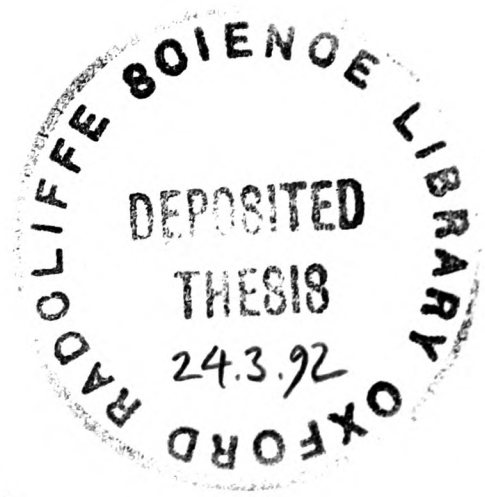
Thesis submitted for the degree of
Doctor of Philosophy

Palaeoceanography and Sedimentology of a Mid-Cretaceous Greensand

Volume 2 - Figures and Tables

by

Stephen Francis Hart



Department of Earth Sciences
& Wolfson College
University of Oxford

Trinity, 1991

TABLE OF CONTENTS

Fig.15: Field outcrop of the lower Chert Beds hardground, Little Beach - Beer Head, south-east Devon (SY 226 879).

Fig.16: Thin development of the lower Chert Beds hardground, Whitecliff, Beer (SY 234 894). Note the chert nodules (black) replacing *Thalassinoides* burrows.

Fig.17: Burrowing developed at the base of the lower Chert Beds hardground, Whitecliff, Beer (SY 234 894).

Fig.18: Vertical profile through the uppermost Foxmould, Chert Beds and Top Sandstones, Little Beach - Beer Head (SY 226 879). Shows the reduction in quartz concentration passing into the Chert Beds; the high quartz content of the Coarse Band; the increase in quartz grain size in the upper Chert Beds pebble beds and Coarse Band; high glauconite concentrations in the uppermost Foxmould and upper Chert Beds pebble beds.

Fig.19: Detailed correlation of the uppermost Foxmould, Chert Beds and Top Sandstones across south-east Devon, indicating the lateral extent and proposed correlation of individual hardgrounds and pebble-shell beds. A = uppermost Foxmould interval of glauconite-rich sands and intraformational pebble-shell beds; B = lower Chert Beds hardground; C = Brecciated Limestone hardground; D = the Coarse Band; E = the top Upper Greensand hardground.

Fig.20: The thick nodular Brecciated Limestone hardground, slipped block, Weston Ebb, west of Branscombe (SY 175 878).

Fig.21: Outcrop of the Brecciated Limestone hardground (lower arrow) and Top Sandstones, Kempstone Rocks, south Devon (SY 161 881). The Coarse Band is developed (upper arrow), weathering back as a notch in the cliffs.

Fig.22: Well-developed rather compacted *Thalassinoides* burrow system, infilled with glauconitic carbonate sand; developed in the lower Top Sandstones, Beer Head (SY 226 879).

Fig.23: Sediment fabric of the Coarse Band, Kempstone Rocks (SY 161 881). Quartz-carbonate sand, rich in coarse rounded quartz grains.

Fig.24: The top Upper Greensand hardground at Whitecliff, Beer (SY 234 894). A well-defined planar surface marks the top of the bed, and a variably-nodular fabric is developed below.

Fig.25: Relict trough cross-bedding preserved in the top Upper Greensand hardground, Beer Head, Beer (SY 226 879).

Fig.26: Small pocket with infill of Beer Head Limestone developed between the uppermost nodules of the top Upper Greensand hardground, Beer Roads, Beer (SY 229 890).

Fig.27: Well-developed rhythmic bedding in the Foxmould, Worbarrow Bay, below Flower's Barrow, south Dorset (SY 866 804).

Fig.28: Close-up view of the rhythmic bedding shown in Fig.27, defined by an increase in the black clay content.

Fig.29: Close-up view of the muddy bed shown in Fig.28; the black mud is redistributed by burrowing activity, often as burrow linings.

Fig.30: Field outcrop of rhythmically-bedded Passage Beds succession at Compton Bay, Isle of Wight (SZ 367 853). Rhythmicity is defined by varying amounts of black mud within pale brown fine-grained siltstones.

Fig.31: Diagram illustrating the cyclicity developed within the Passage Beds of the Isle of Wight. Bed measurement is accompanied by a visual estimate of the mud concentration (1 = very weak; 7 = very strong); the data are plotted as a simple histogram. The 40 first order cycles group into 4 second order cycles.

Fig.32: Glauconite- and serpulid-rich bed developed in the upper Foxmould, below Flower's Barrow, Worbarrow Bay (SY 866 804).

Fig.33: Close-up view of the concretionary horizon shown in Fig.32, indicating the high serpulid concentrations in the sediment.

Fig.34: The Dispar Zone Ammonite Bed, a phosphatic greensand, slipped blocks west of White Nothe, south Dorset (SY 769 809).

Fig.35: Detailed correlation of the uppermost Foxmould, Exogyra Rock, Dispar Zone Ammonite Beds, Chert Beds and Eggardon Grit across south Dorset. Lower Cenomanian faulting at Mupe Bay results in the Chalk Basement Bed resting directly on the Gault. A = uppermost Foxmould glauconitic marly silts; B = Exogyra Rock; C = glauconitic marls; D = Dispar Zone Ammonite Bed; E = thin glauconite-rich bed above the DZAB; F = Chert Beds; G = Eggardon Grit.

Fig.36: Thin development of the Chert Beds at White Nothe, south Dorset (SY 772 806), lying stratigraphically between the Dispar Zone Ammonite Bed and the Eggardon Grit.

Fig.37: The Eggardon Grit, a thick nodular bed of sandy limestone at the top of the Upper Greensand, Durdle Cove, south Dorset (SY 805 806). Top of the bed is just above the hammer head.

Fig.38: A detailed correlation of selected Middle-Upper Albian sections in Normandy, France. A = Poudingue Ferrugineux; B = Gaize Inférieure; C = high *auritus* subzone greensands, basal contact the surface perforée "Cauville"; D = Gaize Supérieure; E = Craie Glauconieuse, basal contact the surface de ravinement "Octeville".

Fig.39: Glauconitic bed developed in sediments of the high *auritus* subzone, Compton Bay, Isle of Wight (SZ 367 853). Pale brown silts pass up into a bed of green, glauconitic marly silt, with a basal contact marked by a zone of sediment-mixing due to bioturbation.

Fig.40: Close-up of the burrowed basal contact shown in Fig.39.

Fig.41: Field outcrop showing the Upper Greensand succession at Gore Cliff, Isle of Wight (SZ 492 763). The Passage Beds (dark grey) in the lower part of the section pass up into pale brown silts of the Upper Greensand; the top part of the cliff is marked by the development of glauconitic marly silts with prominent chert horizons, the Chert Beds.

Fig.42: Detailed graphic log of the high *auritus* subzone interval of sedimentary condensation: thin glauconitic cycles at the top of the Gaize Inférieure, St. Jouin-Bruneval, Normandy coast.

Fig.43: Field outcrop showing the high *auritus* subzone sediments, near St. Jouin-Bruneval, Normandy coast; four greensand beds are developed in this interval (the bases of these are arrowed). Field log of the section given in Fig.42.

Fig.44: Field outcrop of three greensand beds developed in a thin Albian sequence on the eastern side of the Armorican Massif, Carrière le Livet, near Cordebugle, Normandy.

Fig.45: The lower greensand bed shown in Fig.44. Facies change is from muddy fine sands to glauconite-rich, muddy fine sands, which become marly immediately above. The base of the greensand bed is marked by an erosion surface with a coarse quartzose lag, and remanié phosphate nodules.

Fig.46: Field outcrop of the lower greensand bed shown in Fig.44. Outcrop is 5m along the section from that shown in Fig.45. The base of the greensand bed is marked by well-developed burrowing.
Fig.47: Field outcrop of erosion surface in the lower Chert Beds, interpreted as the result of Upper Albian synsedimentary faulting, Culverhole Point area (SY 278 893). The erosion surface is marked by a glauconitic, clayey pebble bed.

Fig.48: Close-up of the bed shown in Fig.47. Note the burrowed basal contact to the glauconitic pebble bed.

Fig.49: Top of the Eggardon Grit, slipped block below Flower's Barrow, Worbarrow Bay (SY 866 804). Note the erosive nature of the contact, with truncation of the nodules highlighted by the nodule-margin (burrow-wall) glauconitization.

Fig.50: Top of the Eggardon Grit, slipped block below Flower's Barrow, Worbarrow Bay (SY 866 804). Erosion of the bed has proceeded to a lower level than in Figure 49, with only traces of burrow-wall glauconitization preserved.

Fig.51: Sipped block of the Upper Greensand below Flower's Barrow, Worbarrow Bay (SY 866 804). Shows a mixed eroded-nodule assemblage, with pale nodules of the Eggardon Grit and smaller glauconitic sandstone nodules of Exogyra Rock lithology.

Fig.52: Field outcrop of the Chalk Basement Bed at Cow Corner, resting on the Exogyra Rock, as a result of Lower Cenomanian synsedimentary faulting.

Fig.53: Complex condensation horizon at the top of the Upper Greensand, Swanage Bay, south Dorset (SY 044 811). 1.2 metres of sediment contain four concretion generations, and represent the equivalent of the Chert Beds and Top Sandstones of south-east Devon (around 23 metres in thickness).

Fig.54: Generation 2 nodules in the complex condensation horizon shown in Figure 53. Pale brown concretions represent the Chert Beds lithology, and preserve burrows filled with glauconitic sediment.

Fig.55: Generation 3 nodules in the complex condensation horizon shown in Figure 53. The phosphatic concretions correlate with the Dispar Zone Ammonite Bed.

Fig.56: Thin Chert Beds Member, at Compton Bay, Isle of Wight (SZ 367 853). Well-developed concretionary horizons are present, but chert is not developed. The top of the Upper Greensand occurs at a level marked by the top of the scale rule; the beds are overlain by the Glauconitic Marl. The Chert Beds expand and become more siliceous towards the south of the island (Fig.41).

Fig.57: Cartoon illustrating the genetic relationship between nodular hardgrounds and phosphoritic greensands.
A: Halt in sedimentation above cross-stratified bioclastic grainstones, and deeper-water marly silts.
B: Development of nodularity within carbonates; glauconite concentration in deeper settings.
C: Nodules are exposed due to winnowing of the overlying sediment; an often long and complex cycle, which includes nodule boring, encrustation, glauconitization and phosphatisation occurs; increased concentrations of glauconite-rich sediment accumulate in deeper settings, a basal zone of strong burrowing and sediment mixing develops, and phosphate nodules develop.
D: Under relative transgression, sedimentation recommences, preserving the hardground and phosphoritic greensand below bioclastic packstones and silty marls.

Fig.58: Summary of stratigraphy, cyclicity and sedimentary environments of the Chert Beds and Top Sandstones Members of the Upper Greensand Formation, Beer Head, south-east Devon.

Fig.59: Glauconite-rich greensand bed marking the base of the Upper Greensand south of Eastbourne (TV 610 977). This bed is equivalent to the Coarse Band of south Devon.

Fig.60: Sequence stratigraphic subdivision of the Upper Albian sediments of the Anglo-Paris Basin, with reference to fourteen designated regional type areas. Ammonite subzonal stratigraphy is plotted as a vertical scale, with proven subzones indicated to the left of each column by a * symbol. Within each column is shown a summary of the sediment composition at a given time interval. Note that no indication of the relative thicknesses is given with this representation. Dotted lines indicate correlative conformities to candidate type II sequence boundaries. Candidate sequential interpretation is given: S.B. = sequence boundary; T.S. = transgressive surface; C.S. = condensed section; TST = transgressive systems tract; HST = highstand systems tract; SMST = shelf margin systems tract.

Table 1: Upper Albian candidate sequence stratigraphy of the Anglo-Paris Basin.

Fig.61: Comparison between the sequence stratigraphy proposed for the Anglo-Paris Basin as a result of this study, and the global cycle chart of Haq *et al.* (1988). Shows candidate sequence boundaries (filled arrows), condensed sections (open arrows), and additional minor flooding surfaces (dotted arrows).

CHAPTER 3 - STORM SEDIMENTATION IN THE UPPER GREENSAND FORMATION (CRETACEOUS) OF SOUTH-WEST ENGLAND

Fig.62: Location map showing the outcrop of the Upper Greensand and Gault across south-west England, and the localities mentioned in the text.

Fig.63: Distal storm laminites, interbedded with fully-bioturbated sediment. Two laminite beds visible, with associated calcareous concretions. Hooken Cliffs, near Beer.

Fig.64: Summary of the typical sedimentological features of a Foxmould member storm laminite bed.

Fig.65: Bioturbated top of a storm laminite bed. Hooken Cliffs, Beer.

Fig.66: Graphic logs of a selected part of the Foxmould member, demonstrating the west-east trend of thinning, fining and disappearance of storm laminite beds. Peak Hill: muddy fine sands with interbedded laminites ; Hooken Cliffs: muddy fine sands with fewer and thinner laminites ; Seaton Hole: muddy fine sands with traces of lamination ; Golden Cap: homogeneous and fully bioturbated muddy silts ; Lulworth Cove: rhythmically-bedded muddy silts (variations in silt : clay).

Fig.67: Thick, proximal storm laminite bed, with a sharp base and bioturbated top. Peak Hill, near Sidmouth.

Fig.68: Large scour at the base of a proximal storm bed, cutting down through thin, amalgamated laminite beds to the top of an underlying thick bed. Peak Hill, near Sidmouth.

Fig.69: Horizontal and low-angle cross-lamination, developed within a thick proximal laminite bed. Peak Hill, near Sidmouth.

Fig.70: Bioturbated top of the bed seen in Fig.67, showing the progression from horizontally-laminated to structureless bioturbated silt.

Fig.71: Amalgamated thin storm laminite beds, preserved within a late diagenetic calcareous concretion, Hooken Cliffs, Beer. Each bed has a concentration of serpulid-rich sediment at the base. Note the burrows in the upper part of the top laminite bed.

Fig.72: Graphic log of amalgamated thin storm laminites and storm-reworked phosphate horizon, from the Foxmould member, Hooken Cliffs, Beer.

Fig.73: Field outcrop of a lens of tabular cross-lamination preserved in the Foxmould Member, Whitecliff, Beer (SY 234 893).

Fig.74: Graphic log of variably-amalgamated, glauconite-rich, thin storm laminites at the Foxmould-Chert Beds contact, Dunscombe Cliff. Correlates with interval shown in Fig.77 and Fig.78.

Fig.75: Fully-bioturbated lithofacies, with very abundant black mud-lined *Palaeophycus* burrows. Little Beach, near Beer.

Fig.76: Fully-bioturbated lithofacies showing the *Thalassinoides-Palaeophycus* trace fossil association, preserved within a concretion. Foreshore east of Axemouth.

Fig.77: Pebble-shell beds and coquina lenses in the uppermost Foxmould, with the Chert Beds Member carbonates above. Whitecliff, Beer.

Fig.78: Graphic log and fabric data from the uppermost Foxmould pebble/shell beds seen in Figure 77, Whitecliff, Beer. Fabric data taken on pebble long axes (pebbles with >2:1 length:width ratio). Correlates with interval shown in Figure 73.

Fig.79: Detailed view of the coquina shell lens seen in Figure 77.

Fig.80: Detailed view of the upper two pebble-shell beds shown in Figure 77, showing the sediment fabric, which has a tendency towards bedding-parallel orientations of the pebble long axes.

Fig.81: Graphic log and fabric data from the upper Chert Beds pebble-shell beds at Beer Head. Fabric data taken on shell and pebble long axes (pebbles with >2:1 length:width ratio) and on shell convexity orientations.

Fig.82: Interbedded carbonate packstones/grainstones and coarse pebble-shell beds, upper Chert Beds, Beer Head (shown graphically in Figure 81).

Fig.83: Pebble-shell bed fabric. Shows a patch of pebble-rich sediment in the upper part, probably infilling a small scour. Shell material is predominantly horizontally-oriented, with a patch of imbricated shells on the left of the picture. Lower pebble-shell bed in upper Chert Beds, Beer Head.

Fig.84: Pebble-shell bed fabric. Shows the predominantly horizontal alignment of the pebble and shell material. An internal sandy lens suggests amalgamation of two beds. A shallow scour at the base of the bed, infilled with pebbles and shells, is present on the left of the picture. Lower pebble-shell bed in upper Chert Beds, Beer Head.

Fig.85: Coquina shell bed in the lower Chert Beds, showing sharp base, lower shelly layer, internal sandy lens, and overlying shelly layer with mounded top. Implies amalgamation of at least two discrete events. Little Beach, Beer.

Fig.86: Graphic log and fabric data from complex proximal shell-pebble beds, Weston Ebb. Fabric data taken on shell long axes and convexity orientations.

Fig.87: Complex proximal shell-pebble beds, upper Chert Beds, just below the Brecciated Limestone hardground, Weston Ebb (shown graphically in Figure 86). Note the internal calcarenite lenses within the uppermost coquina, and thin shell stringers in the sediment immediately below.

Fig.88: Coarse-grained coquina lens and thin shell stringers, upper Chert Beds, Weston Ebb. Note the predominantly convex-down shell stacking in the main part of the coquina lens, and the predominantly convex-up alignments at the top of the lens, and in the shell stringer below.

Fig.89: Fabric of thin pebble layer, finer-grained shell-pebble bed, and coarse shell stringer, upper Chert Beds, Weston Ebb.

Fig.90: Bedding plane view of shell bed from the Beer Head Limestone (Cenomanian), Weston Ebb. Shows the different shell assemblage to the Upper Greensand shell beds, with variably-fragmented *Merklinia* and *Amphidonte* bivalves.

Fig.91: Fabric of coarse-grained complex, proximal coquina bed, upper Chert Beds, Weston Ebb. Note the close shell stacking in predominantly convex-down orientations. Scattered patches of sediment show imbrication, and orientations up to vertical to bedding. Small intraformational pebbles are present at low concentrations throughout.

Fig.92: Gutter infilled with shell-rich sediment, developed at the base of a coarse-grained, complex, proximal coquina bed, Weston Ebb.

Fig.93: Complex pebble-shell bed, showing evidence for amalgamation of three separate pebble and shell concentrations, upper Chert Beds, Beer Head.

Fig.94: Cartoon showing the different types of basal contact to the pebble/shell beds in the Chert Beds calcarenites. (A) basal firmground burrowing and *in situ* nodules ; (B) basal firmground burrowing, all nodules reworked ; (C) no firmground burrowing, all nodules reworked ; (D) sharp base, overlain by a shell-rich bed, sometimes cross-stratified.

Fig.95: Horizontal and undulose to low-angle cross-lamination, the Chert Beds. Wave-polished block, Culverhole Point.

Fig.96: Polished slab from coquina bed, lower Chert Beds, showing the shell fabric. Predominantly horizontal shell orientations, with occasional larger shells up to vertical to the bedding. Note the stratification present within the sample; at least four thin beds are developed, differing in grain size and shell orientation. Little Beach, Beer.

CHAPTER 4 - STABLE-ISOTOPE STRATIGRAPHY OF THE UPPER ALBIAN *DISPAR* ZONE (MID-CRETACEOUS) OF SOUTHERN ENGLAND

Fig.97: Subdivision of the Upper Greensand Formation of south-east Devon, with corresponding ammonite biostratigraphy. Ammonite zonation scheme based on Owen (1976).

Fig.98: Map showing the Upper Greensand and Gault outcrop across south-west England, and the location of the section sampled, at Little Beach - Beer Head.

Table 2: Carbon- and oxygen-isotopic data from Little Beach - Beer Head, south-east Devon. Data are from whole rock samples, generated by crushing, except for the two samples marked *, which were generated by drilling a small amount of powder from fresh specimen surfaces. Normalised data reflect modification to remove postulated silica diagenesis; data normalised to the lowest $\delta^{18}O$ value.

Table 3: Detailed sample set extracted from Table 2, with corresponding normalised values.

Table 4: Isotopic data from repeated drillings of a single hand specimen showing patchy silicification, collected from the top glauconitic pebble-shell bed in the uppermost Foxmould at Whitecliff, Beer (SY 234 893).

Table 5: Carbon- and oxygen-isotopic data from oysters collected throughout the Little Beach - Beer Head section. Normalised data reflects modification to remove postulated silica diagenesis.

Fig.99: Carbon- and oxygen-stable isotope stratigraphy of the Upper Greensand (Chert Beds and Top Sandstones Members), Little Beach - Beer Head, south-east Devon. The $\delta^{13}C$ and $\delta^{18}O$ values are measured from whole-rock carbonate samples. The accompanying lithostratigraphy shows the subdivision of the Upper Greensand in south-east Devon.

Fig.100: Investigation of the isotopic modification resulting from silica diagenesis.
Fig.100A: the isotopic changes across 1.63m of the lower Chert Beds, showing the positions of prominent chert nodules and nodules of siliceous limestone.
Fig.100B: plot of $\delta^{13}C$ vs $\delta^{18}O$, showing the good positive correlation, and the best fit line, the gradient of which represents the isotopic changes caused by silicification.
Fig.100C: original carbon-isotope plot and normalised plot (dotted), removing the effects of silicification.

Fig.101: Plot of $\delta^{13}C$ vs $\delta^{18}O$ values recorded from repeated drillings of a single hand specimen showing patchy silicification, collected from the top glauconitic pebble-shell bed of the uppermost Foxmould at Whitecliff, Beer (SY 234 893).

Fig.102: Carbon-isotope stratigraphy of the Upper Greensand (Chert Beds and Top Sandstones), Beer Head - Little Beach. The three plots show measured $\delta^{13}C$ values, three point moving average of measured $\delta^{13}C$ values, and $\delta^{13}C$ values normalised to remove the variations assumed to represent changes due to silicification.

Fig.103: Plot of $\delta^{13}C$ vs $\delta^{18}O$ values for the whole rock data set (Little Beach - Beer Head section). Data from the lower Chert Beds, upper Chert Beds and the Top Sandstones plot as three distinct groups, with little or no overlap. The silicification trend established in Figure 5B is shown for the lower Chert Beds. Data from the upper Chert Beds, and possibly the Top Sandstones, also show a scatter of values inferring that a major control on recorded $\delta^{13}C$ values (low variability within each group) was silica diagenesis. The plot clearly displays the abrupt positive shift between the lower and upper Chert Beds, and shows that it is not caused by silicification.

Fig.104: Carbon- and oxygen-isotope stratigraphy of the Upper Greensand (Little Beach - Beer Head). The isotopic values are from oysters collected throughout the succession.

Fig.105: Plot of $\delta^{13}C$ vs $\delta^{18}O$ values for the oyster data set (Little Beach - Beer Head section). Data from the lower Chert Beds, upper Chert Beds and Top Sandstones plotted separately. A high degree of scatter is shown, with little indication of any secular changes. Some degree of correlation establishes a tentative silicification modification trend.

Fig.106: Carbon-isotope stratigraphy from oyster samples (Little Beach - Beer Head section). The two plots show measured $\delta^{13}C$ values, and $\delta^{13}C$ values normalised to remove the variations interpreted as due to silicification.

Fig.107: Global distribution of Upper Albian black shales (discussed in the text), plotted on an Albian (105Ma) palaeogeographic reconstruction of Funnel (1990).

CHAPTER 5 - GEOCHEMICAL ANALYSIS OF GLAUCONITIZATION PROCESSES IN THE UPPER GREENSAND FORMATION

Table 6: Microprobe chemical analyses of glauconitic grains from the Foxmould Member, Upper Greensand Formation, Beer, south-east Devon.

Table 7: Microprobe chemical analyses of glauconitic grains from the uppermost Foxmould Member, Upper Greensand Formation, Beer, south-east Devon.

Table 8: Microprobe chemical analyses of glauconitic grains from the Chert Beds, Upper Greensand Formation, Beer, south-east Devon.

Table 9: Microprobe chemical analyses of glauconitic grains from the Chert Beds, Upper Greensand Formation, Beer, south-east Devon.

Table 10: Microprobe chemical analyses of glauconitic grains from the top Upper Greensand hardground, Beer, south-east Devon.

Table 11: Microprobe chemical analyses of glauconitic grains from the Dispar Zone Ammonite Bed, Durdle Cove, south Dorset.

Table 12: Microprobe chemical analyses of glauconitic grains from the Upper Greensand at Gore Cliff, Isle of Wight.

Table 13: Microprobe chemical analyses of glauconitic grains from the basal Upper Greensand at Eastbourne.

Fig.108: Photomicrograph of glauconite filling the porosity within a bryozoan bioclast: coquina bed in lower Chert Beds Member, Upper Greensand Formation, Little Beach, Beer, south-east Devon.

Fig.109: Photomicrograph of glauconite filling the chambers of a foraminifera, and rimmed grains with two accretion phases: middle pebble-shell bed in uppermost Foxmould interval of glauconitic pebble-shell beds, Upper Greensand Formation, Whitecliff, Beer, south-east Devon.

Fig.110: Photomicrograph of glauconite filling the axial canal of a sponge spicule (transverse section): Blue Rag, Upper Greensand, Hollows Lane, Selbourne, western Weald.

Fig.111: Photomicrograph of glauconite filling the axial canal of a sponge spicule (longitudinal section): Blue Rag, Upper Greensand, Hollows Lane, Selbourne, western Weald.

Fig.112: Photomicrograph of glauconite rimming a quartz grain, and a vermicular glauconitic grain: upper thick storm laminite bed, Foxmould Member, Upper Greensand Formation, Hooken Cliffs, Beer, south-east Devon.

Fig.113: Photomicrograph of glauconite forming along cracks in a quartz grain: coquina bed in lower Chert Beds Member, Upper Greensand Formation, Little Beach, Beer, south-east Devon.

Fig.114: Photomicrograph of glauconite growing within the flakes of a muscovite grain: Foxmould Member (loose sample), Upper Greensand Formation, Hooken Cliffs, south-east Devon.

Fig.115: Photomicrograph of glauconite growing within the flakes of a muscovite grain: upper thick storm laminite bed, Foxmould Member, Upper Greensand Formation, Hooken Cliffs, Beer, south-east Devon.

Fig.116: Photomicrograph of glauconitized echinoid bioclast: coquina bed in lower Chert Beds Member, Upper Greensand Formation, Little Beach, Beer, south-east Devon.

Fig.117: Photomicrograph of glauconite replacing an aggregate of silt-sized quartz grains and mud, interpreted as a faecal pellet: coquina bed in lower Chert Beds Member, Upper Greensand Formation, Little Beach, Beer, south-east Devon.

Fig.118: Photomicrograph of glauconite replacing the muddy matrix sediment of fine-grained muddy sand: Foxmould Member (loose sample), Upper Greensand Formation, Hooken Cliffs, Beer, south-east Devon.

Fig.119: Morphologies of glauconitic grains measured by electron microprobe analysis.
119.1: Foxmould glauconites; 119.2: uppermost Foxmould glauconites; 119.3: upper Chert Beds (lower part) glauconites; 119.4: upper Chert Beds (upper part) glauconites; 119.5: top Upper Greensand glauconites; 119.6: Dispar Zone Ammonite Beds glauconites; 119.7: Upper Greensand, Gore Cliff glauconites; 119.8 Upper Greensand, Eastbourne glauconites.

Table 14: Sulphur-carbon analyses.

Fig.120: Sulphur/carbon data - the Foxmould Member, Upper Greensand, south-east Devon.

CHAPTER 6 - CONTROLS ON THE WORLD-WIDE DEVELOPMENT OF THE CRETACEOUS GLAUCONITIC FACIES

GRAPHIC LOGS

KEY TO GRAPHIC LOGS

CRETACEOUS	UPPER	CENOMANIAN	CHALK
	LOWER	ALBIAN	UPPER GREENSAND GAULT LOWER GREENSAND

Fig.1: Simplified stratigraphic position of the Upper Greensand of southern England

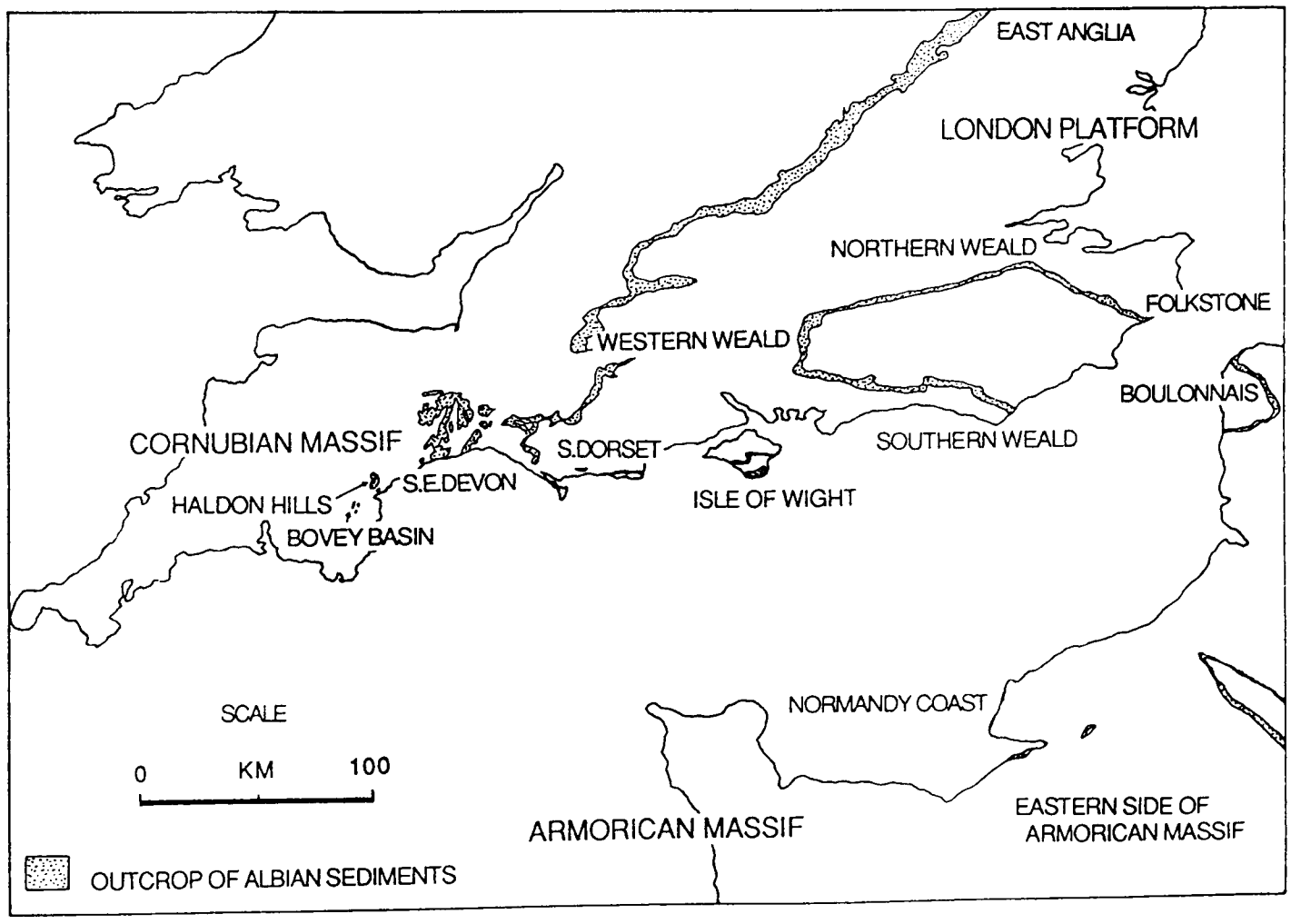


Fig.2: Map of the outcrop of Albian sediments in the Anglo-Paris Basin, showing the locations of areas discussed further in the text.

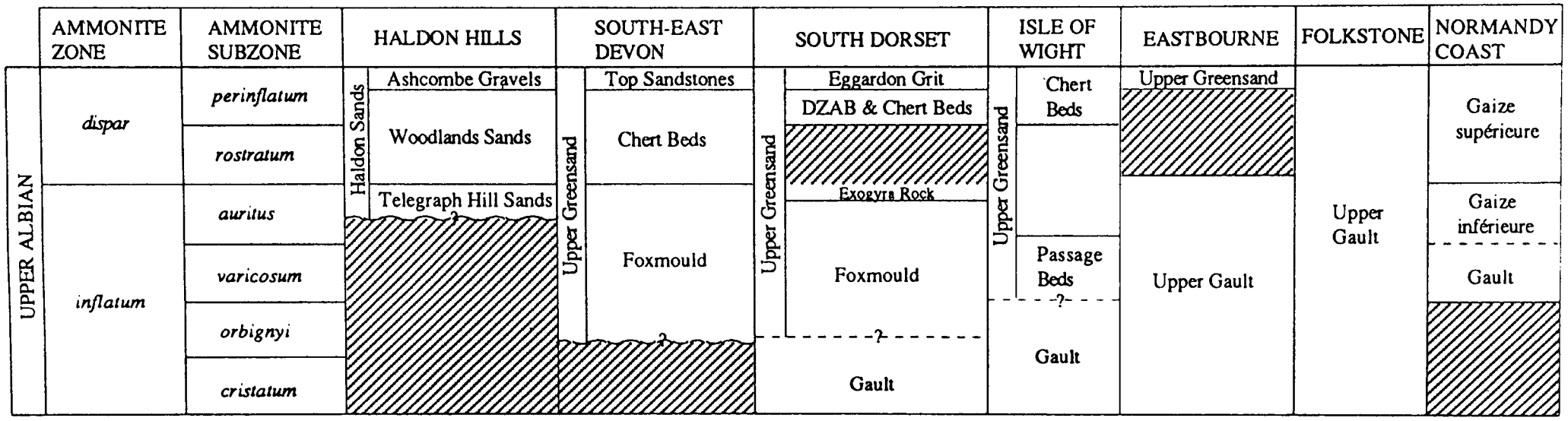
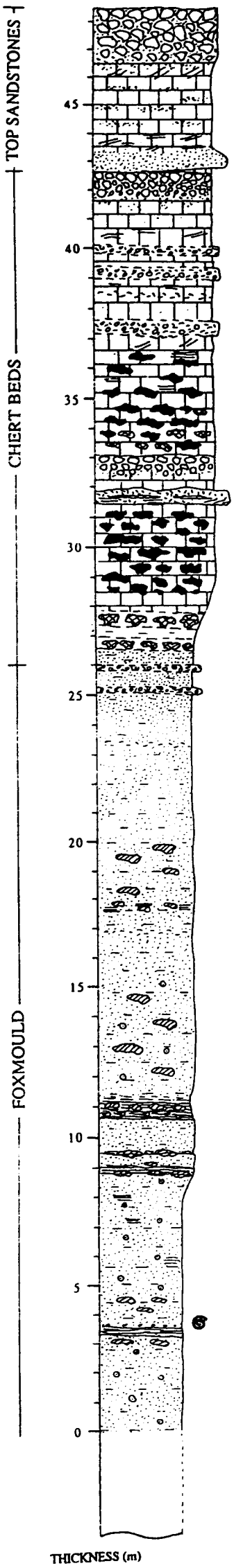


Fig.3. Simplified stratigraphic scheme for the Upper Albian of the Anglo-Paris Basin, based on Jukes-Browne & Hill (1900); Smith (1961); Drummond (1970); Hamblin & Wood (1976); Juignet (1980); Garrison et al. (1987) and the author's own work and interpretation. Ammonite zonation scheme after Owen (1976). Hatched areas indicate biostratigraphic gaps.



The top Upper Greensand hardground; grey-brown, quartzose nodular limestone; matrix sediment strongly burrowed, quartz grains and small granules; relict trough cross-bedding; burrow wall glauconitisation and upper surface phosphatisation

Brown, medium-grained calcarenites; faint trough cross-stratification.

Trough cross-bedded, medium-grained, glauconite-poor calcarenites; rich in comminuted shell fragments; glauconite-rich sediment-filled burrows common.

The Coarse Band; moderately glauconitic coarse calcarenaceous sand; a few small, glauconitised limestone pebbles and coarse shell fragments; gradational upper contact; base is sharp but with basal burrowing, it cuts down to rest on underlying hardground; structureless, but faint traces of horizontal to low-angle stratification.

The Brecciated Limestone hardground; pale grey limestone nodules in a burrowed, glauconite-rich coarse sandy matrix; burrow wall glauconitisation, no phosphatisation.

Complex pebble-shell bed; *in situ* nodules at base, with burrowing, passing up into fully-reworked medium to coarse glauconitic carbonate sand; pebbles marginally glauconitised, bored and encrusted; horizontal shell alignment.

Shell-pebble bed; horizontally-aligned large shell fragments and glauconitised limestone pebbles, sometimes bored and encrusted.

Thin, weakly-defined concentration of shell fragments.

Amalgamated shell-pebble bed, constructed from up to three separate concentrations of shells and glauconitised limestone pebbles; occasional basal scour; well-developed horizontal shell alignment; gradational upper contact.

Pale grey-brown, medium-grained calcarenites, broken bivalve shell fragments common; thick abundant chert nodules; weak traces of horizontal stratification.

Shell-rich sediment overlying the hardground.

The lower Chert Beds hardground; brownish-grey limestone nodules in a burrow-reworked, very shelly, glauconite rich coarse sandy matrix; burrow wall glauconitisation.

Coquina shell bed; coarse bivalve shell fragments, with horizontal and planar cross-lamination; sharp basal contact, top contact is gently mounded; amalgamated, with thin internal sandy layer, often silicified; rare small limestone pebbles

Brown, fine to medium-grained calcarenites; silica-rich; scattered bivalve shell fragments.

Compact muddy limestone, cleaning upwards.

Brown, strongly silicified limestone.

Dark grey, muddy, fine-grained limestone; scattered siliceous concretions.

Pebble-shell bed; matrix-supported fabric with glauconitised and bored pebbles of glauconitic sandstone and shell fragments in a muddy glauconitic sand matrix; transitional bed contacts.

Shell-pebble bed; bivalve-rich, with sandy matrix; well-cemented and nodular; pebble-poor.

Dark brown, strongly bioturbated fine sand.

Minor shell concentration.

Pale greenish-grey, fine-grained silty sands; low mud content.

Strongly bioturbated, fine-grained muddy sandstones.

Traces of horizontal lamination.
Occasional small calcareous concretions after burrows.
Minor shell concentration.

Strongly bioturbated fine-grained muddy sandstones.

Laminated sand bed; sharp base with serpulid concentration; bioturbated top; high concentration of calcareous concretions deflecting the lamination; predominantly horizontal lamination, with occasional low-angle cross-lamination and reactivations.

Thin laminated bed, as above; thins laterally due to variable bioturbation at the top of the bed.

Laminated bed as above; sharp base, with serpulid concentration; concretions centred on this shelly layer

Dark grey, strongly bioturbated, glauconitic muddy silts; occasional patches with traces of horizontal lamination, scattered pyrite nodules.

Shelly, phosphatic, muddy sand; scattered small black phosphate nodules.
Three amalgamated thin beds of laminated fine sand; basal shelly lags.

⊗ : phosphatised ammonite; varicosum Subzone (see page C)

Strongly bioturbated, fine-grained muddy silts; pyrite nodules common.

Basal beds and basal unconformity not exposed.

Fig.4: Detailed graphic log of the Upper Greensand succession between the Hooken Cliffs and Beer Head, Beer (SY 220 879 to SY 227 879).

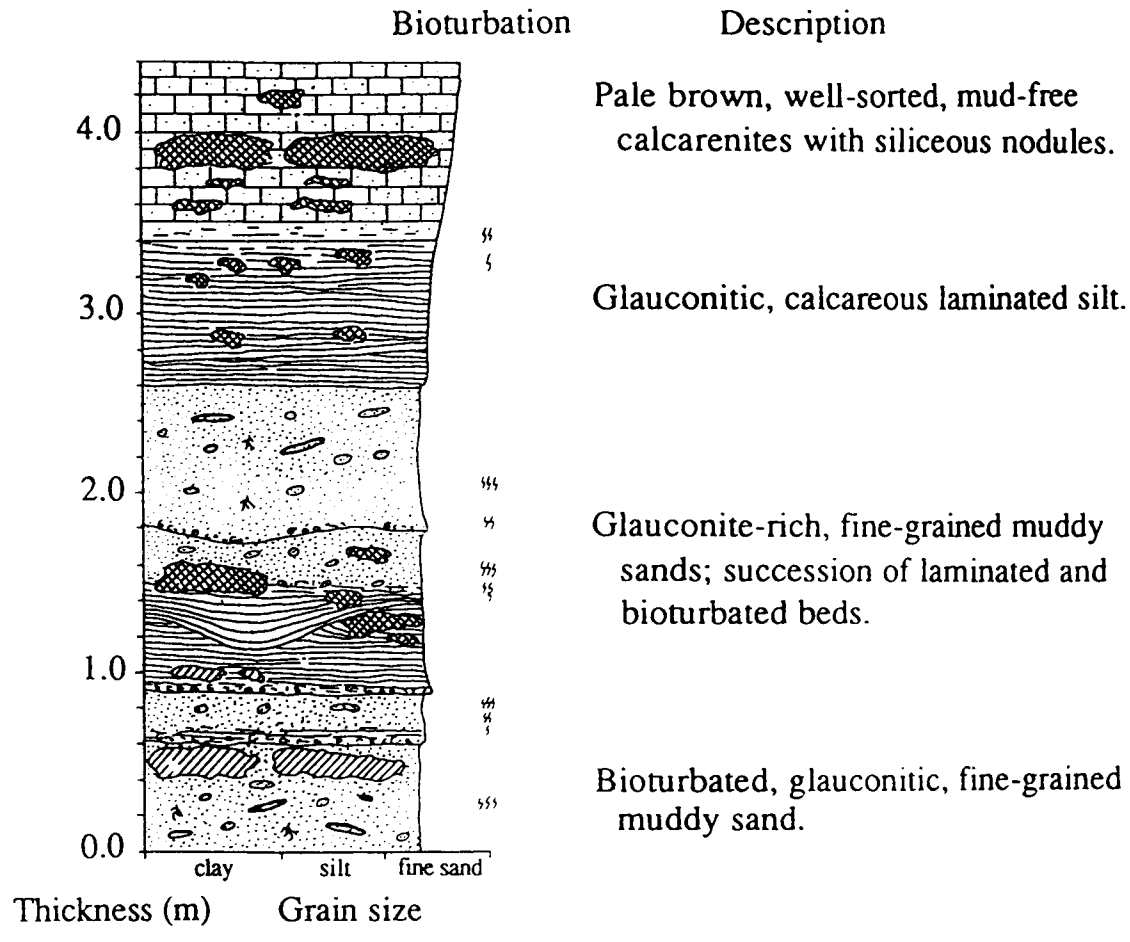
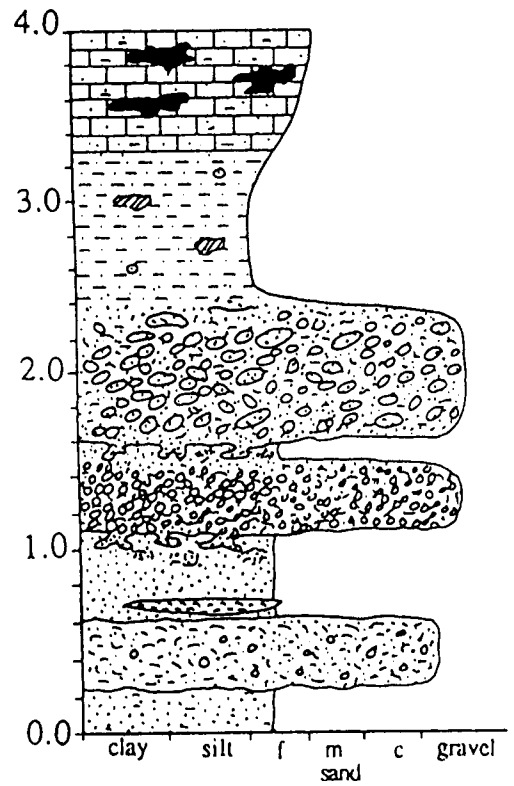


Fig.5: Detailed graphic log of the high *auritus* subzone interval of sedimentary condensation: amalgamated glauconitic storm laminites at the Foxmould-Chert Beds contact, Dunscombe Cliff (SY 153 877), south Devon.

Fig.6: Outcrop of the interval of condensed glauconitic pebble-shell beds in the uppermost Foxmould, Whitecliff, Beer (SY 234 894). Shown graphically in Figure 7.



Description

Muddy, silty fine-grained calcarenites with scattered comminuted shell fragments and scattered chert nodules.

Dark brown, very muddy coarse silt; passes gradationally up into calcarenites.

Palaeophycus burrows, lined with black mud.

Glauconite-rich pebble-shell bed; pebbles of glauconitic sandy limestone in a glauconitic, slightly shelly matrix; fabric varies from pebble-supported to matrix-supported; basal *Thalassinoides* burrowing.

Thin bed of buff-coloured calcareous siltstone; variably nodular.

Glauconitic pebble shell bed; pebbles of limestone in a shelly, glauconitic matrix; pebble-supported fabric; basal *Thalassinoides* burrowing; *Amphidonte*, *Merklinia*, echinoids, bryozoans.

Rather nodular, strongly bioturbated, muddy, fine-grained sandstone; *Palaeophycus* burrows.

Coquina shell lens.

Hard, nodular shell-pebble bed (?laterally overlapping lenses), rich in bivalves.

Fine-grained, muddy, glauconitic sands, fully bioturbated.

Fig.7: Detailed graphic log of the high *auritus* subzone interval of sedimentary condensation: glauconitic intraformational pebble-shell beds at the Foxmould Chert Beds contact, south-east Devon.

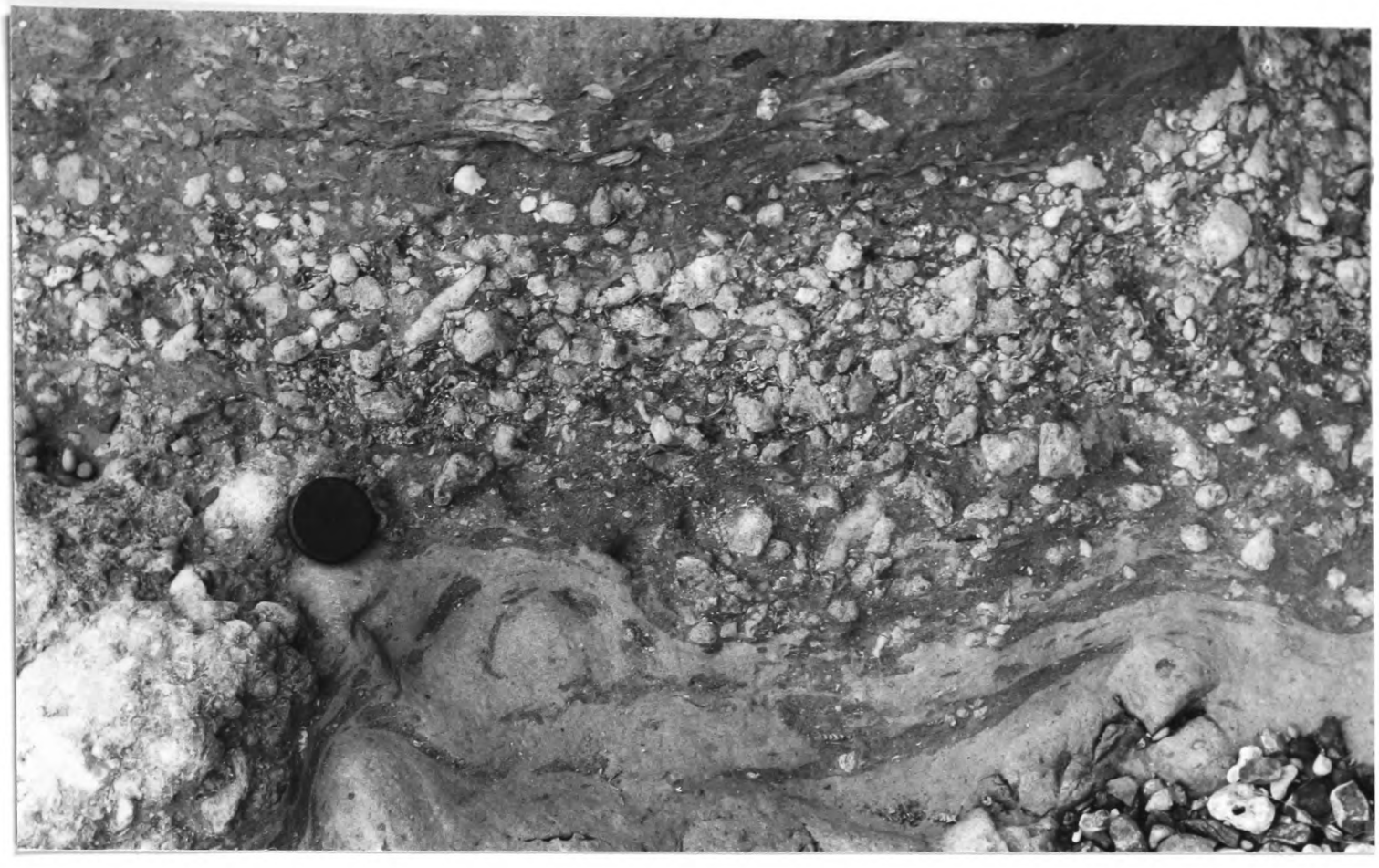


Fig.8: Basal burrowing with glauconitic sediment infill, developed in the glauconitic pebble-shell beds in the uppermost Foxmould, Whitecliff, Beer, south-east Devon (SY 234 894). Middle bed in Fig.7.

Fig.9: Basal burrowing with glauconitic sediment infill, developed in the glauconitic pebble-shell beds in the uppermost Foxmould, Whitecliff, Beer, south-east Devon (SY 234 894). Middle bed in Fig.7.

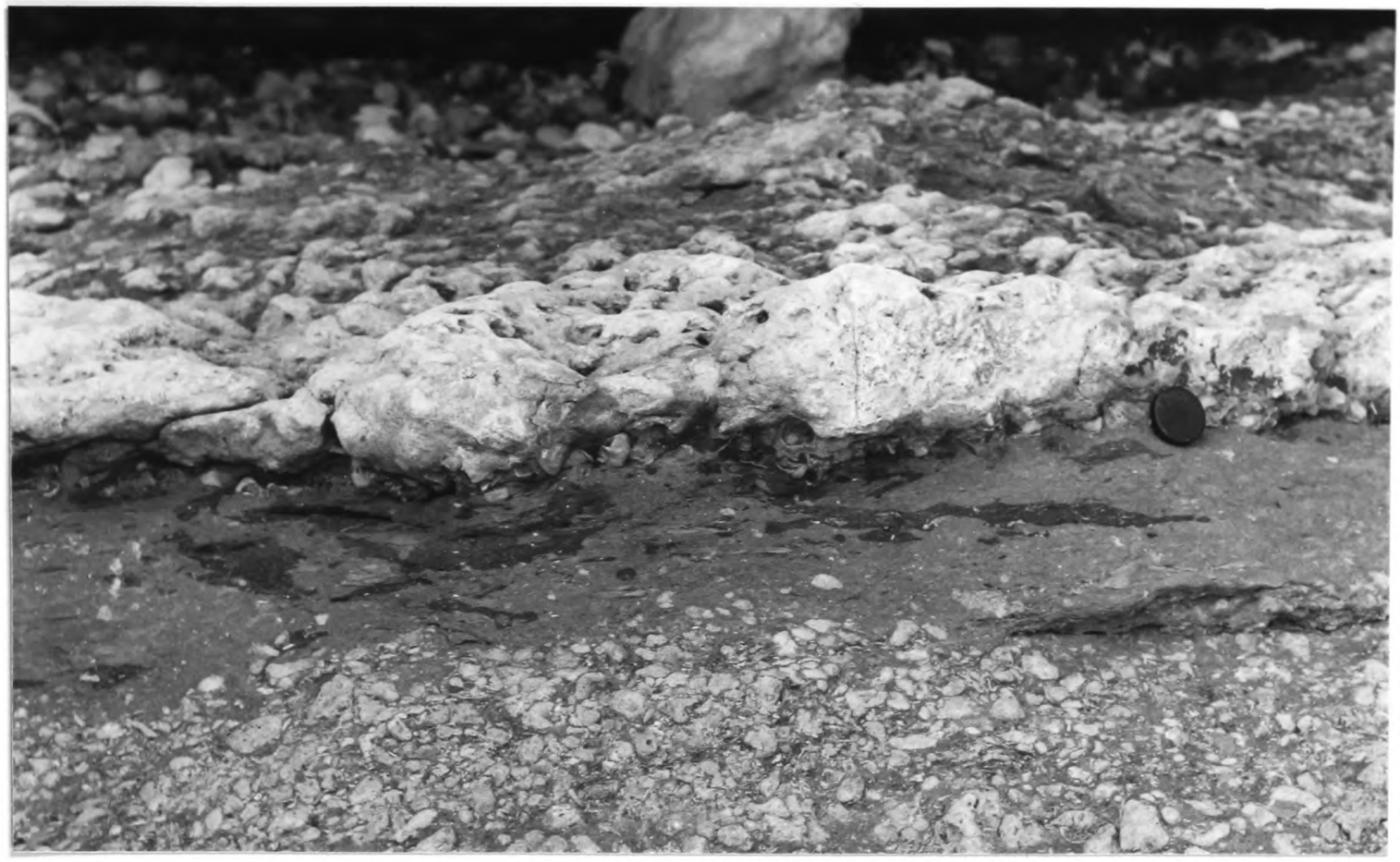


Fig.10: Basal burrowing with glauconitic sediment infill, developed in the glauconitic pebble-shell beds in the uppermost Foxmould, Whitecliff, Beer, south-east Devon (SY 234 894). Upper bed in Fig.7.

Fig.11: Basal burrowing with glauconitic sediment infill, developed in the glauconitic pebble-shell beds in the uppermost Foxmould, Whitecliff, Beer, south-east Devon (SY 234 894). Upper bed in Fig.7.

Fig.12: Two successive nodular horizons developed in the uppermost Foxmould, around Culverhole Point, between Axemouth and Lyme Regis (SY 278 893).

Fig.13: Thick interval of nodular sandstones - pebble beds, section 0.5km east of Corbin Rocks, between Axemouth and Lyme Regis (SY 293 896).

Fig.14: Field outcrop of the lower Chert Beds hardground, Little Beach - Beer Head, south-east Devon (SY 226 879).

Fig.15: Field outcrop of the lower Chert Beds hardground, Little Beach - Beer Head, south-east Devon (SY 226 879).

Fig.16: Thin development of the lower Chert Beds hardground, Whitecliff, Beer (SY 234 894). Note the chert nodules (black) replacing *Thalassinoides* burrows.

Fig.17: Burrowing developed at the base of the lower Chert Beds hardground, Whitecliff, Beer (SY 234 894).

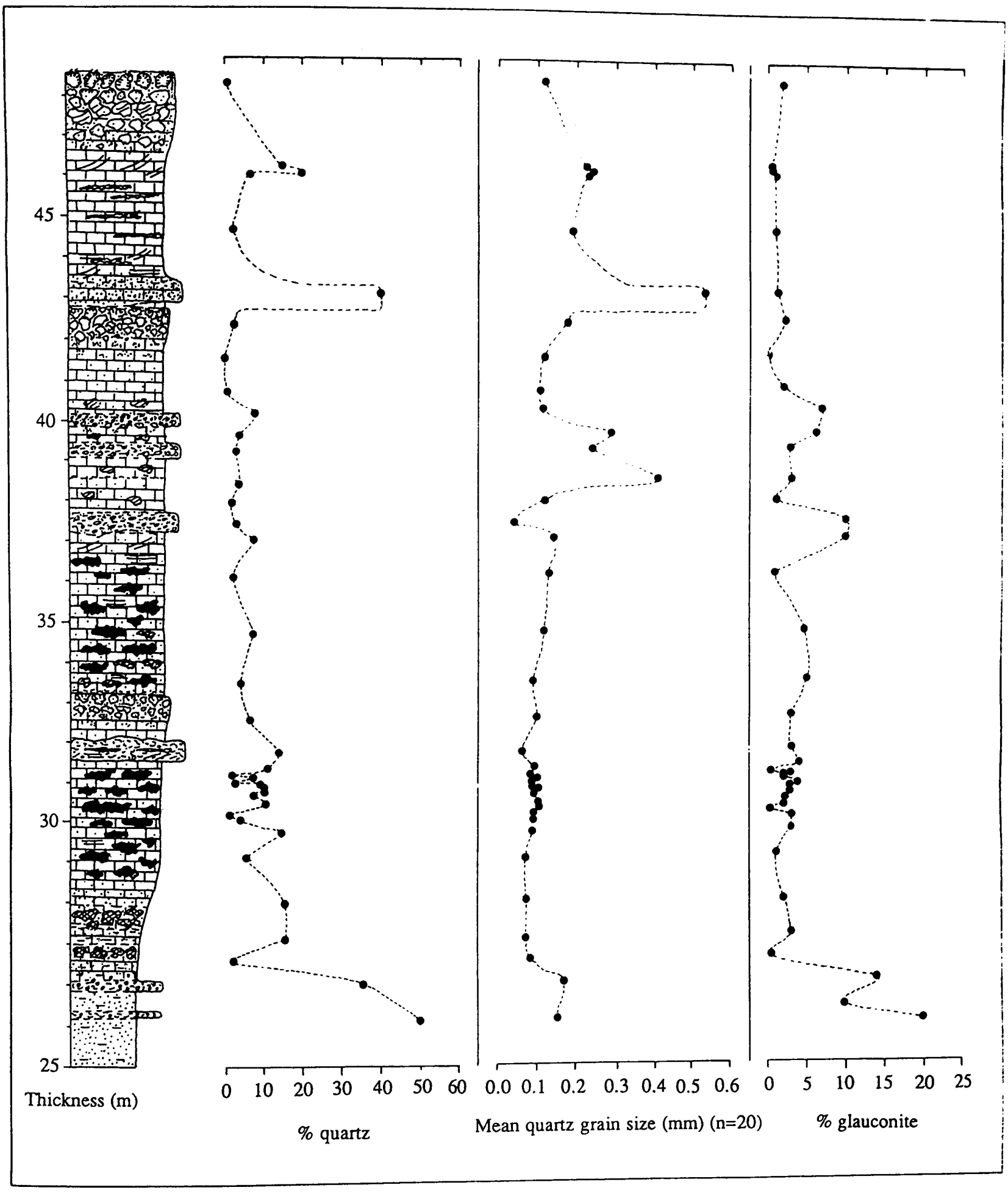
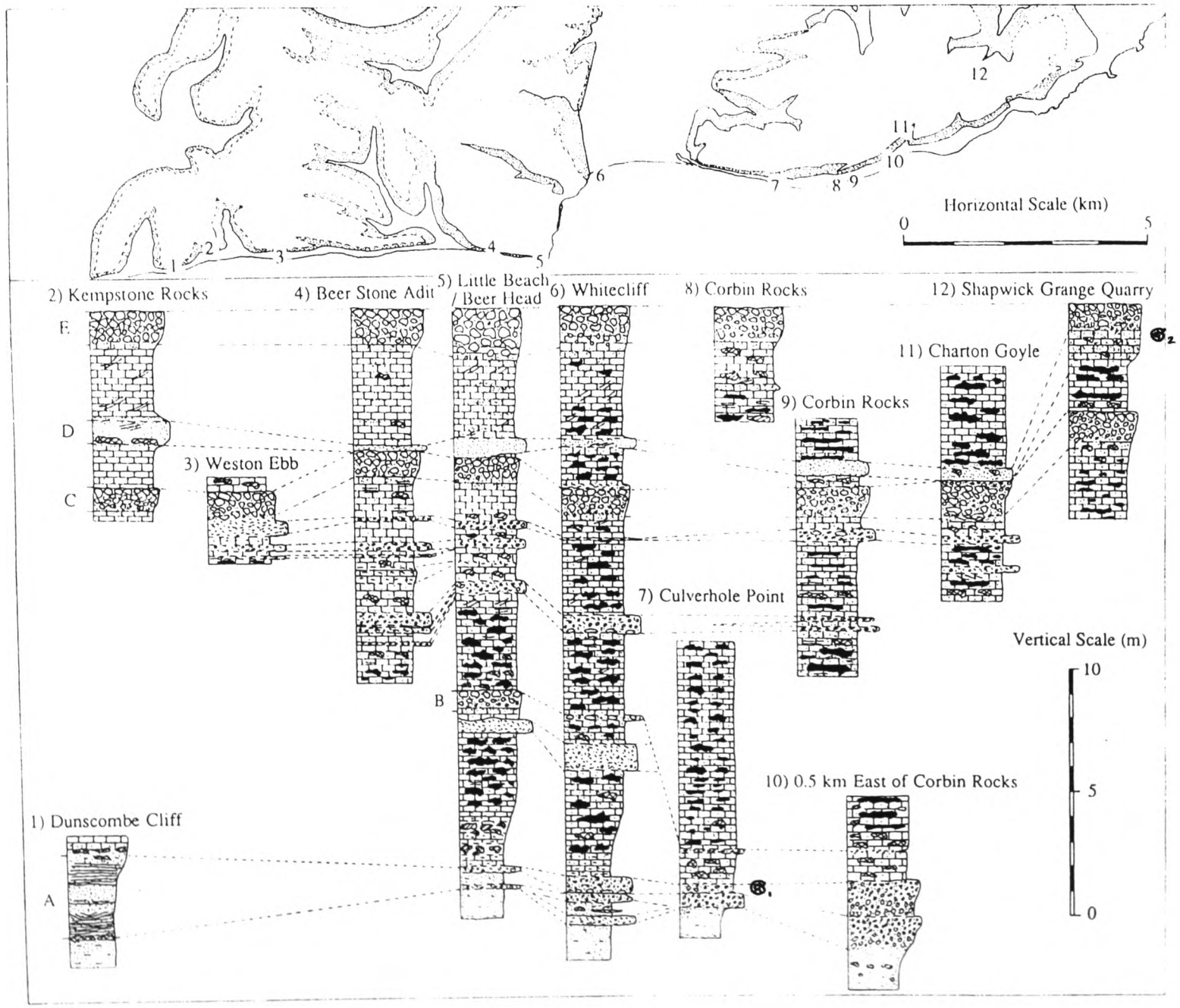


Fig.18: Vertical profile through the uppermost Foxmould, Chert Beds and Top Sandstones, Little Beach - Beer Head (SY 226 879). Shows the reduction in quartz concentration passing into the Chert Beds; the high quartz content of the Coarse Band; the increase in quartz grain size in the upper Chert Beds pebble beds and Coarse Band; high glauconite concentrations in the uppermost Foxmould and upper Chert Beds pebble beds.

Fig.19: Detailed correlation of the uppermost Foxmould, Chert Beds and Top Sandstones across south-east Devon, indicating the lateral extent and proposed correlation of individual hardgrounds and pebble-shell beds. A = uppermost Foxmould interval of glauconite-rich sands and intraformational pebble-shell beds; B = lower Chert Beds hardground; C = Brecciated Limestone hardground; D = the Coarse Band; E = the top Upper Greensand hardground.



Key

- Fine-grained muddy sands and silts
- Laminated fine-grained sands and silts
- Calcareous concretions
- Pyrite
- Bioclastic packstones and grainstones
- Nodular hardground
- Intraformational pebbles
- Shells and shell fragments
- Calcarenaceous sand
- Siliceous nodules
- Chert nodules
- Horizontal- and cross-stratification

$\otimes_1$: Ammonite dating: aureitus subzone (see page 7)

$\otimes_2$: Ammonite dating high perinflatum subzone (see page 11)

Fig.20: The thick nodular Brecciated Limestone hardground, slipped block, Weston Ebb, west of Branscombe (SY 175 878).

Fig.21: Outcrop of the Brecciated Limestone hardground (lower arrow) and Top Sandstones, Kempstone Rocks, south Devon (SY 161 881). The Coarse Band is developed (upper arrow), weathering back as a notch in the cliffs.

Fig.22: Well-developed rather compacted *Thalassinoides* burrow system, infilled with glauconitic carbonate sand; developed in the lower Top Sandstones, Beer Head (SY 226 879).

Fig.23: Sediment fabric of the Coarse Band, Kempstone Rocks (SY 161 881). Quartz-carbonate sand, rich in coarse rounded quartz grains.

Fig.24: The top Upper Greensand hardground at Whitecliff, Beer (SY 234 894). A well-defined planar surface marks the top of the bed, and a variably-nodular fabric is developed below.

Fig.25: Relict trough cross-bedding preserved in the top Upper Greensand hardground, Beer Head, Beer (SY 226 879).

Fig.26: Small pocket with infill of Beer Head Limestone developed between the uppermost nodules of the top Upper Greensand hardground, Beer Roads, Beer (SY 229 890).

Fig.27: Well-developed rhythmic bedding in the Foxmould, Worbarrow Bay, below Flower's Barrow, south Dorset (SY 866 804).

Fig.28: Close-up view of the rhythmic bedding shown in Fig.27, defined by an increase in the black clay content.

Fig.29: Close-up view of the muddy bed shown in Fig.28; the black mud is redistributed by burrowing activity, often as burrow linings.

Fig.30: Field outcrop of rhythmically-bedded Passage Beds succession at Compton Bay, Isle of Wight (SZ 367 853). Rhythmicity is defined by varying amounts of black mud within pale brown fine-grained siltstones.

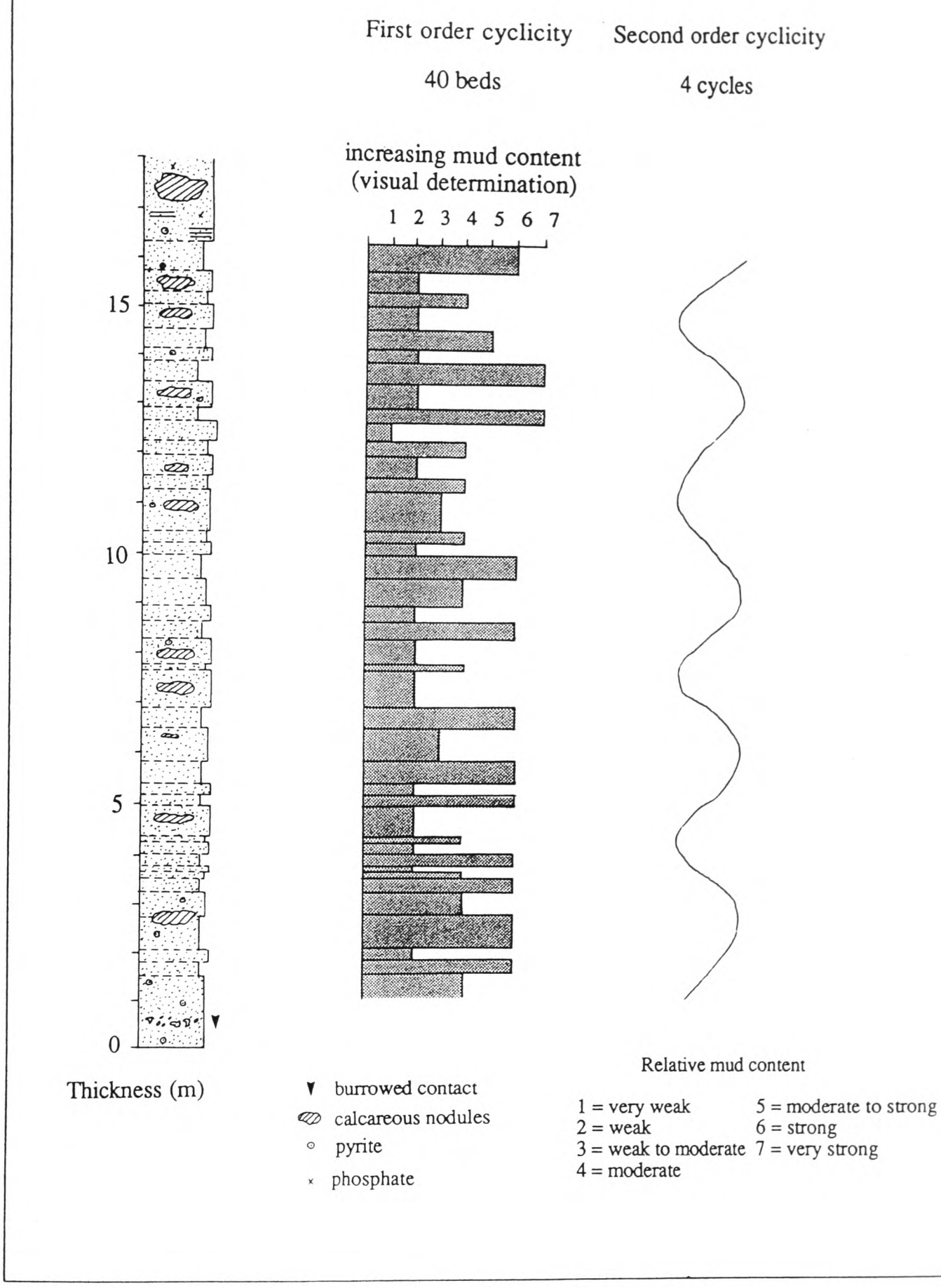


Fig.31: Diagram illustrating the cyclicity developed within the Passage Beds of the Isle of Wight. Bed measurement is accompanied by a visual estimate of the mud concentration (1 = very weak; 7 = very strong); the data are plotted as a simple histogram. The 40 first order cycles group into 4 second order cycles.

Fig.32: Glauconite- and serpulid-rich bed developed in the upper Foxmould, below Flower's Barrow, Worbarrow Bay (SY 866 804).

Fig.33: Close-up view of the concretionary horizon shown in Fig.32, indicating the high serpulid concentrations in the sediment.

Fig.34: The Dispar Zone Ammonite Bed, a phosphatic greensand, slipped blocks west of White Nothe, south Dorset (SY 769 809).

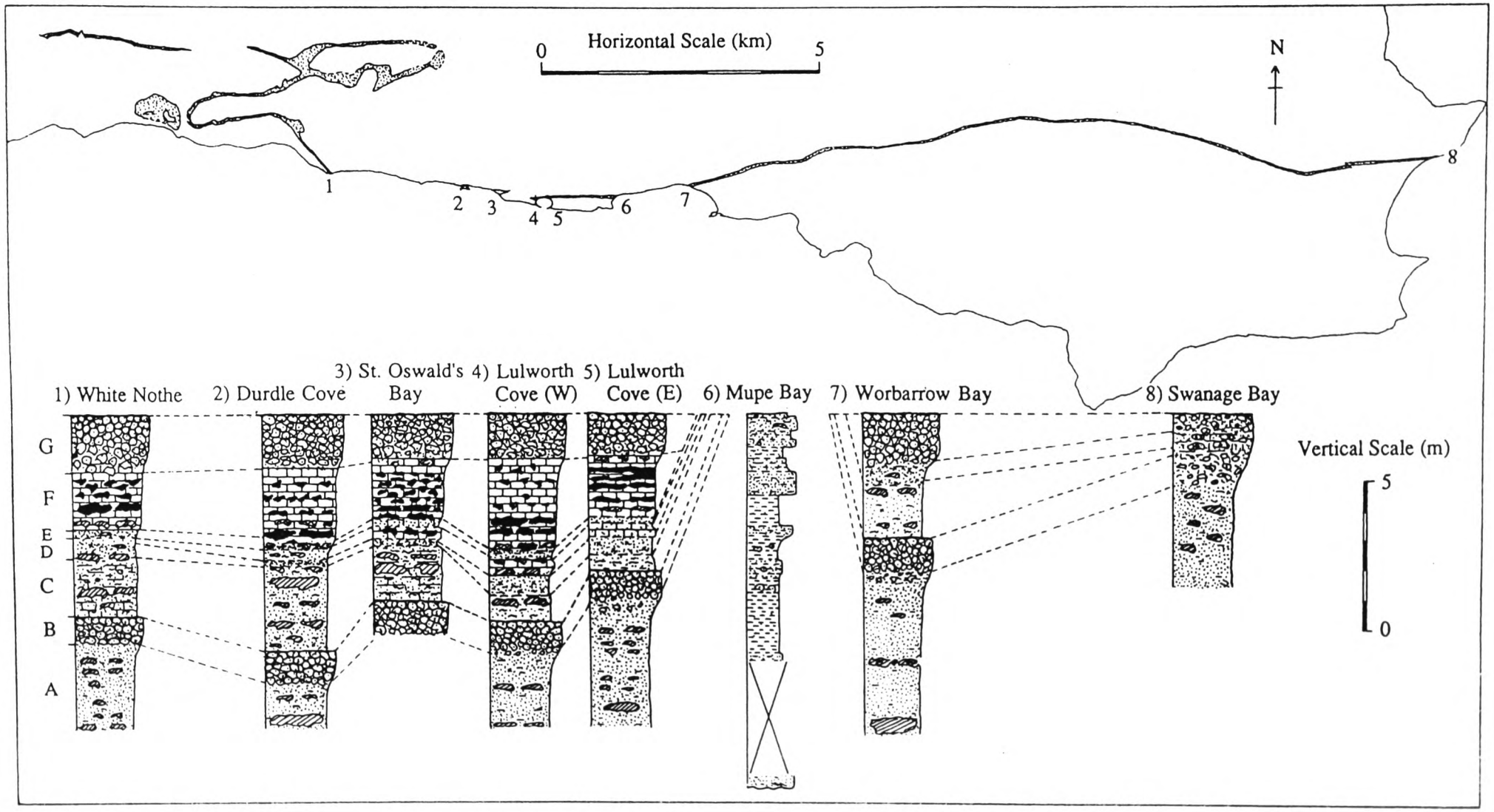


Fig.35: Detailed correlation of the uppermost Foxmould, Exogyra Rock, Dispar Zone Ammonite Beds, Chert Beds and Eggardon Grit across south Dorset. Lower Cenomanian faulting at Mupe Bay results in the Chalk Basement Bed resting directly on the Gault. A = uppermost Foxmould glauconitic marly silts; B = Exogyra Rock; C = glauconitic marls; D = Dispar Zone Ammonite Bed; E = thin glauconite-rich bed above the DZAB; F = Chert Beds; G = Eggardon Grit.

Fig.36: Thin development of the Chert Beds at White Nothe, south Dorset (SY 772 806), lying stratigraphically between the Dispar Zone Ammonite Bed and the Eggardon Grit.

Fig.37: The Eggardon Grit, a thick nodular bed of sandy limestone at the top of the Upper Greensand, Durdle Cove, south Dorset (SY 805 806). Top of the bed is just above the hammer head.

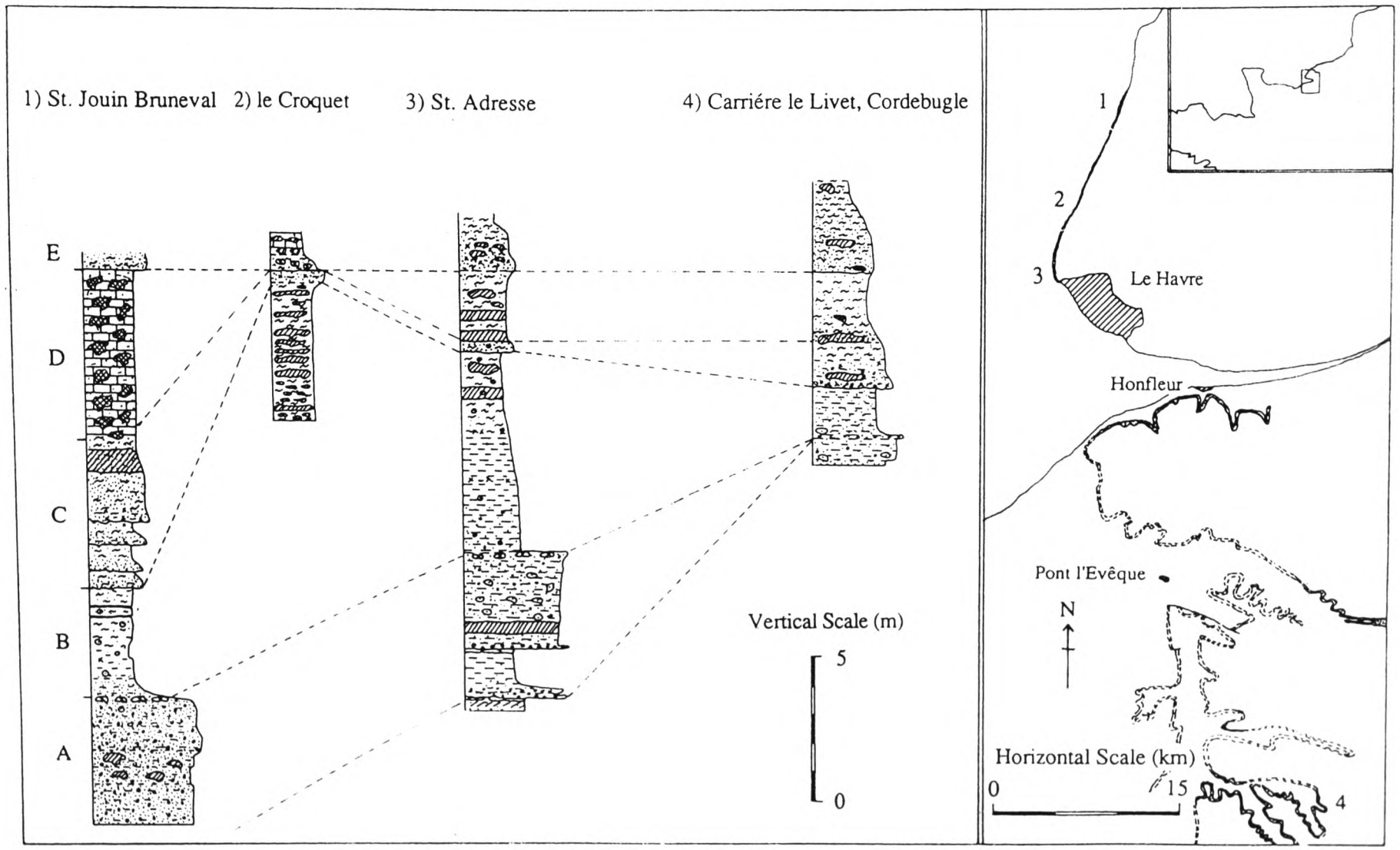


Fig.38: A detailed correlation of selected Middle-Upper Albian sections in Normandy, France. A = Poudingue Ferrugineux; B = Gaize Inférieure; C = high *auritus* subzone greensands, basal contact the surface perforée "Cauville"; D = Gaize Supérieure; E = Craie Glauconieuse, basal contact the surface de ravinement "Octeville".

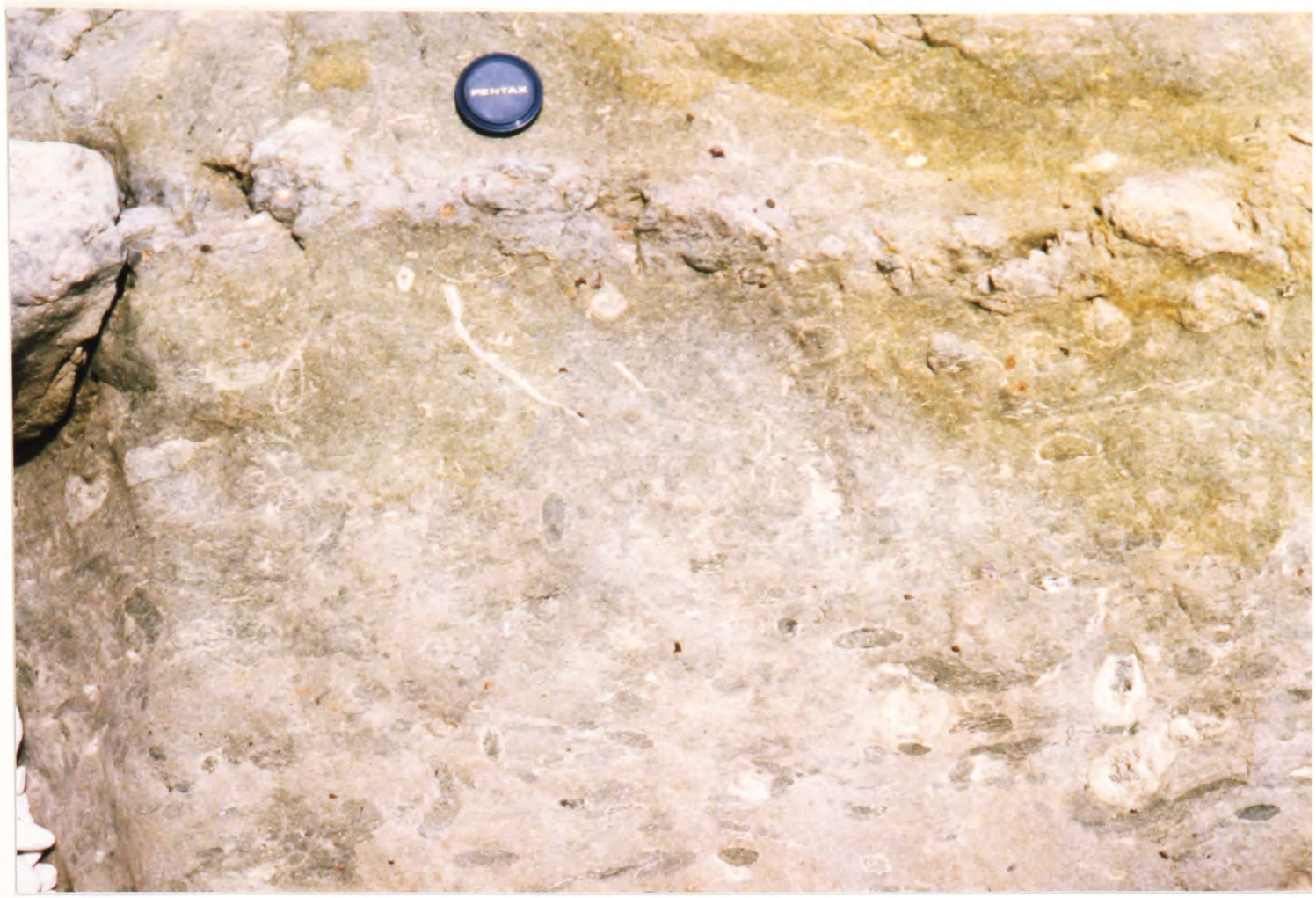
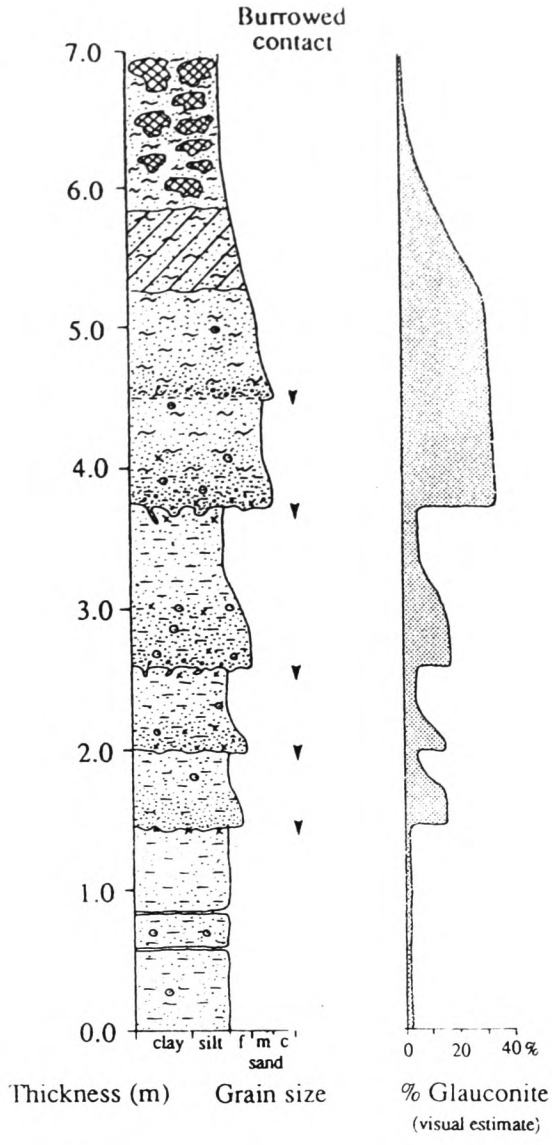


Fig.39: Glauconitic bed developed in sediments of the high *auritus* subzone, Compton Bay, Isle of Wight (SZ 367 853). Pale brown silts pass up into a bed of green, glauconitic marly silt, with a basal contact marked by a zone of sediment-mixing due to bioturbation.

Fig.40: Close-up of the burrowed basal contact shown in Fig.39.

Fig.41: Field outcrop showing the Upper Greensand succession at Gore Cliff, Isle of Wight (SZ 492 763). The Passage Beds (dark grey) in the lower part of the section pass up into pale brown silts of the Upper Greensand; the top part of the cliff is marked by the development of glauconitic marly silts with prominent chert horizons, the Chert Beds.



Description

Pale-coloured, siliceous silty marl; patchy silicification; burrow-mottled due to strong bioturbation.

Concretionary bed of glauconitic marl.

Marly greensand; strongly bioturbated with marl-lined burrows, *Thalassinoides*, and *Chondrites*.

Weak concentration of coarse quartz grains and shell fragments; basal burrowing.

Marly greensand; fully bioturbated.

Glauconite-rich muddy greensand, becoming more marly upwards; basal concentration of coarse quartz grains and small granules; burrowed basal contact; two phosphate generations (buff and black nodules).

Muddy silt with *Chondrites*; scattered buff phosphate nodules.

Glauconitic muddy silt; weak basal concentration of coarse quartz grains; two phosphate generations (buff and black nodules);

Muddy pyritic silt with *Chondrites*.

Glauconitic muddy silt; burrowed basal contact.
Muddy pyritic silt with *Chondrites*.

Glauconitic muddy silt; brown, weakly phosphatised burrows at the base.

Pale grey silts with *Chondrites*.

Two mud-rich thin beds.

Pale grey pyritic silts with *Chondrites*.

Fig.42: Detailed graphic log of the high *auritus* subzone interval of sedimentary condensation: thin glauconitic cycles at the top of the Gaize Inférieure, St. Jouin-Bruneval, Normandy coast.

Fig.43: Field outcrop showing the high *auritus* subzone sediments, near St. Jouin-Bruneval, Normandy coast; four greensand beds are developed in this interval (the bases of these are arrowed). Field log of the section given in Fig.42.

Fig.44: Field outcrop of three greensand beds developed in a thin Albian sequence on the eastern side of the Armorican Massif, Carrière le Livet, near Cordebugle, Normandy.

Fig.45: The lower greensand bed shown in Fig.44. Facies change is from muddy fine sands to glauconite-rich, muddy fine sands, which become marly immediately above. The base of the greensand bed is marked by an erosion surface with a coarse quartzose lag, and remanié phosphate nodules.

Fig.46: Field outcrop of the lower greensand bed shown in Fig.44. Outcrop is 5m along the section from that shown in Fig.45. The base of the greensand bed is marked by well-developed burrowing.

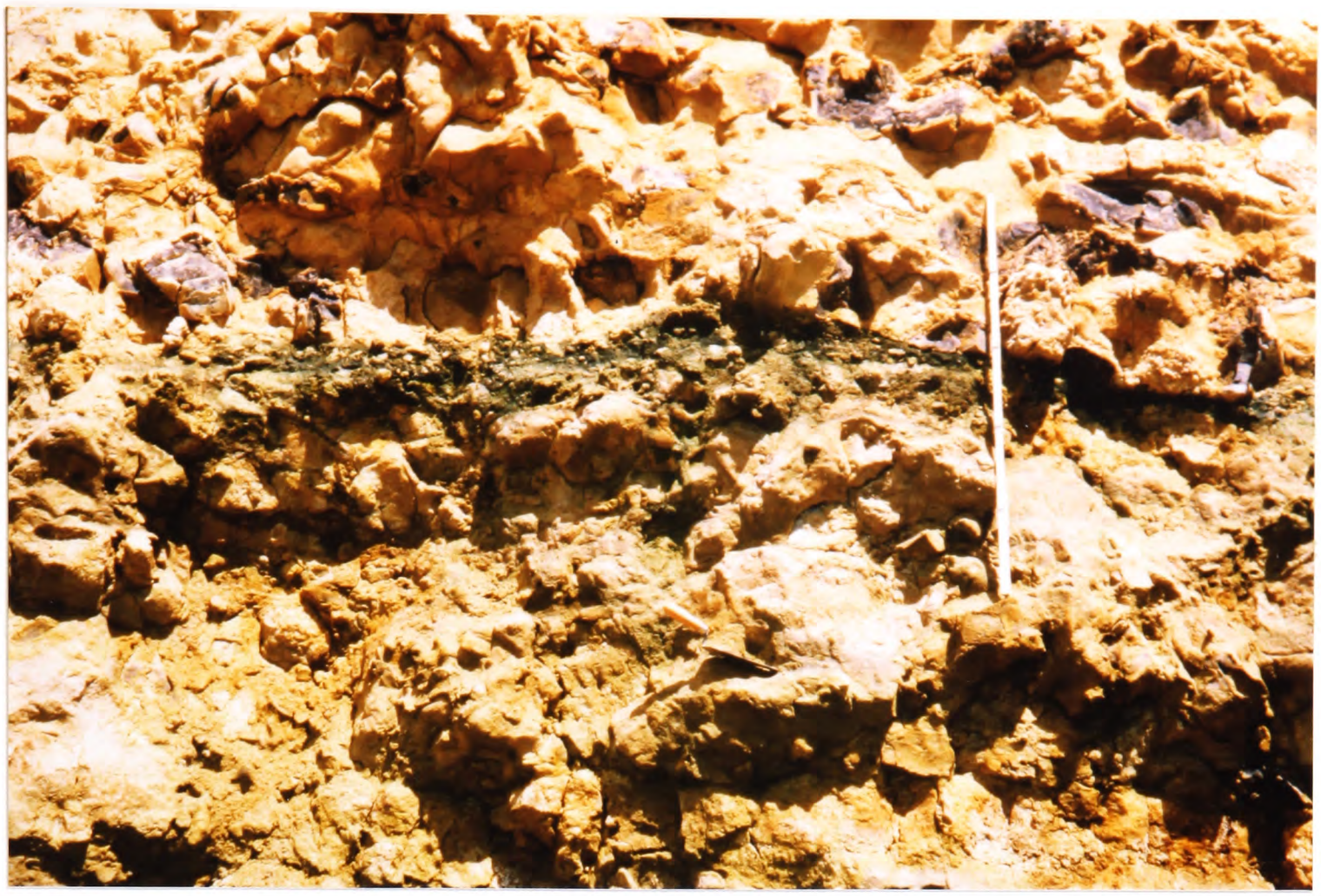


Fig.47: Field outcrop of erosion surface in the lower Chert Beds, interpreted as the result of Upper Albian synsedimentary faulting, Culverhole Point area (SY 278 893). The erosion surface is marked by a glauconitic, clayey pebble bed.

Fig.48: Close-up of the bed shown in Fig.47. Note the burrowed basal contact to the glauconitic pebble bed.

Fig.49: Top of the Eggardon Grit, slipped block below Flower's Barrow, Worbarrow Bay (SY 866 804). Note the erosive nature of the contact, with truncation of the nodules highlighted by the nodule-margin (burrow-wall) glauconitization.

Fig.50: Top of the Eggardon Grit, slipped block below Flower's Barrow, Worbarrow Bay (SY 866 804). Erosion of the bed has proceeded to a lower level than in Figure 49, with only traces of burrow-wall glauconitization preserved.

Fig.51: Sipped block of the Upper Greensand below Flower's Barrow, Worbarrow Bay (SY 866 804). Shows a mixed eroded-nodule assemblage, with pale nodules of the Eggardon Grit and smaller glauconitic sandstone nodules of Exogyra Rock lithology.

Fig.52: Field outcrop of the Chalk Basement Bed at Cow Corner, resting on the Exogyra Rock, as a result of Lower Cenomanian synsedimentary faulting.

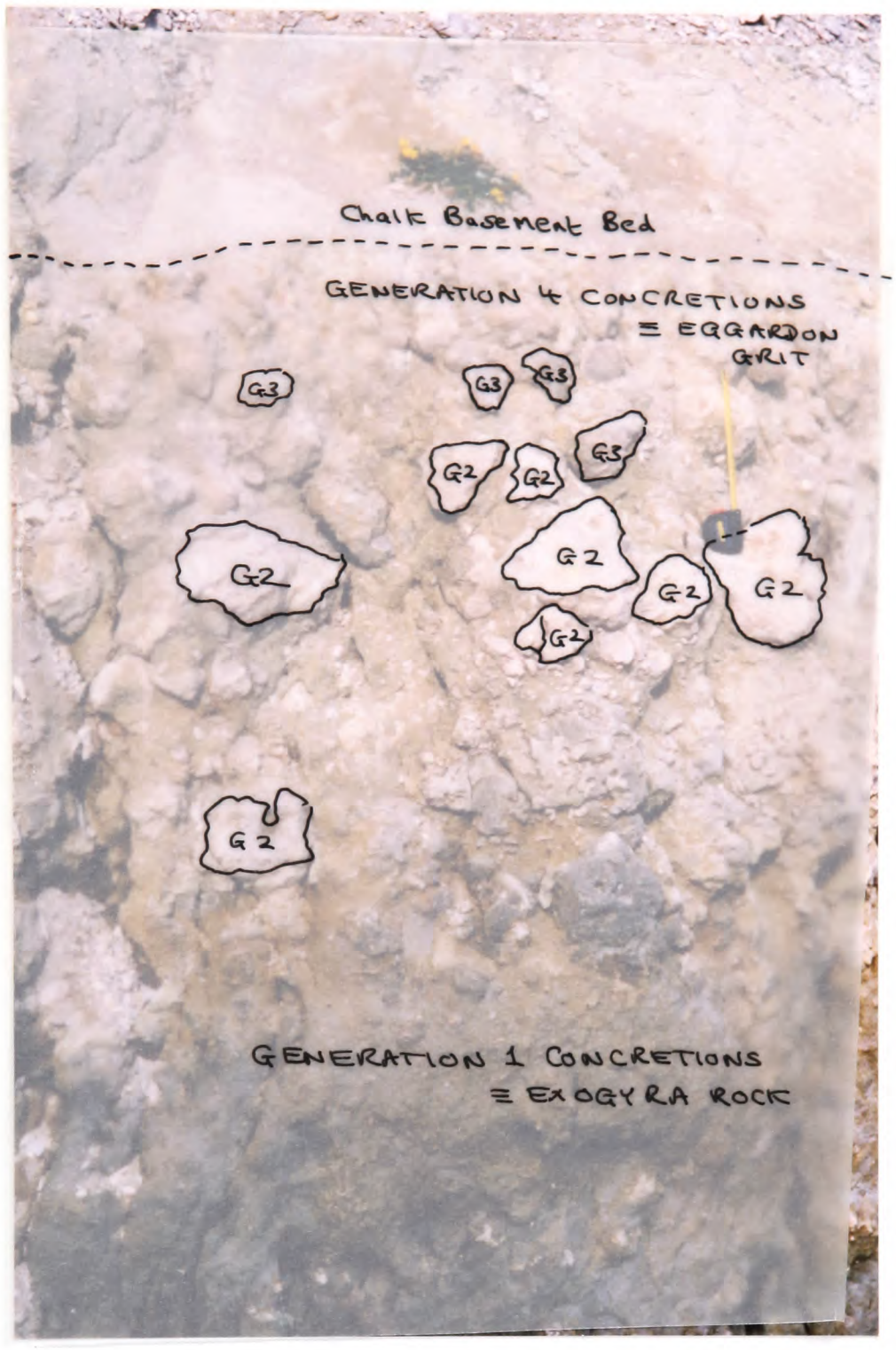


Fig.53: Complex condensation horizon at the top of the Upper Greensand, Swanage Bay, south Dorset (SY 044 811). 1.2 metres of sediment contain four concretion generations, and represent the equivalent of the Chert Beds and Top Sandstones of south-east Devon (around 23 metres in thickness).

Fig.53: Complex condensation horizon at the top of the Upper Greensand, Swanage Bay, south Dorset (SY 044 811). 1.2 metres of sediment contain four concretion generations, and represent the equivalent of the Chert Beds and Top Sandstones of south-east Devon (around 23 metres in thickness).

Fig.54: Generation 2 nodules in the complex condensation horizon shown in Figure 53. Pale brown concretions represent the Chert Beds lithology, and preserve burrows filled with glauconitic sediment.

Fig.55: Generation 3 nodules in the complex condensation horizon shown in Figure 53. The phosphatic concretions correlate with the Dispar Zone Ammonite Bed.

Fig.56: Thin Chert Beds Member, at Compton Bay, Isle of Wight (SZ 367 853). Well-developed concretionary horizons are present, but chert is not developed. The top of the Upper Greensand occurs at a level marked by the top of the scale rule; the beds are overlain by the Glauconitic Marl. The Chert Beds expand and become more siliceous towards the south of the island (Fig.41).

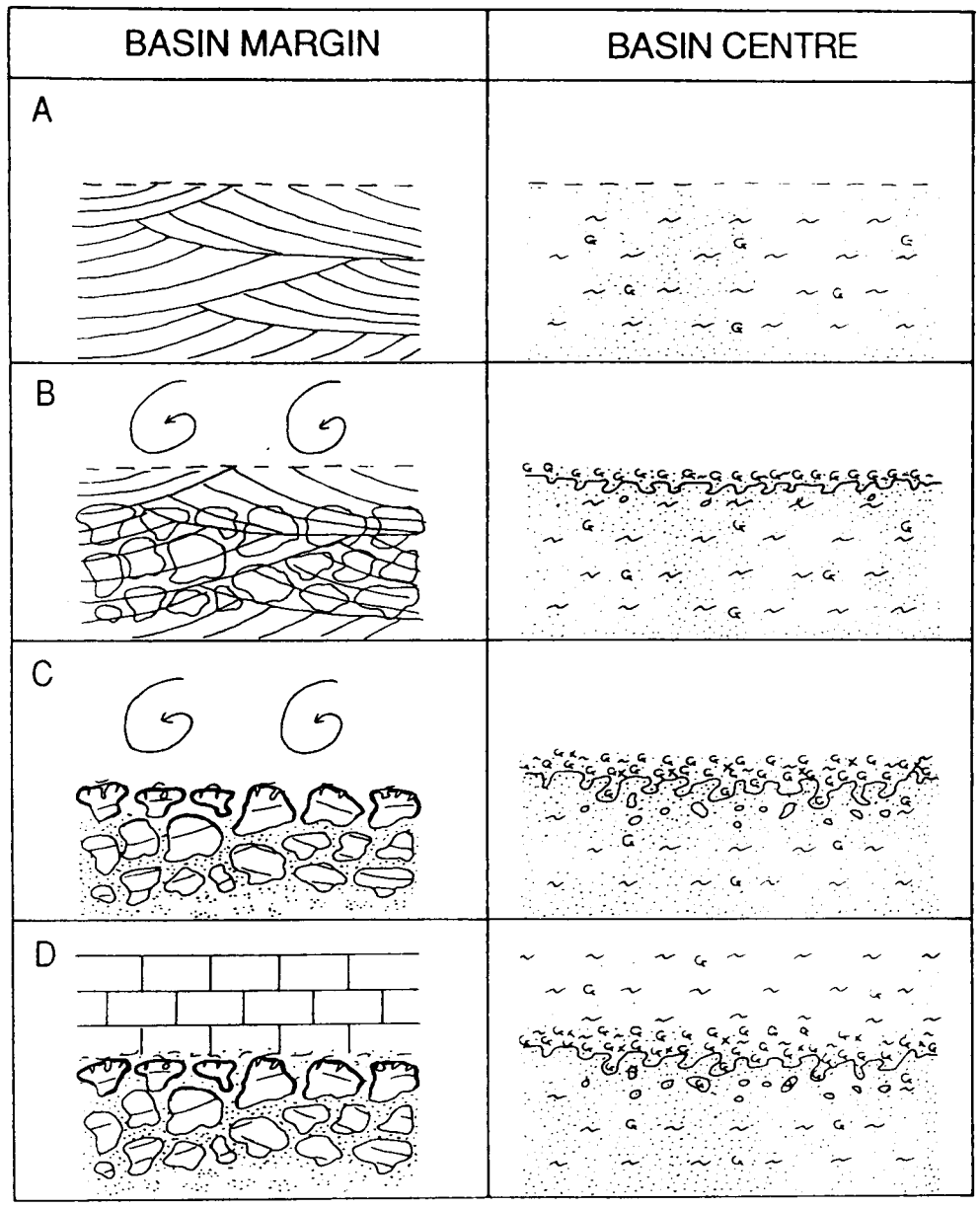


Fig.57: Cartoon illustrating the genetic relationship between nodular hardgrounds and phosphoritic greensands.
A: Halt in sedimentation above cross-stratified bioclastic grainstones, and deeper-water marly silts.
B: Development of nodularity within carbonates; glauconite concentration in deeper settings.
C: Nodules are exposed due to winnowing of the overlying sediment; an often long and complex cycle, which includes nodule boring, encrustation, glauconitization and phosphatisation occurs; increased concentrations of glauconite-rich sediment accumulate in deeper settings, a basal zone of strong burrowing and sediment mixing develops, and phosphate nodules develop.
D: Under relative transgression, sedimentation recommences, preserving the hardground and phosphoritic greensand below bioclastic packstones and silty marls.

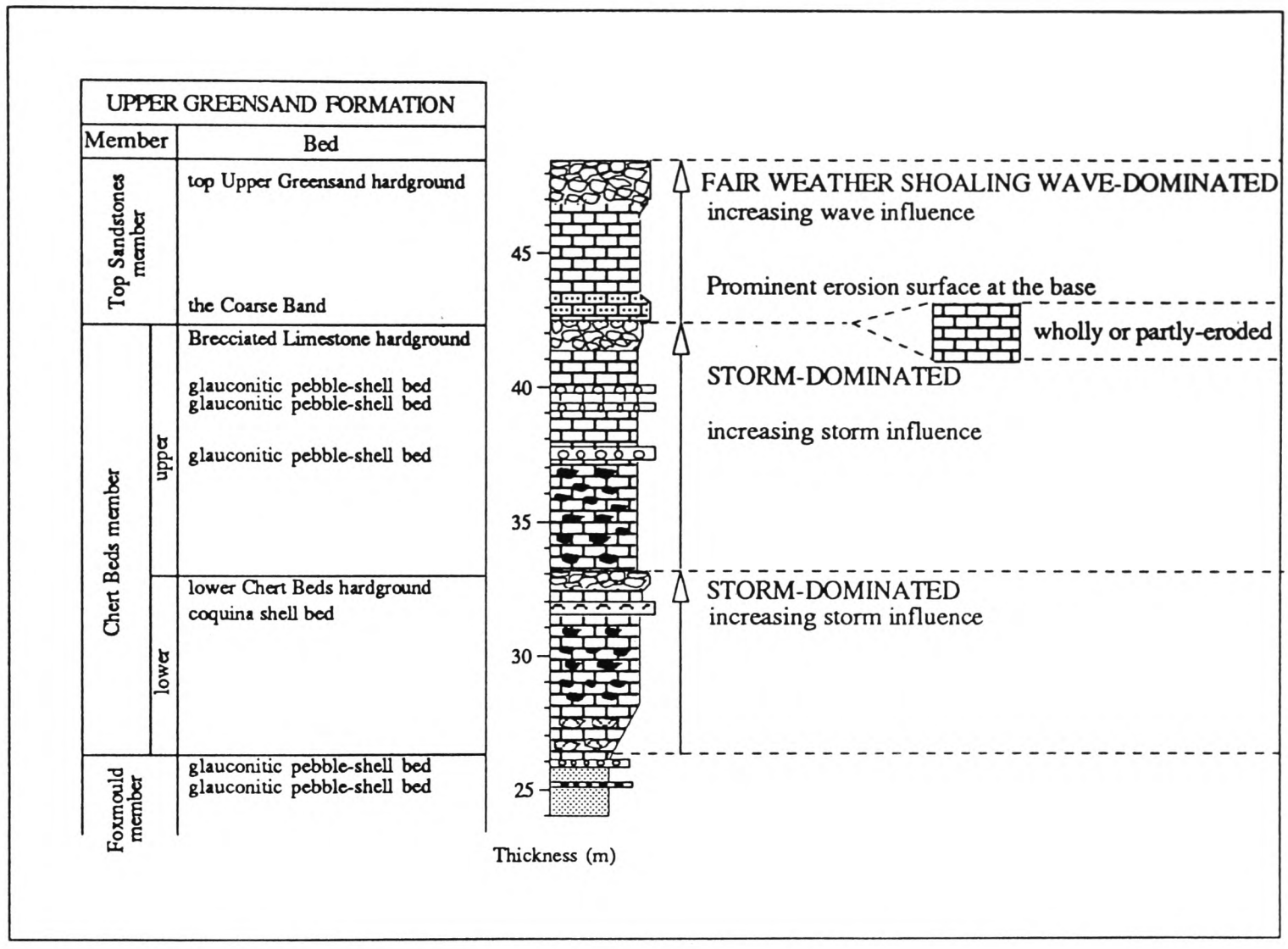


Fig.58: Summary of stratigraphy, cyclicity and sedimentary environments of the Chert Beds and Top Sandstones Members of the Upper Greensand Formation, Beer Head, south-east Devon.

Fig.59: Glauconite-rich greensand bed marking the base of the Upper Greensand south of Eastbourne (TV 610 977). This bed is equivalent to the Coarse Band of south Devon.

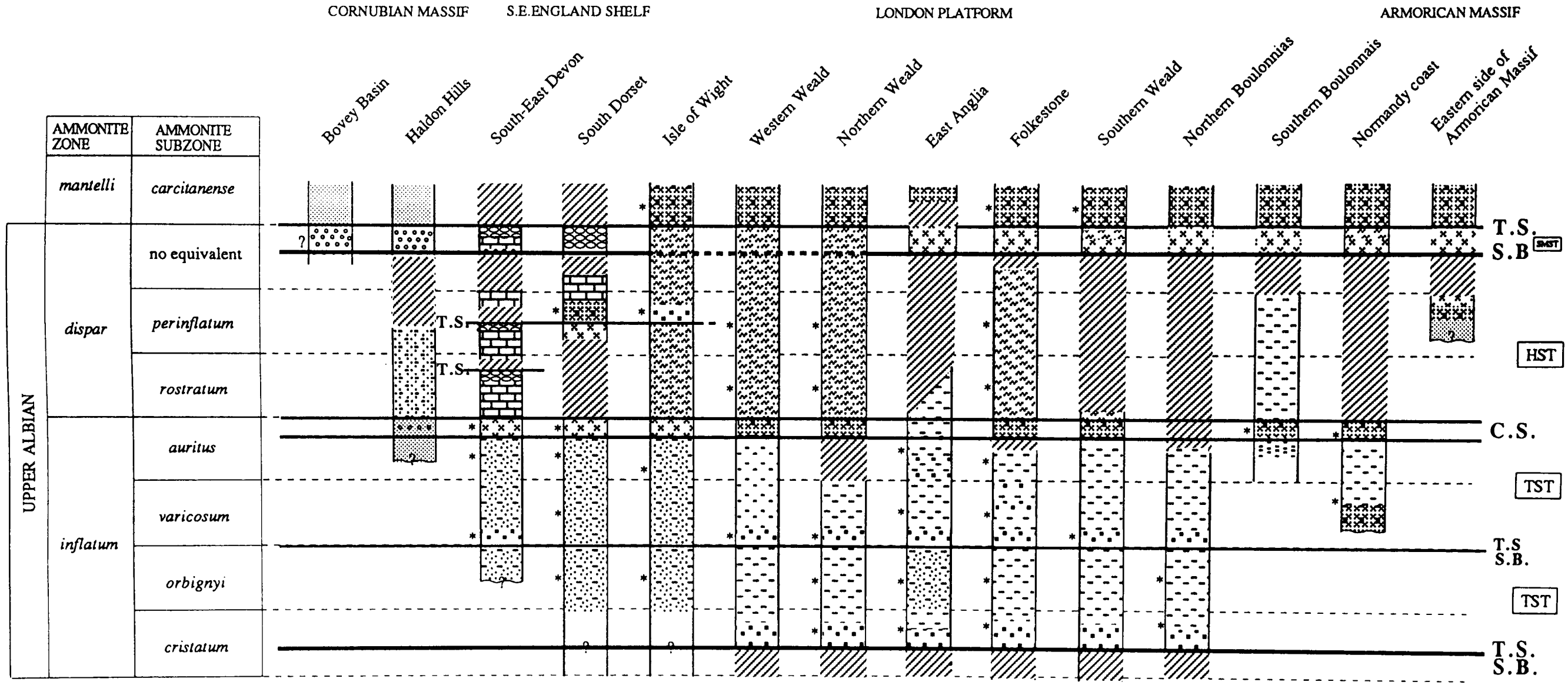


Fig.60: Sequence stratigraphic subdivision of the Upper Albian sediments of the Anglo-Paris Basin, with reference to fourteen designated regional type areas. Ammonite subzonal stratigraphy is plotted as a vertical scale, with proven subzones indicated to the left of each column by a * symbol. Within each column is shown a summary of the sediment composition at a given time interval. Note that no indication of the relative thicknesses is given with this representation. Dotted lines indicate correlative conformities to candidate type II sequence boundaries. Candidate sequential interpretation is given: S.B. = sequence boundary; T.S. = transgressive surface; C.S. = condensed section; TST = transgressive systems tract; HST = highstand systems tract; SMST = shelf margin systems tract. (for key, P.T.O.)

Key to Fig.60

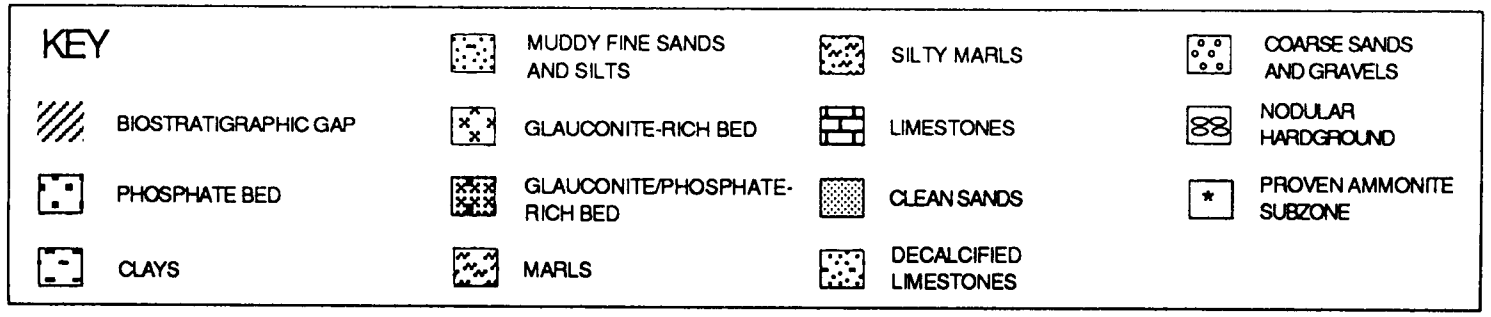

KEY
BIOSTRATIGRAPHIC GAP
PHOSPHATE BED
CLAYS
MUDDY FINE SANDS AND SILTS
GLAUCONITE-RICH BED
GLAUCONITE/PHOSPHATE-RICH BED
MARLS
SILTY MARLS
LIMESTONES
CLEAN SANDS
DECALCIFIED LIMESTONES
COARSE SANDS AND GRAVELS
NODULAR HARDGROUND
PROVEN AMMONITE SUBZONE

TABLE 1 - UPPER ALBIAN CANDIDATE SEQUENCE STRATIGRAPHY OF THE ANGLO-PARIS BASIN

SEQUENCE 3

Transgressive surface. latest Albian/early Cenomanian. The top of the Upper Greensand/base of the Glauconitic Marl across southern England. Marked by a nodular hardground passing basinwards into a phosphoritic greensand.

Shelf margin systems tract. latest *dispar* zone. Comprises a thin shallow-water sequence of sands and gravels, carbonate grainstones (Top Sandstones), sandy limestones and micaceous siltstones.

Sequence boundary (medium). latest *dispar* zone. Placed at the level of the Coarse Band of south-east England and the base of the Upper Greensand at Eastbourne. Marked by an erosion surface with overlying coarse quartzose or glauconite-rich bed.

SEQUENCE 2

Late highstand systems tract. *perinflatum* subzone. In the Chert Beds of south-west England, comprises a thin unit of well-sorted bioclastic grainstones, partially to completely removed by the erosion surface above.

Transgressive surface. *perinflatum* subzone. The Brecciated Limestone hardground of south-west England, a nodular hardground which passes basinwards into a phosphatic greensand, the Dispar Zone Ammonite Bed.

Middle highstand systems tract. *rostratum* subzone. In the Chert Beds of south-west England, comprises a unit of variably-siliceous and glauconitic carbonate packstones and grainstones, shallowing upwards, with several minor transgressive surfaces represented by glauconitic pebble beds.

Transgressive surface. *rostratum* subzone. The lower Chert Beds hardground of south-west England, a nodular hardground.

Early highstand systems tract. *rostratum* subzone. In the Chert Beds of south-west England, comprise siliceous carbonate packstones and grainstones, shallowing upwards.

Condensed interval. high *auritus* subzone. A thin, geographically very widespread glauconitic and phosphatic interval.

Transgressive systems tract. *varicosum* and lower-middle *auritus* subzones. Glauconitic, muddy fine sands and clays.

Sequence Boundary (minor). basal *varicosum* subzone. Represented by the *varicosum* phosphatic nodule bed, with a weak basal erosion surface.

SEQUENCE 1

Transgressive systems tract. middle *cristatum* to *orbignyi* subzones. Very thin deposits of clays and glauconitic muddy silts.

Sequence boundary (major). Lower *cristatum* age. Represented by the *cristatum* nodule bed, and marked by a basin-wide erosion surface.

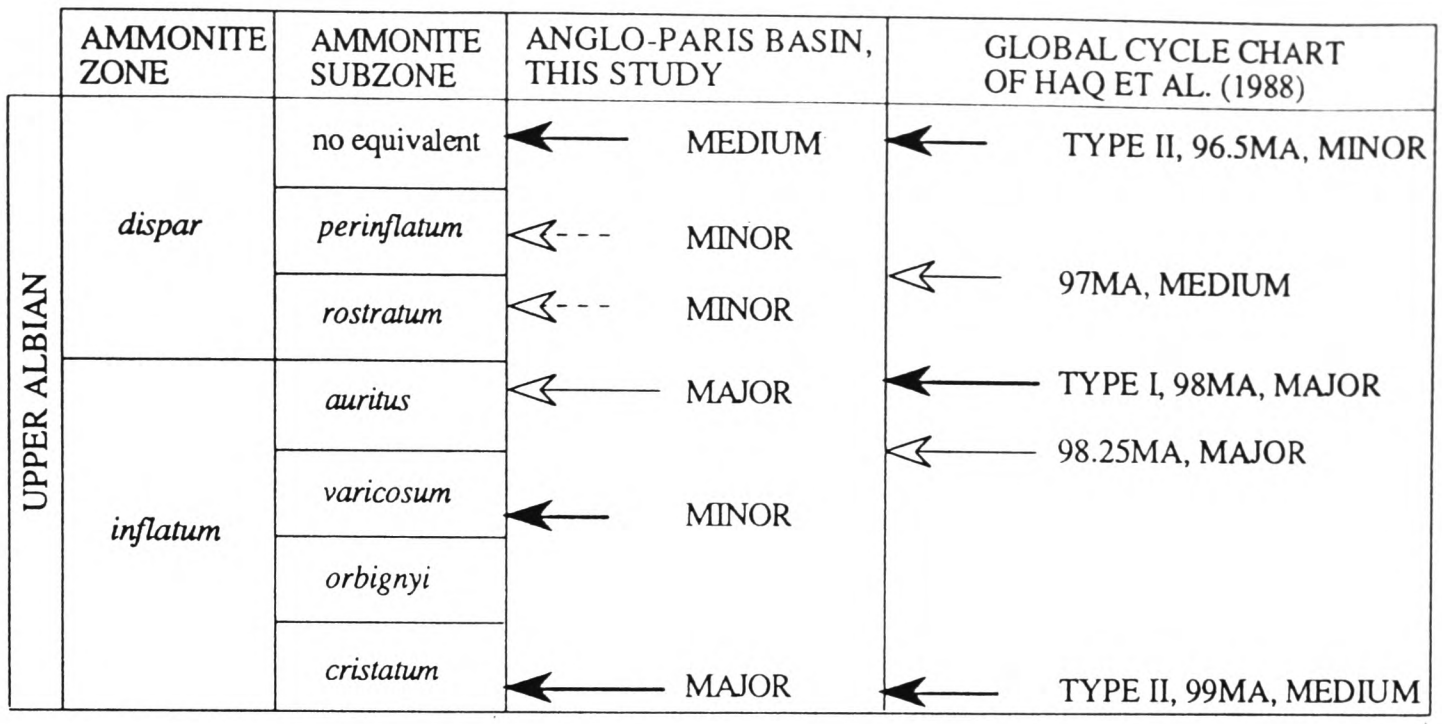


Fig.61: Comparison between the sequence stratigraphy proposed for the Anglo-Paris Basin as a result of this study, and the global cycle chart of Haq *et al.* (1988). Shows candidate sequence boundaries (filled arrows), condensed sections (open arrows), and additional minor flooding surfaces (dotted arrows).

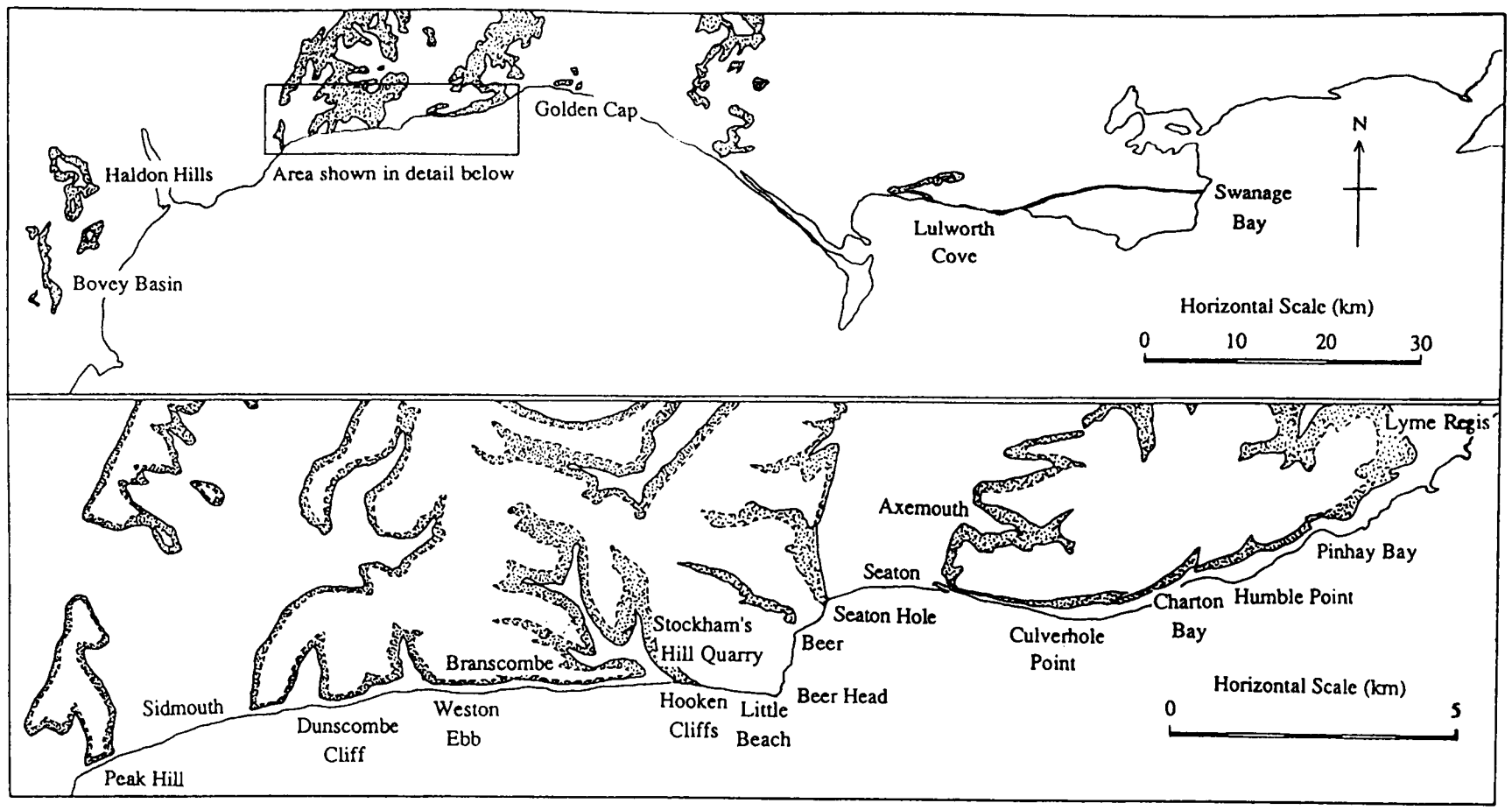


Fig.62: Location map showing the outcrop of the Upper Greensand and Gault across south-west England, and the localities mentioned in the text.

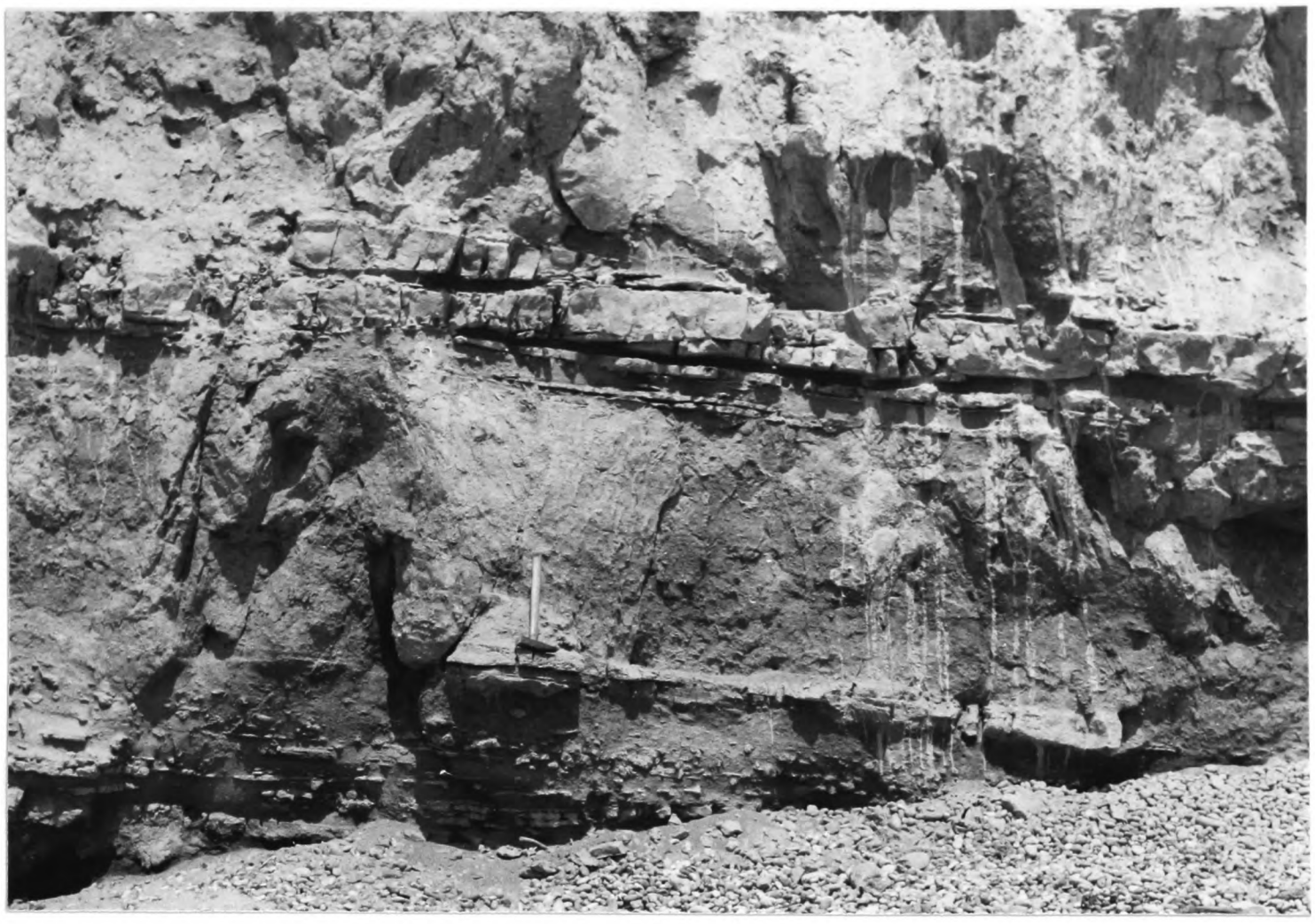


Fig.63: Distal storm laminites, interbedded with fully-bioturbated sediment. Two laminite beds visible, with associated calcareous concretions. Hooken Cliffs, near Beer.

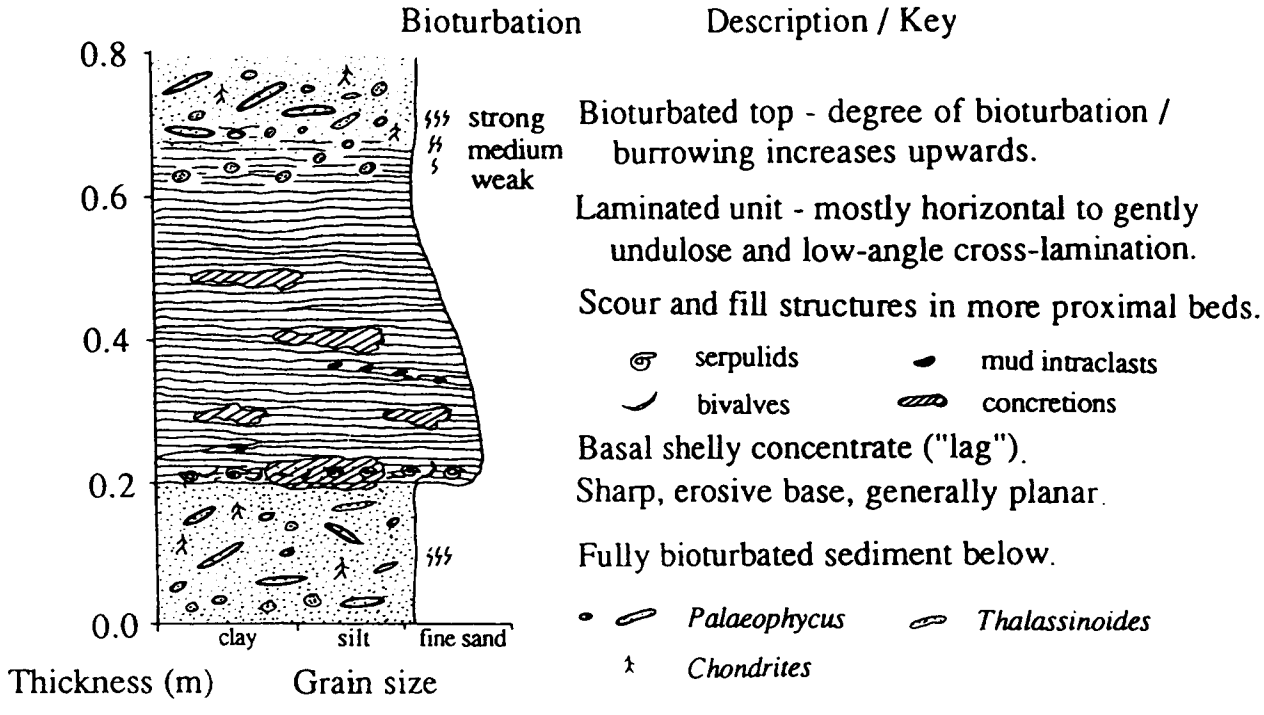


Fig.64: Summary of the typical sedimentological features of a Foxmould member storm laminite bed.

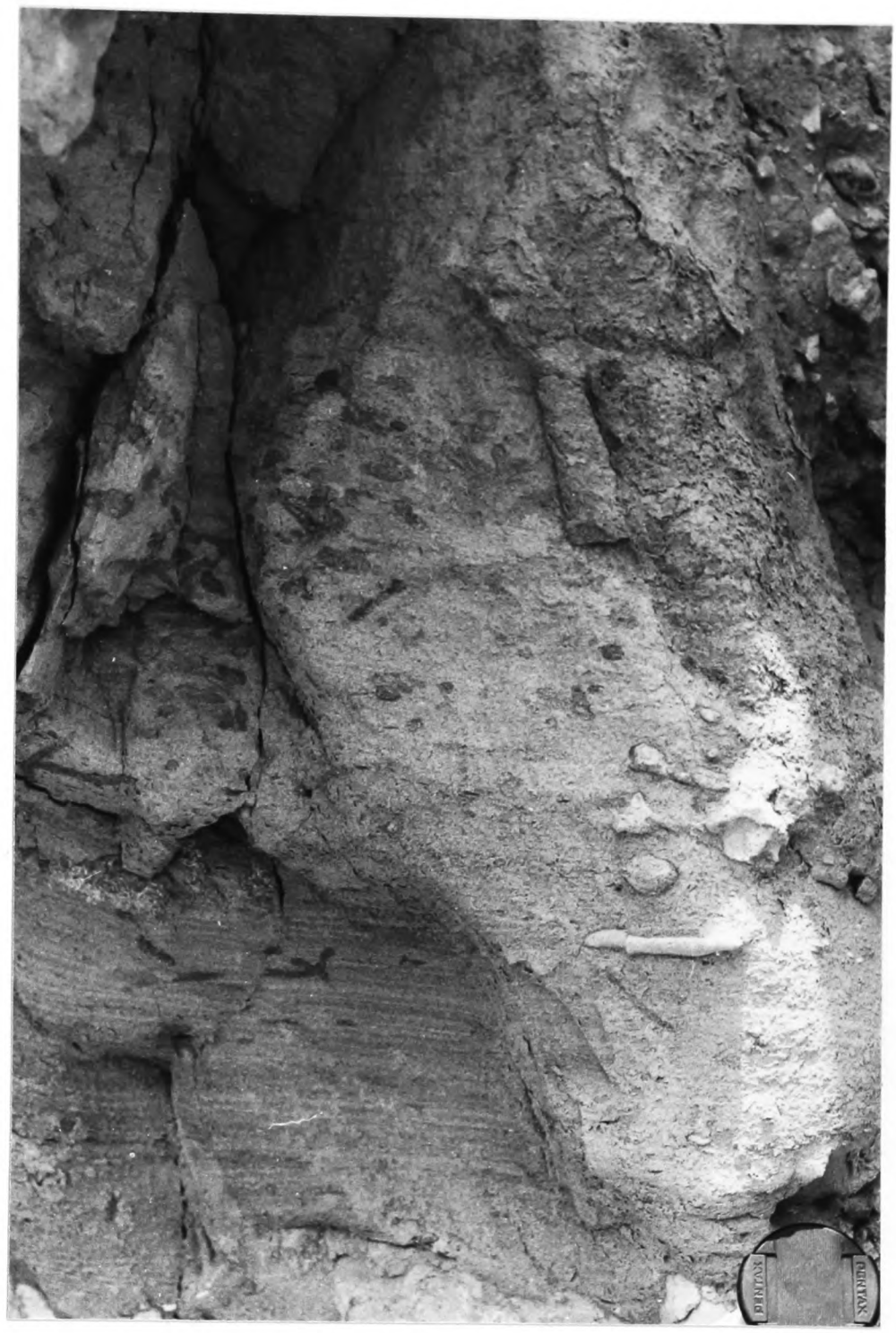


Fig.65: Bioturbated top of a storm laminite bed. Hooken Cliffs, Beer.

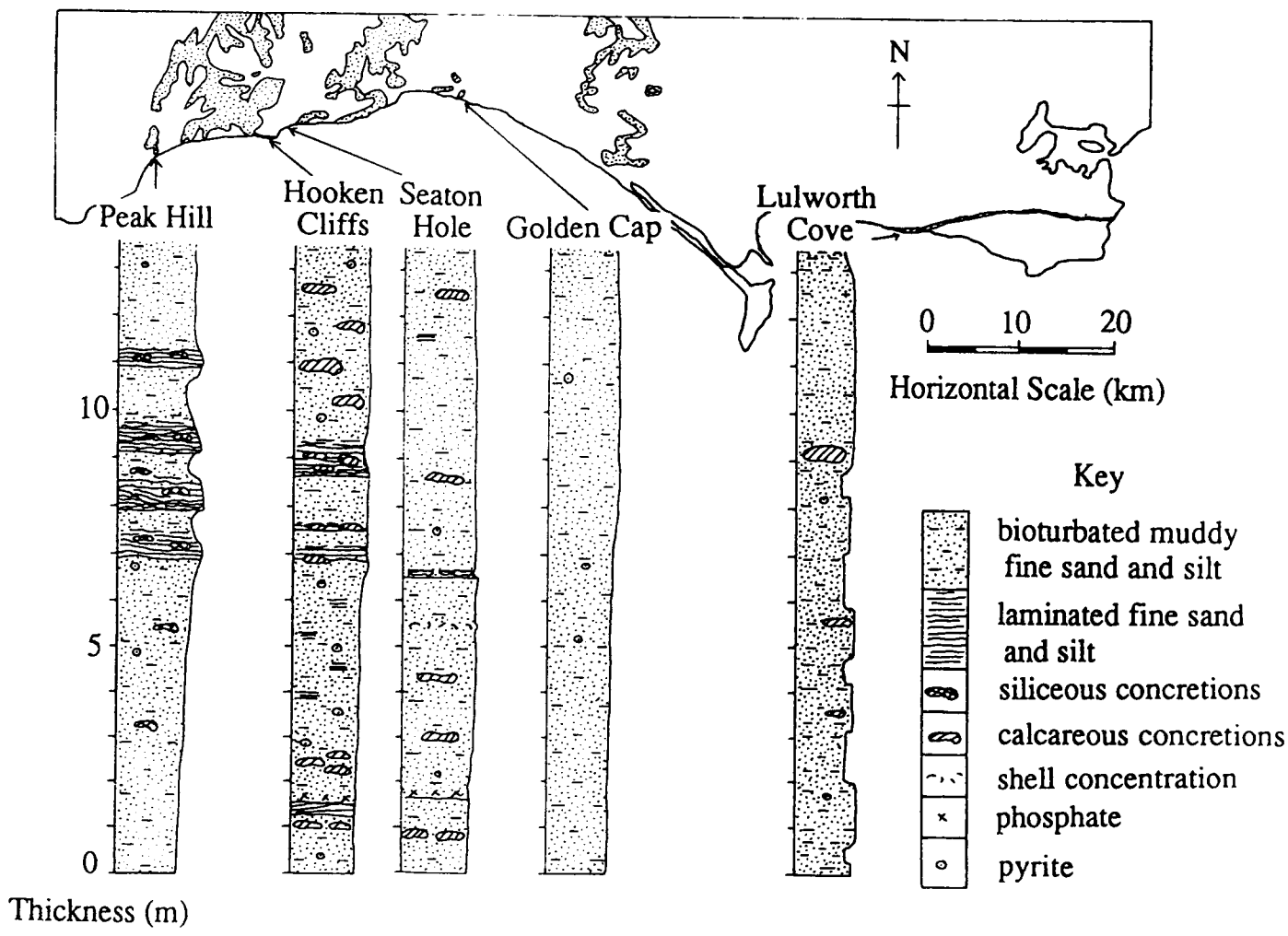


Fig.66: Graphic logs of a selected part of the Foxmould member, demonstrating the west-east trend of thinning, fining and disappearance of storm laminite beds. Peak Hill: muddy fine sands with interbedded laminites ; Hooken Cliffs: muddy fine sands with fewer and thinner laminites ; Seaton Hole: muddy fine sands with traces of lamination ; Golden Cap: homogeneous and fully bioturbated muddy silts ; Lulworth Cove: rhythmically-bedded muddy silts (variations in silt : clay).

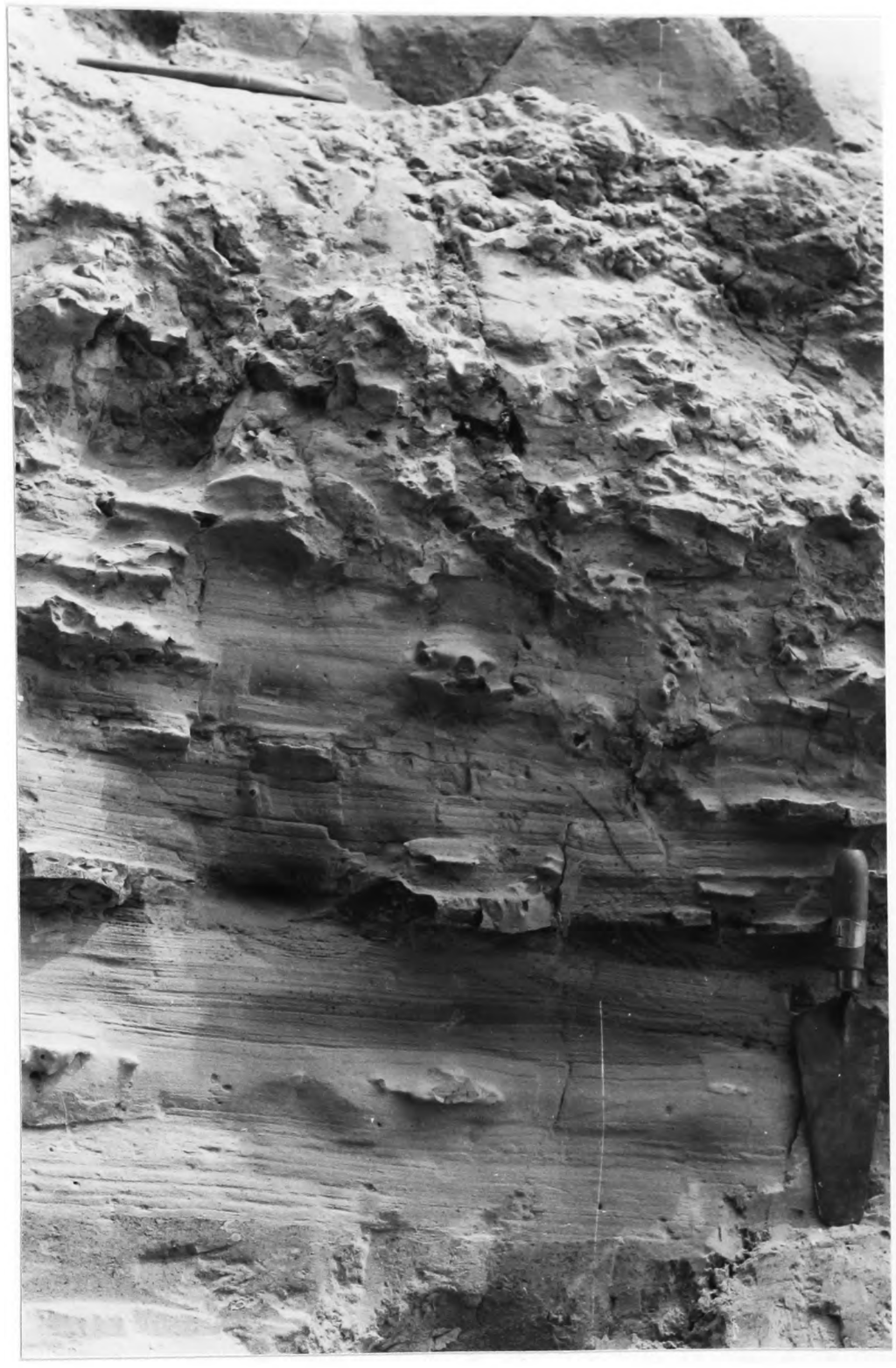


Fig.67: Thick, pı ximal storm laminite bed, with a sharp base and bioturbated top. Peak Hill, near Sidmouth.

Fig.68: Large scour at the base of a proximal storm bed, cutting down through thin, amalgamated laminite beds to the top of an underlying thick bed. Peak Hill, near Sidmouth.

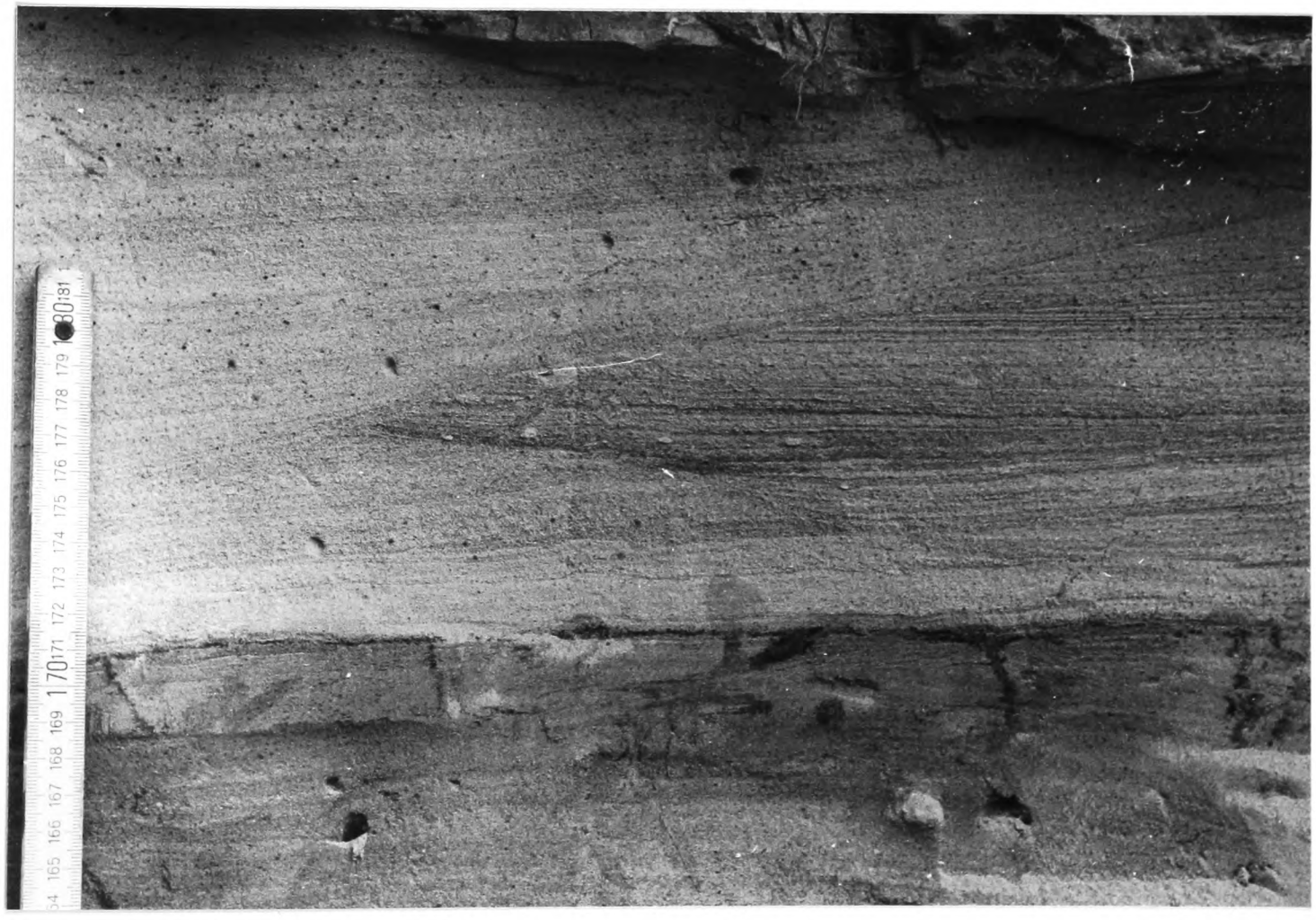


Fig.69: Horizontal and low-angle cross-lamination, developed within a thick proximal laminite bed. Peak Hill, near Sidmouth.

Fig.70: Bioturbated top of the bed seen in Fig.67, showing the progression from horizontally-laminated to structureless bioturbated silt.

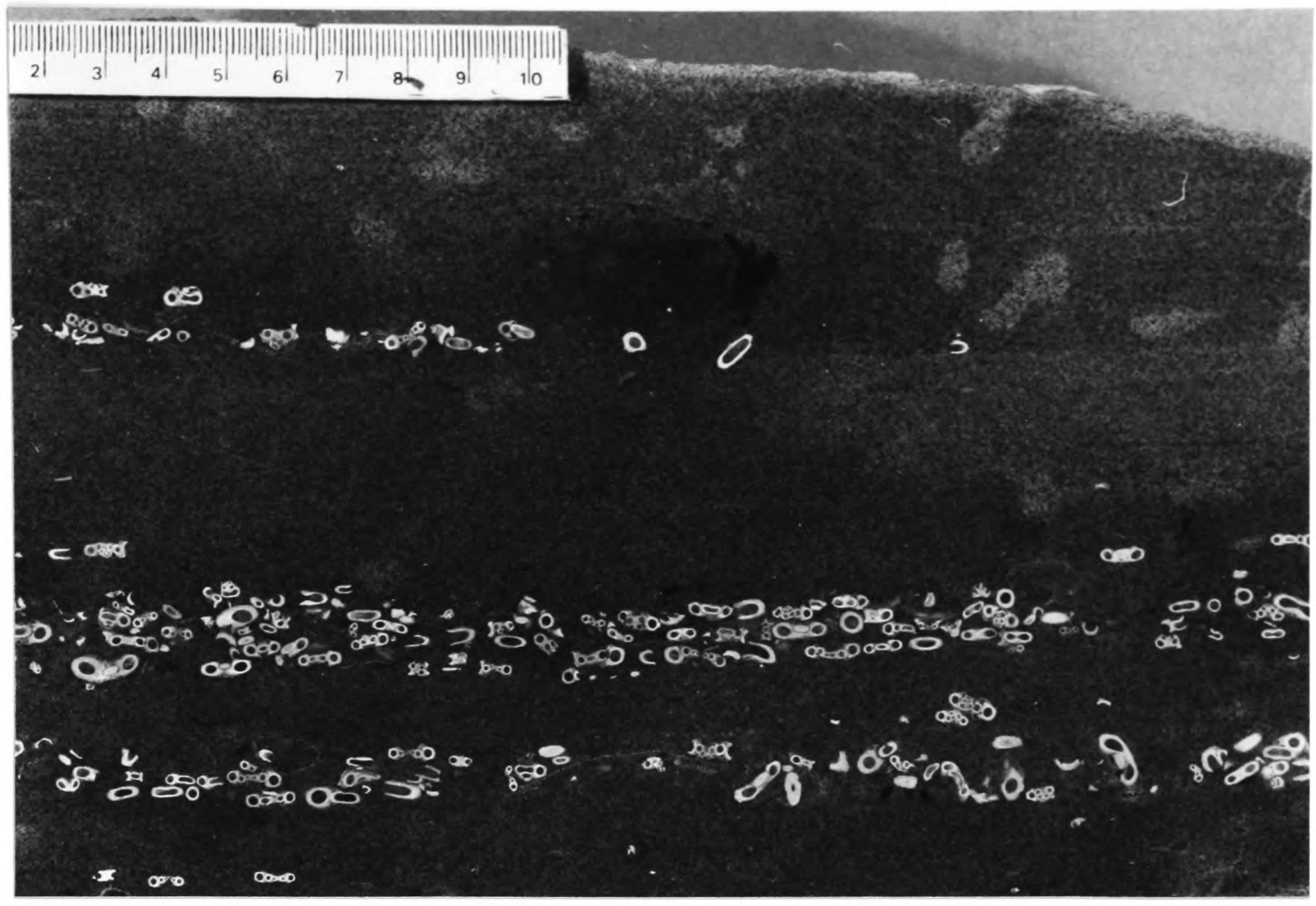


Fig.71: Amalgamated thin storm laminite beds, preserved within a late diagenetic calcareous concretion, Hooken Cliffs, Beer. Each bed has a concentration of serpulid-rich sediment at the base. Note the burrows in the upper part of the top laminite bed.

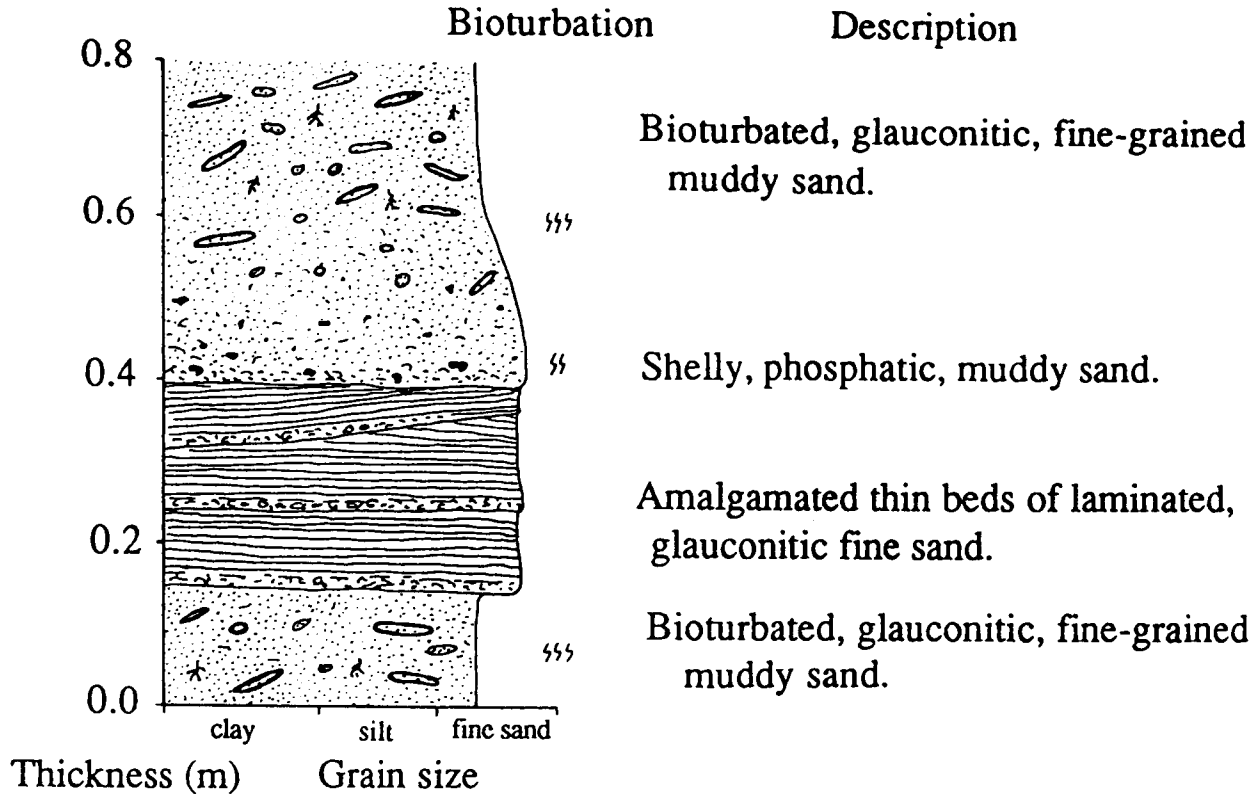


Fig.72: Graphic log of amalgamated thin storm laminites and storm-reworked phosphate horizon, from the Foxmould member, Hooken Cliffs, Beer.

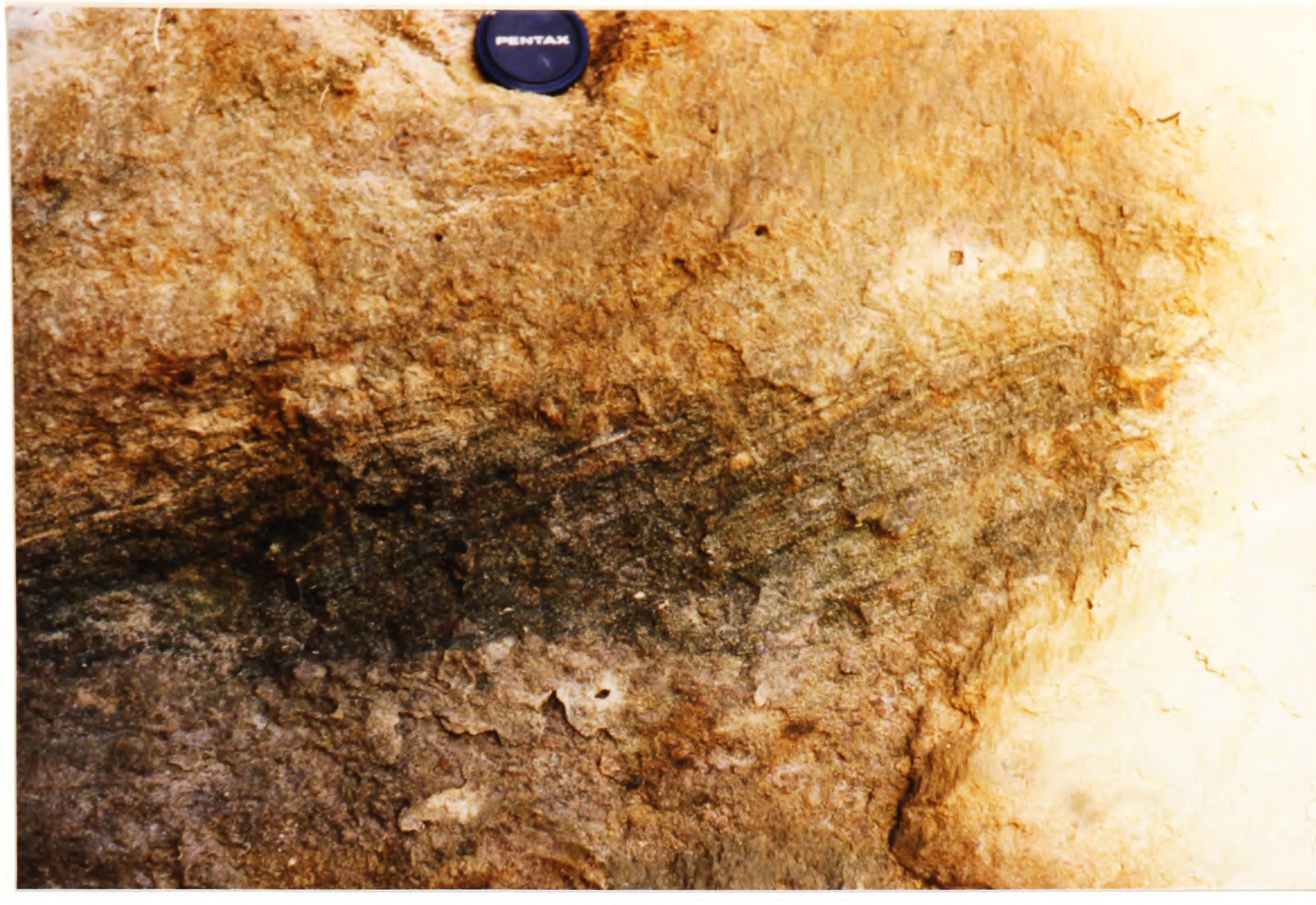


Fig.73: Field outcrop of a lens of tabular cross-lamination preserved in the Foxmould Member, Whitecliff, Beer (SY 234 893).

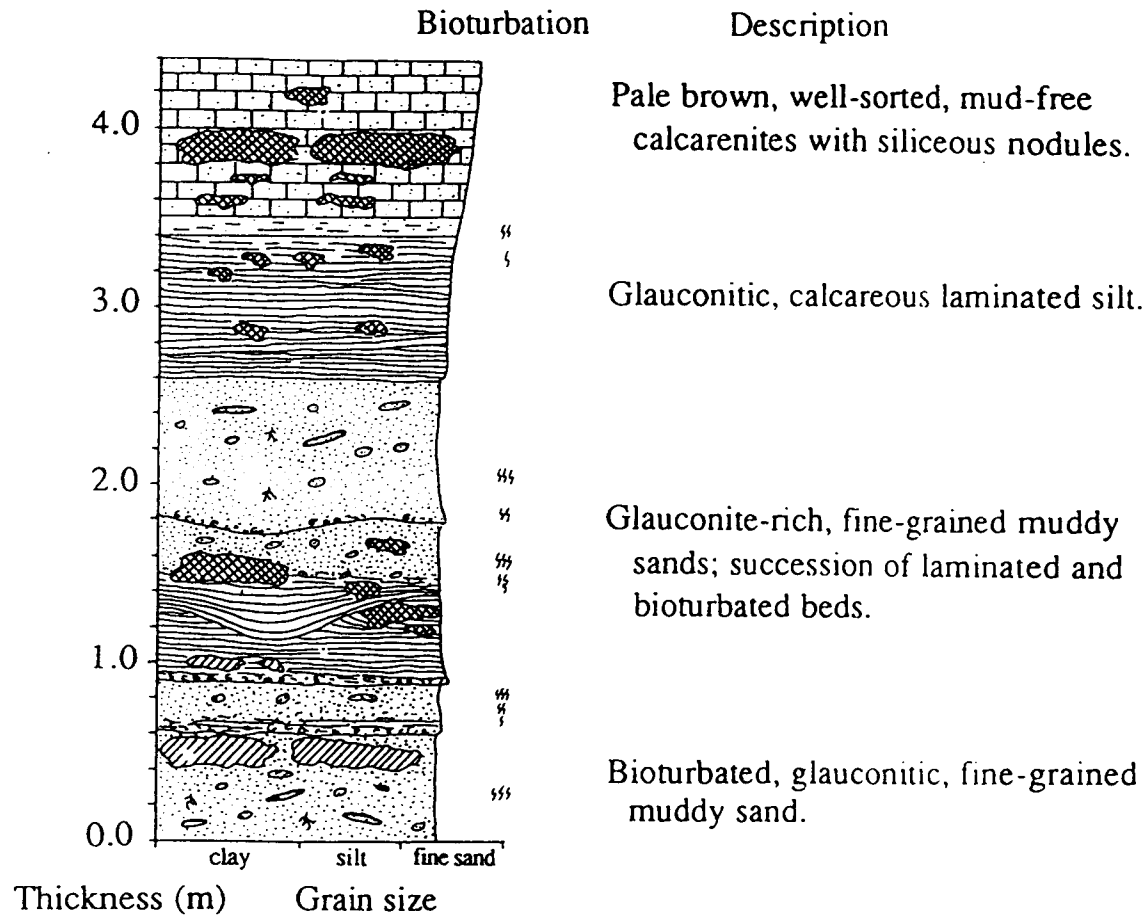


Fig.74: Graphic log of variably-amalgamated, glauconite-rich, thin storm laminites at the Foxmould-Chert Beds contact, Dunscombe Cliff. Correlates with interval shown in Fig.77 and Fig.78.

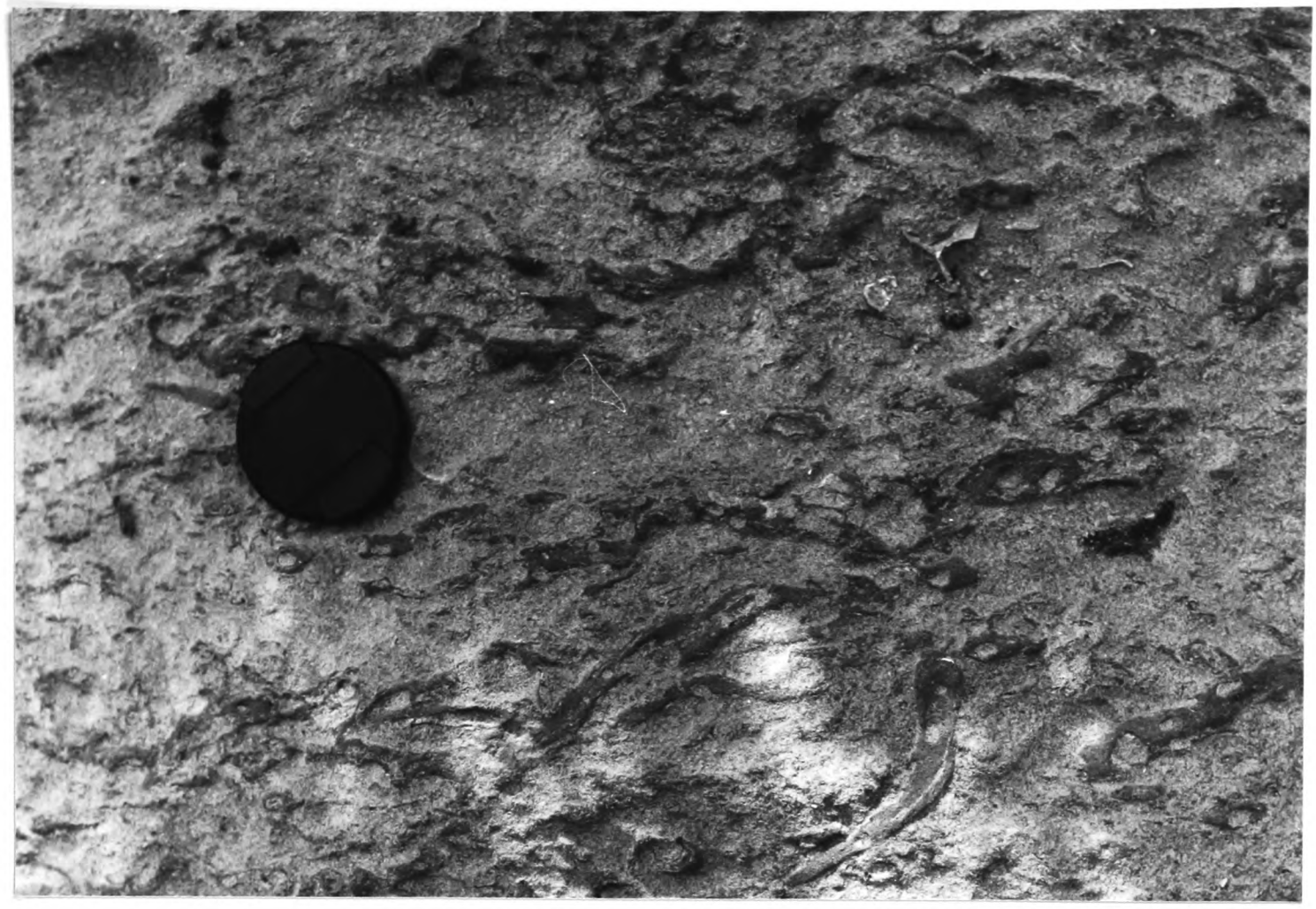
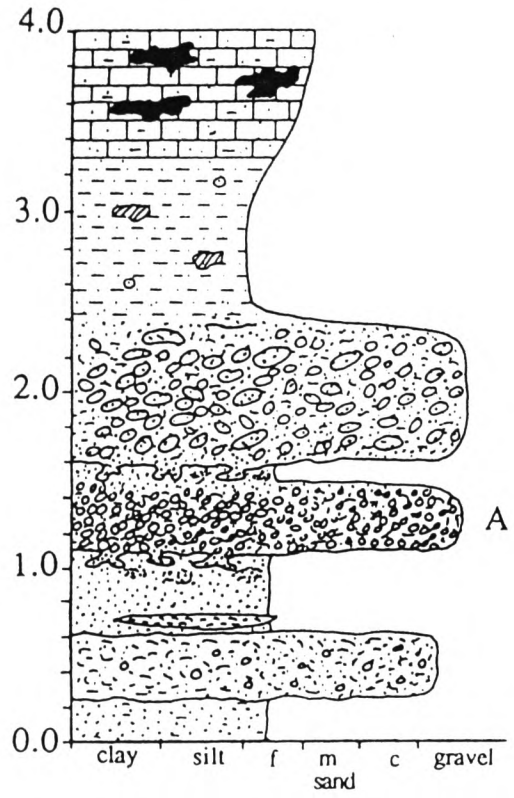


Fig.75: Fully-bioturbated lithofacies, with very abundant black mud-lined *Palaeophycus* burrows. Little Beach, near Beer.

Fig.76: Fully-bioturbated lithofacies showing the *Thalassinoides-Palaeophycus* trace fossil association, preserved within a concretion. Foreshore east of Axemouth.

Fig.77: Pebble-shell beds and coquina lenses in the uppermost Foxmould, with the Chert Beds Member carbonates above. Whitecliff, Beer.



Thickness (m) Grain size

Description

Muddy, silty fine-grained calcarenites with scattered comminuted shell fragments and scattered chert nodules.

Dark brown, very muddy coarse silt; passes gradationally up into calcarenites.

Palaeophycus burrows, lined with black mud.

Glauconite-rich pebble-shell bed; pebbles of glauconitic sandy limestone in a glauconitic, slightly shelly matrix; fabric varies from pebble-supported to matrix-supported; basal *Thalassinoides* burrowing.

Thin bed of buff-coloured calcareous siltstone; variably nodular.

Glauconitic pebble shell bed; pebbles of limestone in a shelly, glauconitic matrix; pebble-supported fabric; basal *Thalassinoides* burrowing; *Amphidonte*, *Merklinia*, echinoids, bryozoans.

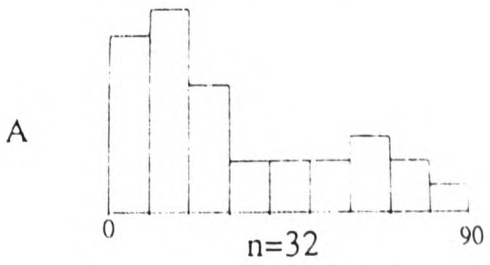
Rather nodular, strongly bioturbated, muddy, fine-grained sandstone; *Palaeophycus* burrows.

Coquina shell lens.

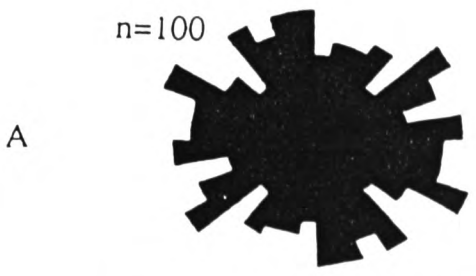
Hard, nodular shell-pebble bed (?laterally overlapping lenses), rich in bivalves.

Fine-grained, muddy, glauconitic sands, fully bioturbated.

Pebble fabric



angle to bedding



Bedding plane orientations

Fig.78: Graphic log and fabric data from the uppermost Foxmould pebble/shell beds seen in Figure 77, Whitecliff, Beer. Fabric data taken on pebble long axes (pebbles with >2:1 length:width ratio). Correlates with interval shown in Figure 74.

Fig.79: Detailed view of the coquina shell lens seen in Figure 77.

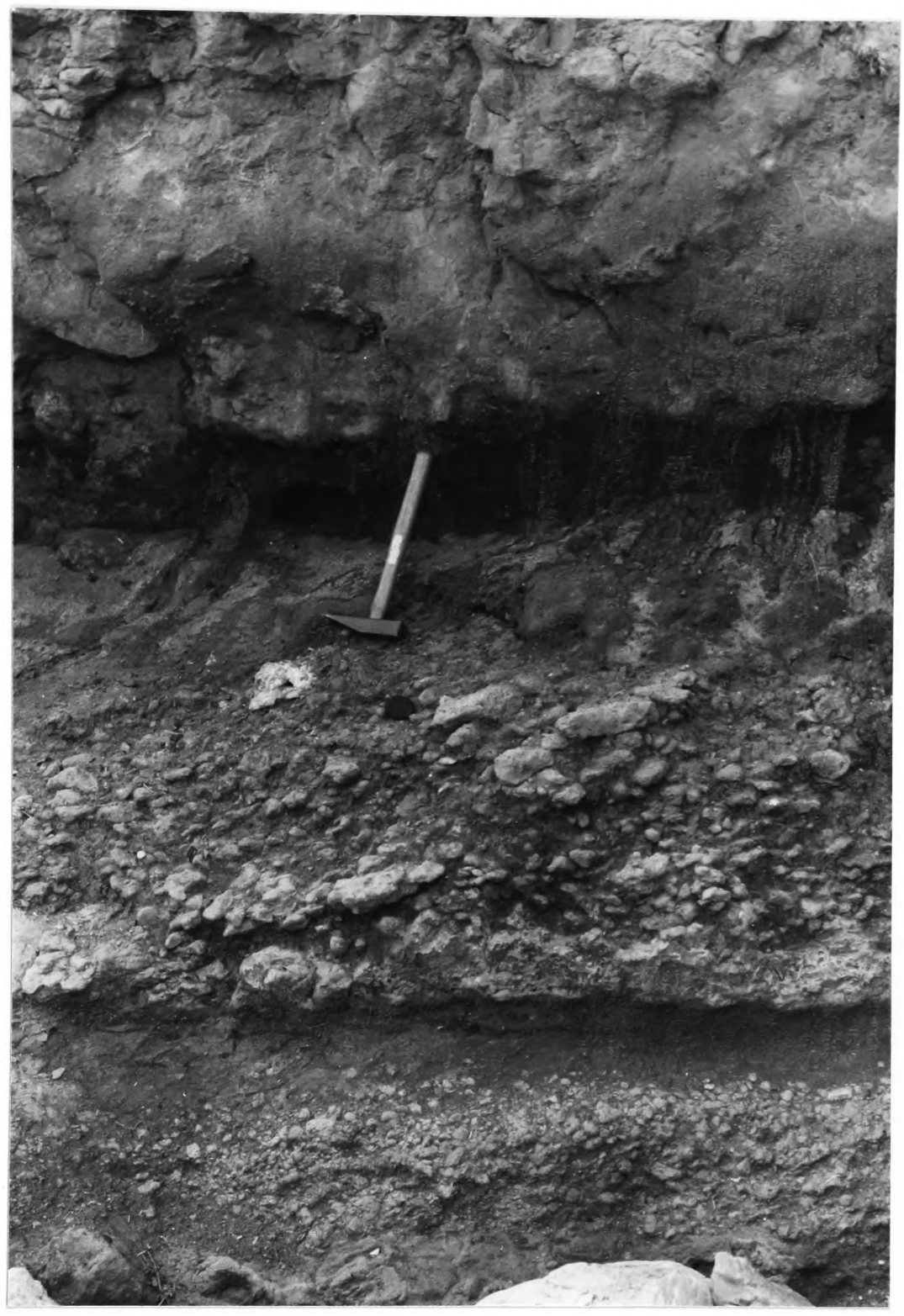
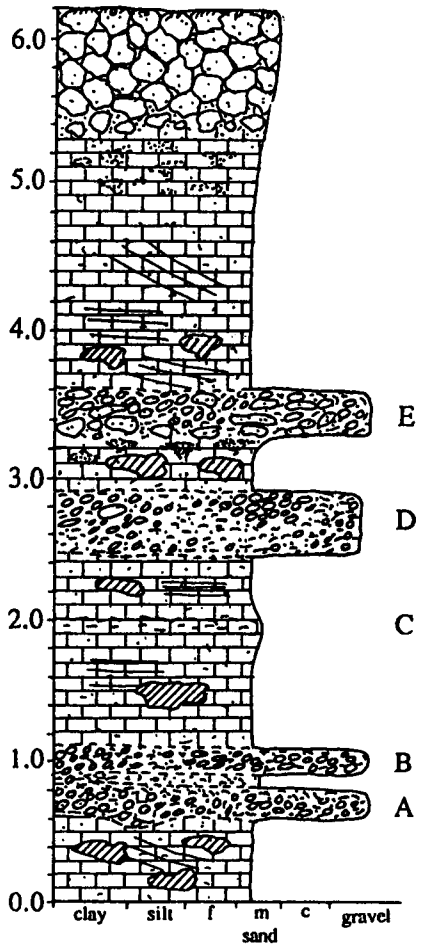


Fig.80: Detailed view of the upper two pebble-shell beds shown in Figure 77, showing the sediment fabric, which has a tendency towards bedding-parallel orientations of the pebble long axes.



Thickness (m) Grain size

Description

The Brecciated Limestone hardground, a well-cemented nodular limestone; *Thalassinoides* burrowing between the nodules; upper nodules glauconitised.

Thalassinoides burrows, filled with coarse, glauconitic sand.

Well-sorted calcarenites with fine shell fragments; glauconite-rich /poor lamination and low-angle to trough cross-bedding.

Complex pebble-shell bed; limestone pebbles in a shelly, glauconitic calcarenite matrix.

Thalassinoides-burrowed calcarenites, burrows penetrating down from base of bed above.

Shell-pebble bed; limestone pebbles and *Amphidonte* shells and shell fragments in a glauconitic calcarenite matrix.

Calcarenites with finely-broken shell fragments and faint horizontal lamination.

Calcarenites with poorly-defined weak concentration of large oyster shells.

Calcarenites with finely-broken shell fragments.

Amalgamated pebble-shell beds, separated by a thin sandy layer in some sections; limestone pebbles and oyster shells, occasional basal scour.

Calcarenites with weak low-angle cross-lamination.

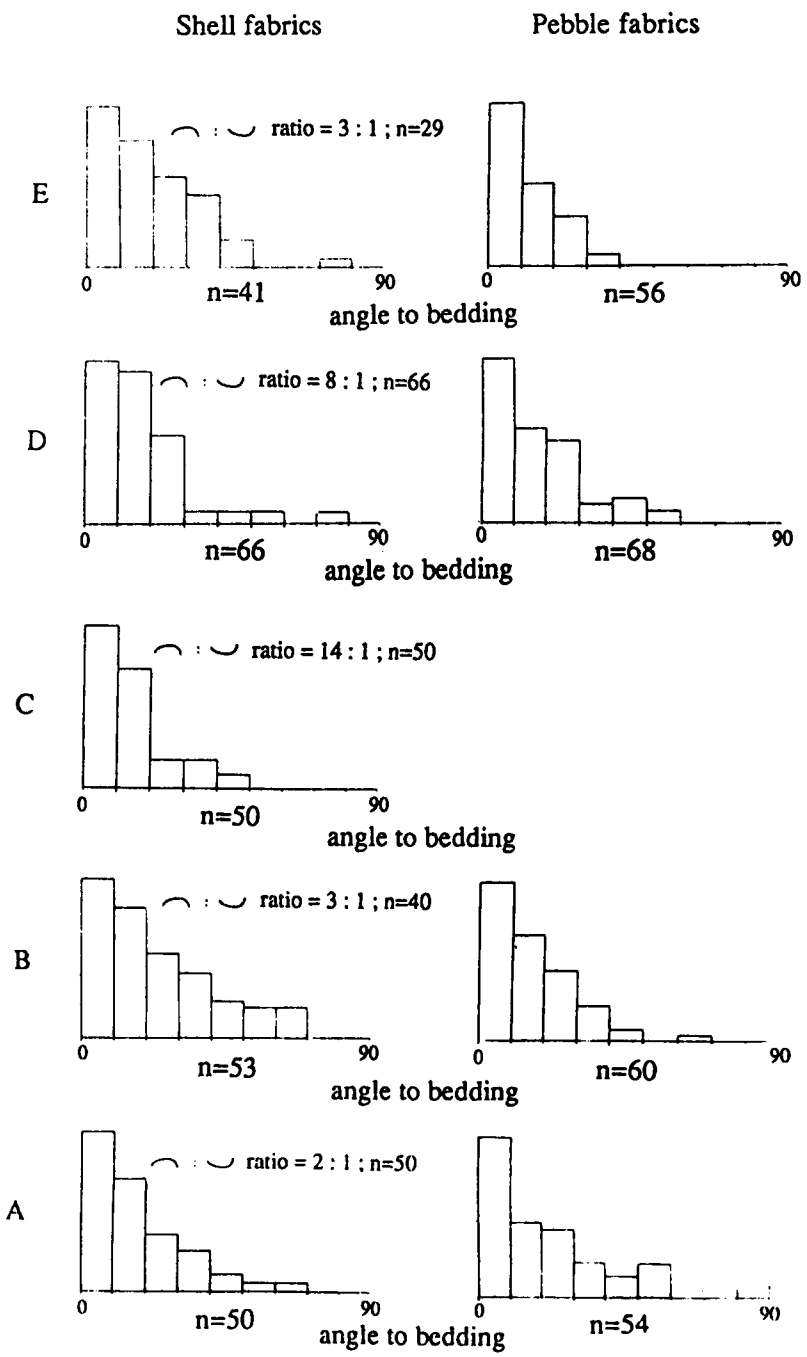


Fig.81: Graphic log and fabric data from the upper Chert Beds pebble-shell beds at Beer Head. Fabric data taken on shell and pebble long axes (pebbles with >2:1 length:width ratio) and on shell convexity orientations.

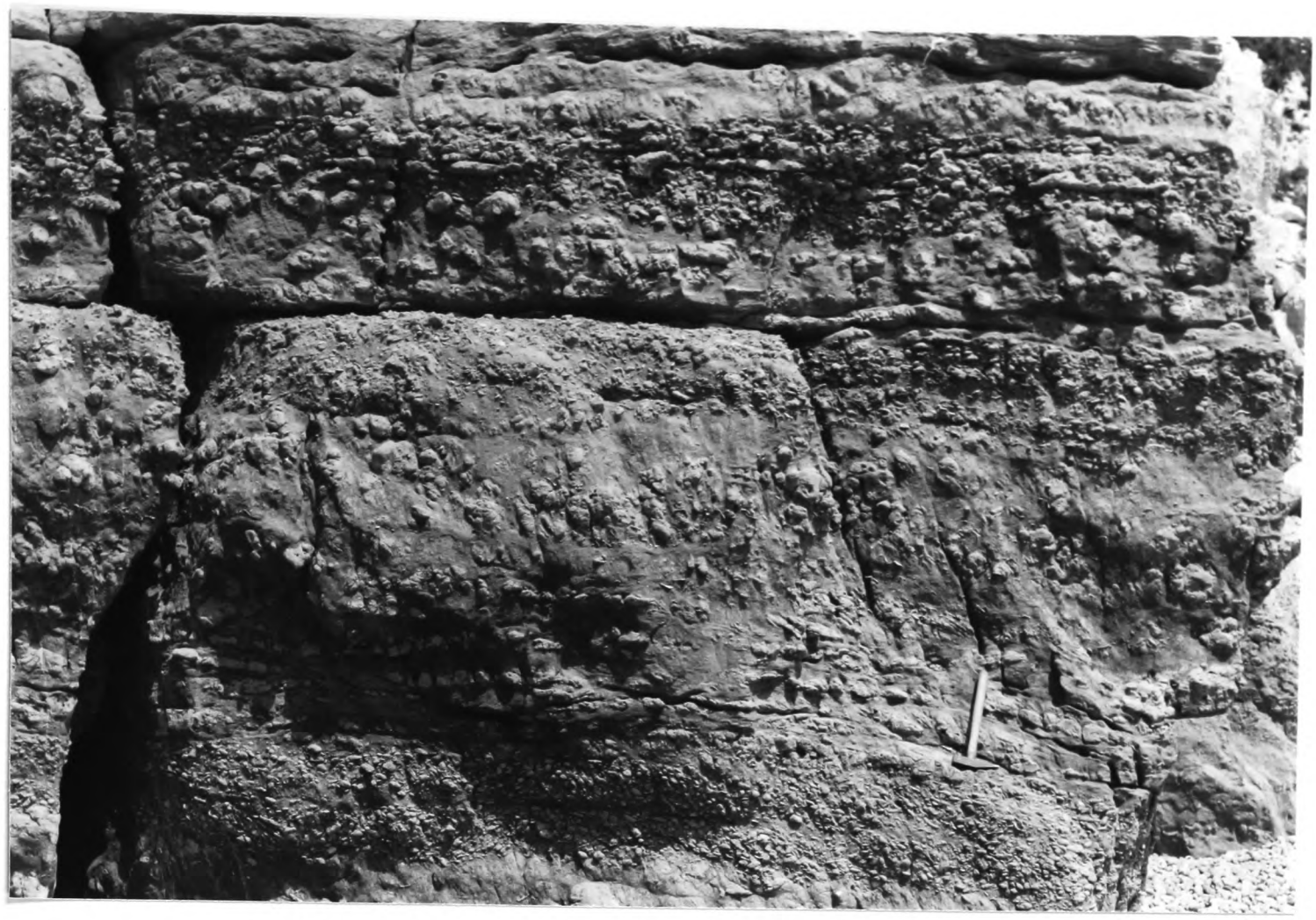


Fig.82: Interbedded carbonate packstones/grainstones and coarse pebble-shell beds, upper Chert Beds, Beer Head (shown graphically in Figure 81).

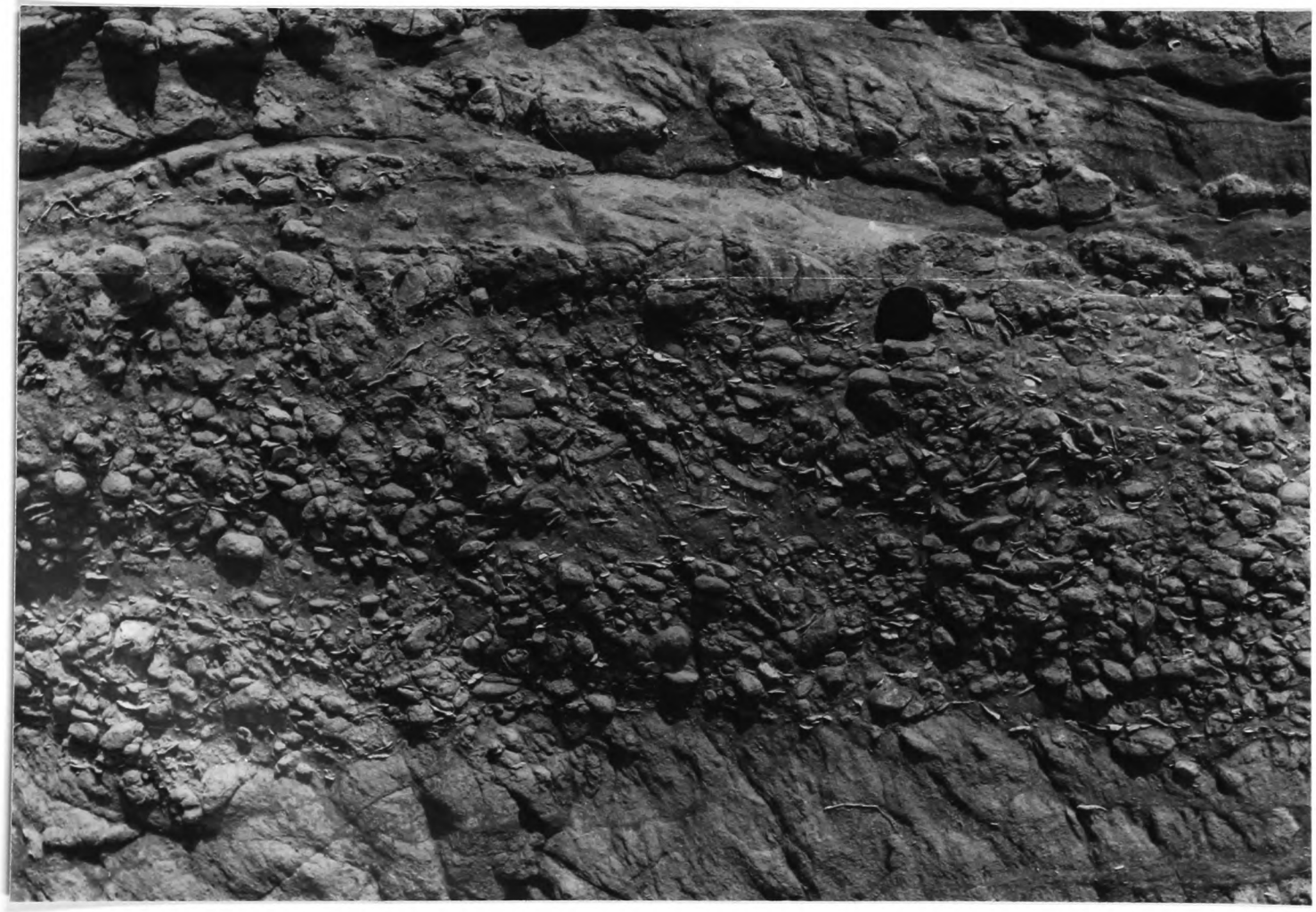


Fig.84: Pebble-shell bed fabric. Shows the predominantly horizontal alignment of the pebble and shell material. An internal sandy lens suggests amalgamation of two beds. A shallow scour at the base of the bed, infilled with pebbles and shells, is present on the left of the picture. Lower pebble-shell bed in upper Chert Beds, Beer Head.

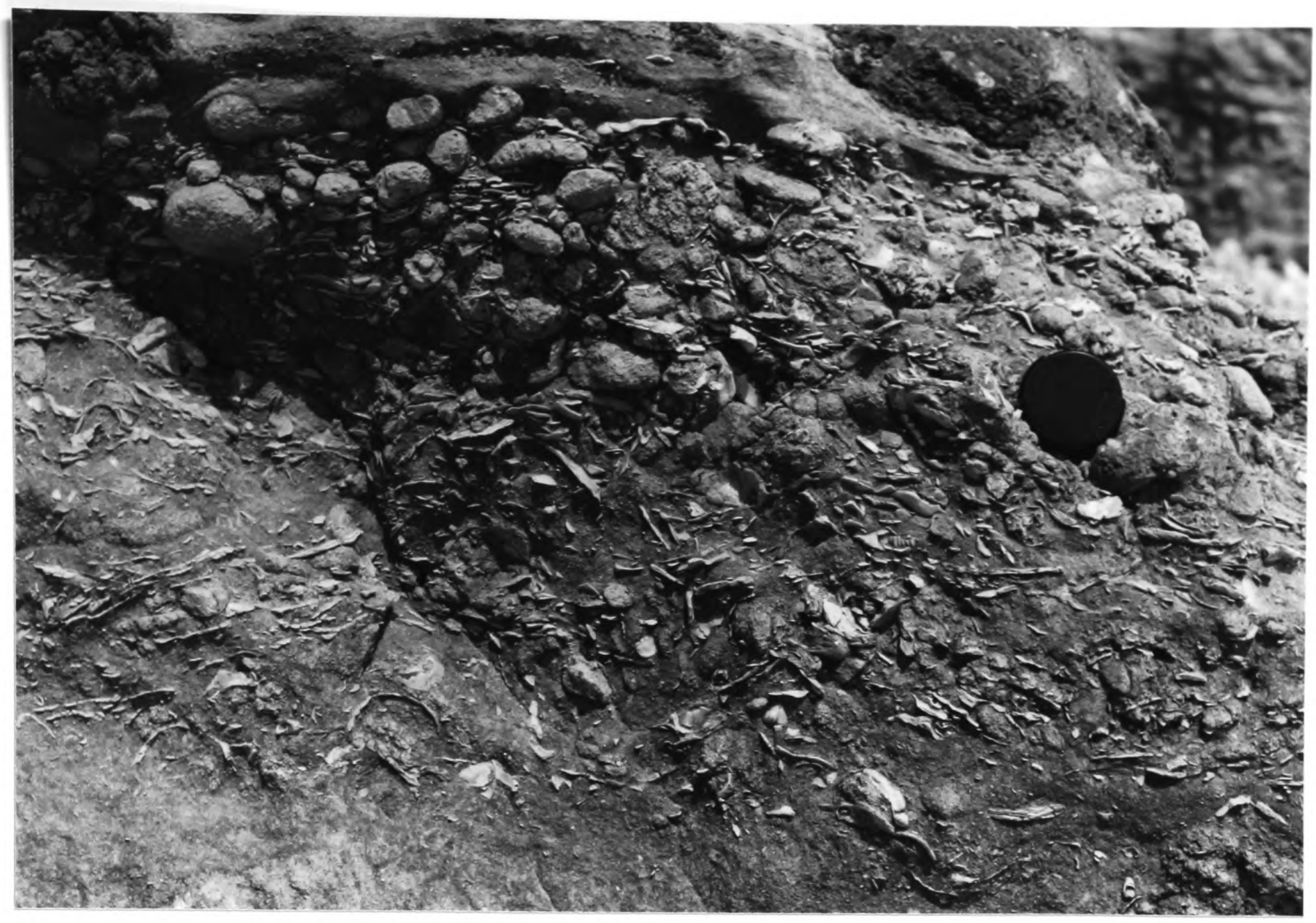
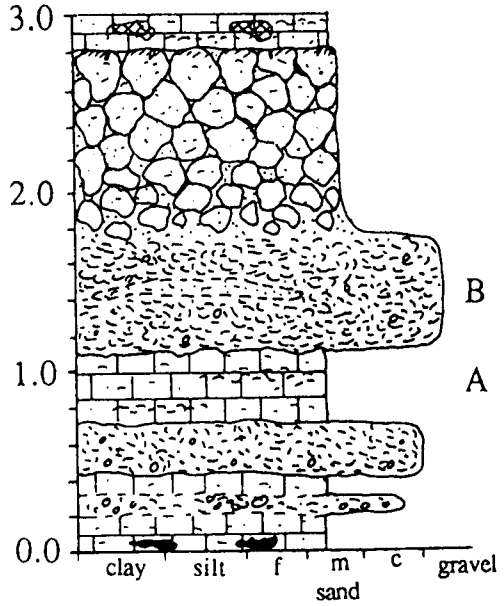


Fig.83: Pebble-shell bed fabric. Shows a patch of pebble-rich sediment in the upper part, probably infilling a small scour. Shell material is predominantly horizontally-oriented, with a patch of imbricated shells on the left of the picture. Lower pebble-shell bed in upper Chert Beds, Beer Head.

Fig.85: Coquina shell bed in the lower Chert Beds, showing sharp base, lower shelly layer, internal sandy lens, and overlying shelly layer with mounded top. Implies amalgamation of at least two discrete events. Little Beach, Beer.



Thickness (m) Grain size

Description

Patchily-silicified glauconitic calcarenites; several thin, weak shell concentrations.

The Brecciated Limestone hardground; a well-cemented nodular limestone; bored nodules on the upper surface.

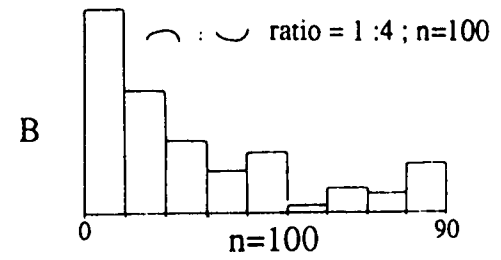
Large Orbitolinid foraminifera at bed top.

Complex, coarse-grained oyster shell bed; rich in large *Amphidonte*; variable thickness and geometry; internal sandy lenses.

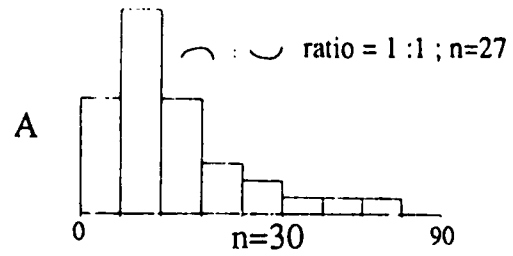
Calcarenites with thin stringers of *Amphidonte*.

Thin, discontinuous, weak concentration of pebbles and shells. Calcarenites with chert.

Shell fabrics



angle to bedding



angle to bedding

Fig.86: Graphic log and fabric data from complex proximal shell-pebble beds, Weston Ebb. Fabric data taken on shell long axes and convexity orientations.

Fig.87: Complex proximal shell-pebble beds, upper Chert Beds, just below the Brecciated Limestone hardground, Weston Ebb (shown graphically in Figure 86). Note the internal calcarenite lenses within the uppermost coquina, and thin shell stringers in the sediment immediately below.

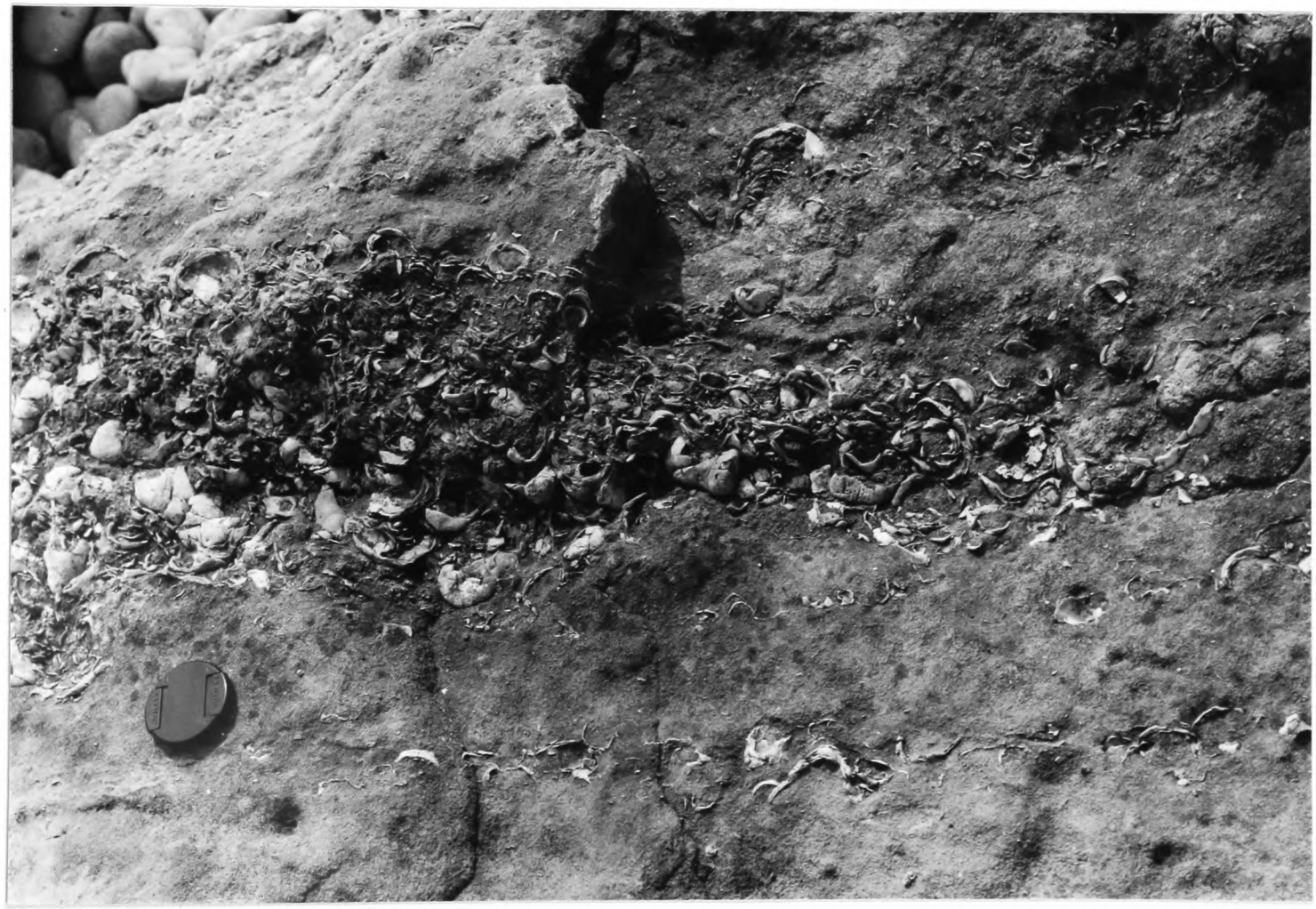


Fig.88: Coarse-grained coquina lens and thin shell stringers, upper Chert Beds, Weston Ebb. Note the predominantly convex-down shell stacking in the main part of the coquina lens, and the predominantly convex-up alignments at the top of the lens, and in the shell stringer below.

Fig.89: Fabric of thin pebble layer, finer-grained shell-pebble bed, and coarse shell stringer, upper Chert Beds, Weston Ebb.

Fig.90: Bedding plane view of shell bed from the Beer Head Limestone (Cenomanian), Weston Ebb. Shows the different shell assemblage to the Upper Greensand shell beds, with variably-fragmented *Merklinia* and *Amphidonte* bivalves.

Fig.91: Fabric of coarse-grained complex, proximal coquina bed, upper Chert Beds, Weston Ebb. Note the close shell stacking in predominantly convex-down orientations. Scattered patches of sediment show imbrication, and orientations up to vertical to bedding. Small intraformational pebbles are present at low concentrations throughout.

Fig.92: Gutter infilled with shell-rich sediment, developed at the base of a coarse-grained, complex, proximal coquina bed, Weston Ebb.

Fig.93: Complex pebble-shell bed, showing evidence for amalgamation of three separate pebble and shell concentrations, upper Chert Beds, Beer Head.

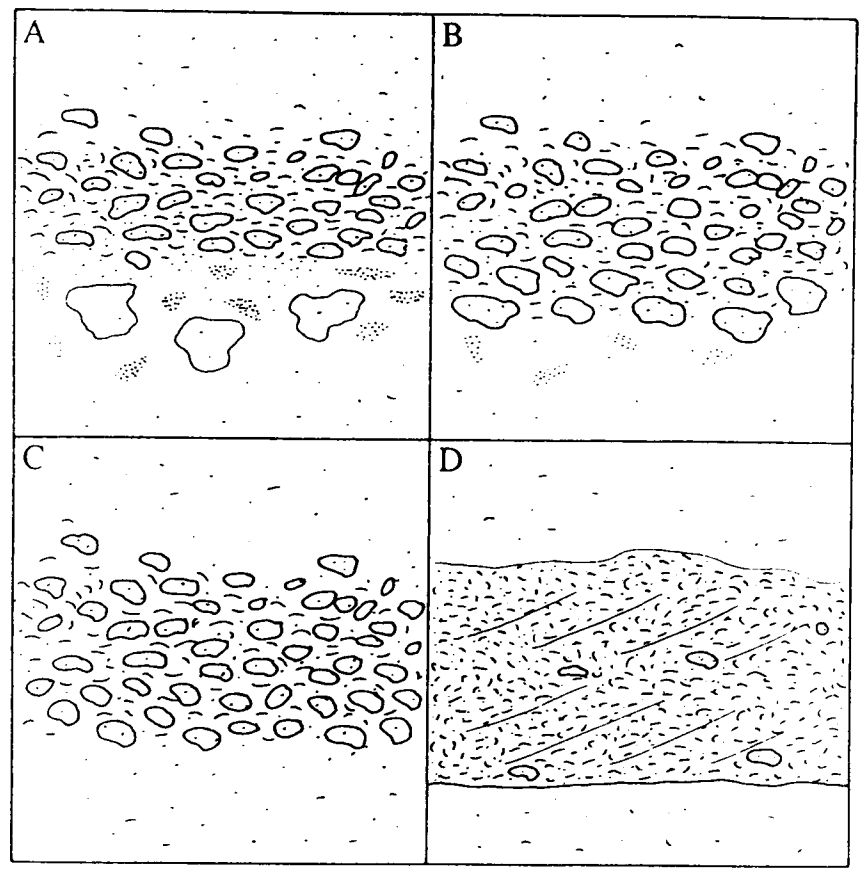


Fig.94: Cartoon showing the different types of basal contact to the pebble/shell beds in the Chert Beds calcarenites. (A) basal firmground burrowing and *in situ* nodules ; (B) basal firmground burrowing, all nodules reworked ; (C) no firmground burrowing, all nodules reworked ; (D) sharp base, overlain by a shell-rich bed, sometimes cross-stratified.

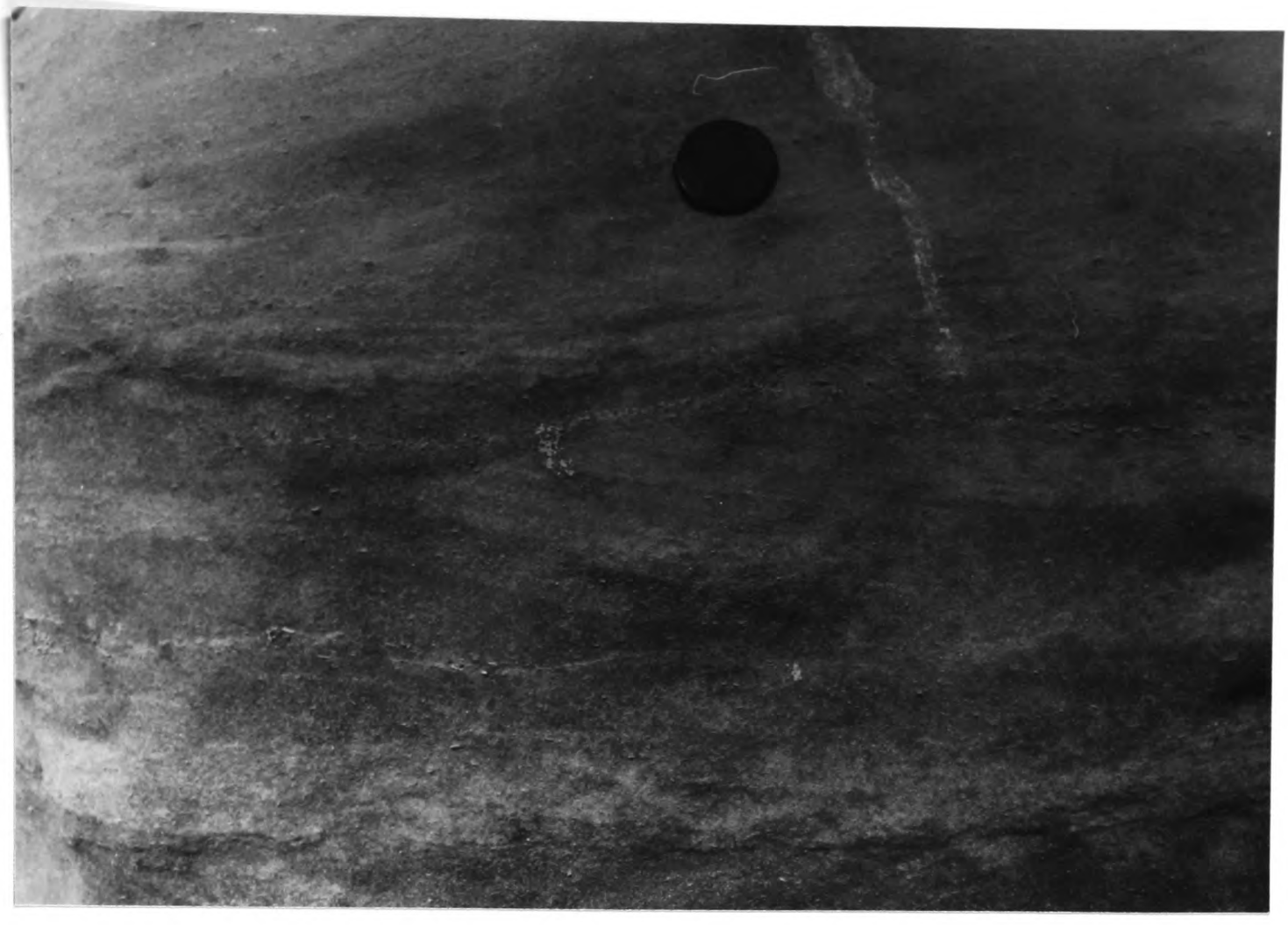


Fig.95: Horizontal and undulose to low-angle cross-lamination, the Chert Beds. Wave-polished block, Culverhole Point.

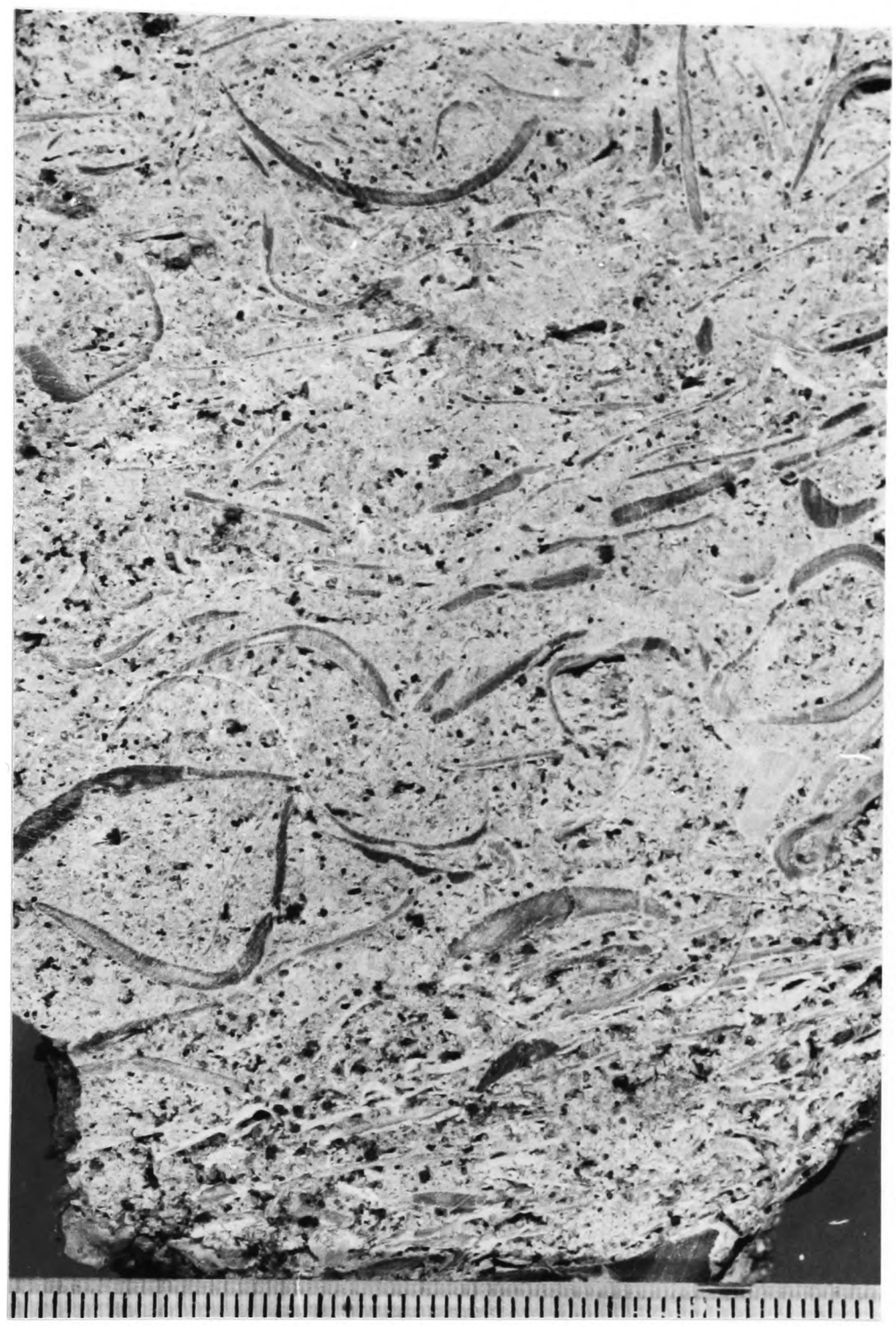


Fig.96: Polished slab from coquina bed, lower Chert Beds, showing the shell fabric. Predominantly horizontal shell orientations, with occasional larger shells up to vertical to the bedding. Note the stratification present within the sample; at least four thin beds are developed, differing in grain size and shell orientation. Little Beach, Beer.

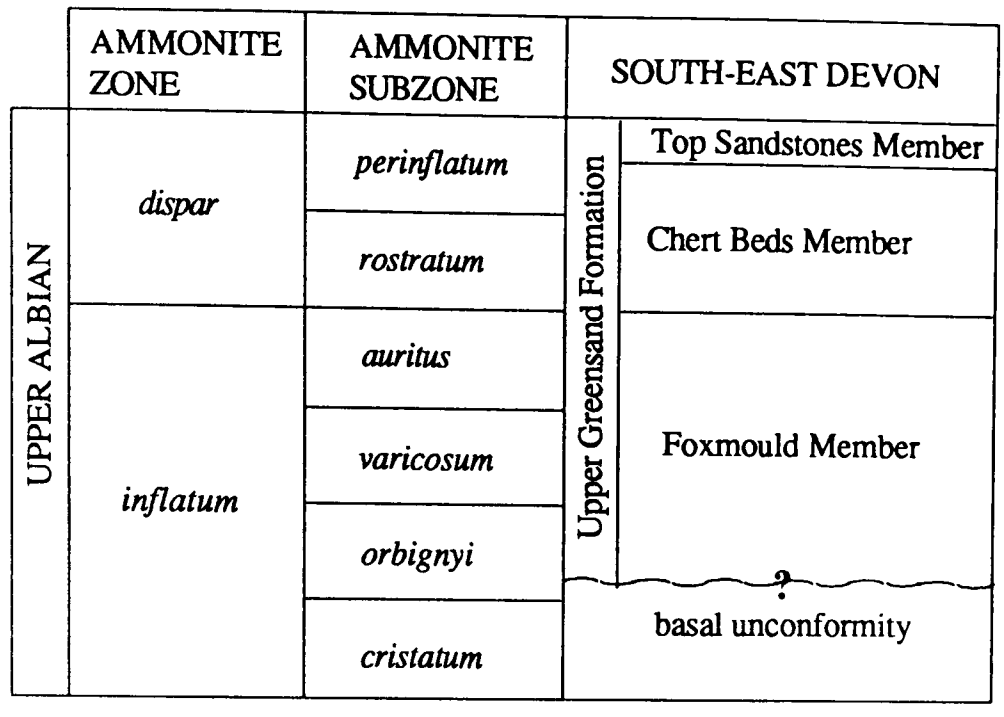


Fig.97: Subdivision of the Upper Greensand Formation of south-east Devon, with corresponding ammonite biostratigraphy. Ammonite zonation scheme based on Owen (1976).

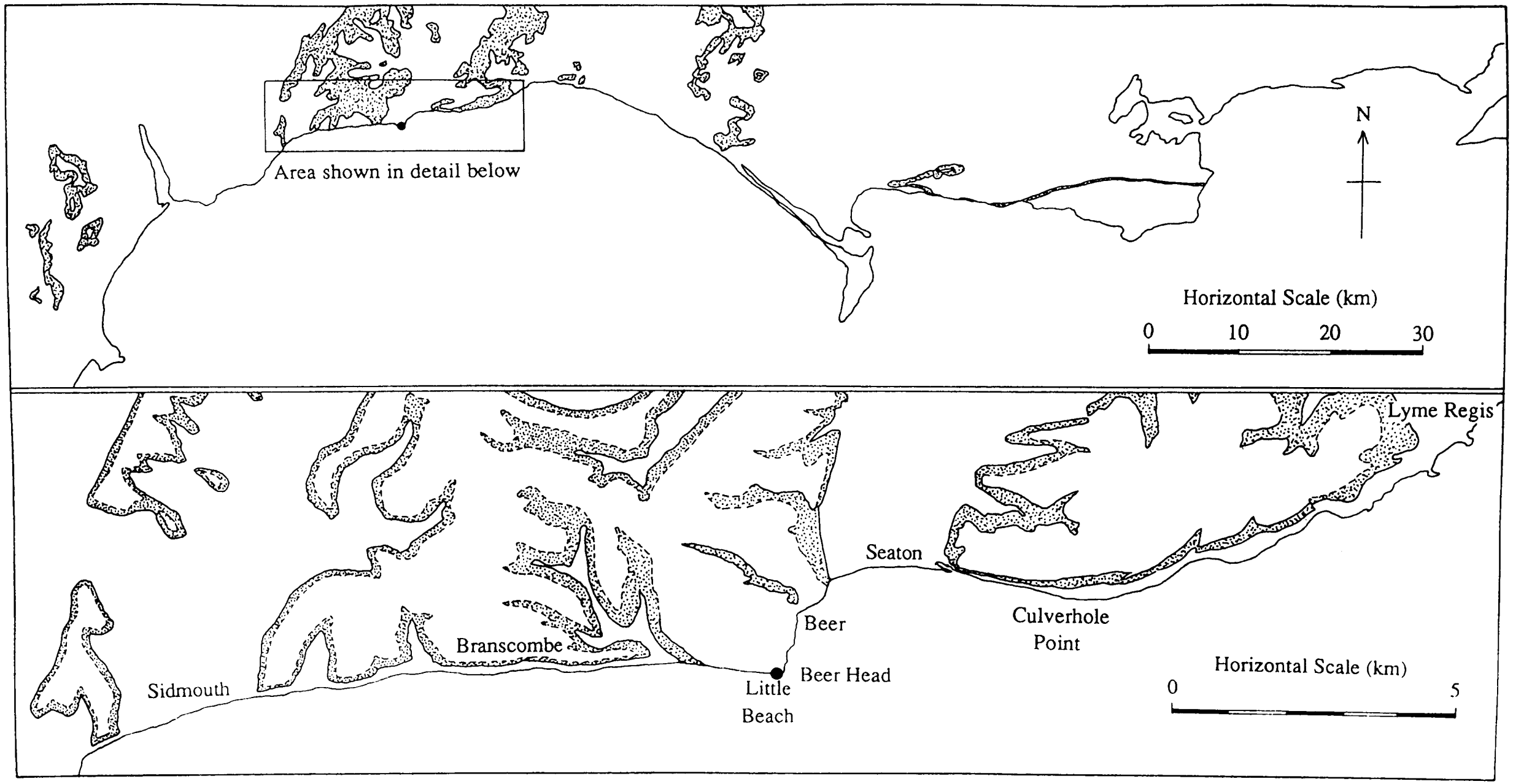


Fig.98: Map showing the Upper Greensand and Gault outcrop across south-west England, and the location of the section sampled, at Little Beach - Beer Head.

Stratigraphy	Sample Number	Sample posn.	Log plot posn.	∂13C	∂13C 3pt. av.	∂18O	∂18O 3pt.av.	Cemtn. Index.	∂13C normd.	∂18O normd
B.HEAD LST.	A90/4184	48.72	48.72	3.188		-1.820		4		
UGS-Top Ssts.	A90/4178	47.62	47.62	3.098	3.111	-2.585	-1.924	4	3.478	-1.484
	A90/1362	46.20-46.30	46.25	3.046	3.046	-1.821	-2.148	1	3.162	-1.484
	A90/1365	46.05-46.15	46.10	2.994	3.011	-2.038	-1.960	3	3.185	-1.484
	A90/1369	45.97-46.05	46.01	2.993	2.903	-2.021	-2.095	1	3.178	-1.484
	A90/1368	44.61-44.69	44.65	2.722	2.876	-2.227	-2.252	1	2.978	-1.484
	A90/4168	43.42	43.42	2.913	2.903	-2.509	-2.181	3	3.267	-1.484
	A90/4169	43.12	43.12	3.075	2.908	-1.808	-2.231	1	3.187	-1.484
U.Chert Beds	A90/1372	41.57-41.67	41.62	2.735	2.796	-2.375	-2.157	1	3.042	-1.484
	A90/1367	40.68-40.80	40.74	2.579	2.656	-2.287	-2.120	2	2.856	-1.484
	A90/1386	40.12-41.37	40.20	2.653	2.628	-1.697	-1.968	1	2.726	-1.484
	A90/1385	39.42-39.82	39.67	2.651	2.652	-1.919	-1.785	2	2.801	-1.484
	A90/1389	38.99-39.42	39.20	2.653	2.637	-1.740	-2.006	4	2.741	-1.484
	A90/1400	38.45	38.45	2.608	2.655	-2.360	-2.071	1	2.910	-1.484
	A90/1358	37.95	37.95	2.703	2.701	-2.114	-1.986	2	2.920	-1.484
	A90/1394	37.15-37.65	37.40	2.792	2.659	-1.484	-1.991	2	2.792	-1.484
	A90/1359	37.05	37.05	2.481	2.596	-2.374	-2.117	2	2.788	-1.484
	A90/1395	36.15	36.15	2.516	2.436	-2.494	-2.560	3	2.864	-1.484
	A90/4495*	35.15	35.15	2.311	2.398	-2.813	-2.476	4	2.770	-1.484
	A90/1361	34.75	34.75	2.367	2.399	-2.120	-2.573	3	2.586	-1.484
	A90/4504*	34.75	34.75	2.519	2.478	-2.785	-2.428	3	2.968	-1.484
	A90/1392	33.55	33.55	2.548	2.246	-2.380	-2.880	4	2.857	-1.484
L.Chert Beds	A90/1363	32.50-32.60	32.55	1.672	1.949	-3.474	-3.339	3	2.360	-1.484
	A90/1397	31.75-32.15	31.95	1.627	1.652	-4.163	-4.011	3	2.551	-1.484
	A90/1402	31.75	31.75	1.656	1.661	-4.396	-3.694	4	2.661	-1.484
	A90/1375	31.28-31.35	31.31	1.700	1.662	-2.524	-3.498	4	2.059	-1.484
	A90/1384	31.15-31.20	31.18	1.631	1.612	-3.573	-2.071	5	2.352	-1.484
	A90/1373	31.04-31.15	31.09	1.505	1.586	-3.116	-3.114	2	2.068	-1.484
	A90/1382	30.97-31.02	31.00	1.621	1.635	-2.654	-2.668	3	2.025	-1.484
	A90/1371	30.90-30.98	30.94	1.778	1.781	-2.235	-2.370	3	2.037	-1.484
	A90/1381	30.80-30.85	30.82	1.945	1.890	-2.222	-2.101	5	2.200	-1.484
	A90/1374	30.76-30.80	30.78	1.946	1.853	-1.847	-2.113	2	2.071	-1.484
	A90/1376	30.66-30.72	30.69	1.667	1.778	-2.270	-2.199	4	1.938	-1.484
	A90/1377	30.39-30.51	30.45	1.720	1.697	-2.481	-2.567	4	2.064	-1.484
	A90/1383	30.29-30.37	30.32	1.705	1.608	-2.950	-2.996	2	2.211	-1.484
	A90/1380	30.11-30.19	30.15	1.400	1.419	-3.557	-3.469	5	2.115	-1.484
	A90/1379	29.99-30.03	30.01	1.151	1.431	-3.899	-3.368		1.984	-1.484
	A90/1378	29.65-29.70	29.68	1.741	1.452	-2.649	-2.867	4	2.143	-1.484
	A90/1364	29.05	29.05	1.463	1.621	-2.052	-2.562	3	1.659	-1.484
	A90/1360	27.95	27.95	1.659	1.625	-2.985	-2.244	2	2.177	-1.484
	A90/1366	27.10	27.10	1.754	1.699	-1.696	-2.293	3	1.827	-1.484
	A90/1403	26.55	26.55	1.684	1.926	-2.198	-2.117	2	1.930	-1.484
Foxmould	A90/1393	25.80-26.05	25.93	2.339	1.825	-2.456	-2.499	2	2.674	-1.484
	A901398	25.15-25.35	25.25	1.452	1.961	-2.843	-2.382	4	1.921	-1.484
	A90/1401	24.99-25.15	25.07	2.093		-1.848		4	2.219	-1.484

Table 2: Carbon- and oxygen-isotopic data from Little Beach - Beer Head, south-east Devon. Data are from whole rock samples, generated by crushing, except for the two samples marked *, which were generated by drilling a small amount of powder from fresh specimen surfaces. Normalised data reflect modification to remove postulated silica diagenesis; data normalised to the lowest $\delta^{18}O$ value.

Sample Number	Sample posn.	Log plot posn.	∂13C	∂18O	Cemtn. Index	∂13C normd.	∂18O norm.
A90/1375	31.28-31.35	31.31	1.700	-2.524	4	1.934	-1.847
A90/1384	31.15-31.20	31.18	1.631	-3.573	5	2.226	-1.847
A90/1373	31.04-31.15	31.09	1.505	-3.116	2	1.943	-1.847
A90/1382	30.97-31.02	31.00	1.621	-2.654	3	1.899	-1.847
A90/1371	30.90-30.98	30.94	1.778	-2.235	3	1.912	-1.847
A90/1381	30.80-30.85	30.82	1.945	-2.222	5	2.074	-1.847
A90/1374	30.76-30.80	30.78	1.946	-1.847	2	1.946	-1.847
A90/1376	30.66-30.72	30.69	1.667	-2.270	4	1.813	-1.847
A90/1377	30.39-30.51	30.45	1.720	-2.481	4	1.938	-1.847
A90/1383	30.29-30.37	30.32	1.705	-2.950	2	2.086	-1.847
A90/1380	30.11-30.19	30.15	1.400	-3.557	5	1.990	-1.847
A90/1379	29.99-30.03	30.01	1.151	-3.899		1.859	-1.847
A90/1378	29.65-29.70	29.68	1.741	-2.649	4	2.018	-1.847

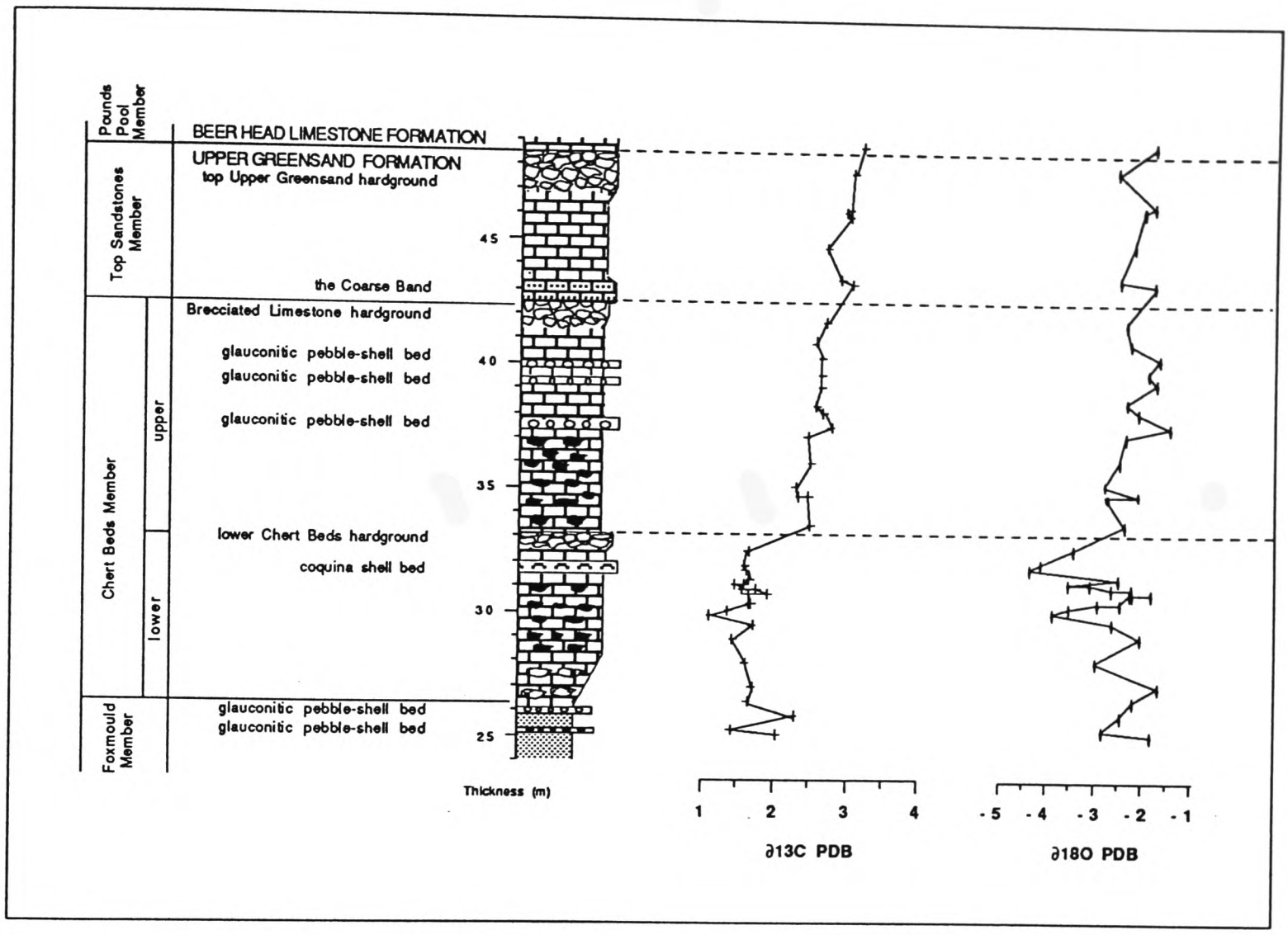
Table 3: Detailed sample set extracted from Table 2, with corresponding normalised values.

Sample Number	Sample type	∂13C	∂18O
A90/4509	matrix	2.828	-2.232
A90/4510	edge sil.nod.	1.596	-4.000
A90/4511	centre sil. nod	1.889	-3.584
A90/4512	oyster	2.381	-3.064
A90/4513	matrix	2.375	-1.903
A90/4514	weak sil.nod.	2.659	-2.065

Table 4: Isotopic data from repeated drillings of a single hand specimen showing patchy silicification, collected from the top glauconitic pebble-shell bed in the uppermost Foxmould at Whitecliff, Beer (SY 234 893).

Sample Number	Oyster posn.	∂13C	∂18O	∂13C normd.	∂18O normd.
A90/4508	48.68	3.530	-2.507		
A90/4192	48.67	2.810	-1.785	3.153	-1.319
A90/4496	48.62	2.991	-1.830	3.367	-1.319
A90/4196	44.02	2.823	-2.025	3.343	-1.319
A90/4506	41.62	2.499	-2.542	3.399	-1.319
A90/4498	40.72	2.918	-1.319	2.918	-1.319
A90/4507	40.05	3.062	-1.708	3.348	-1.319
A90/1457	39.20	2.903	-1.475	3.018	-1.319
A90/4199	38.57	0.814	-2.646	1.791	-1.319
A90/1456	37.40	2.583	-2.131	3.181	-1.319
A90/4493	36.50	2.953	-1.910	3.388	-1.319
A90/1453	36.15	2.149	-2.511	3.026	-1.319
A90/4194	35.85	1.813	-2.225	2.480	-1.319
A90/4200	35.40	1.096	-2.860	2.230	-1.319
A90/4494	35.15	1.596	-3.774	3.403	-1.319
A90/4193	34.70	1.797	-2.823	2.904	-1.319
A90/4503	34.65	2.484	-3.148	3.830	-1.319
A90/4502	34.15	1.990	-3.814	3.826	-1.319
A90/4195	34.00	2.052	-2.426	2.867	-1.319
A90/4505	33.45	2.179	-3.120	3.505	-1.319
A90/4198	33.15	2.220	-2.265	2.916	-1.319
A90/4197	32.30	2.825	-1.733	3.129	-1.319
A90/4499	32.10	1.544	-4.320	3.753	-1.319
A90/1458	31.95	1.486	-3.932	3.409	-1.319
A90/4190	31.50	2.220	-3.345	3.711	-1.319
A90/4501	31.00	1.351	-4.237	3.499	-1.319
A90/4497	30.45	2.819	-2.947	4.017	-1.319
A90/4500	26.50	2.352	-1.924	2.797	-1.319
A90/4191	26.00	4.050	-2.987		
A90/1459	25.25	1.143	-2.755		

Table 5: Carbon- and oxygen-isotopic data from oysters collected throughout the Little Beach - Beer Head section. Normalised data reflects modification to remove postulated silica diagenesis.



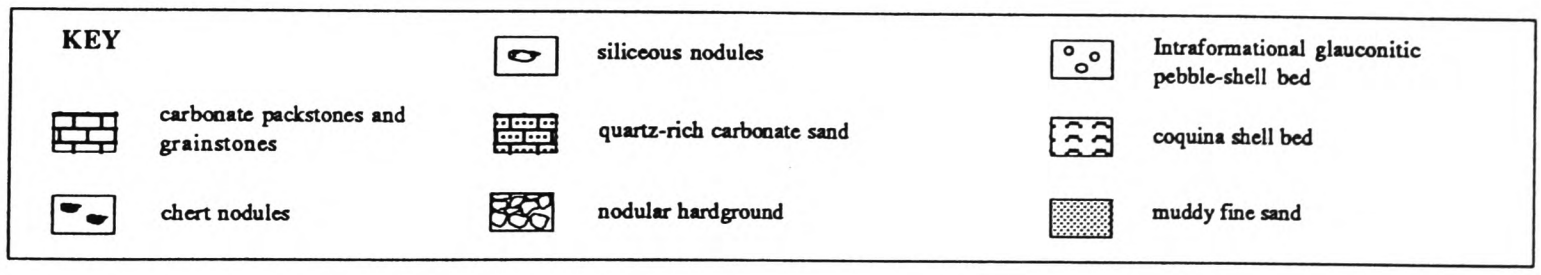


Fig.99: Carbon- and oxygen-stable isotope stratigraphy of the Upper Greensand (Chert Beds and Top Sandstones Members), Little Beach - Beer Head, south-east Devon. The $\delta^{13}C$ and $\delta^{18}O$ values are measured from whole-rock carbonate samples. The accompanying lithostratigraphy shows the subdivision of the Upper Greensand in south-east Devon.

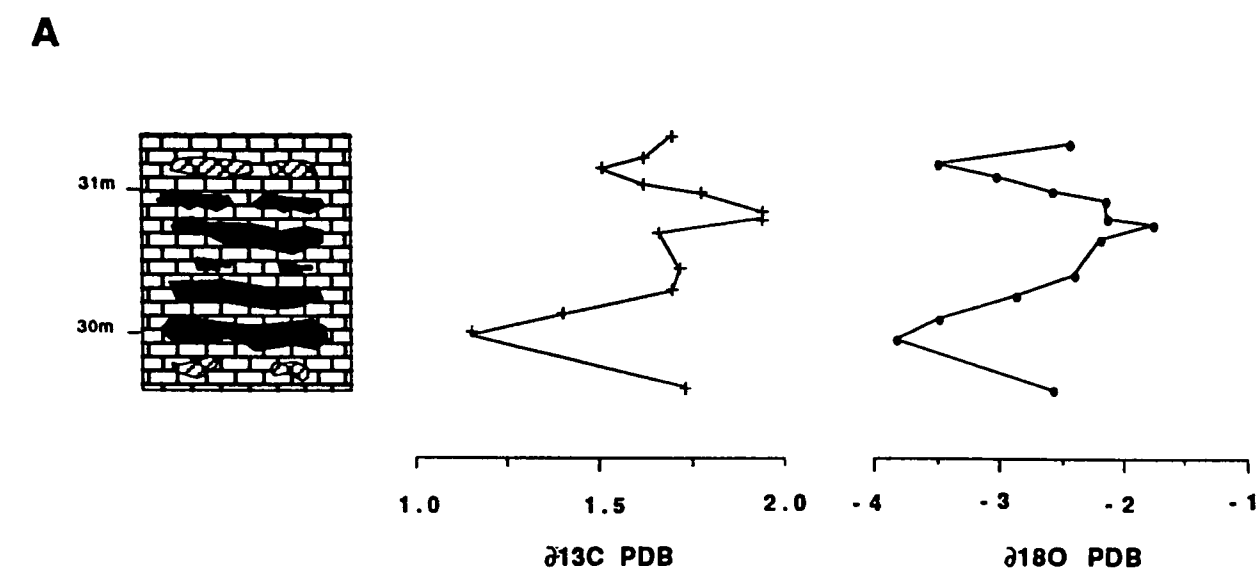


Fig.100: Investigation of the isotopic modification resulting from silica diagenesis.
Fig.100A: the isotopic changes across 1.63m of the lower Chert Beds, showing the positions of prominent chert nodules and nodules of siliceous limestone.
Fig.100B: plot of $\delta^{13}C$ vs $\delta^{18}O$, showing the good positive correlation, and the best fit line, the gradient of which represents the isotopic changes caused by silicification.
Fig.100C: original carbon-isotope plot and normalised plot (dotted), removing the effects of silicification.

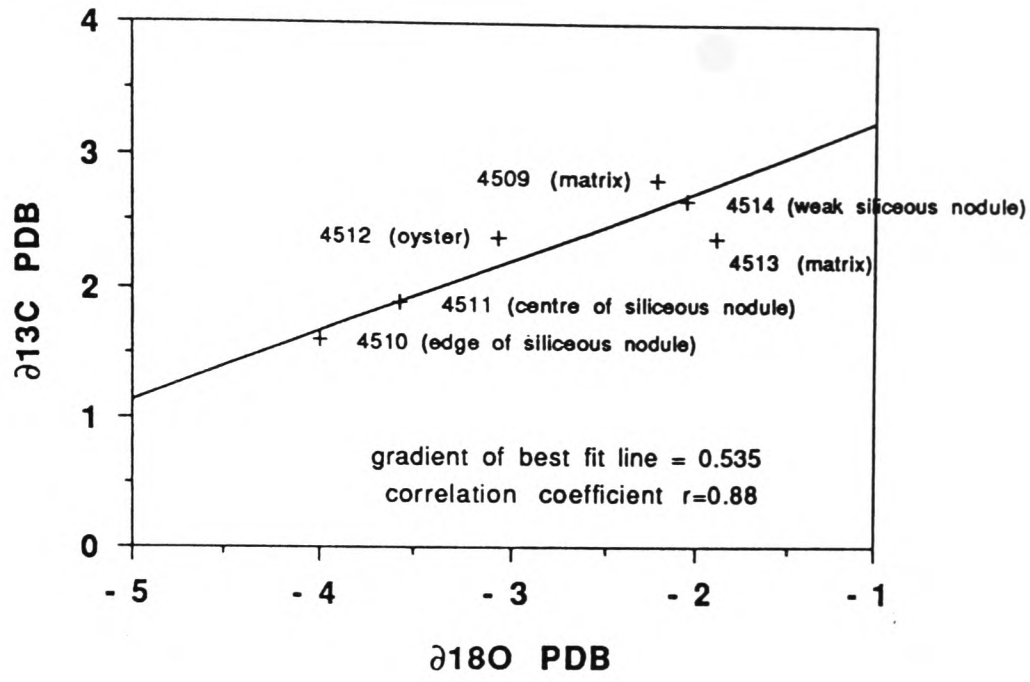


Fig.101: Plot of $\delta^{13}C$ vs $\delta^{18}O$ values recorded from repeated drillings of a single hand specimen showing patchy silicification, collected from the top glauconitic pebble-shell bed of the uppermost Foxmould at Whitecliff, Beer (SY 234 893).

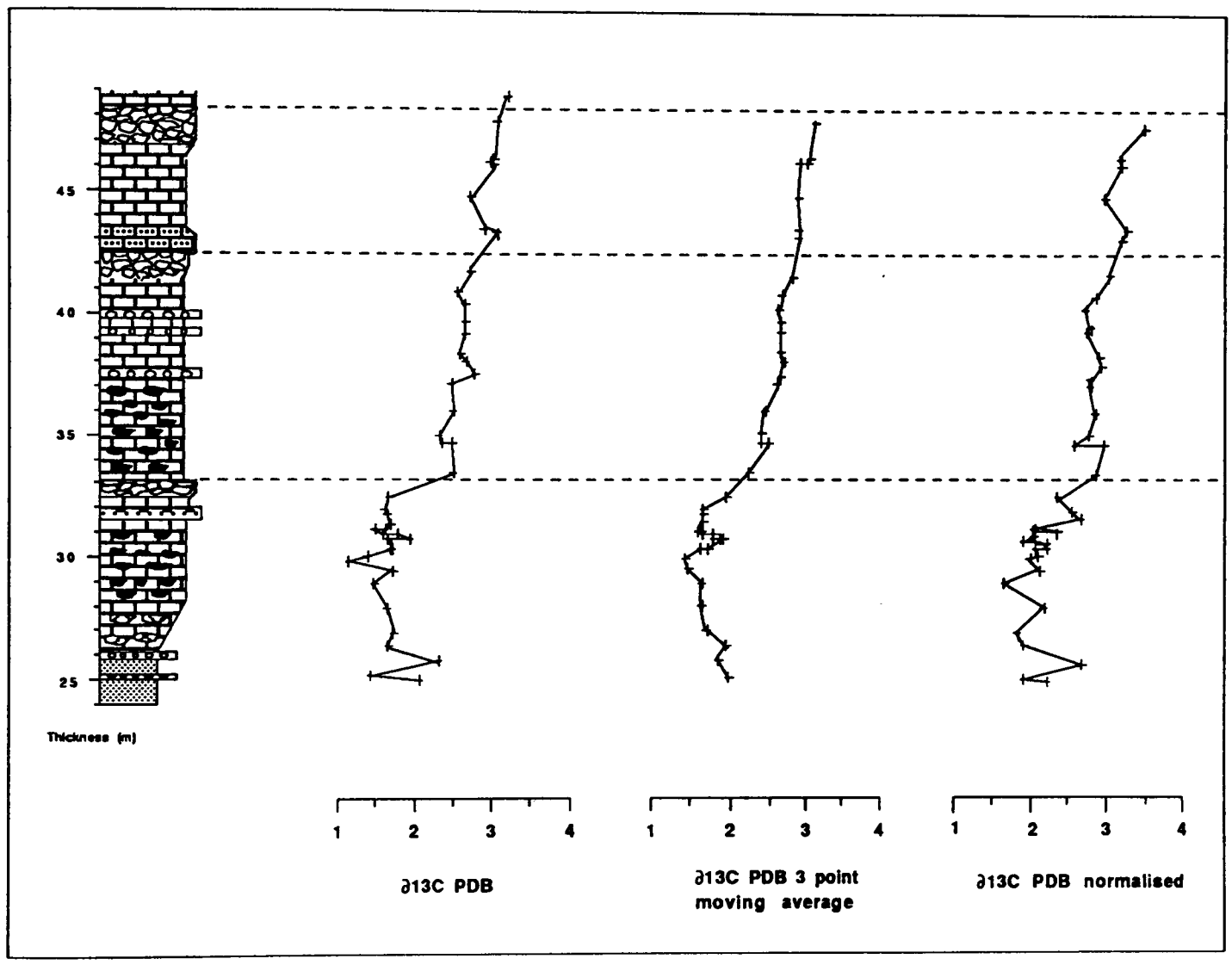


Fig.102: Carbon-isotope stratigraphy of the Upper Greensand (Chert Beds and Top Sandstones), Beer Head - Little Beach. The three plots show measured $\delta^{13}C$ values, three point moving average of measured $\delta^{13}C$ values, and $\delta^{13}C$ values normalised to remove the variations assumed to represent changes due to silicification.

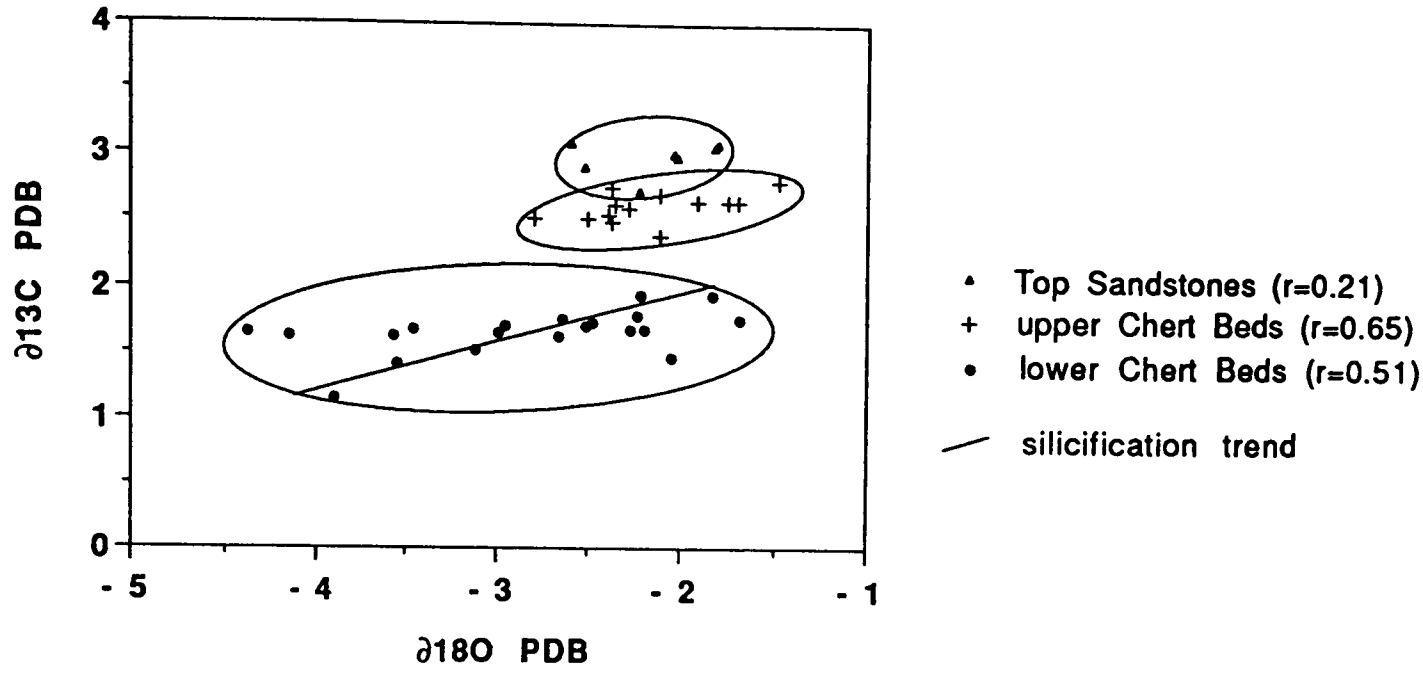


Fig.103: Plot of $\delta^{13}C$ vs $\delta^{18}O$ values for the whole rock data set (Little Beach - Beer Head section). Data from the lower Chert Beds, upper Chert Beds and the Top Sandstones plot as three distinct groups, with little or no overlap. The silicification trend established in Figure 5B is shown for the lower Chert Beds. Data from the upper Chert Beds, and possibly the Top Sandstones, also show a scatter of values inferring that a major control on recorded $\delta^{13}C$ values (low variability within each group) was silica diagenesis. The plot clearly displays the abrupt positive shift between the lower and upper Chert Beds, and shows that it is not caused by silicification.

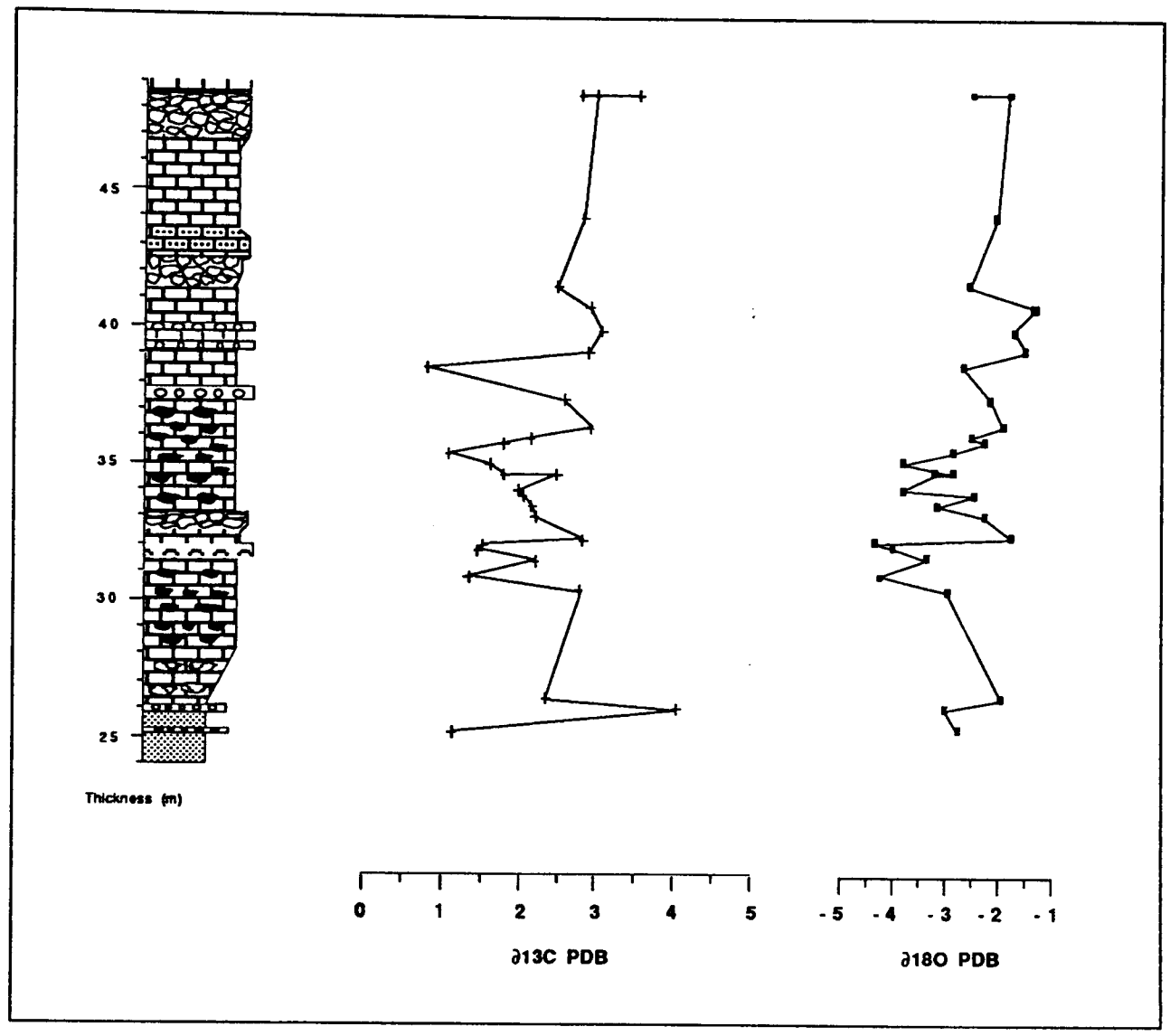


Fig.104: Carbon- and oxygen-isotope stratigraphy of the Upper Greensand (Little Beach - Beer Head). The isotopic values are from oysters collected throughout the succession.

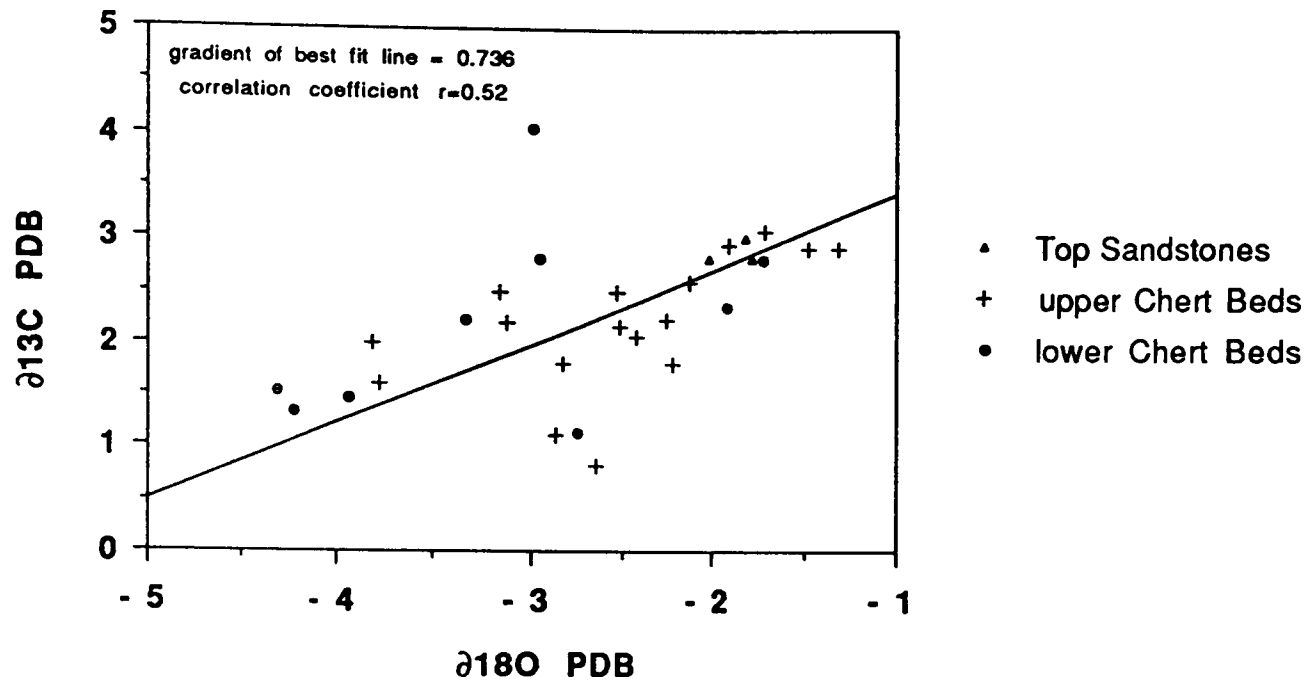


Fig.105: Plot of $\delta^{13}C$ vs $\delta^{18}O$ values for the oyster data set (Little Beach - Beer Head section). Data from the lower Chert Beds, upper Chert Beds and Top Sandstones plotted separately. A high degree of scatter is shown, with little indication of any secular changes. Some degree of correlation establishes a tentative silicification modification trend.

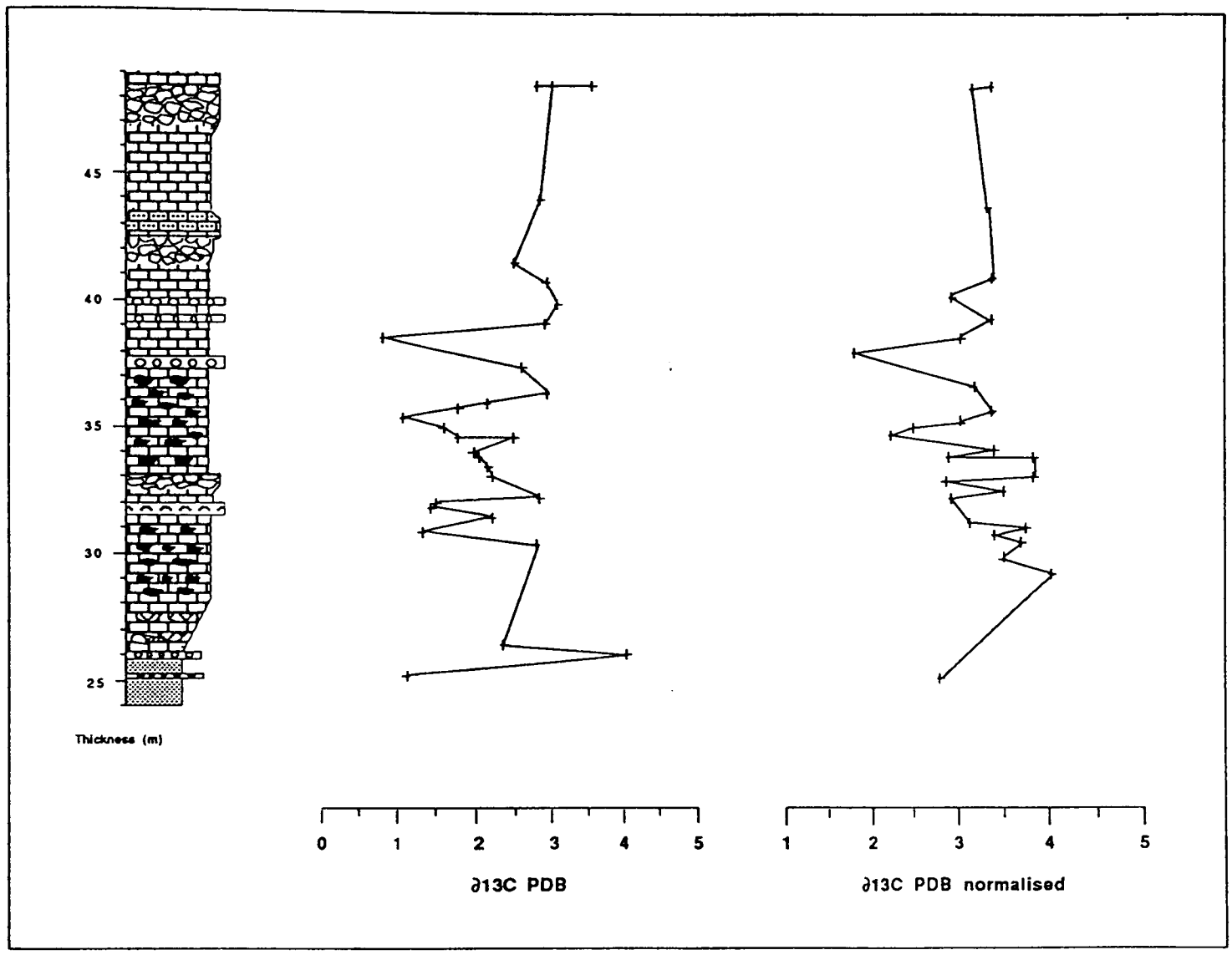


Fig.106: Carbon-isotope stratigraphy from oyster samples (Little Beach - Beer Head section). The two plots show measured $\delta^{13}C$ values, and $\delta^{13}C$ values normalised to remove the variations interpreted as due to silicification.

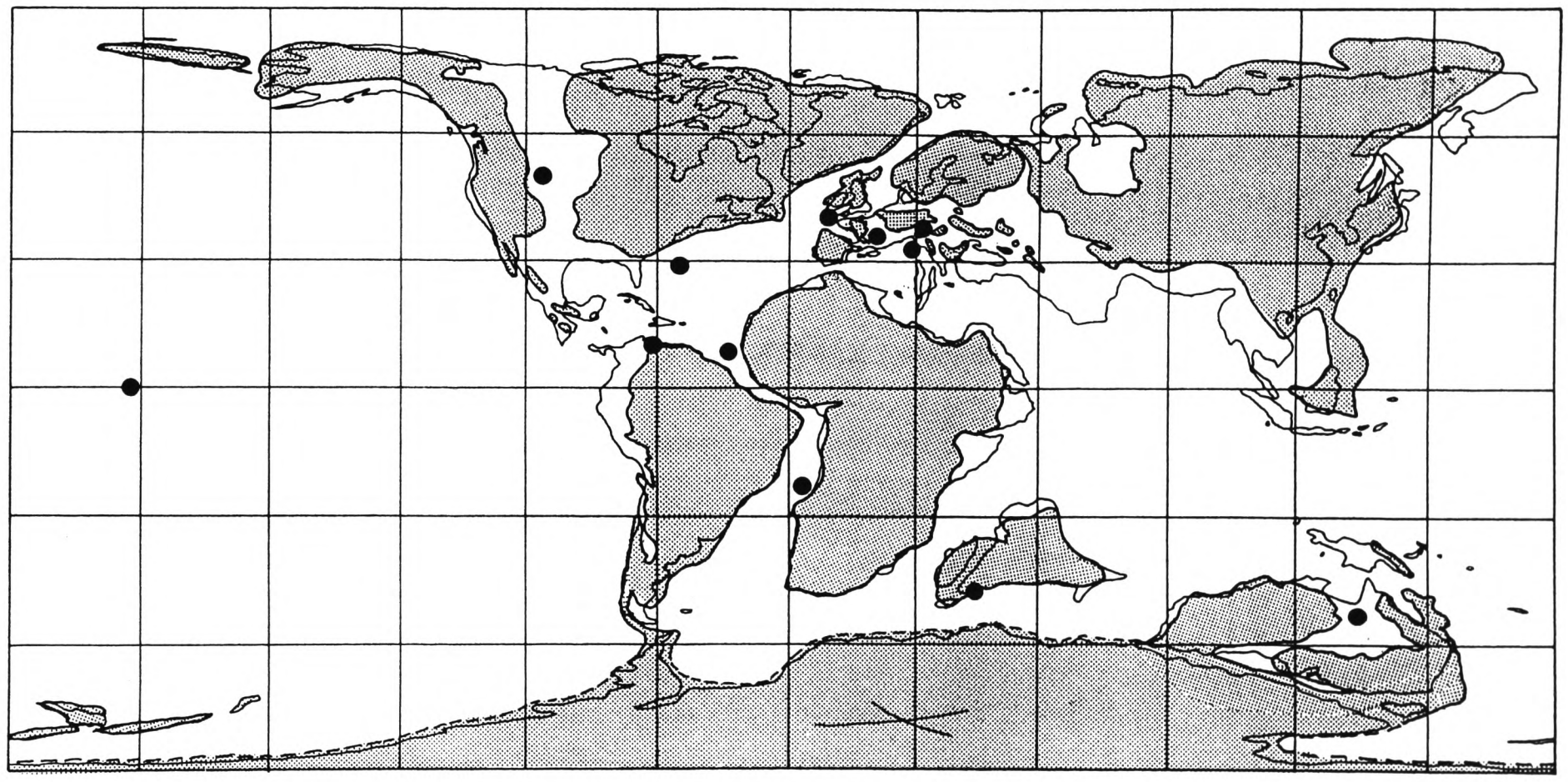


Fig.107: Global distribution of Upper Albian black shales (discussed in the text), plotted on an Albian (105Ma) palaeogeographic reconstruction of Funnel (1990).

MICROPROBE CHEMICAL ANALYSES OF GLAUCONITIC GRAINS

TABLE 6. Microprobe chemical analyses of glauconitic grains from the Foxmould Member, Upper Greensand Formation, Beer, south-east Devon. Total iron is given as Fe_2O_3 in the analyses of this and the following tables.

wt%	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	AV.F1-15
SiO_2	53.73	51.24	52.63	52.71	53.52	51.86	53.67	48.09	46.06	52.33	53.64	46.03	42.41	25.99	48.39	48.81
K_2O	8.15	8.30	8.66	6.81	8.21	8.60	8.15	8.19	7.52	8.49	8.28	8.11	4.47	3.27	8.28	7.57
Fe_2O_3	19.83	25.35	20.84	20.44	21.83	21.01	19.87	20.16	18.94	21.98	20.12	11.22	21.42	20.96	17.13	20.07
Al_2O_3	8.26	7.27	7.70	8.97	7.96	7.74	9.34	6.85	7.51	7.86	9.79	20.37	12.63	5.09	15.27	9.51
MgO	4.07	3.47	4.00	3.45	3.82	4.01	3.87	3.66	3.28	3.63	3.57	2.12	6.34	1.87	2.79	3.60
CaO	0.36	0.34	0.26	0.83	0.43	0.19	0.50	0.30	0.30	0.26	0.42	0.36	0.64	0.74	0.43	0.42
Na_2O	0.09	0.09	0.02	0.11	0.09	0.09	0.11	0.02	0.09	0.07	0.07	0.22	0.13	0.14	0.18	0.10
MnO_2	0.05	0.01	0.05	0.09	0.01	0.03	0.04	0.01	0.03	0.04	0.01	0.04	0.16	0.08	0.01	0.04
TiO_2	0.07	0.05	0.04	0.11	0.04	0.05	0.07	0.05	0.04	0.04	0.09	0.24	0.27	31.20*	0.16	0.09
P_2O_5	0.00	0.12	0.03	0.03	0.03	0.09	0.03	0.06	0.06	0.06	0.00	0.18	0.03	0.03	0.06	0.05
Total	94.77	94.24	94.23	93.55	95.94	93.67	95.65	87.39	83.83	94.76	95.99	88.89	88.50	89.37	92.70	92.23

TABLE 7. Microprobe chemical analyses of glauconitic grains from the uppermost Foxmould member, Upper Greensand Formation, Beer, south-east Devon.

wt%	TF1	TF2	TF3	TF4	TF5	TF6	TF7	TF8	TF9	TF10	TF11	TF12	TF13	TF14	TF15	TF16	TF17	Av.TF1-17
SiO_2	51.02	52.65	51.45	51.19	51.05	52.13	51.92	52.56	51.93	48.68	50.60	50.79	51.12	48.90	51.93	54.07	50.64	51.32
K_2O	7.12	8.20	8.10	7.37	7.30	7.41	8.09	6.74	7.48	7.17	7.19	7.30	7.46	6.66	7.92	7.95	7.50	7.47
Fe_2O_3	17.02	21.31	20.59	16.38	15.81	17.10	20.04	16.53	17.95	15.17	16.03	16.32	16.63	16.96	18.57	18.24	19.43	17.65
Al_2O_3	7.83	7.26	6.88	7.91	7.88	8.88	7.40	10.08	8.30	10.56	7.92	7.84	7.83	7.90	8.04	8.44	7.23	8.13
MgO	4.04	3.71	3.97	4.35	4.59	3.88	3.86	4.23	3.96	4.12	4.28	4.37	4.50	3.51	3.83	4.31	3.91	4.08
CaO	0.34	0.60	0.33	0.53	0.88	0.49	0.36	0.93	0.40	0.67	0.36	0.46	0.47	0.40	0.40	0.66	0.34	0.51
Na_2O	0.13	0.00	0.07	0.34	0.35	0.05	0.05	0.09	0.09	0.11	0.09	0.12	0.07	0.05	0.11	0.02	0.13	0.11
MnO_2	0.03	0.01	0.00	0.03	0.01	0.04	0.05	0.04	0.04	0.04	0.00	0.00	0.01	0.00	0.03	0.04	0.05	0.02
TiO_2	0.09	0.07	0.05	0.09	0.05	0.07	0.04	0.07	0.07	0.07	0.07	0.07	0.07	0.11	0.07	0.05	0.09	0.07
P_2O_5	0.00	0.12	0.00	0.03	0.03	0.03	0.00	0.06	0.03	0.09	0.03	0.03	0.00	0.00	0.03	0.09	0.00	0.03
Total(%)	87.62	93.93	91.44	88.22	87.95	90.08	91.81	91.33	90.25	86.68	86.57	87.30	88.16	84.49	90.93	93.87	89.32	89.35

TABLE 8. Microprobe chemical analyses of glauconitic grains from the Chert Beds, Upper Greensand Formation, Beer, south-east Devon.

wt%	CB1	CB2	CB3	CB4	CB5	CB6	CB7	CB8	CB9	CB10	CB11	AV.CB1-11
SiO_2	49.65	50.78	51.14	51.67	46.55	51.29	51.60	51.09	51.12	50.88	38.79	49.51
K_2O	7.63	7.40	6.99	8.01	7.64	8.42	8.48	7.64	7.52	8.46	5.92	7.65
Fe_2O_3	16.54	20.82	19.18	19.06	19.15	21.22	21.87	20.22	17.88	21.15	12.10	19.02
Al_2O_3	9.38	8.18	8.37	8.91	6.99	7.48	7.49	7.81	9.62	7.62	11.07	8.45
MgO	4.45	4.06	4.60	4.24	3.80	4.13	4.01	3.91	4.56	3.98	2.51	4.02
CaO	1.71	0.50	0.21	0.43	0.51	0.34	0.52	0.54	0.67	0.36	0.49	0.57
Na_2O	0.09	0.06	0.05	0.04	0.07	0.02	0.02	0.02	0.09	0.06	0.14	0.06
MnO_2	0.03	0.00	0.03	0.00	0.00	0.01	0.01	0.03	0.04	0.01	0.01	0.01
TiO_2	0.14	0.09	0.07	0.09	0.07	0.04	0.05	0.07	0.11	0.04	0.25	0.09
P_2O_5	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.03	0.02
Total	89.62	91.89	90.64	92.48	84.81	92.98	94.08	91.36	92.61	92.56	71.31	89.49

TABLE 9. Microprobe chemical analyses of glauconitic grains from the Chert Beds, Upper Greensand Formation, Beer, south-east Devon.

wt%	CB12	CB13	CB14	CB15	CB16	CB17	CB18	CB19	CB20	CB21	CB22	Av.CB12-2
SiO_2	46.81	47.93	46.61	49.03	49.66	40.35	49.29	49.21	51.91	47.42	50.57	48.07
K_2O	6.26	6.12	6.31	6.61	6.63	5.44	6.47	7.46	8.24	6.45	8.12	6.74
Fe_2O_3	17.59	17.99	17.53	18.17	18.61	14.62	17.35	19.77	17.32	17.53	21.03	17.96
Al_2O_3	7.66	8.01	8.08	8.66	8.76	6.98	9.30	7.47	9.57	8.26	6.90	8.15
MgO	3.49	3.51	3.54	3.52	3.65	3.32	3.67	3.80	4.08	3.78	3.94	3.66
CaO	0.58	0.77	1.00	0.63	0.61	5.56*	0.96	0.43	0.65	0.43	0.57	0.66
Na_2O	0.15	0.20	0.29	0.16	0.04	0.26	0.18	0.11	0.00	0.24	0.07	0.15
MnO_2	0.07	0.03	0.04	0.01	0.03	0.03	0.07	0.03	0.01	0.03	0.01	0.03
TiO_2	0.07	0.13	0.25	0.07	0.11	0.07	0.16	0.11	0.07	0.05	0.02	0.10
P_2O_5	0.06	0.06	0.09	0.03	0.03	0.00	0.03	0.03	0.03	0.03	0.03	0.04
Total	82.74	84.75	83.74	86.89	88.13	76.63	87.43	88.42	91.88	84.22	91.26	86.01

TABLE 10. Microprobe chemical analyses of glauconitic grains from the top Upper Greensand hardground, Beer, south-east Devon.

wt%	HG1	HG2	HG3	HG4	HG5	Av.HG1-5
SiO_2	43.34	44.83	44.85	46.32	34.60	42.79
K_2O	5.88	6.33	6.77	4.75	3.86	5.52
Fe_2O_3	14.27	16.26	13.34	11.11	8.80	12.76
Al_2O_3	6.75	6.22	7.61	8.70	7.50	7.36
MgO	3.57	3.58	4.13	4.07	3.48	3.77
CaO	0.64	0.48	0.22	0.77	1.08	0.64
Na_2O	0.02	0.09	0.07	0.07	0.05	0.06
MnO_2	0.01	0.05	0.01	0.04	0.00	0.02
TiO_2	0.04	0.04	0.02	0.05	0.04	0.04
P_2O_5	0.06	0.06	0.00	0.03	0.03	0.04
Total	74.58	77.94	78.02	75.91	59.44	73.18

TABLE 11. Microprobe chemical analyses of glauconitic grains from the Dispar Zone Ammonite Bed, Durdle Cove, south Dorset.

wt%	DZ1	DZ2	DZ3	DZ4	DZ5	DZ6	DZ7	DZ8	DZ9	DZ10	DZ11	DZ12	DZ13	DZ14	DZ15	DZ16	DZ17	DZ18	DZ19	AV.DZ1-DZ
SiO_2	37.35	51.42	51.53	51.65	51.18	51.60	52.32	51.96	51.46	51.38	50.19	50.45	50.71	51.52	51.32	50.28	50.59	51.34	51.13	50.55
K_2O	5.91	8.01	7.54	7.84	8.34	7.21	8.76	7.82	8.64	8.16	7.62	8.11	7.58	8.02	8.38	8.26	8.13	7.84	8.13	7.91
Fe_2O_3	10.70	18.96	18.70	17.83	19.62	19.06	18.92	19.39	19.61	19.36	20.93	20.65	20.42	19.53	20.50	19.97	19.91	18.53	19.29	19.05
Al_2O_3	11.05	8.19	9.49	10.25	6.78	9.21	6.80	9.28	6.49	8.22	7.25	6.45	7.86	8.56	5.75	6.17	7.45	9.22	6.28	8.03
MgO	2.41	3.92	3.84	3.98	4.10	3.77	4.46	3.70	4.32	3.82	3.64	3.96	3.58	3.80	4.32	4.18	3.87	3.93	4.23	3.89
CaO	0.98	0.40	0.56	0.45	0.29	0.63	0.20	0.46	0.22	0.36	0.49	0.43	0.56	0.50	0.26	1.27	0.59	0.47	0.33	0.50
Na_2O	0.16	0.05	0.09	0.05	0.00	0.05	0.04	0.00	0.05	0.05	0.06	0.04	0.02	0.02	0.06	0.06	0.02	0.02	0.00	0.04
MnO_2	0.00	0.00	0.00	0.03	0.00	0.00	0.05	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.03	0.00	0.01	0.00	0.01
TiO_2	0.22	0.02	0.07	0.05	0.04	0.11	0.04	0.02	0.00	0.05	0.04	0.02	0.07	0.04	0.02	0.04	0.02	0.11	0.04	0.05
P_2O_5	0.08	0.03	0.03	0.06	0.00	0.06	0.00	0.03	0.03	0.03	0.06	0.06	0.00	0.03	0.03	0.61	0.18	0.03	0.03	0.07
Total	68.86	91.00	91.85	92.19	90.35	91.70	91.59	92.76	90.83	91.44	90.29	90.17	90.81	92.03	90.65	90.87	90.76	91.50	89.46	89.95

TABLE 12. Microprobe chemical analyses of glauconitic grains from the Upper Greensand at Gore Cliff, Isle of Wight.

wt%	GC1	GC2	GC3	GC4	GC5	GC6	GC7	GC8	GC9	GC10	GC11	Av.GC1-11
SiO_2	29.53	37.79	46.72	45.33	46.53	47.10	32.18	46.59	42.46	23.39	42.11	39.98
K_2O	2.44	5.67	6.77	6.40	6.84	5.70	4.53	6.41	5.00	3.07	3.92	5.16
Fe_2O_3	8.88	13.39	16.30	16.47	16.07	14.21	9.44	15.33	8.72	7.62	9.92	12.40
Al_2O_3	7.96	6.35	8.44	8.76	8.69	9.26	9.99	8.35	14.54	5.87	9.25	8.86
MgO	2.25	2.69	2.82	2.72	2.86	2.93	2.93	3.15	2.11	1.95	2.50	2.63
CaO	12.03	9.48	1.07	2.17	0.39	0.91	8.84	0.54	1.19	17.71	0.77	5.01
Na_2O	0.28	0.00	0.05	0.00	0.11	0.07	0.00	0.07	0.12	0.00	0.31	0.10
MnO_2	0.05	0.05	0.04	0.00	0.01	0.00	0.05	0.04	0.01	0.01	0.00	0.02
TiO_2	0.06	0.05	0.09	0.09	0.05	0.05	0.51	0.07	0.04	0.37	0.11	0.14
P_2O_5	7.88	6.06	0.49	0.98	0.06	0.03	5.61	0.03	0.46	12.32	0.17	3.10
Total	71.36	80.53	82.79	82.92	81.61	80.26	74.08	80.58	74.65	72.26	69.06	77.28

TABLE 13. Microprobe chemical analyses of glauconitic grains from the basal Upper Greensand at Eastbourne.

wt%	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	AV.E1-14
SiO_2	40.11	45.48	46.40	46.87	45.66	46.97	48.42	46.64	44.68	46.59	47.09	47.02	47.61	46.67	46.16
K_2O	5.94	6.40	6.63	6.62	6.59	6.75	6.51	6.84	5.90	6.77	6.65	6.92	7.04	6.98	6.61
Fe_2O_3	11.06	12.47	11.92	10.75	13.60	14.04	12.15	14.56	11.87	13.67	12.23	14.97	13.26	13.16	12.84
Al_2O_3	6.75	8.10	8.53	9.60	6.95	7.19	9.40	6.35	7.77	7.42	8.73	6.88	7.59	7.93	7.80
MgO	3.55	3.73	3.88	4.13	3.68	3.80	4.27	3.89	3.76	3.78	3.98	3.74	4.15	4.09	3.89
CaO	5.21	0.37	0.27	0.33	0.30	0.59	0.27	0.34	3.44	0.34	0.29	0.32	0.27	0.34	0.91
Na_2O	0.00	0.02	0.02	0.09	0.09	0.05	0.12	0.00	0.04	0.05	0.07	0.02	0.04	0.04	0.05
MnO_2	0.03	0.01	0.03	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.03	0.01
TiO_2	0.02	0.05	0.04	0.05	0.02	0.04	0.09	0.02	0.04	0.04	0.07	0.02	0.04	0.04	0.04
P_2O_5	3.11	0.03	0.03	0.03	0.03	0.14	0.03	0.03	1.94	0.06	0.03	0.03	0.03	0.03	0.40
Total	75.78	76.66	77.75	78.48	76.92	79.58	81.26	78.67	79.44	78.72	79.15	79.93	80.04	80.31	78.76

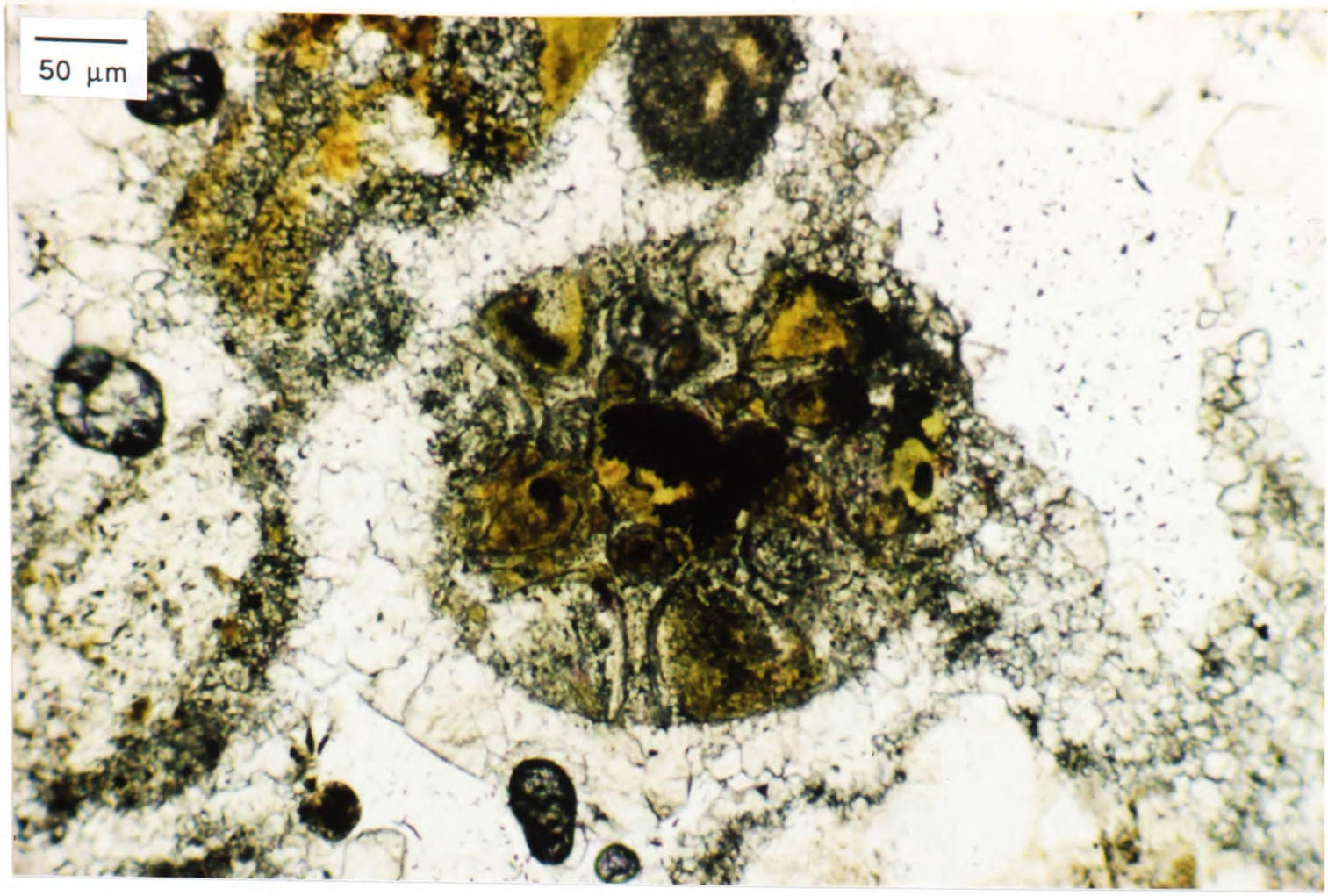


Fig.108: Photomicrograph of glauconite filling the porosity within a bryozoan bioclast: coquina bed in lower Chert Beds Member, Upper Greensand Formation, Little Beach, Beer, south-east Devon.

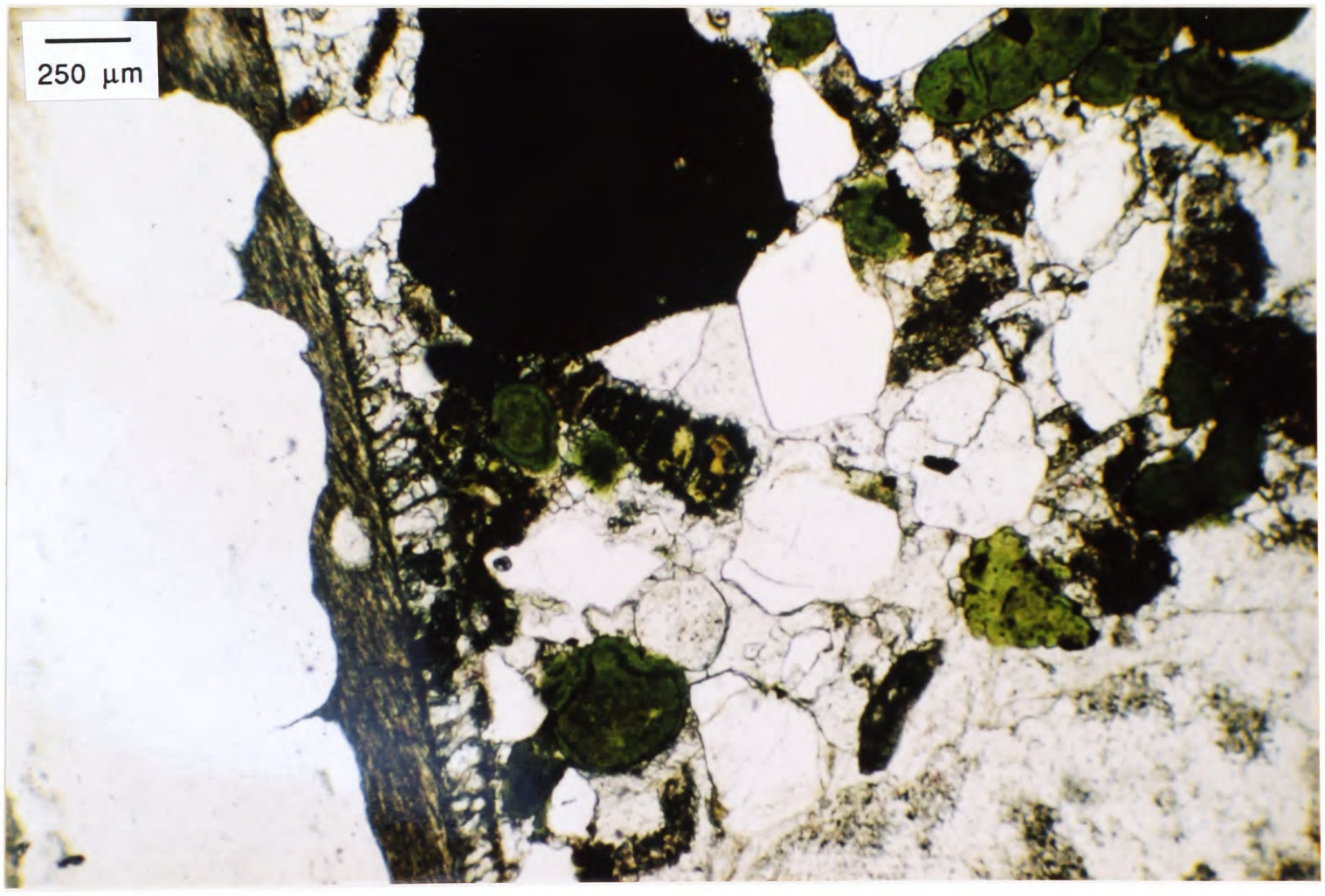


Fig.109: Photomicrograph of glauconite filling the chambers of a foraminifera, and rimmed grains with two accretion phases: middle pebble-shell bed in uppermost Foxmould interval of glauconitic pebble-shell beds, Upper Greensand Formation, Whitecliff, Beer, south-east Devon.

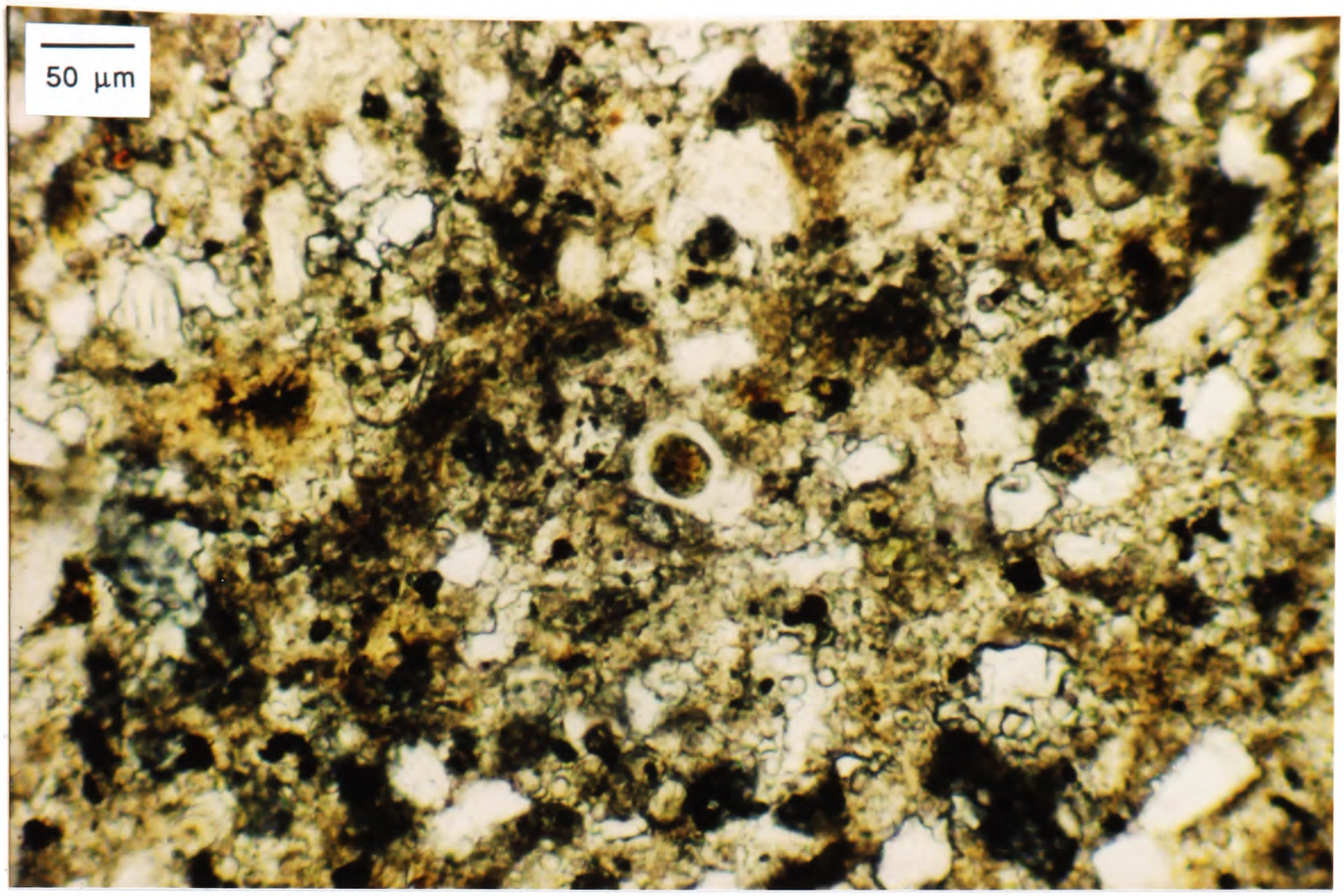


Fig.110: Photomicrograph of glauconite filling the axial canal of a sponge spicule (transverse section): Blue Rag, Upper Greensand, Hollows Lane, Selbourne, western Weald.

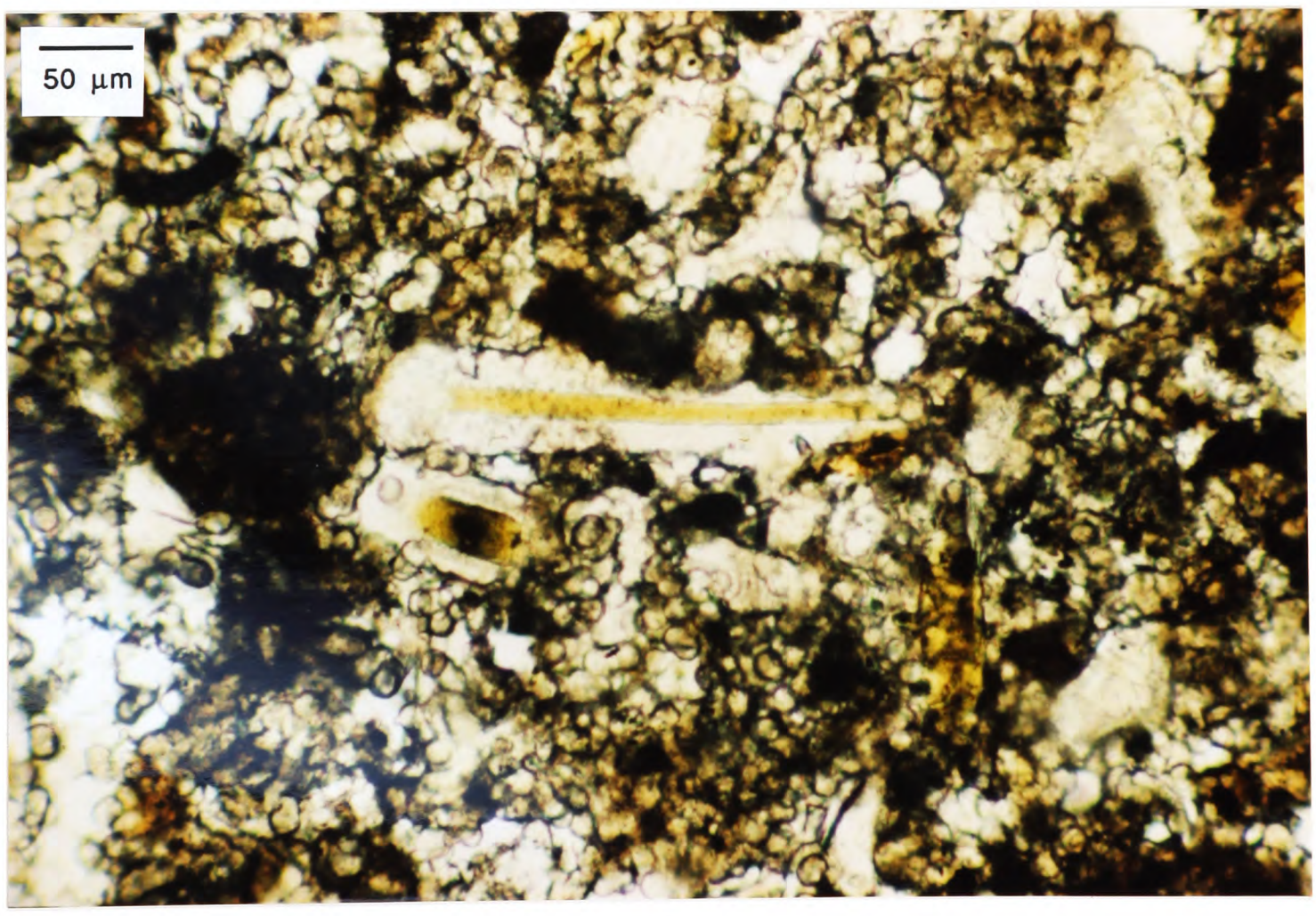


Fig.111: Photomicrograph of glauconite filling the axial canal of a sponge spicule (longitudinal section): Blue Rag, Upper Greensand, Hollows Lane, Selbourne, western Weald.

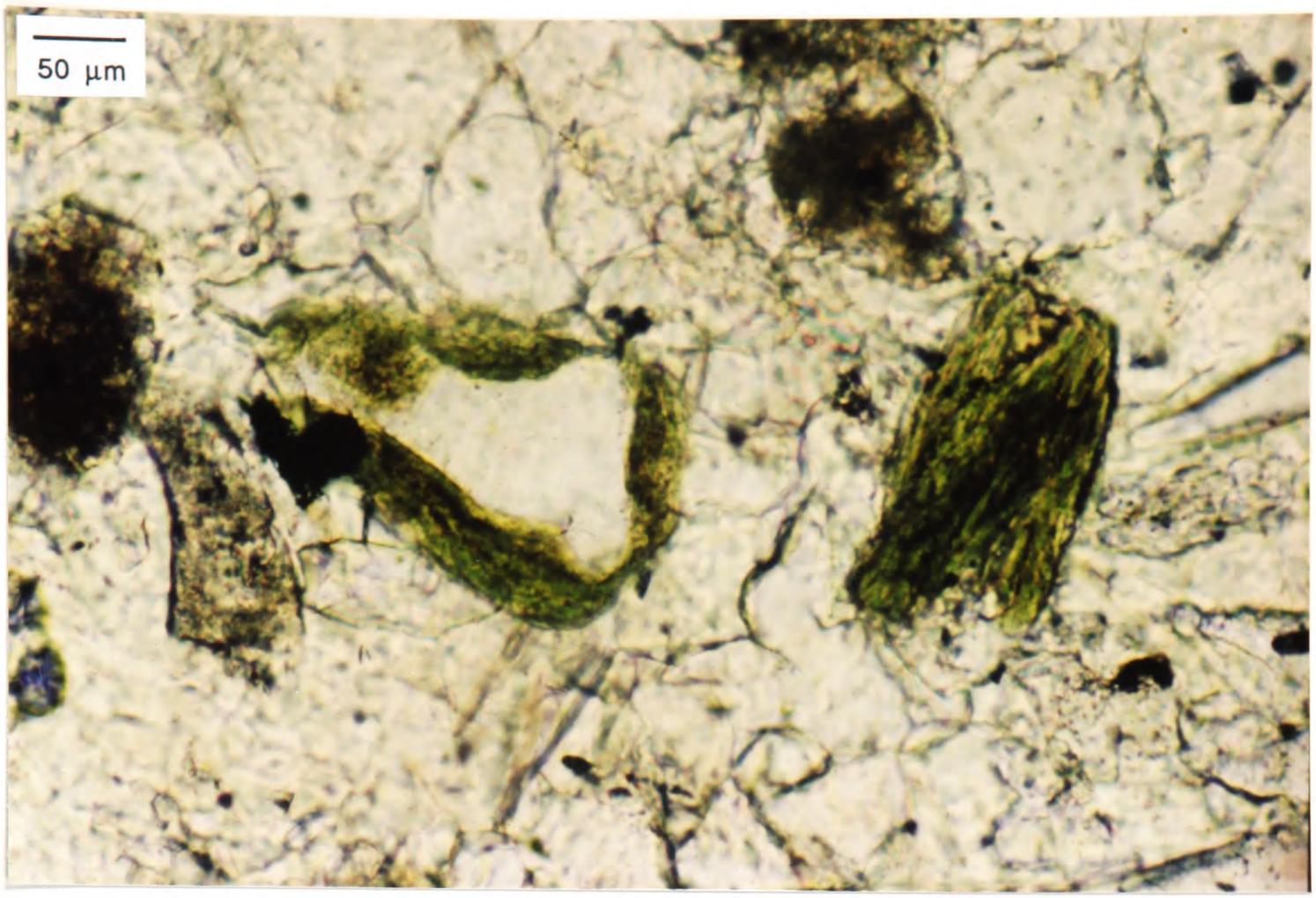


Fig.112: Photomicrograph of glauconite rimming a quartz grain, and a vermicular glauconitic grain: upper thick storm laminite bed, Foxmould Member, Upper Greensand Formation, Hooken Cliffs, Beer, south-east Devon.

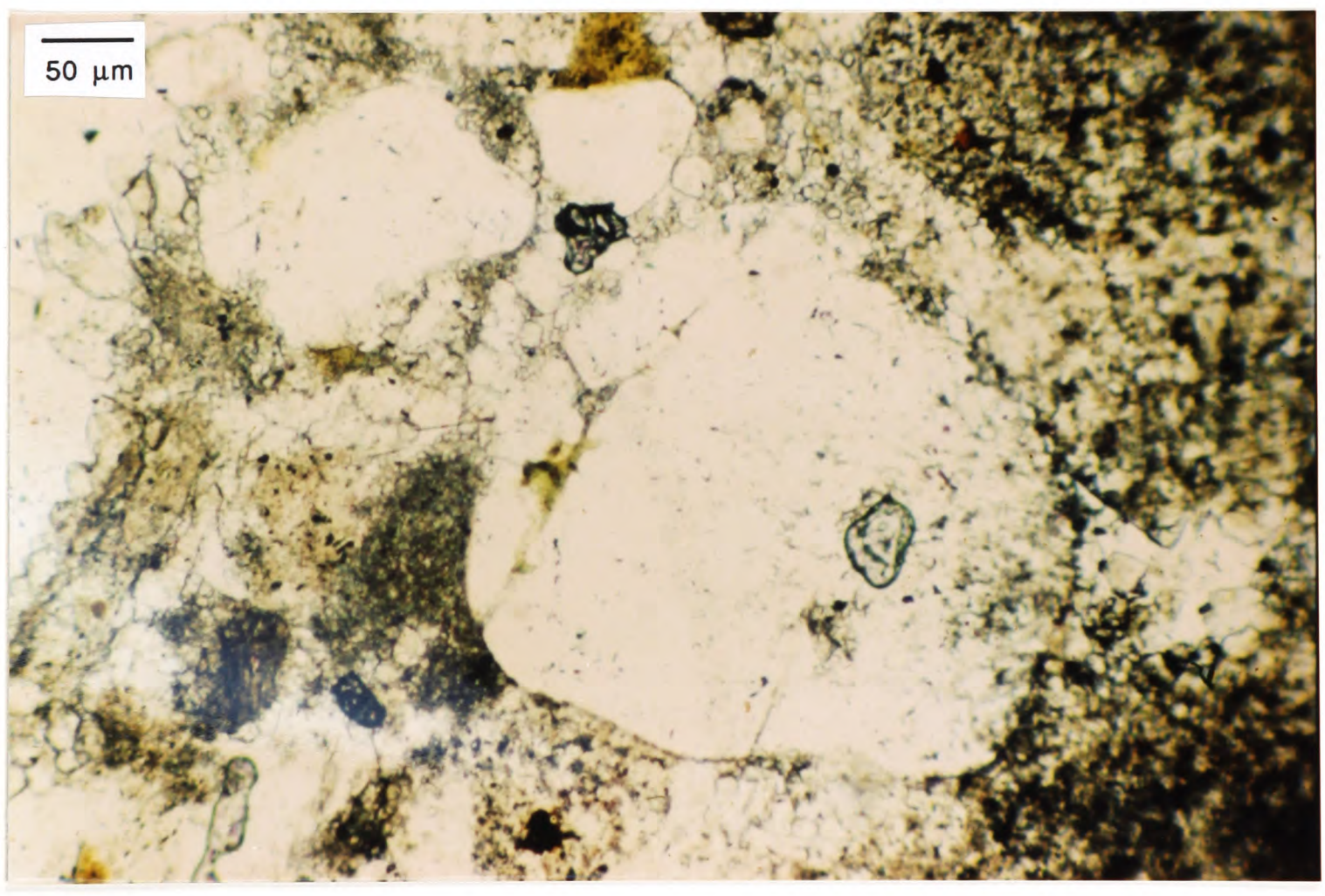


Fig.113: Photomicrograph of glauconite forming along cracks in a quartz grain: coquina bed in lower Chert Beds Member, Upper Greensand Formation, Little Beach, Beer, south-east Devon.

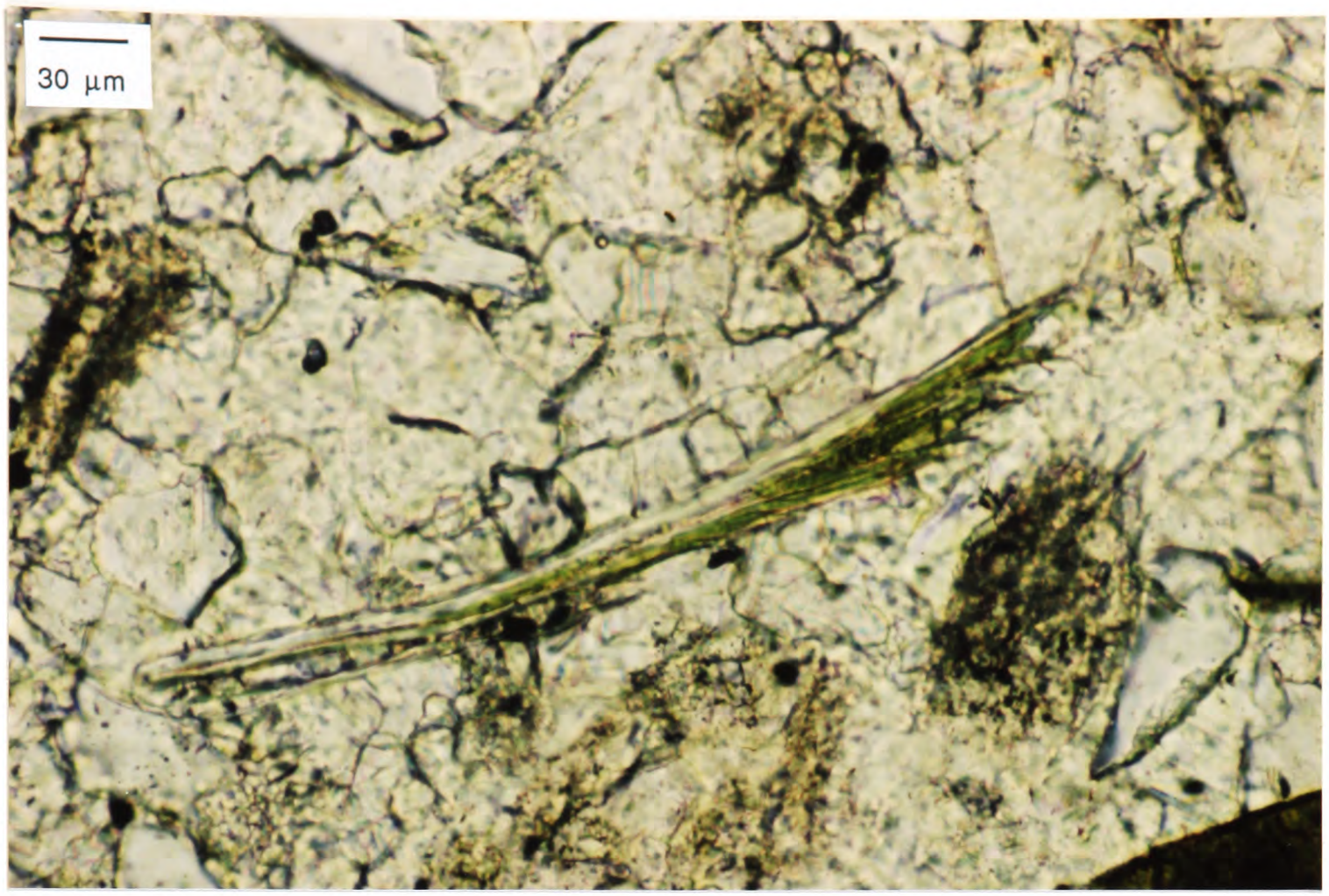


Fig.114: Photomicrograph of glauconite growing within the flakes of a muscovite grain: Foxmould Member (loose sample), Upper Greensand Formation, Hooken Cliffs, south-east Devon.

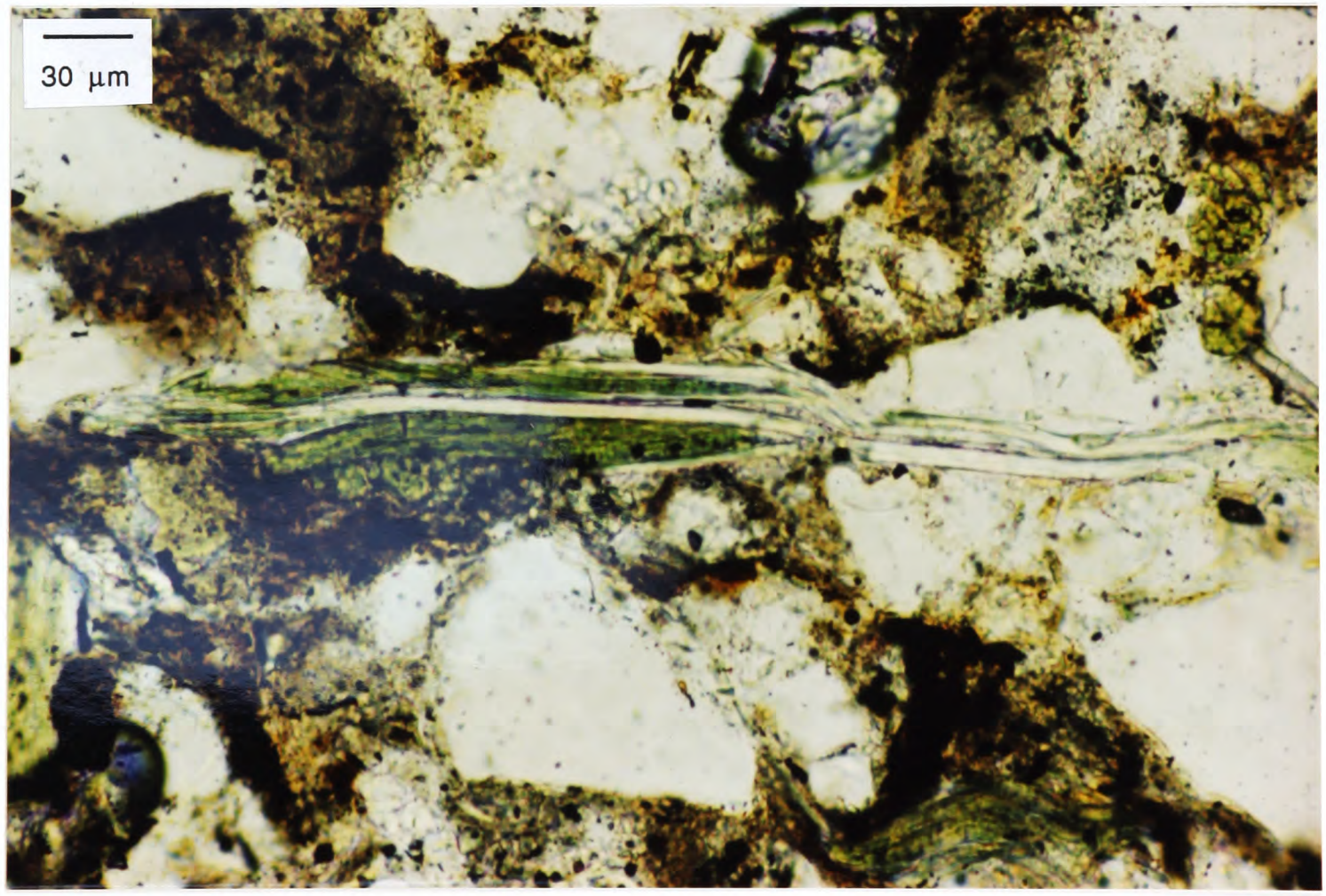


Fig.115: Photomicrograph of glauconite growing within the flakes of a muscovite grain: upper thick storm laminite bed, Foxmould Member, Upper Greensand Formation, Hooken Cliffs, Beer, south-east Devon.

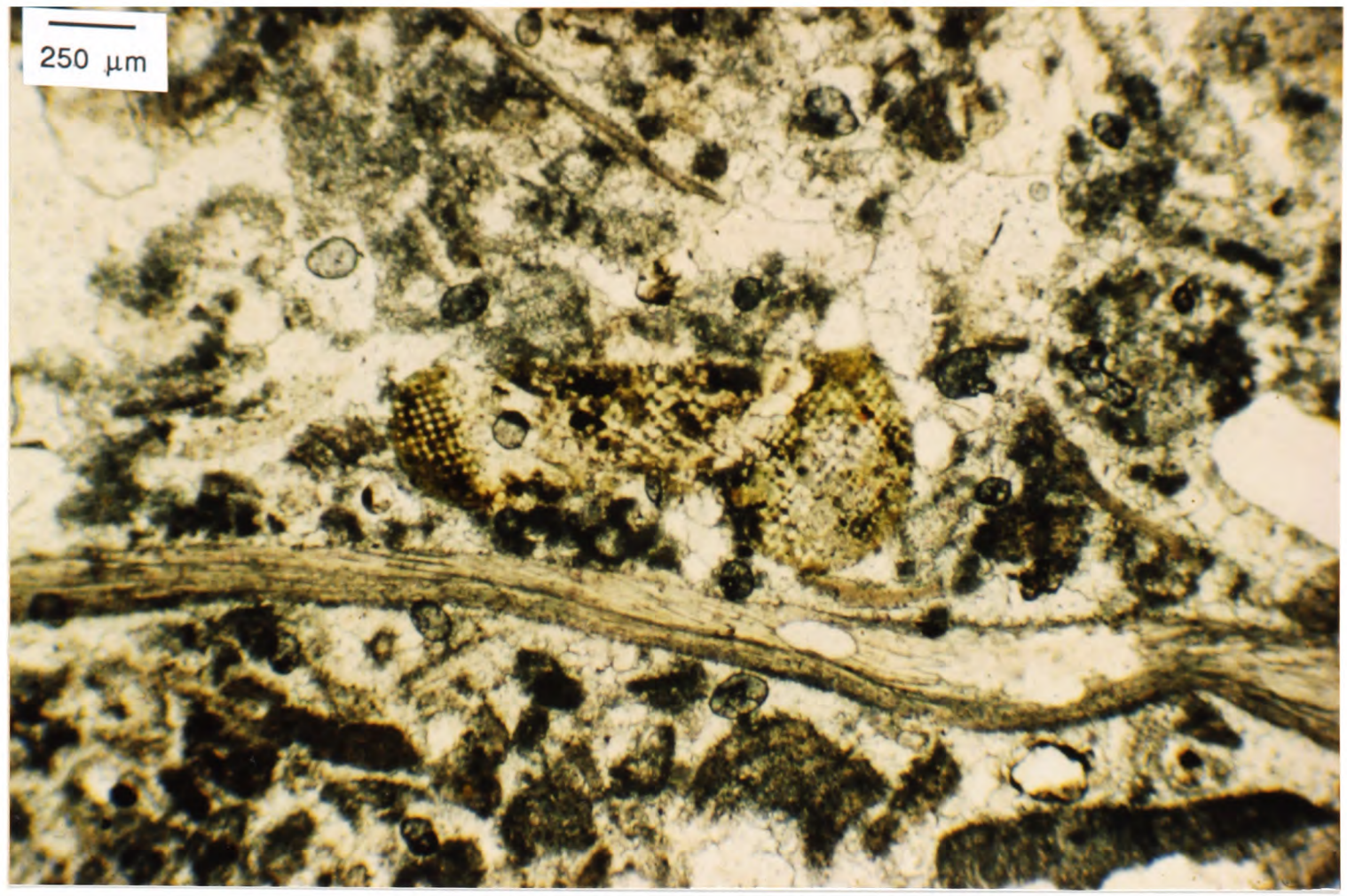


Fig.116: Photomicrograph of glauconitized echinoid bioclast: coquina bed in lower Chert Beds Member, Upper Greensand Formation, Little Beach, Beer, south-east Devon.

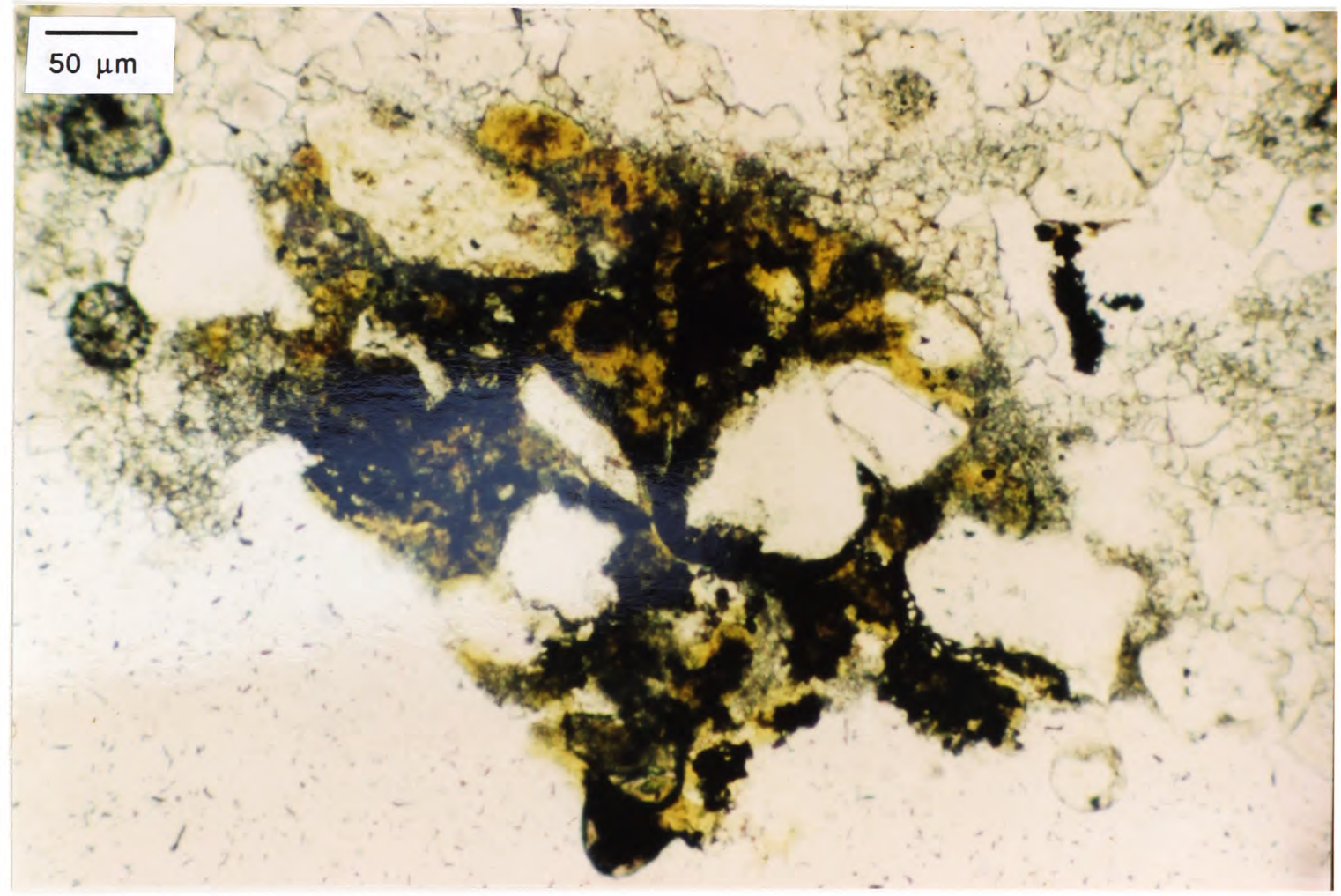


Fig.117: Photomicrograph of glauconite replacing an aggregate of silt-sized quartz grains and mud, interpreted as a faecal pellet: coquina bed in lower Chert Beds Member, Upper Greensand Formation, Little Beach, Beer, south-east Devon.

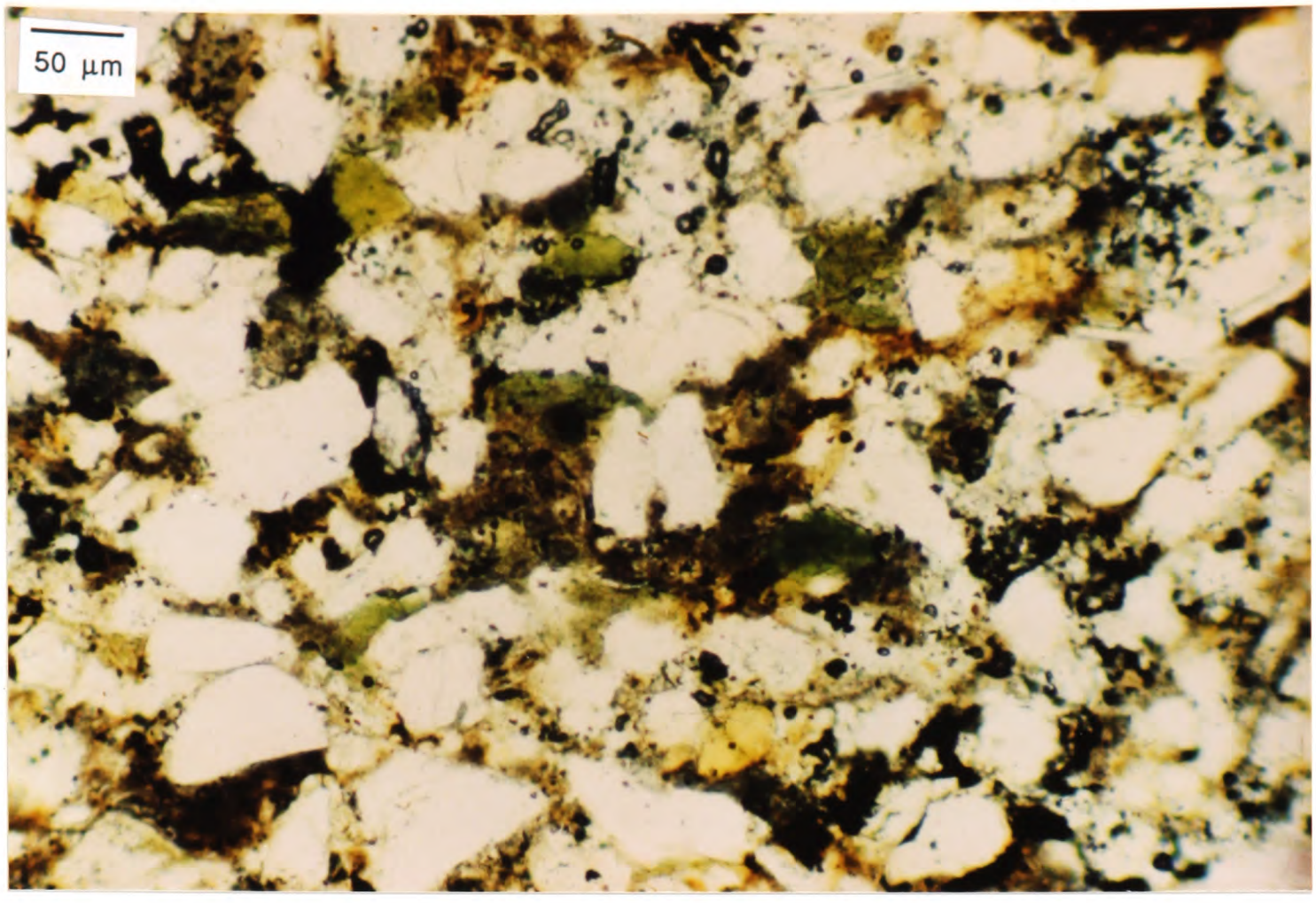
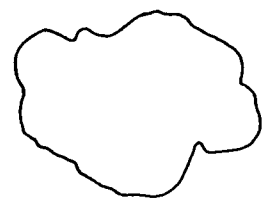


Fig.118: Photomicrograph of glauconite replacing the muddy matrix sediment of fine-grained muddy sand: Foxmould Member (loose sample), Upper Greensand Formation, Hooken Cliffs, Beer, south-east Devon.

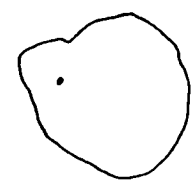
Fig.119: Morphologies of glauconitic grains measured by electron microprobe analysis.
119.1: Foxmould glauconites; 119.2: uppermost Foxmould glauconites; 119.3: upper Chert Beds (lower part) glauconites; 119.4: upper Chert Beds (upper part) glauconites; 119.5: top Upper Greensand glauconites; 119.6: Dispar Zone Ammonite Beds glauconites; 119.7: Upper Greensand, Gore Cliff glauconites; 119.8 Upper Greensand, Eastbourne glauconites.

1) Foxmould

F1



F2



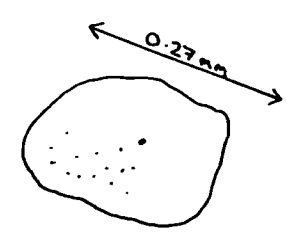
F3

F4

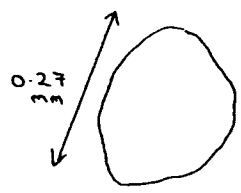
F5

F6

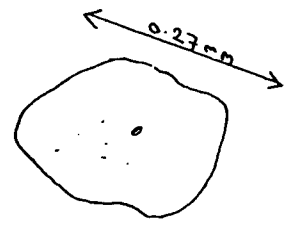
F7



F8

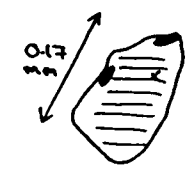


F9

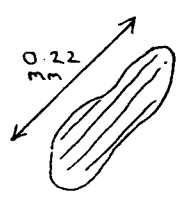


F10

F11

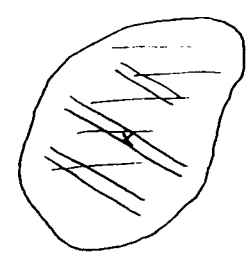


F12



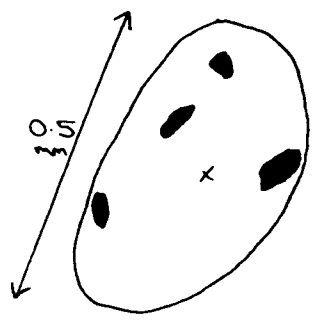
F13

F14

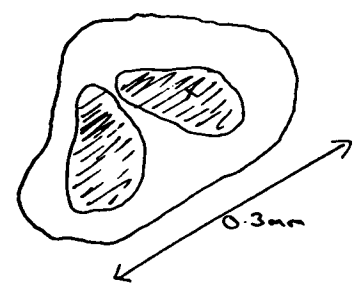


F15

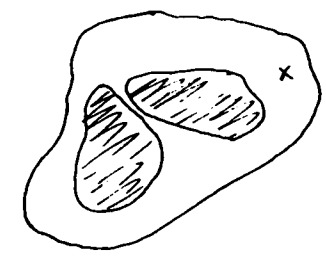
2) uppermost Foxmould



TF1



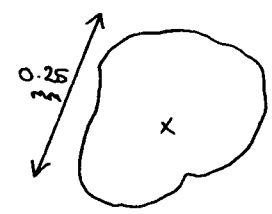
TF2



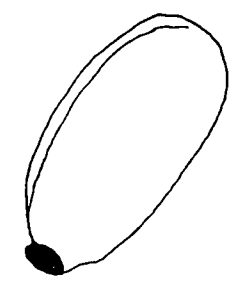
TF3

TF4

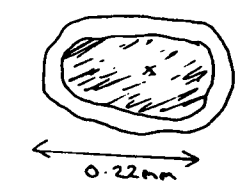
TF5



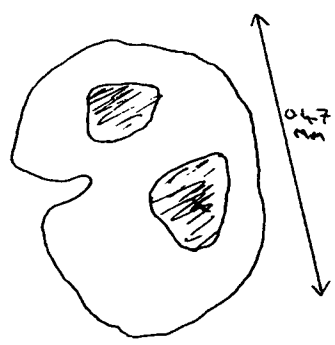
TF6



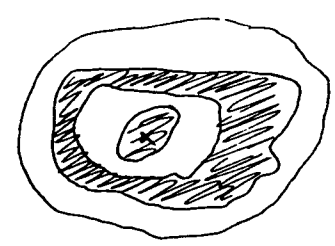
TF7



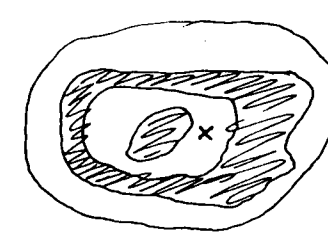
TF8



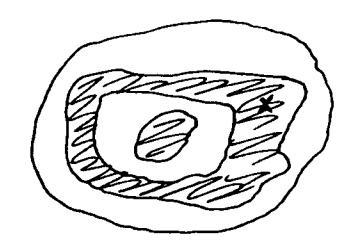
TF9



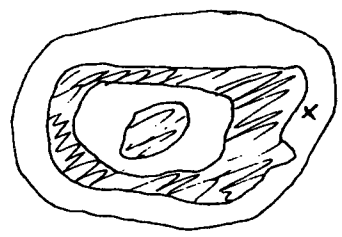
TF10



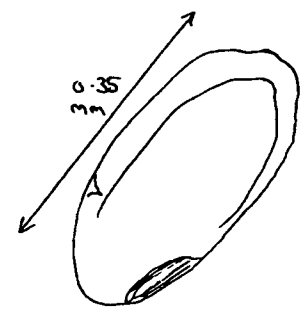
TF11



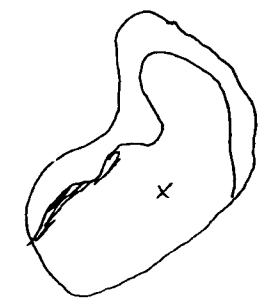
TF12



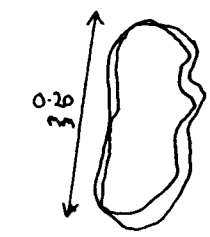
TF13



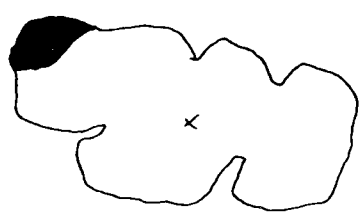
TF14



TF15

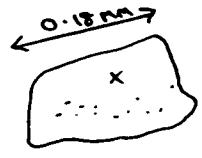


TF16



TF17

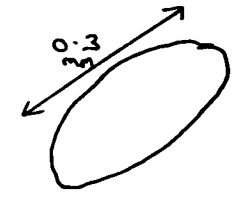
3) upper Chert Beds (lower part)



CB1

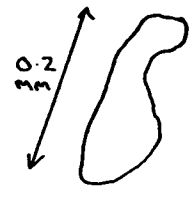
CB2

CB3

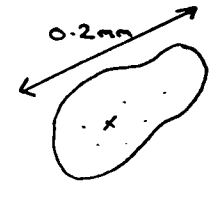


CB4

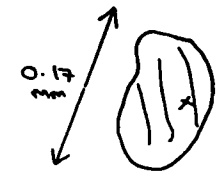
CB5



CB6

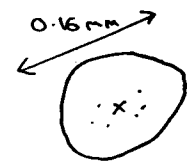


CB7



CB8

CB9



CB10

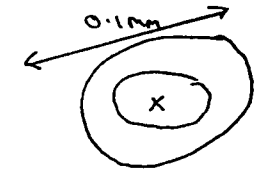
CB11

4) upper Chert Beds (upper part)

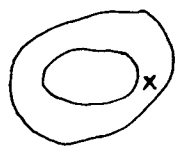
CB12

CB13

CB14



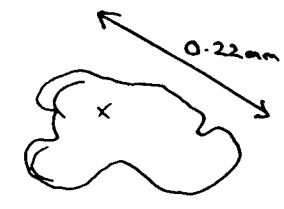
CB15



CB16

CB17

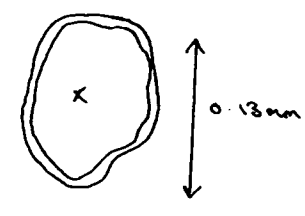
CB18



CB19

CB20

CB21



CB22

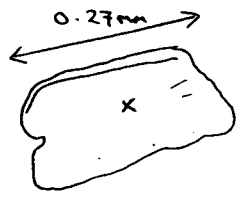
5) top Upper Greensand hardground

HG1

HG2

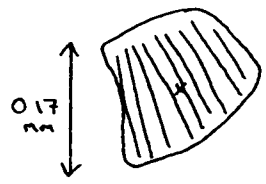
HG3

HG4

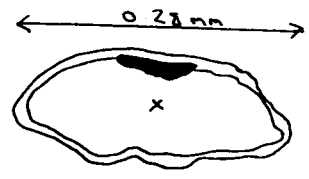


HG5

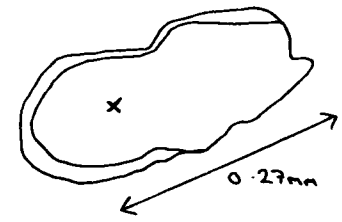
6) Dispar Zone Ammonite Bed



DZ1

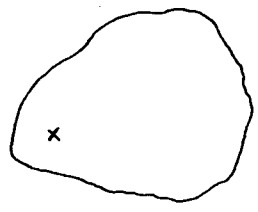


DZ2

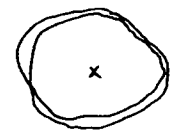


DZ3

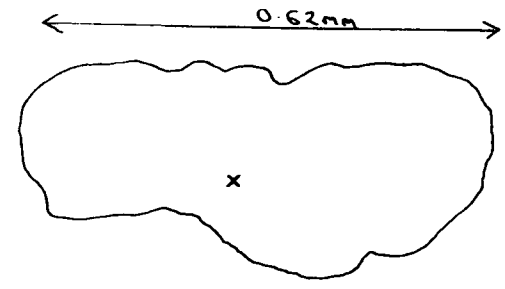
DZ4



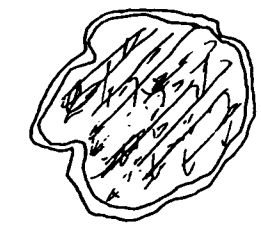
DZ5



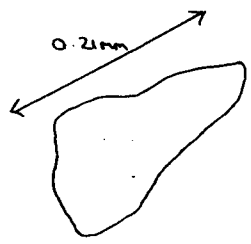
DZ6



DZ7

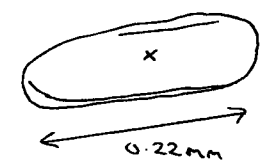


DZ8

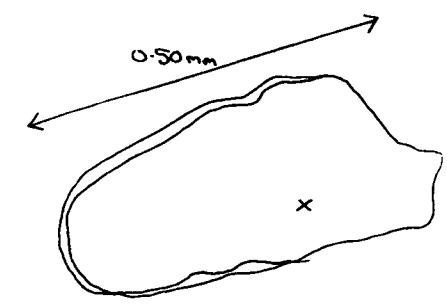


DZ9

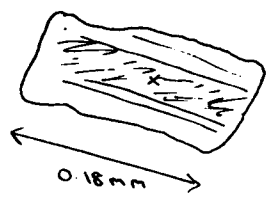
DZ10



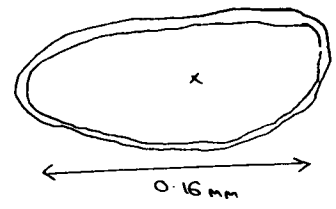
DZ11



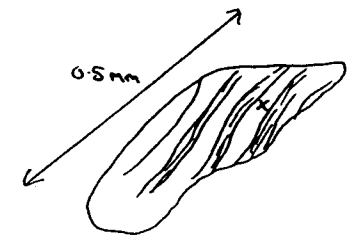
DZ12



DZ13

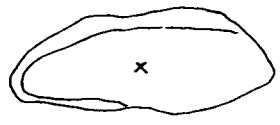


DZ14

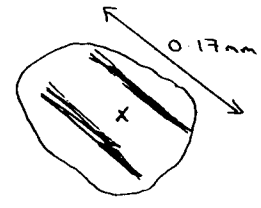


DZ15

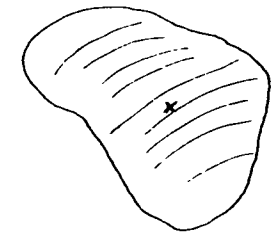
DZ16



DZ17



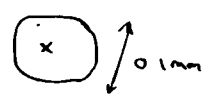
DZ18



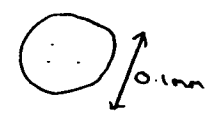
DZ19

7) Upper Greensand, Gore Cliff

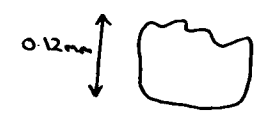
GC1



GC2



GC3



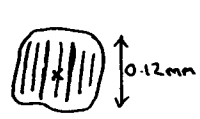
GC4

GC5

GC6

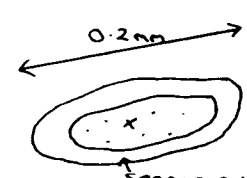
GC7

GC8



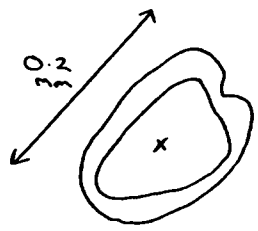
GC9

GC10



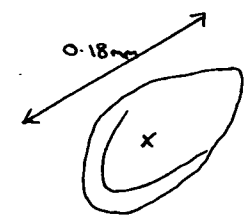
GC11

8) Upper Greensand, Eastbourne



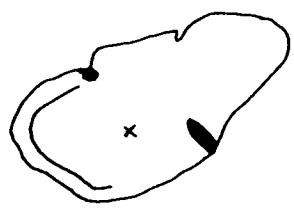
E1

E2

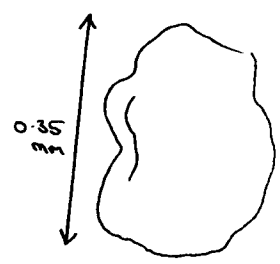


E3

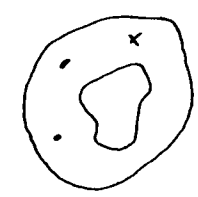
E4



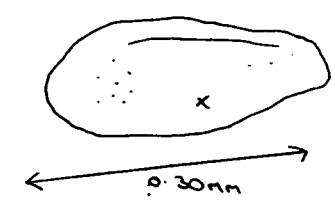
E5



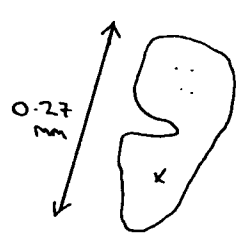
E6



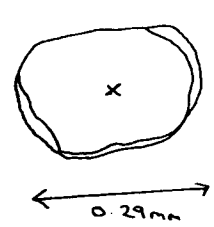
E7



E8

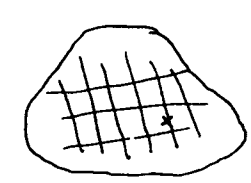


E9



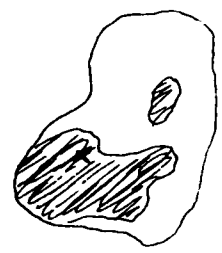
E10

E11



E12

E13



E14

TABLE 14 - SULPHUR-CARBON ANALYSES

	Sample no.	wt% org.C	wt%S
Upper Greensand, south-east Devon			
Foxmould, Upper Greensand, Hooken Cliffs, 8.25m	RP1	0.33	0.24
Loose Foxmould, Upper Greensand, Hooken Cliffs	RP39	0.38	0.11
Foxmould, Upper Greensand, Seaton Hole, 10.25m	RP9	0.13	0.03
Foxmould, Upper Greensand, Seaton Hole, 5.80m	RP34	0.06	0.01
Muddy bed, Foxmould, Upper Greensand, Seaton Hole, 5.40m	RP8	0.28	0.08
Foxmould, Upper Greensand, Seaton Hole, 0.50m	RP12	0.07	0.01
Gault and Upper Greensand, south Dorset			
Limestone, Chert Beds, Durdle Cove, 43.94-46.34m	RP15	0.72	0.02
Glauconitic limestone, minor hiatus just above DZAB, Durdle Cove, 43.64-43.94m	RP51	0.24	0.06
Dispar Zone Ammonite Bed, Upper Greensand, Durdle Cove, 43.39-43.64m	RP54	0.14	0.02
Marly, glauconitic sand just below DZAB, Durdle Cove, 43.09-43.39m	RP42	0.14	0.04
Marly sand just above Exogyra Rock, Durdle Cove, 40.60-41.34m	RP46	0.24	0.07
Glauconitic marly silt below Exogyra Rock, Durdle Cove, 39.25m	RP19	0.12	0.05
Glauconitic fine sand, Upper Greensand, Durdle Cove, 30m	RP52	0.34	0.02
Glauconitic silts, Upper Greensand, Durdle Cove, 26m	RP2	0.18	0.05
Muddy sand, Upper Greensand, Durdle Cove, 23m	RP17	0.27	0.09
Grey silt, Upper Greensand, Durdle Cove, 17.92m	RP20	0.19	0.01
Iron-rich silty clay (rather weathered), Gault, Durdle Cove, 5m	RP13	1.74	0.22
Glauconitic sand below Exogyra Rock, West side of Lulworth Cove, 18.77-21.87m	RP23	0.16	0.32
Upper Greensand, West side of Lulworth Cove, 16.27-18.47m	RP38	0.16	0.05
Black clay band, Upper Greensand, West side of Lulworth Cove, 16.07-16.27m	RP6	0.38	0.30
Thin clayey seam, Upper Greensand, West side of Lulworth Cove, 14.72m	RP10	0.25	0.09
Upper Greensand, West side of Lulworth Cove, 12.67m	RP47	0.23	0.31
Muddy sand, Upper Greensand, West side of Lulworth Cove, 9.2m	RP18	0.37	0.29
Glauconitic clayey silt, West side of Lulworth Cove, 3.15m	RP21	0.27	0.07
Dispar Zone Ammonite Bed, Upper Greensand, excavated section below Flower's Barrow, Worbarrow Bay, 60m	RP4	0.18	0.03
Dispar Zone Ammonite Bed, Upper Greensand, below Flower's Barrow, Worbarrow Bay, 60m	RP22	0.03	0.01
Glauconitic fine sand above Exogyra Rock, Upper Greensand, below Flower's Barrow, Worbarrow Bay, 57.92-59.42m	RP11	0.00	0.02
Glauconitic fine sand below Exogyra Rock, below Flower's Barrow, Worbarrow Bay, 54.00-56.42m	RP48	0.07	0.02
Glauconitic serpulid limestone, below Flower's Barrow, Worbarrow Bay, 54m	RP49	0.00	0.01
Fine sand, Upper Greensand, below Flower's Barrow, Worbarrow Bay, 52.82-53.67m	RP14	0.00	0.01
Black clay band, Upper Greensand, below Flower's Barrow, Worbarrow Bay, 49.37-49.52m	RP7	0.21	0.04
Fine sands, Upper Greensand, below Flower's Barrow, Worbarrow Bay, 45.42-45.0m	RP5	0.02	0.04
Rhythmically-bedded silt, Upper Greensand, below Flower's Barrow, Worbarrow Bay, 37.92m	RP37	0.06	0.01
Rhythmically-bedded silt, Upper Greensand, below Flower's Barrow, Worbarrow Bay, 37.62m	RP24	0.22	0.04
Rhythmically-bedded silt, Upper Greensand, below Flower's Barrow, Worbarrow Bay, 37.17m	RP3	0.10	0.02
Uppermost Gault, below Flower's Barrow, Worbarrow Bay, 34.08m	RP36	0.26	0.08
Gault clay, below Flower's Barrow, Worbarrow Bay, 29.88m	RP16	0.29	0.10
Gault clay, below Flower's Barrow, Worbarrow Bay, 14.7m	RP35	0.59	0.04
Passage Beds and Upper Greensand, Isle of Wight			
Chert Beds equivalent, Upper Greensand, Compton Bay, Isle of Wight, 37.88m	RP50	0.41	0.33
Upper Greensand, Compton Bay, Isle of Wight, 34.13m	RP43	0.18	0.23
Upper Greensand, Compton Bay, Isle of Wight, 23.13m	RP26	1.10	0.10
Upper Greensand, Compton Bay, Isle of Wight, 21.13m	RP45	0.00	0.54
Passage Beds, Compton Bay, Isle of Wight, 14.54-14.74m	RP32	0.16	0.22
Weakly to moderately muddy silt, Passage Beds, Compton Bay, Isle of Wight, 14.14-14.54m	RP40	0.16	0.08
Weakly muddy silt, Passage Beds, Compton Bay, Isle of Wight, 13.89-14.14m	RP33	0.23	0.11
Strongly muddy silt, Passage Beds, Compton Bay, Isle of Wight, 13.45-13.89m	RP28	0.17	0.12
Weakly muddy silt, Passage Beds, Compton Bay, Isle of Wight, 13.32-13.45m	RP29	0.14	0.09
Strongly muddy silt, Passage beds, Compton Bay, Isle of Wight, 12.64-12.92m	RP31	0.15	0.11
Passage Beds, Compton Bay, Isle of Wight, 5.58m	RP27	0.50	0.21
Glauconitic silt, basal Passage Beds, Compton Bay, Isle of Wight, 0.5m	RP44	0.59	0.33
Uppermost Gault/Passage Beds, Compton Bay, Isle of Wight, 0.02m	RP25	0.51	0.31
Gault clay, Folkstone			
Clay 1m above *cristatum* nodule bed, basal Upper Gault, Copt Point Folkstone	RP30	0.69	0.25
Clay 0.6m below *cristatum* nodule bed, upper Lower Gault, Copt Point, Folkstone	RP41	0.80	0.46
Clay 1m above base of the Gault, *spathi* subzone, Lower Gault, Copt Point, Folkstone	RP53	0.43	0.19

Fig.120: sulphur/carbon data - the Foxmould Member, Upper Greensand, south-east Devon

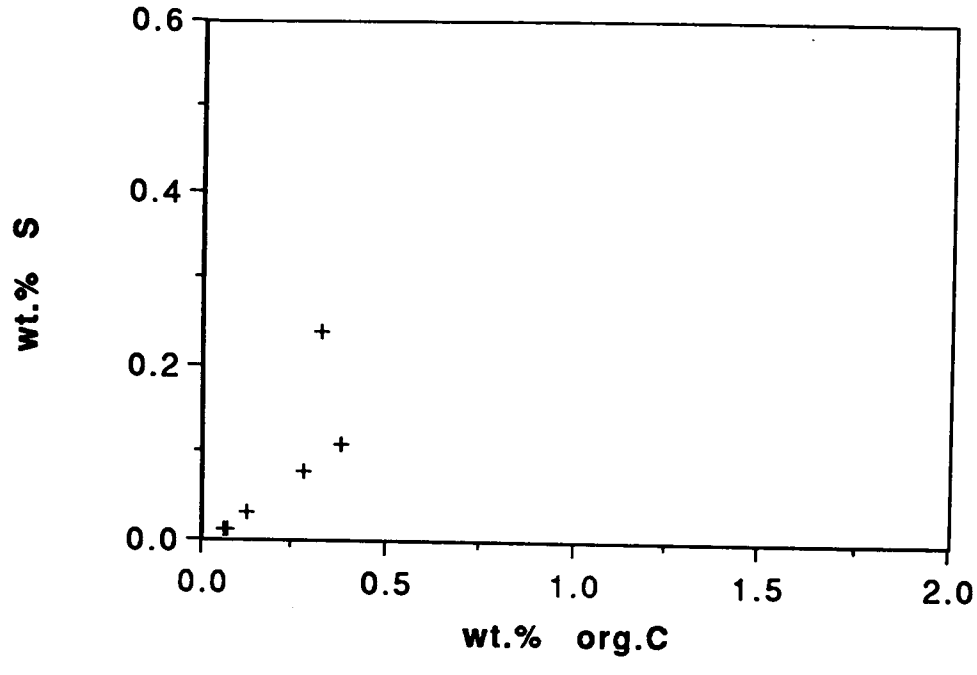


Fig. 121: sulphur/carbon data - the Upper Greensand and Gault of south Dorset

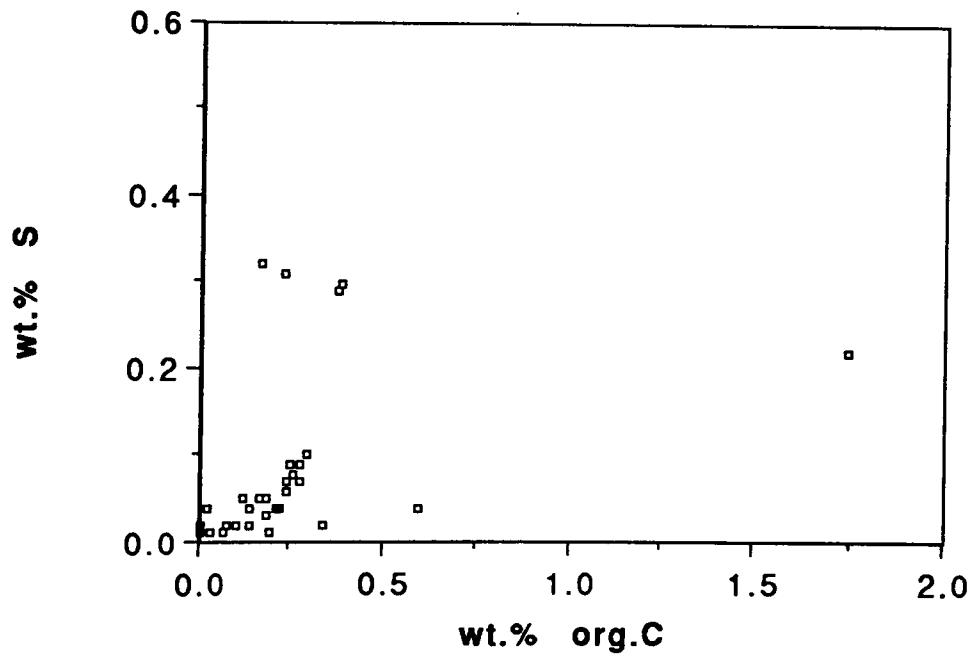


Fig. 122: sulphur/carbon data - Passage Beds and Upper Greensand, Compton Bay, Isle of Wight

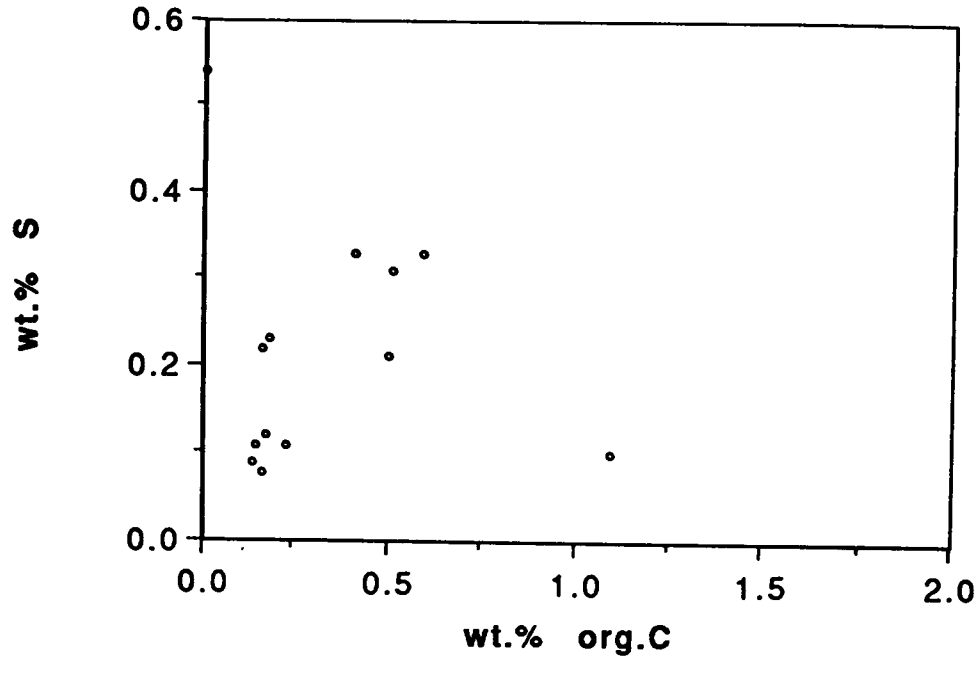
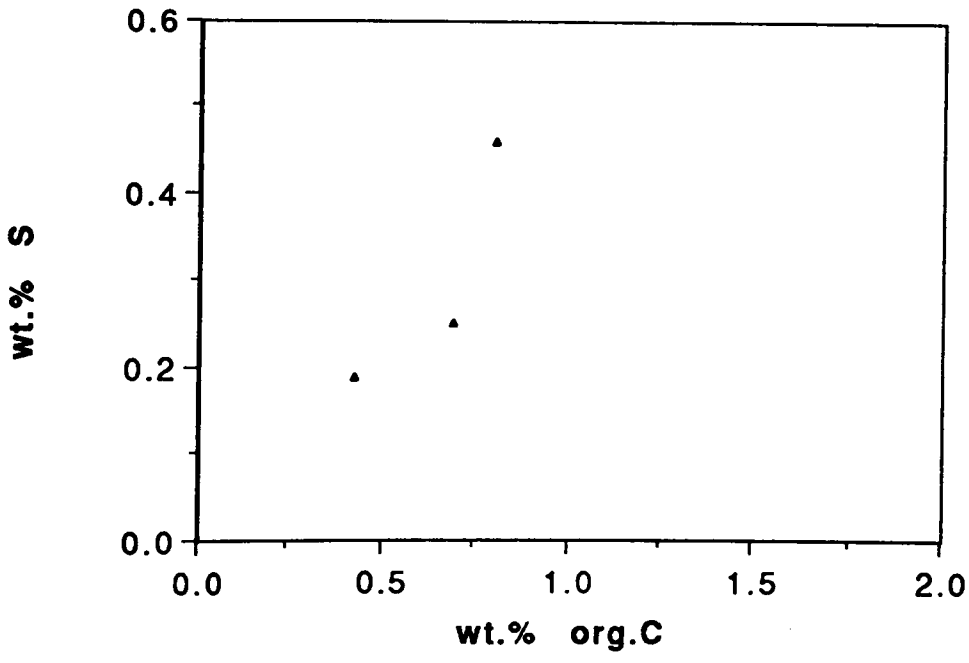


Fig.123: sulphur/carbon data - Gault clay, Folkstone



RYAZANIAN

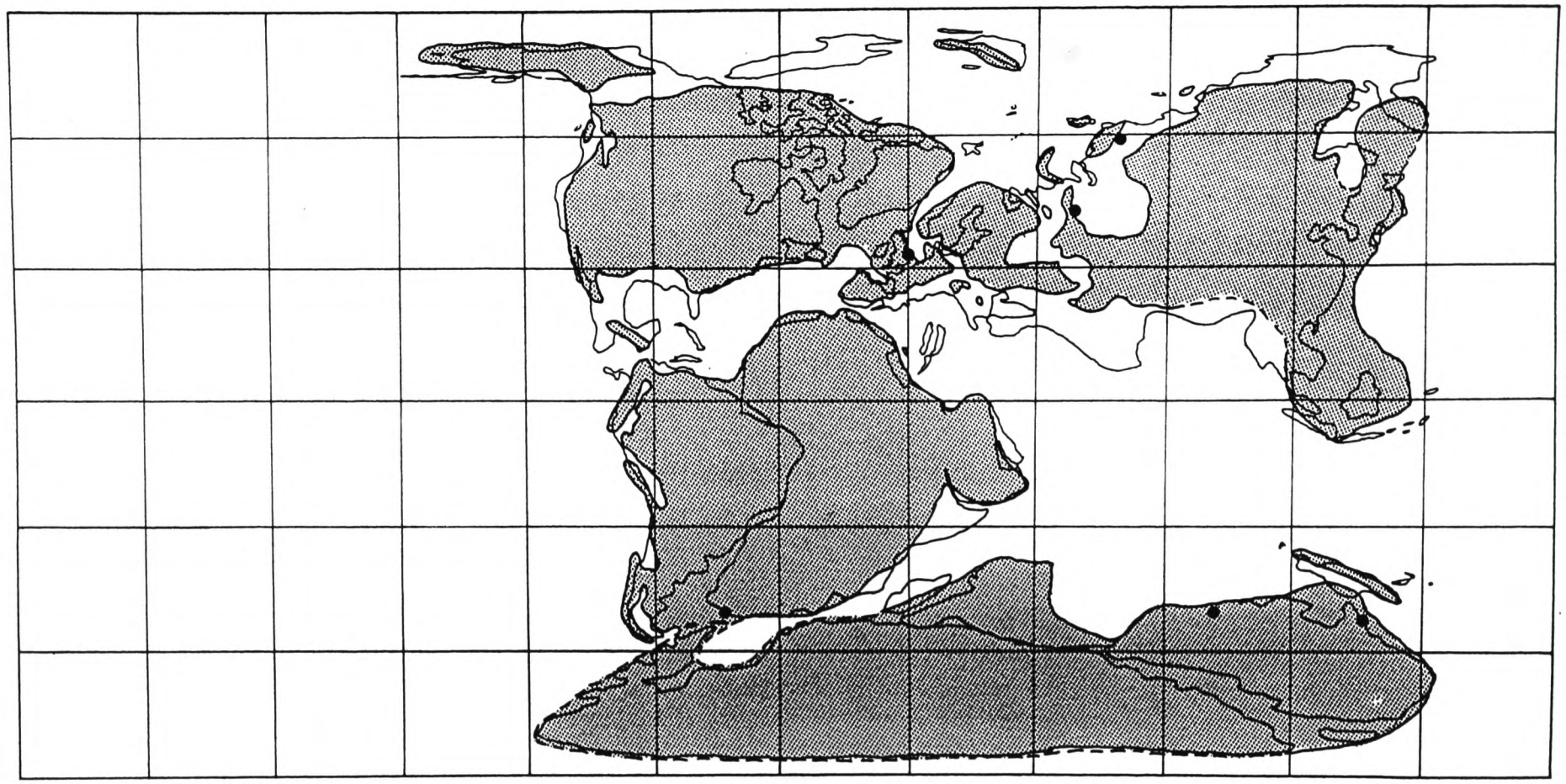


Fig.124: World-wide distribution of glauconitic facies during the Ryazanian, plotted on a palaeogeographic reconstruction of Funnel (1990).

VALANGINIAN

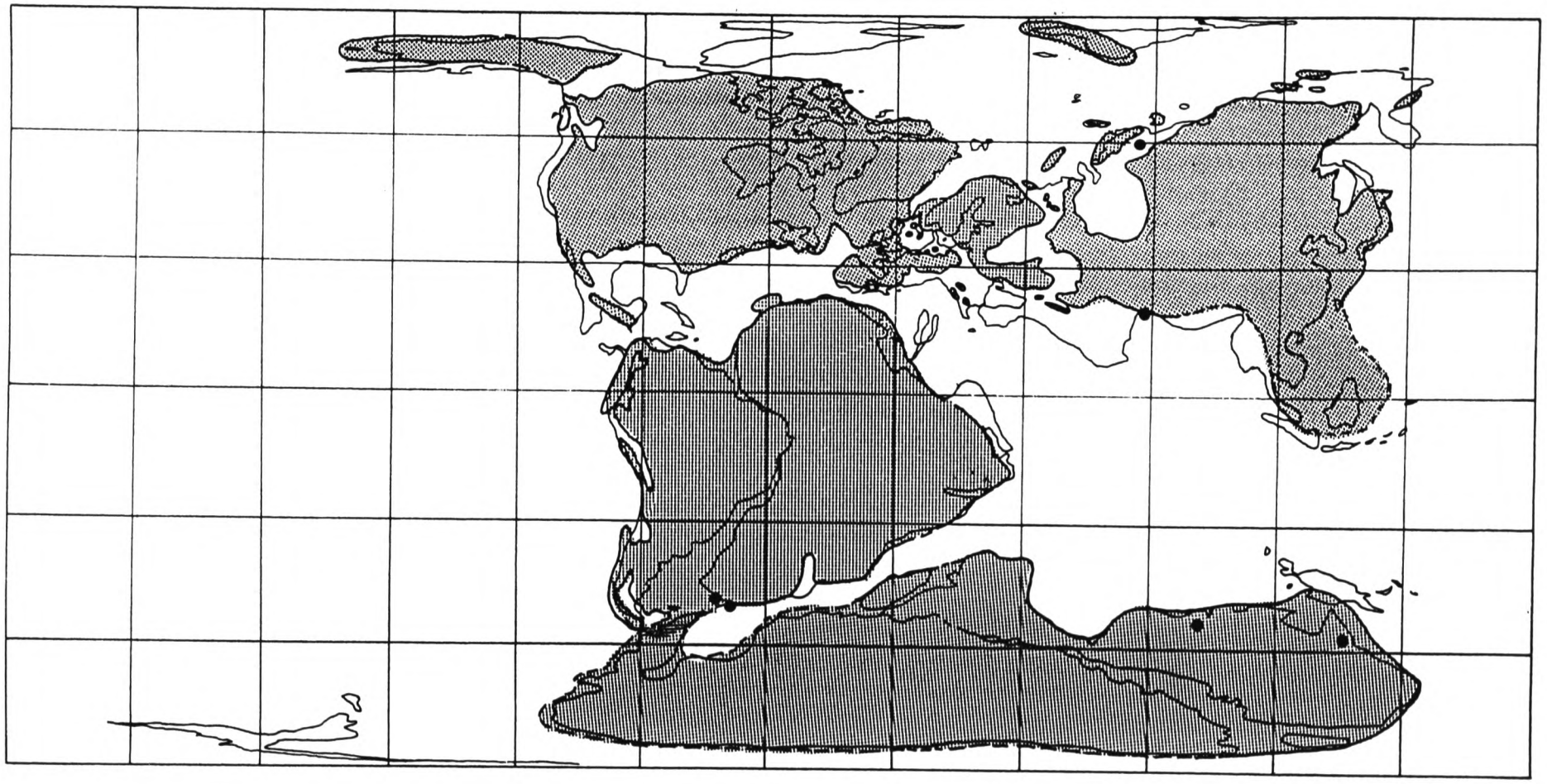


Fig.125: World-wide distribution of glauconitic facies during the Valanginian, plotted on a palaeogeographic reconstruction of Funnel (1990).

HAUTERIVIAN

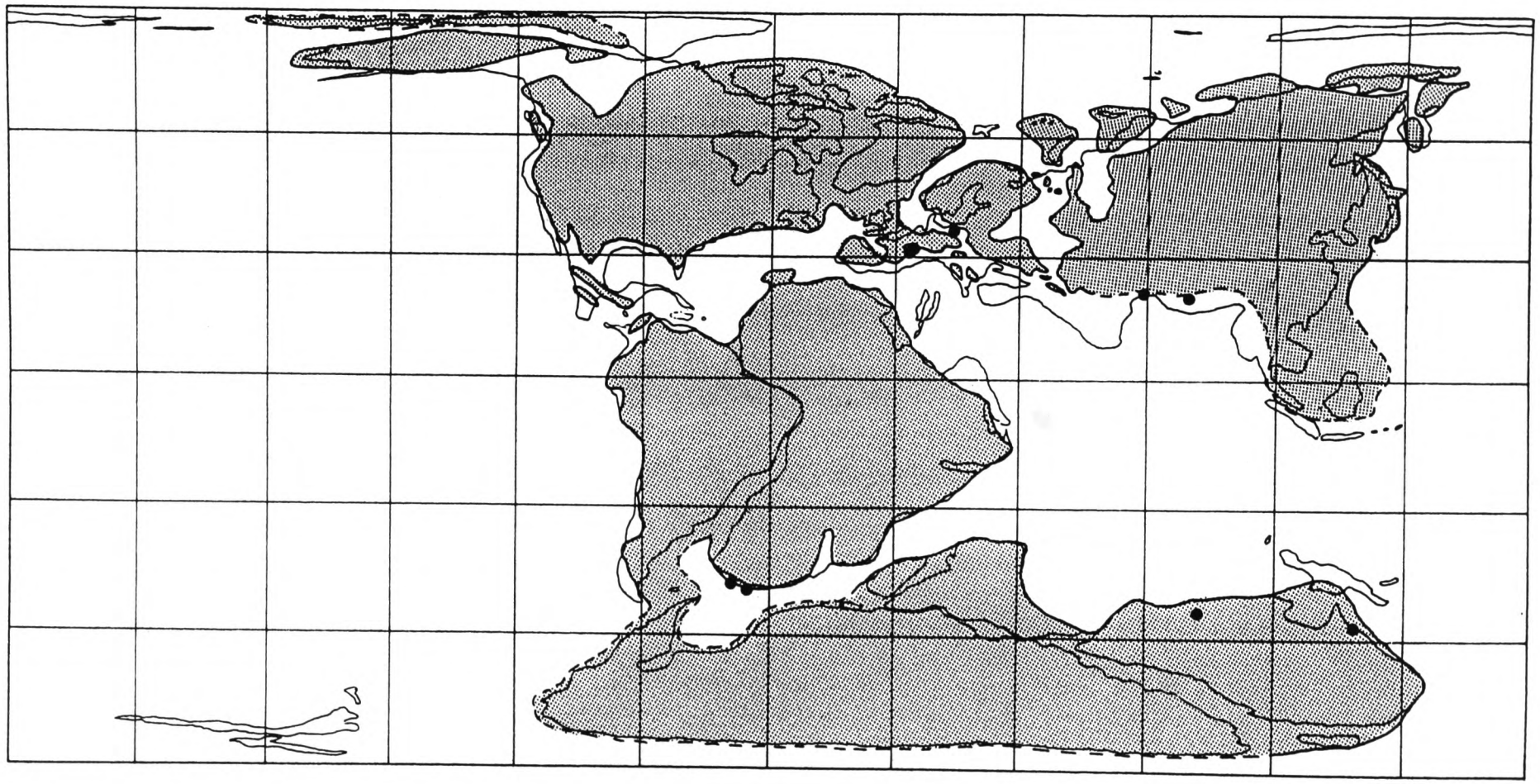


Fig.126: World-wide distribution of glauconitic facies during the Hauterivian, plotted on a palaeogeographic reconstruction of Funnel (1990).

BARREMIAN

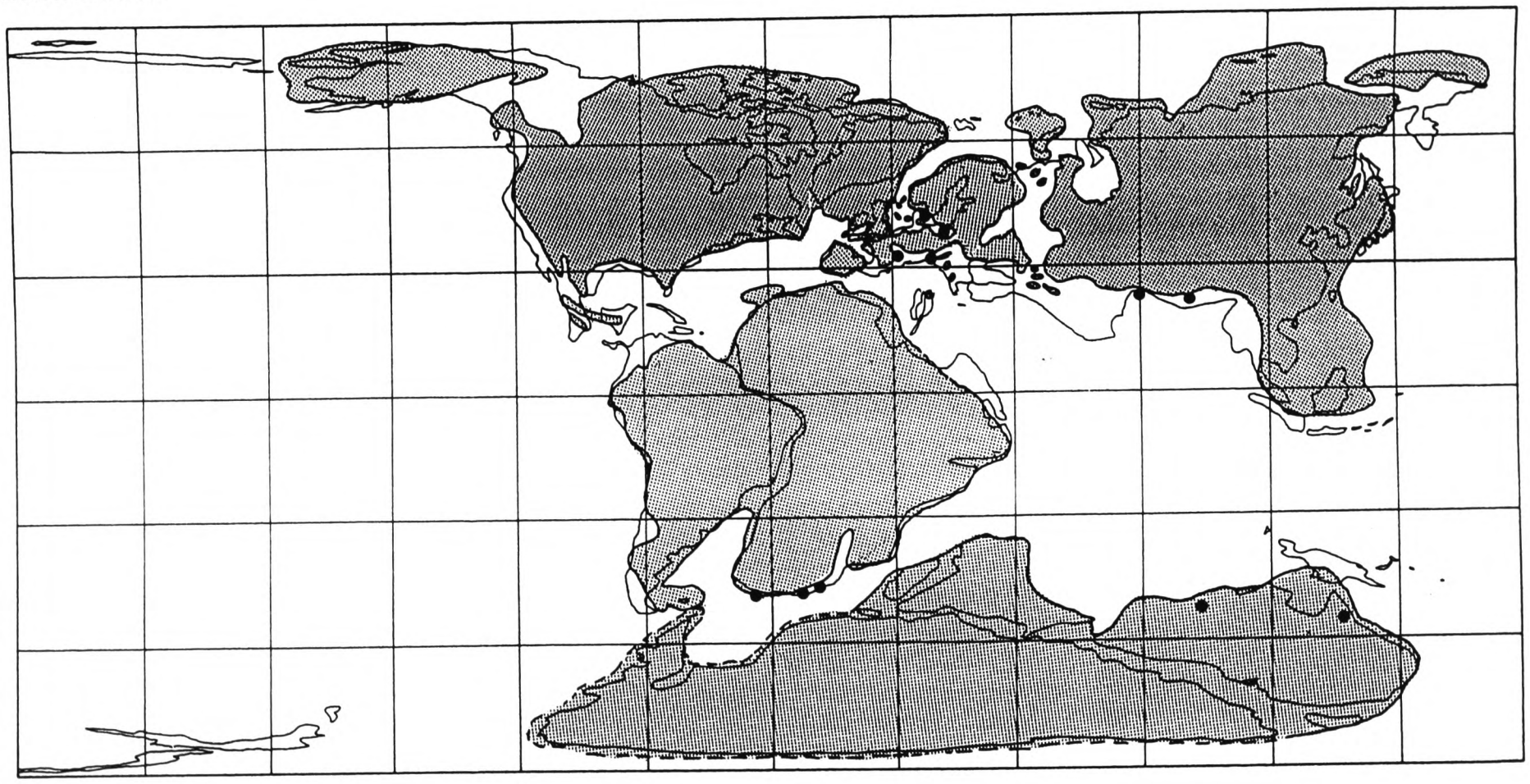


Fig.127: World-wide distribution of glauconitic facies during the Barremian, plotted on a palaeogeographic reconstruction of Funnel (1990).

APTIAN

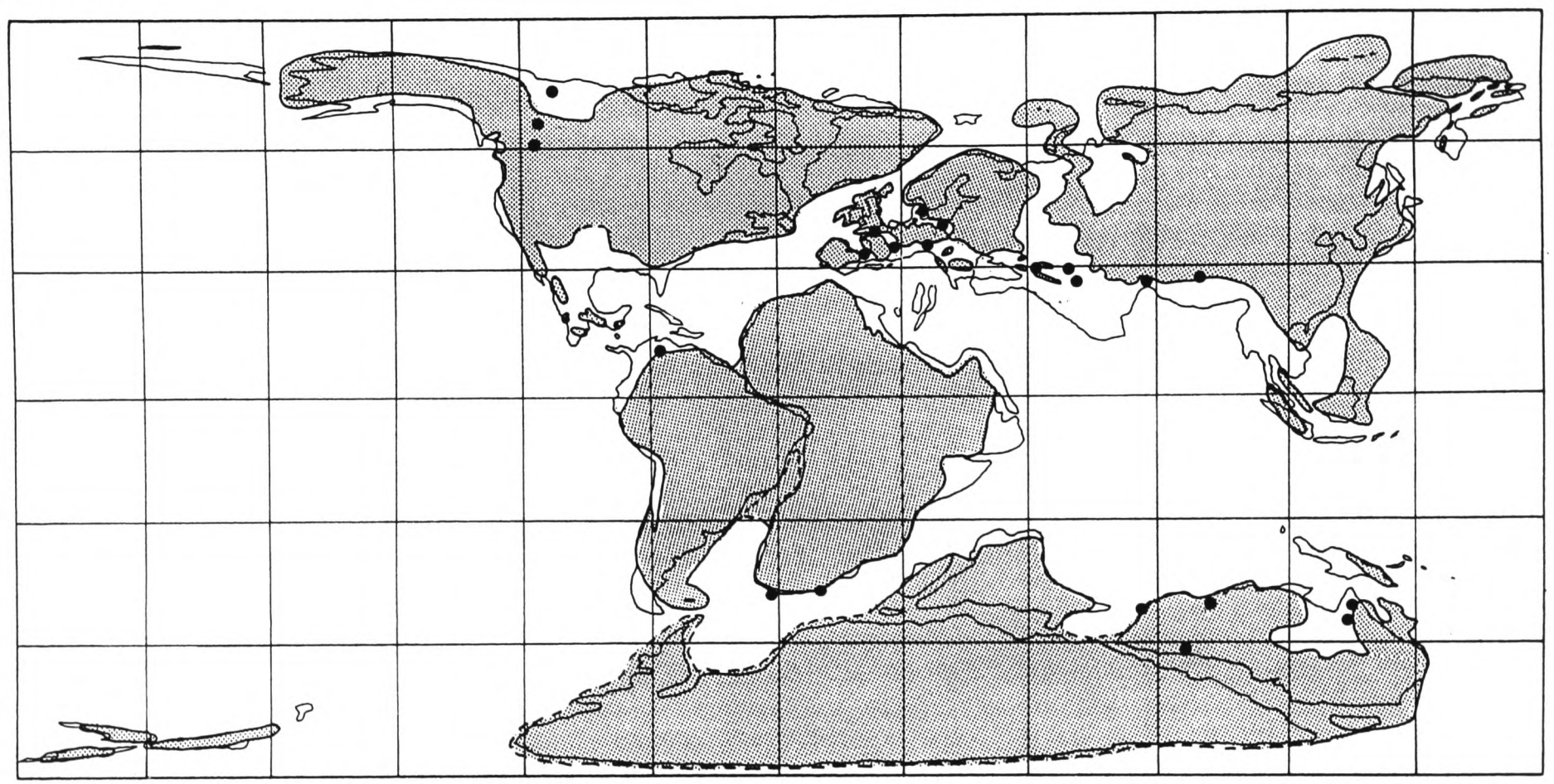


Fig.128: World-wide distribution of glauconitic facies during the Aptian, plotted on a palaeogeographic reconstruction of Funnel (1990).

ALBIAN

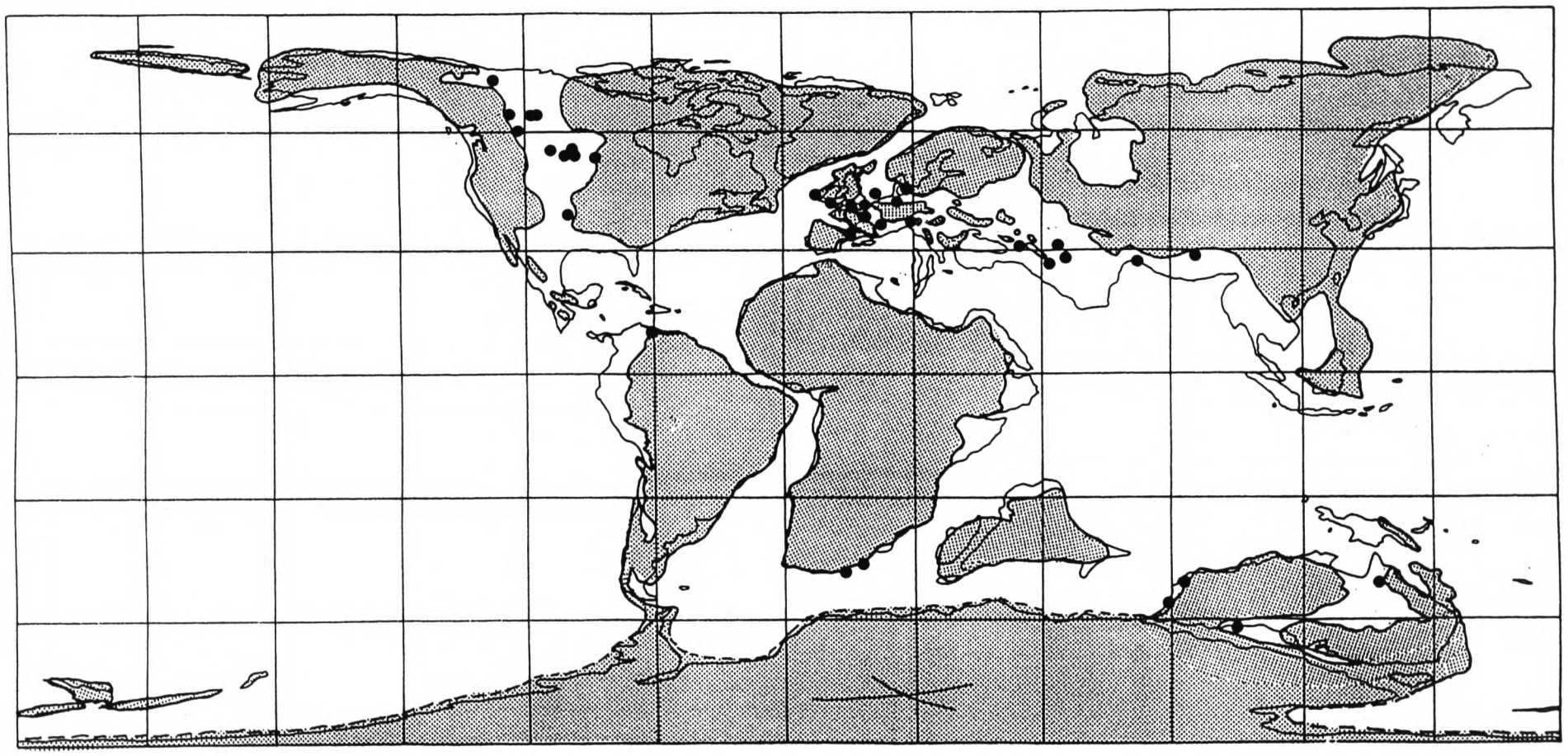


Fig.129: World-wide distribution of glauconitic facies during the Albian, plotted on a palaeogeographic reconstruction of Funnel (1990).

CENOMANIAN

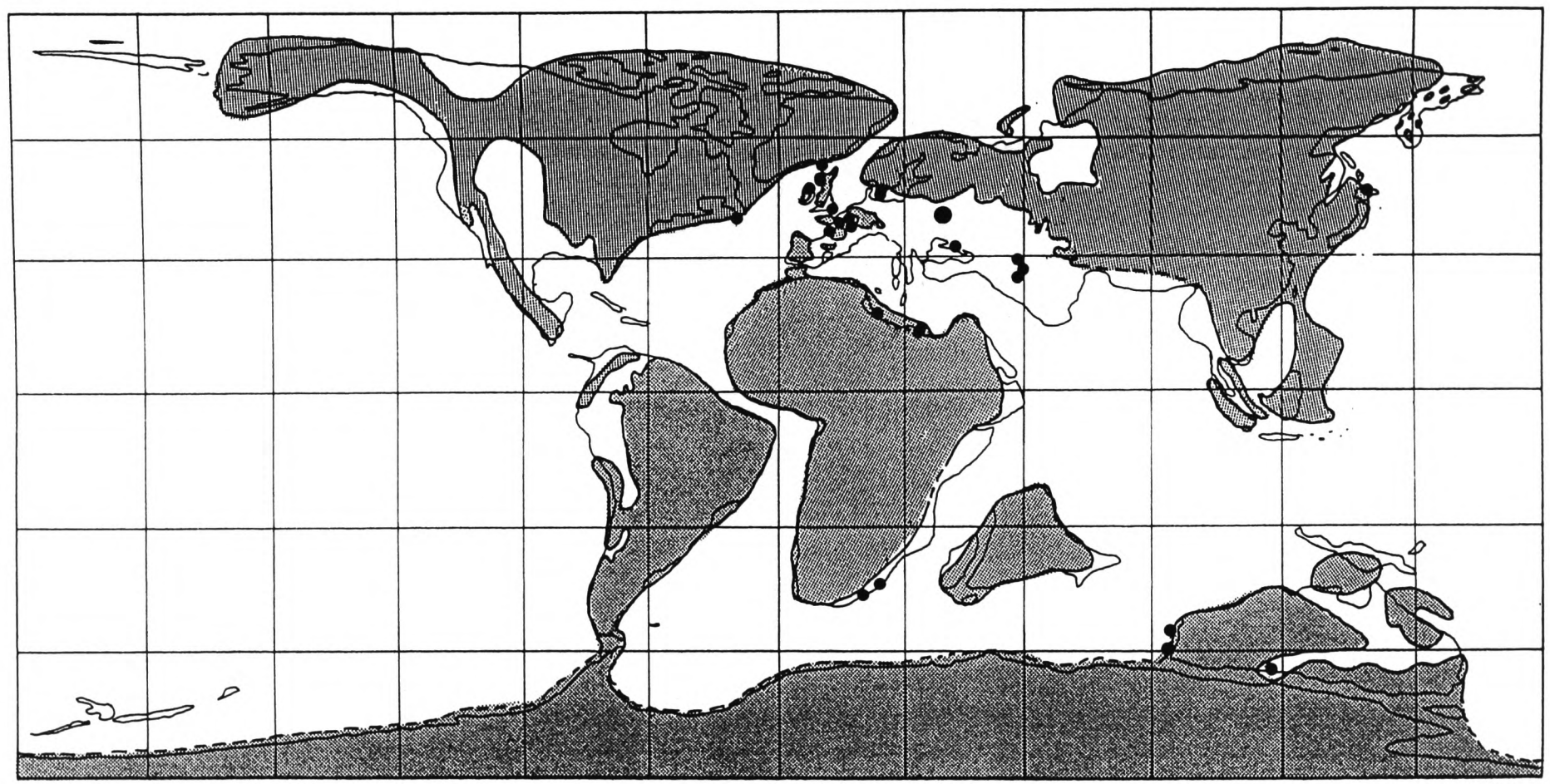


Fig.130: World-wide distribution of glauconitic facies during the Cenomanian, plotted on a palaeogeographic reconstruction of Funnel (1990).

TURONIAN

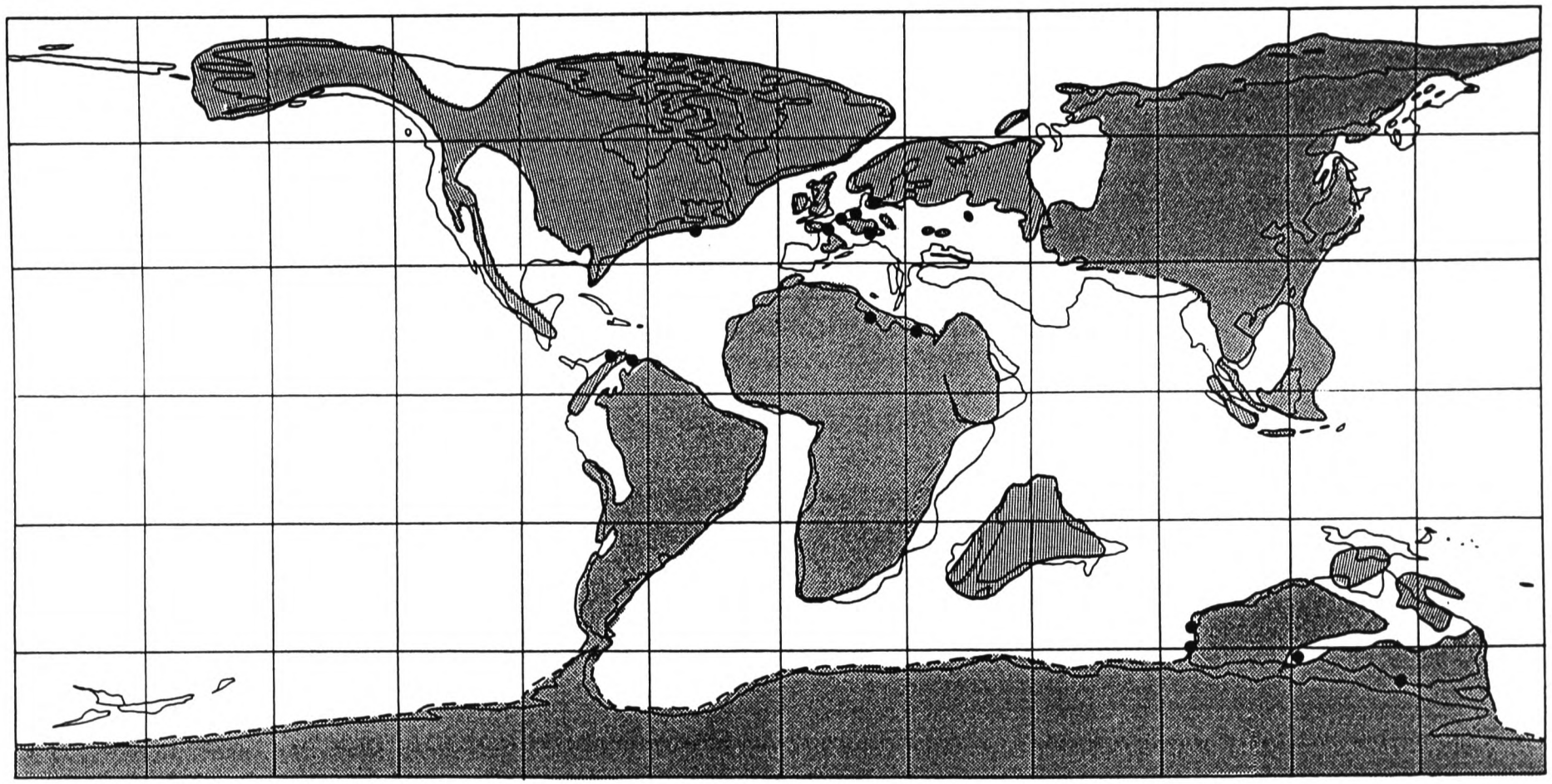


Fig.131: World-wide distribution of glauconitic facies during the Turonian, plotted on a palaeogeographic reconstruction of Funnel (1990).

CONIACIAN

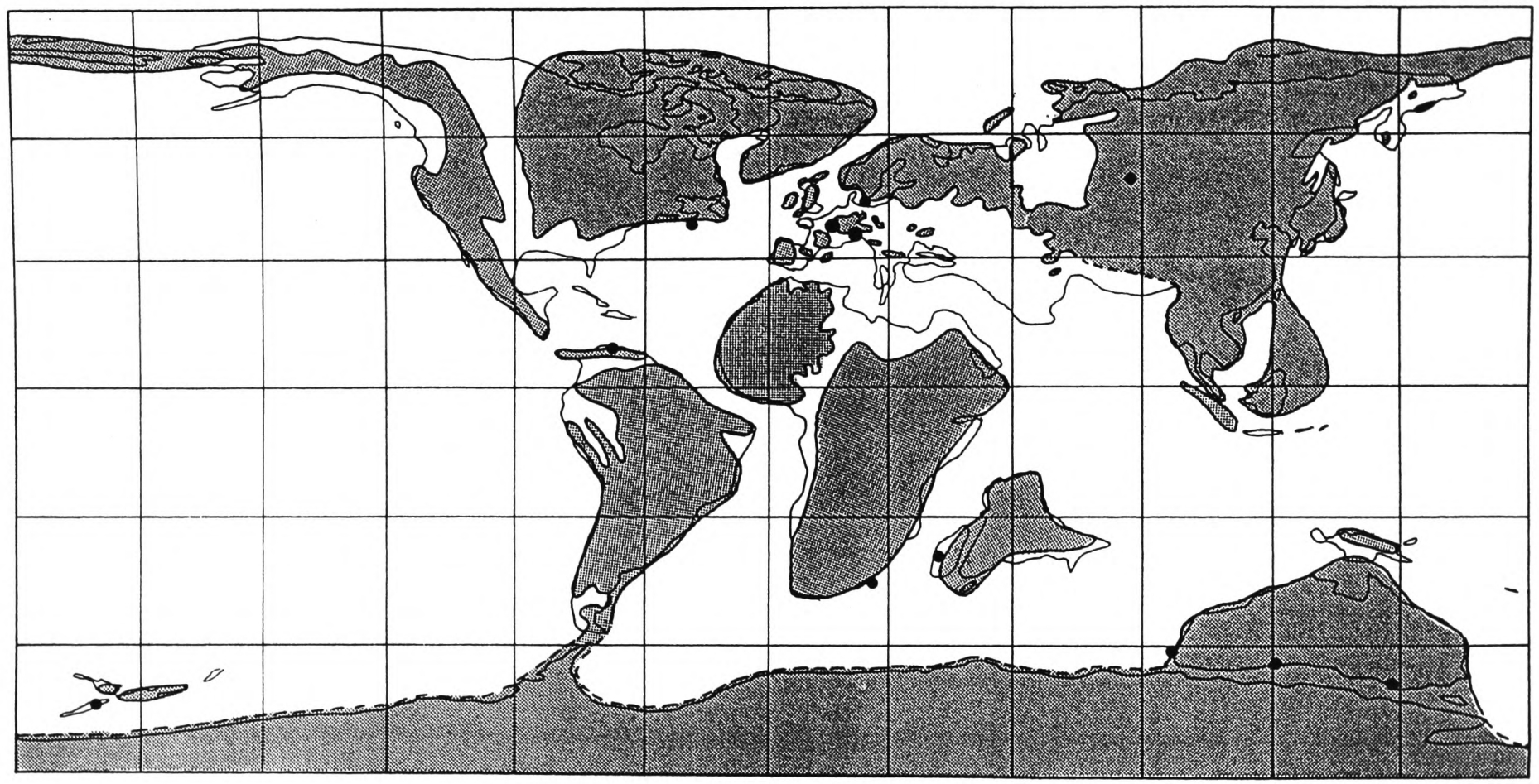


Fig.132: World-wide distribution of glauconitic facies during the Coniacian, plotted on a palaeogeographic reconstruction of Funnel (1990).

SANTONIAN

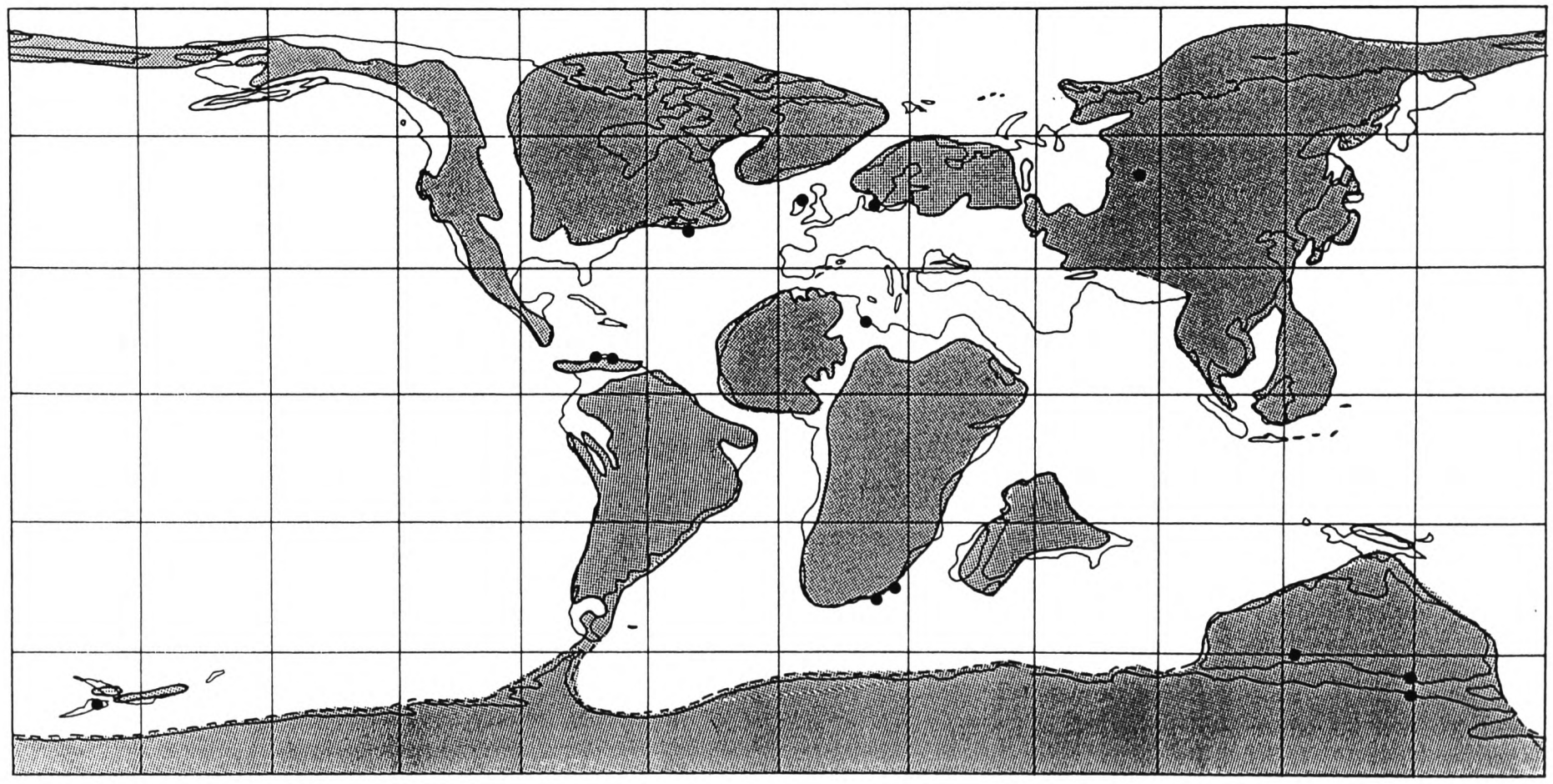


Fig.133: World-wide distribution of glauconitic facies during the Santonian, plotted on a palaeogeographic reconstruction of Funnel (1990).

CAMPANIAN

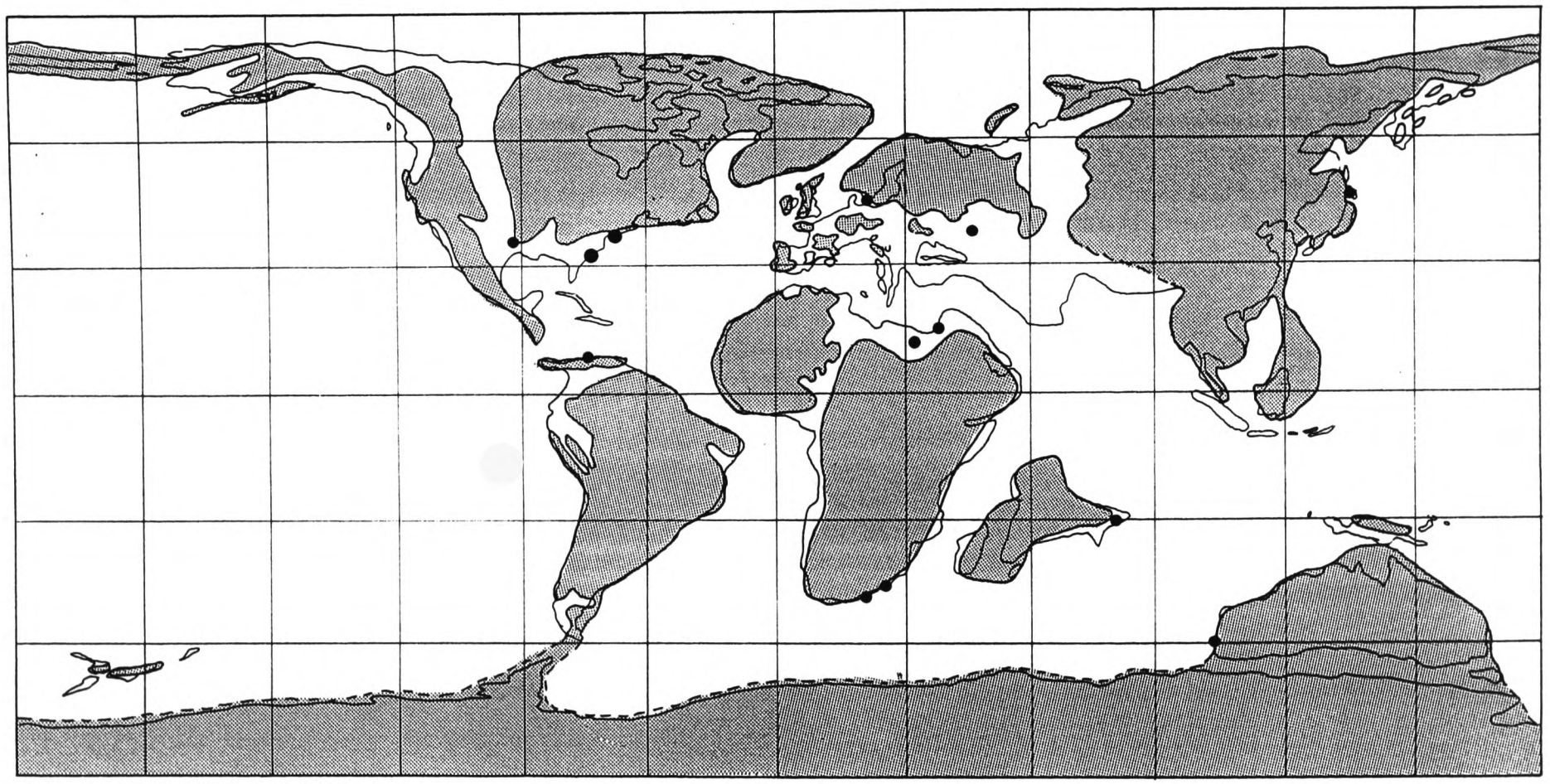


Fig.134: World-wide distribution of glauconitic facies during the Campanian, plotted on a palaeogeographic reconstruction of Funnel (1990).

MAASTRICHTIAN

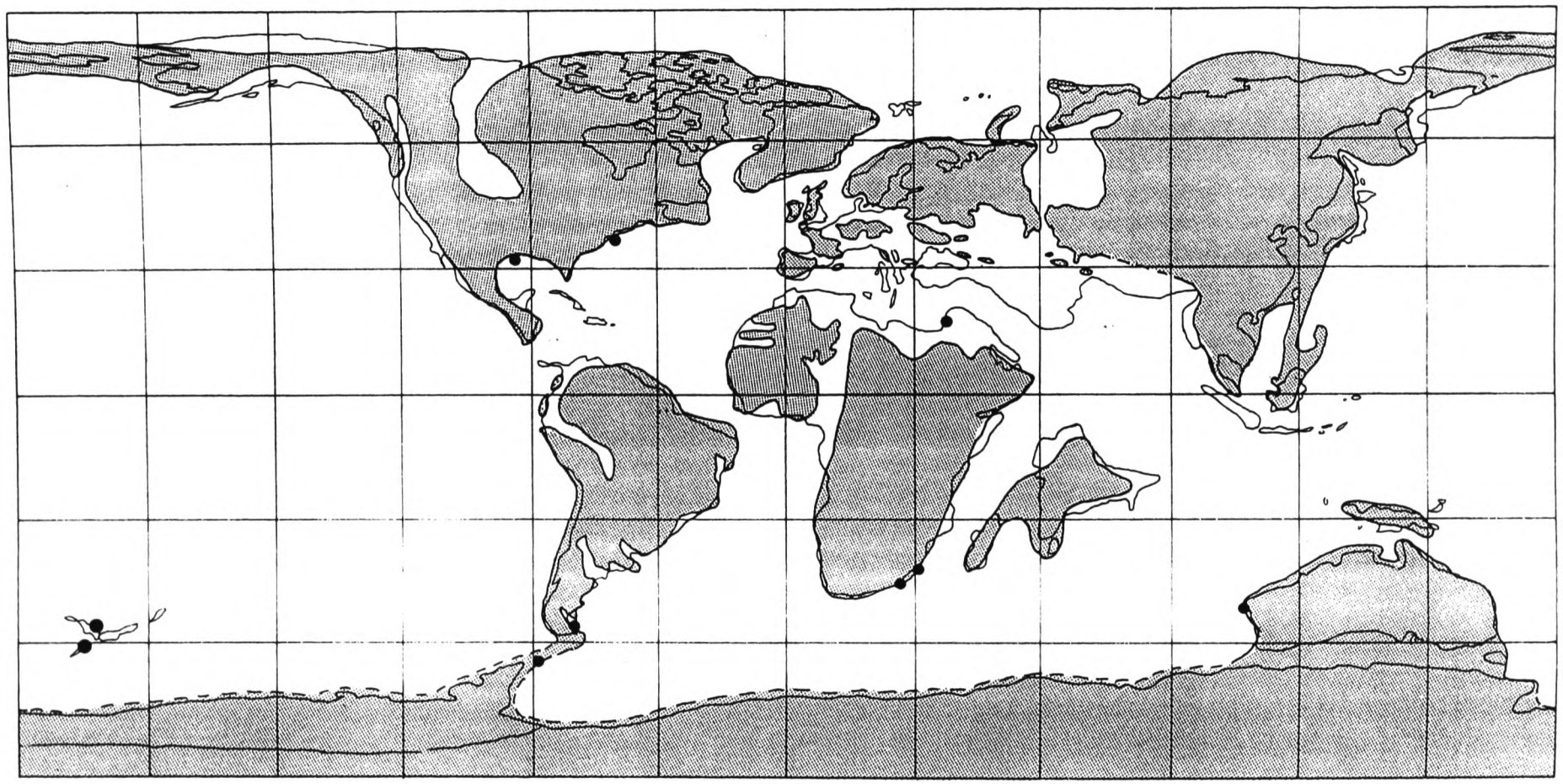


Fig.135: World-wide distribution of glauconitic facies during the Maastrichtian, plotted on a palaeogeographic reconstruction of Funnel (1990).

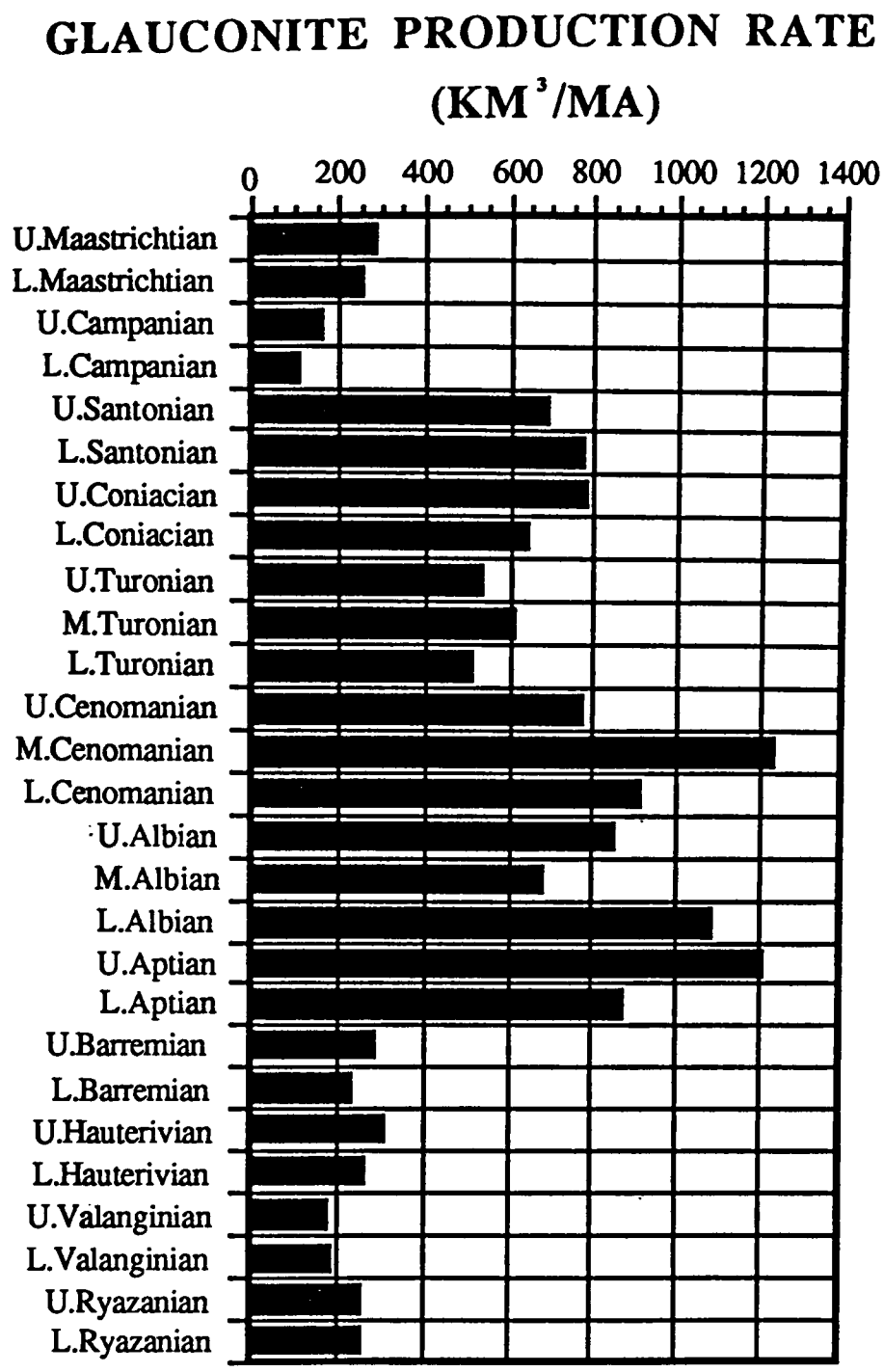


Fig.136: Diagram showing glauconite production rates (measured in km3 per Ma) for each substage of the Cretaceous, derived from volumetric calculations for a large data set of Cretaceous glauconitic facies.

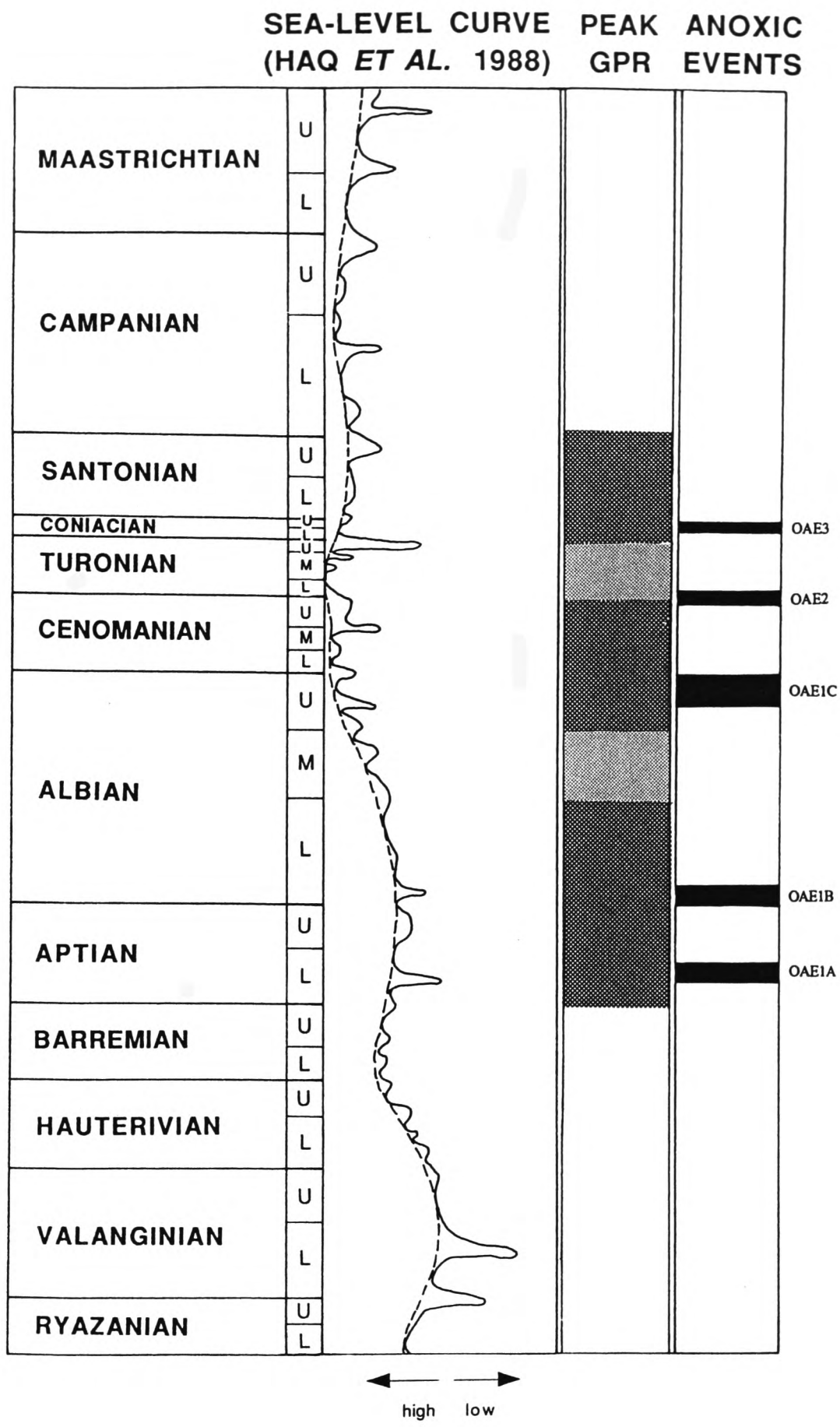


Fig.137: Diagram showing the correlation between the Cretaceous sea-level of Haq *et al.* (1990), peak glauconite production rates (GPR), and the oceanic anoxic events/subevents of Jenkyns (1980), Schlanger *et al.* (1987), Arthur *et al.* (1990) and Jenkyns (1991). Stippled area indicates a middle-Upper Cretaceous interval of high GPR; heavy stipple indicates the three main peaks in GPR during the interval.

GRAPHIC LOGS

A series of 48 graphic logs is presented, covering sections discussed in the text. These are catalogued from west to east across southern England, followed by French examples. All thicknesses are in metres.

1 BABCOMBE COPSE 1 (SX 868 762)
2 BABCOMBE COPSE 2 (SX 868 762)
3 PEAK HILL (SY 109 866)
4 DUNSCOMBE CLIFF (SY 153 877)
5 KEMPSTONE ROCKS (SY 161 881)
6 WESTON EBB (SY 175 878)
7 BEER STONE ADIT (SY 220 881)
8 HOOKEN CLIFFS - LITTLE BEACH - BEER HEAD 1 (SY 220 879) TO (SY 227 879)
9 HOOKEN CLIFFS - LITTLE BEACH - BEER HEAD 2 (SY 220 879) TO (SY 227 879)
10 WHITECLIFF, BEER 1 (SY 234 893)
11 WHITECLIFF, BEER 2 (SY 234 893)
12 CULVERHOLE 1 (SY 272 895)
13 CULVERHOLE 2 (SY 272 895)
14 CORBIN ROCKS 1 (SY 285 893)
15 CORBIN ROCKS 2 (SY 285 893)
16 CORBIN ROCKS 3 (SY 284 893)
17 EAST OF CORBIN ROCKS (SY 293 896)
18 HUMBLE POINT (SY 305 899)
19 CHARTON GOYLE (SY 296 903)
20 SHAPWICK GRANGE QUARRY (SY 312 918)
21 STONEBARROW HILL (SY 378 929)
22 GOLDEN CAP - BASAL GAULT (SY 405 920)
23 GOLDEN CAP 1 (SY 405 920)
24 GOLDEN CAP 2 (SY 405 920)
25 EGGARDON HILL (SY 939 948)
26 STANDER'S MILL PLANTATION (SY 588 975)
27 SLIPPED BLOCK WEST OF WHITE NOTHE (SY 769 809)
28 SECTION BELOW HOLWORTH HOUSE (SY 764 814)
29 DURDLE COVE 1 (SY 805 806)
30 DURDLE COVE 2 (SY 805 806)
31 ST. OSWALD'S BAY (SY 815 800)
32 LULWORTH COVE, WEST SIDE (SY 825 800)
33 LULWORTH COVE, EAST SIDE (SY 828 800)
34 MUPE BAY (SY 843 800)
35 WORBARROW BAY, BELOW FLOWER'S BARROW - BASAL GAULT (SY 866 804)
36 WORBARROW BAY, BELOW FLOWER'S BARROW 1 (SY 866 804)
37 WORBARROW BAY, BELOW FLOWER'S BARROW 2 (SY 866 804)
38 SWANAGE BAY (SZ 044 811)
39 COMPTON BAY, ISLE OF WIGHT 1 (SZ 367 853)
40 COMPTON BAY, ISLE OF WIGHT 2 (SZ 367 853)
41 NATIONAL TRUST CAR PARK, NEAR BLACKGANG CHINE, ISLE OF WIGHT (SZ 491 767)
42 GORE CLIFF, ISLE OF WIGHT 1 (SZ 492 763)
43 GORE CLIFF, ISLE OF WIGHT 2 (SZ 492 763)
44 SOUTH OF EASTBOURNE (TV 610 977)
45 ST. JOUIN-BRUNEVAL
46 LE CROQUET (SLIPPED BLOCK)
47 ST. ADRESSE
48 CARRIERE LE LIVET, NEAR CORDEBUGLE

KEY TO GRAPHIC LOGS

clay

marl

muddy silt

fine-grained muddy sand and silt

laminated fine sand and silt

gravelly sand and sandy gravel

bioclastic packstones and grainstones

intraformational pebbles and shells

shell fragments

calcarenaceous sand

nodular hardground

burrowed basal contact; arrow to lowest level of burrowing

pyrite

phosphate

calcareous concretions

siliceous nodules

chert nodules

horizontal stratification

cross-stratification

Thalassinoides

Palaeopycus, black mud lining

Palaeopycus, buff marl lining

Planolites

Chondrites

bivalve (whole)

fragmentary fossils

gastropod

ammonite

brachiopod

serpulid

echinoid

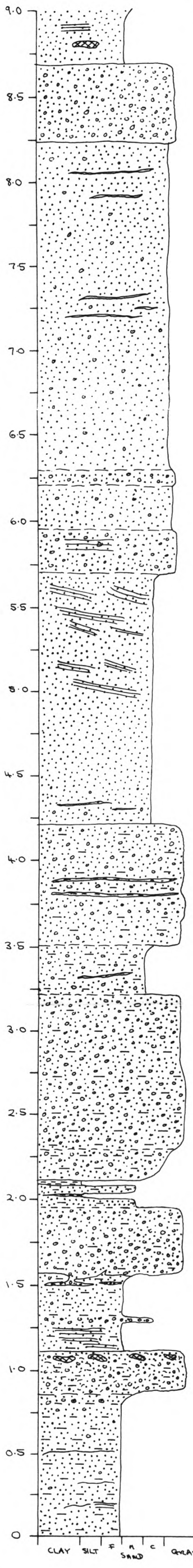
bryozoan

shark tooth

fossil wood

1

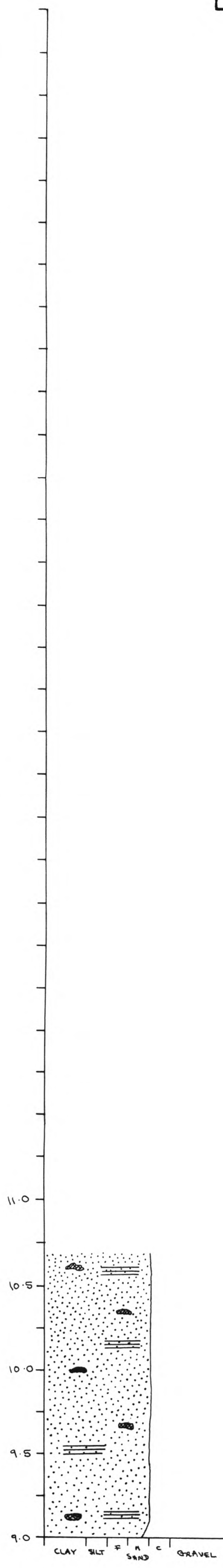
BABCOMBE COPSE 1 (SX 868 762)



PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Grey-brown sandy gravel; abundant small granules; granule-supported; almost mud-free.
				Pale brown, moderately well-sorted (clay-free), coarse, slightly gravelly sand; granules of quartz and feldspar; thin, horizontally-oriented clay laminae (drapes).
				Pale greenish-brown, moderately-sorted sandy gravel; clay-poor; horizontal lamination; strong iron staining
				Pale greenish-brown, soft, medium to coarse-grained, soft sands; heavy mineral-rich, and mud-poor; well-developed horizontal and planar cross-bedding; scattered small granules and clay drapes in basal part.
				Brown, poorly-sorted, sandy, muddy gravel; quartz and feldspar-rich; thin horizontal iron-rich seams (?mineralised clay drapes).
				Brown, poorly-sorted, pebbly, medium-grained, slightly muddy sand; thin, impersistent, internal clay seam.
			rare ▽	Pale green to brown, poorly-sorted, muddy, sandy gravel; structureless and massive; rich in quartz and feldspar.
				Interbedded pale brown clay and greenish-brown sand.
				Greenish-grey, sandy, slightly muddy gravel; white quartz, red jasper and pink feldspar; granule-supported fabric; basal loading and burrowing.
				Brown, iron-stained, micaceous fine sands.
				Brown, fine-grained, slightly muddy fine sand; horizontal mud drapes common; horizontal and cross-lamination.
			▽, ⓥ Amphidonte	Dark brown, poorly-sorted, shelly, rather pebbly muddy sand; iron-stained matrix.
				Pale greenish-brown, poorly-sorted, fine-grained muddy sand with scattered coarse grains and small granules; strongly bioturbated.

BABCOMBE COPSE 2 (SX 868 762)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Brown, medium-grained, slightly muddy sand; occasional grains up to coarse grade; horizontal lamination; concretions of siliceous sandstone.



3

PEAK HILL (SY 109 866)

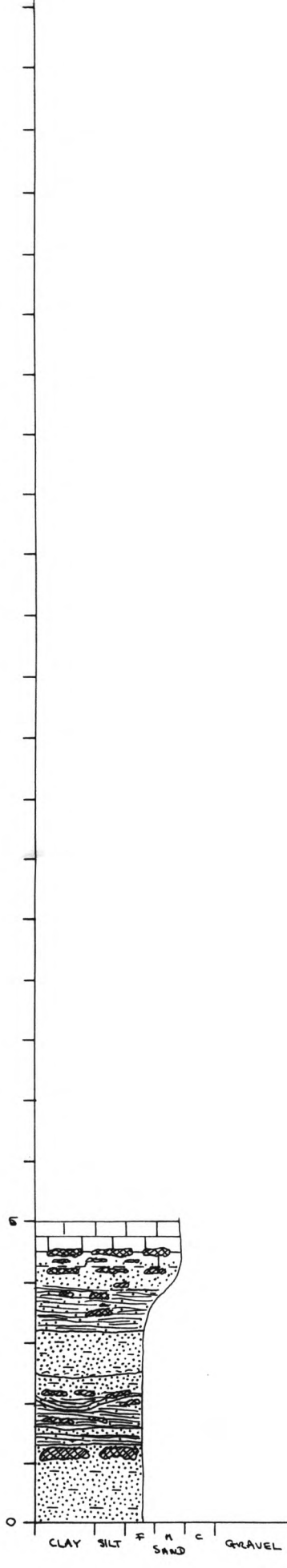
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Chert gravel, representing the decalcified Chert Beds Member.
		sss	–	Fine-grained muddy sand
				no exposure
		sss ↑ = progressive increase in bioturbation		Fine-grained mixed mud, silt and fine sand pale grey in colour.
				Pale grey laminated fine sand
small fining up sequences	Glauconite absent			Structureless, pale-cream coloured, fine-grained muddy silt.
		sss ↑		Pale grey laminated fine sand with small bedding-parallel siliceous concretions.
		sss ↑	Exogyra, Rotularia	Thick bed of pale grey laminated fine sand with siliceous nodules. Large basal scour cutting into 3 thin amalgamated beds of laminated sand
		sss ↑		Laminated sand with siliceous nodules
		sss		Structureless and fully bioturbated fine-grained muddy sand, with small pyrite nodules and occasional small siliceous nodules.
		= brown mud lined		
				inaccessible below this level, for direct examination
				INACCESSIBLE fine muddy sands
				Unconformity not exposed
				Red Triassic marls below.

20
15
10
5
0

CLAY SILT F M C GRAVEL
SAND

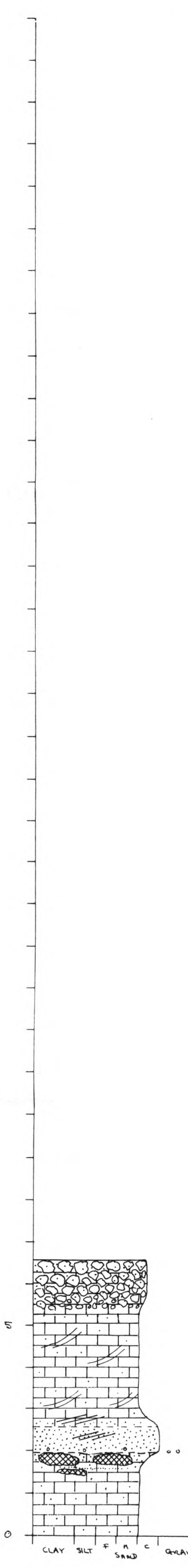
DUNSCOMBE CLIFF (SY 153 877)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Pale brown, well-sorted, mud-free calcarenites with siliceous nodules.
				Glauconitic, calcareous, laminated silt.
				Glauconite-rich, fine-grained muddy sands; succession of laminated and bioturbated beds.
				Bioturbated, glauconitic, fine-grained muddy sand.



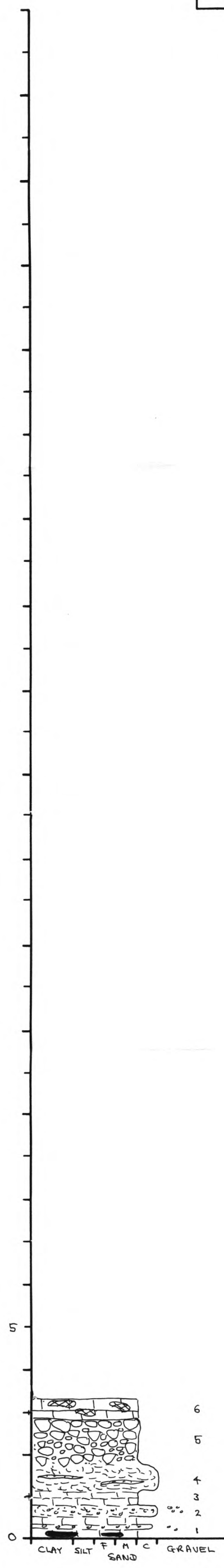
KEMPSTONE ROCKS (SY 161 881)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				↙ Top surface not accessible.
				The Top Upper Greensand hardground, a nodular quartzose (~25% in matrix) only very weakly glauconitic limestone. Coarse qtz grains up to 1-1½ mm diameter. Nodules up to ~15 cm diameter.
				Medium-grained, well-sorted weakly quartzose calcarenites, with tough X-bedding in sets up to 20 cm in thickness. Glauconite <1%
				↙ some low ∠ planar x-sets.
				The Coarse Band, a coarse-grained calcareous sand. Qtz grains up to 7 mm across. Basal surface erosive; top is gradational. Very weak planar X-lamination.
				Medium (to coarse) grained pale brown calcarenites. Occasional thin glauconitic seams.
				↙ Brecciated Limestone nodular hardground just below, but not accessible.



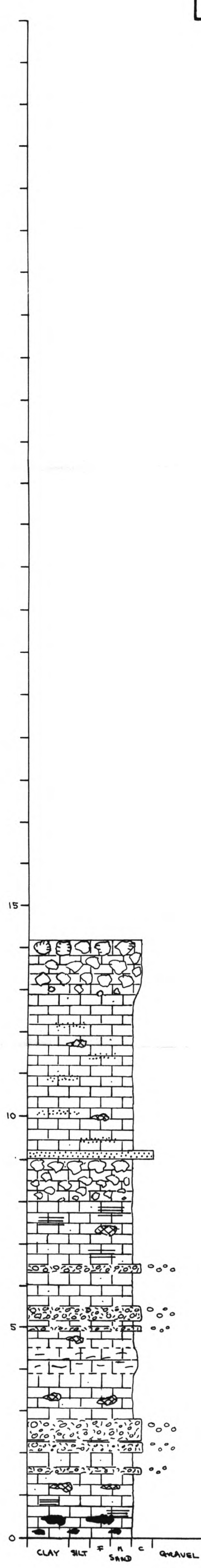
WESTON EBB (SY 175 878)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				6 Greenish-brown, patchily-silicified glauconitic calcarenites; several thin, weak shell concentrations.
				5 The Brecciated Limestone hardground; pale grey-brown, well-cemented nodular limestone; slightly shelly; bored nodules in upper 20cm.
				4 Complex, coarse-grained oyster shell bed, rich in *Amphidonte*; most of the shells whole to little-fragmented; variable thickness and geometry; internal sandy lenses.
				3 Calcarenites with thin, discontinuous shell stringers.
				2 Shell-pebble bed; coarse-grained broken shell fragments and occasional small pebbles.
				1 Thin, discontinuous, weak concentration of pebbles and shells.



BEER STONE ADIT (SY 220 881)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
		tunnels		
			▽	Pebble-shell bed
			rare ▽	
			▽, ▽	Pebble-shell bed
			▽, ▽	Thin pebble-shell bed
			▽, ▽	Shelly calcarenite
			▽	
			▽, ▽	Three intraformational pebble-shell beds
			▽, ▽	
			▽, ▽	



Top Upper Greensand hardground, a pale grey nodular (~~glauconitic~~ weakly glauconitic) limestone

Pale brown Calcarenites with rare small siliceous nodules and Thalassinoides burrowing.

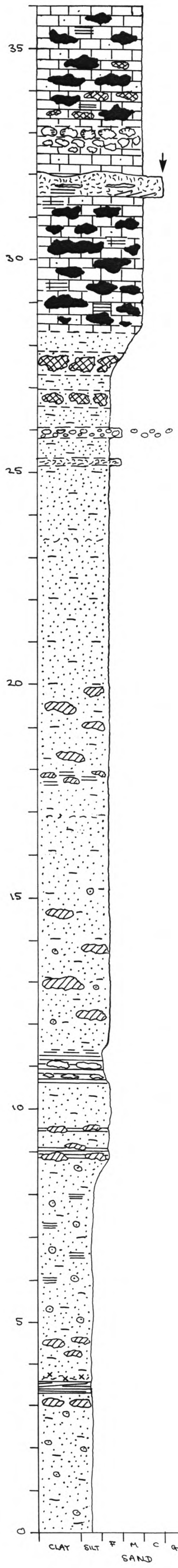
The Coarse Band - coarse calcareneaceous Sand

The Brecciated Limestone hardground a nodular limestone

Calcarenites with traces of horizontal lamination.

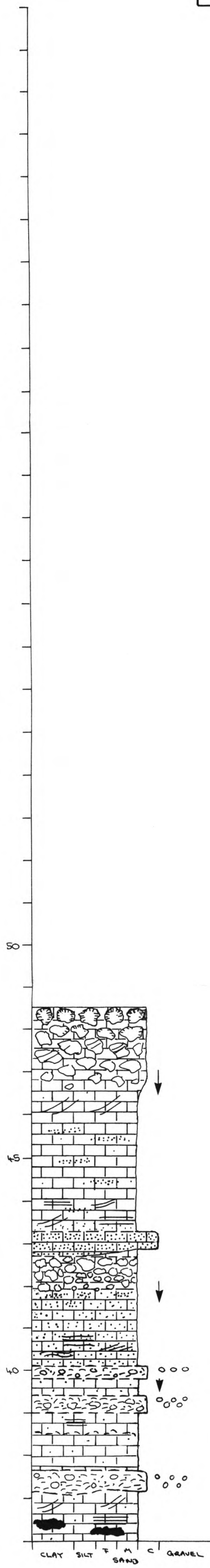
Calcareites with siliceous nodules + chert.

HOOKEN CLIFFS - LITTLE BEACH - BEER HEAD 1 (SY 220 879) TO (SY 227 879)



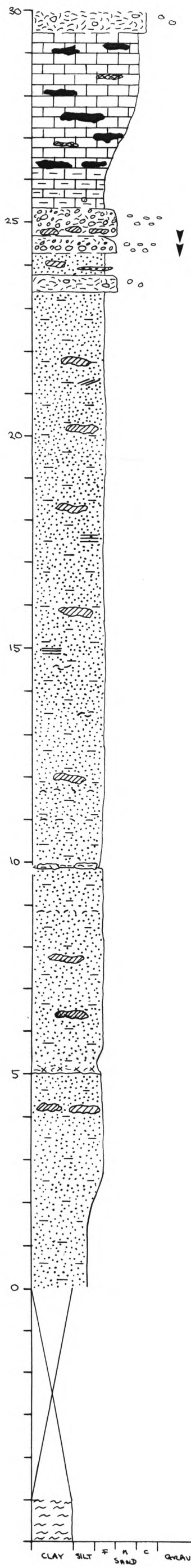
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Pale grey-brown, medium-grained calcarenites, broken bivalve shell fragments common; thick abundant chert nodules; weak traces of horizontal stratification.
				Shell-rich sediment overlying the hardground.
				The lower Chert Beds hardground; brownish-grey limestone nodules in a burrow-reworked, very shelly, glauconite-rich coarse sandy matrix; burrow wall glauconitisation.
350° n=1				Glauconite-poor, grey-brown calcarenite,; strongly burrowed.
				Coquina shell bed; coarse bivalve shell fragments, with horizontal and planar cross-lamination; sharp basal contact; top contact is gently mounded; amalgamated, with thin internal sandy layer, often silicified; rare small limestone pebbles.
				Brown, fine to medium-grained calcarenites; silica-rich; scattered bivalve shell fragments.
				Compact muddy limestone, cleaning upwards.
				Brown, strongly silicified limestone.
				Dark grey-brown, muddy, fine-grained limestone; structureless and strongly burrowed.
				Dark grey, muddy, fine-grained limestone; scattered siliceous concretions.
			ⓥ , ▽	Pebble-shell bed; matrix-supported fabric with glauconitised and bored pebbles of glauconitic sandstone and shell fragments in a muddy glauconitic sand matrix; transitional bed contacts.
			ⓥ , ▽	Grey-brown, fine-grained muddy sandstone; glauconite-poor, weakly-cemented calcareous patches.
			▽	Shell-pebble bed; bivalve-rich, with sandy matrix; well-cemented and nodular; pebble-poor.
				Pale greenish-grey, fine-grained silty sands; low mud content.
				Strongly bioturbated fine-grained muddy sandstones.
			ⓥ + ▽	
				Traces of horizontal lamination.
			▽ + ⓥ	Occasional small calcarerous concretions after burows.
				Minor shell concentration.
				Strongly bioturbated, fine-grained muddy sandstones.
			▽	Laminated sand bed; sharp base with serpulid concentration; bioturbated top; high concentration of calcareous concretions, deflecting the lamination; predominantly horizontal lamination, with occasional low-angle cross-lamination and reactivations.
			ⓥ +	Thin laminated bed, as above; thins laterally due to variable bioturbation at the top of the bed.
				Laminated bed as above; sharp base, with serpulid concentration; concretions centred on this shelly layer.
				Dark grey, strongly bioturbated, glauconitic muddy silts; occasional patches with traces of horizontal lamination; scattered pyrite nodules.
				Shelly, phosphatic, muddy sand; scattered small black phosphate nodules.
			▽	Three amalgamated thin beds of laminated fine sand; basal shelly lags.
			▽ , ⓥ	Strongly bioturbated, fine-grained muddy silts; pyrite nodules common.
				Basal beds and basal unconformity not exposed.

HOOKEN CLIFFS - LITTLE BEACH - BEER HEAD 2 (SY 220 879) TO (SY 227 879)



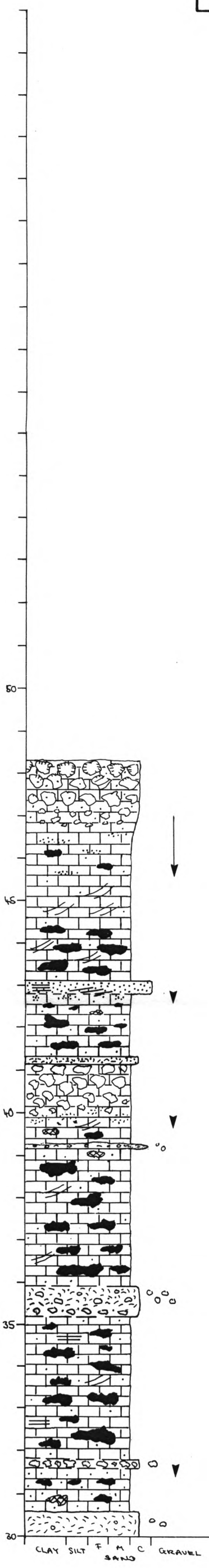
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				The top Upper Greensand hardground. Grey-brown, quartzose nodular limestone; matrix sediment strongly burrowed; quartz grains and small granules; relict trough cross-bedding; burrow wall glauconitisation and upper surface phosphatisation.
				Brown, medium-grained calcarenites; faint trough cross-stratification.
				Trough cross-bedded, medium-grained, glauconite-poor calcarenites; rich in comminuted shell fragments; glauconite-rich sediment-filled burrows common.
				The Coarse Band; moderately glauconitic coarse calcarenaceous sand; a few small, glauconitised limestone pebbles and coarse shell fragments; gradational upper contact; base is sharp but with basal burrowing, it cuts down to rest on underlying hardground; structureless, but faint traces of horizontal to low-angle stratification.
				Fine-grained carbonate sand, cut out by overlying bed.
				The Brecciated Limestone hardground; pale grey limestone nodules in a burrowed, glauconite-rich coarse sandy matrix; burrow wall glauconitisation, no phosphatisation.
				Complex pebble-shell bed; *in situ* nodules at base, with burrowing, passing up into fully-reworked medium to coarse glauconitic carbonate sand; pebbles marginally glauconitised, bored and encrusted; horizontal shell alignment.
				Shell-pebble bed; horizontally-aligned large shell fragments and glauconitised limestone pebbles, sometimes bored and encrusted.
				Thin, weakly-defined concentration of shell fragments.
				Amalgamated shell-pebble bed, constructed from up to three separate concentrations of shells and glauconitised limestone pebbles; occasional basal scour; well-developed horizontal shell alignment; gradational upper contact.
				Pale brown calcarenites; traces of low-angle cross-stratification.

WHITECLIFF, BEER 1 (SY 234 893)



PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				silicified; scattered small limestone pebbles, not marginally glauconitised; basal contact abruptly gradational.
				Light brown, fine-grained calcarenites; scattered small bivalve shell fragments; occasional vague traces of horizontal stratification.
				SEE SEPARATE SHEET FOR DETAILS.
244° n = 1				Single set of tabular cross-lamination (0.13m); isolated as a lens within fully-bioturbated sediment.
				Strongly-bioturbated, muddy, glauconitic, fine-grained sandstone; scattered calcareous concretions.
				Occasional faint traces of horizontal lamination.
				Strongly bioturbated, glauconitic, fine-grained sandstone, less mud-rich; occasional small patches of shelly material.
				Muddy, glauconitic, fine-grained sandstone.
				Thin shelly concentration.
				Thin, shelly concentration.
				Muddy bed, with traces of horizontal lamination; scattered calcareous concretions, centred on a serpulid-rich horizon.
				Thin, weak concentration of shelly material.
				Strongly bioturbated, muddy, fine-grained glauconitic sandstone.
				Shelly, phosphatic, muddy sand; small black phosphatic nodules.
				Homogenous, fine-grained sands; structureless, with no mud-lined burrows.
				Basal beds and basal unconformity not exposed.
				Red Triassic marls (Mercia Mudstones)

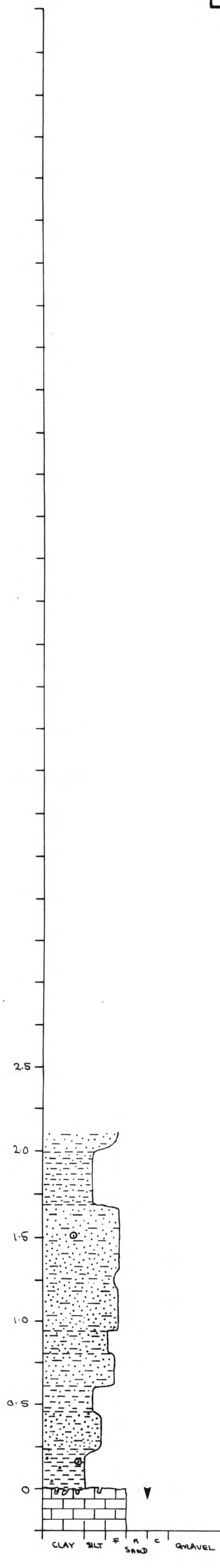
WHITECLIFF, BEER 2 (SY 234 893)



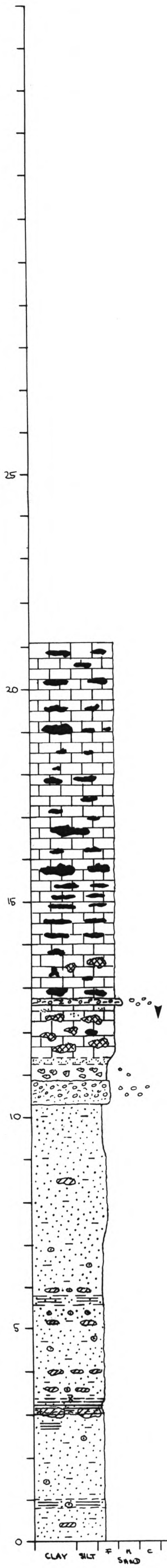
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				The top Upper Greensand hardground. Greyish-brown nodular limestone; scattered medium to coarse quartz grains, rare small granules; variable degree of nodularity laterally; sediment in between the nodules burrow-reworked; relict trough cross-stratification and burrowing in the nodules; nodule margin glauconitisation in the upper part and upper surface phosphatisation.
			▽	Brown, well-sorted calcarenites; abundant, glauconitic sediment-filled *Thalassinoides* burrows; traces of trough cross-bedding; becomes nodular passing upwards.
			▽	Brown, well-sorted medium to coarse-grained calcarenites; traces of trough cross-bedding; chert nodules common.
			rare ▽	The Coarse Band. Greenish-brown, quartz-rich calcarenaneous sand; well-rounded quartz grains; mostly structureless, but traces of horizontal to low-angle planar cross-lamination; planar but burrowed basal contact, with piping down of sediment into the bed below; gradational upper contact.
				Cream-coloured, very pure calcarenites.
			▽-rich,	Cream-coloured, very shell-rich, coarse, quartzose carbonate sand, rich in bivalve shell fragments.
			▽ , ▽	The Brecciated Limestone hardground; a mass of calcareous nodules in a burow-reworked, glauconitic, shelly matrix; little glauconitisation, no phosphatisation; relict cross-stratification; rare upper surface borings.
			▽	Thin, weak concentraton of bored limestone pebbles and shell fragments.
			▽ , ▽	Glauconitic, quartzose calcarenites; abundant bivalve shell fragments; traces of trough cross-bedding.
			▽	Shell-pebble bed; shell-rich, glauconitic carbonate sand; shells in upper part horizontally aligned; glauconitised limestone pebbles; gradational base.
				Brown, fine-grained calcarenites; low quartz content; occasional traces of horizontal and low-angle cross-bedding. Muddy in the basal part.
			▽	Nodular bed; calcareous nodules and smaller glauconitised and bored pebbles; burrowing betwen the nodules.
			▽	Brown, glauconite-poor calcarenites; scattered small bivalve shell fragments.
			▽-rich	Shell-pebble bed, rich in fine shell fragments, now strongly

CULVERHOLE 1 (SY 272 895)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Pale brown to black, burrow-mottled fine-grained muddy sand.
				Grey-brown, fine sandy clay; strongly bioturbated.
				Brown, muddy, fine sand.
				Very muddy, silty fine sand.
				Dark brown, poorly-sorted muddy, silty fine sand.
				Mottled dark brown to black muddy silt.
				Dark brown, slightly micaceous silt; patches rich in small mud clasts.
			rare ▽	GAULT - Soft, slightly silty black clay; scattered tiny clasts of green and grey reworked Triassic clay; occasional coarse quartz grains; basal contact marked by clay-filled bivalve borings and crevices, penetrating the underlying limestone.
				WHITE LIAS - cream-coloured, fine-grained limestone.



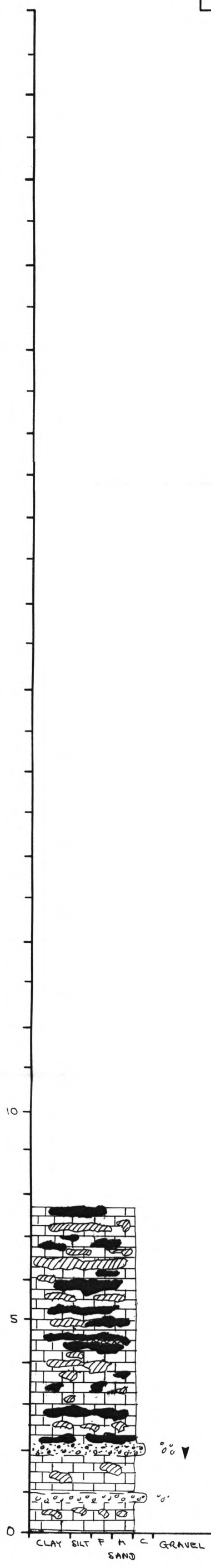
CULVERHOLE 2 (SY 272 895)



PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Pale brown calcarenites; abundant chert masses and carbonate-cemented areas (not fully accessible for examination).
				Pale brown calcarenites with chert nodules and carbonate-cemented concretionary patches; structureless, with occasional weak suggestions of cross-lamination.
				Thin, glauconite-rich pebbly clay; large glauconite grains up to 1mm across; basal burrowing for up to 40cm; pebbles show marginal borings.
				Grey to brown, muddy, slightly glauconitic calcarenites; some siliceous nodules after *Thalassinoides* burrows.
		buff-linings		Dark, greenish-grey, glauconitic calcarenites.
		buff linings		Grey-brown nodular limestone; nodules marginally glauconitised, now weathered to iron oxides.
				Shell-pebble bed, with green, glauconitic sand matrix; gradational basal contact.
				Dark greenish brown, medium-grained muddy, weakly glauconitic sand.
				Pale greenish-grey, glauconitic, medium-grained sand.
				Dark brown-grey, muddy, fine to medium-grained glauconitic sand; scattered pyrite nodules.
				Pale greenish grey, laminated, glauconitic fine sand; horizontal lamination.
				Thin horizon rich in pyrite nodules.
				Dark grey, muddy, fine to medium-grained glauconitic sand; scattered pyrite nodules and calcareous concretions.
				Pale greenish grey, laminated glauconitic sand; basal serpulid and shell lag, with associated line of calcareous concretions.
				Dark grey, fine-grained, glauconitic, muddy sand; strongly bioturbated; scattered pyrite nodules.
				Traces of horizontal lamination.
				Dark grey, muddy, glauconitic, fine-grained sand.

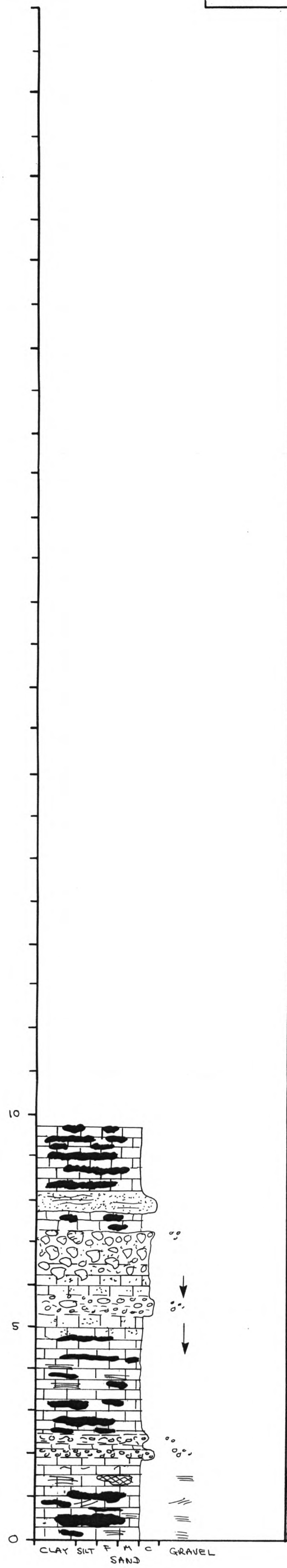
CORBIN ROCKS 1 (SY 285 893)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Strongly-silicified cherty limestone, with rare patches of unsilicified pale brown calcarenite; occasional traces of horizontal lamination.
			rare	Weakly glauconitic, slightly shelly, pale brown cherty limestone.
				Pebble (-shell) bed; horizon of limonitised, bored calcareous concretions in a glauconitic calcarenite matrix; basal burrowing.
		buff-linings		Slightly shelly, soft, pale brown glauconitic calcarenite; patchy calcareous cementation.
		buff	Lopha, oysters	Pebble-shell bed; strongly bored, small limonitised pebbles and oyster shells in a glauconitic calcarenite matrix; passes up into glauconite-rich calcarenite.



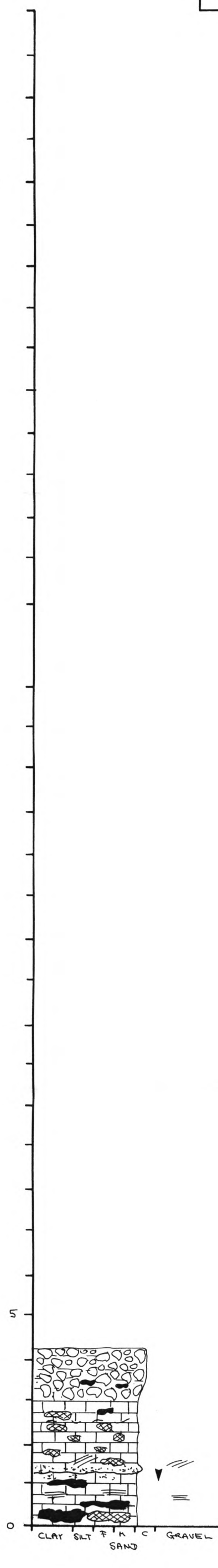
CORBIN ROCKS 2 (SY 285 893)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Pale brown, siliceous calcarenites.
				The Coarse Band; medium to coarse-grained quartz-rich carbonate sand; variable silicification has produced elongate thin zones of silicified sediment.
				The Brecciated Limestone hardground; a nodular limestone, with nodules resting in an uncemented, burrowed, coarse sandy, shelly calcarenite matrix; nodules in the uppermost 25cm are reworked small pebbles with marginal borings.
				Complex pebble (shell) bed; both unreworked nodules and small reworked bored limestone pebbles in a coarse calcarenaceous sand matrix; basal burrowed contact.
				Siliceous calcarenite; slightly shelly; weak traces of horizontal to slightly undulose lamination.
				Weakly-defined shell-pebble bed; oysters common and scattered small bored limestone pebbles.
				Pebble-shell bed; abundant small bored and oyster-encrusted limestone pebbles in a shelly calcarenite matrix.
				Siliceous, shelly calcarenite; horizontal and low angle planar cross-lamination.

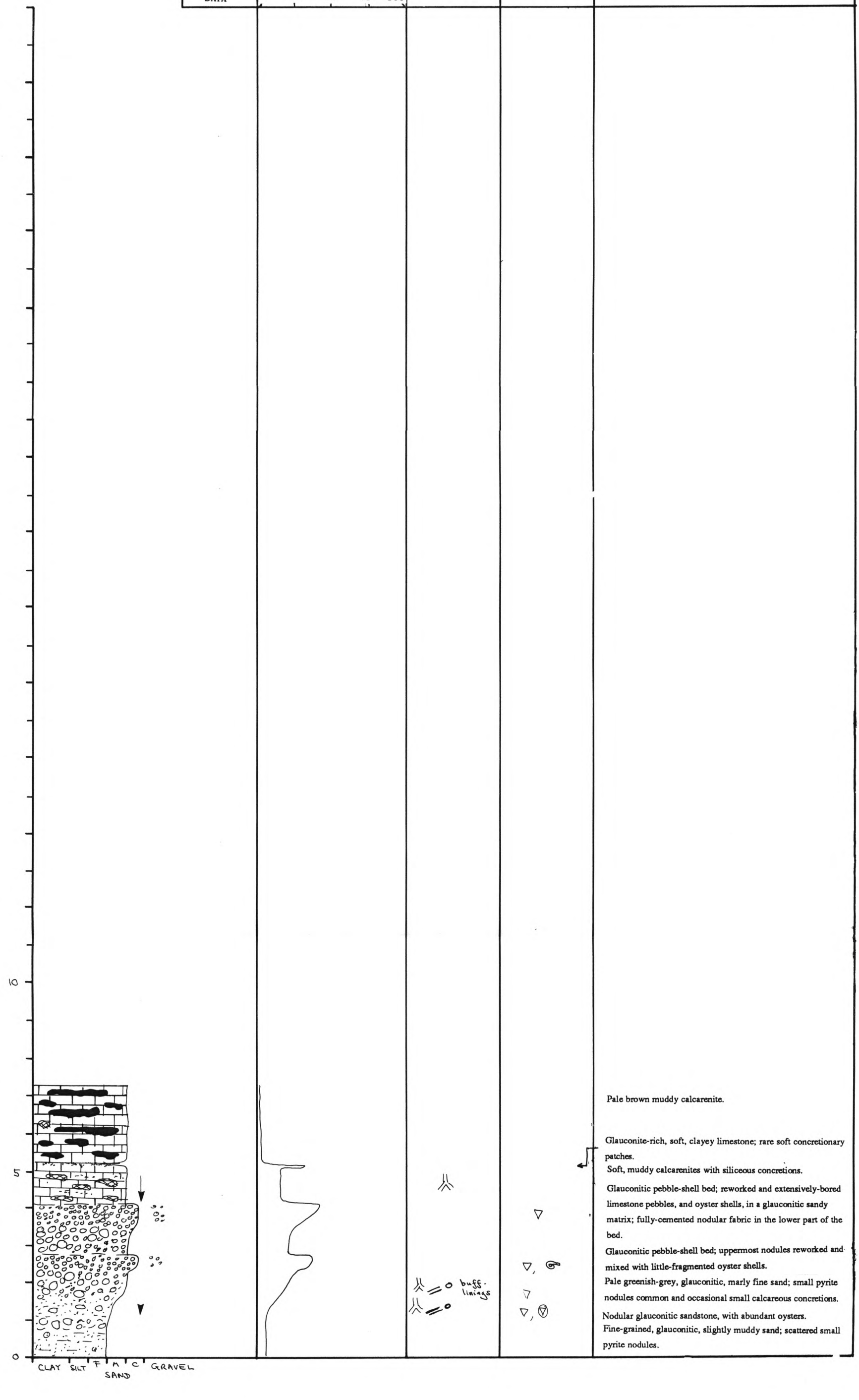


CORBIN ROCKS 3 (SY 284 893)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				top Upper Greensand hardground; nodular limestone with patchily phosphatised upper surface and occasional serpulid encrusters; piping down of overlying Cenomanian sandy limestone between the nodules; nodules in upper part marginally glauconitised.
				Medium to coarse, slightly shelly calcarenite; patchily silicified; horizontally-aligned concentration of thin-shelled oysters.
				Patchily-silicified quartzose calcarenite; quartz of medium to coarse grade; low angle tabular cross sets and burrowed basal contact.
				Pale brown, strongly silicified, weakly glauconitic calcarenites, with horizontal glauconite-rich/poor lamination.

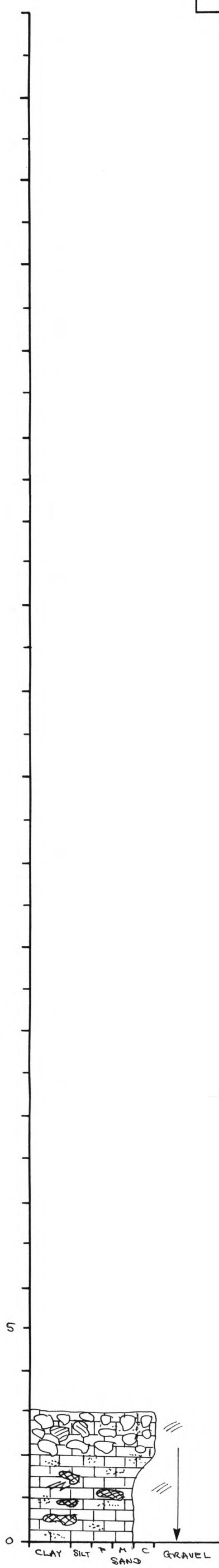


EAST OF CORBIN ROCKS (SY 293 896)



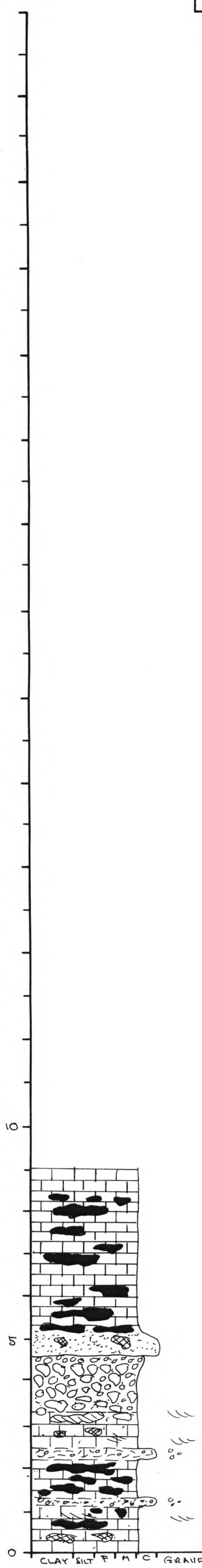
HUMBLE POINT (SY 305 899)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				The Top Upper Greensand hardground; a brown, nodular sandy limestone; coarse rounded quartz grains common, both in and around the nodules; overlying Cenomanian limestone lithology piped into the bed in between the nodules for up to 0.7m; relict lamination in the nodules showing nodule rotation. Brown, medium to coarse-grained calcarenites; well-developed burrow system, infilled with green, glauconite-rich coarse, quartzose sand.

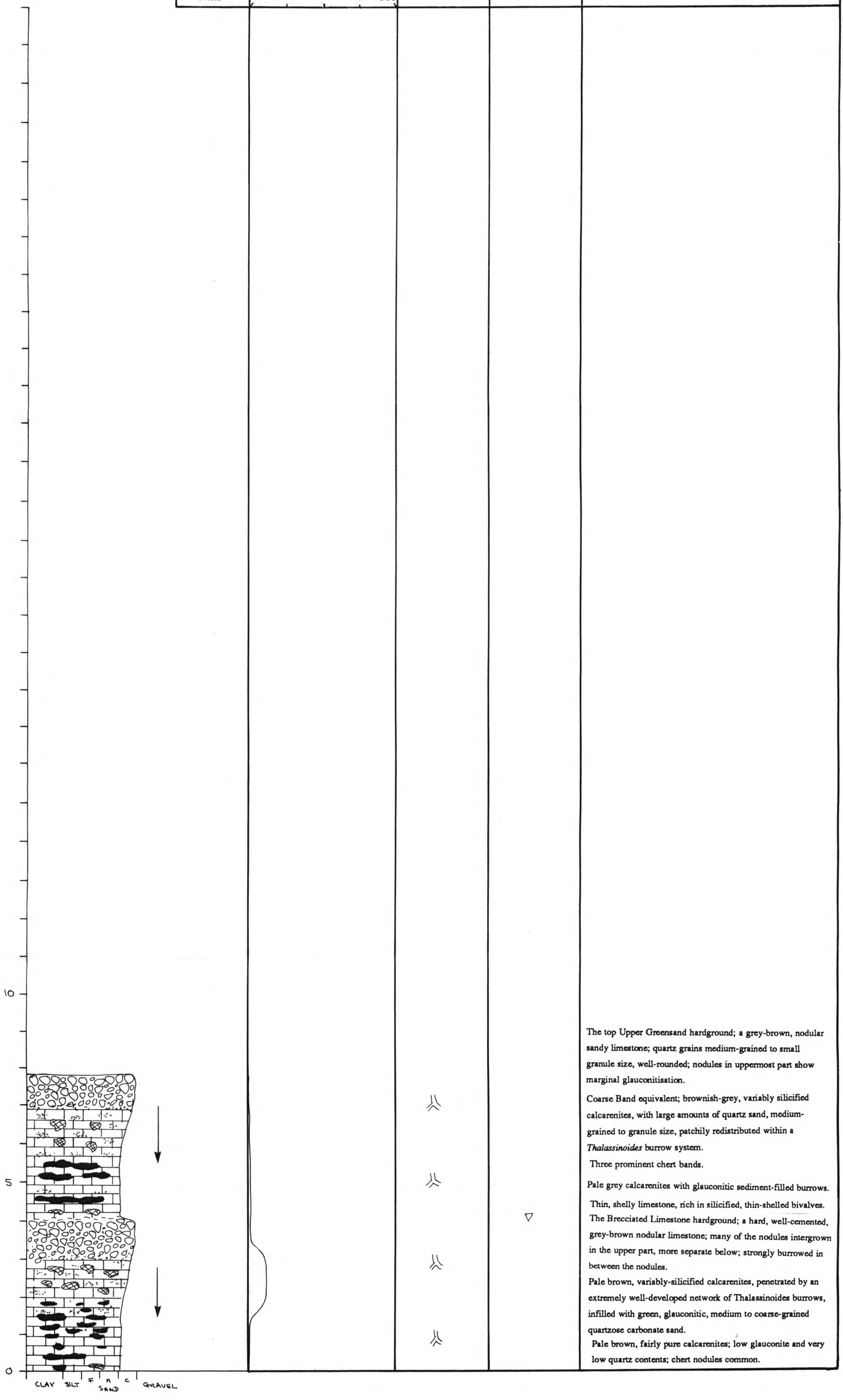


CHARTON GOYLE (SY 296 903)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Pale brown, chert-free calcarenites.
				Medium-grained, pale brown calcarenites with chert nodules.
				Brown, cherty calcarenites.
				Medium-grained, slightly shelly pale brown calcarenites with chert nodules.
			▽	The Coarse Band; a variably silicified, pale cream-coloured, medium to coarse-grained, quartzose, shelly calcarenite.
			▽	The Brecciated Limestone hardground; nodular limestone, strongly burrowed in between the nodules.
			▽	Elongate calcareous concretions in the lower part of the bed.
				Shell-pebble bed; horizontally-aligned shell fragments and occasional small pebbles in a calcarenite matrix; bed is lensoid in form over 3m laterally.
			▽	Pebble bed; a low concentration of reworked small nodules; occasional nodule shows marginal borings.
			▽	Calcarenite with preserved low-angle tabular cross-lamination, also preserved in weakly-cemented concretionary patches.

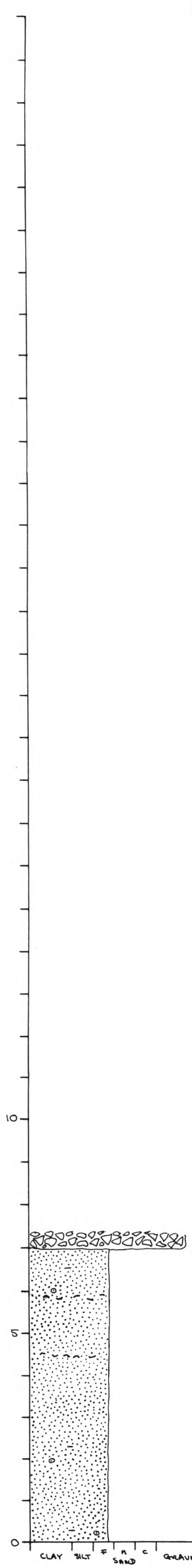


SHAPWICK GRANGE QUARRY (SY 312 918)

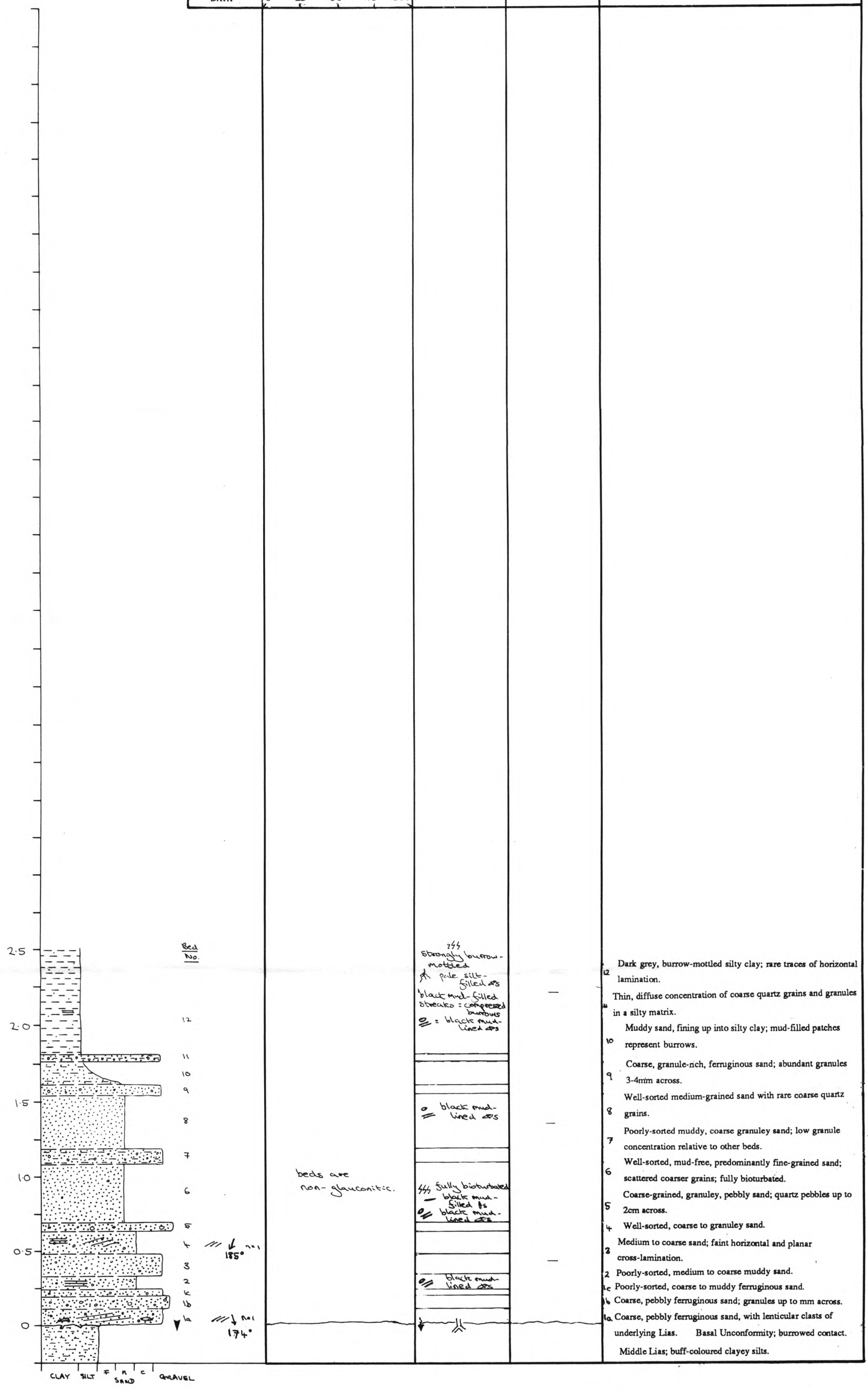


STONEBARROW HILL (SY378 929)

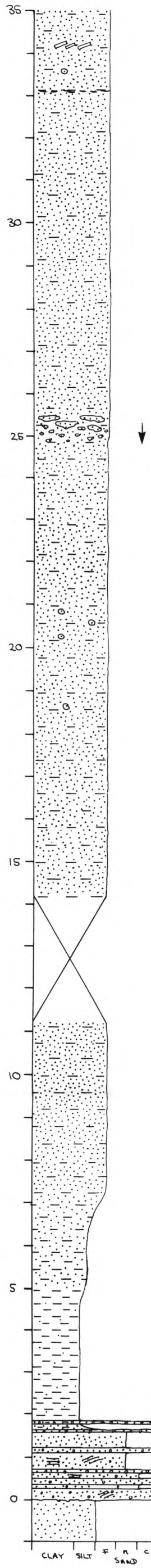
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Chert breccia, formed from the broken-up remnants of the Chert Beds.
				Green, glauconitic sandstone.
			▽	Weak concentration of shell fragments.
				Pale brown, soft, medium-grained, slightly muddy sands; low glauconite concentration.
			▽	Weak concentration of shell fragments.
			▽	Pale greenish-grey, soft, medium-grained, slightly muddy sands; scattered pyrite nodules, now weathered to iron oxides.
			▽	



GOLDEN CAP - BASAL GAULT (SY 405 920)



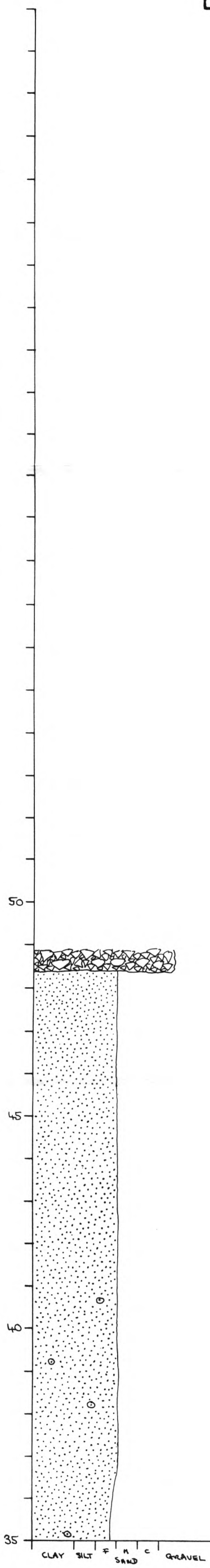
GOLDEN CAP 1 (SY 405 920)



PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				fine-grained, slightly glauconic muddy sand; scattered concentration of black, weathered ?carbonaceous/ ?phosphatic material
				pale green-grey, iron-stained, fine-grained muddy sand; slightly glauconitic, but glauconite probably weathered to iron oxides
				around 33m = contact between unweathered sediments below, and weathered, oxidised sediments above
			▽ , Ⓥ	
				homogeneous sequence of dark greenish-grey, glauconitic, fine-grained muddy sands
			▽ Trigonia	
			▽ internal moulds	
				strongly-burowed contact between brown sands below, and greenish grey, glauconitic fine muddy to marly sand above. *Thalassinoides* burrows well-developed.
				brownish-grey, buff-weathering fine-grained muddy sand; non-glauconitc; soft and uncemented; homogeneous sequence, with little structure, and only occasional black mud-lined burow.
			▽ internal moulds	
				3 metre gap with no exposure
				pale brown to buff muddy fine sand, structureless and fully-bioturbated, occasional burrow-mottling
				dark grey strongly-bioturbated muddy silt
			▽ internal mould	dark grey silty clay, rare traces of horizontal lamination; strong burrow-mottling; not glauconitic
				interbedded poorly-sorted muddy medium-grained sands and coarse gravelly to pebbly sands
				Basal Unconformity; burrowed contact.
				Middle Lias; buff-coloured clayey silts.

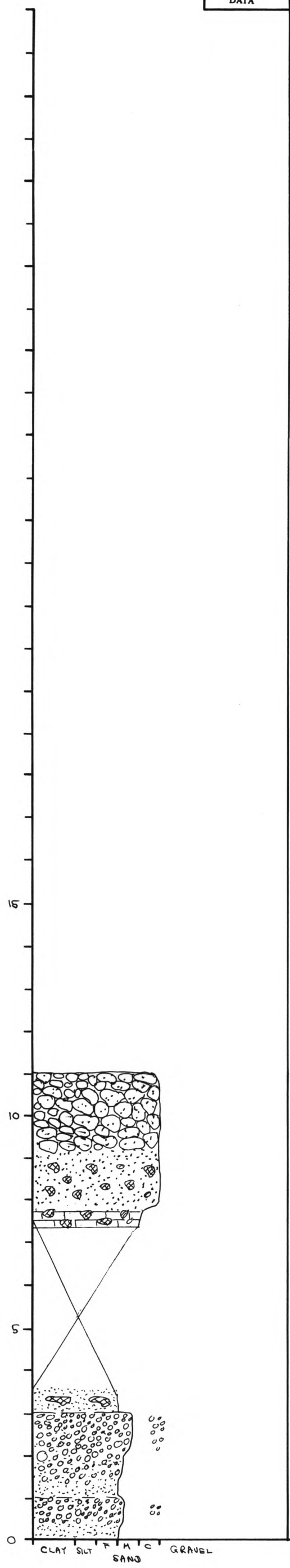
GOLDEN CAP 2 (SY 405 920)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				chert gravel, representing decalcified Chert Beds
				strongly-weathered pale brown fine sand; mud-free; structureless and homogeneous
			Trigonia	pale green to buff-weathering, fine-grained, weakly-glauconitic sand; structureless and fully-bioturbated; little mud, strongly oxidised



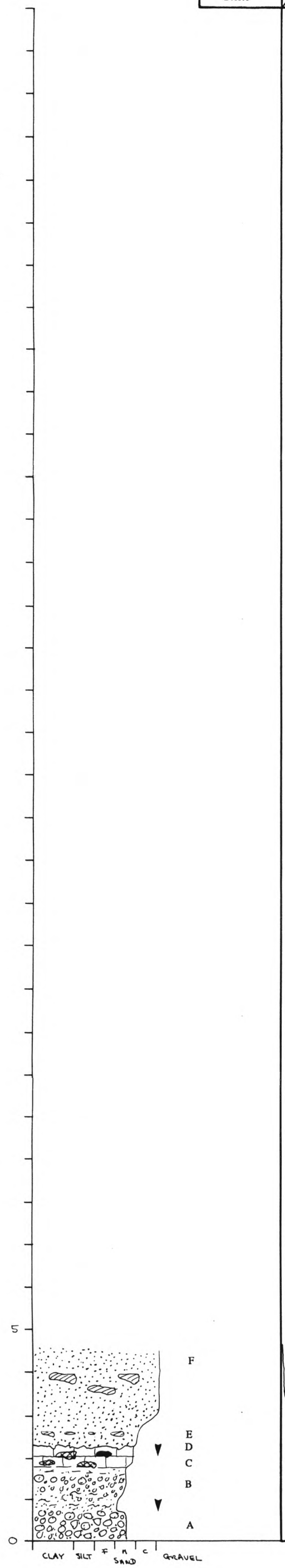
EGGARDON HILL (SY 939 948)

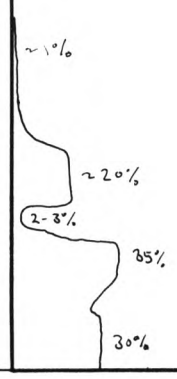
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Eggardon Grit- well-cemented, hard, variably nodular to massive coarse-grained calcarenaceous sandstone. well-rounded coarse quartz grains
	0 - 1 %			soft, poorly-cemented coarse calcarenaceous sand; occasional small granules; abundant small scattered siliceous nodules after *Thalassinoides* burrows
				pale brown soft calcarenites, with common siliceous nodules and chert
				gap in exposure
	30 - 35 %	buff lining		soft green-grey, strongly bioturbated glauconitic calcrenaceous sand; siliceous nodules
	25 %			Exogyra Rock- shelly nodular glauconitic sandstone; more shelly than the bed below; shells in range of random orientations; top 0.9m reworked into a pebble bed, pebbles are smaller (0.5-5cm) than nodules below, and bored and serpulid-encrusted
		buff lining		Exogyra Rock- shelly nodular glauconitic sandstone; nodules 2-10cm across, scattered to intergrown; most oysters are small sprat. ?top part reworked
				fine-grained glauconitic calcareous sand

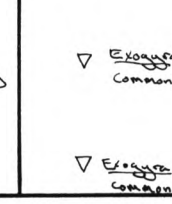


STANDER'S MILL PLANTATION (SY 588 975)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES







F: pale brown, uncemented coarse calcarenaceous sandstone; well-rounded quartz grains 0.5mm across

E:bed of scattered nodules of isolated pale brown limestone intergrown into glauconite-rich sand; these rest in a matrix of muddy, sandy glauconitic greensand

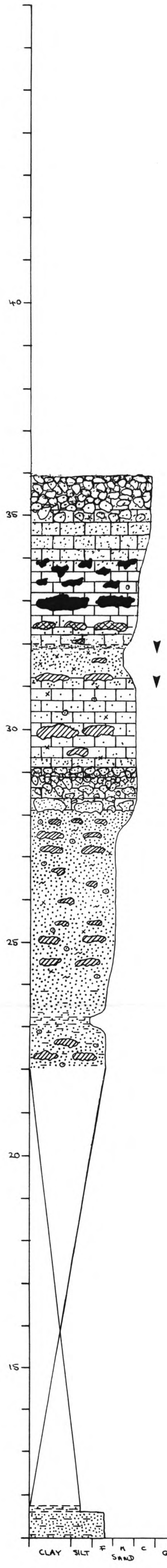
D:prominent basal erosion surface, with piping down of glauconitic sediment in burrows for 0.22m

C: pale, cream-coloured glauconite-free calcarenites with siliceous nodules and chert; muddy glauconitic bed at the base

B: Exogyra Rock: nodular, glauconitic sandy limestone; at base, burrowing and piping of glauconitic marl into underlying pale brown sandy limestone

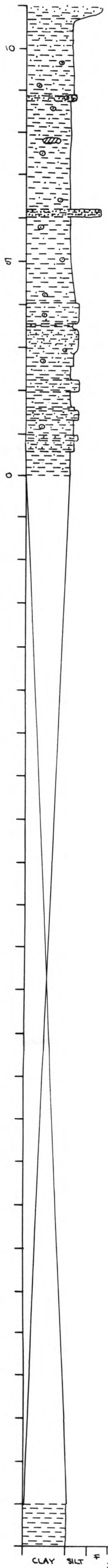
A:Exogyra Rock: nodular, glauconitic sandy limstone; soft glauconitic sandy marl matrix

SLIPPED BLOCK WEST OF WHITE NOTHE (SY 769 809)



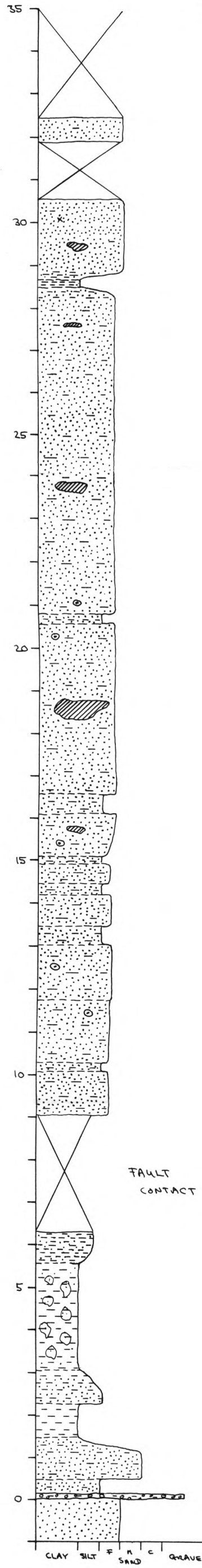
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
	~5%	between the nodules.	∇, ⩓, ▽	The Eggardon Grit, a pale brownish-grey nodular sandy limestone. nodularity appears progressively.
	~7-8%		▽, ⩓	Pale cream-coloured, siliceous limestones/ calcarenites. Abundant chert nodules, also siliceous nodules + rare pyrite nodules.
	~60% glauconite-rich	sss buff mud-lined.	▽, ⩓, many Pecten, Phosphatised	Minor glauconitic hiatus, ↯d basal contact. Dispar Zone Ammonite Bed :- grey-green phosphatic, calcareous greensand ↯d basal contact.
	~30%	sss buff mud-lined	▽ Exogyra Pecten Phd ▽s	Glauconitic, slightly sandy, phosphatic calcarenites, with calcareous concretions.
		buff mud-lined	▽-rich Exogyra Pecten Rotularia	The Exogyra Rock - a nodular, glauconitic sandstone bed. Top 0.7m = a mass of interlocking nodules.
		sss fully bioturbated	▽ Exogyra Common.	Pale green, fine-grained, glauconitic muddy sands. Structureless + sss. Calcareous + muddy-marly. Scattered calcareous concretions. Occasional small dark brown phosphate nodules.
		buff mud-lined		
		sss	-	Thin bed of black, fairly pure, only slightly silty clay.
		sss		Fine-grained muddy sands.
	v. low (0-?%)	sss mottled dark + pale grey	▽	Fine-grained, dark grey sandy clay Very muddy, mottled grey, fine sand

SECTION BELOW HOLWORTH HOUSE (SY 764 814)



PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
		sss pale grey silt fill	▽, Exogyra ▽ Entolium	Mottled grey, very muddy fine sand
		sss few ⌀s, occasional		Dark grey, compact, silty clay. Scattered pyritic nodules.
				Dark grey-brown soft, silty clay
	0% (-?%)	pale grey silt-filled ⌀s 1cm diam.	Fossils not common rare ▽, Entolium	Dark grey. Compact, slightly silty clay. occasional small calcareous concretion.
	slightly glauconitic, ~2%			Pale-weathered muddy fine sand, ⌀d upper and lower contacts.
		pale grey silt-filled ~1mm diameters	▽s, Entolium large + small	Compact, dark grey clay. Fairly pure + silt-free, scattered pyrite nodules
		sss	▽ Entolium	Soft, silty, slightly sandy clay. Mottled dark grey + paler greenish grey. (thin bed of soft weakly silty clay. Mottled greenish-brown and grey, silty. Sandy clay.
		sss pale grey silt-filled common		Interbedded weakly silty and moderately silty clays (rhythmic bedding - weakly defined) Mottled dark grey + paler grey-brown in colour.
				Grey silty clay
				Large gap in the section; basal unconformity not exposed.
				Kimmeridge Clay exposed below

DURDLE COVE 1 (SY 805 806)



PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				pale greenish-grey, fine-grained glauconitic sand
			▽	pale greenish-grey, fine-grained, glauconitic sand; low mud content
		// °		thin bed of dark grey, soft, very pure clay
			▽	
		// °		thick sequence of uniform, mottled darker and paler grey, muddy, silty fine sand
		ϟϟϟ	ᘐ	
			ᘐ	
		// °		
			ᘐ	poorly-exposed sequence of fully-bioturbated, burrow-mottled, fine-grained, muddy sand
		ϟϟϟ		
			ᘐ, ▽	
		// °		
		ϟϟϟ	▽, ᘐ	
			ᘐ	
		/		
		// °	▽, ᘐ	
		/		
		ϟϟϟ		rhythmically-bedded sequence of strongly bioturbated, burrow-mottled, interbedded fine-grained, muddy, silty sands, with subtle variations in the mud:silt:sand contents. brown-grey in colour
		// °		
		/	▽ internal moulds	
		// °	▽ internal moulds	
		// °		
		ϟϟϟ	▽	
		// °		
				gap in the section, with later fault cutting out an unknown thickness of Gault and Upper Greensand
			▽	strongly burow-mottled sandy fine clay
		ϟϟϟ		
		ϟϟϟ	–	dark blue-grey, soft, weakly silty clay; homogeneous with only rare small burrows; strongly yellow sulphur-stained and brown, iron-stained
		// °		
		ϟϟϟ	–	dark grey, poorly-sorted mixed clay and fine sand; burrow-mottled
				soft, dark grey, pure clay, sulphur staining
		ϟϟϟ	–	poorly-sorted fine to coarse to granuly muddy sand
				brown, coarse silt
				brown, iron-stained pebbly silt
				Wealden: pale grey soft, fine-grained sand

DURDLE COVE 2 (SY 805 806)

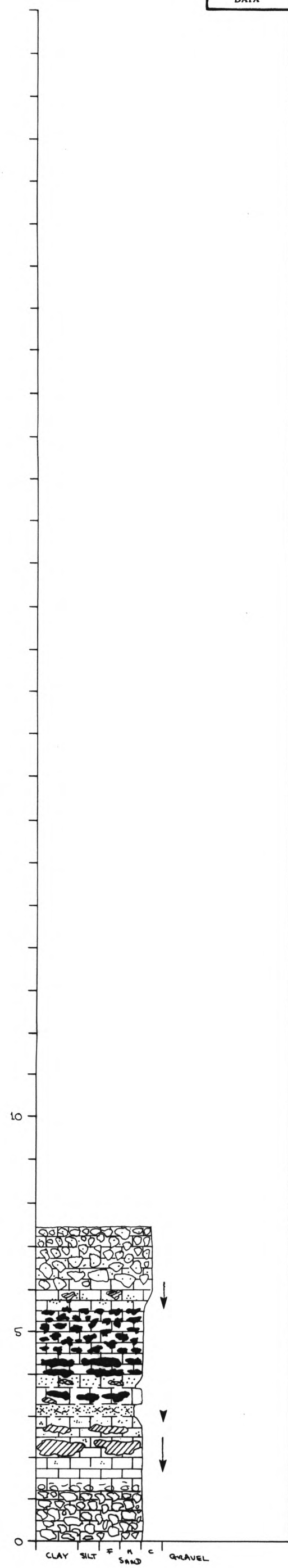
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Eggardon Grit- pale grey thick nodular, sandy limestone; coarse sand infilling *Thalassinoides* burrows at the base; glauconitised nodule margins (burrow walls) in the upper part; phosphatic crusts on upper surface.
				brown limestones with silicified *Thalassinoides* burrows
				brown, compact, slightly glauconitic siliceous limestones; chert nodules up to 0.5m thick in lower part
	smaller peak / major peak		Phosphatised	Dispar Zone Ammonite Bed- dark green to black phosphatic muddy, silty greensand; additional minor glauconite concentration above.
		buff linings	Pk	pale green-grey glauconitic marls with scattered small dark brown phosphate nodules, and occasional buff marl-lined burrows; lines of dark grey calcareous concretions
				Exogyra Rock- a green, glauconitic shelly nodular sandstone; irregular upper surface; decreasing nodule size towards the top
		buff lining		green-brown, fine-grained glauconitic sand; low mud content

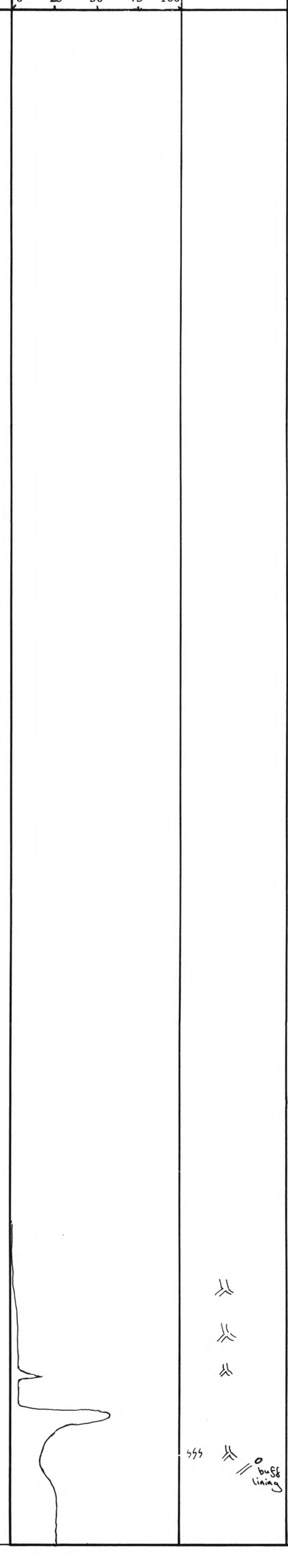
50
45
40
35

CLAY SILT F M C SAND GRAVEL

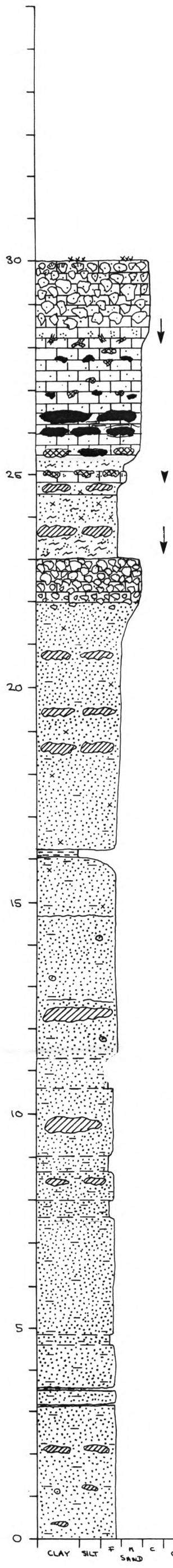
ST. OSWALD'S BAY (SY 815 800)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Eggardon Grit- a pale grey-brown nodular, slightly glauconitic sandy limestone; glauconited nodules in upper part and phosphatic crusts on upper surface
				grey-brown limestones, pervasively penetrated from above by a *Thalassinoides* burrow system, filled with coarse calcarenaceous sand
				grey-brown, chert-rich limestone; up to half the sediment replaced by silica; nodules typically a few cm across
				minor hiatus marked by glauconitic calcarenite; burrowed basal contact
				grey calcarenite with chert nodules and traces of lamination
			Ph	Dispar Zone Ammonite Bed- glauconite-rich phosphatic marly greensand; strongly bioturbated with burrowed basal contact
				dark greenish-grey glauconitic calcarenite
				greenish-grey glauconitic limestone
				Exogyra Rock- greenish-grey shelly, nodular glauconitic limestone; poorly-defined top, becoming less nodular upwards



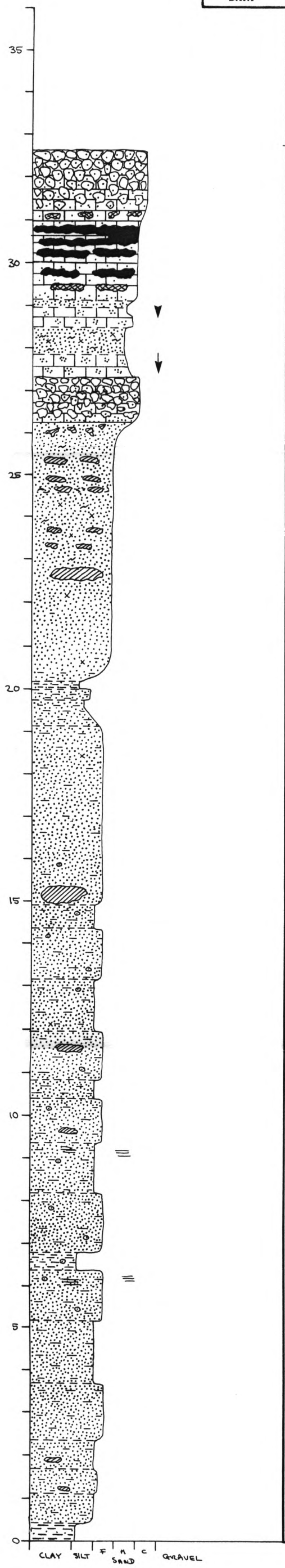


LULWORTH COVE, WEST SIDE (SY 825 800)



PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
			▽	The Eggardon Grit, a grey-brown, nodular sandy limestone. Basal part is a mass of coarse quartz-rich sediment filling Thalassinoides burrows. Upper surface glauconitised, with patchy phosphatic crusts over the nodules. Overlying sandy limestone piped into the top of the bed in burrows.
	~ 2 %			limestones with silicified Thalassinoides burrows.
	~ 10 %		–	grey-brown glauconitic limestones with abundant chert nodules, thick and prominent in the lower part.
		≋		minor glauconitic concentration above the DZAB.
	~ 60 %	≋	Ph ▽, ᘐ	Dispar Zone Ammonite Bed, a dark green, muddy phosphatic greensand, with burrowed basal contact.
			▽, ᘐ	glauconitic marls with phosphate nodules, and calcareous concretions.
	~ 15 %			The Exogyra Rock, a nodular, moderately shelly, glauconitic sandstone
		≋	▽, ᘐ	grey-green, glauconitic (about 15%), fine-grained marly sands with scattered small dark brown phosphate nodules, and calcareous concretions.
	~ 20 %	≋ buff lining		
		≋ buff lining ≋ black lining	▽, ᘐ	black mud to brown marl transition, as shown by changes in the Palaeophycus burrow linings.
	~ 10 %	≋		greenish-brown fine-grained, slightly muddy glauconitic sand
		≋ black lining	▽, ᘐ	thin bed of black, very pure clay
	~ 7 %			fine-grained, glauconitic muddy sand. scattered small dark brown phosphate nodules and ocasional pyrite nodules.
		≋	ᘐ	
	~ 3 %			fine-grained, greenish-brown slightly muddy, slightly glauconitic sands with black mud-lined burrows. line of calcareous concretions.
		≋	ᘐ	muddy fine sands, strongly burrow-mottled, with rhythmic-bedding due to minor variations in the clay content of each bed.
	~ 3 %	≋	▽	
		≋	▽, ᘐ	greenish-grey muddy very fine sand; low glauconite content, around 2%.
		≋	▽, ᘐ	
				thin seams of glauconitic clay
		≋		
		≋	▽	homogeneous grey-brown muddy sand.

LULWORTH COVE, EAST SIDE (SY 828 800)

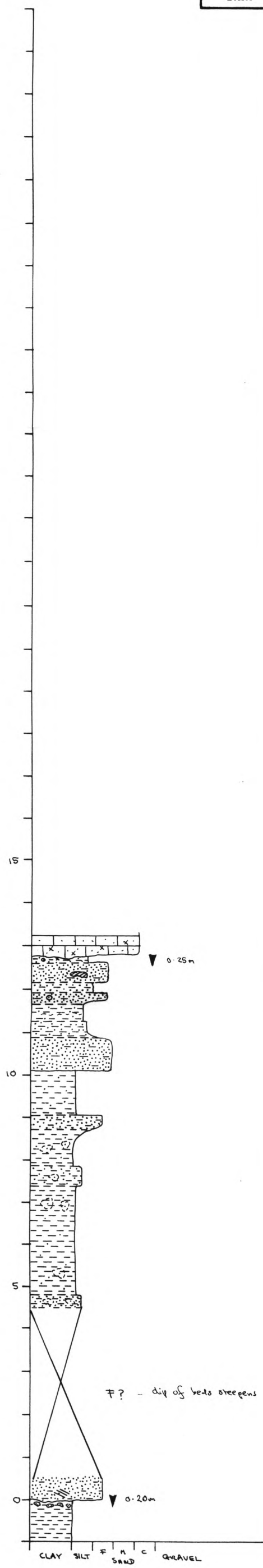


PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
	low ~2%			The Eggardon Grit, a coarse-grained nodular, calcareniteous sandstone. A mass of intergrown nodules. Pale grey colour.
	low, ~2%	Silicified small ✗s	–	Quartz-rich in lower part, representing a Thalassinoides ✗-fill.
			–	Pale brown, slightly glauconitic siliceous limestones. Well-developed chert horizons.
	50%		▽	Muddy, slightly quartzose glauconite-rich greensand. Rd basal contact.
	15%			Glauconitic limestone; cream-coloured.
	55%	buff lining	Ph ▽, ▽	Glauconite-rich marly greensand, the Dispar Zone Ammonite Bed. Phosphatic, with Phd ▽s. Burrowed basal contact
	~15%		▽, Exogyra Pecten, Rotularia Concava	Glauconitic marly limestones. The Exogyra Rocks, a compact mass of well-cemented, nodular, glauconitic sandstone with shelly nodularity dies out at base.
	~12%	buff lining	▽,	Thin bed rich in patches of Exogyra + Rotularia. Correlates with bed at Worbarrow Bay.
			common ▽,	Fine-grained, structureless and strongly bioturbated glauconitic sands. Around 10-15% glauconite. Scattered calcareous concretions + concretionary horizons.
		buff linings		
	↑ increasing glauconite	black linings	▽, Exogyra, Rotularia Concava	Transition from muddy sands below, into marly sands, as reflected by the lining of small Palaeophycus burrows.
	~5%	$$$ fully bioturbated		Fine-grained, slightly muddy, glauconitic sand. Structureless, fully bioturbated, pale greenish grey colour. Burrow-mottled
			Ph ▽	
			▽	Thin bed of dark grey silty clay
		$$$		Fine-grained muddy sand
			▽	Very muddy, fine silty sand
				Fine-grained muddy sand, becoming glauconitic upwards.
			Ph ▽	
	~2%	$$$	rather fossil-poor.	Fine-grained muddy, silty sands, low glauconite concentration, ~2%. Brownish-grey in colour. Burrow mottled and strongly bioturbated. Occasional small pyritic nodules 1-2 cm across.
			occasional small ▽ Exogyra.	
		common		scattered large calcareous concretions.
		$$$	rare	
				Rhythmically-bedded fine-grained, muddy, silty sands and muddy, sandy silts. Rhythmicity defined by subtle fluctuations in the mud: silt contents.
			▽,	
			Ph ▽	Structureless and strongly bioturbated. Burrow-mottled, mud concentrated into black-mud lined ? Palaeophycus burrows.
	0-1%	– no b.m. fossils		Scattered small pyrite nodules, occasional calcareous concretions.
			▽, ▽ internal moulds,	
		$$$	–	
		common		muddy, silty fine sand, with weak suggestions of horizontal lamination
		pale silt fill	▽	
	0-1% glauconite	$$$	▽	
		$$$ brown lining	occasional	soft, slightly silty clay, structureless and $$$

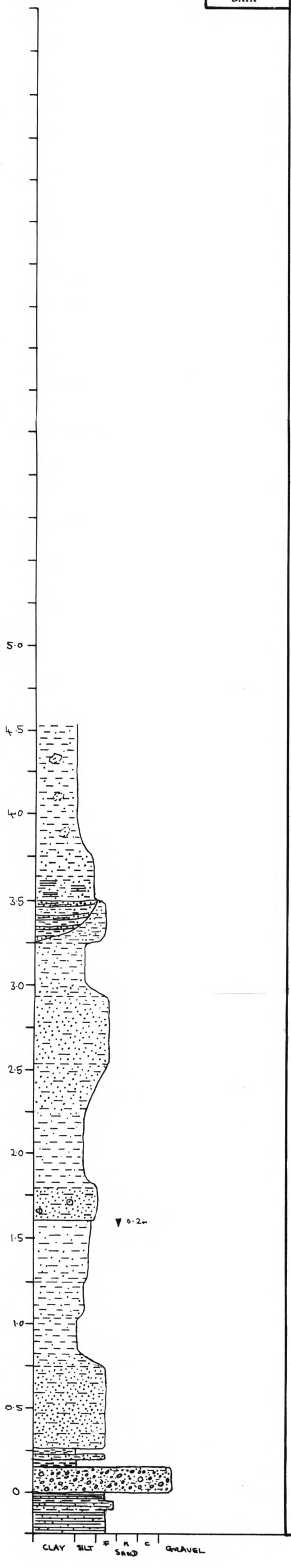
3 4

MUPE BAY (SY 843 800)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Chalk Basement Bed- sandy, glauconitic and phosphatic limestone
	increase in [glauconite]	black clay-lined; burrow clay lined; $$$	Phosphatised ▽s	dark green-brown sandy glauconitic clay
				pale brown structureless muddy fine sand
				sandy clay to muddy fine sand
				greenish grey muddy fine sand
			Rotulana ▽ Entolium	dark silty clay with weak shelly concentration
	3-6%		occasional	pale brown, weakly glauconitic fine sand
		$$$ x - mottled		dark grey silty clay, strong bioturbation
		$$$ x mottled		grey-brown, muddy fine sand, burrow-mottled
		$$$		compact, pure blue-grey clay
		$$$		brown-grey compact silty clay
		$$$		dark grey fine silty clay
			▽ moulds	silty clay, iron-stained
		$$ black mud silted		Green-brown muddy fine sand, burrow-mottled
				Lower Greensand-pale grey clay with bedding-parallel ironstone nodules

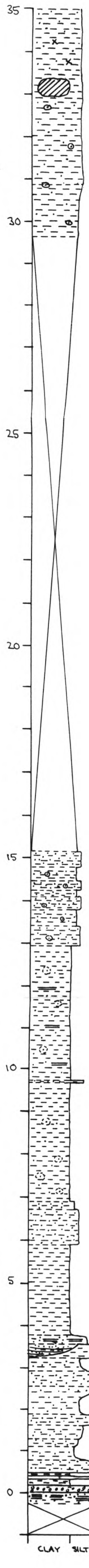


WORBARROW BAY, BELOW FLOWER'S BARROW - BASAL GAULT (SY 866 804)



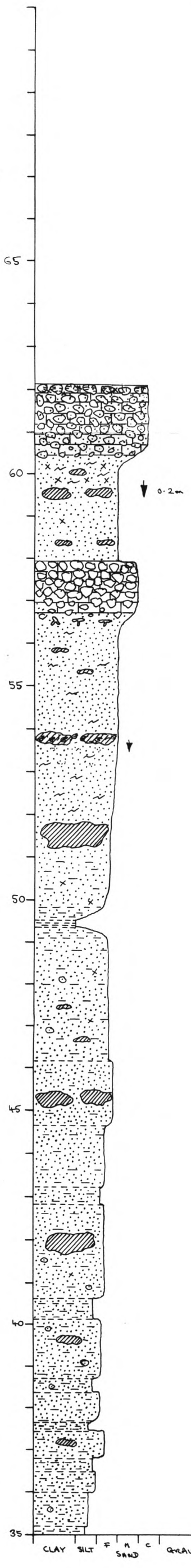
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
	not glauconitic.	Structureless only rare, poorly-developed pale grey muddy silt-filled.	no fossils recorded	Dark grey, very pure, almost silt-free, massive clay. Sulphurous yellow-staining common - incipient pyritic nodules.
		progressive ⌀g	–	Interlaminated white silt and black clay - in patches due to ⌀g.
		silt-filled	–	Large scour, infilled with interbedded brown, muddy sand and clay, with pale silt and clay laminated thin beds. Scour cut into mixed sand, silt + clay.
		⌀ - mixed, with sand in small patches.	–	Mottled dark grey + grey-brown poorly-sorted sandy clay - g̲ up to coarse grade.
			–	Fine-grained muddy sand, poorly-sorted, with occasional g̲ grains up to 2mm diam. Brown + Fe-stained.
	not glauconitic	but no obvious ⌀s	–	Poorly-sorted (fine) sandy clay, dull grey-brown in colour. Scattered coarse g̲ grains + rare small granules up to 5mm diameter.
			–	Reddish-brown muddy fine sand. Poorly-sorted with occasional coarse g̲ grains. Some small pyritic nodules. Basal burrowing.
		small ⌀s 1·5cm diam.		
			–	Dull purplish-grey, sandy, silty clay with scattered small g̲ granules + coarse grains up to 5mm diameter. Sand : silt ratio increases upwards.
		⌀ // - mottled		Mottled dark grey to brown, silty clay. Structureless, ⌀ - mottling.
		pale grey silt-filled	–	Dark bluish grey clay; low silt content. Rare scattered small quartz granules. Scattered small pyrite nodules. (2·7mm diameter)
	few distinct ⌀s		single small ▽	Mottled dark + pale grey, very muddy fine-grained sand.
	not glauconitic		–	Thin bed of dark grey clay. Muddy fine sand Thin bed of purple-grey clay
			–	Poorly-sorted, pebbly clayey sand. Pebbles of quartz and chert.
				Erosion surface
		not ⌀d	–	Lower Greensand - laminated clean white silt + black Mud - (horizontal + (rare) X-lamination

WORBARROW BAY, BELOW FLOWER'S BARROW 1 (SY 866 804)



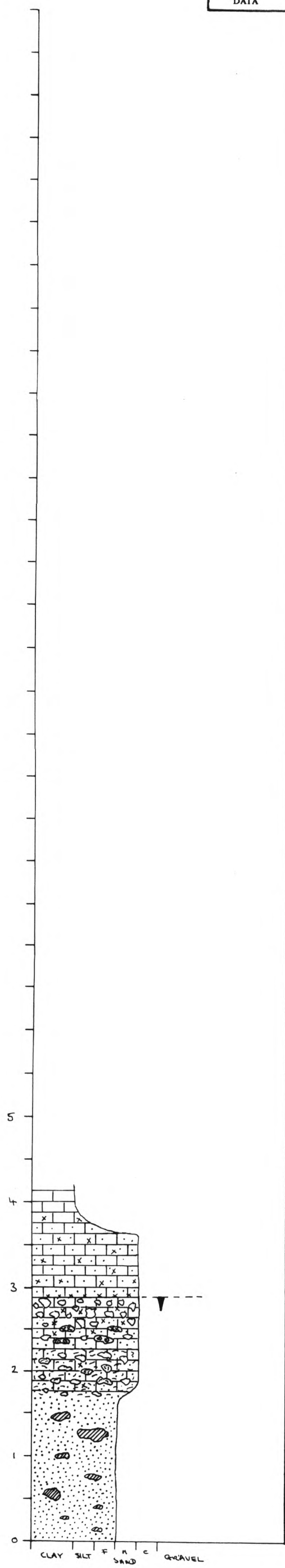
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
		ϟϟϟ with indistinct & mottling	▽s Exogyra Entolium occasional Phosphatised ▽	Fine-grained, (fine) sandy, silty clay. Mottled dark bluish grey - paler grey in colour. Rare small phosphate nodules.
		strongly ϟϟϟ irregular & mottling // black mud-lined	Scattered ▽s Exogyra, Entolium	Fine, silty clay mottled a darker + paler grey
	not apparently glauconitic.	compressed black mud-filled ▽s.	▽s, Entolium	↑ increase in [silt] Dark blue-grey, weakly silty/fine sandy clay. & = mottled
				Clay in the section of approximately 14.5 metres.
		pale grey silt-filled ϟϟϟ	occasional Small ▽s	Mottled brown-grey (fine) sandy clay. Dark grey, only weakly silty clay. Mottled sandy / silty clay. Weakly silty clay. Sandy / silty clay. Dark grey, weakly silty clay Mottled dark-grey / brown-grey silt-rich clay Occasional pyrite nodules. } rhythmic bedding
			occasional Small ▽s	
not apparently glauconitic.		rather homogenous rare pale silt-filled	apparently unfossiliferous	Dark grey silty clay (low to moderate silt content). Small incipient pyritic nodules. Rare traces of pale grey silt and dark grey mud lamination. Lamina thickness ~ 0.25 mm 8cm-thick bed of grey muddy silt - pale colour.
		possibly-developed pale silt-filled.	fossils rare - occasional Small ▽ moulds.	Dark blue-grey, soft, pure clay, low silt content
		no burrows developed	no fossils recorded ▽ Entolium	Almost silt-free dark grey clay with incipient pyritic nodules.
		rare pale grey silt-filled.	—	Dark grey, very pure, almost silt-free clay Yellow Sulphur-staining.
				Large scour, filled with laminated clay, sand + silt
		See additional log for details	—	Interbedded muddy fine sands and variably silty clays } See additional log for detailed section.
				Poorly-sorted pebbly, clayey sand — Basal erosion surface Lower Greensand

WORBARROW BAY, BELOW FLOWER'S BARROW 2 (SY 866 804)



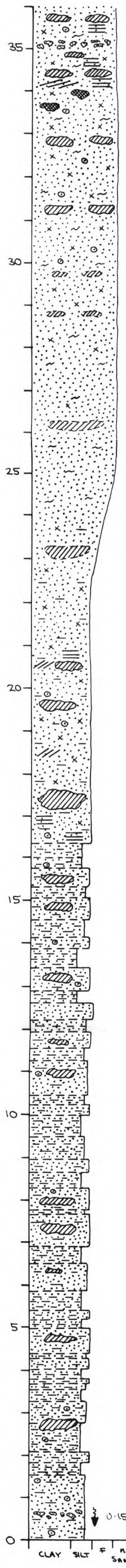
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
	~5%	between the nodules	▽s, Pecten (V), regular Echinoids	The Eggardon Grit – a grey-brown, quartzose, slightly glauconitic nodular limestone. Upper nodules truncated by erosion surface also glauconitised + some phosphate
	~50% approximate	sss //	▽ Exogyra Entolium + Phosphatised ▽s	Dispar Zone Ammonite Bed – green, uncemented marly, sandy greensand, with phosphate. Burrowed basal contact.
	~25%	sss // buff marl-lined		Pale grey-green, slightly marly fine sands. Scattered small calcareous concretions and small light brown phosphate nodules.
	~7%	⇒ Calcareous concretions	▽s Exogyra common Pecten Rotularia	The Exogyra Rock – a shelly, nodular, glauconitic sandstone. Nodules intergrown in the upper part.
	~5%	sss // buff marl-lined 3mm – 1cm diameter	(V)	Pale green-grey, well-sorted, slightly marly, weakly glauconitic fine sands. Unconsolidated, except for calcareous concretions.
	~25%		Rotularia – very rich occasional ▽	
	~5%	sss		Dark green serpulid-rich glauconite-rich sandy limestone, often with calcareous cementation.
	(5-10% estimate)	// buff marl-lined	▽ Exogyra Neithea Entolium occasional Phosphatised ▽	Fine-grained, slightly marly, glauconitic sands; soft + uncemented. Calcareous concretions, scattered small phosphate nodules.
	~3%	sss // buff marl-lined		Thin bed of black slightly silty clay
		MIXED black mud-lined // buff marl-lined transitional	▽ Exogyra Rotularia	Soft, uncemented, fine-grained, moderately muddy fine, silty sand. Scattered small phosphate nodules and pyrite nodules.
		sss // mixed	▽ Exogyra + internal moulds	Pale grey, fine-grained muddy / silty sands.
		// black mud-lined	Rotularia	
		sss	fish tooth small ▽s	
	~2% glauconite	//	▽ Exogyra Rotularia	Rhythmically bedded succession of variably muddy fine-grained silty sands to sandy silts. Rhythmic bedding caused by subtle fluctuations in sand : silt : clay ratios. Strongly bioturbated and ∅ - mottled. Grey-brown to mottled dark brown in colour.
		sss - rich //	▽, (G)	
		//	▽	
		sss //	▽ (G)	
			▽, Pld ▽	

SWANAGE BAY (SZ 044 811)



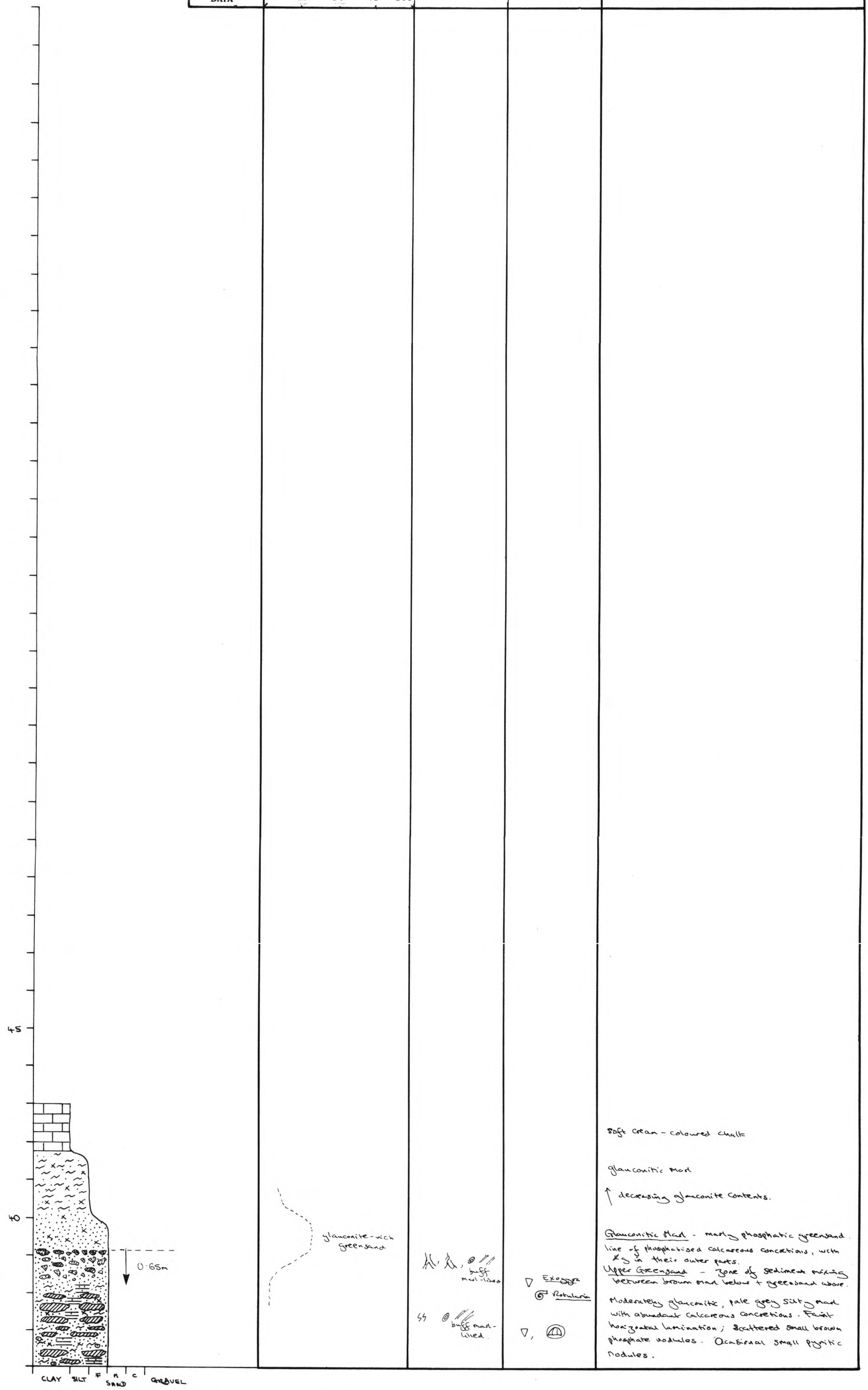
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Glauconitic Marl above- glauconitic, phosphatic marl
		burrowed contact	rare Exogyra	Eggardon Grit equivalent- nodular glauconitic limestone; low sand content; glauconitic weakly phosphatic marly matrix
				Complex concretionary bed with 2 nodule generations - of pale brown limestone with burrow-mixed outer parts - and nodules preserving pale brown phosphate; rest in a glauconitic marly matrix
			Exogyra Nerinea Pecten Rotularia	Exogyra Rock equivalent- shelly glauconitic calcareous sand; scattered calcareous nodules
		Structureless	Exogyra Pecten Rotularia Concava	fine-grained glauconite-rich sand; well-sorted and mud-poor; scattered calcareous concretions

COMPTON BAY, ISLE OF WIGHT 1 (SZ 367 853)



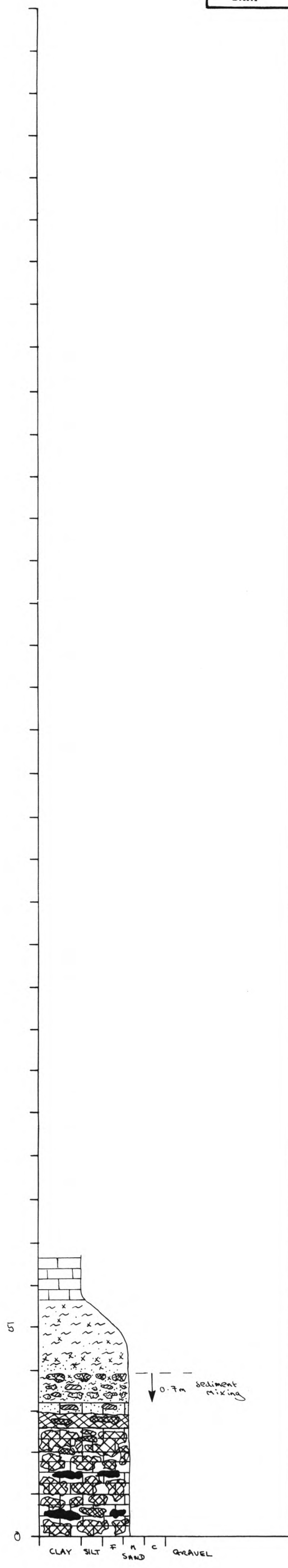
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
	increase in glauconite.	buff marl-lined	Exogyra, Pecten	Glauconite-rich, marly fine silt.
				Traces of horizontal to low-angle cross-lamination.
			Exogyra, Rotularia	Glauconitic, marly, fine-grained silty sand. Structureless and strongly bioturbated. Scattered small phosphate nodules. Calcareous concretions common.
				Fine-grained, slightly muddy glauconitic sand
		buff marl-lined	rare	Small phosphate nodules + calcareous concretions.
				Poorly-cemented calcareous marly siltstone.
			v. rare	soft, very weakly-cemented glauconitic fine sand, slightly muddy.
	gradual increase in glauconite contents.	structureless + fully bioturbated	very rare	Calcareous concretionary horizon
				Phosphate-poor interval of glauconitic fine grained siltstone.
				Phosphate-poor.
v. weak		buff-marl lined common	rare Pecten, Exogyra, Rotularia	Dark grey-brown muddy fine sandy silt. Only weakly glauconitic. Phosphate nodules common.
v. weak			Rotularia, including Exogyra	Muddy fine sandy silt, greenish-brown in colour. Phosphate nodules present, but not common. Scattered small pyrite nodules. Preserved patches of horizontal and planar cross-lamination (flow ?).
		mixed buff marl + black mud linings		
			Exogyra, Rotularia	Thick, laterally persistent concretionary horizon.
Glauconite v. low concentration to absent.				Rhythmic bedding dies out, and passes up into homogeneous, muddy to marly fine silts to fine silty sands. Phosphate uncommon; scattered small pyrite nodules.
			rare	Unit of rhythmically-bedded variably muddy fine-grained silts to silty fine sands = the Passage Beds. Variable mud contents between successive beds.
			Exogyra	
very low to absent			very fossil-poor	Calcareous concretionary horizons and scattered small pyrite nodules.
			very few fossils	
peak in glauconite content			Isognomia mould	Rhythmic bedding appears. Burrowed contact Dark grey muddy silt with pyrite.

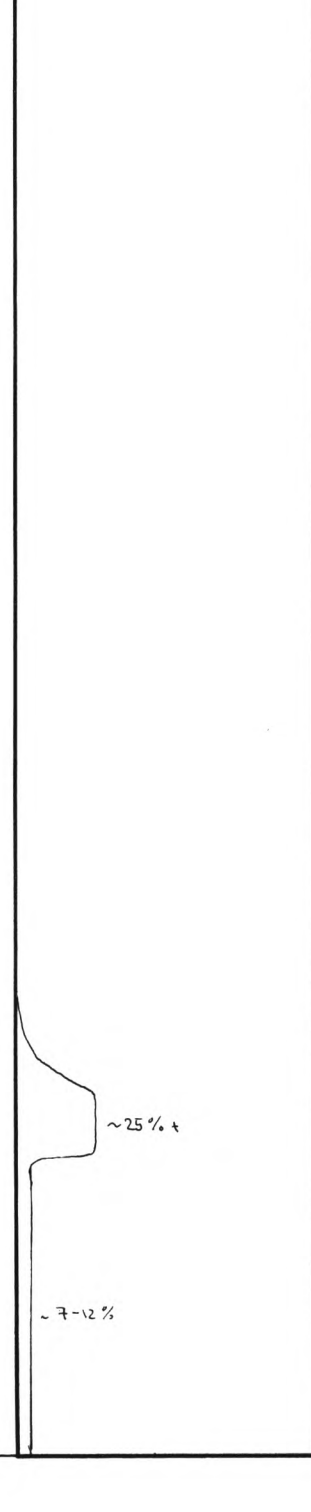
COMPTON BAY, ISLE OF WIGHT 2 (SZ 367 853)



NATIONAL TRUST CAR PARK, NEAR BLACKGANG CHINE, ISLE OF WIGHT (SZ 491 767)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES





Phosphatised ⊛'s.

occasional small Exogyra ▽s.

▽ Exogyra Pecten

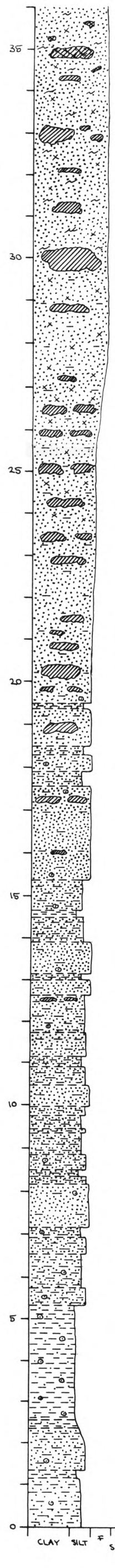
Pale, cream-coloured Chalk; fine-grained, low glauconite content.

gradual ↓ in the glauconite content.

The Glauconitic Marl, a glauconitic-rich, phosphatic marl. Higher phosphate concentration in the lower part. Burrowed basal contact. Phosphatised and glauconitised calcareous concretions at the contact.

The Chert Beds :- silica-rich glauconitic limestones, pale grey to greenish-grey in colour. Strong bedding-parallel siliceous concretionary horizons and chert. ⊛ phosphates.

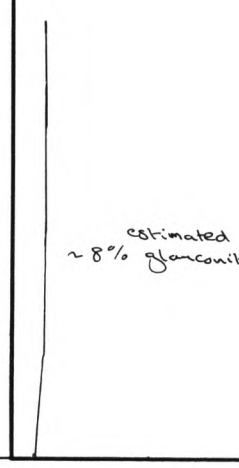
GORE CLIFF, ISLE OF WIGHT 1 (SZ 492 763)

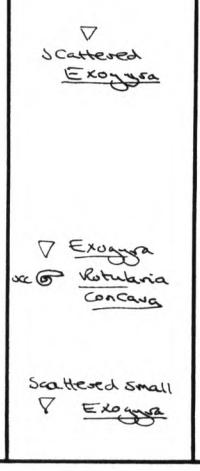


PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
		some silicified		Fine-grained, indurated marly, silty sand with well-developed lines of silico-calcareous concretions.
		buff mud-lined ⌀s common	occasional small Exogyra	Grey-brown, fine marly silty sand, scattered small phosphate nodules.
		buff mud-lined. sss	Exogyra Entolium; Rotularia	Fine-grained, silty, marly sand, only slightly glauconitic; rare small phosphate nodules, 1-2mm in diameter. Sediment a pale-grey brown in colour.
	very low, few %.			Facies change from more muddy sediment matrix below, to a more marly matrix above.
		occasional small clusters of Ph. nods	Rotularia concava	Strongly bioturbated, structureless, fine-grained, muddy silty sand. Scattered small dark brown phosphate nodules
		marly buff mud-lined, a few black mud-lined ⌀s.	Phd.	
		occasional buff marly lined	small Exogyra; Rotularia	Compact muddy slightly marly siltstone, with well-developed lines of calcareous concretions.
		black mud-lined	scattered Rotularia	
	~2-3% maximum concentration	sss but few ⌀s discrete	Rotularia concava; reptile tooth	Fine-grained calcareous siltstone, only weakly muddy/marly. Slightly micaceous (muscovite); very weakly glauconitic (2-3%).
	not glauconitic			The Passage Beds Rhythmically bedded, variably muddy siltstones, with calcareous concretions. Rhythmic fluctuations in the mud contents of successive beds All strongly bioturbated and ⌀ mottled Pale grey to darker grey in colour. Scattered small pyrite nodules. Some beds of silty clay at finest end of the spectrum; range up to weakly muddy siltstones.
		black mud-lined	rare	
			rare Rotularia	
			rare Entolium	
		black mud-lined + throughout		
			rare / occasional Entolium	
			rare	
		⌀s rare		compact. very muddy silt to silty clay. dark grey; scattered incipient pyritic nodules.
		black mud lined		
		bml.	common incl. Entolium	very muddy silt. Muddy fine silt

GORE CLIFF, ISLE OF WIGHT 2 (SZ 492 763)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES





Chert Beds
Pale greenish-grey siliceous marly limestones/marls. Scattered small pale brown + dark brown phosphate nodules. Slightly silty.
Strong bedding parallel siliceous to chert concretionary horizons
Weakly glauconitic sediment.

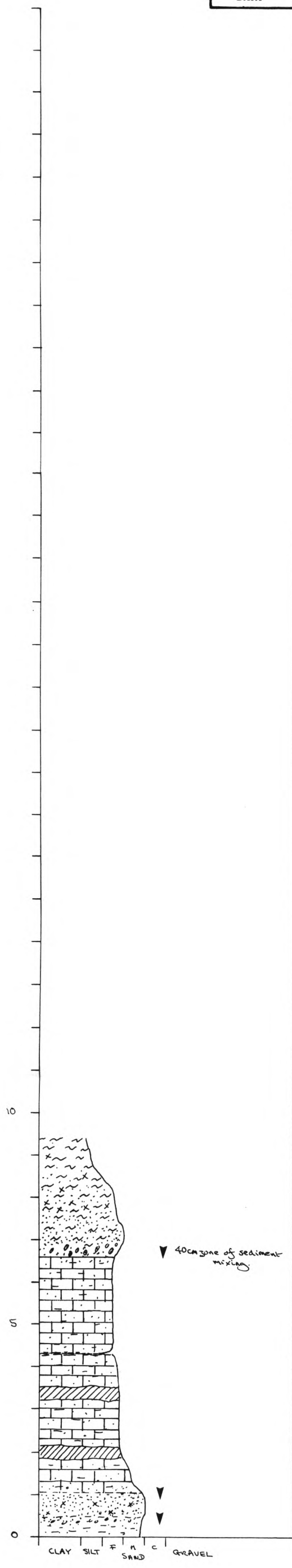
Indurated, fine grained, marly fine silt around 7% glauconite. Pale greenish, brownish grey in colour. Scattered small phosphate nodules and phosphatised ⁂s.

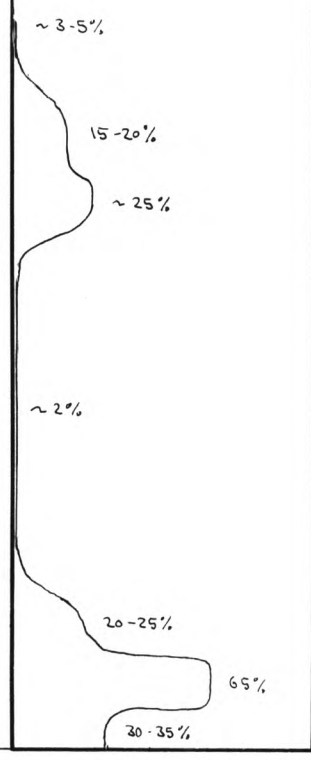
Strongly-silicified concretionary horizon.

Fine-grained, slightly glauconitic, marly fine sand. Scattered small phosphate nodules, included phd. ▽ infills.

SOUTH OF EASTBOURNE (TV 610 977)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES





no fossils found

Pale green, glauconitic marl with scattered dark brown phosphate nodules. Strongly bioturbated.

Phosphate-rich glauconitic marl.

The Glauconitic Marl - a fine-grained, strongly burrowed glauconitic marl.

phosphate-poor in lower part.

Burrowed basal contact

Pale cream-coloured, soft, fine-grained marly limestone. Low [glauconite]

Thin dark brown muddy bed, prominent interbed in pale limestones. Suggestion of sharp base and bioturbated top. 5-6cm thick.

Pale cream to grey-brown, slightly muddy limestones, glauconite-poor. 2 brown, cemented (calcareous) concretionary horizons.

Pale grey, glauconitic, slightly muddy limestone.

Sediment mixing due to bioturbation.

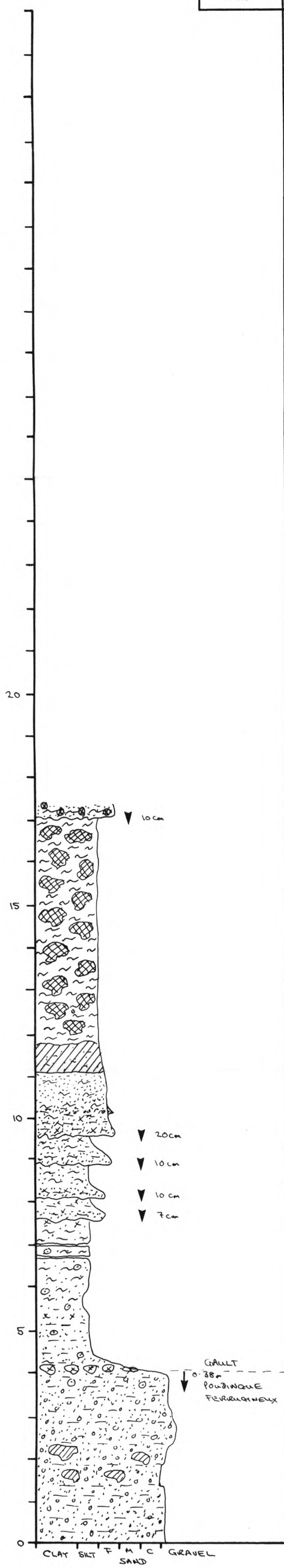
Highly glauconitic, calcareous, silty, marly phosphatic greensand. Mhd. ⌀s. Burrowed basal contact.

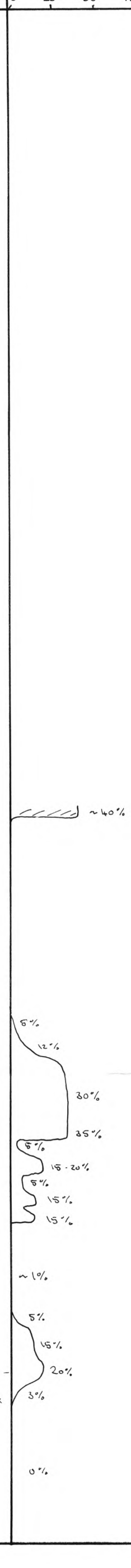
Glauconitic silty limestone

ST. JOUIN-BRUNEVAL

45

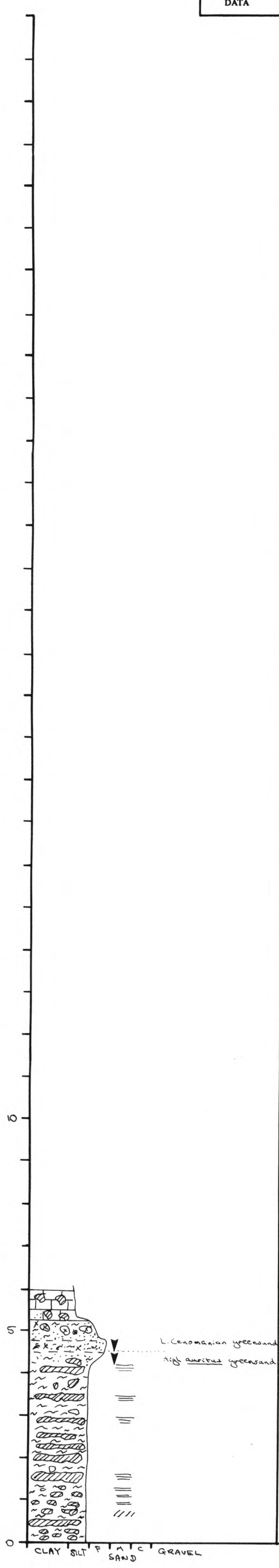
PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
				Green-specked, cream-coloured marly greensand (Glauc. grains v. large - up to 1mm - Abundant bored & glauc. phosphate nodules, up to 4/5-12 across. Occ. nods serpulid-encrusted. Burrowed basal contact.
				Pale grey-brown, buff-weathering, fine-grained siliceous, slightly muddy limestone / marl. Nodular due to patchy silicification. Similar lithology to 'Malmstone' (fine-gr. siliceous siltstone).
		sss many small black mud-filled ⌀s → strong ⌀-mottling		
				rare small pyrite nodules.
				Pale cream-coloured, patchily-silicified limestone Calcareous / siliceous concretions.
		buff marl-lined	serpulid encrusters of Ph. nods.	Concretionary bed of glauconitic marl
		sss		Marly greensand, sss and structureless.
			Exogyra Phd wood	Thin shelly / sandy layer - diffuse concentration Muddy, passing into marly greensand.
			Exogyra Entolium orb. rare gast.	Interbedded glauconitic-rich marly silts, and glauconite-poor muddy silts. Base of each bed a burrowed contact with small Ph. nodules, some incipient nodules just below the contacts.
		pale silt-filled small black mud filled ⌀s		Medium-grey siltstone. glauconite-poor.
		sss pale silt-filled	rare small fragments	2 thin clay-rich seams, 3mm-6cm and 5cm thick sharp lower + upper contacts.
		occasional glauc-coarse sed filled ⌀s		Uniform, dark grey muddy siltstones
		pale silt fill small glauc sed fill 1cm diameter	small Inoceramus bored Phd wood common Inoceramus Entolium	Very weakly glauconitic muddy silt, pyritic, with occasional phosphate nodules.
				Muddy, pyritic, glauconitic silt
				Concentration of pale brown phosphatised nodular gravelly clays; also Phd. wood pieces.
			NB fine shells whole + unbroken	Very poorly-sorted, granuly to pebbly sandy glauconitic clay
		rare, pale silt-filled		Very poorly-sorted pebbly sandy clay Pebbles appear to be randomly oriented. generally well-rounded.
		b.m.l. 7cm long	large Entolium	Moderately gravelly, muddy to coarse sand clay as isolated burrow-linings in patches. Occasional large calcareous concretion.
		sss + structureless		Muddy, granuly fine to medium sand.
				Gravelly, clay-rich silty sand. Common small granules 0-4mm in diameter





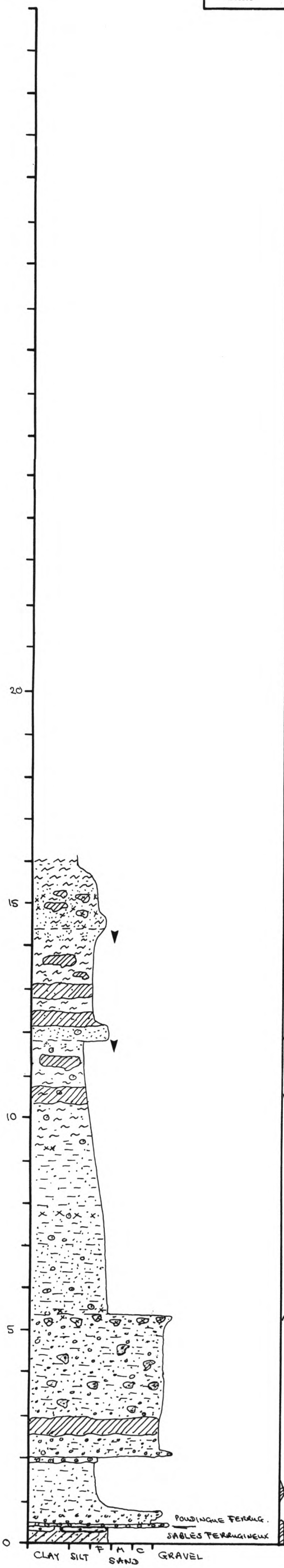
LE CROQUET (SLIPPED BLOCK)

PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
			scattered ▽s	Marly chalk with scattered calcareous nodules.
			scattered ▽s	Glauconitic marl, rich in phosphates, with marginal glauca. + borings. Glauc. calc. nods. & d basal contact.
	~1% ~5% 20% 46%		shelly; ▽-rich; sergs.	Highly glauconitic marly greensand; shelly, rare. Small phosphate nods. (dark brown) Burrowed basal contact.
	~1%	small glauc-lined ▽s ~2cm in diameter; pale silt-filled	–	Medium-brown-coloured marls, with a little silt + muscovite mica. Low glauconite contents. Patches of horizontal lamination, and rarely, planar x-lamination. Calcareous concretions common throughout



47

ST. ADRESSE



PALAEOCURRENT DATA	% GLAUCONITE 0 25 50 75 100	TRACE FOSSILS	FOSSILS	DESCRIPTION / NOTES
	~20%	buff marl-lined	Pecten Entolium Lopha	marly chalk, slightly glauconitic
	25%			Glauconitic marl
	~50%			Marly greensand with calcareous nodules, few Ph. nods. Phosphatic marly greensand — Craie Glauconieuse
				Highly glauconitic, marly greensand, phosphate-poor, burrowed basal contact.
				Gaize Supérieure
	~7% max	Small black mud-filled ⌀s	fossil-poor, occasional small ▽, Exogyra	Compact, weakly glauconitic slightly shelly, fine-grained limestone/marl. Slightly muddy, slightly siliceous. Well-cemented Calcareous } layers. - Siliceous }
	10%			
	~20%		Entolium orbiculare, ▽, Serpula	Grey-green marly greensand, slightly gritty, qz grains up to 1 mm diam., mostly ½ mm. Occasional pyrite nods. Burrowed basal contact for 12 cm
		occasional small b.m.f. ⌀s	▽ Small Entolium orbiculare	GAIZE INFÉRIEURE
				Large Calcareous concretions.
	glauconite dies-out upwards	pale silt-filled ¾ mm diam		Grey, slightly silty marl, little/no glauconite, slightly micaceous
		small ⌀s 0.5 cm diam		occasional buff-coloured phosphate nodules.
		pale silt-fill, glauc sed-fill ¾ cm diam	small Entolium orbiculare	Glauconitic, sandy, silty clay, scattered small coarse qz grains, reaching 0.5 cm diam, occasional small pyritic patches
				Scattered buff phosphate nodules in sandy clay incipient pyrite nodules.
	~25%	1 cm diameter.	—	Poorly-sorted, glauconitic sandy clay. Medium-grey colour - Fine to coarse-grained sand content, up to to 3.5 mm diam. small granules.
				Muddy, marly, quartzose greensand
				GAULT
				← contact
		phosphatic & calcareous ⇒ nodules		POUDINGUE FERRUGINEUX — Gravelly phosphatic concretions in upper part of bed.
		filled with slightly less gravelly sed.	—	Poorly-sorted, brown to grey, ferruginous, muddy, gravelly sand. Scattered Calc } nodules, many after Thalass. ⌀s. to Ph
				Line of smaller Calc } nodules. - Ph
		pyritised ⌀s	—	Calcareous concretionary layer.
		b.m.l. ¾ cm diam	—	Moderately-well-sorted, mud-free, fine to coarse to slightly gravelly sand. Average gr. size # 1 mm. Pebbly, gravelly sand. Pebbles up to 2.5 cm diameter. Iron 'pan' - 8 cm thick pyritic concretionary bed.
	~3%			Burrow-mottled, fine-gr., muddy sand. Slightly glauconitic, muddy fine sand
	~3%		—	Poorly-sorted, muddy, pebbly sand, with thin line of pebbles at top Well-sorted coarse to granular qz. sand Poorly-sorted pebbly sandy clay
				Soft, glauconitic, fine-gr. sand; X-bedded

CARRIERE LE LIVET, NEAR CORDEBUGLE