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Further Research on the Southern Neolithic and the Ashmound Tradition: The Sanganakallu-Kupgal Archaeological Research Project Interim Report

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ABSTRACT

This paper addresses the findings to date of the Sanganakallu-Kupgal Archaeological Research Project, which is aimed at clarifying the origins and development of the earliest food-producing cultures in south India. The project has focused its efforts on a complex of prehistoric sites in the Bellary District of Karnataka that retain rich evidence for Mesolithic through to Iron Age developments. Many of these sites, which are concentrated around a cluster of granite hills between the modern-day villages of Sanganakallu and Kupgal, are currently being destroyed by large-scale industrial granite quarrying and agricultural development. The project is focused on systematically mapping, recording, and, where possible, test excavating the sites prior to their destruction. This work is being carried out in association with detailed material culture, bioartefactual and environmental studies. While our findings are still preliminary, it is clear that they are providing important insights into key late prehistoric developments that led to the emergence of complex societies and political economies in south India. The late Neolithic seems to have seen important economic, social and ritual transformations that resulted in important shifts in patterns of craft production, trade and exchange, and monument construction. These were likely intimately related to the development of elite groups, regional polities and wider oceanic trade networks. Our project findings allow these crucial developments to be traced back earlier than ever before, demonstrating that they find their origins in changes that took place amongst the earliest agricultural societies in the south.

Introduction

The Southern Neolithic of the granitic region of the southern Deccan is one of the earliest well-documented food-producing cultures in South Asia (Fuller 2002, 2003a, 2003b; Korisettar et al. 2001a). As elsewhere in the Old World, the Neolithic in south India represents an important period during which sedentary societies became established, and long-lasting cultural traditions, based on village life, cultivation and pastoralism, probably found their origins. Research into understanding these new societies in south India, how they were organised and how they relate to earlier and later societies has in recent years been undertaken by members of our team (Boivin 2004a,b; Boivin et al. 2002, 2003; Fuller 1999; Fuller et al. 2000–01, 2001; Korisettar et al. 2001a,b; Mushrif et al. 2002–03; Korisettar 2004), and others (e.g. Paddayya 1991–92, 1993a,b, 1998, 2000–01; Paddayya et al. 1995; Devaraj et al. 1995; DuFresne et al. 1998). This area of South Asia is also of interest for its unique regional cultural developments, which include the ashmounds, impressive mounds of accumulated and intentionally burnt cattle dung (Allchin 1963; Boivin 2004a; Paddayya 1991–92, 1998; Korisettar et al. 2001a: 205–16), as well as villages located on visually stunning granitic hilltops, some of which bear concentrations of rock art, the core of which is likely to date to the Neolithic (Allchin and Allchin 1994-95; Boivin 2004b; Gordon 1951; Paddayya 1976).

While we have conducted research at various locales in the southern Deccan, our recent efforts have focused in particular on the cluster of sites in the Sanganakallu-Kupgal area.[1] These rich prehistoric sites, the importance of which was earlier recognised by such scholars as Robert Bruce Foote (1887, 1916), H.D. Sankalia (1969), B. Subbarao (1947, 1948), Z.D. Ansari and M.S. Nagaraja Rao (1969), Raymond and Bridget Allchin (Allchin 1963; Allchin & Allchin 1982) and G.G. Mujumdar and S.N. Rajaguru (1966), are currently undergoing unmitigated destruction. Commercial quarrying and agricultural expansion has already erased several important sites, while many of those that remain have been damaged or partially destroyed by such activities. Sites in the area are being destroyed faster than they can be discovered and recorded at even the most basic level. Within 10 years, it is likely that very few of these sites, which represent a key, internationally-recognised heritage resource for India, will remain. It is with this in mind that we have undertaken a program of survey, mapping, recording, and rescue archaeology. This has been directed by Korisettar, and aided by a team of students, and Indian and international specialists who are bringing new scientific methods to bear on this important set of sites.

The present report addresses findings made in the 2002–2004 field seasons. Due to the rapidity with which the archaeology of this region is being damaged or

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[1] Note that Kupgal is more accurately Kapgal. The spelling used in previous reports is retained by us to prevent confusion however.

destroyed, much of our research has been 'responsive' in nature, driven by the immediate threat to particular sites and the need to test or excavate them before they disappear. Nonetheless, within the confines of these parameters, and the need to rapidly record and sample threatened sites, an overall research strategy has been implemented. The aims of this have been to collect comparable data from a range of sites and site types in the Sanganakallu-Kupgal area, in order to understand their relationship to one another. Of key interest has been the determination of the chronological relationship between the different types of activities in evidence in the area. Thus, the project has focused on gathering material for scientific dating, and trying to understand the nature of activities through material culture and bioartefactual analyses. Research into prehistoric environments has also been carried out in order to understand the context for cultural developments. This strategy has involved voluminous recording in the field and the study of large assemblages of a wide range of material, as well as detailed scientific sampling. Thus, in the present interim report we can only introduce the basic field evidence, selected sub-samples of the artefactual or other evidence, and preliminary results from a few specialist studies, all of which are prone to revision as further work is completed.

Survey and mapping: Recording sites and their destruction in the Sanganakallu-Kupgal area

One of the main aims of the Sanganakallu-Kupgal Project is to carry out detailed, systematic survey and mapping of the Sanganakallu-Kupgal sites, since such work has not previously been undertaken. We have collaborated with a Bangalore-based survey company, KPS Geosystems, which has carried out detailed topographic and geological mapping in the area. This work has been accompanied by systematic archaeological, geological and geomorphological survey and mapping, in order to produce detailed maps of the natural and cultural features in the Sanganakallu-Kupgal area (see figures 1 and 2). Information about modern features and heritage destruction is also included on these maps. These maps will serve as an important record of these important sites once they are destroyed. Together with the detailed artefactual and bioarchaeological analyses that are being carried out, they will constitute an important resource for future study of a disappearing resource.

As shown in the maps, the well-known cluster of Neolithic sites at Sanganakallu-Kupgal is located around a series of castellated granite peaks north of the modern village of Sanganakallu (figure 3). Sannarachamma hill, the south-westernmost peak, is the best known to archaeology (Ansari and Nagaraja Rao 1969; Fuller 2001; Fuller et al. 2001; Korisettar et al. 2001a: 48–52; Subbarao 1948). Samples taken from the site in 1998 provided an important archaeobotanical sequence for this region (see discussion below; Fuller 1999; Fuller et al. 2004). To the east of Sannarachamma is a conical hill, Murkalgudda, without apparent archaeology. The next peak to the east, Choudammagudda, had a small ashmound (now destroyed) on the southwest side of its summit, associated with non-dense occupation, as well as artificially aligned granite boulders and some rock-art (bruisings on granite, and drawings in red pigment).

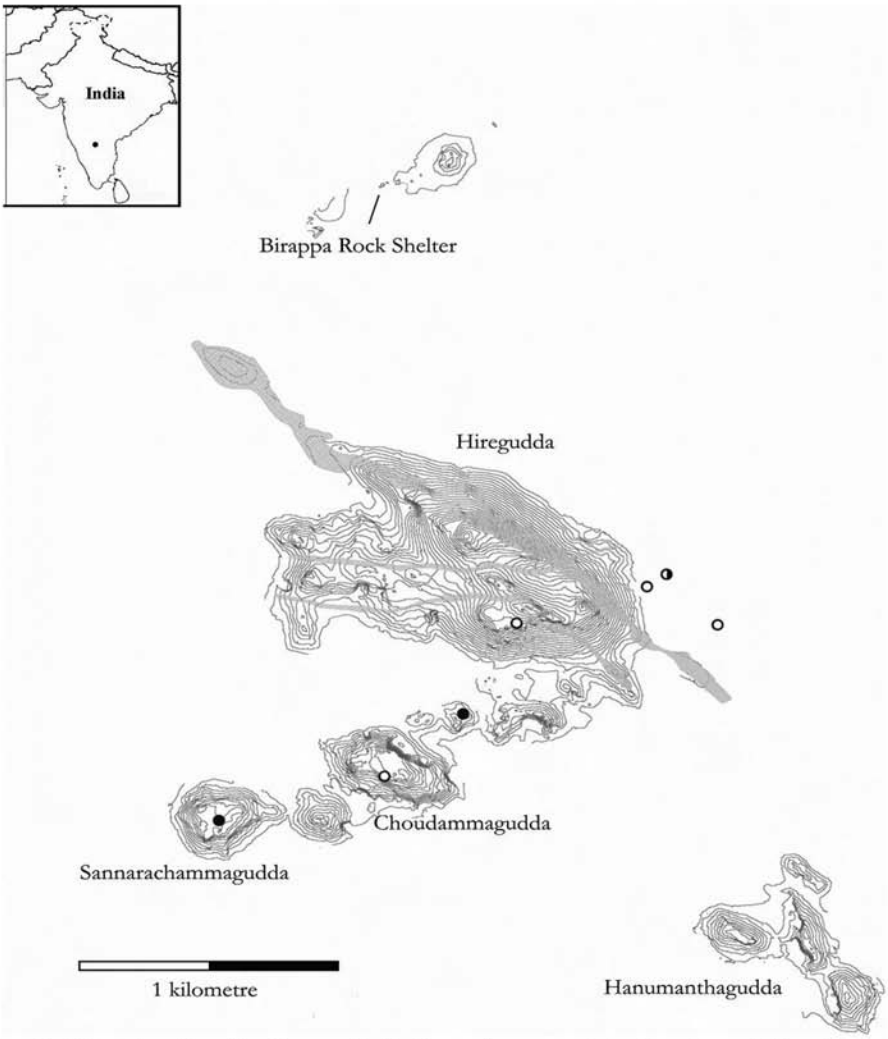

Figure 1 Map showing the Sanganakallu-Kupgal area, and its location within the Indian subcontinent. Grey shaded areas represent dolerite dykes, which focus in particular on Hiregudda. Various types of maps have been produced; this one depicts the distribution of ashmounds. Extant ashmounds are depicted as black dots, destroyed ones as empty circles. The half filled circle indicates a partially destroyed ashmound. Note that only 2 relatively complete ashmounds remain out of a minimum of 7 original ashmounds in the area.

North of these three hills is the large Hiregudda (Kupgal Hill, or "Peacock Hill" of Foote 1887), through which run a number of dolerite dykes (see figure 2). As will be discussed below, evidence for the utilization of some of these dykes for the manufacture of flaked and groundstone axes is extensive. This groundstone axe industry is associated with an area that includes some thick, dense occupational evidence (Area A), located on a natural plateau on the south side of this hill towards it highest eastern peak. In addition, one of the most visible dolerite dykes, which runs in a northwest-southeast direction through the length of Hiregudda and extrudes from the surface for much of this distance, is covered in rock bruisings, especially on its upper reaches (see figures 2 and 4). These are of various styles and probably represent numerous periods, although a focus on bull motifs suggests links of some at least to the Neolithic period (Boivin 2004b). Rock gongs are also found here and at several other localities on the hill (ibid.). On the eastern side of the hill, towards its northern face, is the Kupgal ashmound site, located directly south of Sirivaram village (Mujumdar and Rajaguru 1966). On the south and eastern slopes of Hiregudda, numerous terrace-like features built in stone have also been noted. These have previously been interpreted by us as seasonal occupation localities (see Fuller 2001; Fuller et al. 2001; Korisettar et al. 2001b) due to the association of quernstones and their proximity to the ashmounds.

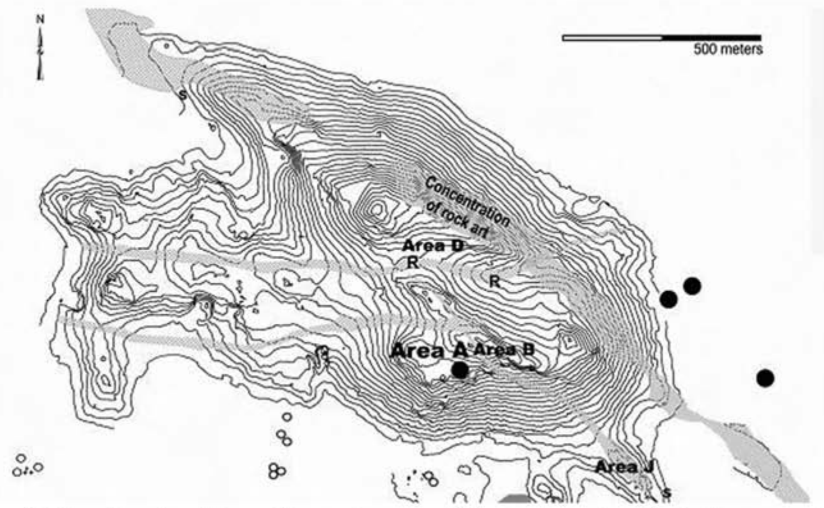

Figure 2 Map showing Hiregudda, and some of the main archaeological areas noted. Grey shading indicates dolerite dykes. Area A is the richest archaeological locality on the hill, and contains abundant evidence for domestic occupation followed by specialised axe production. Area B includes evidence for stone walls, rock art production, dolerite quarrying, granite quern and chert tool production. Area D is a terraced area where several infant urn burials were exposed. Area J contains abundant evidence for Neolithic dolerite mining activity, including well-preserved quarry pits. Other features: S: spring; R: reservoir; large filled dots: ashmounds; small open dots: megalithic stone circles; plus (+) signs: cairns or dolmens.

Additional archaeology comes from the plains around the Sanganakallu-Kupgal hills. A little over a kilometre north of Hiregudda hill, and west of the village of Sirivaram lies a cluster of large granite boulders that enclose a rock shelter with prehistoric remains (Boivin et al. 2002). The locality serves as a shrine to the god Birappa, who is worshipped by a local pastoral community. The shelter and surrounding area are associated with a concentration of microlithic debris, and microlith-bearing deposits have been exposed by recent quarrying activity. Pictographs in red paint are found on the shelter walls, both inside and outside, and some appear to be of great antiquity. Other sites on the plain include a small cemetery of megalithic stone circle graves, located between the hills of Hiregudda and Choudammagudda. Other megaliths, alone or in small groups, are scattered elsewhere in the area.

As indicated, the archaeology of this region is currently under severe threat and undergoing continued attrition. It is therefore worth describing briefly the state of these sites as observed over recent years. On Sannarachamma hill, granite quarrying has taken place on all sides, and continues at selected locations (see figure 5). This has led to the removal or erosion of prehistoric deposits on the hill slopes and from the main hilltop settlement. A road has recently been carved into the hillside, allowing quarriers easy access to the top of the hill and speeding up destruction of the deeply stratified deposits on the plateau. Surface stone features, rock art, extensive grinding features and rock shelters bearing prehistoric remains have all been destroyed in recent years. Meanwhile, quarrying of Choudammagudda is taking place on an industrial scale, and is leading to the gradual removal of the entire hill (see figure 6). An ashmound on the hilltop has already been destroyed (figure 7), as have several rock art sites (figure 8), while erosion is affecting numerous deposits bearing cultural material. The largest hill, Hiregudda, has perhaps seen the most extensive destruction. Here, the entire hill is covered in quarry tracks and scars from the removal of boulders and granite bedrock. Culturally rich deposits spill down the hillside, and are crushed under the weight of passing vehicles. Lack of planning is leading to severe erosion, and erosion gullies cover the hillsides, particularly on the steep southern slopes of the hill. Due to the extensive nature of the quarrying being carried out on this large hill, there is hardly a site or cultural deposit that has not been disturbed and partially destroyed. The extensive prehistoric stone features (walls, structures and terrace-like features) that cover much of the hill have been severely impacted, while many cultural deposits have suffered from erosion. A prehistoric quarry site discovered at the southeast base of the hill has suffered from quarrying of the neighbouring granite, and deep sections preserving intact prehistoric mining features are likely to collapse within a short period.

Out on the plain, much of the damage to sites has occurred as a result of agricultural expansion (as also described in Paddayya 1996). Previous workers describe a complex of 3 ashmounds east of Hiregudda (these are known as the Kupgal ashmounds, due to their proximity to Hiregudda, or 'Kupgal Hill' as it is known in the earlier literature). In 1998, two of these ashmounds were extant, while a third had recently been destroyed by the development of a small road, quarrying and ploughing. Since that time, a second ashmound has been levelled and converted into a ploughed field (figure 9), and thus only one of the three Kupgal ashmounds remained extant as of 2004. This remaining ashmound has seen extensive damage due to apparent mining of its deposits, and only half or less of it remains. Its preservation even to this degree might be attributed to the presence on its summit of a shrine to Shiva, though during a 2004 visit this was recorded as severely damaged due to unknown causes (but possibly treasure hunting). It is worth noting that there appear to be habitation remains, perhaps ca. 50 cm thick, located west of the remaining ashmound (designated Ashmound 1 and excavated by Mujumdar and Rajaguru (1966)) and therefore towards the extinct Ashmound 3. A small remnant of an ashmound was also located on the north-east facing slope of Hiregudda hill, west of these ashmounds. In this same area are also located numerous artificial 'terraces' that are likely to represent some form of occupation rather than agricultural use.

Agricultural expansion has also destroyed many of the megaliths recorded by Subbarao on the surrounding plains (Subbarao 1948). We estimate that only 25% of the megaliths originally recorded in the Sanganakallu-Kupgal area still remain (see figure 10). It is quarrying, however that is to blame for the destruction of sites around the Birappa rockshelter to the north-east. These have led to the removal of numerous granite rock shelters, also apparently associated with microlithic debris and representing a different kind and/or period of occupation than seen in association with the hills themselves. The Birappa shelter itself has suffered from damage due to quarrying (see figure 11), which has destroyed rock art (see figure 12) and disturbed archaeological deposits. Use of the site appears to be a source of dispute between quarriers and the local community (Boivin 2004b).

Investigations at Sannarachamma

Sannarachamma is the classic hilltop site excavated by Deccan College (Subbarao 1948; Ansari and Nagaraja Rao 1969). While referred to in some archaeological reports as Sanganakallu (after the neighbouring village), the hill is known locally as Sannarachamma-gudda. The site is located on the level summit of a castellated peak of archaean granite, rising some 50 metres above the surrounding plain. On the north slope of the hill, below the site, is a natural water reservoir contained by granite. The water is captured rain water and seepage in an eroded vein of dolerite between blocks of granite, and probably served as a perennial water source. There was at one time a spring arising from the neighbouring peak to the east, Murkalgudda (Mujmudar and Rajaguru 1966) although it is no longer apparent due to development and quarrying.

Renewed work at Sannarachamma has primarily involved the excavation of small test trenches in combination with section cleaning and the opening up of some of the earlier trenches of Subbarao and of Ansari and Nagaraja Rao in order to correlate stratigraphic findings and undertake more detailed stratigraphic recording. This work has focused mainly on the centre area of the site, where the most deeply stratified deposits appear to be located. As at all sites excavated by the project at Sanganakallu-Kupgal, all sediment, whether from primary or earlier trench fill contexts, was sieved, and all artefacts recorded. Sediment samples were collected for flotation, and for phytolith, bulk soil and soil micromorphological analyses. Radiocarbon samples were taken from charcoal and flotation samples.

A preliminary set of dates is now available from Sannarachamma (see Table 1), indicating occupation from the Neolithic through to Iron Age periods. One of the main findings of our renewed investigations has been the discovery of a buried ashmound. Although an ashy 'layer' was reported by Ansari and Nagaraja Rao at Sannarachamma, its significance was not clearly recognised by these researchers. The so-called ash 'layer' is interpreted in their report variously as the burnt debris of a structure of some sort (Ansari & Nagaraja Rao 1969: 6), or 'possibly' an ashmound (ibid.: 14). What is not apparent in the report is the extensive nature of the ash deposits, and their importance for understanding Neolithic occupation at the site. These deposits are thickest towards the centre of the plateau, becoming gradually thinner as one moves towards the periphery. While the exact size and shape of the deposits remains to be determined, it is clear that they form a mounded deposit. The character of the layers making up the deposit closely resembles that from other known ashmounds, although vitrified layers are absent. Preliminary dates situate the ashmound between 1900 and 1750 BC. It is now clear that some of the earliest Neolithic activities at Sannarachamma involved the creation of an ashmound in the centre of the hilltop plateau. This new finding indicates the importance of returning to sites excavated many decades previous, when understanding of Southern Neolithic societies was only just developing, and many of today's scientific methods were unavailable.

There is also evidence to suggest that the ashmound was surrounded by some sort of post-trench feature, which was subsequently burnt, creating a charcoal-rich deposit. Prehistoric erosion of this deposit and the ashmound itself is in evidence in the form of size-sorted ashy and charcoal-rich deposits in the outer ashmound area. While evidence for structures is apparent in the form of post-holes and stone walls, the relationship between the growing ashmound and this habitation activity is presently unclear. Clarifying this would require large-scale excavations rather than the limited test-trenching and reanalysis of earlier trenches (re-exposed by modern day quarrying of soil by local villagers and scraping by us) that we have undertaken so far. It is, however, clear that much of the evidence for habitation post-dates the ashmound, and indicates occupation of the site into the Megalithic period. Many post-ashmound stone courses were encountered during the renewed investigations. In addition, later occupation is also characterised by multiple round and flat-bottomed pits that feature multiple white organic linings. These are concentrated in particular on the ashmound itself, and appear to represent some sort of storage activity, perhaps in cow dung-lined pits.

The initiation of investigations on Hiregudda

The Sanganakallu-Kupgal Project has also carried out the first-ever systematic investigations at Hiregudda, the largest of the cluster of hills at Sanganakallu-Kupgal. While the hill is described as an important Neolithic site in some of the earliest reports on the archaeology of the area (for example, Foote 1916: 82), its significance has generally been overlooked by subsequent workers, who have focused excavation efforts on the Sannarachamma and Kupgal ashmound sites. Our investigations suggest that Hiregudda is probably the most important zone of interest within the Sanganakallu-Kupgal area, and crucial to understanding the prehistoric developments that took place here. Surface finds and exposed sections across the hill indicate that it played an important role as a dolerite axe production site. Indeed, Foote described it in the early 1900s as "the largest neolithic manufacturing industry as yet met with in any part of India" (Foote 1916: 82), and there is little to suggest that his assessment would be any different today.

As indicated, our survey efforts have shown that a plateau on the southern side of the southern peak of Hiregudda is home to some of its richest archaeological remains. This area has been catalogued as Area A, and it is characterised by a dense surface scatter of dolerite lithic debitage. Recent mining and quarrying activity have greatly disturbed the area, leading to the exposure of many sections that reveal, along with deposits of lithic material, grey habitation deposits and cultural material. Numerous stone features and walls can be seen on the surface, including the terrace-like features seen elsewhere. As Foote does not comment on the area in his detailed 1916 report, it seems likely that he either did not visit it, or that it was overgrown and hence not accessible, or perhaps visible, in the late 19th century (when vegetation seems to have been more abundant on the hill, though Foote's description makes it clear that its removal was already underway then (Foote 1916). Certainly modern mining and quarrying have made the deposits much more apparent, and exposed material that up until now has remained below the surface.

Most of our work in Area A has focused on the recording and sampling of sections exposed by a large (approximately 20m x 15m) pit excavated into the plateau for the removal of commercially useful archaeological deposits (figure 13). This modern pit has exposed archaeological deposits over a wide area of the site. These deposits reveal two main stages of prehistoric activity at the site. The lower deposits are grey and silty, and contain abundant ceramic, bone and lithic remains, indicating a habitation phase. Above this, however, the deposits become brown and richer in clay, and contain primarily dolerite artefacts. They appear to indicate use of the site primarily for the production of edge-ground axes. Preliminary dates (see Table 2) indicate that this intensive axe-production phase took place in the late Neolithic and/or early Megalithic, from 1400–1250 BC. The main part of the earlier habitation phase dates from 1700 BC to 1500 BC, after which there may have been an abandonment of up to a century prior to the axe production phase.

Of substantial interest is the fact that at this site as well, there is evidence for an ashmound. It is these ashmound deposits that appear to have been targeted by the miners who created the large pit where we have focused our investigations. While most of these deposits have thus been removed, remnant ashmound deposits were found during section cleanings and test-trenching (these had also been noted in previous studies; see Layer 7 in section HGD.98A in Korisettar et al. 2001b). Their location at the base of section profiles would seem to indicate that the ashmound was an early feature of the site, as at Sannarachamma. The ashmound appears to have been located on the southeastern part of the plateau, overtop of a rock shelter that may have delivered gusts of air up to the dung fires above. The ashmound in Area A at Hiregudda appears to have a similar chronology to that at Sannarachamma (it relates to the earliest part of the occupation in Area A, and dates to ca. 1700 BC or earlier), suggesting that they may represent synchronous developments.

Investigations in Area A have also focused on a stone circle visible on the surface, just to the north of the modern mining pit (see figure 14). The circle, described as Feature 1, is approximately 7 metres in diameter, and is made up of boulders 0.2–1 metre in size. It is associated with a particularly dense surface scatter of dolerite debitage. Given the threat of destruction faced by this well-preserved feature, it was decided that total excavation should be carried out. The feature was thus excavated to bedrock, though baulks were left through the middle to preserve a stratigraphic record of its deposits. These divided the circle into quadrants, and enabled spatial analysis of artefactual and bioarchaeological material. Archaeological deposits and artefactual remains have indicated that the structure originally served as a habitation enclosure (at least part of the structure appears to have been roofed, as indicated by preserved post-holes in the northeast quadrant). During this period, which spanned 1750 to 1500 BC or later, axe production was carried out, but other types of lithic tools were also produced. Densities of lithic working debris were significantly lower than in the later phase of use. After 1500 BC, it is possible that the structure was abandoned, as there is a gap of a century or more between the radiocarbon dates in adjacent layers. This proposed hiatus needs to be tested further through dating of additional samples. Then the structure was re-occupied, and was used as an axe production workshop. As already indicated, this intensive axe production phase dates between 1400 and 1250 BC. In later deposits, axe production debitage overwhelmingly dominates the lithic assemblage, while evidence for the more varied types of stone tools used in more domestic contexts is absent (see Brumm et al. forthcoming, for details).

Investigations in other areas of Hiregudda have also provided evidence for axe production. Several dolerite quarry localities, in Areas B (Upper Quarry) and J (Lower

Quarry) were discovered along a non-extruding dolerite dyke. This dyke contains fine-grained dolerite that appears to have been targeted by Neolithic axe-makers. Fracture patterns in the dyke appear to have in some cases created stone slabs ideal for axe production purposes. Limited test trenching of the Upper Quarry and investigations at the Lower Quarry suggest that while preliminary reduction was carried out at the quarry sites, axe blanks were subsequently transferred to localities like that investigated in Area A for further reduction and grinding. Exposure of a section of dolerite several hundred meters in length at the Lower Quarry as a result of modern granite quarrying activities revealed prehistoric mining pits along the entire length. These were in-filled with quarry spoil as well as occasional hammerstones and lithic debitage. The dyke therefore appears to have been the focus of intensive dolerite quarrying efforts, and much of this activity may be hypothesised to date to the Late Neolithic/early Megalithic period, when intensive more specialised axe production was taking place at the site. Also found at the Upper Quarry site as well as various other localities at Hiregudda was evidence for prehistoric quern production from local granite outcrops. A human skeleton exposed by recent quarry blasting was also discovered in Area B, in association with the quarry site. Excavation was carried out to rescue the remains, which were eroding out of the hillslope. Preliminary assessment suggests the burial dates to the later prehistoric or possibly historic period. It consisted only of the remains of an adolescent female unaccompanied by burial goods.

Other investigations at Sanganakallu-Kupgal

Other work at Sanganakallu focused on systematically recording rock art, ringing rocks and grinding grooves. Grinding grooves are ubiquitous at Southern Neolithic sites, and are found on bedrock and boulders on all the Sanganakallu-Kupgal hills, but particularly those associated with more intensive prehistoric habitations. Many new rock art sites were located, in addition to several new ringing rock sites. All of the ringing rocks discovered so far have been found at Hiregudda, and the majority occur on dolerite. Two large banana-shaped ringing rocks were discovered in association with a stone circle in Area D of Hiregudda. These appear to have been carried down from the nearby dolerite dyke, and were found symmetrically situated on the periphery of the circle.

Area D appears to have functioned as an area of non-intensive occupation in the later Neolithic and/or early Megalithic period. Section scraping and associated test-trenching in an area disturbed by modern quarrying revealed several late Neolithic infant urn burials in Area D. Stone features investigated here and elsewhere suggest that terrace-like features date to the Neolithic, and had a primarily habitation-related function. They seem to relate to stone-clearing activities and the creation of enclosed habitation and/or animal stabling areas. Many of the stone features occur on bedrock, and seem to have led to the gradual build-up of sedimentary deposits that has led to the appearance of a system of terraces. However it should be emphasised that investigations to date have been limited, and an agricultural function for some or all of the terraces cannot presently be ruled out. One possibility that should be borne in mind is the re-use of the terrace features at a later date, once sediment had accumulated, for agricultural purposes.

Limited test trenching was also carried out at the Birappa rockshelter on the plain to the north of Hiregudda. This work indicates that the shelter primarily functioned as a locality for the production of microlithic blades from locally-obtained quartz pebbles. This type of production can be traced back to a pre-ceramic period, and may have continued into the historical period. Charcoal samples collected during flotation of sediments from the site were radiocarbon dated, and some gave pre-Neolithic dates (see Table 3). Unfortunately, these dates do not arrange into an appropriate stratigraphical order. This is perhaps not surprising in light of the small size of the charcoal recovered during flotation (fragments were all under 2 mm in diameter), and the overall thinness of the deposits at the site. Movement of small charcoal fragments is likely to have been affected by the local bioturbation processes revealed during excavation. Nevertheless, the early dates must relate to human activities, which included fires at the site as early as 9000 BC, with occupational episodes also indicated for ca. 4300 BC and ca. 3500 BC. In combination with the absence of ceramics in the early levels of the site, the early dates suggest initial occupation of the site and associated quartz reduction activities date to the early and mid Holocene. This fits with the notion of a pre-ceramic Mesolithic occupation proposed by Sankalia on the basis of excavations at a similar microlithic-rich locality in the area (Sankalia 1969), and finds its parallel in a pre-ceramic, quartz flake-dominated industry in the lowermost granite gruss horizon at Sannarachamma (see also Subbarao 1948). Later dates from Birappa suggest sporadic later activities at the site, in the late Neolithic/early Megalithic (1400–1200 BC) and early historic periods. This is not surprising given the evidence for continued activity at the rock shelter associated with its use as a local shrine (see Boivin 2004b).

The animal bones

Preliminary analysis of the animal bones from Sanganakallu-Kupgal suggests the presence of a range of species, both wild and domestic, in keeping with findings at other Southern Neolithic sites (Korisettar et al. 2001a,b; Paddayya et al. 1995). Cattle, along with sheep and goat, dominate the domestic assemblages from all sites in the Sanganakallu-Kupgal area. Interestingly, however, sheep and goat appear to be more common than cattle in domestic contexts, and cattle bones bore a smaller percentage of cut marks and cooking burns than the bones of sheep/goat. This suggests that contrary to the assumptions of previous workers (Paddayya 1975; Thomas & Joglekar 1994; Korisettar et al. 2001a: 191), cattle did not form the mainstay of the everyday diet during the Neolithic. While the large quantity of cattle bone, combined with the quantity of accumulated dung attested in the ashmounds provides clear evidence for the importance of cattle pastoralism during the Southern Neolithic, the results from contextual animal bone studies at Sanganakallu-Kupgal suggest that this may have had an important symbolic and prestige component. Indeed, the creation of virtual 'monuments' out of cattle dung (Boivin 2004a; Boivin et al. 2002; Johansen 2004), the deliberate burial of cattle skulls and bones (Paddayya et al. 1995), and the focus on cattle motifs in Southern Neolithic rock art (Allchin & Allchin 1994–95; Boivin 2004a) suggest a symbolic or social emphasis on cattle that is very much in agreement with these archaeozoological findings. Certainly this would not conflict with ethnographic observations of present-day cattle pastoralists, who often reserve the killing and eating of cattle for important ceremonies and rituals (for example, see Evans-Pritchard 1940). It may be that cattle-eating was something reserved for special occasions, such as the feasts that appear to be attested at sites like Budihal (Paddayya et al. 1995). Cattle were likely prized animals whose economic and social value extended well beyond their nutrient value, and they may well have been traded between Neolithic groups, perhaps at the social gatherings that have often been inferred to have occurred at ashmound sites (Allchin 1963; Boivin 2004a; Fuller 2001).

The faunal analysis has also indicated interesting differences between bones from different sites and also different contexts at Sanganakallu-Kupgal. Cattle (and cattle-sized) remains were significantly less common at the Birappa rockshelter than the other sites, suggesting, in concert with other evidence, a different use of the site. Cattle bones appear to be in highest proportion at Sannarachamma, and this seems to be due to their dominance in ashmound deposits. Analysis of ashmound deposits from Sannarachamma indicates that they contain more bones from cattle and cattle-sized animals than do other kinds of contexts. In addition, the range of species represented in ashmound deposits appears from preliminary analysis to be lower than other contexts. This suggests that ashmounds were not generalised garbage dumps, and that they may indeed have been associated with very particular kinds of depositional activity. It is also of interest that bones from ashmounds tend not to bear cutmarks, and the small percentage that do are predominantly from sheep-sized animals. Bones found in ashmound layers also, surprisingly, do not usually exhibit signs of burning. When burning evidence is found, it appears to result from cooking, rather than intense or prolonged exposure to high temperature burning. This is of significant interest in terms of ashmound formation processes, since it suggests either very low temperature burning (a possibility at Sannarachamma, where no vitrified deposits were encountered), or mixing of the bone with the ash only after burning. This might indicate redeposition of ash deposits from the context of burning, though the stratigraphy does not seem to support such an interpretation.

The struck lithics

The lithic assemblage from Sanganakallu-Kupgal is representative of what is generally known of the Southern Neolithic (Korisettar et al. 2001a: 175–79), although detailed technological studies have been few. There are two major and quite distinct components of lithic production. First there is a struck lithic industry on crypto-crystalline rocks, including cherts and quartz (comparable to that studied from Watgal by DuFresne et al. 1998). This first component can be studied to assess continuities and differences from earlier "Mesolithic" traditions in the region. Second, there is the characteristic "Neolithic" component, consisting of a groundstone industry, in particular of axes and related forms made of dolerite (for a previous study of this region's groundstone industry, see Allchin 1957). The former is more abundant at Sannarachamma hill and the latter at Hiregudda, particularly in the upper layers.

The struck lithic industry is based on a microlithic technology with a bladelet end-product modified by lateral retouch into geometric tools, principally lunates and backed bladelets. The main raw material in the upper levels at Sannarachamma is a micro- to crypto-crystalline silica broadly classified as chert. The chert is principally light brown in colour although some darker red chert is also present. Many flakes and blades are red chert at one end and brown chert at the other, suggesting that the source for the red and brown cherts is the same. Chalcedony with an orange cortex is also present in smaller quantities, along with white/milky white quartz and rock crystal. A few cores have been recovered from the site, indicating that the manufacture of bladelets probably took place at the site, at least in the latest phase of occupation. The bladelets are extremely thin and narrow suggesting that the pressure debitage technique was used in the final stage of production. Given that copper is limited in the Southern Neolithic, the likely indentor was either antler or horn, both of which would have been available from wild and domesticated fauna. Cortical flakes are rare, suggesting that cores or nodules were imported, perhaps having been roughed out at source. Broken bladelets and tools seem to be of a consistent size and may therefore have been deliberately snapped in preparation for retouching or hafting.

In addition to the chert bladelet industry, a number of quartz flakes were recovered throughout the occupation levels, but particularly from the earliest phase of occupation at Sannarachamma. No chert artefacts were recovered from this early deposit, and quartz artefacts were numerous. The distribution of these raw material types is striking when quantified stratigraphically (see figure 15). The quartz industry is flake-based, although there are a few bladelets, some of which have been modified into lunates. Thus it appears that quartz was used initially as a raw material for the lithic industry, to be replaced by chert. Previously it was thought that there were no major local chert sources, and that the chert raw materials in this region were imported from areas to the north such as the Raichur and Shorapur Doab (Korisettar et al. 2001a: 177; Fuller 1999). Recent reconnaissance, however, indicates the presence of local chert deposits in the banded iron formations of the Sandur greenstone belt, which are significantly closer. Interestingly, this transition from quartz to chert sources appears to occur with the depositional transitional from ashmound deposits to "normal" occupational deposits.

The flaked and ground dolerite industry

Hiregudda, with its abundant dolerite, was a location for the intensive production of dolerite tools, at least some of which were finely finished as ground and polished axes. Foote (1916) has already identified this site as a "factory" for axe production, and its importance as a centre for production was further discussed by Allchin (1957) and reviewed in Korisettar et al. (2001a). Axe production, as indicated above, appears to have focused on specific localities on Hiregudda, and a large workshop area has been identified in Area A. As indicated, there is some evidence also for spatial segregation of axe production steps, with initial roughing out taking place at quarry sites prior to further shaping in Area A. While some grinding of axes was carried out in Area A, other larger-scale axe grinding localities have been found away from the area, and particularly at the base of Sannarachamma hill. Other axes may have been ground much further afield, if Hiregudda axes were being traded to neighbouring and other groups, as has been hypothesised (see below).

Analysis of the reduction strategies employed in Area A suggests that three main methods of axe production were used by knappers at Hiregudda (for a detailed discussion, see Brumm et al. forthcoming). These vary in terms of technological complexity and the size and shape of the clasts they were directed at. It is of interest that contextual analysis of the lithics debitage indicates that the most technologically-demanding axe reduction strategy is employed predominantly during the final phase of occupation of Area A. This strategy demanded large clast sizes that would certainly have involved more intensive quarrying of the dolerite at Hiregudda. This, along with evidence from Feature 1 in Area A (discussed above) suggests a shift from more domestic-oriented to specialised axe production, possibly within the context of a developing axe trade. Trade of axes is hypothesised on the basis of the evidence for a shift towards more intensive, specialised axe production in Area A during the final phase of occupation of the site. This would fit with a picture of intensified overall trade activity, as indicated for example by the gradual increase in copper finds in upper levels at Hiregudda. Axes may have been implicated in broader trade networks that encouraged craft specialisation and the eventual emergence of elites at the tail end of the Neolithic or early Megalithic period. In this regard, it is of interest that the site of Budihal bears evidence of axe-grinding but no associated axe production industry (Paddayya 2000–01: 198). Axes from sites rich in high quality dolerite, like Hiregudda, may have circulated to areas lacking appropriate material, and the final intensive grinding of such axes may well have taken place at other sites.

Towards an improved understanding of the ceramics

Some 2000 kg of pottery have been collected during the course of work carried out by the Sanganakallu-Kupgal Project (much of it from the collapsed trench fill of previous excavations, which was thoroughly sieved), and analysis of this material is ongoing. A few salient conclusions and key aspects of variation will be highlighted here. First of all, it is clear that 'Neolithic' ceramic types, handmade and often burnished, persist throughout the history of these sites, while 'Megalithic' types, characterized by being wheelmade, often slipped, and sometimes polished, begin to occur in later levels. These observations confirm those of Devaraj et al. (1995) that Megalithic ceramics emerged during the Late Neolithic, and represent technological developments upon the Neolithic potting tradition, perhaps to be associated with the emergence of more specialized production. In general, this transition appears to date to ca. 1400–1300 BC. A very small number of wheelmade sherds were found in earlier contexts, but might prove to be intrusive.

The ceramics from Sannarachamma and Hiregudda are similar and can be related to Ashmound Tradition Phase III and the Neolithic/Megalithic transition. As evidenced at Sannarachamma in particular, there was an increase over time in slipped or washed types over simple burnished types. In addition, later Neolithic forms often have a 'crackly' surface, because the coating contracted at a different rate than the body clay of the vessels, a trait of the later Neolithic ceramics noted by Allchin (1960). Forms are predominantly open bowls and open-mouthed jars with everted rims, but a smaller number of other forms are also present, most of which are associated with the later Neolithic, especially Phase III, such as spouted forms, perforated bowls, and jars with necks and narrower mouths. Variants of most of these forms (with the exception of perforated bowls) are transferred to wheel production in the Neolithic/Megalithic transition phase. Painted sherds and sherds decorated with incised/impressed designs were rare.

Of particular interest is the wide range of fabrics represented amongst the present material. By fabric, we mean the characteristics of body paste, in terms of colour and texture, as well as non-plastic mineral inclusion types that are visible under low magnification (e.g. x10) on sherd sections freshly fractured after retrieval. Although only a preliminary study of small fraction of the assemblages has been completed, it is clear that the Neolithic assemblage from these sites contains a remarkably wide range of fabrics. Eleven recurrent fabrics for handmade forms were identified, most including various frequencies of quartz (or sand), mica and fine black mineral inclusions. Some fabrics also included calcareous opaque white inclusions, although these were uncommon. This can be contrasted with recent examinations of Kurnool District Neolithic pottery (unpublished data), where mica is largely absent, and both calcareous inclusions and grey and brown limestone fragments are frequent. These broad regional differences are clearly attributable to underlying geology, and it seems possible to infer that distinctions within assemblages are also due to variation between clay sources. While all of the above inclusions may occur naturally in gathered clays (although addition of quartz sand seems likely for certain fabrics), some fabrics included grog-temper, which derived from crushed particles of other pottery.

What the fabric variation suggests is that superficially similar pots were produced from a range of sources, probably by various Neolithic communities, and then exchanged between these communities over short distances. Interestingly, the labour-intensive practice of burnishing these ceramics suggests that most or all potters sought to obtain shiny surface finishes (while roughened and unburnished pottery may have been produced to meet particular functional requirements). The exchange of superficially similar, carefully produced pottery across sites, such that a set range of shapes but wide diversity of fabrics may be found at any particular Neolithic site, suggests the operation of social exchange networks, such as through kinship, in which importance was invested in the act of exchange rather than the commodity per se. This pattern can be contrasted with the more specialised production patterns of later periods, when fabric varieties decrease, as with the polished, wheelmade black-and-red ware ceramics of the Megalithic period.

Also of note are aspects of ceramic preservation that can be related to the nature of site occupation. For example, sherds from the surface and upper layers at Hiregudda Area A were heavily abraded and surface layers were often largely worn off. Similarly abraded sherds were noted in the lowest gruss deposits at both Hiregudda A and Sannarachamma. It is seems likely that the abrasion is due to exposure, presumably from being left on exposed hilltop surfaces during periods without substantial sediment build-up and occupation. The abraded sherds at Hiregudda A might therefore be related to a hiatus in occupation, tentatively placed at 1500–1400 BC, as well as perhaps sporadic or seasonal use for specialized axe production. At Sannarachamma, in contrast, where there is no apparent hiatus, abraded sherds are by and large absent. The few abraded sherds in the lowermost gruss-sand deposits might relate to an earlier, more mobile phase of the Neolithic.

Also of interest amongst the ceramic material were finds of edge-ground potsherds. While edge-ground sherds, sometimes in recurrent shapes, were found throughout the deposits, perforated and rounded edge-ground sherds that can be considered spindle whorls are only know from the later levels of both sites. This suggests that the spinning of fibres for textile production was a development that occurred sometime during Ashmound Phase III and probably intensified towards the Megalithic transition, in the later half of the second millennium BC.

Agricultural and environmental evidence

Archaeobotanical samples were collected through flotation from nearly all contexts and from all investigated localities, trenches and phases. Samples were processed using simple bucket flotation, in particular the wash-over method. This consisted of adding filtered water to the sediment in a bucket, mixing it, and then pouring it into a 500 micron sieve bag to collect the flot. Once all the flot had been collected, the heavy fraction left in the bucket was passed through a 2 millimetre sieve to retrieve any artefacts and heavy environmental remains. In total, about 350 flotation samples have been collected, accounting for the processing of nearly 5500 litres of sediment.

The current work augments earlier research conclusions regarding Southern Neolithic agriculture (Fuller 1999; Fuller et al. 2000–01, 2001, 2004; Korisettar 2004). In particular, four key conclusions of this earlier work appear to be confirmed by the Sanganakallu-Kupgal evidence available at present: 1) the predominant crops throughout these sites are the 'basic Neolithic package' of south India, consisting of Browntop millet (*Brachiaria ramosa*), bristly foxtail (*Setaria verticillata*), mungbean (*Vigna radiata*) and horsegram (*Macrotyloma uniflorum*); 2) although all of these species are wild in parts of peninsular India (Fuller 2002; Fuller and Korisettar 2004), there is no evidence for their domestication in the Ashmound Tradition region, including Bellary District, and all sites sampled so far preserve evidence for established cultivation rather than the transition from foraging; 3) winter cereals of Near Eastern origin (wheat and barley) were present by the early second millennium BC, and from the beginning of Neolithic occupation at Sannarachamma, and these species must have been adopted from the north via the earlier Deccan Chalcolithic; and 4) crops of African origin are still fairly insignificant in the Southern Neolithic, but begin to be adopted in the region ca. 1500 BC, especially the hyacinth bean (*Lablab purpureus*). At Sannarachamma, hyacinth bean is prominent in the levels which include wheelmade 'Megalithic' pottery.

Previously, a simplified settlement-scheduling model was proposed (Fuller et al. 2001; Fuller 1999, 2001), and this requires testing and refinement. This model was based on inferred patterns of cultivation, as well as general differences between sites in terms of their types of deposits. It was also hypothesized that this pattern was reflected in the distribution of grinding stone (quern and mortar) features across the landscape and amongst sites. The seasonality of the major recurrent crops is monsoonal, with sowing in perhaps late June or July, and harvesting between late September and early November. Wheat and barley, by contrast are post-monsoonal, being sown in November or December, with harvest in March or April. During the monsoon agricultural season, we therefore expect the population of the Sanganakallu-Kupgal sites to have been at its peak, as it was at this time of the year that the staple foods were produced. Wheat and barley, in contrast, may have been grown on a smaller scale by a subset of the community, though they would have required tending and probably also labour-intensive irrigation. The presence of dry season gathered fruits, and possibly tubers, which might also be dry season harvested, might also indicate that at least some portion of the population lived at the sites year-round. It is during these drier months, from November onwards, when ceramics must also have been produced.

Nonetheless, some of the regional population must have moved to other ashmound sites at points during the year, and it has been suggested that this is most likely to have occurred during the dry season, when water stress would have been most extreme, and imposed limitations on the support of grazing herds (as already suggested by Allchin 1963). Thus isolated ashmounds, like Kudatini, Toranagallu, Sanavaspur (west of Bellary, south of Kurugodu) or Halakundi (south of Bellary) were suggested to be festival or ritual sites for the gathering of a transhumant populace during the dry season, broadly running from January through June, but perhaps focusing on April–May. Archaeological evidence in support of this scenario includes the absence at ashmound sites of the deeper grinding impressions with rounder profiles that are a recurrent feature of more permanent hilltop village sites, like Sannarachamma and Hiregudda, and are likely to have functioned in grain dehusking. In contrast, flatter-profile quernstones and grinding impressions associated with flour preparation and final food preparation are found at ashmound sites as well (Fuller et al. 2001). The implication is that everyone was consuming ground seed foods, but certain stages of the processing were being carried out only near those sites where cultivation was practiced, namely the hilltop sites.

It should be noted that all of the above work has focused on the identification of food plants through seed remains. The bulk of all the samples, however, consists of wood charcoal, which represents the remains of the routine wood fuels utilized on these sites during the Neolithic. This in turn relates to wood availability, and to a lesser extent wood choice, and thus provides an indication of the surrounding wild vegetation and its exploitation by people tied directly to the archaeological time scale. One of the major foci of current and planned archaeobotanical research is the examination of this wood. This has required carrying out a substantial degree of basic background botany, which is will be addressed in a forthcoming publication (Asouti and Fuller, in press). Wood charcoal evidence so far confirms that the Bellary area was already a semi-arid dry scrub savannah by the Neolithic period, with woody vegetation dominated by spiny *Acacia* species and the non-thorny *Albizia*. This is in general agreement with climate-based reconstruction of the broad vegetation zones of Neolithic south India (Fuller 1999: Ch. 4; Fuller and Korisettar 2004; Asouti and Fuller, in press).

A few additional species have been identified, especially from the upper Neolithic/ Megalithic transition layers at Sannarachamma, that indicate the exploitation of other ecological zones. These include *Strychnos nux-vomica,* a poisonous wood of dry deciduous woodlands that is ethnographically known to be used for magical and medicinal uses, and sandalwood (*Sanatalum album*), a plant with well-known cosmetic and incense uses. Recovered charcoal has also led to the identification of fruits of Bengal madder (*Rubia cordifolia*), a small vine of moist deciduous forests (which would have been situated near the Western Ghats), which has roots that are traditionally used as a reddish dyestuff for cotton. This is of particular interest in light of finds of probable spindle whorls in these upper levels, suggesting some local production of textiles beginning in Neolithic Phase III.

Geological and hydrological perspectives

The geology of the region surrounding the Sanganakallu-Kupgal area can be broadly divided into two types: the Archaean granite batholiths and the greenstone belts. These two rock formations have generally controlled the evolution of geomorphological features in the region, and analysis of the distribution and location of Neolithic and later prehistoric sites with respect to their distribution reveals an interesting pattern. While later sites occur on both types of formation, the majority of Neolithic sites are associated with the granite batholithic landscapes. The association of ashmounds with the greenstone belts – as at the site of Kudatini – is also rare. All other known ashmounds are situated either atop the granitic hills or at their bases. Subbarao's map showing the location of Neolithic sites in the Bellary District (Subbarao 1948) clearly reveals that the sites cluster on the granitic landscapes, and also show a preference for hilltops traversed by the dolerite dykes.

This distribution pattern can in part be attributed to hydrology. It is likely that the water table in the Mid–Late Holocene was higher, and reached the surface where intruding dolerite dykes served as a barrier, giving rise to springs. Hence numerous springs were active on the inselbergs, more or less perennially, and facilitated the formation of surface water ponds and pools that dotted the pediment landscape. Such a network of environmental features facilitated agro-pastoral adaptations, and provides a context for understanding Neolithic developments at Sanganakallu-Kupgal. In addition, numerous patches of black brown soils on the plains around the Sanganakallu-Kupgal hills, some of them very shallow in depth, attest to the former presence of shallow water localities, while the deeper black soils are generally associated with greenstone bedrock. The latter are rich in clays and were primarily suitable for pottery manufacture.

The varieties of stone utilized by the prehistoric inhabitants of the Sanganakallu-Kupgal area include granite, epidote granite, greenstone, quartz, siliceous breccia, hornblende schist, steatite, slate purple, quartzite, hematite jasper, hematite schist, agate, carnelian, chert and local clays. The use of these varieties of rocks was also noted by Foote (1895). Our study is now attempting to clarify the sources of these various mineral resources. While granite, epidote granite, gneiss, and quartz can be sourced to the immediate neighbourhood of the sites, other types of stone appear to have been obtained from greenstone formations in the Sandur greenstone belt. This belt lies to the west of the Sanganakallu-Kupgal site complex, which is just one of a series of Neolithic sites located at a radial distance of 10–15 km from the belt.

The Sandur greenstone belt is best known today for its iron ore and manganese deposits, but it also contains a significant repository of volcanic clastics, metamorphosed sedimentary, and crypto-crystalline silica minerals like jasper, agate, and chert. The belt is composed of six different formations. The Deogiri Formation contains orthoquatzites, limestone and chert, while the Raman Mala Formation possesses banded ferruginous cherts (including banded iron formations). The banded ferruginous chert formations are host to deposits of secondary haematite. The Donimalai Formation is chiefly composed of volcanic and sedimentary rocks, and banded chert formations are common, ranging in thickness from 1–100 m. These include hematite-enriched types, magnetite, jasper, and pyrite-rich cherts, and non-ferruginous cherts, orthoquartzites and phyllite are also common. The Talur Formation is largely made up of metabasalts, though intercalations of banded chert, siliceous chloritic schist, and rhyolitic tuff are also common. The Vibhutigudda Formation, the youngest formation, includes all the above-mentioned silica types.

Conclusion

The Sanganakallu-Kupgal area is one of the richest and most significant prehistoric localities in India. While archaeological studies have previously been carried out in the area, most were conducted prior to the development of scientific studies in archaeology, and have focused only on very specific localities within a much wider and more diverse landscape of prehistoric remains. The current destruction of sites in the region therefore demands an urgent response such as that which has been mounted by the Sanganakallu-Kupgal Project. This project has focused on the creation of the first detailed map of topographic, geological, hydrological and archaeological features in the region, in association with the analysis of sections exposed by modern activities, and limited rescue excavation at sites that are shortly to be destroyed. It has revealed the existence of previously unknown ashmounds on the area's hills, and demonstrated the importance of Hiregudda as a major centre for groundstone axe production in the late Neolithic period. The project has also generated a series of new radiocarbon dates that are enabling the Southern Neolithic to be placed in a firm chronological framework.

The preliminary findings of the Sanganakallu-Kupgal Project suggest that the Neolithic in the southern Deccan was associated with a number of key economic, social and ritual changes. These included changes in craft production patterns, associated with the gradual emergence of craft specialists in such areas as ceramic and stone axe production. Widening trade networks are suggested by the increase in exotic copper objects over the course of the Neolithic sequences at Sanganakallu-Kupgal, as well as the introduction of foreign crops and plants. During the late Neolithic, the introduction of spindle whorls in association with the first finds of cotton (from Hallur) and fabric dying plants suggest the emergence of textile production. The replacement of ashmounds with megaliths as the primary monuments in the landscape at the tail end of the Neolithic signals wider ritual and cosmological changes. These various transformations were likely intimately related to the subsequent development of elite groups, regional polities and wider oceanic trade networks at the beginning of the Iron Age. Our project findings allow these crucial developments to be traced back earlier than ever before, demonstrating that they find their origins in changes that took place amongst the earliest agricultural societies in the south.

It is hoped that the Sanganakallu-Kupgal project may serve as a model for the development of strategies for cultural resource management in areas of India where accelerated development projects are occurring. Such a model would see the detailed recording of sites attended by the application of scientific studies and the investigation of a particular set of research questions and issues. It is also hoped that the project will raise awareness of the need to address site destruction by quarrying and mining activity. Rescue strategies in India have been directed predominantly towards sites that are to be submerged as a result of dam-building activities. Other types of development activities also destroy archaeological sites on a significant scale, however, and need to be met with more organised and systematic rescue efforts. Given the current rate of destruction of archaeological sites in India – still completely unquantified but clearly substantial – the targeting of pristine sites for excavation makes little sense. Without the implementation of more significant and holistic cultural resource management strategy within India, the chance to understand more about the origins and early development of societies on the subcontinent will be lost, not just to present but to all future generations.

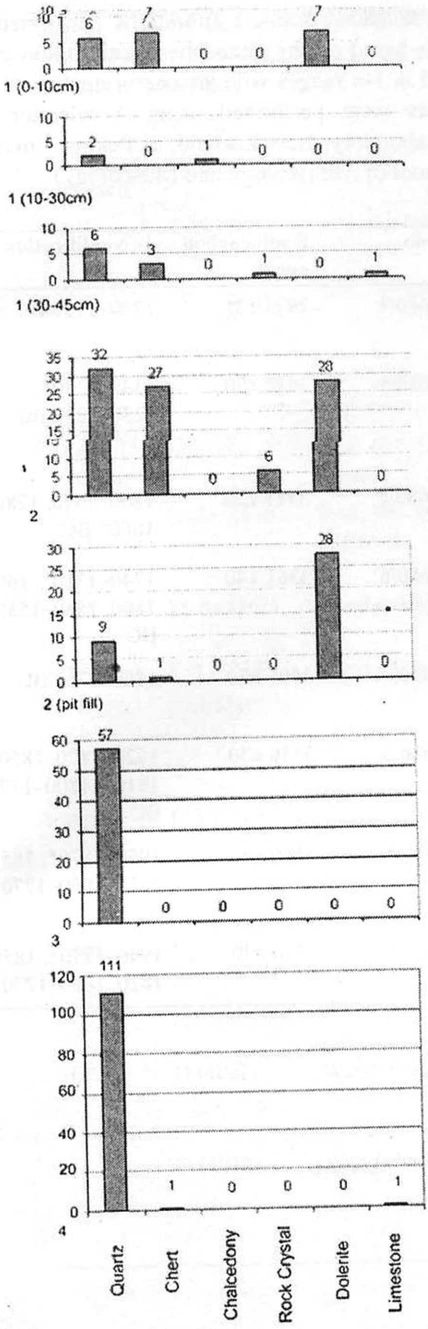

Figure 15 A representative lithic sequence from Sannarachamma showing absolute counts of lithic finds by raw material from Trench D, all sediment sieved. Layer 1 was subdivided into three arbitrary spits by depth, and Layer 2 was separated from the pit that it filled, which was cut into the "ashmound" deposit of layer 3 (data from J. Morris).

Table 1 New chronometric evidence from Sannarachamma. Calibrations performed with OxCal 3.9 (Bronk Ramsey 1995, 2001, 2003), based on the atmospheric calibration data of Stuvier et al. (1998). Calibrations are indicated in 1-σ ranges with an asterix next to what we interpret as the most plausible range. Dates were performed using Accelerator Mass Spectrometry (AMS) by Rafter Radiocarbon Laboratory, New Zealand, or Peking University, Beijing (Institute of Heavy Ion Physics and School of Archaeology and Museology).

Context	**Material**	**Lab no.**	**Radiocarbon age**	**1- σ calibration**
SAN 1147 (Megalithic pit fill)	Seed: *Lablab purpureus*	R 28680/1	2973 ±35	1270–1120 BC
SGK.98A-4 (Earliest *Lablab*, Megalithic)	Seed: *Lablab purpureus*	R 28680/5	3042 ±30	1380–1250*, 1230–1210 BC
SAN 1157 (upper ashmound)	Wood charcoal	R 28680/2	3441 ±30	1860–1840, 1780–1680* BC
SAN 1157 (upper ashmound)	Seed: *Hordeum vulgare*	R 28680/6	3361 ±40	1740–1710*, 1690–1600, 1560–1530 BC
SAN 1166 <1137> (ashmound)	Seed: *Triticum* sp.	BA04390	3505 ±30	1890–1760 BC
SAN 1191	Seed: *Hordeum vulgare*	R 28680/3	3536 ±30	1920–1870, 1850–1810*, 1800–1770 BC
SAN 1204 (lowest ashmound)	Seed: *Triticum* sp.	R 28680/4	3550 ±40	1950–1870*, 1850–1810, 1800–1770 BC
SAN 1204 (lowest ashmound)	Seed: *Ziziphus* cf. *mauretania*	BA04391	3550 ±30	1940–1870*, 1850–1820, 1800–1770

Table 2 New chronometric evidence from Hiregudda. All dates were performed by Rafter Radiocarbon Laboratory (New Zealand) by Accelerator Mass Spectrometry (AMS). Other details as per Table 1.

Area/ Trench	**Context**	**Material**	**Lab no.**	**Radiocarbon age**	**1- σ calibration**
A/1	HGD.03B-1 (=3012)	Seed: *Lablab purpureus*	R 28680/14	3058 ±30	1390–1290* 1280–1260 BC
A/1	HGD.03B-2 spit 3 (≈ 3017)	Seed: *Triticum sp.*	R 28680/15	3282 ±35	1615–1515 BC
A/5	HGD.03F-3	Seed: *Lablab purpureus*	R 28680/16	3235 ±30	1525–1445 BC
A/5	HGD.03F-5	Seed: *Hordeum vulgare*	R 28680/17	3382 ±35	1740–1710 1700–1620 BC
A/5	HGD.03F-6	Seed: *Macrotyloma uniflorum*	R 28680/18	3250 ±30	1600–1560 1530–1490 1480–1450 BC
A/5	Tr. 5 (3162)	Wood charcoal	R 28680/7	3371 ±35	1780–1710 1700–1610* BC
A/9 =HGD. 03C	F. 1 (3034) (≈3012)	Wood charcoal	R 28680/8	3042 ±30	1380–1330 1320–1260 BC
A/9	F. 1 (3148)	Wood charcoal	R 28680/9	3433 ±35	1860–1840 1780–1680*
A/9	F. 1 (3151)	Wood charcoal	R 28680/10	3314 ±30	1680–1670 1630–1520* BC
A/9	F.1 (3167)	Wood charcoal	BA04392	3340 ±30	1690–1600* 1560–1530 BC
A/9	F. 1 (3196)	Wood charcoal	R 28680/11	3346 ±30	1690–1600* 1560–1530 BC
D	D (4027)	Wood charcoal	R 28680/12	3027 ±30	1380–1330 1320–1250 1240–1210 BC
D	D (4040)	Wood charcoal	R 28680/13	3019 ±40	1380–1330 1320–1210 1200–1190 1140–1130 BC

Table 3 New chronometric evidence from Birappa. All dates were performed by Rafter Radiocarbon Laboratory (New Zealand) by Accelerator Mass Spectrometry (AMS). Other details as per Table 1.

Context	Level	Material	Lab no.	Radiocarbon age	1- σ calibration
Tr. 5 (5016)	spit 3	Wood Charcoal	R 28680/19	3031 ±30 BP	1380–1330 1320–1250 1240–1210 BC
Tr. 5 (5025)	spit 7	Wood Charcoal	R 28680/20	4639 ±35 BP	3500–3430 3380–3360 BC
Tr. 5 (5028)	spit 8	Wood Charcoal	R 28680/21	2032 ±30 BP	90 BC– AD 70
Tr. 5 (5018)	spit 4	Wood Charcoal	R 28680/22	5469 ±35 BP	4350–4320 4290–4250 BC
Tr. 2 (5020)		Wood Charcoal	R28680/23	9626 ±40 BP	9210–9110 9000–8900 8880–8840 BC

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Figure 3 The three main hills at Sanganakallu-Kupgal. The picture is taken from the south peak of Hiregudda towards the southwest. Choudammagudda is visible on the left, and Sannarachamma beyond it in the distance. All three hills are associated with evidence for Neolithic activity, which focuses in particular on hilltop plateaux, like the one seen in the middle of this picture (and known as Area A).

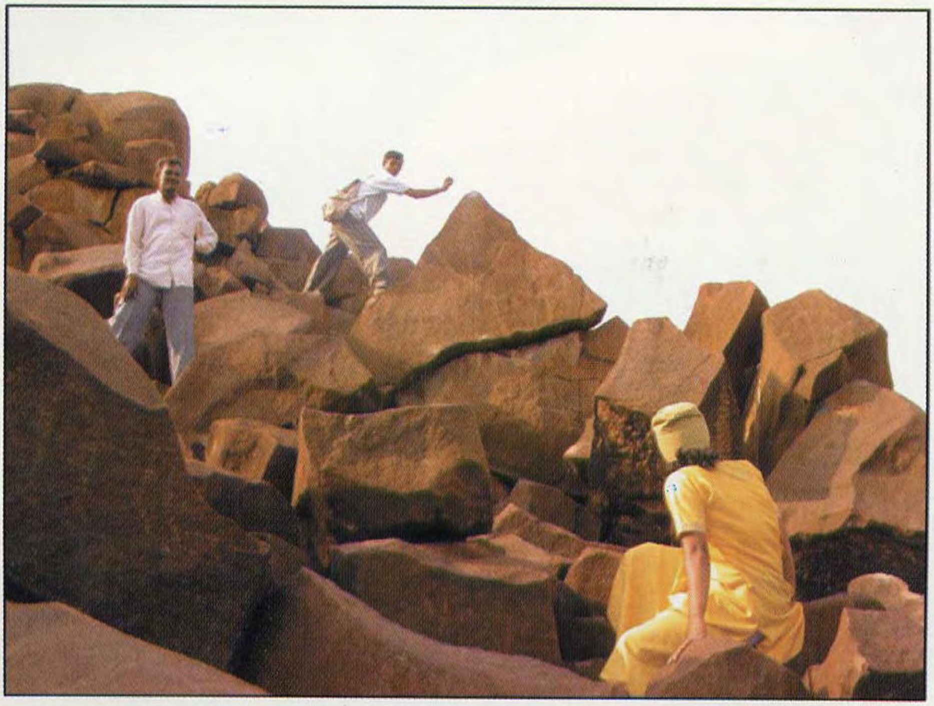

Figure 4 Karnatak University students visiting a rock art site on the large dolerite dyke at Hiregudda. The rock with the triple-horned bull petroglyph is used as a 'rock gong'.

Figure 5 Quarrying of granite boulders at Sannarachamma. Visible in the foreground are the trenches of earlier excavations, which have been partially filled in by wall collapse.

Figure 6 Explosions created during industrial scale granite quarrying at Choudammagudda.

Figure 7 The remnants of an ashmound once located on the top of Choudammagudda. The ashmound was destroyed by quarrying activity prior to 2002, which sent most of it tumbling over the cliff edge.

Figure 8 A rock art site at Choudammagudda, photographed in 2003 and now destroyed completely. The pictographs occupied a granite boulder that has been quarried.

Figure 9 Kupgal Ashmound 2 in 1998. The ashmound had been levelled by 2002, and little evidence of its former presence now remains at the site.

Figure 10 Quarried megalith on the lower northeast slope of Hiregudda.

Figure 11 Birappa rockshelter from the northwest, showing damage due to quarrying. Such activity has removed many large boulders around the rockshelter, and parts of some of the boulders that make up the shelter itself.

Figure 12 Destruction of rock art at Birappa rockshelter by granite quarrying.

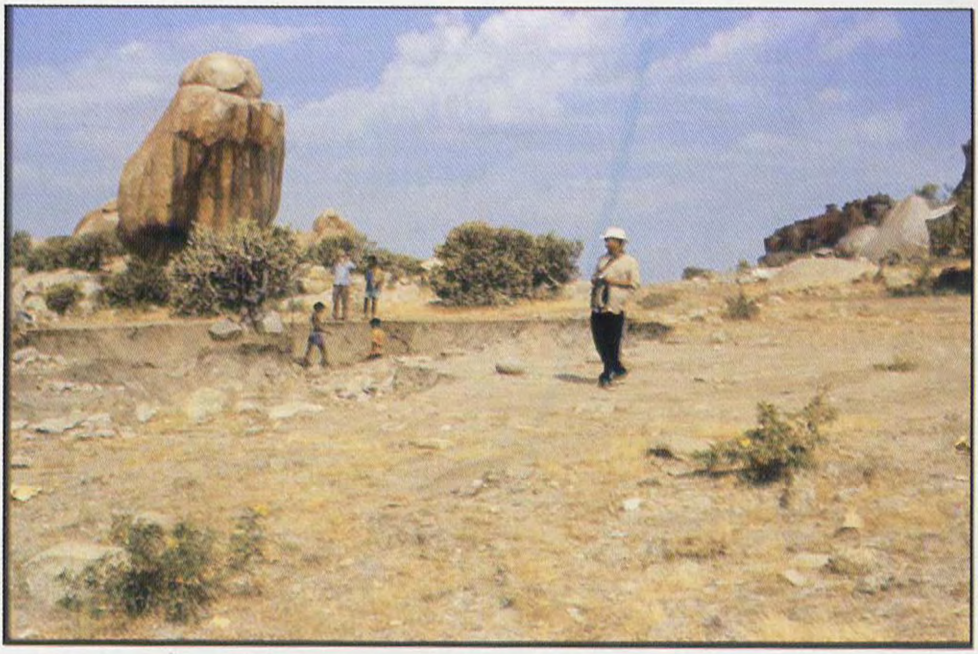

Figure 13 Large modern mining pit in Area A at Hiregudda in 1998. The pit was excavated to remove commercially valuable ashmound and habitation deposits, and was subsequently expanded in size, resulting in the removal of substantially more archaeological material. The large boulder on the left was subsequently partially quarried as well, as seen in Figure 14.

Figure 14 Area A at Hiregudda in 2003. The stone circle known as Feature 1 can be seen in the centre of the picture. The edge of the large mining pit shown in Figure 13 can be seen on the left of the photo, where a small group of people are gathered. The partially quarried boulder behind them is the same boulder seen in Figure 13.