Under the Jungle - challenge of the day - Sunday May 17th.

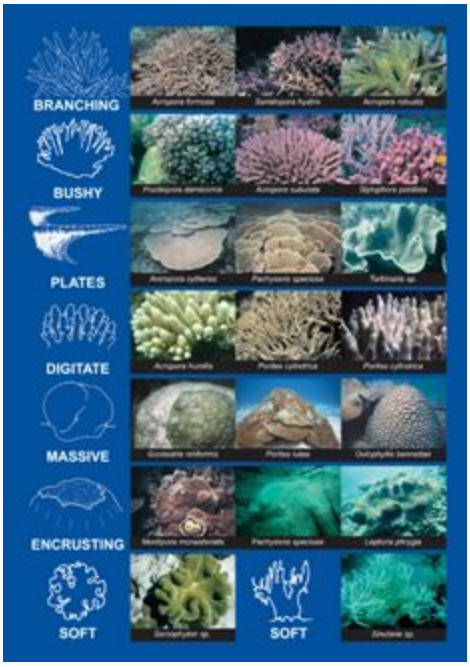
TAJMA HA GEOLOGY game.

Nat says - Coral head, clearly, (not a beehive like Rory OKeefe once thought). Those who have dived at Tajma Ha know it well, as it's adjacent to the end of the gold line and we casually tie off on to it all the time. What can you tell us about this sucker? How old does everyone think it is?

Hello friends,

It is gorgeous CORAL – of course. Some form of massive boulder coral. Given the size and notably irregular shape a good starting point may be Orbicella annularis (https://en.wikipedia.org/wiki/Orbicella_annularis) since it has obvious polyp channels, but they don't seem to be radiating out neatly from a central core, and overall the shape is rather irregular and lumpy – like boulder coral.

Drooling over the beautiful scalloped and sculpted erosion surfaces cross cutting the polyp channels....



Species? Not quite enough here to say, but YES it is some form of star coral. Erick – got that magnifying glass hand yet? Another reason to dive with a lupa. If you can even sketch the cross section (looking straight at) the polyp channel you can often start to identify families or species of coral.

Some coral species have specific environmental tolerances for depth, temperature, water clarity – and unfortunately in this case Orbicella annularis is not picky – and is a broad generalist. Common throughout the western Atlantic AND anywhere from 0 to 80 m water depth.

If you do identify fossil coral species, sometimes you can say something much more specific.

For example – staghorn coral grow at reef crest!!! And finding the paleo reef crest is SUPER fun and valuable. Even better – is mapping it out over space in the geology. The first time I dove in Chickin Ha I was dancing and prancing around like a 5 year old – since the chicken poke marks in the wall are staghorn/branching coral cross cut in the rock face. I was very happy that day – and indeed LOVE to find coral in many dive sites.

So HOW OLD is it!!!!

My initial estimate is >>1 million and likely <10 million years. That puts it in between what most people have been indicating.

The platform does not grow evenly and neatly – so you can't say that if you are at X m depth that the rock is Y older. Indeed most of the layers are pretty massive and are laid out in a pattern of middle oldest and over time off-lapping aprons of younger rock out to the coasts. The very middle of the peninsula is Paleocene/Eocene (65 to 35 million ago). There is some Oligocene and Miocene (33 to ~6 Ma). Then we have a fairly wide ~10 km band of Pliocene, Pleistocene, and even Holocene around the whole perimeter.

The vast majority of the rock you are used to seeing – is Pliocene (5.3 to 2.6 Ma) and Pleistocene (2.6 Ma to ~ 10 000 years ago when the Holocene started).

Fig. 1. Geology of the northern Yucatan Peninsula. (Base map redrafted from data of Servicio Geológico Mexicano, 2007.) Includes strontium isotope ratios of water from wells and cenotes reported in this study. Three digit numbers on the map represent the three digits past 0.70 in the $^{87}Sr/^{86}Sr$ ratios; read 827 as 0.70827. For detailed geology of the region within the box on this figure please refer to Kenkmann and Schönian (2006, Fig. 6); their map shows the Albion Island Formation (comprised of ejecta from the Chicxulub impact crater), which is too complex to delineate at the scale of Fig. 1.

FROM - Perry EC, Paytan A, Velazquez-Oliman G. (2009) Groundwater geochemistry of the Yucatan Peninsula, Mexico: Constraints on stratigraphy and hydrogeology. Geology. DOI:10.1016/j.jhydrol.2008.12.026Corpus ID: 9706525

We have pretty shit geology maps actually….. The surface geology over the whole peninsula is not well known to be fair, and some geologist showed up from mexico city or from Belize at different times post WWII and just said the whole damn place is poorly differentiated Felipe Carillo Puerto Formation. You may know Emiliano Monroy Rios who part of his PhD with me has been attacking the mapping but using chemistry (ie see the boundaries in the chemistry even if we can't see them visually). We have learnt a lot – bit it remains truly a mess and probably some thousands of samples are going to be needed in order to go to the next generation geology map.

Did coral grow on top of the peninsula during the last sea level highstand 100 000 years ago?

Sadly - no. Even 100 000 ago we had high sea level, but they were not that high and even when high - they were not high for long.... Maybe only a little bit higher than today but not flooding the peninsula - and nowhere near enough to have coral growing on the peninsula surface. All the coral you see around is much older then 100's of thousands of years.

It is amazing really - the fossils and the speleothems - stick around alot better then the rock. Turns out the rock sediments around the fossils and speleothems is the soft target for dissolution and erosion. Rock goes away - and the rest is left behind - like this piece!

In general (big general!!!) once you have rock - you need to be thinking of millions of years...

In short - how old is this…. By order of magnitude…

- **Much older than 100 000 years old. Sea level was nowhere near high enough to grow coral there.**
- **In a cave and came out of the rock - so there needs to be time also for the overlying sediments to be laid down, and then those sediments turned into rock too.**
- **Since close to the coastline at 2.x km - likely in the Pleistocene so a few million years.**
- **Exceptional preservation - suggests (but does not mean) on the youngish side.**
- **More then 3 and maybe less than 10 million years old. Basically a geologically "young" fossil :-)**
- **Remembering our lesson from the other day, we also know we have VERY fine grained micrite sediments - which are shallow marine…. Think 100-500 m water depth. So to get the water that deep over the peninsula - we need more time!**

Our list of critical clues / observations :

- Some potentially common coral species, that just happens to be beautiful

- 2.3 km from the modern coast

- 10 m below modern water level – which is ~ = sea level

- Inside a cave ! so underneath other rock layers – not the youngest

- It is beautifully intact in detail – so not extremely old. It would be interesting to know if it glows under UV (black light). Corals deposit aragonite mineral skeletons which glows under UV, but over time and slowly it tends to change to calcite which is exactly the same chemistry but different mineral arrangement. It is definitely a holy grail of geology to find aragonite coral - since we can date that using Uranium-Thorium dating .... And we can not date coral that has turned to calcite. Sadness.

- Large enough that it was not easily moved around – so probably fairly close to its starting position – within some m or maximum 10's of m's.

- Seems likely to have eroded out from the ceiling layer and fallen to the floor. It may have come out of the rock that is now the cave conduit. is there more coral in the ceiling or walls???)

- Cross cutting dissolution – creating sculpted surfaces. Water has had time to work on it.... And given how clean it is – that is mostly likely after it fell out of the rock – and not before it died and ended up in the rock... which often leaves patches of other material in the sculpted surfaces and especially – infill sediments! Making it less beautiful.