacts, terracotta objects, and faunal remains. The site (Fig. 2) exhibits a mix of Classical Harappan, Anarta Tradition, and Reserved Slip Ware ceramics, indicating cultural continuity and interaction. Additionally, radiocarbon dating suggests occupation spanning the Early Harappan (c. 3350-2600 BCE) and Mature Harappan (c. 2600-1900 BCE) phases, while the ceramic assemblage also suggests a brief medieval reoccupation. This research integrates geospatial analysis, historical imagery, and field explorations to understand Kotada's strategic location and its role within the broader Harappan cultural framework. However, modern disturbances, including unauthorised digging and agricultural activities, pose serious threats to the site's integrity. This study emphasises the need for systematic excavations, scientific analysis, and conservation efforts to safeguard Kotada's archaeological significance within the wider Indus Civilization network.

Received : 11-03-2025
Revised : 16-03-2025
Accepted : 22-04-2025

Location and Geology

The Kachchh region in Gujarat can be divided into four major physiographic units from north to south: the Ranns, the low-lying Banni Plain, the Hilly Region, and the Southern Coastal Plain. The hilly areas within the district occur as 'Uplifts' and can be broadly categorised into three: the Island Belt Uplift, the Kachchh Mainland Uplift, and the Wagad Uplift. The Island Belt Uplift consists of four highlands: Pachham, Khadir, Bela, and Chorar highlands, forming an east-west chain of uplifts within the Great Rann of Kachchh in the north. These highlands were islands during the Late Tertiary-Quaternary period when the Great Rann was submerged by the sea (Biswas 1971; Gaur *et al.*

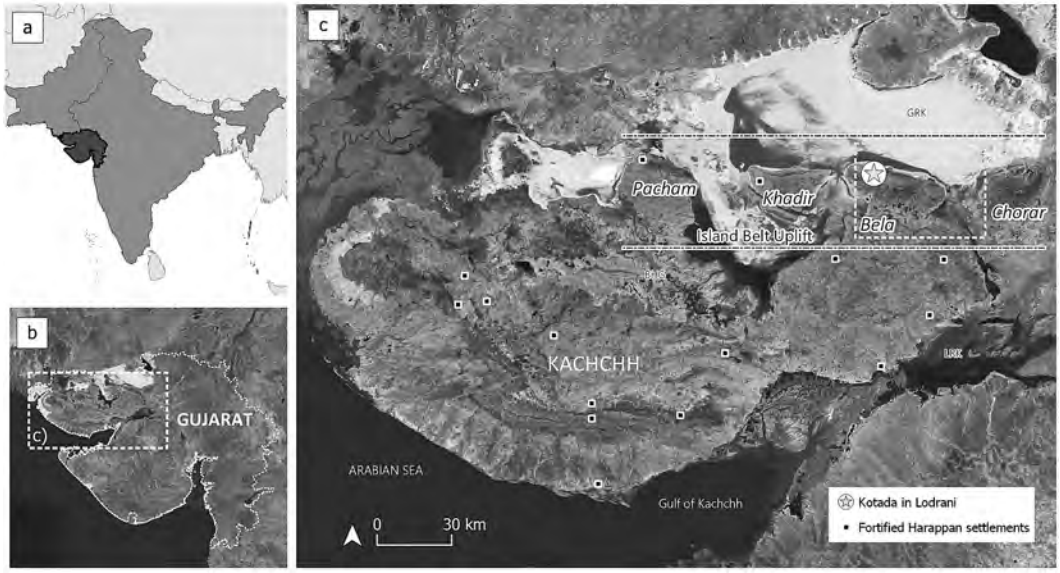

Fig. 1: a), b) and c): general location map of Kotada, Lodrani in the Bela Uplift of the Kachchh region in Gujarat, with location of other published Harappan fortified settlements. Source: prepared by the authors. Basemaps: Bing WMS.

Fig. 2: a to f) General View of Kotada

2013; Makwana *et al.* 2019). Mesozoic rocks are exposed in the highlands, bordered by Tertiary and Quaternary rocks in the southern and western peripheral plains. The Harappan site of Kotada in Lodrani is located on Bela Bet. The northern boundary of all the islands is steeper, while the gradient is gentler towards the south. The Bela Uplift, occurring north of the Wagad Uplift, is juxtaposed by the Gedi Fault. Low-amplitude faults accompanied by basic dykes are common in these uplifts (Biswas 1971, 1974, 1993; Kothyari *et al.* 2017). Bela Island can be classified as an arid region based on its climate, with an annual rainfall of less than 400 mm. There are 27 streams on the island, with the site of Kotada located 280 m northwest of the Sandhan stream (referred to as the Sananau stream on U.S. maps). The soil on the island belongs to the order Aridisols, which develop over aeolian silts and dune sands. These soils range in colour from light grey to brown and vary in texture from sandy to sandy-loam with silty clay-loam. Some of the soils are saline (Merh 1995). Groundwater on the island typically lies 5-20 m below the ground level. According to the villagers, the area around the site has only saltwater, while the well on the mound contains freshwater. However, during explorations, the team consistently found the well dry.

History of Discovery

In the village of Lodrani, there are many archaeological sites. In 1967-68, J.P. Joshi of the Archaeological Survey of India, assisted by K.P. Gupta, K.D. Tripathi, and N.C. Shah, reported the discovery of two late Stone Age sites – Gamania-ni-Timbi-2 and Sayakhan-ni-Wandh, as well as two Early Historic and Medieval sites, Padhrod and Juna Wana, in Lodrani (Lodhrani) (IAR 1967-68: 17). At Sayakhan-ni-Vandh, nine circular cairns with heaps of rubble were noticed on the slope of the Nilva Hills, in close proximity to a prehistoric bund (Joshi 1990: 429). The largest cairn had a diameter of 4.4 m and a height of 1.1 m, while the other cairns had diameters of 2 m and heights of 0.5 m. The site yielded microliths, including blades, flakes, and cores, a few lunates, and scrapers. In the neighbourhood, a small rubble wall of antiquity was also noticed. The nature of the cairns could not be determined, and according to Joshi, the surroundings strongly suggest megalithic cairns; unfortunately, the associated pottery is not available (Joshi 1990: 429). During the excavations at Dholavira from 1989 to 2005, various researchers visited different sites in Lodrani. In January 2014, based on survey maps and Google Earth, Kotada in Lodrani was visited by Bhudia, President of the Kutch Science Foundation (Bhudia 2014).

The location of Lodrani as a potential fortified archaeological settlement was first identified in 2015 using historical satellite imagery and topographical maps by the North Gujarat Archaeological Project (NoGAP), a joint initiative of the Maharaja Sayajirao University of Baroda and the Spanish National Research Council (2008-2018, Conesa, unpublished research). Hence, a team of archaeologists from the University of Kerala, the Maharaja Sayajirao University of Baroda, and KSKV Kachchh University visited the site on 19th February 2016 and 07th March 2016, and identified it as a fortified Harappan settlement of Kotada. The discovery of the site was announced on social media on 20th March 2016, along with numerous photographs of the site and a few artefacts (Rajesh 2016). During the visits, apart from Harappan and regional Chalcolithic ceramics, stone tools including chalcedony blades, Rohri chert blade, carnelian beads, copper objects, shell and terracotta bangles, triangular terracotta cakes, faunal remains, and a few medieval ceramics were also collected from the site.

More recently, on 16th January 2024, the site was explored by Ajay Yadav, former Additional Director-General of the Archaeological Survey of India and a Research Scholar at the School of Archaeology, University of Oxford, who announced it as a new discovery on social media (Yadav 2024). He called the site Morodharo (23° 54’ 49.5720” N, 70° 39’ 00.8892” E). He posted about the well within the fortification, the abundant sherds of perforated jars, chocolate coloured pottery, and terracotta cakes collected from the site, along with a site plan. He also proposed the presence of a possible outer fortification with burials. Alarmingly, and for the first time, these reports were also accompanied by the identification of treasure hunting activities at the site, as echoed in a publication about this re-discovery in the newspaper Times of India (20th February 2024, Rajkot Edition). In 2024, the site was also explored by Mahadev Barad, a research scholar at Shri Govind Guru University, Godhra (Barad 2024). The scholars from the Department of Archaeology, University of Kerala, continued their visit to the site during 2019, 2022, and 2024. After these explorations, various archaeological features of the site were noticed. Here, we present our major findings, which have been complemented with a set of two new radiocarbon dates. As the site is mentioned in the old historical topographic maps as Kotada, we are using this name in this paper.

Kotada in Historic Imagery and Maps

The site of Kotada appears prominently in geospatial legacy data available for Kachchh and Gujarat, such as historical topographic maps and historical satellite photographs. The fortified layout of the site was first spotted in CORONA photographs from the early 1970s and HEGAXON imagery from the early 1980s. In recent years, these archives of historical imagery have become fundamental to mapping the rich archaeological landscapes of neighbouring North Gujarat and to addressing key questions related to long-term landscape change and land use impact affecting archaeological visibility and preservation (Balbo *et al.* 2013; Conesa *et al.* 2014, 2015).

At present, the CORONA images that were first used for this study are fully available at the CORONA Atlas online viewer platform (CAST-UA) (Fig. 3).

The site is also featured in the first editions of the 1:1 Survey of India (SoI) topographic maps (1884-85), where the location is labelled as "Kotada" and is accompanied by an "x" symbol indicating a deserted or abandoned site (Fig. 4). The site is also present in subsequent SoI map copies, such as the 1950s map series by the US Army Map Services. Overall, the depiction of the site as Kotada is a toponym characteristic of many other fortified settlements depicted in Gujarat's historical topographic map series, such as Dholavira (Kotada) or Juni Kuran (Kotra Gadh), among others (see also Conesa *et al.* 2014; Petrie *et al.* 2019; Berganzo *et al.* 2023). High-resolution copies of the SoI map series and US Army map copies are freely available online at Zenodo (Brown 2022) and the Perry-Castañeda Library, University of Texas, respectively.

Architectural Features

The Harappan settlement at Kotada adheres to the typical layout observed for Classical Harappan sites. Explorations at the site unveiled a diverse array of structures, notably featuring a stone fortification crafted from sizable blocks of sandstone and shale. This structure sheds light on the sophisticated construction techniques of the Harappans. In

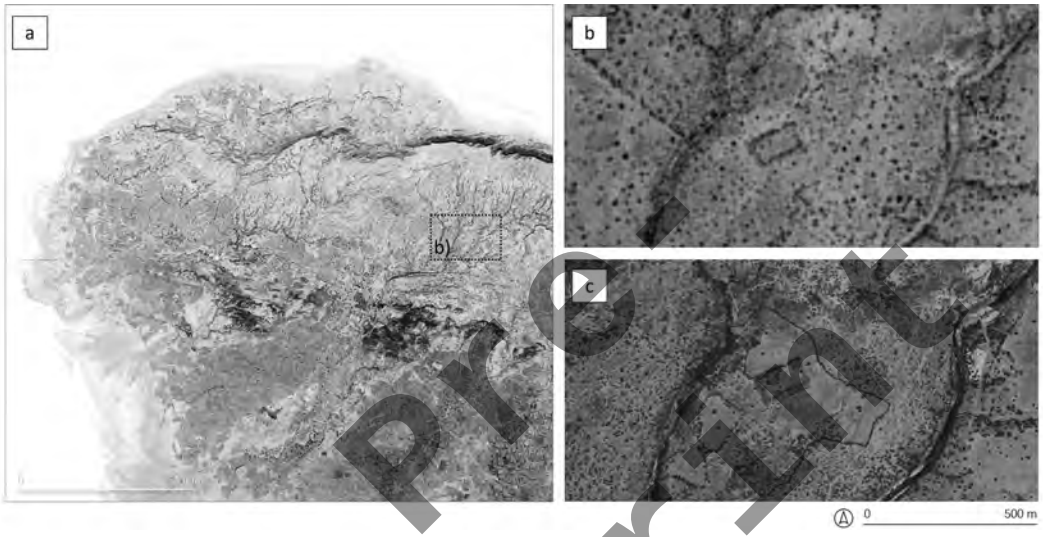

Fig. 3: a) Bela Uplift as shown in the first editions of the 1:1 SoI topographic maps (1884-85); b) detail of Kotada in Lodrani, represented with a deserted "x" symbol; c) the site is also represented as "deserted" in the 1950s map series by the US Army. Source: prepared by the authors. Basemaps: Old Survey of India Maps (Brown 2024), PCL Map Collection (University of Texas).

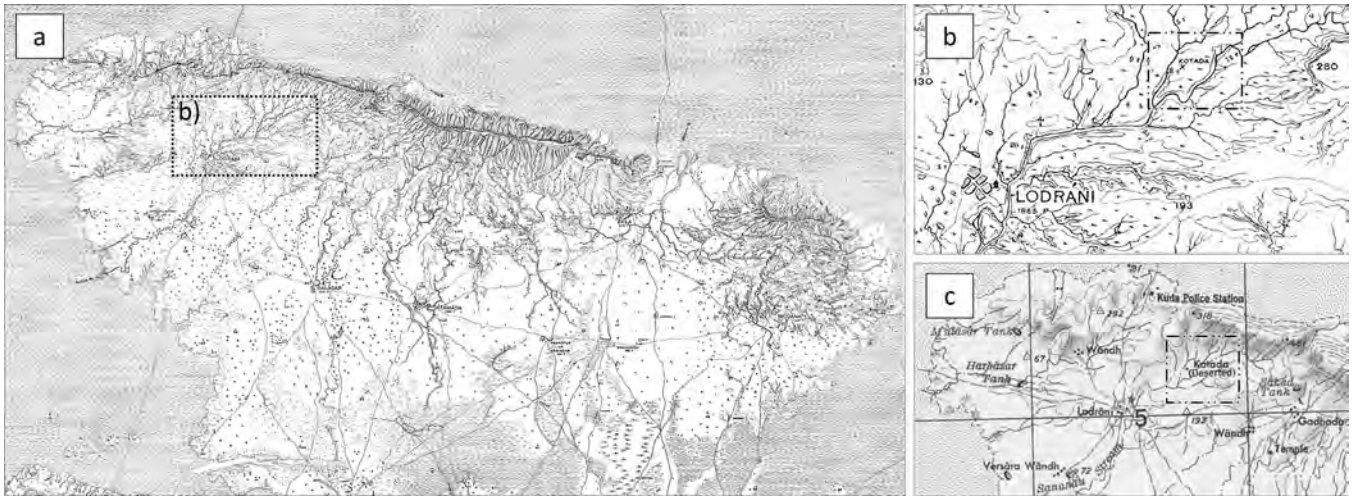

Fig. 4: a) Western region of the Bela Uplift in CORONA historical satellite photographs (1972); b) the fortified perimeter of Lodrani in CORONA imagery; c) present-day satellite view. Source: prepared by the authors. Basemaps: Bing WMS.

addition to the fortification, evidence suggests the presence of various other structures both within and outside its confines. Among these, the discovery of a well signifies the inhabitants' focus on securing a vital water source, essential for sustenance and survival in the arid landscape.

Fortification: The fortification at Kotada is constructed using stone blocks of varying thickness, forming a rectangular structure measuring approximately 100 m in the east-west direction and 60 m in the north-south direction. The walls of the fort are about 3.5 m thick and, when viewed from the lowest point inside the fortification (a portion dug by the looters), appear to have a height ranging from 2 to 2.5 m. At each of the four corners of the fort, square bastions are positioned, although their exact dimensions are obscured by the fallen debris. The fortification features five openings along its perimeter, although not all of them serve as entrances. Notably, the northern side of the fort has one opening, the southern side has two, and the eastern and western sides each have one. Among these openings, the one located centrally along the southern wall and the one in the southeast seem to be original entrances, while the remainder do not exhibit typical entrance features. On the outside, adjacent to the southern entrance, towards the southwest, there is a square projection attached to the fortification wall, measuring approximately 10 x10 m. This structure may have served as a gateway or a room linked to the fort's entrance, potentially facilitating control over the movement of people and goods both inside and outside the fortification. Some of the openings observed in the wall may have resulted from natural erosion, such as from rain, or could be the result of human vandalism.

Well: The site possesses a well located within the northeastern confines of the fortification (Fig. 5). The well boasts an inner diameter of approximately 1.3 m, encased by an outer diameter measuring around 2.3 m, while its walls maintain an approximate thickness of half a meter. Presently, the well goes down to a depth of about 2.6 m. Carved into the bedrock, the well showcases irregular circular edges at its base. Rising from this natural foundation, a well-crafted circular wall ascends to the surface, fashioned from sandstone blocks of varying thickness. The precise number of stone courses remains elusive due to the variability in block sizes. An imposing sandstone slab, measuring roughly 1.5 m in length, adorns the northern edge of the well, likely intended to facilitate water retrieval and ensure the safety of those drawing water. Currently devoid of water, the well stands empty, perhaps cleaned by villagers or subsequent visitors who sought to utilise it for water extraction in a recent period.

Structures Inside the Fortification: A significant quantity of sandstone blocks was found strewn across the interior of the fortification. In the northwestern portion of the inner fortification, numerous collapsed rectangular walls stand, their original function obscured by time. These structures likely served as dwellings or spaces for artisanal endeavours. Their walls boast thicknesses ranging from 50 to 60 cm. To gain insight into the plan and purpose of these buildings, excavations are essential.

Structures Outside the Fortification: On the southern periphery, roughly 50 m from the fortification wall, lies a sizable pile of stones. This heap appears to comprise two distinct structures: one boasting a diameter of

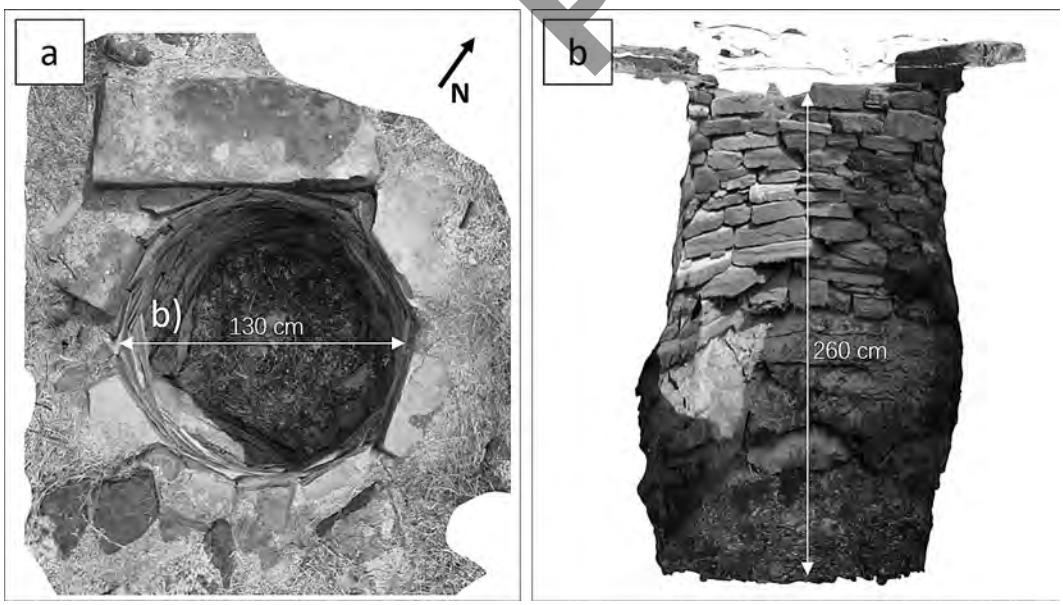

Fig. 5: a) and b) 3D zenital view and vertical section of Lodrani's well. Source: prepared by the authors (February 2024) with mobile LIDAR and Polycam Educational License.

Fig. 6: Circular Structure, Outside the fortification, Kotada (Courtesy: Agisoft Metashape Pro)

Fig. 7: Rectangular Structure, Outside the fortification, Kotada (Courtesy: Agisoft Metashape Pro)

approximately 5.5 m (Fig. 6), while the other takes on a rough rectangular form measuring around 8 by 5 m (Fig. 7). These structures, constructed from stone blocks of varying sizes, might have collapsed over time. Could these heaps of stones possibly be among the circular cairns of megalithic origin mentioned by Joshi and his team in their work? Unfortunately, without precise coordinates or detailed descriptions in their publication, confirming this is challenging (IAR 1967-68: 17; Joshi 1990: 429). If indeed circular in nature, they might represent burials from either the Early Harappan period (c. 3350-2600 BCE) or the huts of the Late Sorath Harappan Phase (c. 1900-1700 BCE). However, the absence of ceramics or other artefacts typically associated with these periods complicates such assertions. While these structures bear resemblance to those described by Joshi and his team as Sayakhan-ni-Vandh, further investigation is warranted to ascertain their origin and purpose definitively.

Pottery

The distribution of ceramics on the site's surface is relatively sparse compared to many archaeological sites near Kotada. Despite its limited presence, the collected pottery includes Classical Harappan, Anarta Tradition, Reserved Slip Ware (Fig. 8), and a few Medieval potsherds (Fig. 9). Notably, the absence of Sorath Harappan and Late Sorath Harappan pottery is a distinctive feature of the site. Additionally, channel-handled bowls, which are commonly found at sites in Kachchh, were not reported during the exploration.

Classical Harappan pottery at Lodrani, characteristic of sites such as Harappa (Vats 1940) and Mohenjo-daro (Marshall 1931) during the Mature Harappan period, is represented by a diverse range of vessel forms. Vessel components recovered from the site comprise rims, bases, stems, necks, shoulders, handles, and body sherds. The assemblage includes cooking pots (handis), bowls, basins, dishes, lids, troughs, dish-on-stands, perforated jars, and a distinctive bird feeder or handled cup (Fig. 8). The assemblage is dominated by red ware, with a smaller presence of white ware vessels, which are coated with a red slip. Slips observed on other vessels include red, buff, and chocolate hues. The pottery exhibits a variety of painted decorations, predominantly comprising thin and thick horizontal bands, either singular, paired, or arranged in multiple groups. These decorations are primarily found on the brim, rim, neck, shoulder, and body of the vessels. In some instances, painted motifs extend to the inner portion of the rim. Notably, a dish-on-stand features two horizontal bands on the inner surface of the stand, while a bird feeder's handle bears two parallel painted bands. Cooking pots display painted bands along the rim, shoulder, and ridge. The pottery includes fine, medium, and coarse varieties, reflecting variations in fabric and finish. Production techniques indicate the predominant use of the fast wheel, with all sherds exhibiting oxidized cores. Additionally, many vessels bear significant encrustations, indicative of post-depositional processes. The Classical Harappan Pottery recovered from the site closely resembles those documented from Stages III to V at Dholavira (Bisht 2015), Periods I to III at Kanmer (Kharakwal *et al.* 2012), Periods IA to IC at Surkotada (Joshi 1990), Phases I to II at Shikarpur (Bhan and Ajithprasad 2008; 2009), Phases I to III at Bagasra (Sonawane *et al.* 2003), Period IA at Desalpur (IAR 1963-64: 10-12), and Period A at Lothal (Rao 1985).

The ceramics of the Anarta Tradition (Ajithprasad and Sonawane 2011) recovered from Lodrani include gritty red ware, fine red ware, and burnished red ware. These vessels are predominantly handmade or produced using multiple techniques, with no evidence of fast-wheel manufacturing. The possibility of a very slow wheel or turntable being used cannot be ruled out. Forms identified at the site include straight-sided bowls with incurved rims,

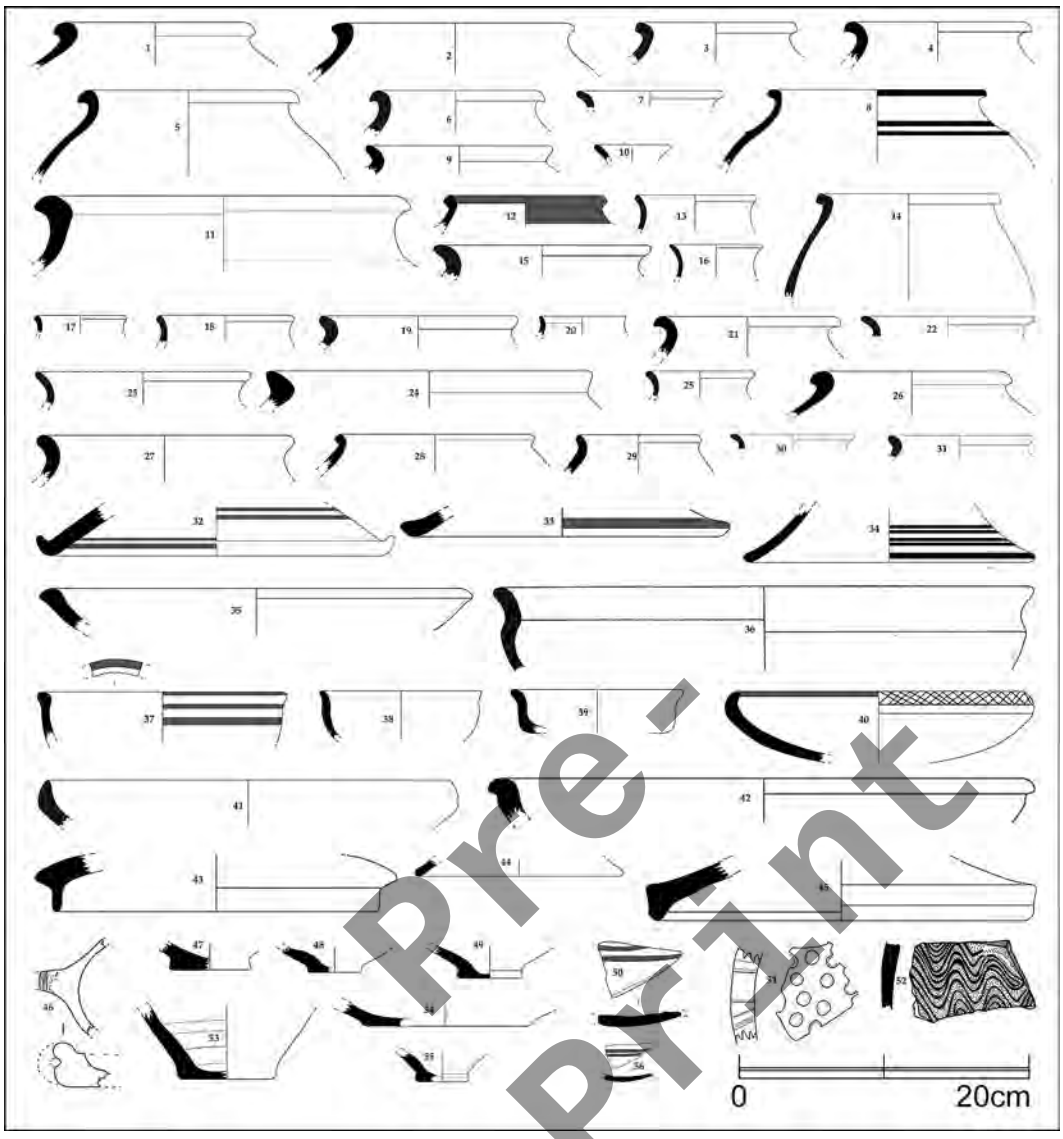

Fig. 8: Classical Harappan, Anarta Tradition and Reserved Slip Ware from Kotada

carinated bowls, pots and jars with flaring rims, constricted necks, and bulbous bodies, as well as blunt carinated basins with thick flaring rims (Fig. 8). A distinctive feature of these ceramics is the presence of sharp carinations in bowls and blunt carinations in basins. Many pots exhibit luting marks, suggesting that parts like the body and rim were separately made and later joined in a leather-hard condition through beating and paddling. The irregularities on both internal and external surfaces, along with visible striations and scraping marks, further support the use of these techniques. Striations on rims appear more regular, likely due to the use of a turntable or slow wheel. Beating and paddling marks are evident on nearly all vessels, while scraping marks are particularly clear on mat-surfaced pots. The predominant ceramic colours are variations of red.

Most vessels have a slip on the external surface. In narrow-mouthed vessels like pots, slip is confined to the rim on the internal surface, whereas in wide-mouthed forms such as bowls and basins, slip is present on both surfaces. Burnishing or polishing is common, with pots showing the highest degree of burnish, followed by bowls and basins. Decorations on the ceramics primarily consist of painted geometric and non-geometric designs, applied in black, white, and reddish-black hues. These are often set against a white background or directly over the slip. Common motifs identified include thick and thin vertical and horizontal bands, slanting lines, crisscross patterns, intersecting panels, and wavy lines. Decoration is mainly found on external surfaces, with limited occurrences on the internal surface, usually restricted to the rim of pots. Texturally,

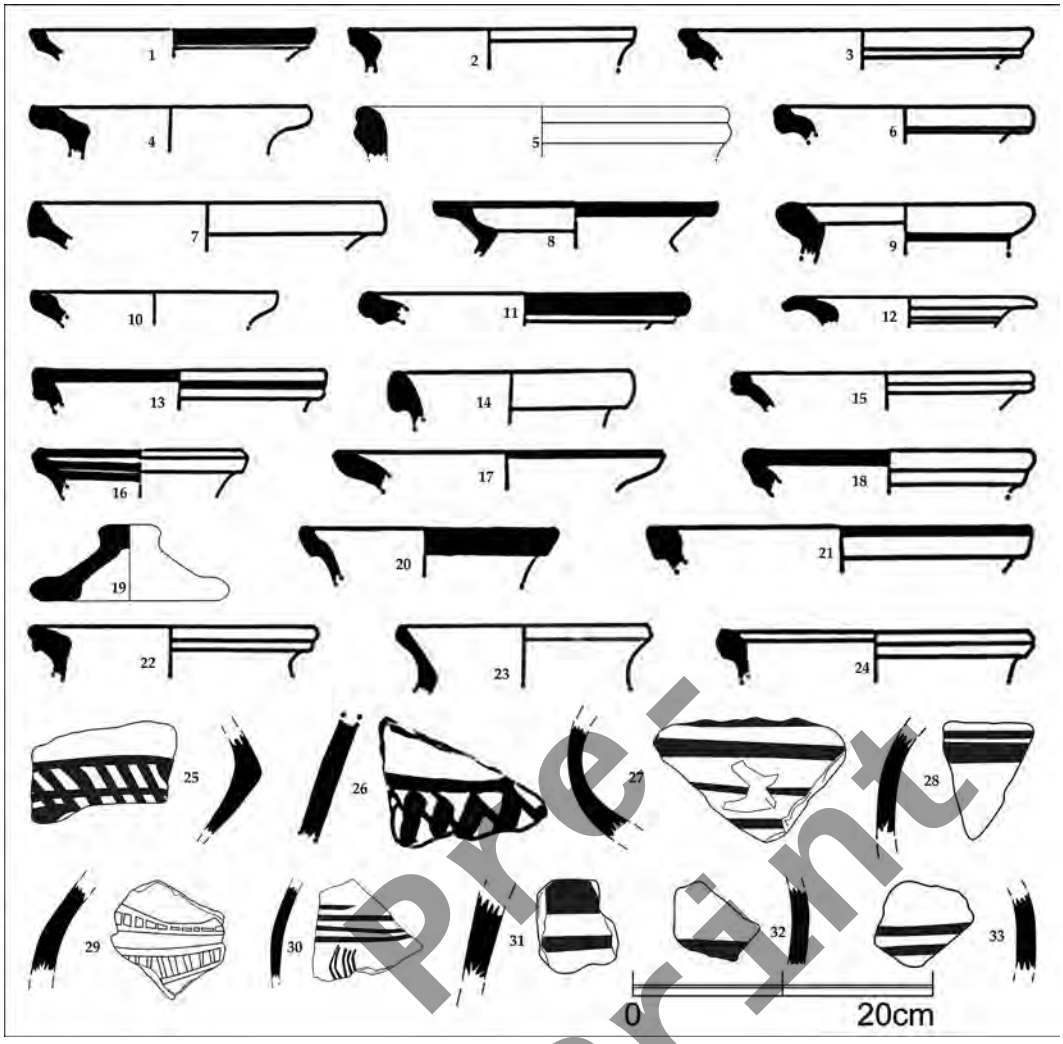

Fig. 9: Medieval Pottery from Kotada

the ceramics can be categorised into coarse, medium, and fine varieties, with the majority being of medium texture. Coarse ceramics, particularly those with mat surfaces, are also present. Most vessels have an oxidized core, though a few exhibit deoxidised cores, likely due to firing inconsistencies or mineral composition in the raw material. All vessels contain small sand particles, with some having larger inclusions. Mica is visible on the surfaces and cores of all sherds. The presence of sand may result from intentional tempering or naturally occurring minerals in the raw material. The Anarta Tradition pot sherds from the site closely resemble those found in the Early Harappan levels at Loteshwar (Rajesh 2011; Rajesh *et al.* 2013) and Datrana (Rajesh *et al.* 2013), as well as the Mature Harappan levels at Dholavira (Bisht 2015), Shikarpur (Bhan and Ajithprasad 2008, 2009), Bagasra (Sonawane *et al.* 2003; Bhan *et al.* 2004), Nagwada (Hegde *et al.* 1988, 1990), Surkotada (Joshi 1990), Desalpur (Uesugi *et al.* 2015), and Kanmer (Kharakwal *et al.* 2012).

A few fragments of small pots made of glazed Reserved Slip Ware were collected from the site (Fig. 8). Although the glazed dual slips on the external surface of many sherds have nearly vanished, these fine ware sherds exhibit a deoxidised core and external surface, indicating reduced oxygen levels within the kiln during firing. Reserved Slip Ware is a distinctive type of ceramic that was popular in the Kachchh region during both the Early Harappan and Mature Harappan periods. Many colour and design variations of this ware can be found throughout Kachchh, with significant quantities reported from sites such as Khirsara (Nath *et al.* 2012; 2015), Dholavira (Bisht 2015), Juna Khatiya (Rajesh *et al.* 2023; 2024), Lakhapar (Abhayan *et al.* 2024), Kanmer (Kharakwal *et al.* 2012), and Shikarpur (Bhan *et al.* 2008; 2009). While these ceramics are also documented in other regions of Gujarat, they appear in limited quantities. The decorative patterns include horizontal bands, wavy lines, and their combinations. Slip colours range from grey, red, and

light blue to light yellow. Interestingly, Reserved Slip Ware is seldom found in sites in the Sindh region and is present only in very limited quantities there. Due to its aesthetically appealing appearance and its resemblance to Classical Harappan vessel shapes, many researchers regard it as a type of Classical Harappan vessel rather than a regional variant of the Kachchh region. The Reserved Slip Ware from the site closely resembles those reported from Dholavira (Bisht 2015), Surkotada (Joshi 1990), Shikarpur (Bhan *et al.* 2008; 2009), Kanmer (Kharakwal *et al.* 2012), Khirsara (Nath *et al.* 2012; 2015), and Desalpur (Uesugi *et al.* 2015).

A few late medieval potsherds, including rims, bases, and body sherds, were collected from the site. The identified vessel types, consisting of pots and lids (Fig. 9), can be categorized into red ware and grey ware. These ceramics exhibit painted and incised decorations, with painted designs executed in black, featuring horizontal bands and irregular vertical strokes. Incised decorations, primarily nail impressions, are common in grey ware, while some mould-made fragments display impressed patterns. The vessels vary in texture, ranging from fine to coarse, and were produced using both the wheel and mould. Compared to Harappan pottery, they are of inferior craftsmanship. Most sherds have deoxidised cores, likely due to firing deficiencies, and mica is present on all fragments. Similar pottery has been reported from Nadapa (Rajesh *et al.* 2020) in Nakhatrana Taluka and Madi (Rao and Kumaran 2015) in Mundra Taluka of Kachchh District.

Fig. 10: Stone Tools and Lithic Debitage from Kotada

Lithic Artefacts

The lithic assemblage collected from Kotada comprises tools as well as lithic debitage (Fig. 10). An ample amount of lithic debitage, which includes exhausted cores, indicates that the stone tool manufacturing activities were being carried out at the site itself. The raw material utilised for tool production is predominantly chalcedony. However, a few flakes of chert have also been found, and prominent amongst these was a retouched broken blade, which looked as if it was made out of chert available from the Rohri hills in Pakistan, signifying long distance contact. Diagnostic tools comprise of unretouched blades as well as a few points which were manufactured by retouching the blades. Tools are mostly found in broken condition. The presence of crested ridge blades as well as one core with an intact crested ridge clearly point towards the crested guiding ridge technique being used for tool production. This preliminary analysis indicates that the lithic assemblage of Lodrani follows a pattern observed from other lithic assemblages belonging to the Early Harappan sites situated in Gujarat, namely Juna Khatiya, Janan and Datrana (Gadekar *et al.* 2021).

Terracotta Triangular Cakes

Thirty-nine triangular terracotta cakes, exhibiting varying degrees of breakage, were collected from the surface of the site (Fig. 11). Among the majority of the fragments, only one corner remains intact, and appears rounded. These cakes display a range of red hues and have smoke clouding on the surface. They are made out of chaff-tempered clay as evidenced by impressions left on the object. Some cakes have cores that show signs of oxidation, while others exhibit deoxidisation, indicating different firing levels within the kiln. In Kachchh, numerous sites have yielded terracotta cakes, with the highest concentration reported from Shikarpur, where over 150,000 fragments were unearthed (Ajithprasad *Personal Communication*). Similarly, sites like Dholavira and Juni Kuran have produced significant quantities of triangular cakes. However, in Saurashtra, they are less common, with reports from sites like Lothal and Bagasra. These cakes have been discovered in various contexts, leading scholars to propose diverse uses for them. A triangular cake recovered from Rangpur shows marks indicative of tubular drill sharpening. Wheeler (1960) suggested they may have been used as toilet paper, while others have interpreted them as ritual objects, heat retainers, cooking or boiling objects, floor paving materials, or kiln setters (Mackay 1938; Rao 1979, 1985; Allchin 1993; Dales and Kenoyer 1993; Sharma 1993; Jarrige 1994, 1995; Nath 1997-98; 1998-99; Pradhan 1999; Thapar 2003; Trivedi and Patnaik 2004; Sant *et al.* 2005; Agrawal 2007; Manuel 2010). Terracotta cakes from some sites bear Indus script, decorations, designs, or figurines. Apparently, these objects served

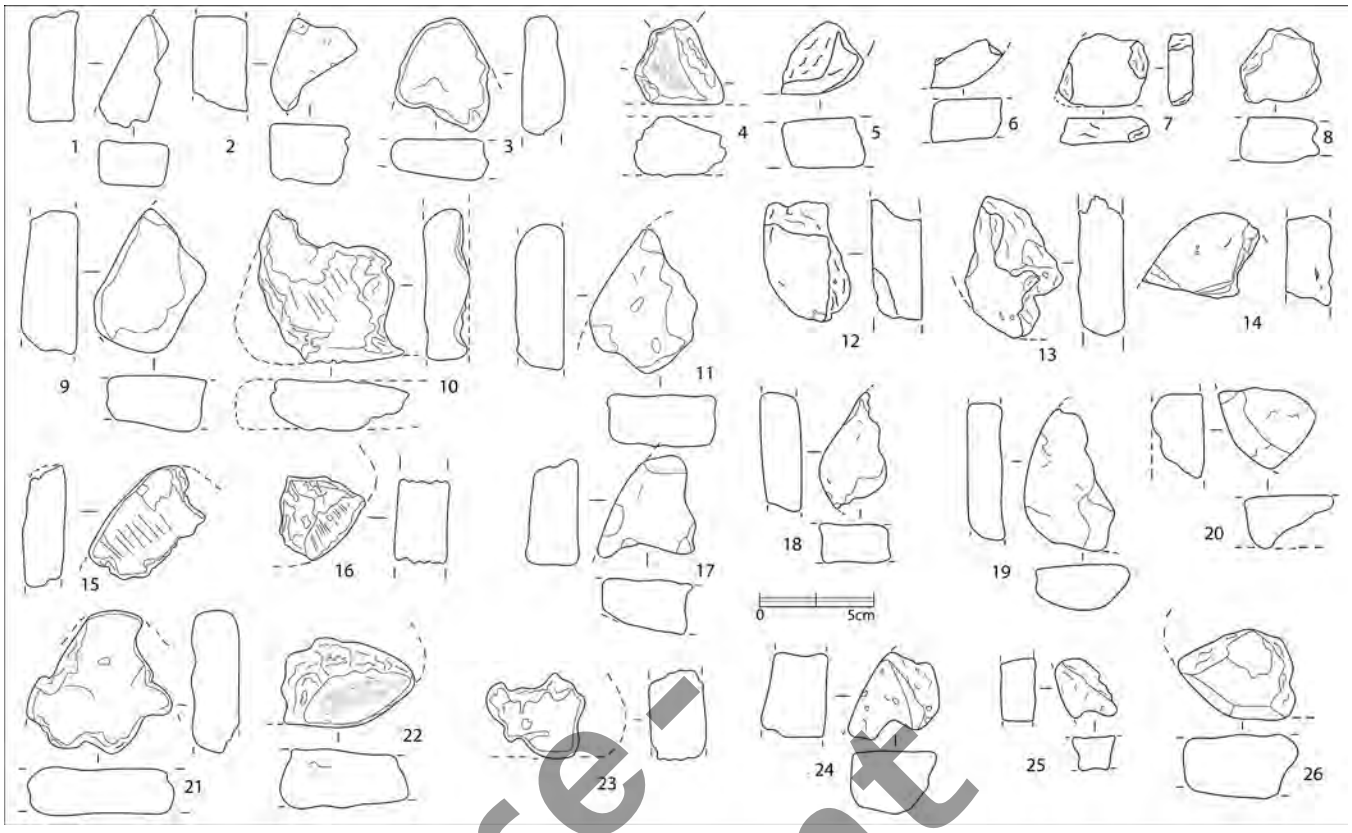

Fig. 11: Fragments of Terracotta Triangular Cakes from Kotada

multiple purposes, most likely their use as heat retainers, given their prevalence in or near firing areas.

Terracotta Pinched Cake

A broken terracotta pinched cake, commonly referred to as Mushtika, was also retrieved from the site (Fig. 12: 1). Despite its damage, it bears finger impressions. Mushtikas have been collected from various sites such as Loteshwar (Rajesh 2011), Zekhda (Momin 1983), and Moti Pipli (Majumdar and Sonawane 1996-97) in North Gujarat. They are frequently associated with ceramics of the Anarta Tradition. Many scholars regard them as objects linked to ritual activities. According to Nath (1998: 43), Mushtikas were, "…*prepared to be placed in cow dung cake fire pans as heat absorbents, after which they were reused either for floor bedding or for raising levels*." The presence of successive Mushtika beddings in the massive mud brick fortification at Rakhigarhi and Mushtika bedding in the cutting of a street at Kalibangan (Nath 1998: 41) illustrates the various types of contexts, some less sacred, in which Mushtikas are discovered.

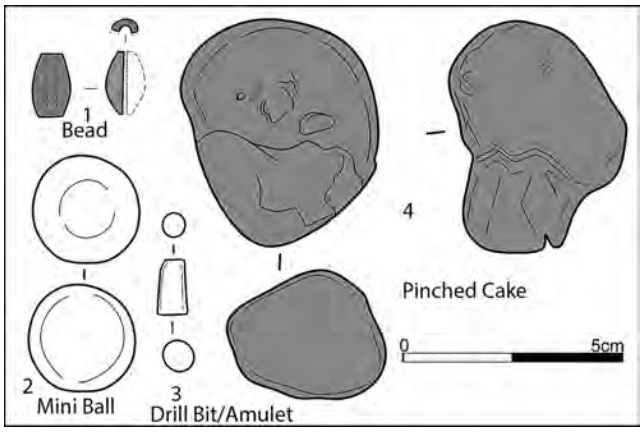

Fig. 12: 1-Bead, 2-Mini Ball, 3-Drill Bit/Amulet and 4-Pinched Cake

Terracotta Bangles

Five fragments of terracotta bangles were discovered from different areas of the site (Fig. 13: a). These bangles exhibit inner diameters ranging from 5 to 5.5 cm, while their outer diameters vary from 6 to 7 cm. They display a uniform red hue and lack any decorations. The surface and fractures of these bangles contain visible sand particles. Despite this, they are well-fired, with an oxidised core. Terracotta bangles, found in various shapes, sizes, and abundant quantities, are encountered at numerous Harappan sites. Notably, a substantial number of terracotta bangles have

been documented at Harappan sites in Kachchh, such as Shikarpur (Chase *et al.* 2014), Surkotada (Joshi 1990) and Juni Kuran (Pramanik 2003-04). It is worth mentioning that some items identified as terracotta "bangles" might have functioned as kiln setters rather than being worn (Halim and Vidale 1984; Kenoyer 1991). The ranking of bangles based on their raw materials and the level of craftsmanship appears to correlate with the overall abundance of bangle fragments found across different sites (Kenoyer 1991). According to Kenoyer (1991), in Harappan sites, gold, silver, stoneware, copper, and faience bangles would be considered the most prestigious, while terracotta bangles would rank lowest, with shell bangles falling somewhere in between.

Terracotta Mini Ball

A single terracotta mini ball/pellet was discovered within the fortification of Lodrani (Fig. 12:2). This diminutive red coloured mini ball measures 1.74 cm in diameter. While the precise function of these mini balls within the Harappan context remain elusive, their roles vary widely across different regions and archaeological sites. They have been interpreted as hunting slings or weapons (Mellart 1966, 1967; Mehta and Chaudhary 1971; Korfmann 1971; Mehta *et al.* 1980; Rao 1985; Joshi 1990), cooking stones (Teit 1930; Ford and Webb 1956; Driver and Massey 1957; Pennington 1963; Tanaka 1980; Hudson and Blackburn 1982; Wandsnider 1997; Tringham and Stevanovic 1990; Perles 2001; Atalay 2005), counting devices or tokens (Rao 1985; Schmandt-Besserat 1992; Dhavalikar *et al.* 1996; Atalay 2005), gaming pieces (Mehta *et al.* 1980; Rao 1985; Dhavalikar *et al.* 1996), weights (Atalay 2005), grinders (Atalay 2005), ritual objects (Rao 1985; Patel and Rajesh 2008),, and decorative items (Patel and Rajesh 2008). Furthermore, it is conceivable that a single sling ball could have served multiple functions during its period of use.

Shell Bangles

Two shell bangle fragments were discovered at Kotada (Fig.13:b). One fragment is a thin bangle measuring 6 cm in outer diameter, 5 cm in inner diameter, 0.4 cm in width, and 0.5 cm in thickness, devoid of any decoration. The other fragment is a broader shell bangle, with dimensions of 7 cm outer diameter, 6 cm inner diameter, 1.4 cm width, and 0.5 cm thickness, featuring chevron decoration. This one is broken from both sides, though leaving the central portion of the chevron design intact. The chevron motif is characteristic of shell bangles from the Classical Harappan period. According to Kenoyer (1991a, 1991b), shell bangles served as symbols of unity, sexuality, and potentially ethnic identity within Harappan culture. The consistent presence of shell bangles with incised chevron designs across settlements suggests a shared aesthetic. However, their limited availability indicates they were not accessible to all members of the community. Excavations at Harappa reveal that these bangles were primarily worn by middle-aged adult women over several generations, indicating stability and continuity within the community (Kenoyer 1991b).

Stone Bead

A broken carnelian bead, measuring 1 cm in length, was also discovered at the site (Fig. 12:1). The bead is vertically split and exhibits a patina on its surface. It has a biconical shape and shows evidence of drilling from both sides. One portion of the bead is blackened, possibly indicating excessive heating, while other parts display the bright red colour characteristic of carnelian. According to Kenoyer (1991b), the variation in ornament styles based on raw material and technology likely reflects social hierarchy within the Harappan society. This hierarchy would have applied both to individuals wearing the ornaments and to the artisans crafting them. Individuals adorned with carnelian and gold ornaments were probably of higher status compared to those wearing similar ornaments made from steatite or terracotta. Similarly, artisans working with carnelian and gold may have held higher rank than those producing red painted terracotta imitations.

Drill Bit/Amulet

A broken piece, possibly a drill bit (Prabhakar *et al.* 2012) or fragment of an amulet, was collected from the site (Fig. 12:3). The material is ernestite and according to Law (2011), ernestite is characterised by its extremely fine-grained texture, adorned with dark-brown to black patches and dendritic veins set within a khaki-coloured matrix. Upon study of the object's thickness, it does not seem to resemble a typical drill bit. The object measures 1.1 cm in length, with one side having a breadth of 0.7 cm and the other end measuring 0.5 cm. If indeed an amulet/pendant, the upper portion of the object appears to be broken.

Copper Objects

Two copper artefacts retrieved from Kotada exhibit distinct signs of antiquity, evident in their fragmented and corroded state. One of the copper fragments appears to be thin, possibly originating from a sheet or a knife blade. The other, notably heavier and irregular in shape, bears resemblance to slag or prill. The presence of corrosion on both objects and their condition suggests a significant age. If indeed the heavier artefact is confirmed to be slag, its discovery implies a level of metallurgical activity at the site. While it may not directly indicate copper smelting, the possibility of copper melting for the production of various tools and implements from ingots cannot be dismissed. Ultimately, conclusive insights regarding the nature of

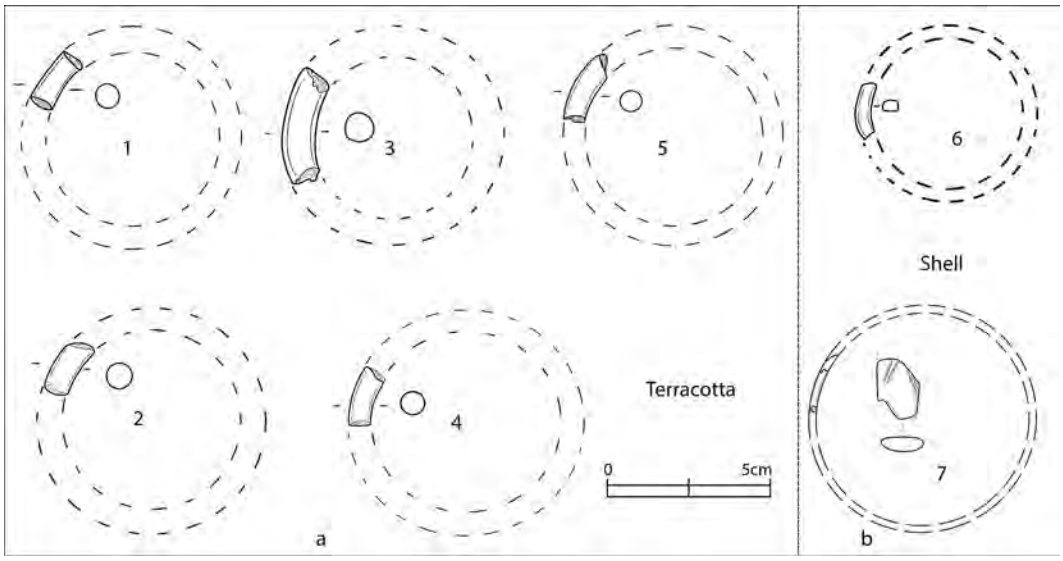

Fig. 13: a) Terracotta Bangles, and b) Shell Bangles from Kotada

metalwork at the site can only emerge through further excavation and analysis.

Grinding Stone

A flat and intact grinding stone measuring 51.5 cm in length, 33 cm in breadth, and 6.5 cm in thickness was recovered from the site (Fig. 14). This - grinding stone of sandstone material exhibits a slight depression at its centre, indicative of its purposeful use. Additionally, the four corners of the same appear rounded in nature. Such a find suggests its involvement in food grain processing or its utilisation within industrial activities for the grinding of raw materials.

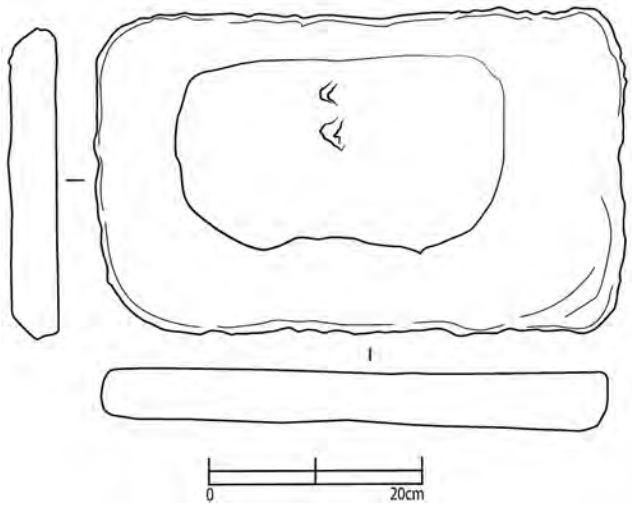

Fig. 14: Grinding Stone from Kotada

Faunal Remains

The surface survey revealed faunal remains with soil encrustation, suggesting significant antiquity. Taxonomic identification revealed the presence of cattle, sheep, and goat bones. The faunal assemblage comprises a diverse range of skeletal elements including long bones (from the distal phalanges to the scapulae) in addition to vertebrae and ribs. A notable characteristic was the abundance of unfused epiphyseal regions in the long bones of sheep/goat individuals. This indicates a mortality profile dominated by young animals within this category. This pattern based on evidence can potentially be interpreted as, the consumption of mutton (cooked sheep/goat) by the inhabitants of the site. Additionally, cut marks and charring observed on sheep/goat and cattle bones reinforce their role as a dietary source for the occupants.

Vandalism/Looting

Compared to many sites in the Kachchh region, this site has experienced relatively low levels of vandalism. However, there are clear signs of disturbance, particularly evident around the well and within the fortification's north-western corner. The well, devoid of any soil cover and exposed to the bedrock, suggests recent cleaning, likely for water retrieval, although it is currently dry. Further evidence of vandalism is observed in the north-western corner of the fortification, where a sizable ditch, approximately 5 x 5 x 1.5 m in dimension, has been excavated, likely using heavy machinery (an excavator) between October and November 2018, as suggested by the analysis of temporal satellite imagery (Figs. 15-16). While this digging has not caused significant damage to

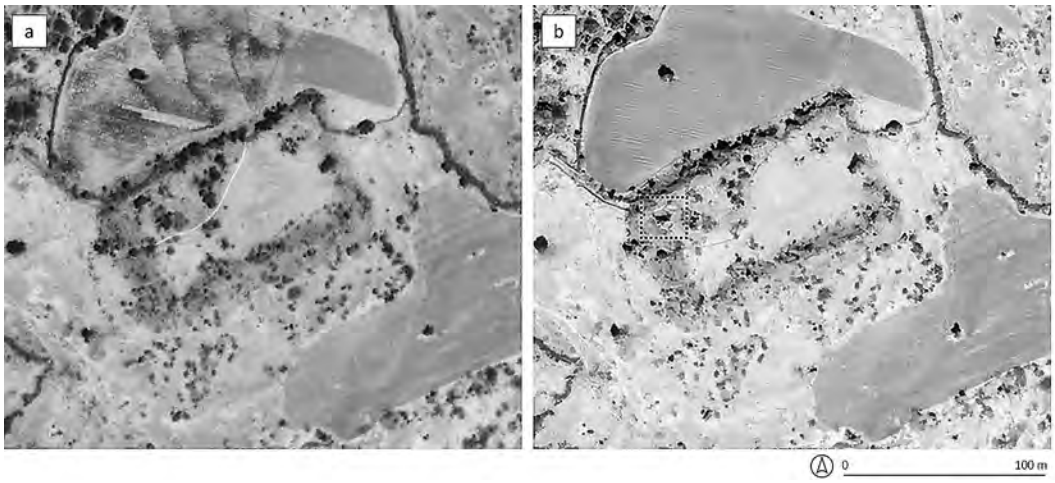

Fig. 15: Evidence of looting activity during the fall of 2018; a) satellite view from October 2018; b) satellite view from November 2018, showing a 5x5m pit disturbance in the inner northeastern corner of the fortification. Source: prepared by the authors. Basemaps: Google @Maxar Technologies.

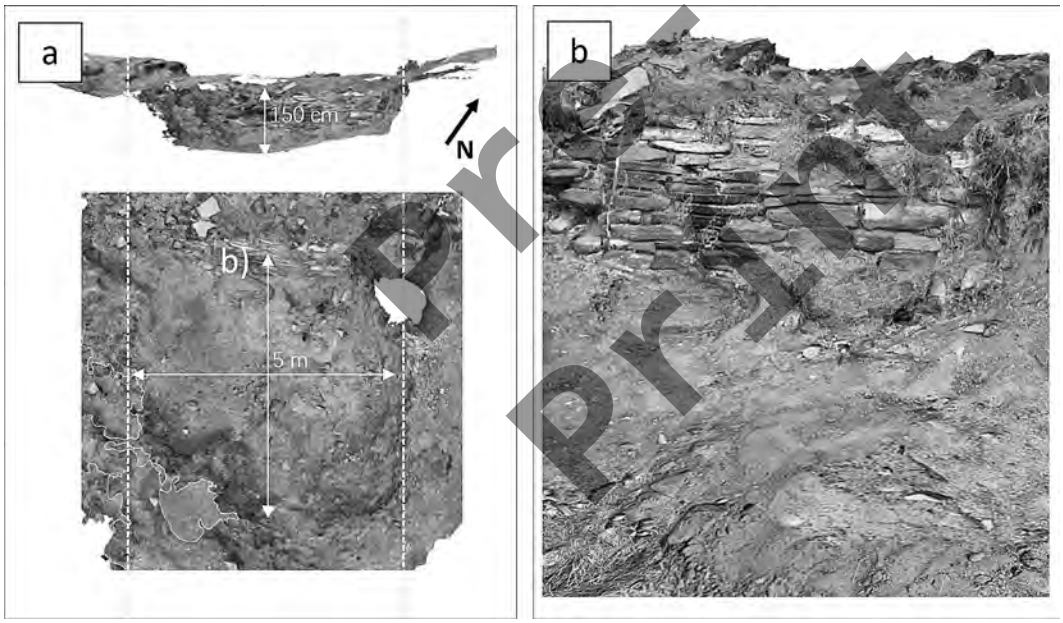

Fig. 16: a) 3D zenital view and vertical section of Lodrani's looting pit; b) vertical section of the exposed inner wall bastion. Source: prepared by the authors (February 2024) with mobile LIDAR and Polycam Educational License.

the fort wall itself, the archaeological sediment excavated from the ditch has been haphazardly scattered over the surface. This sediment contains numerous artefacts such as pottery, bones, and broken terracotta fragments, indicating an intrusion likely motivated by the belief that valuable items could be found in this archaeological site. Outside the fortification, particularly along the eastern, western, and south-eastern perimeters, disturbances consistent with agricultural activities are observed. Large stone boulders, presumably moved with heavy machinery, are strewn near the walls, and structures outside the fortification also bear signs of disruption due to agricultural practices. The prevalence of such vandalism underscores the urgent need for community education on the significance of preserving our cultural heritage for future generations. It is imperative to raise awareness among villagers and neighbouring communities about the archaeological value of the site and the importance of its conservation. To

mitigate further vandalism, concerted efforts are required, including increased vigilance by relevant authorities such as the Archaeological Survey of India and the Gujarat State Archaeology Department, as well as community engagement initiatives. These institutions play a crucial role in the conservation, preservation, and protection of archaeological sites like this one, and their involvement is essential to safeguarding our shared heritage for the future.

Chronology

Based on relative dating, the artefacts from Lodrani can be attributed to the Mature Harappan and late Medieval periods. No Early Harappan Sindh-type pottery or regional Chalcolithic pottery, apart from Anarta Tradition and Reserved Slip Ware, was recovered from the site. Anarta Tradition pottery in Gujarat is dated to c. 3900-1700 BCE, and its shapes, manufacturing techniques, and decorative patterns remain largely consistent across the Early, Mature, and Late Harappan phases, making it difficult to distinguish between them. It is possible that the site was occupied during the Early Harappan phase by people using Anarta Tradition ceramics. While it was certainly in use from the beginning of the Mature Harappan period, a radiocarbon date from the lower levels of the looting ditch at Kotada (c. 3349-3087 BCE) (Table 1) suggests a possible Early Harappan occupation by Anarta-associated people, who were present in Gujarat from 3900 BCE. At several sites in Gujarat, including Shikarpur, Bagasra, Surkotada, Kanmer, and Dholavira, Anarta Tradition pottery is predominant in the early stages of the Mature Harappan period and consistently found alongside Classical Harappan pottery. An examination of the explored materials reveals the same association at Kotada. However, in the absence of excavation and stratigraphic data, the exact timeframe for the introduction of this pottery type at the site remains uncertain. Preliminary analysis of the lithic assemblage at Kotada follows a pattern observed at Early Harappan sites such as Juna Khatiya, Janan in Kachchh, and Datrana in North Gujarat (Gadekar *et al.* 2021), further supporting the possibility of an Early Harappan presence at the site. Given the lack of excavated data, this hypothesis remains tentative and subject to revision.

Samples for radiocarbon (^{14}C) dating were collected from the ditch excavated in 2018 in the fortification's north-western corner to confirm the relative chronology provided by the artefactual evidence. In particular, samples for ^{14}C dating were obtained from the north-east profile of the ditch, which showed a continuous deposit (140 cm in height) towards the interior of the fortification consisting of sediment intersected with stones and a patchy ash layer (Fig. 16). A total of 28 sediment samples (c. 25 g each) were collected every 5 cm along the north-east profile, of which two samples were submitted for ^{14}C dating to the Vilnius Radiocarbon Laboratory: a sub-sample of the sediment from sample LDR01 (135-140 cm, the lowest section of the exposed profile), and a small charcoal fragment found in sample LDR07 (105-110 cm, the ash layer). The sediment from sample LDR01 was dated to 3349-3087 cal BCE, whereas the charcoal fragment from sample LDR07 was dated to 2409-2198 cal BCE (Table 1).

Based on these dates, the Chalcolithic occupation at the site can be attributed to two phases of the Harappan Civilization: Early Harappan phase (c. 3350-2600 BCE) and Mature Harappan phase (c. 2600-1900 BCE). Following the Harappan period, the site remained abandoned for a long time. The presence of a few late medieval potsherds on the surface, along with the absence of other artefacts and structural remains, suggests only a brief and temporary reoccupation during that period.

Discussion and Conclusions

The archaeological explorations at Kotada provide significant insights into the site's occupation, material culture, and broader regional interactions during the Harappan period. The presence of Anarta Tradition pottery, Classical Harappan pottery and Reserved Slip Ware suggests cultural continuity and integration, with radiocarbon dates indicating a possible Early Harappan occupation. However, the absence of stratigraphic data makes it difficult to establish a precise chronology for the site's ceramic traditions. The architectural features, including a stone fortification, bastions, and a well, highlight sophisticated construction techniques and strategic settlement planning. The fortification's multiple openings suggest controlled access, potentially indicating administrative or trade functions. Historical maps and satellite imagery confirm the site's long-term recognition, underscoring the importance of geospatial analysis in archaeological research. The lithic artefacts follow a particular pattern, and the presence of exhausted cores and debitage suggest on-site tool production, aligning Kotada with Early Harappan sites like Janan (Gadekar *et al.* 2018), Juna Khatiya (Gadekar *et al.* 2021) and Datrana (Gadekar *et al.* 2013). The discovery of terracotta cakes,

Table 1: Results of the radiocarbon (^{14}C) dating conducted at the Vilnius Radiocarbon Laboratory. Radiocarbon determinations were calibrated using OxCal v4.4.4 (Ramsey 2021) and the IntCal20 atmospheric curve (Reimer *et al.* 2020).

Sample ID	Depth	Material	Lab code	Radiocarbon age	Calibrated date
LDR01	135-140 cm	Sediment	FTMC-BA47-1	4487±34 BP	3349-3087 cal BCE (91.2% probability)
LDR07	105-110 cm	Charcoal	FTMC-LD66-1	3834±32 BP	2409-2198 cal BCE (87.9% probability)

bangles, and beads indicates functional and ritualistic activities, while the presence of copper objects suggests limited metallurgical practices. Faunal remains, mainly cattle, sheep, and goat bones with evidence of butchering, provide insights into dietary practices. This site is situated approximately 44 km from Dholavira in geo-desic distance. Understanding its relationship with Dholavira and its role within the broader interaction networks of the Indus Civilisation is of significant archaeological interest. The factors influencing the Harappans' selection of this location for habitation, as well as the nature of artefact production at the site, warrant further investigation. To address these questions, systematic excavations and a comparative scientific analysis of artefacts from both sites are essential.

Despite its significance, Kotada faces preservation challenges due to modern disturbances. The excavation of a large ditch using heavy machinery in 2018, along with agricultural activities around the site, has led to structural disruptions. Community awareness and stronger heritage protection measures are necessary to mitigate further damage. Radiocarbon dating suggests two major occupation phases – Early Harappan (c. 3350-2600 BCE) and Mature Harappan (c. 2600-1900 BCE). While the site appears to have been abandoned after the Harappan period, sparse ceramic remains on the surface indicate a brief medieval reoccupation. Future research should focus on systematic excavations to clarify Kotada's occupational sequence and economic functions. Scientific analyses of artefacts and faunal and floral remains could provide further insights into technological practices, trade networks, subsistence patterns and environmental settings at the site. Conservation efforts should also be prioritised to safeguard this important Harappan site for future studies.

Acknowledgements

The authors acknowledge the Archaeological Survey of India for granting permission to conduct explorations in Kachchh, which made this research possible. We also extend our gratitude to the Gujarat State Archaeology Department for providing the necessary permissions and support for the fieldwork. We sincerely thank the University of Kerala and CSIC (PIAR-2021-08), Spain, for their research funding and institutional support. Francesc C. Conesa acknowledges the support of Palarq Foundation and his grants number 2020-BP-00203 and RYC2022-036700-I funded by the Catalan Government and the Spanish MCIN/AEI. Juan José García-Granero acknowledges grant No. RYC2021-033891-I, funded by MCIN/AEI/10.13039/ 501100011033 and the European Union «NextGenerationEU»/PRTR. This research is also part of project PID2023-151176NA-I00, funded by MICIU/AEI/10.13039/ 501100011033 and FEDER, UE. We are grateful to the M.A., M.Phil., and Ph.D. students, as well as the Research Assistants from the Department of Archaeology, University of Kerala, for their dedicated cooperation and assistance during the explorations at Kotada. Our heartfelt thanks also go to the villagers of the survey region for their support and collaboration during the fieldwork. Additionally, we appreciate the assistance provided by Mr. Jaypalsinh M. Jadeja, Mr. Mahendrasingh Jadeja, Mr. Zahid Shaikh, Mr. Narayanbhai Jajani, and Mr. Ketan Praveenbhai Siju. The views expressed in this paper, along with any errors in fact or interpretation, are solely our own.

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