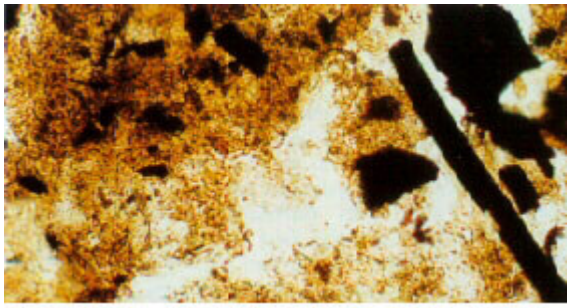
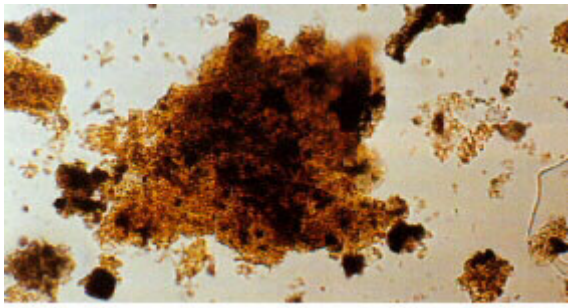
Kerogen image gallery index

These photographs and captions are mostly taken from Tyson, R.V. 1995, Sedimentary Organic Matter: Organic Facies and Palynofacies. Originally published by Chapman & Hall (December 1994), who were taken over by Kluwer Academic. The photographs are copyright protected. These images concentrate mainly on non-palynomorph particulate organic matter, plus some oil-prone "algal" palynomorphs. For other images see the organic matter links. I apologise that there are no scales given, but most of the particles displayed range from 20 to 400 micrometres in diameter.

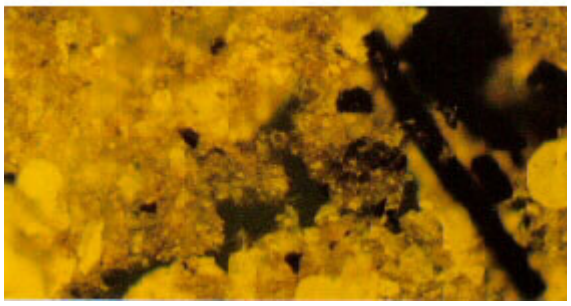
October 5, 2001

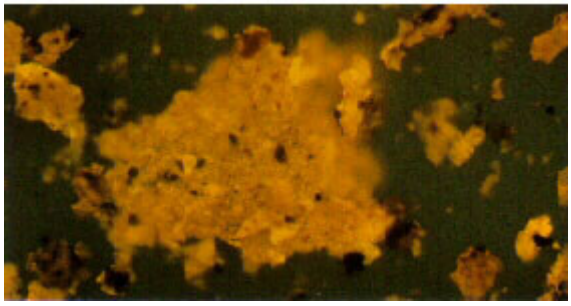


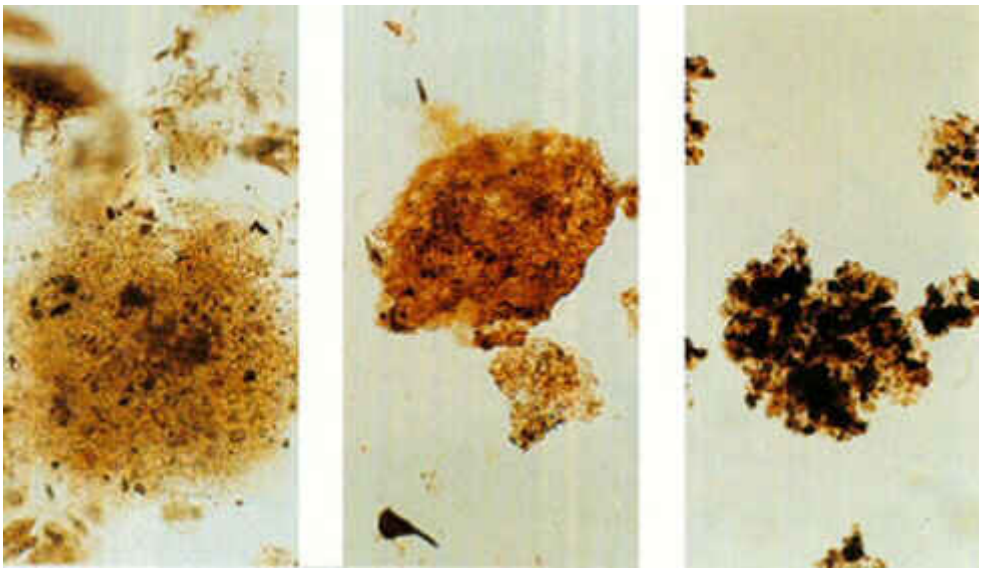
Well preserved 'AOM' seen in transmitted white light and under incident blue light fluorescence. Note that under fluorescence it can be seen that the 'AOM' consists of a dull fluorescing amorphous matrix rich in small unidentifiable fluorescent fragments (equivalent to the maceral liptodetrinite) plus other inclusions (palynomorphs, pyrite and small phytoclasts). The sample has a Type II kerogen composition (typical for such samples where this variety of 'AOM' dominates). Note the complete absence of fluorescence in the phytoclast particles. Sample NRG/EN94-17 (1), an NRG consulting outcrop sample from the Jurassic of W.Scotland, UK; slide prepared by Lexa Summerbell.



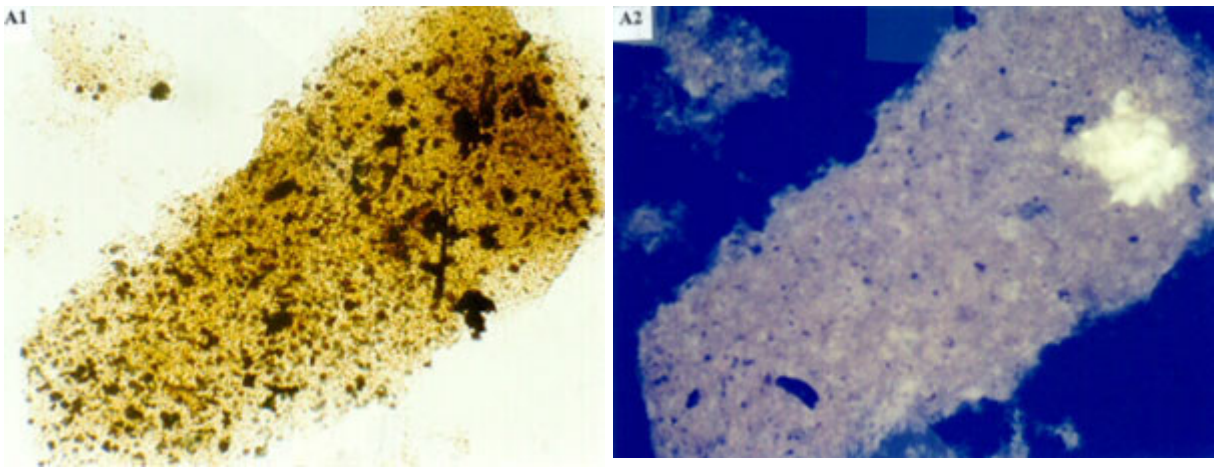
Well preserved 'AOM' seen in transmitted white light and under incident blue light fluorescence. Again note the liptodetrinitic nature of the 'AOM'. The sample lithology is laminated black shale. Sample RVT/P/2-6, Kimmeridge Clay Formation, Kimmeridgian-Volgian, core sample from well 16/29-2, Maureen Field, Northern North Sea (see Tyson, 1989); slide prepared by Robertson Research.



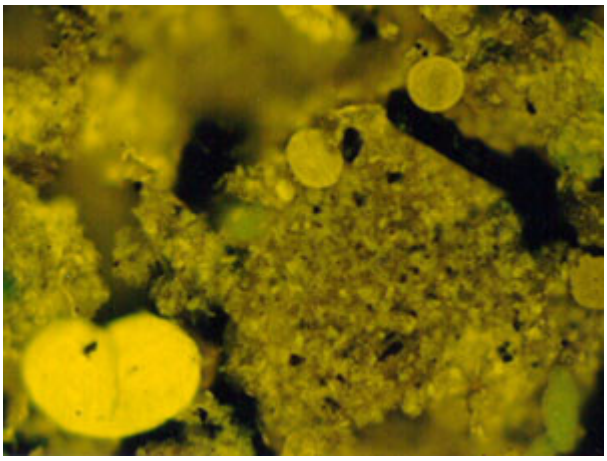




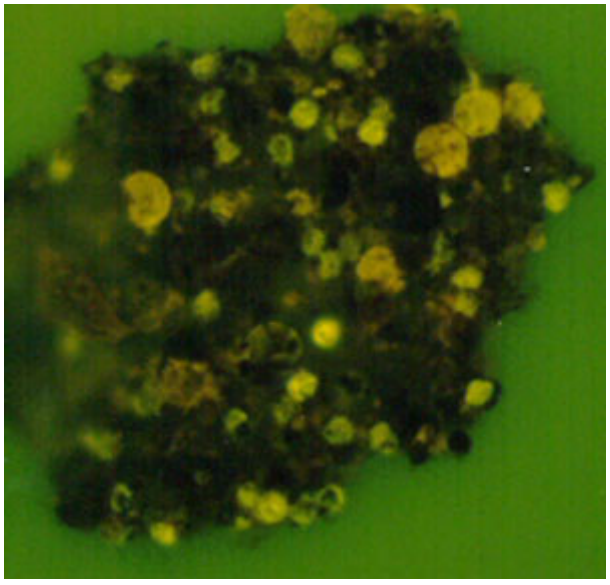
Left: Diffuse edged 'AOM' particle seen in transmitted white light. The form of the edge and the presence of the inclusions indicate that the particle is structureless and not therefore a phytoclast. Sample AOT/BL 18, Westbury Formation, Rhaetic, BGS Blyborough borehole, Humberside, UK; slide prepared by Ali Tuweni.
Centre: 'AOM' particle showing many imprints of coccoliths (small indentations on the surface), giving a pseudostructured appearance. Sample RVT/WS 16, Kimmeridge Clay Formation, mid Volgian, Kimmeridge, Dorset, UK; sample prepared by Robertson Research, courtesy of Les Riley.
Right: Granular variety of 'AOM' which consists of irregular brown granules in an amorphous matrix. The origin of the granules is uncertain, but they do not appear to be conventional phytoclasts. Sample RVT/DSDP535/43-3: 20-22cm, Unit III, early Aptian, DSDP Site 535, eastern Gulf of Mexico; sample prepared by Robertson Research, courtesy of Les Riley.

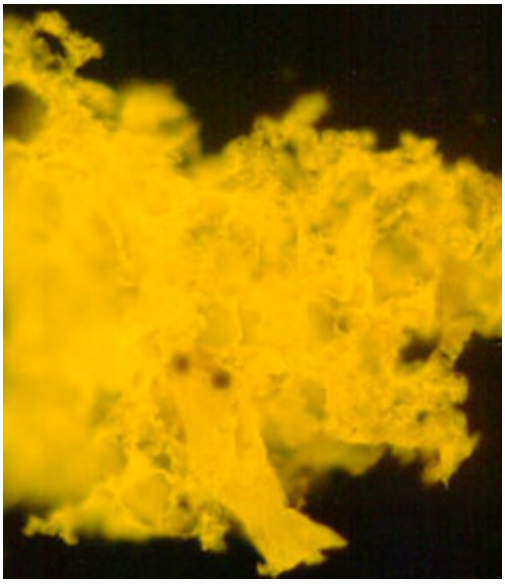


AOM seen under transmitted white light and incident blue light fluorescence (the difference in fluorescence colours is due to the use of different filters). The sample has a Type II kerogen composition. Photograph from Alastair Vincent (1995 thesis); see also Vincent & Tyson (1999). Sample KBK8, Kilmaluag Formation, Middle Jurassic, Skye, Scotland. Bright spot in fluorescent image is a probable Botryococcus fragment.



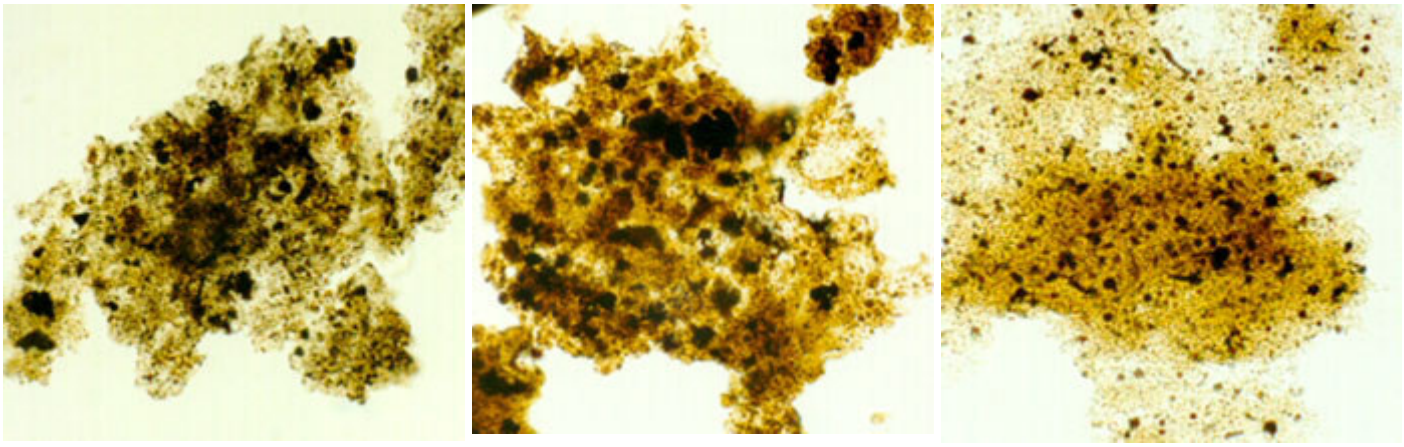
Pelicular 'AOM' sensu Combaz, seen under incident blue light fluorescence. Pelicular 'AOM' is that which has become deformed and imprinted by the growth of diagenetic carbonate crystals; when the rock is dissolved these imprints are left as craters in the kerogen, sometimes imparting a pseudocellular appearance to the 'AOM'. The very high fluorescence of the 'AOM' (6 - the maximum on my scale), and its overhwelming dominance in the sample suggests a Type I kerogen composition, and this was confirmed by very high hydrogen indices. The sample lithology is a dysoxic-anoxic lacustrine laminite rich in fish remains. Sample NRG/EN94 11 (1), Achanarras Fish Bed, Middle Old Red Sandstone, Devonian, Orcadian Basin, Caithness, Scotland, UK; NRG consulting outcrop sample.



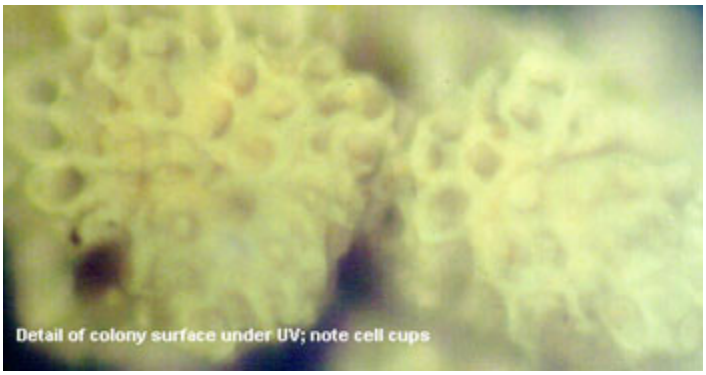


Moderately well preserved 'AOM' with a rather dull matrix, but very common small (<10micrometres in diameter), green-

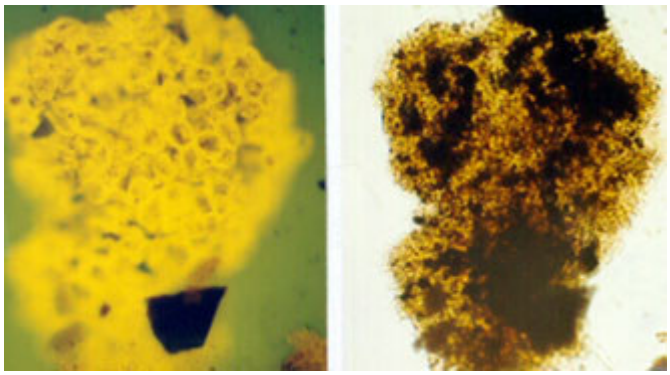
fluorescing micrhystridid acanthomorph acritarchs. The sample is from the deep sea, and it is probably that the 'AOM' matrix was partially degraded within the water column, but fnally preserved in a dysoxic reducing environment. The sample lithology is a laminated black shale. The kerogen composition is Type III, in this case indicating partial oxidation and not terrestrial derivation. Sample RVT/DSDP534/125-4, 140-142cm; Unit 7d, Callovian, DSDP Site 534, Blake Bahama Basin, western Central Atlantic (see Tyson, 1984); slide prepared by Robertson Research, courtesy of Les Riley.



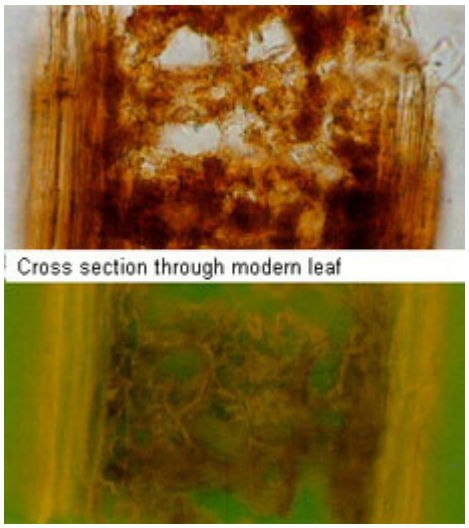
Three transmitted white light views of AOM particles. Note the subtle variations in form: the two examples on the left have a hetereogenous, "clotted" applearance, while that on the right is much more uniform and has a less distinct margin.



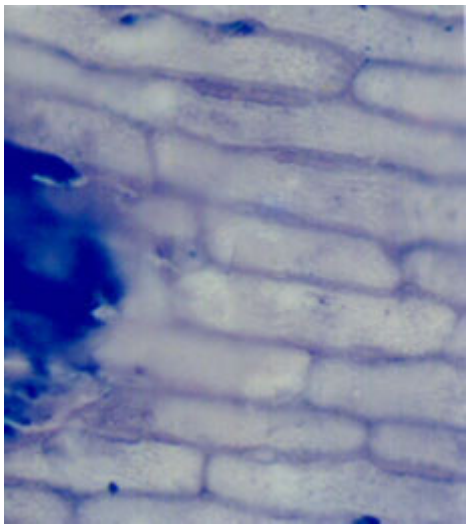
Detail of surface of Botryococcus colony seen in blue light fluorescence, and showing the empty cell cups on surface. Sample SC40, Hundale Sandstone, Scarborough Formation, Bajocian, Scalby Ness Borehole, Scarborough, Yorkshire; photograph by Adrian Piper (1995).



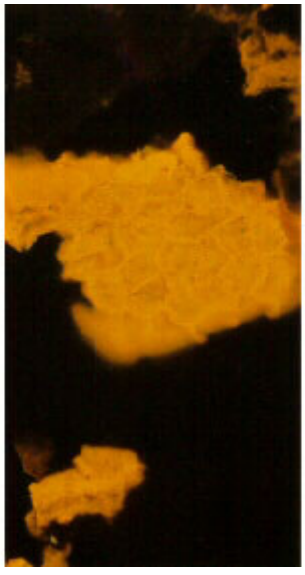
Colony of the freshwater alga Botryococcus colony seen in transmitted white light and blue light fluorescence. Note characteristic globular outline and lustrous yellow-orange colour. Sample SC40, Hundale Sandstone, Scarborough Formation, Bajocian, Scalby Ness Borehole, Scarborough, Yorkshire; photograph by Adrian Piper (1995).



Cross section of leaf fragment from Recent lake sediments, seen in both transmitted white light (upper) and incident blue light fluorescence (lower). The epidermis ('cuticle') is clearly visible as translucent rectangular cells, and also has a stronger and yellow fluorescence. The darker-coloured spongy mesophyll tissue is clearly morphologically less well preserved and has a weaker and orange coloured fluorescence; such material is often almost completely degraded during diagenesis or converted into phyllovitrinite, the cuticle usually becoming detached and separated. Sample DA 4a, Unit Ib, Late Holocene (SubAtlantic), Lake St. Moritz, Switzerland; slide prepared by Daniel Ariztegui.

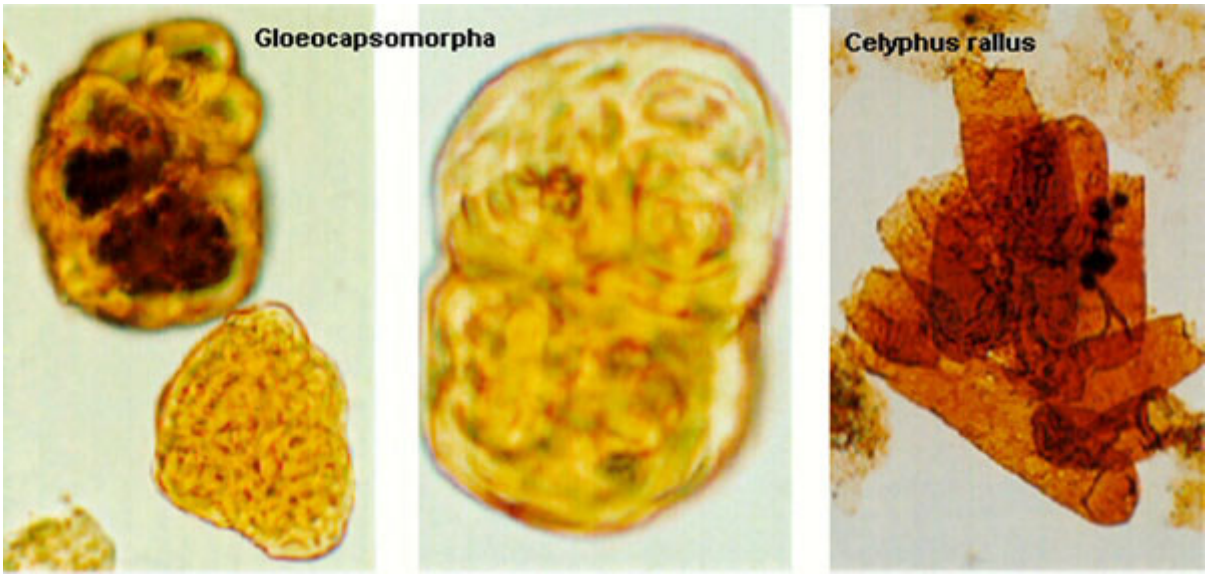


Close up of a fragment of cuticle, showing the cuticular flanges that define the boundaries between adjacent epidermal cells (the cells themselves do not survive). Short axis of cells 20 micrometres. Photograph from Alastair Vincent (1995 thesis); see also Vincent & Tyson (1999). Sample LOK28, Duntulm Formation, Middle Jurassic, Skye, Scotland.



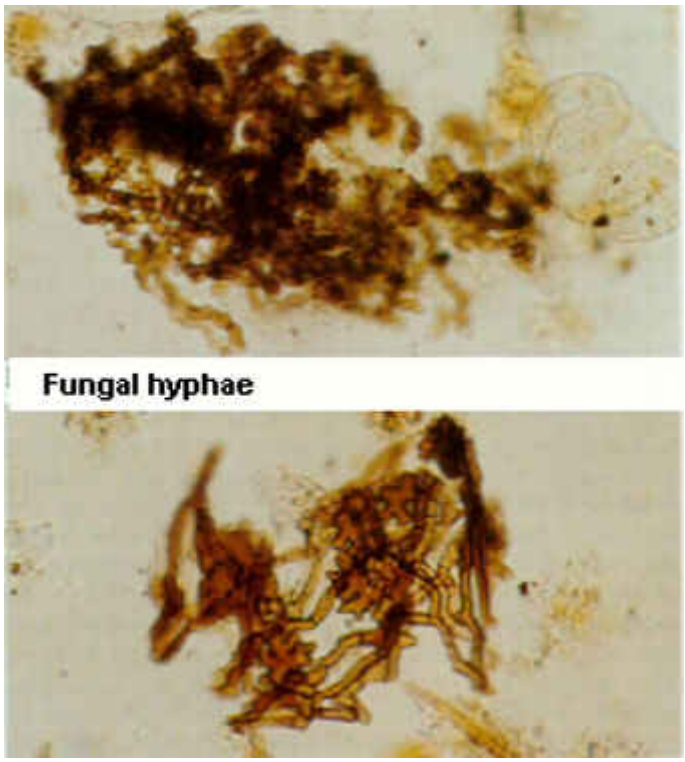
Left and centre: Dispersed cuticle phytoclast seen in both transmitted white light (left) and incident blue light fluorescence (centre). The distinct features of cuticle in immature sediments are the cellular outlines (in this case polygonal) picked out by the cuticular flanges (the cells themselves do not survive), the flat sheet-like character (often larger than most palynomorphs), the high translucency, pale yellow or orange colour, and the strong fluorescence which indirectly indicates an oil-prone composition. The colour may darken and fluorescence diminish during partial degradation under oxic regimes. Sample ATP/BM 58 (T), Saltwick Formation, Late Aalenian, BGS Brown Moor borehole, Yorkshire, UK; slide prepared by Adrian Piper.

Right: Dispersed cuticle phytoclast showing regular rectangular cell outlines (probably gymnosperm in origin). The relatively dark brownish matte colour and lack of fluorescence mainly indicate partial oxidation before or during final deposition, and thus loss of oil-generating capability. Sample RAOM 1, 'Rakb Shale', Late Cretaceous, subsurface of Ajdabia Trough, NE Libya; slide prepared by Rajab Ojaley.



Left and centre: Two small to medium sized colonies of Gloeocapsomorpha prisca (a probable extinct chroococcale cyanobacterium) seen in transmitted white light. Note the globular nature, the smooth exterior surface, lack of radial texture, lustrous appearance, and the presence of internal structure (after the original cells). The morphological resemblance to Botryococcus is only superficial. Gloeocapsomorpha has a very strong yellow to orange fluorescence. Sample RVT/AGD 1, Kukersite, Ordovician, Estonia; slide prepared by Alastair Vincent. Sample courtesy of Archie Douglas.

Right: Group of Celyphus rallus, a probably Rivulariacean freshwater cyanobacterium. Sample JGG '80 up', Wadhurst Clay, Wealden Group, ?Valanginian, BGS Fairlight borehole, near Hastings, Sussex, UK; slide courtesy of Jeff Goodall.



Tangled masses of melanized fungal hyphae (fragments of larger structures, therefore phytoclasts). Sample DA 12a, Unit II, Late Glacial, Lake St. Moritz, Switzerland; slide prepared by Daniel Ariztegui.

Upper: Large equidimensional (equant) opaque phytoclast. The nature of the particle terminations clearly shows the presence of internal microstructural grain (structure); such particles probably often break up into lath-shaped particles by splitting along the grain. Sample ATP/BM 58 (B), Saltwick Formation,

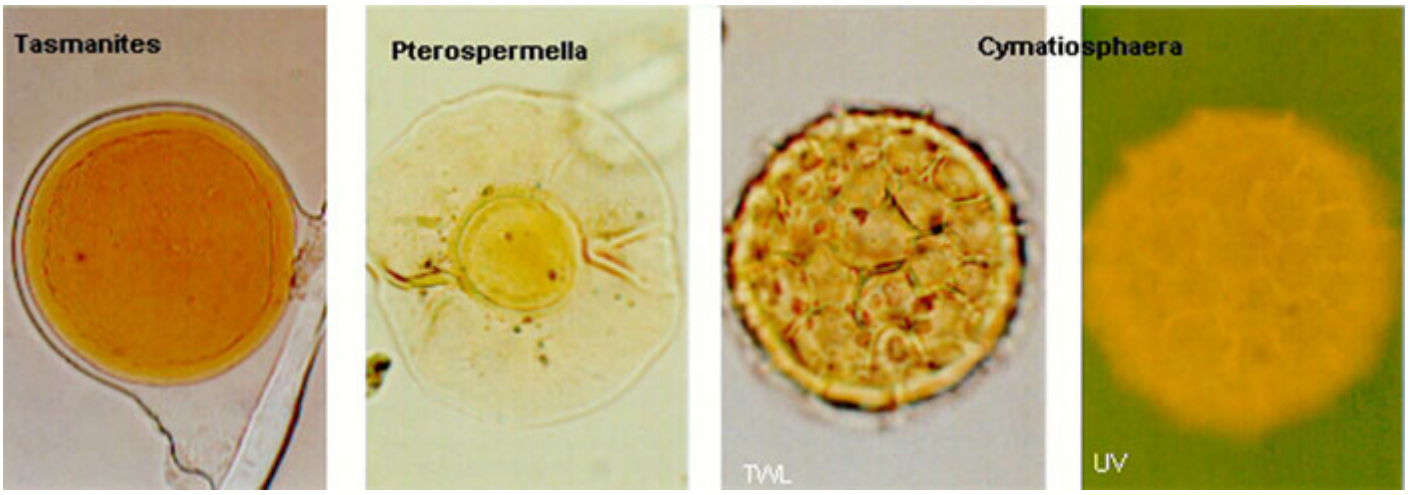
Left: Opaque lath-shaped phytoclast. Note rather 'splintery' nature, suggesting good preservation of structural grain and perhaps a rather brittle character. The angular outline and the structural grain are clear evidence of structure, although no definitive biostructure is present. Relatively large laths like this may break up into smaller opaque particles during extended transport. Sample ATP/YN 40, Lebberston Member, Cloughton Formation, Ravenscar Group, Lower Bajocian, Yons Nab, near Scarborough, Yorkshire, UK; slide prepared by Adrian Piper.

Ravenscar Group, Upper Aalenian, BGS Brown Moor borehole, Yorkshire, UK; slide prepared by Adrian Piper.

Lower: Opaque biostructured phytoclast; the clear scalariform pitting shows that the particle is derived from tracheid tissue, and the fine preservation of the microstructure suggests a charcoal origin. Sample ATP/BM 58A (M), Saltwick

Centre: Group of opaque lath-shaped phytoclasts; note smaller size of the laths compared to the previous photograph. The only evidence of structure is the sharp angular outlines and the elongated shape. Sample ATP/BM 58 (B), Saltwick Formation, Ravenscar Group, Upper Aalenian, BGS Brown Moor borehole, Yorkshire, UK; slide prepared by Adrian Piper.

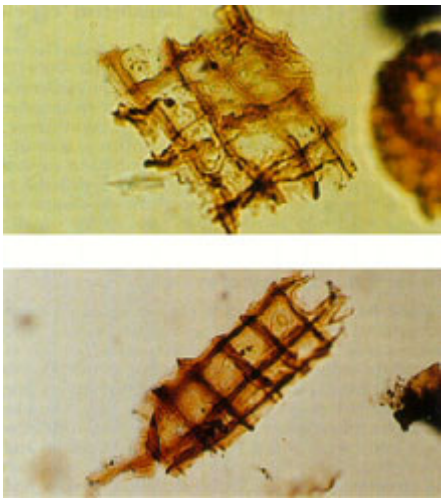
Right: Highly corroded opaque lath-shaped phytoclast. The internal holes may be after original pitting. Sample ATP/BM 58A (M), Saltwick Formation, Ravenscar Group, Upper Aalenian, BGS Brown Moor borehole, Yorkshire, UK; slide prepared by Adrian Piper.

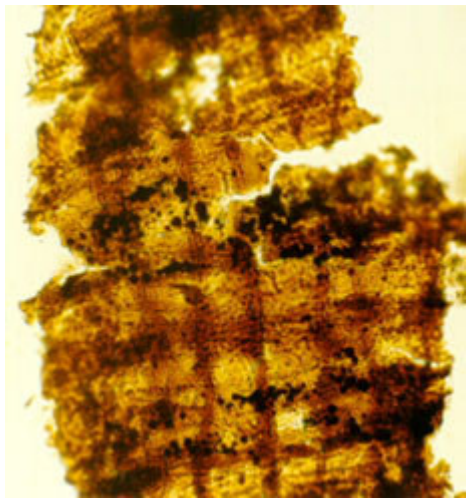


Left: Marine prasinophyte phycoma of the genus Tasmanites. Note the characteristic thick wall with its thin radial canals (giving a radial striate appearance in cross section, and appearing as light coloured dots in end view). The bright ring around the Tasmanites is an air bubble. Sample UCL 15/AJR 8398, a ?Cenozoic sample collected in Cyprus by the UCL M.Sc. Micropalaeontology Class, 1984; slide prepared by Tony Rees.

Centre left: Marine prasinophyte phycoma of the genus Pterospermella. Note central spherical body with equatorial ala (flange) showing typical radial folds (polar view). Sample RVT 85/14, Speeton Clay, D3E Beds, Valanginian, Speeton, Yorkshire, UK; slide prepared by Tony Rees. Sample courtesy of Peter Rawson.

Centre right and right: Marine prasinophyte phycoma of the genus Cymatiosphaera, seen in transmitted white light and under incident blue light fluorescence. Note how the surface of the phycoma is divided up into polygonal fields, visible as raised ridges at the outer edge of the body. Sample BMF/SF 027, The Black Band, late Cenomanian, South Ferriby Cement Quarry, Humberside, UK; slide prepared by Robertson Research, courtesy of Les Riley. Sample courtesy of Brian Funnell.

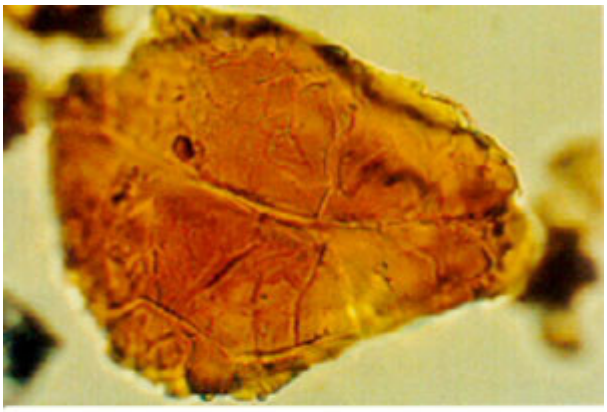




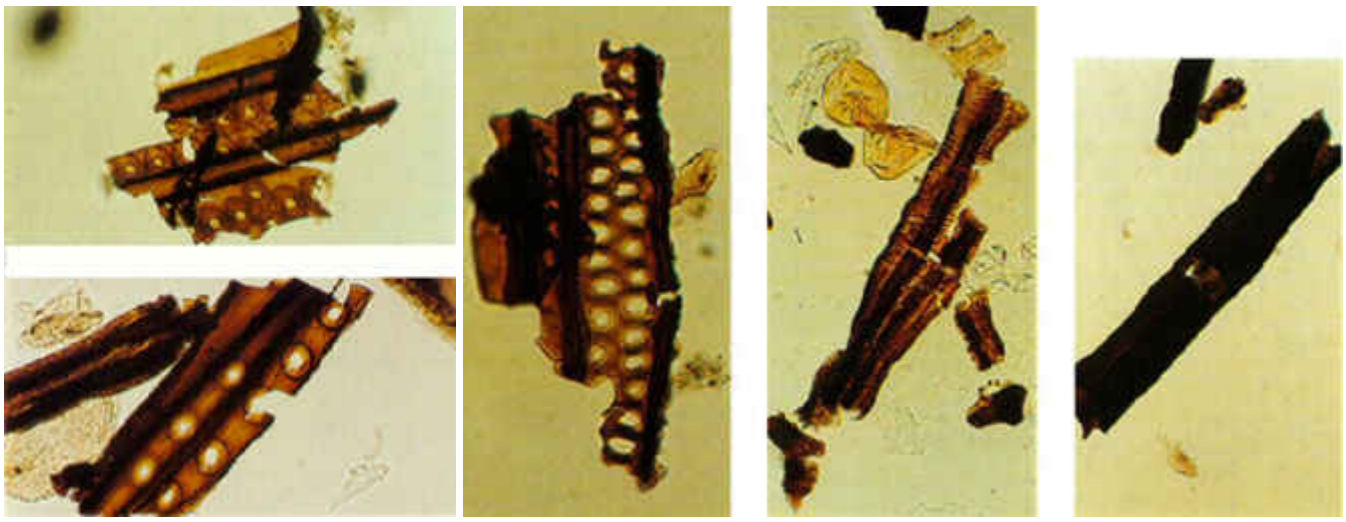

Upper: Structured phytoclast. The 'cross-hatch' structure of the phytoclast, with thickened ribs arranged approximately at right angles to each other, indicates a derivation from ray, rather than tracheid, xylem tissues. Such tissues generally produce more translucent and paler coloured particles than do tracheids. This lighter colour, and the 'cellular' nature of the particles can lead novices to misidentify these particles as cuticle. However, unlike cuticle, ray fragments lack fluorescence, the 'cells' are always regularly arranged columns and rows of squares or rectangles, and the thickened ribs (cell walls) tend to be less uniform (i.e. subparallel, and 'fibrous'). Such tissues are relatively rare compared to tracheids, as they are less lignified, less resistant, and form a lower percentage of the original xylem volume in woody plants. The phytoclast is non-fluorescent. Sample AOT/BL 15, Westbury Formation, Rhaetic, BGS Blyborough borehole, Humberside, UK; slide prepared by Ali Tuweni.

Lower: Biostructured phytoclast derived from gymnosperm xylem ray tissue. Note the 'cross-field' (fenestriform) pitting which is faintly visible in the thin (non-thickened) walls of the ray cells; however, pitting appears to be relatively rare in dispersed ray phytoclasts. The phytoclast is non-fluorescent. Sample AOT/BL 14, Westbury Formation, Rhaetic, BGS Blyborough borehole, Humberside, UK; slide prepared by Ali Tuweni.

Centre and Right: More-degraded examples of ray-derived phytoclasts.



Smaller resin particles showing different degrees of angularity; top photograph shows some rounding of the vertices of the grain (which may eventually result in rounded beads) and also cracking of the surface, while lower photograph is more angular and shows evidence of conchoidal fracture surfaces. Sample ATP/BM 58A (M), Saltwick Formation, Ravenscar Group, Upper Aalenian, BGS Brown Moor borehole, Yorkshire, UK; slide prepared by Adrian Piper.



Upper: biostructured phytoclast **Left:** Biostructured phytoclast composed of at least two

(the term biostructure refers to definitive biologically-derived structure). The phytoclast is composed of a group of at least three adjoining gymnosperm tracheid fragments; the tracheids are incomplete (whole tubular sections do not appear to be present). Note the conspicuous perforated bordered pits (circular holes) in the lighter coloured strips, each pit with a concentric darker (thickened) zone; the pits show a biserial arrangement of two slightly offset parallel rows. This particle is relatively equidimensional, but most tracheid phytoclasts tend to fragment into elongate 'lath' shapes due to the prevalent length-parallel microstructural grain. The phytoclast is non-fluorescent. Sample VA1, Purbeck Group, Tithonian, Dorset, UK; slide prepared by Victor Akinbode.

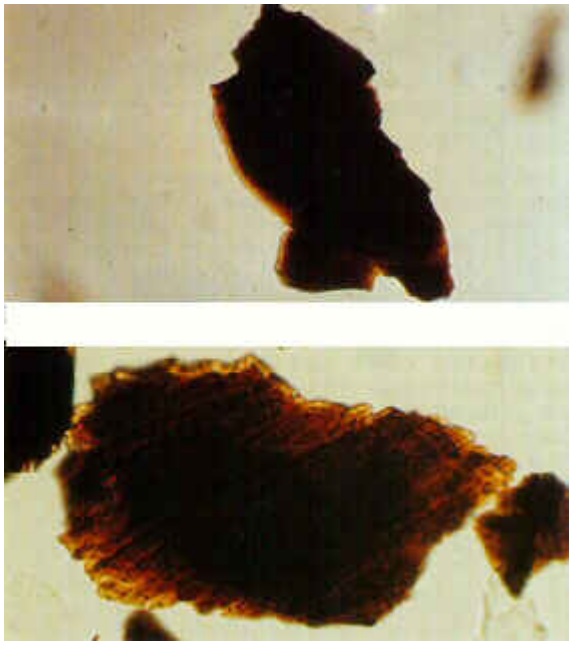
Lower: Biostructured phytoclast composed of at least two adjacent gymnosperm tracheids. The bordered pits have a uniseriate (single row) arrangement. The phytoclast has a typical lath shape; it is non-fluorescent. Sample AOT/BL 15, Westbury Formation, Rhaetic, BGS Blyborough borehole, Humberside, UK; slide prepared by Ali Tuweni.

gymnosperm tracheids. The longer half of the particle shows relatively small bordered pits in a biserial offset arrangement. The greater number of pits may result in such phytoclasts tending to break up into more equant particles. The phytoclast is non-fluorescent. Sample AOT/BL 15, Westbury Formation, Rhaetic, BGS Blyborough borehole, Humberside, UK; slide prepared by Ali Tuweni.

Centre: Biostructured phytoclast, apparently composed of the tapering end of a single tracheid (several sides visible). The tracheid shows scalariform ('ladder-like') pitting. This type of pitting appears to result in weaker particles, and tracheids exhibiting it are less commonly preserved than those with bordered pits; the phytoclast shown is clearly disintegrating along its pitted sides, and if it had been degraded further it is probable that only the thickened strips would survive (as lath-shaped phytoclasts without visible biostructure). The phytoclast is non-fluorescent. Sample ATP/BM 58A (M), Saltwick Formation, Late Aalenian, BGS Brown Moor borehole, Yorkshire, UK; slide prepared by Adrian Piper.

Right: Structured phytoclast lacking obvious biostructure. The form of the two ends of the particle and the view though the central perforation show that this lath-shaped phytoclast is clearly tubular in form, and although it lacks clear pitting it is almost certainly a (gymnosperm) tracheid. Although translucent, the colour is quite dark, partly because the light mostly has to pass through both sides of the tracheid. Note that the external dimensions exaggerate the apparent mass of such hollow particles (especially relative to cross sectional area, as would be determined in reflected light). The phytoclast is non-fluorescent. Sample AOT/BL 15, Westbury Formation, Rhaetic, BGS Blyborough borehole, Humberside, UK; slide prepared by Ali Tuweni.

Two examples of more degraded (less lignified?) brown phytoclasts, which are also probably derived from tracheid tissues, but which lack visible pitting, and thus absolutely definitive biostructure. Photograph from Adrian Piper (1995 thesis). Sample BM52A(T), Sycarham Member, Cloughton Formation, Middle Jurassic, Brown Moor Borehole, Yorkshire, UK.



Structured phytoclasts; external form and the sharp distinct edges indicate a structured particle, but there is no visible internal biostructure. The internal structure of the particles has been infilled and largely obliterated by gelification, making them rather massive, although the lower photograph exhibits relict fibrous parallel structure. Where the gelification totally overprints the microstructural grain, the resulting absence of clear lines and planes of weakness can result in the formation of sub-conchoidal curved fracture surfaces upon breakage (a suggestion of which are visible in the upper photograph). Such massive phytoclasts are most typical of lignites, coals, and other sediments very rich in terrestrial organic matter, where they may dominate the palynological organic matter assemblage. The phytoclasts are non-fluorescent. Plate A9 is from sample YSP/V-3 2520, from the offshore subsurface Cenozoic of the East China Sea Basin; slide prepared by Young-Soo Park. Plate A10 is from sample NRG/EN 570, a ?Mesozoic subsurface consulting sample from the west of Ireland offshore; slide prepared by Lexa Summerbell.

Unusually transparent tracheid fragment from Recent sediments of Lake St. Moritz, Switzerland. Superficially, such fragments can look like cuticle if one is used to looking at ancient sediment (where translucent woody phytoclasts are nearly always brown or orange), but the presence of bordered pits proves the tracheid origin despite the pale colour. Slide prepared by Daniel Ariztegui.