DATING THE NEOLITHIC OF SOUTH INDIA: NEW RADIOMETRIC EVIDENCE FOR KEY ECONOMIC, SOCIAL AND RITUAL TRANSFORMATIONS

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Introduction

The Deccan plateau of south India is a large, arid region featuring rich Neolithic period remains (see Figure 1). Focused in particular on the often spectacular granite hills that dot an otherwise largely featureless landscape, south Indian Neolithic sites reveal a unique manifestation of the transition to sedentism together with early pastoral mobility. The region's ashmound sites, consisting of large accumulations of vitrified and non-vitrified cattle dung ash are argued to have been created during the course of ritual activities (Allchin 1963; Paddayya 1992; 2000-2001; Korisettar et al. 2001a; Boivin 2004a; Johansen 2004). South India is also of interest for its subsequent Megalithic phase, which is marked by the creation of a large number and diverse variety of stone built burial monuments and stone alignments (Allchin 1955; Leshnik 1974; Sundara 1975). These are generally thought to testify to a more complex and hierarchical society (Moorti 1994; Brubaker 2001; Mohanty and Selvakumar 2001), and are attributed by some to the arrival of immigrants into the area (e.g. Leshnik 1974). However, the relationship between the phase of megalithic burials, focused on the first millennium BC, and the Neolithic period, which appears to fall within the third and second millennia BC, remains unclear. In addition, phasing within these periods, especially the two millennia of the Neolithic period, and its implications for changing social and economic systems, is still poorly resolved.

After a lull in Southern Neolithic studies from the early 1970s until the early 1990s, the last decade has seen a re-emergence of interest in the Neolithic developments of south India. Recent investigations have focused, for example, on elucidating agricultural developments and origins (Fuller et al. 2001; 2004; Fuller 2003a; Fuller and Korisettar 2004), lithic production techniques (Paddayya 1993a; 1993b; DuFresne et al. 1998; Brumm et al. 2006), the relationship between sites and landscapes (Boivin 2004a), the role of rock art and ringing rocks (Boivin 2004b), and the early distribution of Dravidian languages (Fuller 2003b; Southworth 2005). Interestingly, recent years have also seen the emergence of a number of debates, focused on the nature of Neolithic site occupations, the evidence for different site types, and potential models of how these sites fit together into a settlement system. In particular, the ashmound debate has polarized those who argue that ashmound sites are always seasonal encampments of mobile herders, or transhumant segments of agricultural villages (e.g. Allchin 1963; Korisettar et al. 2001a; Fuller et al. 2001), and those who regard ashmounds as a component of typical sedentary village sites (e.g. Paddayya 1992; 2000-2001; 2003; Devaraj et al. 1995; Johansen 2004).

Much of the recent debate in Southern Neolithic archaeology relies on evidence collected during excavations and research conducted from the late 1950s through the early 1970s (see Korisettar et al. 2001a for a review). It was during this period that radiocarbon dating techniques were first applied in Indian archaeology. Since this early period, however, Southern Neolithic chronology has been little modified or refined, although it is increasingly clear that numerous key issues require refined chronological understanding. The sparse dating evidence, and tacit acceptance that wide error bars indicate long, continuous phases, has tended to emphasize site longevity and continuity. Recent discussions of ashmounds as Neolithic monuments (e.g. Boivin 2004a; Johansen 2004), for example, are based on an understanding that ashmound sites were in use over long time periods. In addition, the settlement-subsistence model of Fuller et al. (2001) assumes contemporaneity of several hilltop village sites and ashmounds. These models, however, are not clearly supported by all available dating evidence, and the need to objectively establish the contemporaneity of different sites and the length of the formation of sites, including ashmounds, is acute. In addition trends in settlement pattern through the course of the Neolithic require critical assessment.

The present paper offers a new chronological model for the Southern Neolithic that helps to resolve many of these outstanding problems. It not only adds 57 new AMS dates to the existing corpus of 59 published radiocarbon dates (Figure 2), but also offers an assessment of all of the dates based on the application of Bayesian statistical models. The resulting chronologies demand a re-evaluation of accepted ideas about the timing and significance of the distinctive ashmound sites of South India, as well as, consequently a re-interpretation of their role in marking the social landscape of prehistoric South India. It also provides direct dates for a number of important crops, both indigenous and introduced, and clarifies the period of the transition to the Megalithic period, associated with the emergence of craft specialization and social hierarchy.

Old dates, new dates and new calibrations

Most previously-published radiocarbon dates for the Southern Neolithic represent conventional bulk charcoal dates, many of which were obtained in the 1960s and 1970s. They are distributed across 17 sites, half of which have only one or two dates (see Figure 2). The earlier dates, together with ceramic typology and stratigraphic evidence (derived mainly from excavations at Utnur and Piklihal (see Allchin 1963)), formed the basis for the construction of the conventional four phase chronology for this region: three phases of the Neolithic followed by a transitional Neolithic to Megalithic phase (Allchin and Allchin 1968; 1982).

Our new dates derive from excavations and section cleanings carried out as part of several ongoing projects in south India, but especially the Sanganakallu-Kupgal Project (Fuller et al. 2001; Korisettar et al. 2001b; Boivin 2004a, 2004b; Boivin et al. 2005; Brumm et al. 2006), involving work at a number of sites in and around the cluster of hills bracketed by the villages of Sanganakallu and Kupgal near the town of Bellary in eastern Karnataka (Figure 1). Of particular interest in the context of the present discussion are the sites on Sannarachamma and Hiregudda, two hills that form part of a larger cluster in this area. The project has provided 8 new dates for the repeatedly-studied occupation at Sannarachamma, and 13 new dates for Hiregudda, a site that has not previously been dated. Other dates have been acquired within the

context of a project aimed at elucidating the origins of agriculture in south India (for details see Fuller 2003b, Fuller et al. 2001; 2004; Korisettar 2004). These include new dates for Hallur, Tekkalakota and for several previously undated sites (Figure 2).

It has recently become increasingly clear that radiocarbon data can be refined by combining information about other dates and about archaeological context. This analytical process is facilitated by OxCal software (Bronk Ramsey 1995; 2001; 2003). Bayesian statistics are increasingly applied to the calibration of radiocarbon dates, and numerous case studies over more than a decade have now demonstrated their utility in achieving a better understanding of the significance of these dates (Buck et al. 1991; 1992; Bayliss et al. 1997; Zeidler et al. 1998; Bronk Ramsey 2000). The present paper will show the importance of Bayesian statistics for refining our understanding of South Indian Neolithic chronology, and revising models of economic, social and ritual change in late south Indian prehistory.

The Bayesian approach allows two sets of information to be combined: the radiocarbon dates, and models of sequence and phase derived from archaeological observations. Dates from the same stratum, or in some cases artefactual periods, are grouped into phases, while sequence ordering is provided by stratigraphy. By including 'boundaries' in the model between key periods in a given site's history it has been possible to model the probable period of key archaeological transitions. An agreement index between the 'prior' information, consisting of the individual calibrated dates, and the Bayesian model (or 'posterior probability') is indicated as a percentage agreement as generated by OxCal. As will be seen, especially for the new dating evidence, the models below have high indices of agreement. In addition, the fact that similar conclusions regarding the age of key phase transitions is supported by models from multiple sites suggests that our results are robust. All of the new radiocarbon data are reported in full in supplemental online tables, while published dates are incorporated in some calibration figures, with sources cited in the captions.

Dating the beginnings of the Ash Mound Tradition and establishing a general chronology for the Southern Neolithic

The new dates provide no evidence for the beginnings of the Southern Neolithic, although older evidence deserves reassessment (Figure 3). The beginnings of the Southern Neolithic and of the Ashmound Tradition in particular are often dated by reference to the site of Kodekal, where one of the earliest layers produced charcoal dating to ca. 3000-2800 BC (Paddayya 1973: 64). Similarly, the earliest ceramic layers at Watgal date from 2900-2800 BC (Devaraj et al 1995). Unfortunately at neither of these sites is ashmound formation dated, although they do at least provide the beginning point for a chronology of the Neolithic (ceramic) cultural sequence in the region. While Kodekal is indeed an ashmound site, the dated charcoal actually comes from a lower deposit that predates the ashmound. At both these sites, the material from the earliest phases suggests, intermittent, perhaps seasonal use of these sites. At Watgal, more substantial and probably sedentary occupation developed later, beginning ca. 2200 BC.

The earliest date for formation of an ashmound comes from Utnur. Here, excavation established the presence of cattle hoof prints, a sequence of post-hole defined pens, and evidence of episodes of dung burning within these pens, leading to the build-up of an ashmound (Allchin 1963). Three radiocarbon dates are available from Utnur, but how one interprets these is a matter of the assumptions that one brings to the calibration. Do we assume a long span of occupation or a briefer period? When the calibration probabilities are simply added, there is a focus on the centuries between 2800 and 2200 BC, which is very much how most chronologies of South India have treated the site, thus implying a 600-year long ashmound site.

When the dates and stratigraphy are considered together, however, a much shorter timespan can be suggested for the site (Figure 3). While the earliest date suggests the site was founded in the first half of the third millennium BC, conversion to an ashmound (Phase IC) – indicated unequivocally with a levelling, digging of post-holes for a pen, and dung burning – occurs later, ca. 2600-2500 BC. After several phases of ashmound formation the site is abandoned, by ca. 2200 BC. Such a model assumes two phases of ashmound creation over a period of perhaps 300 years. This is in line with the generally held assumption that ashmounds represent long-term, cyclically-used cattle-camps and ritual sites, in a Neolithic landscape of seasonal transhumance and cultivation (Allchin 1963; Korisettar et al. 2001a; Fuller et al.

2001; Boivin 2004a; Johansen 2004), but even so provide a much shorter life span for the site than the 600 years normally quoted. It is worth emphasising that the modelled sequence could be suggested to be considerably shorter, if we take the boundaries to be 2500, 2400 and 2300 BC, for example. This example highlights the need for chronometric evidence to refine southern Neolithic chronology.

Beyond the Ash Mound Tradition core region, other regional manifestations of the South Indian Neolithic appear to begin later (Figure 4). In southern Karnataka and adjacent Tamil Nadu, available evidence indicates the founding of sites only during Phase II, between 2200 and 1800 BC. A later extension of the Neolithic into the Kunderu river valley, known for its distinctive painted pottery (Patupadu Ware), begins from 1900 BC, based on dates from Sanyasula cave, with villages sites in the Kunderu plain from 1700 to 1500 BC . On current evidence, most Neolithic sites of this regional tradition appear to have been abandoned by ca. 1400 BC, which associates Neolithic abandonment in the Kunderu river with the period of major social transformation further west, the Neolithic to Megalithic transition.

Budihal and the question of ashmound-village contemporaneity

To date, the most thoroughly excavated ashmound site is Budihal-south (there are three other ashmounds at the Budihal site), where recent excavations have also provided a large number of radiocarbon dates (Paddayya 1993a; 1993b; 1998; 2000-2001; 2002). Budihal is central to a revisionist hypothesis of Southern Neolithic settlement that sees ashmound sites not as a distinct category of seasonal pastoral camp, but rather as part of sedentary village occupations inhabited year round (Paddayya 1992; 2000-2001). Although this hypothesis has been critiqued on the basis of field observations at a number of other ashmounds sites that lack any substantial non-ashmound occupation deposits (e.g. Kudatini, Utnur, Godekal), in stark contrast to the deeply stratified occupations that are a feature of many hilltop sites (e.g. Sannarachamma, Hiregudda, Tekkalakota, Hatibellagallu) (Korisettar et al. 2001a; Fuller et al. 2001a), the idea that ashmounds are a typical features of Southern Neolithic sedentary villages has received acceptance by several authors (Deveraj et al. 1995; Johansen 2004).

The notion that all ashmounds were sites of year-round occupation during the Neolithic originally emerged when it was found that the cattle-pen and ashmound formation at Budihal was contemporaneous with an occupation area that included evidence of round houses. Our reanalysis of the dates from Budihal radically challenges this interpretation. When dates from the ashmound are simply calibrated and summed, as are those from the village settlement, they indeed show overlapping distributions, of ca. 2450-2100 BC for the ashmound, and ca. 2450-1600 BC for the village area. Use of the dates in this way, however, fails to take into account the available archaeological information, such as the existence of multiple dates and the stratigraphic evidence. Reanalysis using Bayesian statistics indicates a substantial accumulation of dung and the creation of an ashmound over a quite brief period (less than a century; 3-4 human generations), between 2300-2200 BC (Figure 5). While the village occupation area may also begin to be occupied during this period, the village develops and continues until 1700 BC, in the shadow of an ashmound that has long ceased to accumulate. Of additional interest is the apparent temporal association of the ashmound accumulation and a nearby animal butchery floor (Paddayya et al. 1995; 1998: 150-151), which might relate to feasting in relation to ashmound formation. This would seem to constitute further evidence to support the interpretation of ashmounds as special-function (ritual) seasonal gathering sites rather than regular year-round habitation locales. This evidence also suggests a site life history that moved from pastoral penning and ritual burning, i.e. ashmoud formation, to one of a village that is associated with the fixed 'monument' of an ashmound.

Sannarachamma hill: The emergence of a pattern

Recent excavations at Sannarachamma hill near the modern-day village of Sanganakallu provide an opportunity to date ashmound deposits that are sealed within a stratigraphic sequence, as well as the transition to the Megalithic period (Figure 6). This site received much earlier attention as a representative hilltop village of the Southern Neolithic (Subbarao 1948; Ansari and Nagaraja Rao 1969), and has also served as a key site in recent archaeobotanical studies (Fuller et al. 2001; 2004). More recent excavations at Sannarachamma are providing a robust assemblage of lithic, ceramic, bone and plant evidence from complete sieving and large-scale

flotation (Boivin et al. 2005). Of particular interest here are the insights that these renewed investigations are providing into the changing nature of occupation and deposit formation at the site. Especially relevant has been the elucidation of a thick ashmound layer sealed by later Neolithic occupation deposits. 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 ashmound was subsequently concealed as later occupation deposits covered it.

When the new stratigraphic evidence and dates from Sannarachamma are taken into consideration, this ashmound can be seen to represent a fairly short phase of activity early in the site's life history, between 1950 and 1750 BC (Figure 7). The previously reported radiocarbon dates (Ansari and Nagaraja Rao 1969) for the site fit with this general model for the Sannarachamma ashmound. This means that the entire period of ash formation covers perhaps 200 years or even less, suggesting once again a fairly short period, of up to 8-10 human generations, for the formation of a substantial ashmound. Of particular significance is the implication that after ashmound formation ceased, intensive village occupation developed at the site for many centuries (perhaps 500-700 years), and subsequently obscured the evidence for the ashmound. Thus, as at Budihal, the ashmound can be suggested to represent an initial stage in the formation of the Neolithic settlement, raising questions about the symbolic role the ashmound may have played in making or marking (perhaps 'purifying') a place for long-term human habitation.

This emerging model indicates that both sides in the ashmound-village debate require some revision. The 'ashmound' and 'village' actually seem to represent distinct occupation *phases*, each very different in nature. This is consistent with evidence gathered from other sites by Korisettar and colleagues (2001a) in support of the Allchin's (1963) original inference that ashmounds represent seasonal encampments of people and their herds. Nonetheless, it is now also clear that ashmounds do subsequently become villages. These villages replace, rather than coexist with, ashmound activities, however. In the case of Sannarachamma, where occupation on the hilltop plateau was more confined, habitation deposits developed on top of the ashmound, while at Budihal they extended laterally across the plain. Several other recently explored sites also show ashmound and sedentary village phases in

stratigraphic sequence (see below). This suggests that there was a widespread pattern of ashmound creation followed by sedentary village occupation during the Neolithic in the southern Deccan. Thus ashmound creation can be seen to be a recurrent phase in Neolithic site creation and life-history in this region.

Short duration versus recurrent ashmounds

The data discussed thus far imply that ashmound creation activities were relatively short-lived on particular sites. That is, the ritual activities that are argued to have led to such deposits (Allchin 1963; Boivin 2004a), and that involved the cyclical or episodic burning of accumulated, or perhaps heaped, cattle dung, seem to have taken place over a restricted number of human generations. Subsequent to this, these ashmound sites were either abandoned – as at Utnur – or became different kinds of sites, as sedentary village occupation developed – as at Sannarachamma and Budihal. At which point ashmound rituals may have moved to other localities.

This may not, however, be the story for all ashmounds. Some particularly massive ashmounds, like those at Kudatini and Palavoy, contain layers that may represent natural soil formations, and could indicate extended periods of abandonment during which natural pedogenesis took place. Allchin also suggested on the basis of surface ceramics that the Kudatini ashmound appears to have spanned several phases of the Neolithic (perhaps from Phase I to III; see Allchin 1963). Dates from the few ashmounds for which radiocarbon evidence exists are shown in Figure 8. While those from Terdal can be interpreted in terms of a sequence of only two centuries or so, the dates from Palavoy strongly suggest a much longer site span. Overall then it is clear that some ashmounds were indeed formed over quite long time periods, although the possible existence of abandonment layers may indicate that any particular episode of ashmound formation was actually relatively limited. What remains to be resolved is the question of why ashmound formation was re-initiated at some ashmound locales like Palavoy and Kudatini, while other locales were abandoned or became village settlements after one or two centuries of dung-burning activity.

Hiregudda hill: from ashmound to stone axe workshop

Along with Sannarachamma, another major Neolithic site in the Sanganakallu-Kupgal area is Hiregudda (or Kupgal Hill). A medium-sized hilltop plateau referred to as Area A appears to have been the most intensively occupied locale on Hiregudda, and contains the hill's deepest stratigraphy, accompanied by evidence of an ashmound and stone tool production centre. Neolithic activities also took place on other areas of the hill, however, and rock art sites, lithic production areas, stone-walled features and habitation deposits are distributed across most of its slopes and plateaus. Most of the dates come from three adjacent but inter-related stratigraphic sequences in Area A (Figure 9). The chronological model for Hiregudda Area A (Figure 10) suggests that the main occupation dates from 1700 to 1500 BC, with the earlier ashmound represented by some redeposited ash that gives a pre-1700 BC date. This sequence is therefore similar to that on the nearby Sannarachamma hilltop. After 1500 BC, there may have been a hiatus in occupation of a century or so, although further dating evidence is needed to confirm this.

The evidence from Hiregudda suggests that the subsequent transition to the Megalithic period is associated with increasingly specialised craft production. The large-scale production of stone axes on Hiregudda, a possible example of specialized craft production (see Brumm et al. 2006), is correlated both stratigraphically and chronometrically with the production of Megalithic-type wheel-finished pottery (black and red ware), dated to 1400-1300 BC. It is also to this period that several child urn burials from Hiregudda Area D likely date. Such urn burials are common during the Megalithic period (Moorti 1994; Brubaker 2001), but are also well-known from several Southern Neolithic contexts, and represent an element of cultural continuity between the two phases (Korisettar et al. 2001a). Taken together, the evidence from Hiregudda and Sannarachamma indicate that the Neolithic period in the Sanganakallu-Kupgal area begins with ashmound creation activities at Sannarachamma and Hiregudda that ceased by ca. 1750 BC, and concludes sometime around the thirteenth century BC with an intensification of craft production activities that is also associated with a new phase of megalith-building, and ultimately the abandonment of hilltop village sites.

The Neolithic-Megalithic transition

As the above discussion suggests, the new radiometric evidence discussed here is important for addressing the relationship between the Neolithic and Megalithic periods. While the Megalithic period is considered by some to be synonymous with the early Iron Age, its chronology is actually still poorly resolved. Relatively few megaliths have been directly dated (Brubaker 2001). Dates from individual graves are in any case not necessarily helpful for identifying the start of this phase, since it is generally accepted that megalithic burial traditions continued until the end of the first millennium BC and even into the first centuries AD (Leshnik 1974; McIntosh 1985; Moorti 1974; Brubaker 2001; Mohanty and Selvakumar 2001). Nevertheless, some available early dates from graves suggest that in northern Karnataka, megalithic burial practices had already begun by 1400-1300 BC. Four thermoluminescence dates on ceramics from burials are available from the site of Kumaranahalli in northern Karnataka (Singhvi et al. 1991; Brubaker 2001: 294-295), and focus on 1400-1300 BC.

The later part of the sequence at Sannarachamma also preserves evidence of the transition to the Megalithic period (SGK 98A-4, context 1157), and also places it between 1400 and 1250 BC (Figure 7). It is significant, however, that these layers have produced no evidence for iron objects, and thus the beginnings of the Megalithic period, defined in ceramic terms, are not equivalent to the beginnings of iron use.

That the earliest Megalithic relates to the end of Ashmound Tradition is confirmed by evidence from the site of Velpumudugu. Here the earliest layer is composed of ashmound material, sealed by subsequent occupation, and finds include megalithic black and red ware. Two new AMS dates confirm that this ashmound was formed and sealed during this same transitional period of 1400-1300 BC.

At the site of Hallur, located on the upper Tungabhadra River, continuity of occupation was found through the Iron Age (Nagaraja Rao 1971). The radiocarbon evidence provides a clear framework for this, with occupation from ca. 2000 BC, but clearly through several phases between 2000 and 1000 BC (Figure 11). The calibration model suggests that the transition to Phase 3, which included both wheelmade Black-and-Red ware and a few finds of iron, focuses on 1200-1100 BC.

This might suggest that in some regions, the transition to the Megalithic period is somewhat later and does in fact correlate with the spread of iron technology.

Discussion: Implications for economic, social and ritual transformations

The new AMS dates and the reassessment of Southern Neolithic chronology (Table 1) demand a re-evaluation of the significance and role of the ashmounds in south Indian Neolithic society (Table 2). While their status as ritual formations is generally accepted, most models have assumed gradual accumulation over an extended period (e.g. Allchin 1963; Paddayya 1991-92; Korisettar et al. 2001a; Boivin 2004a; Johanson 2004). The available evidence now suggests that many, if not most, ashmounds were formed over a fairly short period of time, perhaps as little as a few human generations, and are thus the outcome of much more intensive activities than previously envisioned. It also appears that the formation of ashmounds was not, as previously thought, restricted to a particular period within the Southern Neolithic, but was rather a locally-contingent element in the life history of individual sites. The creation of many ashmounds through repetitive, symbolic dung-burning events thus takes on significance as an element of local 'performances' that set the stage for the establishment of village sites. Still, some ashmound sites never developed into villages, and some may have been formed over a more extended period of time, through several distinct cycles ash formation and abandonment. What therefore remains enigmatic is the significance of these differences in site life histories: why some ashmounds, such as Utnur, were abandoned, while others, like Budihal, Hiregudda and Sannarachama, were transformed into villages. The available chronometric evidence highlights the importance of assessing individual ashmounds within the particular social and economic context of individual sites and site groups, but also attests to a distinctive and long last-lasting tradition in the creation of settlement spaces and places during the Neolithic of South India.

The new dates also hold implications for our understanding of crop cultivation and diffusion, and hence patterns of trade and interaction (Table 1). Direct dates on the identified seeds of several crop species provide the first direct evidence for the antiquity of their cultivation in South India. Beyond those indigenous domesticates,

we also have the first direct dates on introduced species. For wheat and barley, early domesticates of Southwest Asia that were staple crops of the Indus civilization (Zohary and Hopf 2000; Fuller and Madella 2001), we have direct dates back to 1900-1800 BC at Sannarachamma, 1800-1700 BC at Piklihal, ca. 1700 BC at Hiregudda. The adoption of these cereals correlates with the adoption of new ceramic jar forms, and has been argued to represent a new development in cuisine, or beverage consumption, that played a role in creating a new arena of social differentiation in South India (Fuller 2005). In addition we have the first direct AMS dates on a crop of African origin in India, with several dates on hyacinth bean (*Lablab purpureus*), between 1600 and 1400 BC. At Hallur, the stratigraphically lowest sample with *Lablab* also contained Pearl millet (*Pennisetum glaucum*) a crop of West African origin (Fuller 2003c; Fuller et al. 2004). These data suggest the growing geographic exchange network of which South India had become a part. By the end of the Neolithic period textile production had also begun, indicated by spindle whorls (Ashmound Phase III) and our direct date on cotton from Hallur (900-800 BC). This suggests the early beginnings of the South Indian cotton textile industry, which came to be a major export of peninsular India by the historical (Roman) period (Casson 1989).

The adoption of new crops, including a non-subsistence crop like cotton, highlights the development of long-distance exchange networks during the course of the Neolithic. The elaboration of these networks is clearly associated with the development of specialized craft production activities, evidenced not only by the introduction of new ceramic technologies and production regimes, but also, at Hiregudda in particular, by intensive, standardised axe production activities in the 14th century BC. It is now clear that the transformation from the Neolithic to the Megalithic period needs to be seen in terms of internal economic and social transformations rather than as the product of the arrival of new groups into the region. What remains to be more adequately worked out is how Neolithic cultural practices, which involved creating places for settlement through dung-burning, ashmound-forming rites, came to be abandoned, while labour and ritual practice increasingly focused on the burials of a small segment of society in megaliths, during the same period that specialized craft production increased. The chronological evidence suggests that the origins of this political economy must be sought in the

transformations of the late Neolithic. Further study of ashmounds and related sites is therefore of significance for understanding not only the Neolithisation of South India, in terms of the establishment of agricultural settlements and sedentism, but also the subsequent creation of political economies, featuring craft specialization, trade and social hierarchy.

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PHASE	SITE TYPES, SETTLEMENT PATTERN, EXAMPLES	GEOGRAPHIC DISTRIBUTION	ECONOMIC EVIDENCE
3000 BC **Neolithic I.A**	*Earliest Neolithic occupations, with ceramics. No ashmounds.* E.g. Watgal, Kodekal, Utnur.	Shorapur and Raichur.	No clear evidence of animal herding or plant economy.
2500 **Neolithic I.B**	*First ashmounds*, e.g. Utnur, Budihal, Palavoy, Brahmagiri A(?), Kudatini(?). Early hilltop ashmounds in Bellary District, e.g. Kurugodu, Choudammagudda(?).	Shorapur, Raichur, Bellary(?), Chitradurga, Anatapur.	Bone evidence for cattle, sheep, goats. No archaeobotanical data, but inferred beginnings of cultivation system likely to be established.
2200 **Neolithic II.A**	*Fewer ashmounds (?). Village sites on hilltops.* E.g. Budihal Layer 3 village, Banahalli, T. Narsipur.	Beginnings of Neolithic beyond ashmound zone: southern Karnataka, northeast Tamil Nadu.	Animal herding. Probable cultivation based on native crops.
2000 **Neolithic II.B**	*Hilltop ashmounds that become villages founded*, e.g. Sannarachamma, Hiregudda. Hallur founded. Payaimpalli.	Beginnings of villages on Upper Tungabhadra River.	Abundant archaeobotanical evidence for cultivation: native crops, plus wheat and barley; abundant bone evidence.
1800 **Neolithic III**	*Village continuity.* Sannarachamma and Hiregudda villages. Possible subdivision indicated by Tekkalakota Periods I/II.	Neolithic in Kunderu Basin and Cuddapah District. Greatest number and density of Neolithic sites (equivalent to Malwa/early Jorwe of northern Peninsula).	Reports of chicken bone from several sites. First evidence for crops of African origin ca. 1500 BC. Possible beginnings of arboriculture, fibre crops and textile production. Copper and gold objects.
1400 **Megalithic Transition (Pre-Iron Megalithic)** 800	*Village continuity, some hilltops abandoned. Last ashmound formations cease* (e.g. Velpumudugu). *Megalithic pottery and burials begin.*	Megaliths in eastern Karnataka. By end of period, megaliths in wider region of Tamil Nadu, eastern Maharashtra.	Wheelmade ceramics. Specialized stone axe workshops. A few possible iron implements from this period (?). Possible finds of horse.
800 **Classic Megalithic (Iron Age)** 300	*All hilltop villages abandoned.*	Megalithic burials widespread, including inland Southern Tamil Nadu.	Clear attestation of iron working. Clear attestation of horses. Earliest finds of cultivated rice in South India (Veerapuram).
300 **Late Megalithic/ Early Historic** 100 AD	*Settlement mounds on plains.*	Megalithic burials continue, and cease during this period (?). First agricultural village sites in inland southern Tamil Nadu.	Rice agriculture more widely adopted.

Table 1. A revised chronological framework for the Southern Neolithic, with major trends in archaeological evidence indicated.

SITE	PRE-ASHMOUND EVIDENCE	ASHMOUND DURATION	POST-ASHMOUND USE	MEGALITHIC USE
Utnur	Pre-ashmound occupation; 2800-2500 BC.	2500-2300 BC (ca. 200 years).	Abandoned.	None reported.
Kodekal	Pre-ashmound occupation; 3000-2500 BC.	Unknown.	Abandoned.	None reported.
Palavoy	None reported.	Ashmound(s), including multiple episodes: 2500 BC-1700 BC (ca. 700 years).	None reported.	None reported.
Kudatini	None reported.	Long period (Phases I to III of Allchin; ca. 500-700 years)	Abandoned?	Re-used in Megalithic for burials
Budihal	Pre-ashmound occupation from 2400 BC.	Ashmound I: 2300-2200 BC (ca. 100 years).	Village: 2300-1700 BC.	None reported.
Terdal	None reported.	2200-2000 BC (ca. 200 years).	None reported.	Re-used in Megalithic for burial(s).
Sannarachamma	Pre-ceramic occupation; minimal ceramic/ Neolithic.	1900-1700 BC (ca. 200 years).	Village: 1700-1200/1000(?) BC.	Village abandoned by classic Megalithic.
Hiregudda	None.	1900(?)-1700 BC (ca. 200 years).	Village: 1700-1500 BC.	Reused as stone axe workshop ca. 1400-1250 BC.
Velpumadugu	Unknown.	1350-1250 BC (ca. 100 years).	Village: 1250-1000 (?) BC.	Village abandoned by classic Megalithic.

Table 2. Site life-histories of ashmound sites, if available, including dating evidence discussed in this paper.

Figure 1. Map of sites discussed in this paper. Circles represent those sites with radiometric evidence. Sites mentioned but without radiometric evidence indicated by crosses. Sites numbered, 1-16 of Ashmound Tradition, 17-26 non-ashmound traditions: 1. Terdal, 2. Budihal, 3. Kodekal, 4. Piklihal, 5. Watgal, 6. Utnur, 7. Godekal, 8. Tekkalakota, 9. Kurugodu, 10. Toranagallu and Kudatini ashmounds, 11. Sannarachamma (Sanganakallu), 12. Birappa rock shelter, 13. Hiregudda and nearby Kupgal ashmounds, 14. Velpumudugu, 15. Hattibelagallu, 16. Piklihal, 17. Banahalli, 18. T. Narsipur, 19. Veerapuram, 20. Ramapuram, 21. Peddamudiyam, 22. Hanumataraopeta, 23. Paiyampalli, 24. Sanyasula Gavi, 25. Komaranahalli megaliths, 26. Hallur. B indicates the modern town of Bellary.

Figure 2. The quantity of available radiocarbon dates for Southern Neolithic sites, indicating the distribution of new data reported in this paper and "old published dates". Some post-Neolithic dates have been included when they come from the same site as the Neolithic dates and thus provide stratigraphic controls on chronology (e.g. Iron Age Veerapuram and Hallur).

Figure 3. The probability distributions of calibrated ages of radiocarbon dates for the earliest phases of the South Indian Neolithic and the earliest ashmounds, with a new suggested subdivision between Phases I.A and I.B. The sequences from Watgal and Utnur have been calibrated with Bayesian statistics taking into account the stratigraphic ordering of samples and modelling boundaries between periods. For these calibrations shown in white is the simple calibration and in black the refined calibration suggested by the Bayesian model.

Figure 4. The calibrations for radiocarbon dates from Neolithic sites outside the Ashmound Tradition, including Southern Karnataka (Banahalli, T. Narsipur), Northwest Tamil Nadu (Paiyampalli), and the Kunderu river region of Andhra Pradesh (other sites). The dates from Veerapuram and Hanumataraopeta are shown as Bayesian calibrations based on stratigraphic ordering. Indiacted in grey is the suggested transition to the early Megalithic/Iron Age in this area inferred from Veerapuram. Shown at the bottom is the sum of the calibration probability for all Kunderu Neolithic dates. For Sanyasula and Hanumataraopeta dates see online archive Table 2, for others Vebkatasubbaiah et al 1992; Agrawal 2002

Figure 5. A Bayesian model of chronology of Budihal Ashmound and settlement site. In this model individual stratigraphic sequences are modelled for the Ashmound, the butchery floor and the settlement area, but it is assumed that the lowest layer at the village, the butchery floor and Ashmound all precede the later Layer 2 in the village area. Shown at the bottom of the figure is the sum probability for calibrations from the Ashmound and the settlement area (including Layers 2 and 3).Data from Paddayya (2000-2001; 2002).

Figure 6. Stratigraphic section of Sannarachamma Trench 10, with dated layers labelled. The sampled context from 1998 (SGK.98A-4) is indicated in terms of it probable stratigraphic equivalence with (1267). Although excavated as a single unit, (1191) was noted in section to consist of 4 thin sub-layers, including upper floor (1257), and charcoal rich silt and an ashmound layer above another floor.

Figure 7. A Bayesian calibration model of the Sannarachamma dates based on stratigraphic ordering, incorporating the 1969 dates (from Ansari and Nagaraja Rao 1969) and new dates (see online archive Table 3). The two lowest dates (from trench SGK.98B) are not in this stratigraphic sequence. Key phases within this site are indicated.

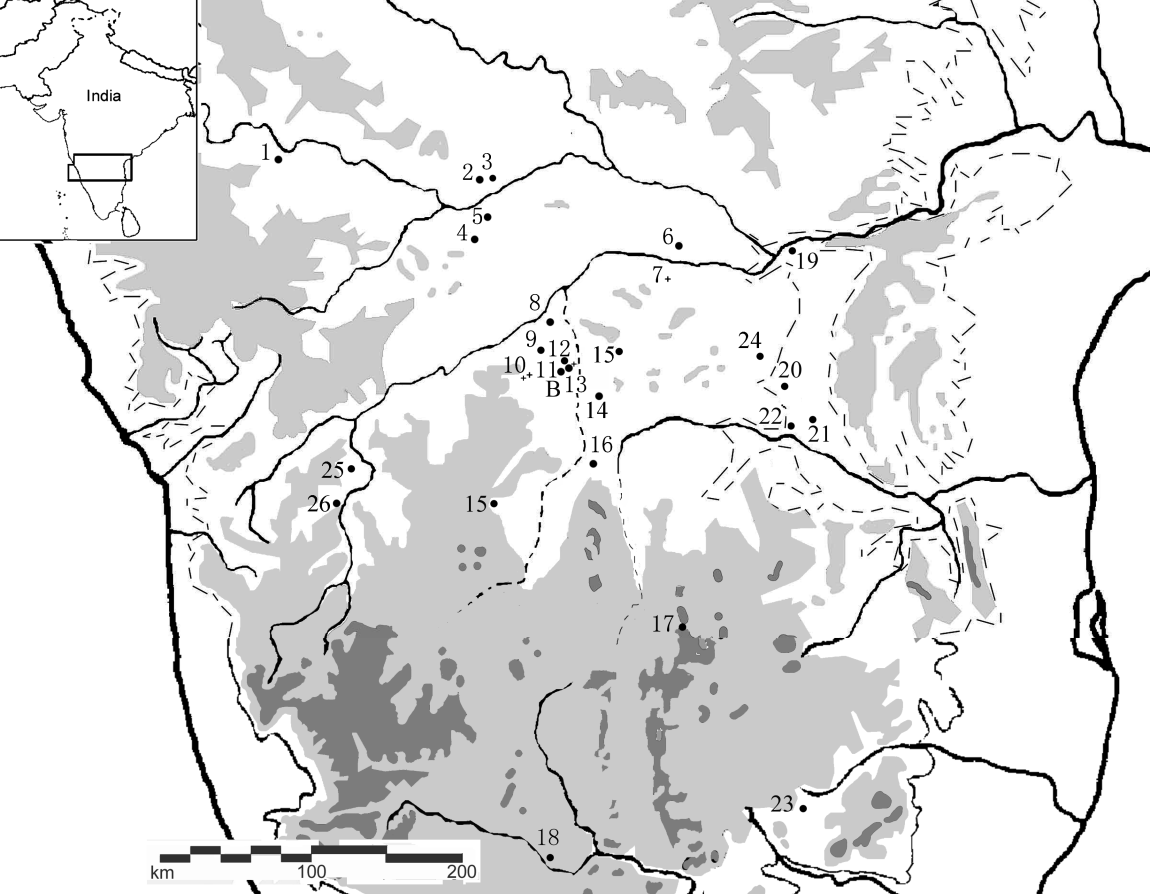
Figure 8. Radiocarbon from additional Ashmound sites, including new dates from Velpumuduugu which represents a sealed Ashmound layer, representing the latest documented Ashmound (online archive Table 6); older dates from Terdal and Palavoy may indicate longer duration or recurrent Ashmound sites (Data from Possehl and Rissman 1992; Agrawal 2002)

Figure 9. Simplified stratigraphic matrix of Hiregudda Area A excavations, relating radiocarbon samples, and schematic representation of horizontal variation in bedrock topography, on a NW-SE transect, facing north. Location of the, archaeobotanical sequence HGD.98A is indicated (see Fuller et al 2004; Korisettar et al 2001b).

Figure 10. Calibrations of new dates from Hiregudda, indicating the archaeological phases including a possible hiatus. Bayesian calibrations for Trench 5 and Trench 1 are based on stratigraphic ordering. The poor agreement indices of 03F-6 and 03F-5 suggest that some stratigraphic mixing has occurred in this sequence. Dates from the latest use of Area A, associated with the intensive manufacture of ground stone axes place this in the 14th century

BC at start of the Megalithic transition. Dates from Area D, associated with an urn burial, also come from this period. Raw data in online archive Table 4.-

Figure 11. A Bayesian calibration model for Hallur, including stratigraphically ordered dates from the original excavations (Nagaraja Rao 1971) and new dates (online archive Table 5).


India
1
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19
20
21
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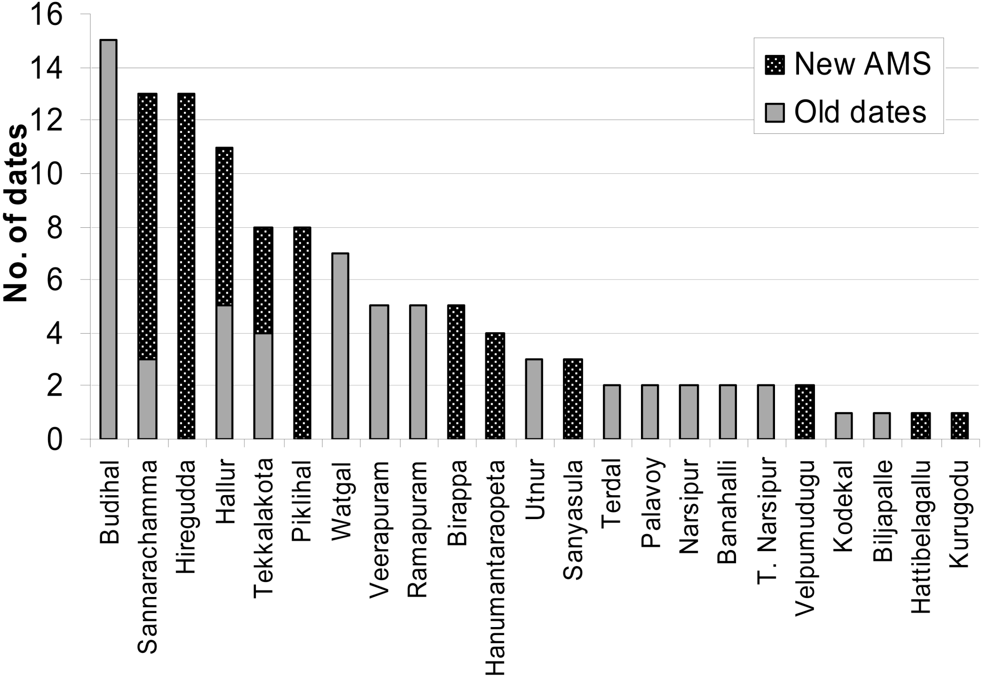
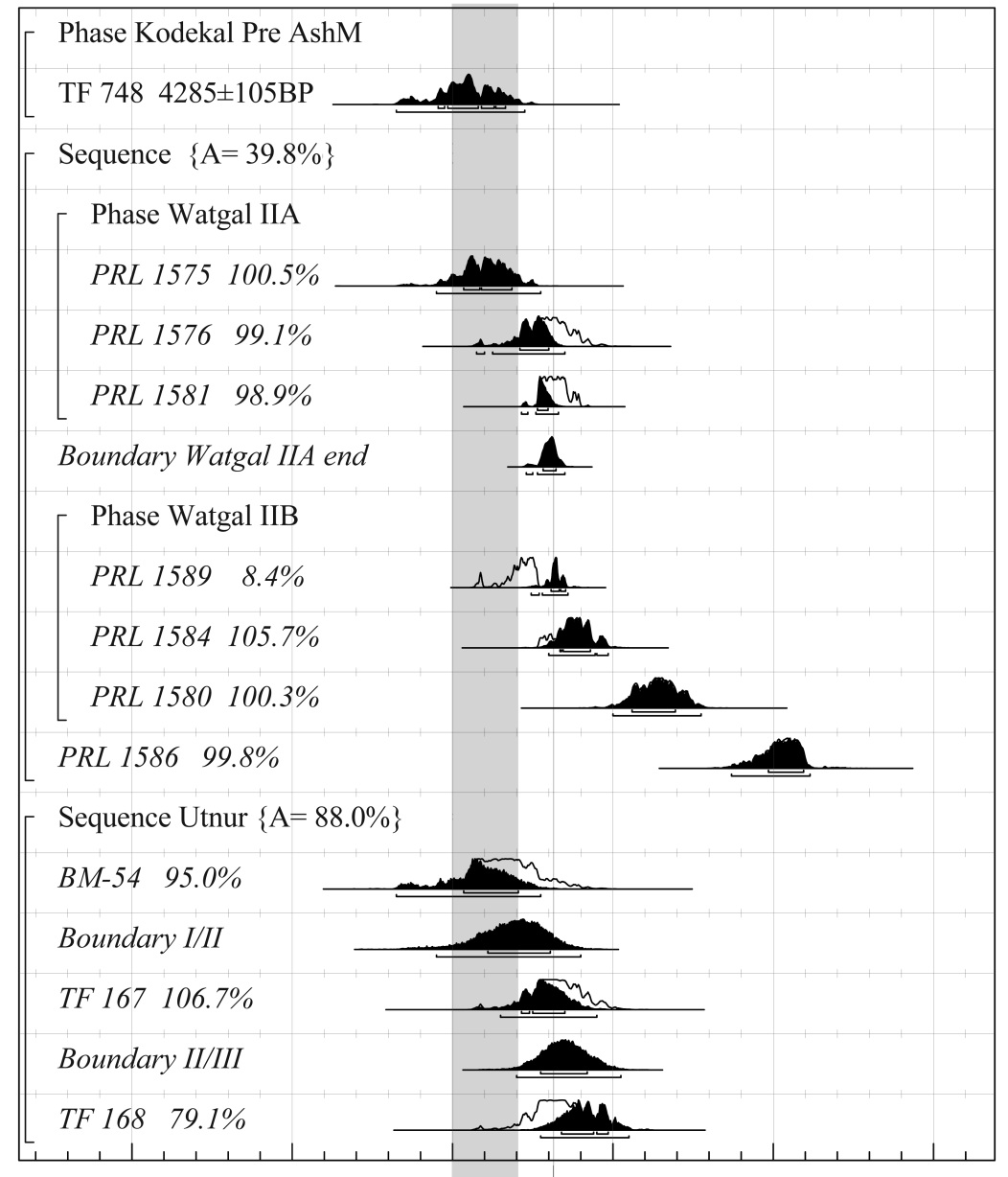
23
24
25
26
B
km
100
200

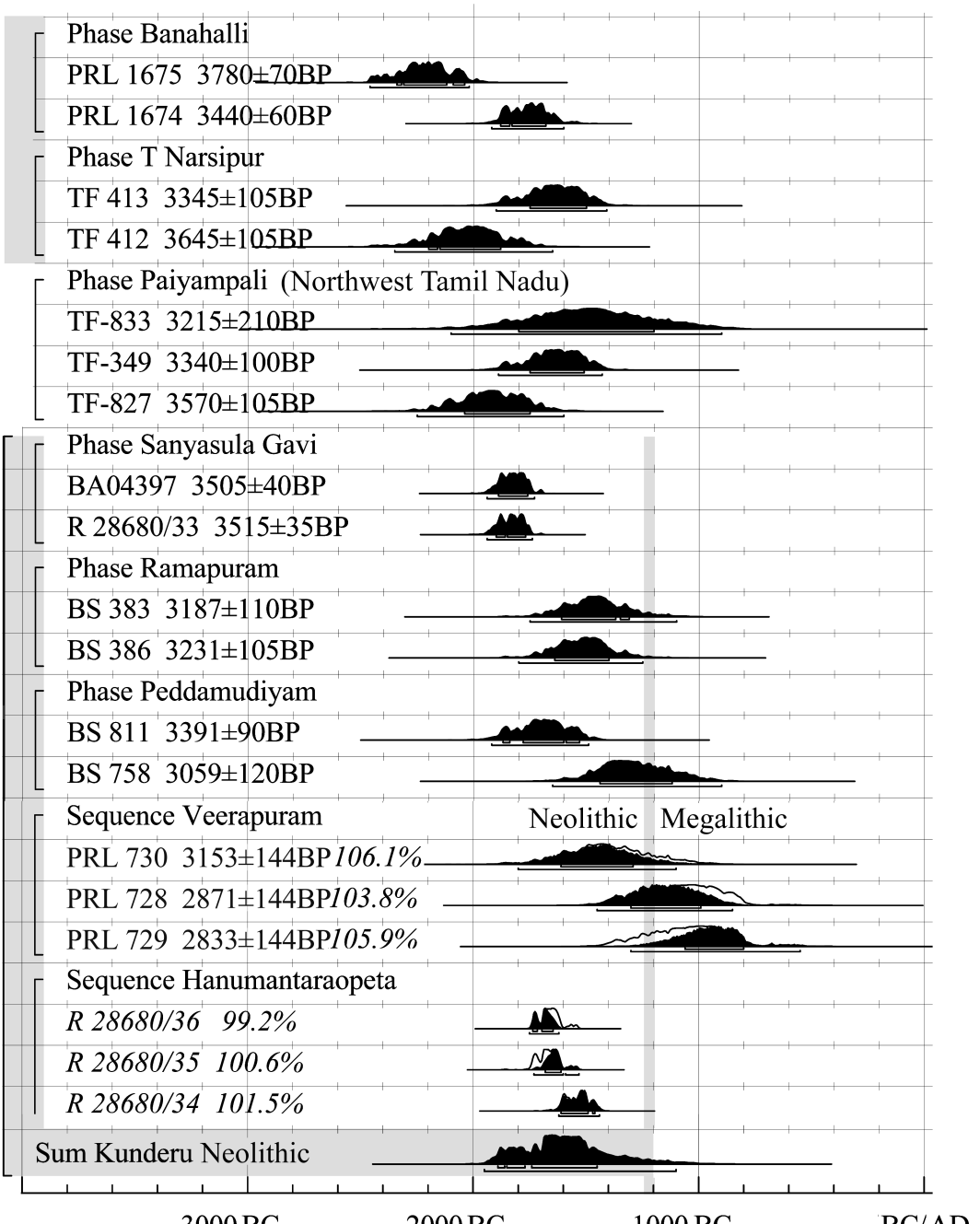


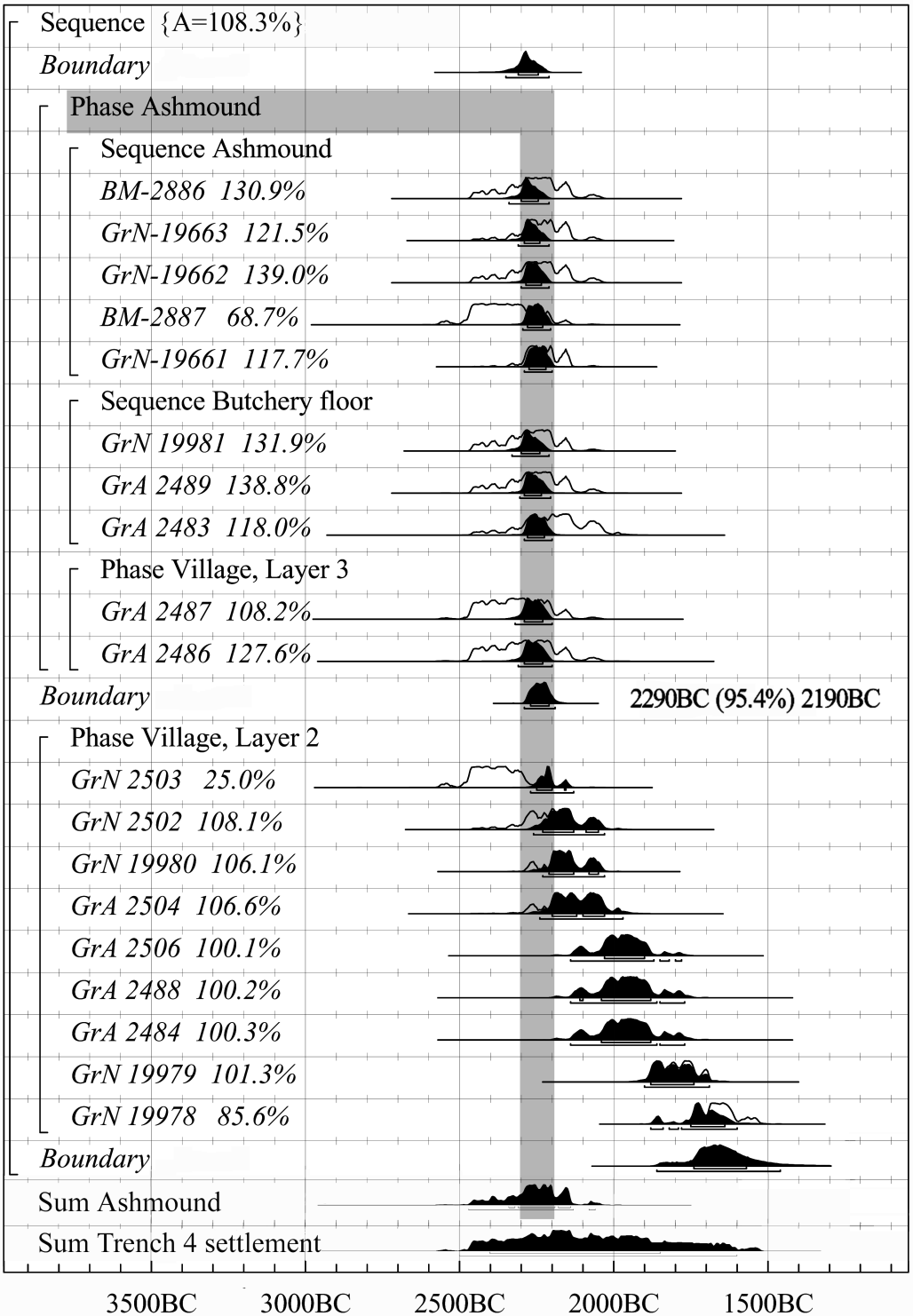
No. of dates
0
2
4
6
8
10
12
14
16
New AMS
Old dates
Budihal
Sannarachamma
Hiregudda
Hallur
Tekkalakota
Piklihal
Watgal
Veerapuram
Ramapuram
Birappa
Hanumantaraopeta
Utnur
Sanyasula
Terdal
Palavoy
Narsipur
Banahalli
T. Narsipur
Velpumudugu
Kodekal
Biljapalle
Hattibelagallu
Kurugodu

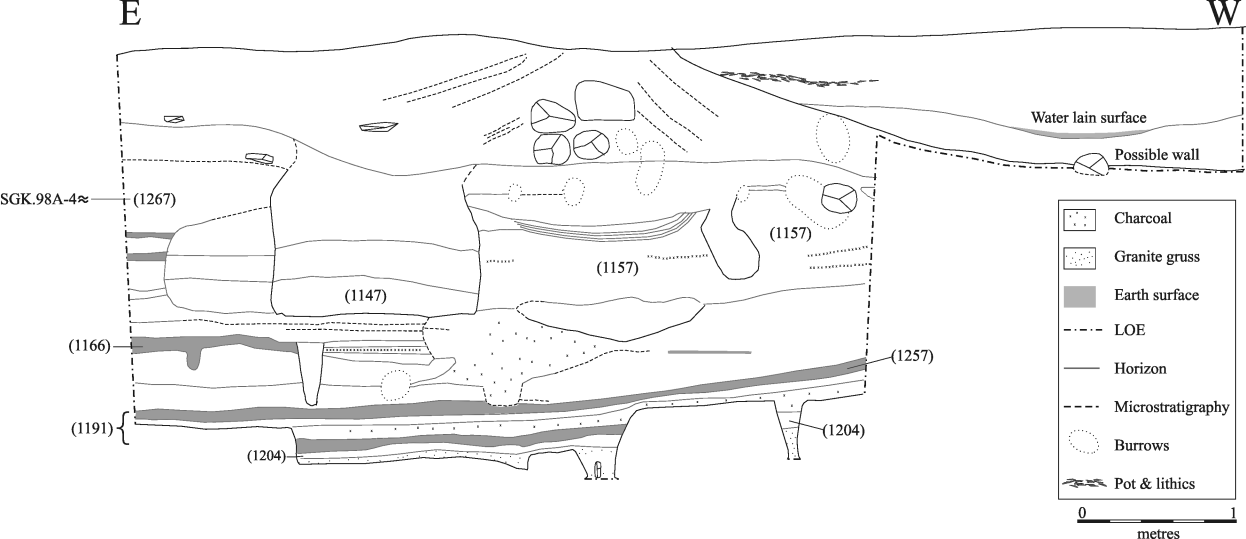


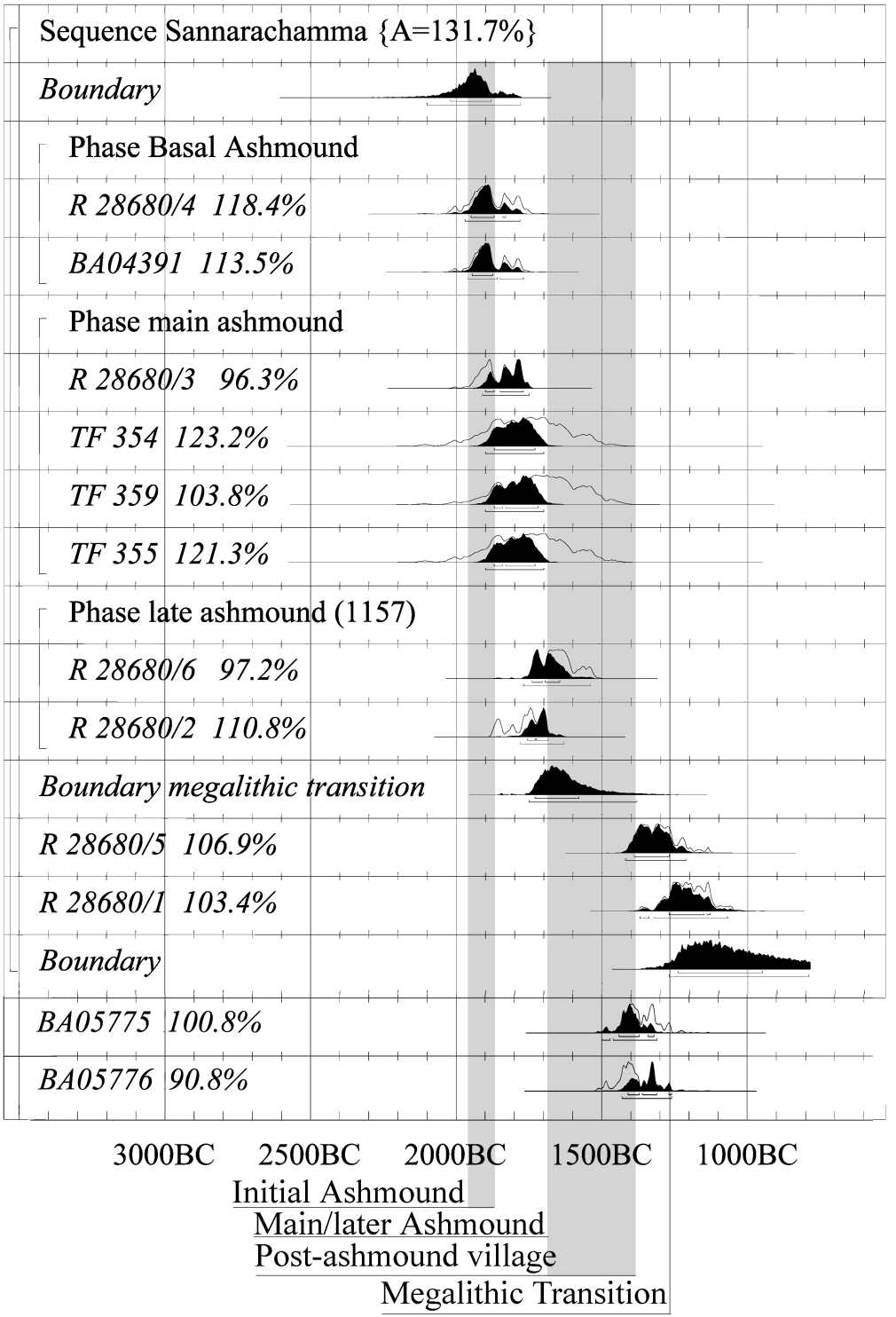
Earliest occupations/ceramics (I.A)

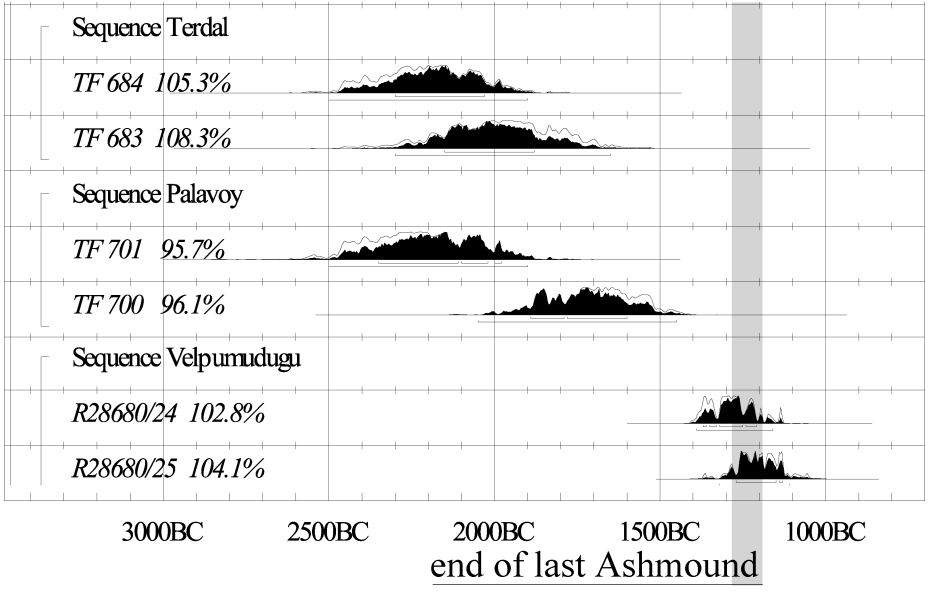
Early ashmound formation (I.B)

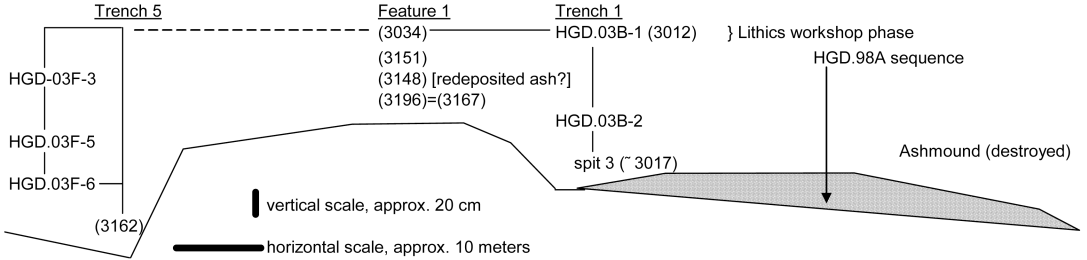

Phase Banahalli
PRL 1675 3780±70BP
PRL 1674 3440±60BP
Phase T Narsipur
TF 413 3345±105BP
TF 412 3645±105BP
Phase Paiyampali (Northwest Tamil Nadu)
TF-833 3215±210BP
TF-349 3340±100BP
TF-827 3570±105BP
Phase Sanyasula Gavi
BA04397 3505±40BP
R 28680/33 3515±35BP
Phase Ramapuram
BS 383 3187±110BP
BS 386 3231±105BP
Phase Peddamudiyam
BS 811 3391±90BP
BS 758 3059±120BP
Sequence Veerapuram
Neolithic
Megalithic
PRL 730 3153±144BP 106.1%
PRL 728 2871±144BP 103.8%
PRL 729 2833±144BP 105.9%
Sequence Hanumantaraopeta
R 28680/36 99.2%
R 28680/35 100.6%
R 28680/34 101.5%
Sum Kunderu Neolithic
3000 BC
2000 BC
1000 BC
BC/AD

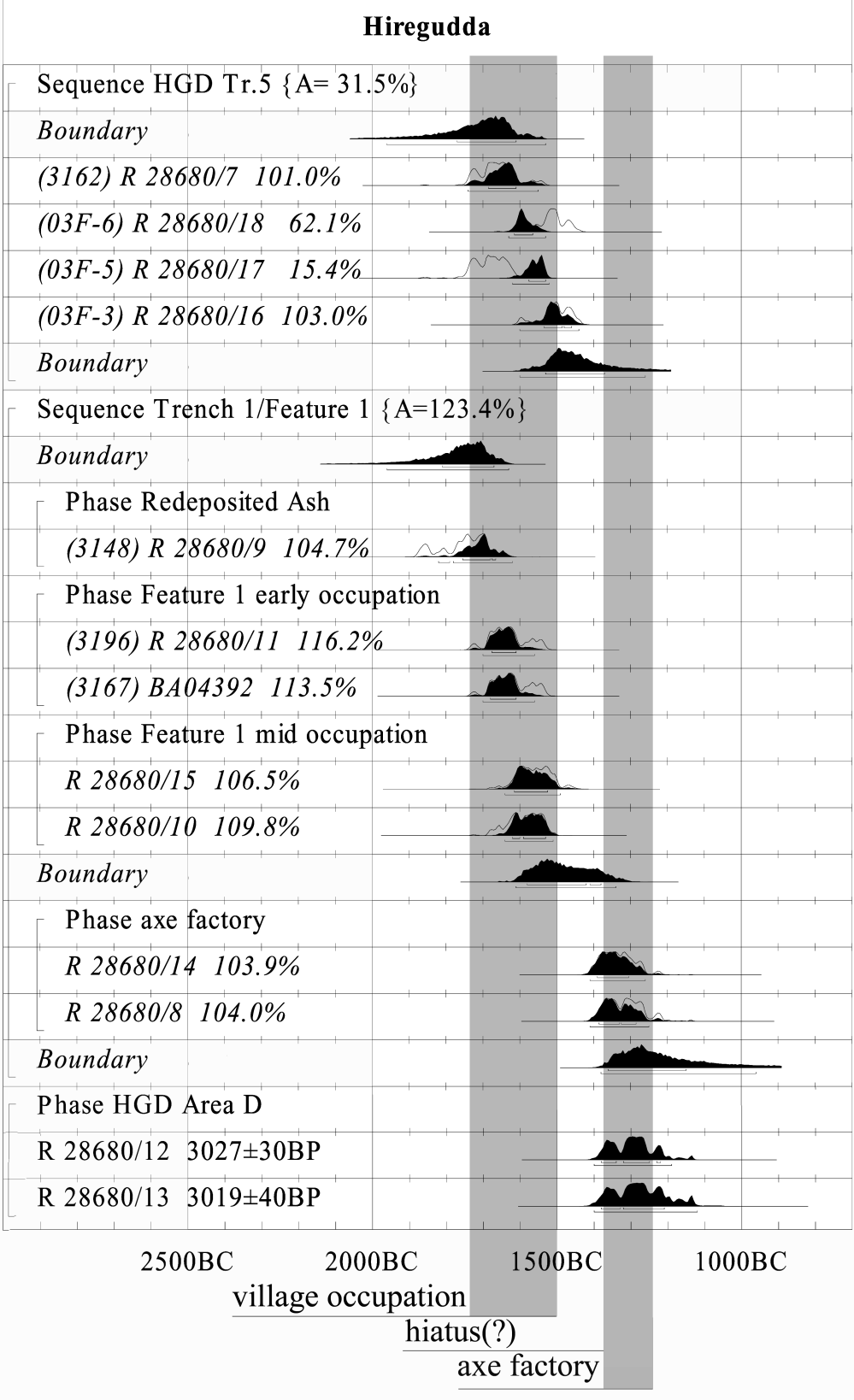

Sequence {A=108.3%}
Boundary
Phase Ashmound
Sequence Ashmound
BM-2886 130.9%
GrN-19663 121.5%
GrN-19662 139.0%
BM-2887 68.7%
GrN-19661 117.7%
Sequence Butchery floor
GrN 19981 131.9%
GrA 2489 138.8%
GrA 2483 118.0%
Phase Village, Layer 3
GrA 2487 108.2%
GrA 2486 127.6%
Boundary
2290BC (95.4%) 2190BC
Phase Village, Layer 2
GrN 2503 25.0%
GrN 2502 108.1%
GrN 19980 106.1%
GrA 2504 106.6%
GrA 2506 100.1%
GrA 2488 100.2%
GrA 2484 100.3%
GrN 19979 101.3%
GrN 19978 85.6%
Boundary
Sum Ashmound
Sum Trench 4 settlement
3500BC
3000BC
2500BC
2000BC
1500BC

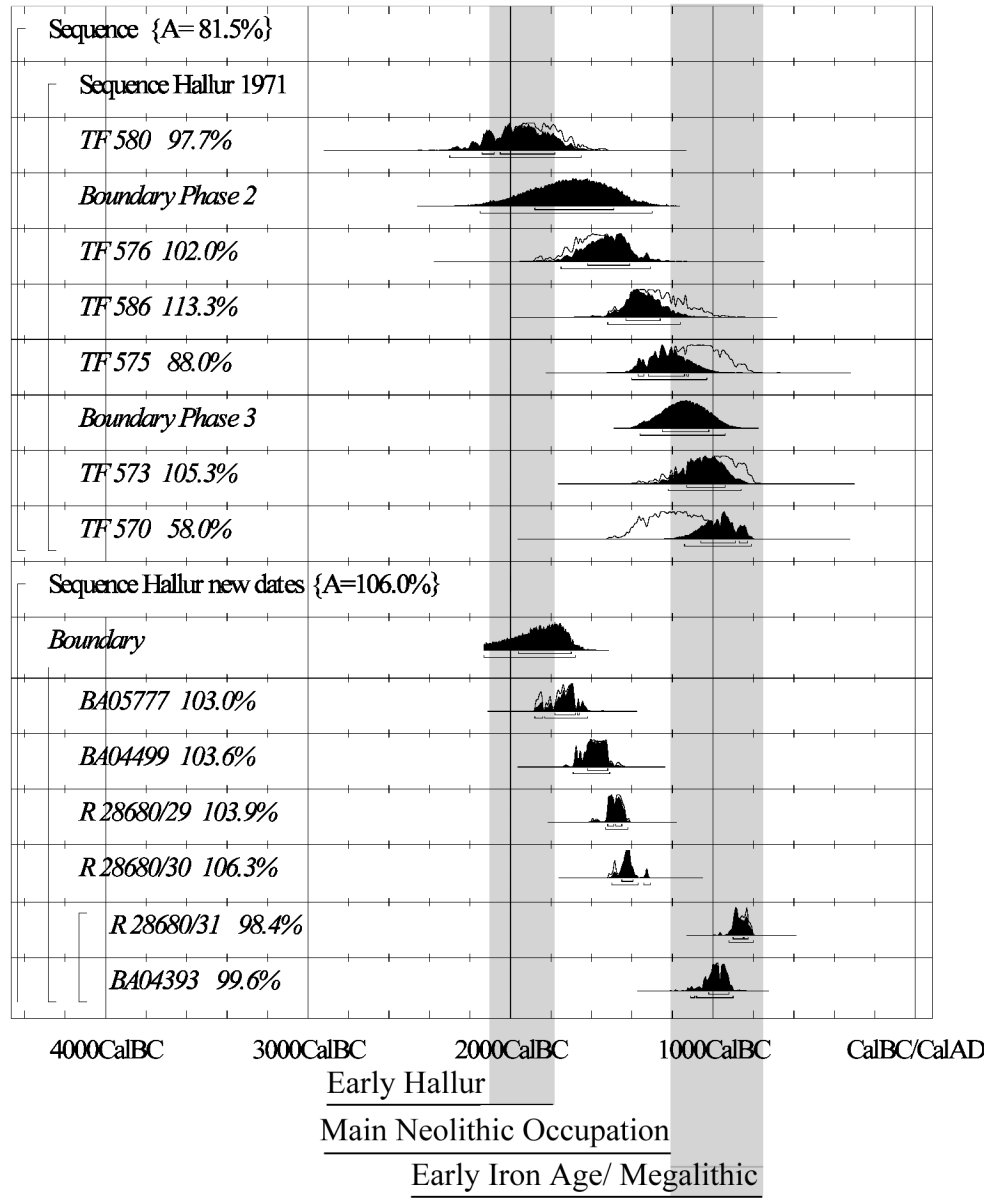

E
W
Water lain surface
Possible wall
SGK.98A-4≈
(1267)
(1157)
(1157)
(1147)
(1166)
(1257)
(1191)
(1204)
(1204)
Charcoal
Granite gruss
Earth surface
LOE
Horizon
Microstratigraphy
Burrows
Pot & lithics
0
1
metres


Sequence Sannarachamma {A=131.7%}
Boundary
Phase Basal Ashmound
R 28680/4 118.4%
BA04391 113.5%
Phase main ashmound
R 28680/3 96.3%
TF 354 123.2%
TF 359 103.8%
TF 355 121.3%
Phase late ashmound (1157)
R 28680/6 97.2%
R 28680/2 110.8%
Boundary megalithic transition
R 28680/5 106.9%
R 28680/1 103.4%
Boundary
BA05775 100.8%
BA05776 90.8%
3000BC
2500BC
2000BC
1500BC
1000BC
Initial Ashmound
Main/later Ashmound
Post-ashmound village
Megalithic Transition


Sequence Terdal
TF 684 105.3%
TF 683 108.3%
Sequence Palavoy
TF 701 95.7%
TF 700 96.1%
Sequence Velpumudugu
R28680/24 102.8%
R28680/25 104.1%
3000BC
2500BC
2000BC
1500BC
1000BC
end of last Ashmound


Trench 5
Feature 1
(3034)
Trench 1
HGD.03B-1 (3012)
} Lithics workshop phase
(3151)
HGD.98A sequence
HGD-03F-3
(3148) [redeposited ash?]
(3196)=(3167)
HGD.03B-2
HGD.03F-5
spit 3 (~ 3017)
Ashmound (destroyed)
HGD.03F-6
vertical scale, approx. 20 cm
(3162)
horizontal scale, approx. 10 meters


Hiregudda
Sequence HGD Tr.5 {A= 31.5%}
Boundary
(3162) R 28680/7 101.0%
(03F-6) R 28680/18 62.1%
(03F-5) R 28680/17 15.4%
(03F-3) R 28680/16 103.0%
Boundary
Sequence Trench 1/Feature 1 {A=123.4%}
Boundary
Phase Redeposited Ash
(3148) R 28680/9 104.7%
Phase Feature 1 early occupation
(3196) R 28680/11 116.2%
(3167) BA04392 113.5%
Phase Feature 1 mid occupation
R 28680/15 106.5%
R 28680/10 109.8%
Boundary
Phase axe factory
R 28680/14 103.9%
R 28680/8 104.0%
Boundary
Phase HGD Area D
R 28680/12 3027±30BP
R 28680/13 3019±40BP
2500BC
2000BC
1500BC
1000BC
village occupation
hiatus(?)
axe factory


Sequence {A= 81.5%}
Sequence Hallur 1971
TF 580 97.7%
Boundary Phase 2
TF 576 102.0%
TF 586 113.3%
TF 575 88.0%
Boundary Phase 3
TF 573 105.3%
TF 570 58.0%
Sequence Hallur new dates {A=106.0%}
Boundary
BA05777 103.0%
BA04499 103.6%
R 28680/29 103.9%
R 28680/30 106.3%
R 28680/31 98.4%
BA04393 99.6%
4000CalBC
3000CalBC
2000CalBC
1000CalBC
CalBC/CalAD
Early Hallur
Main Neolithic Occupation
Early Iron Age/ Megalithic