11. Artefacts

11.1 Published pictures of artifacts from Mata Menge

Unfortunately I was not allowed to study or even see the artefacts in the trenches from the 2011 excavation. It would have been interesting to exactly see, where the artefacts were placed in the stratigraphic layer structure. Discussions with the Indonesian archaeologists gave me some hints, which I have used in chapter 8. During the 3 months of excavation during the summer 2011, 1500 artefacts were found and locked up in the campus. Previous excavations in 2006-2010 gave about 500 artefacts, which are described in two publications [Brumm 2006, Brumm 2010b]. Several of these photos and drawings of the artefacts gave some impression of the technology. However there are no stratigraphic informations. The excavations by Verhoeven in 1970 have also resulted in articles [Maringer and Verhoeven 1970 a & b] with pitures of the artefacts. Again without information on how and exactly where they were found. In Appendix A2 a complete list of photos and drawings of the stone artefacts from these articles are shown. A deeper analysis (Toth et al. 2006; Eriksen 2000] of these artefacts is impossible on the basis of the given information.

The types of artefacts are very close to the types, which one finds in east Africa belonging to the socalled Oldowan culture. There are no handaxes. It looks as if the flakes are knapped with hard technique, and there are only a few knapping blows to each stone. The resulting technology is similar to what has been found in the Liang Bua cave at level with Homo floresiensis fossil bones. The only difference being that the number of blows to each stone at Liang Bua can be up to 39, far exceeding the Mata Menge stoneartefacts, which has a number of 23.

It would have been interesting to know exactly where in the stratigraphic layers the artefacts were found. Handpicking the artefacts would also have given an opportunity to try to fit the worked stones together. It would also have been interesting to compare the artefacts from the different Soa Basin Sites. On the animal fossils no cutting marks (or at maximum a few) were seen in spite of the fact that more that 2000 fossile bones were excavated on the 200 m^2 in 2011.

12. Discussion and Perspectives

12.1 Geology. The fluvio-lacustrine sediments

The accurate age determination of the Mata Menge excavation site has interesting consequences for the continued work in the Soa Basin. The first $^{40}Ar/^{39}Ar$ dating from 2010 [Brumm et al, 2010a] of the Wolo Sege is there attempted to be fitted into the stratigraphy of both Wolo Sege and Mata Menge as seen in the scheme, figure 12.1 (a), displaying the believed 200.000 years difference. The results of this master thesis contradict this, because it is here shown that the Mata Menge excavation is of a similar age as Wolo Sege. Therefore the layer sequence suggested in Brumm et al. [2010a] and shown in figure 12.1 (a) is to be replaced by a diagram, figure 12.1 (b), where the age in the two sheet flow layers in respectively Mata Menge and Wolo Sege are aligned at the same age of 1.02 Ma BP, as shown in figure 12.1 (b). Even so there is a 6 meter difference in height between the layers of Mata Menge and Wolo Sege, the sheet flow layers are identical in the dating results. More corrections to the geological chronology in Soa Basin are probably needed as more of the accurate $^{40}Ar/^{39}Ar$ dating is performed in the future.

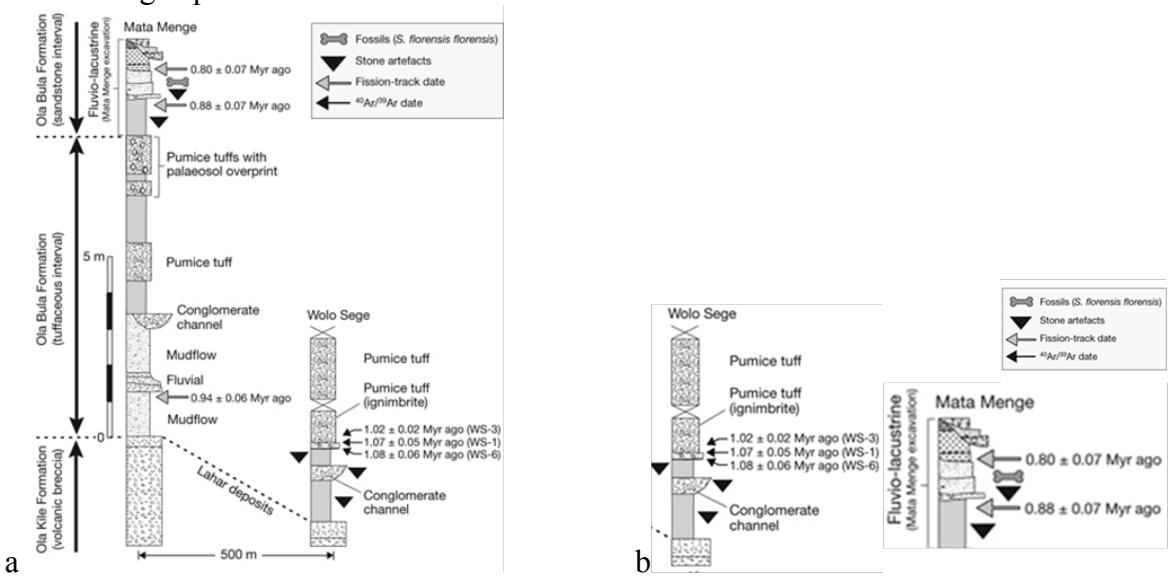


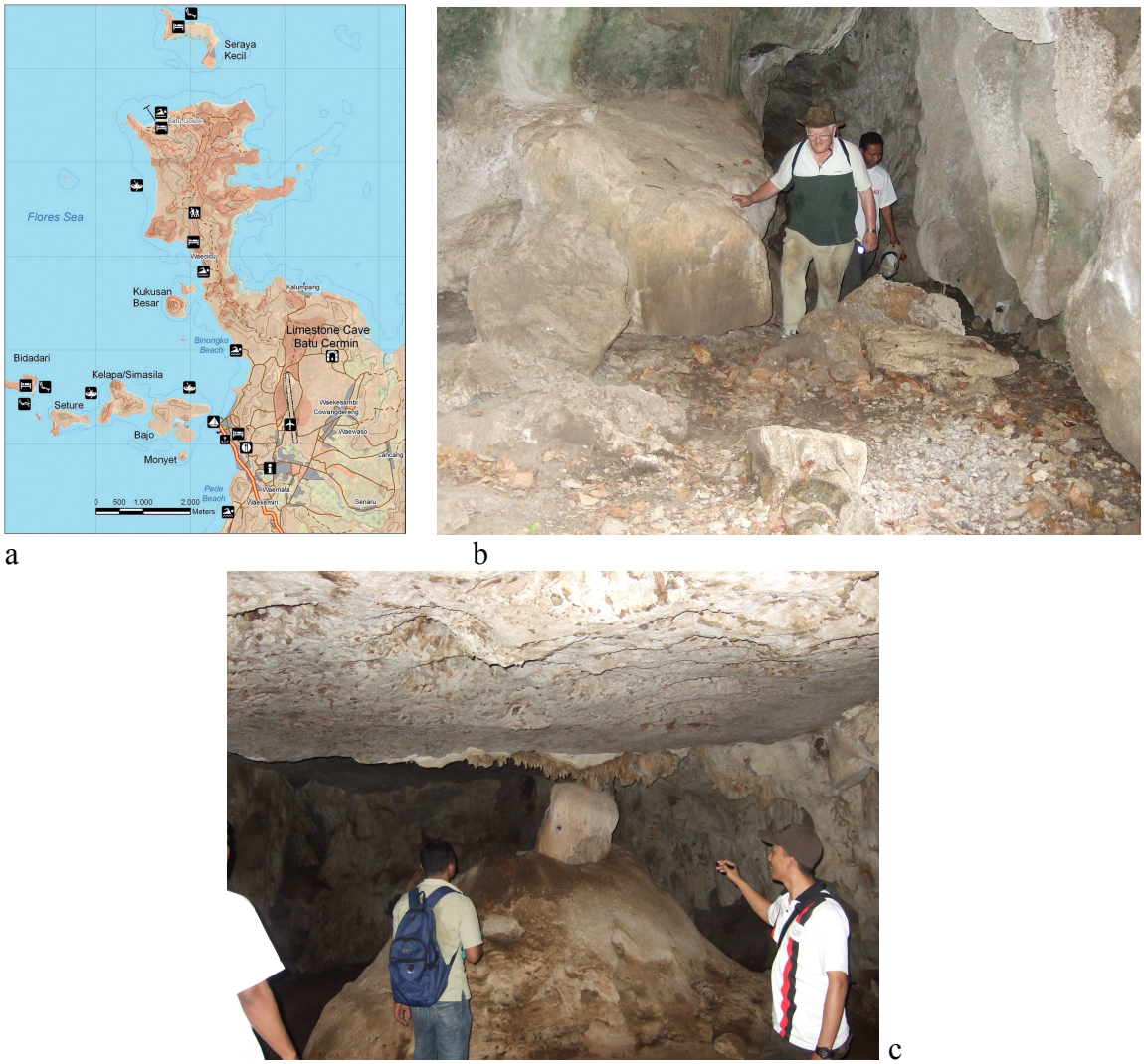
Figure 12.1. The relative layer heights at Wolo Sege and Mata Menge. (a) An attempt to make the geological layer sequence in Mata Menge and Wolo Sege consistent [Brumm et al. 2010], (b) A forced alignment of the identical $^{40}Ar/^{39}Ar$ results obtained in this master thesis (1.02 Ma BP) of Mata Menge and Wolo Sege.

12.2 How do we find the human Pleistocene fossils at Soa Basin or on Flores?

The most interesting discovery we can wish in relation to this master thesis would be to find fossils of the humans, who lived in Soa Basin 1 million years ago (or just 17.000 years ago). What were they like? The Soa Basin seems an obvious place to search. However excavations have been carried out over the last 50 years and in 15 different locations. Lots of animal fossils and Palaeolithic artefacts have been found, but no human fossils. Perhaps they never got close to the rivers or lakes, which was populated by Komo dragons and crocodiles. They may have lived 50-100 m higher up in the landscape. But up there no artefacts have been found or perhaps nobody has looked carefully enough. It will not be as rich with artefacts as the sheet flow layers in the water. Anyway the human fossil bones will probably not be preserved higher up in the landscape.

The only Palaeolithic human fossils on Flores are Homo floresiensis in the Liang Bua Cave. Perhaps the best option would be to look for human fossils in caves. In Soa Basin any Palaeolithic cave would have been covered by ash and lava. But perhaps there are still caves hidden under the volcanic layers. They may be covered with 100 m of tuff, but modern acoustic and electric underground search methods may reveal the caves and it should then be relatively easy to dig into the ground to look for human remains. Drilling could also do search for caves. Clearly one should look for caves in other areas than the Soa Basin.

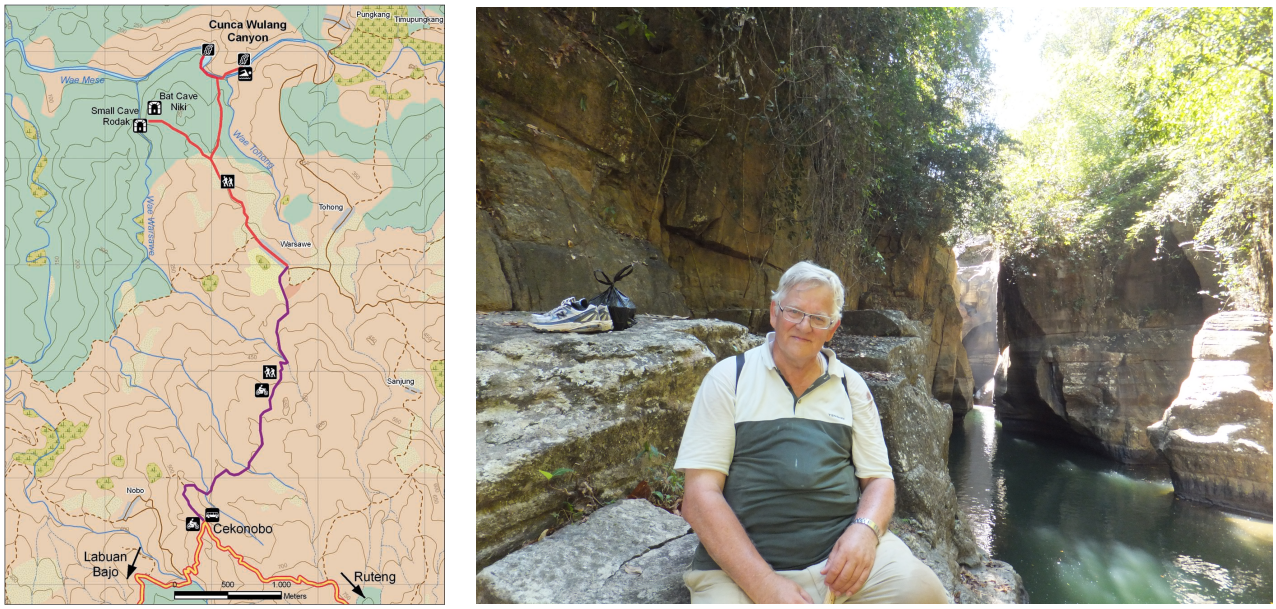
Theodor Verhoeven has already systematically searched for caves on Flores and he found the Liang Bua cave and was the first to conduct excavations there. He found lots of Neolithic material, but as already described it was the Wollogong-Jakarta team who found the Palaeolithic humans. It was indeed a lucky punch to find a cave like Liang Bua. But it is the nature of archaeology to look for the impossible.



a b c

Figure 12.2. Batu Cermin (the Mirror Cave). Situated North of Labuan Bajo. (a) Map of the surroundings of Batu Cermin, (b) Getting out of the very narrow entrances to the big, dark cave. The tunnel leading to the big cave had a place, where a narrow ray of the sun hits the ground (possibly the reason it is called the mirror cave) and (c) the big Hall is in the deepest part of the cave. This is the place, where I was told, people fled, when enemies approached the village. (Photo by my guide and by me).

My stay on Flores was only two weeks. However, I did spend also a few days in the western part of Flores to look for caves. My guide in Labuan Bajo gave me advice of how to get into the caves and was knowledgable about the caves. I went to two very remote places 5 and 30 km from Labuan Bajo, The Batu Cermin, the Mirror Cave and the two Warsawe caves at the Village Warsawe.



a b

Figure 12.3. Two caves at the Warsawe Village. (a) Map of Warsawe west of Labuan Bajo north of the road to Ruteng, (b) The two caves may only be approach across the river. One of the caves are seen on the photo behind the narrow gorge in the background. (Photo by Calis, my guide).

The Batu Cermin cave, figure 12.2, is large and with an enormous central and dark Hall. Very narrow passages lead to the Hall. It has two entrances. In the middle of the Hall is a strange stone. The cave is a popular tourist place (but I was the only guest that day) and for that reason concrete stairs have been built to facilitate entering the cave. However passages inside the cave could only be passed climbing on the knees. The guide was quite knowledgeable about the cave. He new that several archaeologists had visited the cave, but nobody had done an archaeological excavation there.

The two caves at Warsawe shown in figure 12.3 were not accessible except svimming or by boat. This was too demanding for me, and I did not enter the caves. It is a very remote place and definitely not a tourist attraction.

An archaeological study of the palaeolithics on Flores should involve a study of all caves. By excavating one should examine, if early humans have occupied the caves. A second cave beside Liang Bua Cave, with the now famous Palaeolithic human fossils, would of course be extremely interesting.

13. Conclusion

Mata Menge in Soa Basin on the Indonesian island Flores has the richest Palaeolithic excavation on Flores apart from the much younger excavation in the Liang Bua Cave. It it therefore of particular importance to have an accurate determination of it's age. This master thesis deals with this problem. $^{40}Ar/^{39}Ar$ age dating of avolcanic layer emmediately above the layer with palaeolithical artefacts gives an age of 1.02±0.02 million years BP. Together with the $^{40}Ar/^{39}Ar$ age determination of artefacts in the small excavation Wolo Sege only 500 m from Mata Menge, my age determination is at least a factor ten more accurate than any previous dating in the whole Soa Basin as well as on Flores altogether. Interesting enough the ages of Mata Menge and Wolo Sege matches accurately each other.

The new $^{40}Ar/^{39}Ar$ age determination is discussed in the perspective of any possible systematic error, a problem that also haunts the earlier results at Wolo Sege by Gitte M. Jensen. However, also the more inaccurate fission track measurements are affected by such systematic errors. The most relevant systematic error occurs, if the layers are deposited from streaming water. It is argued that the volcanic layer is to a large degree formed directly through the water, whereas the layer with the artefacts and animal bones are likely to be flow sediment. The result is that the artefacts in this case may actually be older than the age determined by $^{40}Ar/^{39}Ar$ dating. The small wear on the stone artefact indicate that they have not been moved far by the water, though. It is interesting that the only two $^{40}Ar/^{39}Ar$ measurements by Gitte M. Jensen [Brumm et al. 2010a] and myself are identical. This demonstrates that humans have populated Mata Menge and Wolo Sege simultaneously.

These very old settlements of homonids in Soa Basin pose a number of new and exciting questions. Which homonid genus lived on Flores 1 million years ago? Was Homo erectus a genus related to Homo Floresiensis? How did they get there? They had to cross wide and deep water twice to get to Flores.

Future archaeological investigation should pay more attention to the landscape outside Soa Basin on Flores and possibly find new proof of Palaeolithic homonids on Flores.There are many more caves than Liang Bua. They ought to be studied. I have spent part of my time on Flores visiting three caves, none of which, according to the locals, have been archaeologically investigated before.

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WWW-Addresses

WWW 1 (Used in figure 52 (a) Sanidine single crystal)
http://commons.wikimedia.org/wiki/File:Sanidine-477065.jpg
WWW 2 (Used in figure 53 (a) Hornblende single crystal)
http://www.denstoredanske.dk/It,_teknik_og_naturvidenskab/Geologi_og_kartografi/Mineraler/hornblende
WWW 3 (referred to in the Conclusion on page 65) "A needle in a Haystack". Conference at Stony Brook on Homo floresiensis and several videos of Richard Leakeys talks
http://www.turkanabasin.org/humanevolution/hew-07/schedule/
and also
http://www.youtube.com/user/turkanavideo
and references there.

Wordbook and Abbreviations

Andesitic breccia = Very solid, finegrained hard magma. Forms the free-standing mesas in Soa Basin.

Auchelean hand axe = Tear-drop shaped stone tool formed by bifacial stone technology. Marked the period after the Oldowan Culture i.e. from around 1.8 million years BP in East Africa.

Australopithecus afarensis = One of the latest human apes found as the so-called Lucy fossil found in the Afar region in Etiopia. Precurser to the Homo branch. ~3.5 million years BP.

Australopithecus africanus = One of the latest human apes found as the so-called Taung fossil in South Africa. Precurser to the Homo branch. ~3 million years BP.

BP = Before present

Breccia = Zones of igneous rock containing fragments of the country rock in various intrusions.

Fission track = Tracks of crystal damage in (typically) zircon or obsidian from high velocity nuclear fragment of ^{238}U.

Fluvio-lacustrine sediments = Layers formed in water by streaming water (a flood or a lake) which takes material along and dump it somewhere

Fossil = Bone which has turned inorganic by processes in the earth.

Frantz magnetic separator = Separation of magnetic particles based on the balance of gravity on a slope and a magntic field.

Hominides = The human fossils characterized with the designation Homo. The human genus over the last ~2.5 million years.

Hominines = The fossils of human character developed over the last ~7 million years, where the chimpanzees and the human direction separated.

Homo erectus = In most modern archaeology used as synonymous with Homo ergaster. In Asia Homo erectus is believed to be the leading development until 200.000 years BP or even later.

Homo ergaster = The first human with all the traits om modern humans. The brain is smaller (900 cm3) . First found in East Africa. (e.g. The Turkana boy) ~1.8 million years BP and simultanously Migrated to Asia. Inseparable from Homo Erectus.

Homo floresiensis = A not very well understood branch of the human evolution. It is also known as Hobbits due to the small heights (~1 m). It is fould only on Flores, Indonesia.

Homo habilis = The first Human (2.5-1.8 million years BP) fossils. Found only in East Africa.

Homo heidelbergensis = Precursor to Homo sapiens and Homo neanderthalis. Developed in Africa and spread to Europe. 1.0 – 0.3 million years BP.

Homo neanderthalis = Parallel development to Homo sapiens. Lived in Europe 300.000 – 30.000 years BP.

Homo sapiens = Developed in Africa ~200.000 years BP first as a more primitive genus called archaic Homo sapiens and from ~100.000 years BP as what is often called modern Homo sapiens, which migrated into East Asia and Europe around 50,000 years BP-

Hornblende = Beautiful black volcanic silicate crystal with <1% potassium. Used by Gitte M. Jensen [Brumm 2010].

Ion gauge = vacuum pressure measuring device based in an ionization and subsequent acceleration of restgases.

Isochron = Plot of ratios between various argon isotopes against each other. The slope gives the age of a sanidine crystal after many heating steps and the plot sensitively checks the consistency of the age determination in the $^{40}Ar/^{39}Ar$ method.

Laser = powerful coherent light source ("laser" = light amplification of stimulated emission of radiation).

Ma = million years

Mesa = Free standing mountain structures with horizontal top in a landscape. Due to removemet of material by air or water. (Spanish "mesa" = table). Wolo Sege is an example.

Mesolithic period = The period between the Palaeolithic and Neolithic period. Only relevant for the underdeveloped areas and cultures at that time (e.g. Denmark).

Miocene = 26 to 6 million years BP

Monsoon wind = The strong north-going wind (Winter) and the strong south-going wind (summer).

Neolithic period = Synonomous with the agricultural Stone age 12.000 years BP – 24.000 years BP

Nuclear Reactor = Generates heating (and neutrons) by spontaneous fission of uranium nuclei.

Oldowan Culture = The first Homo culture producing stone artefacts. It is believed to be first developed in East Africa (The Olduvai Gorge). 2.5-1.8 million years BP.

Out of Africa I = Suggested as the first ergaster/erectus migration of humans out of Africa. 1.8 - 1 million years BP. The migration is believed to be by Homo.

Palaeolithic period = 2.5 million – 12.000 years BP. 2.5 million-300.000: older Stone Age; 300.000-40.000 middle Stone Age; 40.000-12.000 younger Stone Age.

Palaeoontology = Human skeleton in the Pleistocene period

Palaeolithic Stone Age = Stone technology period from 2.5 million years BP to 12.000 years BP

Pleistocene = 2.5 (sometimes 1.8) million years BP to today.

Pliocene = 6 to 2.5 million years BP

Pumice = Frothy and low density pieces of magma.

Sanidine feldspar = Alkali silicates with large amount (~1%) of potassium.

Sheet flow layer = Layer formed by sediment from a stream of water.

Stegodon = Prehistoric elephant. Lived millions of years ago. The last appearance of this animal was ~10.000 years BP on Flores.

Stalactite = Dripstone needles that hangs from Cave ceilings.

Stratigraphy = Arrangement of earth in layers (stratas).

Sublimation pump = Freshly evaporated titanium absorbs any gas in the vacuum system

Tuff = solidified volcanic ash

Turbo pump = pump were fast rotating blades remove the gas. Can reach 10^{-9} torr.

Wigner-Seitz cell = The unit cell of a given crystal structure, which gets closest to a sphere.

XRF = X-ray (Røntgen) fluorescence

A1.

Photos of the Western Baulk of Trench no. 18

The 36 photos below show the complete western baulk of Trench 18. The orange string is horizontal and has been used as a reference (see figure 6.1). The 3 photos above each other give an overlapping picture of the baulk. This is then repeated 12 times along the 2.147 m long trench from south to north. Trench 18 is L-shaped, but inly the North-south going trench has been described in this master thesis.