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Analysis of Iron Artefacts from Megalithic context at Niramakulam, Pamba river basin, South Kerala

Ambily C. S.[1], Ajit Kumar[2], Rajesh S. V. and Abhayan G. S.[3]

[1]Assistant Archaeologist, Pt.Deendayal Upadhyaya Institute of Archaeology
[2]Professor (Retd.), Department of Archaeology, University of Kerala
[3]Assistant Professor, Department of Archaeology University of Kerala
E-mail: ambilyananova@gmail.com; ajitkumarku@gmail.com; rajeshkeraliyan@yahoo.co.in; abhayangs@gmail.com

Abstract: *The present study is an attempt to bring forth the typo technological aspect of iron implements unearthed from the salvage operation conducted in a Cist burial at Niramakulam, District Pathanamthitta, Kerala. To know the properties of metal a quantitative chemical analysis has been done by using Thermo Scientific Niton XL3t XRF Analyser. Fifteen specimens were selected for the analysis which includes knives, sickles, nails, slags and some unidentified objects. Typology, percentage of composition of metal, comparative study with other iron artefacts reported in Kerala and chronology of the implements with the help of C^{14} dates are discussed in this paper. The highest percentage of iron found in a knife is 95.15%, and with the help of carbon dating from the site, the chronology of iron implements can be dated to 4th century BCE.*

Keywords: *Iron objects, Niramakulam, Typology, Chemical analysis, Comparative study, chronology*

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Introduction

The earliest pyro-technological discoveries resulted in the making of plaster and ceramics which was followed by metallurgy, first copper, then of other metals like iron. Iron objects are significant cultural relics of the Megalithic period in India and found from many excavated sites. Hence, the Megalithic period is also referred to as the 'Iron Age'. Iron was the main metal used by the Megalithic people for making tools and other objects (Pillai 2014:6). Some of the major iron-using centres identified in India are located in the Indo-Gangetic Divide and the upper Gangetic valley (Hastinapur, Atranjikhera and Noh (800 BCE-200BCE)), eastern India (Barudih, Chirand, Mahisdal and Pandurajar Dhibi(1000 BCE-600BCE)), Malwa (Nagda, Eran, Prakash and Bahal) and Berar (Takalghat Khapa, Mahurjhari

and Junapani) in central India (1100 BCE -650 BCE) and in southern Indian states such as Kerala, Tamil Nadu, Andhra Pradesh and Karnataka (1000BCE) (Chakrabarti 1976:117-119). There are four principal assemblages in the early Iron Age of India which are Gandhara Grave culture, Painted Grey Ware culture, Pirak assemblage and the Megalithic complex (Possehel et al. 1999:154).

The origin of the introduction of iron in India is always a controversial topic. In earlier days, it was connected with diffusion from the west. According to Belck iron was possibly obtained from Phoenicians whilst Smith suggested that iron came from Babylonia. It is suggested that there was a separate diffusion of iron to south India, which took place through sea route. But later it was changed, and scholars like Chakrabarti stated that India has a separate and possibly an independent centre for the manufacturing of iron (Chakrabarti 1976:115) Several dates are available for iron from different sites in India. Radiocarbon dates from Atranjikhera, early deposits at Kausambi near Allahabad, Jakhera in district Etah in the Ganga Valley, Nagda and Eran in central India, and Hallur in Karnataka suggested the dates around 1000 BCE for iron (Tewari 2003:536). Presence of iron in the Chalcolithic deposits at Ahar suggested that the date of the beginning of iron smelting in India may go back to as early as the 16th century BCE. On the basis of four radiocarbon dates, the iron bearing period at Gufkral in Jammu and Kashmir has a proposed range of 1550-1300 uncal.BCE (Tewari 2003 :537). More recently, early contexts containing iron at Jhusi in district Allahabad have been dated to 1107-844 cal. BCE. The early Iron Age deposits of Komaranahalli (Karnataka) and Veerapuram (Andhra Pradesh) have given TL dates in the 15th to 12th centuries BCE and radiocarbon dates in the 13th to10th centuries BCE, while in the Vidarbha region radiocarbon dates for the iron ranges between the 14th and 10th centuries BCE. Iron working and the use of iron was prevalent from the early second millennium BCE at Raja Nala-ka-tila, Malhar, Dadupur, Lahuradewa, and Jhusi in Uttar Pradesh (The dates obtained are in three groups: three dates between c.1200-900 Cal BCE, three between c. 400-1200 Cal. BCE and five between c.1800-1500 Cal BCE(Tewari 2003:536-544).

Indications to iron can be found in literature also. 'Ayas' mentioned in Rigvedic and subsequent literature must have had connection with iron. In the *Taittiriya Samhitii* of the Black Yajurveda there are references of ploughs which were drawn by six or even twelve oxen. The ploughshares of plough might have been made out of iron. The *Atharvaveda* speaks of an amulet born of a ploughshare could be made of iron and there is a reference of a smith also ('the skilful smith hath smitten thee away with the hand by a knife'). The *Satpatha Brahmana* clearly associates iron with the peasantry. Furthermore, the earliest Buddhist canon the *Suttanipiita* (Kasi-Bharadwiija-sutta) describes a ploughshare which must be of iron: 'as a ploughshare that has got hot during the day when thrown into the water splashes hisses and smokes in volumes' (Chakrabarti 1976:120). The *Natural history* by Pliny states that the iron was imported from 'Seres' identified with the Cheras, and the *Periplus of the Erythraean Sea* clearly mentions the import of iron and steel from India (Srinivasan et al. 2009:117).

Niramakulam

Niramakulam (90 11'335''N; 76059'583''E), is situated 4km. west of Kokkathode, a remote village located in the forest tracts of Western Ghats. The site is located 1538 ft. above MSL. Buses ply up to Kokkathodu which is located 29 km. east of Konni town in Kozhencherry taluk of Pathanamthitta district. The site is surrounded by highly vegetated hilly terrains with plenty of granitic and gneissic rock outcrops. Kokkathodu and Kallar, which are feeder streams to River Pamba and Achankovil, flow through rocky and pebbly beds at the foothills, 5 to 6 km away from Niramakulam. The Niramakulam region is notable for the presence of Megalithic burials. About ten megaliths have been identified from the site including the variety of cist and dolmenoid cist. All these burials are located in a rubber

plantation and disturbed in nature. A salvage operation conducted by the first author unearthed iron objects from a cist burial from Niramakulam in 2012. Eight iron implements were found from the cist which included varieties of sickles and knives **(Figure 1a).** Among these, six are almost intact but two are broken. But all of them are corroded and soil encrusted. Besides these implements, one iron nail and some unidentified objects were also recovered from the site (Figure 1b). Iron slags/ingots were also collected from the vicinity of the site Niramakulam and Kurichy area -1. The iron implements show variations with respect to their measurements **(Table 1).**

Table 1: List of Iron Objects and Their Measurements

Specimen number	*Type*	*Length (cm)*	*Breadth (cm)*	*Thickness (cm)*
1	Knife	12	2.6	0.6
2	Unidentified	2.5	1	0.3
3	Unidentified	3.5	2	0.4
4	Unidentified	3	1.9	0.3
5	Nail	3	0.5	0.5
6	Knife	16	2.5	0.6
7	Knife cum sickle	18	2.3	0.7
8	Knife cum sickle	15	3.8	0.8
9	Sickle	16.5	2.4	0.8
10	Sickle	19.5	4	0.9
11	Sickle	9	1.2	0.4
12	Sickle	23	5.2	1
13	Iron slag/Ingot	8	5	3.6
14	Iron slag/Ingot	4	4	1.7
15	Iron slag/Ingot	11	9	5

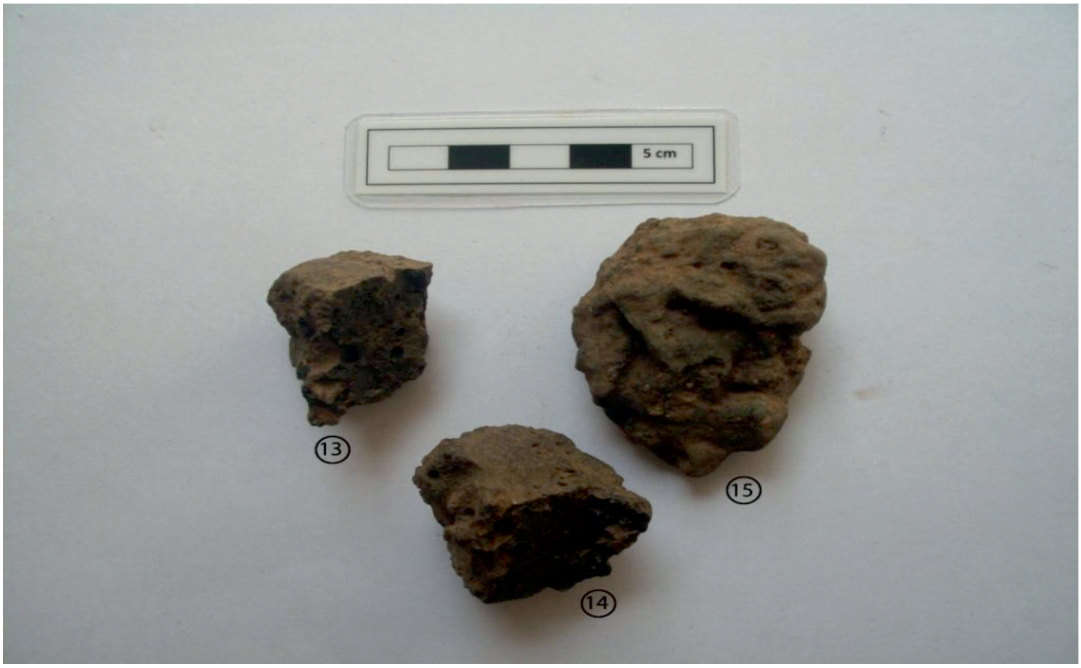


Figure 1 A & B: Iron Objects and Slags from Niramakulam

Details of Iron implements

1. It is almost a complete knife with a pointed tip and a solid tang. The knife was broken into three pieces and highly corroded. Soil is also encrusted. It is made out of thin sheets of metal.
2. It is an unidentified highly corroded and soil encrusted object.
3. It is an unidentified highly corroded and soil encrusted object.
4. It is an unidentified highly corroded and soil encrusted object.
5. It is a corroded nail.
6. It is an almost complete part of the knife with a pointed tip and solid tang. The knife is broken into 4 pieces and in a highly corroded condition. Knife is encrusted with soil and made out of thin sheets of metal.
7. It is an almost complete part of the knife cum sickle. Tip of the specimen is a little broken. It has slight curved blades and a thin cross section and seems to be made out of a thin sheet of metal. The tool is corroded and encrusted with soil.
8. It is a complete knife cum sickle with flat tip and solid tang. This specimen is also corroded, encrusted with soil and seems to have been made out of using a thin sheet of iron.
9. It is a complete sickle with pointed tip and solid tang. The sickle is highly corroded and encrusted with soil. It also seems to have been made out of a thin sheet of iron. It has a curved blade on the tip like a hook.
10. It is an almost complete sickle with a curved blade, a pointed tip and a solid tang. The sickle was broken into two pieces. It is corroded in nature and encrusted with soil. The specimen was made by a thin sheet of iron.
11. It is a small sickle with curved blade and solid tang. It is broken into 6 pieces and encrusted with soil. It appears to have been made from thin sheets of metal which are welded and forged to shape into a sickle. Flaking and lamination marks are visible.

12. It is a big sickle with curved blade, solid tang and a ring at the handle. The sickle is broken into several pieces as it is placed in between the ceramics found in the northwestern part of the cist burial. The specimen is so corroded and encrusted with soil. It is also made by using a thin sheet of metal forged into the shape of a sickle. The iron ring of the sickle has 20.21mm diameter. Flaking and lamination marks are visible.
13. Iron slag/ingot
14. Iron slag/ingot
15. Iron slag/ingot

Total fifteen specimens were studied. The physical examination of iron objects implies that they might have been made from thin sheets of metal which were repeatedly welded and then forged to shape into objects or the extracted metal was beaten to shape. A quantitative chemical analysis was done by using Thermo Scientific Niton XL3t XRF Analyser to know the properties of metal. The detected elements include iron, copper, nickel, chromium, phosphorus, zirconium, titanium, vanadium, sulphur and molybdenum **(Table 2).**Undetected elements also noticed in these objects, which is named as 'waste' in the table.

Table 2: Percentage of Composition of Iron Implements and Slags

Sl. No	*Specimen*	*Fe Iron*	*Cu (Copper)*	*Ni (Nickel)*	*Cr (Chromium)*	*P (Phosphorous)*	*Zr (Zirconium)*	*Ti (Titanium)*	*V (Vanadium)*	*S (Sulfur)*	*W (Waste)*	*Mo (Molybdenum)*
1	Knife	95.15	0.315	0.416	0.051	0.393	-	0.087	-	-	2.78	-
2	Unidentified	80.05	1.01	2.33	-	-	0.048	0.415	-	-	14.64	-
3	Unidentified	84.31	0.920	2.06	-	-	0.109	0.393	-	-	11.27	-
4	Unidentified	80.94	1.33	2.22	0.054	0.251	-	-	-	-	14.55	-
5	Nail	80.33	1.30	2.20	0.056	-	-	0.118	0.055	0.173	14.55	-
6	Knife	75.78	1.62	2.83	-	-	-	0.549	0.218	-	18.4	-
7	Knife cum sickle	92.08	0.601	0.850	0.107		0.064	0.487	-	-	5.32	-
8	Knife cum sickle	92.86	0.498	0.829	0.123	-	-	0.356	0.052	-	4.87	0.018
9	sickle	88.77	0.743	1.60	-	-	0.036	-	-	-	8.27	
10	sickle	92.86	0.523	0.698	-	-	0.045	0.064	-	-	4.72	-
11	Sickle	82.58	1.12	1.80	0.096	-	-	0.078	-	0.184	12.34	-
12	Sickle	83.08	1.17	2.04	0.057	-	-	-	0.048	-	12.50	-
13	Slag/ingot	71.05	2.01	3.24	0.089	-	0.029	0.175	-	-	23.11	-
14	Slag/ingot	59.85	2.66	4.36	-	-	-	1.05	-	-	31.73	-
15	Slag/ingot	78.78	1.31	2.32	0.082	-	-	0.153	0.064	0.212	15.75	-

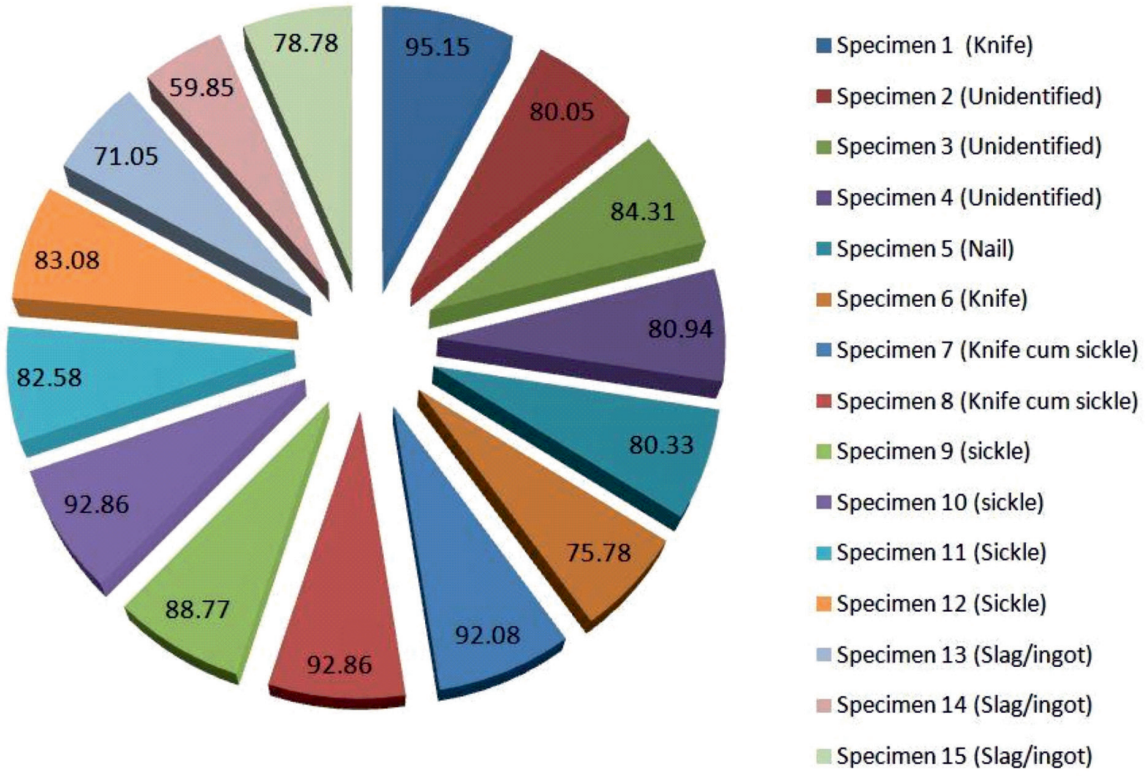
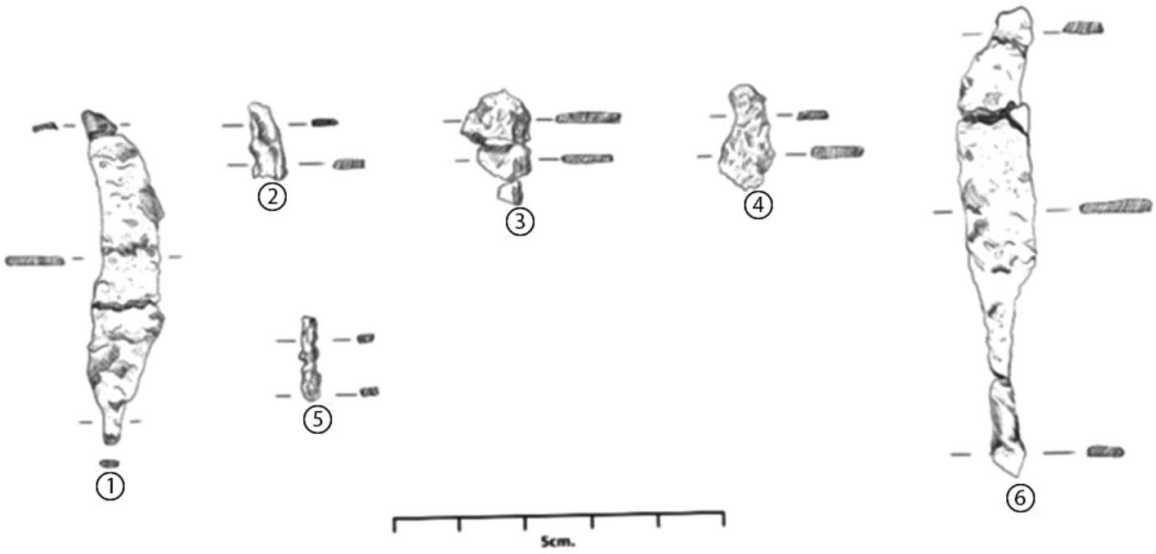


Figure 3: Percentage of Iron Content in Specimens, Niramakulam

The highest percentage of iron was found in a knife (specimen 1) which is 95.15%. The lowest percentage of iron was found in another knife (specimen 6) which is 75.78%. The percentage of waste (Undetected elements) comes second and Nickel comes third. Percentage of chromium, phosphorus, zirconium, titanium, vanadium and sulphur are ranging below 1%, except copper. The percentage of copper is ranging from 0.315 to 1.62 in implements. In the case of iron slags the percentage of iron was found less and the percentage of other elements was found more when compared to the iron objects. Except iron, copper and nickel, other metals are even absent in some specimens.



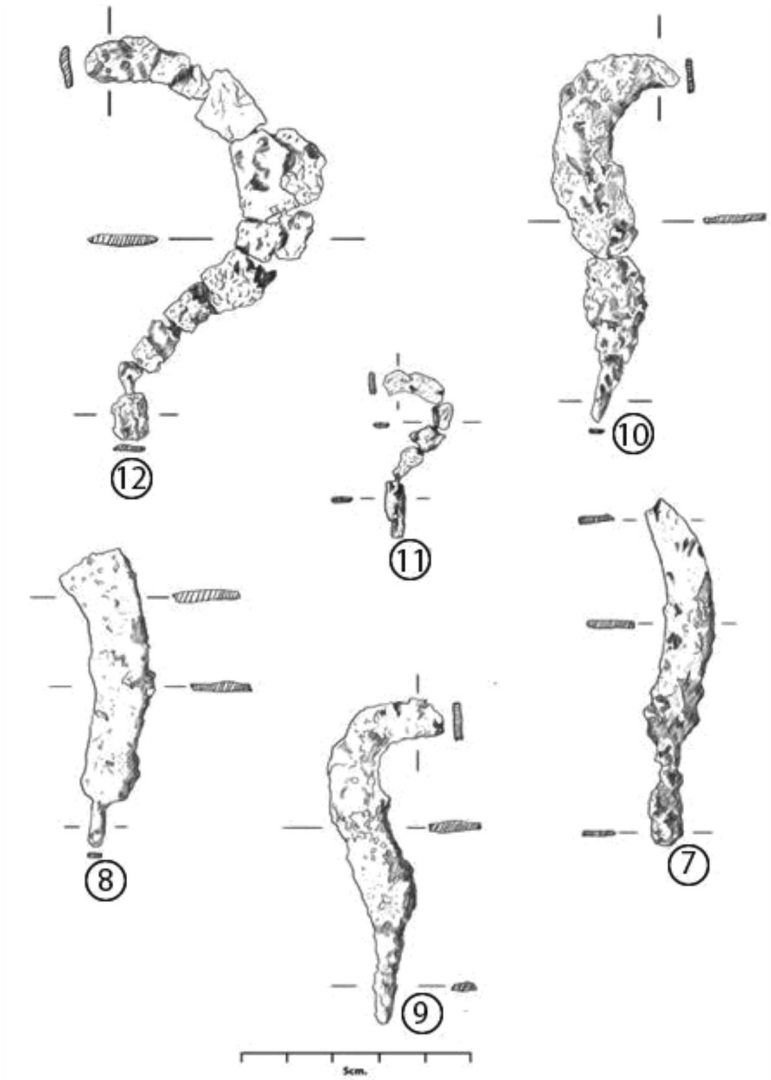


Figure 4: Drawings of Iron Implements from Niramakulam

Discussion

As said earlier, the Megalithic Culture is also known as Iron Age culture because of the presence of iron objects in almost all the burials. Varieties of iron objects like swords, tanged daggers, wedge shaped blades, barbed arrowheads, hanger and hooks, nails, spindles, spearheads, knives, rods with forked end, tripods, axes, bayonet like object, chisels, bill-hooks, iron wedges, flanged spades, hoes, shovels, spades, sickles and ploughshares, lamps, crowbars, hook-lambs, simple rods, hanger, fish hook, tridents, etc. were unearthed from various excavations from Kerala (Gurukkal and Varier 1999). Apart from these, a stick identified as '*Narayam*', '*Urumi*', human and animal forms were also reported among the iron objects (Ambily 2021.In press).

All these objects can be classified into weapons, cutting tools/ agricultural implements, household/ domestic, toys or ritual objects, writing material, fishing tools and other ritualistic tools. Tripod, lamps, trident, crowbars, hook-lambs and simple rods might be used as ritualistic objects, like swords, '*Urumi'* tanged daggers, wedge shaped blades, barbed arrowheads, spearheads, tridents, knives, rods with forked end, bayonet like object as weapons, '*Narayam*' as writing material, hoes, bill hooks, chisels, wedge and ploughshares, axes, shovels, spades. as agricultural /cutting tools, bullock with

animals and plough, human and animal forms as toys or ritual objects, nails, spindles, knives, sickle, tripod stand, hanger, nails, lamps as domestic or household objects. A fishhook has been identified from Nalloor in Calicut is a rare example of evidence of fishing in the Megalithic period. Some of these tools have multiple uses as well. Chisels might be used for cutting stone, wood and even metal, axes for clearing trees, cutting logs, as a weapon and ceremonial symbol, sickle for agriculture (Harvesting, or cutting fodder) and domestic purpose, daggers as weapons of offense or ornamentation, arrowhead for hunting or war, bill hooks are for slashing vines and hooking branches, hoes for digging up the roots, to prepare a seed bed, weeding and ridging, etc. (Chedambath 1997:281).

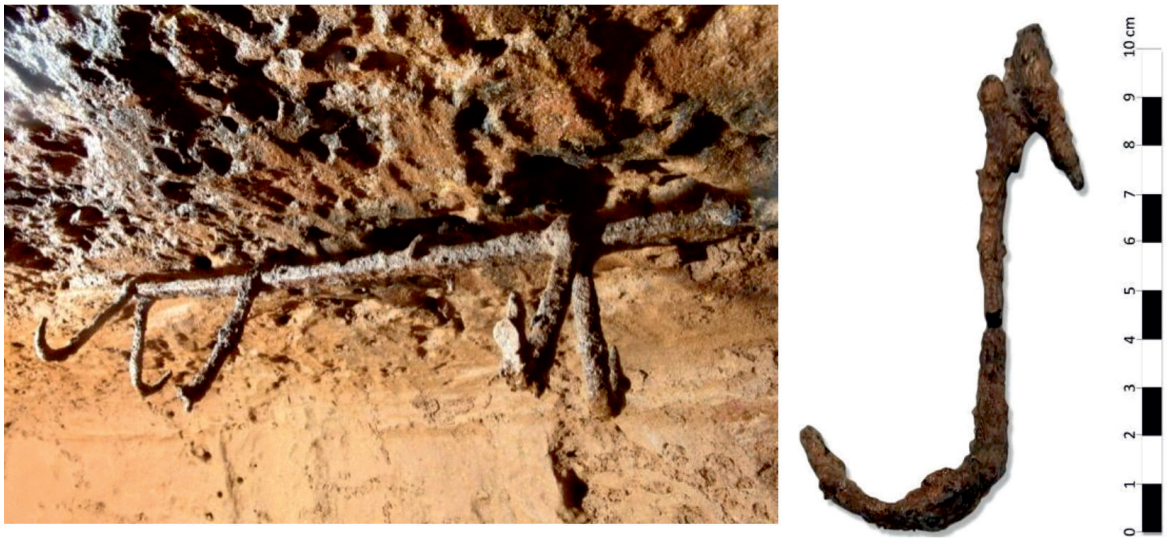


Figure 5: Iron Hanger, Kakkodi and Iron Fish Hook, Nalloor, Calicut (Courtesy: Krishnaraj K.)

Pulimath, Venjaramood, Sasthamangalam, Pirappanamcode and Maruthur Irumbu in Thiruvananthapuram district, Mangadu, Aeeram, Karimpaloor, Poredam, Valiyapadam and Arippa from Kollam district, Oliyani and Kadanad in Kottayam district, Anjunadu valley, Cardamom hill/ Thondaimalai, Chellarkovil and Periakanal in Idukki district, Chengamanad, Cochin university, Okkal, Kunnukara, Srimulnagaram, Kuttippadam, Veliathunadu, Kurumassery and Kanjur from Ernakulum, Machad and Pazhayannur, Cheramangad, Porkkalam, Kadukkassery, Koonamoochi, Kallumpuram, Kattakambal and Eyyal, Punkunnam and Meenakshipeth in Thrissur, Malambuzha, Chulannur, Anakkara, Kongad, Vellinezhi and Chingachira in Palakkad, Chathanparamba, Feroke/Chenaparambu and Parambantalli, Neelacaperamba, Challil Kurinyoli, Panniyannur Amsom, Perumundassery, Thanakottur Desom, Pallumala, Palangad, Mullen kunnu, Atholi, Mononthody, ViyurChevayur, Vykkilaserry Desom, Kakkodi, Chelavoor, Thondannur, Kuruvattur, Koyakkad, Nalloor in Calicut, Pattapiriyam, Kodakkal, Kaladi/Ponnani, Pullukunnu,Vattakkulam and Perinthalmanna and Kuttippala in Malappuram, Vaiytiri from Wayanad, Panunda, Punnol, Bangala Motta Paramba, Keraltheruvu, Kotturvayal and Perungulam in Kannur, Pilikode, Ummichipoyil, Muttatody, Kuttikkol, Kattipoyil, Chembena/Peralam and Kudol /Peralam in Kasargode district are the sites having iron objects reported from the Megaliths so far(Ambily 2021:In press). Anthropomorphic figure from Punnol (Ghosh.1989.353), zoomorphic forms from Valiyapadam (IAR.1989-90:45) and three serpents from Oliyani (Rajendran.2005: 41-42) are the animal and human forms reported from Kerala. Narayam or "iron stick" reported from Punnol (Ghosh.1989:353) and iron "Urumi ‘’ reported from Srimulnagaram in Ernakulum district (Ismail Pallipram: 2017). Long rod and long rod with curved edges have been reported from Kadanad in Kottayam district (IAR 2007-2008:81-85). A pair of bullocks in cast

iron along with a plough and yoke and an elephant were found in Angamaly in Ernakulam district (Chedambath.1997:284).

Figure 6. Ploughshares from Kuruvattur in Calicut and Kongad in Palakkad (Courtesy: Krishnaraj K.)

Figure 7: Iron Serpents from Oliyani and Iron Implements from Kadanad, Kottayam (Courtesy: Rajendran and Abhayan.G.S)

Apart from this evidence, iron slags and ingots were also found from various sites in Kerala. Iron Age smelting sites reported from Ezhuvanikkonam in Thiruvananthapuram having burnt wood, charcoal, iron slag and smelted crucible with laterite gravel (IAR 1995-1996:46). Abhayagiri in Kollam has crucibles, iron slag, smelting blocks of iron and charcoal (IAR 1995-96:46), and Varanampadam in Thrissur has iron slags and large blocks of tapped slag. Other sites having iron slags were reported from Mangad in Kollam, Nalancheri and Manjalur in Palakkad and Periyar river valley (Abhayan.2018:180), etc. A terracotta crucible was reported from Kallimali in Idukki district (Sandra.et.al:2017). Iron ore mines are also reported from Payippara in Ernakulam district (Selvakumar.2005:74)

Iron sickles from Chenkalthadam (IAR 1990-91:33),blade from Puliyur(Sathyamurthy.1992:25), axe from Karimpaloor (IAR 1990-91:3), bayonet like object from Valanjavattom (Mathew et al.2006:14), lamps and swords from Kavumbhagam(Menon.1975:24), lamp from Thiruvalla locality-I (Nambyar.1932: 61), sword from Illimala Bridge (Mathew et al.2006:14-17), rusted and coated iron implements from Kavumgumprayar (IAR 1969-70:59), iron implements from Mudimala (IAR

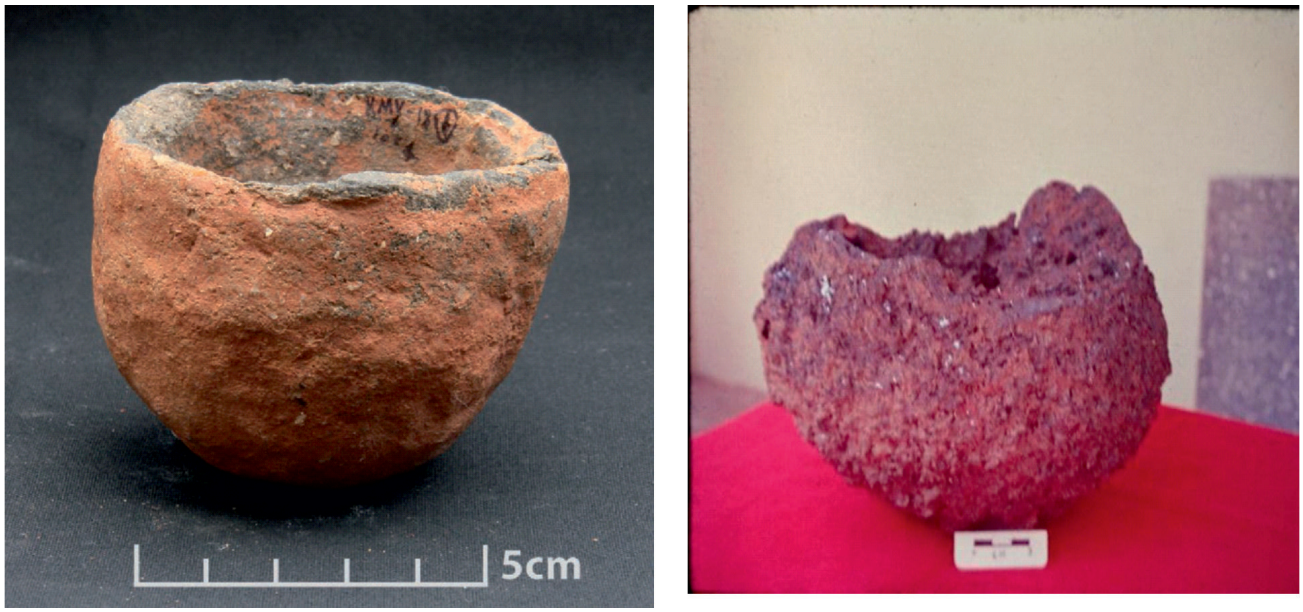


Figure 8: Terracotta Crucible, Kallimali, Idukki (Courtesy: Sandra M.S.) and Iron Ingot, Abhayagiri in Kollam (Courtesy: P. Rajendran)

1992-93:113), few iron pieces from Njalikkandam(Archana. Personal Communication), tools from Phoothankara (IAR 1960-61,1961-62.21& Abhayan.2019) are the sites having iron implements already reported in the Pamba basin. As mentioned earlier eight iron implements including sickles, knives and sickle cum knife, one iron nail, and three unidentified objects have been unearthed from the excavated site at Niramakulam. Iron slags also have been collected from the vicinity of the site Niramakulam and near Kurichy locality-I. The iron implements from Niramakulam were probably used for agricultural and domestic purposes. The sickle seems to be used for reaping the crops and knives might be used for domestic activities. Likewise, sickle from Chenkalthadam and axe from Karimpaloor were also used for domestic or agricultural activities. Swords from Illimala Bridge and Kavumbhagam and bayonet-like objects from Valanjavattom might be used for hunting or war purposes. Lamps must be used in houses for domestic purposes. One of the noteworthy features is a stone trough (Figure 10) probably used for storing water during the time of iron smelting has been found at Niramakulam along with iron slags and impressed potsherds (Figure 9). Interestingly, slicing/cutting marks has been noticed in two of the iron slags which might have happened during the time tool making process.

Figure 9: Iron Ingot/Slags Found Near To the Cist Burial Site At Niramakulam And Potsherds Including Plain Red Ware And Impressed Shreds And Slags/Ingot Found Near The Stone Trough, Niramakulam Locality-1

Figure 10: Stone trough found at Kurichy Locality-1

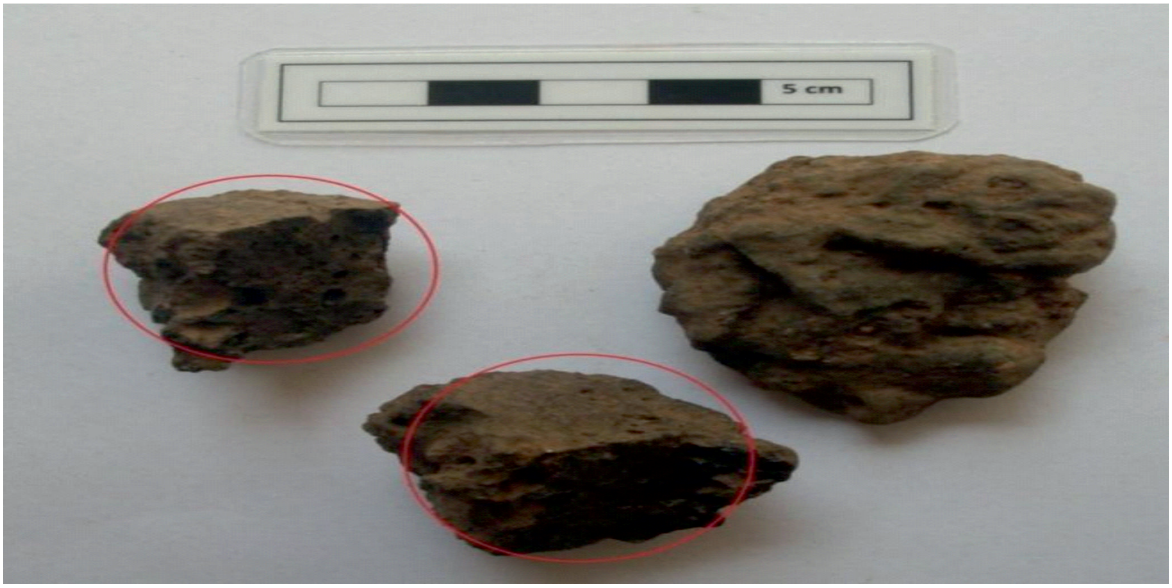


Figure 11: Cutting/Slicing Mark on Iron Slag, Niramakulam Locality-1

In Kerala very few iron specimens have been studied properly. One specimen from Pazhayannur in Thrissur District is analysed for the same. Abhayagiri (IAR 1995-96:46), Ezhavanikonam in Bharathannur, Trivandrum and Tenmala (IAR 1990-91:33) are some of the iron ore smelting/melting areas and evidence of slags were reported from south Kerala. 35 % of iron was found in the slag from Bharathannur, 35% and less than 0.5 % was reported from Abhayagiri (IAR 1995-96:20). As mentioned before, the highest percentage of iron is found in a knife from Niramakulam which is 95.15%. The lowest percentage of iron found in another knife is 75.78%. The highest percentage of iron content noticed in one among the three slags/ingots is 78.78% and the lowest percentage is 59.85%. The Pandalam area of the Pamba basin, where laterite Menhirs are found, are rich in iron content (Ambily.2017).Unlike the iron implements from Pazhayannur, all the implements from Niramakulam were analysed. Only one hook found from the Pazhayannur cist was used for analysis. The result was 99% pure iron. Apart from iron, Manganese, aluminium and cobalt are also found as minute impurities in hook. Megalithic sites at Tagalghat and Khapa and an early historic site at Dhatwa also got 99% pure iron (Mehta and George.1974:20-23) in other parts of India. But the percentage of iron content varies from implement to implement and slags in the case of Niramakulam.

The AMS dates of Niramakulam from the Pamba river basin range from 4th century BCE to 4th century CE. The earliest date (2190+-30 years BP) is from a depth of 164-185 cm within the cist and the later date was from the outside of the burial which was from 96-105 cm depth from the surface (1790+-30 years BP). These dates are significant for the fact that they are the earliest dates of sepulchral activity and artefacts from the hill range of the Pamba basin as of now. Second importance is that the dates divulge human activity of two different periods of time. There is a chance for continuation of Megalithism and settlement in the same area even in the early historic period too. Early historic potsherds (Impressed shreds) were also collected from the vicinity of these monuments (Figure 9). All the implements from Niramakulam are collected from inside the cist burial. On the basis of carbon dating, the iron implements can be dated to 4th century BCE as the sample number one was collected from inside the chamber (Ambily et al. 2020)

Conclusion

Iron implements recovered from the cist at Niramakulam are comparatively small in size. Sickles of similar type have been reported from other megaliths in Kerala and outside. These types of iron implements are still in vogue in the Pamba basin according to ethnographic parallels. Other unidentified objects have resemblance with those reported from the sites like Oliyani in Kottayam, Machad in Thrissur and Kadambapur and Pochampad in Godavari basin. Iron implements from Niramakulam were probably used for agricultural and domestic purposes. It is interesting to note that the iron implements from Niramakulam are not as pure as the iron implements found in other parts of Kerala like Pazhayannur and neighbouring states such as Tagalghat and Khapa. The impurities within the iron implements are also different from them. The percentage of iron content varies from implement to implement and slags in the case of Niramakulam. Selection of the ore for the extraction of iron and technique might be the reason for this. However, both the implements and slags from the site have the same impurities giving a possibility that these iron implements were manufactured locally. The location of ore for the extraction of iron could not be identified. But the presence of iron slags, stone trough, slicing mark on slag etc., from the premises of the Megalith at Niramakulam and Kurichy areas suggests that the implements were probably made locally (Ambily.2017). As all the specimens were unearthed from within the cist burial, with the help of carbon dating, the chronology of iron implements can be dated to 4th Century BCE.

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