part of the Schmidtsdrift Formation.

The quartz arenites contain well-rounded quartz grains are extremely mature, and this type of sand is commonly developed in shallow marine environments (PettiJohn, *et. al*. 1972). The black mudstones, however, can develop under marine or non-marine conditions, in poorly-oxygenated or anaerobic waters, and their depth significance is open to question (Hallam, 1967). If the dark dolomites are generated in a similar manner to Recent micrite mud, this may indicate subtidal conditions, below wave-base, since lime-muds are normally winnowed out of intertidal areas by current activity and deposited in lower-energy environments (Bathurst, 1971). The intraclastic dolomicrites represent sub-aqueous debris-flows, similar in origin to turbidity currents, but it is not possible to infer palaeobathymetry.

The Transition Zone essentially displays the change from siliciclastic to chemical sedimentation, and this has been described in the northern Cape Province by Beukes (1977). The evidence from this area suggests that deposition took place under alternating low- and high-energy marine conditions and fluctuating physico-chemistry. A reducing, oxygen-deficient nature is inferred by the presence of carbonaceous mudstones, and, as the intraclastic dolomicrites contain chert and dolosparite clasts, this environment may have been situated adjacent to established carbonate sedimentary environments. It is significant to note the upward decrease in clastic material in the Transition Zone, which is an indication of growing stability and a gradual removal of the source-area, prior to the deposition of the Malmani dolomite. In the northern Cape, there are many progradational cycles, consisting of quartz arenites, at the base, finning upwards into dolomicrite. These cycles are interdigitated and were formed during repeated marine transgressions, which migrated farther and farther eastwards, establishing the stable carbonate shelf, upon which the rest of the Olifants River Group sediments were deposited.

The isopach data (Figure 14), not only displays east-west channel-like features, but also a north-striking antiform in the east, and a north-trending, south-plunging synform in the west. These structures modifided the initial depositional environment, causing slight increases and decreases in sediment accumulation. It was not possible to determine current directions in the Transition Zone, but it is possible that the east-west features parallel the prevailing marine currents, generated during the marine transgression.

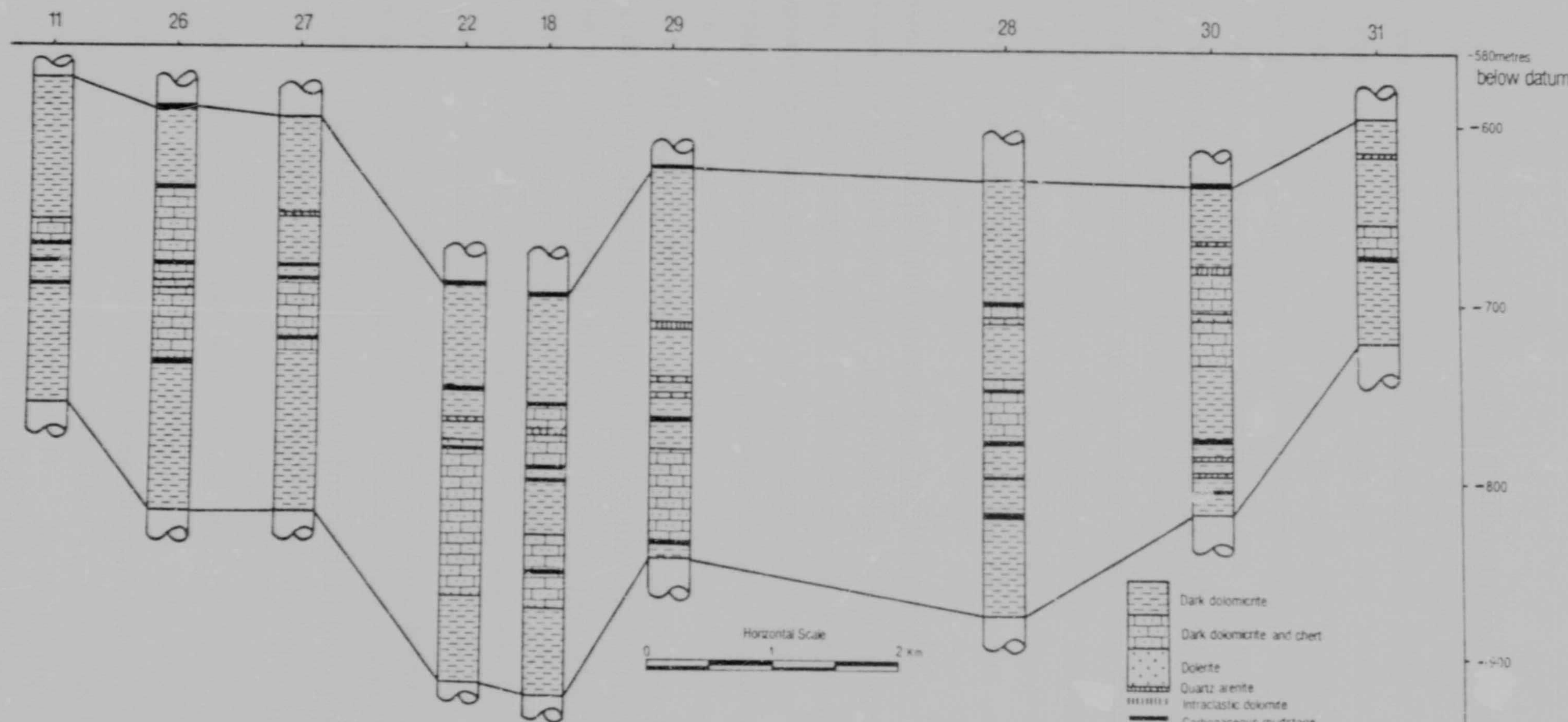


Figure 15 : A panel-diagram illustrating the lateral variation of the Lower Dark Dolomite.

The presence of the green-coloured rock, which is similar to the Ventersdorp Lava, suggests that perhaps Ventersdorp igneous activity had not entirely ceased at this stage.

G. LOWER DARK DOLOMITE ZONE

1. Introduction

This zone is very distinctive and is generally chert-poor. It consists of homogeneous dark-grey dolomicrite, minor intraclastic dolomicrite, and black, carbonaceous mudstone. The stratigraphic panel-diagram (Figure 15) illustrates the high degree of correlation of lithologies within this zone, with the exception of the partly silicified horizons, indicating that silicification was not uniform. However, in all other respects this zone is remarkably homogeneous, and attains a mean thickness of 186 metres. The isopach map (Figure 16), reveals a slight increase in thickness in the central parts of

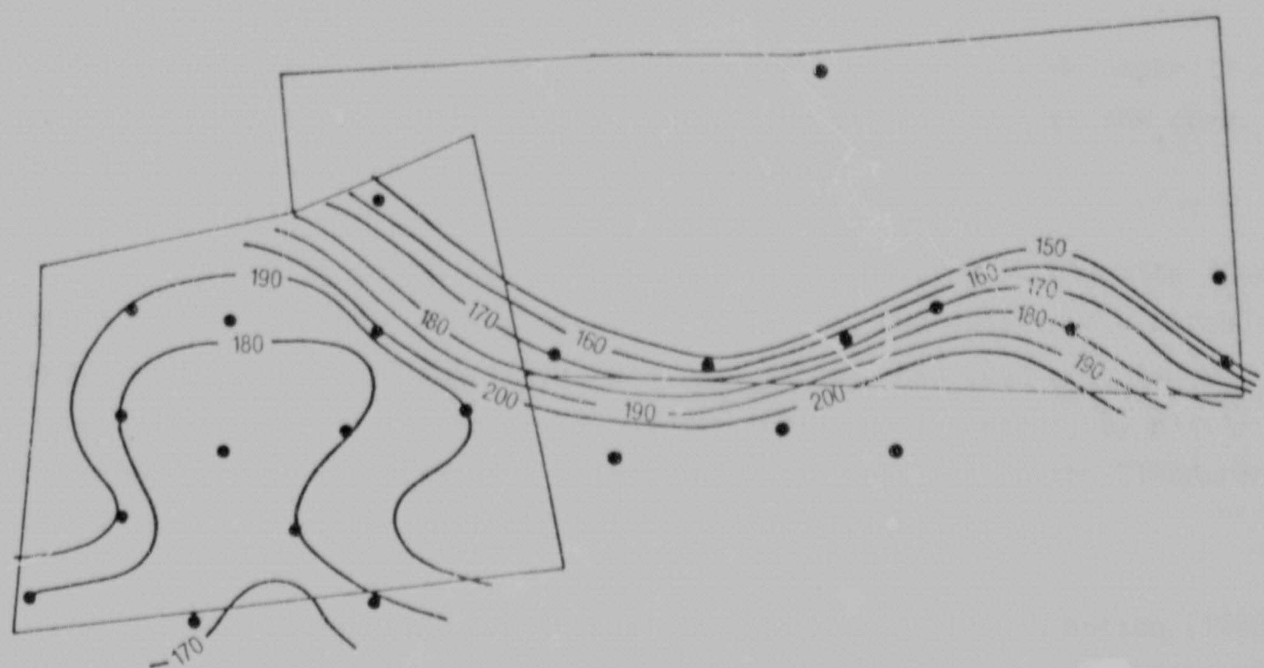


Figure 16 : An isopach map of the Lower Dark Dolomite Zone. Contour intervals 10 metres.

the area, and two northerly trends are apparent. The one in the east indicates a southerly-deepening depression, whilst the trend in the west suggests the presence of a low ridge-like feature, shallowing to the south. However, apart from a thin oncolite, in Borehole UD27, there is no sedimentary evidence of a shallow-water environment.

In all the boreholes, this zone is readily identified. Sedimentary structures are uncommon, apart from numerous, tall, columnar stromatolites and a fenestral fabric. The stromatolites consist of tall columns up to 1 metre in height, which have a cylindrical cross-section up to 5 centimetres in diameter. The columns display inter-column linkage and appear to be branched (Plate 1a). The columns consist of thin laminations, less than 2 millimetres thick, which are slightly darker in colour than the dolomicrite matrix. This dark colour is caused by finely-disseminated black, dusty material which represents the decomposed organic remains of the original algal colony, and this variety of stromatolite is similar to *Jurisania*, from the Aphebian of Canada, described by Donaldson (1976). Domal varieties are present in small numbers. These are normally laterally-linked hemispheroids, and each dome is composed of finely-laminated dolomicrite. They are usually less than 10 centimetres high and 30 centimetres in width. A fenestral fabric is invariably present between the stromatolite columns and this texture is generally associated with tidal-flat deposits (Wilson, 1975; Assereto and Kendall, 1977). The fenestrae are filled with cryptocrystalline silica or dolosparite, and, where both minerals occur together, the dolosparite generally forms a rim to the cavity, whilst the silica occupies the core. This indicates that the silica is a later cement.

Chert is only a minor component in the Lower Dark Dolomite Zone. Some horizons do contain chert nodules and layers, but this rarely exceeds more than 5 per cent of the total rock. An attempt has been made in Figure 17, to illustrate the aerial variation in chert content, by plotting a percentage map. This shows a slight increase in silica on the Elandsrand Gold Mine property, and reflects heterogeneous silicification.

Quartz arenites are unusual in this zone, although Button (1973) recorded several arenites in the eastern Transvaal. Carbonaceous mudstones frequently form thin laminations within the dolomicrite, particularly towards the base of the unit, and are generally less than 5 centimetres in thickness. Intraclastic dolomicrites form several horizons within the Lower Dark Dolomite Zone, but are usually only 10 centimetres thick and it is interesting

Figure 17 : A percentage map showing the estimated variation in total chert content within the Lower Dark Dolomite Zone. Contour values in per cent.

to note that they contain chert and pale, laminated dolomite fragments, set in the typical creamy dolomicrite matrix (Plate 1b).

Pale, mottled dolomite occurs above and below abundant columnar stromatolite horizons, and contacts between them are usually gradational. The mottled dolomite is dark-coloured but white, dolosparite stromotactoids give the rock a mottled texture. In thin-section, the dark dolomite consists of dark-grey, amorphous dolomicrite, and the minor, euhedral dolomite rhombs, of up to 8 microns, scattered throughout the dolomicrite, represent points of recrystallization. The chert, where developed, consists of cryptocrystalline silica. No evidence of chalcedony was observed in any samples from the Lower Dark Dolomite Zone, which would provide evidence of replaced evaporites.

2. Sedimentology

Sedimentary structures in the Lower Dark Dolomite Zone are uncommon, although a fenestral fabric is frequently developed and stromatolites are invariably of the columnar type, with occasional small, domal varieties.

PLATE 1

(a) Columnar stromatolites from the Lower Dark Dolomite Zone. The matrix of the stromatolite consists of dolomicrite, and the laminae are, in part, outlined by dark-grey dolomicrite containing finely-disseminated, carbonaceous material. The stromatolites are linked, partly branched and dolosparite occupies some of the inter-column spaces. From Sample A92, Borehole UD20, depth 1338 metres. (Natural size).

(b) Intraclastic dolomicrite, displaying a texture reminiscent of flow. It consists mainly of extremely fine-grained, white dolomicrite, with minor chert. Many small, angular intraclasts are present in the upper part of the specimen. From Sample A33, Borehole UD28, depth 1118 metres ($^2/_3$ natural size).

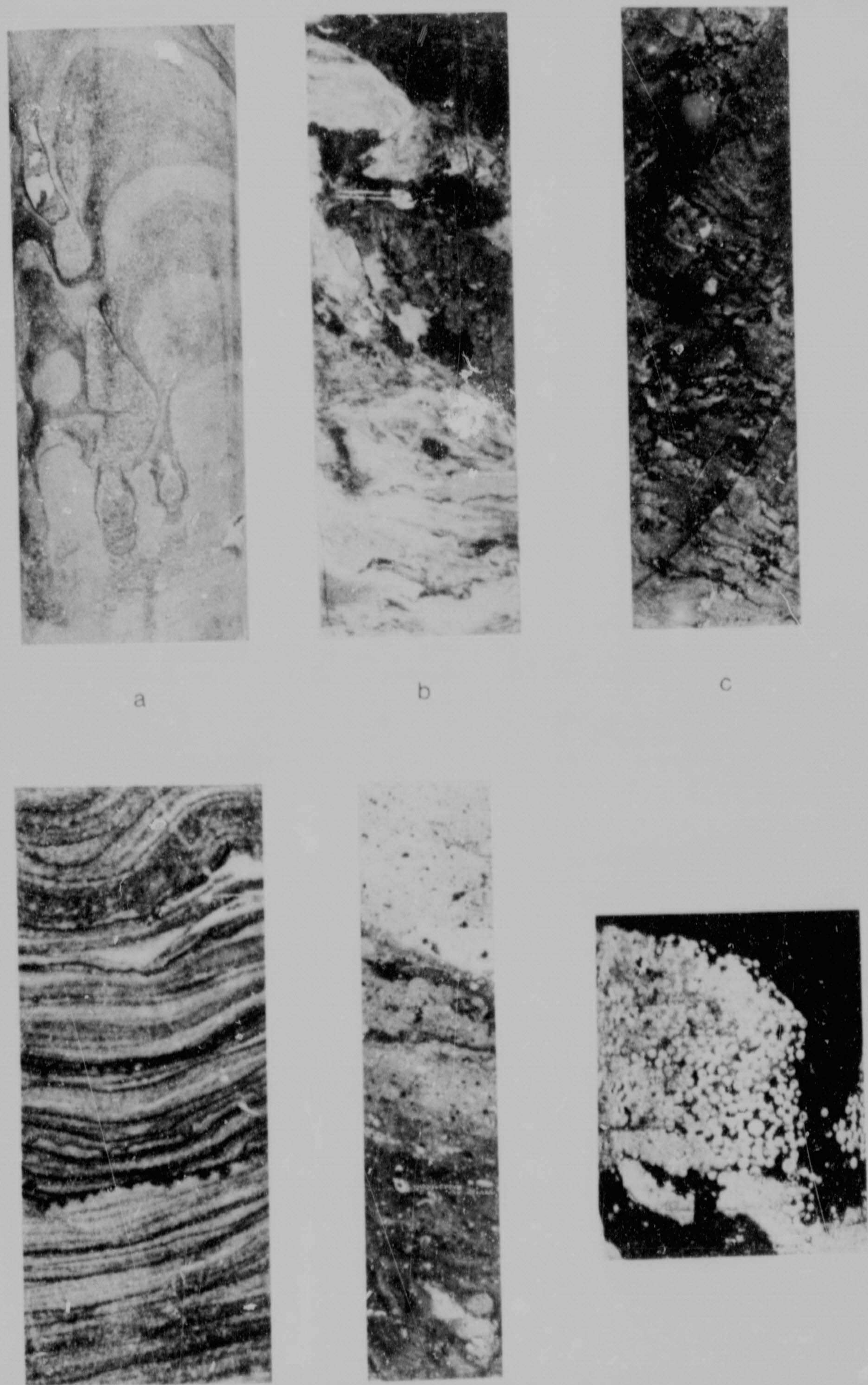
(c) Admixed coarse, white dolomite and black, carbonaceous material. In several places, dolomite rhombs appear to "float" within the carbonaceous matrix. From Sample A83, Borehole UD27, depth 1770. ($^1/_2$ natural size).

(d) Coarse, white dolomite, with numerous thin, black, pencil-line laminae which resemble stromatolite domes (top), or possible cross-bedding (bottom). Precise origin is unclear. From Sample A75, Borehole UD26, depth 1466 metres. (Natural size).

(e) Intraclastic dolomicrite, containing intraclasts of chert, coarse, white dolomite, carbonaceous mudstone, dolomicrite, and dolosparite, set in a grey-and-white, dolomicrite matrix. From Sample A108, Borehole UD19, depth 658 metres. ($^1/_2$ natural size).

(f) Silicified ooids encapsulated in black, carbonaceous material. The edge of the oolitic chert appears to be corroded by the carbonaceous matrix. From Sample A88, Borehole UD22, depth 1661 metres. ($^2/_3$ natural size).

PLATE 1



a b c

d e f

Fenestral fabrics are considered to result from dessication in tidal-flat sediments (Wilson, 1975), but an intertidal environment is also characterised by flat-pebble breccias, thin laminated sediments, and algal mats. These structures were only detected, in minor amounts, in Boreholes UD27 and UD18. The columnar-stromatolites are not environmentally specific, and, so, the only evidence which supports an intertidal interpretation is the fenestral fabric. However, this texture can result from minor recrystallization of the dolomicrite to dolosparite, which was noted in thin-section, and should not be regarded as diagnostic in isolation.

The dark colour of the dolomicrite, could indicate anaerobic, deeper-water conditions, and the fact that the dominant lithology is dolomicrite suggests quiet-water, carbonate deposition. In the eastern Transvaal, Button (1973) describes algal laminations, ripple marks, some "mega-dome" stromatolites, and, at one locality, flat-pebble conglomerates. This is evidence of shallow-water conditions, however, throughout the Malmani dolomite stratigraphy, dark dolomicrite units are common, and, in most cases, they are lithologically identical. This suggests similar depositional conditions. The most obvious feature in the boreholes is the lack of sedimentary structures, and it is tentatively suggested that the majority of the dark dolomites were deposited in deeper-water, quiet environments. The stratigraphic data indicates contemporaneous tectonic activity, with two north-trending features, illustrated by thickening and thinning of the Lower Dark Dolomite Zone. These structures are similar to those shown in the Transition Zone and the base of the dolomites (Figures 12 and 33). The dark dolomites reflect major changes in the prevailing physico-chemistry of the environment, and, during diagenesis, have been subjected to mild silicification and dolomitization processes.

H. <u>COMPLEX DOLOMITE ZONE</u>

1. <u>Introduction</u>

This zone is lithologically very complicated because it consists of a wide variety of dolomite types. It is the only zone in the Malmani dolomite which contains thick beds of extremely coarse-grained white dolomite, indicating that, during the deposition and diagenesis of these carbonate

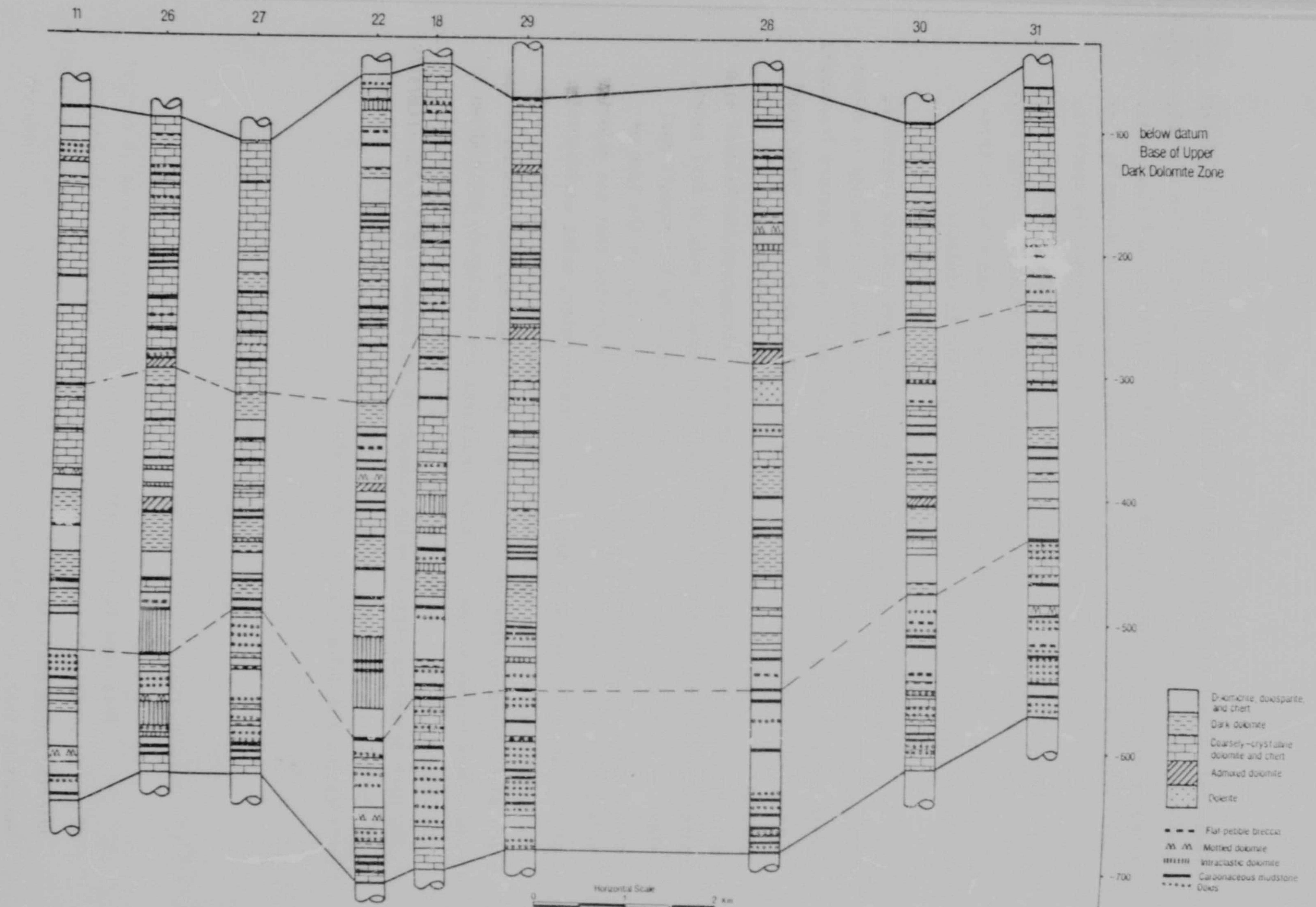


Figure 18 : A panel-diagram illustrating the lateral variation within the Complex Dolomite Zone.

sediments, certain processes were active which did not operate in the other parts of the stratigraphy. For this reason, and as there are no distinctive dolomite units in this zone which can be correlated over any distance, it has been decided to group all the varied and intricately-interbedded lithologies which lie above the Lower Dark Dolomite Zone, but below the Lower Laminated Dolomite-and-Chert Zone, into the Complex Dolomite Zone. The basal contact with the Lower Dark Dolomite Zone is sharp, and is often marked by a 5 centimetre-thick, black, carbonaceous mudstone, or the Lower Dark Dolomite Zone is overlain directly by coarse-grained white dolomite. From the generalized stratigraphic column (Figure 9), and the panel-diagram (Figure 18), it can be seen that ooids are abundant in the first 150 metres, but, above this, coarse white dolomite predominates. Also, in this lower part of the Complex Dolomite Stratigraphy, sedimentary structures are less common, and it is considered unnecessary to make a subdivision on the basis of presence or absence of ooids, because the termination of ooid activity is not abrupt and is ill-defined.

The isopach map of the Complex Dolomite Zone (Figure 19), shows a thickening

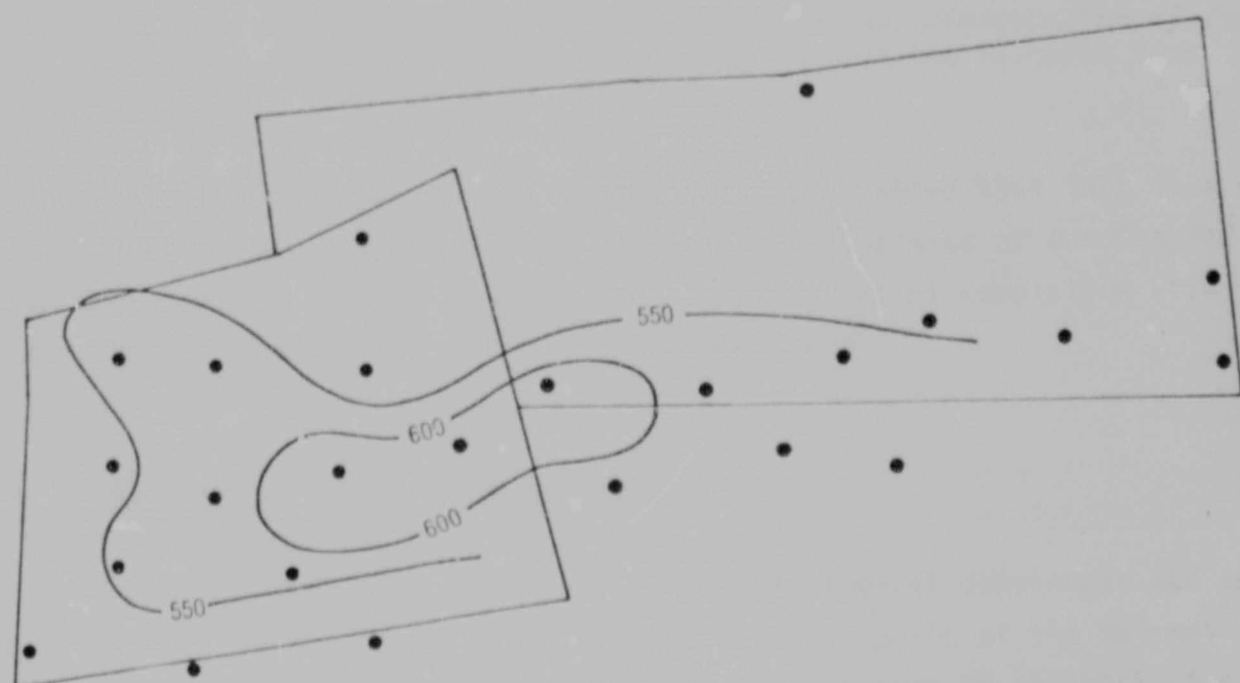


Figure 19 : An isopach map of the Complex Dolomite Zone. Contour interval 50 metres.

of the sequence in the central part of the area, and the panel-diagram (Figure 18), further illustrates this thickening in the middle part of the Complex

Figure 18 : A panel-diagram illustrating the lateral variation within the Complex Dolomite Zone.

Dolomite Zone, in Boreholes UD18, UD22, and UD29. This greater accumulation of sediment reflects a region of increased syndepositional subsidence, and, when the total number of ooid horizons from each borehole are plotted in the form of an isolith map (Figure 20), it is evident that there is an east-west-striking zone of increased ooid development. As this zone is partly

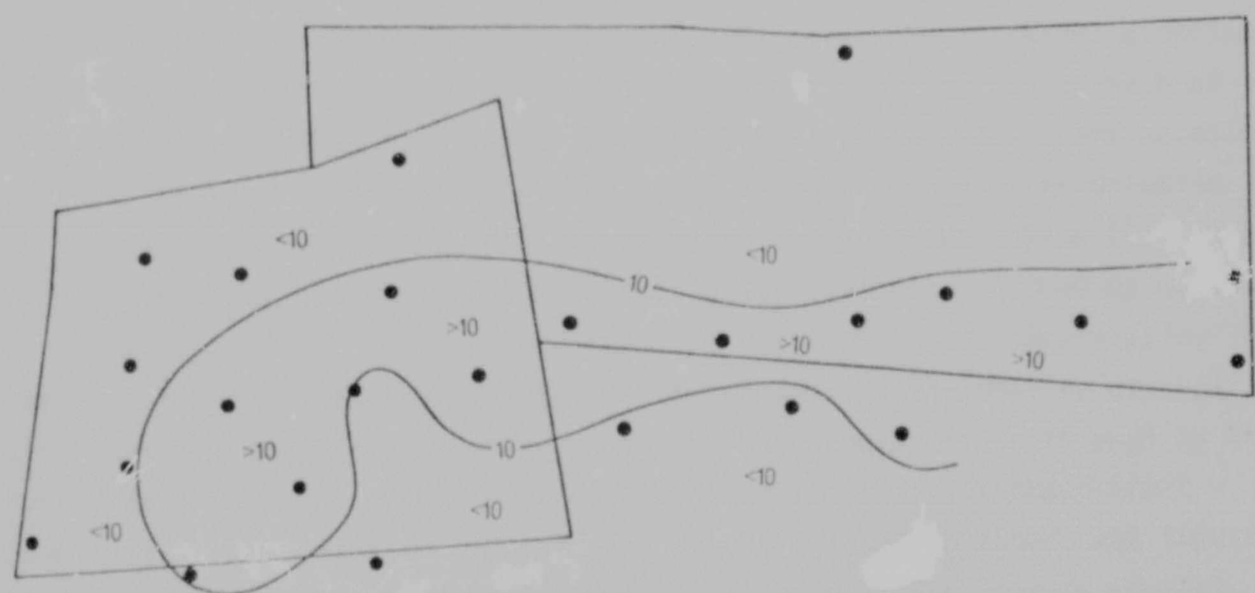


Figure 20 : An isolith map illustrating the aerial distribution of the observed ooid horizons within the Complex Dolomite Zone. Contour values in per cent.

coincident with the area of subsidence, it is considered that this is a result of vertical facies stacking. The variation in thickness of the Complex Dolomite Zone does not appear to be related to differential compaction effects since the lithologies are similar in each borehole.

2. Components of the Complex Dolomite Zone

As this zone contains all the lithological components and sedimentary features developed variously within the other parts of the Malmani dolomite, a review is presented, at this point, of some of the most significant fabrics and structures.

(a) Coarsely crystalline dolomite

The coarsely crystalline dolomites are pure white in colour and display a glittering texture, due to the reflection of light from a myriad of randomly-orientated crystal faces. Most of the euhedral dolomite rhombs are greater than 5 millimetres in width, and are classified as very coarsely crystalline dolomites and are the result of recrystallization. However, the average crystal-size ranges between approximately 30 microns and 100 microns. Sedimentary structures are poorly preserved, as is to be expected, considering the intense fabric modification which accompanies recrystallization, together with the theoretical volume increases associated with the transformation of calcite to dolomite. This may be as much as 40 per cent (Fuchtbaüer, 1974). Stromatolite and ooid ghosts are occasionally present, but are difficult to recognize. In thin-section, the dolomite is invariably euhedral and often displays an undulose extinction (Plate 2a). This is possibly the result of internal lattice defects, induced by molecular strain (Dana, 1958). Where large crystals have developed, they display coalescive growth, partial absorption of the surrounding smaller crystals, and represent porphyritic grain-growth. This process is an attempt by the system to reduce interfacial energy, in order to achieve thermodynamic stability. The dolomite crystals are rarely twinned or zoned, and impurities, such as carbon dust, have been forced to the edge of the growing crystal, where they now form a thin, rim cement. Of particular interest in the Complex Dolomite Zone is "admixed dolomite". This consists of a mixture of coarse, white dolomite and black carbonaceous material (Plate 1c). It is a very distinctive texture, and the carbonaceous material often has a texture suggestive of flow. Large dolomite rhombs are frequently encapsulated in chert, and, as in the case of the admixed dolomite, this illustrates post-recrystallization transport of the dolomite rhombs, and the silica is, therefore, late diagenetic. In the borehole core, the white, coarsely-crystalline dolomites are massive, but many thin, black, pencil-line laminations occur, which are parallel to bedding. These laminae are undulatory or stylolitic and resemble stromatolite structures, cross-bedding, and ripple marks (Plate 1d). The precise origin of these partings is unclear.

The genesis of the extremely coarse-grained dolomite and admixed texture is puzzling. Petrographic analysis reveals coarse recrystallization textures and the assimilation of fine-grained dolomite. This is probably a late-stage event, since most primary sedimentary structures are completely destroyed. The massive white dolomites are extremely pure, but admixed dolomite and black carbonaceous material are generally associated with them. It is known that during recrystallization and crystal growth, impurities are ejected from the lattice, and it is postulated that these migrate to, and accumulate in, areas of increased porosity and decreased pressure, which results in an "admixed" fabric. This process of coarse dolomitization and migration of fluids may be important in the transportation of metal ions within the dolomites.

The lithologies which sandwich the extremely coarse-grained dolomite units display sharp contacts in the borehole core and consist of either dark dolomicrite, carbonaceous mudstones, or laminated dolomite-and-chert. These rock-types are unaffected by coarse dolomitization. For this reason it is difficult to envisage a reflux or evaporative-pumping, brine mechanism which selectively dolomitizes specific units, but it is possible that the surrounding lithologies were initially, relatively impermeable and confined the dolomitizing solutions. Once coarse dolomitization had been initiated, increased porosity could have enabled further influx of Mg^{2+} ions, giving rise to a self-perpetuating process.

(b) Dolosparite and dolomicrite

Pale-grey and white dolosparite and dolomicrite form numerous beds intercalated with the other dolomite varieties and have not suffered the intense, destructive recrystallization processes which were responsible for the development of the coarse white dolomites. These sediments are often laminated and contain stromotactoid and fenestral fabrics, as well as stromatolite and allochemical components. Dolomicrite, which, by definition, has a grain size of less than 5 microns, generally forms an amorphous, granular matrix. Occasionally, this matrix reacts with dilute hydrochloric acid, indicating that some calcium carbonate is present, but it has not been possible to determine whether the dolomicrite is a primary precipitate or an early product of dolomitization. The dolomicrite also forms the matrix of the intraclastic dolomicrites (Plate 1e).

Dolosparite is invariably intimately associated with the dolomicrites. In thin-section, dolomicrite and dolosparite occur together within small domal stromatolites (Plate 2b). Parts of the stromatolites, particularly the interdomal sediment, have recrystallized to subhedral and euhedral dolosparite. During this process, the black, dusty, carbonaceous material migrated to the crystal-edges leaving the dolosparite crystals relatively pure, and these crystals rarely display undulose extinction. Some stromatolite structures consist of alternating laminae of dolomicrite and dolosparite.

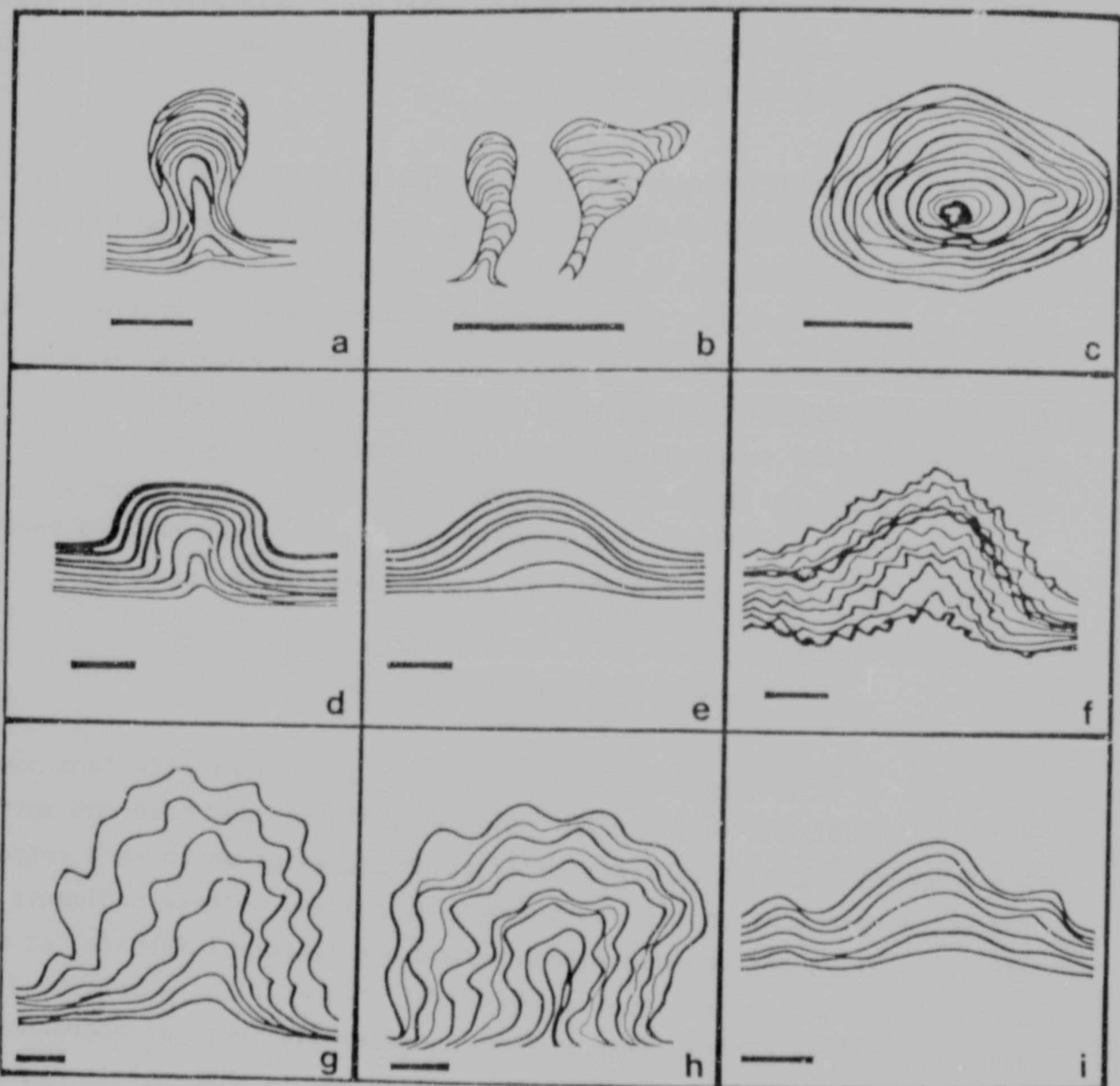


Figure 21 : Longitudinal schematic sections of stromatolites from Malmani Dolomite Subgroup, Carletonville, Transvaal. a. Small columnar stromatolite; b. Two columnar stromatolites, one displaying nodular development; c. Oncoid or spherical stromatolite; d. "Box"-shaped small domal stromatolite, with smooth laminae; e. Convex domal stromatolite, with laminae and low relief; g. Fairly-high-relief domal stromatolite, with crinkled laminae; h. Globoid-type domal stromatolite, with crinkled laminae; i. Fairly-closely-linked, small, low-relief, domal stromatolites.

Length of the bar-scale = 1 centimetre.

The coarser-grained dolosparite is generally poor in impurities, and, this is further illustrated in Plate 2c, where algal filaments are preserved, together with carbonaceous-rich dolomicrite patches set in a dolosparite matrix, which represents the recrystallized dolomicrite.

(c) Stromatolites

Stromatolites display varied morphological characteristics. However, because borehole-core limits the area of observation, it was not possible to identify large structures with widths greater than 20 centimetres and heights of more than 50 centimetres. All the stromatolites associated with the dolomicrite and dolosparite in the Complex Dolomite Zone are of the domal type and are generally laterally linked. Typical varieties include d, e, and i, illustrated in Figure 21, while f, g, and h are inter-mixed with coarse, white dolomite. The stromatolite laminae may be composed of dolomicrite, dolosparite, coarse white dolomite or silica, and carbonaceous material is often scattered throughout. In Plate 2c, algal filaments are preserved, displaying a variety of shapes and sizes, and are similar to trace-fossils detected by MacGregor (1978). These filaments are situated in the space between two small domes and probably flaked off the top of one of these structures, were cemented, and were subsequently degraded to carbonaceous material during a period of dessication or diagenesis.

The term stromatolite was first used by Kalkowsky in 1908 and is now defined by Walter (1976) as:

Stromatolites are organosedimentary structures produced by sediment trapping, binding and/or precipitation as a result of the growth and metabolic activity of micro-organisms, principally cyanophytes.

In the past stromatolites were thought to be restricted to marine intertidal environments, but there are now many published accounts of other occurrences which indicate that they can form in almost any body of water, under a wide range of environments (see Hoffman, 1976). It is for this reason that stromatolites display a variety of morphologies, and, in recent years, much research has been concerned with relating structure to palaeobiology and palaeoenvironmental conditions. In the Malmani Dolomite Subgroup and Campbell Rand Formation, stromatolites have been described by

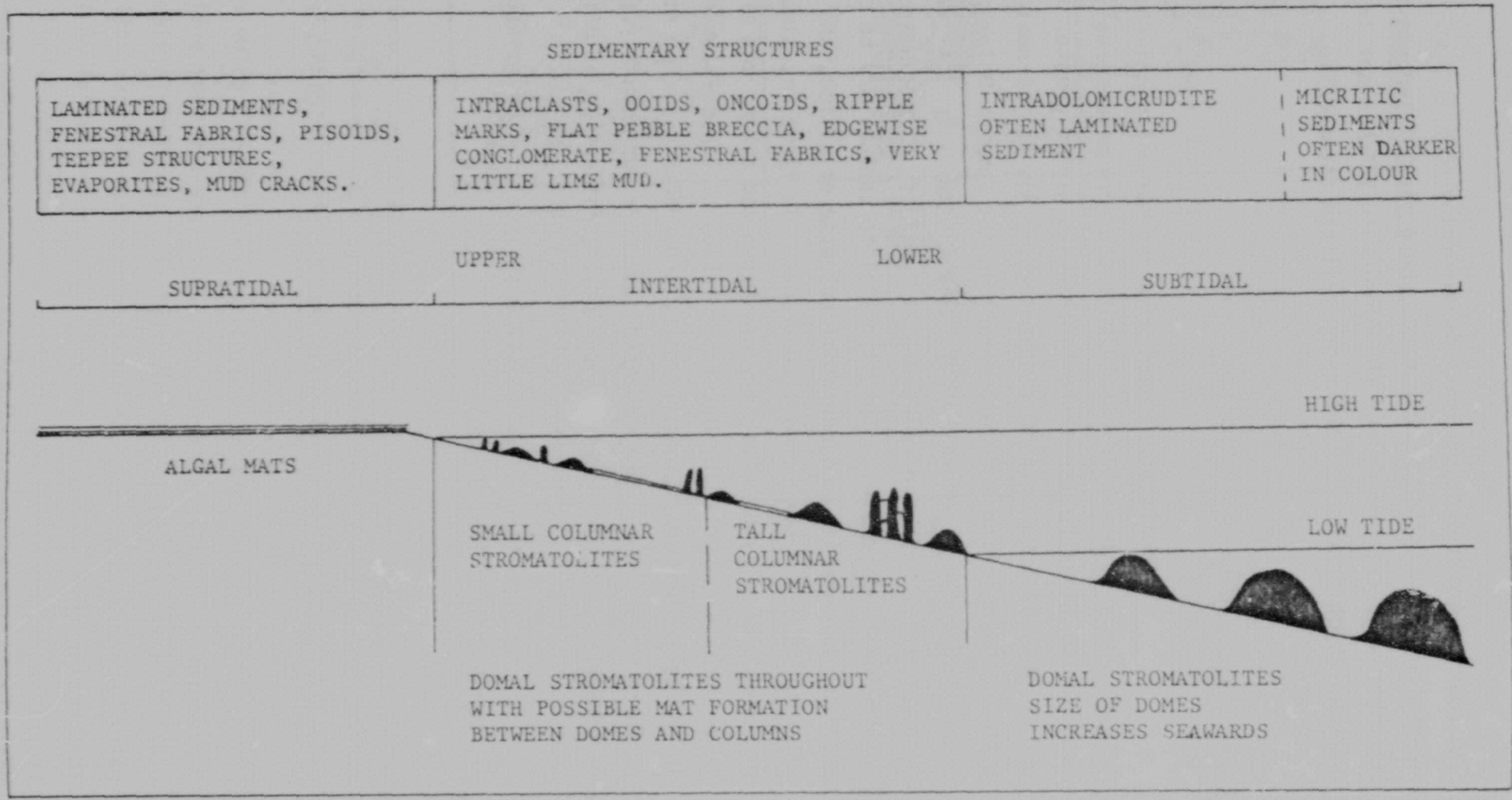


Figure 22 : Schematic relationship between stromatolite morphology and sedimentary structures in a shallow water, near-shore carbonate succession (modified after Eriksson et. al. 1976).

numerous authors including Button (1973), Eriksson and Truswell (1974), Eriksson, Truswell, and Button (1976), Truswell and Eriksson (1973, 1975), Toens (1966), and Young (1932). The paper by Truswell and Eriksson (1973) is of particular importance, since this documents facies associations with different stromatolite morphologies. This is often difficult since the mere presence of stromatolites is not sufficient to interpret the environment of deposition. A brief synopsis of their findings is illustrated in Figure 22. The classification of stromatolites has been summarised by Hofmann (1969) and essentially involves the study of morphology, including size, relief, linkage, spacing, and shape of individual laminae. In the borehole core examined, it was often impossible to gain an overall impression of the size and structural attributes of individual stromatolite colonies, and, for this reason, stromatolites have limited application in this study. However, the broad distribution of stromatolite varieties in the Malmani dolomite is shown in Figure 23.

(d) Allochems

Ooids are particularly abundant in the dolomicrite and dolosparite sediments of the lower part of the Complex Dolomite Zone, and generally form thin bands less than 10 centimetres thick. Coarsening-upward cycles are often evident, consisting of small ooids, less than 0,5 millimetres in diameter, grading into larger ooids which may be in excess of 2 millimetres. Modern marine ooids are, according to Fabricius (1977), restricted to tropical and subtropical climatic zones. Their origin has been a subject of controversy in geology for hundreds of years and no theory regarding their genesis has been universally adopted. Theories of ooid formation include physical, chemical, and biological origins, and these have been reviewed by Bathurst (1971).

Most opinions agree that ooids form in water which has elevated temperature, supersaturation with respect to $CaCO_3$, high turbulence, and a supply of nuclei. With the advent of the scanning electron microscope detailed analyses were made of the ooid cortex, and it was discovered that, in marine ooids, the outermost lamination consists of very uniformly-sized aragonite rods or granules, less than 1 micron in length. These are radially arranged and intimately associated with mucilagnous organic material. In artificial and non-marine ooids, this structure was not observed, and it was

Figure 22 : Schematic relationship between stromatolite morphology and sedimentary structures in a shallow water, near-shore carbonate succession (modified after Eriksson et. al. 1976).

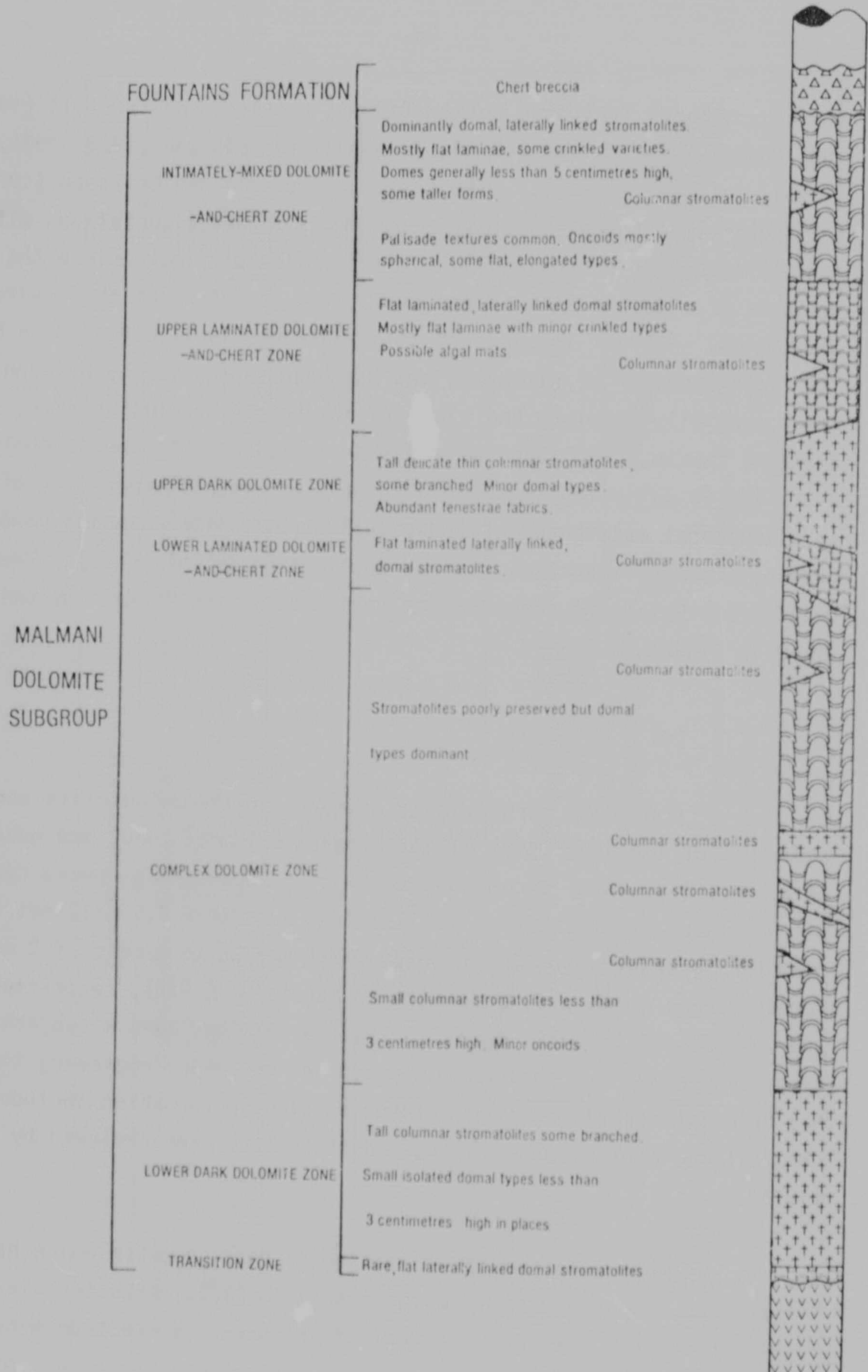


Figure 23 : Distribution of stromatolite varieties within the Malmani Dolomite, in the Carletonville area, Transvaal

concluded that marine ooids are a product of biomineralization by blue-green algae. The conditions of formation are, therefore, governed by algae, i.e. bright light, elevated temperature, and supersaturation of water with calcium carbonate.

It has been postulated (Fabricius, 1977), that the algae grow on a nucleus, the nature of which is unimportant, and secrete a mucilagnous sheath, as shown in Figure 24. The algae draw nutrients and water from their

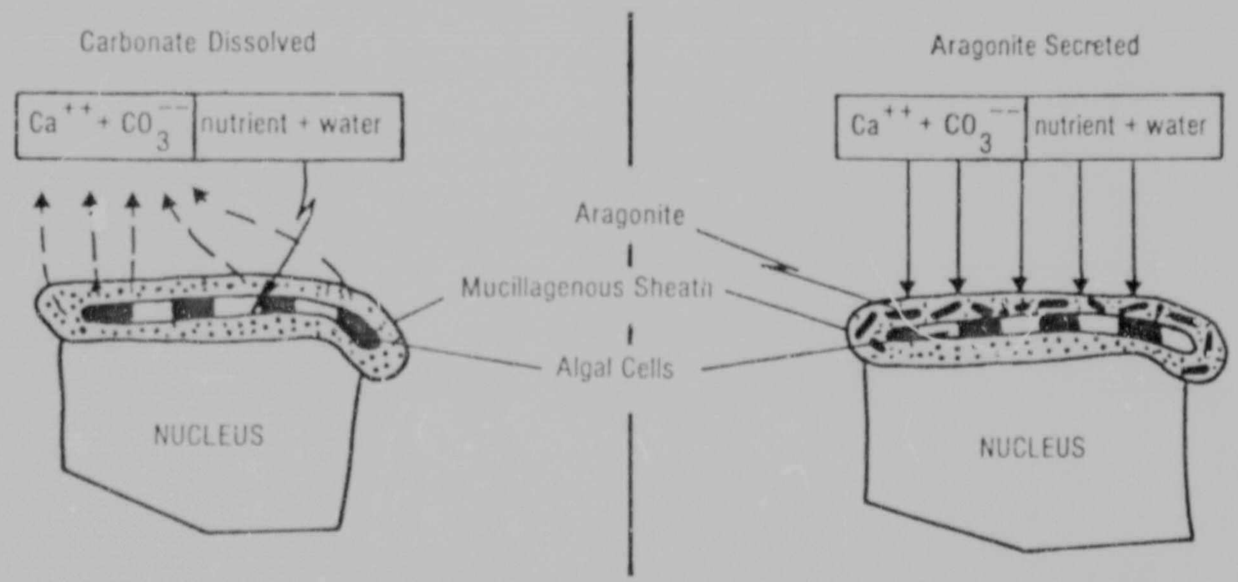


Figure 24 : Algal sheath encrusting carbonate substrate function in varying temperature and carbonate saturation conditions in marine water (after Fabricius, 1977).

surroundings and, depending upon the temperature and $CaCO_3$ equilibrium, either adsorb or release Ca^{2+} or CO_3^{2-} ions. Calcium carbonate, which is adsorbed, forms aragonite rods or granules, which may be influenced by some form of organic template present in the mucilage. As the aragonite coat develops, the algae migrate upwards towards the surface-water interface, and agitation causes the algal activity to move to a peripheral position. Gradually the nucleus becomes encapsulated. In turbulent water, a complete coating is formed, but, in more calm conditions, the coats may be incomplete. Modern ooid surfaces are frequently inhabited by algae, and Newell, et. al. (1960) have considered that ooids will only form in water less than 2 metres deep.

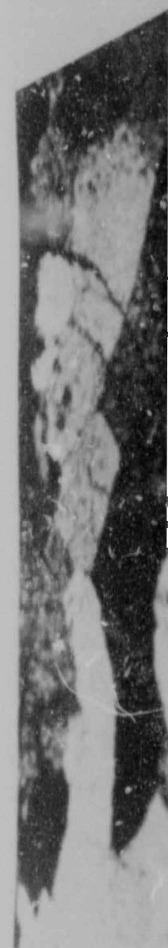
PLATE 2

(a) Very coarsely-crystalline, white dolomite. The large, euhedral dolomite rhomb, right of centre, displays a faint undulose extinction. From Slide A58. (Crossed polars).

(b) Part of a small, domal stromatolite, composed of dolomicrite and minor dolosparite, displaying fine, internal laminations. The inter-column space is filled with layers of mixed dolosparite and dolomicrite. Note the black, dusty, carbonaceous material outlining the laminae and columns. From Slide A58. (Plane polarized light).

(c) Algal filaments of various shapes and sizes, deposited in an inter-column space. The light cement is dolosparite and the dark patches are dolomicrite. Note that the filaments are matrix supported. From Slide A68. (Plane polarized light).

(d) Two ooids, the one at the bottom consists of brownish-coloured dolomicrite, with a relict, concentric, laminated structure; the ooid at the top, consists of recrystallized dolosparite, and is outlined by a diffuse, dusty, black, carbonaceous layer. From Slide A115. (Plane polarized light).



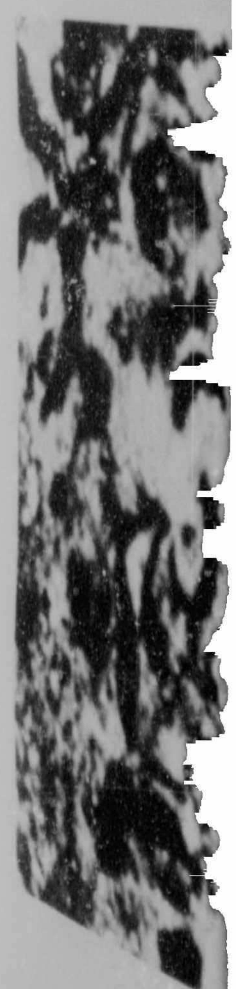
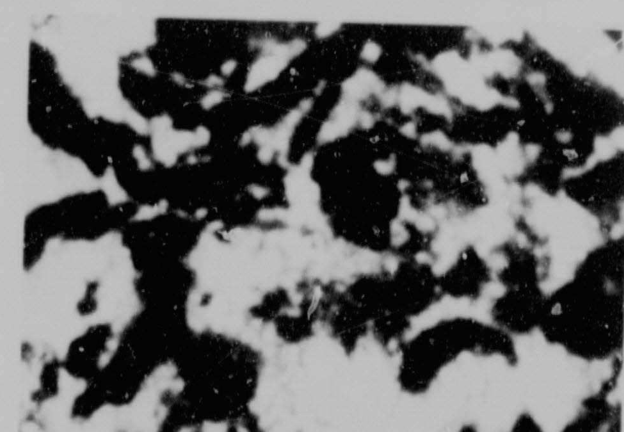


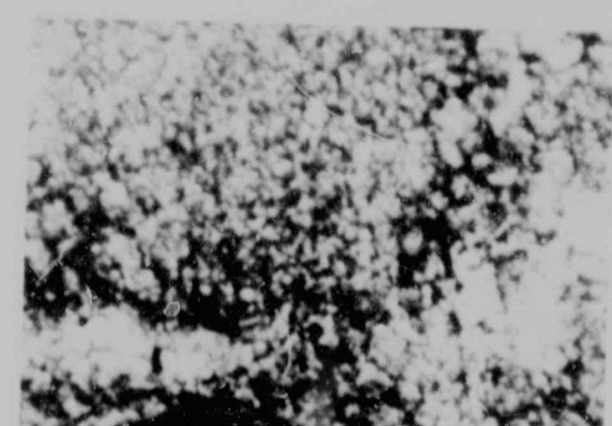
PLATE 2

a 50 μ

b 50 μ



c 50 μ



d 50 μ

The ooids in the Complex Dolomite Zone generally display a radial-crystalline dolomite fabric (Plate 2d), which is similar to the primary, radial-crystalline spheroid shown in Figure 25. Concentric laminations are

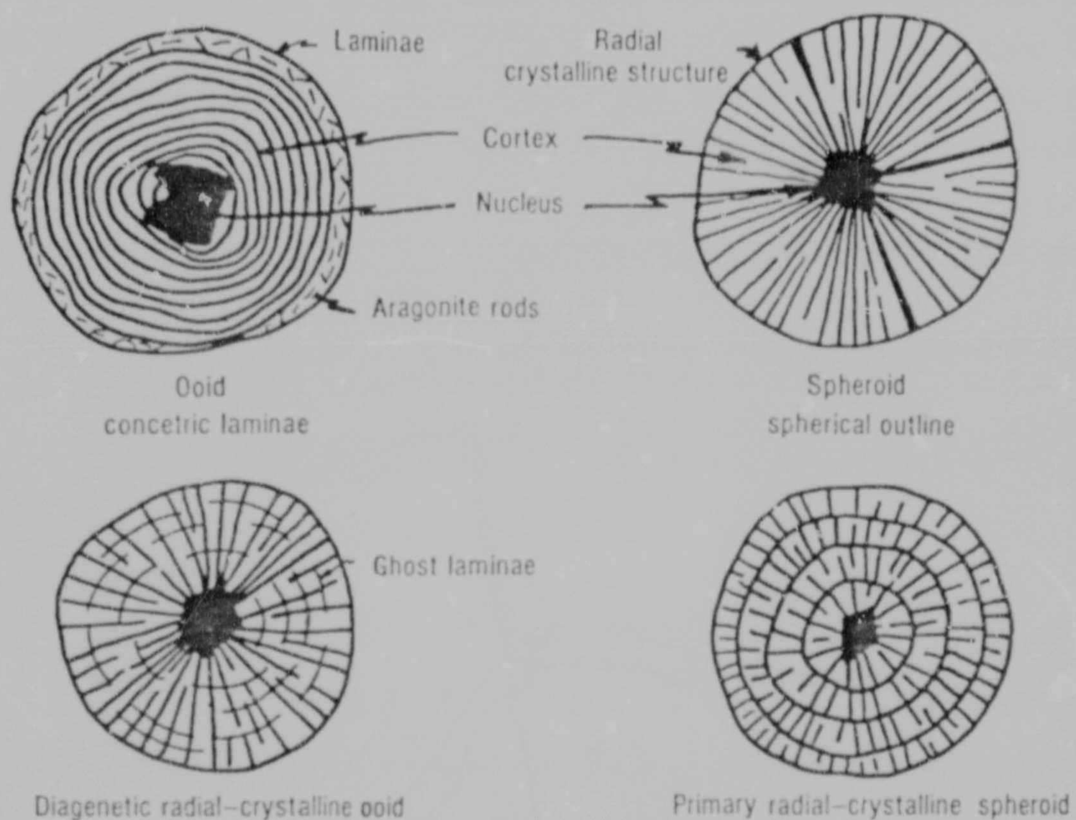


Figure 25 : Distinguishing features of spheroids and ooids.

often preserved, but some ooids have recrystallized completely to fine-grained dolosparite (Plate 2d). The recrystallized ooids are still recognizable, as the dusty carbonaceous material has migrated to the ooid boundary. The ooids are frequently silicified, but thin concentric laminae, less than 5 microns in thickness, composed of dolomicrite, appear to be preferentially preserved (Plate 3a). The silica is cryptocrystalline, except for the core of the ooids, where it is slightly coarser-grained, and, in Plate 1f, silicified ooids are encapsulated in black carbonaceous material. This particular texture forms a distinct marker horizon, approximately 10 metres above the base of the Complex Dolomite Zone, and is present in each borehole. The origin is unknown, but this is further evidence of the mobility of the carbonaceous substance.

The isolith map (Figure 20), displays the total number of ooid horizons developed in each borehole. An east-west trending zone of greater ooids is apparent which swings southwards on the Elandsrand Gold Mine property. If, during the sedimentation of the Malmani dolomites, ooid shoals were restricted to very shallow and turbulent water, then this trend indicates the presence of a persistent, high-energy channel. This trend also reflects areas of better preservation, and mirrors the increased thickness of the Complex Dolomite Zone; illustrated in the isopach map (Figure 19). The aerial distribution of flat-pebble breccias is shown in Figure 26, and

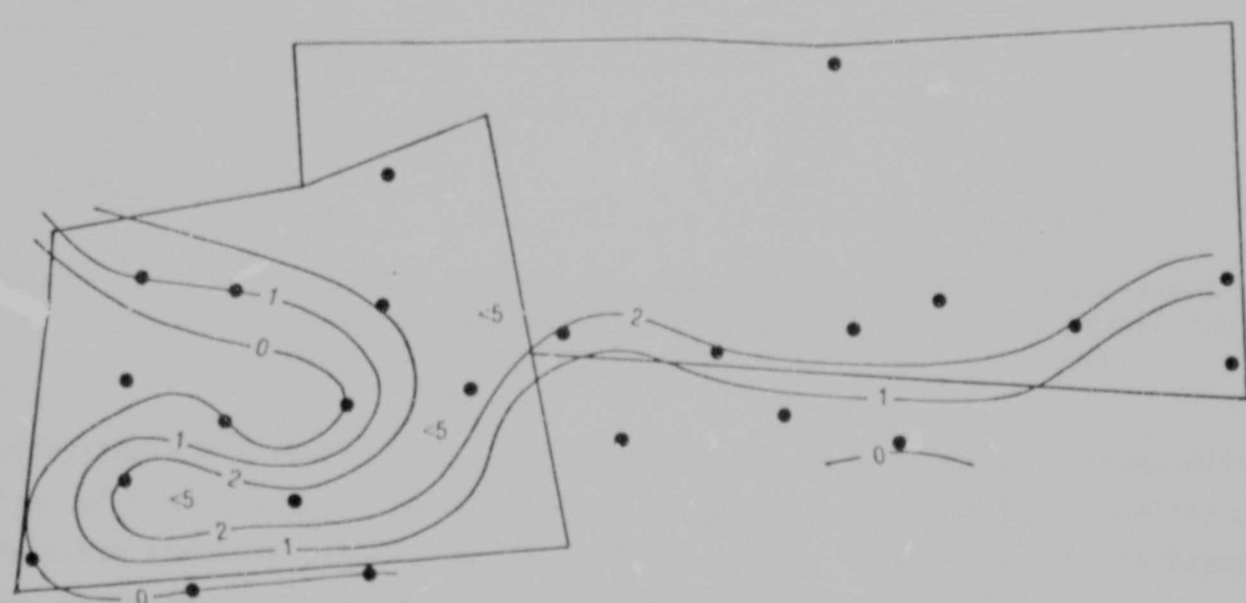


Figure 26 : An isolith map illustrating the aerial distributi f flat-pebble breccias in the Complex Dolomite Zone. Con- intervals represent number of horizons.

this trend closely resembles the ooid isolith map. It is concluded that this east-west trending zone developed in a region of subsidence, in which a greater quantity of sediment accumulated. As currents were relatively strong, many finning-upward cycles were generated, and this accounts for the abundance of ooids, flat-pebble breccias, and intraclastic dolomicrites, in the same area. The isolith map for the intraclastic dolomicrites is shown in Figure 27.

Oncoids, or algal balls, are similar to ooids but, they are generally greater than 2 millimetres in diameter (Plates 4a and 4b). Oncoids behave in a similar manner to ooids in the response to alteration and silicification, as shown in Plate 3b. Here, length-slow chalcedony spherulites are noted within the silicified laminae, indicating that evaporite minerals were