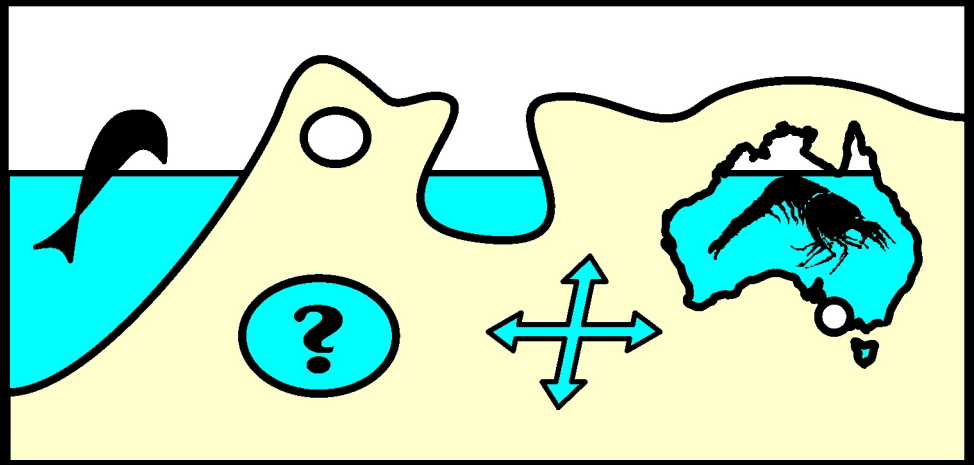
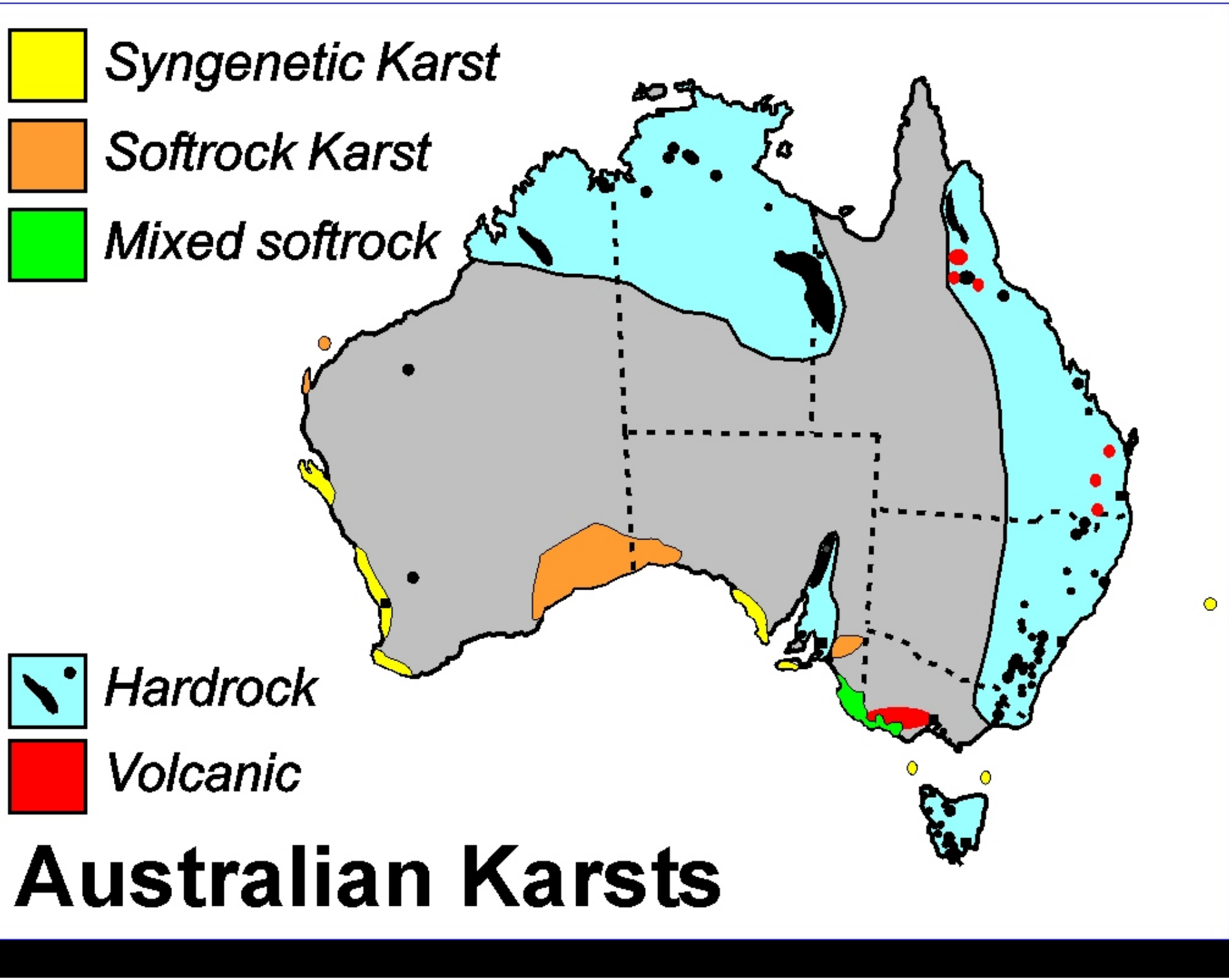
Syngenetic Karst in Australia

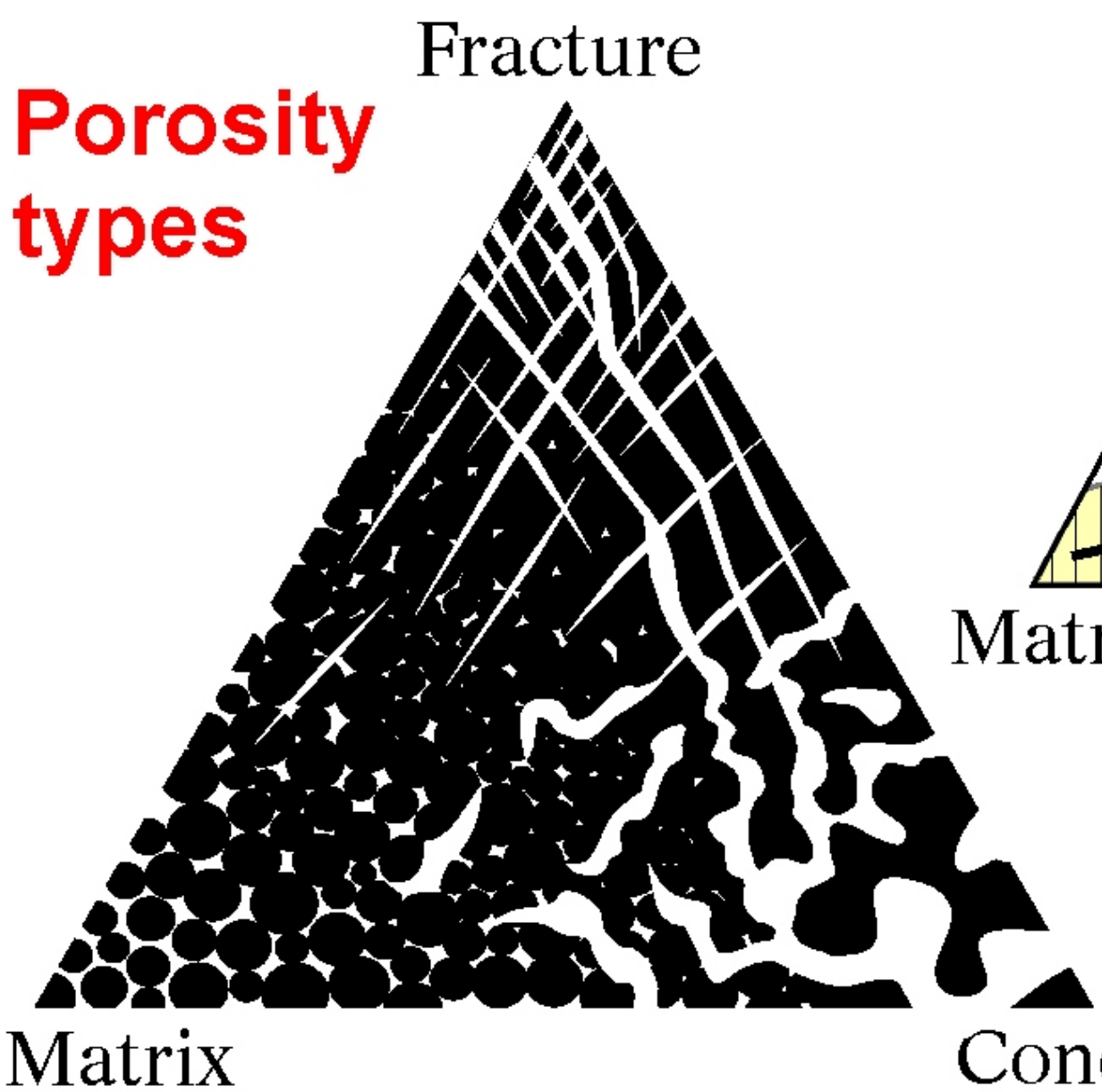
Ken G. Grimes

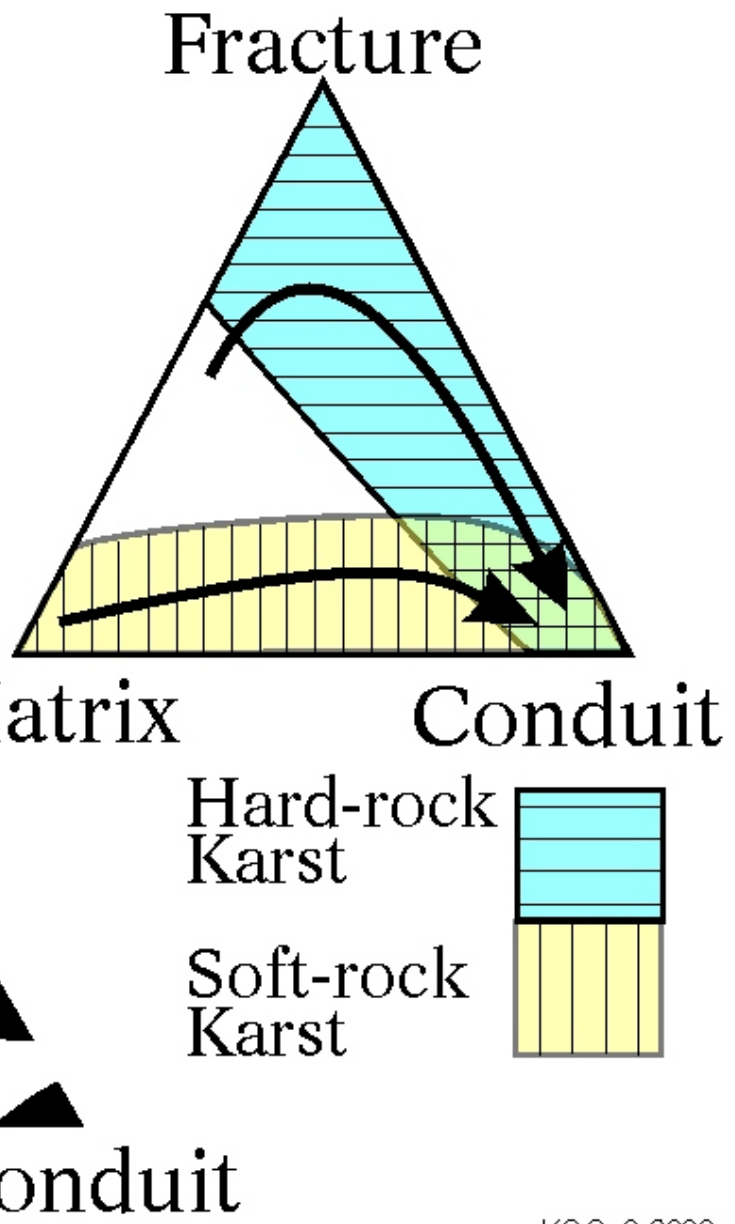


Limestone Coast 2004

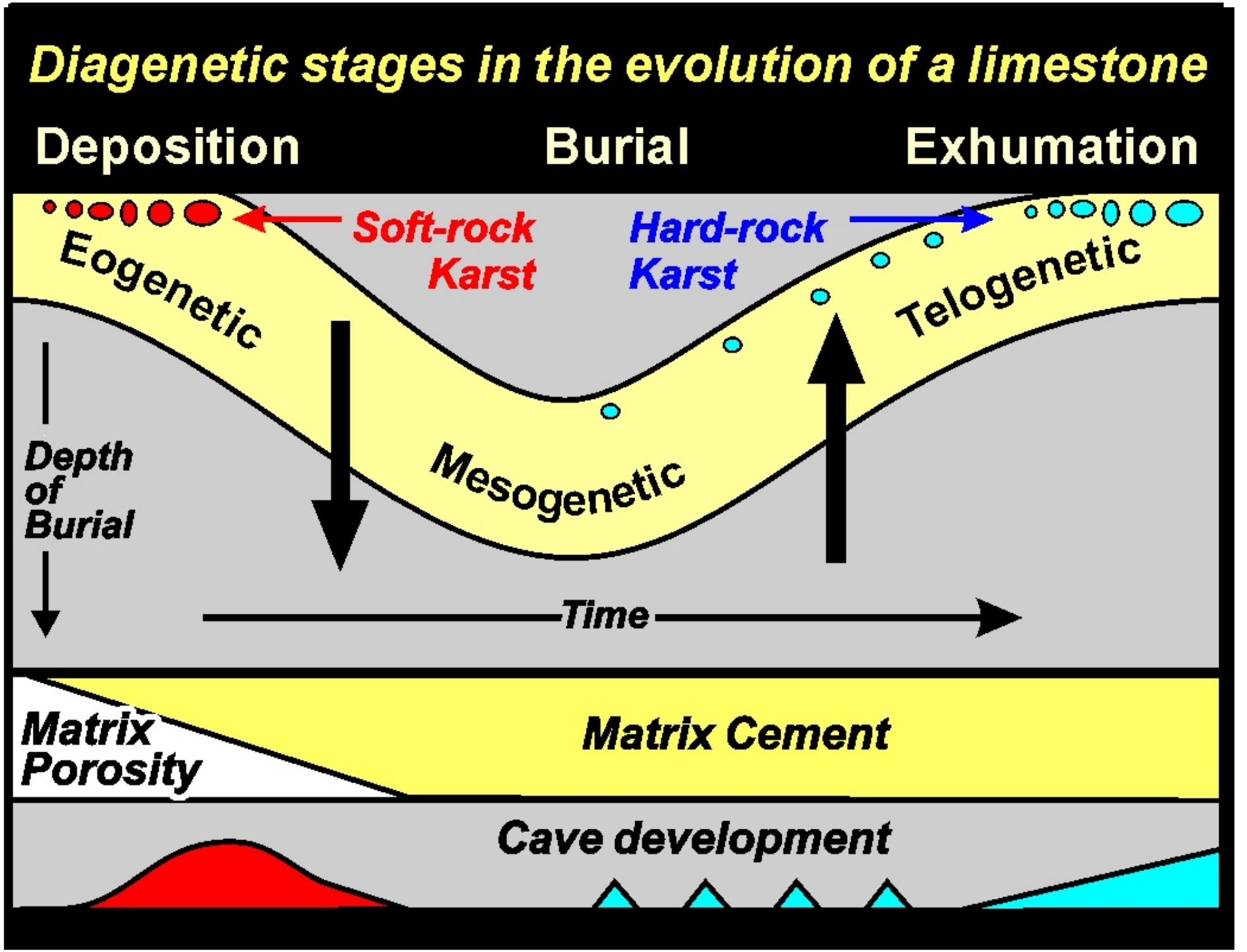

Syngenetic Karst
Softrock Karst
Mixed softrock
Hardrock
Volcanic
Australian Karsts

Porosity types





KGG 8-2000


Diagenetic stages in the evolution of a limestone
Deposition
Burial
Exhumation
Soft-rock Karst
Hard-rock Karst
Eogenetic
Mesogenetic
Telogenetic
Depth of Burial
Time
Matrix Porosity
Matrix Cement
Cave development

Soft-Rock Karst

broad term

- Tertiary & Quaternary Limestones
- Soft, poorly consolidated rock
- Abundant primary (matrix) porosity
- Syngenetic development of karst and the limestone rock

Syngenetic Karst

narrow term

- Quaternary Dune Limestones
- Soft, calcareous coastal sands
- Simultaneous solution and induration
- A suite of characteristic feautures ...

Early & Late Syngenesis

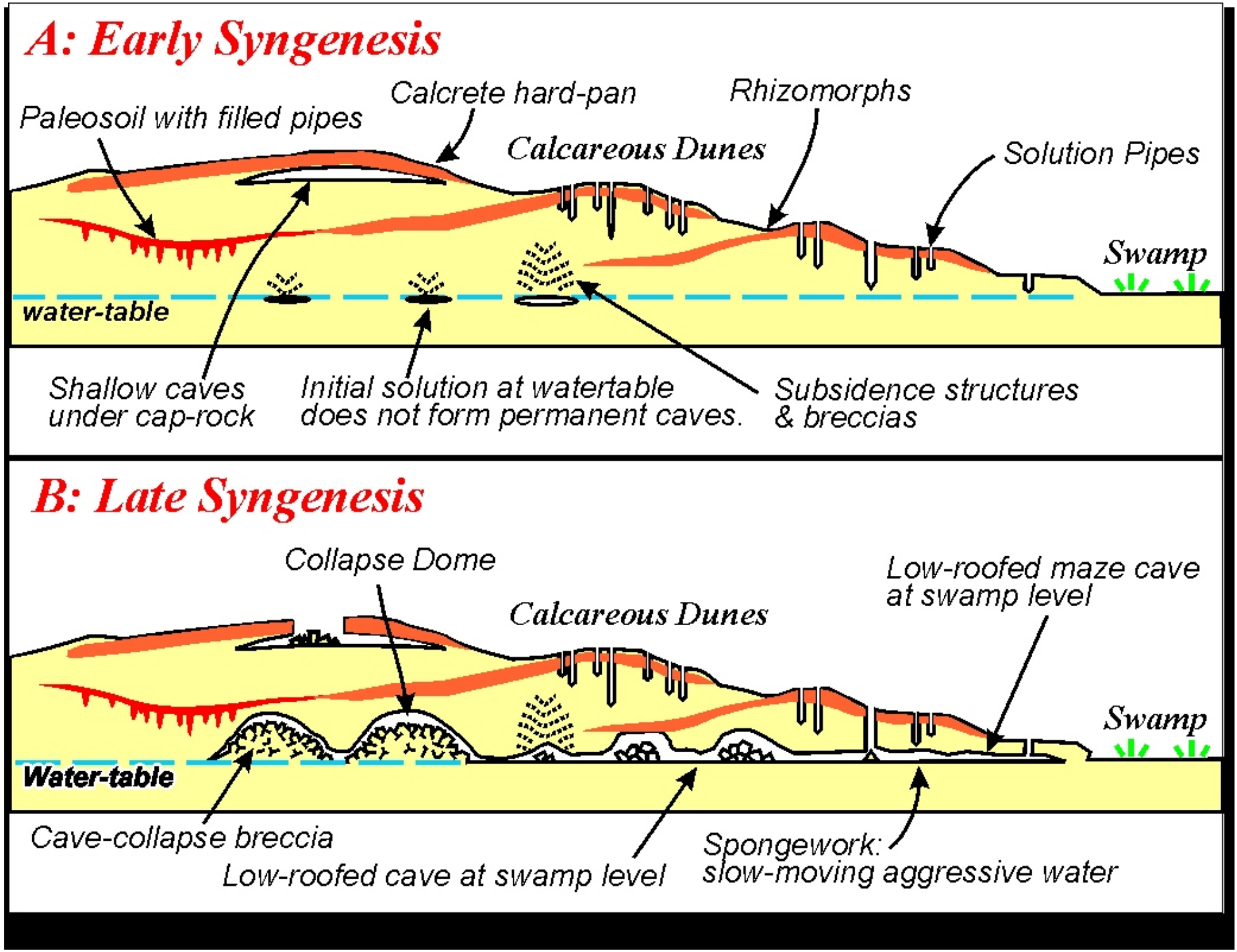
....

- Early Syngenesis
  - Limited cementation - so caves cannot survive
- Late Syngenesis
  - More cement - so caves can now exist

Early Syngenesis

Generally too soft for caves

- Soil cementation (rhizomorphs, caprock)
- Caprock (breccias, shallow caves)
- Solution Pipes
- Subsidence structures


A: Early Syngenesis
Paleosoil with filled pipes
Calcrete hard-pan
Rhizomorphs
Calcareous Dunes
Solution Pipes
Swamp
water-table
Shallow caves under cap-rock
Initial solution at watertable does not form permanent caves.
Subsidence structures & breccias
B: Late Syngenesis
Collapse Dome
Calcareous Dunes
Low-roofed maze cave at swamp level
Swamp
Water-table
Cave-collapse breccia
Low-roofed cave at swamp level
Spongework: slow-moving aggressive water

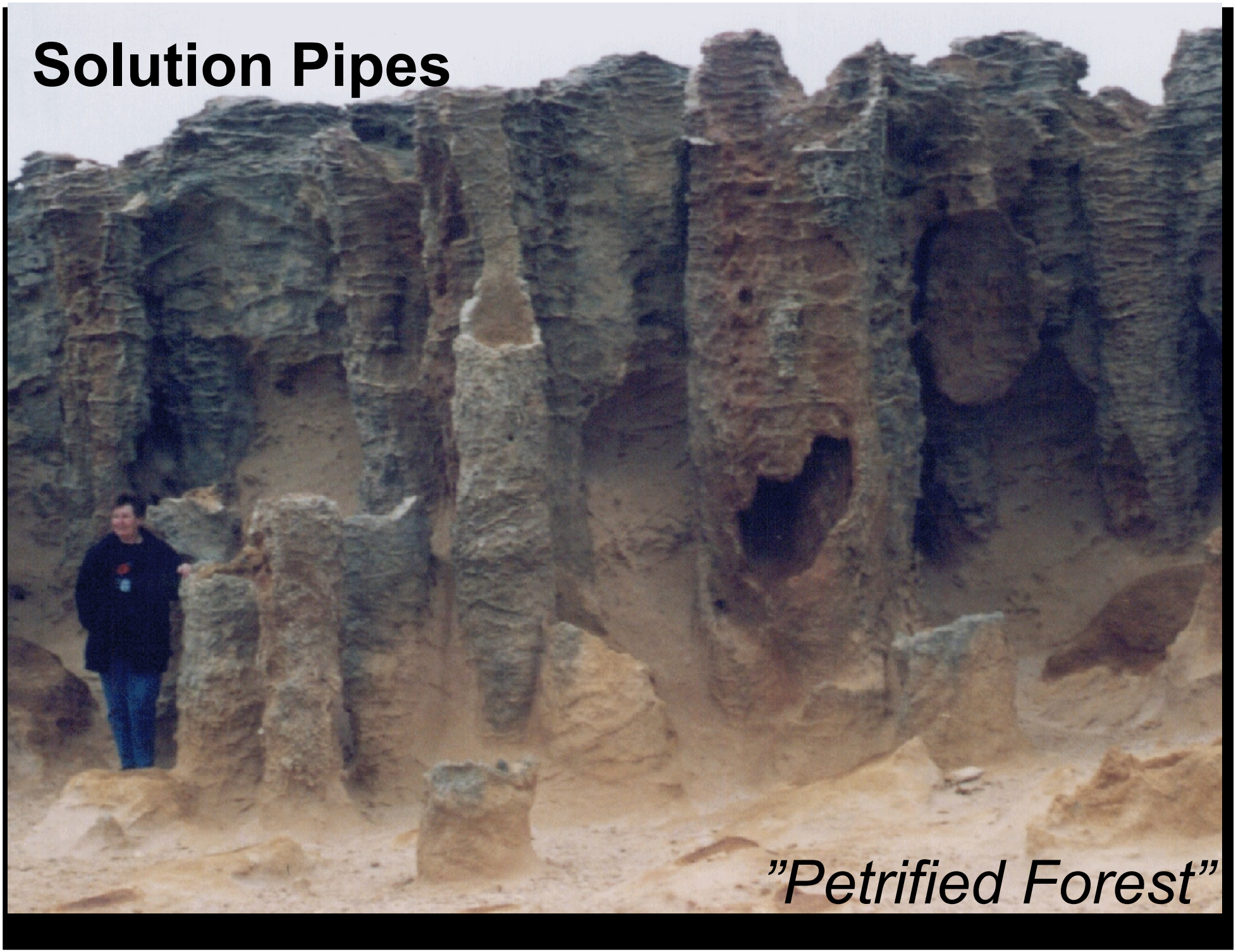
Rhizomorphs

Calcrete Caprock

Caprock
with small caves in the soft sand beneath

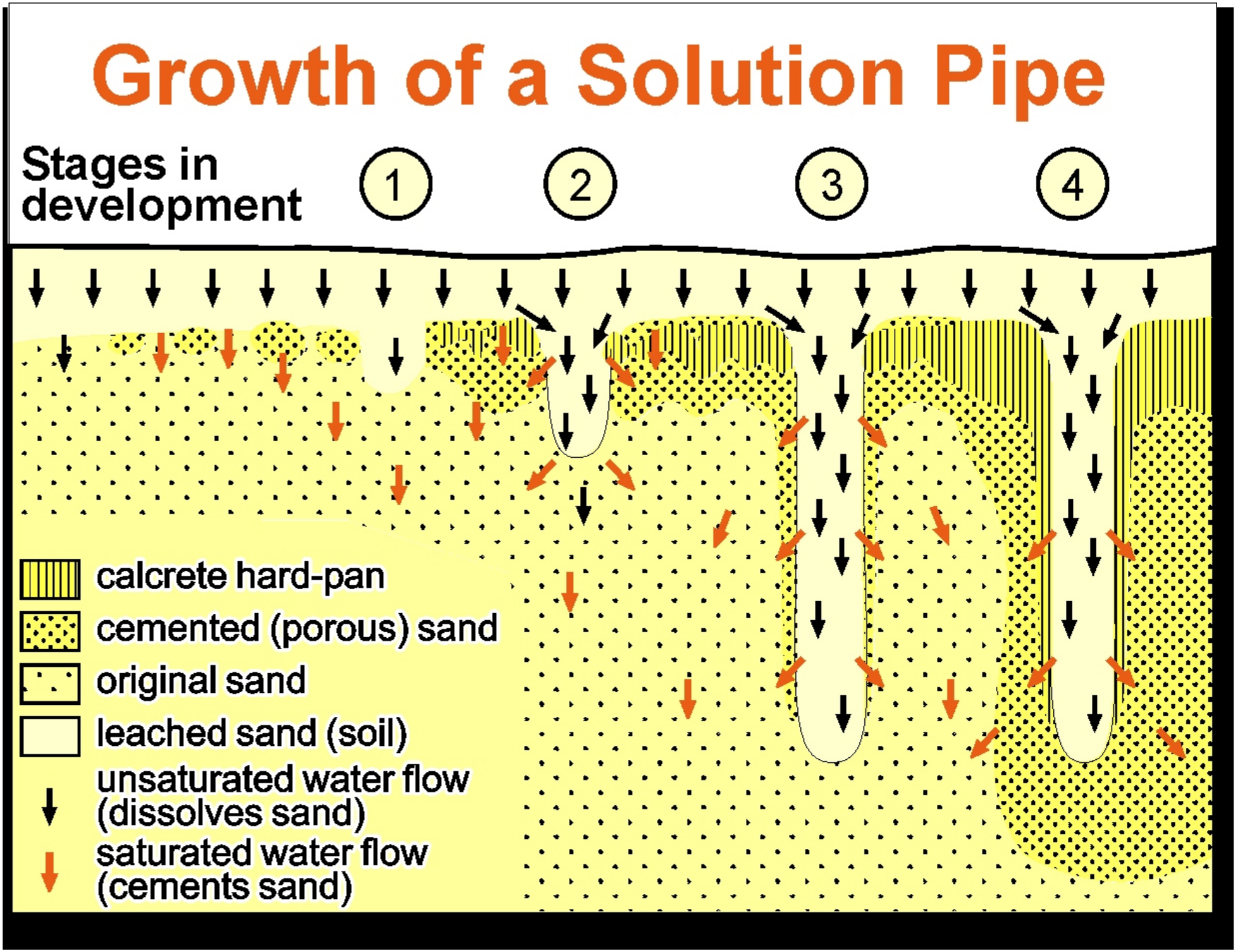
Solution pipes
in hard band

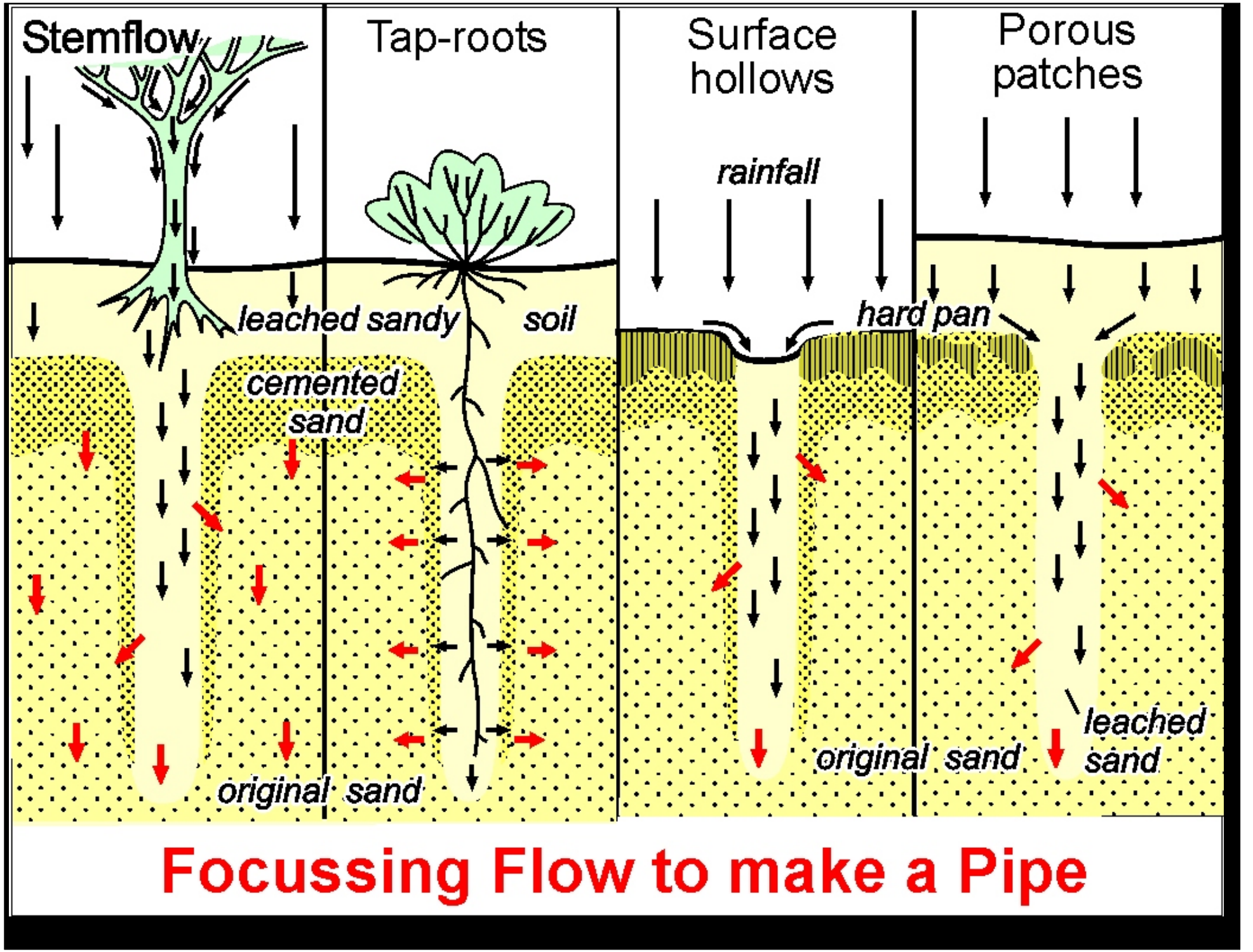
Solution Pipes



Solution pipes - terminations

Growth of a Solution Pipe



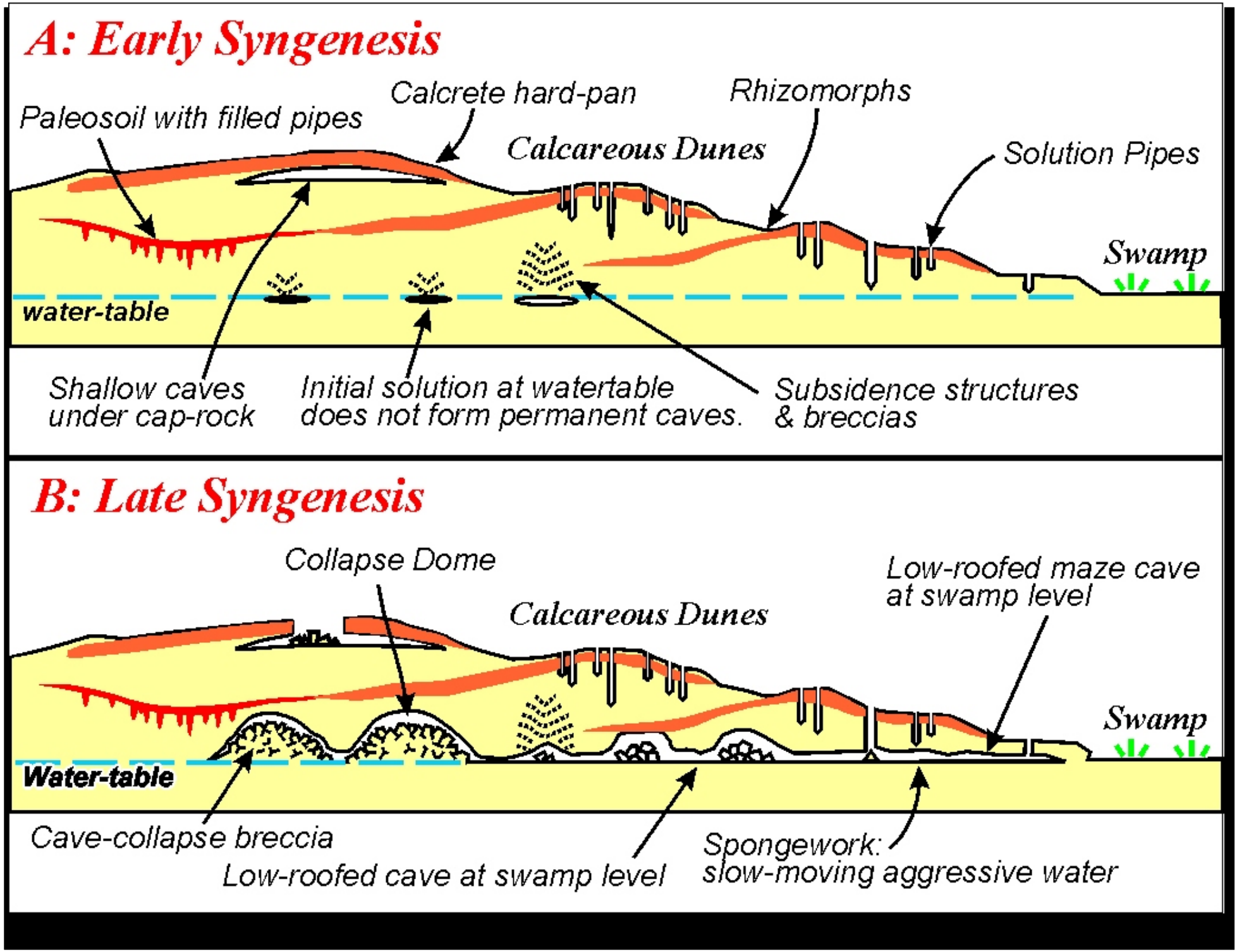

Stemflow
Tap-roots
Surface hollows
Porous patches
rainfall
leached sandy
soil
hard pan
cemented sand
original sand
original sand
leached sand
Focussing Flow to make a Pipe

Subsidence structures

Late Syngenesis

Stable caves can now form

- Horizontal mazes
- Collapse modifications
- Flat roof
  - Water-table, caprock or bedding
- Porous host-rock
  - Dispersed speleothems,
  - moonmilk,
  - roots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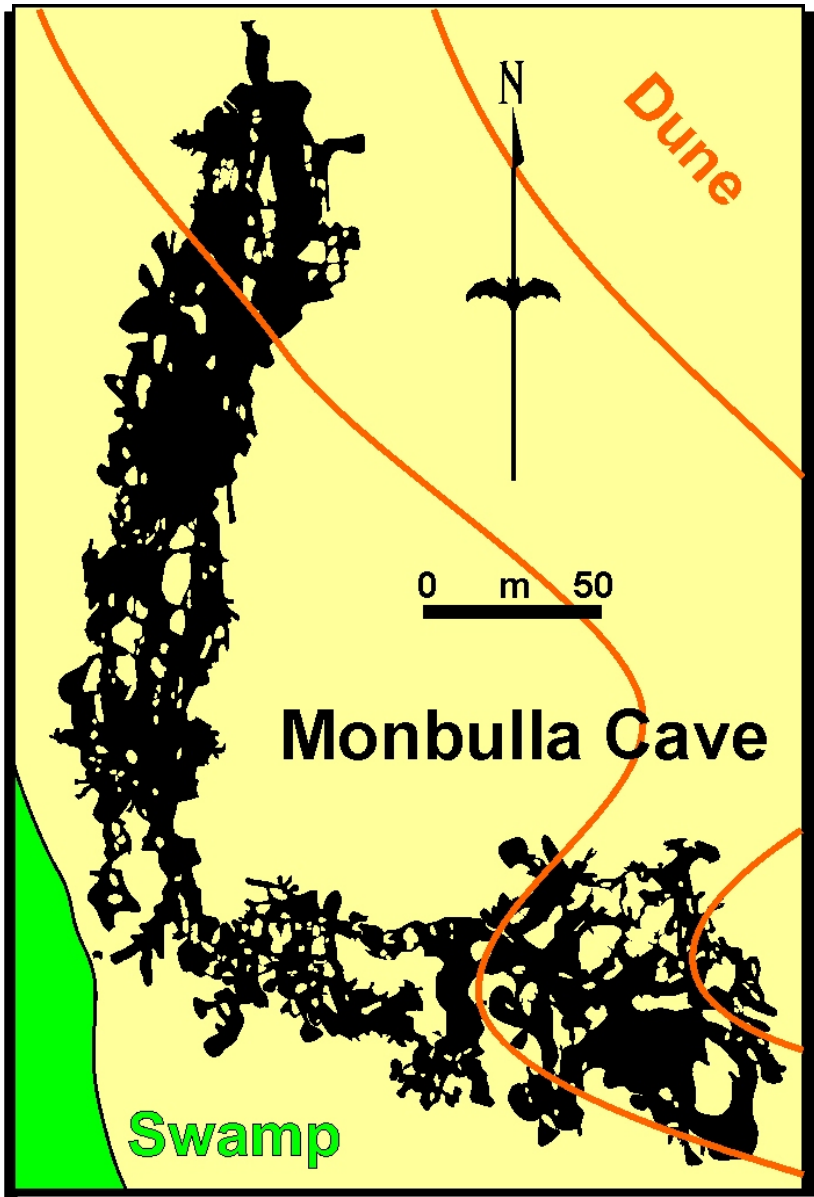
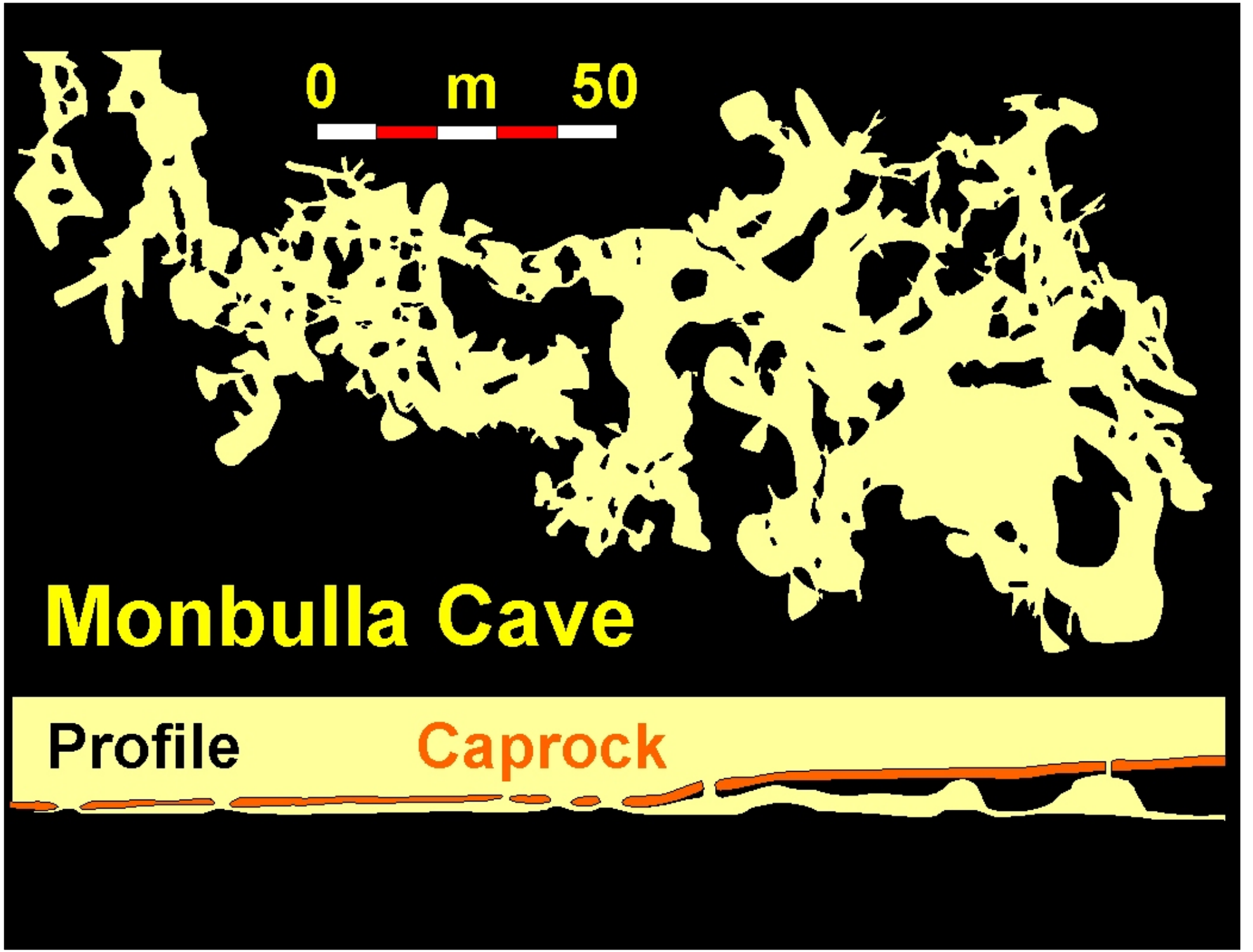
Monbulla Cave

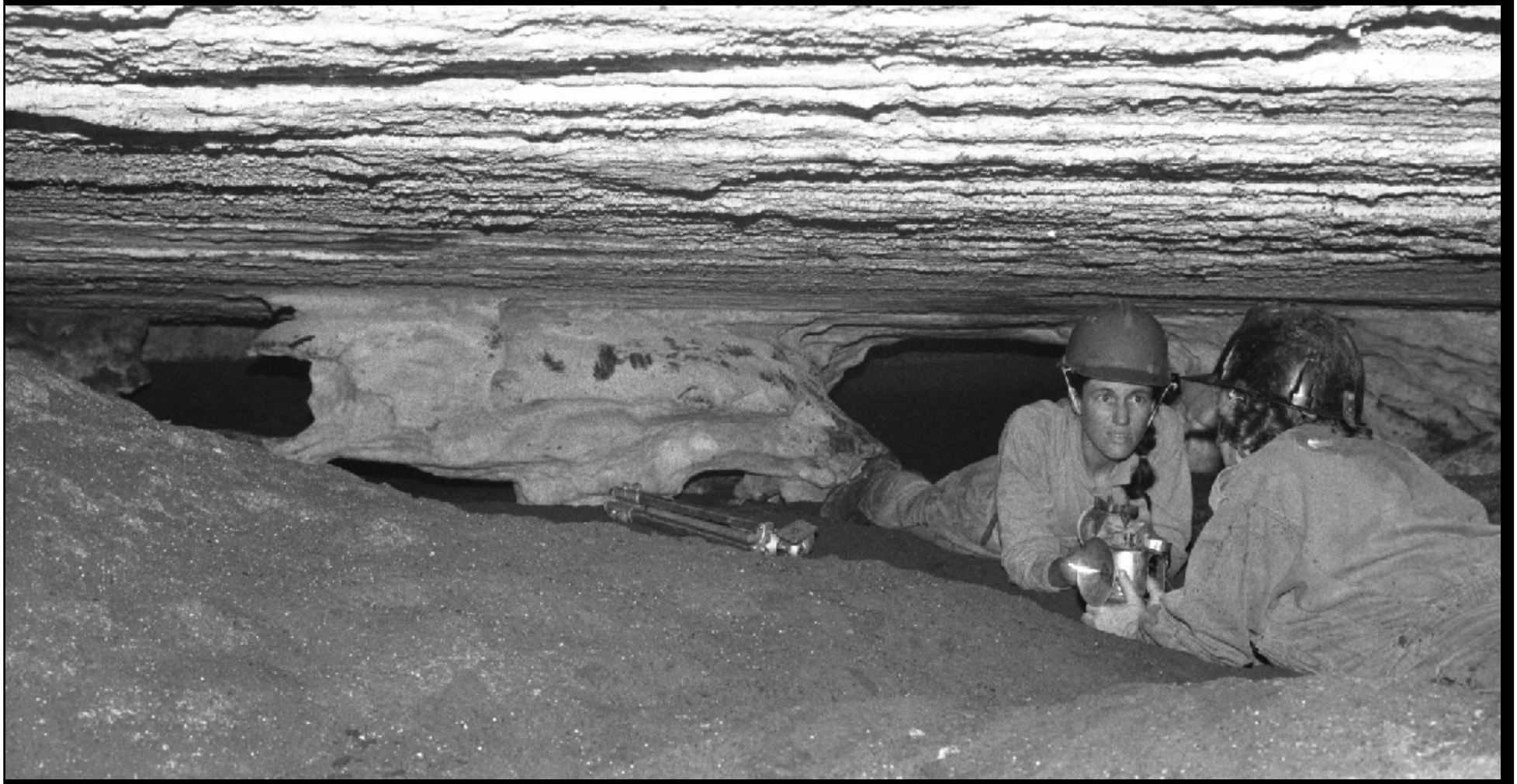


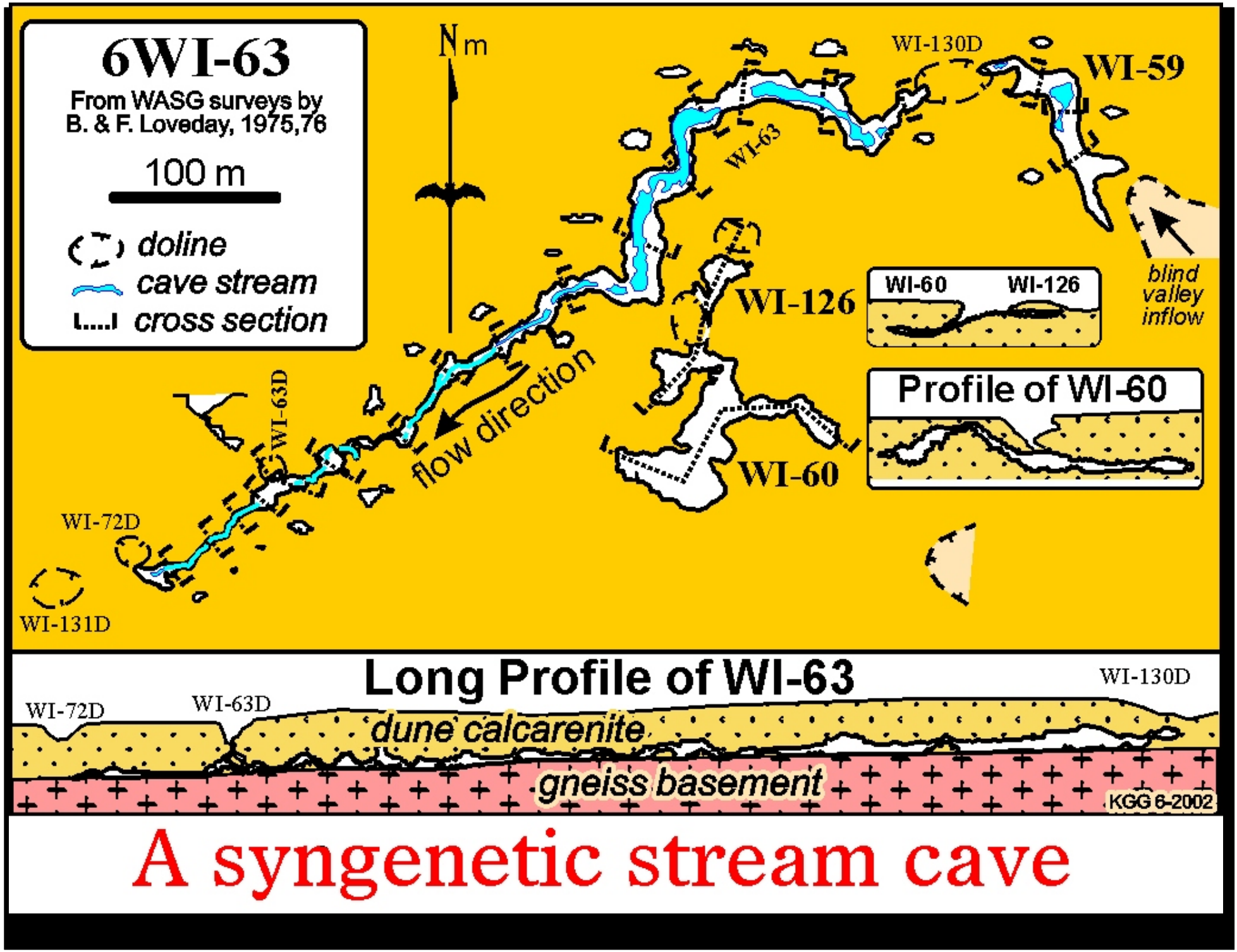
- Horizontal maze cave
- Adjacent to a swamp, at edge of a dune range
- In both beach & dune sand
- Thin roof formed by caprock


0 m 50
Monbulla Cave
Profile
Caprock

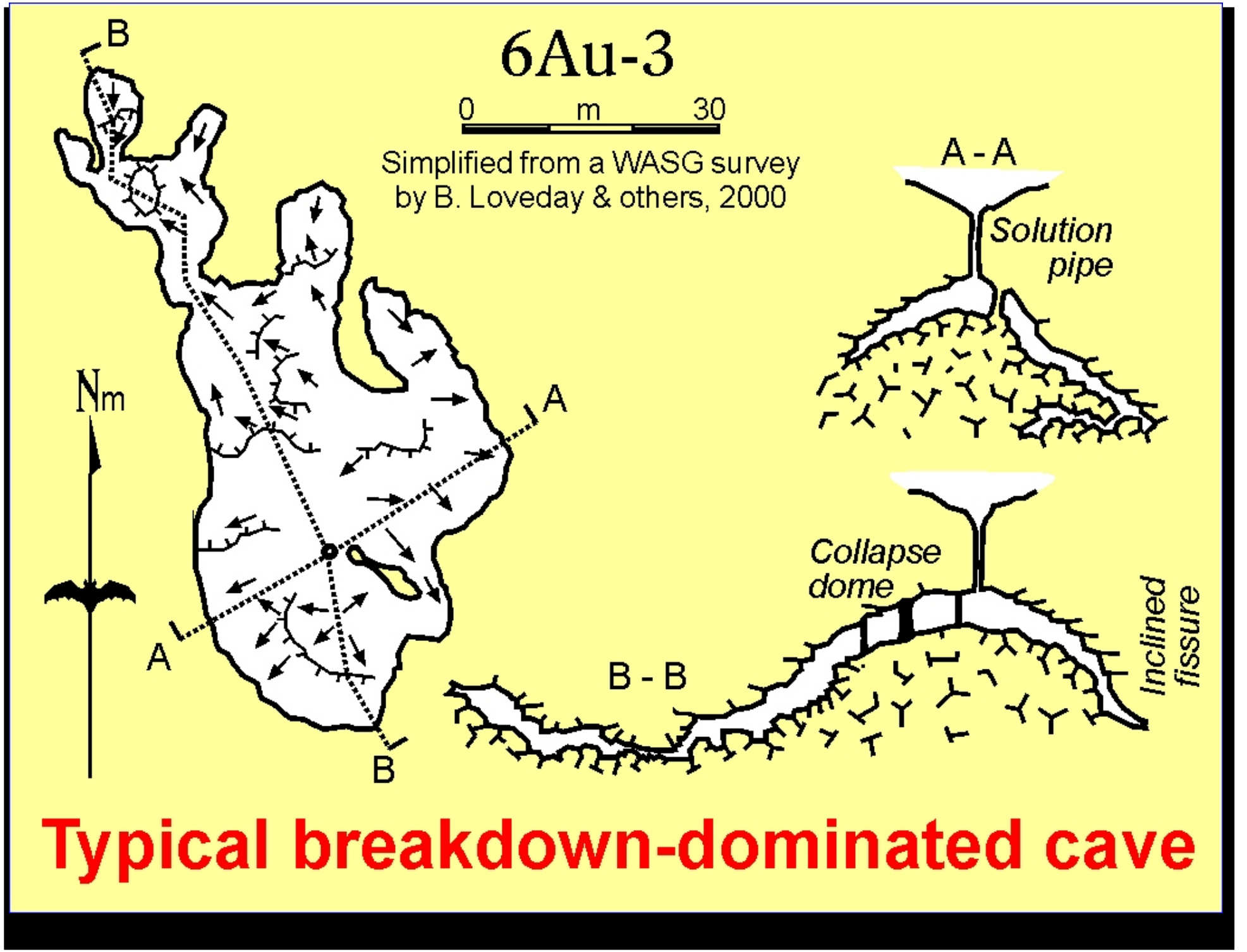
Phreatic spongework

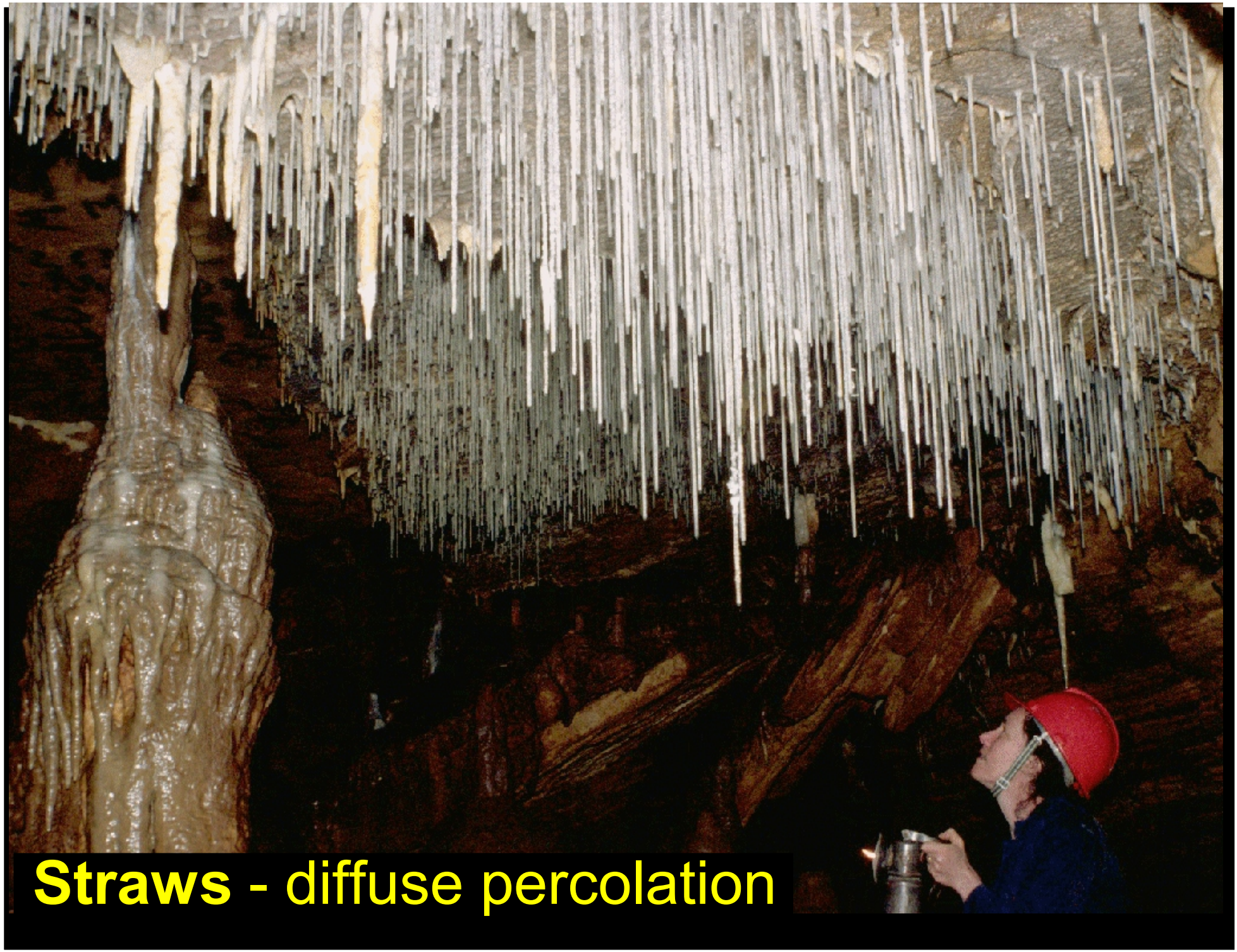
Flat roof, at old groundwater level





A syngenetic stream cave


6Au-3
0 m 30
Simplified from a WASG survey
by B. Loveday & others, 2000
Nm
B
A
A
B
A - A
Solution
pipe
Collapse
dome
B - B
Inclined
fissure
Typical breakdown-dominated cave

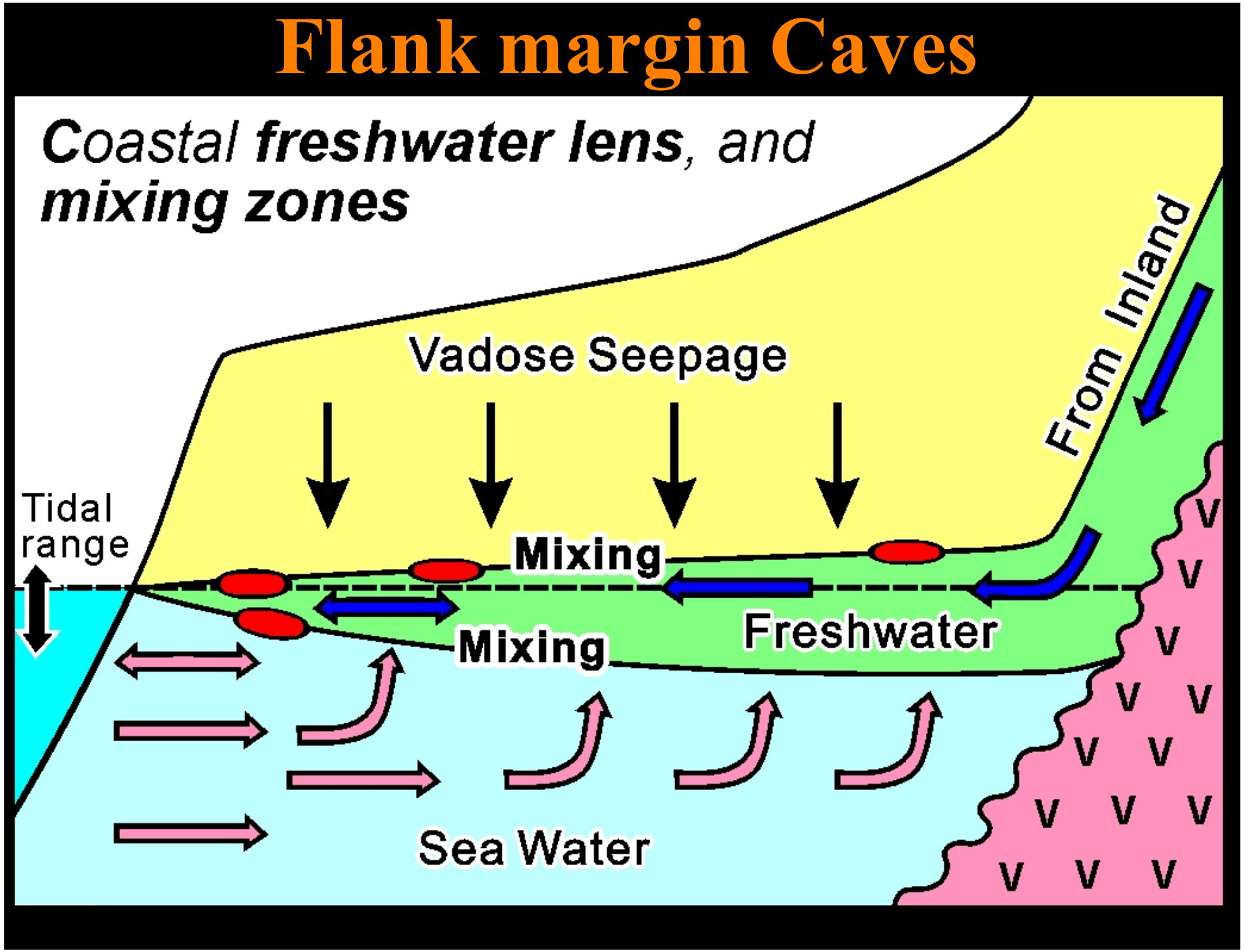

Straws - diffuse percolation

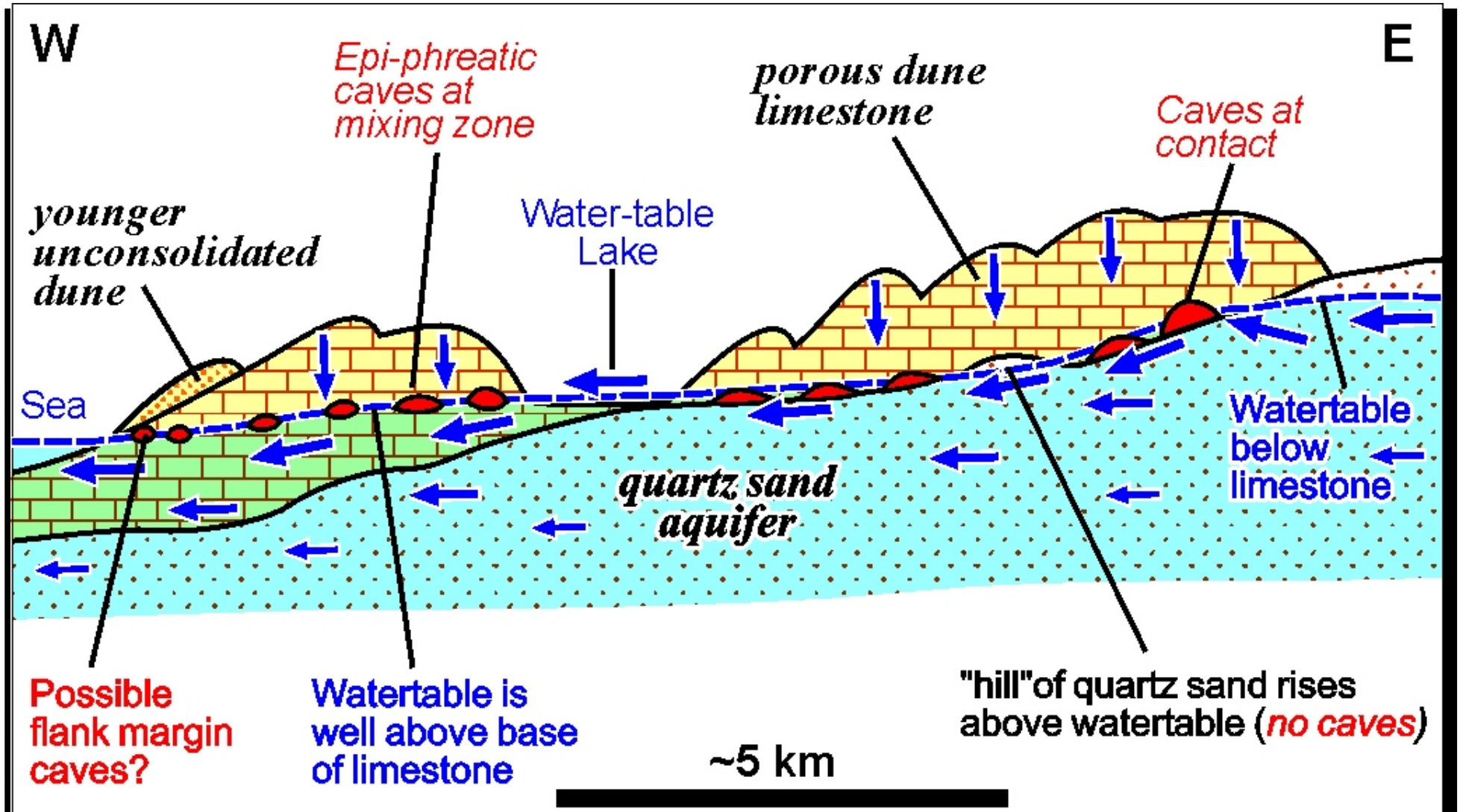
Some special cases...

From various parts of Australia

- Flank margin caves
- Water from below (Yanchep. WA)
- Linear stream caves
- Pinnacles at Nambung (WA)

Flank margin Caves





Hydrology at Yanchep, WA.

porous dune limestone overlies a quartz sand aquifer

Nambung Pinnacles

Focused solution or cementation

?