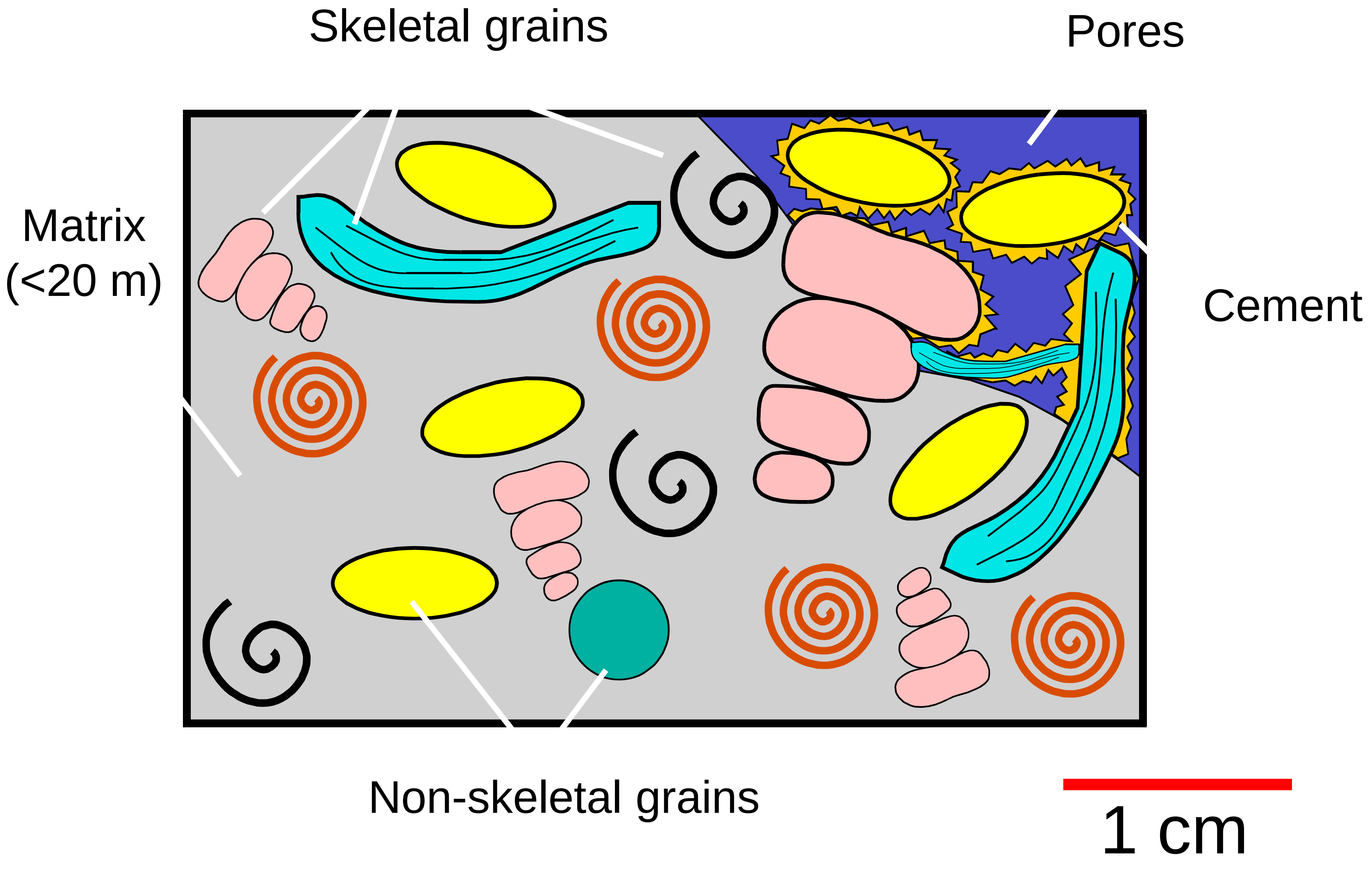
Components of a Carbonate rock



Matrix = Lime Mud

- What is it?
  - silt & clay-sized carbonate sediment (<62 μm)
- Why is it important geologically?
  - constitutes 50% of carbonate strata by volume
- How is it Formed?
  - precipitation from seawater
  - post-mortem decay of calcareous algae
  - Biomechanical breakdown

Modern Shallow Water Depositional Env.

- High porosity (50-80%)
- Aragonite & HMC
- 5-62 μm size, broken shells
- 5-10 μm size, Aragonite needles

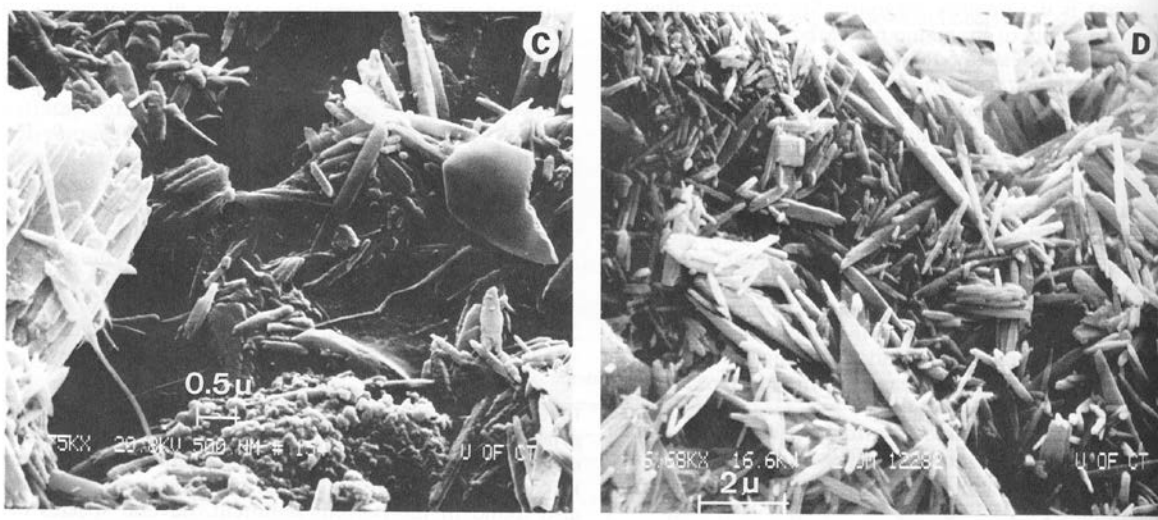
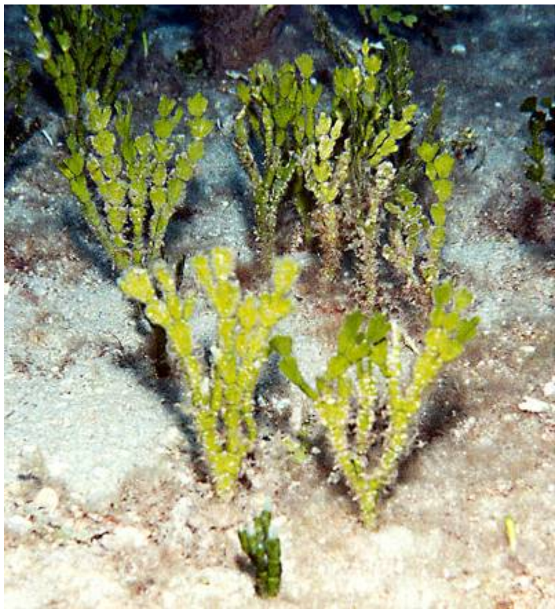
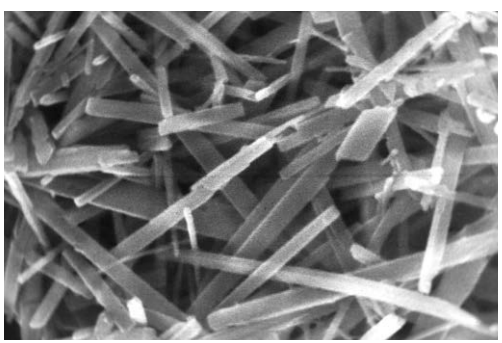


FIG. 9.—SEM photomicrographs of bottom sediments collected at four different locations on the Great Bahama Bank west and northwest of Andros Island. Sediment, composed predominantly of needlelike crystals, is characteristic of the fine-grained sediment of the entire area. Note numerous multicrystalline particles in A, B, C, and D, derived from molluscs and calcified worm tubes, and foraminifera in C. Also note absence of diatoms and other siliceous skeletons.

Origin of Lime Mud: Decay of calcareous Algae

- Modern aragonite muds (< 10 μm) produced by the post-mortem disintegration of calcareous green algae (e.g., Halimeda & Penicillus)

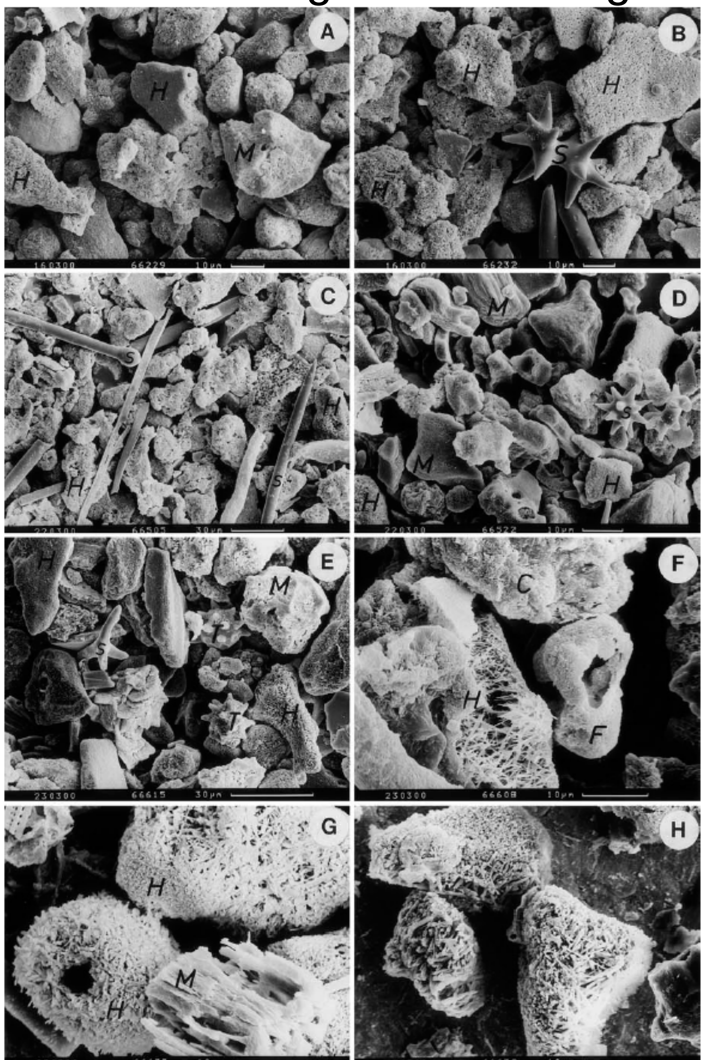


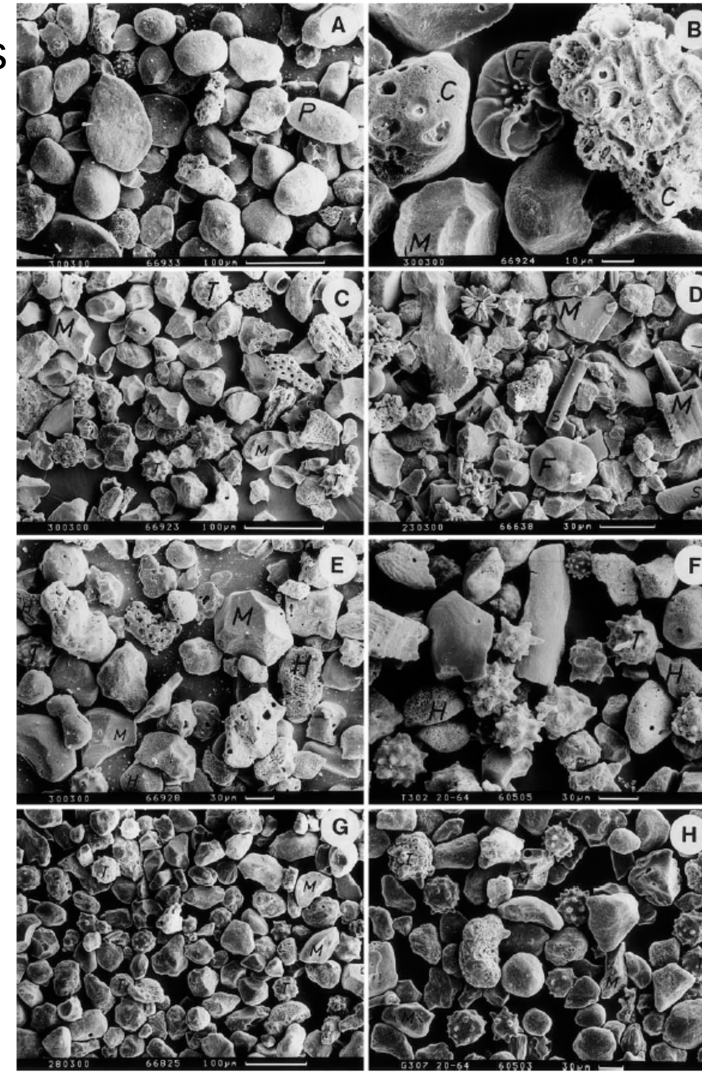


Origin of Lime Mud: Skeletal Breakdown

- Browsers/scrapers eat substrate, make pellets that decay
- Results of boring endolithic organisms

20-4 μm fraction

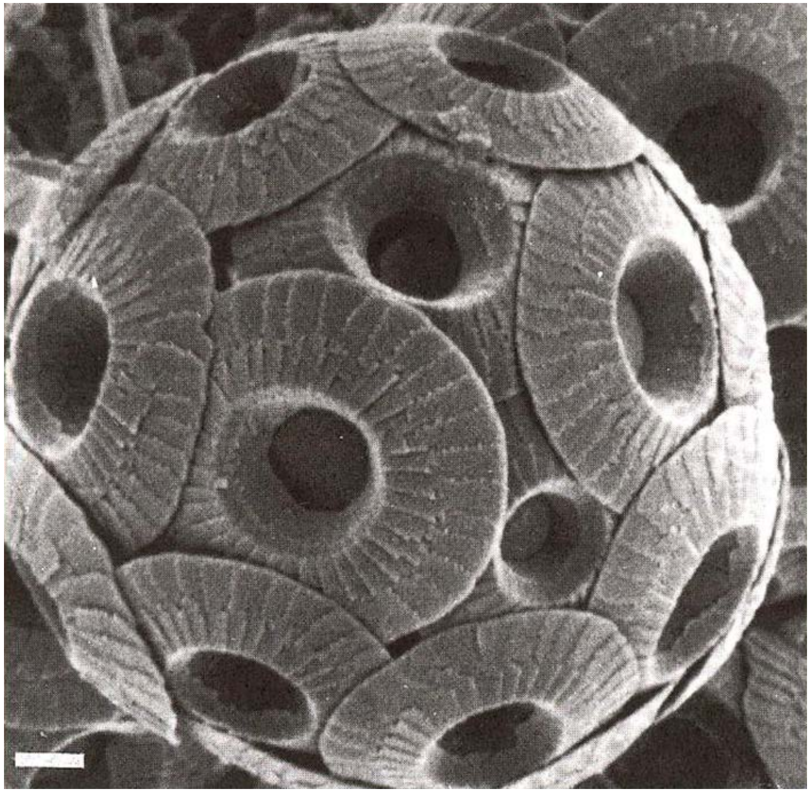




63-20 μm fraction

Ancient Lime mud Deposits: Chalk

- Cretaceous was a time of massive chalk deposition
  - Cliffs of Dover; Austin Chalk
- Chalk mostly comprised of calcareous nannoplankton (coccoliths)



Origin of Lime Mud

- Modern
  - Inorganic precipitate - not likely
  - Skeletal breakdown - big part of the answer
  - Decay of calcareous green algae - big part of the answer
- Fossil Record
  - Phanerozoic - like modern ?
  - Precambrian - Biotically induced ?

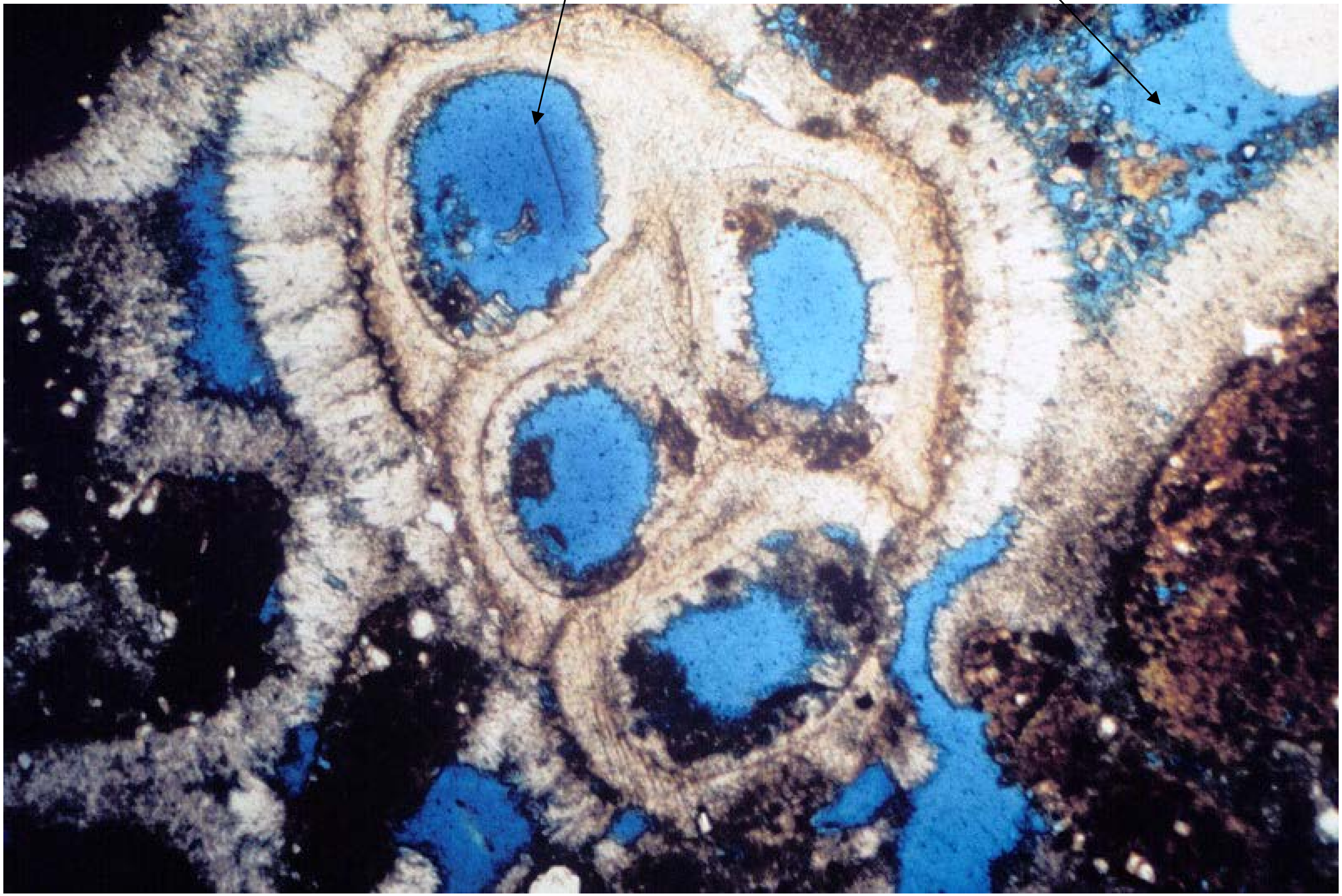
Porosity in Carbonate Rocks

- Primary
  - voids left during original deposition between or within grains
- Secondary
  - voids formed by dissolution after original deposition

Recognizing the difference can inform us about the history of the rock/sediments

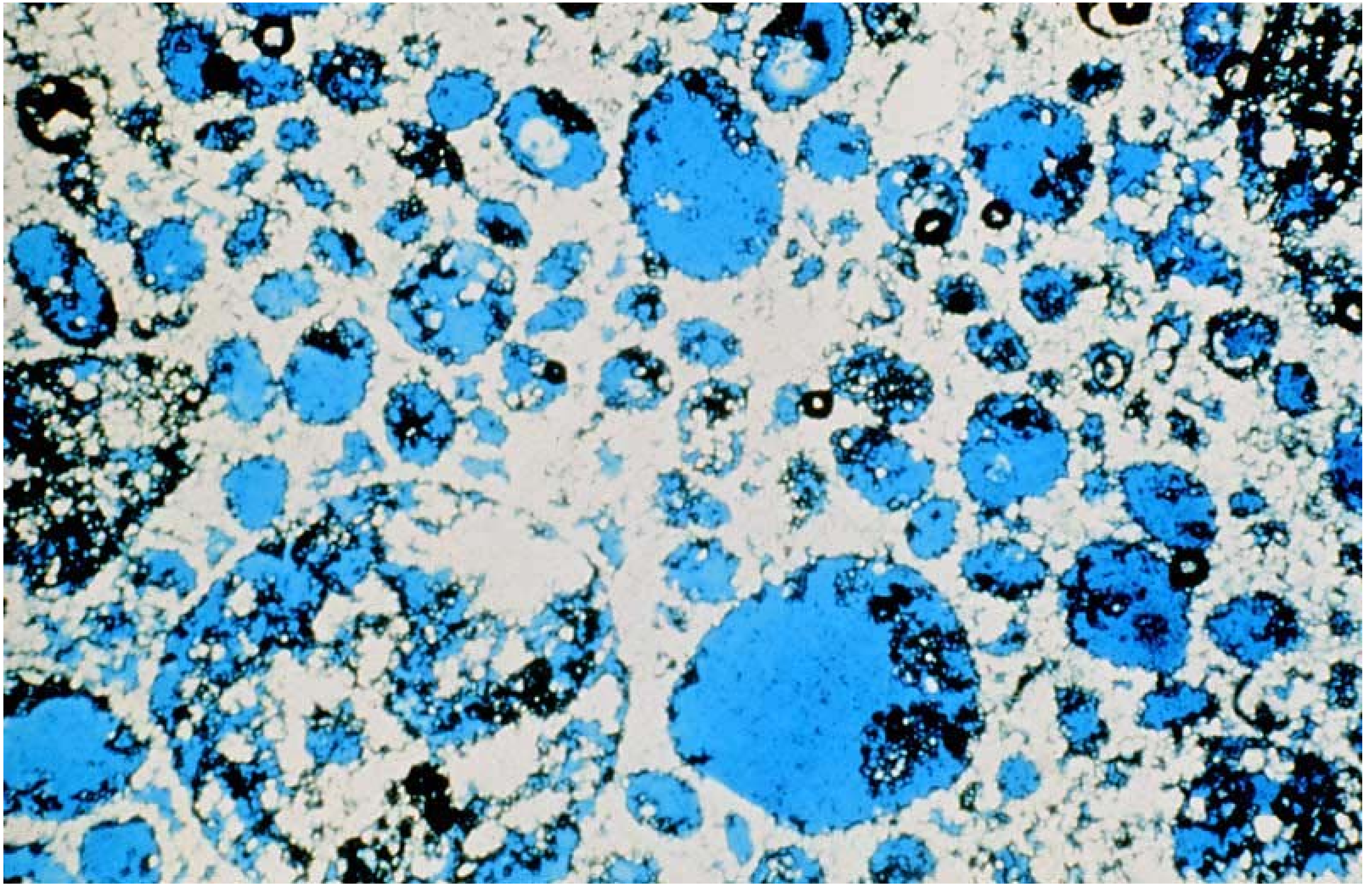
Porosity in Carbonate Rocks

Intraparticle & Interparticle



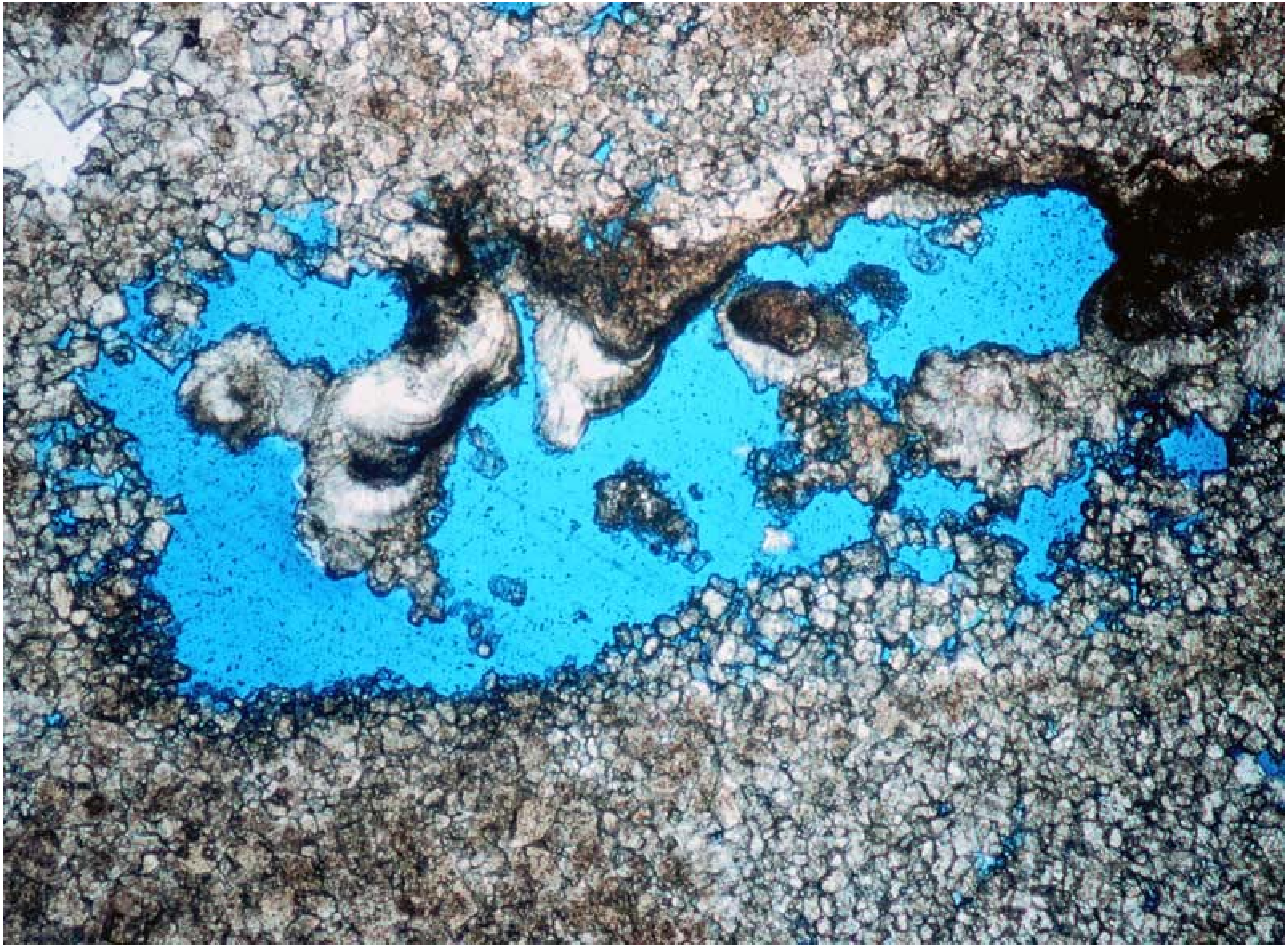
Porosity in Carbonate Rocks

Moldic – voids left by dissolved grains



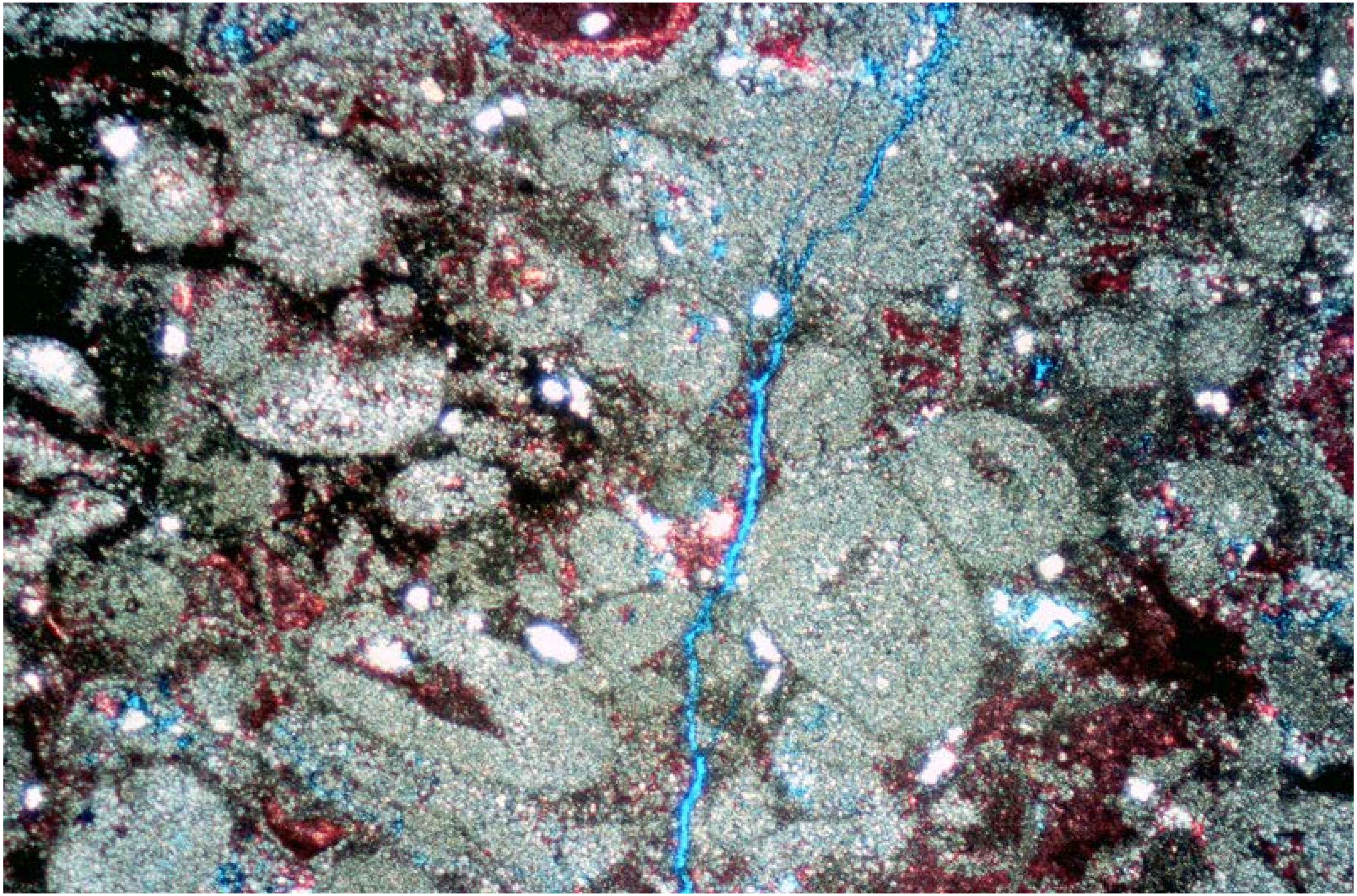
Porosity in Carbonate Rocks

Vugs – voids larger than dominant grain size



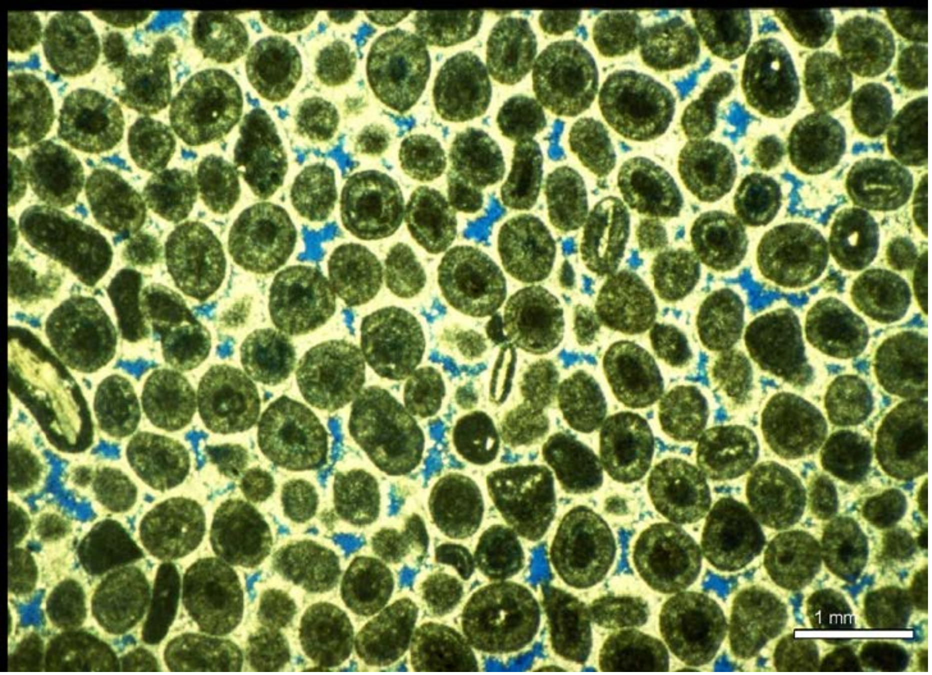
Porosity in Carbonate Rocks

Fractures can create large interconnected voids

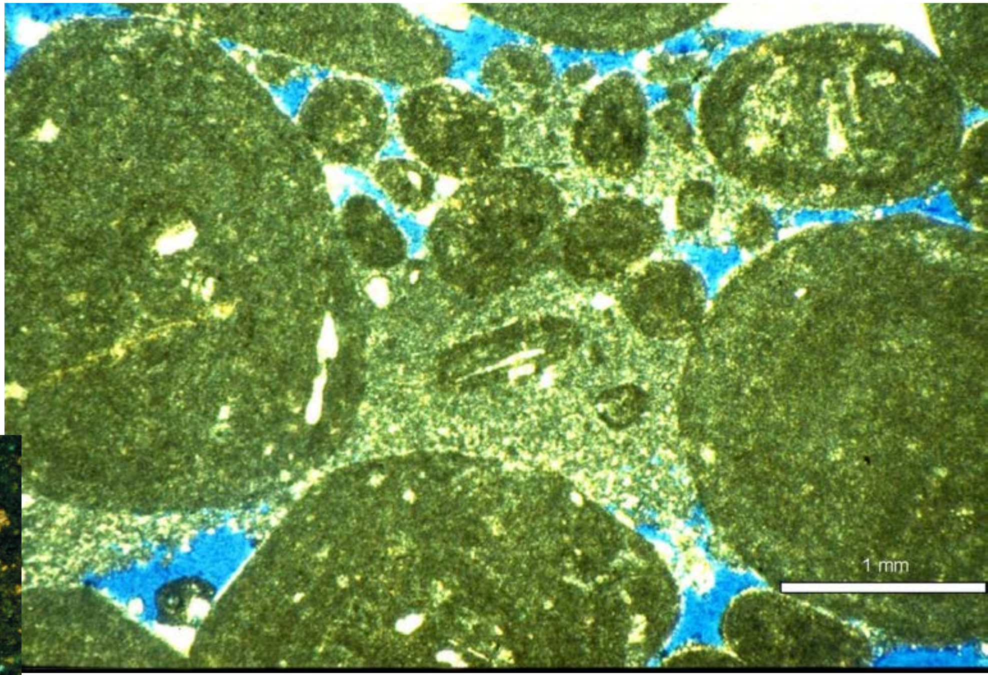


Porosity in Carbonate Rocks: Lucia

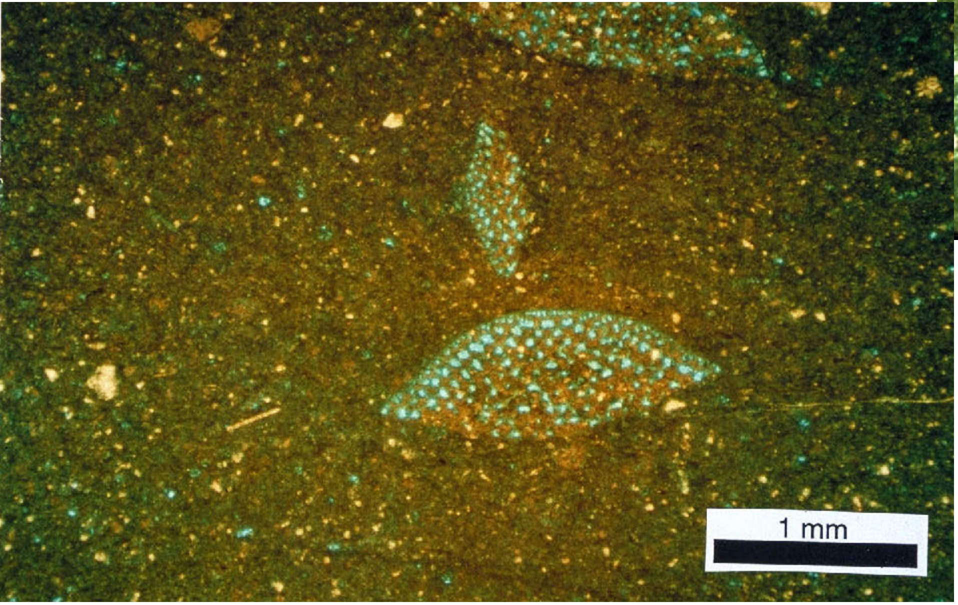
- 2 Types of Porosity
  - Interparticle
    - Intergranular
    - Intercrystalline
  - Vuggy
    - Separate vugs
    - Touching Vugs



Grainstone w/ particle size of 500 microns



Packstone w/ particle size of 500 microns



Mudstone w/ particle size of 5 microns

Carbonate Cements

-Crystalline carbonate that fills voids and/or replaces grains in (carbonate) rocks

-Cements can form early or form late

-Cements can form in 5 different environments

- -Marine Vadose (marine waters - possibly hypersaline)
- -Marine Phreatic (~salty groundwater - below seafloor)
- -Meteoric Vadose (freshwater - above water table)
- -Meteoric Phreatic (freshwater - below water table)
- -Deep Basin (basinal brine)

-The form, mineralogy, spatial arrangement can help distinguish environments of origin

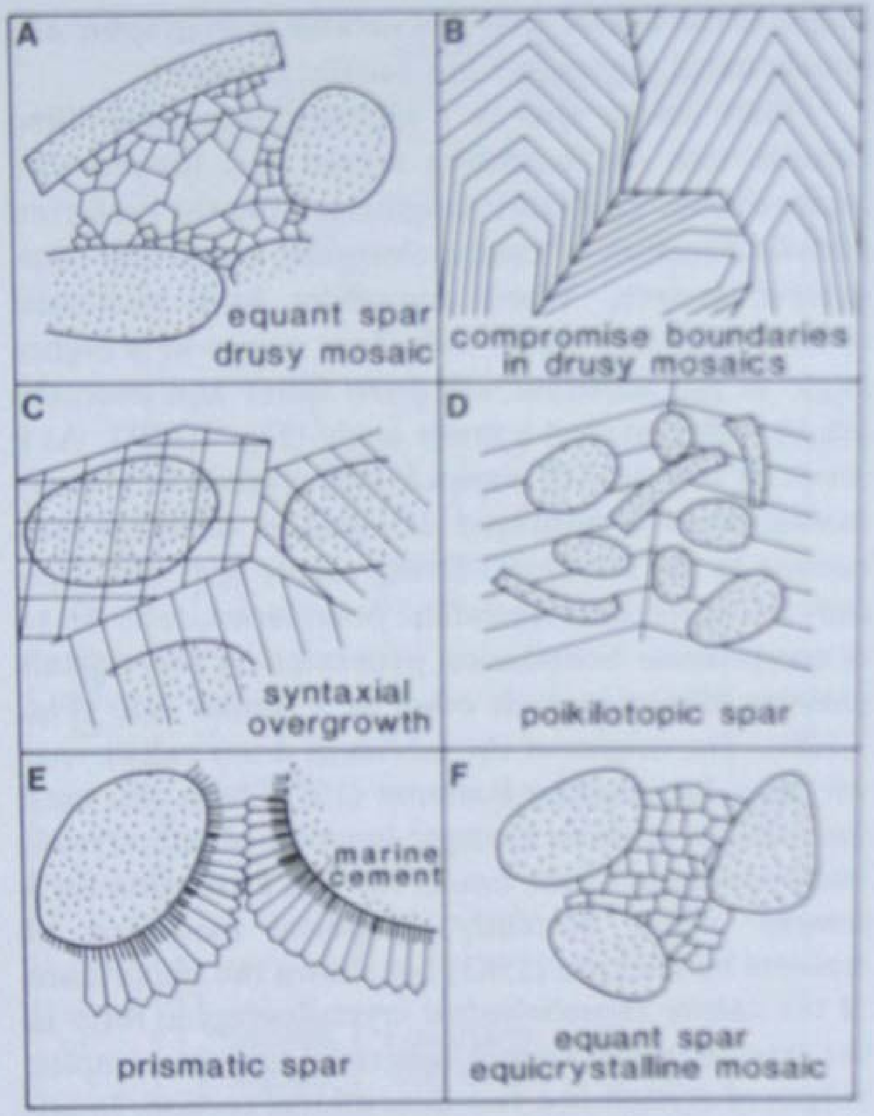


Fig. 7.32 *Calcite spar: sketches illustrating the common types.*

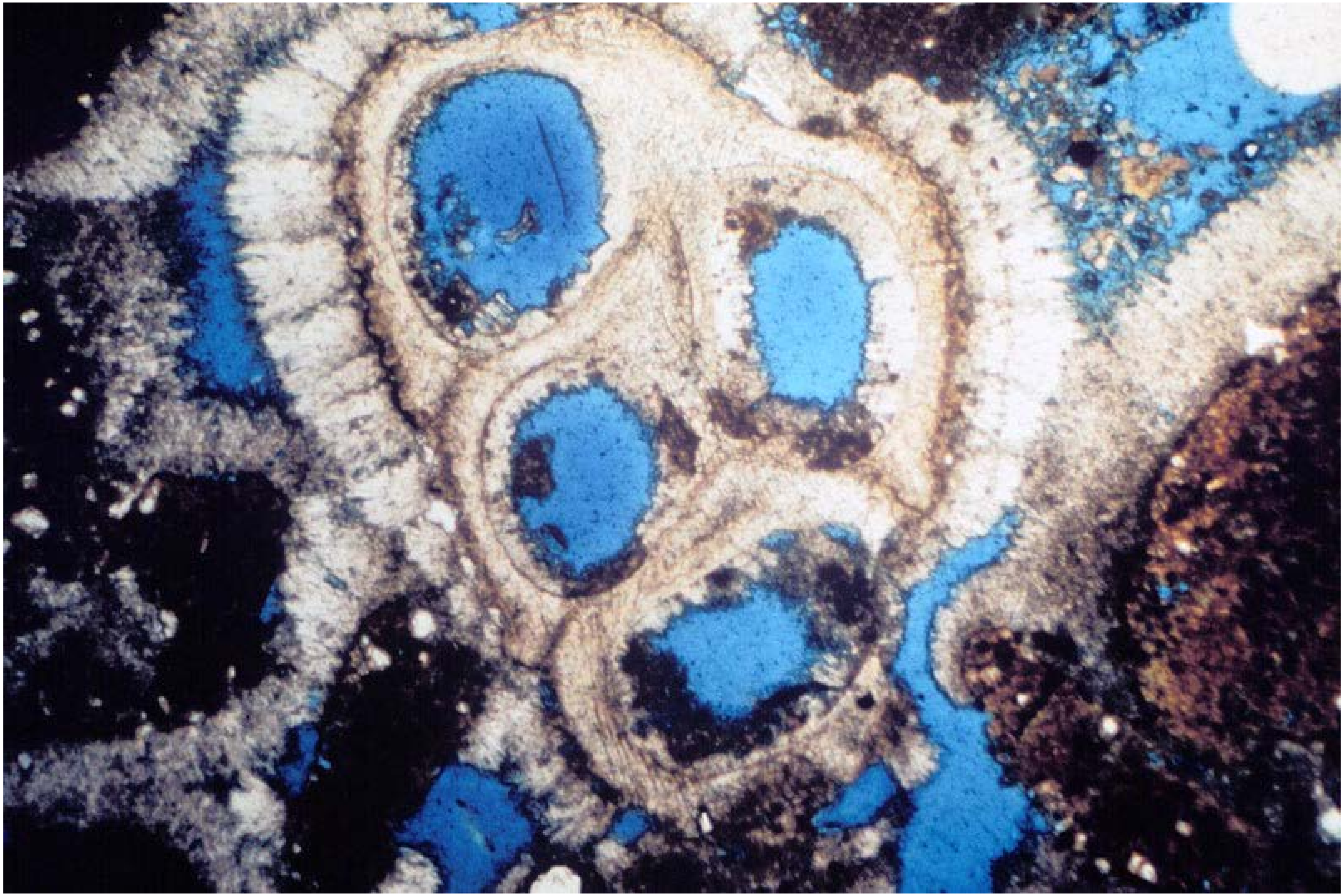
Vadose cements

- **-tend to grow fast- favors**
- **-prismatic = aragonite (fibrous, acicular)**
- **-meniscal & stalactitic**

Phreatic cements

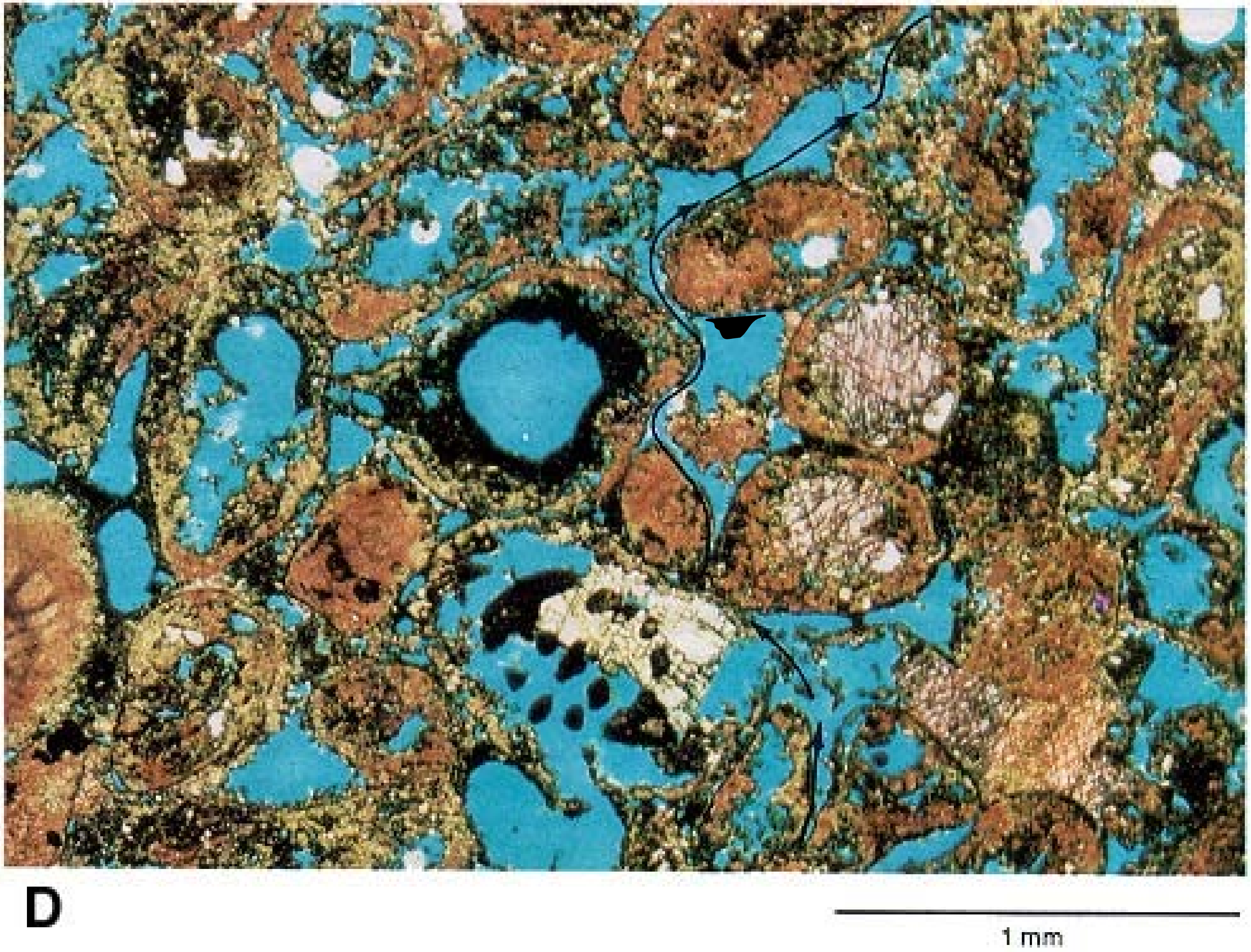
- **-tend to grow slow- favors**
- **-equant (blocky)**
- **-druzy**
- **-syntaxial**
- **-poikilotopic**

Fibrous or Acicular – needles of cement that grow radially outward from the grain into the pore

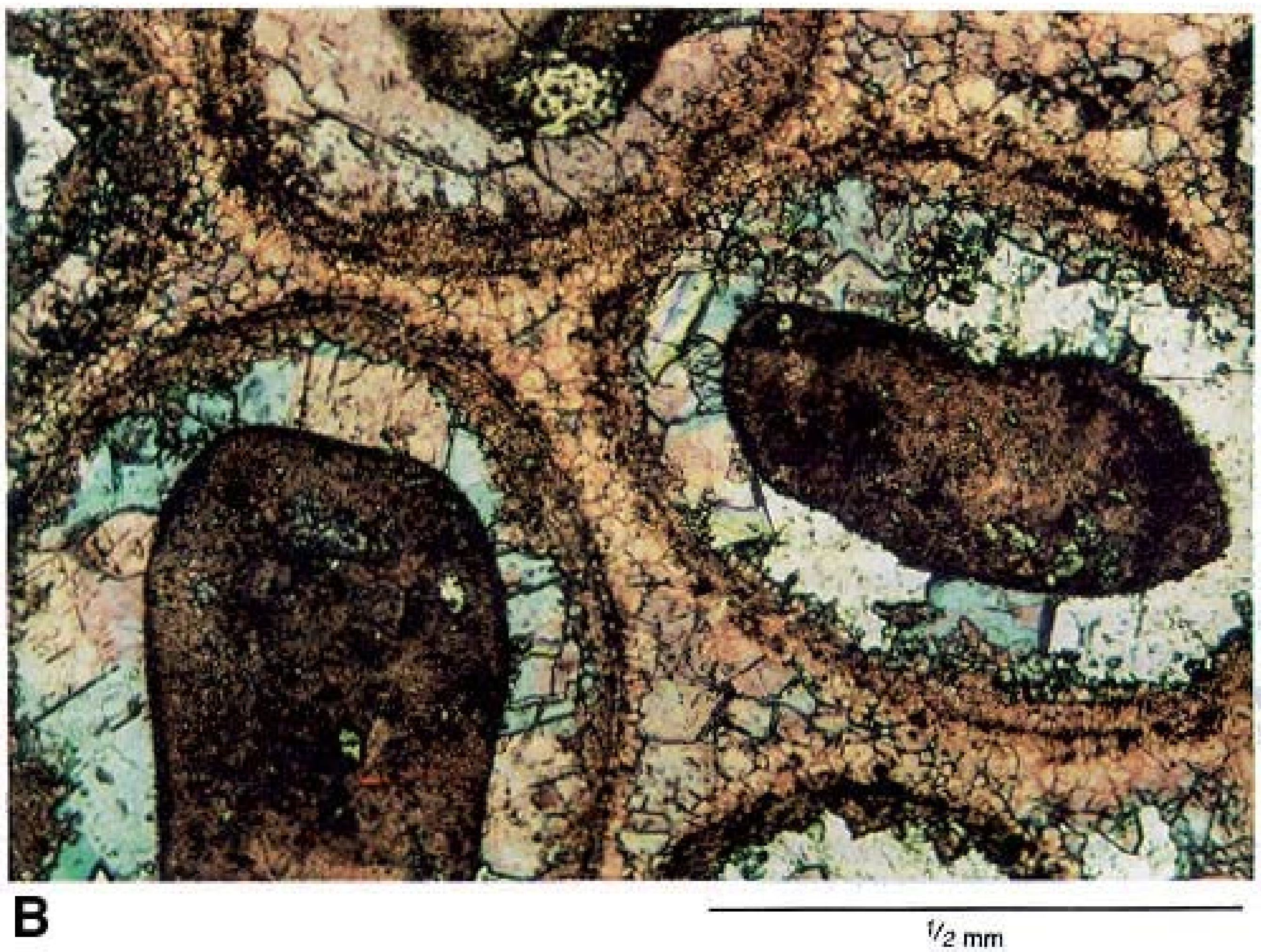


Meniscal - like meniscus - bridge of cement through pore that connects two grains

Stalactitic - like stalagtite, a hanger-on



Equant or Blocky - shape of cement grain
Druzy - pattern of pore filling cement that is largest in center of pore



Syntaxial – optic axis of cement is aligned with grain over which it grew