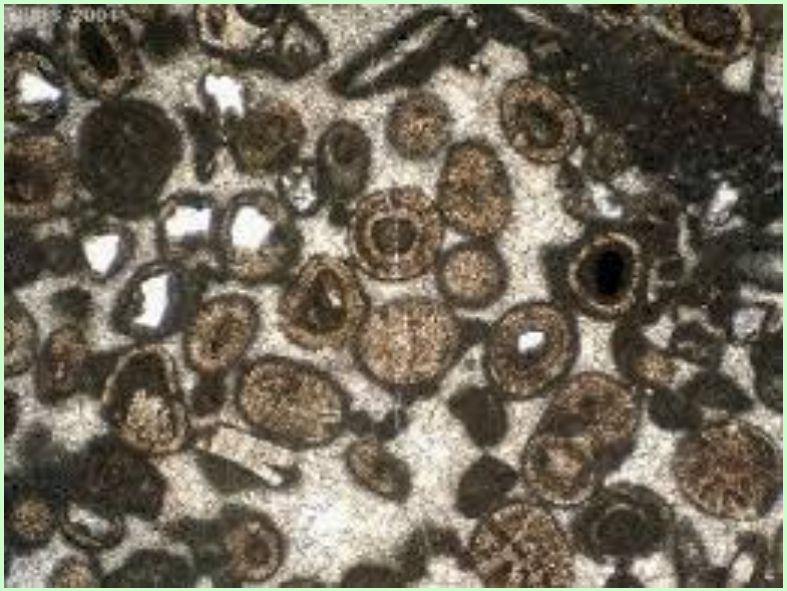
# Calizas y Dolomías



**Importancia de las rocas carbonáticas:**

1) Abundancia entre 20 y 25% del total de las rocas sedimentarias

2) Contienen una gran parte de los fósiles del registro geológico

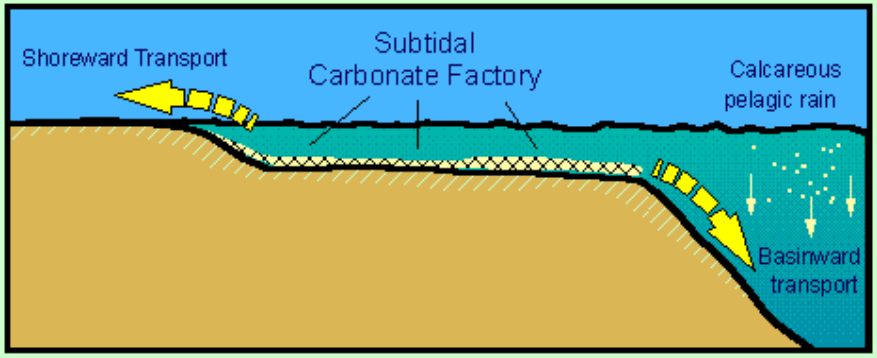
3) Abundantes texturas y estructuras para estudiar el pasado geológico (depositacional y diagenético)

4) Rocas reservorio

5) Rocas de construcción (cal) y aplicación

# Características de las rocas sedimentarias químicas

Los carbonatos y evaporitas ¨nacen¨ como precipitados o concentraciones esqueletales dentro del mismo ambiente depositacional.



Not to scale. Modified from James (1984)

Para los carbonatos:

1) La composición del sedimento es primordial para caracterizar el ambiente depositacional

2) Los cambios granulométricos no necesariamente implican cambios en el régimen hidráulico

3) Grandes estructuras, como los arrecifes, son producidos eneteramente por sedimentos formados in situ

4) El arreglo espacial y temporal de las acumulaciones de sedimentos dependen de la naturaleza de los mismos sedimentos.

# ROCAS CARBONÁTICAS

Principales tipos litológicos: calizas (dominantemente Paleozoico-reciente) y dolomías (mayormente precámbricas y paleozoicas)

Principales carbonatos en calizas y dolomías: Calcita, Aragonita y Dolomita

Otros minerales comunes durante la diagénesis: ankerita, siderita

Tipos de calcita: magnesiana (>4 mol %) y calcita (<4 mol %). También calcita ferrosa.

# Calcita vs Aragonita

| Era | Period | Dominate Carbonate Mineral |
|---|---|---|
| Ceno-zoic | Neogene-Quaternary | A + HMC (Aragonite Sea) |
| | Paleogene | Low-magnesian Calcite (LMC) (Calcite Sea) |
| Mesozoic | Cretaceous | |
| | Jurassic | Aragonite (A) + High-magnesian Calcite (HMC) (Aragonite Sea) |
| | Triassic | |
| Paleozoic | Permian | |
| | Pennsylvanian | |
| | Mississippian | Low-magnesian Calcite (LMC) (Calcite Sea) |
| | Devonian | |
| | Silurian | |
| | Ordovician | |
| | Cambrian | |

# COMPONENTES PRINCIPALES DE LAS ROCAS CARBONÁTICAS

1) Partículas carbonáticas (aloquímicos de Folk, 1959)

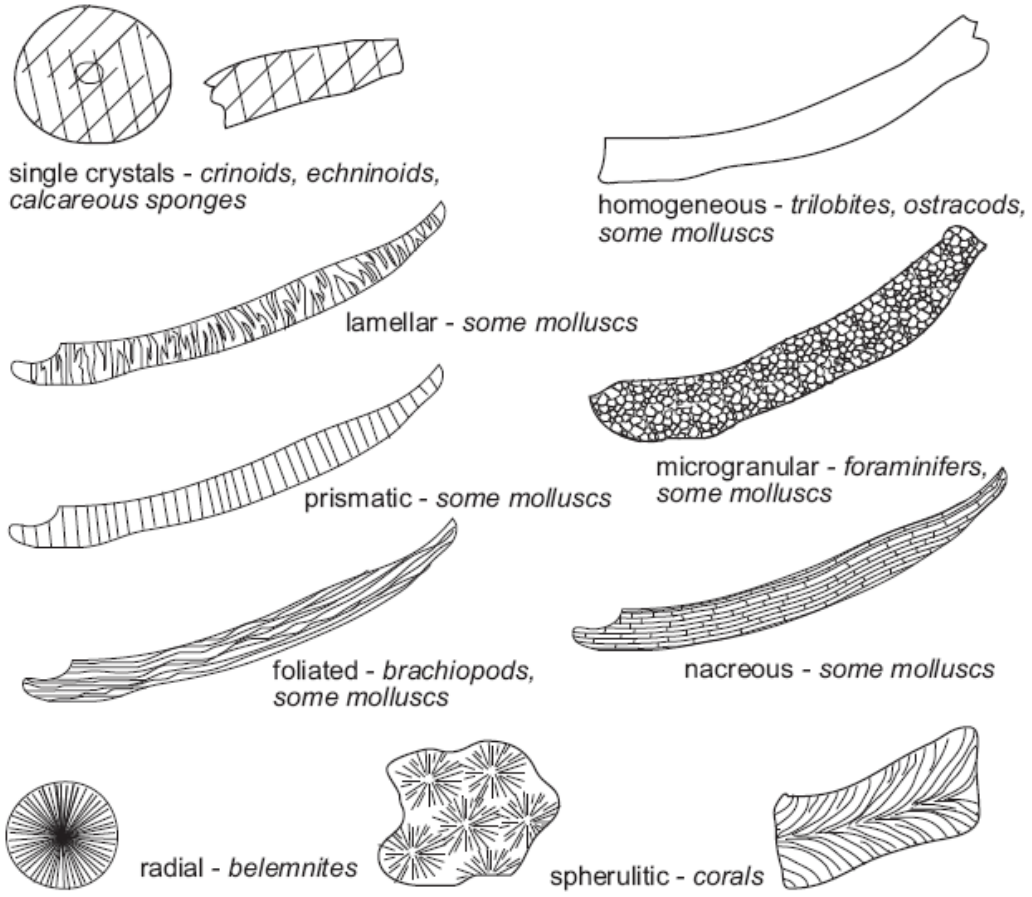
-Litoclastos (Intra y Extra clastos)
-Granos recubiertos (ooides, oncoides y cortoides)
-Peloides
-Agregados o lumps
-Granos eskeletales

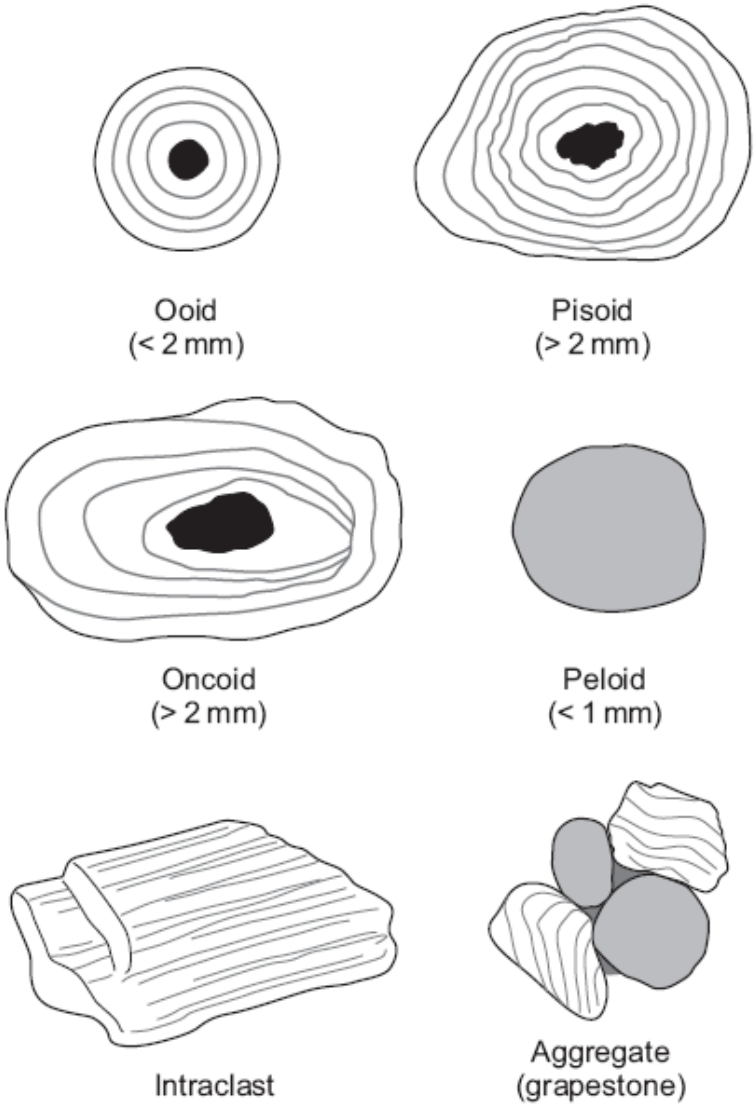
2) Terrígenos (no carbonáticos)

3) Fango carbonático (micrita de Folk, 1959) entre 1 y 5 micrones

4) Esparita (sólo cemento!) mayor a 20 micrones

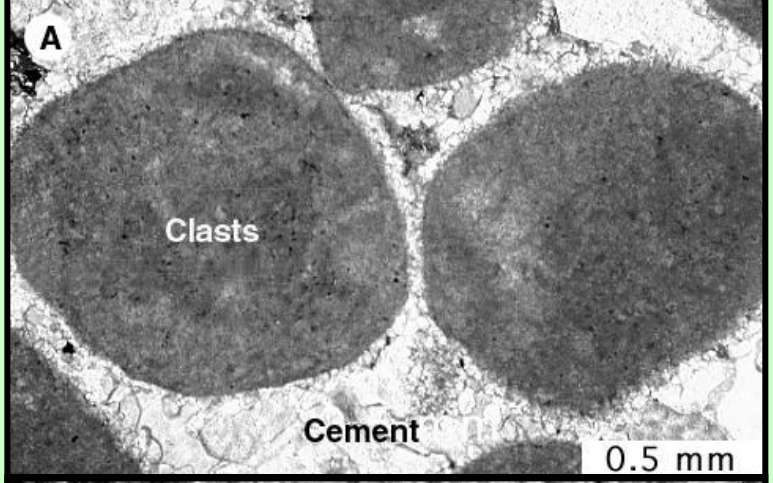
# Partículas carbonáticas

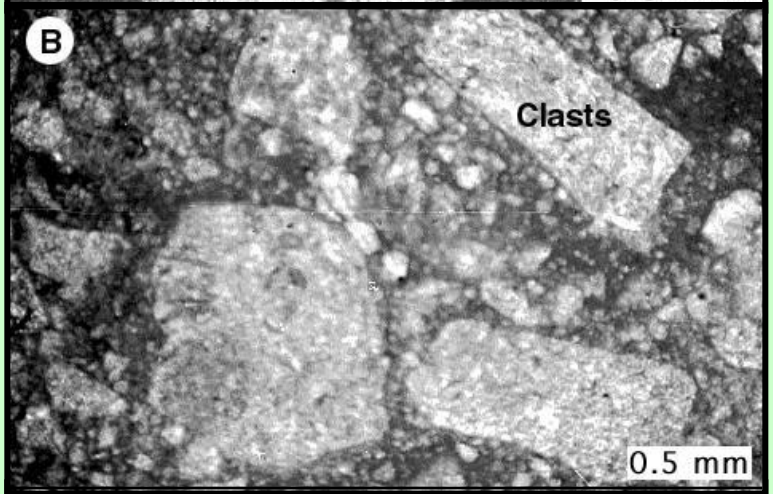


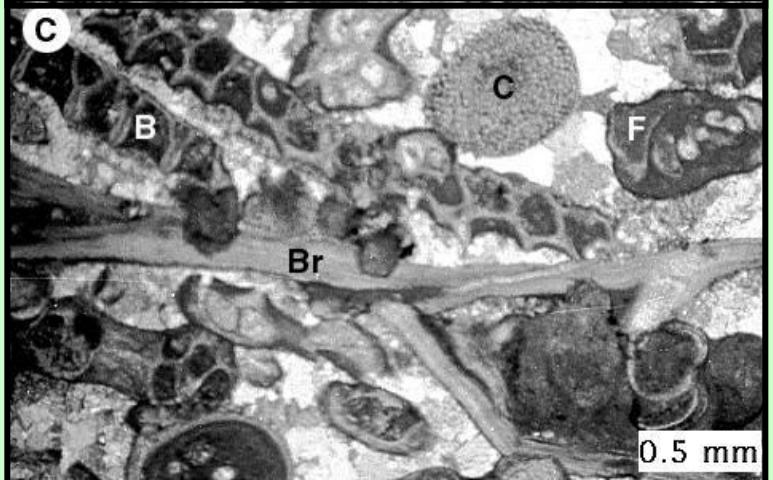



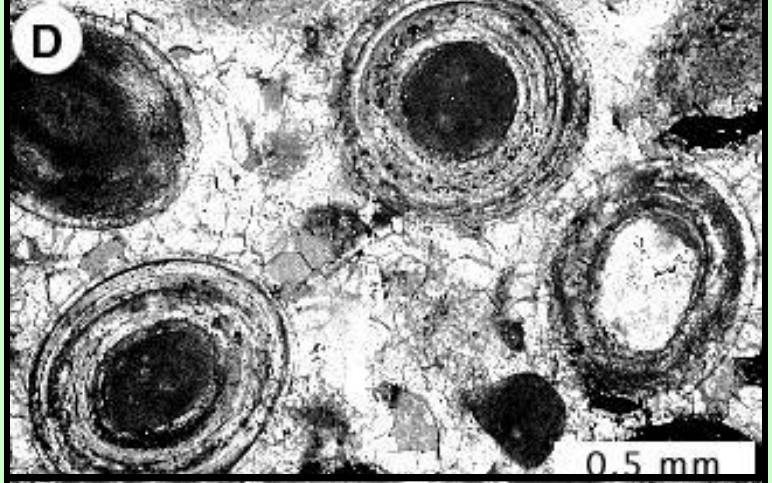

Esqueletales

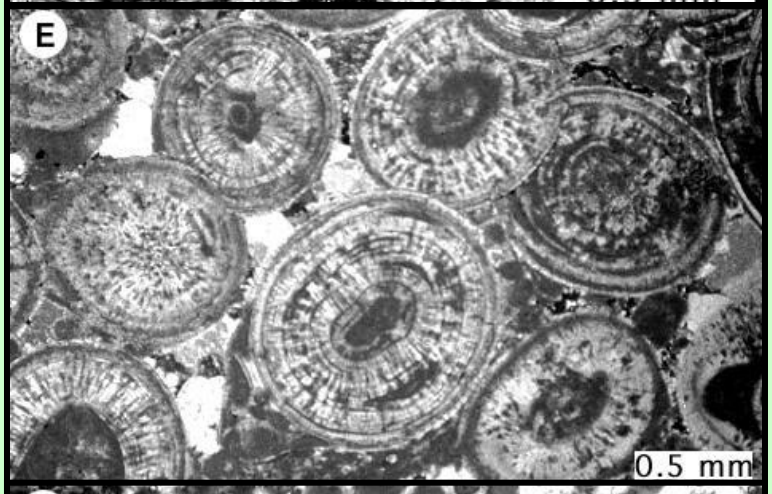
No esqueletales

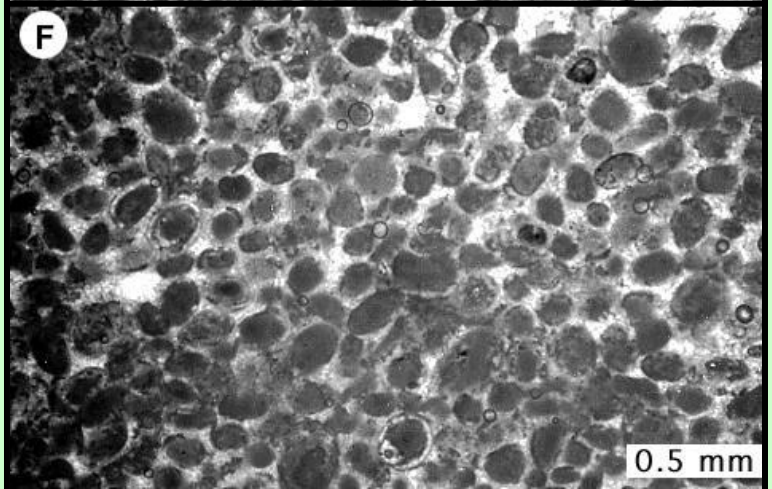

A
Clasts
Cement
0.5 mm


B
Clasts
0.5 mm


C
C
B
F
Br
0.5 mm

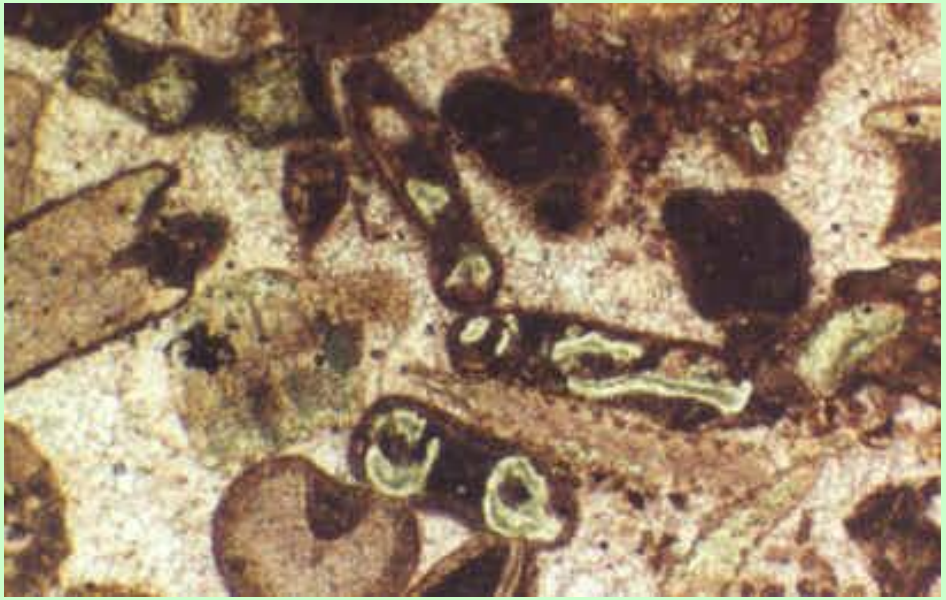

D
0.5 mm

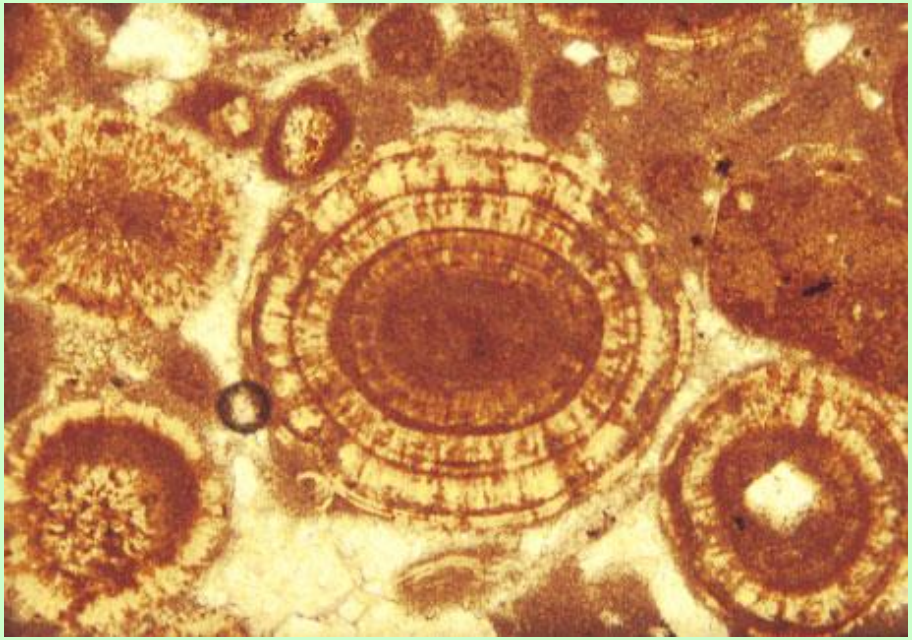

E
0.5 mm


F
0.5 mm

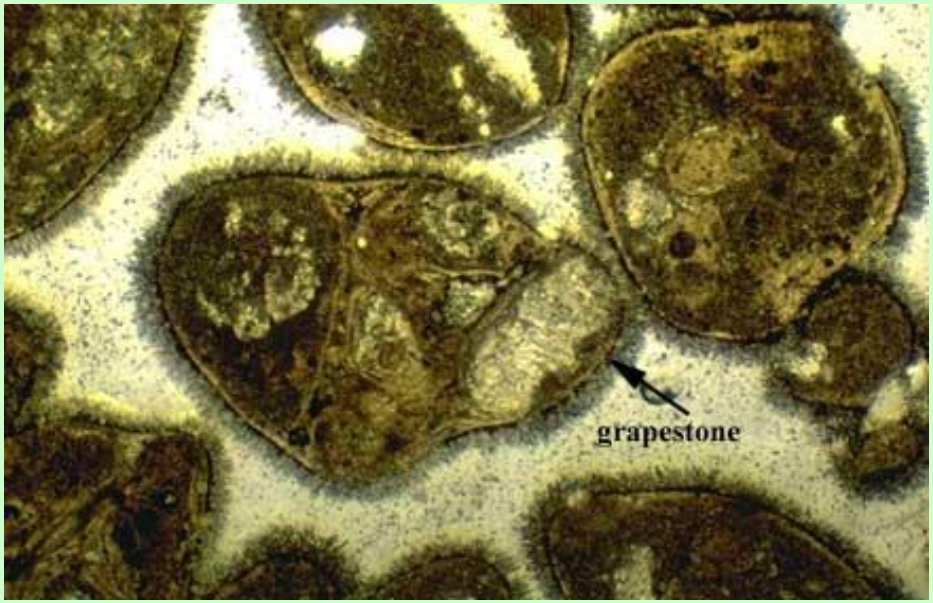
Fango carbonático (micrita)

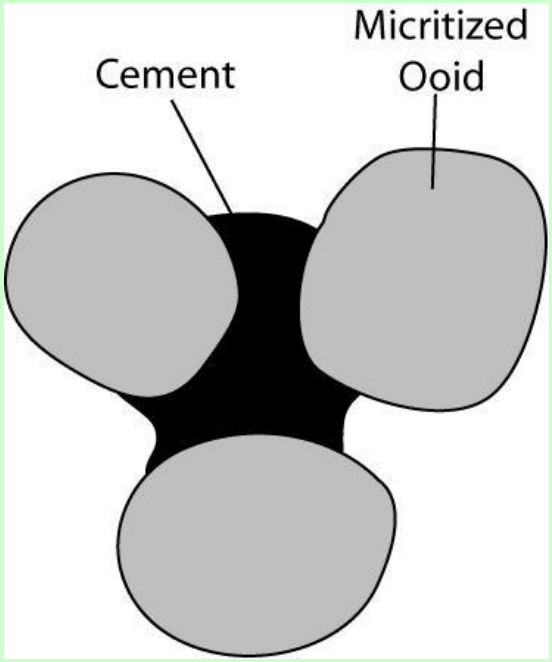
Cemento (esparita)



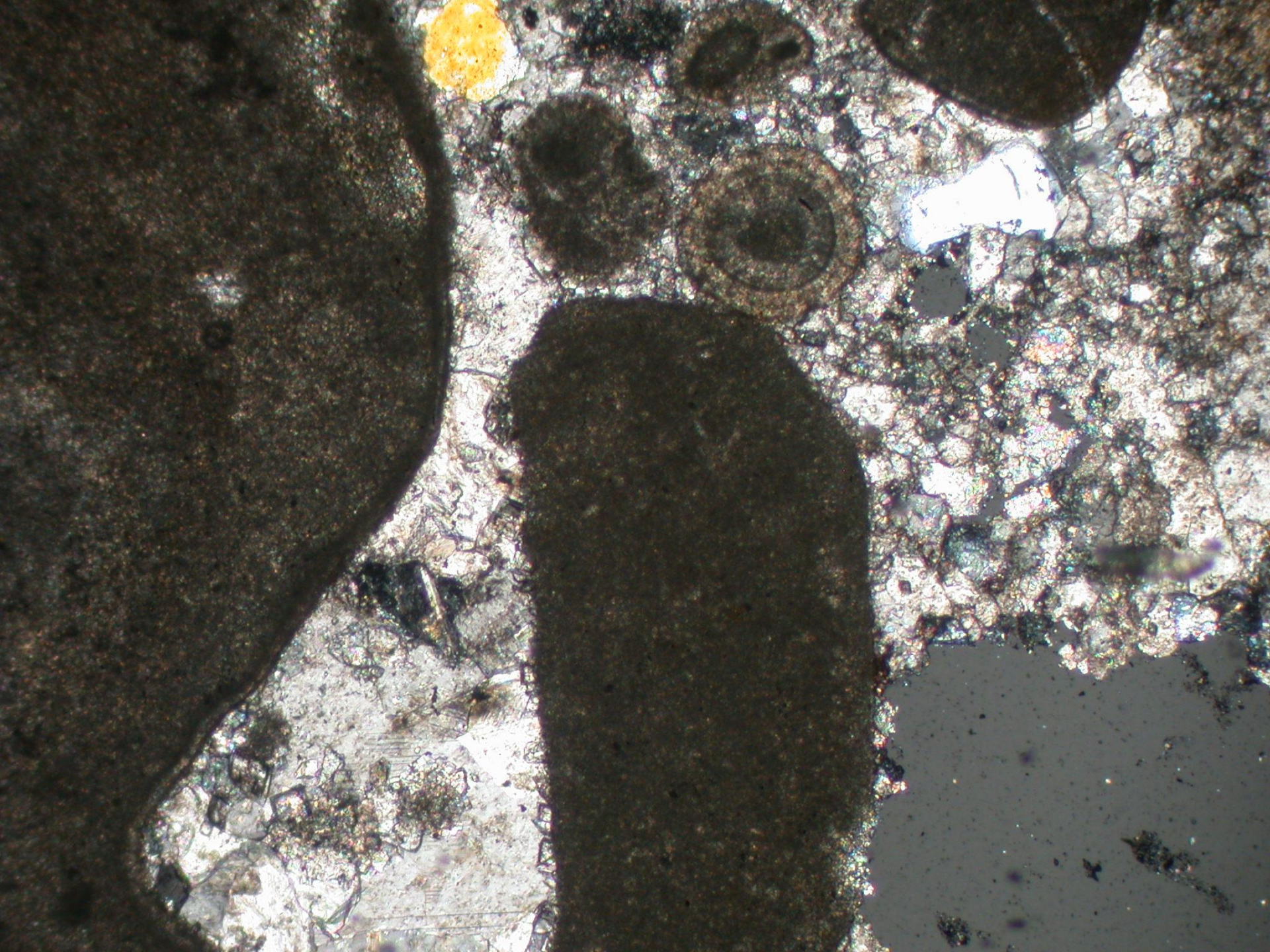


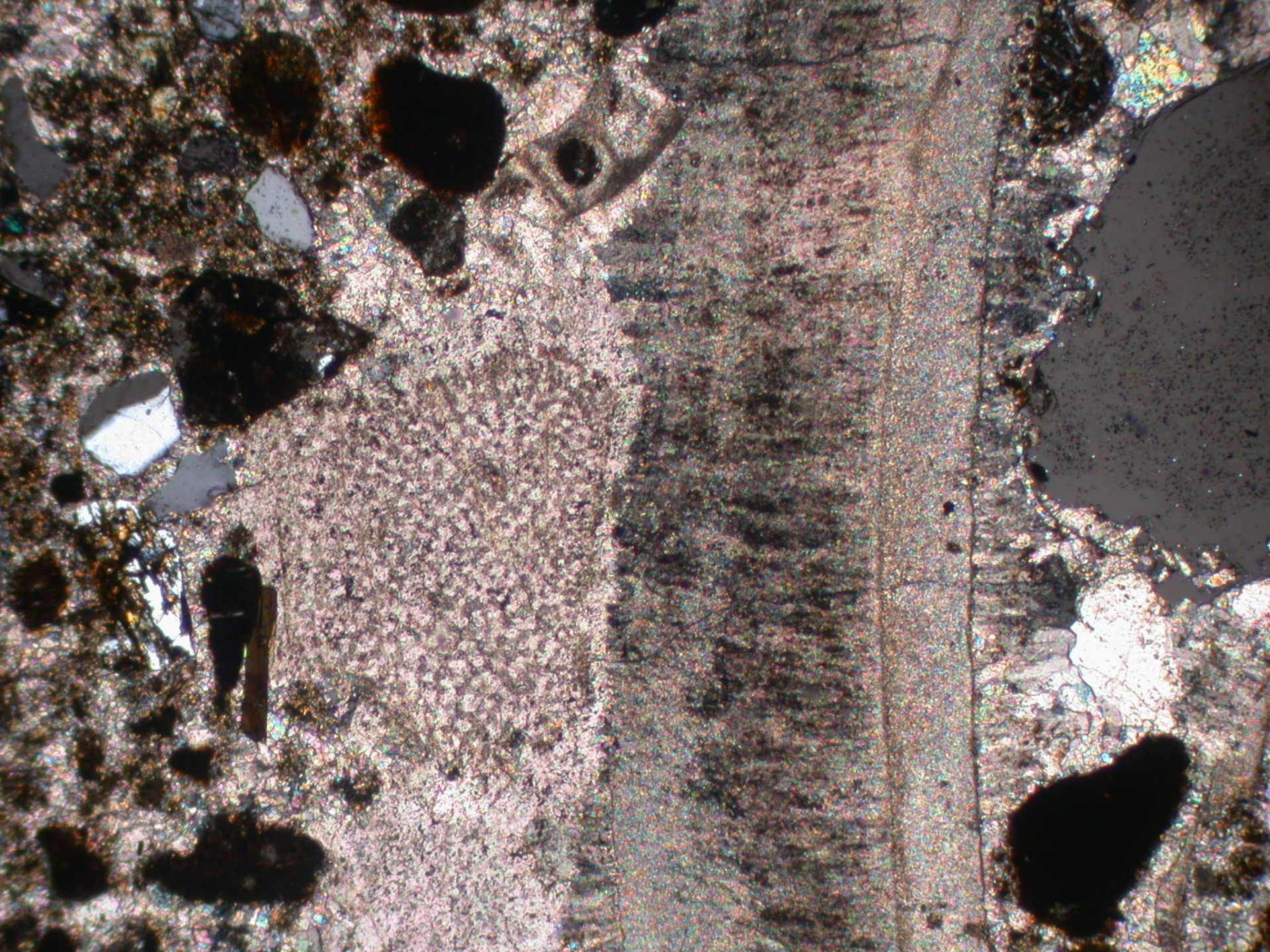
**Ooides (oolitas y pisolitas)**

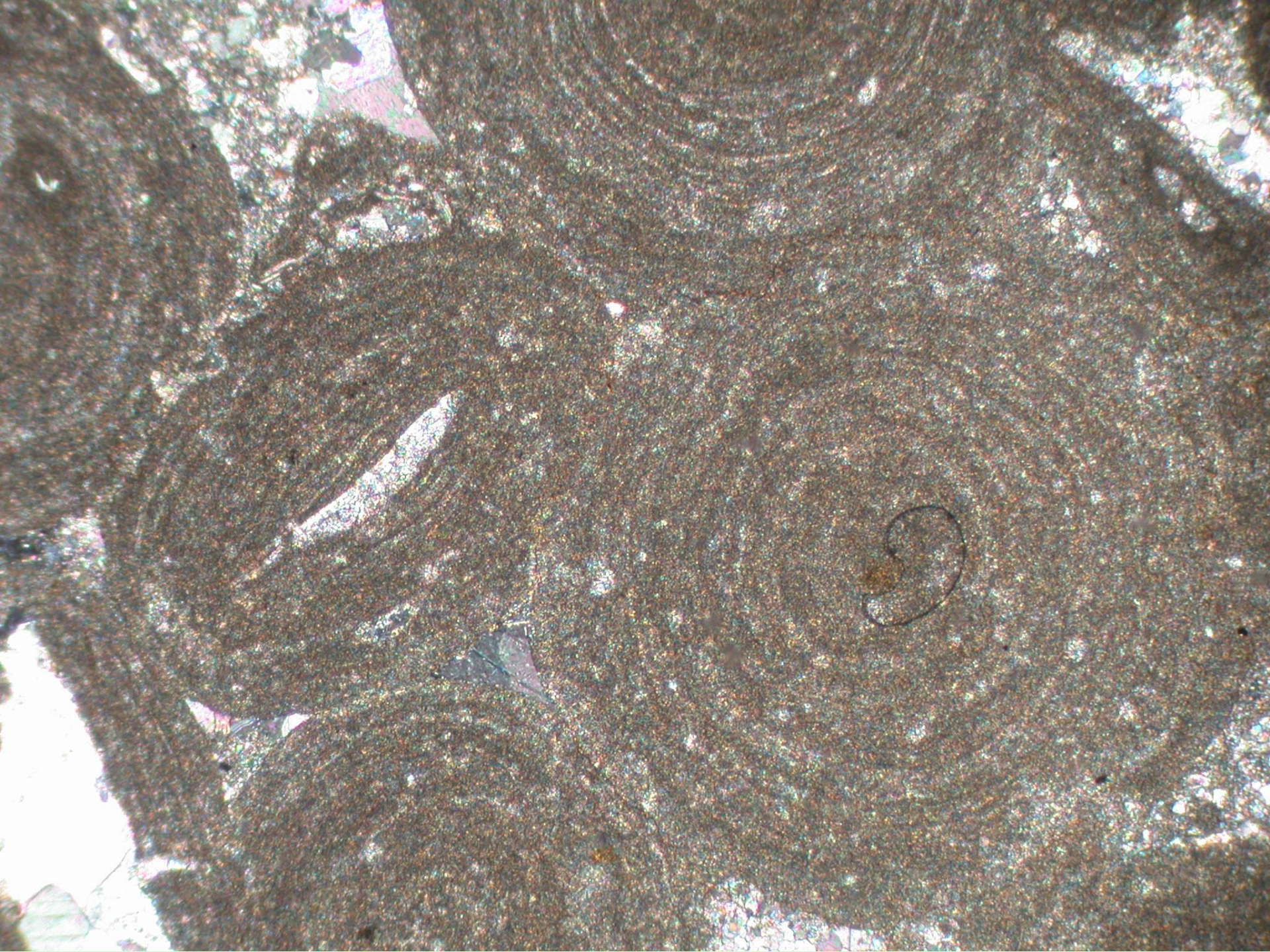


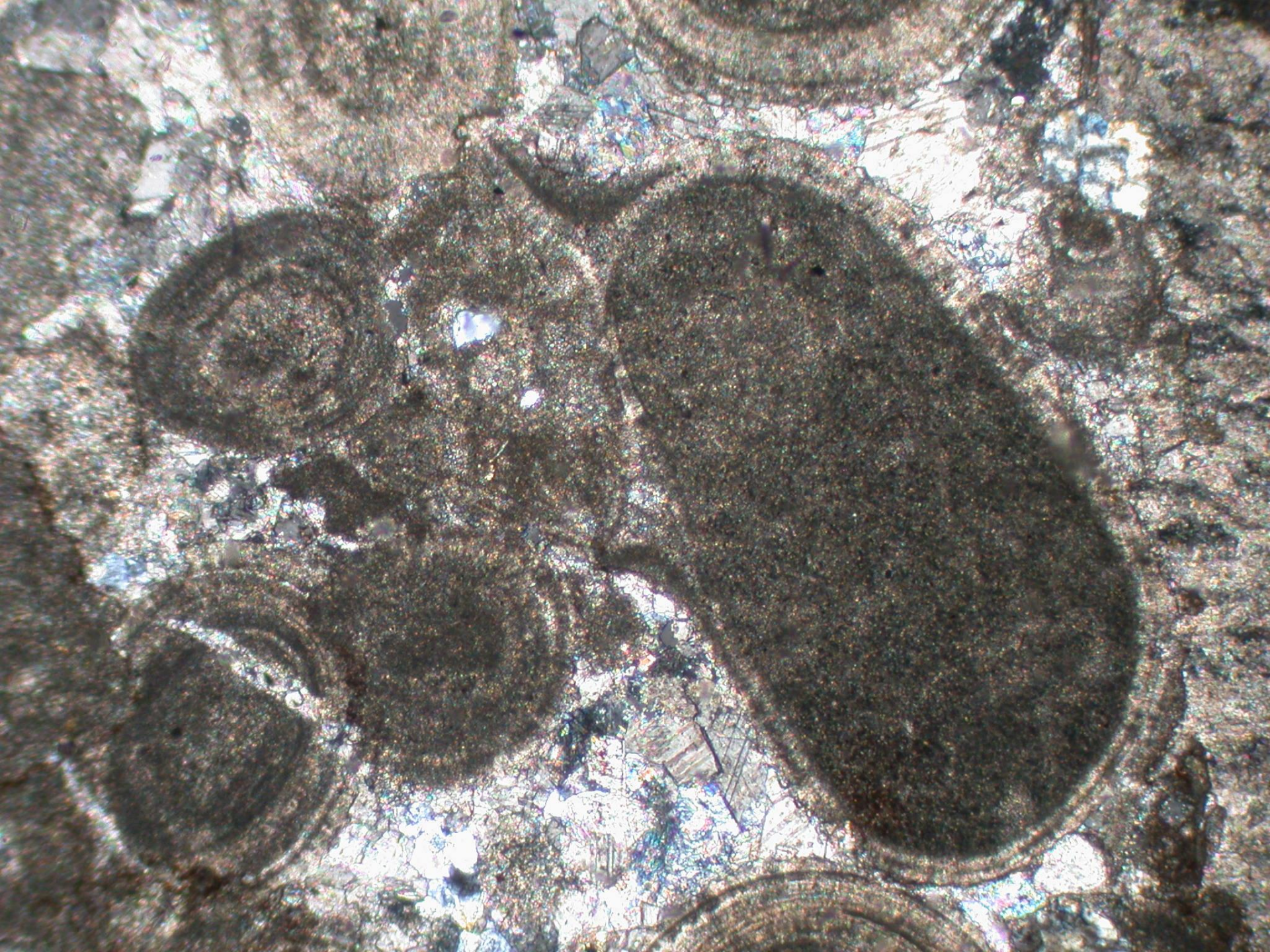



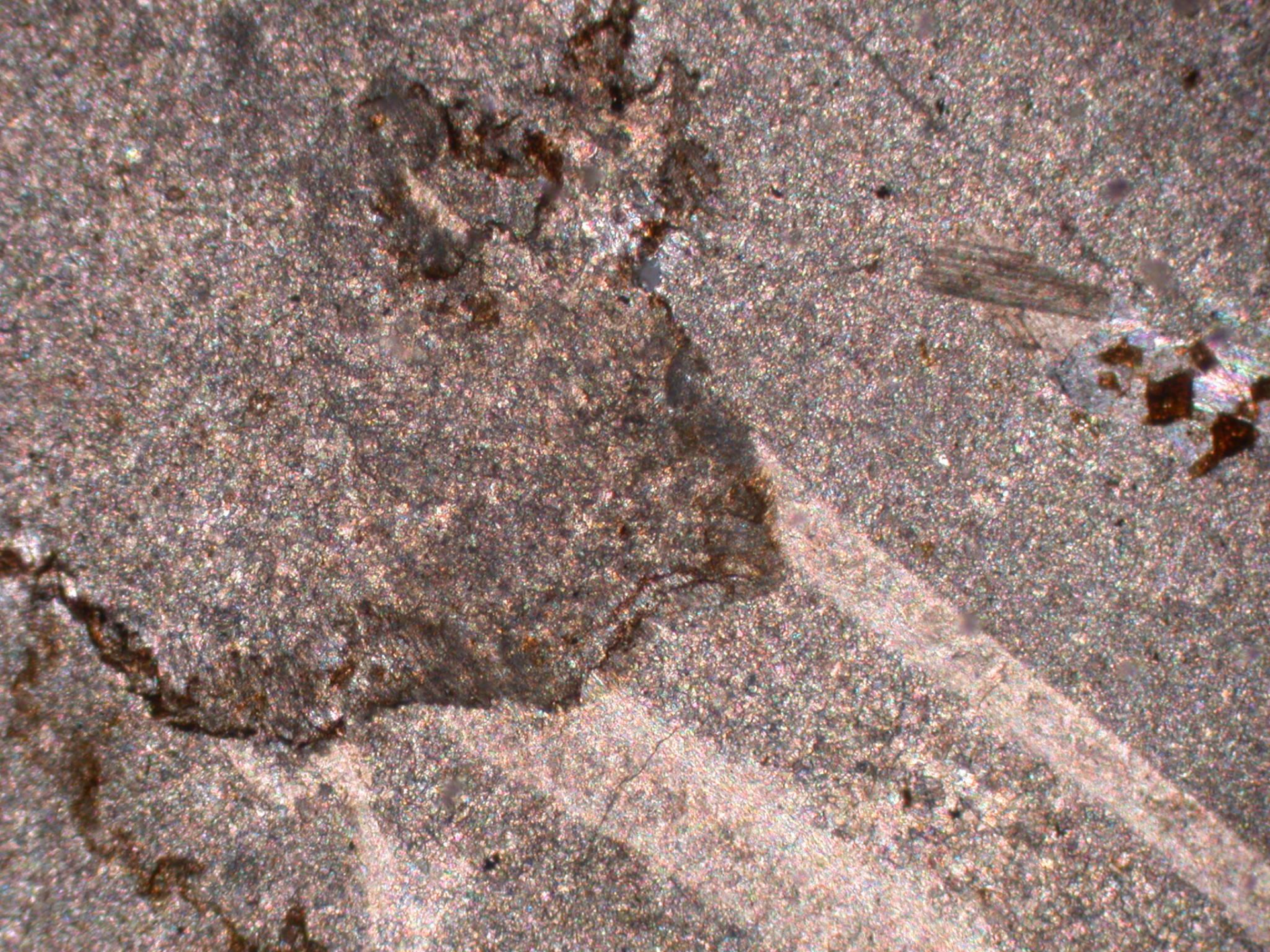

**Agregados (Grapestone)**



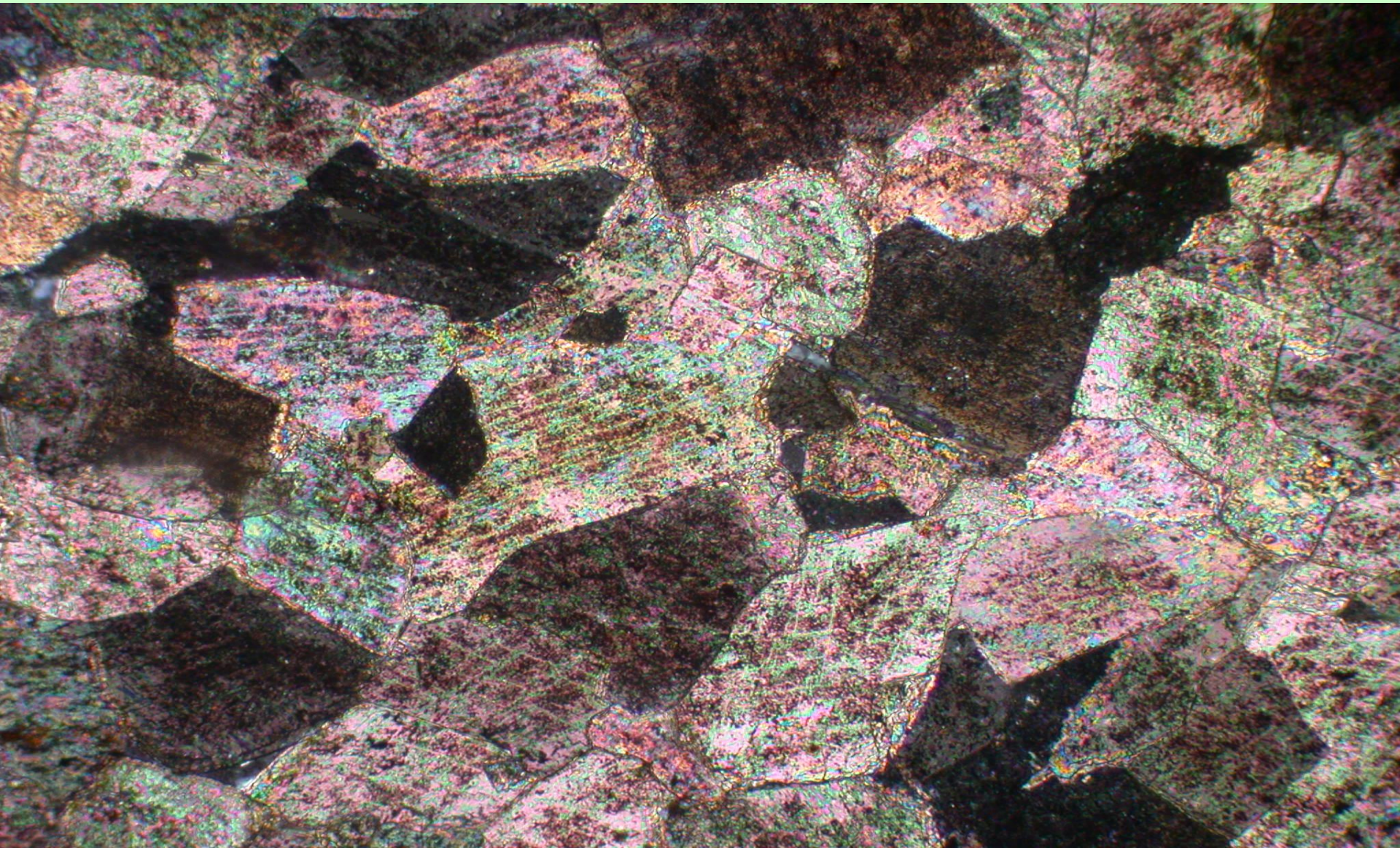


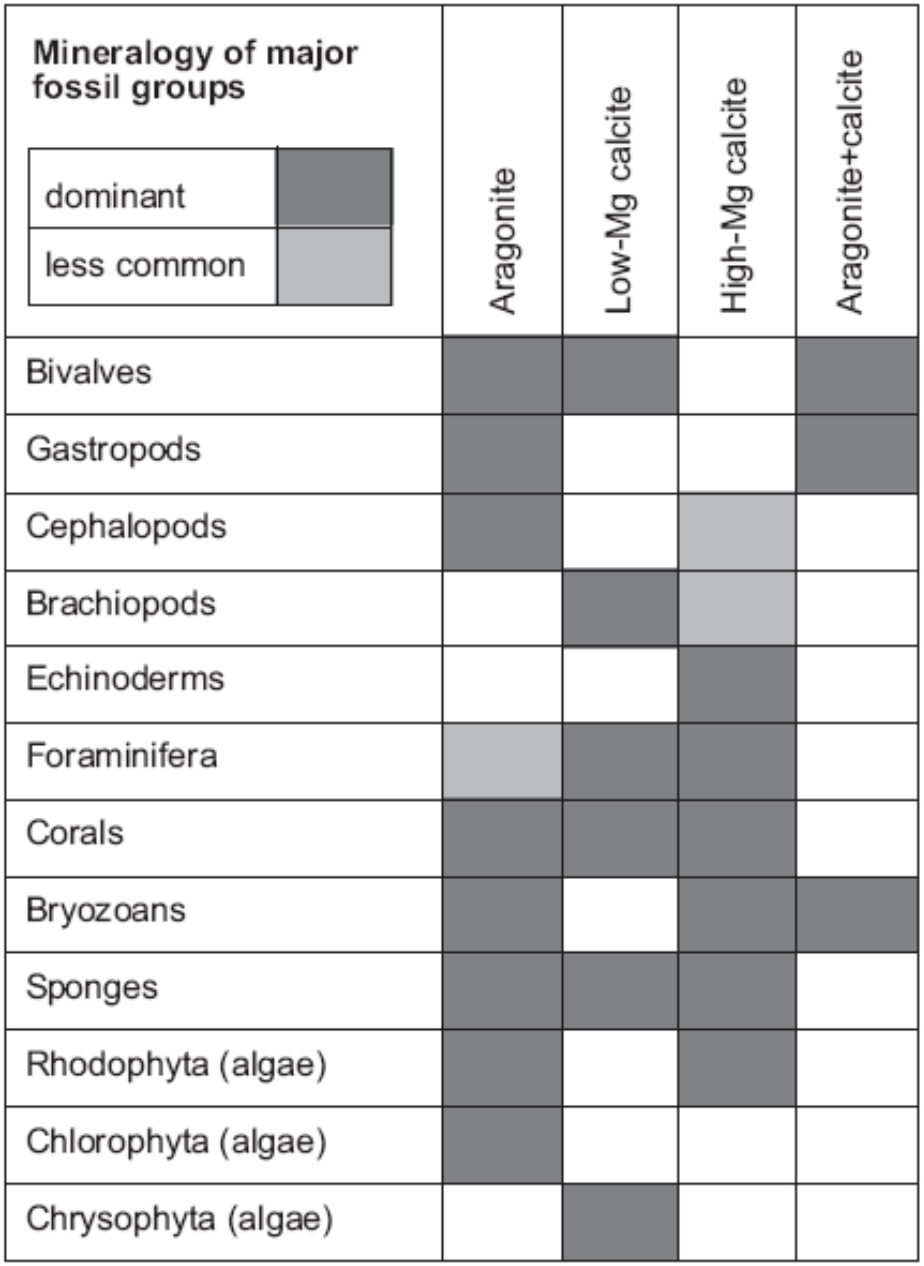






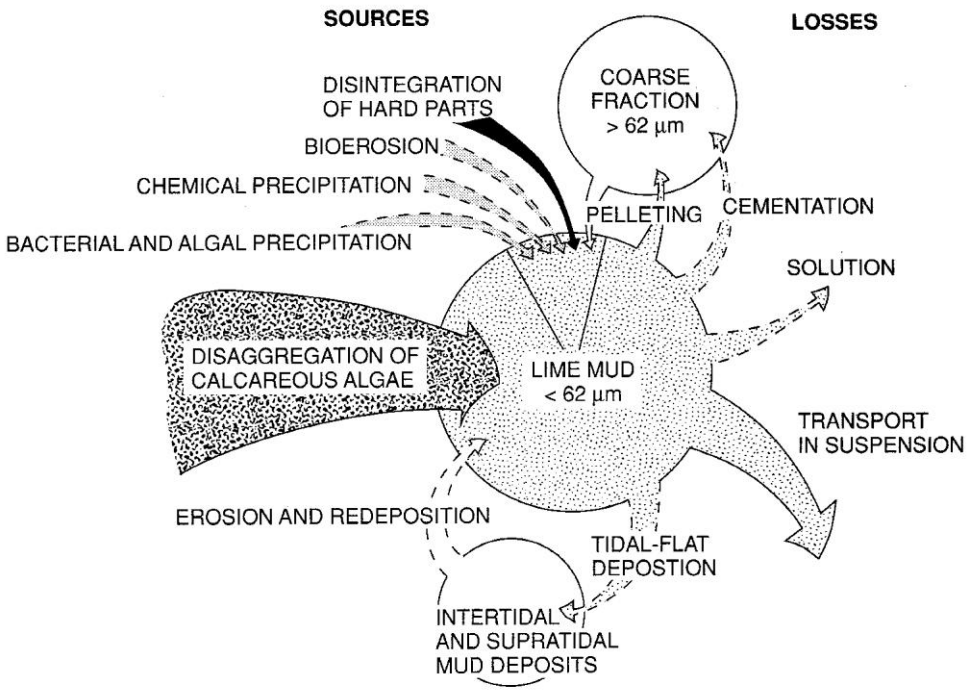
Dolomita: mayormente formada por cristales. Tipos texturales:
-Planar o idiotópica (cristales rómbicos euhedrales o anhedrales)
-No planar o xenotópica (no-rómbica)



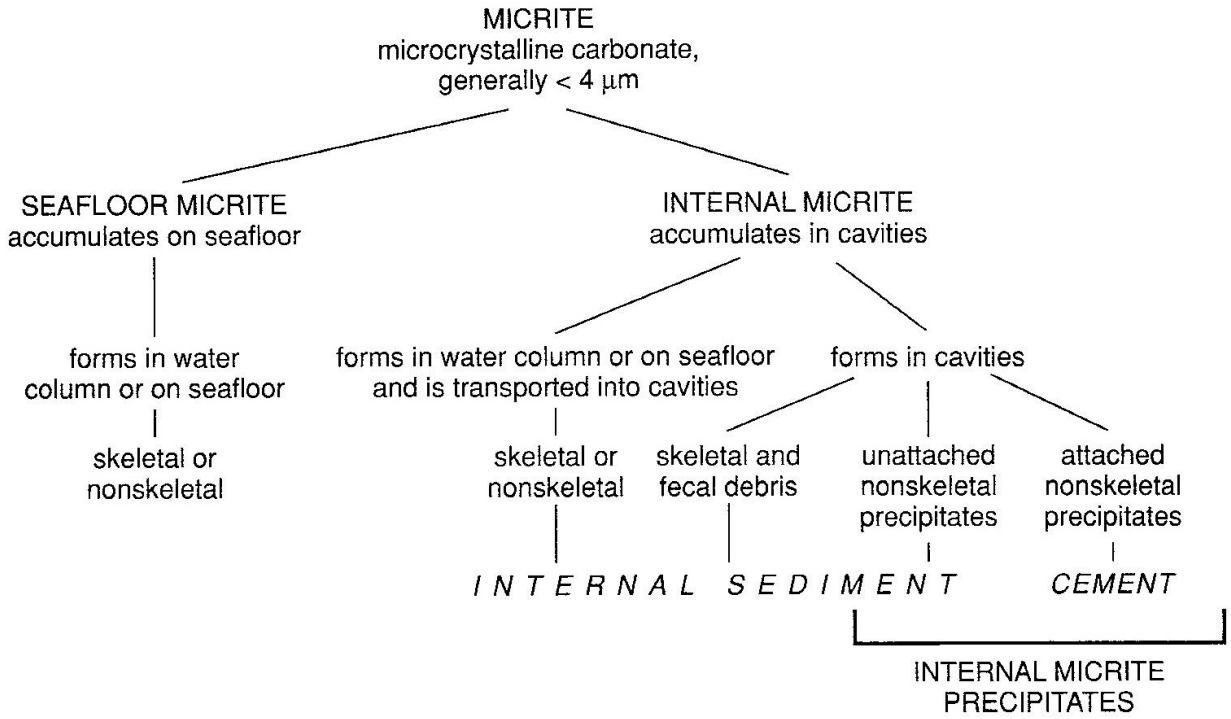



Elementos esqueletales y su composición

# Origen de la micrita




# Clasificación



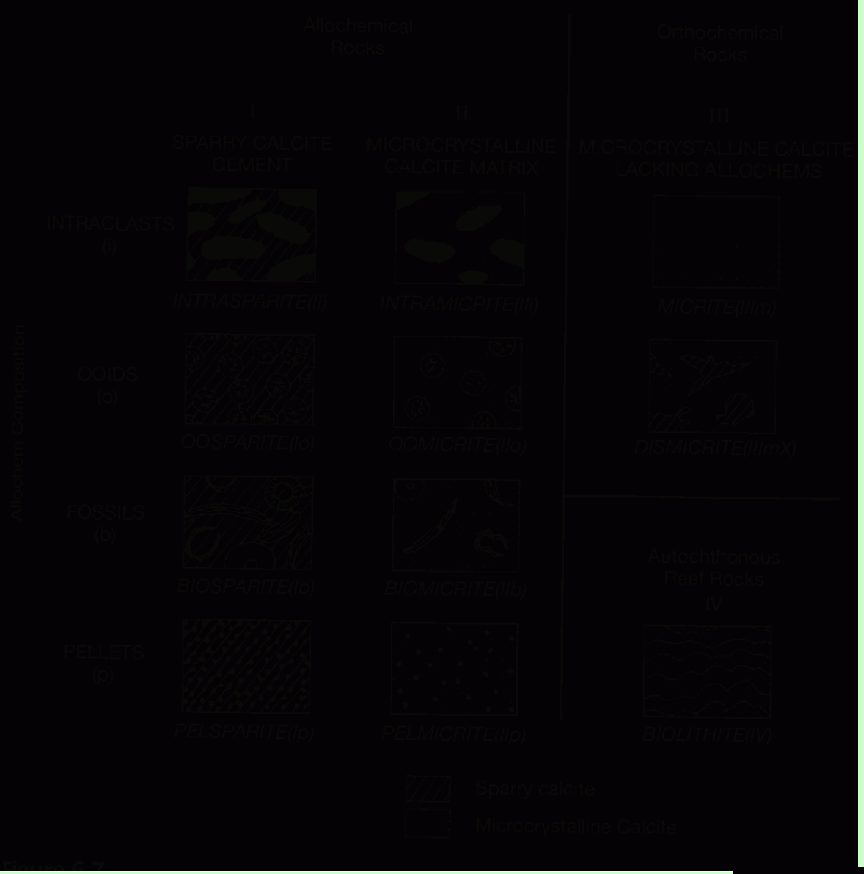
# Clasificación de Folk, 1959, 1962

Classification of carbonate rocks by Folk (1962)

| Relative abundance of allochems, sparry calcite cement and micrite / Normalized volume percent allochems | | | | Limestones, partly dolomitized limestones, and primary dolomites | | | | | Replacement dolomites (V) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | >10% Allochems Allochemical rocks (I and II) | | < 10% Allochems Microcrystalline rocks (III) | | | | |
| | | | | Sparry calcite cement > microcrystalline ooze matrix | Microcrystalline ooze matrix > sparry calcite cement | 1–10% Allochems | <1% Allochems | Undisturbed bioherm rocks (IV) | Allochem ghosts | No allochem ghosts |
| | | | | Sparry allochemical rocks (1) | Microcrystalline allochemical rocks (II) | | | | | |
| Volumetric allochem composition | >25% Intraclasts | | >25% Intraclasts | Intrasparrudite Intrasparite | Intramicrudite Intramicrite | Most abundant allochems: Intraclasts: intraclast-bearing micrite | Micrite; if disturbed, dismicrite; if primary dolomite, dolomicrite | Biolithite | Evident allochem: Finely crystalline intraclastic dolomite | Medium crystalline dolomite |
| | | | >25% Ooids | Oosparrudite Oosparite | Oomicrudite Oomicrite | Oolites: oolite-bearing micrite | | | Coarsely crystalline oolitic dolomite | Finely crystalline dolomite |
| | <25% Ooids | Volume ratio of fossils to oncoids >1:2 | Volume ratio of fossils to peloids >3:1 | Biosparrudite Biosparite | Biomicrudite Biomicrite | Fossils: fossiliferous micrite | | | Aphanocrystalline biogenic dolomite | |
| | | | Volume ratio of fossils to peloids 3:1 – 1:3 | | | | | | | etc. |
| | | | Volume ratio of fossils to peloids <1:3 | Biopelsparite | Biopelmicrite | Pellets: pelletiferous micrite | | | Very finely crystalline pellet dolomite | |
| | | Volume ratio of fossils to oncoids ≤1:2 | | Pelsparite | Pelmicrite | | | | | |
| | | | | Oncosparite Oncosparrudite | Oncomicrite Oncomicrudite | Oncoids: oncoid-bearing micrite | | | | |

*Source:* After Folk, R. L., 1962, Spectral subdivision of limestone types, *in* Ham, W. E., ed., Classification of carbonate rocks: Am. Assoc. Petroleum Geologists Mem. 1. Table 1, p. 70, reprinted by permission of AAPG, Tulsa, Okla.

*Note:* The classification of oncoids in this figure is modified from Flügel (1980, p. 370).


Allochemical Rocks
I
SPARRY CALCITE CEMENT
II
MICROCRYSTALLINE CALCITE MATRIX
Orthochemical Rocks
III
MICROCRYSTALLINE CALCITE LACKING ALLOCHEMS
INTRACLASTS (I)
INTRASPARITE(I)
INTRAMICRITE(II)
MICRITE(III)
OOIDS (O)
OOSPARITE(IO)
OOMICRITE(IIO)
DISMICRITE(III)
FOSSILS (B)
BIOSPARITE(IB)
BIOMICRITE(IIB)
PELLETS (P)
PELSPARITE(IP)
PELMICRITE(IIP)
Autochthonous Reef Rocks
IV
BIOLITHITE(IV)
Sparry calcite
Microcrystalline Calcite


OVER 2/3 LIME MUD MATRIX
SUBEQUAL SPAR & LIME MUD
OVER 2/3 SPAR CEMENT
Percent Allochems
0 – 1%
1 – 10%
10 – 50%
OVER 50%
SORTING POOR
SORTING GOOD
ROUNDED & ABRADED
Interstitial Lack Terms
MICRITE & DISMICRITE
FOSSILIFEROUS MICRITE
SPARSE BIOMICRITE
PACKED BIOMICRITE
POORLY SORTED BIOSPARITE
UNSORTED BIOSPARITE
SORTED BIOSPARITE
ROUNDED BIOSPARITE
Terminology
Micrite & Dismicrite
Fossiliferous Micrite
Biomicrite
Biosparite
Diagenetic Analogues
Chalk
Sparry Calcite
Chalk or Immature Sandstone
Mature Sandstone
Submature Sandstone
LIME MUD MATRIX
SPARRY CALCITE CEMENT

# Clasificación de Dunham (1962) y su modificación por Embry y Klovan (1972)

**A**

| DEPOSITIONAL TEXTURE RECOGNIZABLE | | | | | DEPOSITIONAL TEXTURE NOT RECOGNIZABLE |
|---|---|---|---|---|---|
| Original components not bound together during deposition | | | | Original components were bound together during deposition . . . as shown by intergrown skeletal matter, lamination contrary to gravity, or sediment-floored cavities are roofed over by organic or questionably organic matter and are too large to be interstices. | CRYSTALLINE CARBONATE |
| Contains mud (particles of clay and fine silt size) | | Grain-supported | Lacks mud and is grain-supported | | (Subdivide according to classifications designed to bear on physical texture or diagenesis.) |
| Mud-supported | | | | | |
| Less than 10% grains | More than 10% grains | | | | |
| MUDSTONE | WACKESTONE | PACKSTONE | GRAINSTONE | BOUNDSTONE | |

**B**

| ALLOCHTHONOUS LIMESTONE Original components not organically bound during depositionc | | | | | | AUTOCHTHONOUS LIMESTONE Original components organically bound during deposition | | |
|---|---|---|---|---|---|---|---|---|
| Less than 10% >2 mm components | | | | Greater than 10% >2mm components | | By organisms that build a rigid framework | By organisms that encrust and bind | By organisms that act as baffles |
| Contains Lime mud (<0.03 mm) | | No lime mud | | Matrix-supported | >2 mm component-supported | | | |
| Mud-supported | | Grain-supported | | | | | | |
| Less than 10% grains (>0.03 mm <2 mm) | Greater than 10% grains | | | | | | | |
| | | | | | | BOUNDSTONE | | |
| MUD-STONE | WACKE-STONE | PACK-STONE | GRAIN-STONE | FLOAT-STONE | RUD-STONE | FRAME-STONE | BIND-STONE | BAFFLE-STONE |

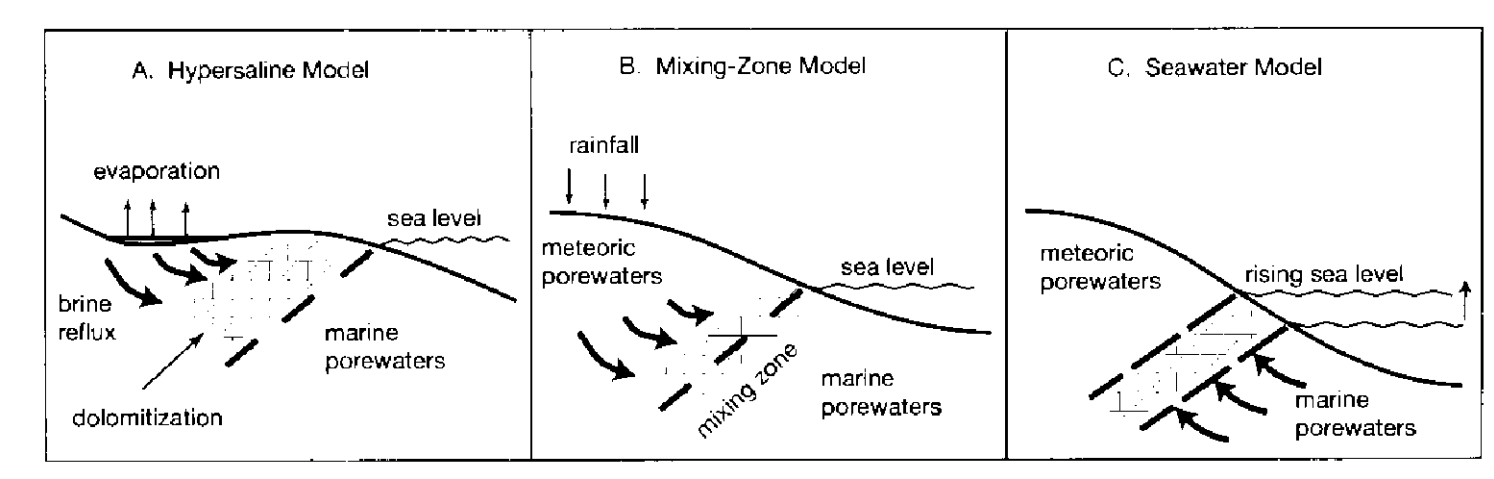
*Source:* A, Dunham (1962); B, as modified by Embry and Klovan (1972). After Dunham, R. J., 1962, Classification of carbonate rocks according to depositional textures, *in* Ham, W. E., ed., Classification of carbonate rocks: Am. Assoc. Petroleum Geologists Mem. 1. Table 1, p. 117, reprinted by permission of AAPG, Tulsa, Okla.; Embry, E. F., III and J. E. Klovan, 1972, Absolute water depth limits of late Devonian paleoecological zones: Geol. Rundschau, v. 61. Fig. 5, p. 676, reprinted by permission.

# El ¨problema¨ de la dolomita

-Subsaturación de Mg con respecto al Ca en el agua de mar

-Imposibilidad de formar dolomita ¨estequiométrica¨ en condiciones de baja P y Ten laboratorio

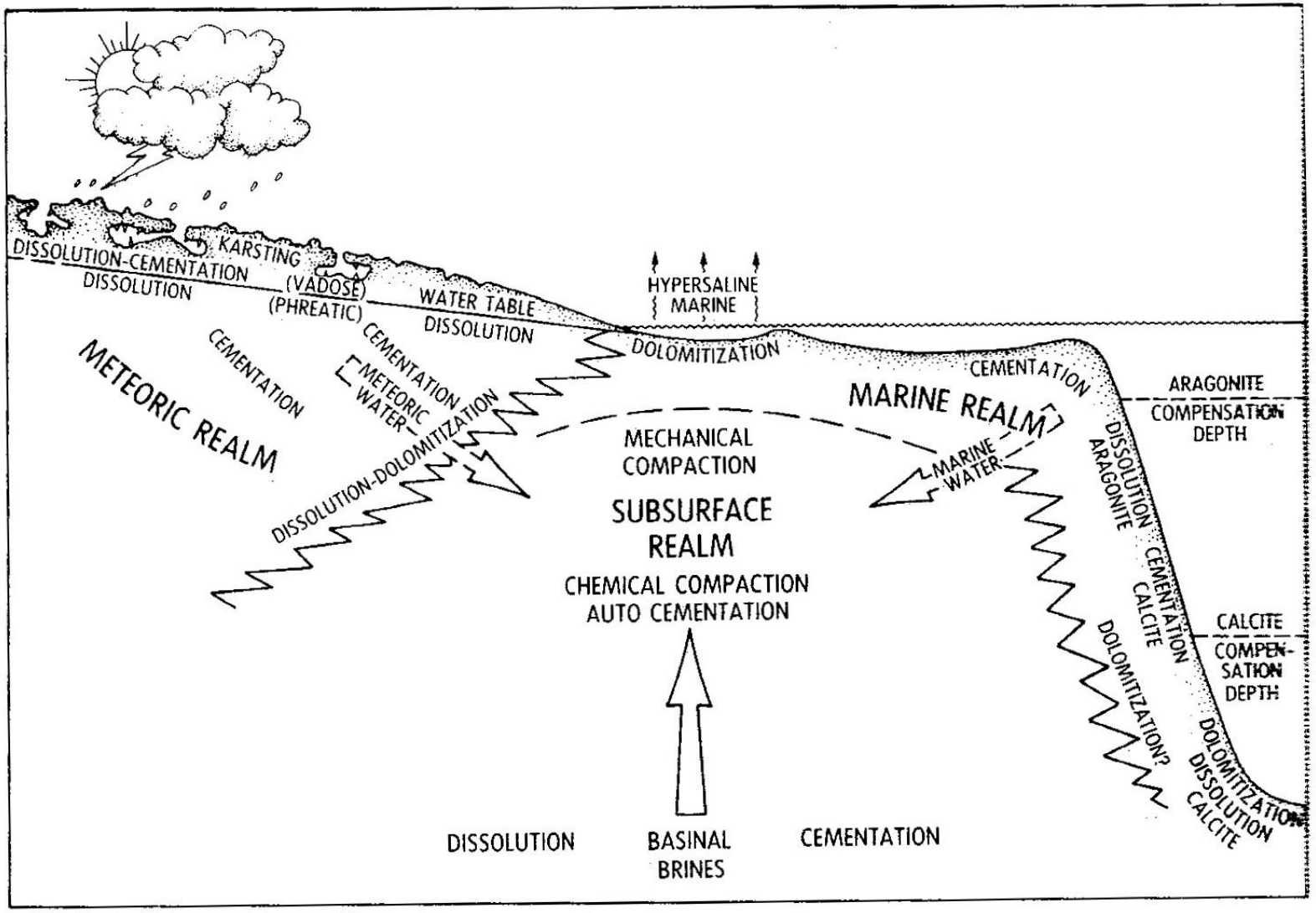
1) Dolomita como precipitado ¨primario¨
    a) Modelo hipersalino-sabkha
    b) Modelo zona de mezcla (o Dorag)
    c) Modelo subtidal somero




2) Dolomita como reemplazo ¨secundario¨

# Regimenes diagenéticos carbonáticos

1) Marino  2) Metórico (vadoso y freático)  3) Freático marino



La mayor parte de los carbonatos se depositan en el mar aunque hay también de agua dulce.

El ámbito **Marino** incluye el fondo marino y unos pocos cms por debajo. Principalmente bioturbación, perforación y cementación.

Los sedimentos pueden ser llevados al ámbito **Meteórico** por dos procesos: descenso del n.del m o sedimentación y relleno de la cuenca Está caracterizado por la presencia de agua dulce. En la zona vadosa (por encima de la freática) los poros no están completamente saturados en agua mientras que en la zona freática si. Principalmente disolución de aragonita y calcita magnesiana y precipitación de calcita.

El ámbito de **Subsuperficie** se alcanza con el soterramiento. Compactación física y química, disolución, cementación y reemplazo.

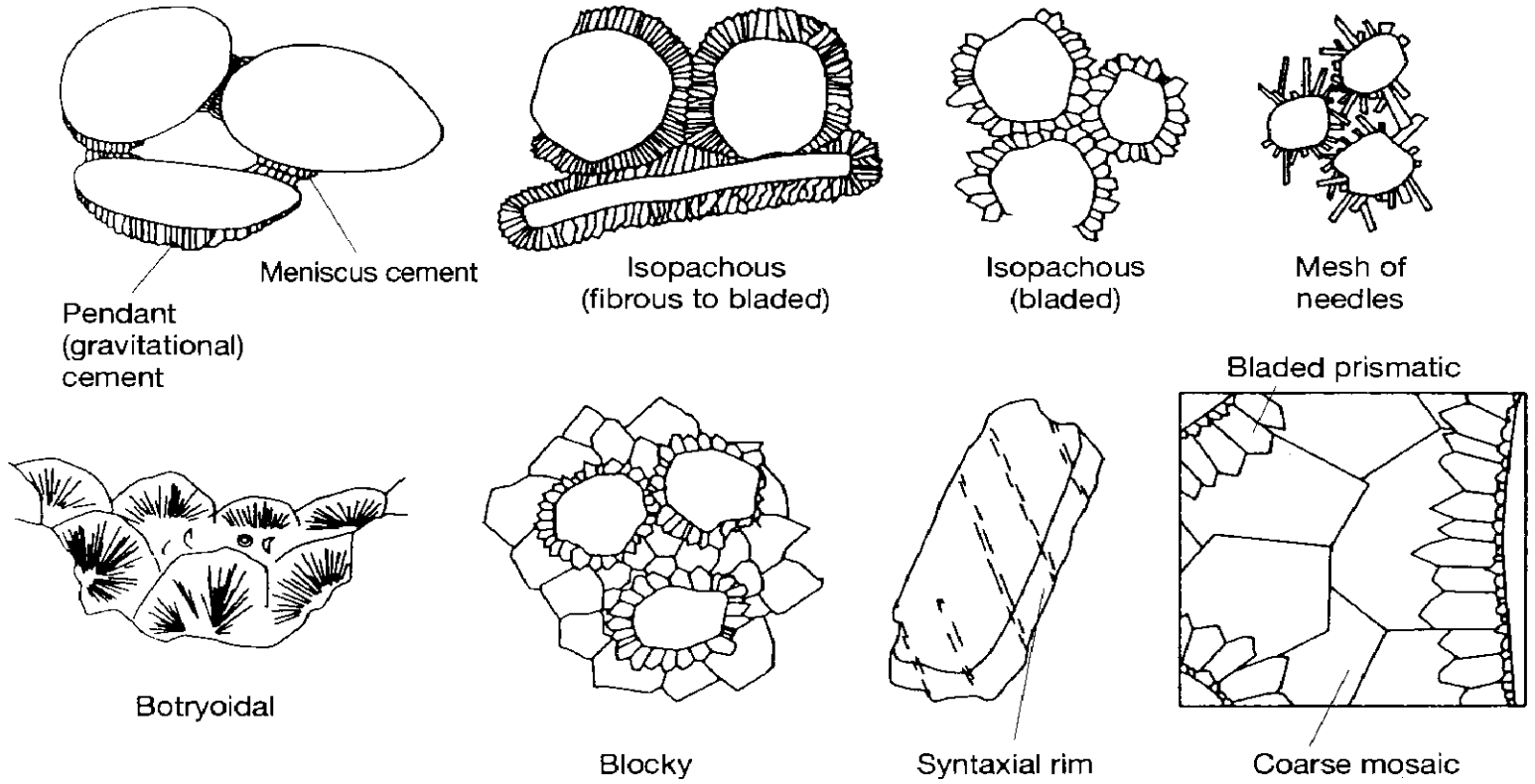



**Figure 6.15**
Principal kinds of cements that form in carbonate rocks during diagenesis. **Seafloor diagenetic environments** are characterized particularly by aragonitic meniscus and pendant cements (in beachrock), isopachous cement, needle cement, and botryoidal cement. **Meteoric-realm** cements are composed dominantly of calcite and include meniscus and pendant cements in the **vadose zone** and isopachous, blocky, and syntaxial rim cements in the **phreatic zone**. Cements of the **subsurface burial realm** are also mainly calcite and include syntaxial rims, bladed prismatic, and coarse mosaic types. [Modified from James, N. P., and P. W. Choquette, 1983, Geoscience Canada, v. 10, Fig. 3, p. 165; 1984, Geoscience Canada, v. 11, Fig. 24, p. 177; 1987, Geoscience Canada, v. 14, Fig. 21, p. 16.]