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

Dorian Q Fuller[1], Nicole Boivin[2] and Ravi Korisettar[3]

1. Lecturer, Institute of Archaeology, University College London, 31-34 Gordon Square, London WC1H 0PY. Email: d.fuller@ucl.ac.uk [author for correspodance]
2. Fyssen Foundation Post-Doctoral Research Fellow, Maison de l'Archéologie et de l'Ethnologie, Université de Paris X
3. Professor, Department of Ancient History and Archaeology, Karnatak University

Abstract

The present paper reports new radiocarbon dates for the Neolithic period of south India. These new dates are presented in the context of a reassessment through Bayesian calibration of all of the available chronometric evidence for late prehistoric south India, and the development of a chronological model for the Southern Neolithic and the life-history of individual sites. This new model has important implications with respect to creation of Neolithic settlements and landscapes in south India. In particular, it highlights the potentially important role of cattle dung burning activities in the foundation and establishment of new settlement sites in Neolithic south India.

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 and pastoral mobility that occurred in many parts of the world during the Holocene period. The region's ashmound sites, representing large accumulations of cattle dung ash from presumed ritual activities have received much attention over a long period (e.g. Foote 1887; Allchin 1963; Paddayya 1992; 1998; 2000-2001; Korisettar et al. 2001a; Boivin et al. 2002; 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; Moorti 1994; Brubaker 2001). These are generally thought to testify to a more complex and hierarchical society (Moorti 1994; Brubaker 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), the relationship between sites and landscapes (Boivin et al. 2002; Boivin 2004a), the role of rock art and ringing rocks (Boivin 2004b), and the early distribution of Dravidian languages (Fuller 2003b). 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 2001; 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; Johanson 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 and they provided a basis for the chronology developed at the time (Allchin and Allchin 1968, 1982; Paddayya 1971). Since this early period, however, Southern Neolithic chronology has been little modified or refined, although it is increasingly clear that several issues of current debate and interest require refined chronological understanding. The relatively 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 2002, 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 over the course of Phase II. 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 the 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 35 new AMS dates to the existing corpus of 61 radiocarbon dates that have previously been published for the South Indian Neolithic, but also offers a assessment of all of the dates based on the application of Bayesian statistical models (see below). These models take into account stratigraphic evidence and the grouping of dates into site phases, thus providing the possibility of a much more informed reading of radiocarbon dates. The resulting new chronological evidence makes an important contribution to our understanding of the phasing of South Indian prehistory, and also provides direct dates for a number of important crops, both indigenous and introduced. In particular, it also tends to suggest shorter phases for many occupations than have previously been assumed. Specific issues we will address include: 1) the dating of the beginning of the Southern Neolithic and the start of ashmound creation activities; 2) the temporality of individual ashmounds, and its implications for their continued use as monumental sites and their relationship with year-round or seasonal occupation; and 3) the timing of the transition to the so-called 'Megalithic Period', as defined by the occurrence of new wheelmade pottery types and stone burial monuments. This evidence requires a re-evaluation of accepted ideas about the beginnings of Neolithic settlement in different areas, and 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.

Old dates, new dates and new calibrations

Most of the 61 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). Only two sites have more than six dates, and in both cases these derive from more recent excavations (at Budihal (Paddayya 2000-2001; 2003) and Watgal (Deveraj et al. 1995)). 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 Neolithic followed by a transitional Neolithic to Megalithic phase (Allchin and Allchin 1968; 1982). The wide error margins and limited number of dates provided the basis for the basic chronology summarized in Table 1, and Allchin and Allchin (1982) suggested general trends in the nature of settlement evidence. In general, Phase I was considered to be dominated by seasonal ashmound sites, and to be restricted to the Raichur and Shorapur Doabs. Phase II witnessed the foundation of numerous village sites, as well as expansion south of the Tungabhadra river and the beginnings of Neolithic settlement on the Upper Krishna river basin (e.g. Terdal ashmounds), Upper Tungabhadra river basin (at Hallur) and in Southern Karnataka (e.g. T. Narsipur). By Phase III most ashmound formation may have ceased, while Neolithic settlement expanded eastwards to the Kunderu river basin of Kurnool District and south of the Pennar River in Cuddapah District (cf. Korisettar et al. 2001a).

Our new dates derive from excavations and section cleanings carried out as part of several ongoing projects in south India. These include investigations conducted under the umbrella of what is now referred to as the Sanganakallu-Kupgal Project (for details see Fuller 2001; Fuller et al. 2001; Korisettar et al. 2001b, in press; Boivin 2004a, 2004b; Boivin et al. 2002, forthcoming a and b; and Brumm et al. forthcoming a and b), and 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

Bellary District, 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 and dating the origins of agriculture in south India (for details see Fuller 2001, 2003b, Fuller et al. 2001; 2004; Korisettar 2004). These include new dates for Hallur, and for previously undated Hanumantaraopeta, Piklihal and Velpumadugu (see Figure 2).

The application of new calibration approaches is crucial to the arguments developed in this paper. 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 the freely available OxCal software (Bronk Ramsey 1995; 2001; 2003). The process is based on the recognition that for any individual date, calibration is not simply a corrected age or date range, but rather a probability distribution produced by the interception of the atmospheric radiocarbon curve (Stuvier et al. 1998) with the normal distribution of a measured radiocarbon age and its error. An example of this is illustrated in Figure 3, which shows a simple OxCal output from the calibration of a single date. It has also been shown that simple median intercepts of the calibration curve may be poor representations of radiocarbon data, especially when multiple dates are involved (Telford et al. 2004). Bayesian statistics have therefore been 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 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 contemporaneity and sequence derived from archaeological observations of relevant patterns, like stratigraphy. It allows the statistical modelling of the dates of transitions between archaeological phases (e.g.

Bayliss et al. 1997; Zeidler et al. 1998). These are incorporated into the models as statistical boundaries, where artefactual or stratigraphic evidence suggests important changes. In some cases radiocarbon dates on different specimens from the same context have been combined in what is defined as a 'phase' by the Oxcal program. 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, falling in only a couple of cases below 80% and in most cases scoring higher than 100%. 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 (which come from Rafter Radiocarbon New Zealand or the Peking University AMS facility) are reported in full in tables in this paper, while published dates are only shown in 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. The beginnings of the Southern Neolithic and of the Ashmound Tradition in particular are often dated by reference to Kodekal, where one of the earliest layers produced charcoal dating to ca. 3000 BC (e.g. Paddayya 1973; Allchin and Allchin 1982; Korisettar et al 2001a). While Kodekal is indeed an ashmound site, the dated charcoal actually comes from a deposit that underlies and predates any ashmound deposit, i.e. Layer 4 (Paddayya 1973: 64). This layer consists of a deposit of dark brown soil more than a metre thick, and containing artefacts, bones and charcoal. The ashmound at this site, representing the accumulation and then burning of dung, occurs in two phases represented by Layers 3 and 1. These remain undated, however, and it is not clear how much time passed between the occupational episode of Layer 4, which dates probably to the early third millennium BC, and the creation of the ashmound layer. Thus, while Kodekal provides the earliest date associated with Neolithic ceramics and ground stone tools, it provides no evidence for when ashmound creation practices began.

A more recently excavated site that bears on the beginnings of the Ashmound Tradition is Watgal (Deveraj et al. 1995). While no ashmound deposits were apparently excavated at this site, an ashmound does exist in exposed sections some 50 meters to the west of the excavated area (authors' observation). Watgal includes sparse evidence for a first phase that is pre-ceramic and microlithic (Watgal I). The Watgal IIA phase then consists of Neolithic ceramics, as well as flaked lithics, in a grey-brown clay soil. This becomes greyer towards the top of the layer. From the limited description available, Watgal IIA therefore recalls the lower, dated deposits at Kodekal and the earliest deposits at Utnur (see below), and it has a ceramic assemblage that is similar to those found at these other two sites. The available radiocarbon dates suggest that this occupation had begun by perhaps 2900/2800 BC, much like that at Kodekal. A Bayesian calibration model puts the transition from Watgal period IIA to IIB quite tightly on ca. 2200 BC, the conventional date for a key Neolithic Phase transition (Figure 4).

Another site in the same region that is of chronological significance is Piklihal. The excavations at this site in the 1950s provided the first stratified artefactual assemblage from which it was possible to define early and later Neolithic phases, and a subsequent Megalithic period (Allchin 1960). The ceramic corpus from this site remains at the heart of typological studies of the Southern Neolithic and, in combination with subsequent excavations at Utnur, provided the backbone for the standard three-phase Neolithic chronology for South India (Allchin and Allchin 1968; 1982). Piklihal is in fact a complex of occupation areas in and around a series of granite outcrops. A pilot re-investigation of this site was carried out in 2003, and involved cleaning and sampling from two sections exposed by recent destructive digging and two test excavations (in the area of Locality VIII of Allchin 1960). All four localities were sampled for flotation and were sieved in their entirety for artefactual and faunal material, which is still undergoing analysis. From the upper levels of PKL.03B, iron slag was recovered, suggesting that the upper half of this sequence was Iron Age in date. The new data provides evidence for an extended sequence of occupation through the Neolithic into later periods. Of interest in the initial archaeobotanical analysis was the presence of chickpea (*Cicer arietinum*), one of the winter pulses of Southwest Asian origin, which as a group have been absent from Southern Neolithic contexts (Fuller et al. 2004; Fuller, in press). This crop was directly dated to the start of the first millennium AD. The radiocarbon data indicate that the Neolithic occupation in this part of the site occurred in Ashmound Phase III (Table 2; Figure 5), which appears widely represented on most dated sites. Continuity of occupation through the Iron Age into the early centuries AD is suggested by a third date from the site.

The classic ashmound site is undoubtedly Utnur, where Allchin's (1963) 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. 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 (see Figure 6), which is very much how most chronologies of South India have treated the site, thus implying a 600-year long ashmound site. However the three dates have wide error margins in line with their place early in the history of C-14 dating. When the dates and stratigraphy are considered together a much shorter time period makes better sense of the site.

The date BM-54 comes near the base of the Utnur sequence, from Layer 11A (Allchin 1963: 46, 144), and suggests that the site was founded in the first half of the third millennium BC. This deposit represents occupational debris that predates any post-holes or clear ashmound accumulation on the site. Thus, as with Kodekal, it could be that this site, starting sometime in the first half of the third millennium BC, served as an occupation site, perhaps seasonally. Allchin regarded this Phase (IB) as of long duration (Allchin 1963: 145). Conversion to an ashmound (Phase IC) – indicated unequivocally with a levelling, digging of post-holes for a pen, and dung burning – occurs later (ibid.: p. 146). The two other dates at Utnur come from the subsequent Phases IIA (TF-167) and IIIA (TF-168) in the sequence of the site (Allchin and Allchin 1968: 338). If we attempt to use these dates to model the probable date for the boundary between Phases I and II, we find a focus for the transition on 2600-2500 cal.BC. If we attempt a similar model for the boundary between Phases II and III, we get a focus on ca 2400-2300 BC, with an end of the sequence by perhaps ca. 2200 BC

(Figure 6). 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; Fuller 2001; Boivin 2004a; Johansen 2004), but even so provide a much shorter life span for the site than the 600 years normally quoted. In the case of this particular site, however, it should be noted that there is no evidence for continued occupation, use or visits after the final ash layer. And thus after ashmound-creating burnings stopped, Utnur ceased to be a site of occupation. Utnur remains the earliest dated ashmound, with the inception of ashmound formation occurring at ca. 2500 BC. 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. Unfortunately the extremely limited number of radiocarbon dates precludes either confirmation or refutation of such a view. This latter, brief chronology for the Utnur ashmound might, however, be recommended on the basis of evidence which has come to light from other ashmound sites more recently, as discussed below.

Beyond the Ash Mound Tradition core region, other regional manifestations of the South Indian Neolithic appear to begin later. In southern Karnataka and adjacent Tamil Nadu, available evidence indicates the founding of sites only during Phase II, between 2200 and 1800 BC (Figure 7). A later extension of the Neolithic into the Kunderu river valley of Kurnool District is known for its distinctive painted pottery (Patupadu Ware). Four new dates for this tradition come from Hanumantaraopeta, which appears to date from 1700 to 1500 BC (Figure 8; Table 3). These dates fit with the few published dates for this eastern extension of the Neolithic (Figure 9). On current evidence, most Neolithic sites of this regional tradition appear to have been abandoned by ca. 1400 BC, after which occupations with Megalithic style, wheelmade pottery and probable megalithic burials were established, as at Veerapuram. The likelihood of a transition from the Neolithic to the Megalithic period at 1400-1300 BC is now supported by additional evidence (see below).

Budihal and the question of ashmound-village contemporaneity

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 essentially 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 feature 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. When dates from the ashmound are simply calibrated and summed (Figure 10), as are those from the village settlement (Figure 11), they indeed show overlapping distributions (though not strictly co-terminus occupations, as Paddayya implies), 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. When the dates are considered statistically and in stratigraphic order, it is clear that the ashmound sequence ends long before that of the village occupation. Calibrated in relation to layers rather than metric depth, the dates from the village provide a coherent chronological sequence (Figure 12) in which the transition between Layers 3 and 2 falls most likely between 2300 and 2200 BC, while Layer 2 represents several centuries, from 2200 BC to perhaps 1800/1700 BC. This implies occupation from 2300/2200 BC to 1800/1700 BC. In contrast, the ashmound is represented by a tight group of dates. These dates cover the main period of formation of the Budihal-south ashmound, and, when calibrated using a sequence model, suggest creation of the mound over a period of less than a century, sometime between 2300 and 2200 BC (Figure 13). This indicates a substantial accumulation of dung and the creation of an ashmound over a quite brief period (3-4 human generations). While a small additional hump of mostly vitrified deposits on top of the main mound was not dated, it is unlikely that this would add significantly to this formation period. The hump at Budihal-south represents a significantly smaller volume of cattle dung than the main mound, and possibly a change in the nature of formation, from in situ dung accumulation to heaping, just prior to the termination of ashmound forming activities at the locale.

Of additional interest is the apparent temporal association of the ashmound accumulation and a nearby animal butchery floor (Figures 14). This butchery floor was so interpreted on the basis of in situ bone and artefact finds (Paddayya et al. 1995). Paddayya (1998: 150-151) suggested that this evidence could relate to feasting, and it is therefore of interest that this period of cattle butchery and related feasting coincides strongly with the main period of ashmound formation. This would seem to constitute further evidence to support the interpretation of ashmounds as special-function seasonal gathering sites rather than regular year-round habitation locales.

The dating evidence can also be plausibly modelled such that there is no overlap. In such a scenario, the ashmound sequence ends, except perhaps for the uppermost undated “hump” layers, and then the habitation begins. Figure 15 depicts such a chronological model, in which the sequences for ashmound and butchery floor are accepted as one phase and assumed to be prior to the occupation of habitation area Layer 3. Given the range of probability on the two Layer 3 radiocarbon dates, such a model has high consistency. Nevertheless an even higher agreement index is achieved by assuming that Layer 3 is contemporary with the period of the ashmound and butchery floor. This is more archaeologically likely, as there appears to have been some stratigraphic inter-fingering of habitation deposit and lowermost ashmound in Trench 1 (see Layers 10 and 7, Figure 24, in Paddayya 1993a). In either case, it is clear that ashmound formation ceased long before village occupation ended, and occurred over a relatively short period of time. Thus the story of Budihal I must be seen very much as the creation of a village in the shadow of an ashmound. What remains unclear is whether the three other ashmounds reported from the Budihal area should be seen a representing phases distinct from the main excavated ashmound-settlement sequence.

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. 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 (Korisettar et al., in press). 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 discovery at Sannarachamma of a thick ashmound layer sealed by later Neolithic occupation deposits. While this layer was observed during the excavations of Ansari and Nagaraja Rao, its significance was then unclear. It 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). The extensive nature of the layer (or, more accurately, layers) and its key role in understanding Neolithic occupation at the site, has not been addressed by any of the site's previous excavators. 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 (Table 4; Figures 16-17) are taken into consideration, this ashmound can be seen to represent a fairly short phase of activity early in the site's life history. While the start of the ashmound can be seen to focus on 1950-1900 BC, all of the dated ashmound deposits fall earlier than 1700 BC. 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. This is significantly less rather than a period of many centuries assumed by more traditional understandings of ashmound formation. The previously reported radiocarbon dates (Ansari and Nagaraja Rao 1969) fit with this general model for the Sannarachamma ashmound. Although these conventional dates have wide error bars, they form a close group and fit well with the other new dates from within the Sannarachamma ashmound sequence. Of particular significance is the implication that after ashmound formation ceased, intensive village occupation continued 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 important initial stage in the formation of the Neolithic settlement, raising questions about the symbolic role the ashmound played in making or marking a place for long-term human habitation.

This emerging model has two important implications. The first is that 'ashmound' and 'village' represent distinct occupation phases, each very different in nature. This is consistent with evidence gathered from other sites by Korisettar et al. (2001a) in support of the Allchin's (1963) original inference that ashmounds represent seasonal encampments of people and their herds. Although at both Sannarachamma and Budihal, occupation seems to begin adjacent to a cattlepen/ashmound area, it is not yet clear whether this represents year-round sedentary occupation. But what is clear is that after ashmound formation ceases, occupation, probably sedentary, continues at Budihal and at Sannarachama. 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 site creation and life-history.

Later samples from layers with wheelmade Megalithic ceramics (SGK 98A-4, context 1157), provide dates suggesting that the Neolithic-Megalithic transition begins between 1400 and 1250 BC. 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, although the "Megalithic" is often regarded as synonymous with the Iron Age.

Short duration versus long duration 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 in the cases discussed here 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.

This may not, however, be the entire story for all ashmounds. Some particularly massive ashmounds, like those at Kudatini or 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 18. 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, though 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 prior to 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. Test-trenching in one area of extensive stone-walled features (Area D) has also revealed several infant urn burials. Dates for Hiregudda are shown in Table 5. Most of the dates come from three adjacent but inter-related stratigraphic sequences in Area A (Figure 19).

The earliest phase of activity on Hiregudda is inferred to have involved the creation of an ashmound. This phase, however, is largely preserved in the negative, since the area where the ashmound was located has been quarried out for sediment in the past decade. Observation and section scraping around the growing quarry pit in 1998 and 2003 noted remnants of ashmound deposit near the base of some sections, especially towards the southern side of the dug out area**.** One of the lower layers in a section cut in 1998 (HGD.98A-7) consisted of ashmound material. The ashmound appears to have been capped by a grey, silty occupation deposit, as was the case on Sannarachamma, which is found in various parts of an uneven terrace in Area A. The Area A hilltop plateau also contains a significant concentration of surface stone features, many of which may relate to this period of occupation. The upper layer in much of this area is rich in dolerite axe by-products, but with less general occupation waste, suggesting specialist use of the site for intensive axe production in its final phase of occupation.

The chronological model for Hiregudda Area A (Figure 20) 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. Thus this sequence is 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 transition to the Megalithic period is associated with increasingly specialised craft production. The large scale production of stone axes on Hiregudda, an example of specialized craft production (see Brumm et al. forthcoming b), is correlated both stratigraphically and chronometrically with the production of Megalithic-type wheelmade 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 (Figure 21). Such urn burials are common during the Megalithic period (Moorti 1994; Brubaker 2001), but are also well-known from several Southern Neolithic contexts, and have elsewhere been discussed as 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 that cease by ca. 1800 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.

The Neolithic-Megalithic transition

As the above discussion suggests, the new radiometric evidence discussed here is important for addressing another poorly understood aspect of South Indian chronology: the so-called Megalithic period and its relationship to the Neolithic and Iron Age periods. While the Megalithic is considered by some to be synonymous with the Iron Age, its chronology is actually only still poorly resolved. Relatively few megaliths are 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 Kumaranahalli (Singhvi et al. 1991; Brubaker 2001: 294-295), and focus on 1400-1300 BC, especially if we combine them as indicating a single short phase (Figure 22).

Another site of importance is Hallur, located on the upper Tungabhadra River (Nagaraja Rao 1971). Crucially, the site appears to show continuity of occupation through to the Iron Age. The radiocarbon evidence provides a clear framework for this, with occupation from perhaps before 2000 BC but clearly through several phases between 2000 and 1000 BC (Figure 23). 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.

Among the Southern Neolithic sites sampled for archaeobotanical evidence in recent years, Hallur is particularly important. It is the only site with archaeobotanical evidence from Western Karnataka, a region of transition to wetter forest environments where South Indian agriculture has been suggested to have begun (Fuller et al. 2004; Fuller and Korisettar 2004). Hallur possesses the most diverse archaeobotanical assemblage yet encountered for the Neolithic of south India. Three AMS dates from the main Neolithic occupation calibrate to between 1600 and 1400, while two samples from a later level with a distinctively different plant assemblage date to the first centuries of the first millennium BC (Figure 24; Table 6). This includes a directly dated cotton seed, the earliest direct evidence for this crop in South India.

Taken as a whole, there is good evidence for the transition to the Megalithic period, marked by burial practices and wheelmade ceramics (but not, in its initial period, by clear evidence for iron-working) during the fourteenth or thirteenth century BC and certainly by ca. 1200 BC. It is of interest that this period also saw the transformation of the settlement area at Hiregudda into a possibly large-scale dolerite axe production site. This is likely to be connected to the increasing importance of craft production for trade. It is of interest that the new suite of dates also suggests the persistence, in some cases, of ashmound-creation practices into the early Megalithic period. The evidence for this comes from the site of Velpumadugu, in western Andhra Pradesh, where recent investigations revealed two main straigraphic units. The lower one is an ashmound layer, ca. 60 cm thick, which is sealed by a subsequent occupation deposit. Thus this site provides yet another example of an ashmound that ceased and was subsequently sealed by settlement deposits. However, in this case, the ceramics in both the ashmound and habitation layers include wheelmade, slipped black-and-red ware, i.e. Megalithic, types. Two AMS dates, one from each layer, confirm that this ashmound dates between 1400 and 1250 BC, while the subsequent occupation dates to the later thirteenth or twelfth century BC (Table 7; Figure 25). The site of

Velpumadugu thus provides evidence for the latest perseverance of ashmound creation activities in south India to date.

Discussion: Implications for economic, social and ritual transformations

The new AMS dates and the reassessment of Southern Neolithic chronology (see Tables 8 and 9 for a summary) demand a re-evaluation of the significance and role of the ashmounds in south Indian Neolithic society. 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 restricted to a particular period within the Southern Neolithic, but was rather was 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 of shorter term ash formation. 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 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 9). Direct dates on the identified seeds of several crop species provide the first direct evidence of the antiquity of their cultivation in South India. For those species that have been suggested to form part of an indigenous package of cultivars (Fuller et al. 2001;

2004), and that have wild progenitors in the region (*Vigna radiata*, *Macrotyloma uniflorum*) or represent wild-gathered fruits (*Ziziphus mauritiana*), the direct radiocarbon dates offer little insight outside of the regional phasing. For other species that have their origins outside of south India, however, we now have direct attestation of their earliest known appearance in peninsular India. As the presence of these species cannot be attributed to wild food sources, they provide unequivocal evidence for cultivation, as well as minimum ages for the diffusion of these crops from elsewhere. This is the case for wheat and barley, early domesticates of Southwest Asia that had become established in Pakistan by the mid-Holocene and served as staple crops of the Indus civilization (Zohary and Hopf 2000; Fuller and Madella 2001). We now have direct dates for these crops of 1900-1800 at Sannarachamma, 1800-1700 BC at Piklihal, and 1700-1500 BC at Hiregudda. Crops of African origin have also been reported from the Southern Neolithic sites, most prominently the hyacinth bean (*Lablab purpureus*), which now has several direct dates 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 et al. 2004). The earliest finger millet, which would have come from east Africa, comes, by contrast, from a later context at Hallur (cf. Fuller 2003c), which also yielded cotton directly dated to ca. 900 BC. A direct date on a chickpea (*Cicer arietinum*) from Piklihal of 100-300 AD supports the suggestion that winter pulses were *not* selected as part of Southern Neolithic crop adoptions, despite being cultivated further north in Maharashtra in the second millennium BC (Fuller 2003a; in press). Meanwhile, a direct date on the specimen of cotton from Hallur (900-800 BC) provides the first evidence for this important non-subsistence, 'cash' crop in South India. By the end of the first millennium BC, when Roman trade in the Indian Ocean is prominent, cotton cloth is a major export of peninsular India (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 the initiation of intensive, standardised axe production activities in the 14th century BC. To date, the transformation from the Neolithic to the

Megalithic period has been inadequately investigated, although it is becoming increasingly clear that it 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 (see discussion in Korisettar et al. 2001). 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. Recent reviews of the megalithic evidence have highlighted the emerging signs of hierarchy and the plausible emergence of polities during this period (Moorti 1994; Brubaker 2001; Mohanty and Selvakumar 2001). The chronological evidence suggests that the origins of this later social complexity must be sought in the transformations of the earlier 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 undisputed evidence for craft specialization, trade and social hierarchy.

Acknowledgements

Funding for fieldwork and associated analyses has been provided by the British Academy, AHRB, McDonald Institute for Archaeological Research, Leverhulme Trust, and Karnatak University. Archaeobotanical research has been funded by the Leverhulme Trust. We gratefully acknowledge also the hard work of the Sanganakallu-Kupgal team, including Eleni Asouti, Janardhana B., Adam Brumm, Subhas Chincholi, Franca Cole, Nick Drake, Neha Gupta, Anitha H.M., Deepak Havanur, Linganna K., Udayashankar K., Jinu Koshy, Helen Lewis, Lindsay Lloyd-Smith, Kalyan Malagyannavar, Paul Masser, Stephanie Meece, Justin Morris, Michael Petraglia, Pragnya Prasanna, Shankar Pujar, Arun Raj, Ramadas, Nick Rees, Dave Robinson, P.C. Venkatasubbaiah, S.R. Walimbe, and Paula Whittaker.

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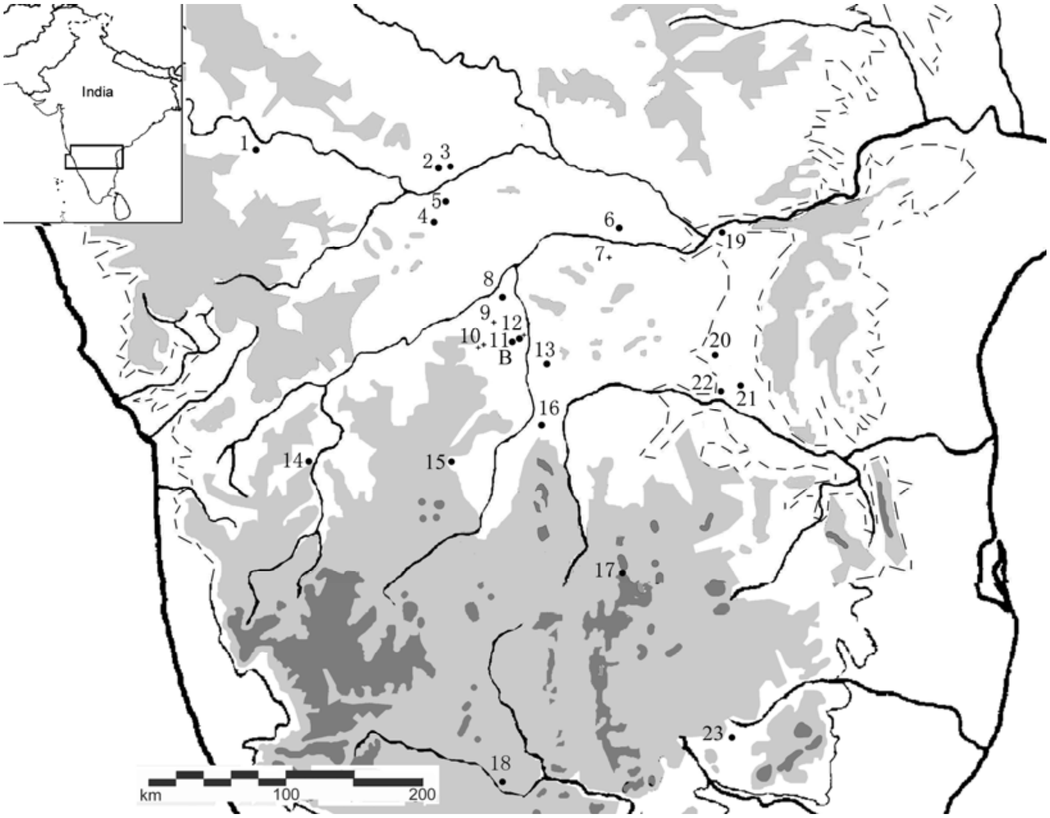

Figure 1. Map of sites discussed in this paper. Circles represent those sites with radiometric evidence. Sites mentioned but without radiometric evidence indicated by crosses. Sites numbered: 1. Terdal, 2. Budihal, 3. Kodekal, 4. Piklihal, 5. Watgal, 6. Utnur, 7. Godekal, 8. Tekkalakota, 9. Kurugodu, 10. Toranagallu and Kudatini ashmounds, 11. Sannarachamma (Sanganakallu), 12. Hiregudda and nearby Kupgal ashmounds, 13. Velpumudugu, 14. Hallur, 15. Kumarnahalli, 16. Palavoy, 17. Banahalli, 18. T. Narsipur, 19. Veerapuram, 20. Ramapuram, 21. Peddamudiyam; 22. Hanumataraopeta; 23. Paiyampalli. The modern town of Bellary is indicated by B.

Phase	**Site types, representative site phases**
3000/2800 **Neolithic I**	*Mainly ashmounds*, Kodekal, Utnur Brahmagiri IA(?), Lower Piklihal , Watgal IIA
2200 **Neolithic II**	*Fewer ashmounds*, *Village sites on hilltops*. Brahmagiri IB. Sanganakallu II.1, Tekkalakota 1. Hallur I, T. Narsipur I, Upper Piklihal, Watgal IIB
1800 **Neolithic III**	Few/No ashmounds. Tekkalakota II, Sanganakallu II.2, Hallur 2, Paiyampalli I, Piklihal “intrusion”, Watgal III
1400/1200 **Neolithic/Megalithic Transition**	*Some hilltops abandoned, villages move onto plains. Megalithic pottery and burials begin*. Sanganakallu III, Hallur 3, Paiyampalli II
800 **Megalithic (Iron Age)** 300	*All hilltop villages abandoned. Iron-working clearly established*

Table 1. Conventional Chronological Framework for the Southern Neolithic with major trends in archaeological evidence indicated (based on Allchin and Allchin 1968; 1982; Korisettar et al 2001a). All dates calibrated BC. For a revised framework see Table 9.

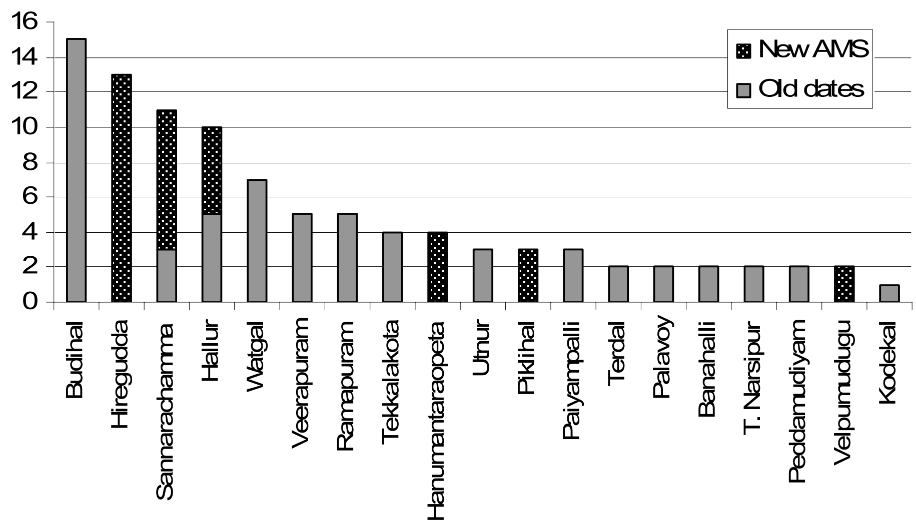

Figure 2. The quantity of available radiocarbon dates, across sites indicating the distribution of new data reported in this paper. Some post-Neolithic dates have been included when they come from the same site as Neolithic dates and thus provide stratigraphic controls on chronology (e.g. Iron Age Veerapuram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

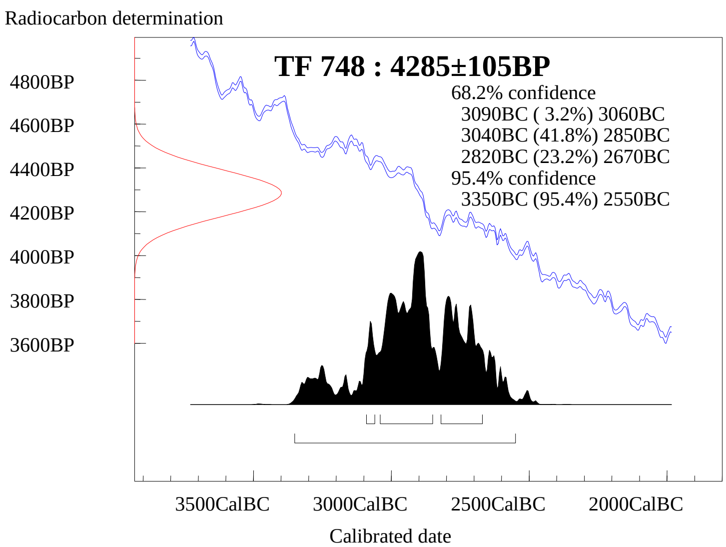

Figure 3. Kodekal radiocarbon date, from pre-ashmound occupation layer (Paddayya 1973). This graphical output from the OxCal 3.9 program shows, the measured age with error on the Y-axis, which is combined with the calibration 'curve' (the jagged diagonal line) to produce the probability profile of the calibration on the X-axis (see Bronk Ramsey 2001; 2003). Calibration is based on the atmospheric C14 curve of Stuivier et al (1998).

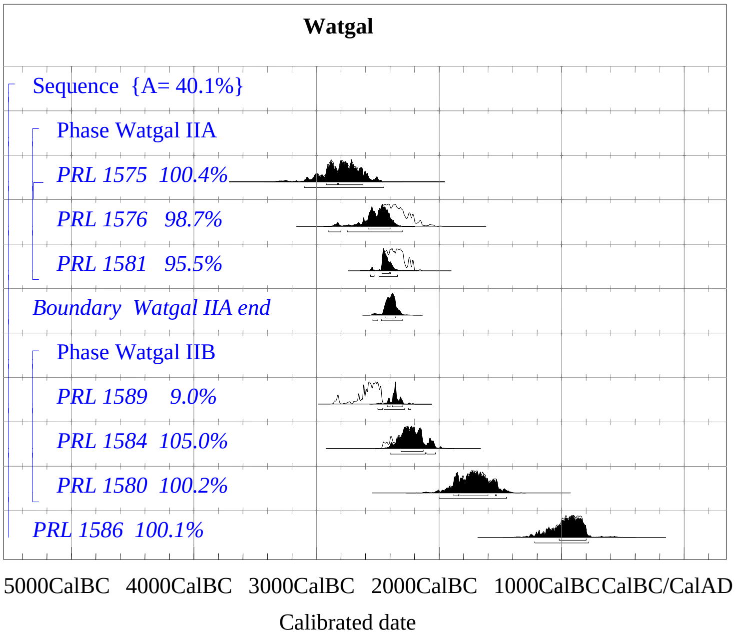

Figure 4. Calibrated radiocarbon dates from Watgal (data from Devaraj et al 1995), with exclusion of PRL 1586, which must indicate later contamination, the other three dates each from site phases IIA and IIB are modelled as representing two distinct phases. The areas in white present the full probability distribution of the calibration profiles, while those areas in black are the preferred calibration on the basis of the Bayesian model. The modelled transition between these phases is tightly focused on ca. 2200 BC. Note, however, that there is poor consistency between the dates of archaeological defined phases at Watgal. Reassessment of the stratigraphic relationship of dates must, however, await more complete publication.

Context	Material	Lab no.	Radiocarbon age	d13C (o/oo)
PKL.03D-4	Seed: Macrotyloma uniflorum	R 28680/26	3366 ±30 BP	-20.79
PKL.03B 130-160cm	Seed: Triticum sp.	R 28680/27	3441 ±30 BP	-20.66
PKL.03B 20-50 cm	Seed: Cicer arietinum	R 28680/	1747 ±30 BP	-23.46

Table 2. New chronometric evidence from Piklihal. Dates were performed by Accelerator Mass Spectrometry (AMS) by Rafter Radiocarbon Laboratory (New Zealand).

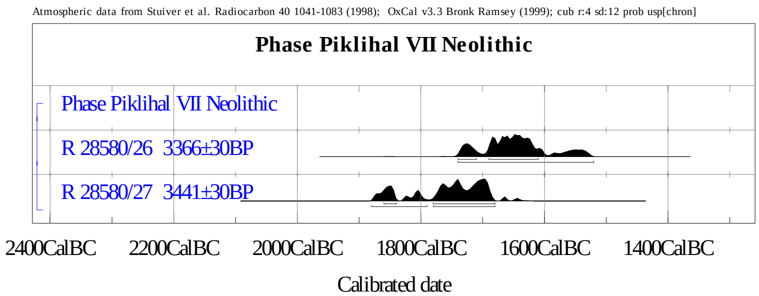

Figure 5. Calibration of two Neolithic dates from Piklihal, and an upper level Early Historic chickpea (Data from Table 2).

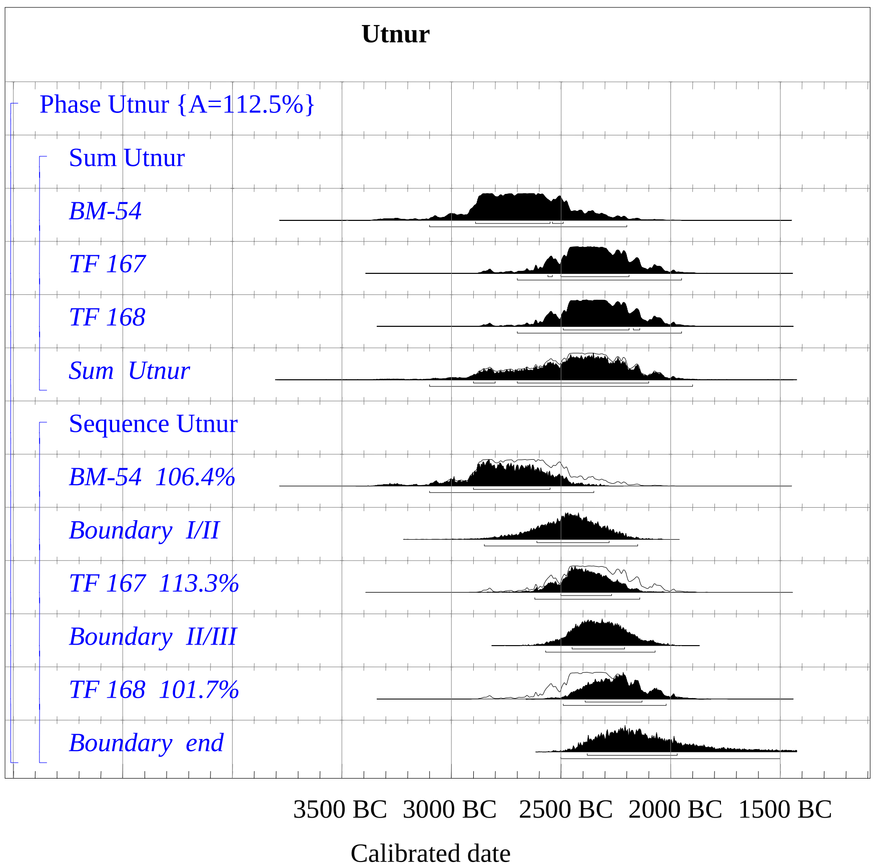

Figure 6. Two ways of looking at the dates from Utnur. On the upper part of this daigram the three radiocarbon dates are simply summed, suggesting a long occupation of the site of perhaps 600 years or more. By contrast, a Bayesian model based on the stratigraphic ordering of these dates, into three phases implies a much shorter period for the formation of the entire ashmound. Data from Allchin and Allchin 1968: 338.

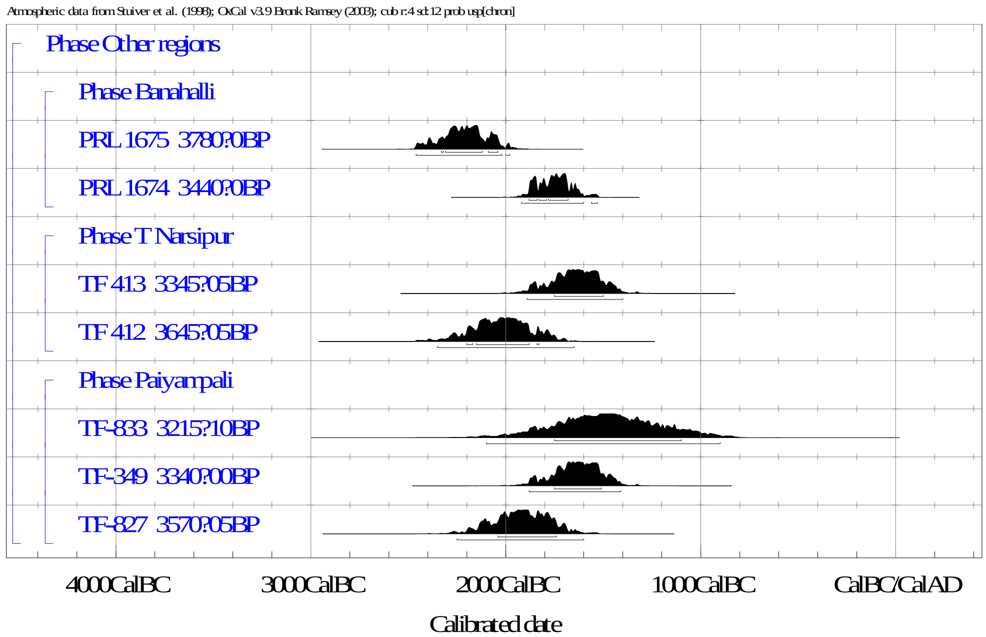

Figure 7. Available radiocarbon dates from more southerly sites of the Neolithic, in regio beyond the Ash Mound Tradition zone. Data for Banahalli from *Indian Archaeology—A Review* 1996-97; for T. Narsipur and Paiyampalli data from Possehl and Rissman (1992), two contaminated dates from Paiyampalli that give dates in the second millennium AD have been excluded.

Context	Level	Material	Lab no.	Radiocarbon age	d13C (o/oo)
HRP97.1-3		Seed: Macrotyloma uniflorum	R 28680/34	3259 ±40 BP	-22.82
HRP97.1-3		Seed: Hordeum vulgare	BA04394	3295 ±30 BP	
HRP97.1-5		Seed: Vigna radiata	R 28680/35	3374 ±35 BP	-24.19
HRP97.1-6		Seed: Vigna radiata	R 28680/36	3365 ±30 BP	-23.48

Table 3. New chronometric evidence from Hanumantaraopeta. Dates were performed by 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. Carbon fractionation measures were not included in the Peking report.

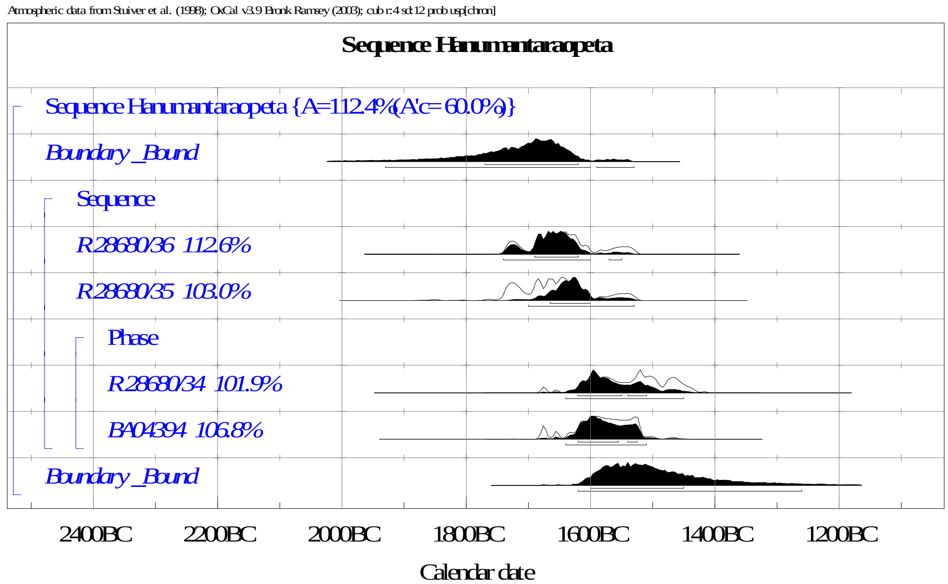

Figure 8. Model of chronologuical sequence through Hanumantaraopeta based on the dates in Table 3. This site of the Kunderu valley Neolithic tradition in Cuddapah distirct fits with available evidence from Kurnool and Cuddapah districts (see Figure 9)

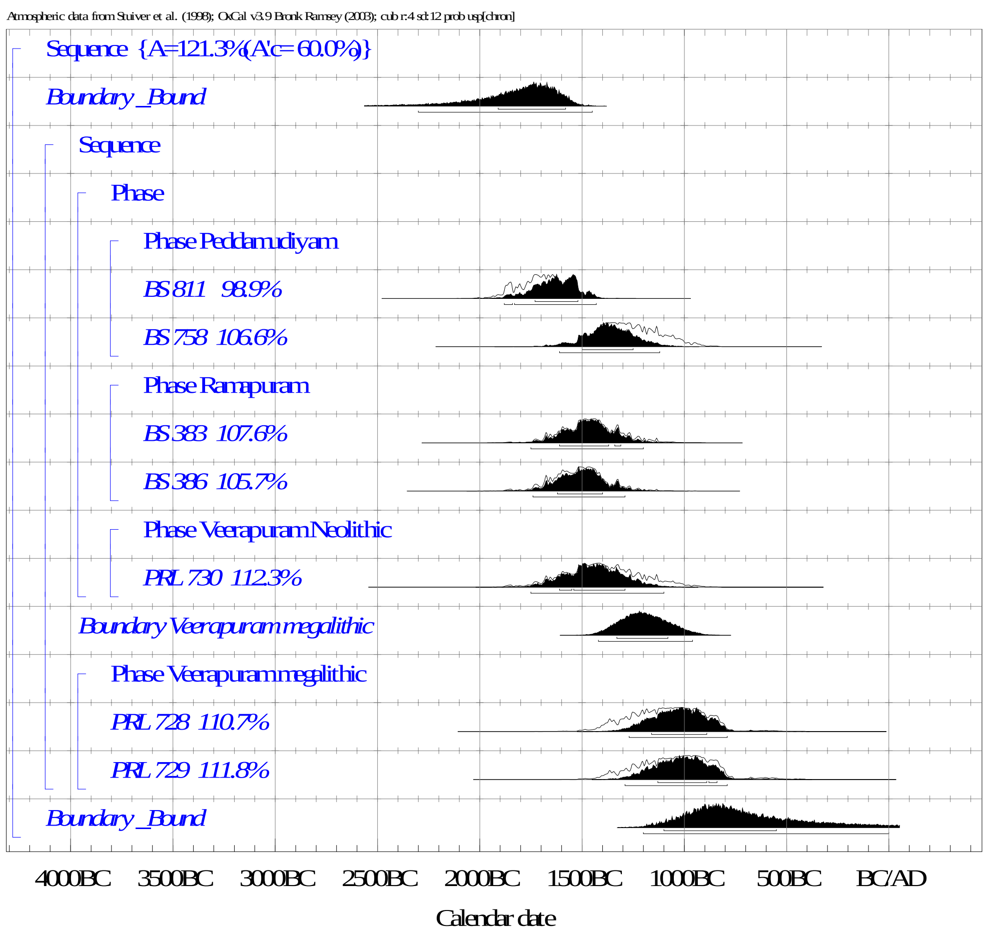

Figure 9. Neolithic settlement in the eastern Kurnool and Cuddapah district beyond the Ash

Mound Tradition. The two later dates from Veerapuram represent the transition to the Megalithic period. Data from Venkatasubbaiah and Kajale 1991; Sastri et al. 1984.

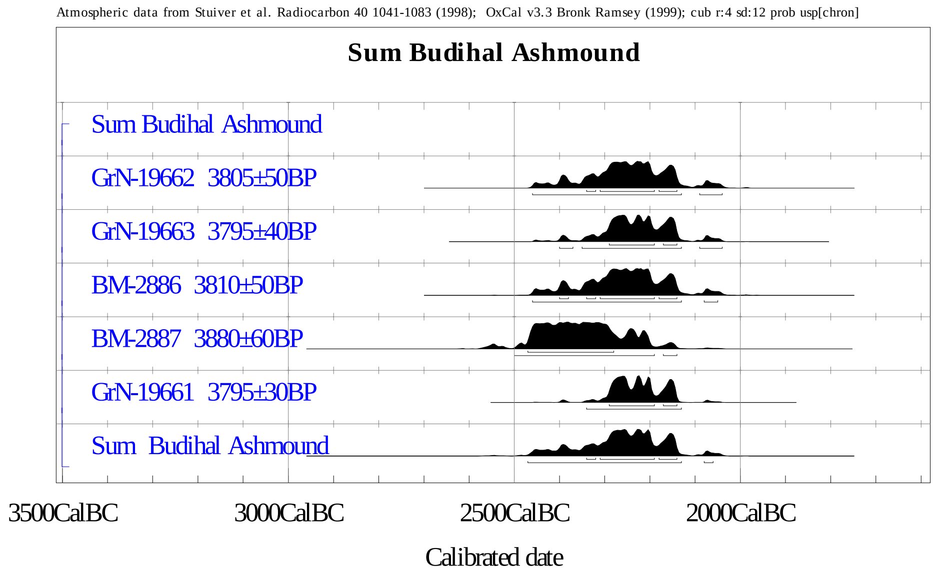

Figure 10. Simple calibrations of the Budihal ashmound dates with a sum of their total distribution (data from Paddayya 2000-2001; 2002).

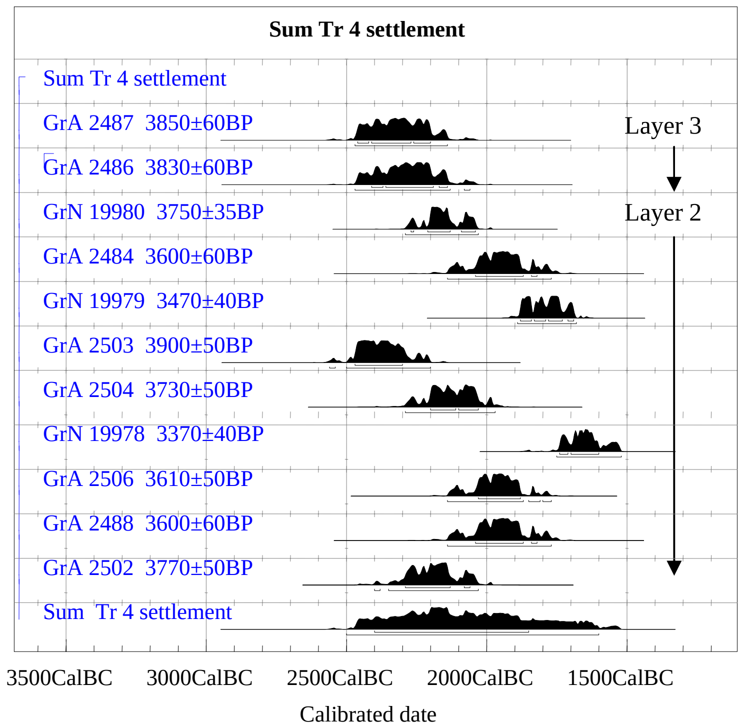

Figure 11. Radiocarbon dates from Trench 4 settlement area at Budihal (data from Paddayya 2000-2001; 2002). The sum of the all the dates, however, indicates a long duration from the beginning of the settlement area, equivalent to the period of the ashmound, until at least 1800 BC or later. Dates area arranged by depth with the lowest at the top. While the sequence suggests inconsistencies, when grouped only by stratigraphic layer, only GrA 2503 is out of order.

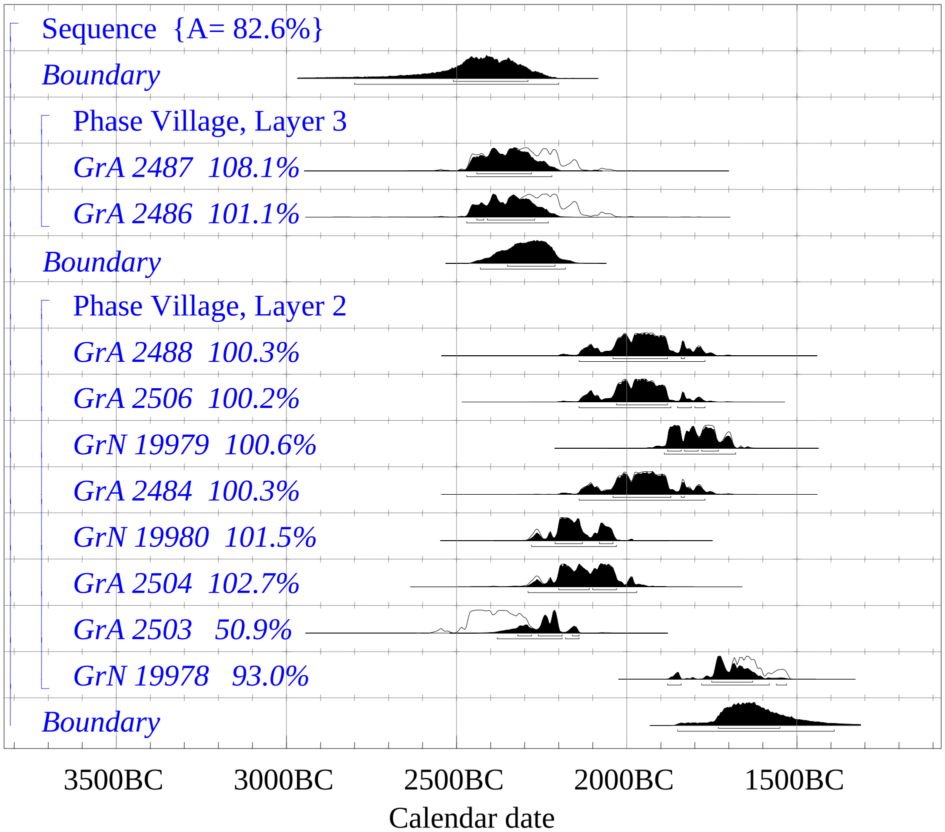

Figure 12. The radiocarbon dates from the habitation area grouped into phases by stratigraphic layer, with a model of layer/phase boundaries (data as for Figure 10). Only a single date, GrA-2503, is a poor fit and may include residual material.

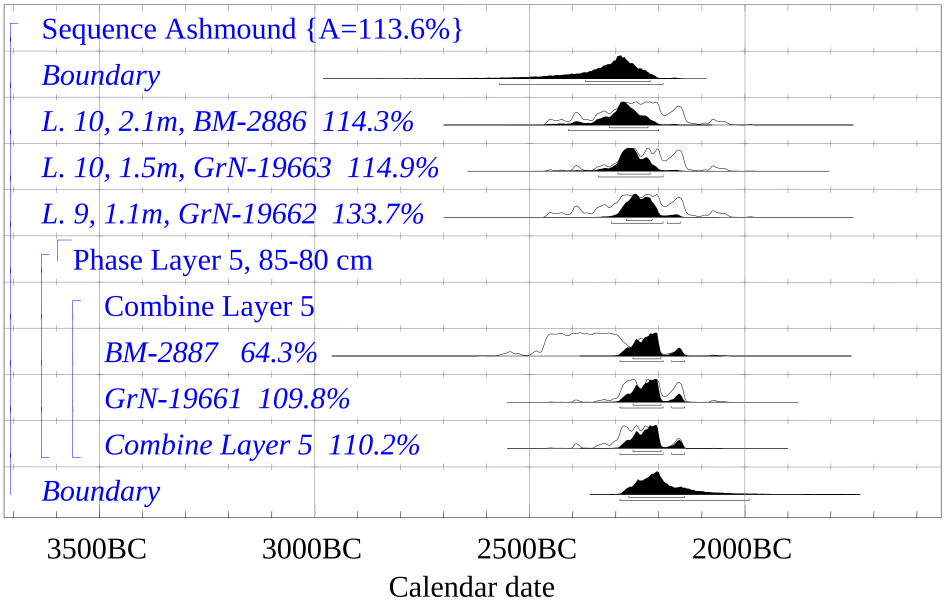

Figure 13. A sequential model of the Budihal I Ashmound dates in stratigraphic order, with the two dates from Layer 5 combined. (data from Paddayya 2001).

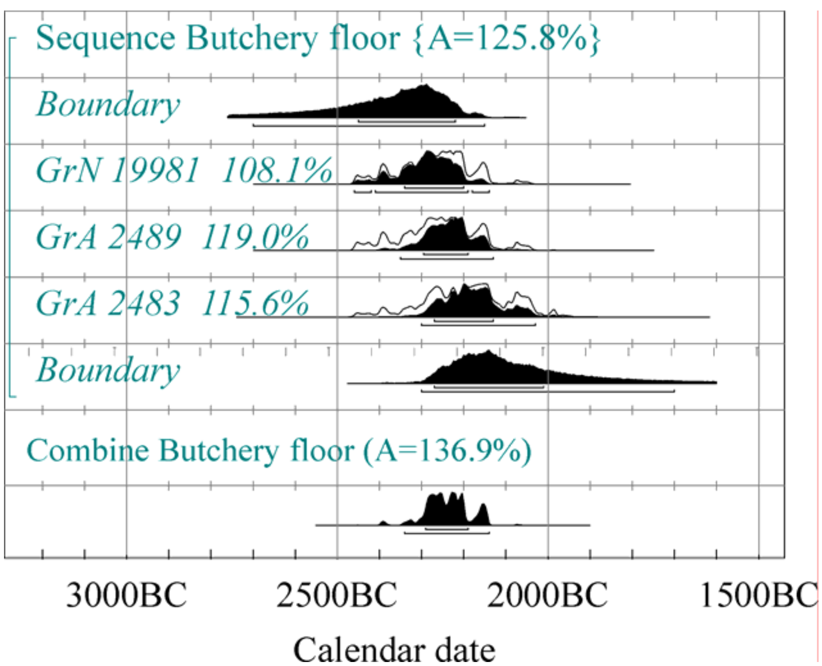

Figure 14. The dates for the animal butchery floor area modelled as a sequence, ordered by excavation depth. The full sequence falls easily between 2300 and 2150 BC. If the probability of the three dates is simply combined it can be seen to focus tightly on the same century in which the ashmound formed, with a high agreement index. Data from Paddayya et al. 1995; Paddayya 2002.

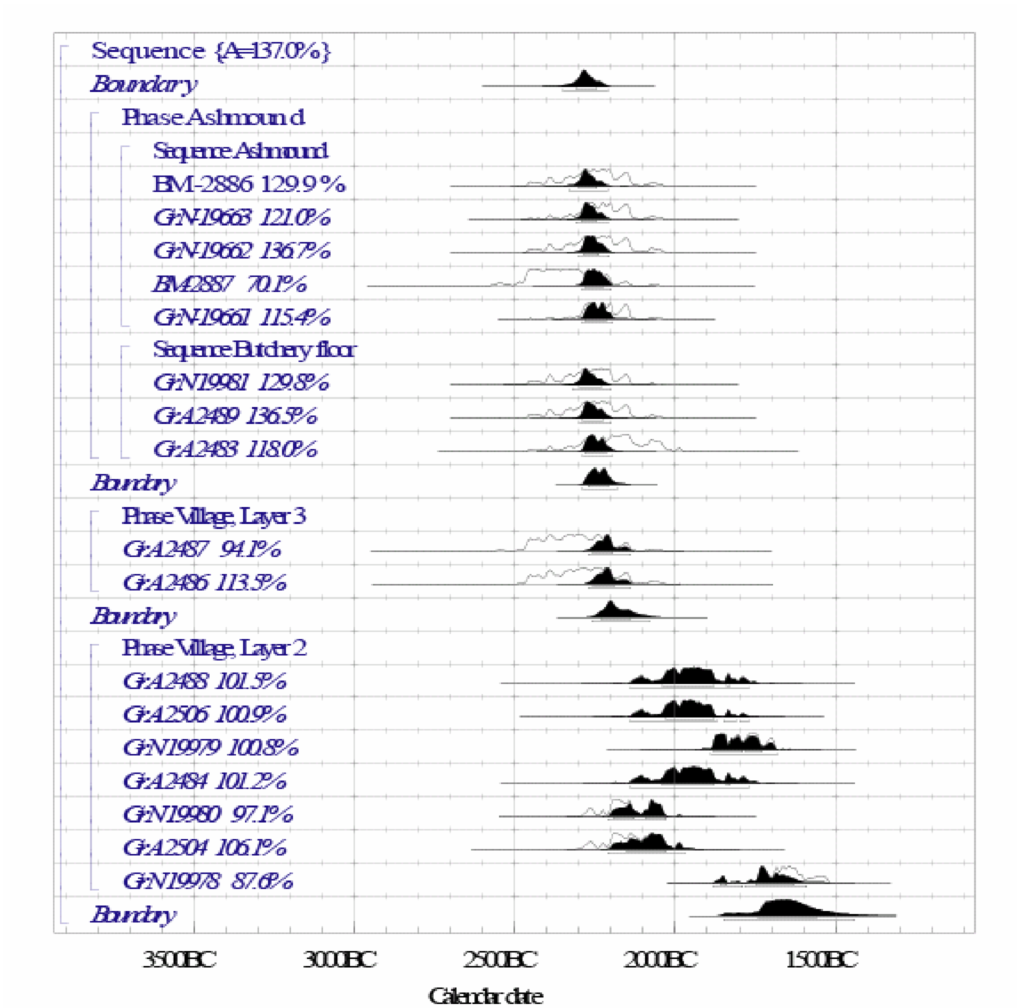

Figure 15. A Bayesian model of the entire Budihal sequence in which it is assumed that the village occupation only begins as ashmound formation ceases. Statisically this is highly plausible, with an agreement index of over 137%. Thus on current stratigraphic and chronometric evidence there is no clear reason to assume village and ashmound contemporaneity, although it still seems archaeologically plausible that ashmound formation and settlement occupation began together, and a model that assumes that Layer 3 and the ashmound are the same phase gets an agreement index of 149%. Both models were run with the exclusion of GrA2503, which reduces agreement indices substantially, and may represent an ‘old wood’ sample (cf. Figure 9, above).

Context	Material	Lab no.	Radiocarbon age	d13C (o/oo)
SAN 1147 Megalithic pit fill	Seed: *Lablab purpureus*	R 28680/1	2973 ±35	-22.69
SGK.98A-4 Earliest *Lablab*, megalithic	Seed: *Lablab purpureus*	R 28680/5	3042 ±30	-22.39
SAN 1157 (upper ashmound)	Wood charcoal	R 28680/2	3441 ±30	-24.77
SAN 1157 (upper ashmound)	Seed: *Hordeum vulgare*	R 28680/6	3361 ±40	-23.15
SAN 1166 <1137> (structure within ashmound)	Seed: *Triticum* sp.	BA04390	3505 ±30	
SAN 1191	Seed: *Hordeum vulgare*	R 28680/3	3536 ±30	-24.2
SAN 1204 (lowest ashmound)	Seed: *Triticum* sp.	R 28680/4	3550 ±40	-23.09
SAN 1204 (lowest ashmound)	Seed: *Ziziphus* cf. *mauritiana*	BA04391	3550 ±30	

Table 4. New chronometric evidence from Sannarachamma Hill. Dates were performed by 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. Carbon fractionation measures were not included in the Peking report.

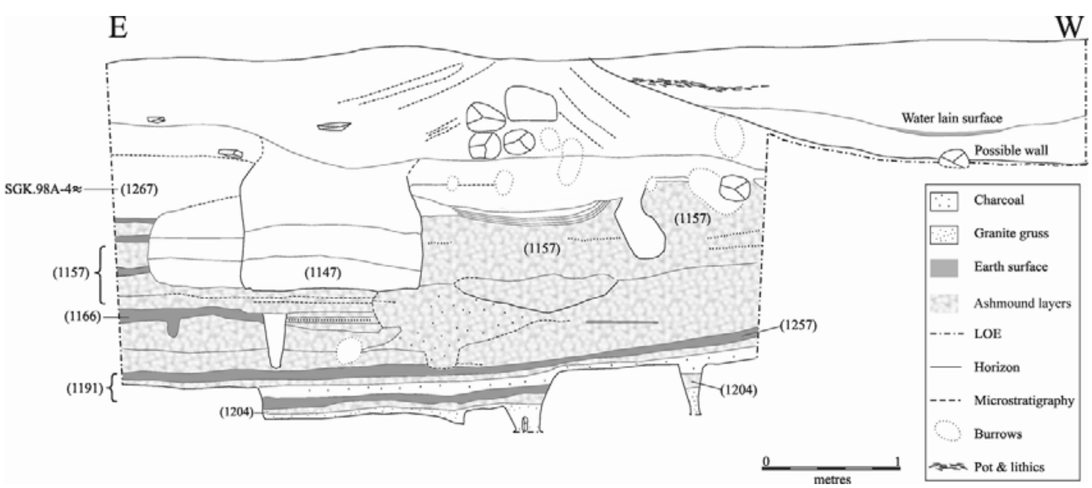

Figure 16. Stratigraphic section of Sannarachamma Trench 10, with dated layers labelled. The sampled context from 1998 (SGK.98A-4) is indicated in terms of it probable stratigraphic equivalence with (1267). Although excavated as a single unit, (1191) was noted in section to consist of 4 thin sublayers, including and upper floor (1257), and charcoal rich silt and an ashmound layer above another floor.

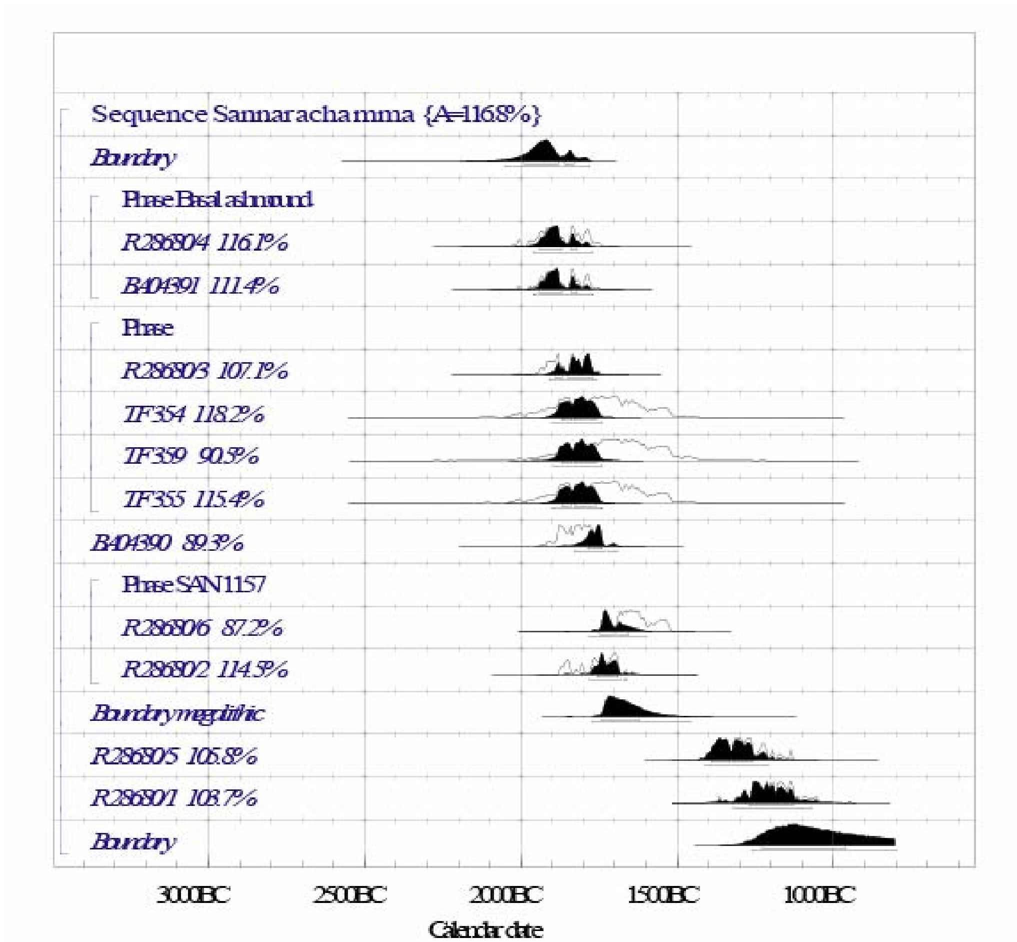

Figure 17. A calibration of the Sannarachamma dates (Table 4) incorporating the 1969 dates (from Ansari and Nagaraja Rao 1969).

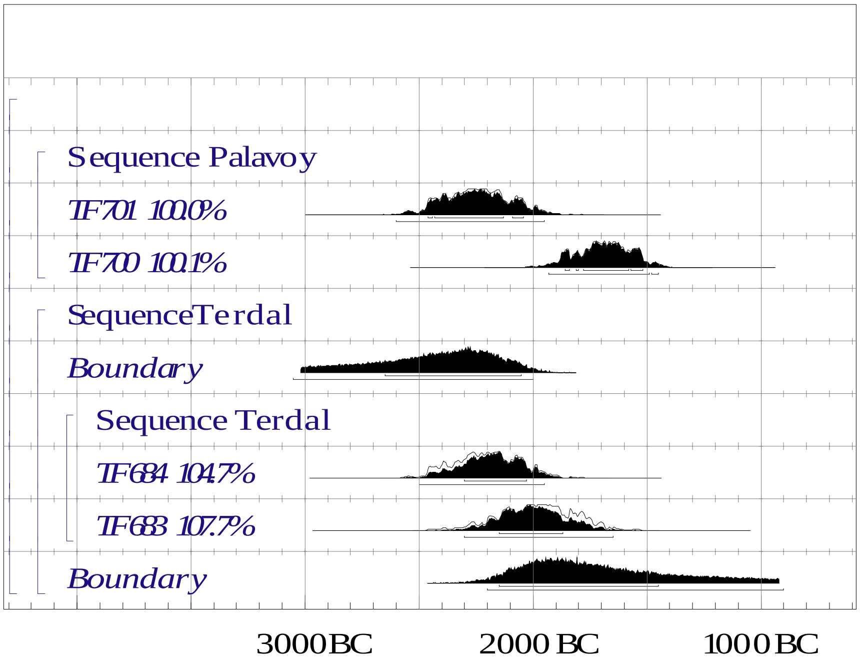

Figure 18. Calibrated radiocarbon dates from Terdal ashmound. and Palavoy Ashmound. Data from Reddy 1976; Possehl and Rissman 1992; Agrawal 2002.

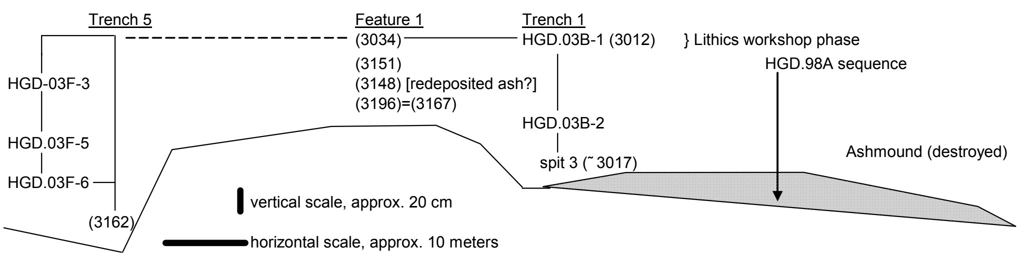

Figure 19. Simplified stratigraphic matrix, relating radiocarbon samples, and schematic representation of horizontal variation in bedrock topography at Hiregudda Area A, on a NW-SE transect, facing north. Location of the, archaeobotanical sequence HGD.98A is indicated (see Fuller et al 2004; Korisettar et al 2001b).

Area/ Trench	Context	Material	Lab no.	Radiocarbon age	d13C (o/oo)
A/1	HGD.03B-1 (=3012)	Seed: Lablab purpureus	R 28680/14	3058 ±30	-21
A/1	HGD.03B-2 spit 3 (≈ 3017)	Seed: Triticum sp.	R 28680/15	3282 ±35	-24.05
A/5	HGD.03F-3	Seed: Lablab purpureus	R 28680/16	3235 ±30	-22.97
A/5	HGD.03F-5	Seed: Hordeum vulgare	R 28680/17	3382 ±35	-21.65
A/5	HGD.03F-6	Seed: Macrotyloma uniflorum	R 28680/18	3250 ±30	-24.07
A/5	Tr. 5 (3162)	Wood charcoal	R 28680/7	3371 ±35	-24.36
A/9 =HGD.03 C	F. 1 (3034) (≈3012)	Wood charcoal	R 28680/8	3042 ±30	-24.83
A/9	F. 1 (3148) (redeposited ash)	Wood charcoal	R 28680/9	3433 ±35	-23.94
A/9	F. 1 (3151)	Wood charcoal	R 28680/10	3314 ±30	-24.98
A/9	F.1 (3167)	Wood charcoal	BA04392	3340 ±30	
A/9	F. 1 (3196)	Wood charcoal	R 28680/11	3346 ±30	-24.59
D	D (4027)	Wood charcoal	R 28680/12	3027 ±30	-25.53
D	D (4040)	Wood charcoal	R 28680/13	3019 ±40	-24.87

Table 5. New chronometric evidence from Hiregudda. Dates were performed by 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. Carbon fractionation measures were not included in the Peking report.

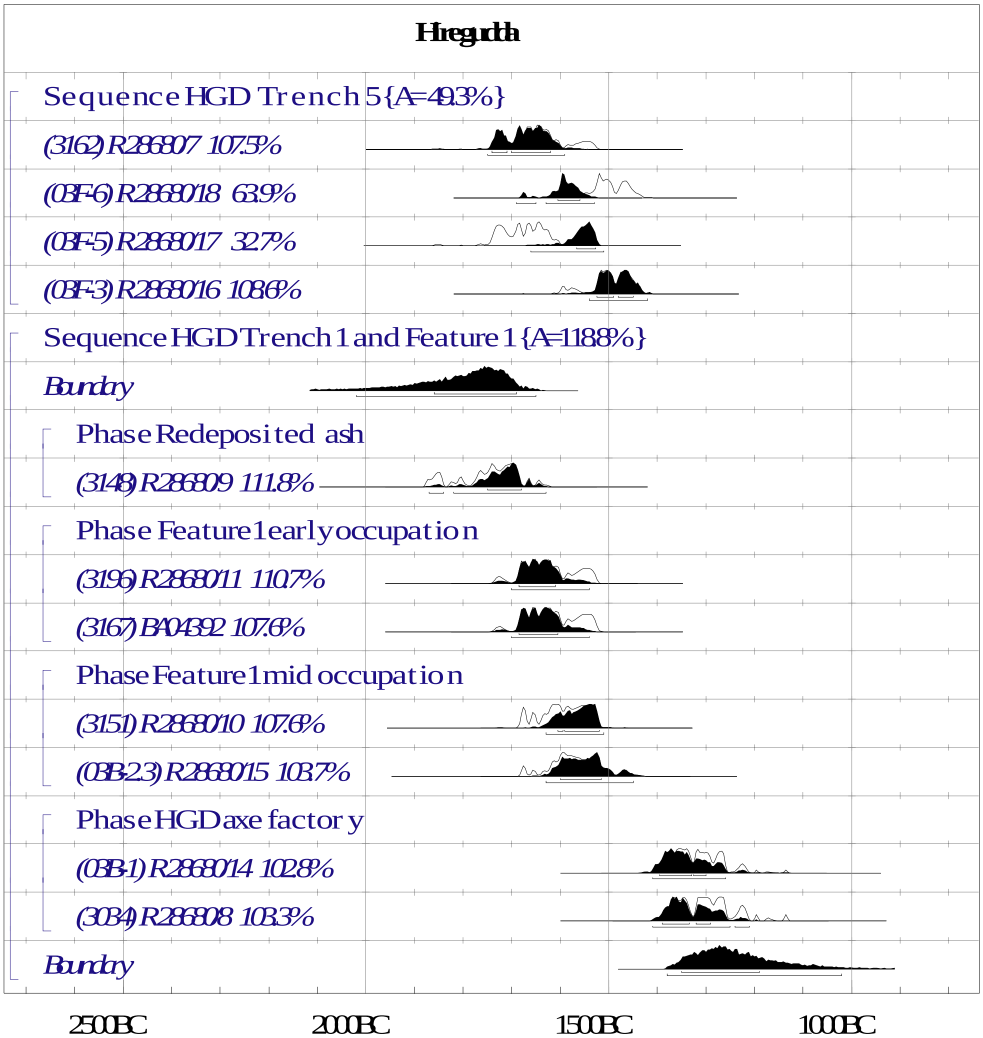

Figure 20. Calibrated dates from Huiregudda Area A in a Bayesian model based on stratigraphic relationships (data from Table 5, cf Fig 19).

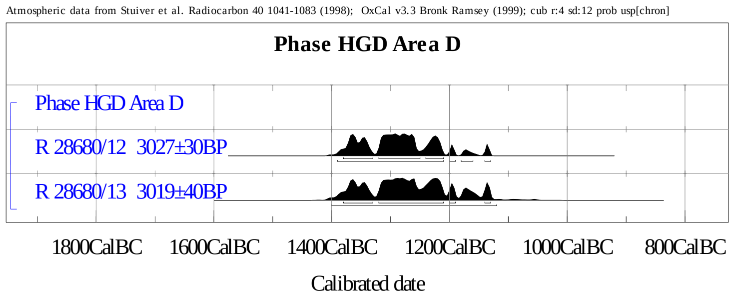

Figure 21. Calibrations of two dates from the excavations at Hiregudda Area D. The upper one represents a layer that sealed three pits, including two pits containing burial urns. The lower date is from the fill of the third pit, which contained grinding equipment (data from Table 5).

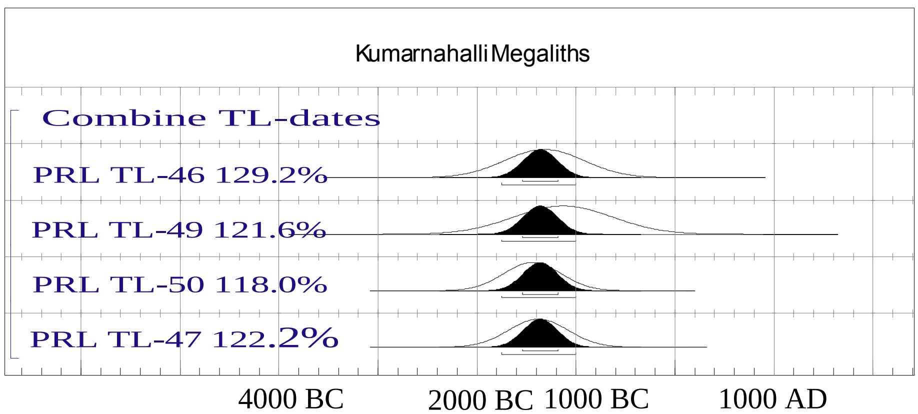

Figure 22. Thermoluminesce dates on ceramics from Kumarnahalli megalithic sherds, showing the combined focus of their probabilities on the earlier 13th century BC (data from Singvi et al 1991).

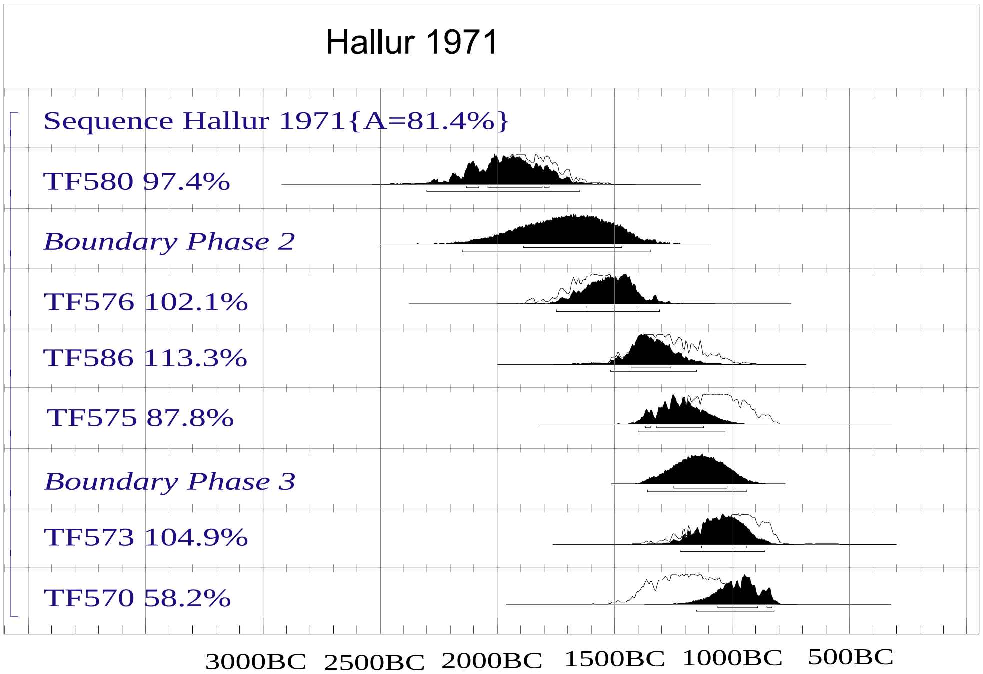

Figure 23. Bayesian calibration of the radiometric evidence from Hallur in stratigraphic order with transitions between phases modelled. Phase 3 represents the megalithic period.

Context	Material	Lab no.	Radiocarbon age	d13C (o/oo)
HLR.98A-7	Seed: Lablab purpureus	BA04499	3300 ±40	
HLR.00 +30cm	Seed: Macrotyloma uniflorum	R 28680/29	3221 ±30 BP	-22.34
HLR.00 +50cm	Seed: Lablab purpureus	R 28680/30	3154 ±30 BP	-23.01
HLR.98B	Seed: Gossypium cf. arboreum	R 28680/31	2709 ±30 BP	-23.99
HLR.98B	Seed: Macrotyloma uniflorum	BA04393	2835 ±30 BP	

Table 6. New chronometric evidence from Hallur

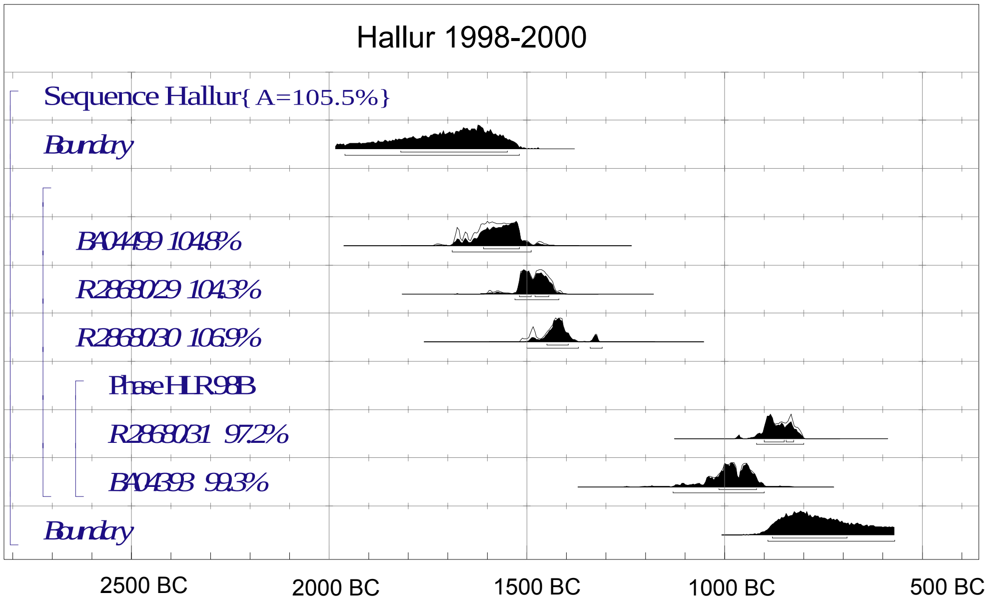

Figure 24. Calibration of new dates from Hallur (data from Table 6). These include two direct dates on Lablab purpureus, an African domesticate (BA04499, R 28680/30), and cotton (R 28680/31).

Context/Level	Material	Lab no.	Radiocarbon age	d13C (o/oo)
VPM.03A-3	Seed: *Macrotyloma uniflorum*	R 28680/24	3029 +/- 35 BP	-25.25
VPM.03A-2	Seed: *Ziziphus* cf. *mauritiana*	R 28680/25	2974 +/- 30 BP	-23.15

Table 7. New chronometric evidence from Velpumudugu

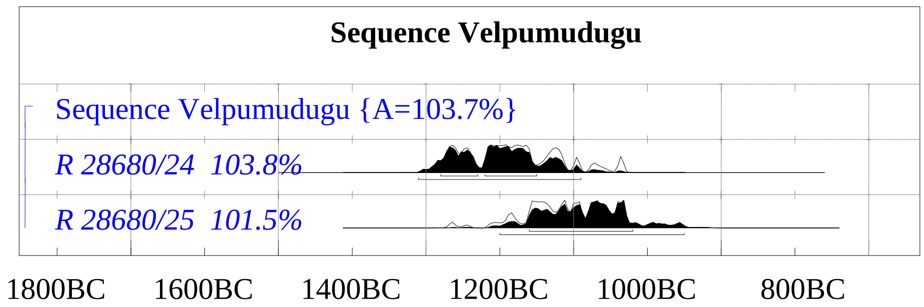

Figure 27. Calibration of new dates from Velpumudugu (data from Table 7).

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 8. Site life-histories of ashmound sites, including dating evidence discussed in this paper.

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