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## **Underwater Archaeological Study on Prehistoric Material Culture in Matano Lake, South Sulawesi, Indonesia**

インドネシア・南スラウェシのマタノ湖における水中考古学調査と物質文化

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### Abstract

Lake Matano (Indonesian: Danau Matano), also known as Matana, is a natural freshwater lake in South Sulawesi, Indonesia. With a depth of 590 m (1,940 ft), make this lake the deepest lake in Indonesia (ranked by maximum depth), and the 8th deepest lake in the world. The first archaeological survey in Matano lake in 1998 found numbers of artifacts which are approximately between 6th and 16th centuries and our archaeological investigation was conducted in some potential areas in both land and underwater during 2016. We report the findings by our survey in 2016 which include lithics (flakes), potteries, animal bones, metal goods and possible house features under the lake. This is the first underwater archaeology research in the lake environment in Indonesia, thus our research outcomes could be useful for future development of underwater archaeological studies in Indonesia.

キーワード: マタノ湖、水中考古学、金属器時代、南スラウェシ、インドネシア

### 1 Introduction

Underwater archaeological research on the lake has not been done much before, even it has never been done once in Indonesia. This become our concern because many lakes in Indonesia have high archaeological potential and historical value. One of them is Lake Matano in South Sulawesi Province, this lake is one of the deepest lake in the world, have a lot of histories that not many people know. The lake is also the only connect between South Sulawesi (Sorowako) and Central Sulawesi (Marowali). This lake has clear water, because it does not come from the confluence of the surrounding rivers, this lake also will not experience drought because it is formed from thousands of springs under it.

Previous archaeological research at Lake Matano precisely in 1998 was done through OXIS project but they're not did any underwater surveys in Matano Lake. The Oxis projects conducted by Iwan Sumantri (Hasanuddin University archaeologist), David F

Bullbeck (Australian National University), and Bagyo Prasetyo (National Archaeological Research Center). The result of this study is that Matano region was well-known in the past for its products of iron and nickel which have high quality. Because of the quality of iron in the field, many of the past people work as blacksmiths, with the evidence of a lot of archaeological data found in the form of ax funnel, hammer, grounding, spear, machetes, war caps, plates, and kettles. Interpretation of archaeologists mentions that from the 10th century until the middle 15th century, allegedly Luwu has exported the iron to Majapahit, this information is obtained from the ancient text of Negarakertagama (Mulyana 2006, Robson 1995).

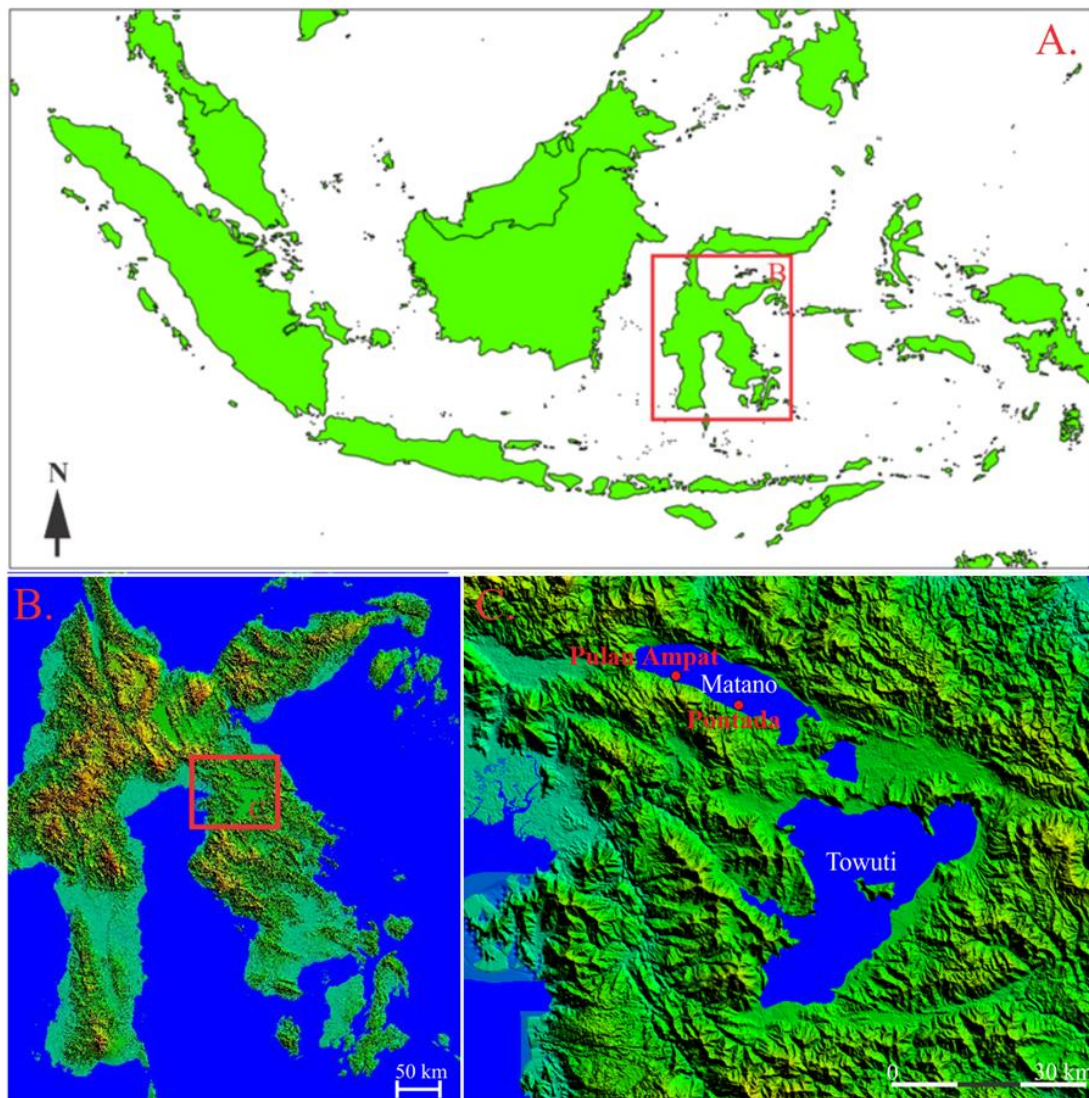


Figure 1. Map of Lake Matano Which Located in Luwu District in South Sulawesi Province (Source: Puslit Arkenas/Suryatman)

The history of Lake Matano can not be separated from the role of the Kingdom of Matano and Luwu in the past, word of Luwu has been used in the past for the title of iron Pamoro Luwu. Luwu people have no expertise in managing iron, they can only prepare raw materials. After the raw materials are prepared they send to the capital of Luwu Kingdom that is in the area of Ussu, Ussu people then forge the raw material in the form of iron into an object, such as machetes, swords, to badik and kris. The long history of

the Luwu kingdom is contained in the text of I La Galigo, hence the term Bessi to Ussu-Iron Ussu or Iron Luwu. However, at present there are no traces of the Luwu Kingdom through archaeological research conducted on the land.

The underwater research of Lake Matano was conducted to record the traces of the existence of the past Matano settlements. Starting from prehistoric times to the middle ages when the community of blacksmiths were very well-known in the Archipelago. Given many data by the local and divers community of Lake Matano, they discovered archaeological data such as pottery, swords, spears, and other irons with no in situ studies has been done. The underwater archaeological search at Lake Matano also aims to reveal other cultural heritages, which may be older than those mentioned above. National Archaeological Research Center Indonesia (*Puslit Arkenas*) as a state institution engaged in archeology initiative here conducts research of maritime archaeological and underwater archeology in Lake Matano for the advancement of science as well as to explore the identity of the Matano community.

This study uses inductive reasoning path, the method accords to the primary evidence has led to discipline approaches to material culture, and to extensive description and documentation of the evidence with close attention to detail (Tanudirjo 1995). The research type chosen are explorative and comparative descriptive. Exploration is conducted on primary archaeological data and the context of the findings of artifacts with their terrestrial and underwater environments. The survey was conducted by diving technique using SCUBA (Self Contained Underwater Breathing Apparatus) equipment for underwater objects and make a dive plan according tables for diving in high altitude lake. In site recording and measurement using underwater archaeological methods such as baseline and radial (Bowens 2009). After the primary data were collected, description of data was performed, and a comparative analysis was performed with related historical sources. We also conducted surveys and observations of cultural inhabitants on land area.

The main reference data discussed in this article are from literatures studies and interviews conducted to assess the opinions and views of the community on the existing cultural landscape. For Analysis of pottery and metal artifacts, X-ray fluorescence (XRF) element analysis is also conducted. Database recording was also done to perform a complete data collection of archaeological findings in Lake Matano. The spatial analysis such as the presentation of map data of the distribution of archeological findings and the transformation of archaeological data in Lake Matano are also helpful and conducted in this study. We also performs 3D photogrammetry recording and analysis on object and sites located at the bottom of the lake.

## 2. Matano environment and descriptions of each site

### 2.1 Lake Matano

Lake Matano is an ancient lake located in Malili region, South Sulawesi Province. Lake Matano is one of the highest lakes of the other lake complex. Malili is the capital of East Luwu Regency, consists of 11 districts, among others: District Burau, Wotu, Tomoni, East Tomoni, Angkona, Malili, Towuti, Nuha, Wasuponda, Mangkutana and Kaleana. Lake Matano has a depth of 590 m or the bottom of the lake is located 203 m below sea level. Lake Matano is known as the eighth deepest lake in the world (Herder et al. 2006) and the deepest lake in Southeast Asia, with an area of 16,408 hectares and a length from west to east 28 km. Water from Lake Matano flows into Lake Mahalona then to Lake Towuti and then flows into the river Larona. Geologically, the nearby Matano Fault

Zone is still active with tectonic movement of approximate 2 cm per year. Lake Matano is considered to be 1–4 million years old (i.e., formed in the late Pliocene) (Tamuntuan *et al.* 2010).



Figure 2. Landscape of Matano Lake From Soroako

The environment around Lake Matano contains many metal elements such as iron and nickel. At this time the natural resources of these metals have been utilized by PT Vale to produce ingots (iron ore) for national and international supplies. The geological map also shows sites found around Lake Matano residing in the rock formations of Matano and Ultrabasa. In addition to Lake Matano there are also other lakes located in the District Malili, South Sulawesi, in the Gulf of Bone the tip. The lakes scattered in the Malili region are also called the Malili lake complex. The lakes include Lake Mahalona and Lake Towuti. There are two smaller lakes located within the Malili complex namely lake Wowontoa and Lake Masapi. Among these five lakes are Matano lakes located in Nuha District, while the other four are located in Towuti District.

Nuha District consists of five villages, including Soroako, Nikkel, Magani, Matano and Nuha villages. Matano village is the most vast area of  $\pm 242$  km<sup>2</sup>, and the village of Nikkel is the smallest village among the five villages in Nuha District. Surveys were conducted in the sub-districts of Nuha and surrounding villages such as Nuha, Matano, Soroako, And other areas related to archaeological remains.

## 2.2 Pulau Ampat Site

Pulau Ampat (four islands) site is in the western part of Lake Matano, which locates on a cluster of four small islands in Lake Matano (Fig. 4). There are currently various names exist for the islands, though according to our local informants, the ancient name of the island was Ampat Island, therefore we named the site as Pulau Ampat. The islands are now covered by overgrown trees and grasses, and shrubs (Fig.2). Pulau Ampat site is located at a depth of 3-10 meters from the surface of the lake water and in the karst



area of Lake Matano. The location of this site is at  $2^{\circ}28'19.78''\text{S}$  and  $121^{\circ}15'41.85''\text{E}$  (Fig. 3). Accessibility to the location can be reached by using *Katingting* Boat with travel time about 30 minutes from Sorowako, from Ide Beach and Matano Yacht Club. The underwater environment of this site is very beautiful, dominated by rocks and has a fairly visible distance of about 15-20 meters in the best condition. The good visibility is influenced by the lack of mud sediment. Underwater profile of Lake Matano is slope with a depth of 500 meters. At the base on the sloping part, the site is dominated by sand and rocks. Overbed marine organisms were some freshwater shells and fishes species.

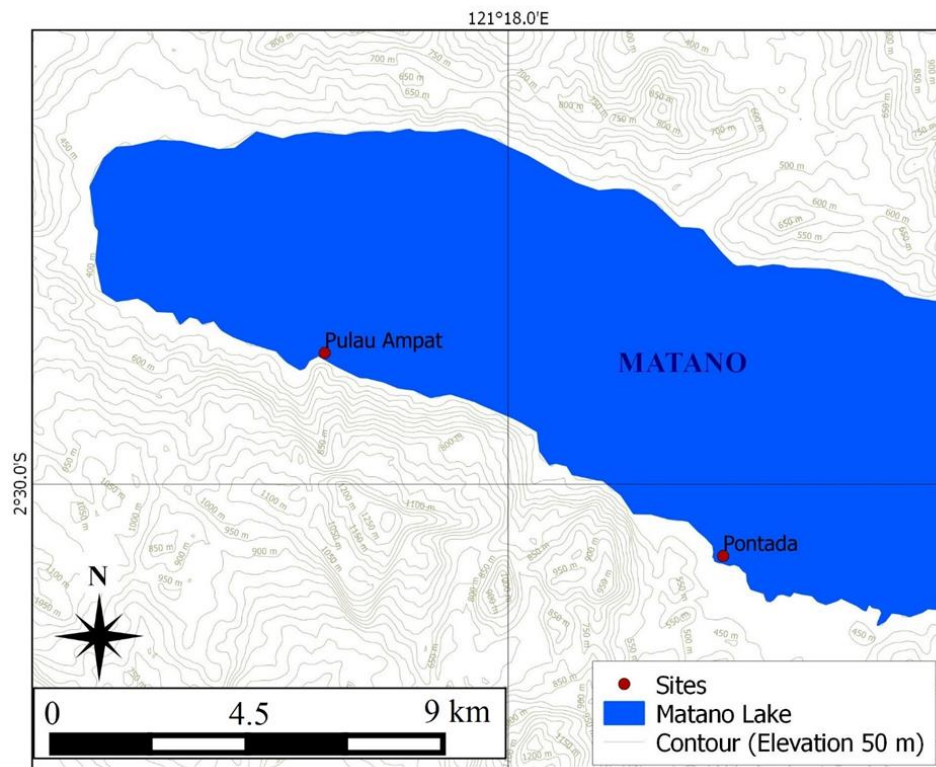


Figure 3. Sites position (Pulau Ampat & Pontada in Matano Lake (Source: Puslit Arkenas/Suryatman)

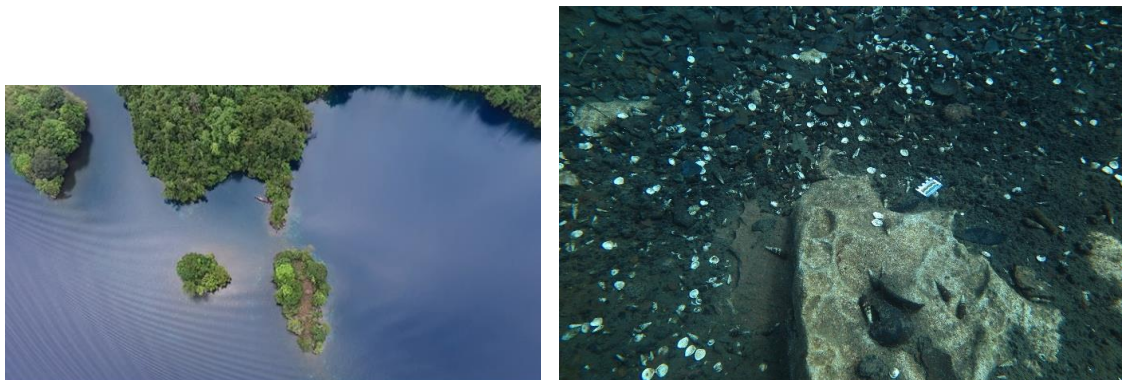
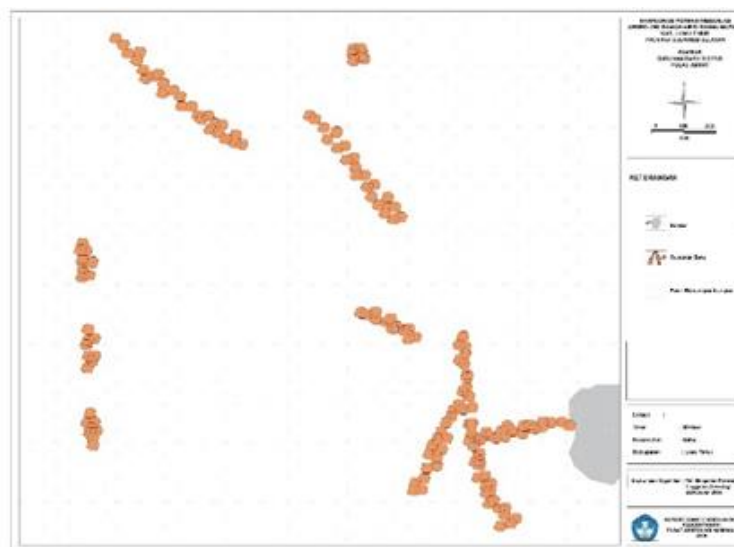


Figure 4. Sky view of the Pulau Ampat site and square where we found a lot of pottery and flakes (Source: Puslit Arkenas)

During our underwater survey, we found some human cultural remains at a depth of about 3 meters from the surface of the lake. The findings were mainly fragments of pottery. This finding is quite dense and tucked between the rocks that are on the slopes. These findings span almost all parts of the island, the team traces the west to east of the island and still find complete pottery jar and many pottery fragments findings on both parts of the island. Some of potsherds has motifs with geometric patterns (Fig.11), while others are mainly plain. The team dove to a depth of 8-10 meters from the lake's water level. At a depth of 10 meters from the surface of the lake, we still found more pottery with the same motif and style like in 3 meter depth spreads on a plot of land at the bottom of Lake Matano just few of them still in complete condition, and we also found the alleged rocks as lithics flakes by much carefull survey. The discovery of this flakes stone has the same context as that of pottery and in the same depth. In addition, we also found a few fragment of animal bones and teeth of vertebrate animals.

We also found the composition of the elongated stones on bottom of the lake (Fig.5). The stones are carefully arranged, though the exact function of the stone structure is unclear yet. The stones used for this structure are white limestone possibly from a single source. The location of the stone composition is at a depth of 3-4 meters from the lake surface and about 30 meters distance from the lake beach, near where we found pottery and flakes. The numbers of fragmented pottery and flakes are scattered around the composition area. These findings are possibly from the same cultural context and the same period, yet we need further study to confirm such possibility.



Figures 5 Plan of the area with composition of the elongated stones on bootom of the lake (Source: Puslit Arkenas)

### 3.3 Pontada Site

This site is named Pontada because local people call this site area as past village area of Pontada. The location of this site is on the south side of Lake Matano precisely on the east coast Ide Beach, as administratively enter the Nuha District, East Luwu, South Sulawesi. This site is located at 02°30'52.4"S and 121°20'43.6"E (Fig.3). Access to the location can be reached by land and lake. The land route can be reached by using two-wheeled and four-wheeled vehicles with travel time about 15 minutes from the terminal

Sorowako, while the lake route by using *katingting* boat with travel time about 5 minutes from the port of Sorowako. The site is located close to Ide Beach which is a tourist attraction in the Sorowako area. Located at the depths between 3-7 meters from the lake's surface, and the distance from the beach is approximately 20 meters. It has worse visibility than the previous site because the bottom of this site is dominated by sand and mud sediments that cause the site to have a visibility of only 3-5 meters vertically.

Our survey was conducted to search the traces of a well-known blacksmith production in Lake Matano in the past, possibly during the 13th century to the 15th century. In fact, our investigation found a possible house foundation in the bottom of Matano Lake (Fig.6), while all the metal artifacts we confirmed by our investigation were the collection salvaged by the villagers. Numbers of these salvaged iron products from the site indicate the genius (local genius) of the Matano Lake community in processing iron, even the product has been exported to the Land of Java.

During the survey, we found the rest of the wooden poles which could be suspected as the foundation of the house. The wooden poles were scattered on the bottom of an average lake with a length of 2 meters (Fig. 6), there was also a wooden pole that still stuck in the bottom of the lake. The existence of these findings can be expected that the wooden poles are the remains of settlements on the coast of Lake Matano. In addition, we also found a large log near with where we found the wooden poles, which was over 20 - 30 cm in diameter (Fig.7). The number of logs we found were considerable amounts, ranging from 5 to 8 pieces spread and some are collected in one spot at the bottom of this site in 4 meters from the lake's surface. This finding is suspected as a piston blower / bellows or in regional languages called various kinds such as *ububan* or *kempa gutak* which is a wind blowing instrument to light a fire in the heating of iron, which functions as an air / wind producer in the processing of metal artifacts used by the clever iron. It was found also wood in this area that allegedly was as a base and equipment to support blacksmiths activities. These findings are a testament to the activity of blacksmiths on the coast of Lake Matano in the past.



Figures 6 The wooden poles under the lake which could be a house foundation in the past village (Source: Puslit Arkenas).



We also found the distribution of fragments of carved pottery with geometric motifs (Fig. 8). The poteries from this site are clearly different from the potterries found in Pulau Ampat Sites. Types of decorations and its techniques looks different at first glance. One interesting pottery is the invention of a large bowl, this object is interesting because at the bottom of the bowl there was a black burning remains. The bowl is thought to be the *kowi* used for the smelting of iron ore in the processing of metal artifacts. Unfortunately we could not find any metal artifacts which are in situ condition. According to Mokole Matano, the King in the Matano area and heirloom observer community, the metal artifacts are saved by being lifted to the surface and stored in Mokole Matano's house to be more protected. This is done because the illegal salvagers looting of metal artifacts at the bottom of the lake are stolen and sold, therefore to secure this cultural heritage, the community took the initiative to lift and store it. The major metal artifacts we found are machetes, spear eyes, knives, and farm equipments.



Figures 7 A large log finding is suspected as a piston blower / bellows (Source: Puslit Arkenas)



Figures 8 A fragment of carved pottery with geometric motif in the bottom of lake (Source: Puslit Arkenas)

### 3 Analysis of Artifacts

#### 3.1 Lithic (Flakes)

All the lithics we found are chert flakes. These flakes were found both on the surface of the coastal area and underwater of Lake Matano as associated with pottery fragments. Our analysis confirm that there is no technological and typological difference between the artifacts found along the coast and underwater. These flakes are mainly utilized, hence can be identified as flake tools

(Fig.9). Categories of the flake artifacts found along the coast are debris, core, utilized flake with indication of use traces (usewear) and retouched flake. Some flake fragments which could be used as tool has irregular shape. It seems these reduction flakes are not made by blade making technique, unlike to the Toalian flake-blade techno complex in South Sulawesi mainly during 8.000 and 3.500 years BP (Bellwood, 1996; Glover, 1976; Bulbeck et al., 2000). The complete flakes basically have a nipped edge on its side. The material of these flakes is a kind of chert rock (*rijang*) which consists of two colors, namely dark brown and greenish gray. The green gray stone is derived from opiolite ultrabas (Ultramafic opium stone rocks) while dark brown is a matano formation rock (Member Chert Matano). Both materials are formed from the deep ocean environment which then lifted to the soil surface due to endogenous movement a few years ago (Rusmana et al, 2010).



Figures 9 Variation of flakes collected from the bottom of Lake Matano by our survey (Source: Puslit Arkenas/Ratno Sardi)

The usewear seen on the flake tools show that lithic artifacts are used for scrapping or cutting. There is no indication that the tool is used as a point or borer (Fig. 9 : A-D). The type of tool produced was just a side shrink type (side scrapper) and end shellers (end scrapper). The flake tools found tend to be small with a range of 3 to 2 cm in size. Unifasive dripping technique on some devices was done to re-sharpen the side of the sharpening that may have been collected. The core stone found shows a various size. Some of them are 10 to 14 cm in size. However, some core stones are also found in small size with a range of 4 to 6 cm. The flake scars to core shows flakiness randomly (Multidirectional Core).

### 3.2 Pottery

Based on our observations, the pottery fragments that we recover from underwater of Lake Matano are classified into a pot with globular type of jars (Fig. 10), incense (for the ceremony), plates, vases, and places of food. Surface observation of the fractional forms of sand is not very smooth grains, and burned with a standard pottery burning temperature, approximately 600-700°C. The existence of rounded shapes and fractions may indicate that these potteries were made by a wheel swivel and then followed by landing technique, so that the trajectory of the puar wheel is very thin and even disappear altogether. The use of landing is very common in this area up to now. The major decorative patterns of the potteries are geometric images with combination of straight, curved, triangular tumpal, point, and circles. The decorative techniques used are scratch, gouged (*cukil*) and in-press. The decoration on the rim part of the container is made by subtractive process (reduction) on the material object. Another major motif is the zigzag with a combination of straight and curved lines (Fig. 11). These motifs are common in Metal aged potteries in Sulawesi and also among Eastern Indonesia. The rencet excavations in Topogaro cave complex site in easte rn coast of Central Sulawesi (Morowali district) also confirmed numbers of such decorated potteries dated after 1800 BP (Ono 2017, personal com).



Figures 10 Globular tyoed jars collected from the bottom of Lake Matano (Source: Puslit Arkenas)



Figures 11 3D Recording on The Pottery with geometric motifs (Source: Puslit Arkenas)

For further analysis, we also conducted X-Ray Fluorescence (XRF) analysis which is a technique that forms a material on the basis of X-ray interaction with the analyte material and non-destructive analysis. The XRF method is used to determine the elemental composition of a material and has been widely used by researchers (Viklund, 2008). In terms of the elemental composition of potteries, the main mineral constituents are Fe, Al, Si and O<sub>2</sub>. This mineral is natural from its origin, i.e the earth's crust. Earth's crust is the outer layer of the weathered earth composed of feldspathic rock, which consists of granite rock and igneous rocks. Silicon, Oxygen and Aluminium elements are the original elements present in the earth's crust. The main content of clay is Kaolinite ( $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ ), dolomite, quartz. Thus, the elements that come in the pottery are not much different from the material from which the compiler originated (see Table 1).

Table 1: The Result Of Pottery XRF Measurement on Matano Lake Pottery

Pottery mtn-PTD	2/10/2017 9:50	Concentration (MA1)	
NaKa1	1.998344197 ppm	0.259585769	
MgKa1	2.076006895	0.869339256	
AlKa1	3.509500024	1.423931987	
SiKa1	51.90489891	13.27456778	
P Ka1	3.79237217	0.019915417	
S Ka1	9.771694083	0.412654998	
K Ka1	10.04894273	0.079251189	
CaKa1	91.18196973	1.582528356	
BaLa1	24.39045893	-0.035088226	
TiKa1	27.45894376	0.200106045	
V Ka1	17.48591027	0.033186829	
CrKa1	37.37315103	0.041354413	
MnKa1	57.79102307	0.185781878	
FeKa1	3,250.28	18.19039404	
CoKa1	193.9104447	0.00692756	
NiKa1	44.27608288	0.034203231	
CuKa1	12.41345503	0.005420677	
ZnKa1	10.7710945	0.003710224	
Gerabah mtn side b	2/10/2017 9:53	Concentration (MA1)	
NaKa1	1.711888042	0.502354699	
MgKa1	1.963785494	0.577605864	
AlKa1	3.608001667	1.659720319	
SiKa1	41.62380313	11.17533311	
P Ka1	2.642587365	-0.006040646	
S Ka1	6.578905958	0.230116547	
K Ka1	16.82468477	0.313494169	
CaKa1	37.03693178	0.670572676	
BaLa1	33.48469973	-0.055862889	
TiKa1	38.33055677	0.316886161	

V Ka1	17.0461832	0.015321021	
CrKa1	26.69080564	0.029590406	
MnKa1	44.42239148	0.121297767	
FeKa1	2,065.44	11.0916751	
CoKa1	132.0850288	0.004481982	
NiKa1	43.4704216	0.033027298	
CuKa1	12.13535565	0.005355045	
ZnKa1	11.27472161	0.005362569	

By such XRF analysis, we confirmed the Matano potteries contain high ratio of nickel, while the cobalt element is not the main element. A large element is Nickel, an unusual element that many pottery contain in general, it could be the pottery is contaminated by the water of Matano Lake which contains nickel. This large Ni content is apparently influenced by the environment of Matano lake which contains a lot of nickel. The lake water Matano was according to previous researchers contain lots of lead metal (Pb) and Nickel (Ni). Matano region is a nickel mine area, therefore it is not surprising if the clay soil around the place contains lots of nickel. However the soil in this site has not been tested in laboratory, but this has indirectly indicated that the area around Lake Matano is an area containing lots of nickel ore. This is reinforced by a large mining company (mining) in the area of PT. Vale in Sorowako, Nuha District, which almost surrounds Lake Matano. The results of this analysis also proves that the pottery found on Matano sites are very likely made in Matano area as well as the surrounding area, with the evidence of the dominance of Ni content.

### 3.3 Metal Artifacts

All the metal artefacts reported here (Fig. 12) are the collection by the local community for the purpose of protecting against theft activities. These metal artifacts were all collected on the bottom of Lake Matano. The community took the initiative to dive at Pontada Site and other dive spot in Lake Matano to save and protect these metal artifacts. Most of the metal artifacts are stored safely at the Matano King / Mokole House named Mr. H. Umar Ranggo La Makandiu. In his home the metal artifacts are kept in excellent condition. According to the community, the metal artifacts was found no more than 10 meters in depth from the lake's surface.



A: Metal spears



B: Metal machete





C: Metal Ax *Endramu*



D: Metal Knife

Figures 12 Spears, machete, ax, knife collected in Lake Matano (The Collection of Mr. Umar Ranggo) (Source: Puslit Arkenas)

Our analysis of these collection confirm the past productions by the blacksmith at Lake Matano contains quite diverse and variety types (Fig. 12:A-D). Among them, long machete locally called as *ponai*, were found more than 30 pieces in the collection of Mr. H. Umar Ranggo La Makandiu. The collection contains a shorter machete which is locally called as *owu*. Another type of metal aretifact is ax locally called local as *endramu*. This type of ax was used for agrarian or agricultural activities accroding to the informants. A funnel ax, which was probably used for religious events was also among the collection (Fig.13). Since most of these collections were found in the bottom of Lake Matano by Mr. Umar, their conditions are basically corroded. Yet our analysis identified that the most of the metal artifacts are made of iron. In fact, Lake Matano is a well known source of iron mine until recent times. Only the except is the funnel ax which shows no attraction to the magnet we used for analysis, and our XRF analysis confirm the ax contains equal of copper element and iron. Such metal pr oduct as mix with copper and iron elements is not so common, and such evidance shows that Matano community made various type of weapon and distributed to another island in the past.



Figures 13 A Funnel Ax Which Recover From The Bottom Of Matano Lake (Source: Puslit Arkenas/Alfindra. P)

### 3.3 Faunal remains



Figures 14. Animal Teeth Found in The Same Depth and Context With Other Finds

The existence of faunal remains including animal teeth raises many questions about the deposition and transformation of them since they were found at a depth of 10 meters with the same context and at the same depth as findings of pottery and stone tools (Fig. 14). This allegedly the result of human interaction with fauna in the past. The animal teeth we found were small in number and we collected only one sample. Our morphological analysis confirm the tooth is belong to vertebrate animal, the mammalian class, possibly Cervidae, or deer. Since it is known that there were no endemic deer species in Sulawesi, and all the current deer specise in the island were intoduced by human possibly after the Metal age or much rencent past, the possible deer tooth could be aged after the Megal age. It is unclear in this stage wether these animal teeth were food remains or used for other purposes then discarded at the site, and we need further analysis and more samples for the past animal use by the Lake Matano community.

#### 4 Conclusion & Interpretation

Water is the main source for human life and we can not survive without water, thus the lake coast had been used for human as one of the main habitation area since the Paleolithic times. Lake Matano might have been important area for the past human activities and also habitation, thus it keeps the rich archaeological remains or the past material culture in this region. The transformation process of lake water rise might make the past village or settlement drowned underwater. Our research discovered traces of remarkable and well-known iron cultures in the bottom of Matano Lake region. The numbers of stone tools (flakes) from Ampat Island Site, in the bottom of Lake Matano are one of the archaeological evidence. The similar types of such lithic tools are also exacated in other sites in Sulawesi, and most similar stone tools were found on the Routa Site aged around 19,000 to 3,000 years ago (Suryatman et al, 2016).

The technology of stone artifacts in Matano is very different from the technology of stone artefacts found in the late Pleistocene culture layer up to the middle Holocene (which is known as “Toalian culture”) in the Maros Pangkep karts region of South Sulawesi. (Glover 1976, 1981). The resulting shale device uses blade technology with a systematic slashing pattern (Bellwood, 1997). Even recent research shows that early modern humans in South Sulawesi at 30,000 to 23,000 BP have made a scratch pattern on stone artefacts as a symbol of their behavior (Brumm et al., 2017). That’s technique is not found in stone artifacts from the Lake Matano region. This shows that the influence of the lithic culture that developed in South Sulawesi did not reach Matano territory, or alternatively the age of Matano lithics are much younger than the Pleistocene lithic culture and also the Toalian lithic culture which

were mainly developed during the middle Holocene. Yet the exact date of these lithic tools in Matano are unclear now, and the early inhabitants community in Lake Matano might be older or much younger than the Routa.

Another interesting finding is the distribution of fragments of pottery located at the bottom of Lake Matano, in the same site with where we found the flakes. Judged with the number and intensity of pottery fragments, it seems the duration of human habitation in the site could be long term. Based on our temporal analysis, the types and major motifs of these potteries are similar to the Metal aged potteries in Indonesia, thus the site could be back at least somewhere between the Metal age, mainly after 2000 years ago. The number of pottery fragments found at the bottom of Lake Matano (Pulau Ampat Site) are shows the high intensity of human activity in the past before it become submerged. To ensure the process of lake water rise, we need further investigation with geological data to get a more clear picture for site formation and dates.

The heyday of Lake Matano culture is in the period of *perundagian* (metal) or Metal Age in Indonesia including Sulawesi. Somewhere during this age, the prehisotric Lake Matano people started mining activities to process metal by themselves. The existence of metal findings including spear heads and knives from some cave burial sites in Sulawesi indicates that the metal artifacts are also used as burial goods during the Metal age. The production of metal tools also encouraged the expansion of the Bugis people into the Gulf of Bone. Metal tools such as machetes and axes are often referred to as *bessi* (=iron) Ussu. The local Bugis term for Luwu iron, Ussu 'bessi, or Ussu iron, points to Matano as a possible source of Luwu iron, and Cerekang as a coastal settlement where the iron is traded. The idea that Bugis group who live in the Cerekang-Ussu region to preserve trade relations with iron fighter Matano (as suggested by Cerekang's reputation for excellence in later palace sites) is not supported by the past archaeological investigation and the aquired radiocarbon dates. The dates obtained from the charcoal associated with iron smelting in Kampung Matano showed that the smelter began only at the end of the 15th century (Bulbeck and Caldwell, 2000).

The number and volume of metal artifacts in the Matano Lake Area are huge, thus it can be said this region had large metal processing industry with amount of metals resources, especially iron. Metal products are important for the Matano Lake community as their daily farming tools etc and also as commercial export goods to other area in Sulawesi and other regions in Indonesia. The culture and technology of metal processing in this region has been passed down from generation to generation. The quality of the Matano Lake metal production have been well known in Java as well since at least by the 10th century AD (Bulbeck and Caldwell 2000). In the early 20th century, Nuha ferrous iron in Sulawesi was traded northward towards Lemo valley, and exported from Bungku beach, mainly to eastern Indonesia (Sarasin and Sarasin 1905: 305; Grubauer 1913: 59; Reid 1981: 12). On the other hand, the location of Matano on the western end of this lake is a logical location for a melting center that is exported to the south through the Bay of Bone. Matano is located on a frequent trek through the Bonepute, Laroeha and Turungang Damar, to the inner lagoon at Cerekang, an outpost of the Bugis strategically located in the deepwater coastal complex of the Malili region. This footprint transverse through hills and lading, and possibly formed during the initial settlement about 2000 years ago (Bulbeck and Caldwell, 2000), which is cleary in the Early Metal age in Sulawesi and Eastern Indonesia.

The secret of Matano's economic success seems to be on its high-quality iron, and possibly reinforced by a small amount of chromium in the seeds. In the 17th century, Rumphius recorded that the iron produced in Lake Matano cost six swords from Bungku, 'because they tinsel (damascus) repeatedly, they know how to forge iron in such a way that it is almost steel' (Beekman 1999: 238) . In the next century, Blok (1759: 75) wrote about Luwu: 'The land is very fertile for rice and sagu, and produces excellent iron.' Until the early 20th century, iron equipments produced in Lake Matano were traded as far away as Maluku, and the iron ore of Matano lake was exported to northern Sumatra (Bronson 1992: 92). In ancient texts such as *Negarakertagama* have mentioned export activities from the mainland of Luwu / Matano to Majapahit Kingdom. In the literature of *La Galigo* also much told about the production activities of metal tools that have superior quality in his time.

However, it is quite unfortunate that the tradition and culture of metal production in the Lake Matano Area has being disappeared in this time. We need to built public and government awareness to revive and preserve such culture as one of great local traditon in this region. Our findings from the bottoms of Matano lake and temporal results should be useful data and icon to evoke the people and government interests and future preservaiton of both the intangible and tangible cultural heritages in Matano region. In terms of Underwater Archaeology and it's methods in Indonesia, our studies and investigations has just started within this 10 years and still under the developping process. Our underwater archaeological investigation in Lake Matano has also just started and our data and analysis is yet limited, specially to tell information about transformations data in the bottom of Matano Lake. Though we consider it is our great first step for such archaeological study on underwater site on lake environment in Indonesia.

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