Chronology of Lithic Culture in Prehistoric at Flores: Case Study on Liang Bua Site and Soa Basin

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Abstract. The province of East Nusa Tenggara (NTT) is among the areas in the eastern part of Indonesia, which geographically and regionally is bordered by Australia and Timor Leste. The area that consists of some big islands (often known as Flobamor: Flores-Sumba-Timor) and a number of small ones has a strategic role in the study of life in the past, particularly as the human and faunal migration routes in East Indonesia. Based on the results of archaeological research carried out in that area thus far, we know that some islands in East Nusa Tenggara have very interesting archaeological potencies and resources, especially with regard to cultural remains as lithic tools from the prehistoric period. Once of the islands as a topic this study is Flores, especially Liang Bua and Soa basin site whereas among research by Arkenas in since 1980 to present now. Both sites have specific chronology and character but looked similar as lithics technology. As a chronologic, Soa basin areas is oldest site at central Flores from early – middle Pleistocene epoch, while Liang Bua site as a settlement cave has younger chronology from the late Pleistocene. Cultural development and chronology a both this site to be discussed as a topic problem in ancient life context at Flores.

Keywords: Lithic chronology · Liang Bua · Soa basin

1 Introduction: Base Consideration and Background

Indonesian archipelago which regionally is located between the Asia and Australia continents has a very strategic position. This does not seem to only apply in the present, such as in relation to bilateral relations (politically) between countries in the Asia-Pacific region, but also seen in the past (prehistoric) where Indonesia's position played an important role. One of Indonesia's important roles in prehistoric times was related to the process of cultural distribution and migration of humans and fauna from mainland Asia to Oceania. This indicates the context of understanding and developing knowledge about early human migration and settlement from mainland Asia to Oceania, or vice versa (Fig. 1).

East Nusa Tenggara (NTT) is a province in Indonesia which is geographically located in the eastern part of Indonesia. The province which consists of various islands (among them the islands of Sumba, Sabu, Rote, Timor, Flores, Solor, Alor, etc.) and is often

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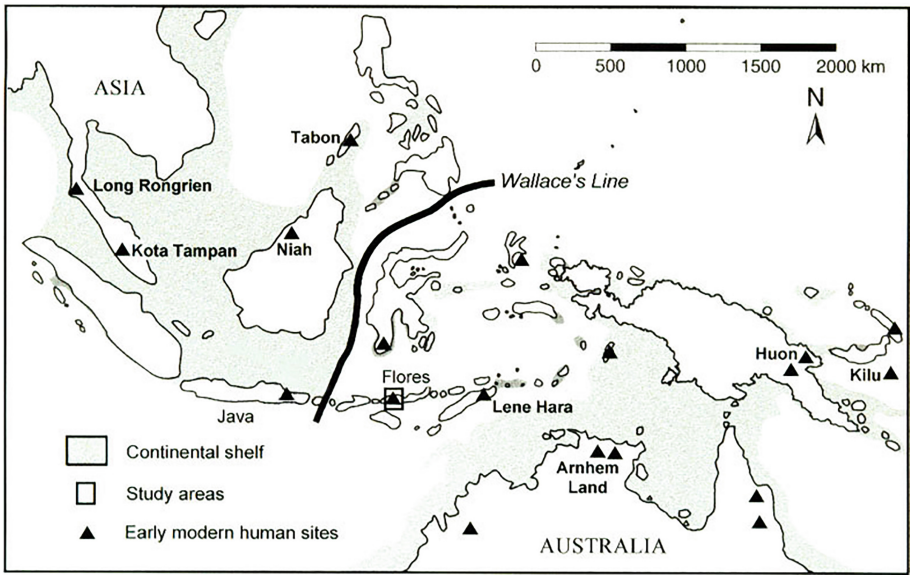

Fig. 1. The map of prehistoric sites spread and Indonesia location in regional scale (Source: Sutikno, 2018 [1])

called 'Flobamora' (an abbreviation of Flores, Sumba, Timor) has the abundant cultural resources potential (especially the remains of archaeological) and remaining ancient traditions that still exist today. The evidence of culture that remains in both material objects (tangible) as well as art forms and various (intangible) traditions that still exist today in East Nusa Tenggara show that this region has strong ancient tradition and culture that managed to survive in the current era of globalization and modernization.

Evidence of cultural remains from prehistoric times (Pleistocene) which are mostly found in the province of East Nusa Tenggara has actually provided a very significant new perspective to the archaeological research, especially to the process of migration and human adaptation to the environment as well as the development of human evolution and culture in the past.

Research on archeology (archaeology) in the eastern part of Indonesia, especially in the province of East Nusa Tenggara (NTT) was first pioneered by Th. Verhoeven, a Dutch missionary around the 1950s. In his research report it was stated that around East Nusa Tenggara there were many archaeological remains found, including remains of simple-level hunting and food-gathering activities (Paleolithic), farming periods (Neolithic), worship buildings from the megalithic tradition and the remains of other prehistoric activities. In the 1960s Verhoeven conducted a research in the area around Matamenke, Boa Lesa and Lembahmenke (Ngada District, Central Flores) and found a number of stone tools (artifacts) associated with ancient animal fossils (Stegodon) which were considered about 750,000 years ago [2, 3]. The results of Verhoeven's research activities in the following years was followed up by the Geological Research and Development Center (P3G) Bandung through research collaboration with the Dutch and Japanese governments in the 1980s and produced a number of findings that were almost the same

in the Dozu Dhalu area and the other sites in the Soa Basin [4]. Research in the Tangi Talo area resulted a number of findings in the form of fossils of pygmy Stegodon (Pigmy), giant turtle (*Geochelonidae)* and Komodo dragon (*Varanus komodoensis*) which are around 900,000 years old; whereas at the Matamenge site, apart from Stegodon fossils discovery, several stone tools (artifacts) dated back to 850,000 years ago were also found [5].

Apart from conducting research in the Ngada area (Central Flores), in 1950 and 1965 Verhoeven also conducted archaeological research at the Liang Bua Site (Manggarai Regency, West Flores) and succeeded in obtaining various types of cultural remains from prehistoric times. These remains include a number of human skeleton graves (in the cave) and various materials (pots/pottery, metal objects, stone tools and beads). Archaeological research at this site was then handed over and continued by the National Archaeological Research Center in 1978, 1981, 1982, 1985, 1987 and 1989. After being inactive for more than 12 years, the research at Liang Bua started with the cooperation of foreign participation; the University of New England (Australia) in 2001–2004, with Wollongong University (Australia) in 2007–2009, with the Natural History Museum of the Smithsonian Institution, Washington DC (USA) in 2010–2016, and with Lakehead University, Canada in 2017 - until now.

Discussion towards cultural remains from the Pleistocene or paleolithic tools in Indonesia are usually always associated with migration aspects involving humans as carriers of the ancient stone tool culture itself. The expert believed that the participator of the Pleistocene culture were Homo erectus [6]. There is also another statement regarding this old stone civilization (culture) that emerged since the existence of humans on earth or to be precise in the Pleistocene Epoch. The Pleistocene epoch is streched in a very long period of time, starting from about 2 million to 11,500 years ago. During this time earth movement was still unstable causedby volcanic activity and the result of glaciation. As a result, several 'land bridges' appeared and connected one island to another, such as what happened in Southeast Asia, Indonesia, and Australia [7], where it was assumed that many humans and animals migrated and moved places to adapt to the new surrounding environment. As a result of the Plio-Pleistocene tectonic activity, Indonesia is divided geologically and physiographically into two areas bounded by the Wallace Line; western Indonesia (Sunda Shelf) and eastern Indonesia (Sahul Shelf) [8]. One proof of the existence of a relationship between Asia (Southeast), Indonesia, and Australia that occurred during the Pleistocene is shown by the spread of paleolithic tools that have the same shape, style, and technology. Traces of the Pleistocene culture spread (paleolithic tools) began to appear from mainland China, Vietnam, Thailand, Malaysia, and then to Indonesia via Sumatra, Java, Bali, Lombok and Sumbawa (west-east route from the south); and South Sulawesi, Flores and Timor (west-east route from the north) to Australia (north part).

Based on the data collected through research so far, populations of the Pleistocene culture (paleolithic tools) are found in almost every archipelago in Indonesia; starting from Sumatra (Nias, Lahat, Baturaja, Tambangsawah, Kalianda), Java (Ciamis, Jampang Kulon, Parigi, Gombong, Sangiran, Punung, etc.), South Kalimantan (Awangbangkal), South Sulawesi (Cabenge, Paroto, Rala, Wallanae, etc.), Bali (Sembiran,

Trunyan), Lombok (Plambik, Batukliang), Sumbawa (Batutring), West Sumba (Langgang Pamalar), Flores (Liang Mikel, Liang Bua, Soa Basin, etc.), Sabu Island, and West Timor (Manikin-Noelbaki, Atambua) [9–12].

2 Research Materials and Methods

2.1 Location

The study will discuss the results of research (excavation) conducted at the Liang Bua Site and the Soa Basin, Flores, especially in the chronological aspect or dating of lithic culture. Through comparative or comparisons studies between the two major sites in Flores (Liang Bua and Soa Basin) their lithic technological characteristics will be discovered, as well as the chronology/age and the migration process applied by the early human inventing the culture (Fig. 2).

Liang Bua is a cave site located in a karst hill area and administratively included in the area of Liang Bua Village, North Rahong District, Manggarai Regency. The location of the cave is about 14 km north of the city of Ruteng, at coordinates 08°31 ′50.4 ″South Latitude and 120°26 ′36.9 ″East Longitude with an altitude of 500 m above sea level. While the Soa Basin is an area or open site about 35 × 22 km and is located 15 km northeast of the city of Bajawa. The research locations are in 2 administrative regions, namely Ngada Regency and Nagekeo Regency in Central Flores.

2.2 Data Collection

The method or strategy in the research is implemented through 3 stages; the data collection/recording stage (survey and excavation) – the data processing (analysis) stage – and the data interpretation stage. Data recording is completed through accurate descriptions (recording, mapping, drawing and shooting) and then inventoried through a data bank (*data base*).

Data collection through *surface surveys* is intended as a basis for determining further steps in the research. Surveys in collecting and recording data were carried out using library and field observation techniques. In addition, this research method is also carried out through *excavation techniques.* This technique is intended to capture data systematically, in-situ and accurately so that its validity is guaranteed.

Data Analysis. Data analysis was carried out by sorting lytic findings based on the aspects of form, space, and *time*. Next, the functional aspects and chronology will be explained through contextual analysis; to look for relationships between objects with each other, between objects and sites, relationships between sites, and relationships between sites and their physical environment [13]. The analysis of these findings includes the classification of technology, function, and form along with a comparative analysis (comparison) between the two sites.

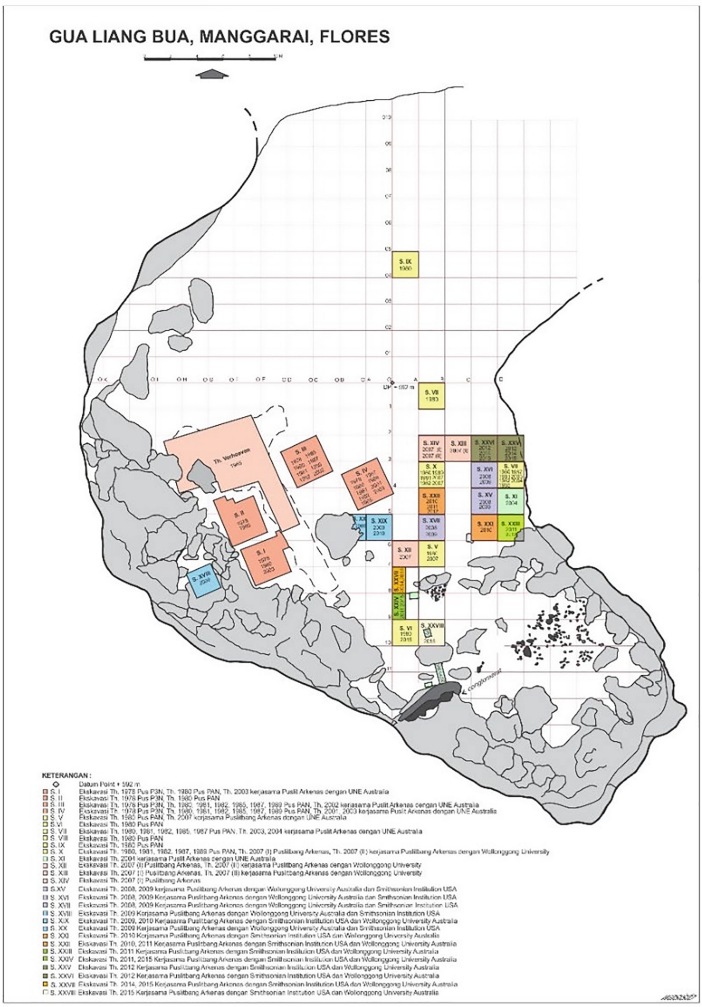

Fig. 2. Excavation site map in Liang Bua (Source: Research Team)

3 Data and Discussion

3.1 Liang Bua Site

Based on the results of research (excavation) at the Liang Bua Site, various interesting data and information have been obtained regarding ancient life that chronologically shows the phases of prehistoric occupation; that is, from the cultural level of paleolithic - mesolithic (pre neolithic) - neolithic to paleometallic (early metal period). This information illustrates that Liang Bua is an occupational cave site that was inhabited continuously from the Pleistocene to the Holocene. The layer at the top is a cultural layer originating from the early Paleometallic (Perundagian) period which was around 450 ± 25 BP (depth between 35–45 cm) to the Neolithic period with traces of 3,820

± 120 BP (depth between 165–175 cm); while layer at the bottom is a cultural layer originated from the pre-Neolithic (Mesolithic) period with an age range of around 9,830 ± 490 BP (minimum depth 305–315 cm) to the Paleolithic period with a date of 95,000 BP (minimum depth 750–765 cm) [14].

The types of remains found in this lower layer include lytic tools (generally in the form of flakes) and various bone and tooth fragments of animals from large mammal species. The context of the findings of lithic tools and remains of endemic fauna associated with *Homo floresiensis humans* at the Liang Bua Site has clearly provided very significant evidence relating to the supporting humans. In the context of the findings of fauna, humans and their culture was found in the lower layers (5.95 m deep), under thick tuff deposits of volcanic ash that was about 12,000 years ago. These findings from the lower layer have not been found in previous studies [15]. In addition to the discovery of the human skeleton *of Homo floresiensis*, many kinds of endemic fauna were also discovered, most of which are now extinct; such as ancient elephants (*Stegodon*), Komodo dragons (*Varanus komodoensis)*, large rats (*Betu*) and various types of birds such as giant storks (*Giant Marabau Stork*) and other types of birds of prey [16–18]. The results of dating using the Carbon-14 method taken from charcoal samples in the soil layer containing traces of *Homo floresiensis findings* previously showed a chronology of life that lasted around 38,000–18,000 years ago [19], but this stage was later revised to 100,000–60,000 years ago, because there was an error in charcoal sampling in the layers that were carried out incorrectly in a more recent sediment deposit [20]. Absolute determination of this age is very important to determine traces of 'inhabitants' at the Liang Bua Site, so that it can be confirmed that the early human life of *Homo floresiensis* existed and took place since the end of the Pleistocene Epoch before the arrival of early modern humans in this cave.

One of the most blatant features or characteristics of cultural remains in Liang Bua is the finding of lithic artifacts. The lithic artifacts found are very abundant and the number reached were more than 100,000 where they were found in archaeological excavations. These artifacts are made of rock or gravel which is trimmed by using a strike-stone to produce flakes with sharp part on the sides or its edges. These flake tools function as knives or are used as sharpeners, sharpeners, drills (drills), arrowheads, and so on. The process of making these stone tools is called the Reduction stage. By understanding the process of making these stone tools, we can gather information about various behaviors, ways of thinking (*cognitive*), and human adaptations in the past.

The lithic tools found in excavations at Liang Bua are generally in the form of flakes (*non-massive*) and made from various raw materials (rock), including chert (*chert*), gritty tuff, gritty limestone, chalcedony, jasper, quartz and andesite. Among these raw materials, grizzly tuff and chert are the most dominant rock types and appear to be chosen by the people living in the Liang Bua cave [21]. This is considered to be related to environmental factors where the raw material (type of rock) is easy to find around the cave and/or in the Wae Racang River. They already understood that this type of rock had good qualities as a tool. Stone tools at Liang Bua were found scattered in stratigraphic layers, starting from the upper layer which was inhabited by modern humans to the lower layer which was inhabited by *Homo floresiensis.* This cultural fact clearly shows that

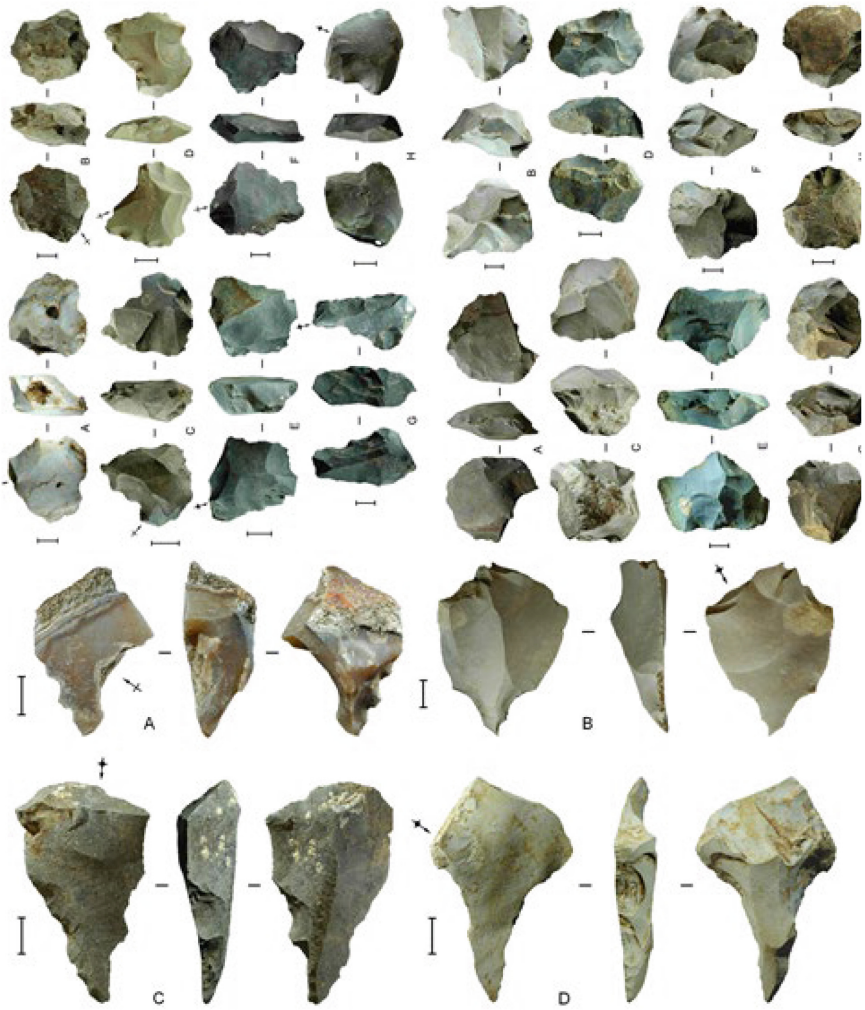

Fig. 3. Stone tools (flakes and borer) on Liang Bua excavation (Source: Moore 2009 [21])

the existence of producing stone tools in Liang Bua was carried out continuously by cave-dwelling humans, from the end of the Pleistocene to the Holocene (Fig. 3).

3.2 Soa Basin Areas

The Soa Basin is an area (complex) of ancient sites in Flores contains many findings ancient fossil bones of fauna and tools (stone artifacts). In this area,at least more than 15 locations (Sites) have been found which contain traces of ancient fauna fossils and stone tools [22, 23] (Fig. 4).

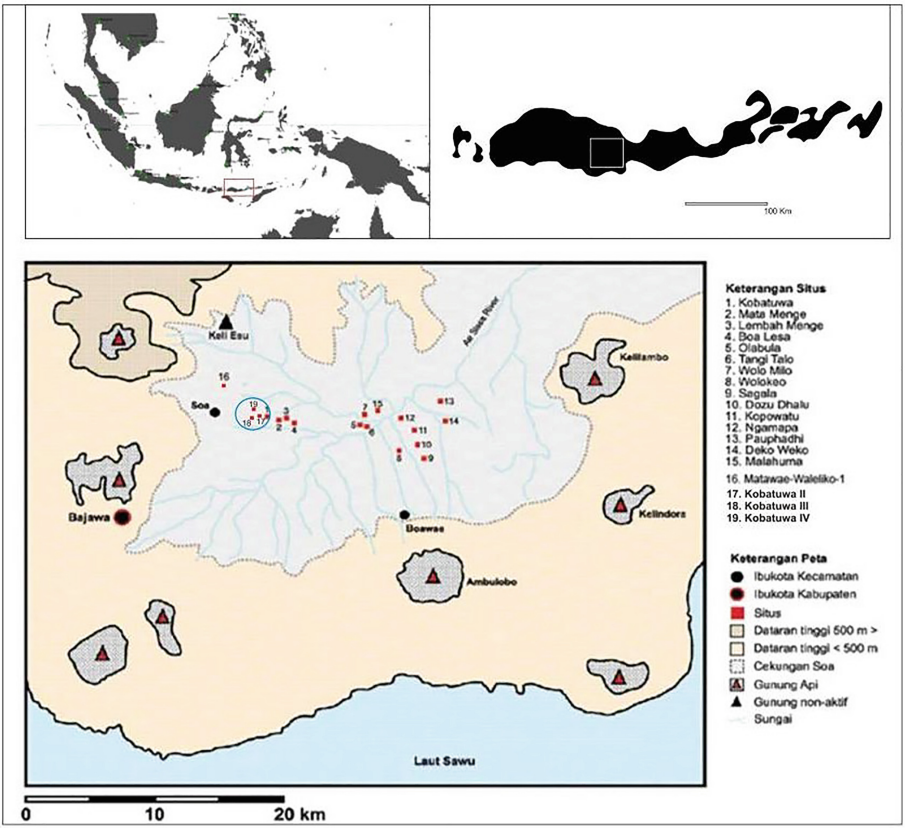

Fig. 4. Map of the configuration sites in Soa Basin (Source: Morwood 1999 [22])

The discovery of fossils of ancient animals that are now extinct, such as ancient elephants (*Stegodon*), crocodiles (*Crocodillus*), Komodo dragons (*Varanus komodoensis*), and tortoises (*Geochelonidae*) in several locations in this region proves that the Soa Basin has bee inhabited since millions of years ago [4]. Traces of ancient life in the form of findings of fossil bones of fauna and stone tools (artifacts) attached in layers of hard soil and volcanic tuff deposits for hundreds of thousands or even millions of years ago have become evidence of life in the Soa Basin. The existence of *Stegodon* ivory and bone fossils found in thousands of excavations proves that the Soa Basin is a large area that was once the habitat of large mammals on Flores.

Traces of ancient fauna in the Soa Basin have been proven through the findings of fossilized bones of ancient elephants and other animals that are already extinct, including those found in the Kobatuwa and Matamenge sites which have traces record of more than 800,000 years ago. The type of large mammal found in the Soa Basin in Latin is called *Stegodon florensis-florensis.* This type of ancient elephant is also commonly found in Java (at the Sangiran Early Man Site), but has a larger shape and is called *Stegodon trigonocephalus.* In addition, ancient elephant ivory and bone fossils were

also found in excavations at the Tangitalo Site (still in the Soa Basin area), but the shape is smaller (*pygmy*) and is called *Stegodon sondaari.* Despite its small body, *the pygmy Stegodon* from the Tangitalo Site has traces of a very old age, dated from about 1.4 million years ago (Source: Dr. Gert van den Bergh, a paleontologist from the University of Wollongong, Australia).

Traces of early human life in the Soa Basin began to reveal in 2014 when several fossilized fragments of ancient human jaws and teeth were found in a large-scale excavation conducted at the Matamenge Site. The discovery of these ancient human fossil tracks has provided new insights and perspective about the existence of early humans *Homo erectus* on Flores who were previously believed to have ended up on Java. These findings are predicted to be more than 600,000 years ago or in the Middle Pleistocene period of life.

The findings of early humans at the Matamenge Site, Soa Basin are also supported by various types of findings of paleolithic tools (stone artifacts) which are very abundant and strongly assumed to be cultural products from *Homo erectus* [6]. These evidences confirm that *Homo erectus* existed in the Soa Basin around the end of the Lower Pleistocene – Middle Pleistocene. During this period, the classical type of *Homo erectus* may have inhabited the Matamenge Site, Soa Basin. This is also supported by the abundant discovery of stone tools (shale) with an age of more than 800,000 years ago [24]. The discovery of the oldest artifacts at the Wolosege Site, which dates back to 1.02 million years, is also the earliest evidence of stone tools used by archaic *Homo erectus humans* outside Java (Flores) [25] (Fig. 5).

Apart from the Matamenge Site, evidence of tools (paleolithic tools) in the Soa Basin were also found at the Kobatuwa Site, which is one of the locations that is a priority for the research conducted by the National Archaeological Research Center. A number of evidences of stone artefacts consisting of massive tools (chopper and *chopping-tools) as well as various flakes from andesitic and volcanic rocks associated with fragments of Stegodon* fossils were found in abundance at this site [26]. The stone artifacts excavated

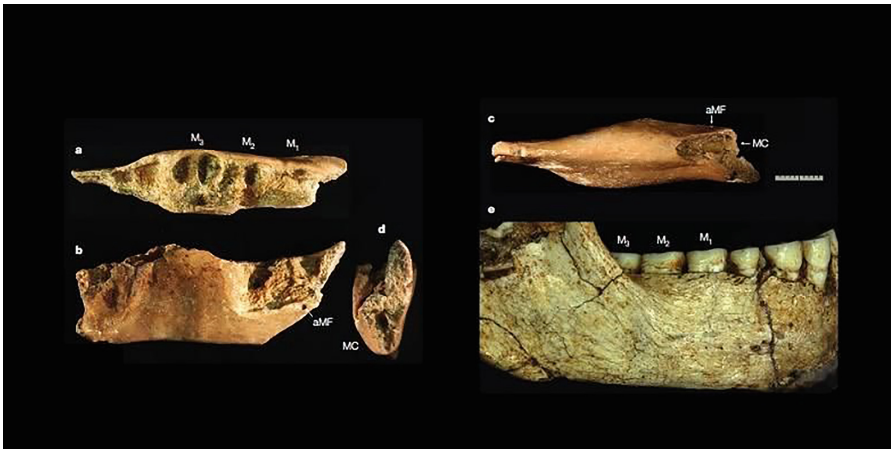

Fig. 5. Human Jaw fossil fragment of Matamenge found in Soa basin (Source: Kompas Sains)

at the Kobatuwa Site have a different shape from those found at the Matamenge Site. In general, the stone artifacts at this site show massive characteristics and made simply from *monofacially* trimmed cobblestone, (one side) and *bifacial* (two sides). The condition of the tool generally has experienced moderate to advanced rounding.

Dating traces at this site are at least from about 700,000 ± 60,000 BP [22]; however, the results of stratigraphic observations show an older chronology and are assumed to have aged more than 1 million years ago. In addition to various stone artifacts finding, the Kobatuwa Site also found many fossil bones of ancient elephants (*Stegodon*), Komodo dragons (*Varanus komodoensis*), crocodiles (*Crocodillus, sp*) and tortoises (*Geochelonidae*) (Fig. 6).

Correlation of the Soa Basin and the Liang Bua Site. Traces of ancient life at the Liang Bua Site and the Soa Basin seem to have similarities, both from the cultural aspect (lithic technology), the supporting fauna and humans, despite the separation of the two parties in a very longtime span and different environments. Liang Bua is a closed dwelling cave site, while the Soa Basin is an open area.

The correlation between these two sites, among others, can be seen from the types of lithic tools (shale tools) found at the Matamenge Site which have similar characteristics (in terms of technology) to the findings of stone tools from the Liang Bua Site [28]. On the fauna aspect, they also have similarities, many types of animals such as Stegodon, Komodo dragons, large rats and poultry were also found in excavations at these two sites on Flores. The discovery of traces of early human fossils in Matamenge has also provided new insights and horizons about the presence or migration of early *Homo erectus humans* in Flores which were previously believed to have ended in Java. According to Van den Bergh, the early humans of Matamenke also had a small physical form similar to *Homo floresiensis* anatomically. The Matamenge ancient man is thought to be a relative of the ' *Hobbits'* in Liang Bua but has a much older age. The discovery of ancient human fossils from the Soa Basin further strengthens the theory that *Homo floresiensis* is not a type of *Homo sapiens* that has physical abnormalities.

Chronologically, the correlation between the two sites raises questions and new assumptions that contradict the theories that have been developed so far; Is it possible

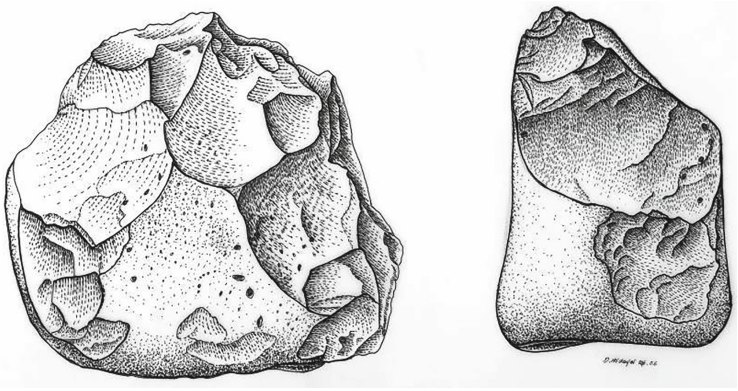

Fig. 6. Stone Artefact (Chopper) from Kobatuwa site, Soa Basin (Source: Jatmiko, 2008 [27])

that ancient human migration in eastern Indonesia (especially in Flores) originated from east to west and not vice versa? This of course must be proven through in-depth research studies, because so far experts believe that early human migration in Indonesia started from west to east.

4 Conclusion

Flores is an island that has historical value and holds a million mysteries and a long history of research. Beginning in the 1930s, more than 80 years research by various parties on this island has achieved a lot of progress to provide an understanding of ancient life on this island. Behind this progress, various unconfirmed fact are still surround the ancient life in this region. Various discoveries that give new views do not necessarily stop the research, but instead it would open new perspectives for a more comprehensive understanding. Flores is an island that is classified as 'unique' because it holds various major events that occurred in the past, including the discovery of the ancient human skeleton of *Homo floresiensis* at the Liang Bua Site and various findings of fauna fossils and very old stone artifacts in the Soa Basin.

The evidence of prehistoric findings in Liang Bua and the Soa Basin have provided new perspectives and horizons about ancient life on Flores and added crucial information for the development of science in exposing traces of migration and evolution of early humans and their culture which was believed to have ended in Java. Early humans *Matamenge* and *Homo floresiensis* are thought to have the same physical characteristics (dwarfs) and are thought to still have a relatives relationship, but are separated by a very long distance of time. The younger *Homo floresiensis* periodization is considered a human link between *Homo erectus* and modern humans (*Homo sapiens*). The location of his discovery on Flores Island has also given its own meaning, because the insular environment in this eastern Indonesian region has a role that is no less important than the island of Java. Flores Island is one of the important routes of past human migration from west to east or vice versa during the Pleistocene era.

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