

**APPENDIX 4: SLIDE DESCRIPTIONS AND PETROLOGICAL
INTERPRETATIONS**

Slide Descriptions for samples collected at Bill Kalina (“Margaret”) Springs

Sample No MSRS001

Location

644874E, 6740065N (GDA94 Z53)

Texture

Vuggy Limestone. Fenestra present. Grains supported in a variably carbonate mud matrix. Poorly distributed occurrence of clastic grains in matrix. Clotted texture evident in carbonate muds?

Carbonate Grains

10% peloids, 10% lumps, 5% fossils (gastropods, ostracods and possibly charophytes).

Siliciclastic Grains

5% quartz sand unevenly distributed. Tr. plagioclase

Voids

25% voids rounded and up to 5mm in diameter, 5% unfilled (dissolution?), 5% filled, 10% partially filled (often geopetal).

Carbonate Mud

30%.

Cements

10% microcrystalline, 6% bladed, 6% granular, 3% radial fibrous zoned.

Other

Tr. goethite, tr. zircon, tr. manganese oxide.

Comments

Complex history of deposition in shallow vegetated pool.

Classification

Fenestral packstone.

Interpretation

Vegetated pool environment.

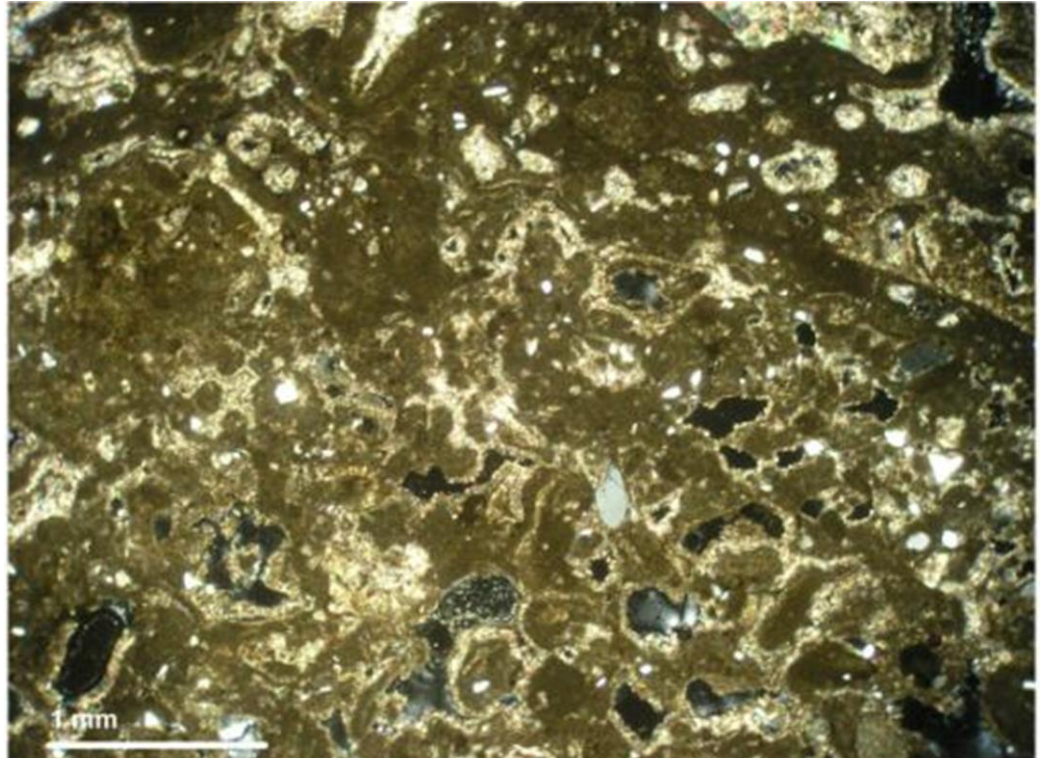


Photo 1: General view of sample matrix. Note peloidal texture as well as fenestral and inter-particle voids. Crossed polars.

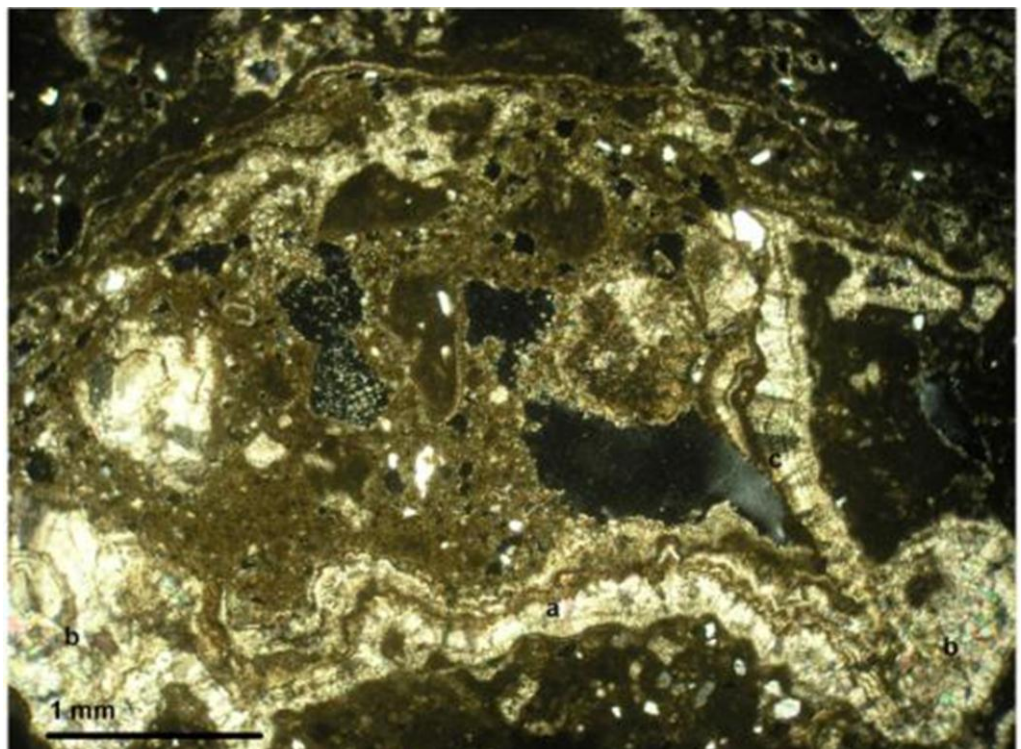


Photo 2: Example of cement void-fill. Laminated fibrous radiaxial cement occupies a section towards the base of the photograph. Microcrystalline and granular cements occupy voids near the bottom left and right hand corners. Much of void is filled with micrite and lumps and siliciclastic particles (matrix materials). Void in centre cross-cuts older cement fill and may be a product of dissolution. Crossed polars.

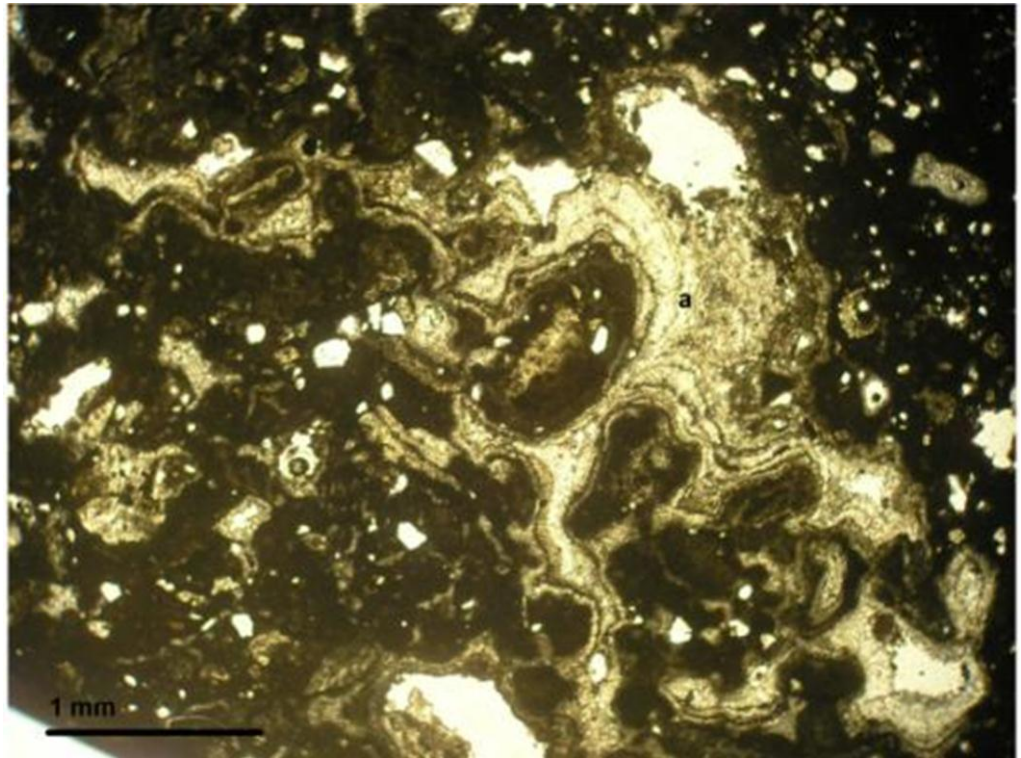


Photo 3: Inter-particle cement void fill consisting of laminated radiaxial fibrous cement and microcrystalline cement. Peloidal carbonaceous matrix. Plane light.

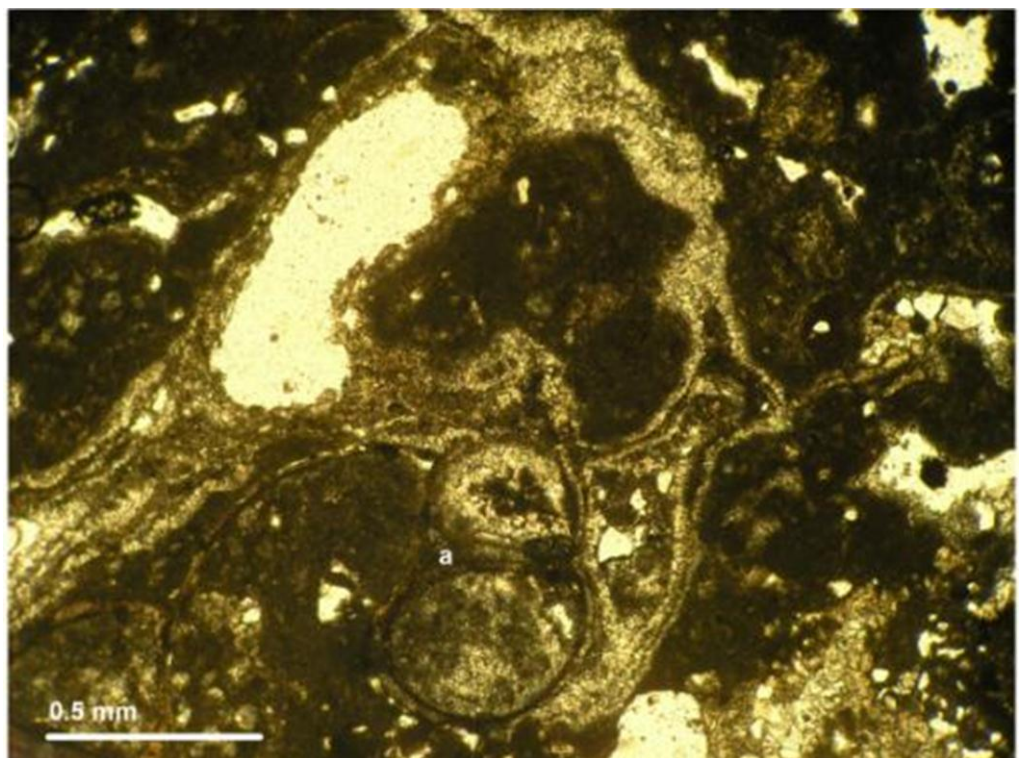


Photo 4: Gastropod shell with intra-particle granular and microcrystalline void-fill. Plane light.

Sample No: MSRS002

Location

644867E, 6740059N (GDA94 Z53)

Texture

Very Vuggy limestone. Mainly peloidal carbonate grains with small percentage of irregularly distributed quartz sand and silt grains. Vugs are both bridging and fenestral

Carbonate Grains

20% peloids, 20% ooids, 5% fossils, 5% lumps.

Siliciclastic Grains

1% quartz sand

Voids

40% cavities up to 10mm in diameter, 20% rounded, 10% unfilled, 10% partially filled, 10% filled.

Carbonate Mud

-

Cements

9% Microcrystalline void fill, 5% granular void fill, 4% bladed void fill, 2% meniscus, 4% radiaxial fibrous zoned.

Other

Tr. goethite (staining and grains), tr. manganese oxide

Comments

Presence of large number of primary voids, ooids, abundance of microcrystalline cementation and lack of carbonate muds is indicative of a relatively high energy environment that may have been subject to sub-aerial conditions (such as a small waterfall or vegetated drape).

Classification

Fenestral ooidal grainstone.

Interpretation

Spring limestone deposit from vegetated slope of mound.

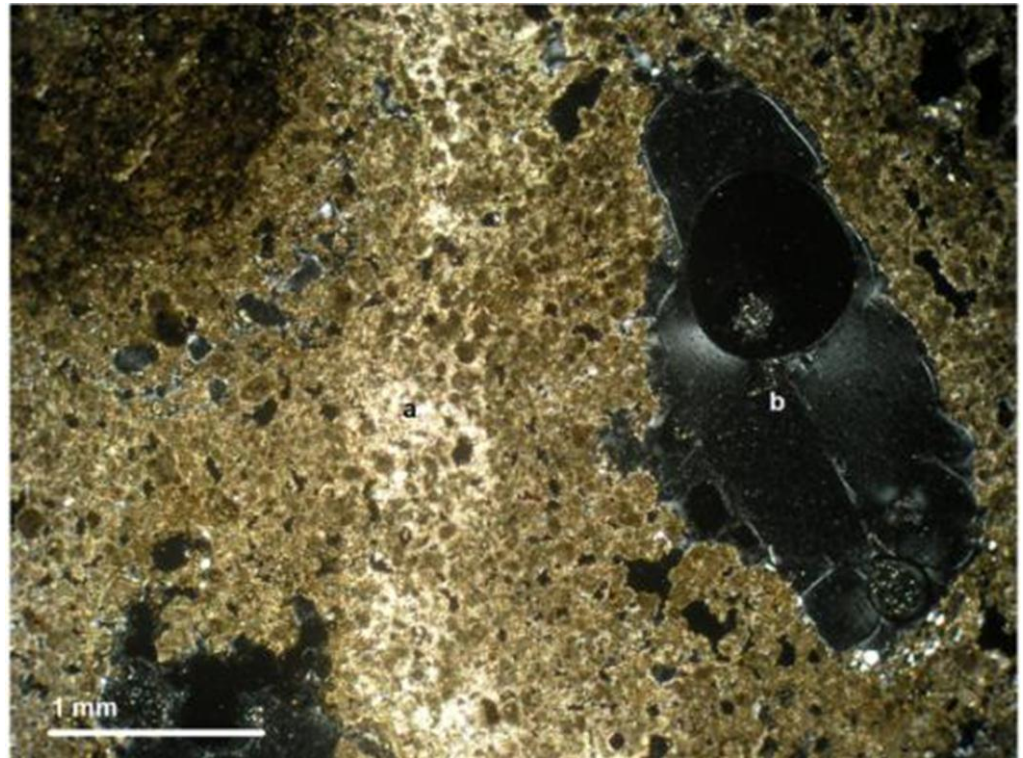


Photo 1: Peloidal and ooidal matrix with inter-particle meniscus cements and zone of microcrystalline cement. Primary void to left of photograph. Cross polars.

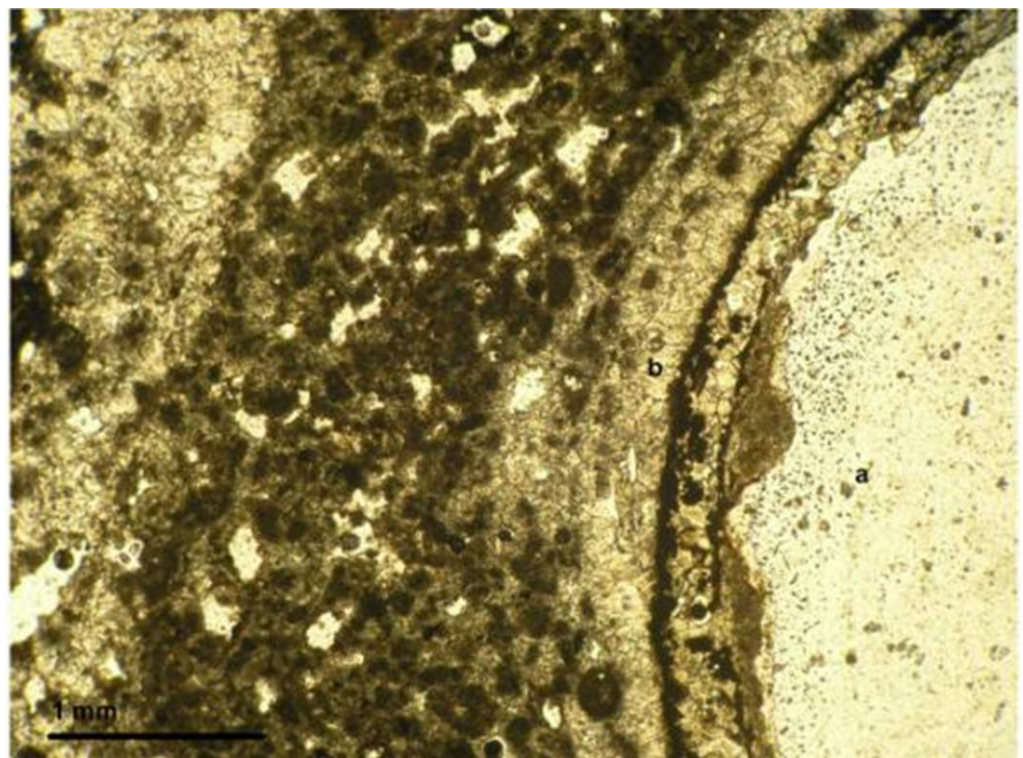


Photo 2: Fenestral void (a) lined with micritic and microcrystalline cement and clay (b). The centre of the image displays peloidal and ooidal matrix material. Cross polars.

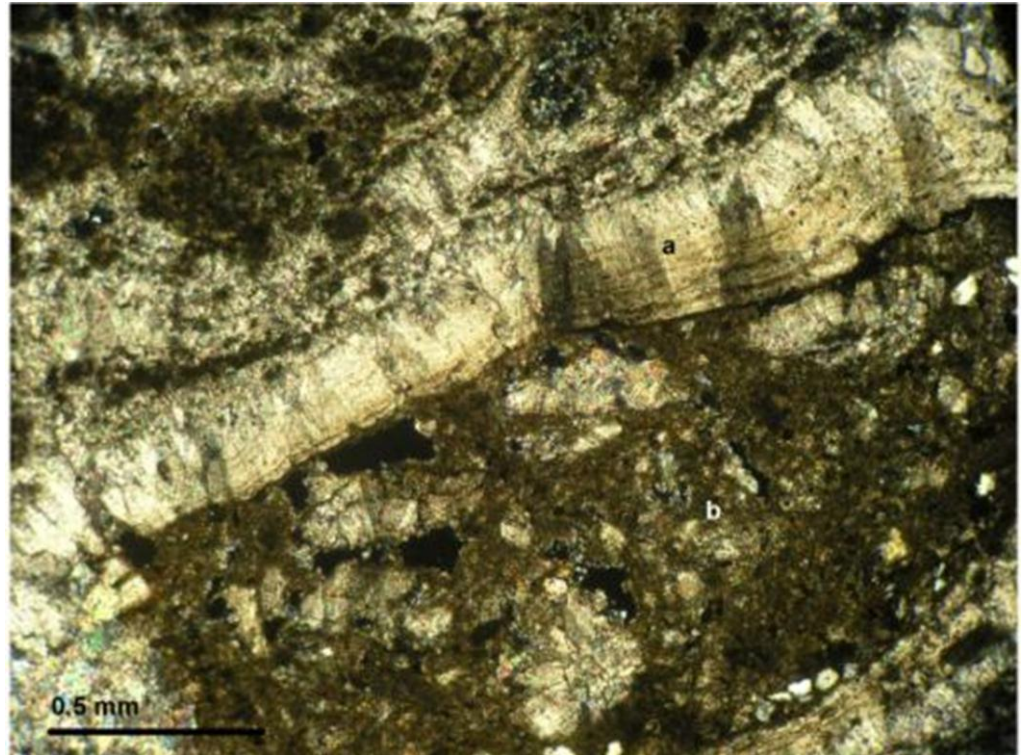


Photo 3: Void lined with laminated microcrystalline and radiaxial fibrous cement. Later filled with micrite, carbonaceous and siliciclastic particles and further radiaxial fibrous, granular and microcrystalline cement. Cross polars.

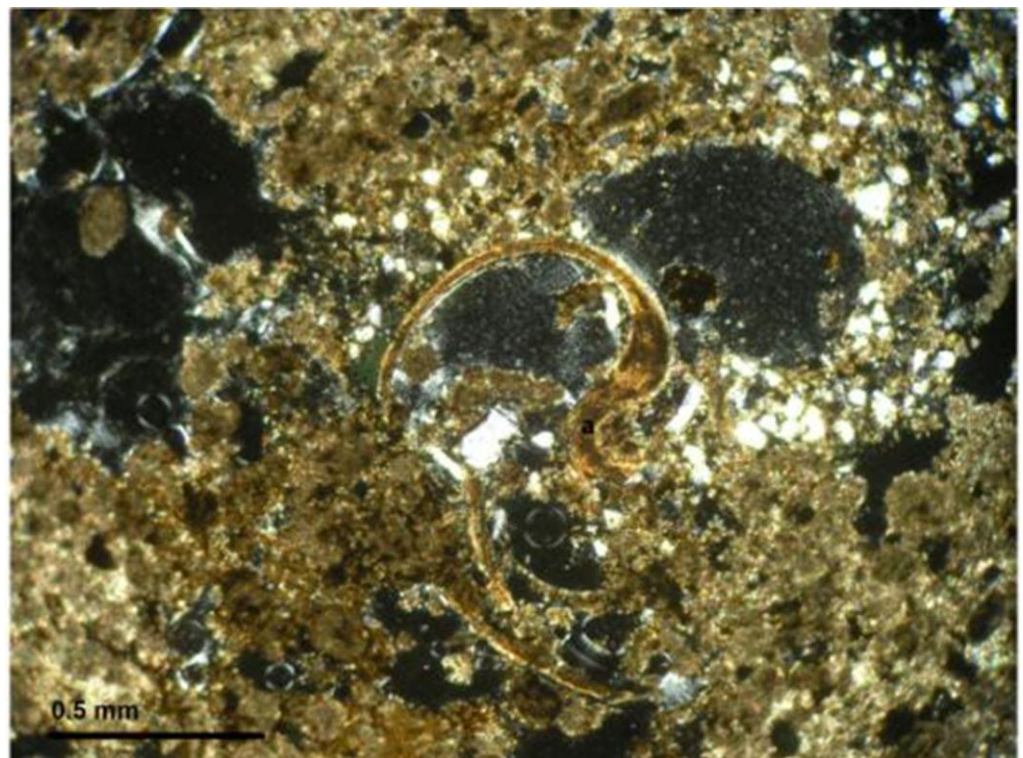


Photo 4: ostracod shell (a) within peloidal carbonate matrix. Clastic silica grains also present in matrix material surrounding void. Crossed polars.

Sample No MSRS003

Location

644870E, 6740056N (GDA94 Z53)

Texture

Uneven distribution of micritic/microspar and Clotted micritic and peloidal textures. Distribution of matrix types conformable with laminar fabric in sample.

Carbonate Grains

16% peloids, 1% fossils (gastropods, charophytes), 5% lumps.

Siliciclastic Grains

1% quartz.

Voids

20% fenestral and intra-particle, 10% Unfilled, 5% partially filled (geopetal), 5% filled.

Carbonate Mud

40%

Cements

5% microcrystalline, 5% bladed, 1% dogtooth, 1% granular, 5% micritic.

Other

Tr. goethite.

Comments

Microspar textures unevenly distributed through sample, although they are conformable with lamination that is also evident. Given the cross-cutting nature of fenestra and associated cement infill, it is speculated that microspar texture may be a consequence of diagenetic processes associated with burial and possible recrystallisation in the vadose zone.

Classification

Microbial peloidal wackestone.

Interpretation

Complex history of initial deposition in shallow vegetated pool followed by burial by later carbonate deposition and possible diagenesis within vadose zone (Caliche environment).

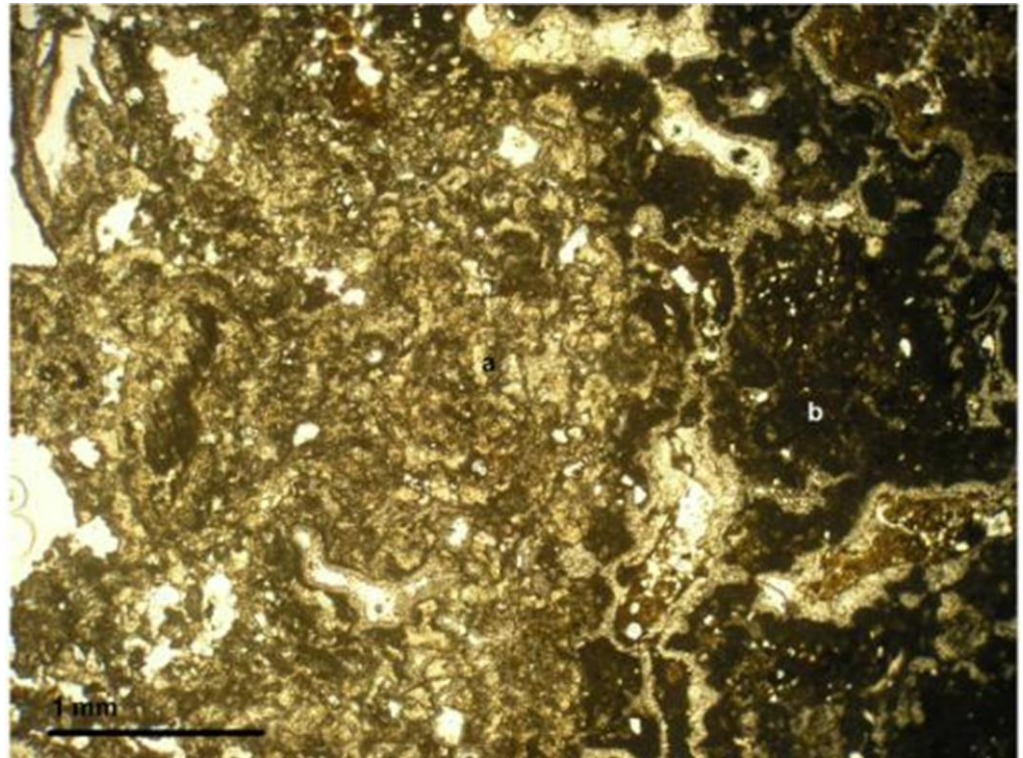


Photo 1: "Contact" between micritic/ microspar matrix to the left and a carbonaceous mud matrix to the right. Fenestra and associated cement infill cut across this feature in places, suggesting this may be a weathering feature (?). Plane light.

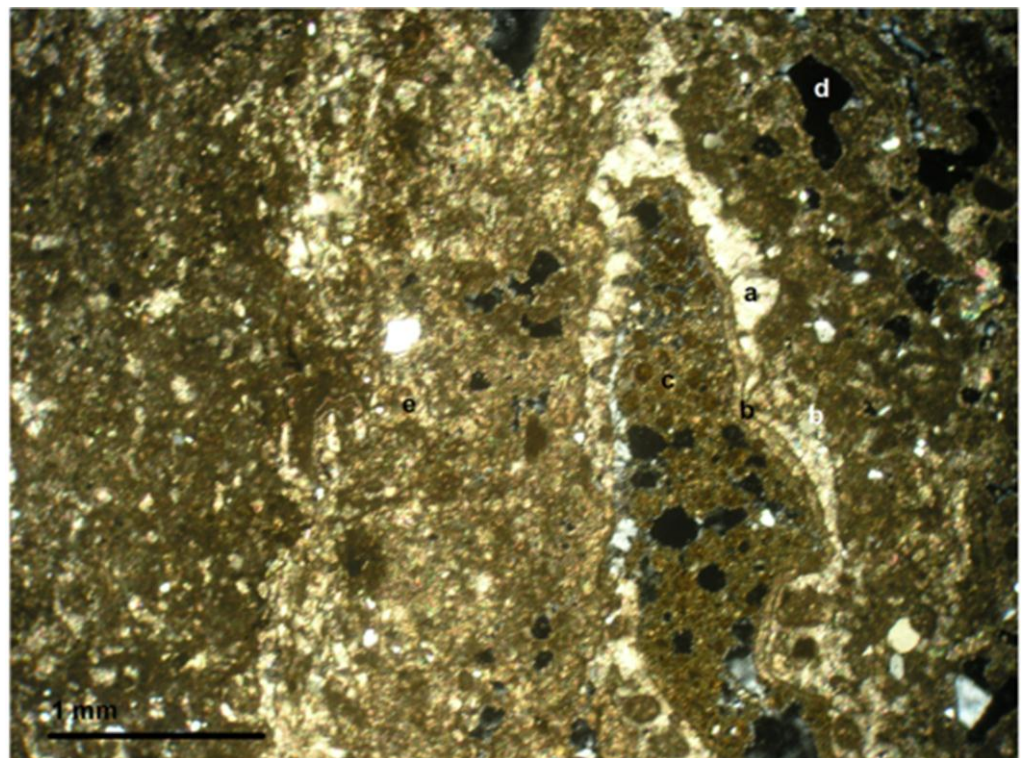


Photo 2: Laminar void with complex history of infill. Bladed and granular cementation followed by possible partial dissolution and geopetal microcrystalline and micritic cement. Remainder of void filled with peloidal micrite (Matrix material?). Recent voids may be caused by dissolution. Crossed polars.

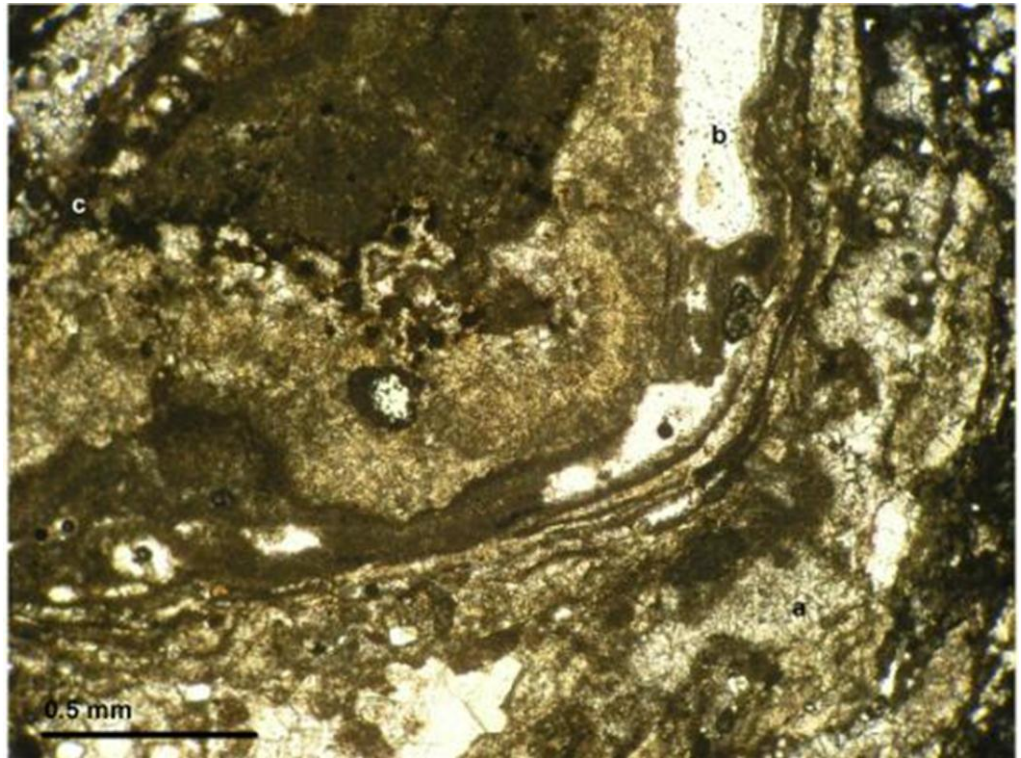


Photo 3: Complex example of undulose laminar fabric in sample with variations is carbonaceous mud/micrite and micrite/microspar matrices. Granular and bladed cementation evident to right and base of image, voids near top and centre are largely unfilled with only a veneer of micritic cement. Manganese oxide specks evident within top left quarter of image. Plane light.

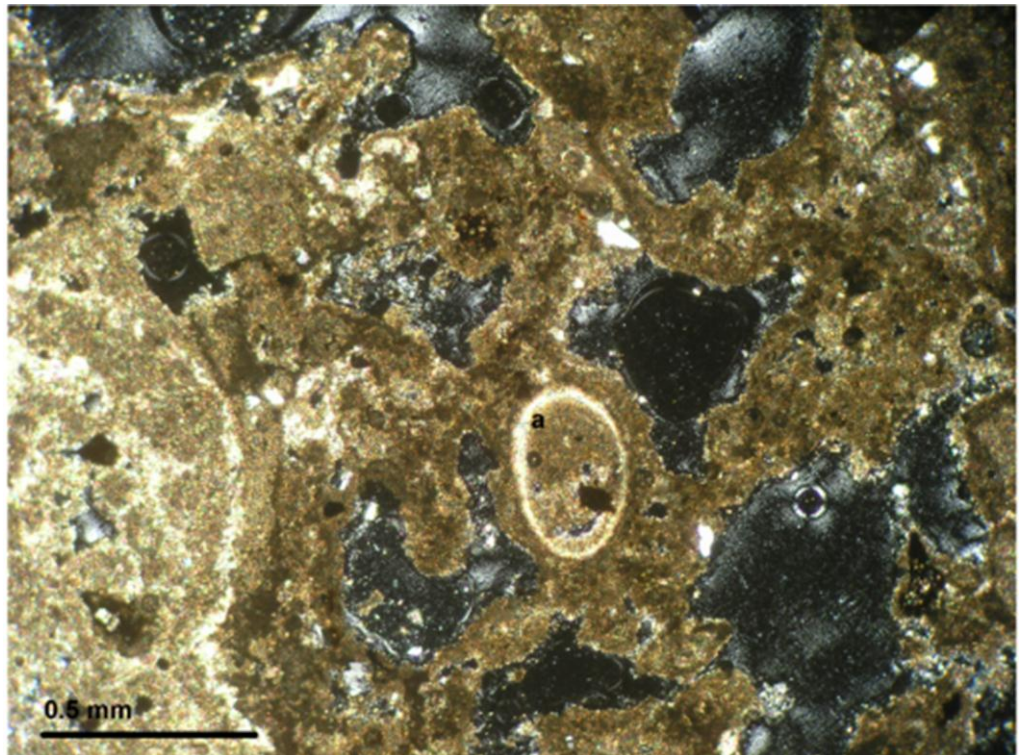


Photo 4: Ostracod fossil within clotted micritic matrix. Voids are largely unfilled. Cross polars.

Sample No MSRS004

Location

644874E, 6740058N (GDA94 Z53)

Texture

Vuggy limestone. Clotted texture. Peloidal and oncoidal grains.

Carbonate Grains

10% peloids, 44% oncoids, 1% lumps.

Siliciclastic Grains

Tr. quartz.

Voids

23% fenestral, 3% inter-particle, 3% filled, 10% partially filled. 7% unfilled.

Carbonate Mud

-

Cements

10% microcrystalline, 5% bladed.

Other

5% goethite (staining and particulate), 5% manganese oxide (ovoid particulate, dendritic void fill), tr. gypsum void fill.

Comments

Oncoids are micritic porostromate oncoids either rounded or shrub laminated construction. Internal fibrous structure evident. "Peloids" may be formed from disaggregated surficial crystal precipitates from cyanobacterial stems. Some oncoids have microspar cement fill at nucleus (macrophyte nucleus?). Flowing water was possibly turbulent due to the presence of manganese oxide and goethite (oxygenation due to turbulence leading to precipitation of oxides)

Classification

Oncoidal grainstone.

Interpretation

Shallow tail environment on side of established mound.

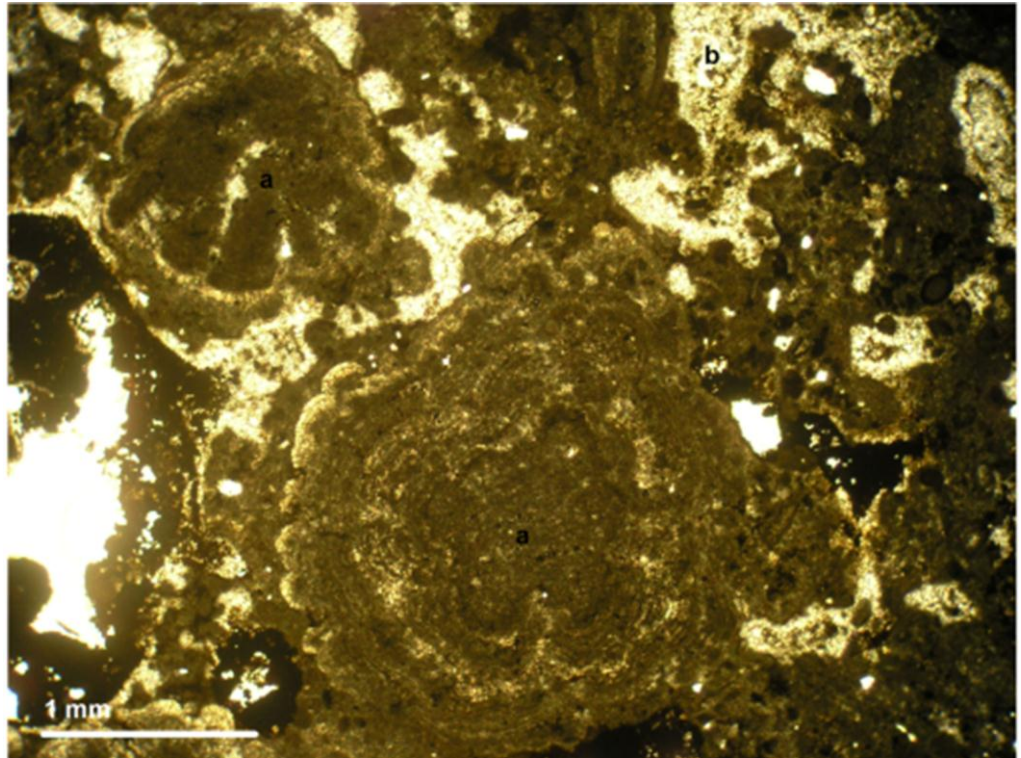


Photo 1: "Oncoids within clotted micritic texture. Fenestral voids partially filled with microcrystalline and bladed cement. Plane light.

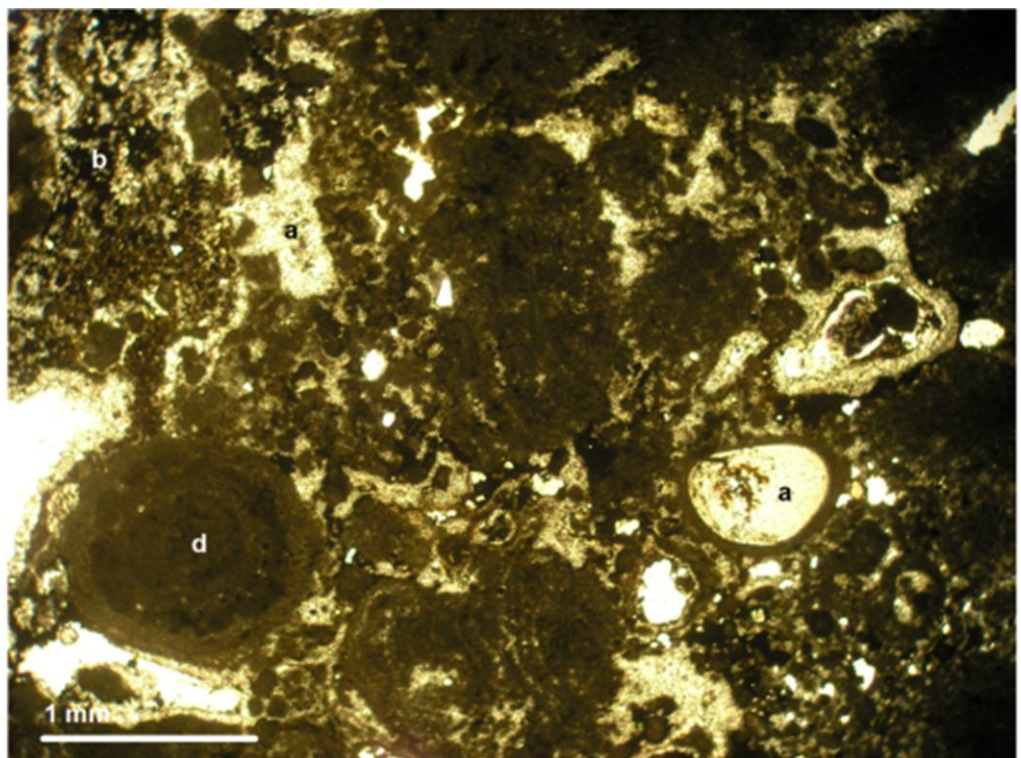


Photo 2: Peloidal and microbial texture. Microcrystalline and bladed carbonate cement-fill. Manganese oxide and goethite void fill also evident. An ostracod (?) fossil is observed \ to the right of the image. Crossed polars.

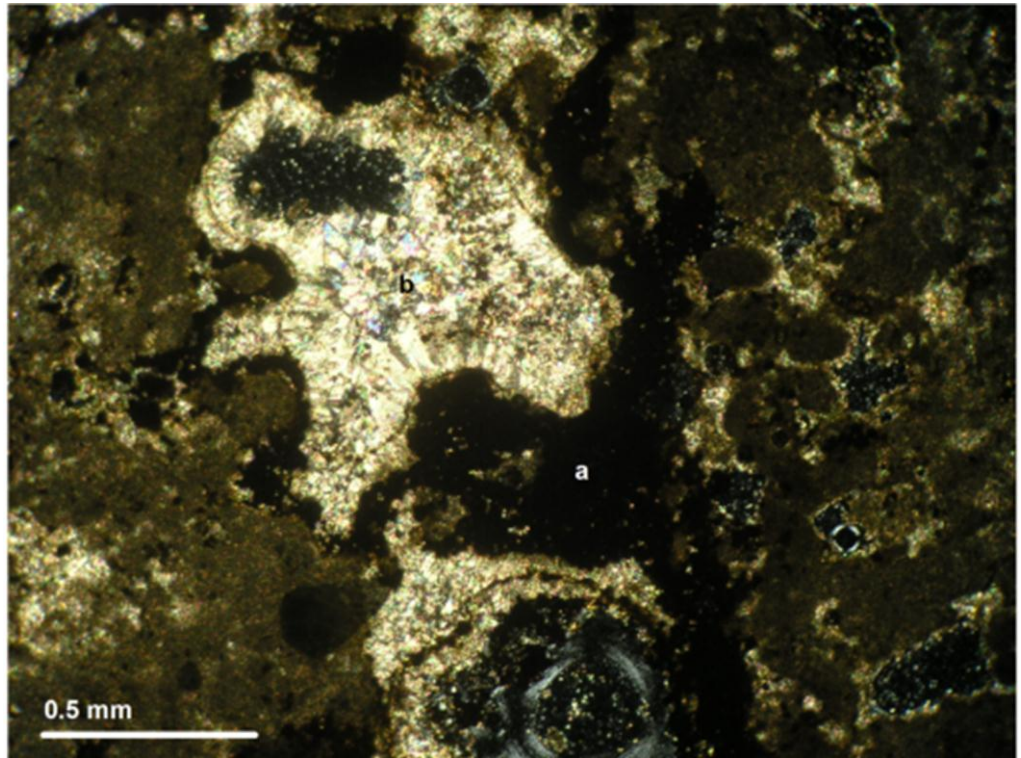


Photo 3: Fenestral void fill – Manganese oxide first deposits in the void, followed by laminated bladed carbonate cement and microcrystalline carbonate cement. Geopetal void fill. Crossed polars.

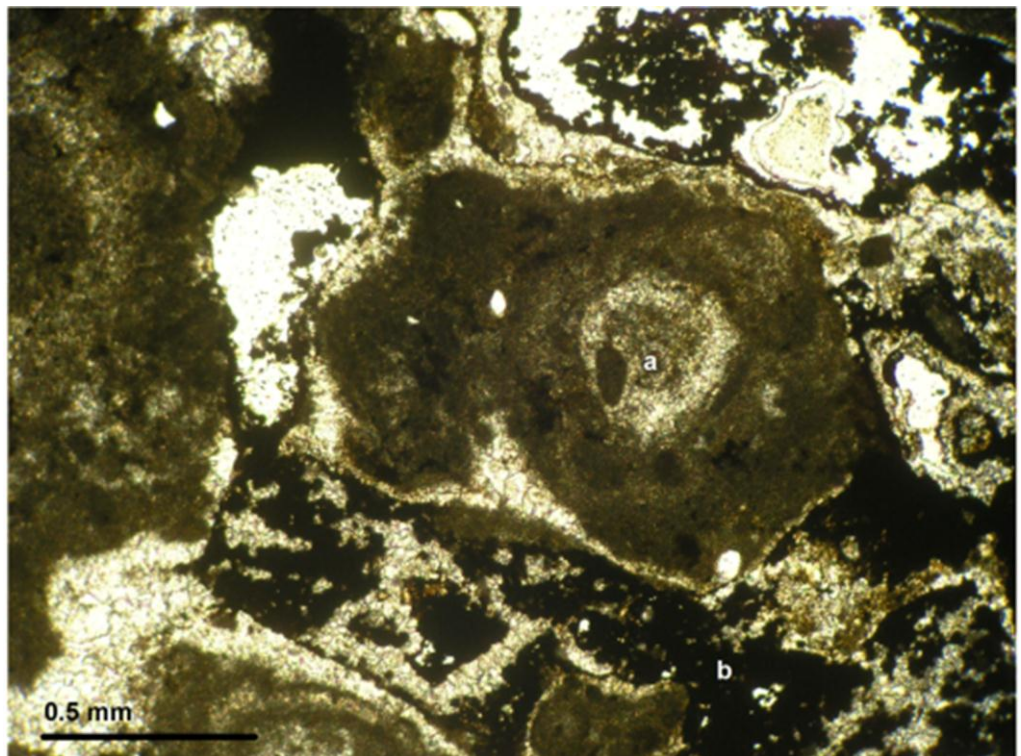


Photo 4: Oncoid with microcrystalline carbonate fenestral void fill. Note manganese oxide and goethite void fill surrounding oncoid. Crossed polars.

Sample No MSRS005

Location

644879E, 6740058N (GDA94 Z53)

Texture

Vuggy limestone. Manganese oxide and Goethite fracture fill. Peloidal and oncoidal grains within clotted matrix

Carbonate Grains

5% peloids, 20% oncoids, 7% lumps, tr. bioclasts.

Siliciclastic Grains

1% quartz.

Voids

5% fenestral, 5% inter-particle, 5% filled, 5% partially filled

Carbonate Mud

-

Cements

3% microcrystalline, 4% bladed, 4% granular, 1% Crustal

Other

15% goethite (staining and particulate), 20% manganese oxide (ovoid particulate, dendritic void fill).

Comments

Goethite and manganese oxide compose a large percentage of material - usually as inter-laminar deposits, rounded precipitate grains or void fill. Oncoids are micritic porostromate oncoids either round or shrub laminated construction. Internal fibrous structure evident. Similar to MSRS004.

Classification

Oncoidal grainstone.

Interpretation

Shallow turbulent tail environment on established mound.

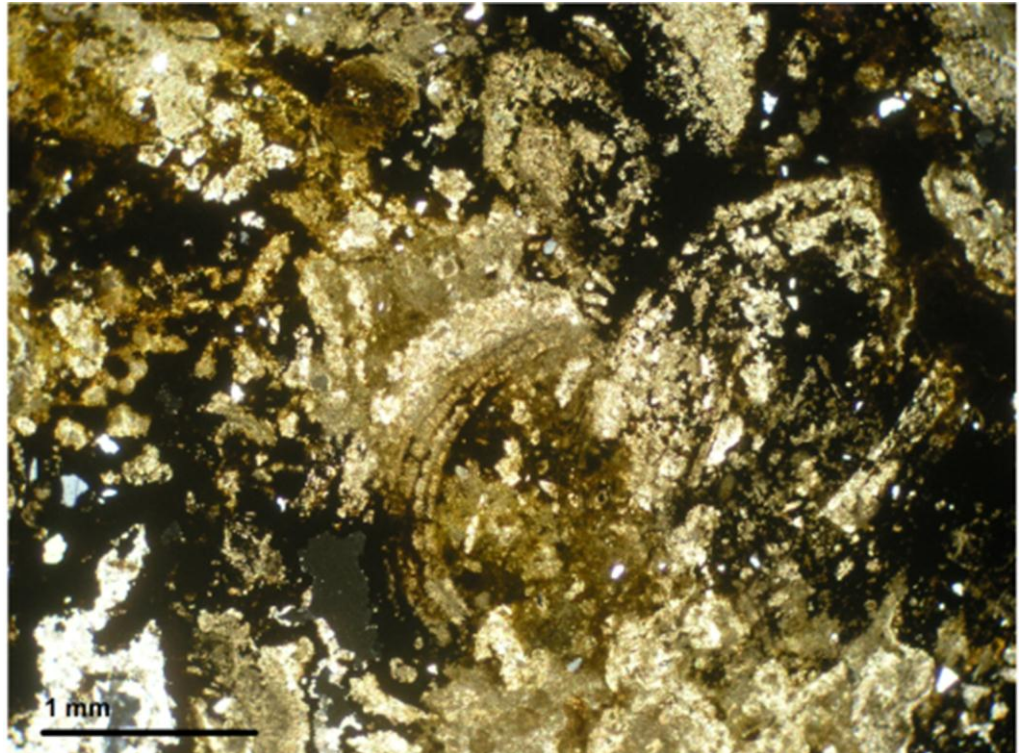


Photo 1: Goethite and manganese oxide void fill. Note corroded nature of carbonate textures (b).
Crossed polars.

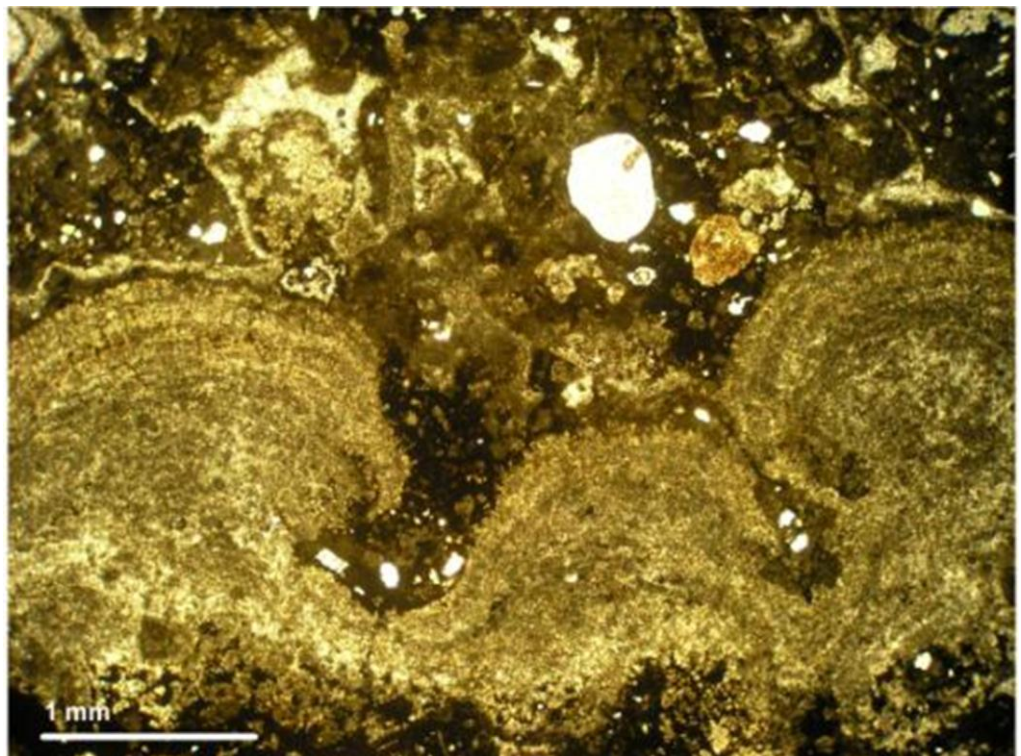


Photo 2: Oncooids in profile, forming shrub-like depositional texture. Matrix composed of peloidal carbonate manganese oxide and goethite. Plane light.

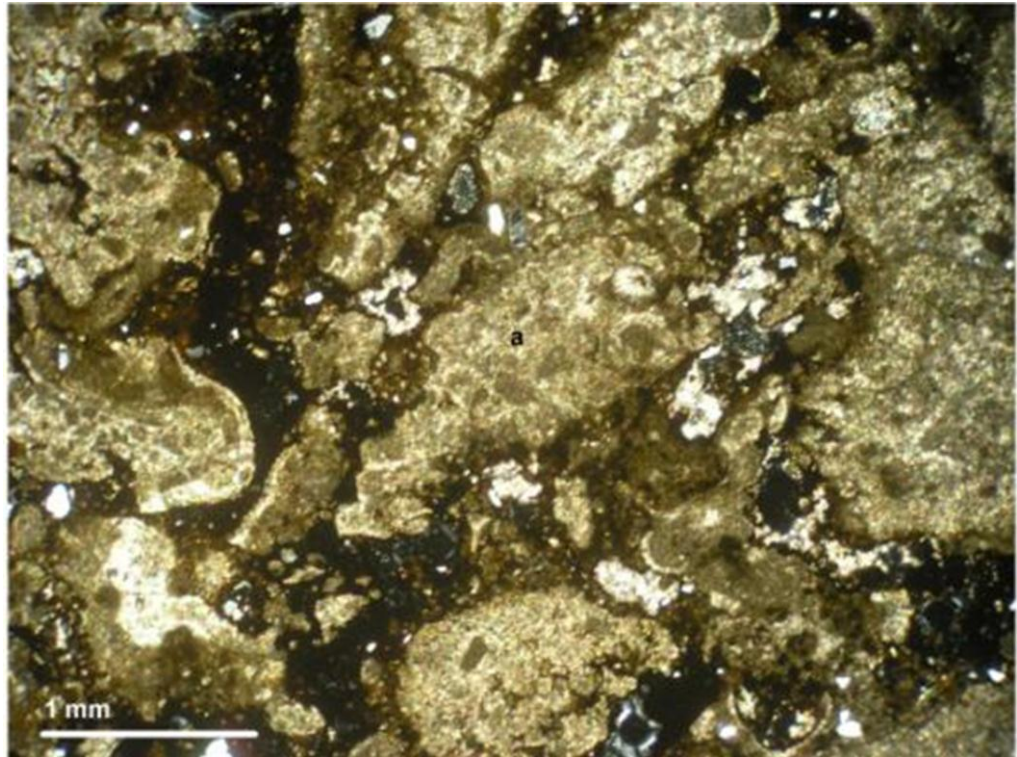


Photo 3: Renalcid (?) texture composed of micrite and microspar, with fenestra filled with peloidal carbonate, manganese oxide, goethite and carbonate cements. Crossed polars.

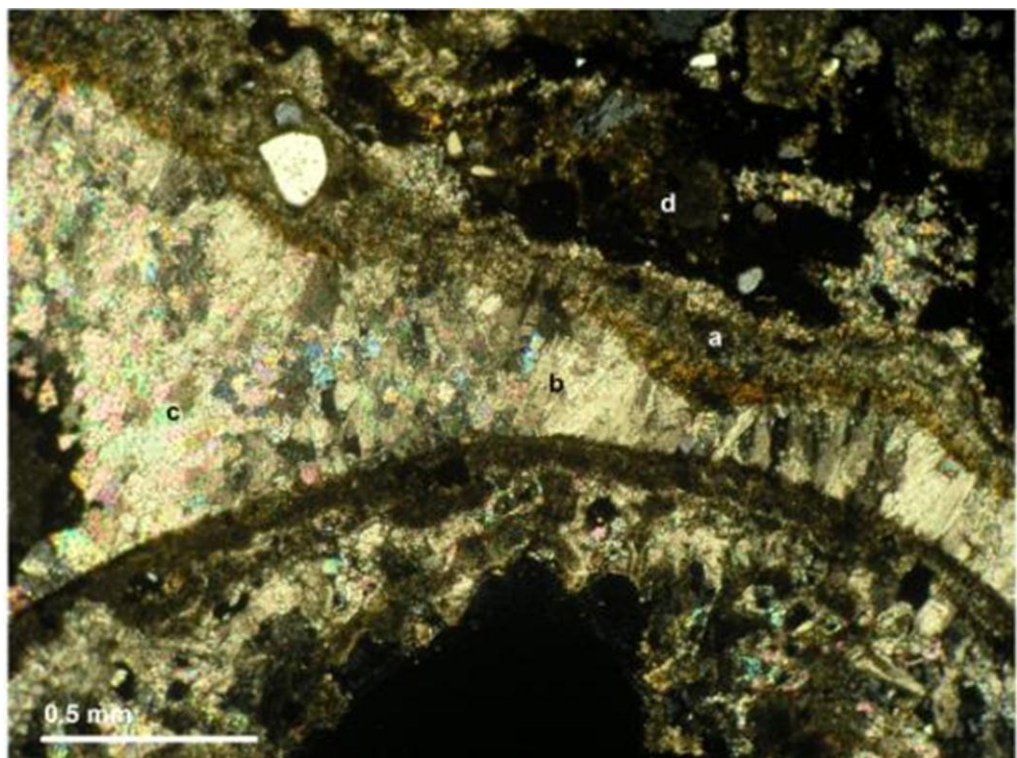


Photo 4: Carbonate cementation. The first cementation represented here is a microcrystalline, which appears crustal in the larger void. This is preceded by bladed cementation and then finally granular within the larger void. Manganese oxide and goethite occupy space in earlier cementation phases. Crossed polars.

Sample No MSRS007

Location

645013E, 6739947N (GDA94 Z53)

Texture

Fine grained massive calcareous root casting (calcrete)

Carbonate Grains

1% peloids (neomorphic alteration into microspar)

Siliciclastic Grains

15% quartz sand, 2% plagioclase.

Voids

1% fractures (shrinkage).

Carbonate Mud

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Cements

Microcrystalline spar matrix (neomorphic alteration?). Circum-granular deposition around sand grains.

Other

1% goethite staining deposited as rim near edge of sample, 1% dendritic manganese oxide

.Comments

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Classification

Caliche (Calcrete).

Interpretation

Vadose zone caliche deposit.

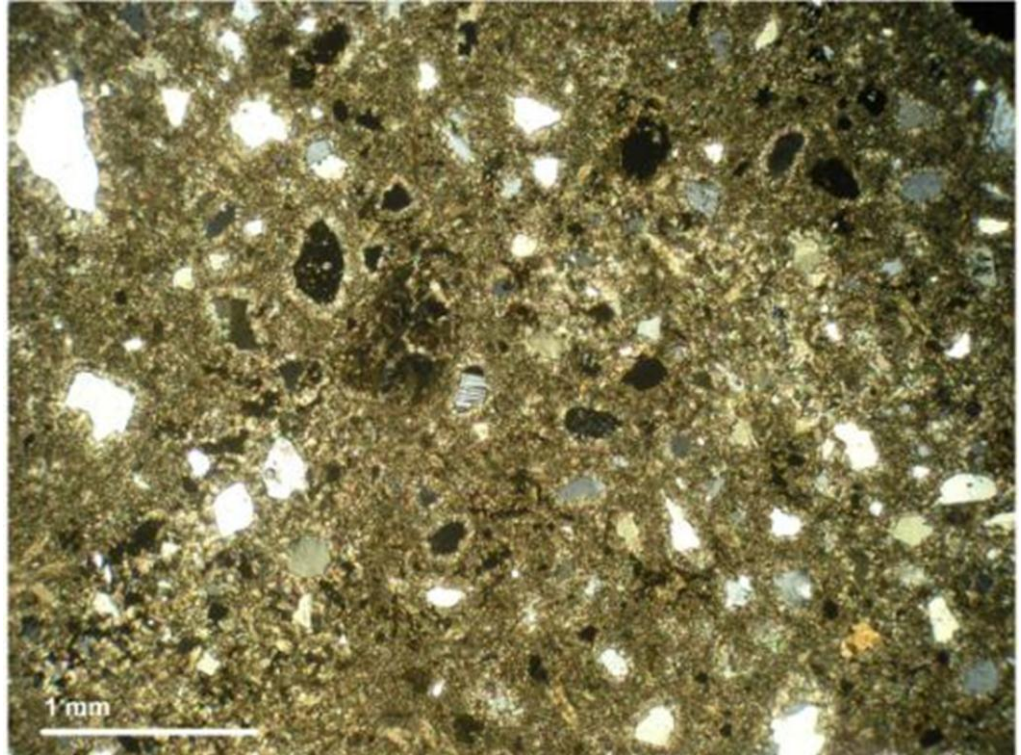


Photo 1: Siliciclastic sand grains in microspar matrix. Circum-granular CaCO₃ deposition on contacts with sand grains. Crossed polars.

Sample No MSRS008

Location

644925E, 6740021N (GDA 94, Zone 53)

Texture

Clotted micritic matrix with clastic particles. Fenestral voids and some shrub textures. Neomorphic alteration apparent.

Carbonate Grains

15% peloids, 10% pisoids, 5% oncoids, 8% lumps, 1% bioclasts. Many of the peloids and oncoids appear broken.

Siliciclastic Grains

2% quartz

Voids

10% fenestral, 5% inter-granular, 1% fracture.

Carbonate Mud

36% (partially altered).

Cements

5% microspar, 5% granular, 5% micritic, 1% bladed, 10% filled, 5% partially filled
1% unfilled.

Other

2% Goethite staining.

Comments

Carbonate and silicate clasts indicate that sample was deposited at the base of a mound. Complicated diagenetic history involving cementation, neomorphic alteration, fractionation and possible dissolution. Broken oncoids, clasts and dislocated void fills indicate depositional history.

Classification

Fenestral clastic floatstone.

Interpretation

Ancient vegetated tail environment at base of mound.

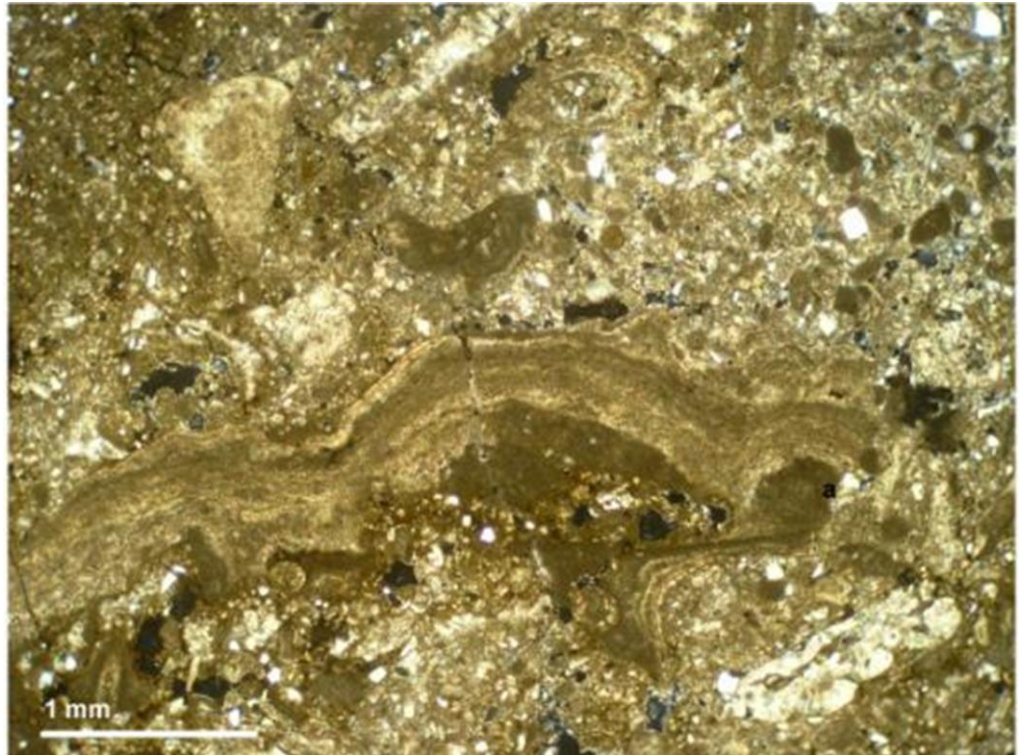


Photo 1: Laminated micritic material displaying evidence of fragmentation. Note fracture on right hand side of image. General matrix composed of peloidal micrite and detrital quartz sand. Plane light.

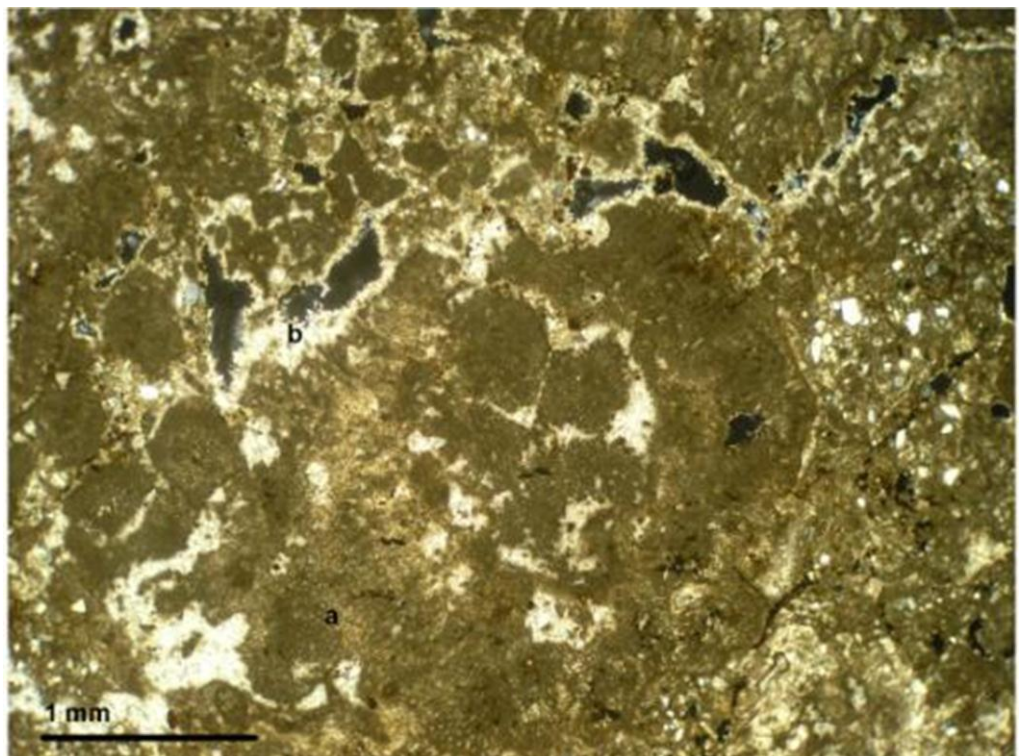


Photo 2: Broken porostromate oncolite in center of the image. Small point and tube-like fenestra radiating away from a core composed of four segments. Fracture towards top of image partially filled with meniscus and microspar cement. Crossed polars.

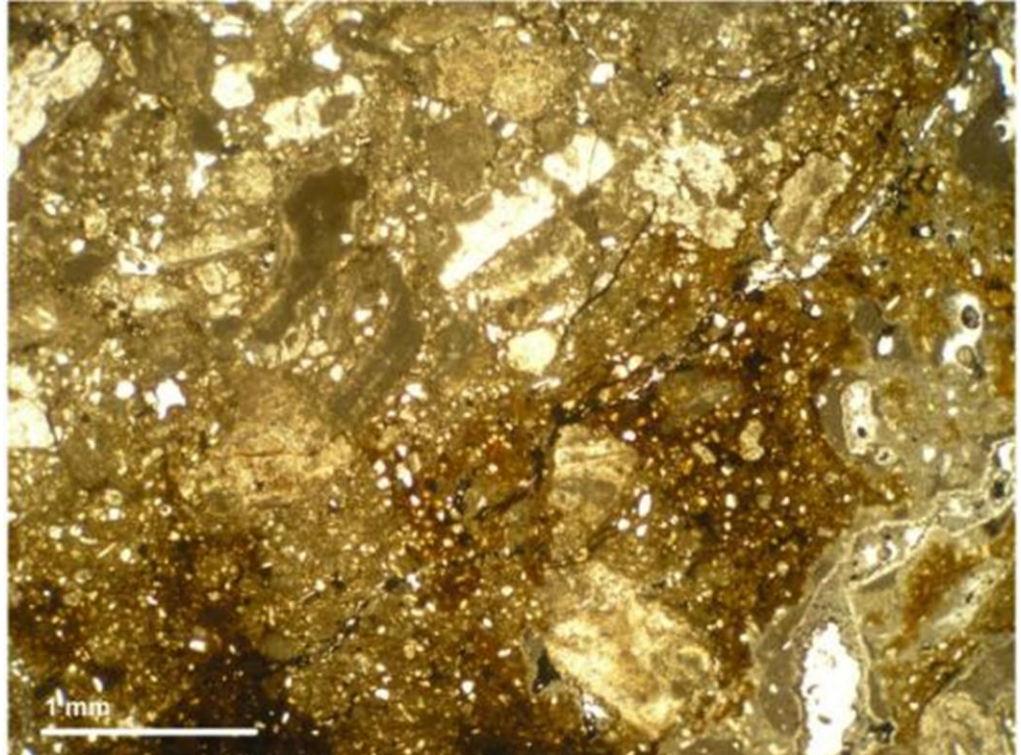


Photo 3: Micrite and detrital quartz sand matrix with fractured carbonate clasts. Heterogeneously distributed goethite overprint associated with fractures Crossed polars.

Sample No MSRS010

Location

644883E, 6739952N (GDA94, Zone 53)

Texture

Matrix material composed of micrite with quartz sand with sparry inter-granular cement. High goethite content.

Carbonate Grains

40% lumps and clasts, tr. bioclasts, 1% peloids.

Siliciclastic Grains

2% quartz.

Voids

25% inter-granular/ dissolution, 5% fracture. 18% filled, 10% partially filled, 2% unfilled.

Carbonate Mud

9%

Cements

10% bladed, 10% granular, 5% microspar, 3% micritic.

Other

20% goethite

Comments

Clasts formed via dissolution of original rock material. Clasts are goethite stained, particularly around edges. Fractures have high proportion of goethite precipitate.

Classification

Clastic wackestone.

Interpretation

Relict calcareous clastic tufa at base of mound/ within tail.

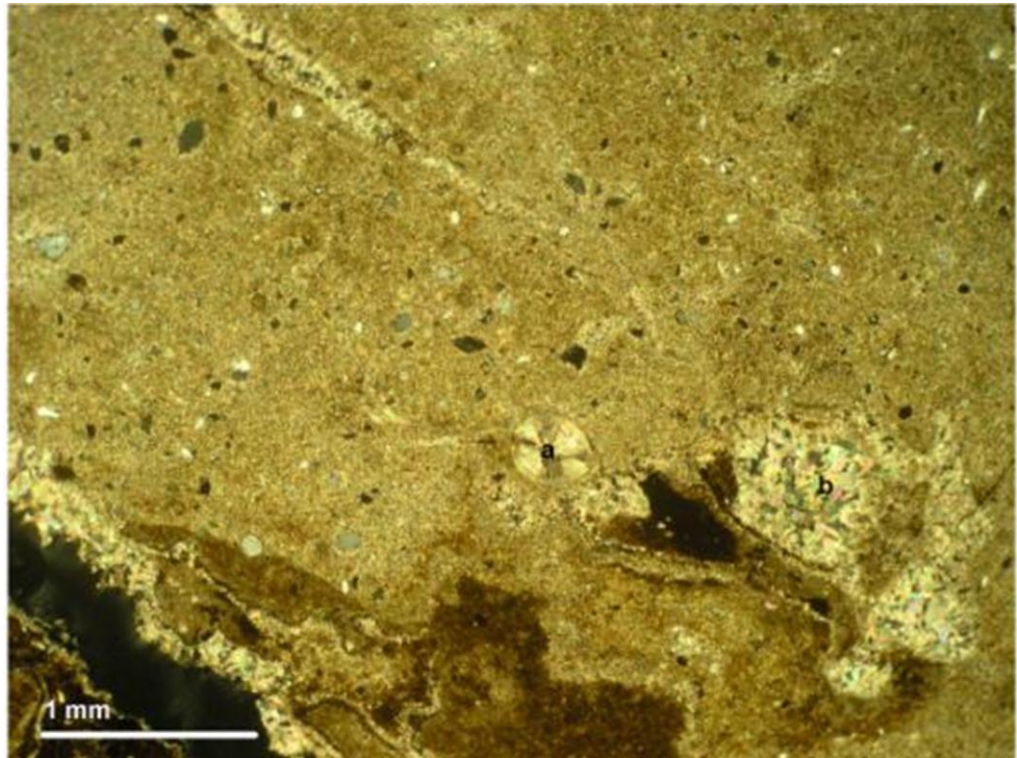


Photo 1: General matrix of micrite/ microspar and detrital quartz sand. Ostracod and fenestral void near centre of image has been filled with granular and radial fibrous cement. Crossed polars.

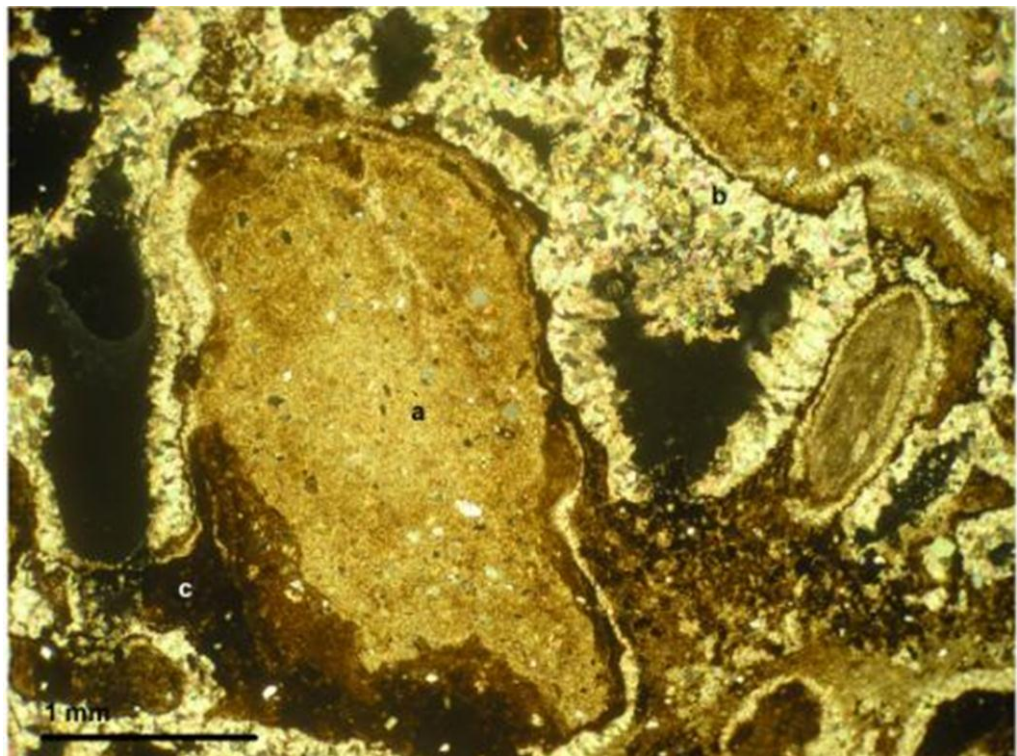


Photo 2: Clasts of micritic tufa with inter-clastic voids partially filled with microspar, micritic, bladed and granular cement. Note that goethite has partially filled void and has also partially infiltrated calcareous clasts. Crossed polars.

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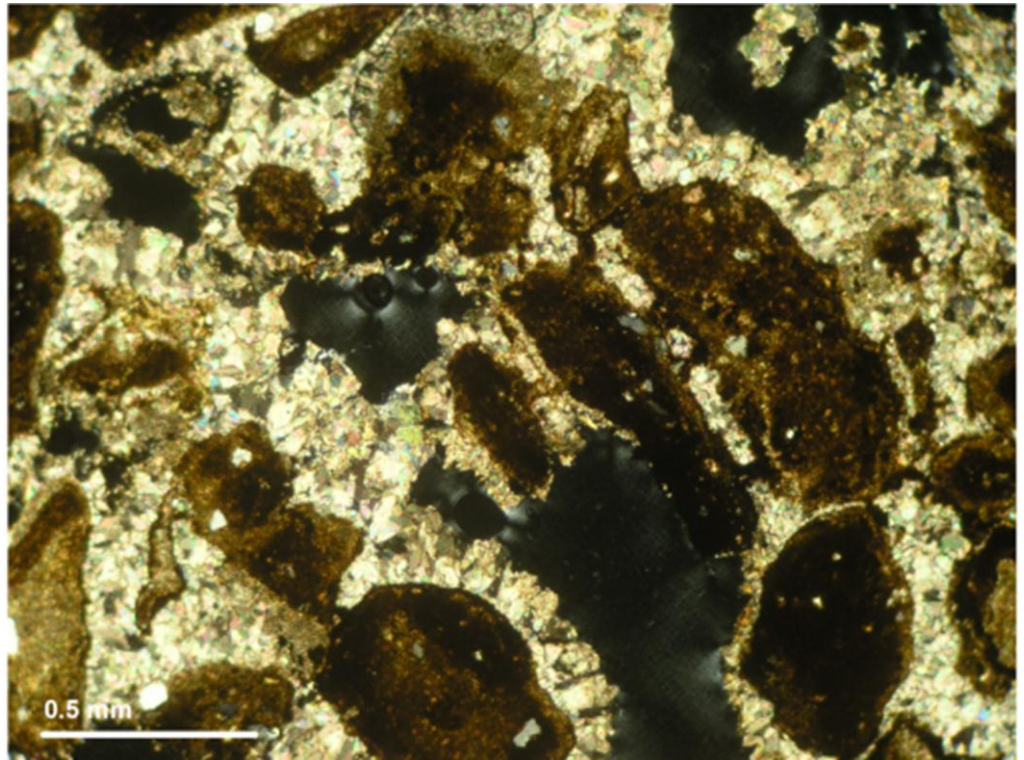


Photo 3: Closer shot of goethite-stained carbonaceous clasts with micro-spar bladed and granular, partial inter-clastic void fill. Crossed polars.

Sample No MSRS011

Location

644852E, 6740080N (GDA94, Zone 53)

Texture

Peloidal micrite with fenestra after hydrophytes. Modern phytohermal tufa.

Carbonate Grains

2% bioclasts, 25% peloids, 2% oncoids.

Siliciclastic Grains

Tr. Quartz silt and zircon.

Voids

35% fenestral, 5% inter-granular 2% moldic. 35% unfilled, 7%, partially filled.

Carbonate Mud

25%

Cements

5% microspar, 5% micritic, tr. bladed.

Other

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Comments

Micrite and micritic peloids compose bulk of material. Peloids, shrub textures and oncoids indicate role of microbes in controlling deposition of carbonate. Fenestral textures largely to do with root and reed casting. Some cementation indicates rapid drying environment.

Classification

Fenestral mudstone.

Interpretation

Modern phytohermal tufa. Modern tail environment.

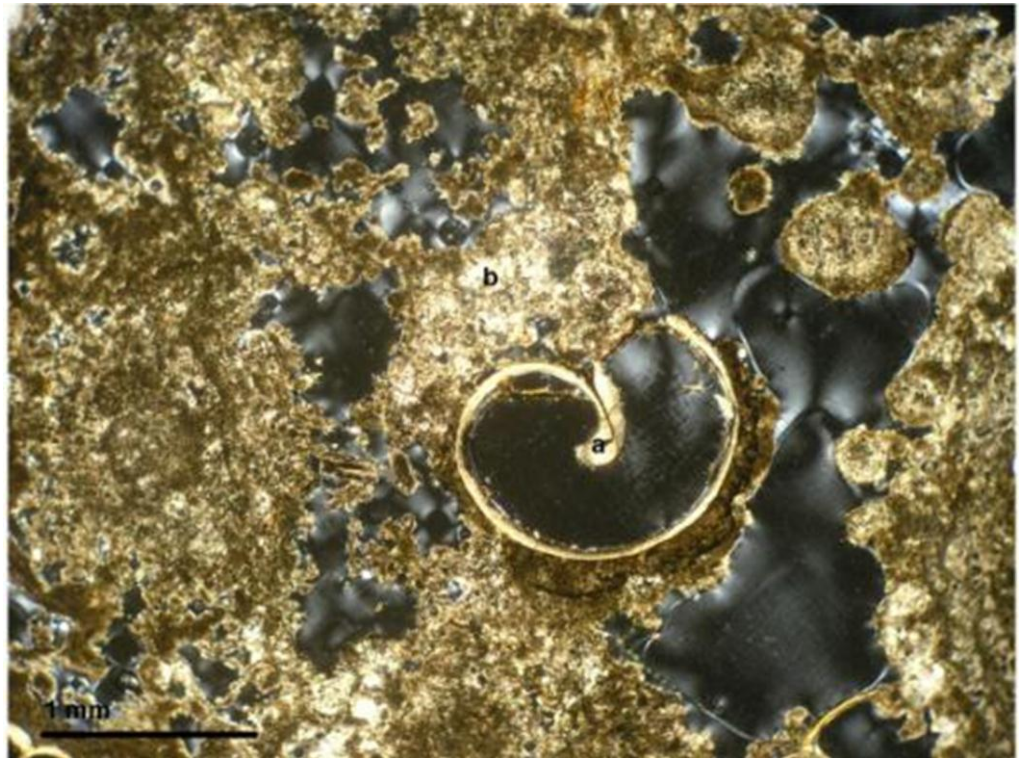


Photo 1: Gastropod bioclasts set within clotted and peloidal micritic matrix. Microspar and meniscus cement has partially filled fenestral voids. Crossed polars.

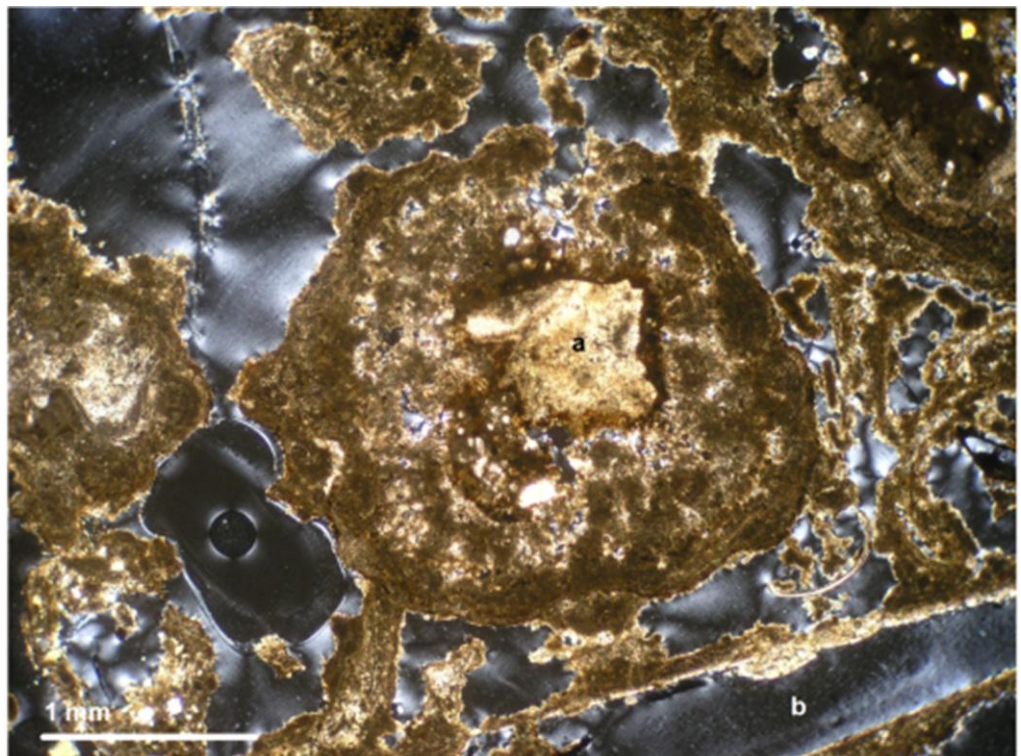


Photo 2: Porostromate oncolite with sparry clast (?) as nucleus. Clast appears partially coated/infiltrated with goethite. Bioclast and reed castings observable near the bottom right of image. Crossed polars.

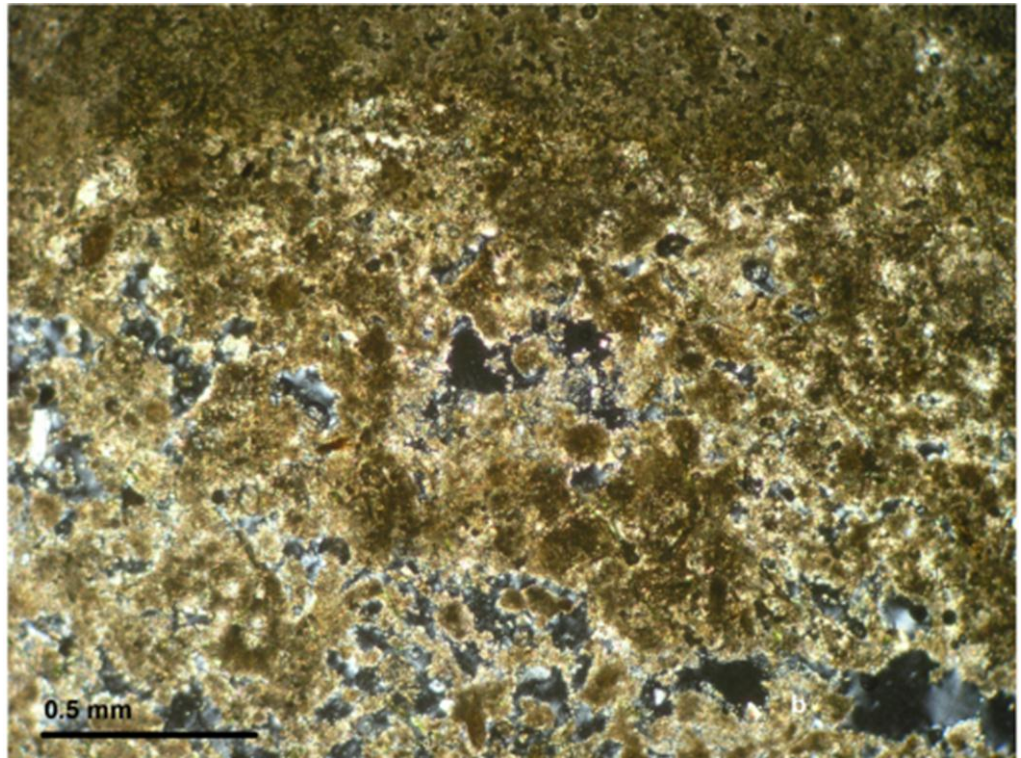


Photo 3: General peloidal and clotted micritic matrix. Inter-particle voids partially filled with meniscus and microspar cement. Cross polars.

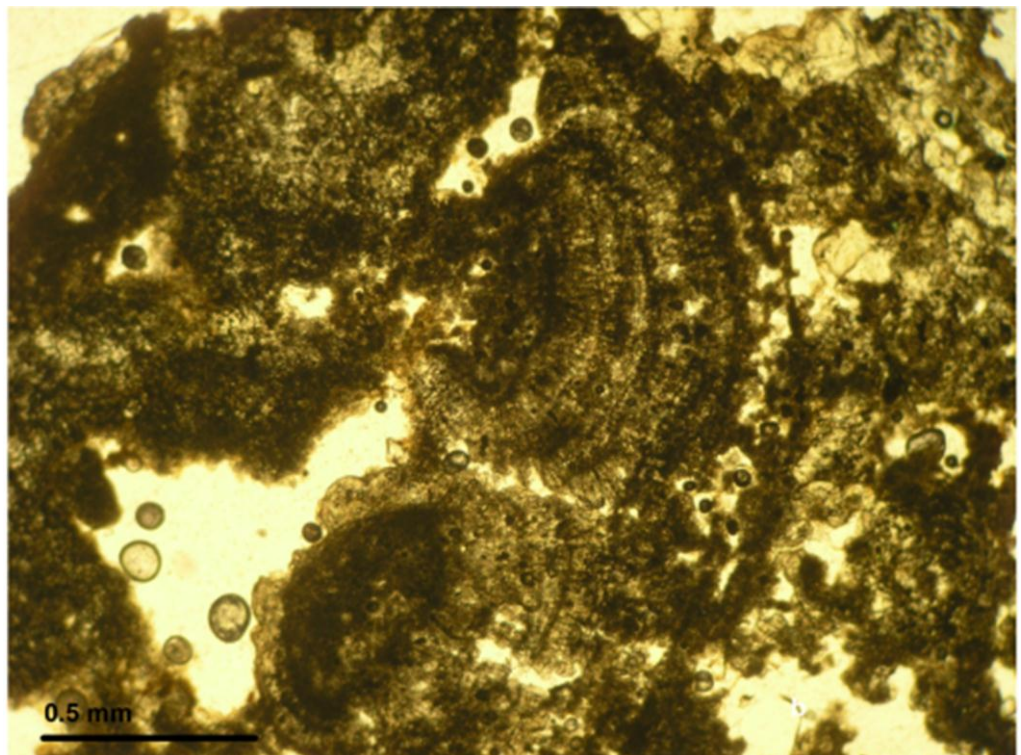


Photo 4: laminated microbial shrub texture. Laminations show potential seasonal growth. Growth also appears to favour one side. Plane light.

Slide descriptions for samples collected at Beresford (“Little Beresford”) Spring

Sample No LBSRS001

Location

661628E, 6761620N (GDA94 Z53)

Texture

Fine grained oncoidal limestone. Clotted micritic matrix.

Carbonate Grains

38% Oncoids, 5% peloids, 2% fossils (gastropods, ostracods, bivalves charophytes).

Siliciclastic Grains

1% Quartz silt and sand.

Voids

5% rounded, 1% intra-particle (bioclasts), 2 % fenestral (largely oncoidal intra-particle), 2% moldic.

Carbonate Mud

47%

Cements

3% microcrystalline, 2% micritic, 1% granular, 1% felted, 2% bladed/fibrous (some show laminated zonation and undulose extinction). Geopetal cementation evident – partly drusy.

Other

tr. zircon, tr. goethite

Comments

Internal lamination structures within oncoids are very faint- possibly recrystallised. Shell fragments often dissolved or recrystallised

Classification

Oncoidal wackestone.

Interpretation

Shallow, poorly vegetated, tail environment.

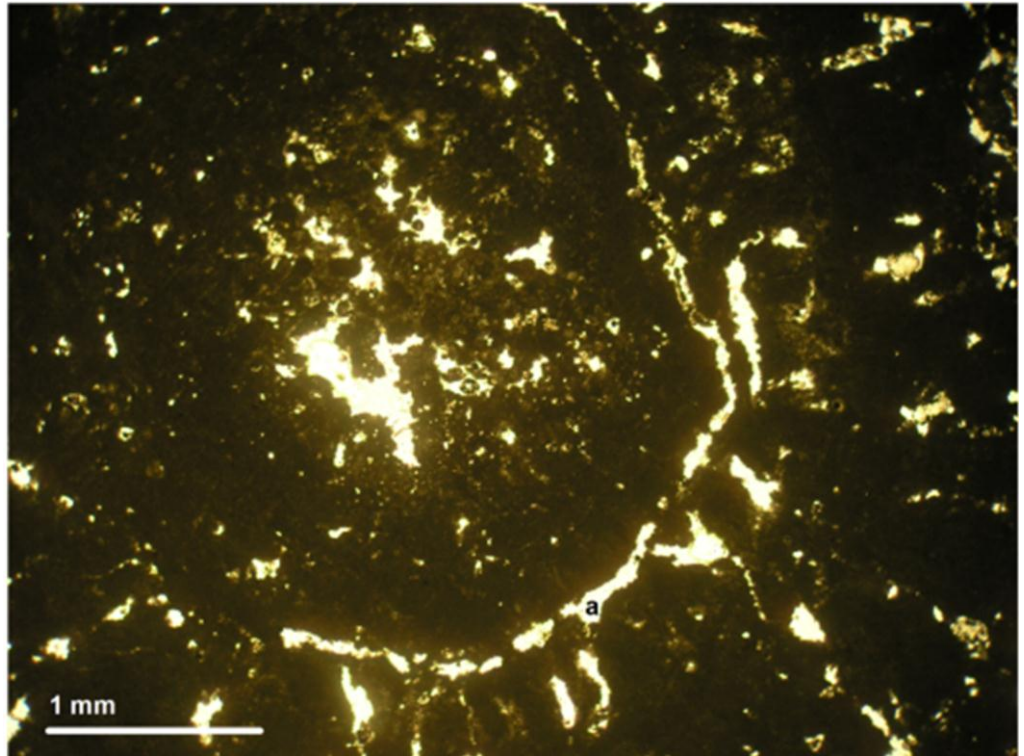


Photo 1: Fenestral unfilled voids (a) associated with an oncolite. Matrix composed of micritic cement. Plane light.

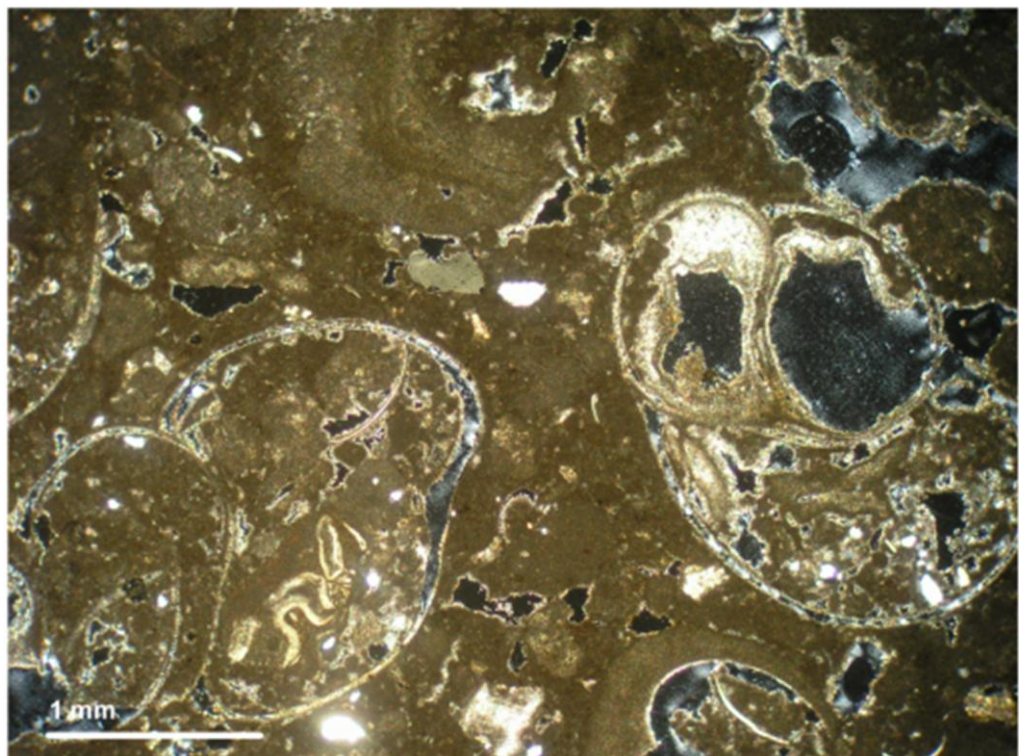


Photo 2: Gastropod shells in peloidal (clotted?) matrix. Intra-particle void fill consists largely of matrix muds, and particles, with geopetal laminated microcrystalline cementation evident. Crossed polars.

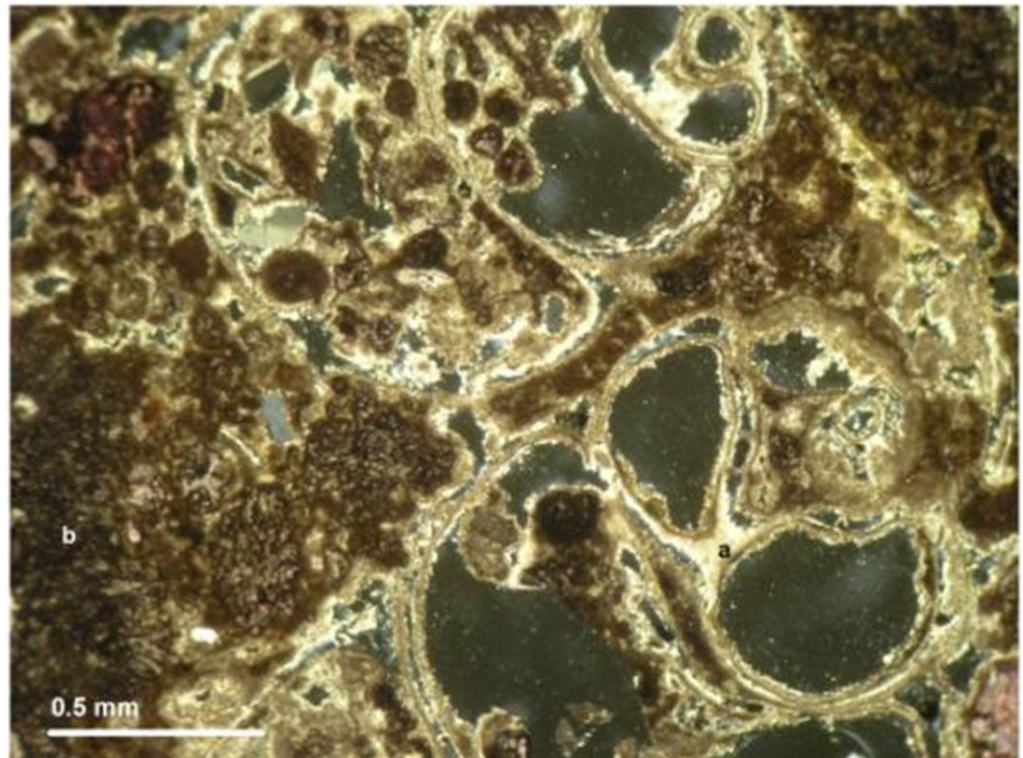


Photo 3: Gastropod shells in peloidal (clotted?) matrix. With partial micritic and microspar geopetal void fill. Later stage microspar cement (a) is dolomitic. Crossed polars.

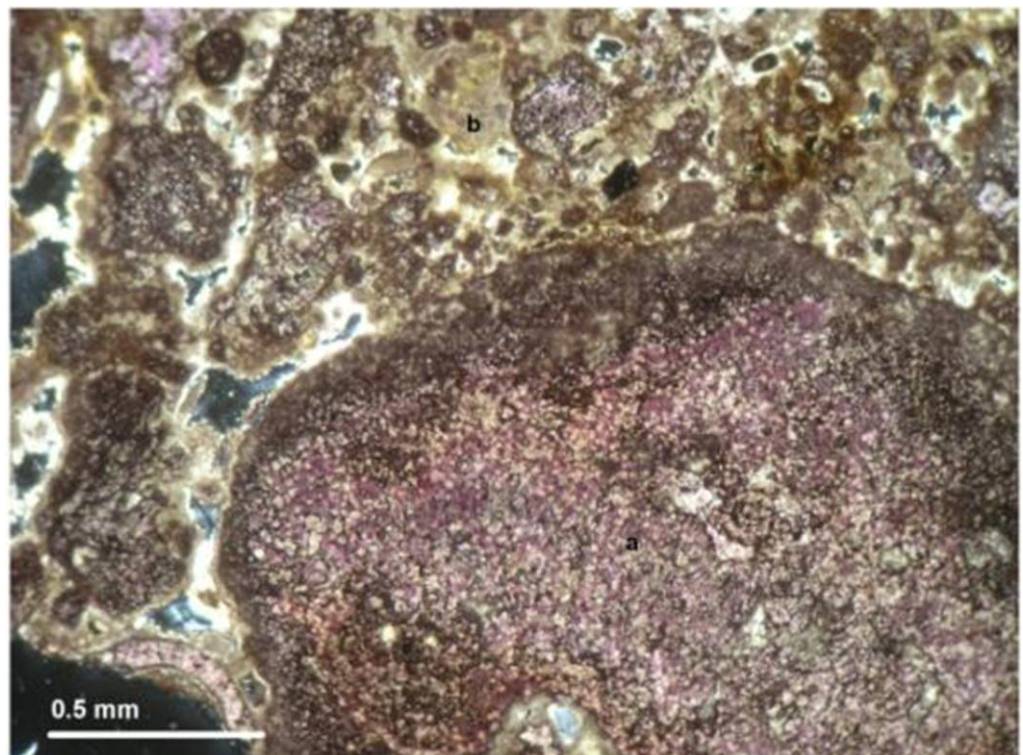


Photo 4: Pinkish-mauve porostromate microbial textured bioclast. Note unstrained dolomite that appears as small subhedral rhombs. Mauve material interpreted to be ferroan calcite. Crossed polars.

Sample No LBR002

Location

661660E, 6761635N (GDA94 Z53)

Texture

Clotted and renalcid texture composes most of slide. Edges of slide have a composite vuggy texture of clastic carbonate grains, peloids oncoids and carbonate cement. Large fragments of carbonaceous clastics present in sample

Carbonate Grains

2% peloids, 2% oncoids, 7% lumps, 10% Carbonate clastics, tr. fossils.

Siliciclastic Grains

1% quartz, largely in carbonate clastic fragments.

Voids

5% shrinkage fractures, 1% intra-particle, 4% fenestral, 5% partially filled, 5% filled.

Carbonate Mud

55%

Cements

6% microcrystalline, 5% micritic, 1% fibrous radialial, 1% bladed.

Other

1% Goethite - microbial tubing fill.

Comments

Appears to show deposition of large carbonate fragments in an otherwise a relatively quiescent environment of carbonate mud deposition in an environment conducive for microbial activity. Shrinkage cracks and microcrystalline cements indicate potential for sub-aerial exposure. Carbonate clastics show high degree of alteration due to weathering: shrinkage cracks that give the fragments a "tessellated" appearance, goethite staining is prevalent and the higher proportion of siliciclastic material indicated a different provenance from the rest of the sample.

Classification

Clastic microbial wackestone.

Interpretation

Very shallow, sparsely vegetated mud flat, near the base of the mound.

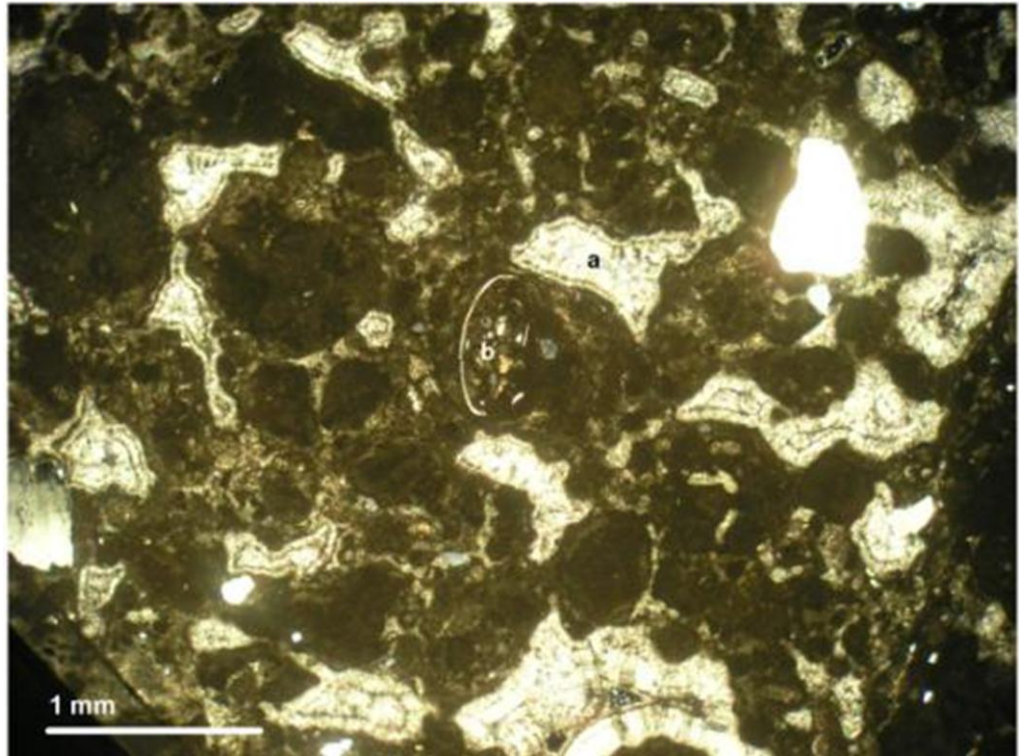


Photo 1: Peloids and lumps with rounded fenestral voids filled with laminated fibrous radiaxial and microcrystalline cement. Meniscus cement also present. Fossil (ostracod?) in centre of image. Plane light.

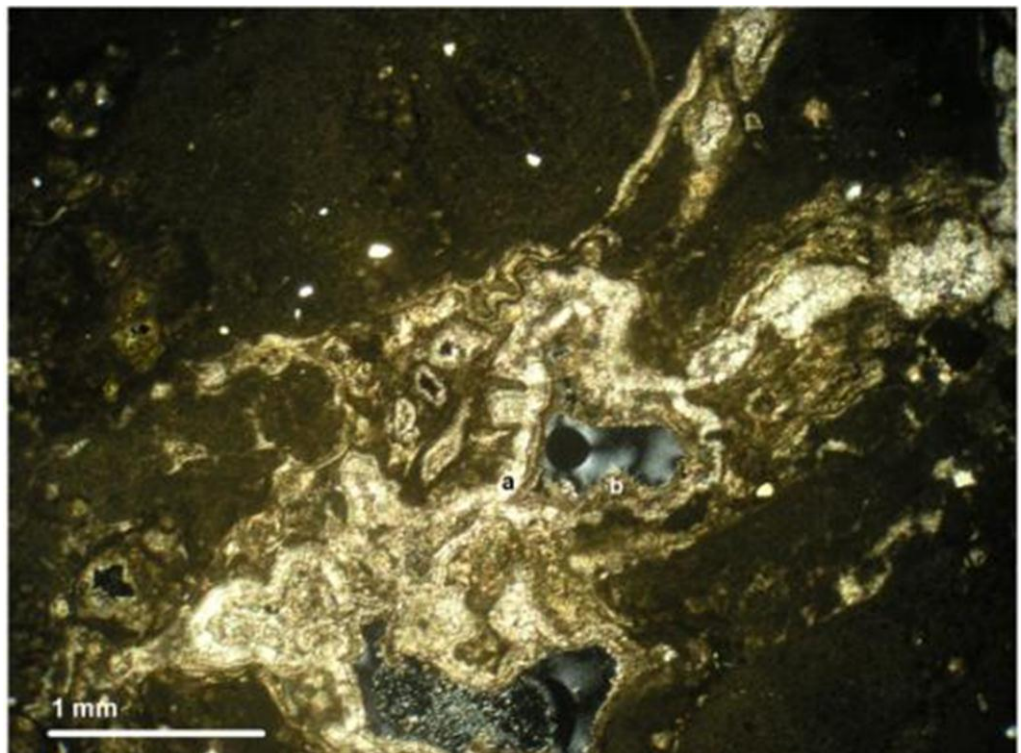


Photo 2: Laminated radiaxial fibrous and microcrystalline CaCO_3 cement fills fenestral and inter-particle void. Layered micritic cement occupies areas towards the edges and centre of the void. Clotted carbonate mud matrix. Shrub-like textures in cement and matrix may be indicative of microbial activity. Crossed polars.

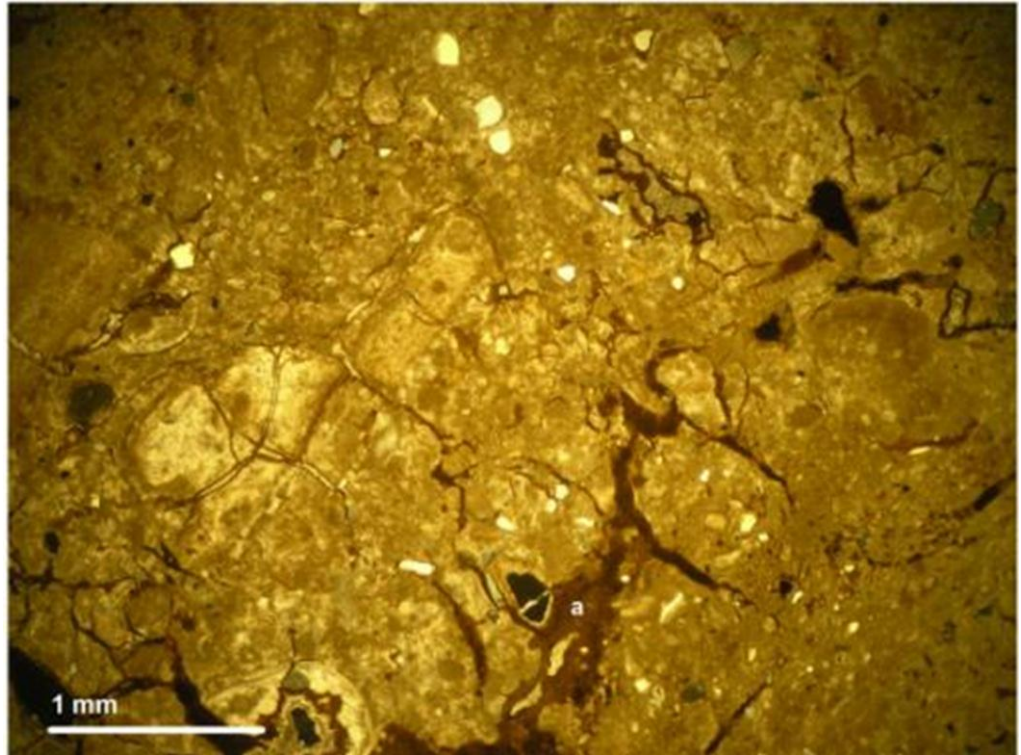


Photo 3: Clastic fragment within sample. Note shrinkage fractures that give sample a “tessellated” appearance. Goethite staining, particularly within fracture fill is prevalent. Blotched texture is a consequence of weathering. Plane light.

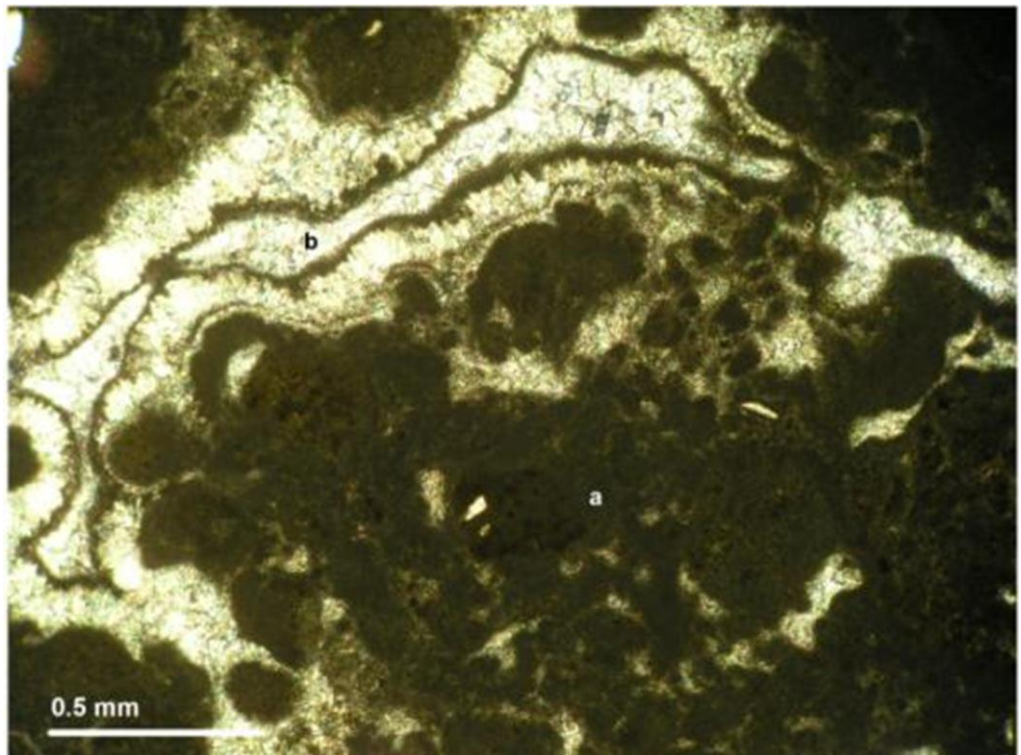


Photo 4: Peloidal carbonate mud after microbial activity. Fenestral and inter-particle CaCO_3 void fill takes the form of laminated bladed and microcrystalline cement. Layer of micritic cement also present. Crossed polars.