



## **INTRODUCTION**

*Marine lakes (anchialine lake) or **Doline** is a macro form of karst in the marine environment. This concave part was formed because of the karstification process on the surface of the earth for millions of years.*

## WHERE?

Bahamas, Palau, Vietnam dan Indonesia

Indopasifik:

Palau = 57 Lakes

Ha Long Bay Vietnam = 46 Lakes

Derawan Islands = 14 anchialine habitat

Raja Ampat, West Papua = 55 Lakes

(15 Lakes at Wayag and Gam, 40 at Misool Islands)

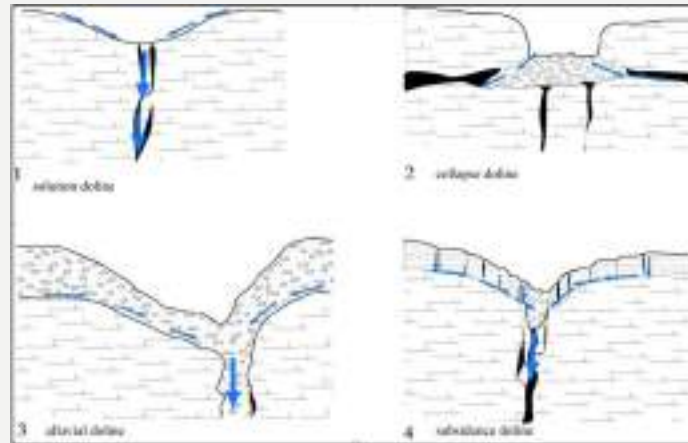


## DOLINE (SINKHOLE, SINK, SWALLOW HOLES, CENOTE, DAN BLUE HOLE)

A **doline** is a natural enclosed depression found in karst landscapes. They are described as small to medium sized closed depressions, ranging from metres to tens of metres in both diameter and depth.

## DOLINE TYPE BASE ON ITS FORMATION GENETIC

Ford dan Williams (2007)



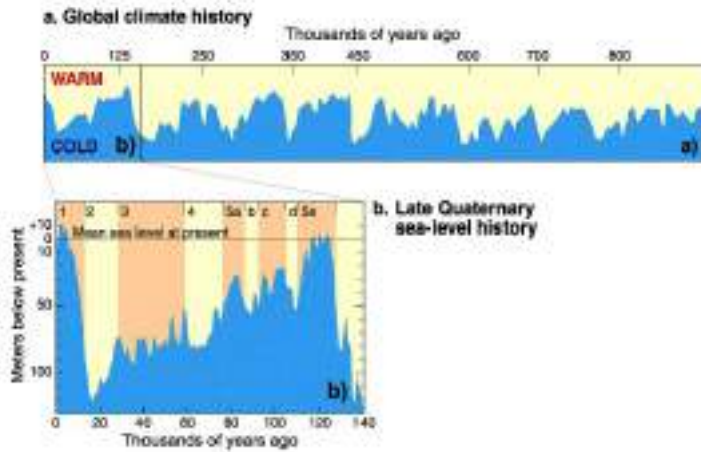
Source: Sauro, 2009

## KARSTIFICATION PROCESS

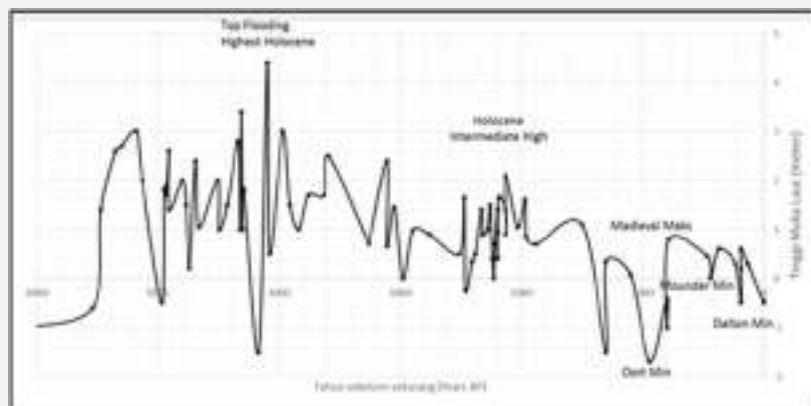
Formation karst landform that is dominated by weathering proces.



## SEA LEVEL FLUCTUATION



## MEAN SEA LEVEL FLUCTUATION OF MALAYSIA PENINSULA AT HOLOCENE TIME



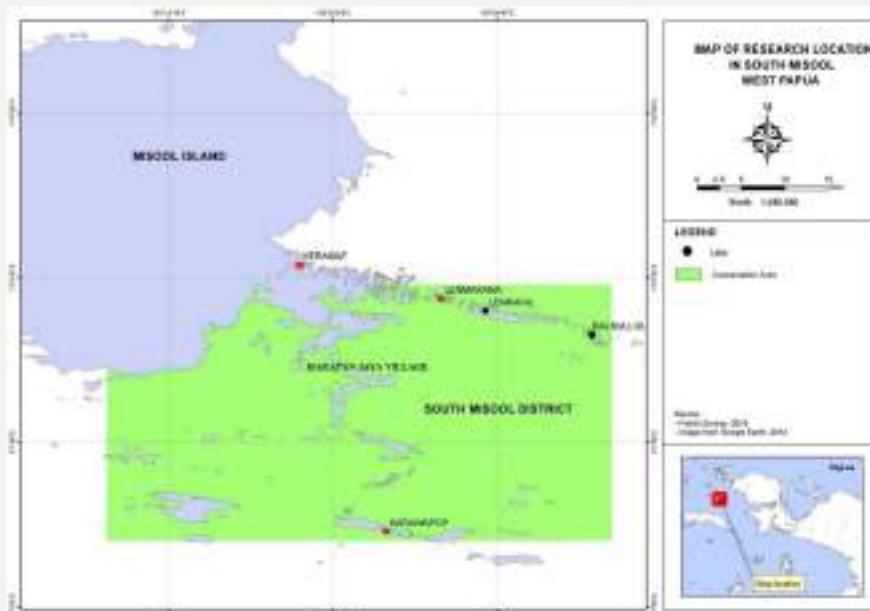
Graph was buided from radiocarbon age date at Langkawi, Perlis-Kedah, Penang-Pangkor-Perak-Selangor, Negeri Sembilan-Malacca, Johor-Pulau Tioman, dan Pahang-Trengganu. All unit become aht (*above high tide*).

Source: Tjia and Mastura, 2013

## QUESTION?

HOW AND WHEN FORMATION OF MARINE LAKE IN MISOOL RAJA AMPAT

## LOCATION

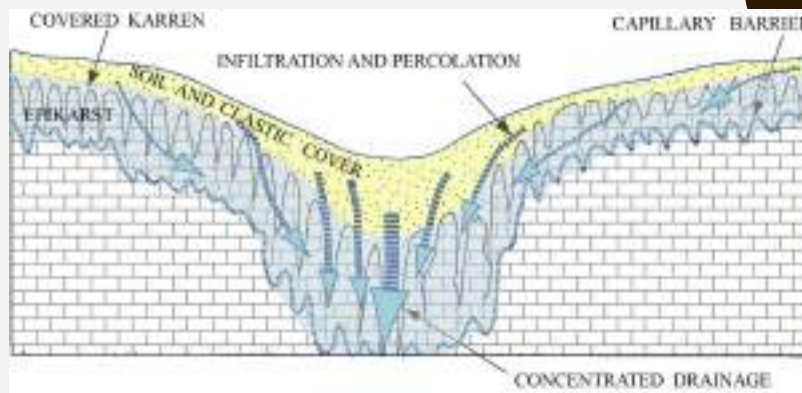


**Table : Characteristics of lake in Misool**

Lakes	Distance to sea (m)	Area (ha)	Maks depth (m)	Conection	Lowest cliff (m)	Tide delay (minute)	Salinity insitu (ppt)	Salinity time series
Lenmakana	55.78	1.25	18.30	medium cave	2	0-120	27.67	*27.78-28.62
Balbullo	44.63	1.94	38.00	pore, hole	3.45	60-240	32.50	**32.44-34.00
Lenkafal	117.24	0.73	24.00	pore	3.35	45	31.50	-
Keramat	108.95	3.23	7.30	big cave	2	45	32.00	-
Karawapop	23.29	0.57	4.5	pore	flat	30	32.00	-
Keramat-2	46.12	1.35	7.7	pore, hole	2	45	33.78	-
Keramat-3	70.41	3.26	8.9	canal	2	-	29	-
Sea Harapan Jaya	-	-	-	-	-	-	-	*24.90- 29.14

\* From 5 November 2015 to 13 January 2016  
 \*\*From 4 November 2015 to 26 December 2015

*Purba et al., 2020 (in review)*



(sauro, 2009)

### DISSOLUTION DOLINE OR DRAWDOWN DOLINE

Depth of the lake  
gradually deeper  
Shaped bowl and  
funnel

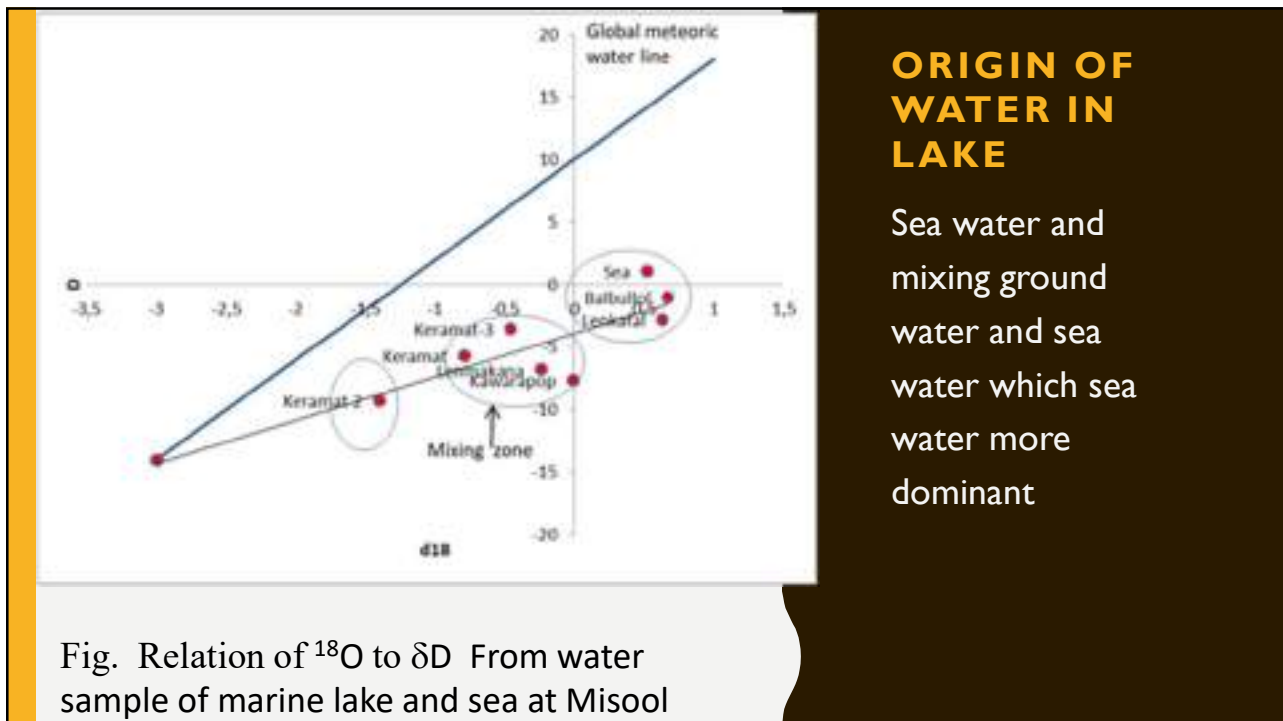
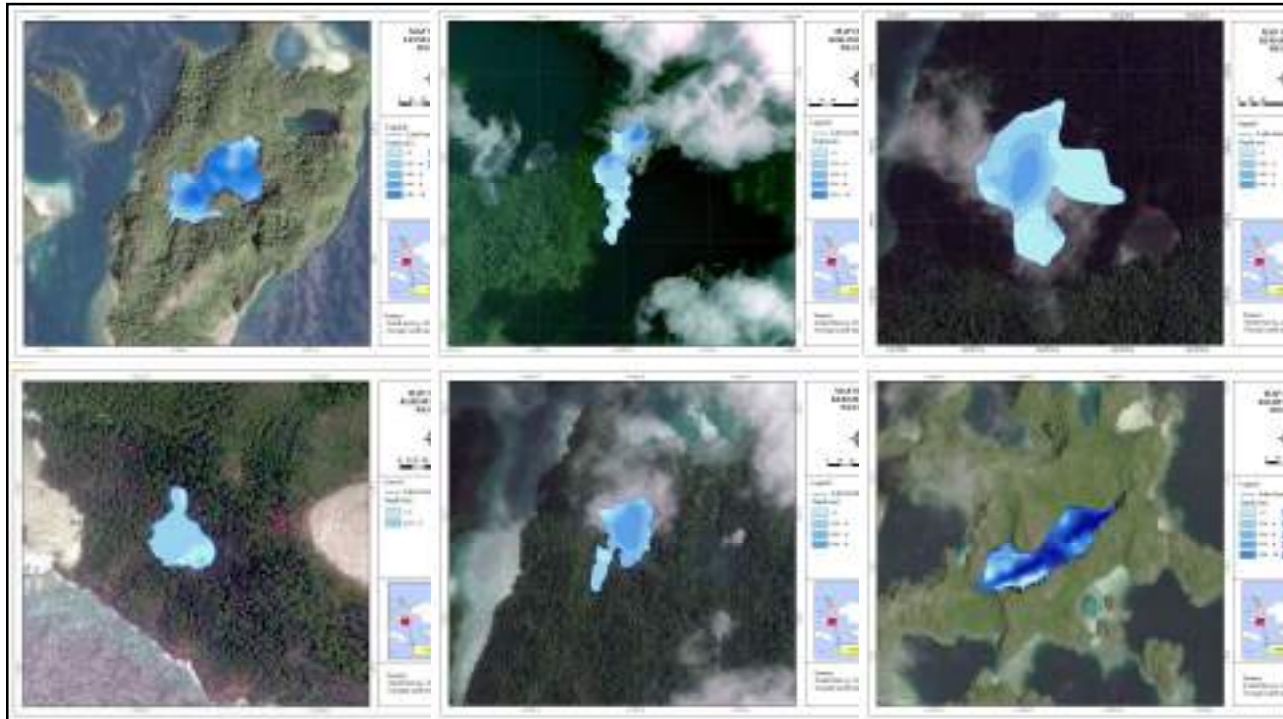
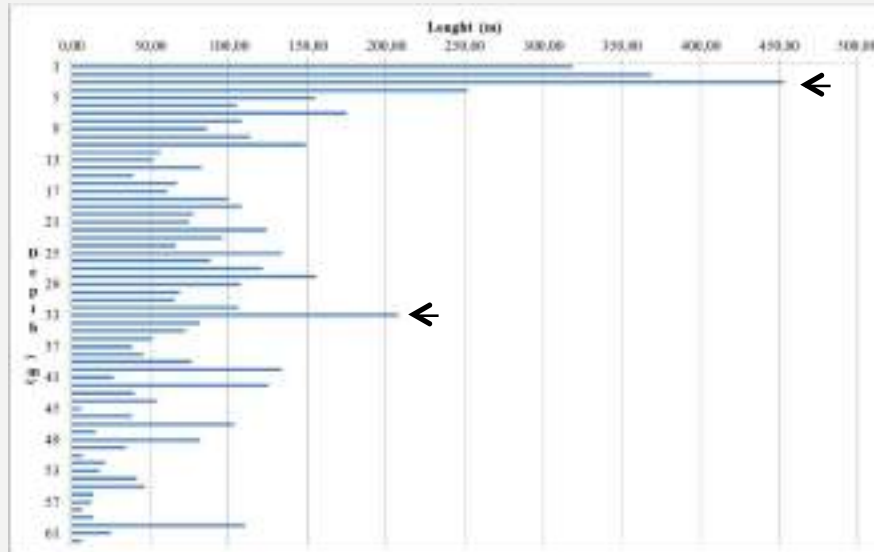


Fig. Relation of  $^{18}O$  to  $\delta D$  From water sample of marine lake and sea at Misool



FIGURE. HYPSOGRAPH OF MARINE TERRACE

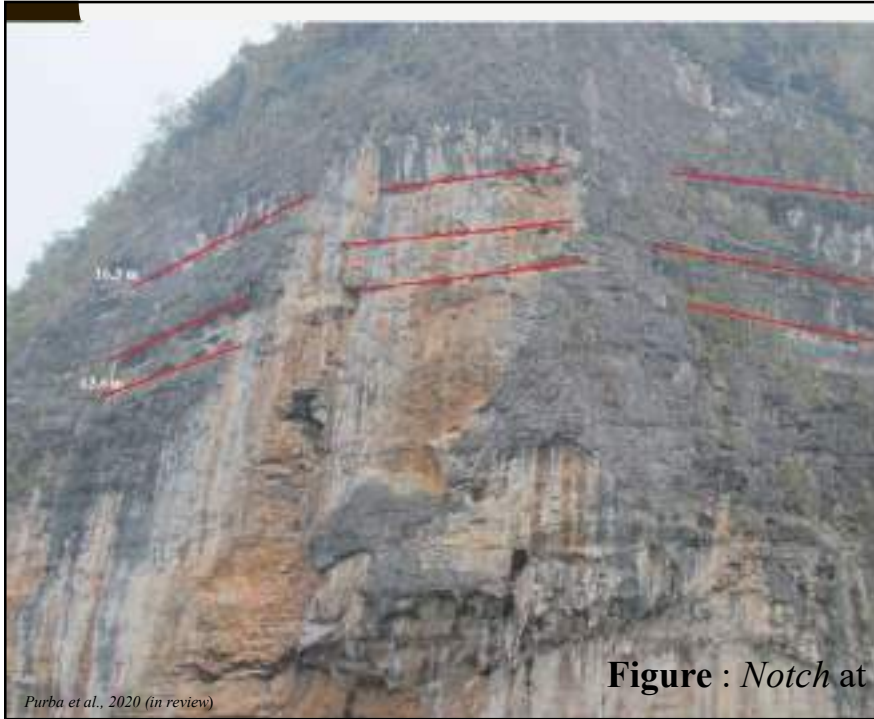


Purba et al. (in review)

Tabel . Mean Sea Level Reference in Holocene

Depth (m)	Time (BP)	Location	Sample	Source
-33	10.500	Sunda shelf	Ekstrak dari ETOPO2 National Geophysical Data Center (NGDC), USA	Sathiamurthy and Voris (2006)
-22,15±0,55	9.700-9.250	Malaysia and Thailand Peninsula	Tumpukan <i>Palynomorph</i> yang didominasi oleh serbuk sari mangrove dan genangan air tawar	Horton <i>et al.</i> (2005)
-33,41- -33,42	9.265±105	Sea bottom of Malaka strait	<i>Woody peat</i> yang tertutup lumpur laut	Geyh <i>et al.</i> (1979) in Tjia dan Mastura (2013)
-33	8.671	Sunda Self	Kontur batimetri	Voris (2000)
-3,435	6.985	Negeri Sembilan-Malaka	Kayu mangrove	Steif (1979) dalam Tjia and Mastura (2013)
-3	6.900	Sunda Self	Ekstrak dari ETOPO2 National Geophysical Data Center (NGDC), USA	Sathiamurthy and Voris (2006)
0	6.000	Sunda Self	Ekstrak dari ETOPO2 National Geophysical Data Center (NGDC), U.S.A.	Sathiamurthy and Voris (2006)
+4	6.000	Awana Kijal, Trengganu, Malaysia- Thailand Peninsula	Permukaan abrasi meta-sedimentary hard rock	Tjia and Fujii (1992) in Tjia dan Mastura (2013)
+3	5.180±130	Bukit Keluang, Besut. Trengganu	Fosil batu dan tiram yang menempel	Tjia <i>et al.</i> (1977) in Tjia dan Mastura (2013)





Purba et al., 2020 (in review)

**Figure :** *Notch* at entrance of Balbullol Lake



Purba et al., 2020 (in review)

**Figure :** Cave and notch high at entrance of Keramat Lake

## CONCLUSION

Marine lake in Misool is a dissolution doline. It started to fill in 10.500 BP dan filled a shallow lake in 6.985 BP. As a tectonic area, there's likely to be earlier time when lake in Misool formed. Originally, water lakes is sea water. It filled through cavity system at lake wall.