Subterranean Wetlands, Stygofauna and Stromatolites of the Limestone Coast

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Subterranean Wetlands

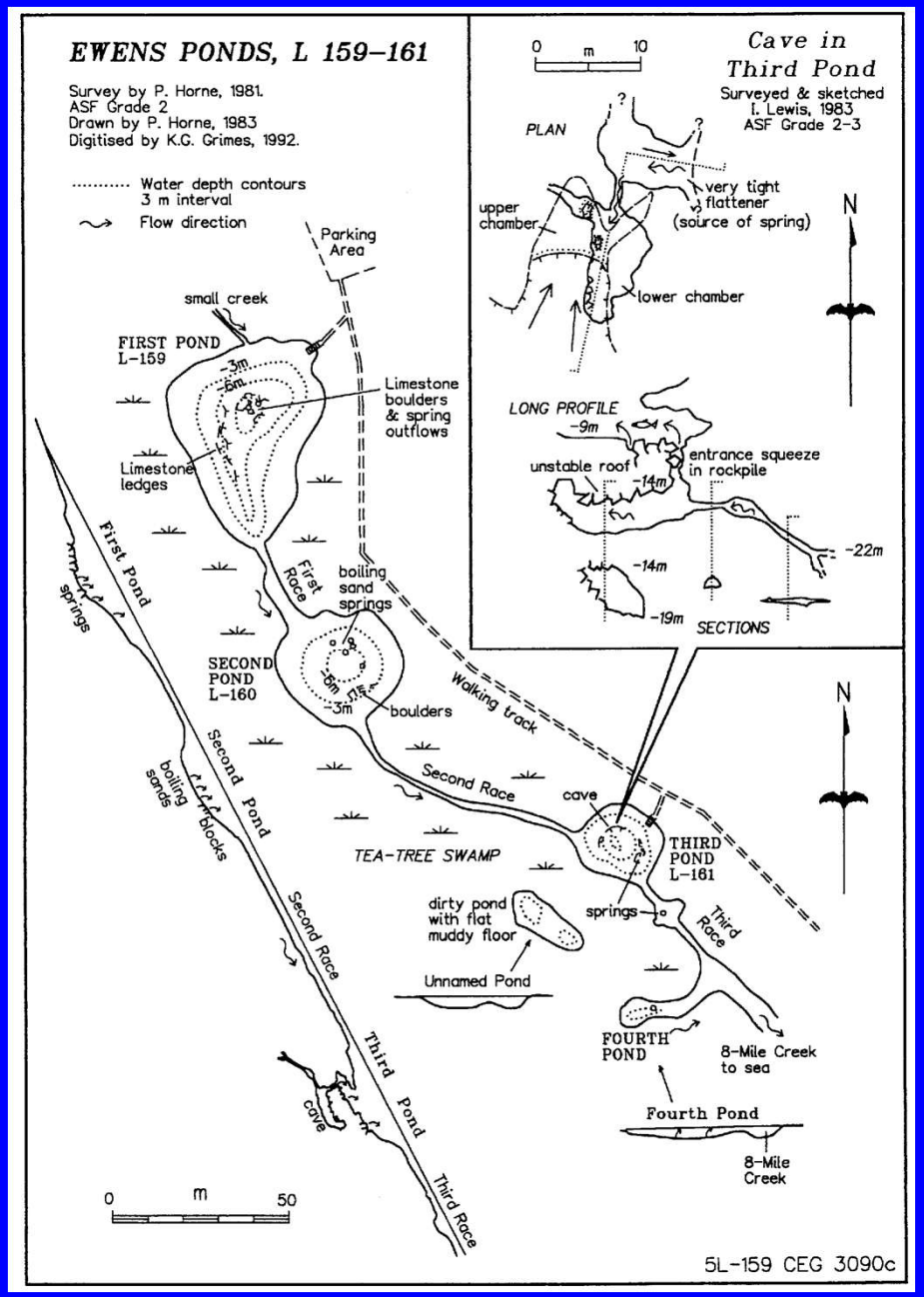
- **Ramsar definition:** all underground voids containing water
- Karst subterranean wetlands are a major grouping
- Should viewed as part of karst hydrological system

Examples in Limestone Coast

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

•Volcanic lakes fed by groundwater

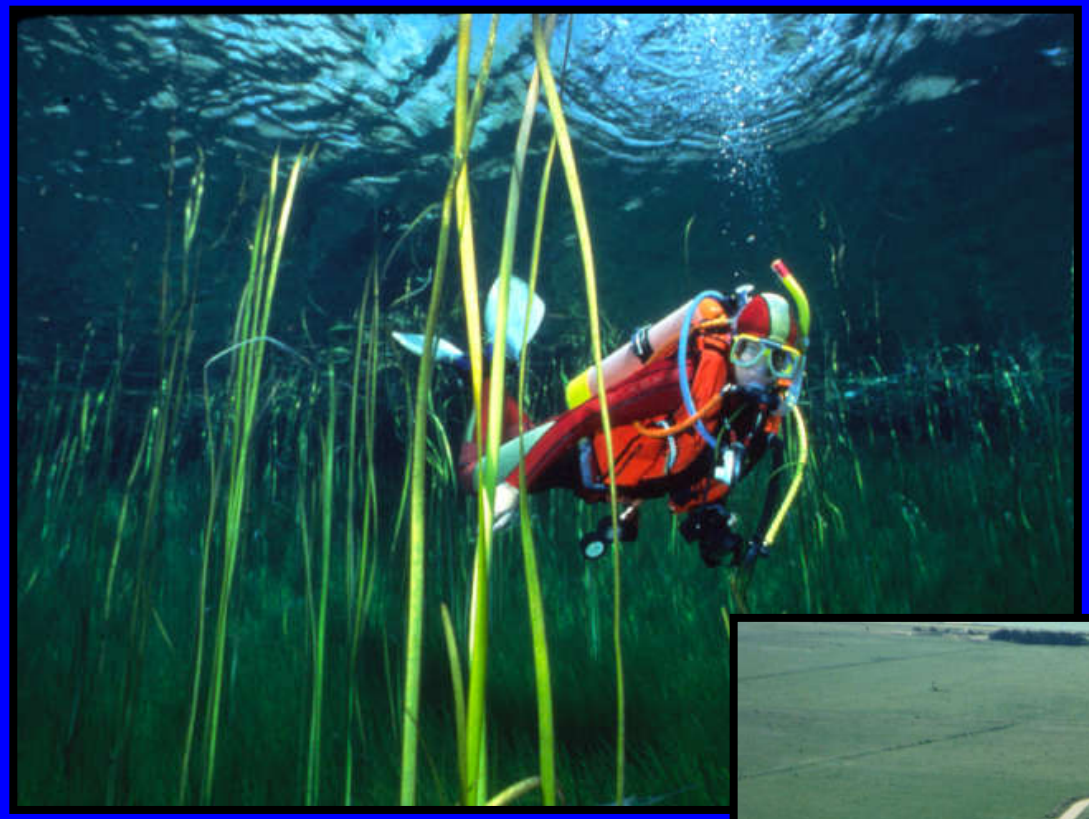
•Coastal lakes fed by groundwater



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

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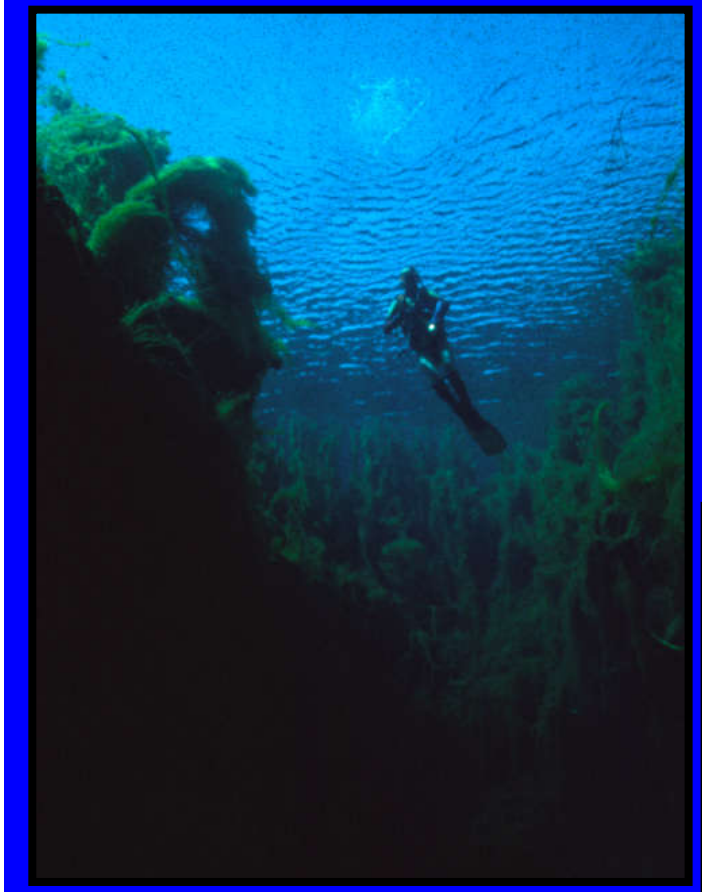
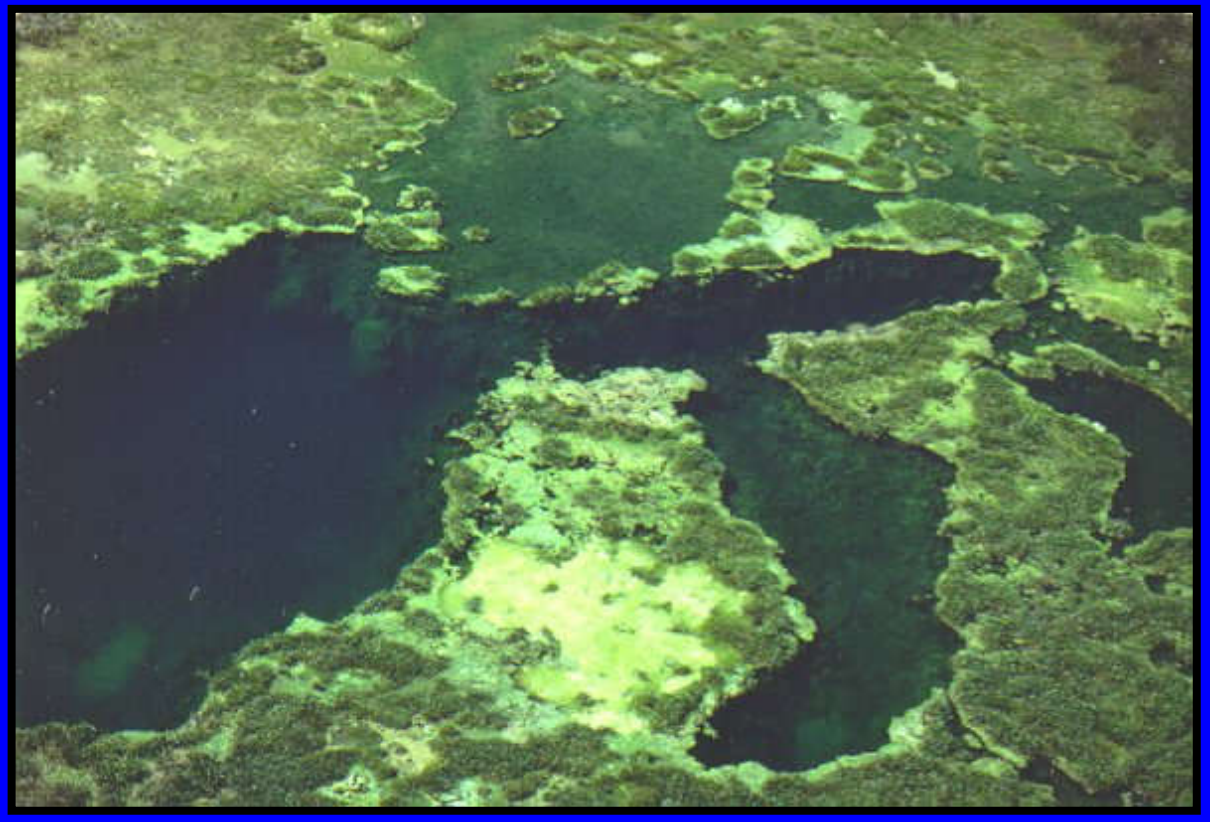
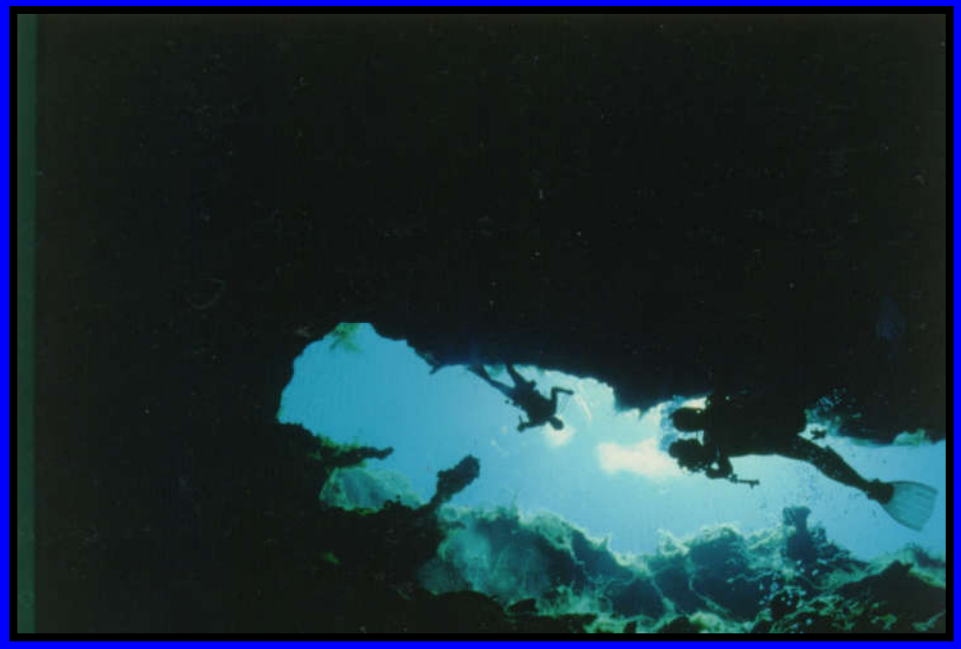
Karst springs





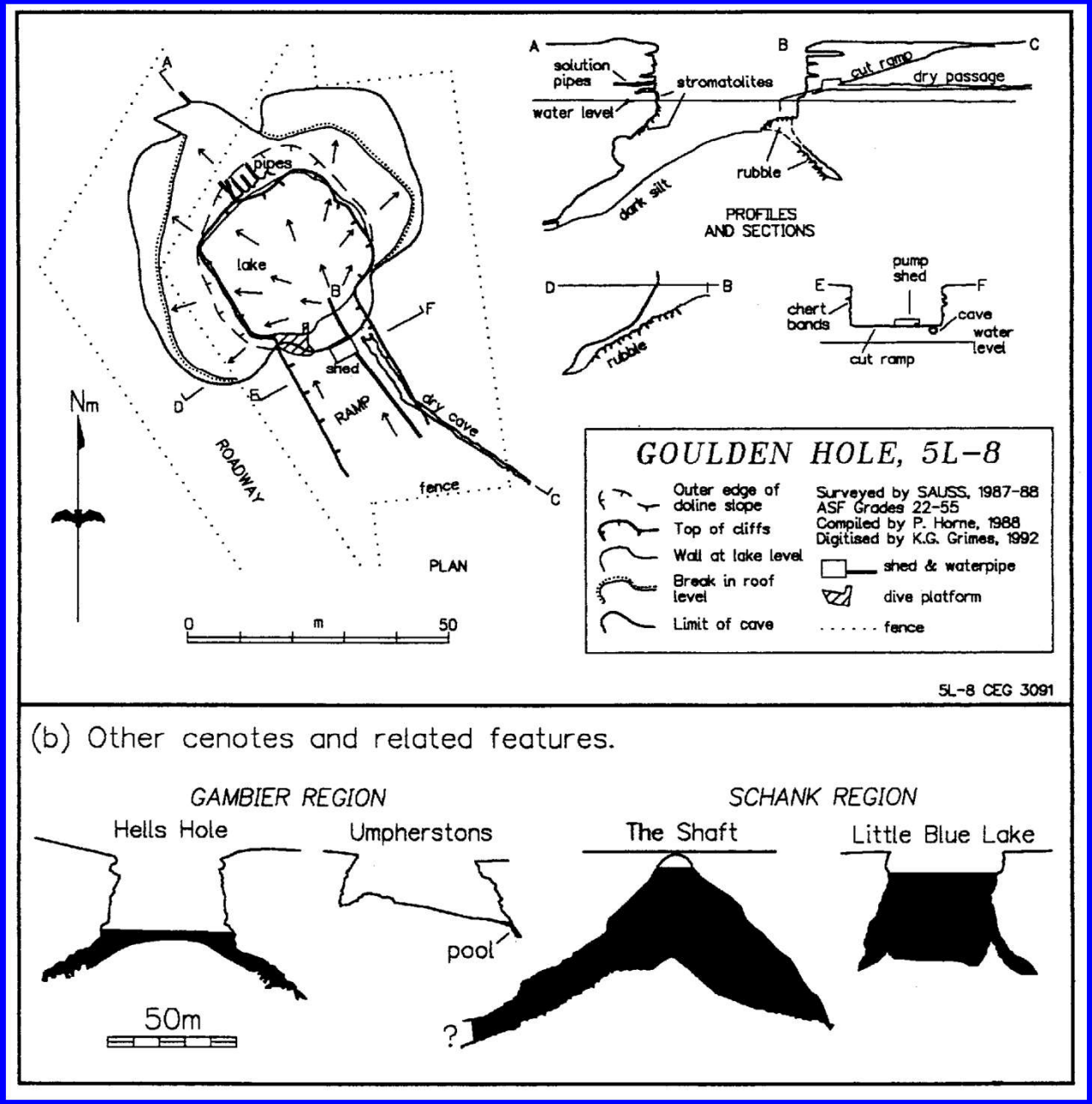
Piccaninnie Ponds – Ramsar nomination pending

Caves



Caves

Cenotes: windows to the waterable



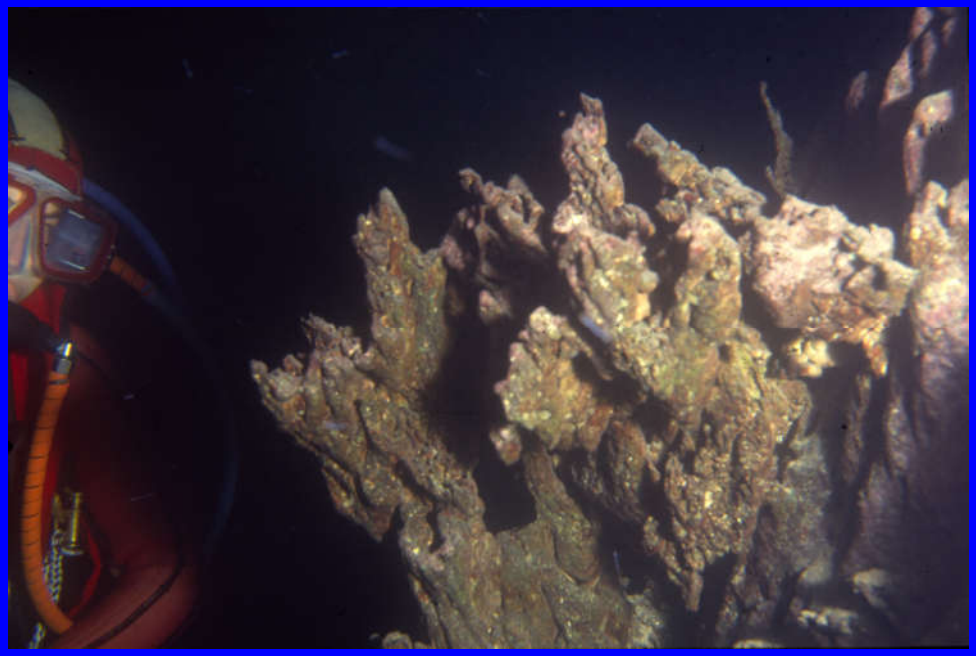
Cenote Structure

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

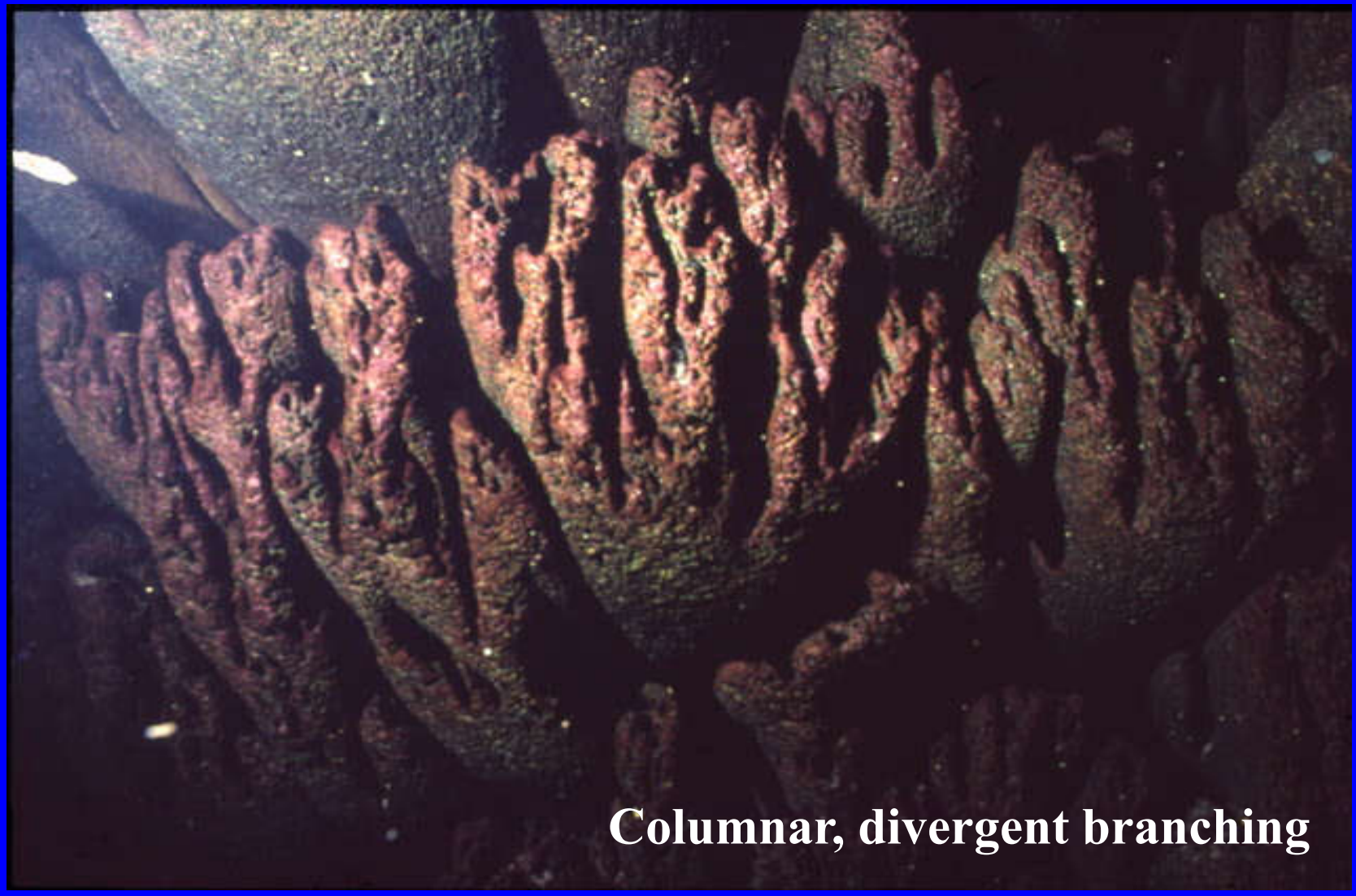
- Mt Gambier (Limestone Coast) is centre of stromatolite diversity
- Over 25 different types (most places 4-8 types)
- Found in 8 cenotes, the Blue Lake and saline/hypersaline groundwater-fed lakes in north
- Each location has own unique suite of microbes & strom types

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)

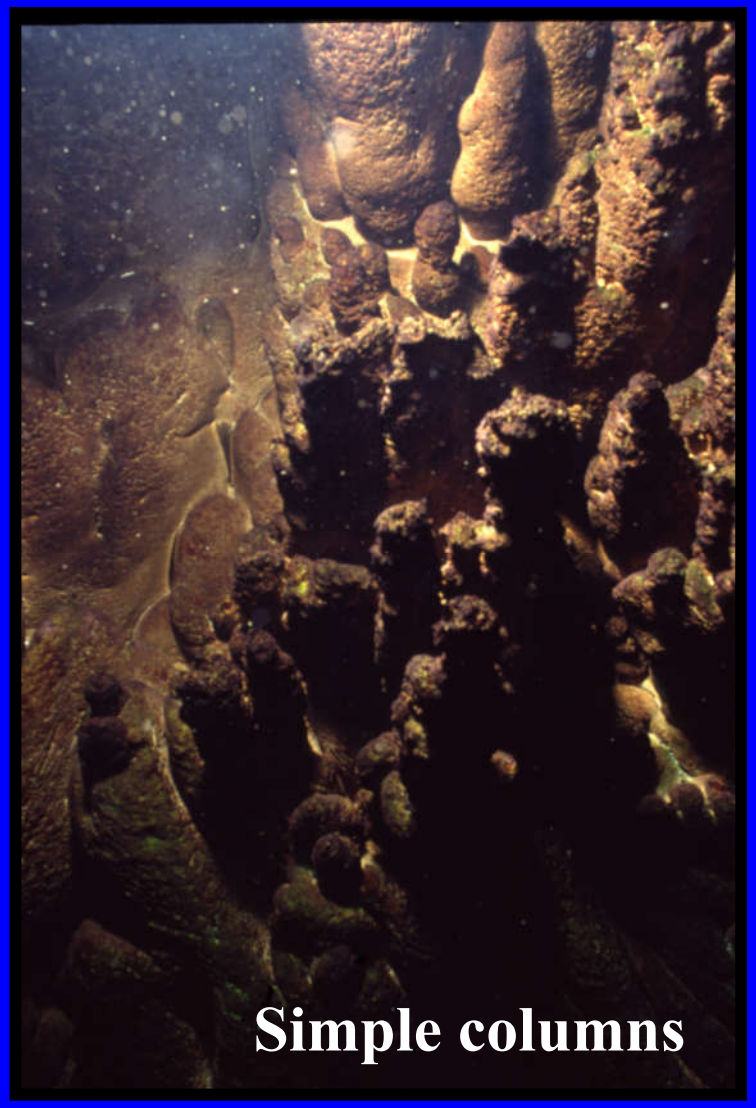
Cenote stromatolites

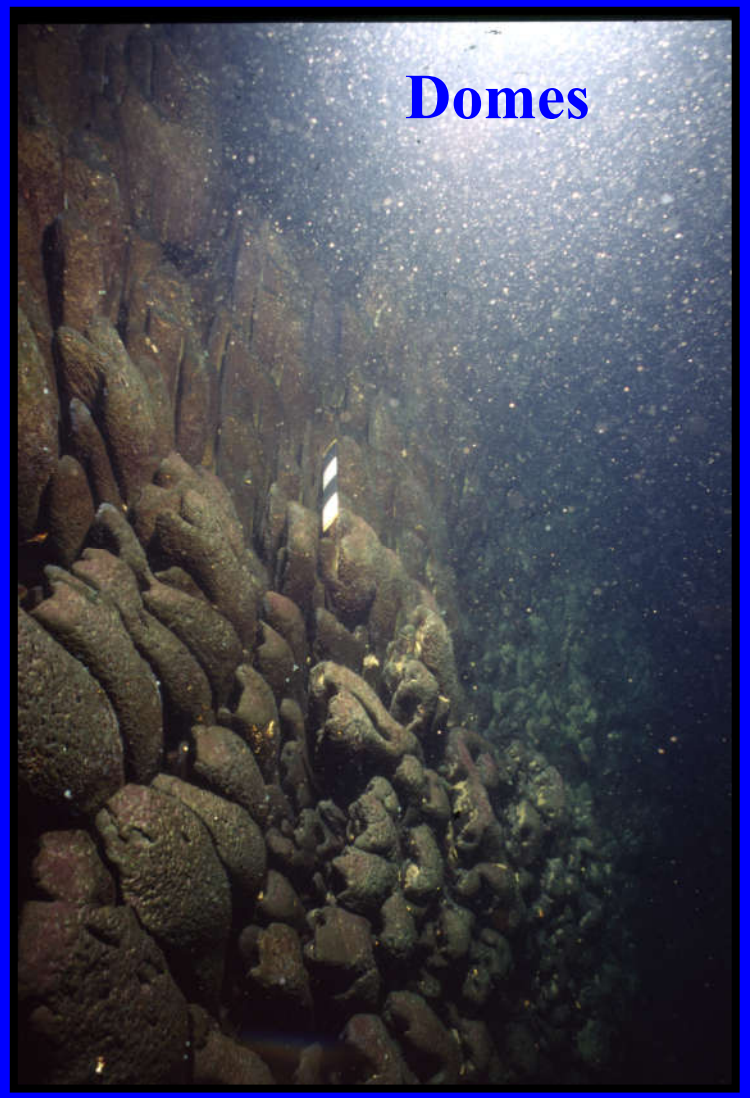
Cenote stromatolites

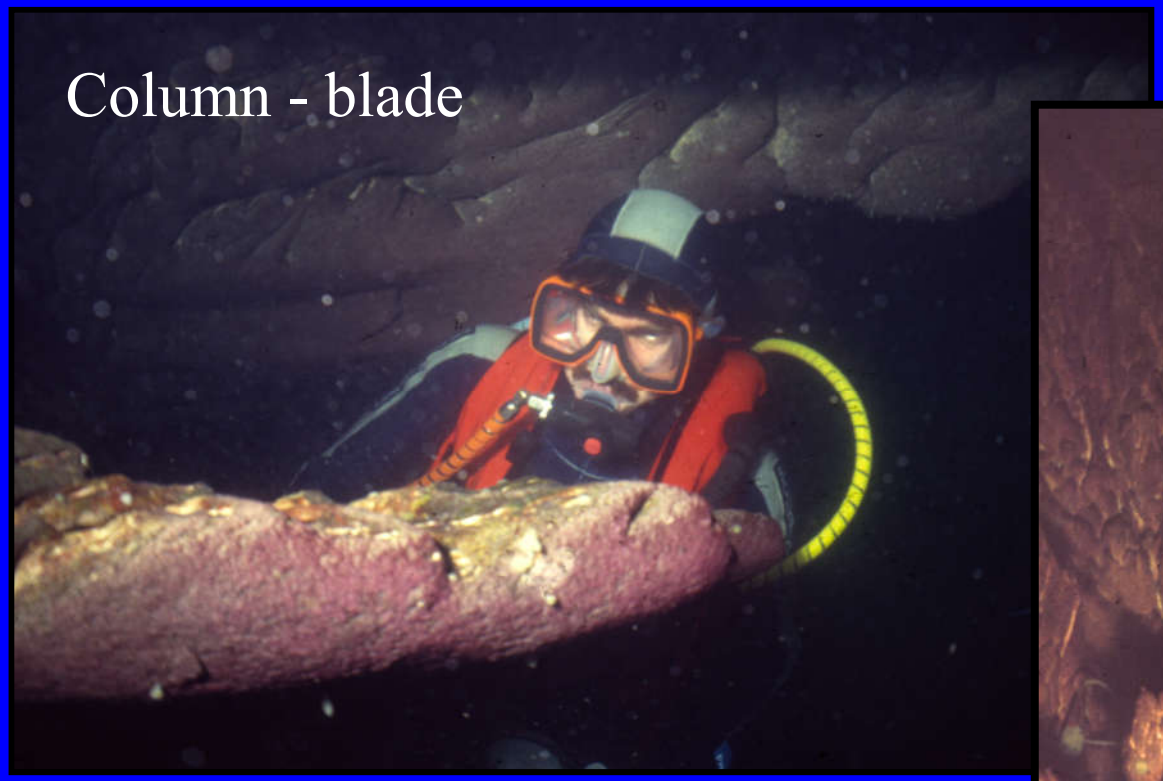


Columnar, divergent branching

Cenote stromatolites







Cenote stromatolites

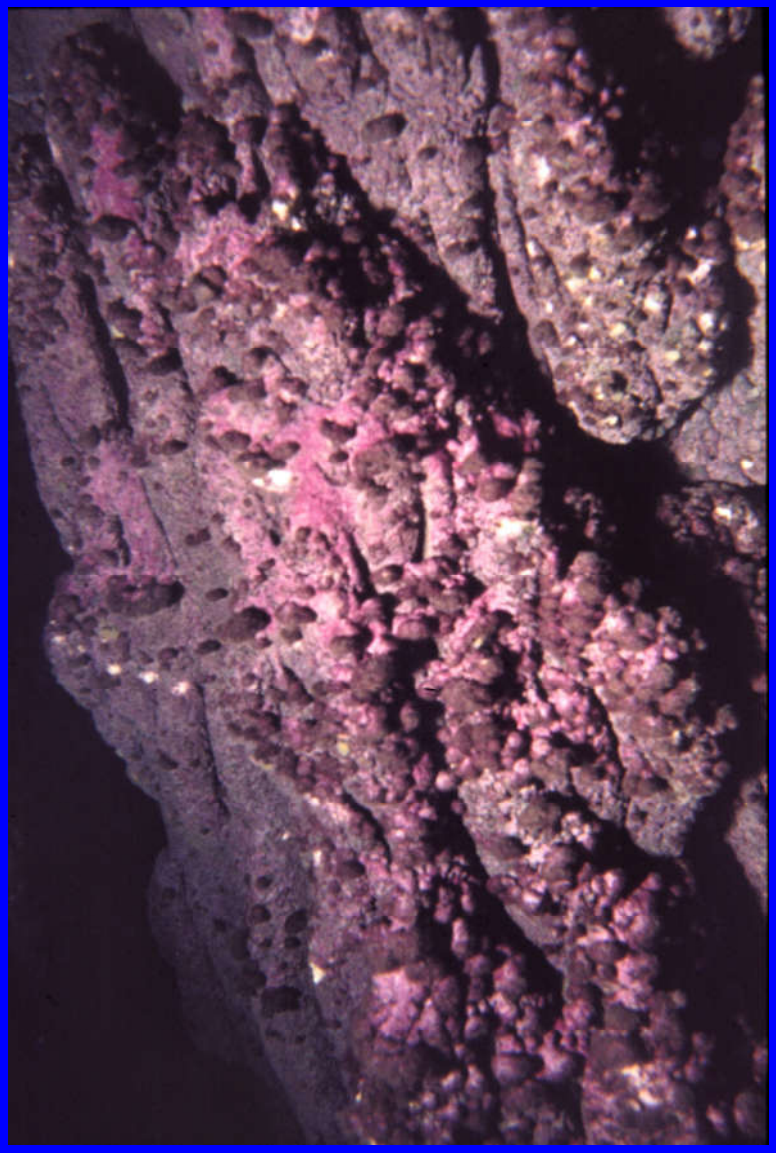
Cenote Stromatolites

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?

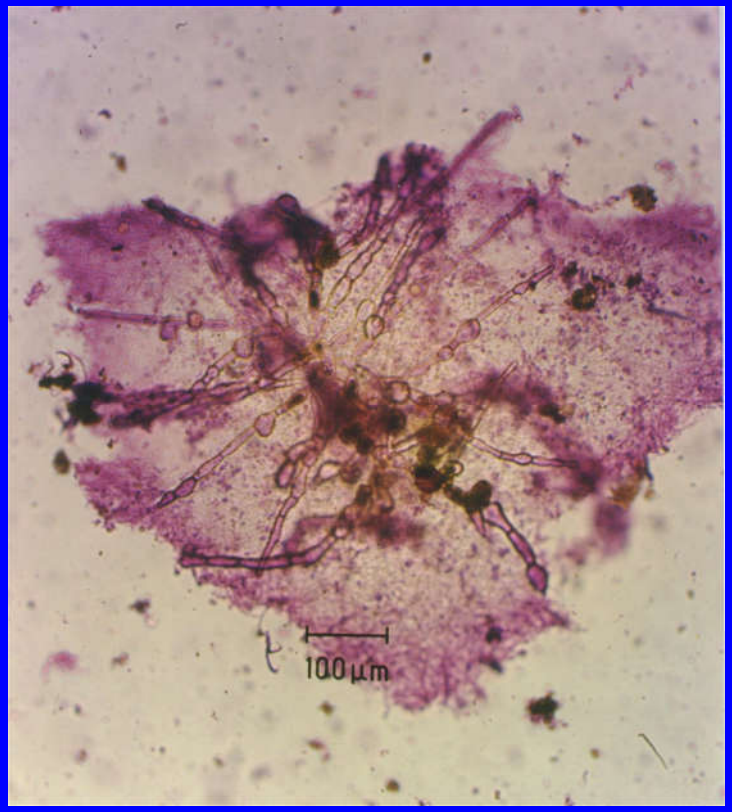
- Core & outer (light-facing) layers are dense with fine (<1mm) laminations
- Wall facing layers more complex, friable, clotted fabric, poor lamination

Internal structure

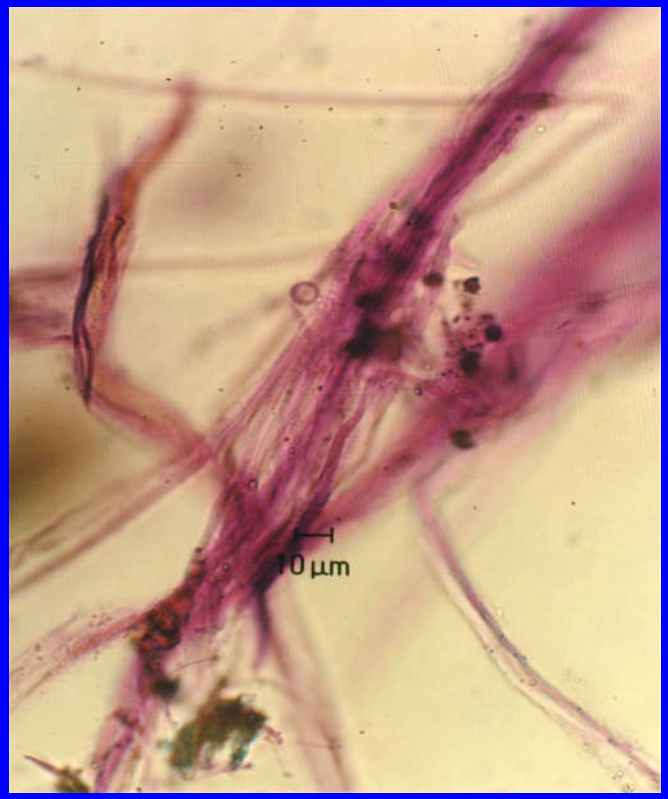
- Few microfossils survive
- Gastropod & bivalve shells in wall-facing surfaces & embedded
- Fenestrae common – grazing gastropods?

Stromatolite-building microbes

(Cynanophytes)



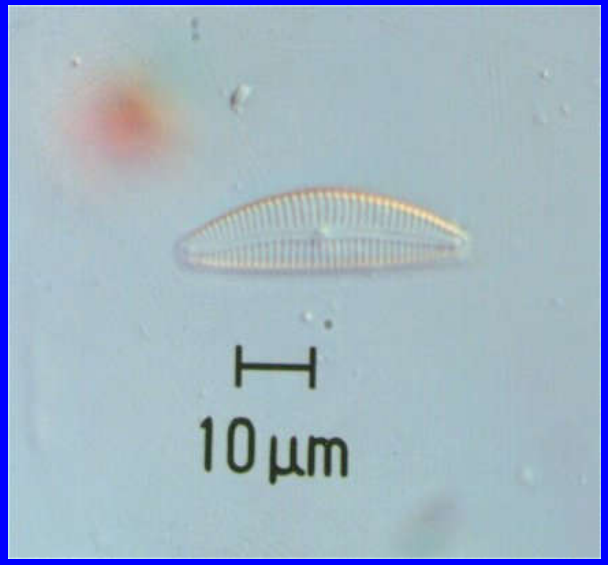
Chaetophora sp.



Schizothrix sp.

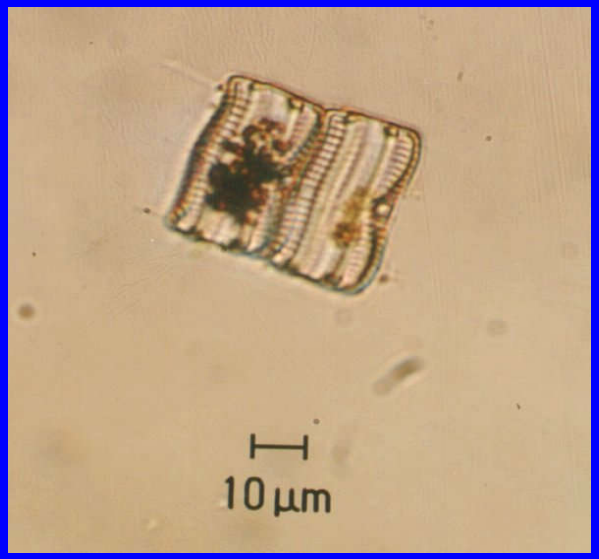
Stromatolite-building microbes

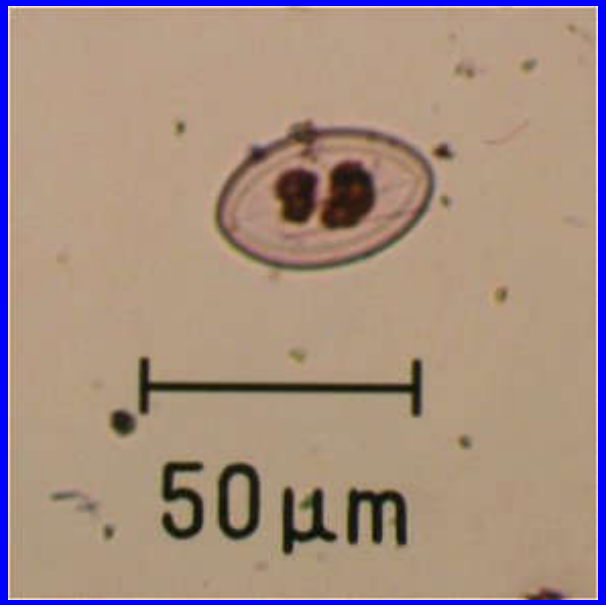
(diatoms)



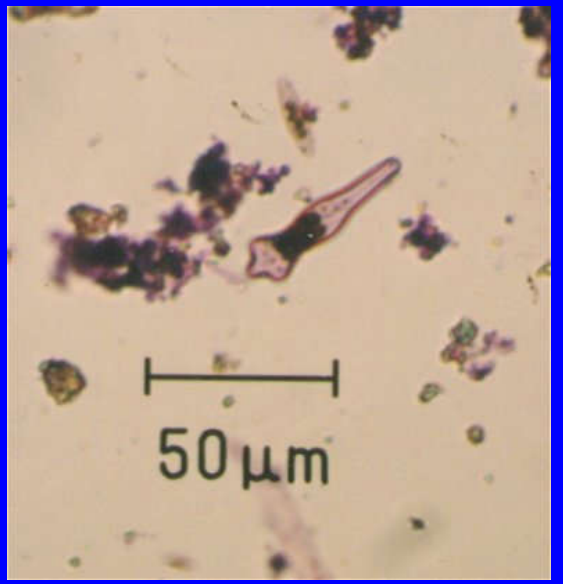
Cymbella sp. ▲

Acnanthes brevipes ▼



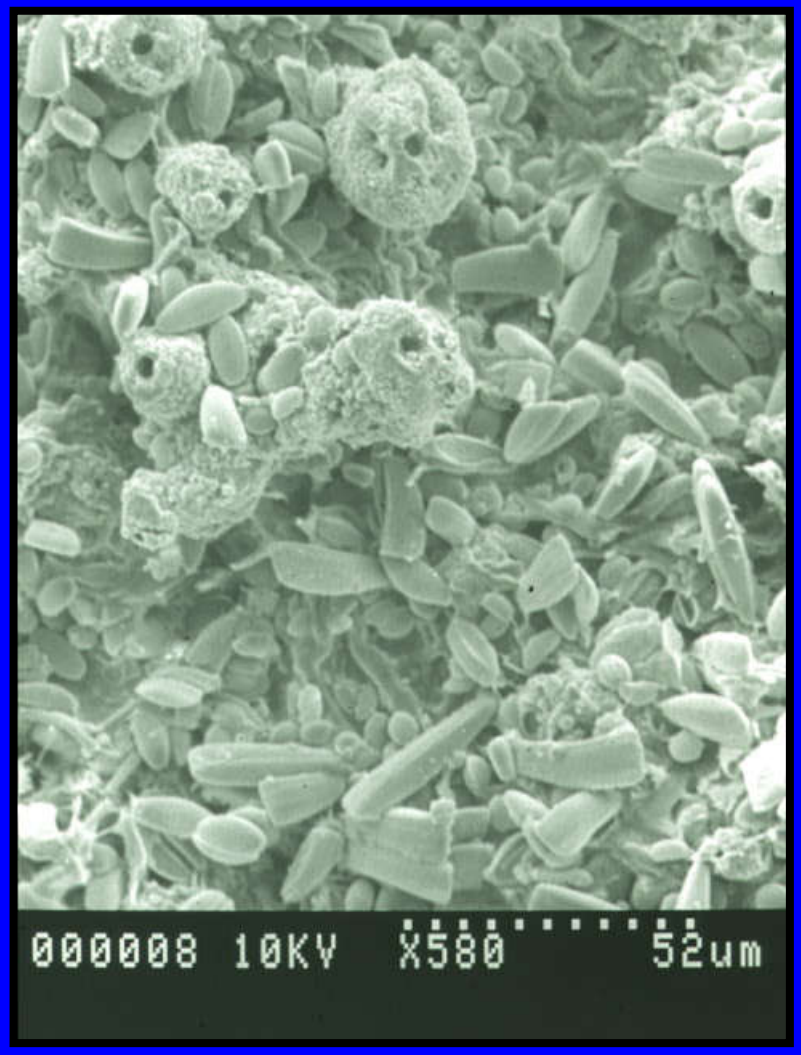


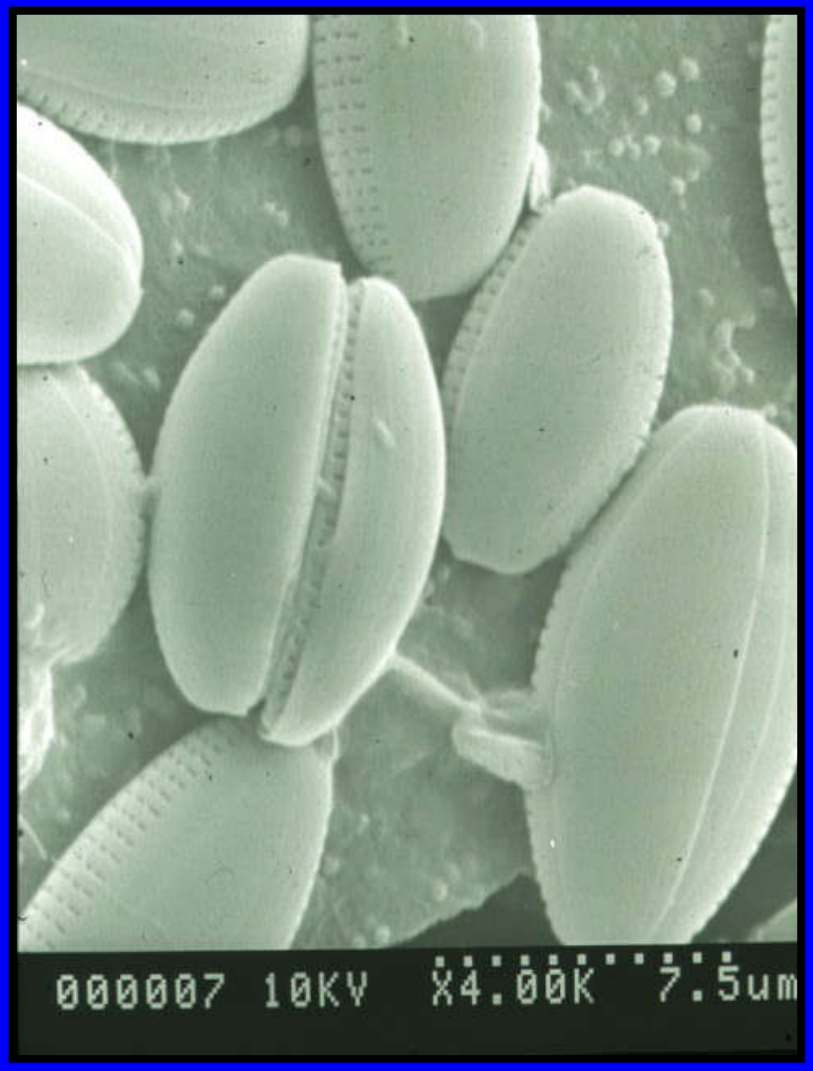
Cocconeis placentula



Gomphonema acuminatum

SEM images of diatoms

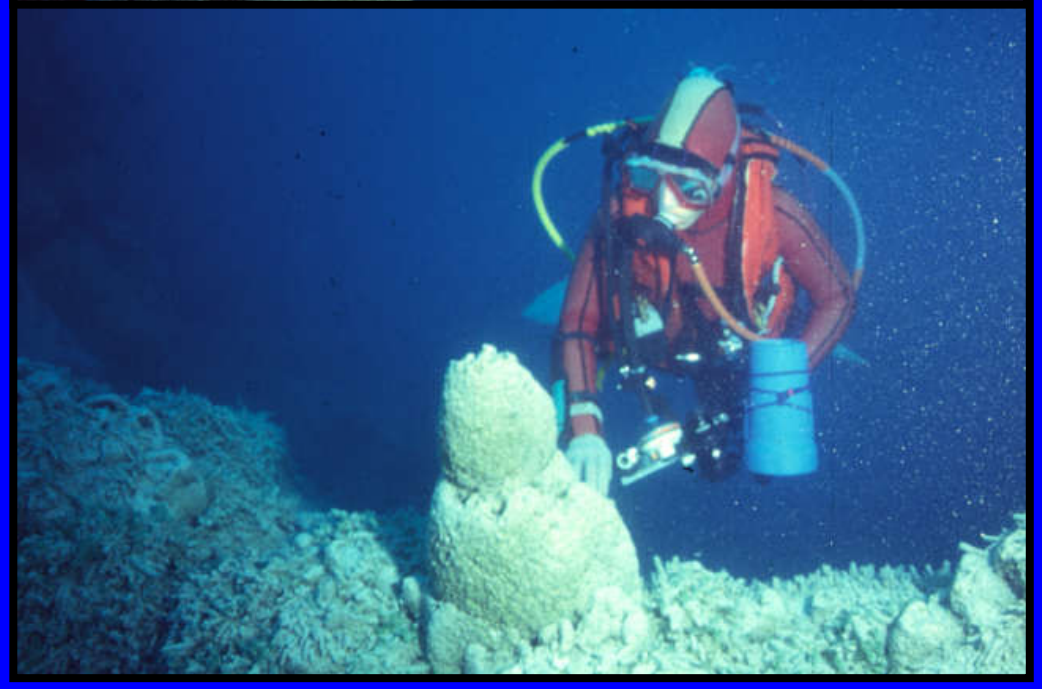




Blue Lake stromatolites

Key points: Blue Lake stroms

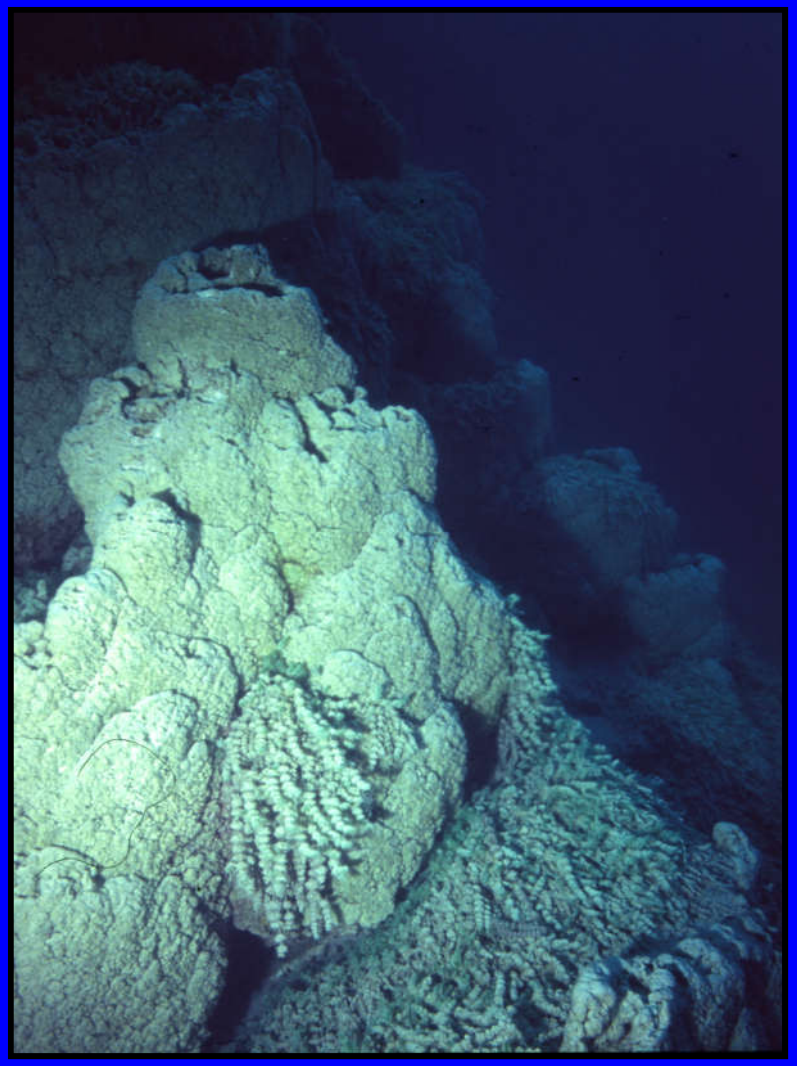
- Lake is ~ 28,00 years old: max. depth 77 m, shoreline 1 km
- 5 sites visited – only 1 morphology similar to cenotes, total 10 morphotypes
- On walls & in sediment floor, latter distributed around points of GW upwelling
- Mostly columns (0.5-8 m) & reefs 10 x 20 m also domes and linear ‘canyon’ structures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



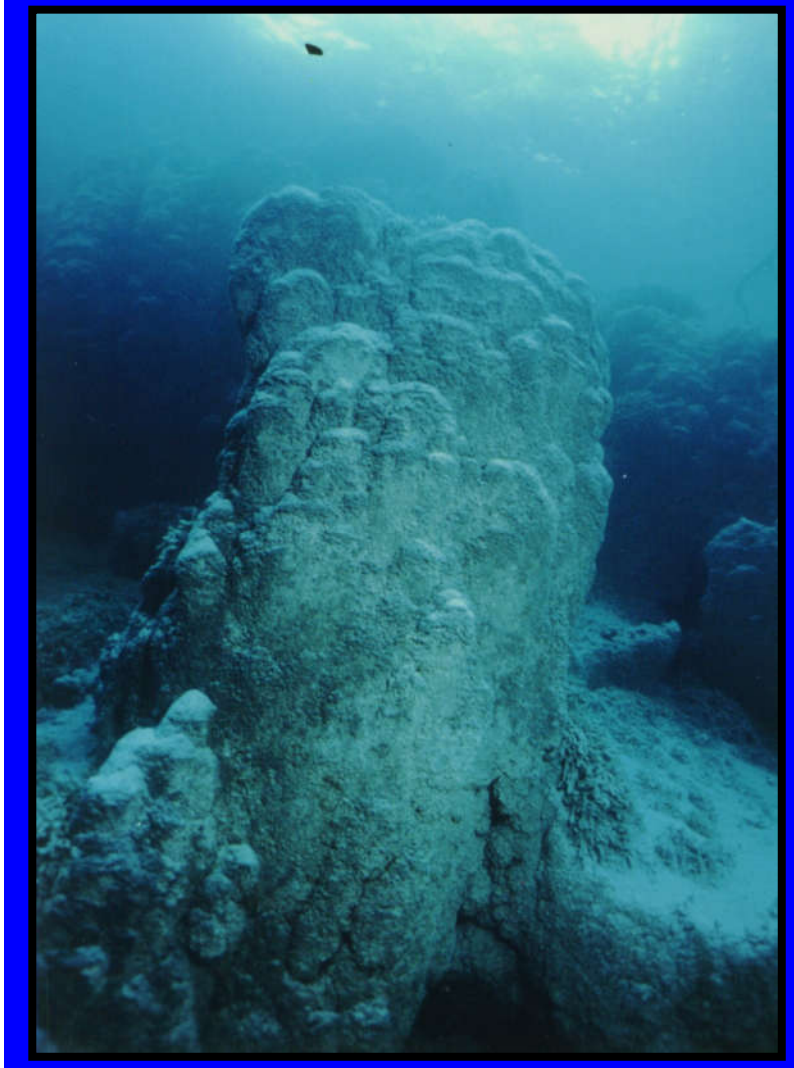
Blue Lake stromatolites

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

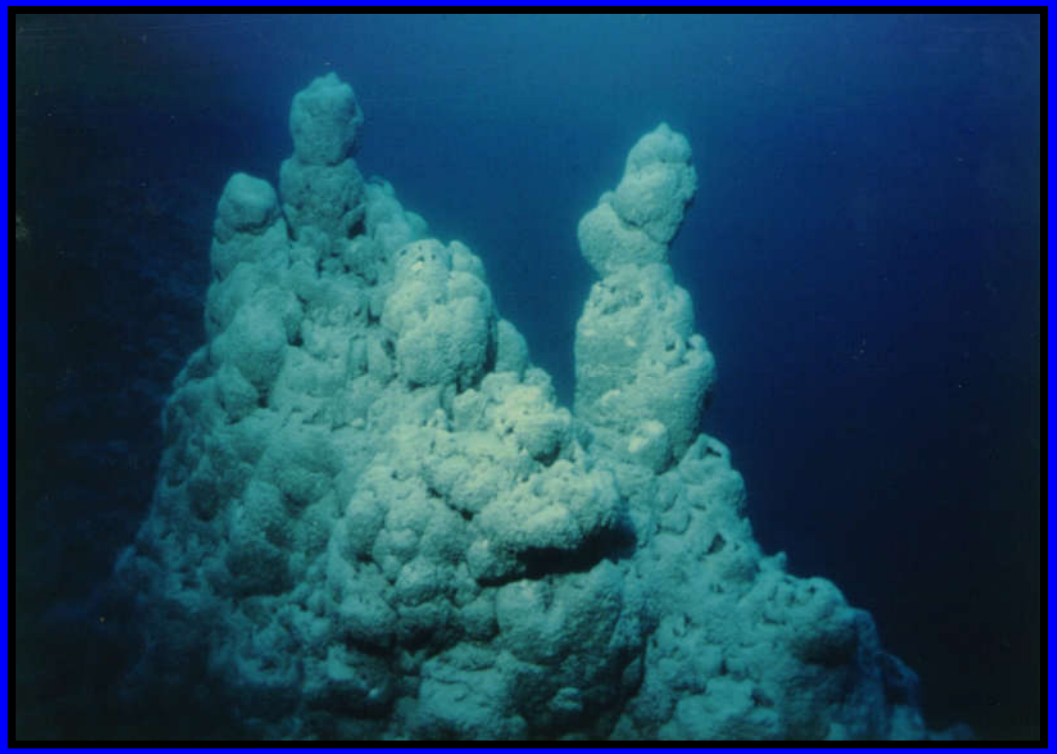
Blue Lake stromatolites



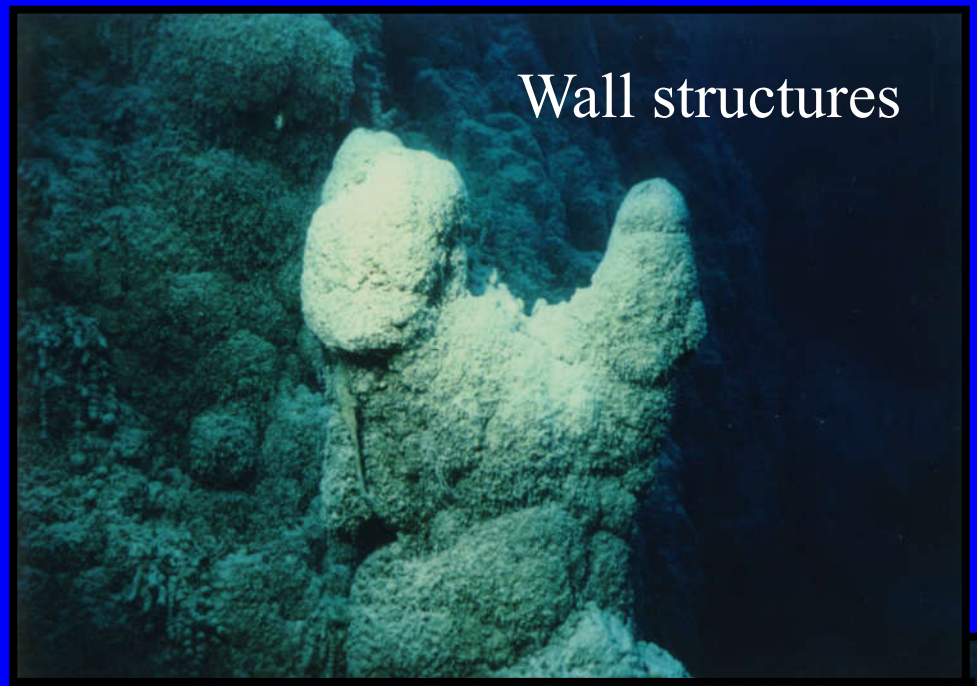
Blue Lake stromatolites



Coalesced forms build large towers and complex columns

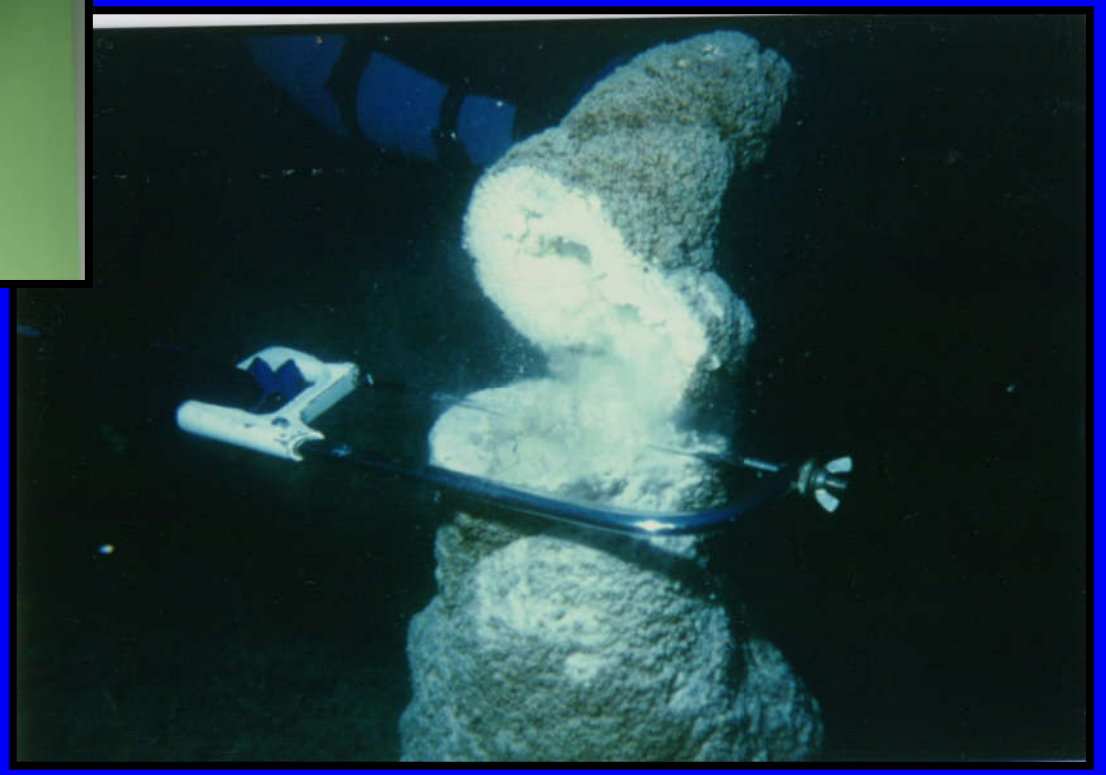


Blue Lake stromatolites



Internal structure – Blue Lake

Hollow core, crude lamination, crystalline central rims

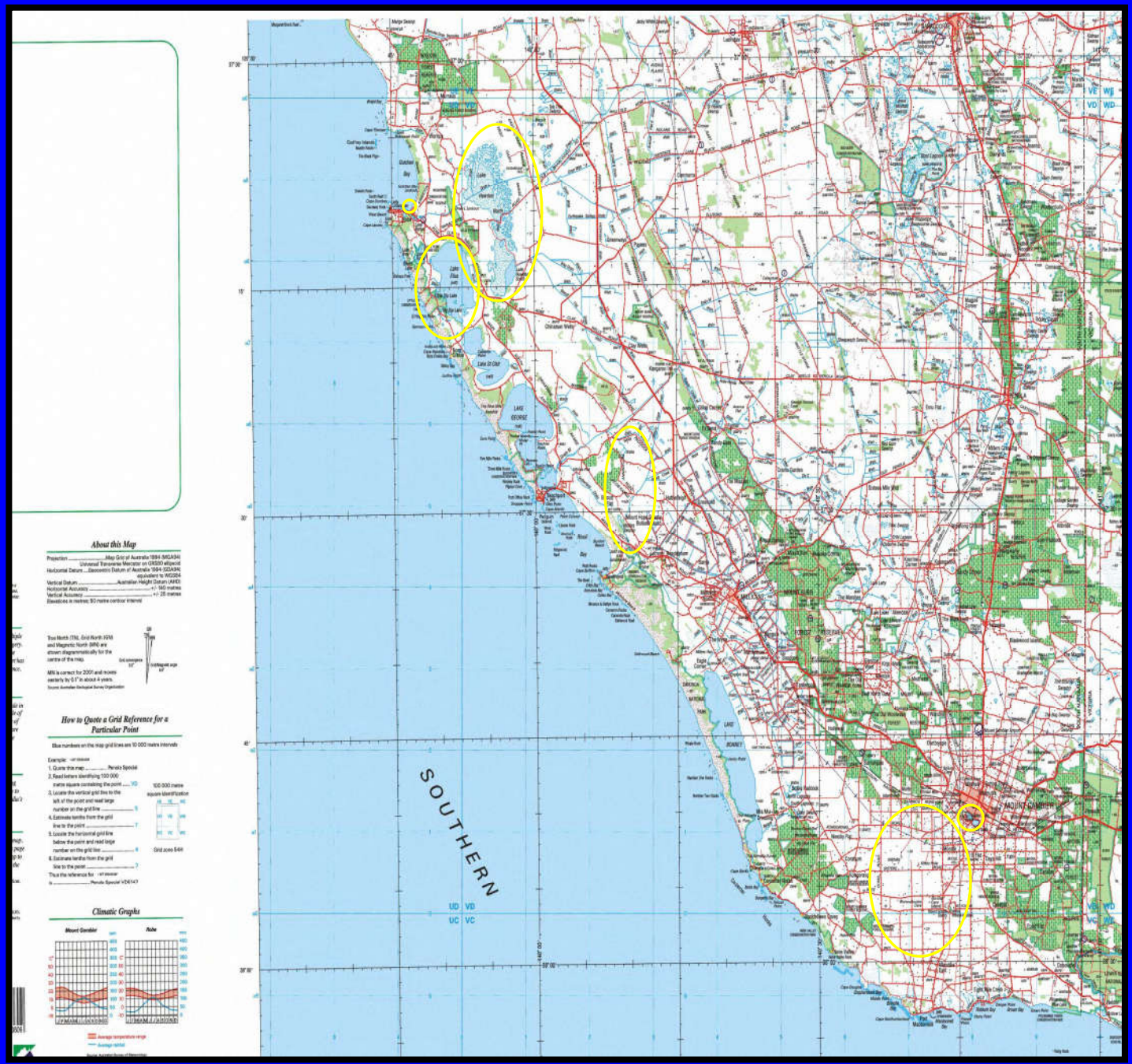


Model for Strom Development

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

Other microbialite occurences

- 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
How to Quote a Grid Reference for a Particular Point
Climatic Graphs
Mount Gambier
Robe
SOUTHERN
UD VD
UC VC
VE WE
VD WD
VB YD
VC YC

Lakes Fellmongery
& Butler
(monohydrocalcite)

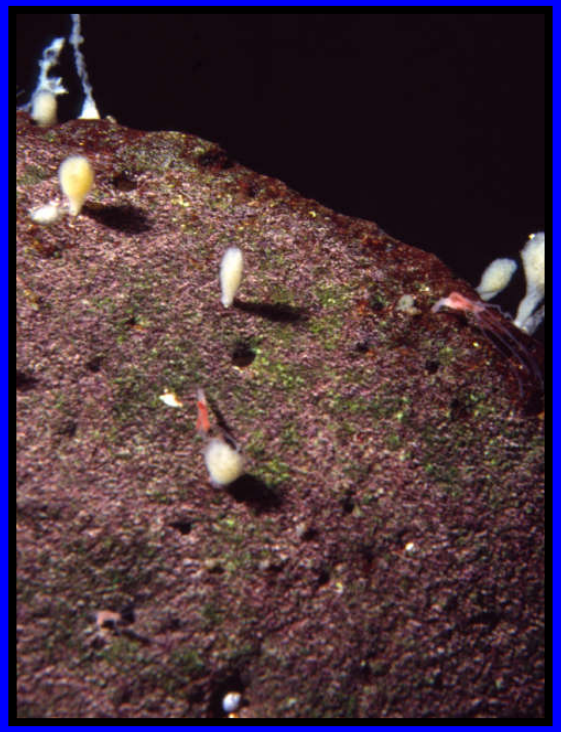
Other occurrences

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