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Stiva Cave: A New Discover Of Prehistoric Hominid Underwater cave

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Abstract
Stiva Cave is an underwater cave (15,3 m below recent sea level), which located in Nusa Penida, Bali, Indonesia. Nusa Penida is a Karst landscape island in southern Bali Island. No many underwater caves are known and explored in this area, Stiva Cave is a first underwater cave which explored and discovered in Nusa Penida area. In this cave we found a number of fossils that we identified as vertebrate fossil and unique process that very potential for geotourism, especially for fun diving tourism. We mapped entire cave tunnel and measure a safety and risk for scuba diving, then we identified the fossil. At the result, there a several risk that need to be aware and several safety procedures that must be allow for observer. In other way, we found many similar fossils that and it spread in different tunnel that very potential for education in geotourism. We suggest that this cave is a shelter for hominid species when Last Glacial Maximum happens, before 21.000 years ago.

Keywords: Underwater Cave, Hominid, Fossil, Last Glacial Maximum

1. Introduction

Nusa Penida located in southern Bali, mostly it's a karst ecosystem. There are several underground river system which has connection to other river system. Based on its genesis, Karst in Nusa Penida has three sequences which can derived based on its characteristics in lithology. In several discussions, this ecosystem start at Miocene (23,5 millon years ago). Until today, sedimentation of carbonate in this system still produce, almost in shoreline in Nusa Penida (P.H. Barber, 2000).

Stiva cave is an underwater cave in Nusa Penida, Bali, Indonesia. It is has been found in 2016 by local diver. This cave located in below recent mean sea levels. Stiva cave is one attractive site for tourism in Toyapakeuh, Nusa Penida (N:-8.685659, W:115.479822), see Fig. 1. But until we start to explore this cave, no one realized that there are several fossil which deposited in this cave because these fossil covered by sediment. So in this research we aim to discover all the cave tunnels, fossil that deposited, and reconstructing how these fossil deposited in this cave. This research hopefully gave advice for guiding diver in moment entered the cave

Fig 1. Location of Stiva Cave, Toyapakeuh,Nusa Penida, Bali, Indonesia.

2. Method

Cave Mapping. There are three parts mapping sections, this procedure necessary to do because we need to calculated the oxygen tank, because it is our limitation when mapping in underwater cave and it in dark condition (see Fig. 2). We measured the width and height in every part cave tunnels for sketching its tunnel morphology. In every section, we collected sediment sample using

tube coring, completed with thick of the sediment and it's characteristic. This sample very important for further analysis. We also collected several fossils for identification and reconstructing the paleoenvironment of this cave.

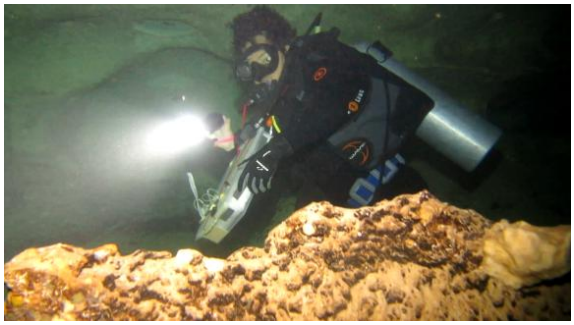

Fig. 2. Stiva Cave condition, we need plan more comprehensive for underwater mapping

Sediment Analysis. This procedure necessary to do. We can identify how this cave submerge at few step based their sediment characteristic. We classify sediment based their size (sand, silt, and clay) by its percentage.

3. Result

Stiva cave enterance at 15,3 m below mean sea level. It is heading to northeast and has height 280 cm and width 510 cm. liniage in N 241°E. This cave has two branches heading to east (N 273°E) and south (N 164°E). The Cave tunnel has 179 m, south tunnel is the longest tunnel in this system, 37,5 m and the other is 25,8 m. We can find several chamber in along tunnel (see Fig. 3)

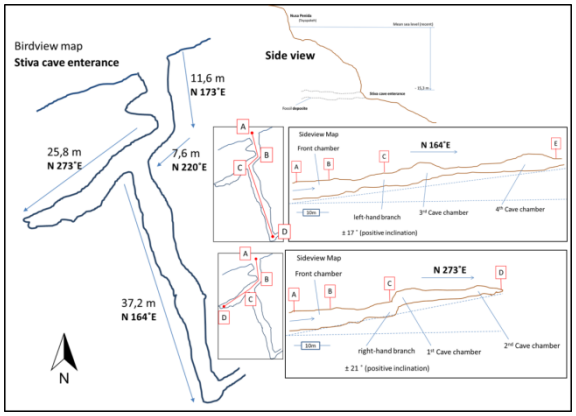

Fig. 3. Sketch of the Stiva Cave tunnel and its position from mean sea level.

The thickness of sediment layer from mouth to edge is gradually thinny and smoothy. Percentation of clay increase gradually into deep cave, follow by decreasing percentation of sand and silt. We can found several chamber in each tunnel branch. The east tunnel/right-hand branch (N273°E) has two chamber and the south tunnel/left-hand branch (N164°E) has 2 chamber too (see Fig. 3 and Fig. 4).

We also found several vertebrate, its looks accumulated in chambers. There are Proboscidea mandibular that can be found in front chamber, the sarchum of Turtoise in 1st chamber I right hand branch, then the femur and vertebrate of Cervidae in 2nd chamber. In left-hand branch we also can found more Cervidae fossil and Probocidea Scapula, accumulated in 3rd and 4th chamber (see Fig. 5).

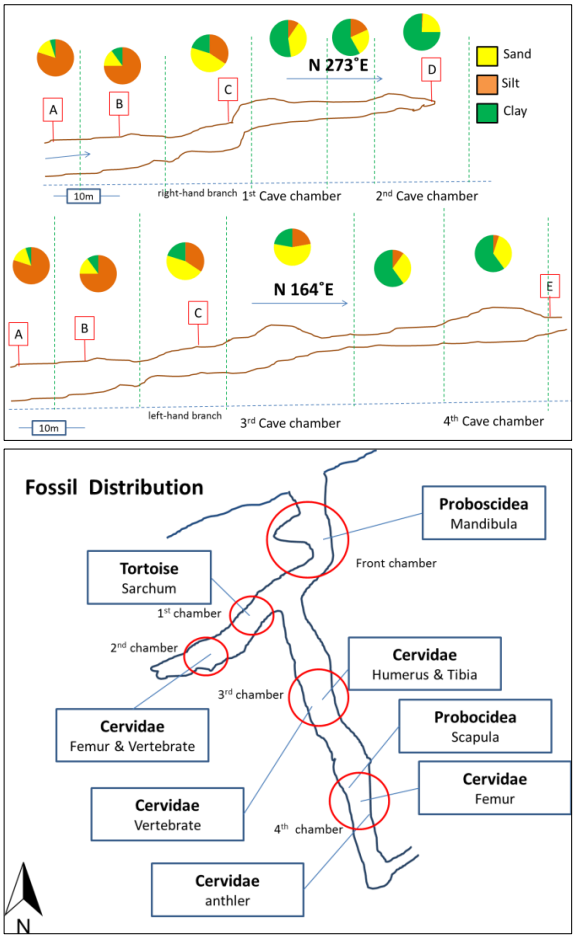

Fig. 4. Distribution of sand, silt, and clay in each tunnel of Stiva Cave (top) and their fossil distribution (bottom).

4. Discussion

Stiva cave form from sub-surface hydrology system of karst landscape. The freshwater from the rain penetrated into body of carbonate rock to crack and weak rock then eroded and made it into a cave tunnel. When the carbonate rocks exposed into atmosphere, it will react with the air and the acid from rain. When this cave form it will make tunnel bigger and bigger in time. But it very fragile and has potential to break if the tunnel structure can't handle the roof weight. This cave is big enough to entered by dwarf humanoid, but very difficult to enter by scuba. It needs special technique to access safely.

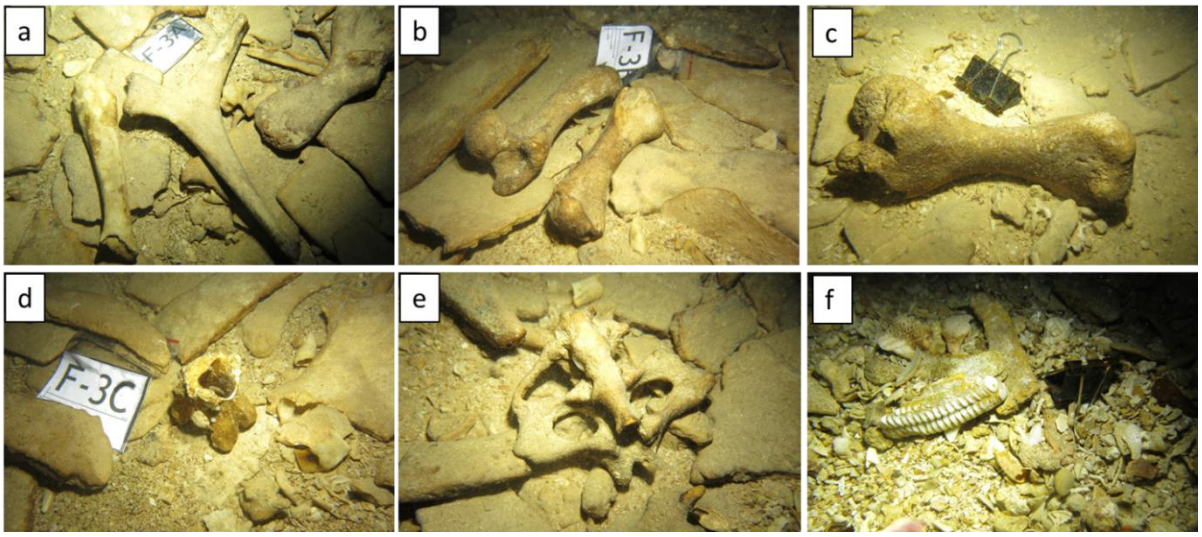

Fig. 5. There are several fossil that can be found in Stiva Cave, that is Cervidae antler (a), femur (b), humerus (c), vertebrate (d). Also we can found Turtoise Sarchum (e) and Probocidae mandibular (f).

Based on location of fossil in that cave, it has potential that in past time this cave is a pre-historic hominid cave. We predict, in the past time, this cave is a shelter for cavern hominid. There are a group of hominid carrying the hunted pray into their shelter, share, and eat them together. They share it to each other then, left the bone into cave floor. When the cave abounded, the bone deposited in this cave until the cave submerge, and gradually change into fossils.

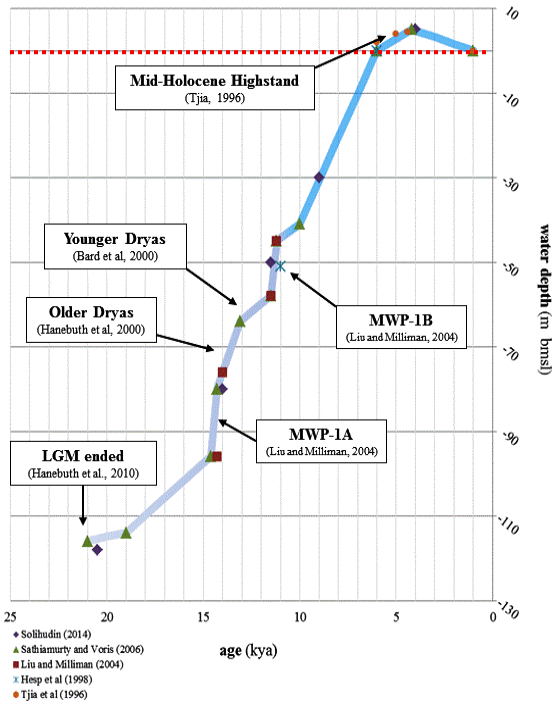

Fig. 6. the sea level change graphic began in Pleistocene (21.000 years ago) to recent mean sea level.

We suggest that this cave is a terrestrial cavern system, specially at the end of Pleistocene, around 21.000 years ago, the sea level is -114 m below recent sea level (see Fig. 6), it known as Last Glacial Maximum (Liu, J. P., & Milliman, J. D. 2004; Tjia, H. D. 1992; Tjia, H. 2014) In this condition, Stiva Cave still exposed to the atmosphere and can be access by terrestrial fauna include the hominid (Fairbanks, 1989; Hanebuth, et al, 2000; Solihuddin, 2014). Cave in karst ecosystem is the best for hominid shelter, it will cool in heat atmosphere condition, and it will warm if in cold condition. Karst can maintain the temperature more stable in fluctuative environment temperature. It must be good to be shelter. After the Pleistocene ending, the global temperature is rising faster and make the ice in earth polar melting faster (Abdussamatov, 2011; Geyh, et al, 1979; Sathiamurthy and Voris, 2006). The implication of that, sea level rising faster and reach into recent sea level. When sea level rising, Stiva Cave will drown by sea water and left the bone in that cave and fossilized, it can explain why in that cave we can found fossil so many in specific type and accumulated in specific location in cave. The sediment in this cave can explain how sedimentation happen in that time. In front of cave we can found more course sediment correlated in more deep tunnel. The beach sand can enter the cave, but it more hard to enter, if sea more deep. This cave has geological value, especially in paleontology.

5. Conclusion

Stiva Cave is one of underwater cave that has rich vertebrate fossil. The fossil preserved well in cave condition, which expels from the sunlight and covered by sediment which has small grain. We suggest that the rich fossil in this cave is a result of prehistoric hominid activity, that carry they hunted and eat them in this cave. This cave must be exposed to the atmosphere at that time,

when global mean sea level still far below compared with recent. It could be happened when last glacial maximum happens, 21.000 years ago. Then this cave abounded by them, when this cave close enough with shore or frequently flooded at high tides.

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