

An underwater photograph of a rocky seabed. The rocks are covered with green and brown microbial mats, likely stromatolites. The lighting is dim, creating a dark, moody atmosphere. The text is overlaid on the image.

Subterranean Wetlands, Stygofauna and Stromatolites of the Limestone Coast

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Subterranean Wetlands

- **Ramsar definition:**
all underground voids containing water
- Karst subterranean wetlands are a major grouping
- Should viewed as part of karst hydrological system

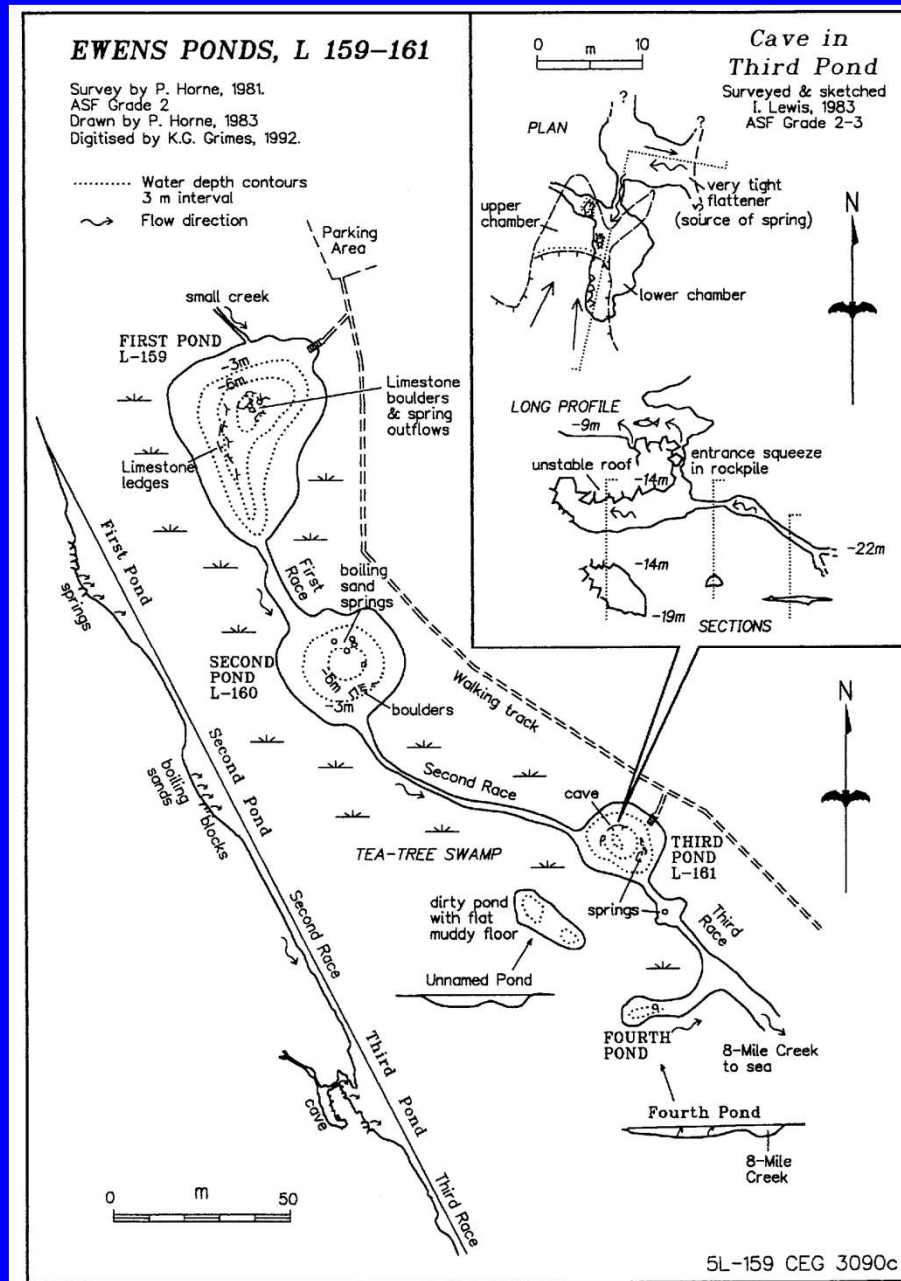


Examples in Limestone Coast

- Karst springs
- Wetlands associated with caves
- Temporary & permanent doline lakes
- ?Beach springs & offshore (marine) springs



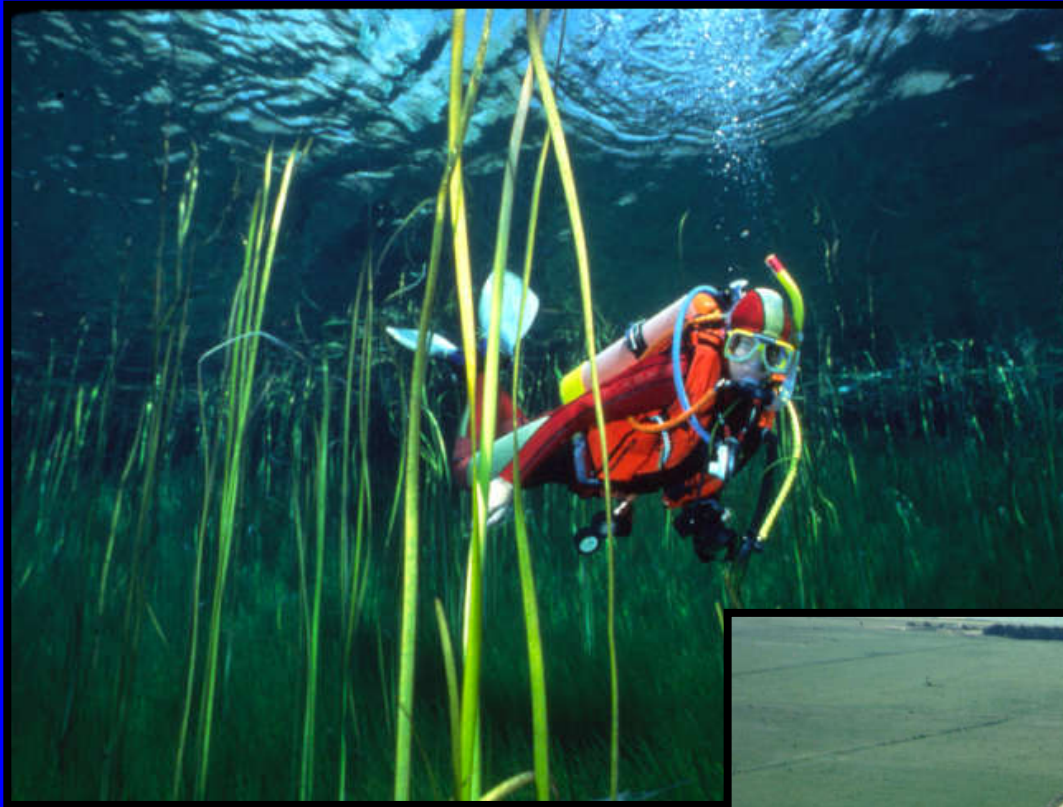
- Volcanic lakes fed by groundwater
- Coastal lakes fed by groundwater



Karst springs

- Solution dolines with small caves at base
- Discharge for aquifer
- Remnant veg (peatland)
- Threatened species (F & F)
- Migration stop-over
- Endemics
- Cave diving sites
- No stygobites (yet) but diverse biota

Karst springs



Ewens Ponds



Karst springs



Ewens Ponds

Karst springs



Piccaninnie Ponds –
Ramsar nomination
pending



Caves



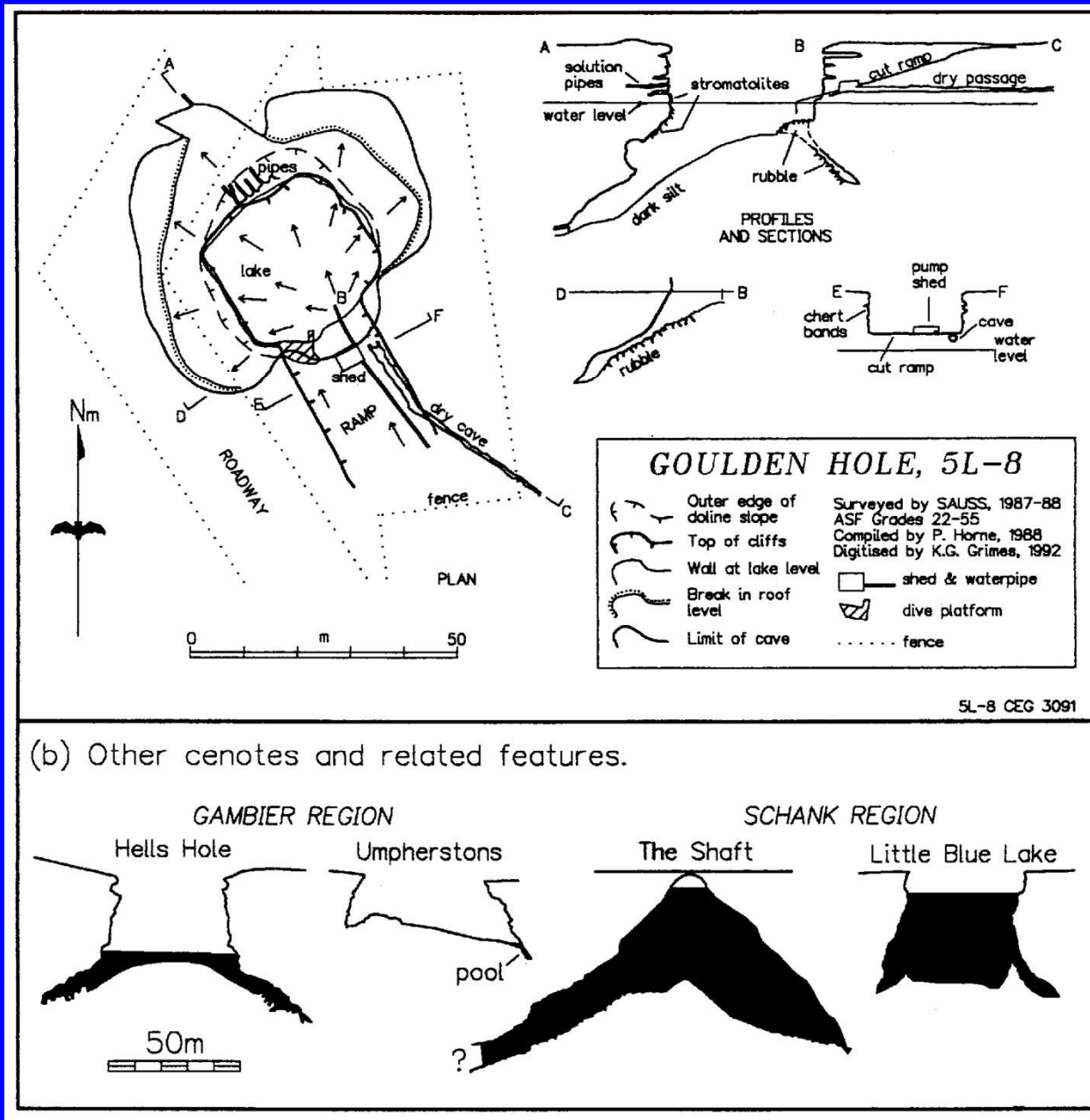
Caves



Cenotes: windows to the waterable



Cenote Structure



Surface features of cenotes



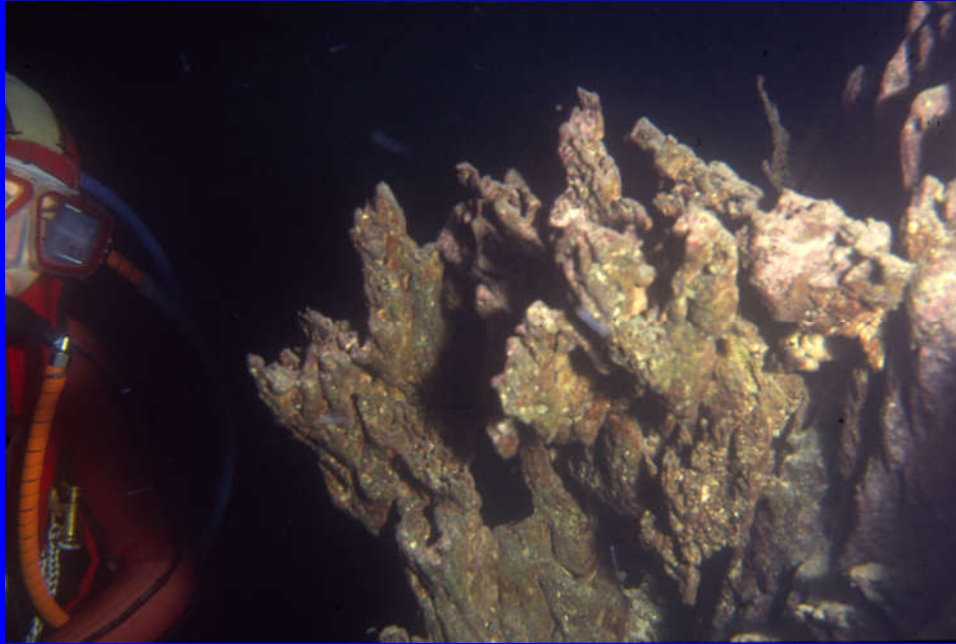
Surface features of cenotes



Stromatolites – part of microbialite spectrum



- Lithified, organo-sedimentary deposits formed by a complex ecological association of algae, bacteria & other microbes (benthic microbial communities)
- Trap and bind detritus (high energy environments, cyanophytes)
- Induce the precipitation of chemical sediments (still waters, seepage points, diatoms)
- Stromatolites are laminated (layered), thrombolites are clotted (no regular internal structure)

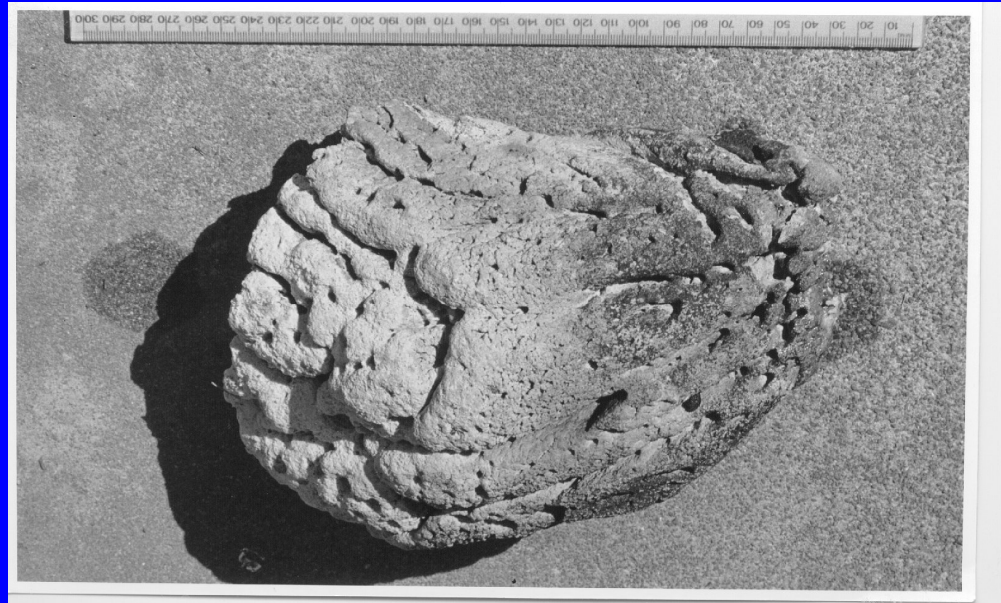


Key Points: Stromatolites

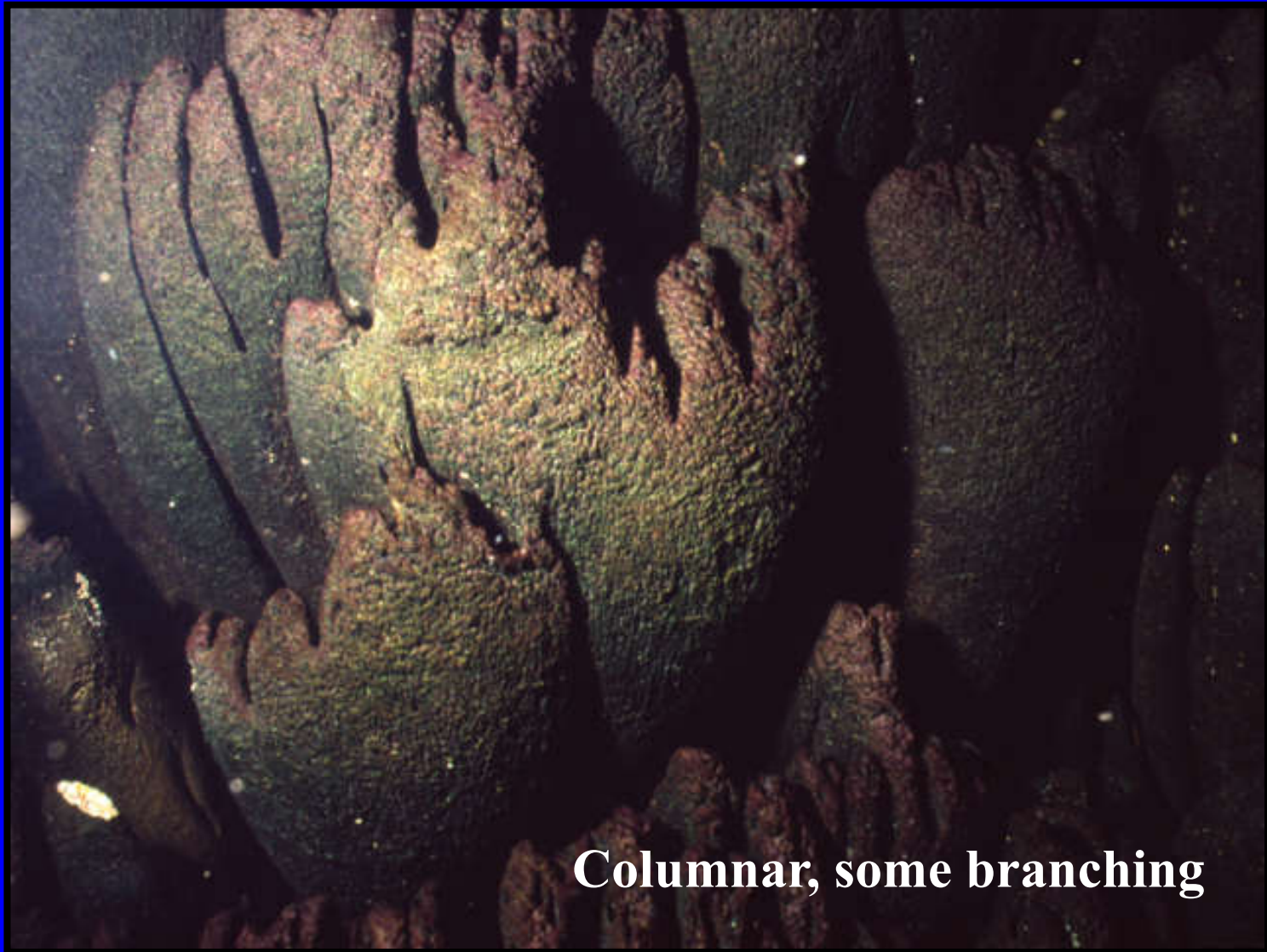
- Mt Gambier (Limestone Coast) is centre of stromatolite diversity
- Over 25 different types (most places 4-8 types)
- Found in 8 cenotes, the Blue Lake and saline/hypersaline groundwater-fed lakes in north
- Each location has own unique suite of microbes & strom types

Key points: Stromatolites

- Dating of several samples (Goulden & Black Hole) ~ 20, 000 YBP
- Growth rate approx. 0.1 mm per year
- Biologically-induced precipitation (link to photosynthesis)

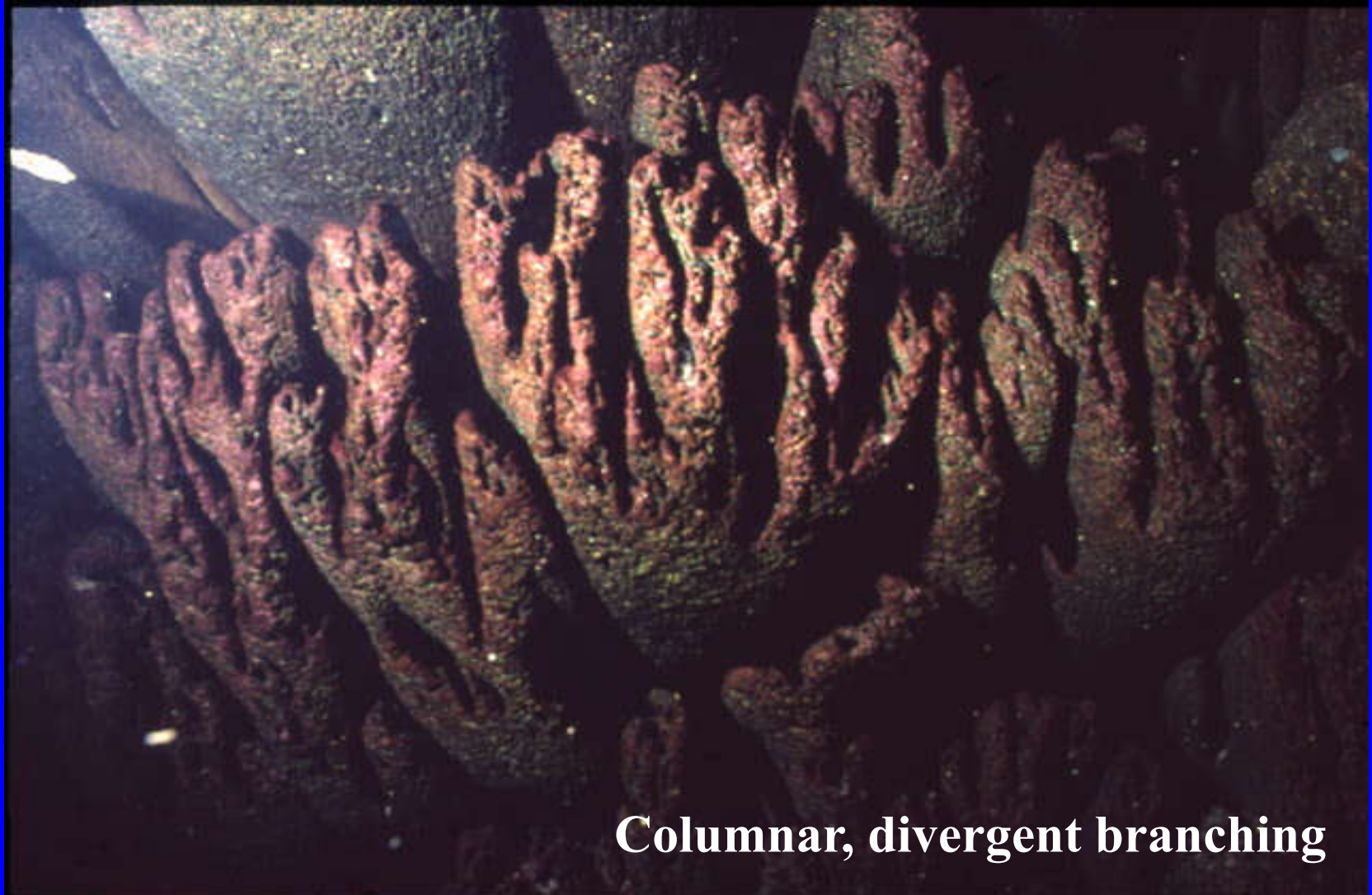


Cenote stromatolites



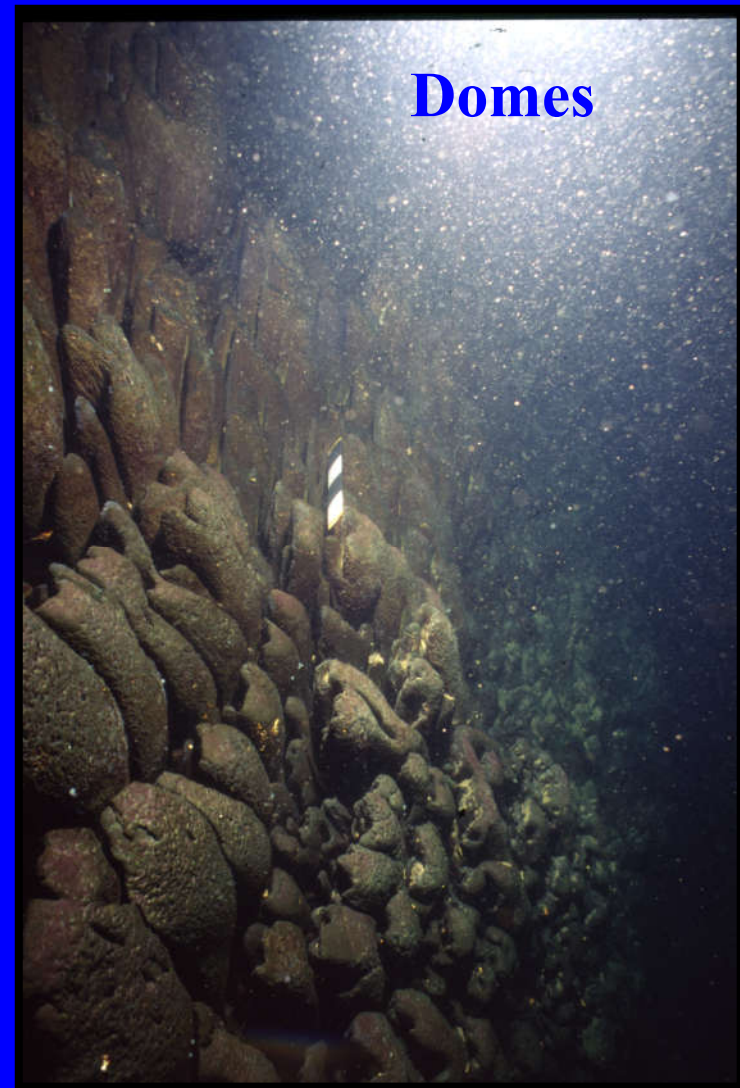
Columnar, some branching

Cenote stromatolites

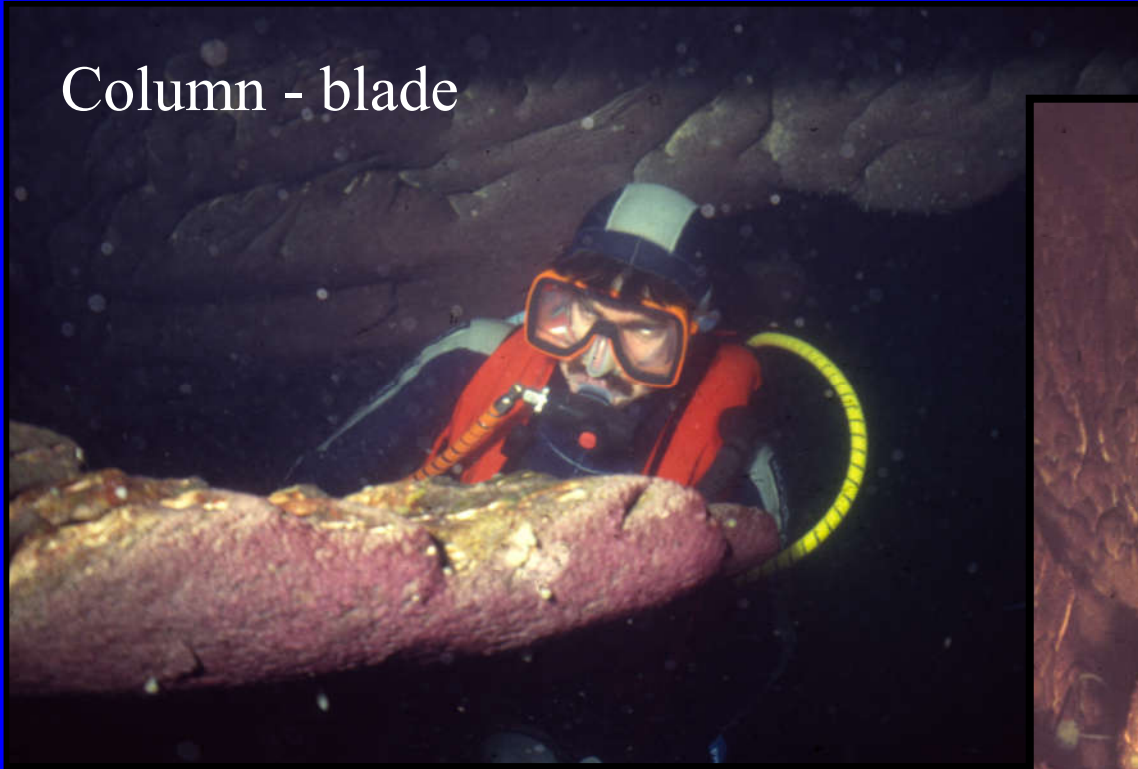


Columnar, divergent branching

Cenote stromatolites



Column - blade



‘Cauliflower’



Cenote stromatolites

Cenote Stromatolites



Blades & cylindrical columns

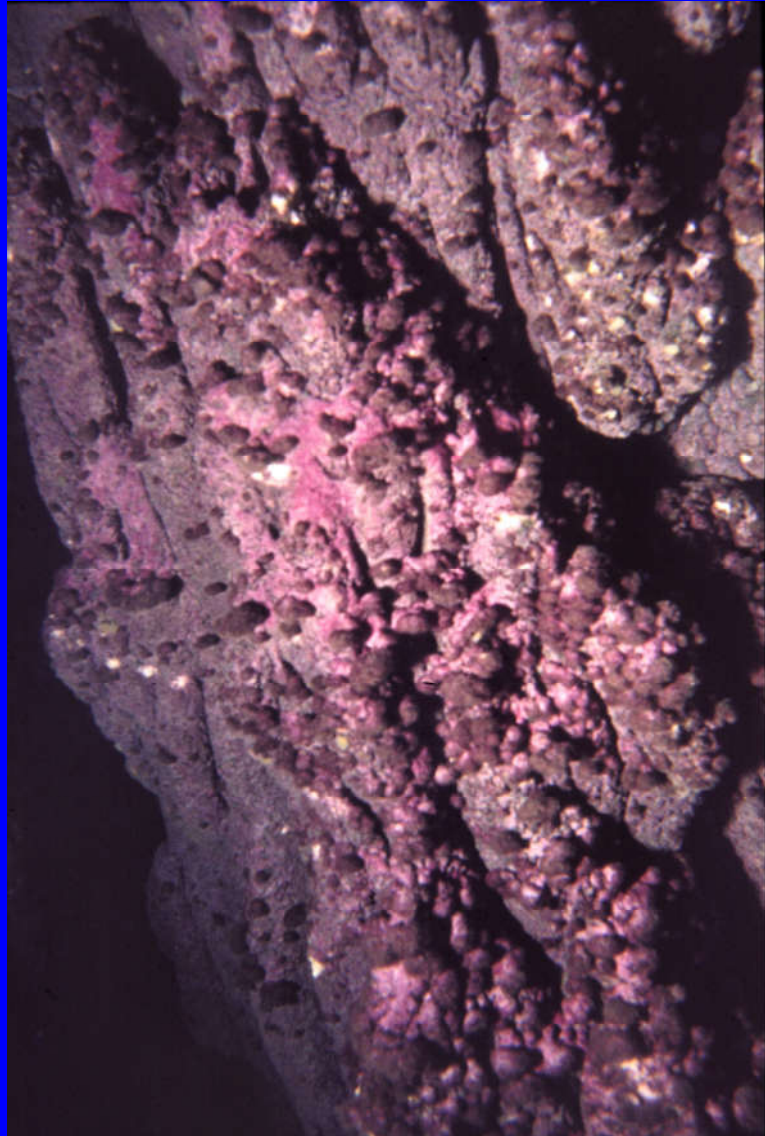
Cenote stromatolites



Shaded and deep water stromatolites



Reef structures (tabular)



Cenote stromatolites



Internal structure



1. Variable texture & density +
 2. Alternating light/dark layers
= changing environ conditions?
- Core & outer (light-facing) layers are dense with fine (<1mm) laminations
 - Wall facing layers more complex, friable, clotted fabric, poor lamination

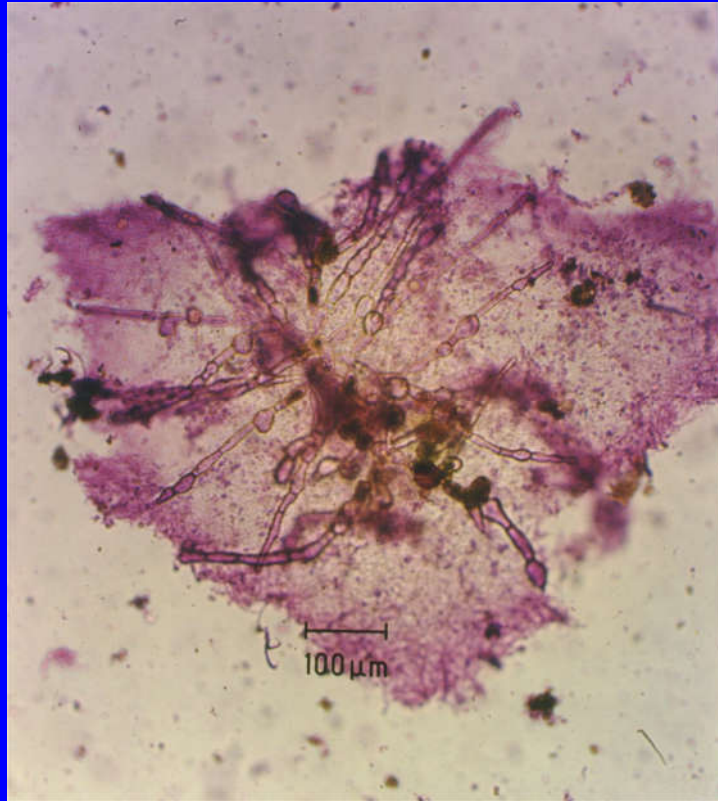
Internal structure



- Few microfossils survive
- Gastropod & bivalve shells in wall-facing surfaces & embedded
- Fenestrae common – grazing gastropods?

Stromatolite-building microbes

(Cyanophytes)



Chaetophora sp.



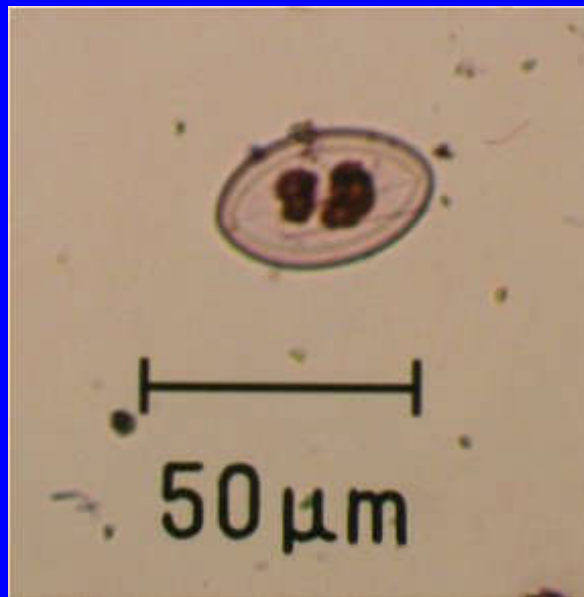
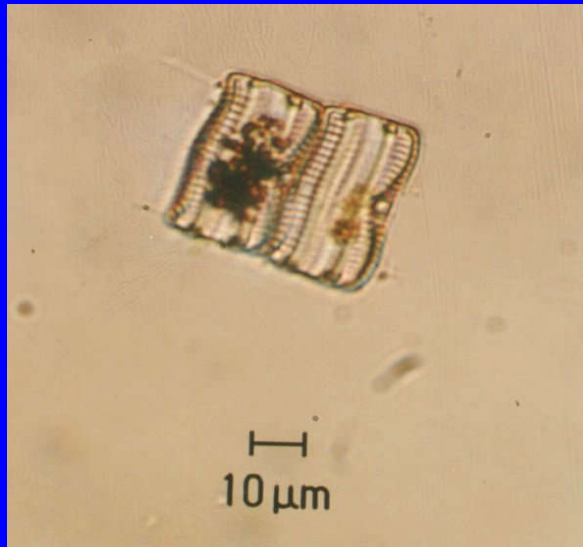
Schizothrix sp.

Stromatolite- building microbes (diatoms)



Cymbella sp. ▲

Acnanthes brevipes ▼

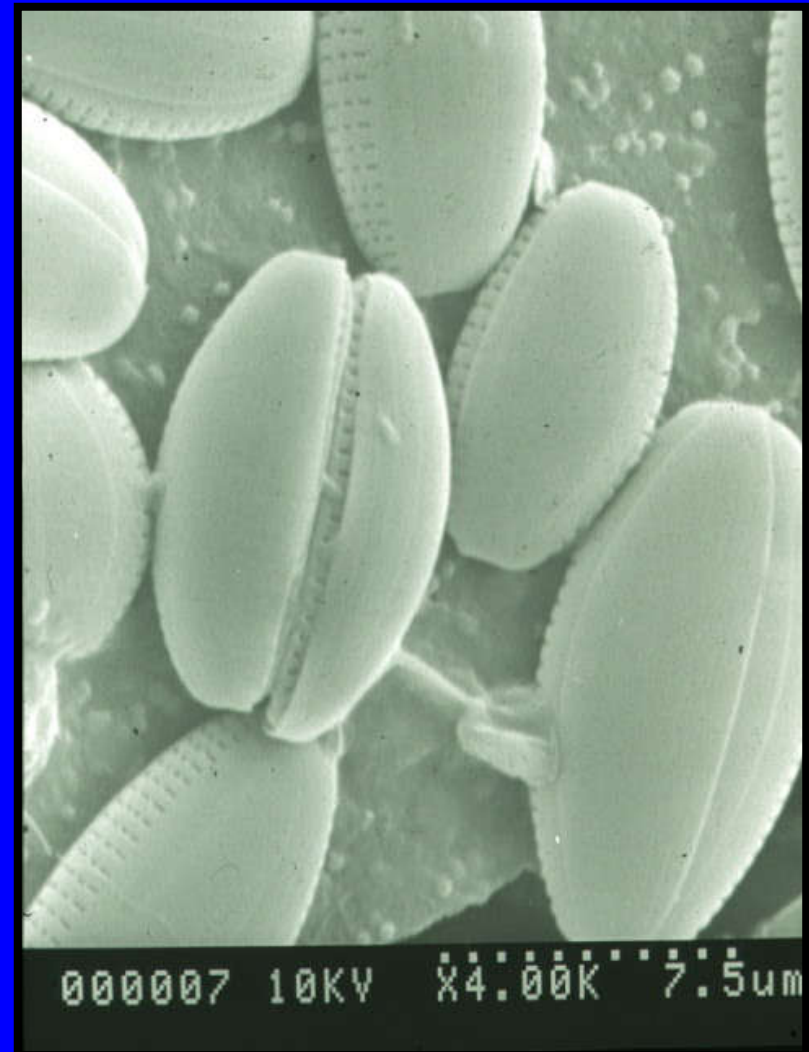
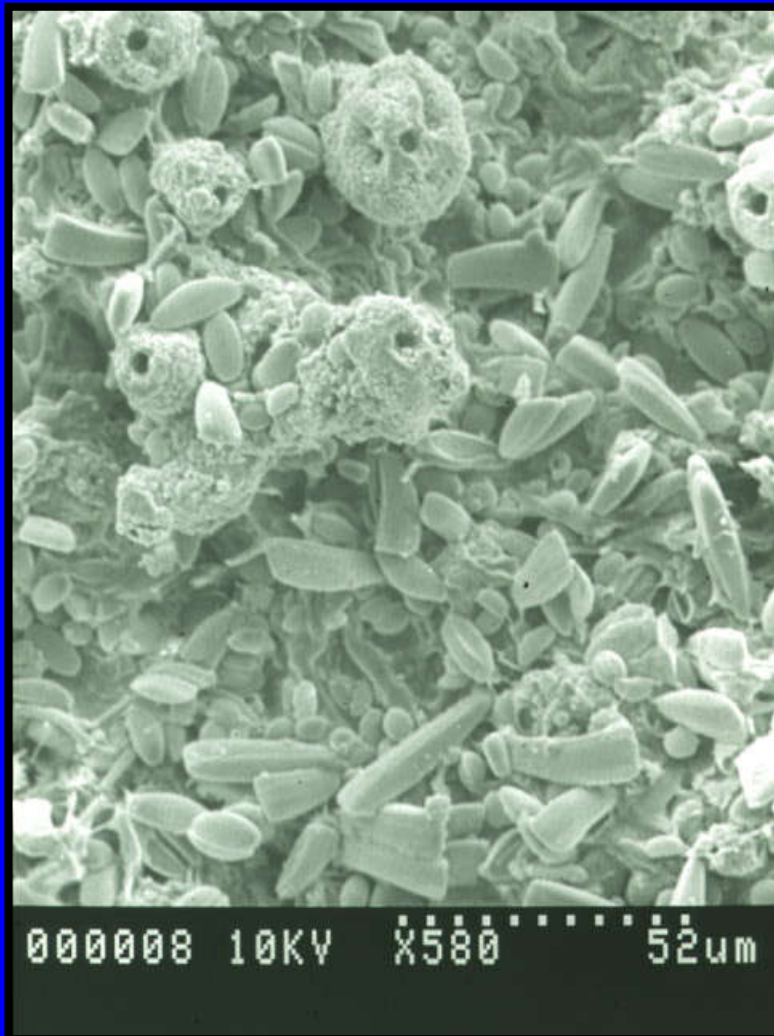


Cocconeis
placentula



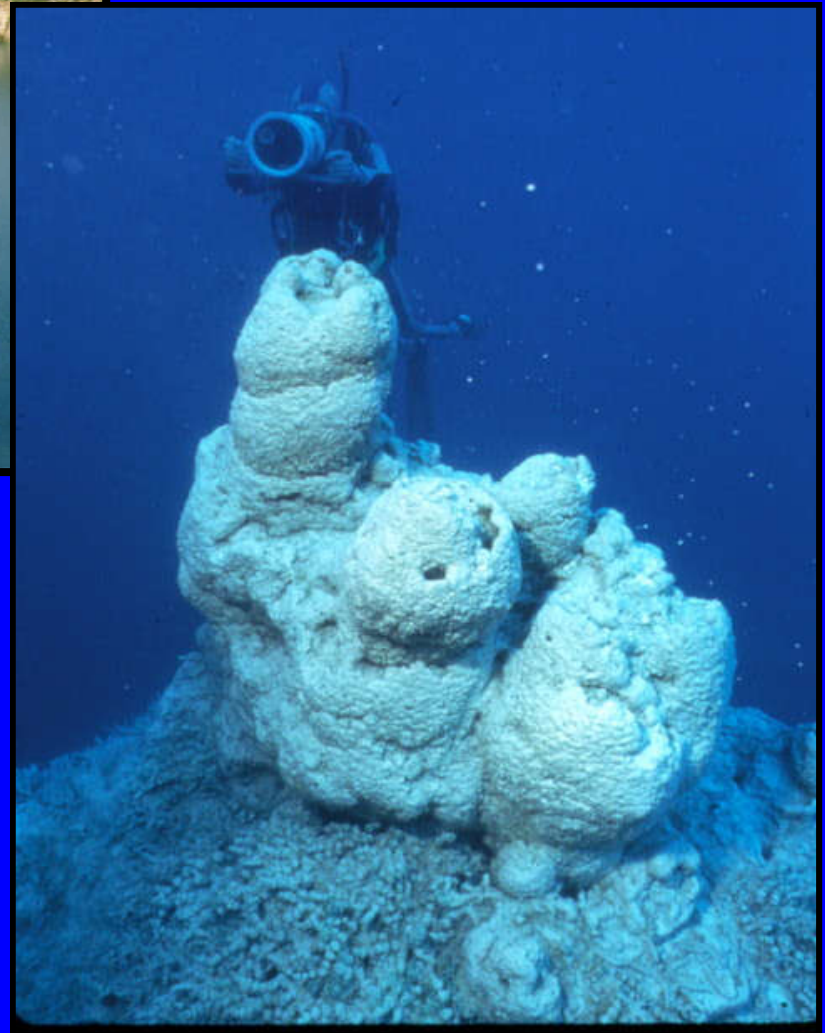
Gomphonema
acuminatum

SEM images of diatoms





Blue Lake stromatolites



Key points: Blue Lake stroms

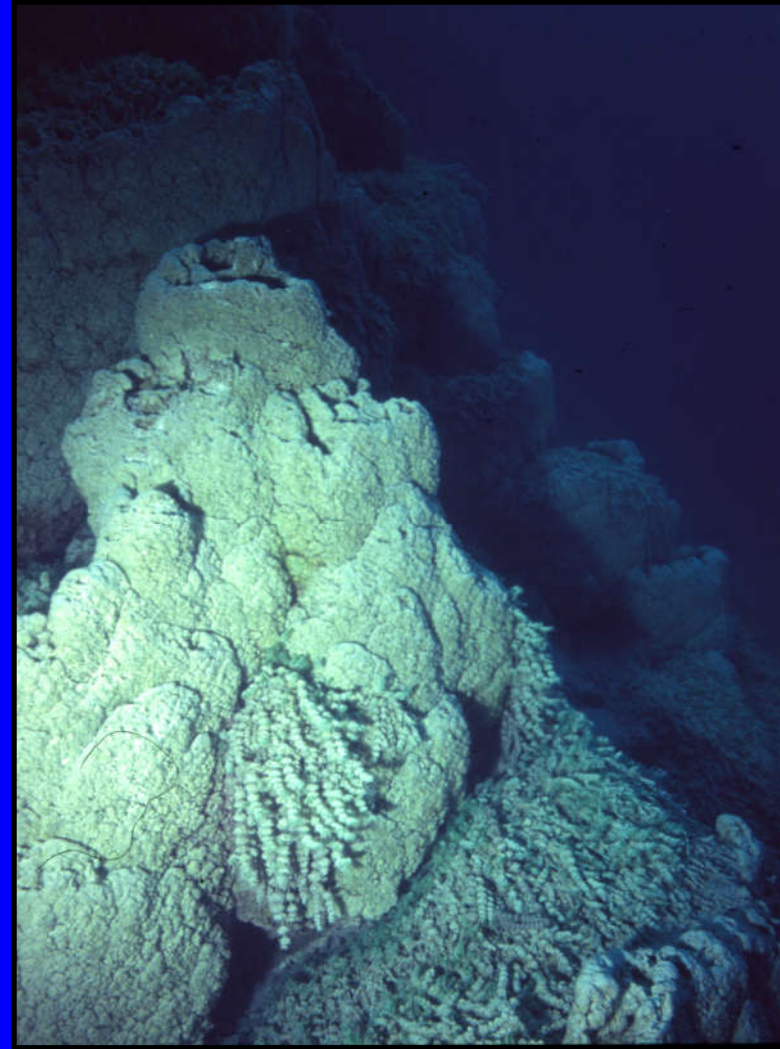
- Lake is ~ 28,00 years old: max. depth 77 m, shoreline 1 km
- 5 sites visited – only 1 morphology similar to cenotes, total 10 morphotypes
- On walls & in sediment floor, latter distributed around points of GW upwelling
- Mostly columns (0.5-8 m) & reefs 10 x 20 m also domes and linear ‘canyon’ structures
- From surface to 45 m+

Blue Lake stromatolites

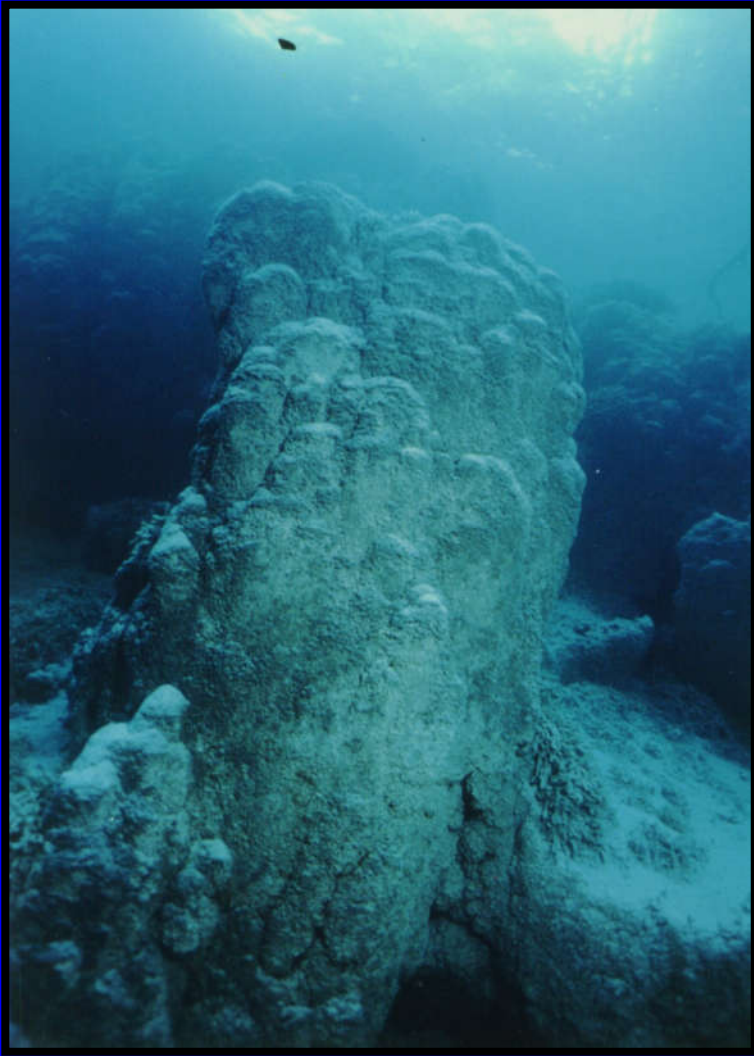


Surfaces covered by *Chara* sp., remains incorporated into structure

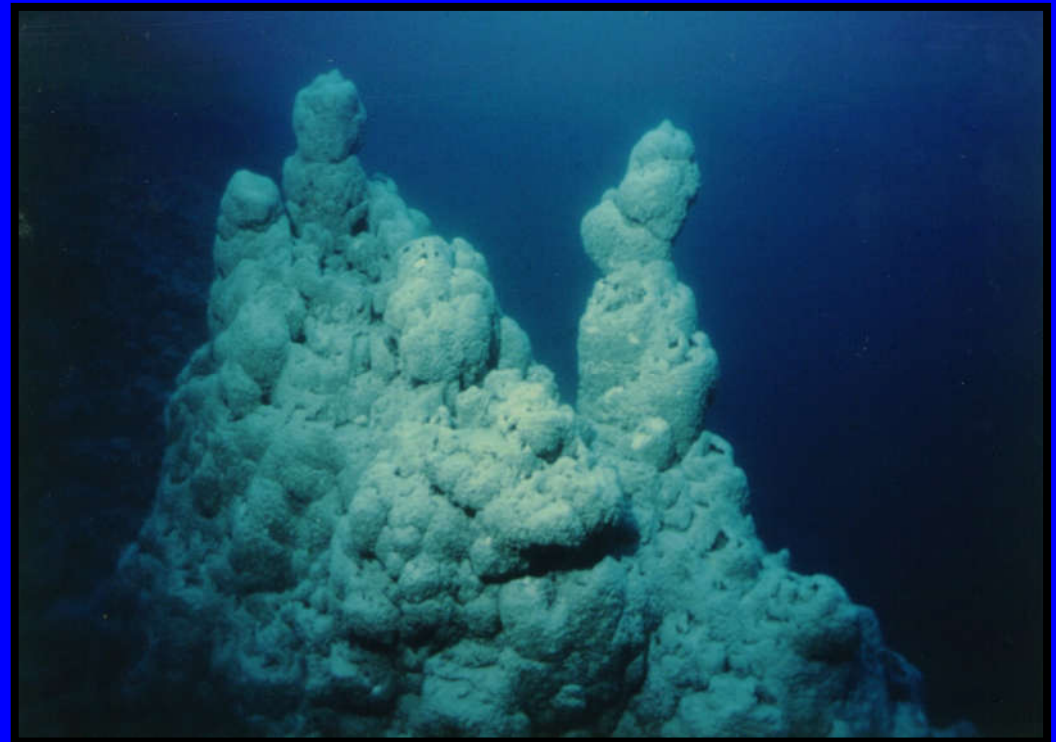
Blue Lake stromatolites



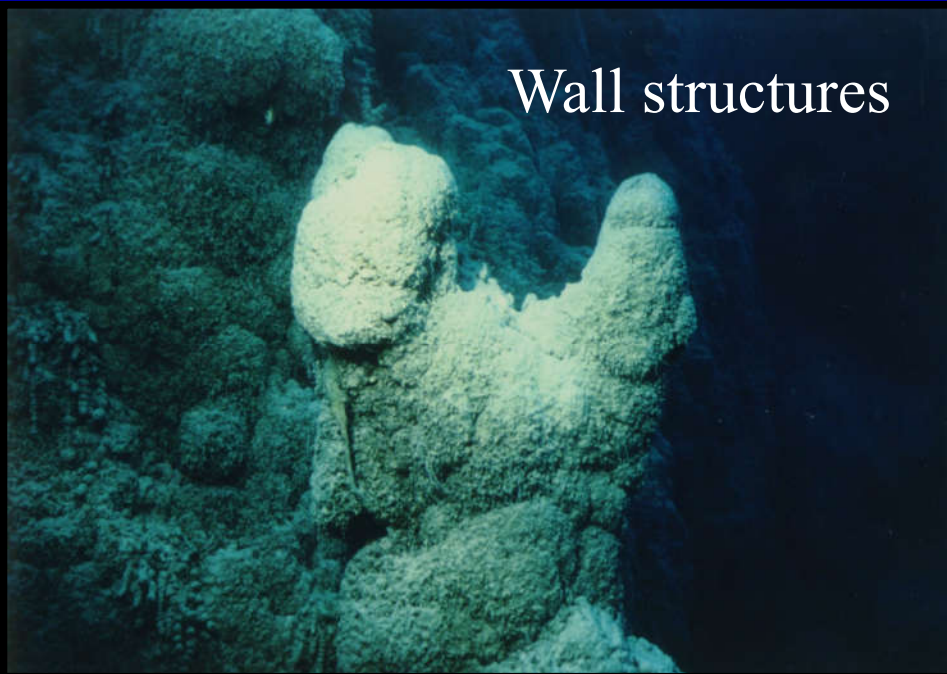
Blue Lake stromatolites



Coalesced forms build
large towers and complex
columns



Wall structures



Blue Lake stromatolites

Deep water
mounds/domes



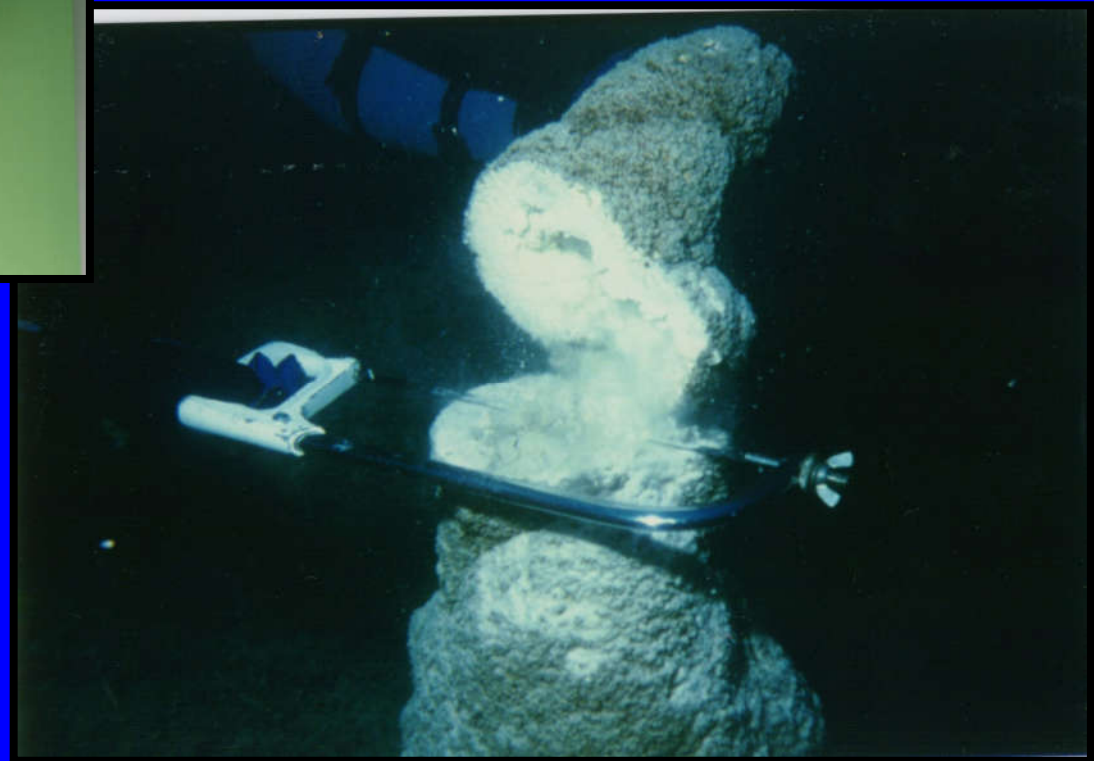
Note opening @ top



Internal structure – Blue Lake



Hollow core, crude
lamination,
crystalline central
rims



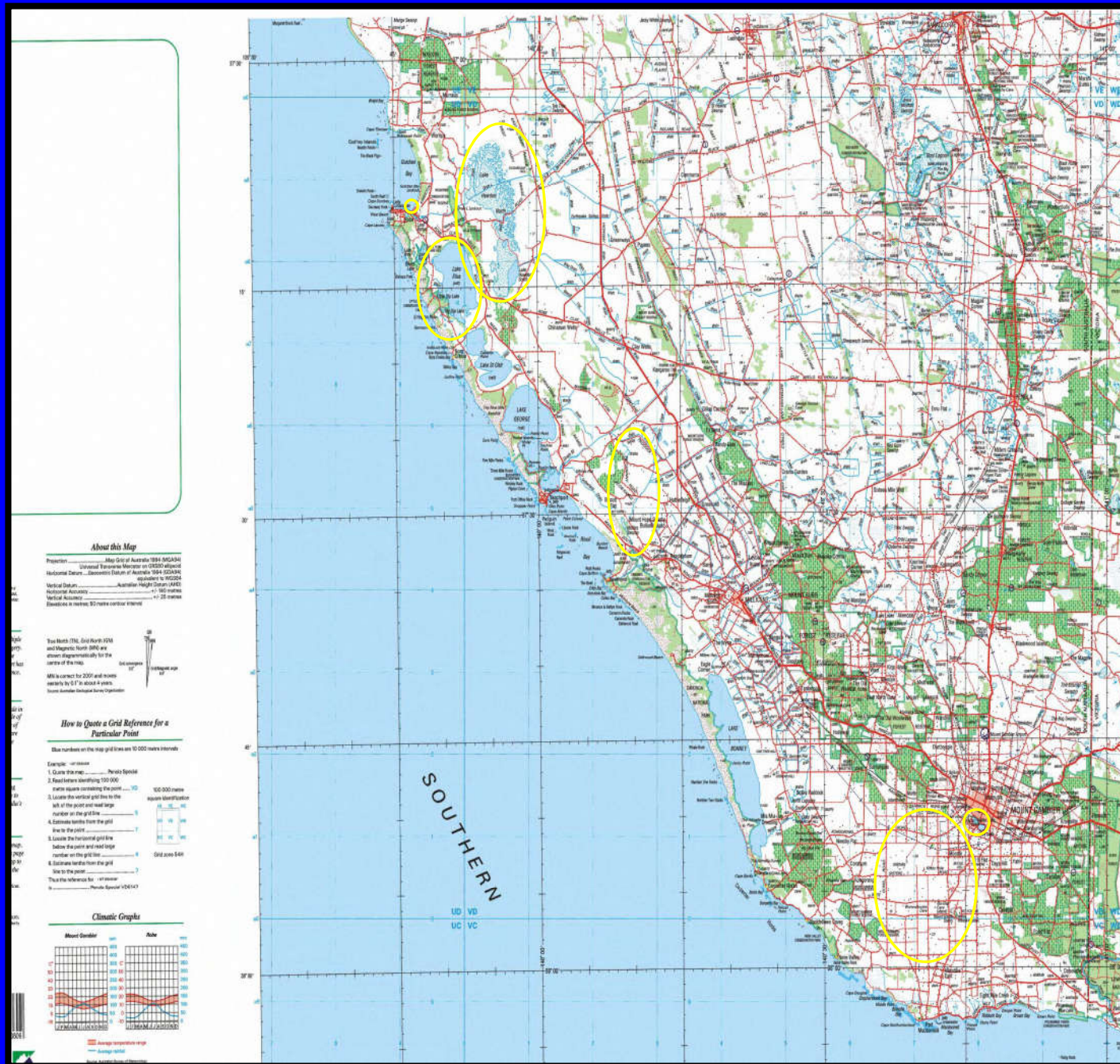
Model for Strom Development



- Resemble the stroms of Lake Van, Turkey
- Multi-stage development
- Ca-rich groundwater seeps upwards
- Colonised & stabilised by microbes
- Continued upwelling through porous structure, maintains upward growth
- Microbially-induced precipitation & secondary mineralisation stabilises
- Incorporation of *Chara* remains on exterior

Other microbialite occurrences

- Laminated microbial mats in coastal lakes including Coorong
- Limestone biscuits (Mawson 1929) in Biscuit Flat (cyanophytes)
- Monohydrocalcite pellets in Lake Fellmongery (cyanophytes, chlorophytes)
- Thrombolites in Lakes Eliza & Hawdon



About this Map

Projection — Map Grid of Australia 1984 (MGA84)
Universal Transverse Mercator on GDS83 ellipsoid
Horizontal Datum — Geocentric Datum of Australia 1984 (GDA84)
Equivalent to WGS84
Vertical Datum — Australian Height Datum (AHD)
Horizontal Accuracy — ±1 m
Vertical Accuracy — ±1 m
Scale — 1:250,000
Gridlines in metres, 50 metres contour interval

True North (TN), Grid North (GN)
and Magnetic North (MN) are
shown diagrammatically for
the centre of the map.

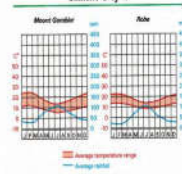
MGA is correct for 2000 and moves
westward by 0.1 m in years.
Source: Australian Geospatial Agency

How to Quote a Grid Reference for a Particular Point

Blue numbers on this map grid lines are 10 000 metres intervals.

- Example: on river
1. Quote the map. — Peninsula Special
 2. Read letters identifying 100 000
metre square containing the point. — VD
 3. Locate the vertical grid line to the
left of the point and read large
number on the grid line. — 50
 4. Estimate metres from the grid
line to the point. — 10
 5. Locate the horizontal grid line
below the point and read large
number on the grid line. — 40
 6. Estimate metres from the grid
line to the point. — 10
 7. Quote the reference for "on river". —
 8. — Peninsula Special V24147

Climatic Graphs





**Lakes Fellmongery
& Butler
(monohydrocalcite)**

**Other
occurrences**



Other occurrences

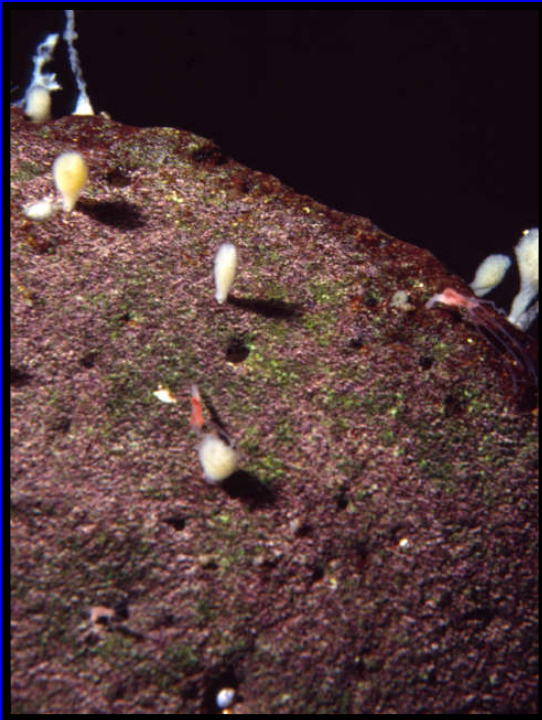


**Lakes Hawdon
& Eliza
(thrombolites)**



Stromatolites as habitat

- Outer surfaces often covered in hydra & sponges + filamentous algae (summer)
- Beetles & other insects + crustaceans seen hiding within strom beds and/or grazing surfaces



Conclusions

- Exceptional stromatolite diversity
 - Wide range of morphotypes (2-6 vs. 26+)
 - Diverse microbial communities & range of environmental settings
 - Cenotes & Blue Lake mostly columnar: diatoms
 - Saline lakes mostly domes & mats: cyanobacteria
- Rare (branching) forms
- High abundances
- Size distribution, depth of occurrence

Considerations for Ramsar nominations

- Springs already recognised as internationally/nationally important subterranean wetlands
- Cave wetlands largely unassessed but heaps of potential (to do list)
- Cenotes, Blue Lake should be considered for national & Ramsar listing
- Ensure that microbial communities are recognised as important component of STW