Chapter 16

The Megalithic Landscape of Central Sulawesi, Indonesia: Combining Archaeological and Palynological Investigations

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Abstract

Central Sulawesi is characterized as both a hot spot of biodiversity as well as a megalithic landscape with a clustered distribution of megalithic sites. One of the main goals of this preliminary evaluation is to untangle the development of societies with monumental constructions in relation to environmental change and diversity. Initial results presented in this paper highlight the research potential of a combined investigation of ecological data and archaeological surveys. The conclusions are based both on pollen data as well as data regarding the spatial distribution and architecture of megalithic "*kalambas*" (jars), combined with the interpretation of the few available excavation reports. The palynological investigations concentrate on a comparison of on-site and off-site cores, to identify both the general vegetation dynamics as well as local anthropogenic influences that correspond with the environment. The archaeological considerations are based on spatial analyses and typological comparison of the architectural features of 15 sites (including 93 megaliths) in the Besoa valley and particularly at the Pokekea site. As a result of this work, we assume the existence of one central prehistoric domestic site with ritual activities and an associated spread of smaller hamlets, reflected in the distribution of megaliths for each basin. However, the chronological framework of the development is still uncertain. Anyhow, we offer a *terminus ante quem* for the erection of *kalambas* of around AD 830. Hypothetically, an initial opening of the landscape around 50 BC, as indicated by pollen analyses, may be linked to a possible early construction phase of the monuments. However, the combination of both environmental and preliminary archaeological analyses results in the first interpretations of ecological and monumental developments in the central Sulawesian region.

Introduction

The Besoa valley (60km²) study area is situated in a UNESCO biosphere reserve surrounding the Lore Lindu National Park in central Sulawesi, covers 218,000ha and holds the largest remaining mountainous rainforest of Sulawesi. Vegetation gradients range from lowland rainforests below 1000m to upper montane and elfin forests above 2000m (Kirleis *et al*. 2011: 166). The temperature is constant over the whole year. Lowland temperatures vary between 26° and 32°C during the day, whereas they decline about 6°C for every 1000m elevation towards the highlands (Guide Lore Lindu 2001: 3).

The prominent archaeological features in the Besoa valley are monuments, the megalithic *kalambas*, that indicate long-term human impact on the landscape. The *kalambas*, with their elaborate decorated disc-shaped lids, are unique megalithic features of central Sulawesi [Fig. 16.2]. They are supplemented by cup-marked stones and ornamented stelae of animal- and human-shaped figures in relief (Kaudern 1938; Dwi Yani Yuniawati 2001: 20). Sparse remains of, potentially later disturbed, *kalamba* infillings indicate that the *kalambas* were used for burial purposes (Haris Sukendar 1980a). Urn burials excavated in the vicinity of *kalambas*, typological considerations of retained artifacts, stylistic parallels, and first results of radiometrically-dated pollen analysis from two *kalambas* point to construction times before

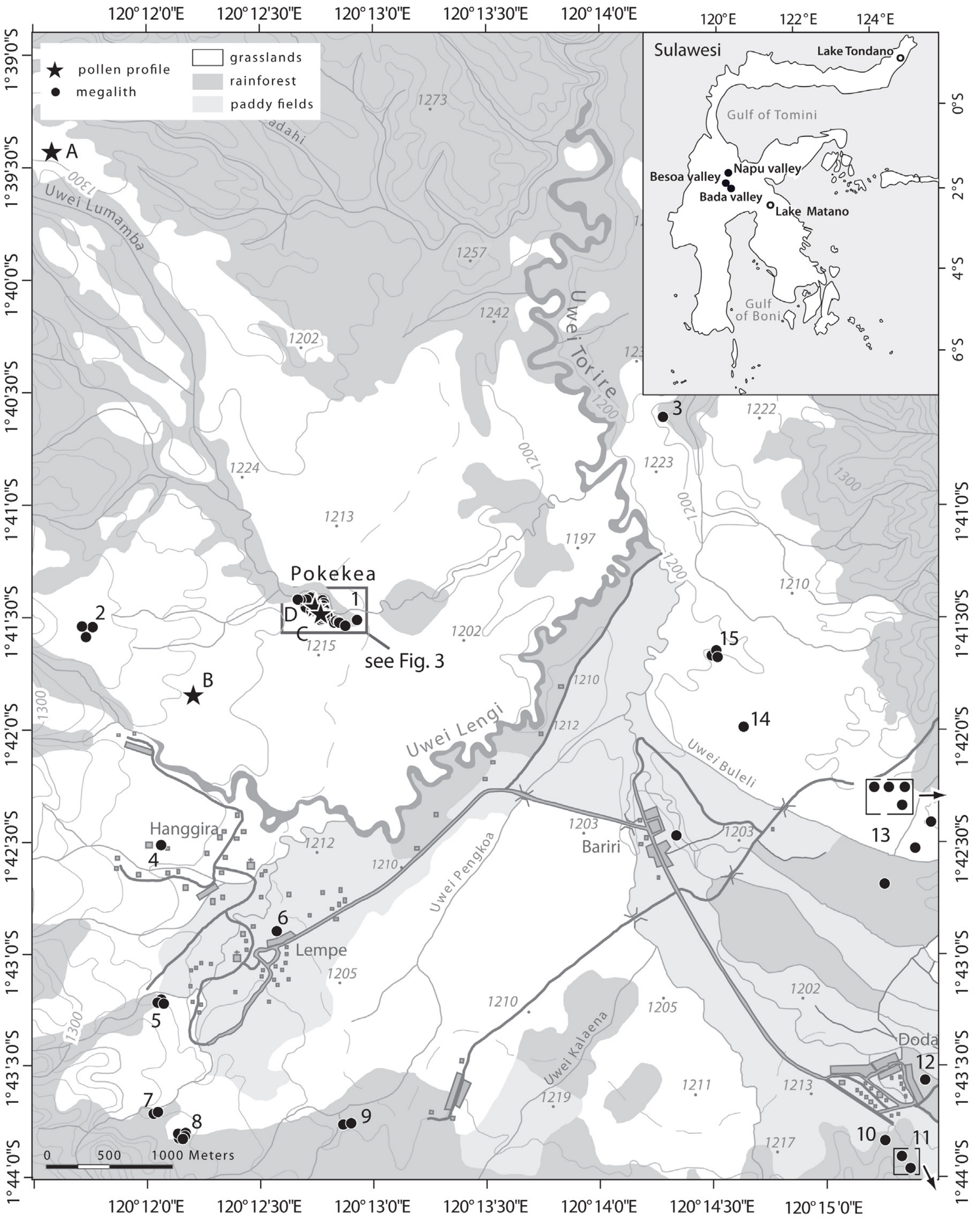

Fig. 16.1: Locations of Bada, Besoa and Napu valleys and two further important palaeo-ecological sites in Sulawesi, Indonesia, and distribution of archaeological and palaeo-ecological sites in the Besoa valley (Map: W. Kirleis / I. Reese).

1. *Pokekea*: 60 features (21 *kalambas*, eight lids, one stela, four boulder complexes, seven cup-marked stones, 19 blocks); 2. *Pongkore*: three *kalambas*; 3. *Bangkeloeha*: one *kalamba*; 4. *Hanggira*: one block; 5. *Entovera*: three *kalambas*; 6. *Lempe*: one block; 7. *Lempe 2*: two *kalambas*; 8. *Padang Hadoa*: five *kalambas*; 9. *Pengkoa*: two boulder complexes; 10. *Doda-South*: one *kalamba*; 11. *Doda-Besoa*: two *kalambas*; 12. *Doda Village*: one block; 13. *Tadulako* and surroundings: seven megaliths (one stela, six *kalambas*); 14. *Padantanga*: one block; 15. *Masora*: three features (two blocks, one *kalamba*).

A Pollen profile Bariri Tower, BT [Fig.16.7], B Pollen profile Pokekea (POK) [Fig.16.8], C and D Pollen profiles MP-2a and MP-4a [Figs. 16.7 and 16.8].

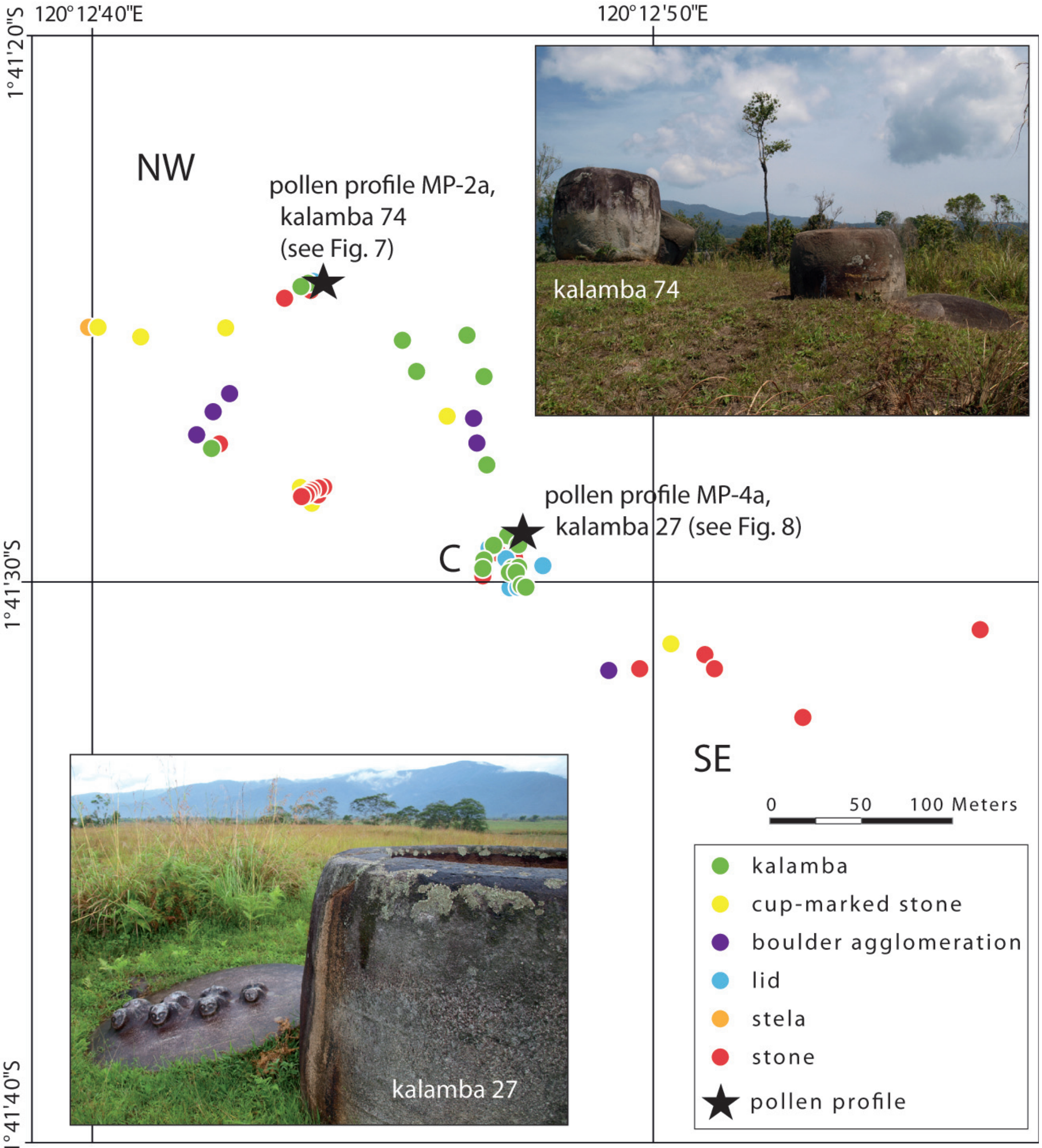

Fig. 16.2: *Kalambas* and lids at Pokekea, Besoa valley (Photos: W. Kirleis). *Kalambas* sampled for pollen analyses [*kalamba* 74 at the very left: see Figure 16.7, *kalamba* 27 at the very right: see Figure 8] (Source: W. Kirleis).

AD 1210 and before AD 830 respectively (Haris Sukendar 1980a, 1980b; Dwi Yani Yuniawati 2001: 28; Kirleis *et al*. 2011: 174). Megaliths and urn burials appear in several central Sulawesi valleys (Kaudern 1938; Bintarti 2000: 73), such as the Besoa, the Bada and the Napu valleys [Fig. 16.1]. Both previous and recent sondages revealed domestic waste in between the megaliths (Haris Sukendar 1980a; Dwi Yani Yuniawati 2001: 27; Dwi Yani Yuniawati *et al*. 2004). Therefore, most of the *kalambas* were probably constructed within domestic sites.

All archaeological data (location, size of sites and monuments, architectural types and decoration patterns) was combined in a dataset of 15 sites consisting of 93 megaliths [Fig. 16.1]. A quantification and qualification of the data provided first insight into possible interpretations of the archaeological record [Table 16.1]. A spatial analysis based on Thiessen polygon structures was conducted to identify aspects

Table 16.1: Megalithic and sub-megalithic features and design of the decoration in Pokekea (1), Bewa (2) und Masora (3). Sum of design appearance of each category is marked in brackets behind the site label

Design / Item Site no. (n)	Kalambas	Lids	Stelae	Dolmen / circles / Boulder complexes	Cup marked stones	Stones / Blocks	Grinding stones	Sum (n)
Human faces	1(8)	1(1)	1(1)		3(1)	1(1), 2(2)		18
Cup marks	1(1)			1(1), 3(1)	1(7), 3(8)	1(5)		16
Cup marks and beams	1(1)			1(1)		1(3)		5
Bands		1(1)		1(1)				2
4 bands	1(2)							2
5 bands	1(3)							3
6 bands	1(4)							4
7 bands	1(1)			1(1)				1
Animals		1(2)	1(1)		3(1)	1(2), 2(2)		8
Geometrical forms						3(1)		1
Hearts						3(1)		1
Squares					1(1)	1(1)		2
Central hollow					1(1), 3(1)		3(1)	3
Knob		1(5)						5
Circles						1(1)		1
Floral design						3(1)		1
Site	n	n	n	n	n	n	n	n
1 Pokekea	21	8	1	4	7	19		60
2 Masora	1					2		3
3 Bewa (Bada)	11		4	1	8	13	1	38

Source: C. Kortemeier / J. Müller.

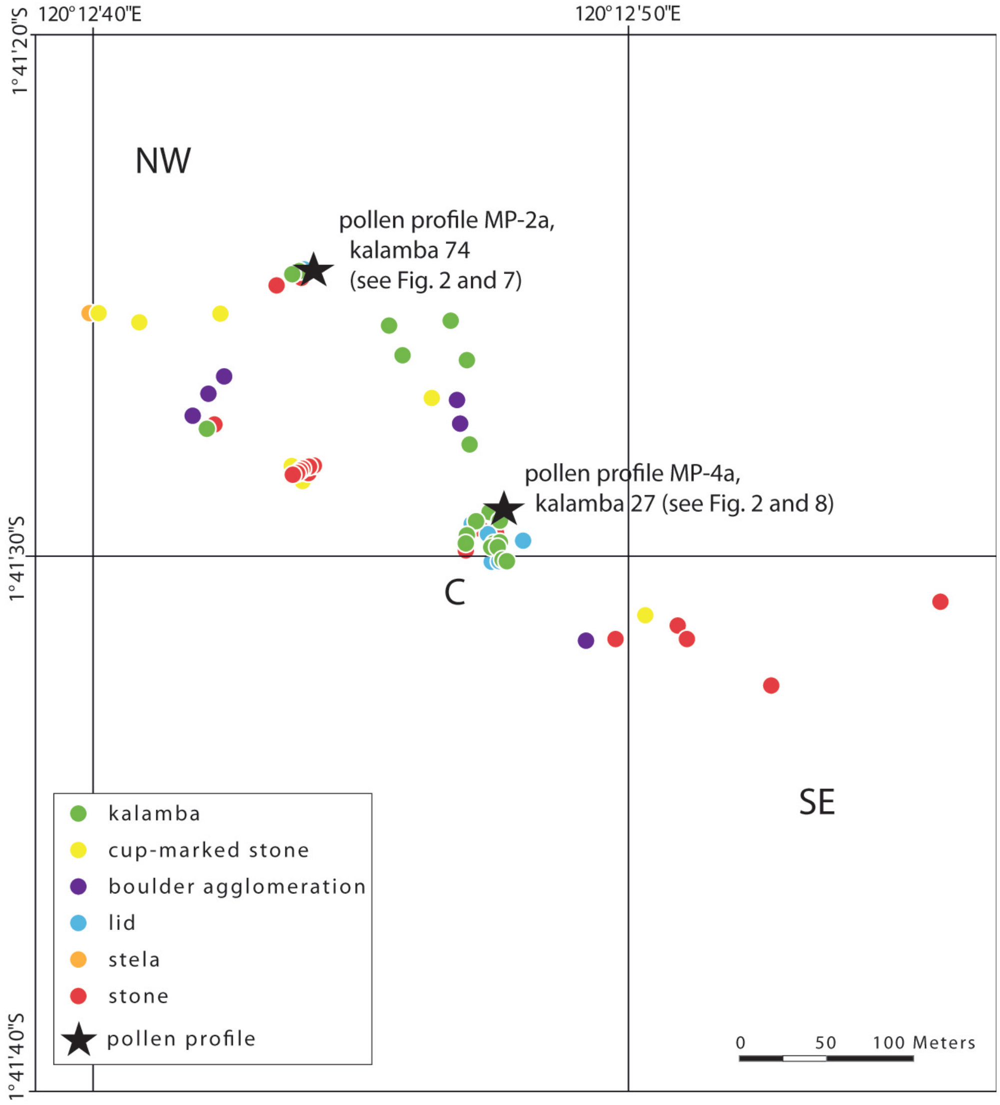

Fig.16.3: Spatial arrangements at Pokekea: Thiessen polygon structures, S 01°41'29.25'', E 120°12'48.08'' (Drawing: C. Kortemeier).

of the centrality and diversity of different sites [Fig.16.3]. Our study focuses on the Pokekea site (S 01° 41'29.52'', E 120° 12'48.08''), situated not only on a promontory offering a strategically favourable location along the bends of the rivers Lumamba and Lengi, but also surrounded by agriculturally fertile areas [Fig. 16.1]. This site shows the highest density of all the widely distributed megalithic and sub-megalithic sites in the valley.[1]

Pokekea offers the opportunity to carry out palynological investigations on peat from the immediate vicinity and on sediment in-fillings of the *kalambas*. The two short on-site core profiles and two landscape profiles, taken with a Russian peat corer (50cm length, 5cm diameter) during a sampling campaign in August 2006 by Wiebke Kirleis and Herrman Behling close to the archaeological remains, indicate past human-environment interactions and allow for deeper insight into the land-use of the first megalith-building Sulawesian societies. Original data from the two on-site cores is presented in this paper, while the off-site pollen analyses are summarised from a previous paper by two of the authors (Kirleis *et al.* 2011). As the latter show severe changes in the composition of past vegetation in the Besoa valley, one of our main research questions was whether a first fire clearance of tropical rainforest about 2000 years ago can be connected to the construction of megalithic sites.

Research history

Archaeological Research History

The research history since the late 19th century comprises expeditions, surveys and small excavations in central Sulawesi (Adriani and Kruyt 1898; Kruyt 1908; Heine-Geldern 1928; Kaudern 1938). Excavations by Haris Sukendar (1980a, 1980b) on sites in the Bada valley have shown that the *kalambas* were used as multiple burial containers. Fragments of human skeletons, skulls, teeth and pottery were discovered. Later observation of the bones showed that at least ten individuals must have been buried in one jar.

The jars are described as the "metal age megaliths" and as belonging to the metal ages of Southeast Asia (Bellwood 1979), featuring an ornamentation of anthropomorphic, zoomorphic and geometric figures (Kaudern 1938; Whitten *et al*. 2002). In 2009, a visit by two of the authors (Kirleis / Müller) confirmed the possibility of further investigations in the area. The first results of earlier data collections are summarized by one of the authors in a thesis at Kiel University (Kortemeier, in prep.).

Archaeobotanical Research History

There is a general lack of archaeobotanical studies in Indonesia, especially in Sulawesi. Recently, several pollen profiles from central Sulawesi have been analyzed within "Stability of Rainforest Margins, STORMA" research program funded by the German Research Foundation (Cook *et al*. 2008a, 2008b; Kirleis *et al*. 2011; Haberzettl *et al*.). These pollen records can be interpreted in the face of human development in central Sulawesi from the mid-Holocene onwards. Further reconstructions of vegetation history through pollen analyses on terrestrial material have been carried out in Borneo (Hunt and Rushworth 2005), Halmahera (Papay Suparan *et al*. 2001), Java (Stuijts 1993; van der Kaars *et al*. 2001; van der Kaars and van den Bergh 2004), Kalimantan (Anshari *et al*. 2001; Eko Yulianto *et al*. 2005), New Guinea (Hope 1983; Haberle *et al*. 1991), Sumatra (Morley 1982; Flenley 1988; Maloney 1990; Flenley and Butler 2001) and Sulawesi (Gremmen 1990; Dam *et al*. 2001; Hope 2001). Along with investigations of marine cores (van der Kaars 1991, 1998; Wang *et al*. 1999; van der Kaars *et al*. 2000, 2010) which give further information on climate variation and sea-level fluctuation, the results display quaternary vegetation development in Indonesia in the long run, focusing on major shifts and drifts like the Pleistocene-Holocene transition. Two main pollen records from Sulawesi deal with long-term vegetation developments and show hardly any evidence of human activity: palynological research at Lake Tondano, North Sulawesi [Fig. 16.1], displays the last 33,000 years of vegetation history; at the transition from the Pleistocene towards the Holocene an increase of precipitation and temperatures furthered the spread of forests and the rising of lake levels. During the Holocene, human influence was marginal (Dam *et al*. 2001). Another pollen record from a swamp near Lake Matano, in South Sulawesi [Fig. 16.1], shows vegetation events reaching back 75,000 years, demonstrating a forest spread during the last glacial maximum (LGM) about 20,000 years ago. Smaller amounts of micro-charcoal without any further hints of anthropogenic influence suggest that natural fires occurred throughout the Holocene (Hope 2001).

Archaeological Survey

In the central Sulawesian basins of Bada, Besoa and Napu, 147 megalithic features were observed, of which 93 cluster in the Besoa valley (Kaudern 1938; Haris Sukendar 1980a; Dwi Yani Yuniawati 2004; Kortemeier, in prep.).

To conceptualize the development of the megaliths and related sites in combination with completed and in progress environmental studies, we concentrated our inquiries on the Besoa valley and the site of Pokekea. The collected data from about 15 sites with 93 megalithic features enabled us to start first analyses [Fig. 16.1; Table 16.2].

The Pokekea site contains the overall highest number and the widest spectrum of megalithic features in central Sulawesi. The 60 megaliths feature six categories of architectural types: cup-marked stones, *kalambas*, *kalamba* lids, stelae, ornamented and unornamented blocks and agglomerations of diverse blocks [Table 16.1]. Most prominent are the 21 *kalambas*, the highest number in other category.

Table 16.2: Radiocarbon dates, Pokekea on-site pollen profiles. Radiocarbon dates were calibrated with the Calib radiocarbon calibration program based on the dataset for the southern hemisphere (Stuiver and Reimer 1993; McCormac *et al*. 2004)

	Lab. code	Depth [cm]	Material	^{14}C age, BP	cal BP (mean; 2σ-range)	AD (mean; 2σ-range)
Jar no. 74	Erl-10584	23	seed	1251 ± 31	1120 (1052-1184)	830 (766-898)
	Erl-10585	43–44	bulk	1197 ± 30	1050 (968-1141)	900 (809-982)
Jar no. 27	Erl-11305	32–33	bulk	949 ± 45	740 (678-804)	1120 (1033-1215)
	Erl-11306	45–46	bulk	890 ± 39	830 (735-917)	1210 (1146-1272)

Source: W. Kirleis.

Spatial Arrangements at Pokekea

The spatial arrangement of the 60 megaliths at Pokekea was analyzed using GPS coordinates for each megalith [compare Table 16.1]. As a first attempt to map spatial patterning, Thiessen polygons were calculated [Fig.16.3]. As calculated from the point accumulations and the size of polygons, the polygon structures indicate that the main cluster marks the centre of the Pokekea site, showing a *kalamba* as the most central point. In addition to its centrality, the spatial tendency of the site was revealed, using the evaluation of the standard deviation of all megalithic features (standard deviation ellipse). The entire site extends to the Northwest, retaining the majority of megalithic features in the North and West of the plain. However, as cup-marked stones appear only in the northwestern and the southeastern areas but not in the central jar cluster of Pokekea, different activities might also be responsible for intra-site differences. The whole Pokekea site measures about 5ha (judging from the current distribution of megaliths), and is more densely agglomerated than other sites in the Besoa valley [Fig. 16.1].

Thus, Pokekea presents itself as a unique site, not only in the appearance of the megaliths, especially the *kalambas* and lids, but also in the dissociation from other sites or single *kalamba* finds. The site lies slightly detached from other sites in the landscape, but not only with regards to the spatial arrangement in the valley. Such a large accumulation and density of features cannot be detected at any other site, nor can a higher appearance of *kalambas* representing the outstanding block agglomerations be located at any other area. In addition, some decorative designs of the Pokekea jars are unique to the entire Besoa valley and even in central Sulawesi — circles and knobs, which belong to the lid decoration, only occur at Pokekea. Furthermore, the design combination of cup-marks and beams can also be considered as specific to Pokekea (Kortemeier, in prep.: 51–2). Internal site structures might indicate a focus on the central cluster of jars [Fig.16.4]. To summarize, Pokekea represents the highest concentration of megalithic monuments in the Besoa valley, including those which are the most elaborate. While the average number of known megalithic structures at each Besoa site is 6.2, Pokekea possesses almost ten times this number. The 60 Pokekea megaliths are part of an arrangement of 147 megaliths in the three central Sulawesian basins with megaliths. Both this agglomeration of megaliths, as well as the outstanding combination of megalithic types and decoration elements, may indicate that Pokekea had a central function within the Besoa valley. Further research might also indicate if we are dealing with a population agglomeration, an economic and / or a ritual centre in contrast to smaller dispersed sites.

Decoration Patterns and Ritual Architecture

The *kalambas* differ in arrangement, ornamentation and size [Fig. 16.2]. Of the 21 *kalambas* at Pokekea, 52% are in a vertical position and ornamented, thus representing the most common situation. 29% of the jars are vertical without decoration, while 19% represent other variations, like sub-surface jars. Some *kalambas* are situated very close to lids. This indicates that the specific lids might belong to a certain

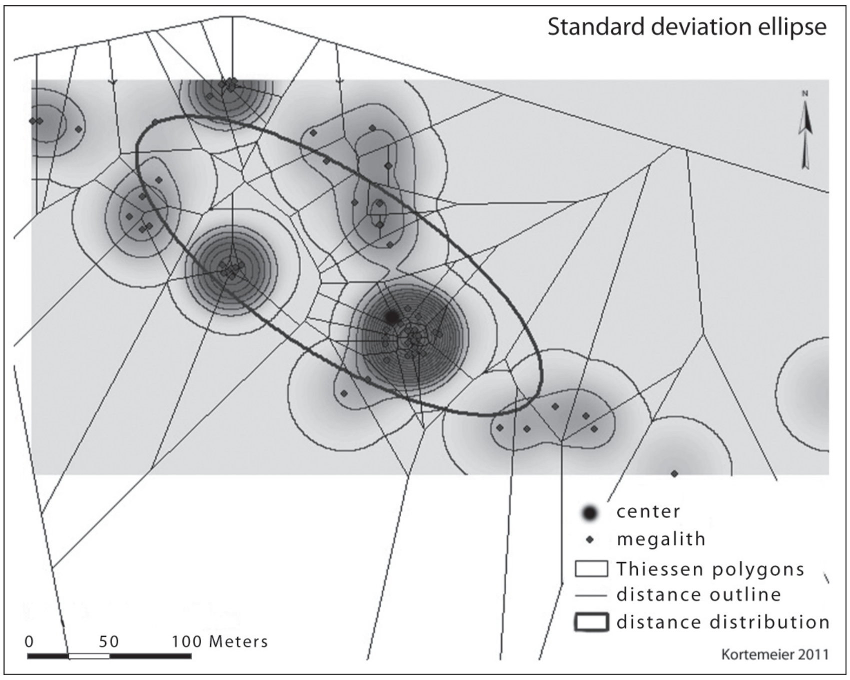

Fig.16.4: Pokekea site, detail map. NW northwest area; C central cluster of jars; SE southeast area (Drawing: C. Kortemeier / I. Reese).

kalamba, although the 21 jars exceed the number of lids, of which there are only eight (Kortemeier, in prep.: 25, 32). The tallest jars' measurements go up to 2m in height and 1.2m in diameter, while the smallest specimens are about 0.7m in height and 0.5–0.6m in diameter (Kaudern 1938: 50). Different styles of decoration exist among the ornamented *kalambas*. Besides two *kalambas* with cup-marks and one with human faces, 10 of the 21 jars carry a band design, although the number of bands differs between the jars. Only three out of the 13 decorated specimens demonstrate a more complex design. One *kalamba* shows more than 25 cup-marks along its thickened rim. Another jar is also engraved with cup-marks, but accompanied by a "radiating beam" decoration. One of the largest *kalambas* has eight human faces along its upper lip (Kortemeier, in prep.: 25–6). Out of the eight *kalamba* lids at Pokekea, three have decoration, while five are unadorned. Seven lids are located directly in the central cluster of jars and the five undecorated lids have a central knob of varying size. Out of the three decorated ones, two show animal carvings, either arranged in a row across the lid, or radiating around the rim [Fig. 16.2]. The design of these animal carvings resembles the geometric style of the human face designs found on one *kalamba* and several stelae. Another lid features a human face decoration similar to the ones found on the largest *kalamba*. The animal figures supposedly resemble monkeys, appearing similar to the Black Sulawesi Macaque (*Macaca nigra*) which inhabits the entire island. The notion of the animal figures representing monkeys is also shared by the natives of Sulawesi (Kaudern 1938: 69).

Besides Pokekea with its 60 megalithic finds, 14 other sites comprising 33 megaliths are known from the Besoa basin. Of these smaller sites, Masora is one of the most remarkable with respect to decoration and uniqueness [compare Table 16.1]. The Masora site (01°41'54.5" S, 120°14'32.0"E) is also situated close to the river Lengi. Two large ornamented blocks resemble a facial design, either human or animal. The two megaliths are arranged as counterparts and the engraved faces appear to look at each other.

Interpretation Model

Without clear ideas about the chronological development of the above-mentioned sites, it is difficult to evaluate their meaning. As a working hypothesis, we will describe most of them as former settlement sites, with both the size and the decoration of the megaliths representing the effort which could be invested by each household unit / lineage into the display of their ancestry (compare e.g. Bloch 1971; Bradley 2002). Thus, *kalambas*, stelae and other features display economic and socio-political abilities. The agglomeration of such megaliths, in Pokekea for the Besoa valley and close to Bewa for the Bada valley, contrasts to a dispersed distribution of sites with fewer than five megaliths in the above-mentioned valleys. Observed stylistic differences between sites and whole basins (Dwi Yani Yuniawati 2001: 21; Kortemeier, in prep.: 52–3) might be due to individual or kinship differences within the population (for theoretical background, compare Dietler and Herbich 1998; Müller 2006). As an alternate hypothesis, a higher number of megalithic features might not only represent a larger population agglomeration, but may also suggest a longer duration of sites. Therefore, larger sites might also be places and landmarks where traditions are formed and political decisions made. Nevertheless, without better knowledge about the duration and chronology of the sites, the reconstruction of economic, political, and social developments remains unclear. This is also true of the environmental preconditions limiting the demographic size within these valleys. Besides the vague archaeological hints towards a general typo-chronology of the sites, palaeo-ecological analyses with absolute dating represent a first step towards a better consideration of chronology and environment.

Environmental Reconstruction from On-Site and Off-Site Pollen Analyses

The On-Site Pollen Analyses at Pokekea

Two short on-site core profiles, taken from the interior of two different *kalambas* at the Pokekea site, were evaluated to supplement the archaeological investigations [Fig. 16.2]. Samples were taken and prepared in the laboratory of the University of Kiel and analyzed following standard laboratory methods (Fægri *et al*. 1989). Pollen percentage calculations are based on the terrestrial pollen sum. Depending on pollen preservation, 150 to 200 terrestrial pollen grains define the total for the calculations conducted using Tilia 2.0 software. Visualization is carried out with Tilia Graph View. Both profiles present sediment in-filling rather than in-situ natural soil development. From radiocarbon dating on bulk sediment and one seed, a chronological classification for the cores, but also a *terminus ante quem* for the *kalambas*, are determined [Table 16.2].

Pollen diagrams MP-2a [Fig.16.5] and MP-4a [Fig.16.6] feature similarities in pollen-contributing taxa and in lithology layers. The color of the lowest parts, which is darker than the upper parts in both profiles, is notable. Since material from the surrounding areas was filled into the *kalambas*, the soil characteristics were also transferred into the jars. The two major soil types of central Sulawesi are vertisol and ferralsol, soils characteristic for eluviations and alteration processes. The leaching of humic substances, silicon dioxide and nutrients, leads to secondary quartz sand in the upper soil sections, enforced by intense rain events. These secondary quartz sand fragments appear in both sediment cores in the form of mica. Where the *kalambas* were not covered by lids, further eluviation processes occurred in the interior of the jars after intense rain events, and also had an influence on the sediment core colors (Kortemeier, in prep.).

Pollen diagram MP-2a [Fig.16.5] is divided into five pollen assemblage zones (PAZ). Two radiocarbon dates show an age of around AD 900 for the bottom of the core and AD 830 for the section with the high amounts of micro-charcoal [Table 16.2]. The lowermost PAZ 74-1 is dominated by Poaceae including cereals (the latter hidden in the pollen curve labeled Poaceae >37μm). Together, both curves make up an average of 70% of the terrestrial pollen. *Grewia*, *Evodia*, *Boehmeria*, *Castanopsis*-type and *Macaranga* are the main contributors of tree pollen; furthermore *Dodonea*, *Rutaceae* and *Acer* also occur. *Typha* represents the wetland plants, Davallia, the ferns. The assemblages of PAZ 74-2 are similar, but a slight decrease is observable within the main tree pollen taxa. In PAZ 74-3 *Blumeodendron*, *Ilex* and Rosaceae supplement the tree pollen. Most obvious however, is the jump in the number of micro-charcoals and non-pollen palynomorphs (NPP) in this PAZ. While the values for NPP and micro-charcoal decline in the course of PAZ 74-4, the highest diversity in tree pollen and herbs is shown. The uppermost PAZ 74-5 shows the highest tree pollen values of the whole record due to an increase of *Macaranga* pollen input; Poaceae, including cereals, reach only about 40% of the terrestrial pollen.

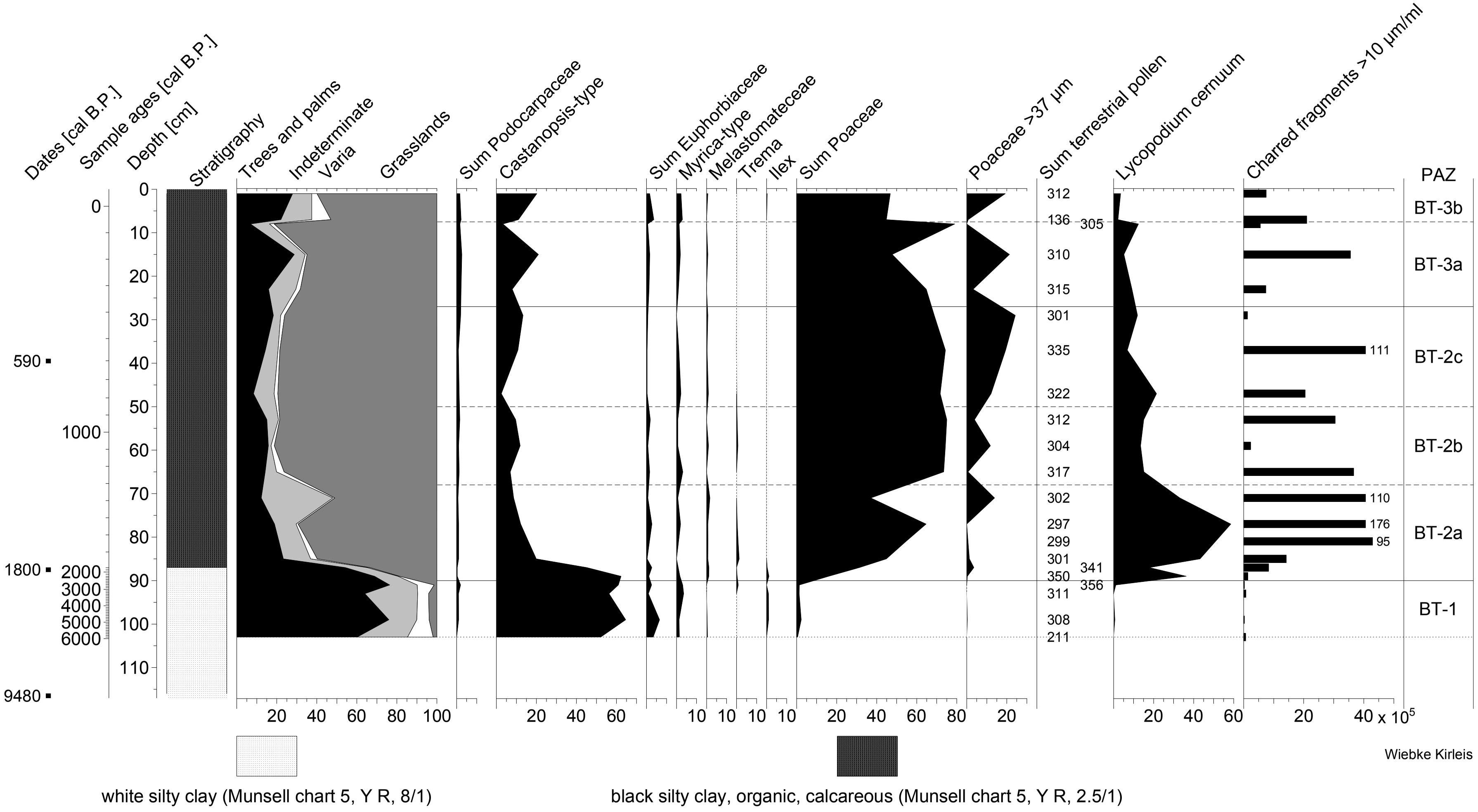

Fig.16.5: Percentage pollen diagram MP-2a, *kalamba* 74 at Pokekea [see Figure 16.2] (Diagram: C. Kortemeier).

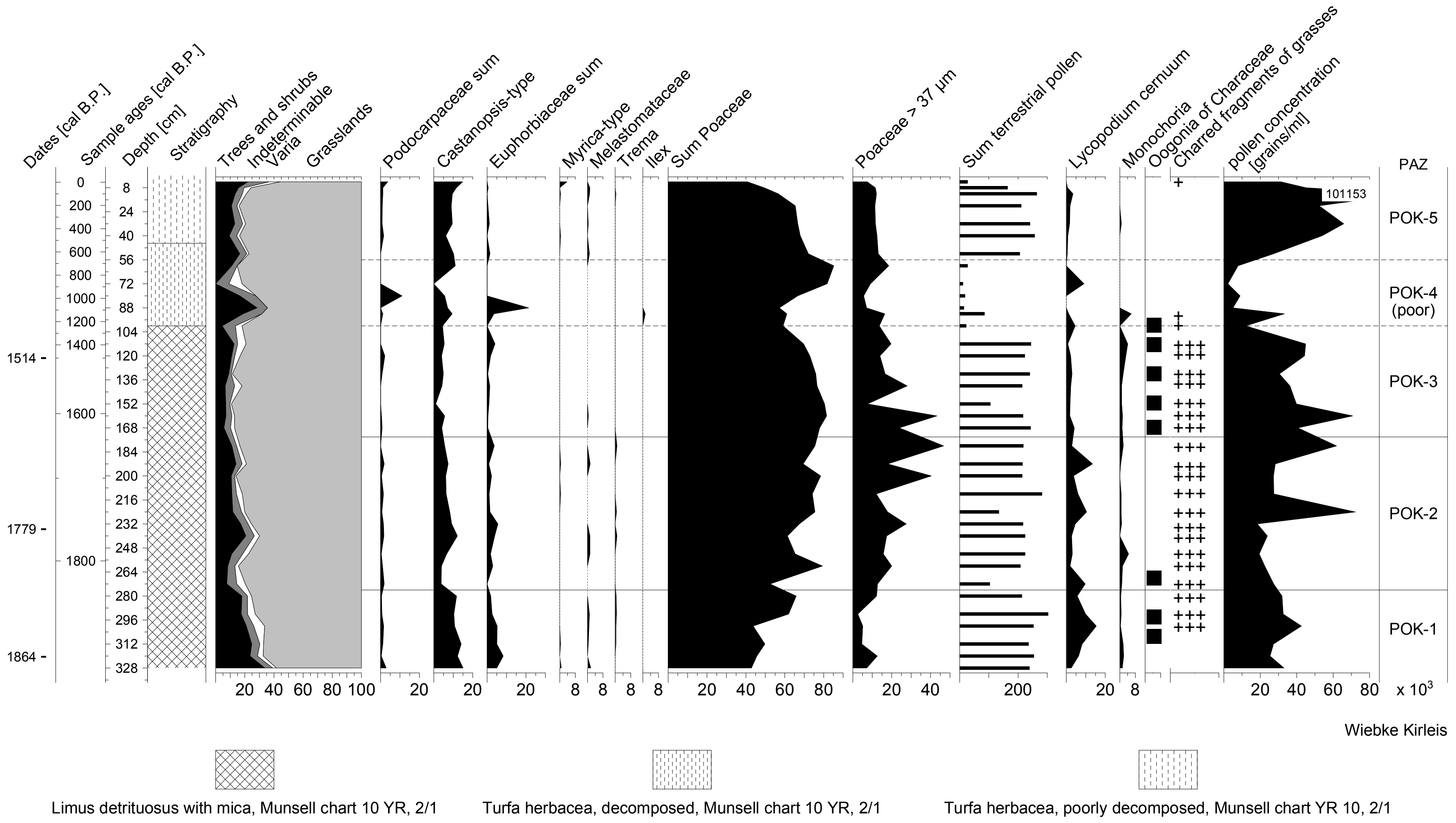

Fig.16.6: Percentage pollen diagram MP-4a, kalamba 27 at Pokekea [see Figure16.2] (Diagram: C. Kortemeier).

Pollen diagram MP-4a [Fig.16.6] is divided into four PAZ. Two radiocarbon dates show an age around AD 1210 for the bottom of the core and AD 1120 for the section with higher amounts of micro-charcoal [Table 16.2]. In the following section we consider both as an indication for the youngest age of this *kalamba*, although the dates are inverse, because the range of dates of the standard deviations overlap. The lowermost PAZ 27-1 is characterized by Poaceae and cereal values summing up to around 60% of the terrestrial pollen. *Boehmeria*, *Macaranga* and *Euphorbia* dominate the tree pollen spectrum, which is completed by *Acer* and *Castanopsis*-type. Micro-charcoal values are low (max. 25%). Towards PAZ 27-2, tree pollen declines; *Acer* is the most important remaining species with values up to 8%, and all the other tree species almost disappear. Poaceae and cereals are dominant, spores and NPP increase slightly and micro-charcoal reached the highest values of the entire record. PAZ 27-3 shows the highest diversity of tree pollen for this record. *Macaranga*, *Euphorbia*, *Acer*, *Castanopsis*-type, Rosaceae, *Evodia*, *Mallotus*, *Acalypha*, *Blumeodendron*, *Grewia* and *Ilex* occur, but *Boehmeria* is no longer present. Nevertheless, Poaceae plus cereals dominate the assemblages while the values of micro-charcoal decline. The uppermost PAZ 27-4 is characterized by tree pollen values reaching 70%; the main contributors are *Macaranga*, *Evodia*, *Mallotus* and *Grewia*. Poaceae plus cereals show with about 30%, the lowest values of the whole record. Micro-charcoal is absent.

Three interpretation models were developed based on three initial assumptions that were tested through palynological investigations of both on-site pollen profiles. The first assumption is that all bone remains from the former use of the jars (as burial containers) must have been expelled before new material was filled in. In both pollen cores, no anthropogenic remained, charred bones or floral grave goods were found instead. The second assumption is that the *kalamba* content is anthropogenically filled-in material from the surrounding areas. The third assumption concerns the cover of the jars; whether a lid covered the jars or not is uncertain, as wooden or braided plant lids might have existed as well. Thus we assume that the *kalambas* were initially closed with a lid. We made three attempts at interpretation based on these initial statements.

Results and Interpretation: Anthropogenic or Natural Kalamba Fillings?

Model one assumes contemporary anthropogenic filling layers, two filling sections for MP-2a and three filling sections for MP-4a. The first filling for MP-2a (pollen assemblage zone (PAZ) 74-1 to PAZ 74-2) comprises pollen of primary lowland forest (*Grewia*, *Boehmeria*, *Mallotus*, Asteraceae liguliflorae), pollen of montane rainforest (*Evodia*, *Castanopsis*-type, *Macaranga*, *Dodonea*) as well as pollen of open landscape areas (Poaceae, *Typha*). This range of pollen either suggests pollen input from the region by wind or sediment collection from montane and lowland forest regions as well as the surroundings of the site. The occurrence of *Typha* either indicates an influence from the nearby river vegetation or shows the growth of *Typha* directly in the *kalamba*, if the jar was not covered by a lid. Some taxa such as *Grewia*, *Boehmeria* and *Dodonea*, which possess useful traits, could have been intentionally deposited. The second filling of MP-2a (PAZ 74-3 to PAZ 74-5) indicates open landscape, forest clearance by fire and the creation of secondary forest. Noticeable is the appearance of new taxa (*Ilex*), which were not present in the first filling section. The uppermost section resembles modern pollen rain and shows a local pollen signal. In particular, *Macaranga*, as an indicator for shifting cultivation (Eichhorn 2006), reaches high values in PAZ 74-5.

The MP-4a pollen record is separated into three anthropogenic filling sections. PAZ 27-1 indicates species from primary lowland forest as well as those from montane rainforest and open landscape and thus is similar to the first infilling of the *kalamba* MP-2a. *Boehmeria*, *Macaranga* and *Euphorbia* show the highest values among the trees and shrubs. As already mentioned for MP-2a, the material of the first filling might have been collected from different areas or could be the result of regional pollen input through wind and insects. Noticeable in PAZ 27-2 is the decline or disappearance of the formerly present tree taxa, while the values of Poaceae remain high. The material of the second filling could have been taken from the nearby surrounding area, which explains the high amount of Poaceae and low values of tree pollen. The values of charred fragments again suggest fire events in the jar's surroundings. The diversity of taxa increases in filling section three (PAZ 27-3 to PAZ 27-4); this could be the result of collecting the filling material from different areas again, or might, similar to MP-2a, indicate modern pollen rain from the immediate vicinity of the jar.

A second interpretative model asserts that the different fillings of the *kalambas* were not necessarily connected. This model suggests different fillings related to ritual activities or cultural sacrifices. The *kalambas* would have then been emptied completely before they were filled again. The appearance of single pollen grains of particular species could be a result of earlier filling remains at the bottom or on the inner walls of the jars. The idea of emptying and refilling the *kalambas* during rituals, for example, burial rituals or for a sacrifice, could explain the partly incoherent taxa values. If the *kalambas* were used as sacrifice as well as burial containers, special cultural objects and special, meaningful plants were possibly placed inside the jars.

The third interpretative model assumes that the *kalambas* were never covered by a lid and that no anthropogenic filling took place. According to that model, the filling is comprised of pollen input in a naturally developed soil. This does not exclude the possibility that the jars could have been emptied at some point. The high amounts of charred fragments are then interpreted as remains from the burning of surrounding grasslands and paddy fields. The fumes could have been effectual enough to transport such an amount of charred fragments that makes the arrangement in layers found in the jars noticeable (Kortemeier, in prep.: 81–3).

Off-Site Pollen Analyses in Besoa Valley

The two off-site cores at 1km and 4km distance from the archaeological site Pokekea provide the first clue about the environmental development and human impact in the Besoa valley. Results from previous investigations by two of the authors (Kirleis *et al*. 2011) are summarized here.

Prehistoric Forest Clearing and Grassland Maintenance in Besoa Valley

The pollen record from the northeastern part of Besoa valley shows the regional vegetation dynamics of the last 10,000 years [Fig.16.7]. About 2,000 years ago, an abrupt change of the vegetation composition occurred. Montane rainforests, dominated by *Castanopsis* (or *Lithocarpus*, that is included into the *Castanopsis*-type), were replaced by grassland vegetation. As is shown by the high input of charred fragments, the vegetation shift was initiated and maintained through fire clearing. Meanwhile, slightly higher values of large Poaceae pollen grains and the secondary forest species *Trema* indicate human activity in the area. The new vegetation distribution in the valley, mainly open grassland with some patches of forest vegetation, remains stable. Slightly higher values of indeterminable pollen grains in the summary diagram (68cm depth) coincide with a drawback in the Poaceae curve. It reflects an effect of bad pollen preservation, causing a lot of crushed, hardly identifiable Poaceae pollen grains. Thus, the general tendency of vegetation dynamics shows that, until modern times, periodic burning has been hindering the recovery of montane rainforests.

Human Impact versus Climate Change

A second off-site pollen record originates from the floodplain of the meandering rivers Lumamba and Lengi in the vicinity of the megalithic Pokekea site. It completes the picture of the regional pollen record from the northeastern part of Besoa valley because it covers only the last 2000 years and thus has a higher time resolution [Fig.16.8]. In general, we have traced a human landscape with open grassland vegetation and cereal cultivation throughout the last 2,000 years. Small patches of montane rainforest with *Castanopsis* or *Lithocarpus* as main tree species are randomly distributed in the open vegetation area. However, the most striking feature of this pollen record is the section POK-4, where the sediment composition is changing from lacustrine to peaty at 100cm depth and the pollen concentrations decrease to nil due to hydrological variations. The poor pollen concentrations are the result of an elevated oxygen supply to the peat, due to water-level fluctuations, that furthers decomposition of organic material. Thus, the peat growth indicates an aridification of the floodplain area and may have been caused by

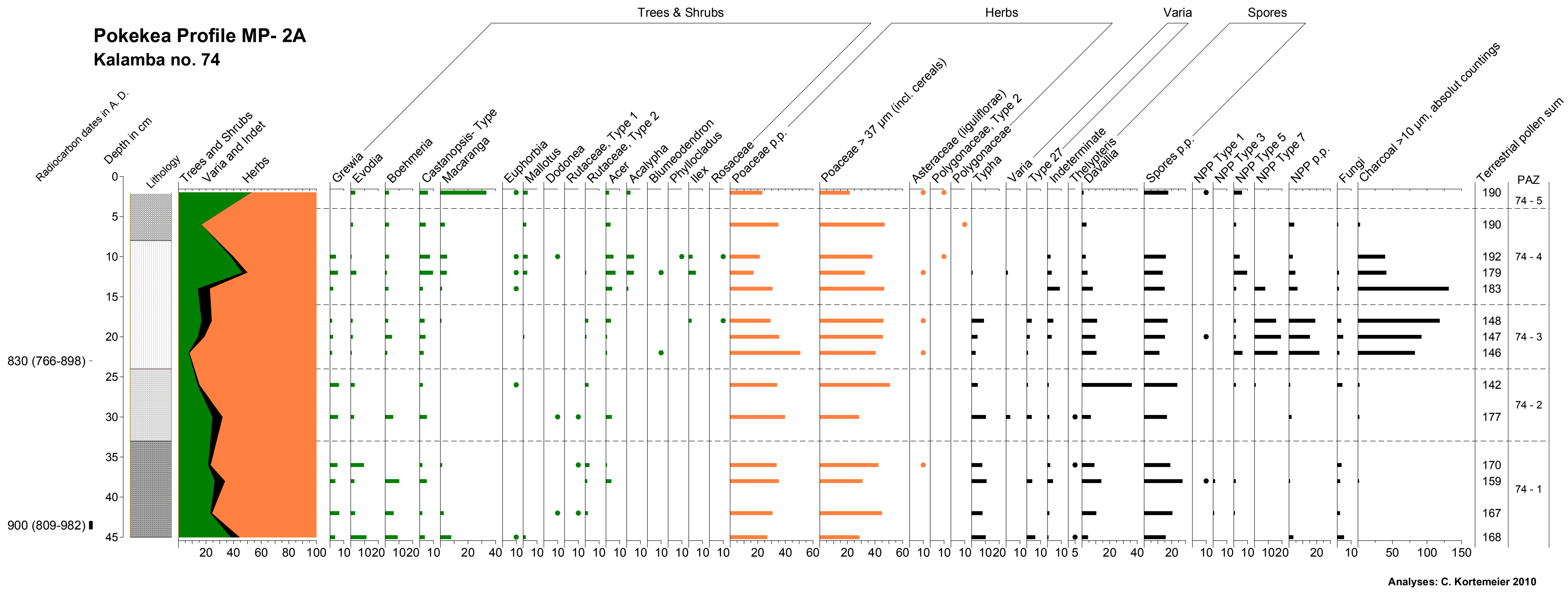

Fig.16.7: Excerpt from the percentage pollen diagram Bariri Tower, BT, 1331m a.s.l., 01°39.247'S, 120°11.364' E (Diagram: W. Kirleis).

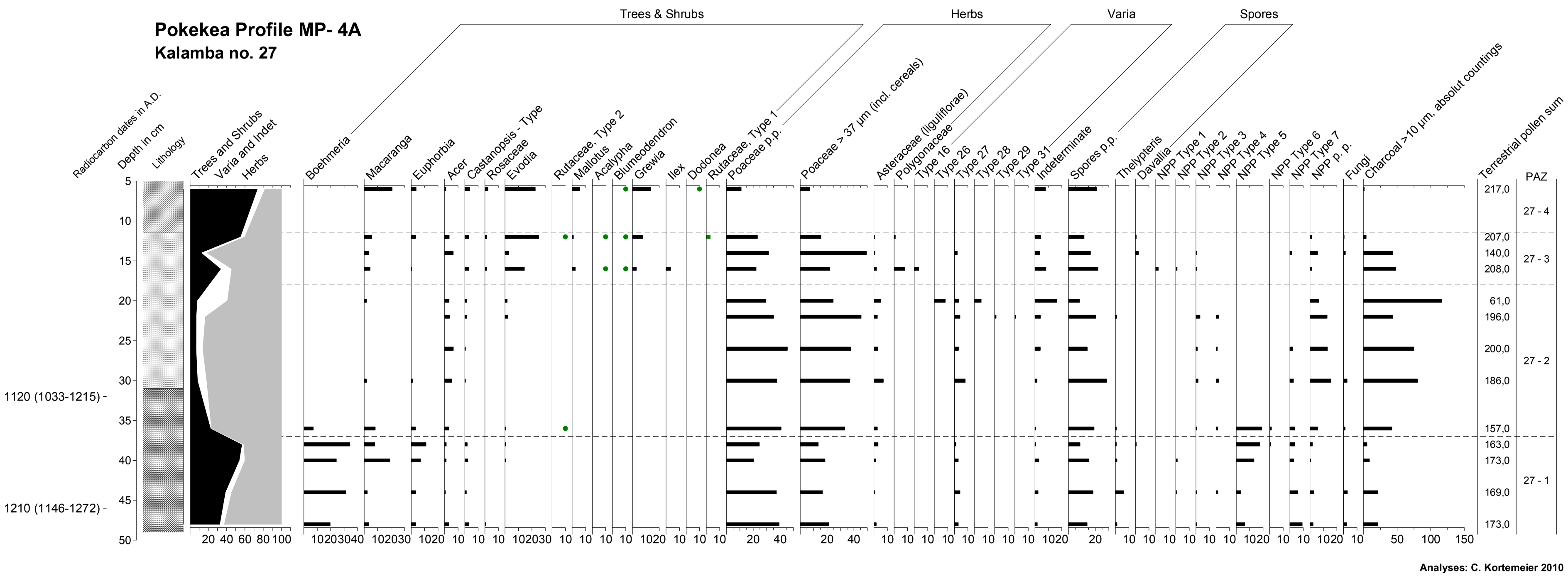

Fig.16.8: Excerpt from the percentage pollen diagram Pokekea, POK, 1,213 m a.s.l., S 01°41.530', E 120°12.758' (Diagram: W. Kirleis).

either human impact or drought. This drying-up of the floodplain coincides with human activity at the adjacent archaeological site of Pokekea. Radiocarbon dating applied to a seed from the interior of one large stone jar [Table 16.2] provides a *terminus ante quem* of around AD 830 for the site, whereas three radiocarbon dates on bulk material are accordant, despite being slightly younger. Even the erection of the monuments may have been contemporaneous with the hydrological changes in the floodplain. The people at the Pokekea site might have changed the courses of the rivers Lengi and Lumamba to get better access to the site. However, drought cannot be excluded as a possible trigger of hydrological changes in the floodplain. The drying could also be the result of a local or a regional to inter-regional phenomenon. However, variations in past micro-climates are difficult to trace. We have to consider a strong inter-linkage of climate events and human activity that intensify one another. The time resolution of the regional pollen record at Bariri Tower is not sufficient to elucidate small-scale changes.

On a macro-regional scale, records of sea surface temperatures (SST) in the western Pacific warm-pool (WPWP) are available. They show the dynamics of the El Niño Southern Oscillation (ENSO) and the East Asian monsoon (Oppo *et al*. 2009; Linsley *et al*. 2010) that both affect the environment of central Sulawesi as well as part of the Indonesian archipelago. Measurements of Mg / Ca ratios and $d^{18}O$ on planktonic foraminifera from the marine core MD9821-60 in the Makassar Strait provide data that show a 400-year-long period with warm temperatures and high salinities starting around AD 1000. This is equivalent to the northern hemisphere medieval warm period (Newton *et al*. 2006). This evidence is supported by measurements of $d^{15}N$ ratios from the marine core BJ8-03-102GGC from Kau Bay, Halmahera, where a basin stagnation was observed during the period AD 1000–250 that indicates less ENSO-like conditions (Langton *et al*. 2008). Evidence for a short-term drought period from ca. AD 1275-325 is shown by geochemical analyses on a laminated sediment core from East Java (Crausbay *et al*. 2006). However, this drought period may not necessarily have affected Sulawesi because of micro-regional differences. Furthermore, compared to the Pokekea record, the dating is slightly too late and older material was not available from the Java sediment core. More convincing is the correlation between stratigraphical change towards peat with good pollen preservation due to wetter conditions at 56cm core depth and the general cooling trend of the Little Ice Age (LIA) beginning around AD 1400. Again it is the foraminifera record of the Makassar Strait marine core MD9821-60 (Newton *et al*. 2006) that shows evidence for increased precipitation south of the equator during the LIA (AD 1400–850). Additional evidence for wetter climate during the LIA is available from El Junco Lake on the Galapagos Island San Cristobal (Sachs *et al*. 2009). This is in contrast to observations for the (sub-)tropical regions north of the equator, where increased aridity is indicated during the LIA (Wang *et al*. 1999; Watanabe *et al*. 2001; Haug *et al*. 2001; Sachs *et al*. 2009). The contrasting latitudinal precipitation / aridity pattern is interpreted as being indicative of a pronounced and rapid southwards displacement of the inter-tropical convergence zone (ITCZ) that reached its southernmost position during the LIA (Newton *et al*. 2006; Sachs *et al*. 2009). Direct evidence for drivers of the hydrological change in the catchment of the rivers Lengi and Lumamba in the Besoa Valley around AD 1000 is still missing. Future investigations have to show whether human-induced change of the river course or drought have to be taken into consideration as the main trigger of the hydrological change.

Bringing Together of On-Site and Off-Site Data at Pokekea

The environment of the Pokekea site offers the rare opportunity to combine palaeo-ecological on-site and off-site analyses. The three pollen profiles POK, MP-2A and MP-4A [Figs. 16.6–16.8] are available to evaluate human activity in the vicinity of the site.

For better comparison of the three profiles, we assume that, in general, the vegetation development shown in POK has been stable throughout the last 2000 years. Obvious changes in the record occur only due to hydrological variation around 1000 years ago that have resulted in poor pollen preservation (PAZ-4), but in the following POK-5, pollen composition resembles the previous PAZ (POK-1 to POK-3). Thus, in order to directly compare the records, which have different time depths, it was necessary to compress the data from the off-site pollen diagram. Presence-absence data of identifiable taxa were used for comparison, since this remained stable over the entire time-depth of the pollen diagram. Therefore, it

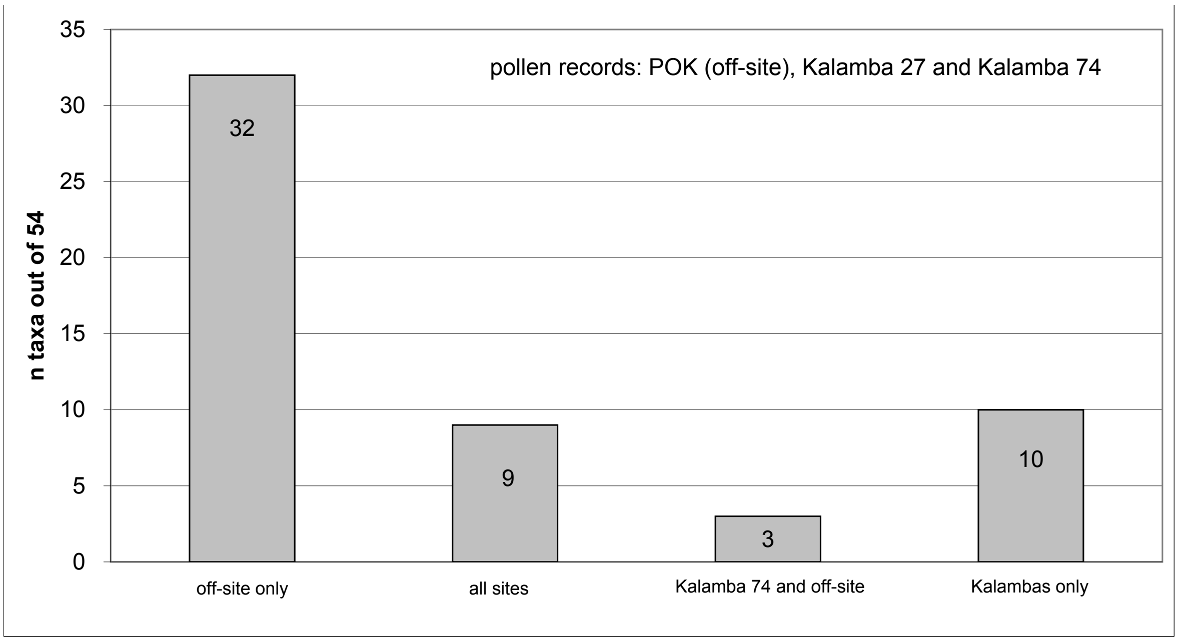

Fig. 16.9: Presence and distribution of pollen from 54 taxa in the on-site and off-site pollen profiles at Pokekea (Diagram: W. Kirleis).

can be treated as analogous to the information in the on-site profiles from the *kalambas*. The comparison of 54 taxa in all three records is shown in Figures 16.9 and 16.10. It is noticeable that 32 out of the 54 taxa only occur in the off-site profile and just nine are shown in all three records. However, the matching nine taxa include the main contributors to the pollen assemblages from the off-site pollen profile (like cereals or other Poaceae (named as Poaceae p.p., with p.p. = pro parte), and the *Castanopsis*-type that grow in the Besoa basin) and thus show the inter-connectivity of the sediments in the stone jars and the surroundings. Useful plants are included in those taxa occurring only in the *kalambas*; for example, the fibre plant *Boehmeria*, and *Dodonea*, of which the timber is used and red dye is produced from the fruit. Other plants can be interpreted as floral grave goods, such as the perfume plant *Evodia* with its leaves rich in essential citrus oil.

To conclude, the pollen assemblages from the sediment infillings of the *kalambas* show the "background noise" of the past local to regional scale vegetation development and in addition, hint to a deposition of particular plants in the jars.

Conclusions

Following the results of the radiocarbon dating of the two short on-site core profiles from the interior of the Pokekea *kalambas* (AD 766–898 earliest and AD 1146–272 latest [Table 16.2]), a *terminus ante quem* for the *kalamba* erections is given. Therefore the jars could date to the time period of Island Southeast Asia when metallurgy had already commenced, and they belong to the metal ages of Southeast Asia (Bellwood 1985: 313; Glover 1998 / 1999). It cannot yet be determined if the erection of the megaliths can be linked with the first forest clearance about 2000 years ago. However, in general, the Sulawesi megaliths are connected with the realm of death in the sense of building a monument for deceased ancestors (Dwi Yani Yuniawati 2001: 3, 20).

Regarding the spatial arrangement, the central character of some sites and the meaning of the size and extent of decoration of the megaliths, our initial investigations show that in each central Sulawesian basin, an agglomeration of megaliths (e.g. Pokekea) exists in contrast to the dispersed pattern of single or small groups of megaliths. We identify them as central domestic sites with ritual activities and probably

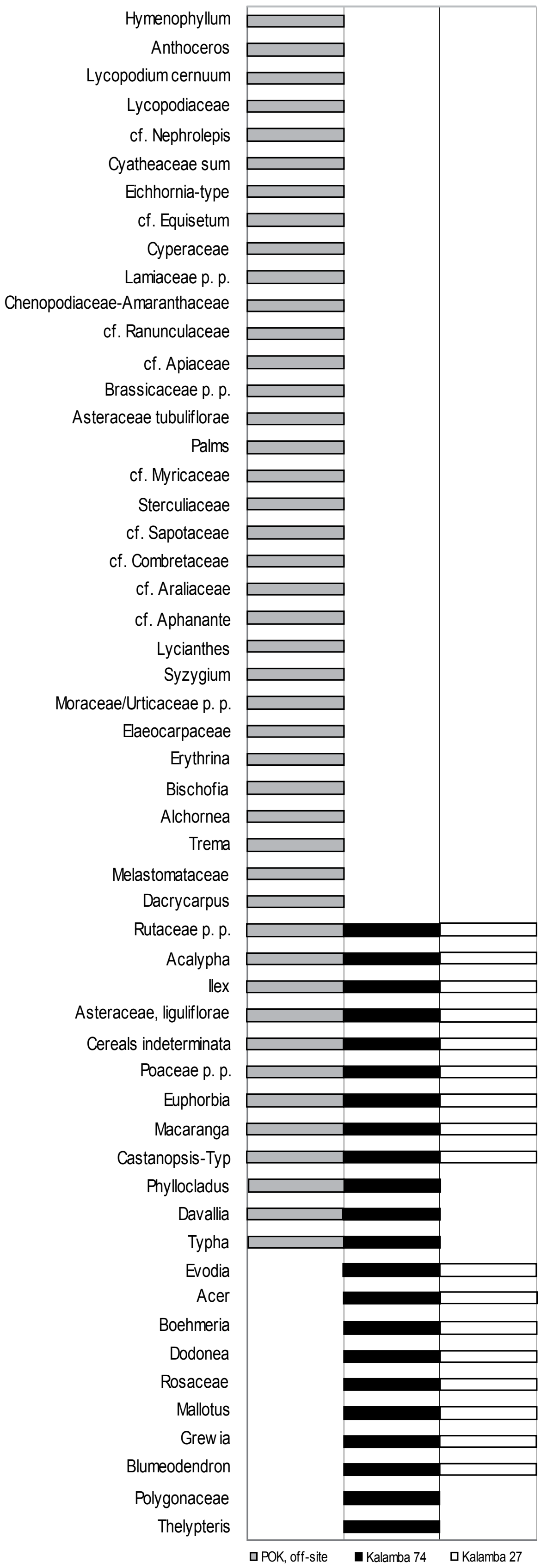

Fig. 16. 10: List of 54 taxa occuring in the on-site and off-site pollen profiles at Pokekea based on presence-absence data (Diagram: W. Kirleis).

an intra-site spatial organization, which could be the focus of further research.

Concerning the decoration patterns, band designs are characteristic of the Pokekea jars alone. The megalithic stones and the lid designs represent the local fauna, in most cases monkeys (Kortemeier, in prep.: 89). Thus, investment in ornamentation was used to display the local environment on monuments. The investment in energy, in terms of their large size (highly visible even from a distance) and elaborate decoration of *kalambas* probably displayed the power of Pokekea inhabitants within the basin. The material from the inside of the jars is possibly an anthropogenic filling, collected for cultural reasons; natural in-filling of the sediments is less probable. Intentional deposition of plants into the jars is a reasonable conclusion from the palynological evidence. Whether the *kalambas* were covered by lids cannot yet be determined; wooden discs or lids of braided plants might have existed and would have decomposed.

Parallels exist between the pollen assemblages in the *kalamba* interior and the Pokekea off-site pollen profile, such as high values of Poaceae and cereals in all three profiles. Euphorbiaceae, *Castanopsis*-type pollen and pollen of *Ilex* appear in all profiles, but with different values and in different time periods. One congruent factor among all profiles is the similar percentage (average 50–60%) of grasslands and herbs as compared to trees (Kirleis *et al*. 2011; Kortemeier, in prep.: 70–80). Furthermore, the off-site profiles show that human activity in the region, for about 2000 years, may be related to the megalithic sites. Changes in the peat composition of one profile further hint at climate deterioration towards the LIA, with the latter perhaps linked to the southwards shift of the ITCZ that leads to increased precipitation south of the equator.

This study has produced a preliminary chronological framework for the *kalambas*, as well as positing various hypotheses regarding their use and socio-economic relevance. Additionally, the palaeo-environmental data has shown clear evidence of human influence in the region. As such, these initial investigations on the megalithic landscape of central Sulawesi show a high potential for detailed studies aimed towards a deeper understanding of human-environment interactions in the region. Further research combining the two lines of evidence will also provide improved insights into the specific role the *kalambas* played for early Sulawesian societies.

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Note

1. In contrast to the widespread use of the term "megaliths" for Sulawesian standing stones, *kalambas* and boulder agglomerations, some of these would be called only "sub-megalithic" in European terms. These sub-megalithic features were constructed of boulders less than 1m in diameter or length, while boulders usually are labeled "megalithic" if their dimensions extend beyond the aforementioned standard. For simplicity, we use the term "megalith" for megalithic and sub-megalithic structures as is common in most of the literature about this Sulawesian phenomenon.

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