Early Historic Gemstone Bead Workshops in the Middle Mahanadi Valley Region, Odisha, India.

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Abstract

Archaeological investigations conducted in the Middle Mahanadi Valley region of Odisha during the last three decades have brought to light evidence of human occupation ranging in date from the Lower Palaeolithic to the Early Historic period, without much discernible habitation hiatus. However, compared to the Prehistoric and Protohistoric settlements, sites belonging to the Iron Age-Early Historic periods are fairly widespread in the region. A series of test excavations and exploration in the region have brought to light both fortified and non-fortified types of Early Historic settlements. Studies on the material remains recovered from the excavated sites revealed that the Iron Age villages were gradually developed into full fledge urban and semi-urban centers in the Middle Mahanadi Valley region during the Early Historic times. Some of these settlements have also been found to be associated with evidence for craft specialized production i.e. glass objects, iron objects besides precious and semi-precious stone beads. One of such craft specialized centres associated with gem stone beads production have been found in the Harihar stream, a major northern tributary of the river Mahanadi in the district Subarnapur. The present paper outlines the results of the preliminary archaeological investigation conducted at these sites during last one and a half decade.

Keywords: *Gemstone Bead, Workshops, Early Historic period, Middle Mahanadi Valley,*

Introduction

Physiographically, the middle Mahanadi valley lies between the Northern Uplands and the South-Western Hilly Regions of Odisha Highlands and stretches from the Hirakud Dam Reservoir to about the Tikaraparha Gorge (Singh, 1971: 754-775). Geographically it is a transitional zone between the Chhattisgarh plains and the coastal plains of Odisha. Characterised by sub-tropical climate with medium to high annual precipitation it is a self contained geographical entity with sufficient range of ecological diversity. Archaeological investigations conducted from time to time by different scholars in this region have brought to light evidence of human occupation ranging in date from the Lower Palaeolithic period to the Early Historic period without much discernible habitational gap (Mohapatra, 1962; Mishra, 1982-83: 31-42; Ota, 1986: 47-56; Behera, Panda and Thakur, 1996: 15-26; Behera, 2000-01: 13-34, 2002-03: 87-103, 2006: 1-62; Behera and Chattopadhyay, 2012: 125-34). Results of these investigations have shown that due to the presence of vast mineral/raw material potential, ecological diversity and stretches of alluvial tracts along the major and minor river valleys, during the Early Historic period the region was densely populated with several fortified and non-fortified settlements of various nature and dimensions (Fig.1). Some of these settlements have also been found associated with evidence for craft specialized production of glass objects, iron objects (Singh and Behera, 2001-02: 173-76; Behera, 2002-03; Behera and Chattopadhyay, 2004-05: 118-25) and precious as well as semi-precious stone beads (Behera and Hussain, 2017: 269-282). Archaeological excavations conducted by the P.G. Department of History, Sambalpur University during 2000-2001 at the site of Badamal Asurgarh located in the upper course of the *Harihara* stream, a major northern tributary of the river Mahanadi, have brought to light extensive evidence for precious and semi-precious stone bead manufacturing activities, dating back to the Early Historic period (Behera *et.al,* 2007: 41-46). With a view to tracing the extension of such sites recently further exploration was conducted in the Harihar stream and adjacent area in the middle Mahanadi valley, which resulted in the discovery of another open air stone bead manufacturing site near the village Bhutiapali (Fig. 2). In the following pages we intend to provide a preliminary account of our archaeological investigation conducted at the sites of Badmal Asurgarh and Bhutiapali. However, a detailed techno-typological study of beads and other associated objects, which is under way, will be discussed separately in a later date.

The Gem Bead Production Site at Badmal

The site of Badmal Asurgarh (Lat. 21° 07' 84" N; Long. 84° 04' 42" E) is located in the middle Mahanadi Valley (Singh, 1971: 773) of the Odisha highland region, and is situated on the bank of a major stream called *Harihar,* which is a northern tributary of the river Mahanadi. The area is flanked on the west, north and east by a series of hill ranges of varying heights. The general elevation of the terrain floor varies between 155 and 170m amsl. The valley, as well as the hilly areas, is covered with thick vegetation growth of a dry, deciduous, mixed type of forest. Although the area receives an average annual precipitation of about 1500mm, the present population largely depends upon seasonal rains, besides lift irrigation for crop cultivation. In addition to limited agriculture, local population also depend upon the vast natural resources available in the area to meet their day-to-day requirements, such as large and small game animals, aquatic resources and other forest products. The oldest rock formation of the area belongs to the Archaean series, followed by those of the Dharwarian and Cuddapah series. Overlying Cuddapah, the sediments of the Gondwana formations represented by Talchirs, Damuda, etc. were deposited on a Precambrian platform, almost separating the Eastern Ghats and the North Odisha craton (Mahalik, 1994: 41-51). The Quaternary formations are represented by thin to thick deposits of secondary laterite, colluvium and alluvium of variable extent.

The most noteworthy geological feature of this belt is its rich gem stone deposits. Some 200 pegmatite bodies, varying in size from 2 to 15m in width and about 1 km in length, have been identified in the area (Mishra and Mohanty, 1995: 185-202). Mostly gemstones in this area occur in secondary contexts where they have been derived from weathering of pegmatite bodies with subsequent transfer of the minerals into the fluvial network active in the region. These secondary deposits constitute an easily amenable source for good quality gems. Major gemstones found within this area include beryl, aquamarine, topaz, garnet, heliodor, ruby, sapphire, tourmaline and amethyst. For manufacturing beads and pendants, the Early Historic settlers of Badmal Asurgarh exploited some of these gemstones, as well as other semiprecious stones, such as chalcedony, agate, banded-hematite-red-jasper (BHRJ) and chert.

The fortified site of Badmal Asurgarh is roughly lozenge-shaped (Fig. 3) and spreads over an area of about four hectares (180 x 220m) (Yule, *et al*, 2005: 307-318). The site is protected on all sides by a massive earth rampart, which rises to a height of about six to seven metres above the surrounding plains and is approximately 20-25 metres wide at the base. In addition to the main fortification, two additional small earth ramparts are located on the northwestern side of the site, towards the stream, presumably to protect the settlement from seasonal flooding. At least three entrances to the settlement have been identified, located on the south-western, north-western, and north-eastern sides. While the north-eastern and north-western prominences of the rampart wall are to some extent better preserved, other parts have already been destroyed by the intensive surface agricultural activities carried out by the present villagers. The rampart was quite possibly originally encircled by a 15-20m wide moat, which has now been converted into agricultural land. Another important factor which has seriously impaired the preservation of the site is the frequent illegal mining operations undertaken by the present villagers inside the fortified area, particularly in the southern sector in search of gemstones.

Trial excavations were conducted in 2002 to understand the nature and succession of cultures at the site, first on the northern sector and subsequently on the southern part of the site. While the first settlers of occupied the northern part, mainly represented by Iron Age remains, the southern part was subsequently occupied during the Early Historic period. On the basis of available radiocarbon dates, particularly from the northern habitation area, stratigraphic contexts and a careful study of changes in the ceramic and other cultural assemblages, two broad periods of human occupation, corresponding to the Iron Age and the Early Historic period, have been identified. The Iron Age is further divided into three sub-Periods (IA, IB and IC), mainly on the basis of changes in the ceramic assemblages, as well as radiocarbon dates (Table 1).

In Trench-I excavated in the northern sector of the site, an occupational break represented by a 30-35cm thick culturally sterile deposit was noticed between the two major periods. Most probably due to frequent inundation in the *Harihar* stream, the site was deserted by the Iron Age people and was reoccupied subsequently during Early Historic times by about the early 4th-3rd century BCE.

After a brief habitational break, the site was again occupied by the people of the Early Historic period. During this period, the settlement expanded to its fullest extent and was protected on all four sides with a massive earth rampart with at least three entrance passages. While some of the cultural features of the preceding period continued to exist, the site now transformed into a massive stone bead manufacturing centre. The low-lying southern part of the mound was exclusively used for manufacturing precious and semi-precious stone beads. For manufacturing beads, the craftsmen of this period not only exploited the locally available beryl of greenish-blue, golden-yellow and pale blue to sea-green colour (Fig. 4), aquamarine (Fig. 5), smoky quartz, amethyst, corundum, and tourmaline, but also imported materials such as banded-hematite-red-jasper (Fig. 6 and 7), agate (Fig.8), chalcedony (Fig.9) and amygdaloidal basalt, obtained from regional and extra-regional contexts by way of trade or exchange. While majority of the semi-finished/finished beads showing different stages of manufacturing process, comprise long and standard type barrel shaped, other types include short triangular, short barrel, spherical, cylindrical, rectangular, disc, etc., besides pendants and amulets (Fig.10). Here particular mention may be made of an amulet of a turtle made of banded agate, which is very skillfully prepared (Fig. 11). Interestingly, while huge amount of manufacturing waste (n 3000) , blanks and roughouts (n 347), beads and only 33 finished beads of gemstones have been recovered from the excavations, very few semi-finished (n 61) and finished (n 33) beads were encountered in the assemblage.

Besides beads, craft tools including bead polishers with shallow parallel grooves made of pegmatite rock, small-sized pestles with sub-triangular cross-section, anvils, hammers, mulers and two-legged querns with pitted surface at the middle part, probably used for making holes on the beads, have also been retrieved from the limited excavations, (Fig. 12). In addition to beads and bead wastes indicative of different stages of the manufacturing process, the trench also yielded a sizeable number of iron objects including drill bits, pottery discs of various sizes and weights and a large quantity of pottery, which also included black-and-red ware.

Despite the technological advances associated with the emergence of specialized craft industry, there was no marked change in the general lifestyle of the people of this period as the Early Historic people continued to live in wattle-and-daub houses.

Unlike the preceding phase *i.e.* Iron Age, in which only a few hunting weapons are represented, it seems that the emphasis during Early Historic time was placed on procuring and using craft-related tools, including drill bits, saws, nails, etc (Fig. 13).

Excavations at Badmal did not yield any evidence pertaining to on-site iron smelting activities. However, during the excavations, a few lumps of chromites ore was retrieved from Trench-III , located in the southern sector of the mound. In order to determine the source of this iron and the technology involved in the manufacture of the iron objects found at the site, four iron objects, one from Period IA and the rest from Period II , were subjected to External Particle Induced X-ray Emission (PIXE) and metallographic examinations (Behera and Chattopadhyay, 2004-2005; Chattopadhyay, et al., 2007: 387-402).

The PIXE analysis was conducted at the Institute of Physics, Bhubaneswar, India, which uses a 3mA tandem type Pellet Ron Accelerator with proton beam energy of 3 Me (Vijjayan, *et al*., 2003: 772-777). This method is extremely useful for analyzing archaeological samples, since it is not only fast, sensitive and capable of simultaneous multi-elemental analysis, but it also ensures that samples of any size can be quantitatively analysed without causing physical damage to the artefacts (Johansson and Campbell, 1988; Campbell, *et al*., 1995: 279-292; Demortier, 1997: 91-114, 2000: 125-136; Hajivaliei, *et al*., 1999: 645-50; Govil, 2001: 1542-49). However, in PIXE experiments, all the calculations are based on the hypothesis that the material is homogeneous in all the depth of the analysed material (5-10μm). The analysed depth of the irradiated artefact is less than 10μm, even for particles crossing 25 to 30μm in the material, due to the decrease of X-ray production with decreasing energy of the projectiles. Thus, archaeological applications are generally restricted to non-corroded materials or to drillings involving partial destruction of the sample (Mando, 1994: 815-823). In the present analysis, the target areas (1cm^2 surface) of the iron samples were thoroughly cleaned by carefully removing the outer corrosive layer and keeping the original shape intact before the artefacts were irradiated. The results of the analysis are shown in the Table-2.

Table-2 indicates that the iron objects were possibly produced from multiple ore sources and may well therefore have been procured from different locations. However, the most interesting result of the analysis is the presence of vanadium and chromium in three of the four samples analysed. Vanadiferous magnetite deposits are found in small pockets near the Nuasahi-Boula area on the eastern boarder of Keonjhar, in the Baripada-Rairangpur belt in Mayurbhanj district, and in the Betei-Rangamatia area in the district of Balasore (Nayak and Das, 1995: 288-97). It is known that the addition of even less than 0.1% of vanadium to steel or cast iron can significantly increase strength, toughness and ductility. Whether this characteristic feature of vanadium was known to the early settlers of Badmal cannot be determined with any amount of certainty based on the presently available evidence. Similarly, one of the iron samples also contains chromium, sources of which are located in the Tomka-Daitari belt of Keonjhar district (Sahoo, 1995: 108-144). The source lies some 180 km east of the Badmal Asurgarh site (Fig.14). As mentioned above, a few lumps of chromites ore has also been recovered from the Early Historic deposit at the site. In addition, the bead workers of Badmal extensively used banded-hematite-red-jasper raw material for bead production. The nearest source for this lies about 140km north-east of Badmal, in the Bonaigarh area of Sundargarh district. The possibility that the early settlers of Badmal imported iron objects from this area cannot therefore be ruled out. Thus, circumstantial as well as scientific evidence appear to suggest that during the Iron Age and Early Historic periods, iron was procured either as finished goods or in the form of ore by way of trade or exchange from locations at least 140-200km away from the site of Badmal. However, only future investigations using geochemical and other scientific techniques will solve the question of the provenance of iron at Badmal for extensive bead manufacturing activities.

Bhutiapali: An Open-Air Gem Bead Workshop

Spreading over an area of about 180m east-west and 156m north-south and rising to a height of about two meters above the surrounding plains the Early Historic site is located about one and a half kilometer north-east of the village Bhutiapali (Lat. 20° 57′ 02.3″ N; Long. 84° 05′ 05.6″ E). The site lies about eleven kilometers north-east of the sub-divisional headquarters of Birmaharajpur, district Subarnapur and about twenty kilometers slightly south-east of the Early Historic fortified site of Badamal Asurgarh (Fig.2). The site is situated about half a kilometer south of the right bank of the *Ghunguni* perennial stream, a minor tributary of the Surubali river, which is a major northern tributary of the river Mahanadi. Between the Ghunguni stream and the site an irrigation canal has been excavated which runs in northwest-southeast direction.

Seasonal rains, annual overbank flooding of the *Ghunguni* stream, besides anthropogenic factors like agricultural activities, excavation of the irrigation canal and illegal mining of the site by the villagers in search of gemstones, have rendered substantial damage to the overall integrity of the site. The natural and anthropogenic interferences have exposed innumerable potsherds, manufacturing waste of precious and semi-precious stone beads and other antiquities on the surface of the mound.

About 150m east of the site lies a massive outcrop of pegmatite deposit, which measures about 150m x 120m and rises to a height of about 4-5m above the surrounding plains (Fig.15). Our exploration in and around this outcrop has yielded a broken fragment of a bead polisher, besides villagers have reported to have retrieved extensive gemstones like aquamarine, beryl and emerald from this pegmatite deposit through illegal mining process. Most probably this outcrop, besides other nearby pegmatite outcrops were extensively exploited by the Early Historic settlers for raw material procurement for manufacturing stone beads.

With a view to contextualizing the surface finds and to determine the extent and nature of the habitation deposit, two small trial trenches (BTP-I and II) were laid towards the northern slope of the mound and were excavated up to the natural soil (Fig.16). The excavations revealed a 40-50cm thick habitation deposit in both the trenches divisible into three layers based on sedimentary composition, texture and colour. The excavation was carried on spit-wise (5cm a spit) and for the retrieval of artefacts the excavated deposits were went through wet sieving method. The trial excavation at the site yielded a total of 2663 potsherds of different ware types with a predominance of Red Ware (66.87%). Other associated wares include Red Slipped Ware (2.25%), Black Ware (9.69%), Black Slipped Ware (7.81%) and Black-and-Red Ware (13.37%). The identifiable shapes are represented by vases, basins, dishes and bowls. In most of the cases potsherds were found in rolled and extremely fragmentary condition with slip peeled up, indicating their long exposure to natural formation processes.

Besides potteries the excavation also yielded a large quantity of manufacturing-waste of precious and semi-precious stone beads. The raw material of these wastes includes, quartz including quartz crystal (60.42%), aquamarine of different colours (34.28%), garnet (0.87%), amethyst (1.92%), smoky quartz (2.16%), corundum (0.33%) and chert (0.02%). A total of 11,023 such materials have been recovered from the excavation, with a predominance of quartz, emerald and sea green aquamarine (Fig.17). Apart from manufacturing-wastes, the excavation brought to light a good number of semi-finished and finished beads of different precious and semi-precious stones and glass (Fig.18) showing various stages of manufacturing process. The evidence clearly indicates that the site of Bhutiapali was occupied mainly for large-scale manufacturing of stone and glass beads, obviously for regional and/or extra-regional trade. Significantly, several tools and equipments, namely, bead polishers, anvils (Fig.19), iron drill bits etc., (Fig.20), used in the bead manufacturing process have also been recovered from the excavation. Other artefacts from the excavation comprise pottery discs (hop scotch), pestles and mulers, few glass beads, glass bangles and a sizeable quantity of burnt clay lumps, some of which bear reed impressions. In the absence of brick structures at the site it may be said that the settlers lived in wattle-and-daub houses. Future extensive excavation at the site will definitely throw more light on the nature of this open air bead workshop site.

Concluding Remarks

The foregoing accounts on the excavations conducted at Badmal Asurgarh and Bhutiapali clearly reveal that the rich bio-habitat and the vast mineral resources of the region have attracted human occupation during the later part of 4^{th}-3^{rd} century BCE. Besides, the above sites, there is a host of fortified and non-fortified Early Historic settlements recently reported from the major tributaries like the Tel and the Udanti of the Mahanadi, *viz*. Manamunda Asurgarh (Behera, 1982: 16-22; IAR, 1989-90: 80-85, 1991-92: 86), Khaligarh (Pradhan, 2003: 51-61), Budhigarh (Mohanty *et al*, 1998-99: 121-131; Mohanty and Mishra, 1999: 14-15; Mishra, 2010; Mishra, 2016: 21-28), Taraporegarh (Behera *et al*, 2015: 178-196), Nehena (Brandtner,1993:101-114), etc., where large number of beads of different raw materials and varieties were recovered. However, detailed report on beads from these sites is yet to see the light of the day. Moreover none of these sites have produced evidence for large-scale bead manufacturing activities. It is reported that beads from the Early Historic Budhigarh site were made of different precious and semi-precious stone (Tripati 2017: 10) *i.e.* carnelian, aquamarine, jasper, crystal quartz, agate, garnet, etc. (Fig. 20). Our intensive studies in the region clearly reveal that the fortified and non-fortified Early Historic settlements developed out of the existing Iron Age cultures of the Middle Mahanadi Valley, and rose to prominence during the Early Historic period as craft specialized centres, including bead manufacturing workshops in this part of the Odisha highlands. Domestic trade was perhaps one of the important factors in this process of development. Iron definitely played a catalytic role in the development of the specialised bead industry at these sites, as attested by the iron tools that were employed to craft the beads. Presumably in exchange of finished beads, the settlers of this region were importing iron objects, as well as other resources for their day to day requirements. Future intensive and extensive investigation in the region will definitely provide more insight into our understanding of various factors responsible for the emergence and regional and extra-regional networking of the Middle Mahanadi Valley region with the contemporary settlements within and outside Odisha.

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Table 1: Radiocarbon dates from the Iron Age deposit of Badmal Asurgarh.

Sl. No.	Trench No./ Depth (cm)	Cultural Affiliation and Periods	Lab. Code	Calendar Age (BCE)
1	Trench-I/120	Iron Age (IC)	IP-275	468±76
2	Trench-I/160	Iron Age (IB)	IP-274	838±86
3	Trench-II/45	Iron Age (IB)	IP-285	803±44
4	Trench-II/50	Iron Age (IB)	KIA-20155	617±27
5	Trench-II/115	Iron Age (IB)	KIA-20154	785±12
6	Trench-II/125	Iron Age (IB)	KIA-20153	786±11

Table 2: Elements detected through external PIXE in weight percent.

Sample No.	Period	Object Type	P	S	Ca	Ti	V	Cr	Mn	Fe	Ni	Cu
BDM-18	IB	Spear head	0.15	0.13	-	-	0.13	-	0.7	95.15	0.15	-
BDM-7	II	Drill bit	0.49	0.41	0.41	0.29	0.076	-	0.58	95.76	0.29	0.12
BDM-8	II	Drill bit	0.58	0.40	0.23	-	-	-	0.44	95.71	0.27	-
BDM-16	II	Toothless saw	0.53	0.43	0.12	-	-	0.06	0.56	95.08	0.43	-

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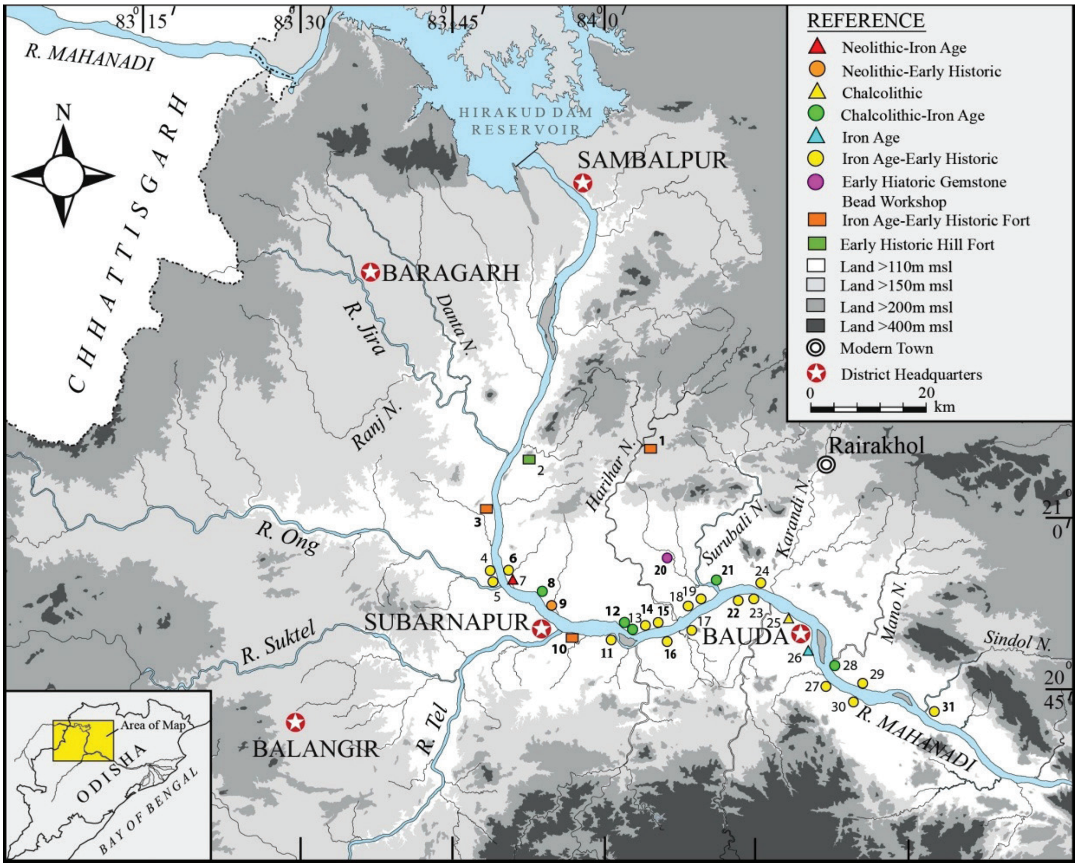
Figures



LIST OF EXCAVATED SITES

1. Badmal Asurgarh	10. Manamunda Asurgarh	16. Kurumpadar
3. Taraporegarh	11. Ammuda	20. Bhutiapali
6. Kapasira	12. Khameswaripali	21. Subulia
8. Khajeriapali	14. Kumersingha	22. Jagati
9. Hikudi	15. Nuagarh	31. Kantipuleswar

Figure 1: Distribution of Early settlements in the Middle Mahanadi Valley ranging in date from the Neolithic to the Early Historic Periods.

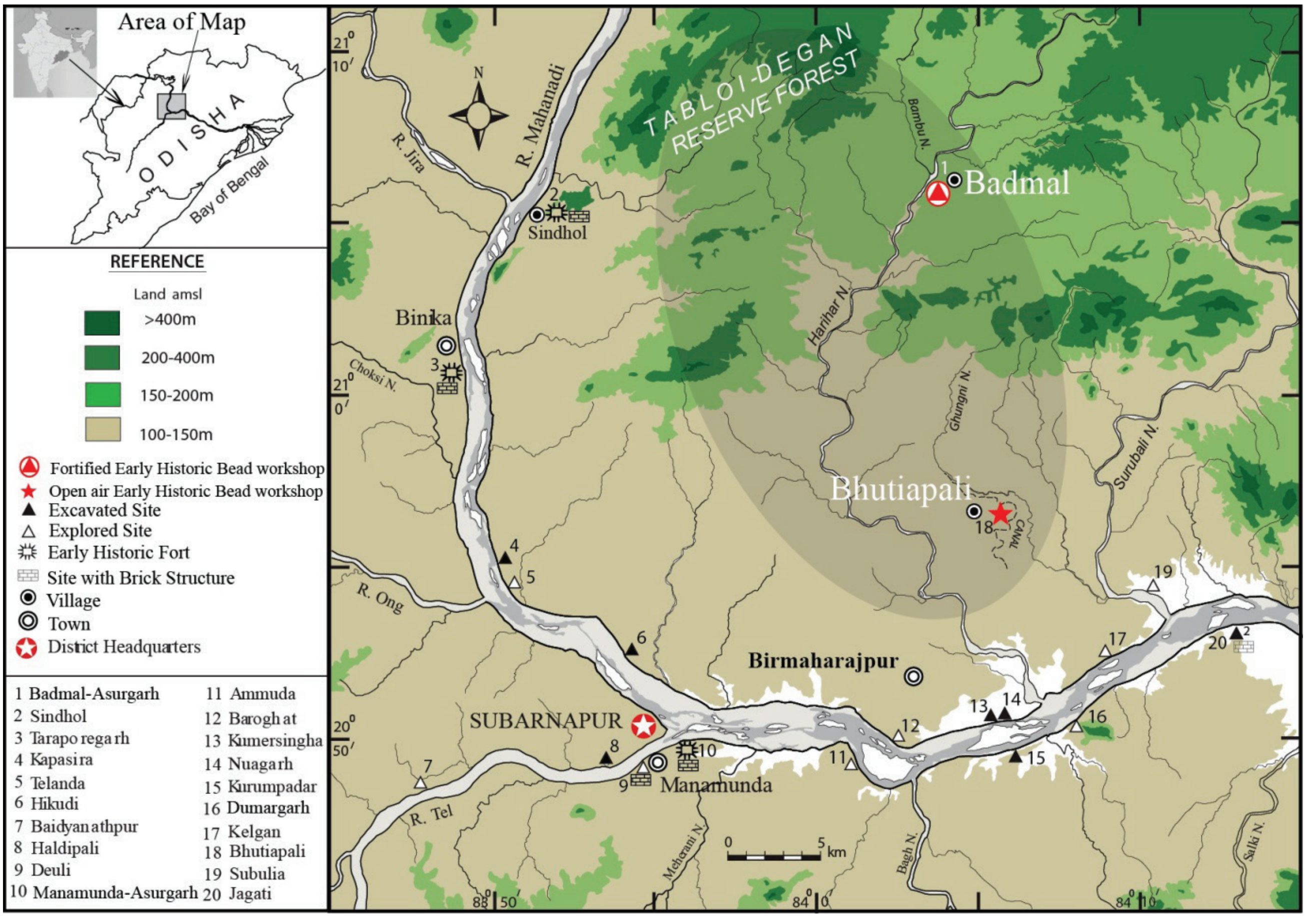


Figure 2: Map showing the locations of the Bead workshop sites of Badmal Asurgarh and Bhutiapali in the Harihar and Ghunguni stream, besides other contemporary Early Historic sites. The gem bearing belt in the area is shown in elongated ovaloid shade.

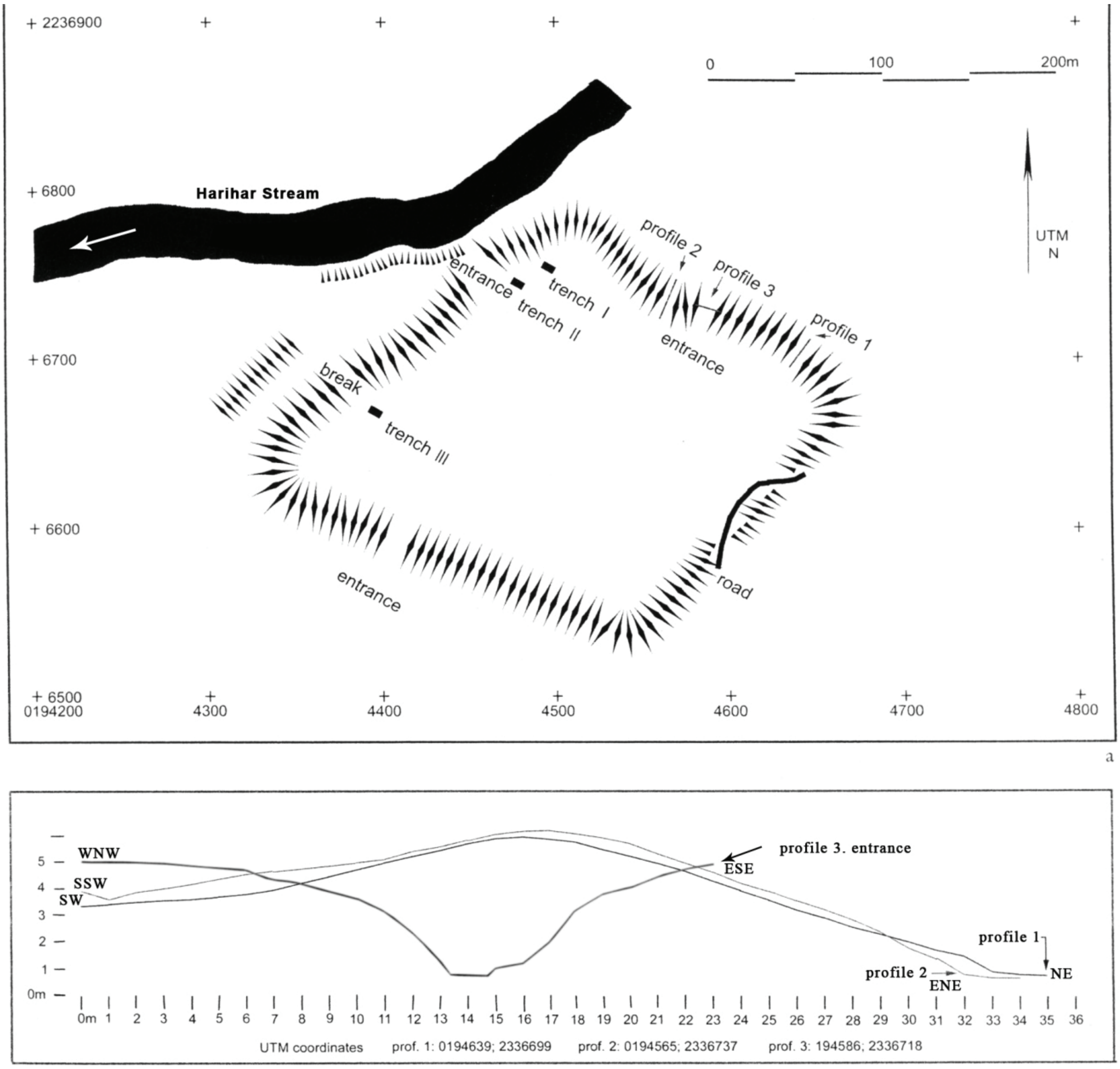


Figure 3: Plan of the Badmal Fortified site with the elevation of the rampart wall (after Yule *et al*., 2005, p. 311)

Figure 4: Chunks/blanks of light blue and yellow aquamarine assemblage from Badmal Asurgarh site.

Figure 5: Blanks of light bluish coloured aquamarine from Badmal Asurgarh site.

Figure 6: Bead roughouts and associated assemblage of Banded Haematite Red Jasper (BHRJ) from Badmal Asurgarh site

Figure 7: A lump of raw material and bead waste of BHRJ from Badmal Asurgarh site

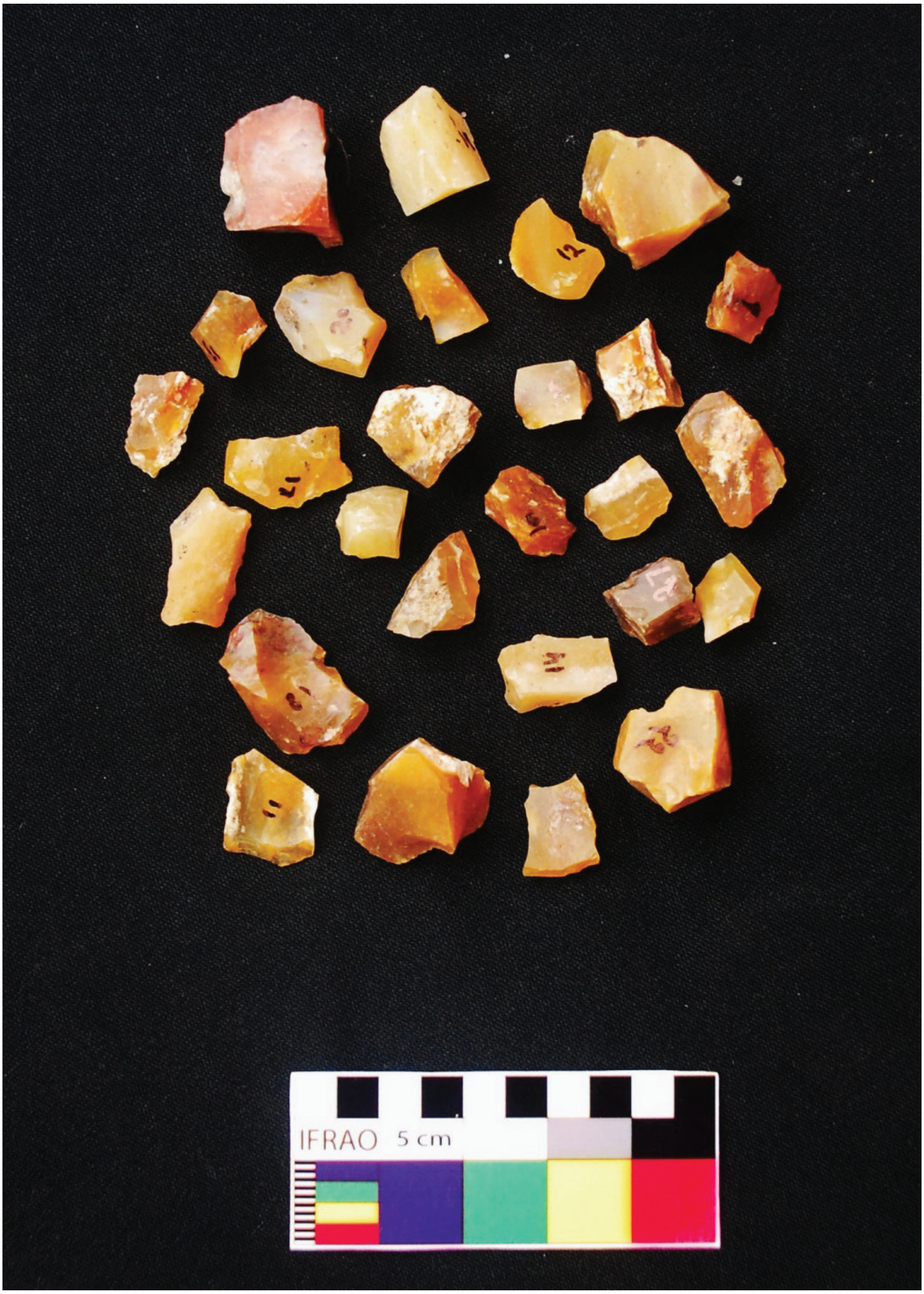


Figure 8: Assemblage of blanks of agate from Badmal Asurgarh site

Figure 9: Bead waste of carnelian from Badmal Asurgarh site

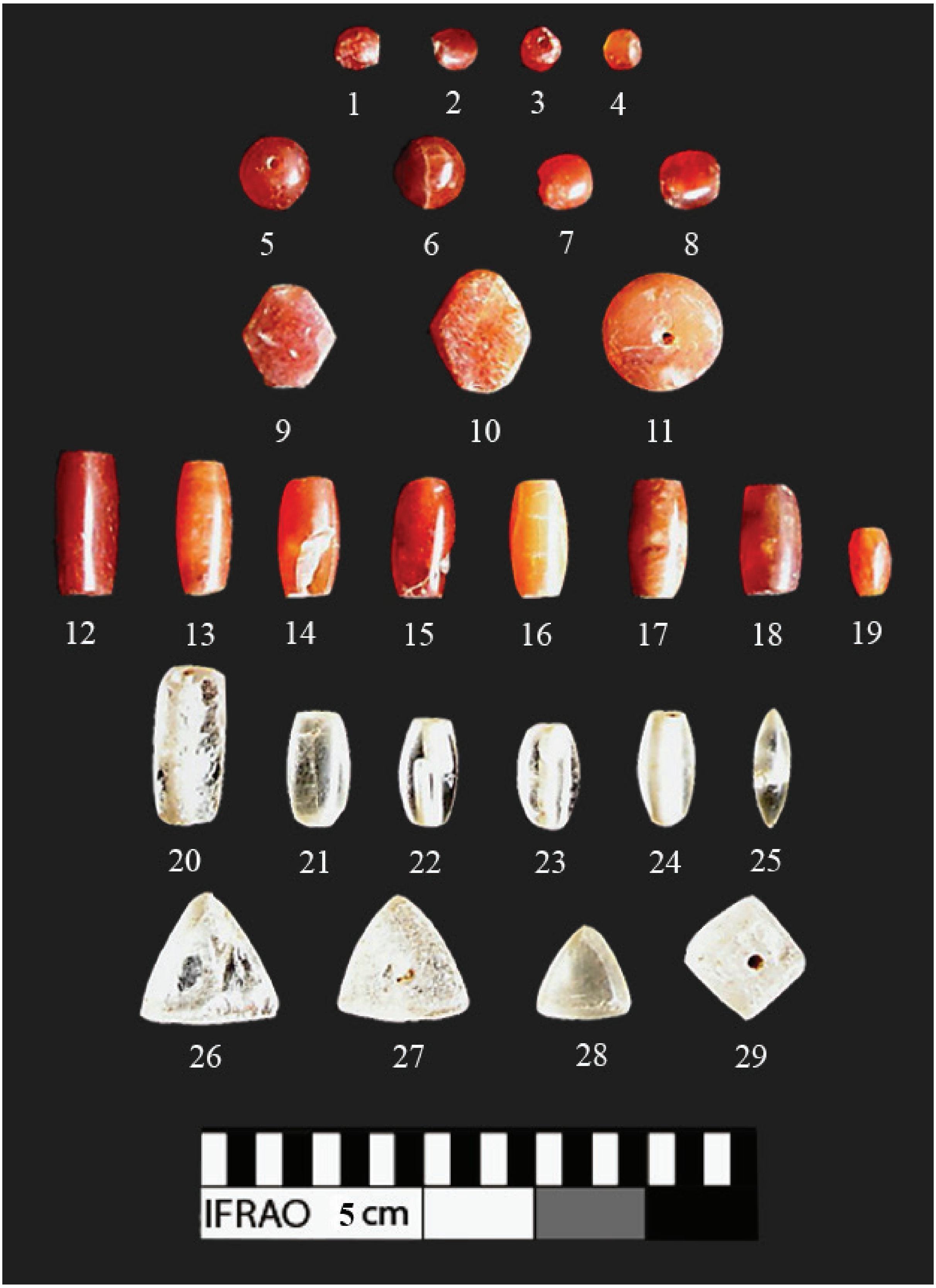


Figure 10: Representative beads of different materials and shapes from Badmal Asurgarh site

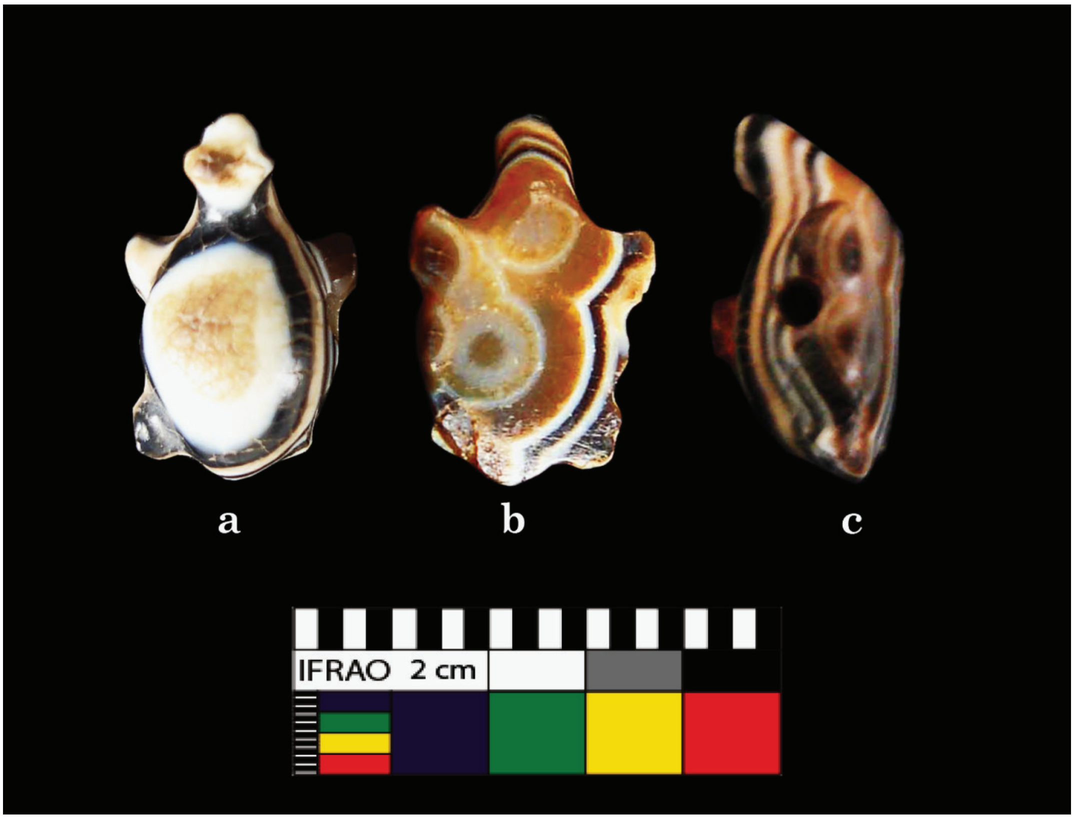


Figure 11: Obverse, reverse and profile views of a highly finished turtle amulate of banded agate from Badmal Asurgarh site

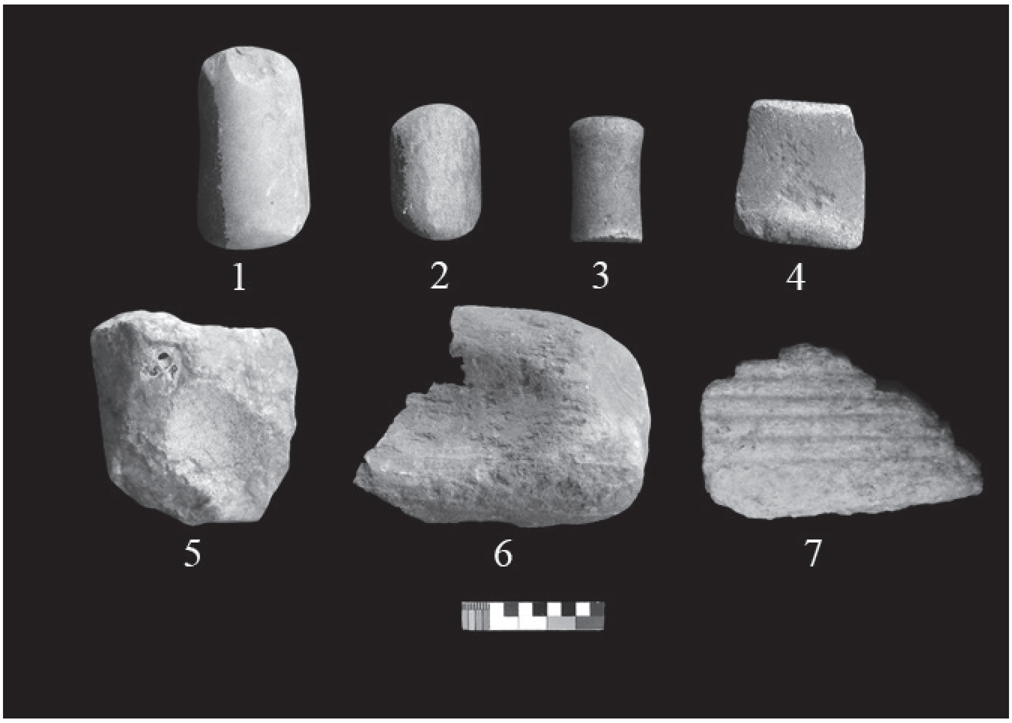


Figure 12: Tools used in bead manufacturing at Badmal: 1 & 2 pestle with roughly triangular cross section, 3 muler, 4 two-legged quern with pitted marks at the center, 5 & 6 bead polisher with shallow polished surface on the obverse, 7 bead polisher with parallel grooved surface on the obverse side.

Figure 13: Different iron objects recovered from the Early Historic deposit from Badmal Asurgarh site.

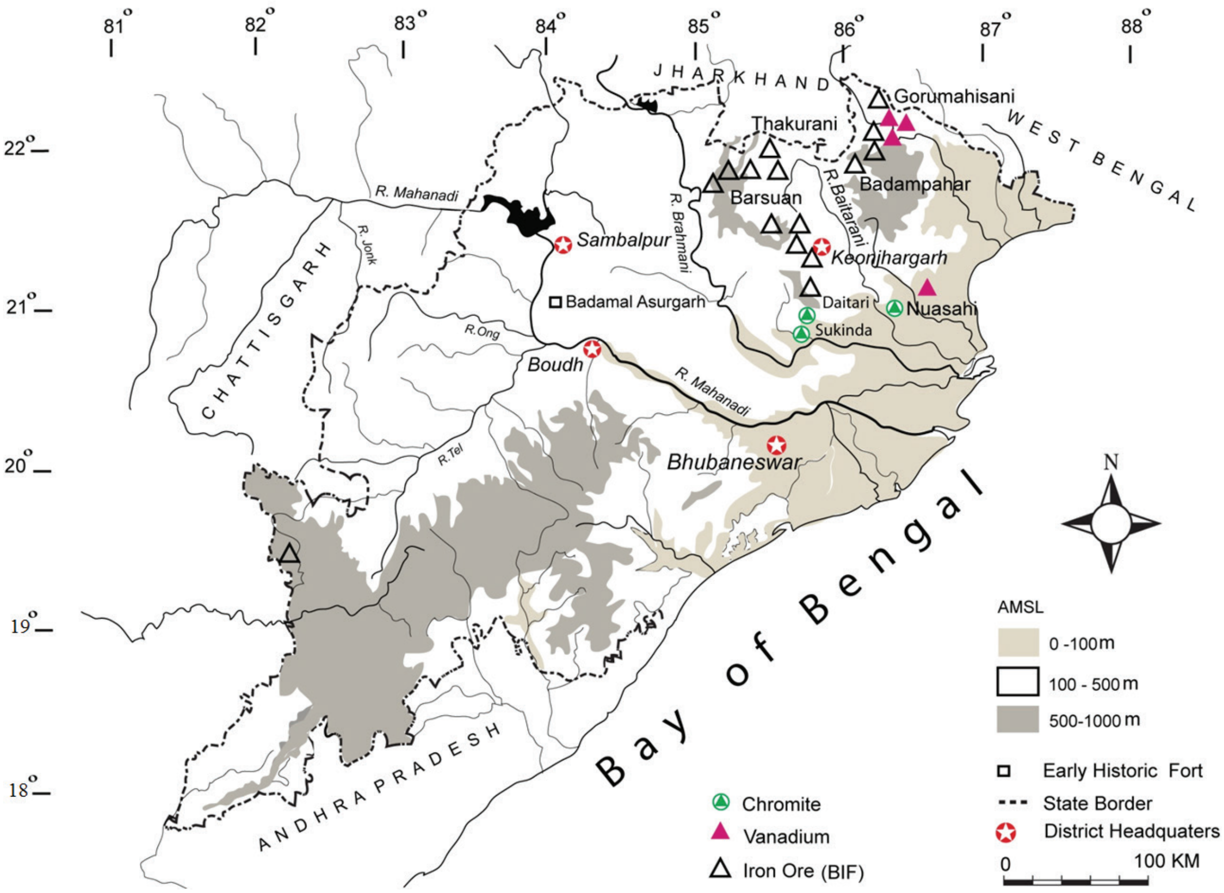


Figure 14: Distribution of different iron ore mines in Odisha mentioned in the text.

Figure 15: A general view of pegmatite outcrop near the site of Bhutiapali.

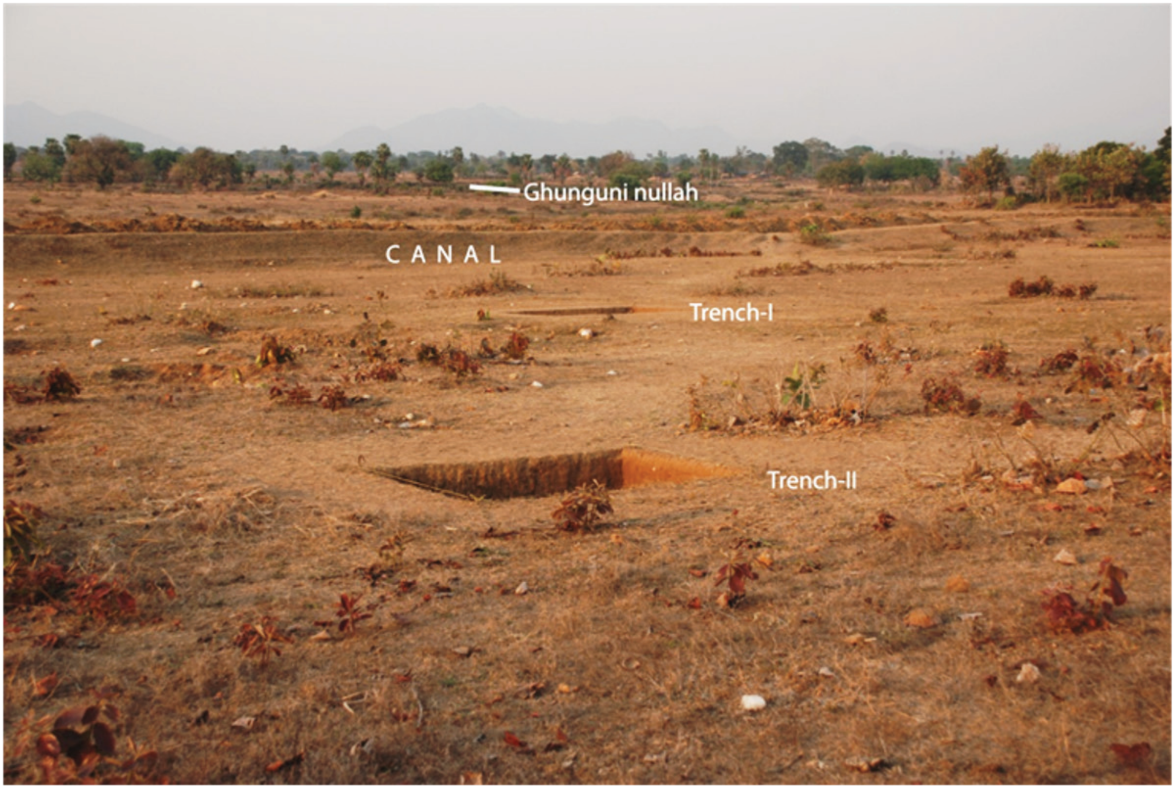


Figure 16: View of the location of trial trenches in relation to the Ghungni stream at Bhutiapali.

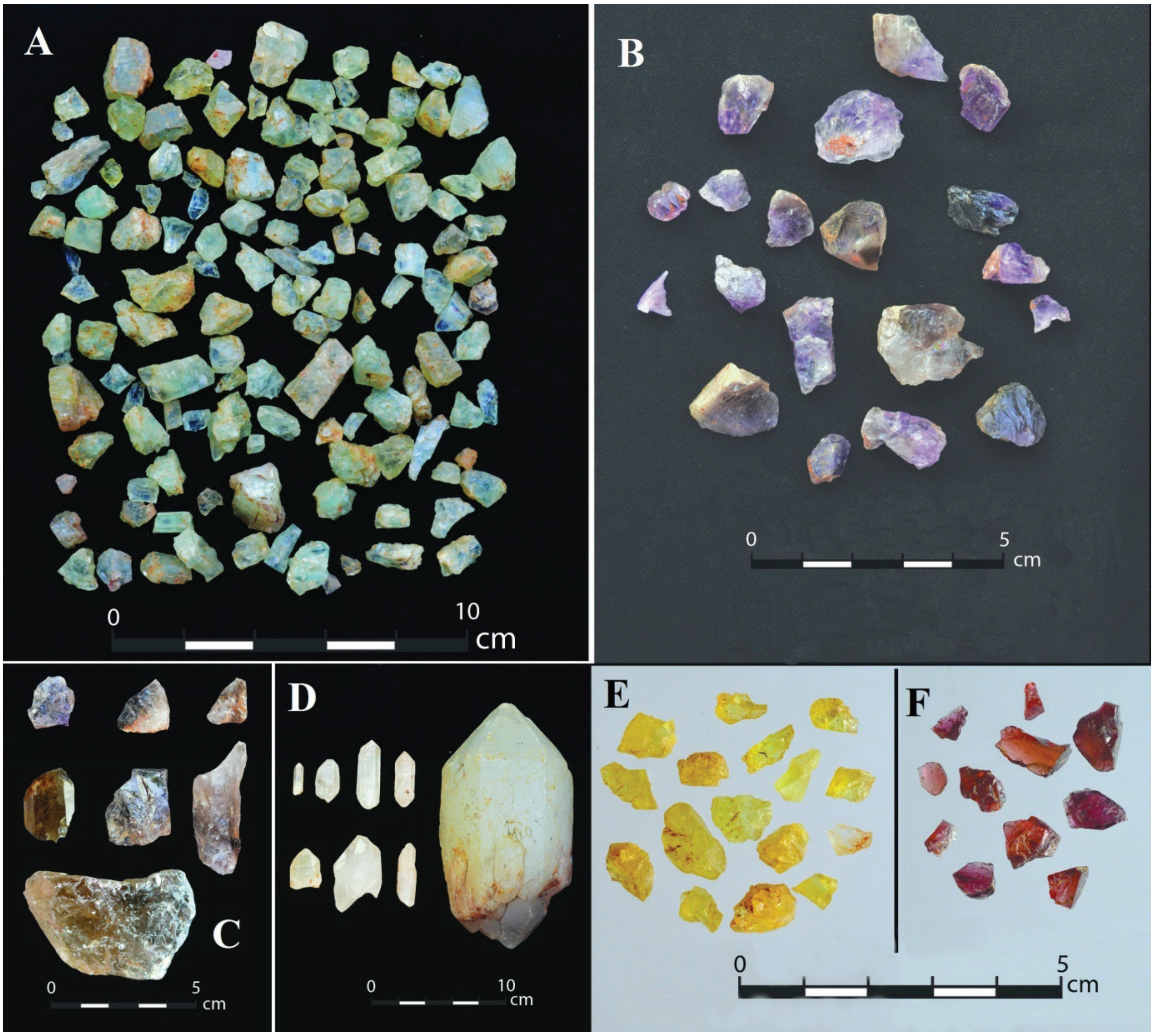


Figure 17: Different types of gem bead waste excavated from Bhutiapali.

Figure 18: Finished beads and stud from Bhutiapali site: 1-8 Glass micro beads, 9-11 Carnelian, 12-14 Garnet, 15 banded agate, 16 & 17 emerald, 18 & 19 topaz, 20-24 aquamarine, 25 & 26 black beryl, 27 ear stud of crystal quartz, 28-31 crystal quartz beads, 32 & 33 glass beads.

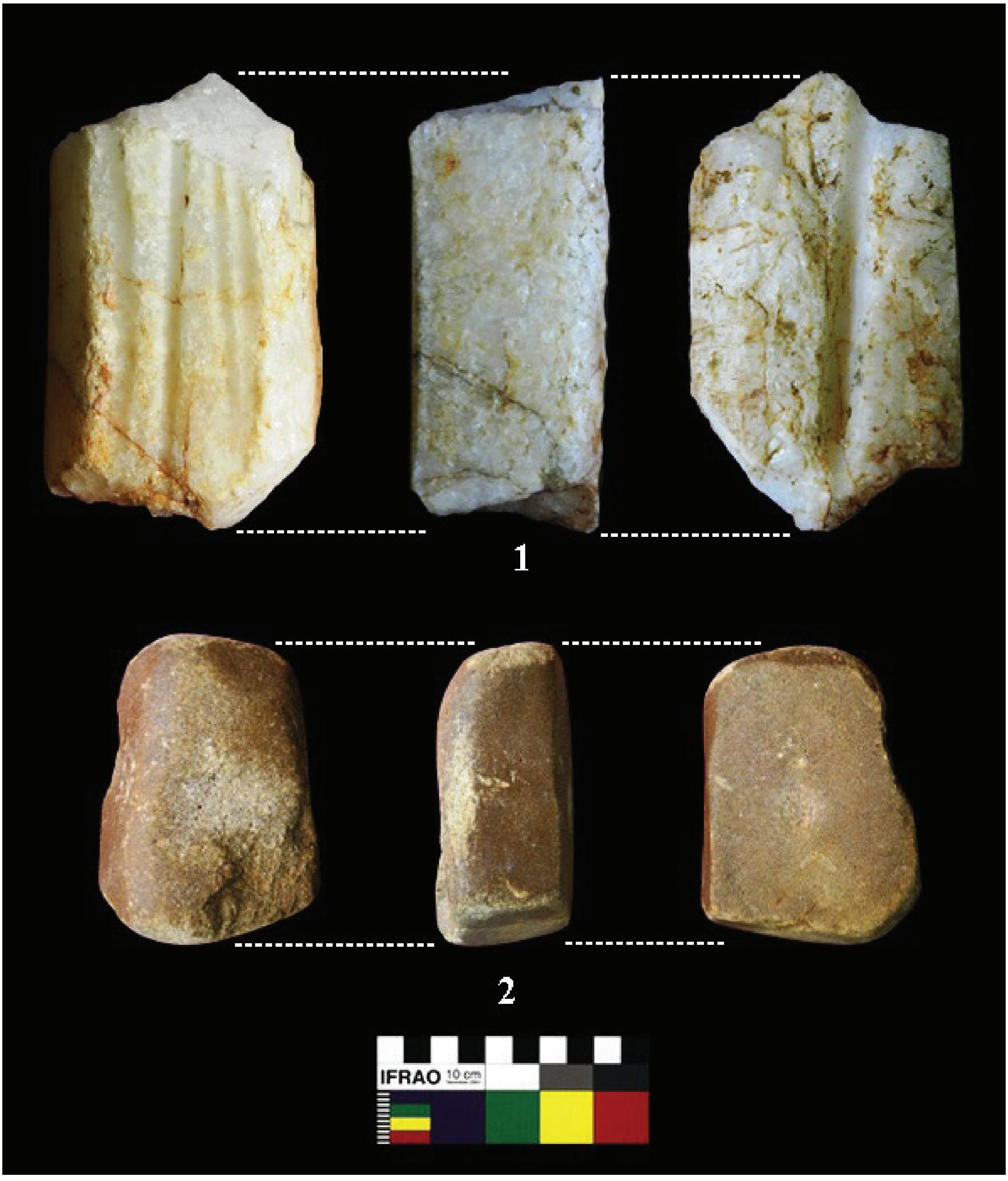


Figure 19: Bead manufacturing tools: 1 bead polisher with shallow parallel grooves, 2 Anvil with pitted marks on the obverse side from Bhutiapali.

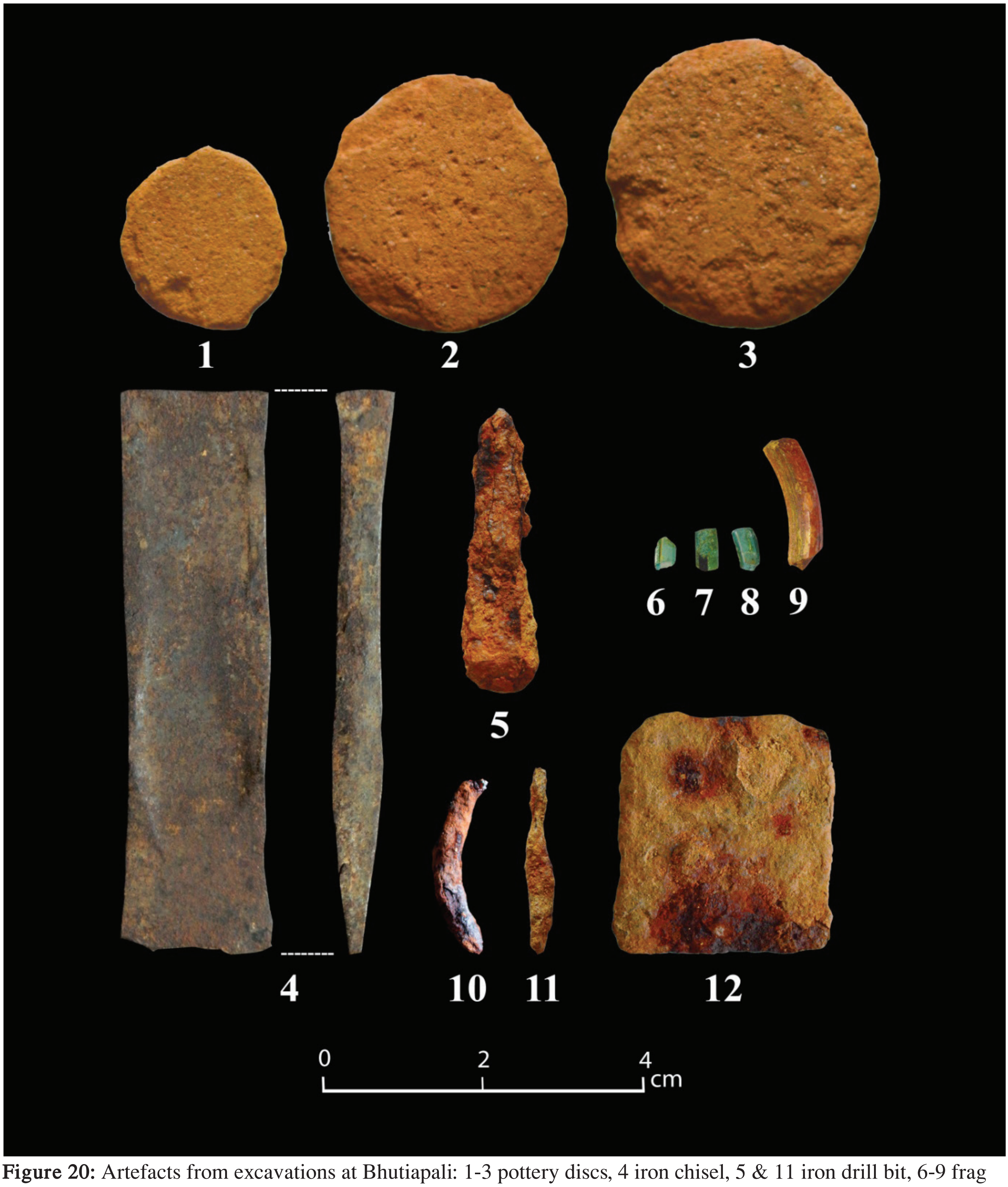


Figure 20: Artefacts from excavations at Bhutiapali: 1-3 pottery discs, 4 iron chisel, 5 & 11 iron drill bit, 6-9 fragments of glass bangles, 10 & 12 unidentifiable iron objects.

Figure 21: Different types of beads reported from Budhigarh and other sites from the Tel river (after Tripati, 2017,p.10.)