5. Archaeological and palaeontological excavations at Boa Lesa, central Flores, Indonesia.

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Abstract

This paper describes excavations at Boa Lesa, a site containing large-bodied *Stegodon florensis* fossils and stone artefacts in the Soa Basin of central Flores. The deposits at Boa Lesa are broadly contemporaneous (~840,000 BP) with those at the nearby site of Mata Menge. The faunal remains and artefacts accumulated in a fluvial channel near its confluence with a smaller tributary. Both channels are cut down into lacustrine deposits, perhaps signalling prolonged low lake levels.

5.1. Introduction

Boa Lesa occurs midway along a peninsula between two tributary gorges of the Ae Bha River. It runs 315˚ - 135˚ and has two prominent residuals on its crest: a higher ridge at the southern end overlooking the main river channel and a conical shaped hillock about 8 metres high. The high ridge grades into a lower section to the north (see Chapter 4: Fig. 4.2). The fossil-bearing deposits at Boa Lesa are exposed on the northeastern slope of the lower hillock. The elevation (333 m above sea-level) is the same as the fossil-bearing layer at Mata Menge some 685 m to the northwest. The slope has two terrace scarps with fossils exposed in the lowermost terrace and scarp. It is grassed with occasional trees in more sheltered areas.

Fossils and stone artefacts occur on the surface for at least 16 metres to the east of the excavations. These surface deposits give some idea of the extent of *in situ* material. The fossil and artefact-bearing layers are part of the middle sandstone member of the Ola Bula Formation (see Chapter 2). About 120 metres to the northeast, a 30 cm thick conglomerate layer at the same elevation designates a former creek bed ~3 metres wide. The conglomerate contains *in situ* stone artefacts, while an extensive artefact scatter occurs on the conglomerate surface and down the slope at 30˚ N.

Verhoeven excavated at the site in 1963 and his 10 x 8 metre cutting is still evident on the slope (Fig. 5.1). He recovered a large assemblage of *Stegodon* fossils and associated stone artefacts (Maringer

and Verhoeven 1970a, 1970b). The *Stegodon* remains can be attributed to *Stegodon florensis florensis* (van den Bergh, 1999; van den Bergh *et al.*, 2008).

We excavated at Boa Lesa from July 22nd to August 16th 1998 (Morwood *et al.*, 1999), and the following year from July 29th to August 5th. Our aims included:

a) Record the stratigraphy and other information on the context of deposition.

b) Ascertain whether stone artefacts occur *in situ in* the deposits associated with fossils, as claimed by Verhoeven.

c) Collect geological samples for dating, grain size analysis and palynological assessment.

d) Recover a representative sample of fossils and stone artefacts.

Fig. 5.1. General view of Boa Lesa towards the east at the beginning of the 1998 excavation. The 1961 excavation of Verhoeven was cleaned first as shown here. Visible in the background are the massive breccias of the Ola Kile Formation capped by thin-bedded layers of the Ola Bula Formation.

5.2. Procedure

The site was surveyed, then the south and east walls of Verhoeven's excavation were cleaned, straightened, recorded and interpreted. Considering the age of the strata, there has been little post-depositional distortion. The strata are still horizontal, and the fact that the area is grassland means that there has been little root damage to the profile.

It was evident that the fossils had been deposited in a channel running approximately east-west and that Verhoeven had ceased digging when he encountered the resistant yellow-brown siltstone layer that comprised the southern bank of the channel (Fig. 5.2). This substratum does not contain fossils. There is no evidence in the locality for the northern bank of the channel, so we cannot estimate its original width. A small creek entered this pond from the south (flowing ~340˚ N).

Verhoeven's excavation area was oriented obliquely, rather than at right angles to the bank. An *in situ* chert artefact was found at the base of the fossil deposits during cleaning of Verhoeven's section. The fossil-bearing layers were overlain by a white tuffaceous siltstone, and probably accumulated in a pond formed after abandonment of the main channel. Samples for fission track dating were taken from the white tuffaceous siltstone.

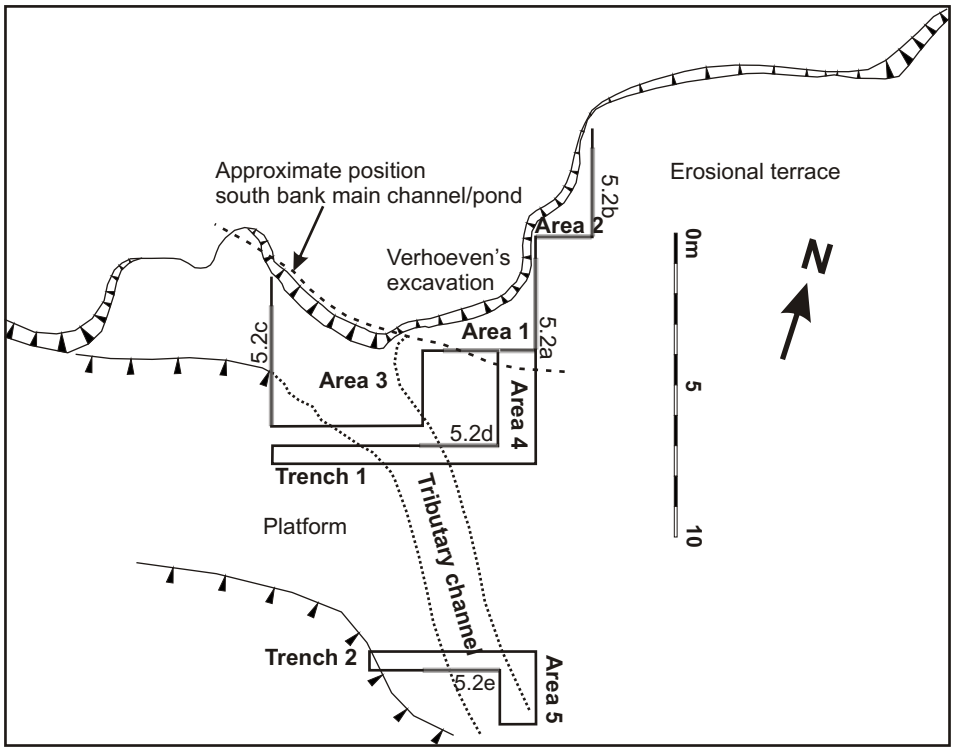

Fig. 5.2: Plan of the 1998 and 1999 excavations at Boa Lesa. Also shown is the area excavated by Verhoeven in 1961. The excavations are situated at the junction of a major paleochannel with a channel axis oriented northeast-southwest and a smaller tributary channel running from south to north. Profiles of the excavation baulks shown in Figure 5.3 are indicated with thick grey bars.

A baseline was established oriented 80˚ east and parallel to the main southern face of Verhoeven's excavation and our excavations were oriented relative to this. Three areas were selected for excavation as a means of examining spatial differences in deposition. Two narrow trenches (1 and 2) were also dug to clarify the stratigraphic relationship between the channel deposits and those of higher 'platforms' to the south (Fig. 5.2). In each case the rock was removed in 15 cm thick levels with picks, geological hammers and chisels, then broken up and closely examined in the 'sieving' area. (Pulverising of excavated rock to get it through a 10 mm sieve proved futile).

5.3. Stratigraphy

The general stratigraphy throughout the excavation area comprises up to 9 distinct stratigraphic units with local variations. From old to young the following units can be distinguished:

Assemblage D

Unit D1: Light brown tuffaceous silt.

Unit D2: Light brown coarse sandstone.

Assemblage C

Unit C4: Light grey coarse to very coarse tuffaceous sandstone with gravel and fossils.

Unit C3: Light grey fine tuffaceous sandstone.

Unit C2: Light grey tuffaceous medium sand with gravel and fossils.

Unit C1: Grey tuffaceous fine to medium sand.

Assemblage B

Unit B1: White tuffaceous silt. Homogeneous. No artefacts or faunal remains.

Assemblage A

Unit A2: Coarse, reworked deposits containing materials of different ages, including lenses of gravel and a few stone artefacts.

Unit A1: Topsoil.

Units D1 and D2 consist of well-consolidated yellow-brown clastics that were deposited in a lacustrine/floodplain and fluvial environment, respectively. Assemblage D is widespread and contained no artefacts or fossils. The younger strata comprising Unit C (C1-C4) cut down at least 2 m into D strata. The base level of the Soa Basin must have lowered for this to have occurred.

Assemblage C consists of clastic fluvial units that filled in the incised channel. Towards the southern bank of the palaeo-channel most units wedge out, while the fine-grained Unit C1 is only developed in the “deeper” part of the channel. The basal coarse-grained sandy and pebbly sand layers of Assemblage C contain large lumps eroded from the underlying brown siltstone of Unit D1.

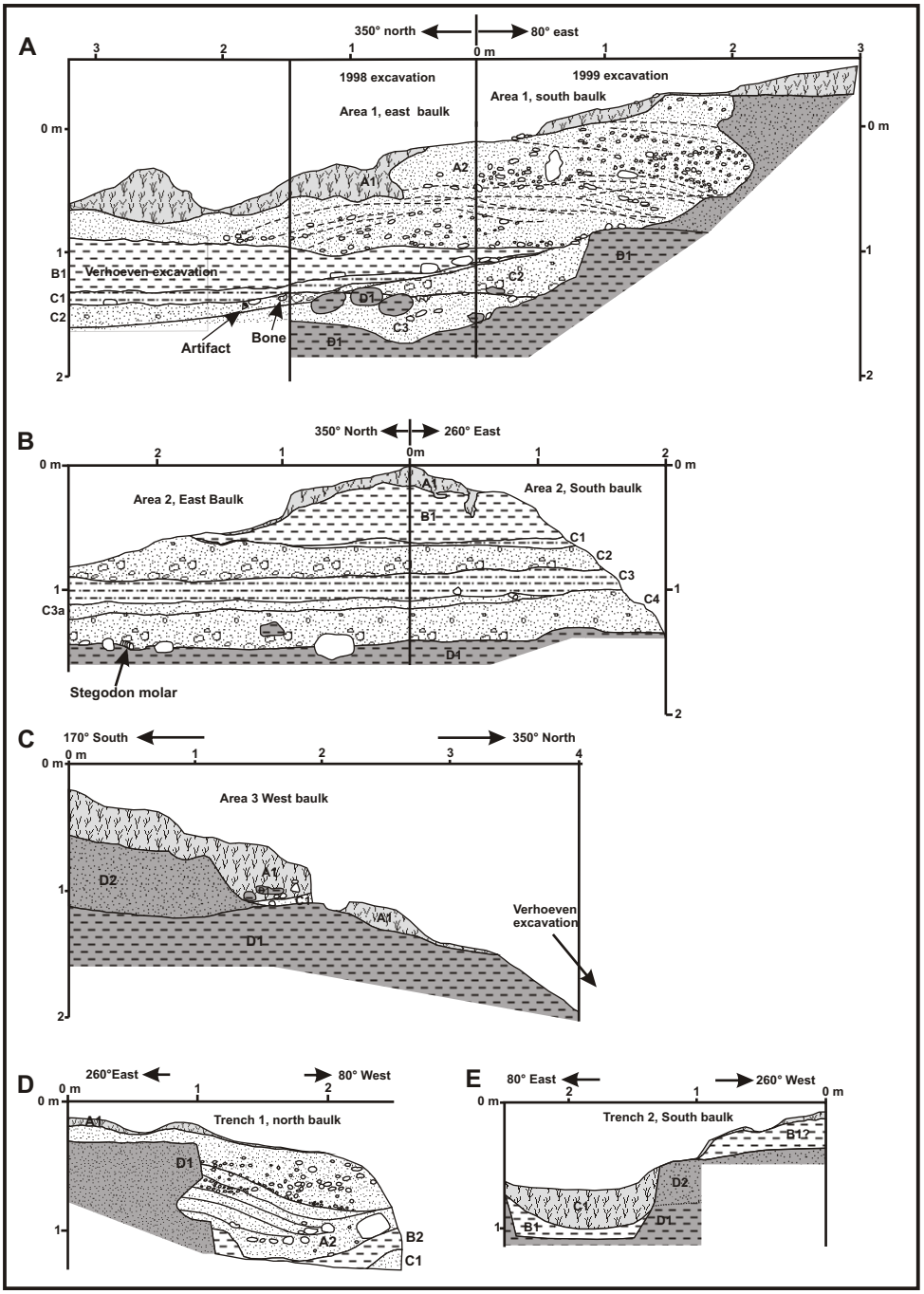

Fig. 5.3. Profiles of some of the Boa Lesa excavation baulks clarifying the local stratigraphy. A: east and south baulks of excavation Area 1; B: east and south baulks of excavation Area 2; C: west baulk of excavation Area 3; D: part of the north baulk of Trench 1; E: part of the south baulk of Trench 2. Lithology of the various units is explained in the text.

Fossils and artefacts occur *in situ* in these coarse clastics of Assemblage C, which are covered by white tuffaceous silts of Unit B1. The latter have filled existing depressions and were deposited under calm hydrodynamic conditions, in ponds that remained in the abandoned channel complex. Coarse-grained slope-wash sediments (A2) unconformably cover this white tuffaceous siltstone, and topsoil up to 30 cm thick (Unit A1) covers the strata in most places.

Fig. 5.4. View of Area 1 towards the east during the 1999 excavation. The white tuffaceous siltstone of Unit B1 wedges out towards the south.

5.3.1. Age of the deposits

The white tuffaceous siltstone (B1) overlying the fossil/artefact deposits yielded a fission track age of 840,000 ±70,000 years BP (Morwood *et al.*, 1999; O'Sullivan *et al.*, 2001). We also sampled the Unit D1 tuffaceous siltstone, into which the channel was incised, but the sample did not contain sufficient zircons to yield a fission track age.

5.4 Profiles

5.4.1. Area 1

Excavation Area 1 cut across the channel bank boundary in the southeast corner of Verhoeven's excavation area, but the bank was left intact. The area measured 5 x 2 metres. Deposits overlying the basal siltstone unit (D1) were a maximum of 180 cm deep here (Fig. 5.3a). They comprised more recent topsoil (A1) and unconsolidated slope wash sediments (A2) unconformably overlying a white tuffaceous siltstone (B1), with underlying sandstone layers. The latter had flow structures (C1- C4). The bed of the channel had been incised into a very extensive, light brown siltstone layer (D1). In 1999, the excavation was extended 60 cm to the east and a 4 metre long trench was excavated from the south-eastern corner towards the south (Area 4 in Fig. 5.2; 5.4). This extension showed that the original watercourse had also cut through the coarse sandstone layer (D2) overlying the basal siltstone unit (D1).

Vertical concentrations of bones, stones and occasional artefacts occurred within the sandstone, particularly at interfaces between strata, including the base of the channel. The bones were disarticulated but many were complete. Nor was there much evidence for water-rolling of the associated stone artefacts. The faunal remains and stone artefacts must have entered the channel from nearby dryland areas.

5.4.2. Area 2

Excavation Area 2, measuring 3 x 2 metres, was positioned further away from the south bank of the channel - more midstream (Fig. 5.3b). Deposits here were a maximum of 165 cm deep. Again, the substratum was formed by the brown siltstone of Unit D1, which is overlaid by the same basic stratigraphic sequence encountered in Area 1. However, in Area 2 the layers are laterally more homogeneous in thickness, and the coarse clastics appear to contain fewer rock fragments, bones and stone artefacts, with bone tending to be more fragmented. An additional Sub-unit C3a was developed between Units C3 and C4, consisting of a 15 cm thick sheet of fine-grained sand with fossil bone. This layer disappeared towards the east.

5.4.3. Area 3

Excavation Area 3, measuring 4 x 3 metres, was positioned to investigate the stratigraphic relationship between the D1 siltstone platform immediately south of the channel bank and the channel deposits (Fig. 5.3c**)**. The platform is 3 metres wide with an overlying higher bank of coarse sandstone (D2). A water laid deposit of tuffaceous siltstone/sandstone up to 35 cm thick and containing pebbles, boulders and fragmented *Stegodon* bone (Unit C1?) occurred with an erosional contact on top of Unit D1 and lateral of Unit D2. Eroded lumps of white tuffaceous siltstone and yellow siltstone were still recognizable in the topsoil layer covering the assemblage. The evidence shows that when the main channel was flooded strong water flow deposited material on the adjacent rock platform.

5.4.4. Other trenches

Excavation Area 5, as well as Trenches 1 and 2, provided evidence for a tributary channel, which like the main channel had cut down into the Assemblage D strata, but to a lesser depth (Figs. 5.3d and e). This tributary flowed from the southeast, and joined the main channel in Area 3 (Fig. 5.2). Remnants of white tuffaceous silt in the base of the tributary channel and the manner in which the channel is incised into units of Assemblage D indicate that the series of ascending scarps and flat

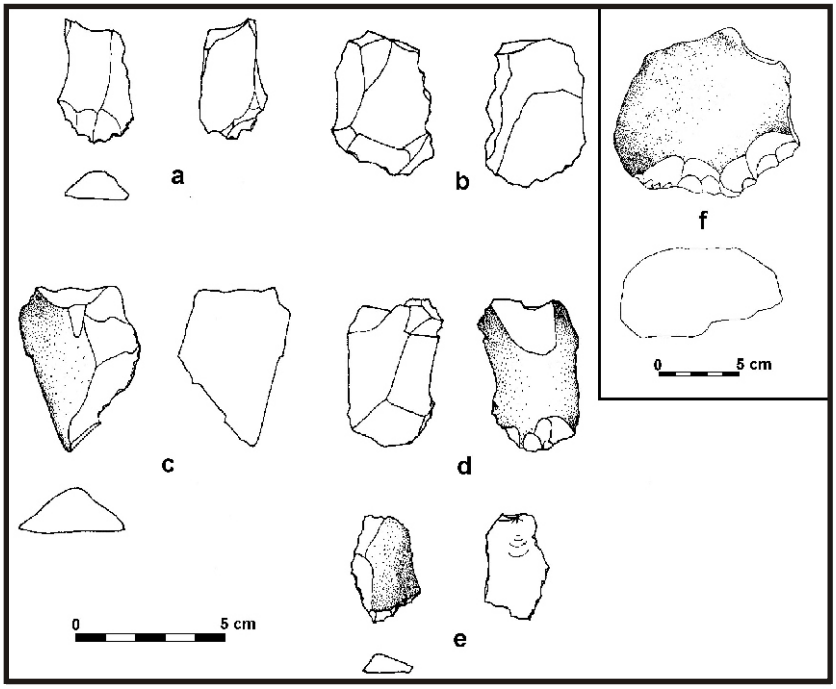

Fig. 5.5: Stone artefacts excavated in situ during the 1998 and 1999 excavations at Boa Lesa. a: Chert flake (BL1/0/98); b: Retouched andesite flake (BL1/2/98); c: Basalt flake BL1/1/98); d: andesite flake BL2/1/98); e: Retouched chert flake BL2/9/98); f: (BL1/4/98) A flat andesite pebble with unifacial flake removal ('chopper').

areas immediately south of the main fossil deposits were in place when the main and tributary channels were active. Although exposed by relatively recent erosion, the present-day topography of this slope was largely determined by alluvial down cutting during the Lower Pleistocene.

5.5 Finds

Only *Stegodon florensis* bones were found, despite careful examination of excavated rock. Much bone was fragmented, but notable specimens included a complete femur and tibia, ribs, a pelvis, and half a mandible. These were found associated with other evidence for strong water flow, such as

water rolled pebbles. There was a concentration of such coarse material on the bottom of the eroded surface cut into Unit D1 in Areas 1 and 2. This appears to comprise a lag deposit.

Six stone artefacts were found (Fig. 5.5), as detailed below. Grid co-ordinates (x, y, z in cm) were taken from the southeast corner of each excavation area. The datum for Area 1 was 41 cm above that of Area 2.

5.5.1. Area 1

BL1/0/98: Chert flake. Base of Unit C4 on top of the channel bedding next to a *Stegodon florensis* pelvis fragment.

BL1/1/98: Basalt flake from water rolled pebble. Base of Unit A2. In sieve.

BL1/2/98: Andesite flake with retouch. Base of Unit A2. In sieve.

BL1/4/98: A flat andesite pebble with unifacial flake removal ('chopper'), found at the interface between Units C1 and C2 with a concentration of other water rolled andesitic and siltstone pebbles, and *Stegodon* bone, including a complete femur and ribs.

5.5.2. Area 2

BL2/1/98: Andesite pebble flake. Layer C1. In sieve.

BL2/9/98: Chert flake with retouch. Layer C3.

5.6. Interpretation of Boa Lesa excavation results

At Boa Lesa, stone artefacts and fossil *Stegodon florensis* bones occur together in fluvial tuffaceous silts. They were deposited around 840,000 years ago in a water channel that was cut down several metres into an assemblage of sterile siltstones (D1) overlaid by fluvial sandstone (D2). The channel was oriented west-east and, considering the basin configuration; river flow was probably to the east.

The main fossil deposit at Boa Lesa accumulated at the junction of this channel with a smaller tributary that entered from the southeast. At that time the direct surrounding area must have been dry land with a series of terraced, rock platforms immediately to the south. The fine grained tuffaceous strata overlying the fossil-bearing fluvial sandstones were deposited under calm hydrodynamic conditions, presumably in ponds remaining in the main channel after its abandonment, or following a major influx of fine-grained tuffaceous sediments into the basin causing a rapid fill of existing river channels. Alternatively, a rise in lake level could have caused the river valleys to be filled in with sediment.

Low energy conditions prevailed in the channel, but occasionally strong discharges washed in heavy coarser-grained sands together with bones, pebbles and stone artefacts from adjacent dryland areas. Most bones and artefacts do not appear to have been transported over long distances.

The uppermost pond deposit (B1) comprises a white tuffaceous siltstone, which contains occasional bones, but no pebbles or stone artefacts. This localised siltstone layer of fine-grained tuff probably corresponds to a volcanic eruption that blanketed the entire area, was partly reworked and was redeposited in existing watercourses. The tuffaceous siltstone were later truncated and unconformably overlain by unconsolidated gravel-rich, slope-wash deposits (A2).

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