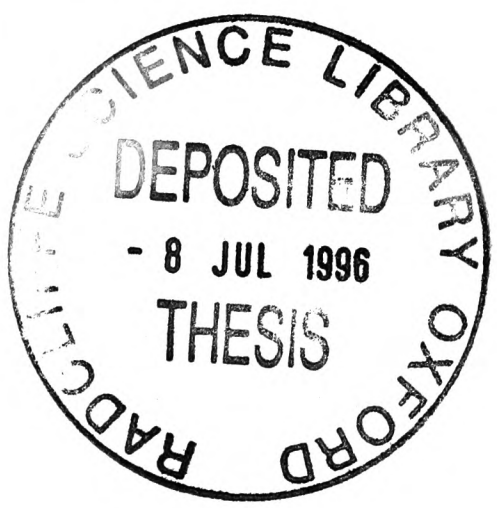
High-Resolution Outcrop Gamma-Ray Spectrometry of the Lower Lias, Southern Britain.

VOLUME 2

FIGURES & APPENDICES

Julian L. Bessa

Saint Edmund Hall and Department of Earth Sciences.



Thesis presented to the University of Oxford for the Degree of Doctor of Philosophy.

Michaelmas Term 1995

High-Resolution Outcrop Gamma-Ray Spectrometry of the Lower Lias, Southern Britain.

Contents to Volume 2 - Illustrations and Appendices

CHAPTER 1

Introduction to the Depositional Basins of Southern Britain and the Techniques and Theory of Gamma-Ray Spectrometry.

CHAPTER 2

The Methodology and Experimentation Required For Outcrop Gamma-Ray Spectrometry

CHAPTER 3

The Gamma-Ray Characteristics of the Lower Lias in Southern Britain

CHAPTER 4

Interpretation of the Gamma-Ray Characteristics shown by the Lower Lias in Southern Britain

CHAPTER 5

A Sequence Stratigraphic Synthesis for the Lower Lias in Southern Britain and Final Conclusions

APPENDIX 1
(TABLES 1.10 to 1.36)

APPENDIX 2
Tables 2.01 to 2.11

****

Chapter 1
(Figures 1.01 to 1.18)

Introduction to the Depositional Basins of Southern Britain and the Techniques and Theory of Gamma-Ray Spectrometry.

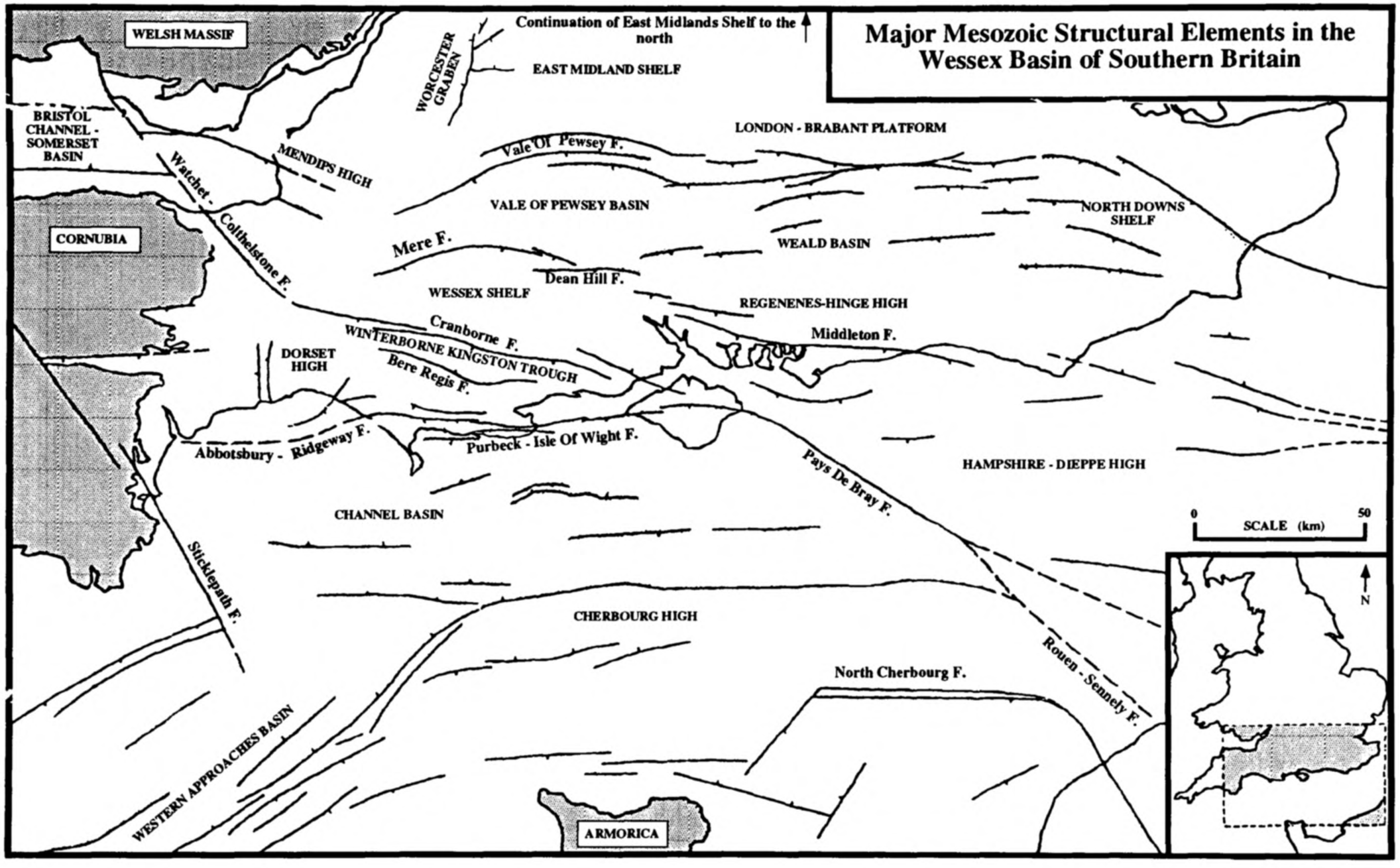


FIGURE 1.01 Simplified regional tectonic map of the major Mesozoic structures in the Wessex Basin. The stippled area represents outcropping basement of pre-Permian age. The diagram is based upon Stoneley (1982), Whittaker (1985) and Karner *et al.* (1987). British Geological Survey sheet maps have also been used in this complilation.

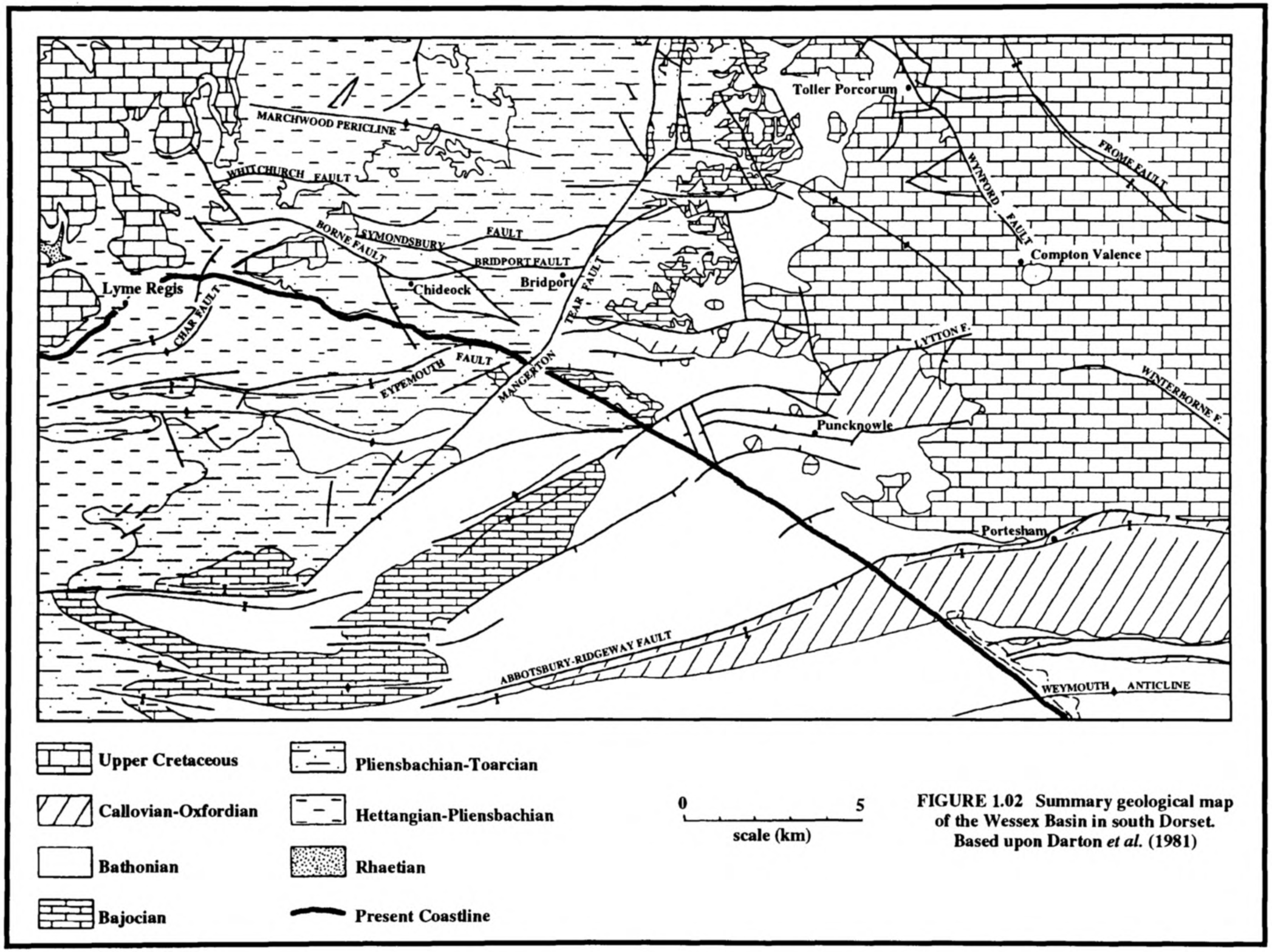


FIGURE 1.02 Summary geological map of the Wessex Basin in south Dorset. Based upon Darton *et al.* (1981)

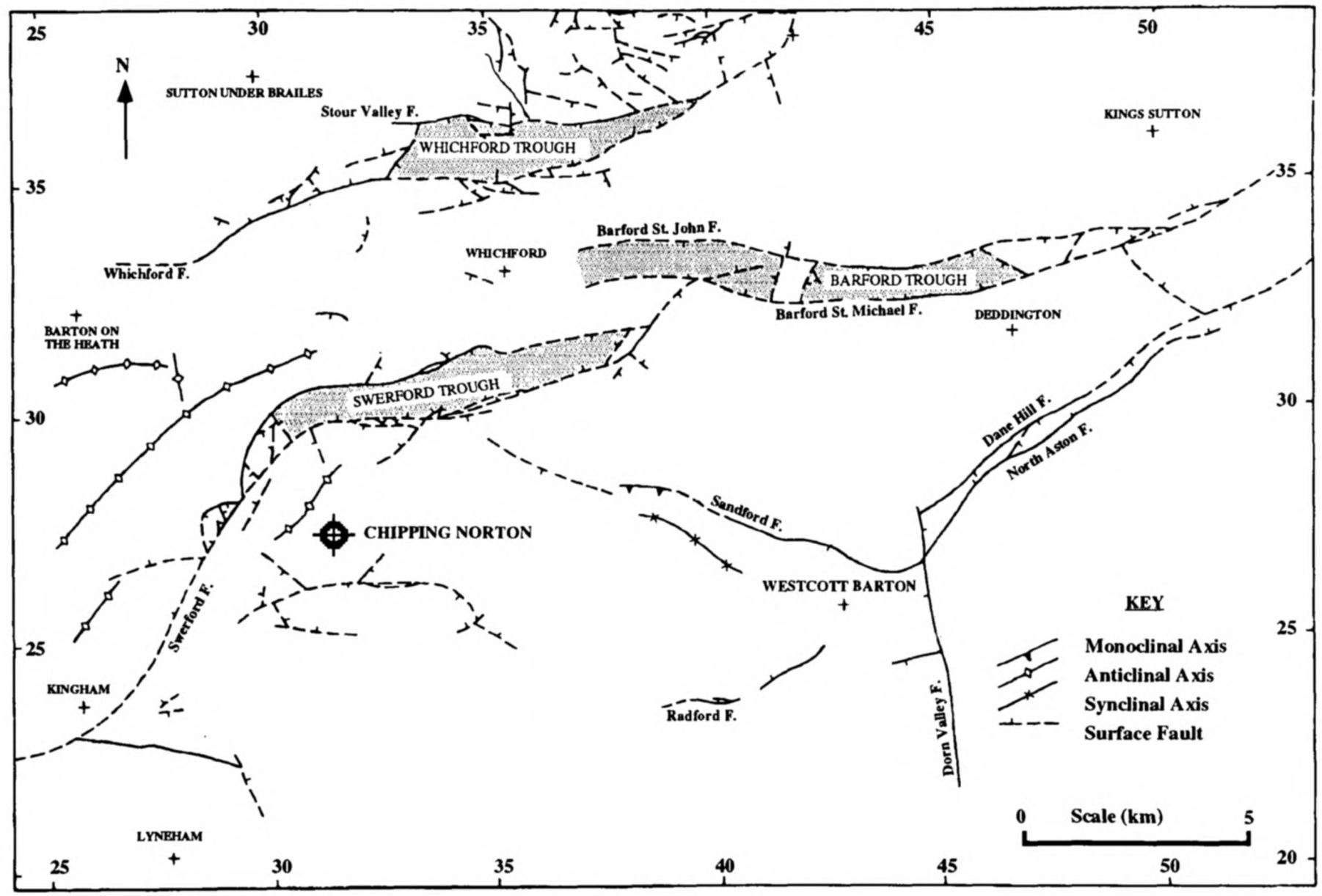


FIGURE 1.03 Structure of the East Midland Shelf in the Chipping Norton District, based on Sheet 218 (Chipping Norton). Stippled areas represent present-day structural troughs. The considerable structural heterogeneity may account for the development of local unformities within the Lower Lias in this region. Redrawn and modified from Horton & Poole (1987).

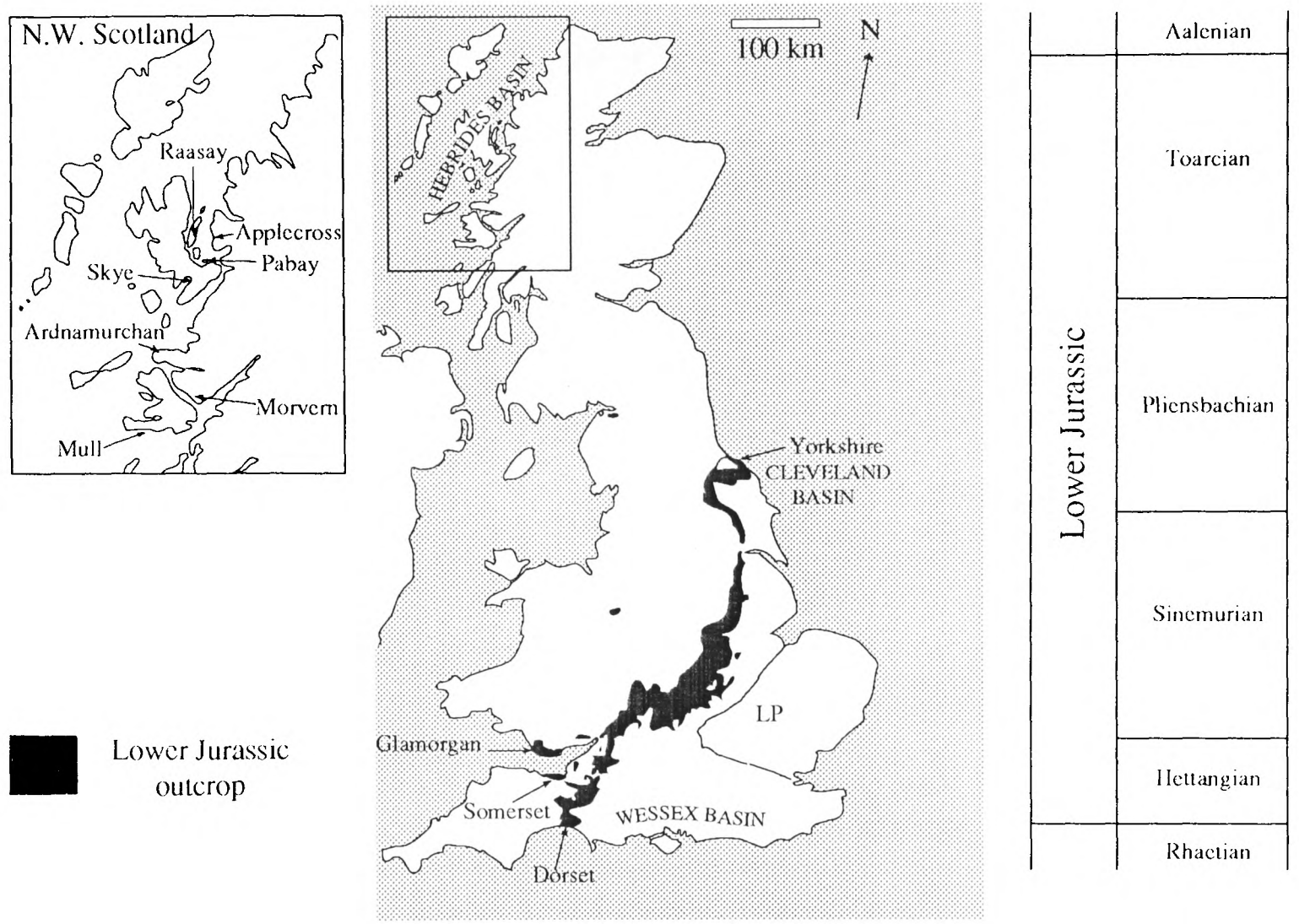


FIGURE 1.04 Outcrop pattern for the Lower Jurassic of the British Isles. This study is concerned with outcrop of Rhaetian to Pliensbachian age found in southern Britain, namely Glamorgan, Somerset and Dorset (LP = London Platform). Taken from Hesselbo & Jenkyns (1995).

Biostratigraphy		Lithostratigraphy	Chronostratigraphy	
Zone	Subzone			
Tragophllyo--ceras ibex	*Beaniceras luridum*	Belemnite Stone	Lower Pliensbachian	Lower Jurassic or Lias
	Acanthopleuroceras valdani	Belemnite Marls		
	Tropidoceras masseanum			
Uptonia jamesoni	*Uptonia jamesoni*			
	Platypleuroceras brevispina			
	Polymorphites polymorphus			
	Phricodoceras taylori			
Echioceras raricostatum	*Paltechioceras aplanatum*	Hummocky	Upper Sinemurian	
	Leptechioceras macdonnelli			
	Echioceras raricostatoides	Black Ven Marls		
	Crucilobiceras densinodulum			
Oxynoticeras oxynotum	*Oxynoticeras oxynotum*	Coinstone		
	Oxynoticeras simpsoni			
Asteroceras obtusum	*Eparietites denotatus*			
	Asteroceras stellare	Black Ven Marls		
	Asteroceras obtusum			
Caenisites turneri	*Microderoceras birchi*	Shales-with-'Beef'	Lower Sinemurian	
	Caenisites brooki			
Arnioceras semicostatum	*Euagassiceras resupinatum*			
	Agassiceras scipionianum			
	Coroniceras lyra	Blue Lias		
Arietites bucklandi	*Arietites bucklandi*			
	Coroniceras rotiforme			
	Vermiceras bucklandi			
Schlotheimia angulata	not differentiated		Hettangian	
Alsatites liasicus	*Alsatites laqueus*			
	Waehneroceras portlocki			
Psiloceras planorbis	*Caloceras johnstoni*			
	Psiloceras planorbis			
Pre-*planorbis* Beds			Rhaetian	Triassic

Figure 1.05 Stratigraphic scheme for the Rhaetian - Pliensbachian interval as represented by the sediments of the Dorset coast, based upon Cope *et al.* (1980). The boundary between the Blue Lias and Shales-with-'Beef' is taken from Hallam (1960). The extent of the disconformity/hiatus associated with the Coinstone and Hummocky are indicated.

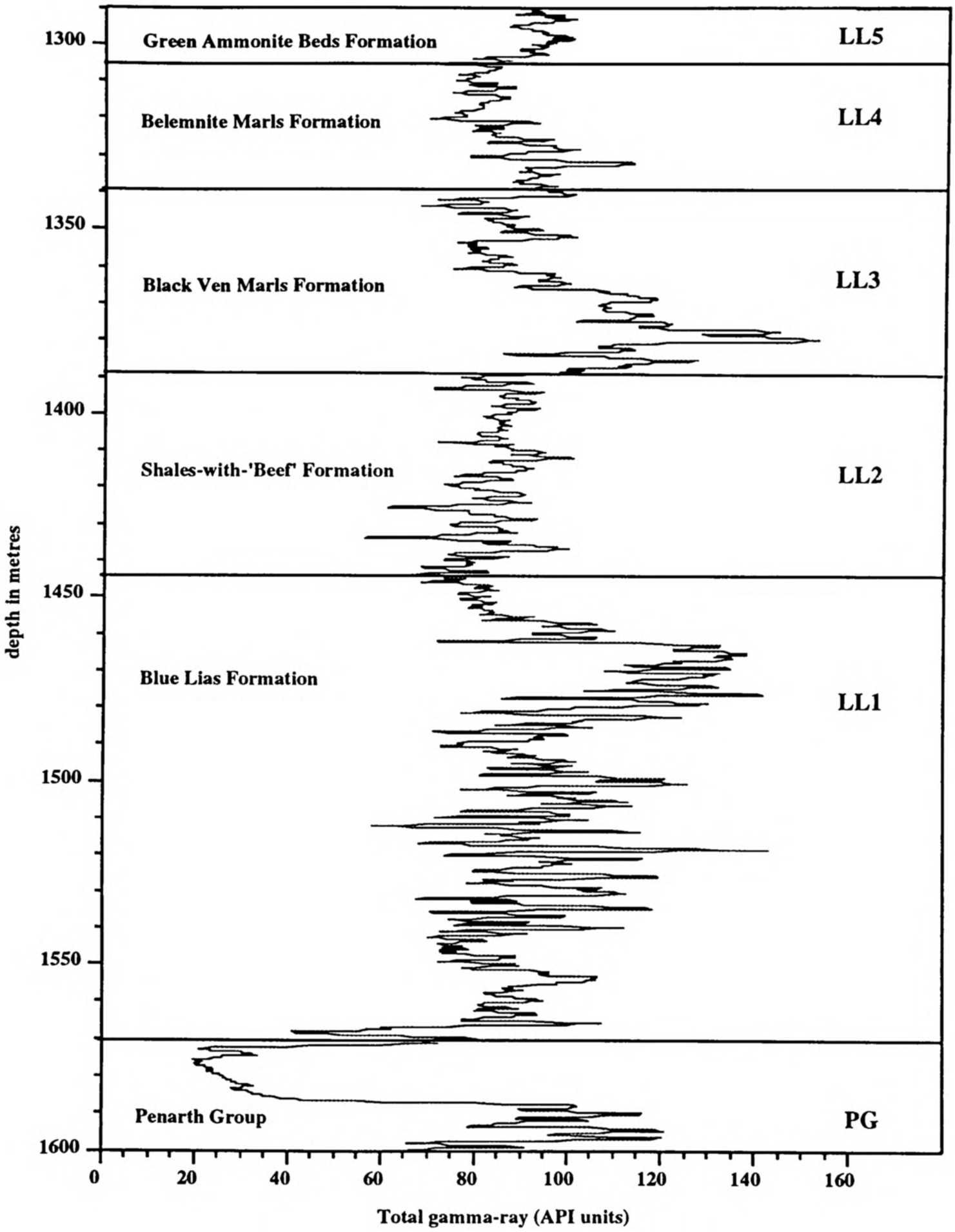


FIGURE 1.06 Division of the Lower Lias interval in the Winterborne Kingston borehole into lithological gamma-ray units as proposed by Whittaker *et al.* (1985). Redrawn from Whittaker *et al.* (1985)

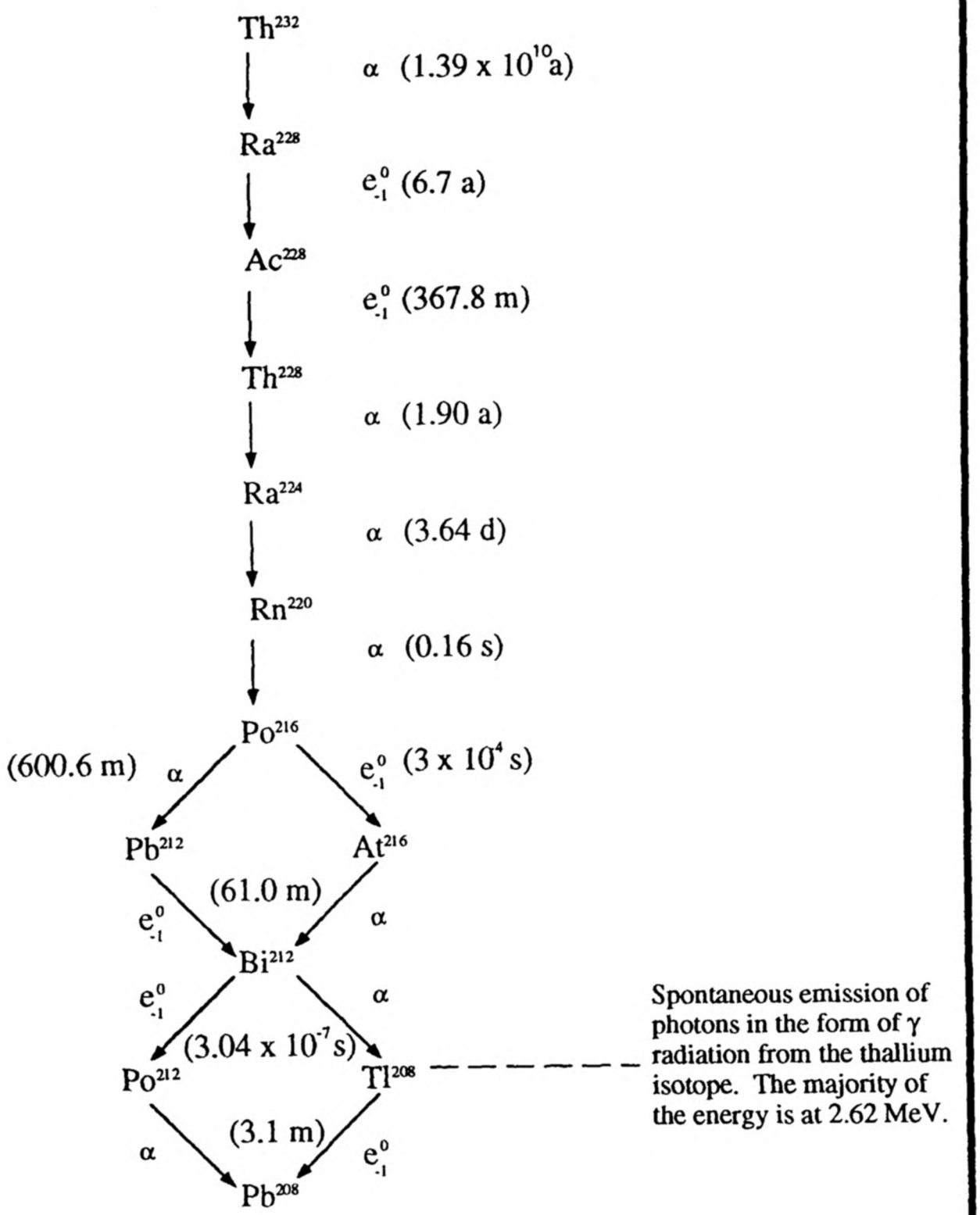
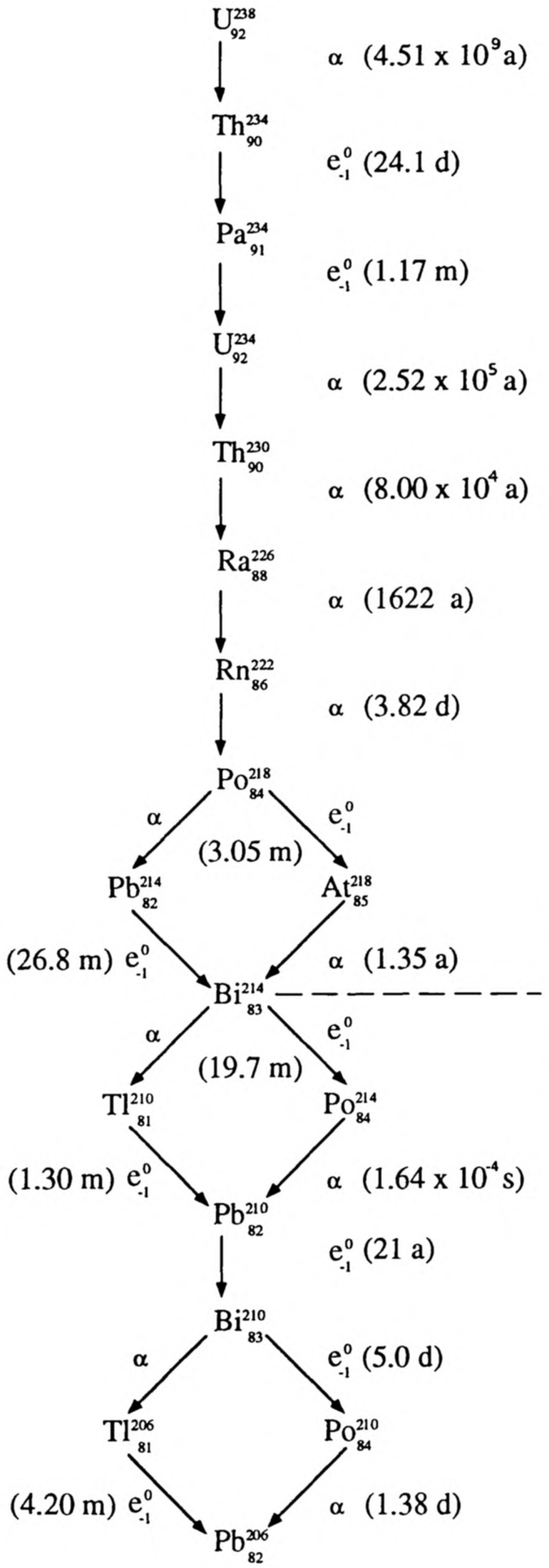


FIGURE 1.07 Thorium decay series of naturally occurring radiogenic isotopes. The thorium series corresponds to the simple formulae 4*n* and terminates with a stable isotope of lead. (Based upon Rankama 1954)



The α and β radiation is followed by spontaneous emission of photons in the form of γ radiation from the bismuth isotope. The majority of the energy is at 1.46 MeV.

FIGURE 1.08 Uranium decay series of naturally occurring radiogenic isotopes. The uranium series corresponds to the simple formulae $4n$ +2 and terminates with a stable isotope of lead. (From Murray 1987)

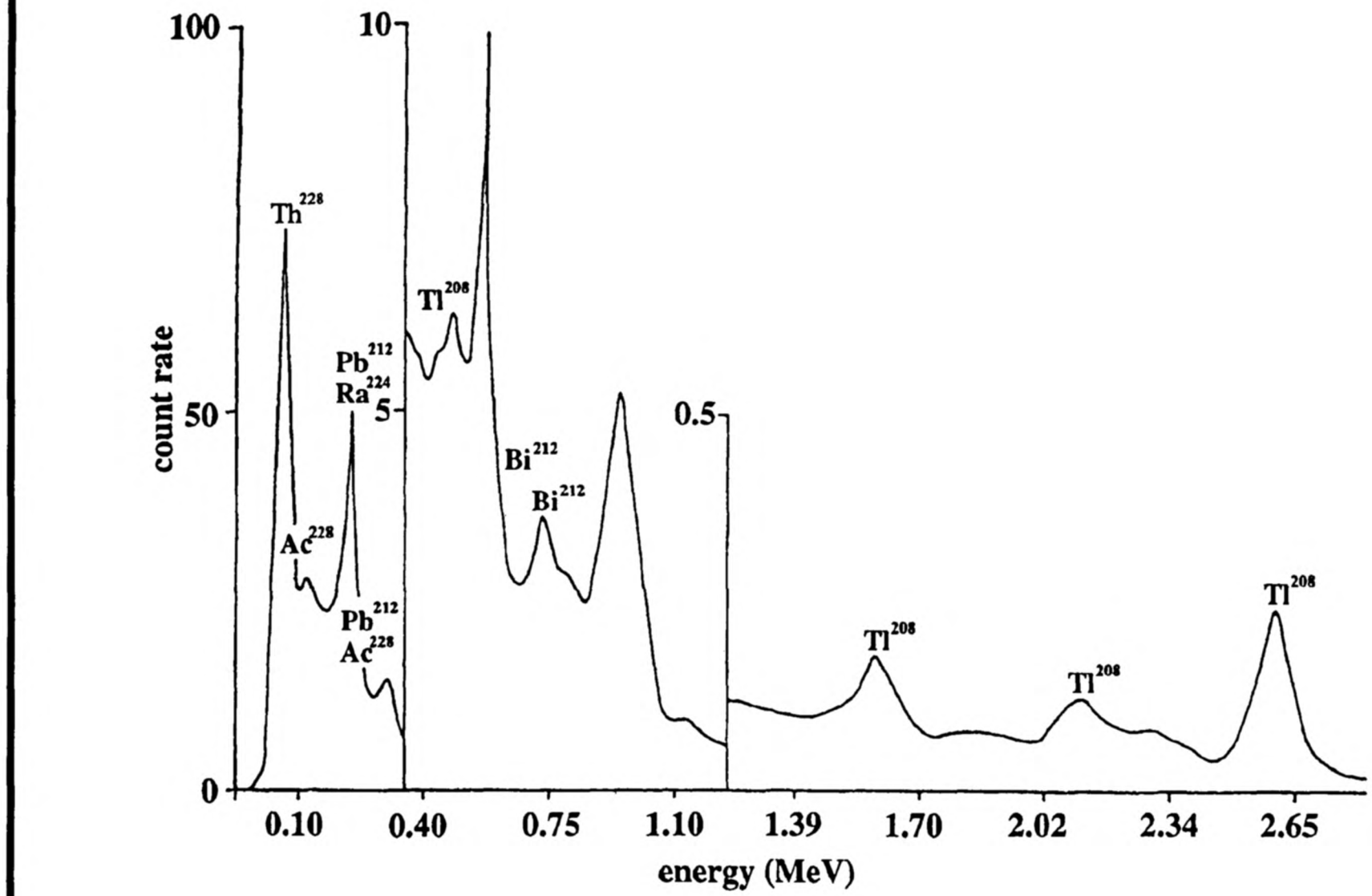


FIGURE 1.09 Gamma-ray spectrum of the Th^{232} decay series (Redrawn from Durrance 1986)

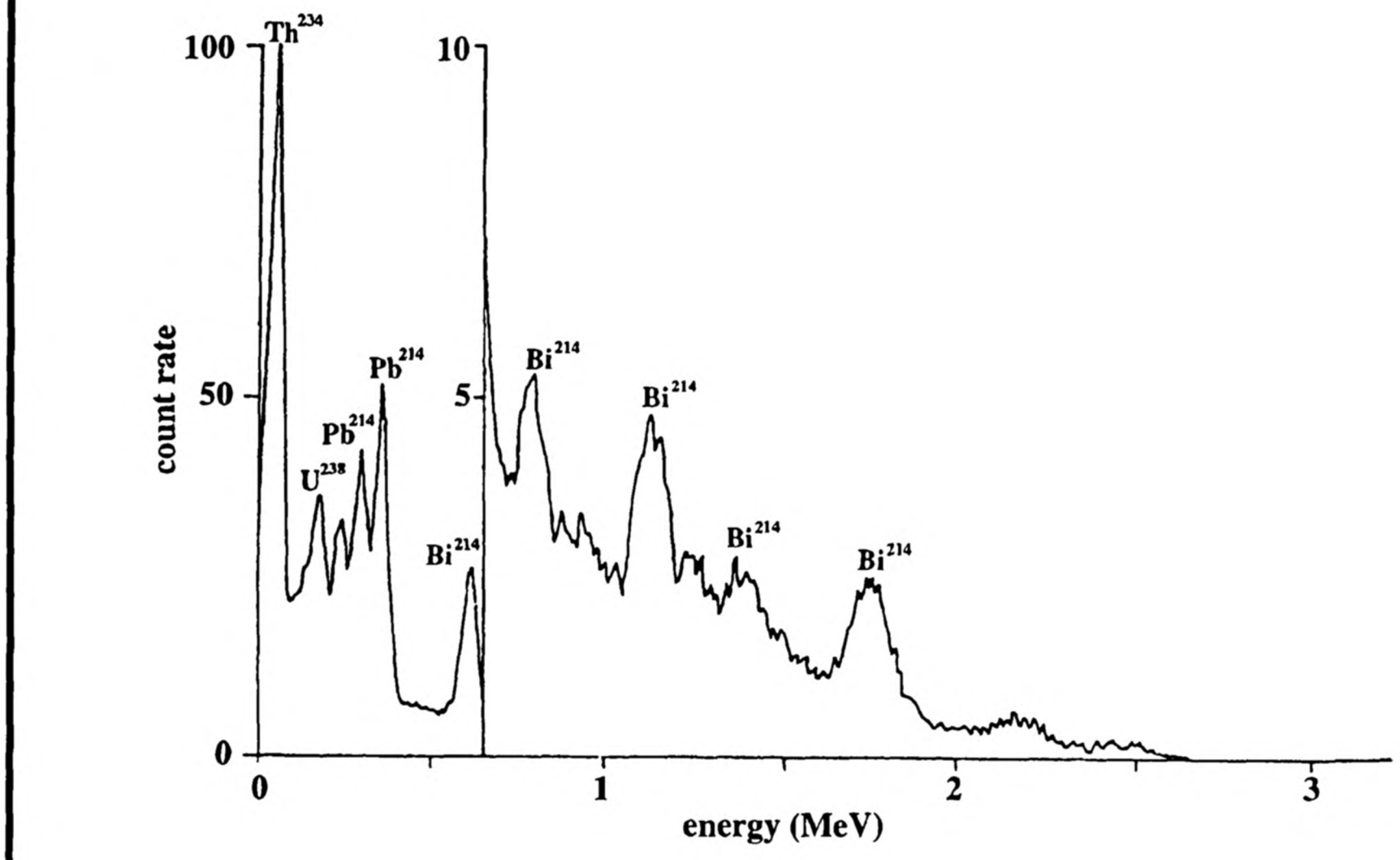


FIGURE 1.10 Gamma-ray spectrum for the U^{238} decay series. (Redrawn from Durrance 1986)

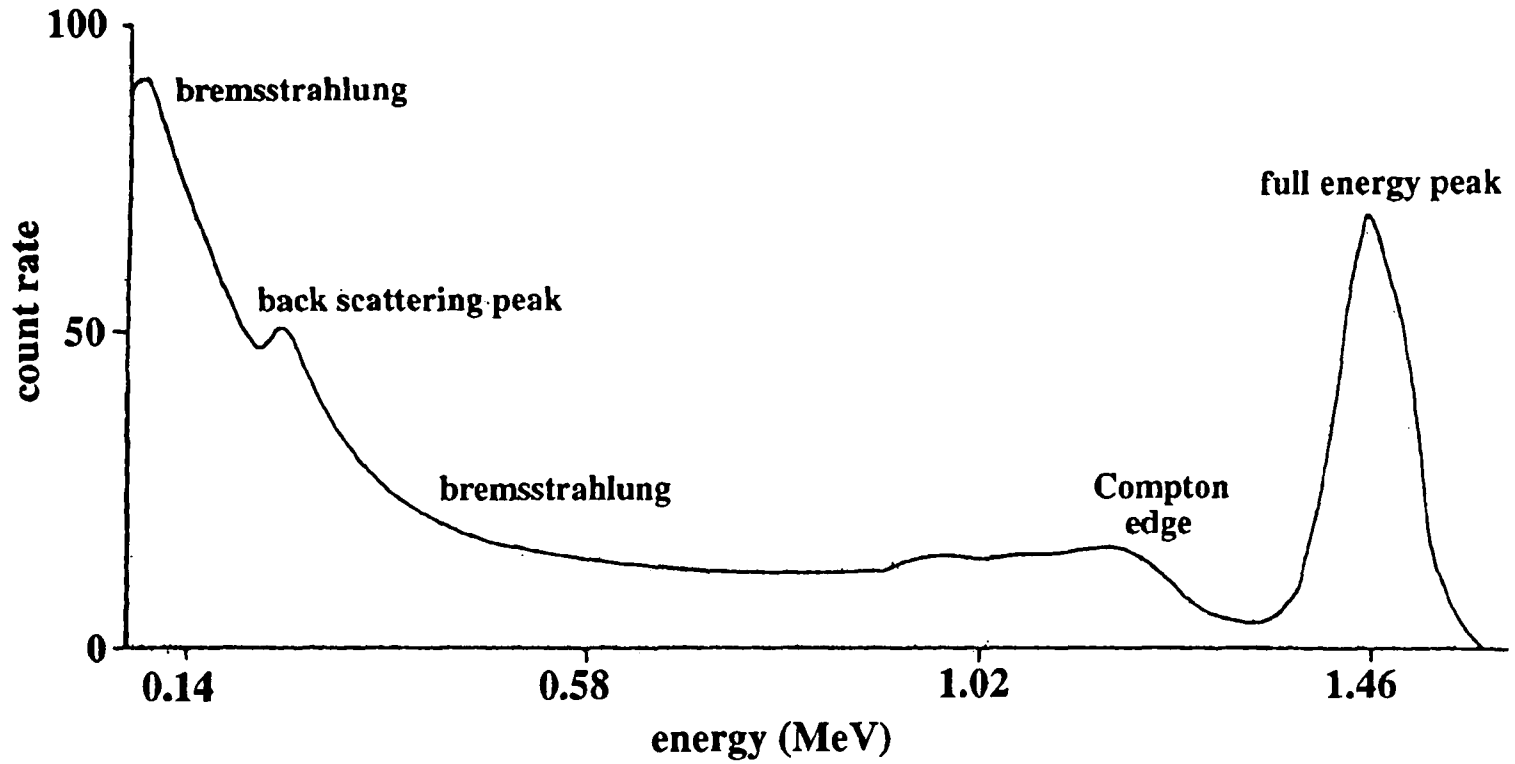


Figure 1.11 Gamma-ray spectrum for the the isotope ^{40}K (Redrawn from Durrance 1986).

Bremsstrahlung is known as 'breaking radiation' and is a consequence of the interaction between orbital electrons with gamma-rays as photons are emitted from the nucleus. This electrostatic attraction produces an accleration upon the photon and causes deflection of the gamma-rays from the original pathway resulting in an overall loss of energy.

The Compton Edge marks the boundary at which the gamma radiation recieved by the detector is lower than would theoretically be expected (full energy peak). The loss of energy is due to Compton scattering (as explained in Chapter One, Section 1.31.)

Back-scattering refers to photons that have been deflected back along their incident pathways through Compton processes.

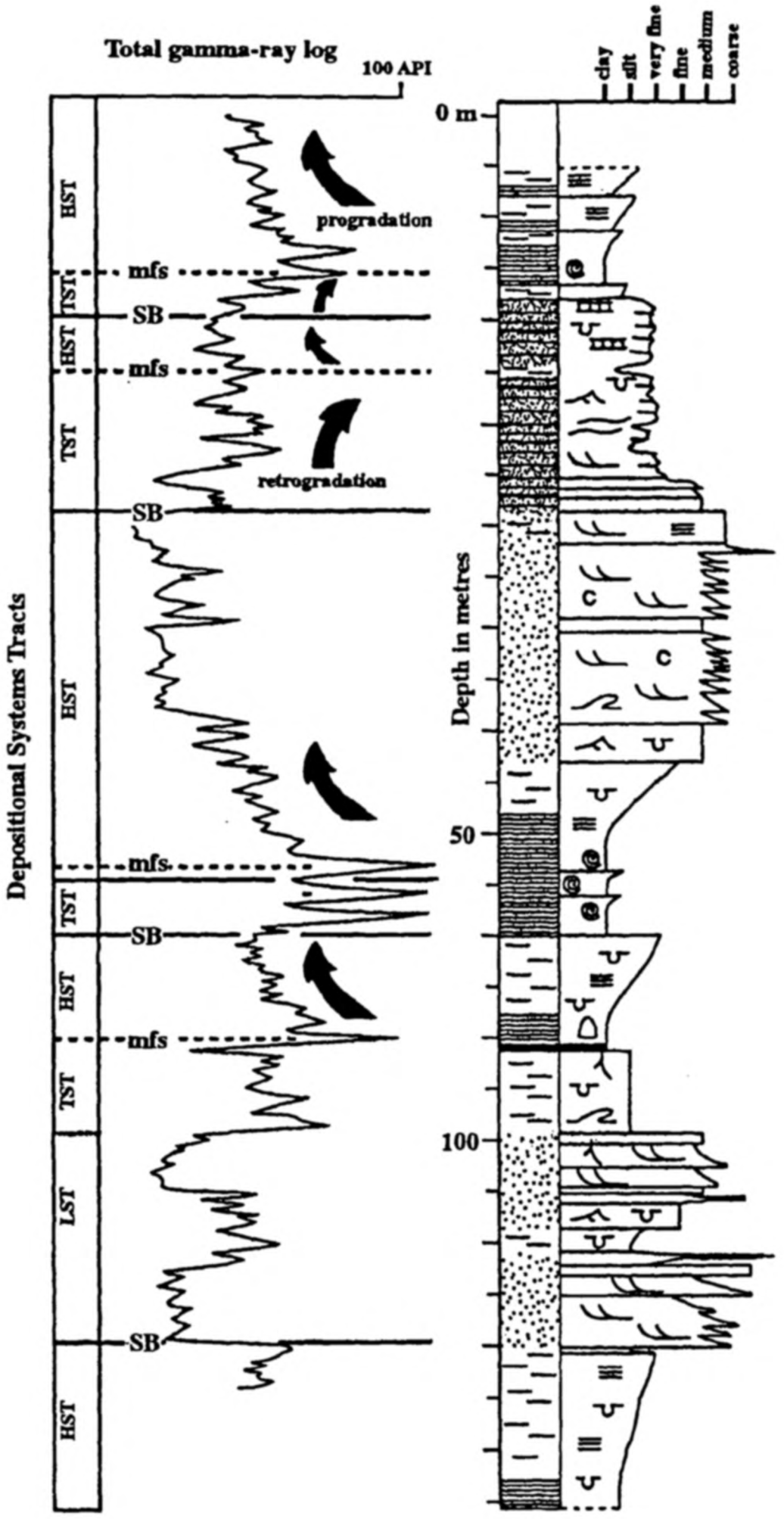


FIGURE 1.12 Depositional sequence stratigraphic interpretation of a total gamma-ray log for a coarse-grained siliciclastic system. The associated lithological log is also given. The interpreted maximum-flooding surface is denoted mfs and the interpreted sequence boundary SB. Interpreted Vail *et al.* (1977) depositional systems tracts are also given. (Based upon Gawthorpe *et al.* 1994)

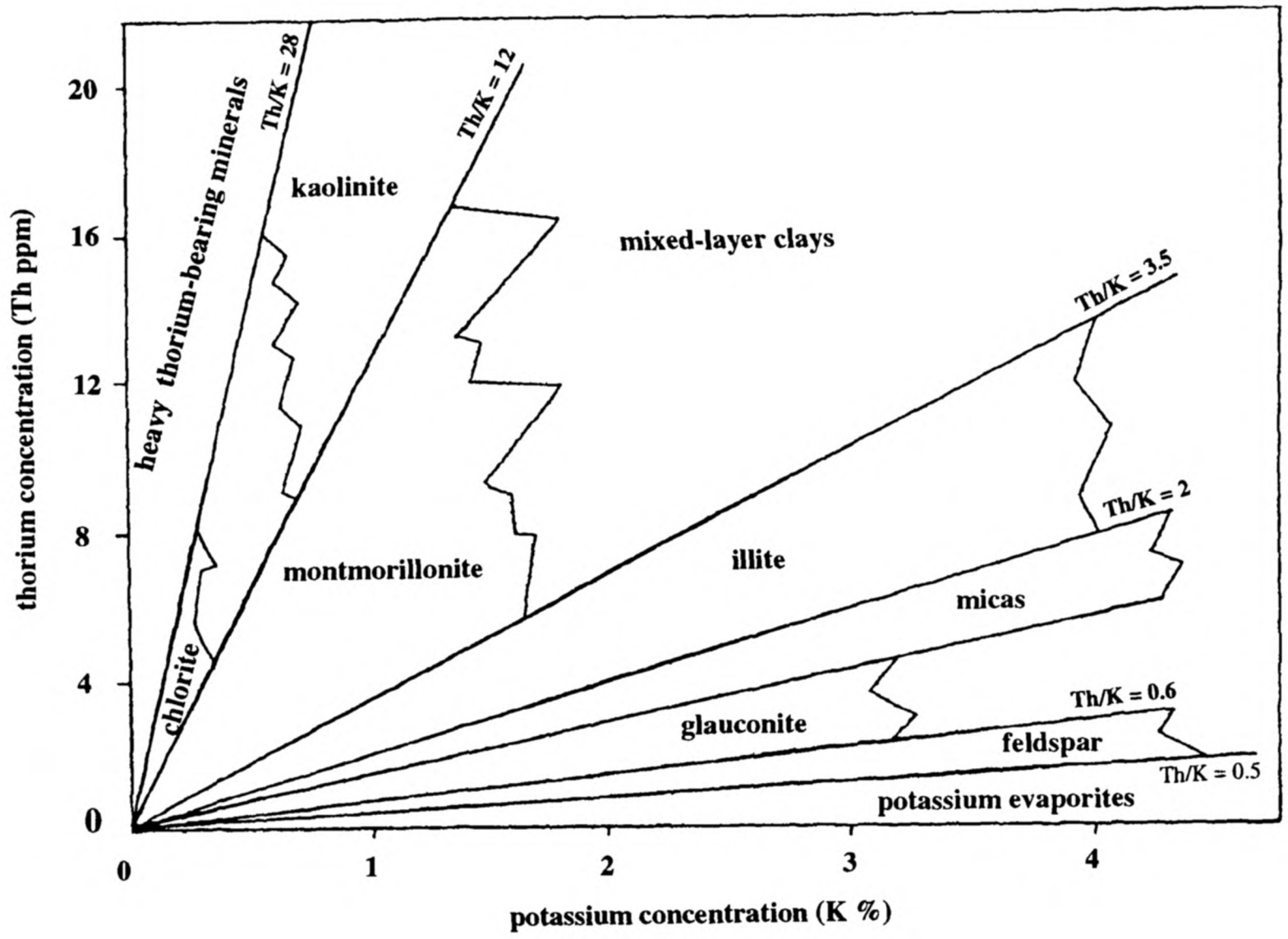


FIGURE 1.13 The theoretical distribution of clay minerals, heavy minerals and evaporites in terms of potassium and thorium content. The fields are delineated by discrete Th / K ratios. (Redrawn from Quirein *et al.* 1982)

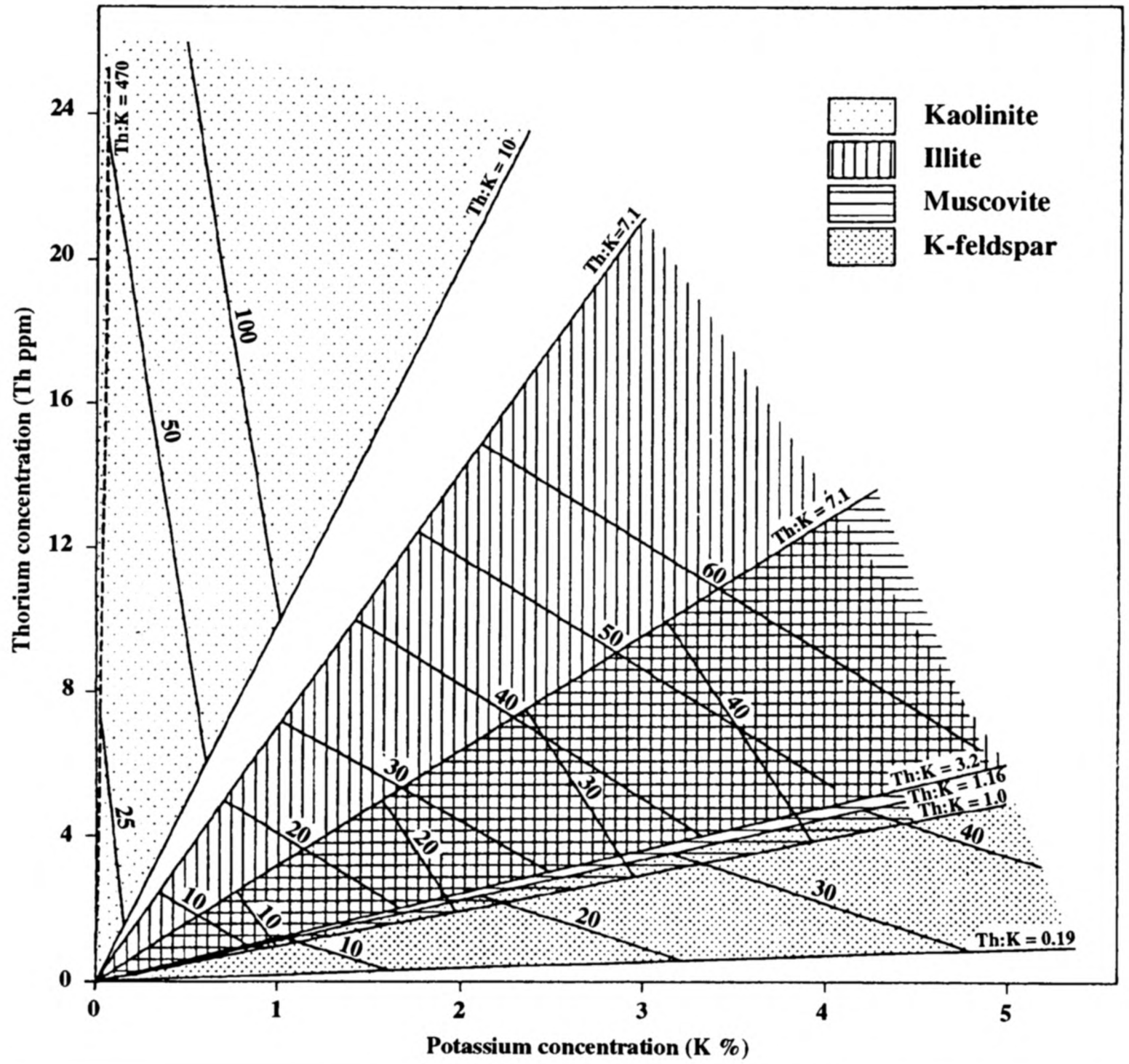
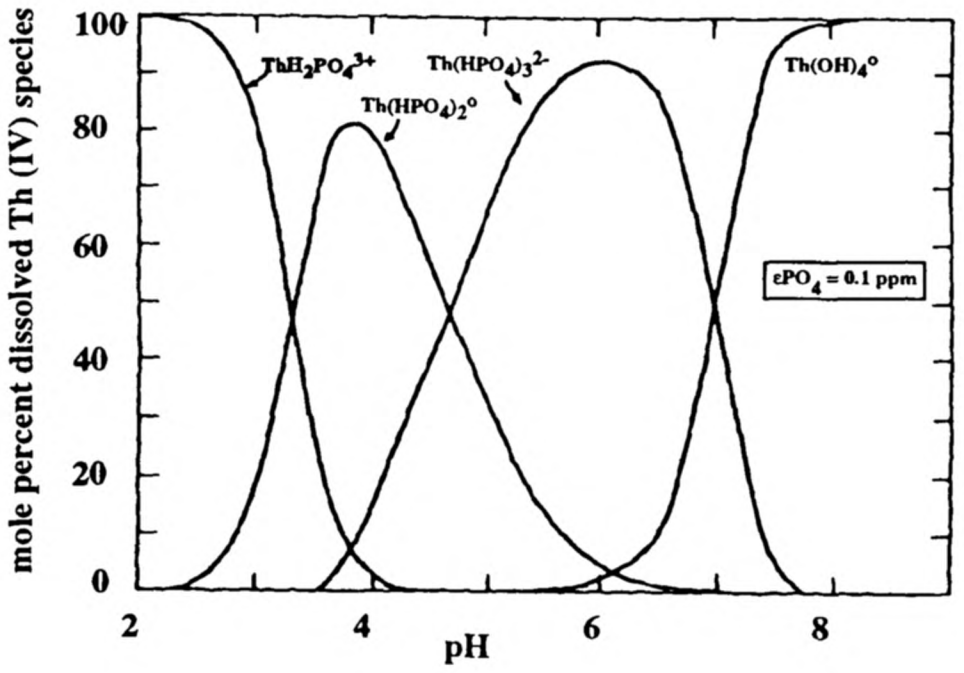
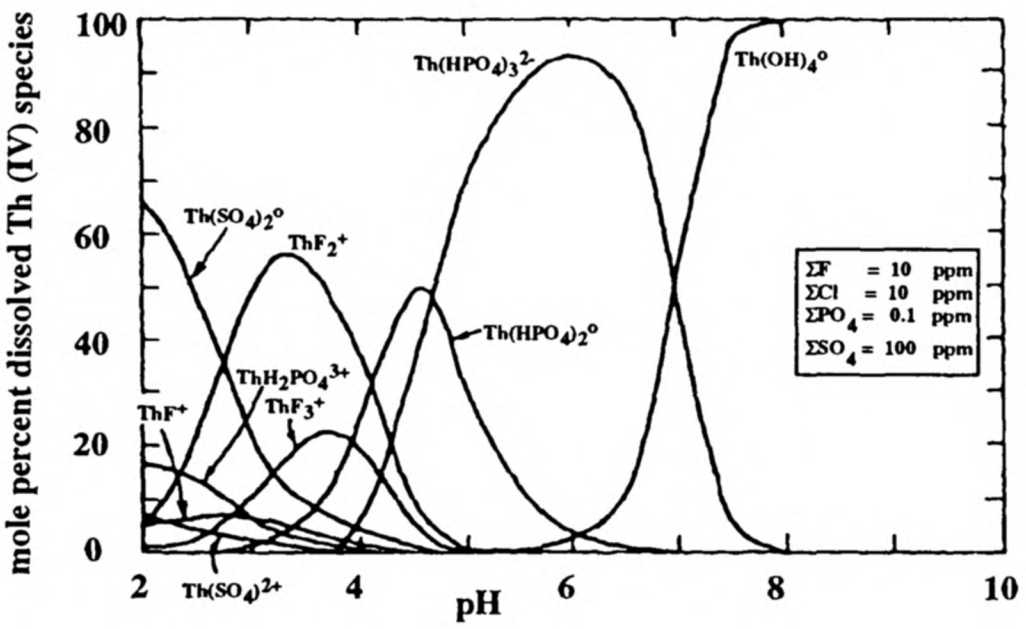


FIGURE 1.14
Thorium - potassium cross-plot given in Hurst (1990). There are considerable areas of overlap between the K-rich minerals and the broader kaolinite field. Kaolinite normally has a negligible K-content. (Redrawn from Hurst (1990)

A



B



C

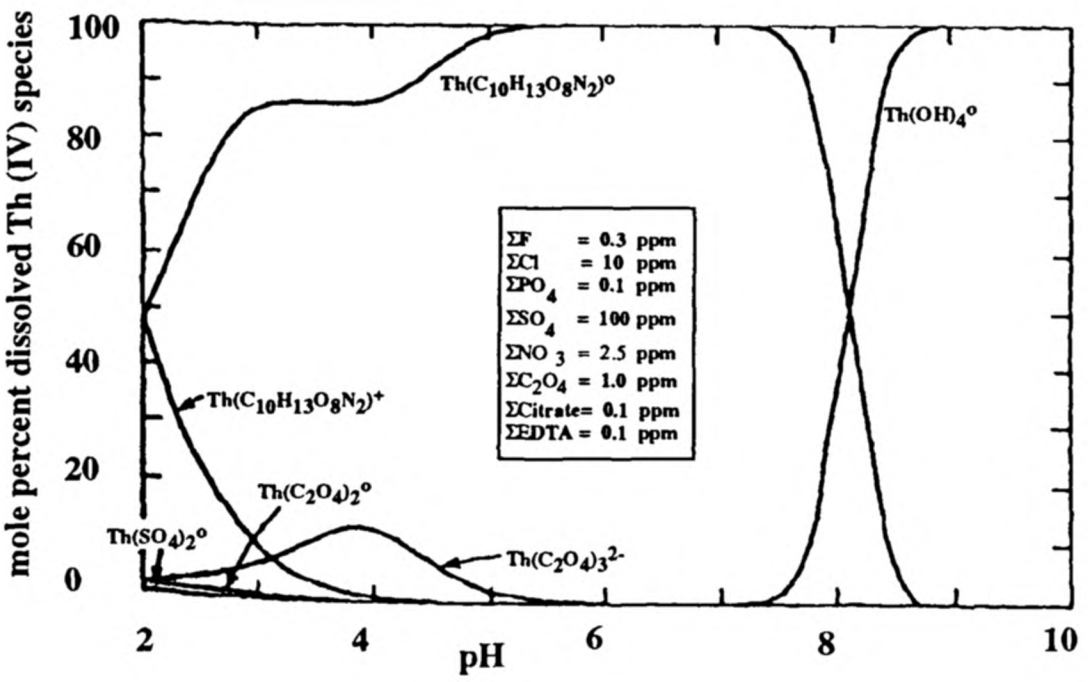


FIGURE 1.15 Distribution of (A) thorium-hydroxy and phosphate complexes (B) thorium-ligand complexes and (C) thorium complexes vs. pH in a solution containing inorganic and organic species at the concentrations indicated and 25°C with ΣTh = 0.001ppb.

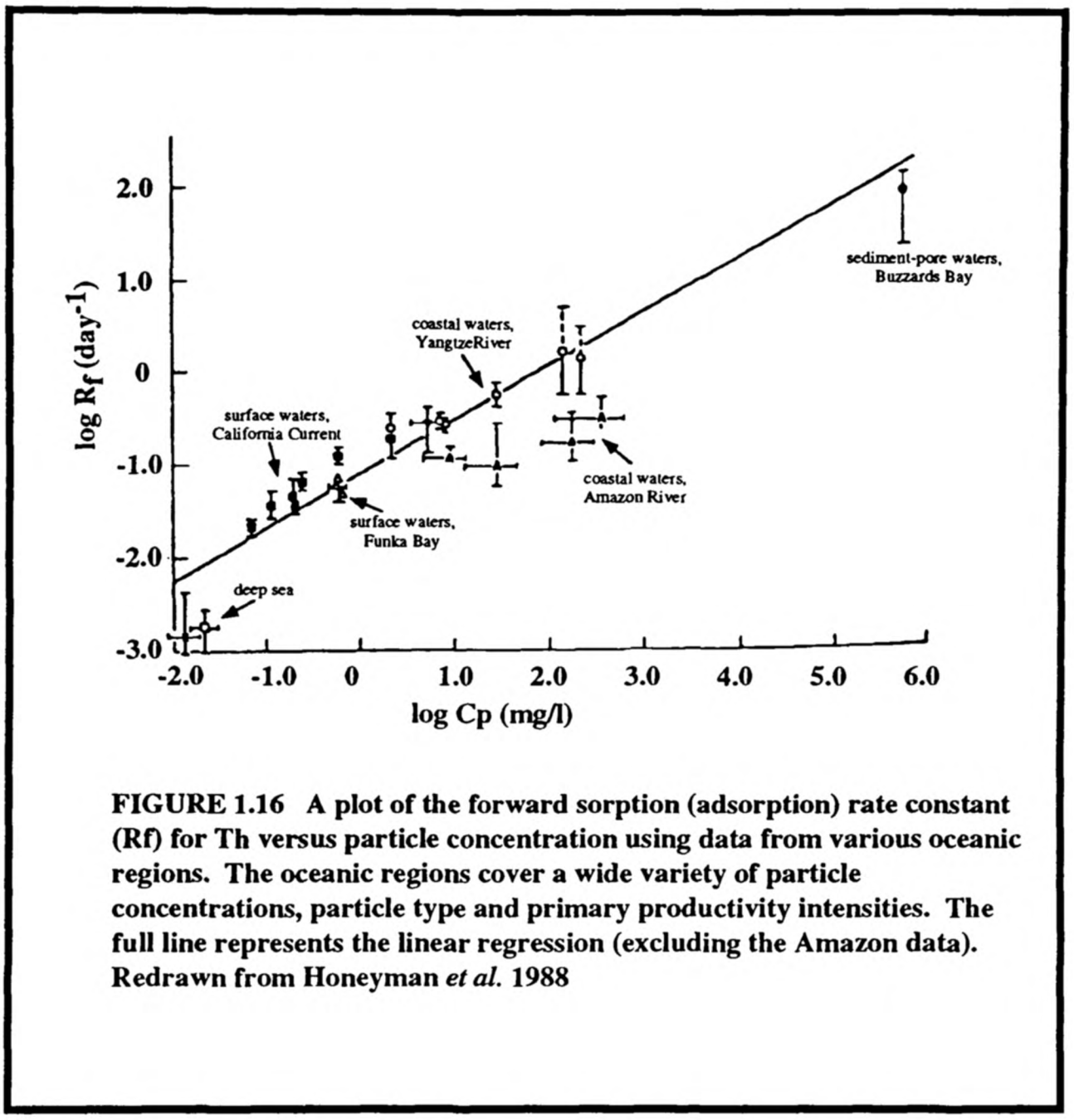


FIGURE 1.16 A plot of the forward sorption (adsorption) rate constant (Rf) for Th versus particle concentration using data from various oceanic regions. The oceanic regions cover a wide variety of particle concentrations, particle type and primary productivity intensities. The full line represents the linear regression (excluding the Amazon data). Redrawn from Honeyman *et al.* 1988

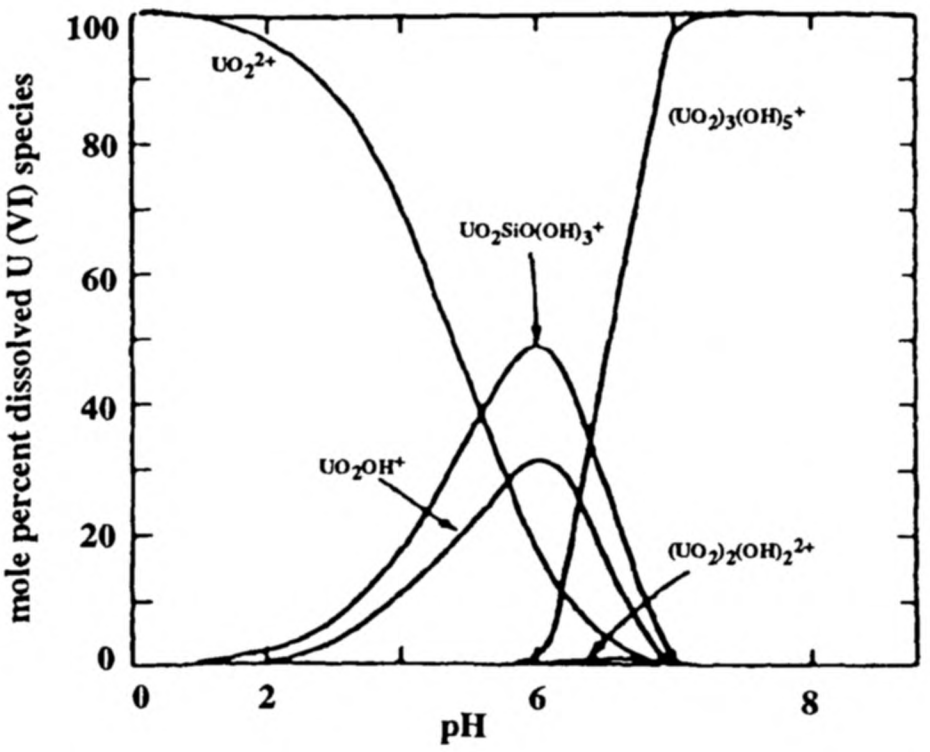
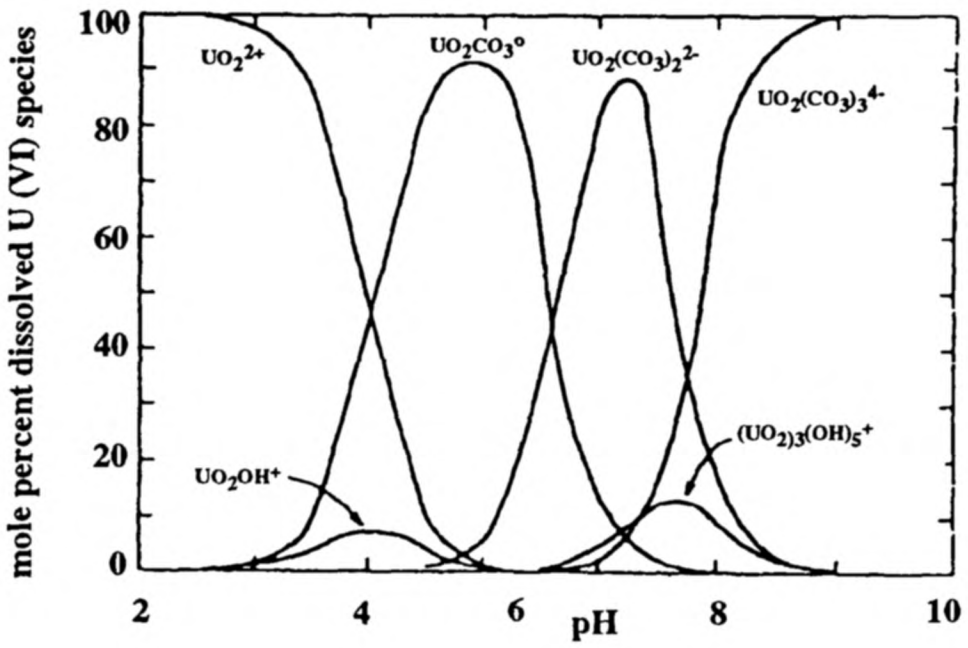


FIGURE 1.17 Distribution of uranyl-hydroxy and silicate complexes vs. pH at 25 ^{o}C with $\Sigma U = 10^{-8}$ M and $\Sigma SiO_2 = 1\ 0^{-3}$ M (60 ppm). Redrawn from Langmuir (1978).

A



B

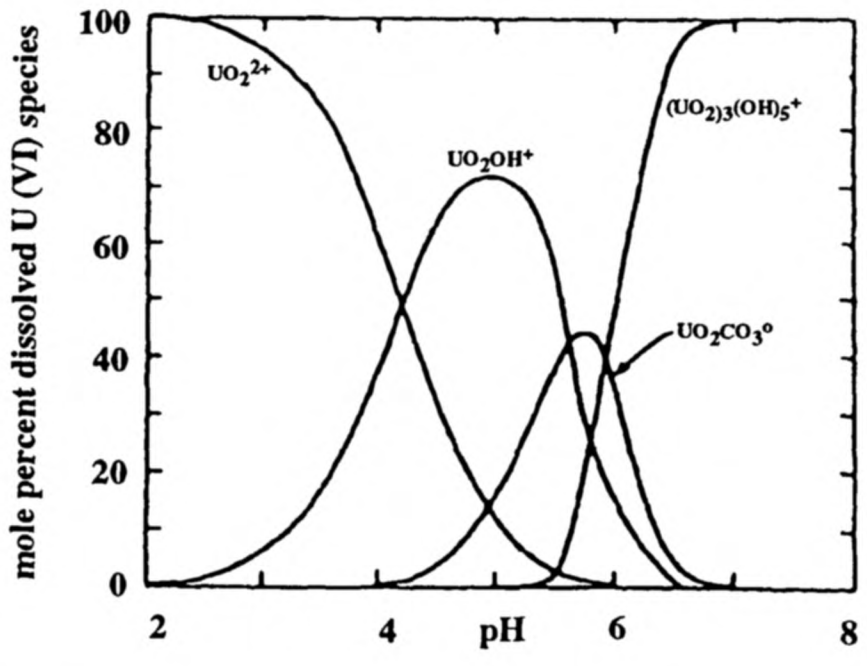


FIGURE 1.18 Distribution of uranyl-hydroxy and carbonate complexes vs. pH at with $\Sigma U = 10^{-8}$ M and $P_{CO2} = 10^{-2}$ atm at 25 ^{o}C (A) and100 ^{o}C (B). Redrawn from Langmuir (1978).

Chapter 2
(Figures 2.01 to 2.20)

Methodology and Experimentation Required For Outcrop Gamma-Ray Spectrometry

FIGURE 2.01 The GRS-500 portable gamma-ray spectrometer. The machine is ideal for general reconnaissance work involving the detection of local concentrations of radionuclides at outcrop or the rapid location of finite sources (*e.g.* uraninite). However, the maximum sample time is 10 seconds and the machine therefore has limited applicability to studies involving the detection of low radionuclide concentrations.

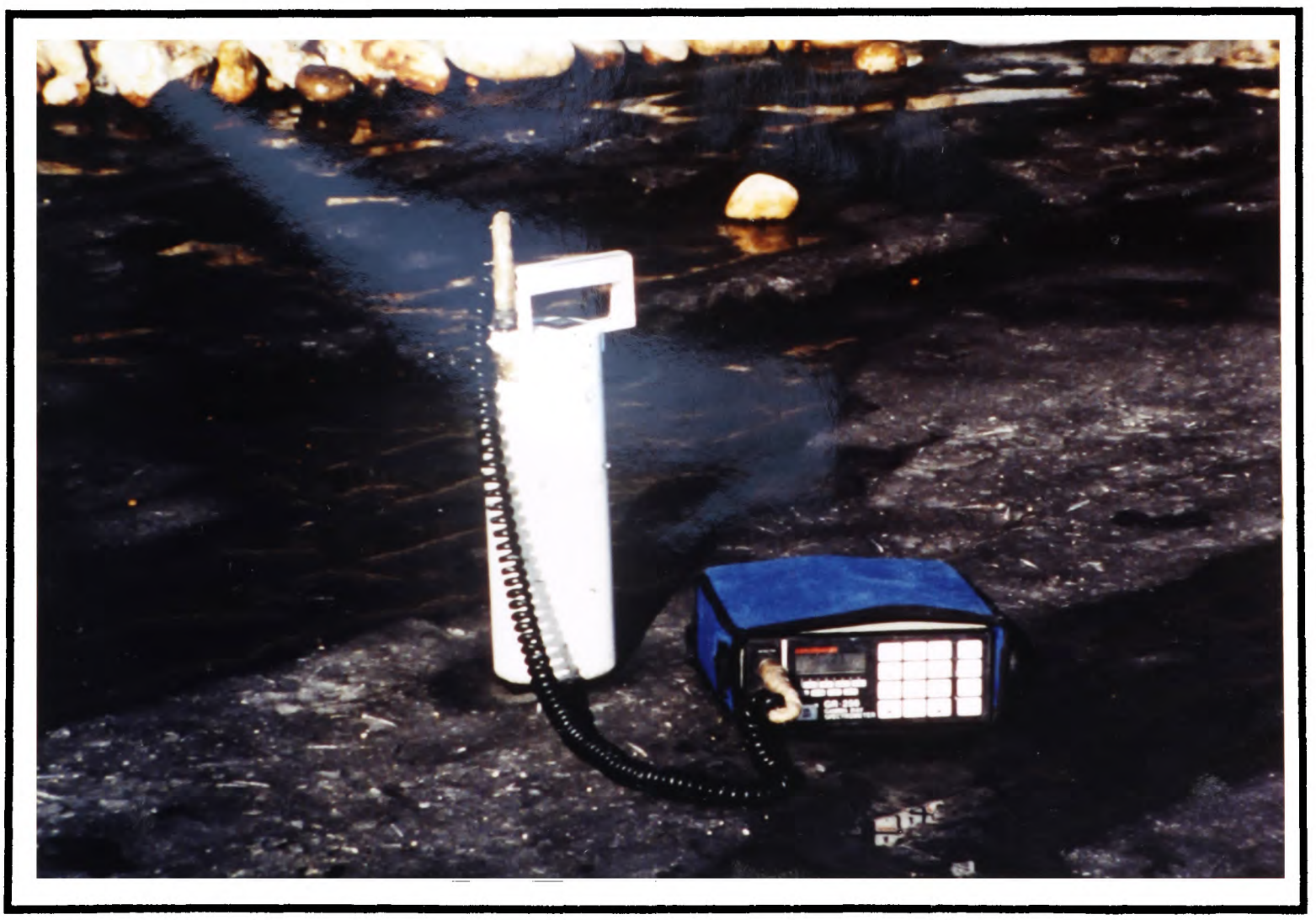


FIGURE 2.02 The GR-410 gamma-ray spectrometer (above) and the GR-256 gamma-ray spectrometer (below). Both models can be accurately calibrated. The GR-410 records total counts attributed to K, U and Th whilst the GR-256 automatically converts the data to radionuclide ground concentration (*e.g.* K %, U ppm and Th ppm).

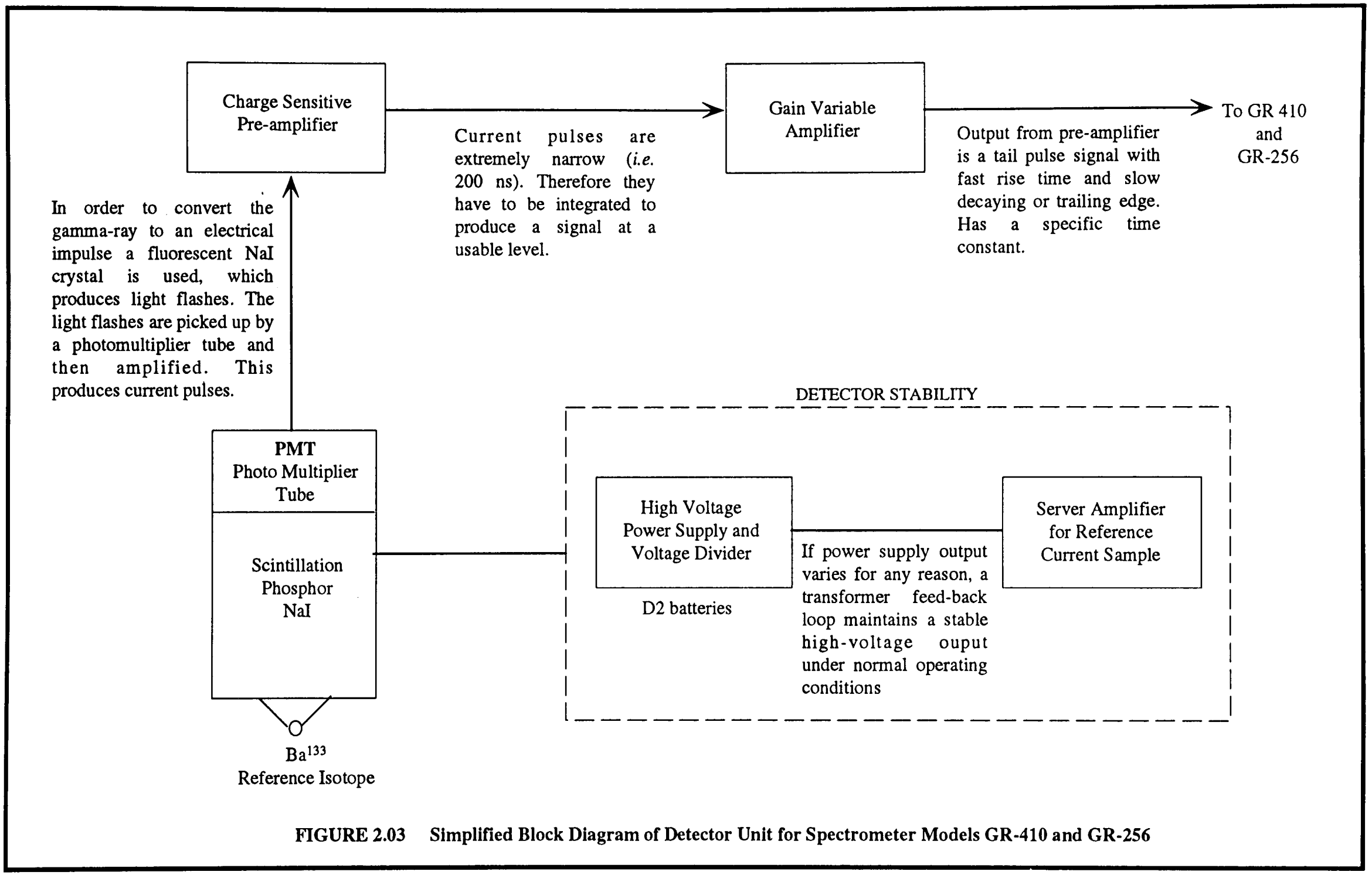
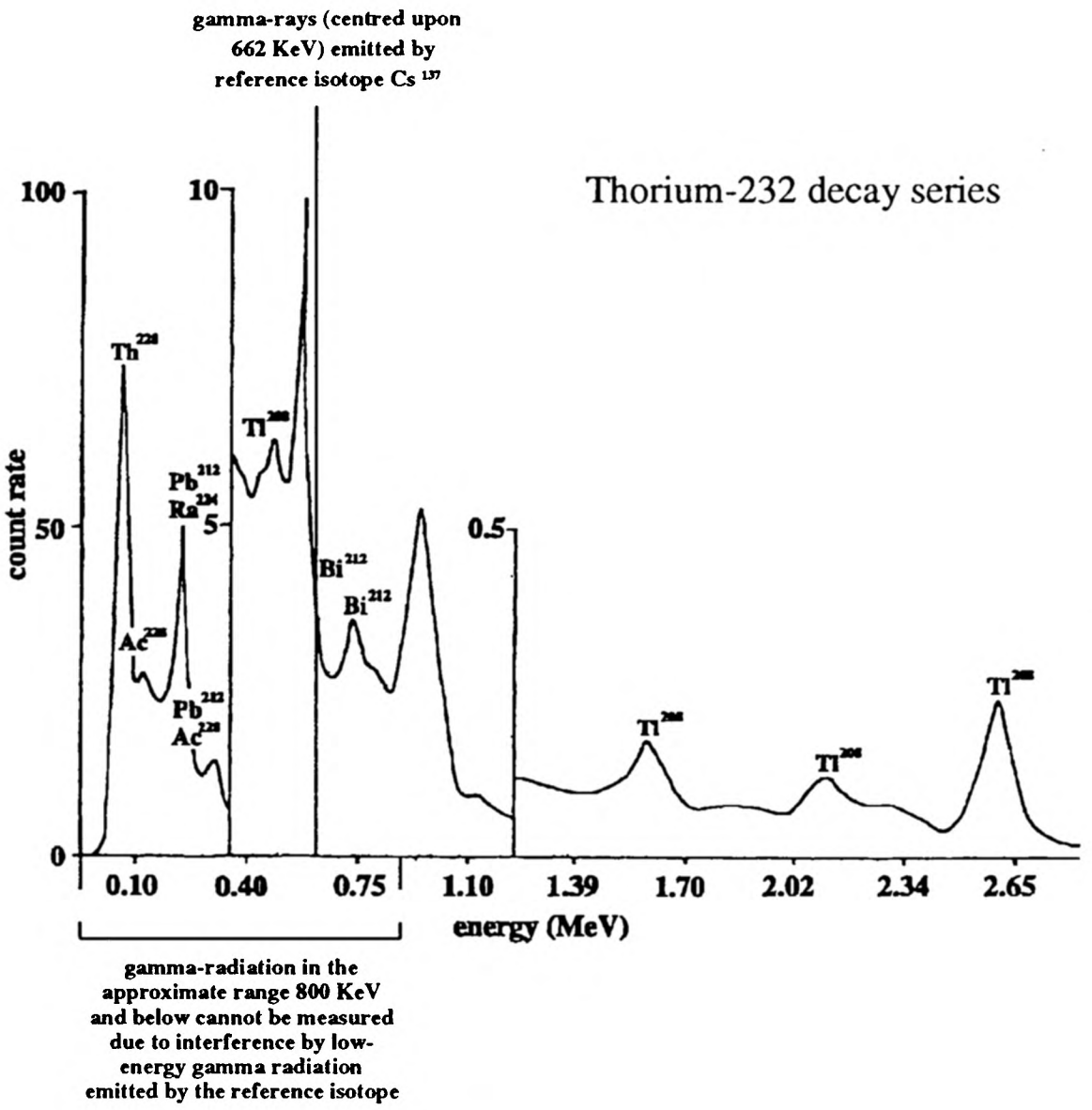


FIGURE 2.03 Simplified Block Diagram of Detector Unit for Spectrometer Models GR-410 and GR-256



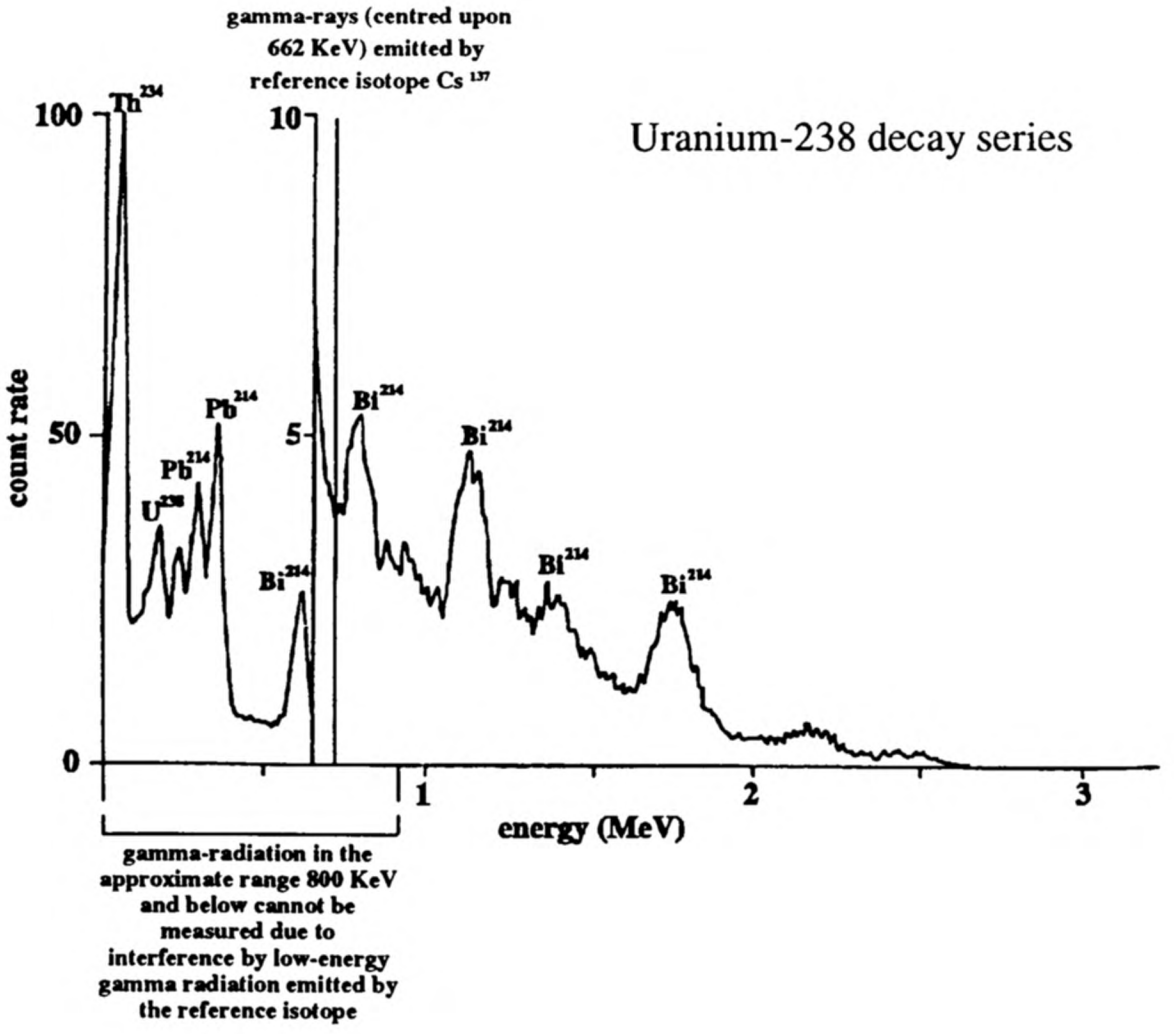
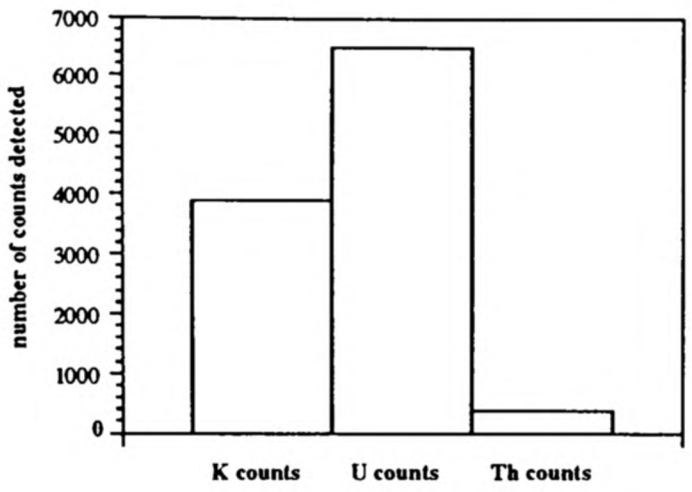
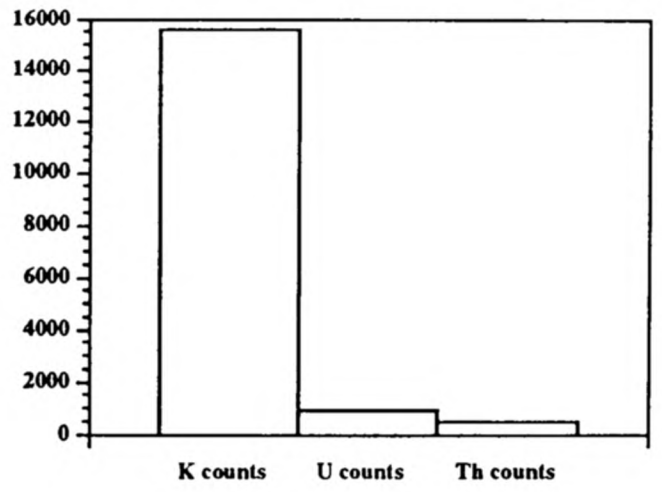


FIGURE 2.04 Interference effects with the lower-energy part of the gamma-radiation spectrum from the Caesium reference isotope incorporated into the GR-256 detector system. Gamma radiation in the energy 800 KeV and below cannot be reliably resolved.

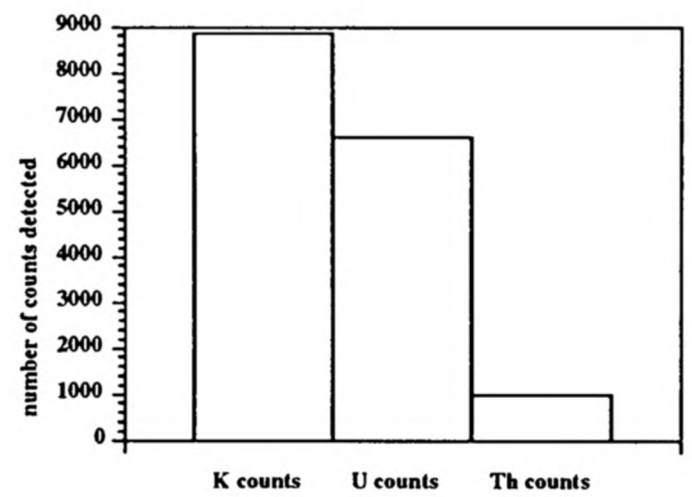
Temperature Drift **Correct Results**

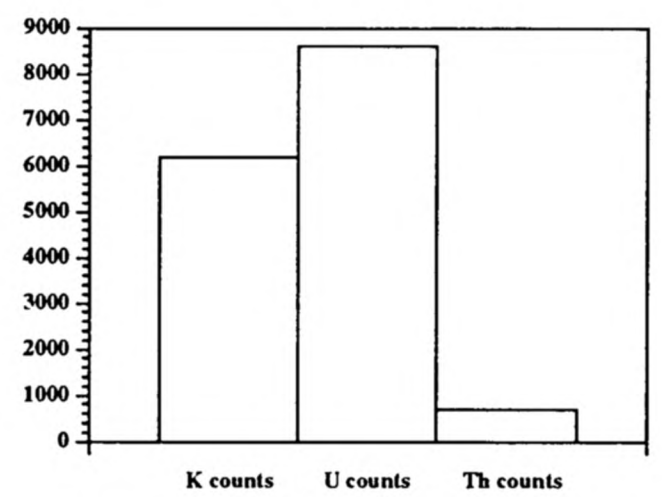
(A) K3-88 Pad (High K concentration, low U and Th concentration)



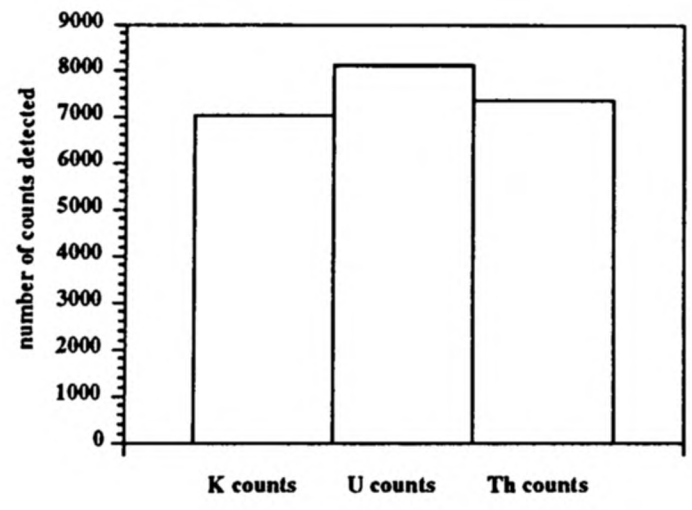


(B) K8-89 Pad (High U concentration, low K and Th concentration)





(C) T3-88 Pad (High Th concentration, low K and U concentration)



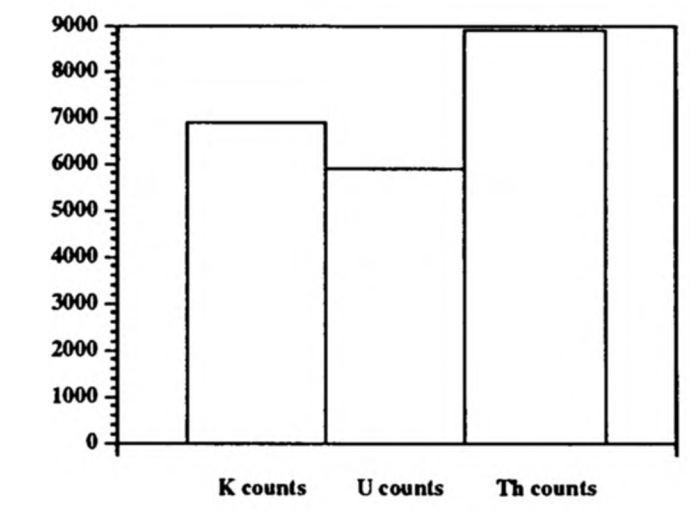


FIGURE 2.05 Calibration results with temperature drift are compared to calibration results collected when the GR-410 gamma-ray spectrometer was stable. The results were collected over a ten minute time interval on the BGS calibration pads. During temperature drift on the K pad, the number of counts recieved by the K window are lower than the number recieved by the U window. Similarly on the U pad the number of counts recieved by the K window are larger than the number of counts recieved by the U window. Therse results would not be expected considering the K and U concentrations of the K3-88 and U8-89 pad.

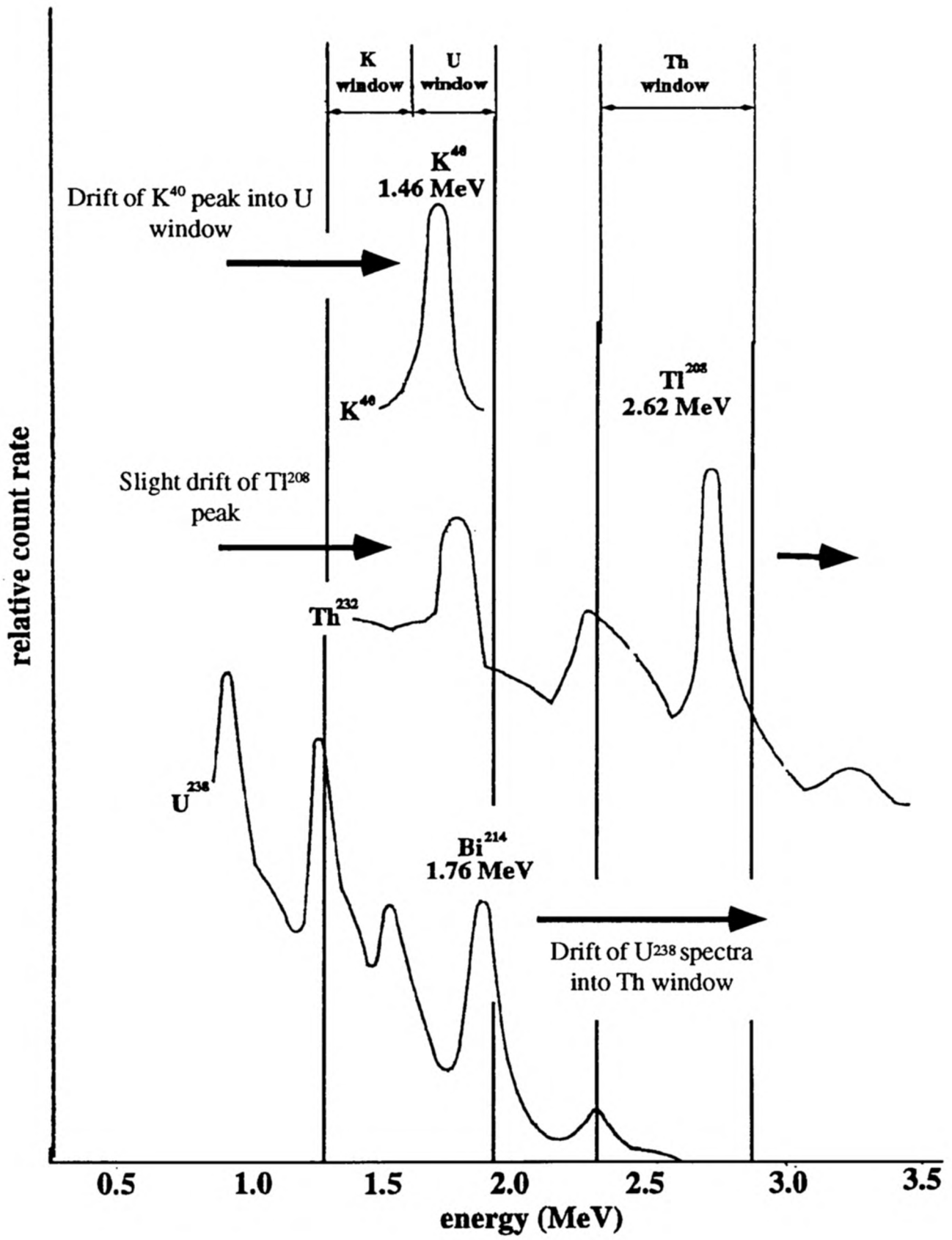


FIGURE 2.06 Temperature drift. Temperature drift is an important source of unpredictable error within the gamma-ray data-set collected with the GR-410 spectrometer. The under-sensitivity towards K shown by the machine used in this investigation can be explained by drift of the K^{40} gamma-ray spectrum into the U window. This would deplete the number of counts detected in the K window but increase the number of counts recieved in the U window and so elevate the calculated U concentration. The slight over sensitivity towards Th can be explained movement of the higher portion of the U gamma-ray spectrum into the Th window. This is not accounted for by stripping factors and hence the calculated Th concentration would be elevated.

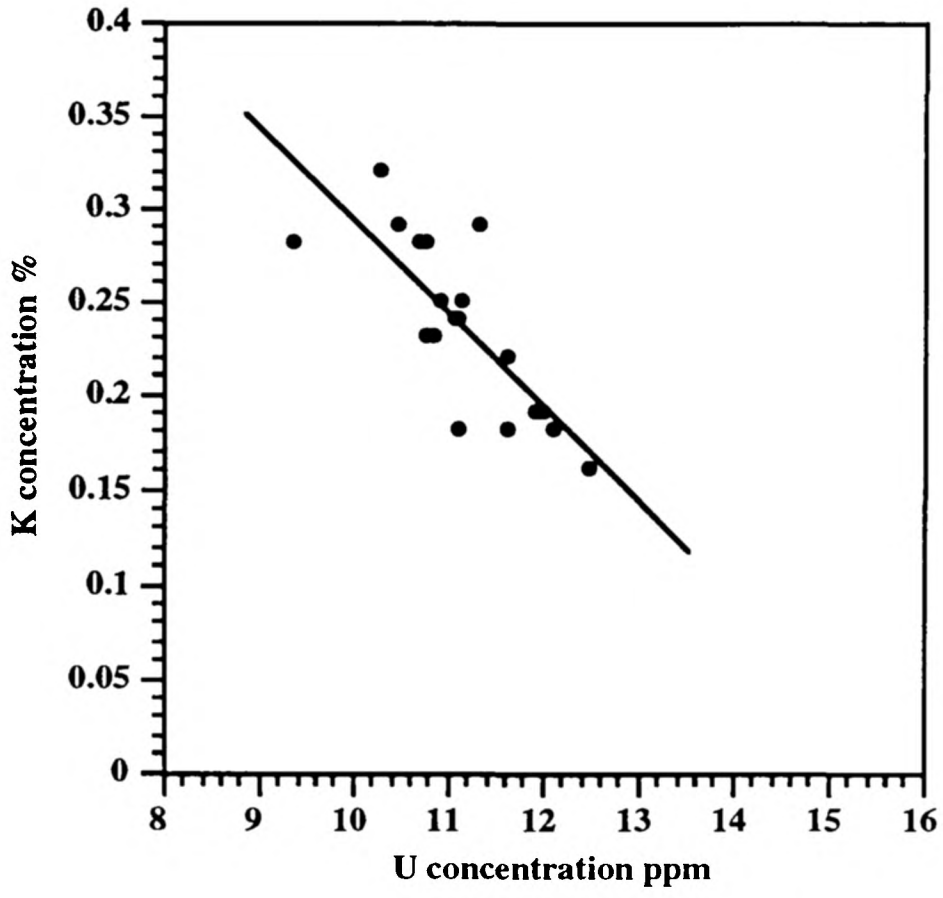


FIGURE 2.07 A Negative covariant relationship between calculated K and U concentration from total counts measured with the GR-410 spectrometer. The data-set represents twenty repeated readings from a single point that were taken on Iron Ledge in the horizontal plane.

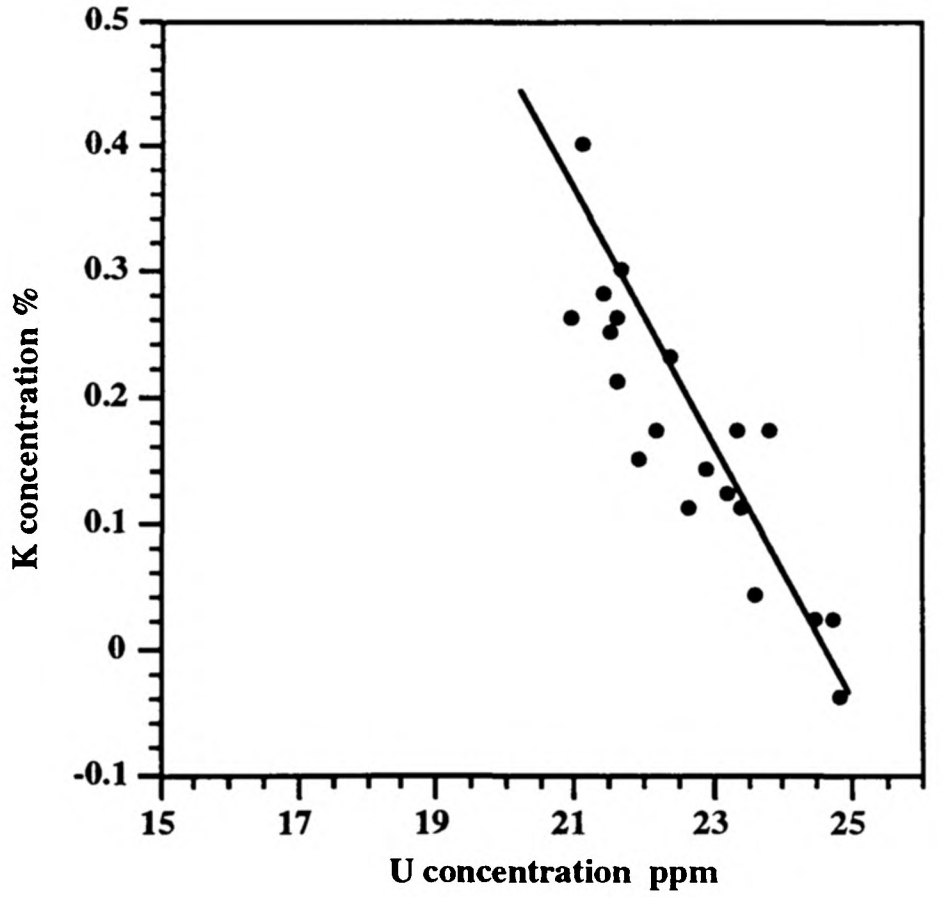


FIGURE 2.07 B Negative covariant relationship between calculated K and U concentration from total counts measured with the GR-410 spectrometer. The data-set represents twenty repeated readings from a single point that were taken on Belemnite Bed in the horizontal plane.

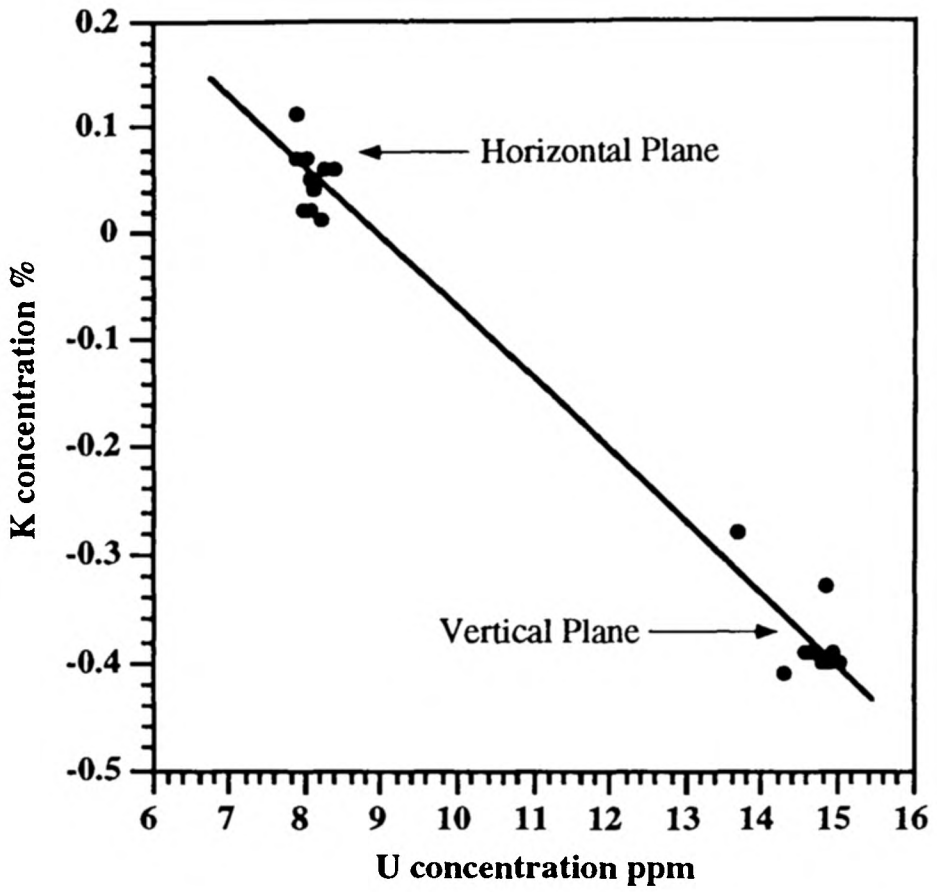


FIGURE 2.07 C Negative covariant relationship between calculated K and U concentration from total counts measured with the GR-410 spectrometer. The data-set represents twenty repeated readings from a single point that were taken on the Lower Cement Bed in the horizontal and vertical plane.

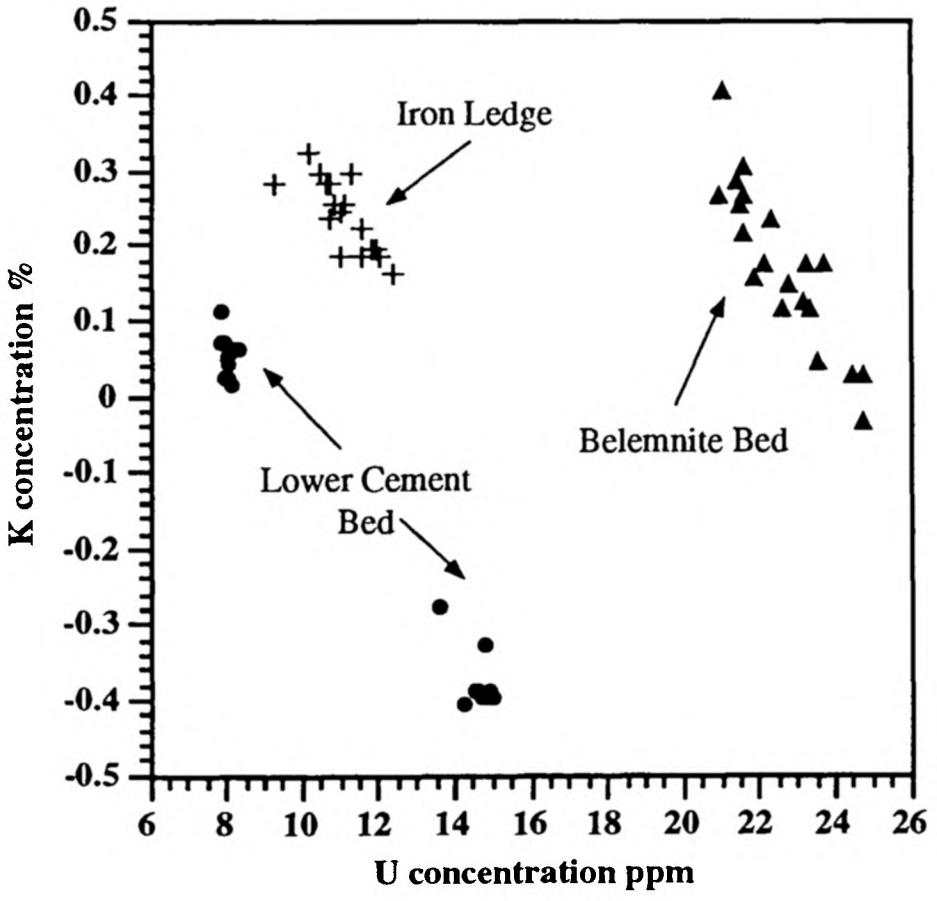


FIGURE 2.07 D Relationship between calculated K and U concentration from total counts measured with the GR-410 spectrometer for the three data-sets (60 samples)

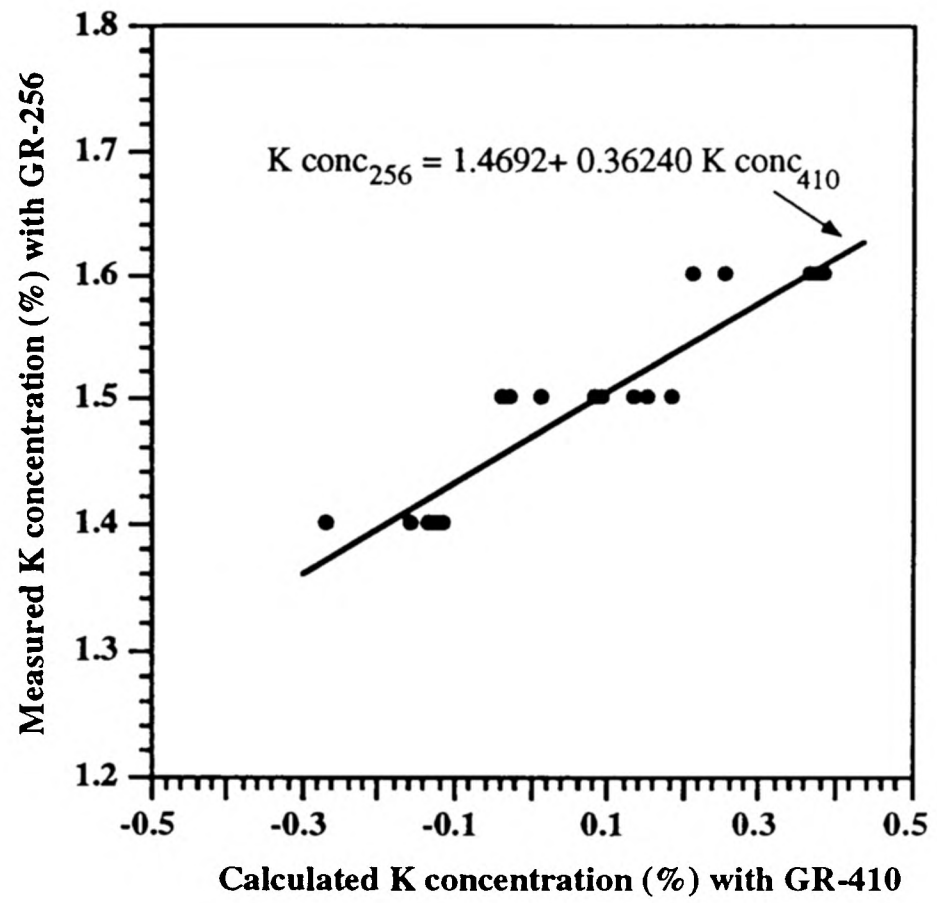


FIGURE 2.08 A Numerical relationship between K concentration calculated from total counts detected with the GR-410 and K concentration detected by the GR-256. Readings were taken in the horizontal plane on the Belemnite Bed. (Correlation significant at the 95 % level for a coefficient of 0.866)

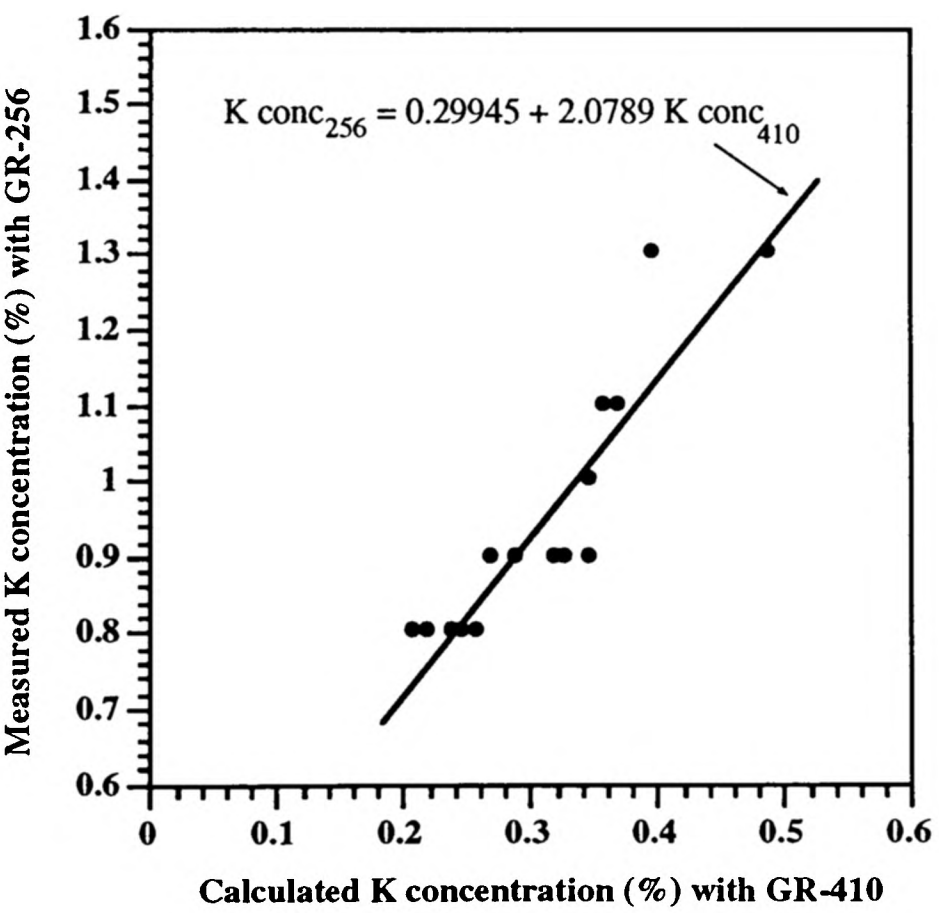


FIGURE 2.08 B Numerical relationship between K concentration calculated from total counts detected with the GR-410 and K concentration detected by the GR-256. Readings were taken in the horizontal plane on Iron Ledge. (Correlation significant at the 95 % level for a coefficient of 0.856)

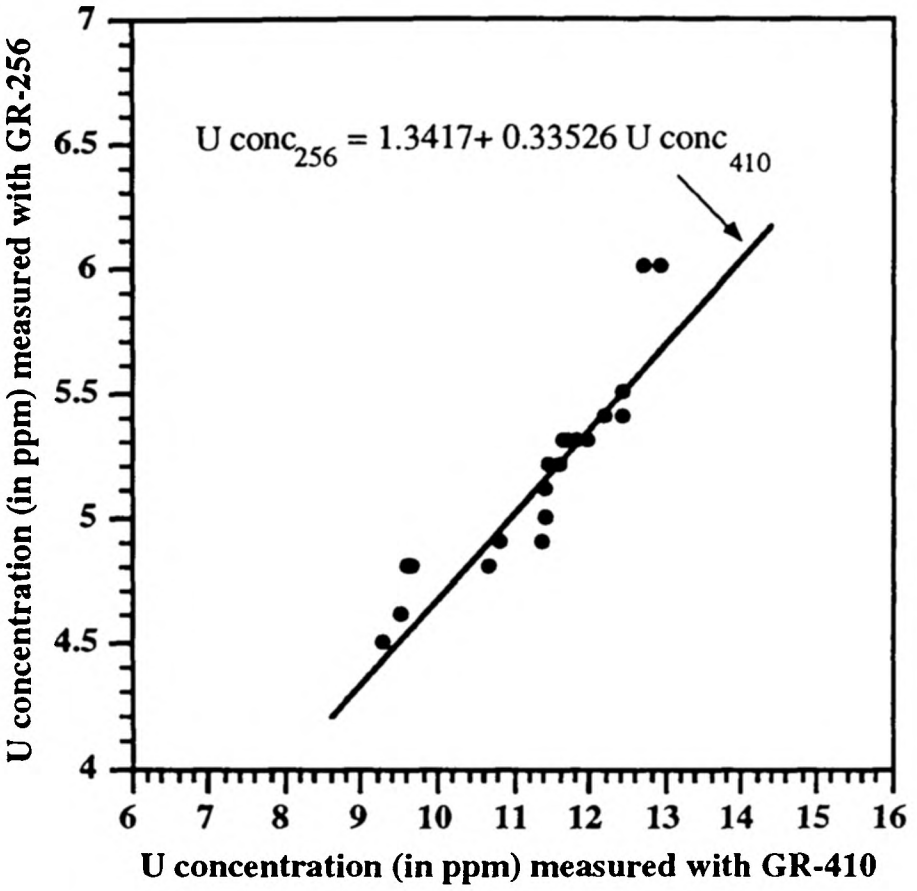


FIGURE 2.09 A Positive covariant relationship between U concentration calculated from total counts detected with the GR-410 and U concentration detected by the GR-256. Readings were taken in the horizontal plane on the Belemnite Bed. (Correlation significant at the 95 % level for a coefficient of 0.835)

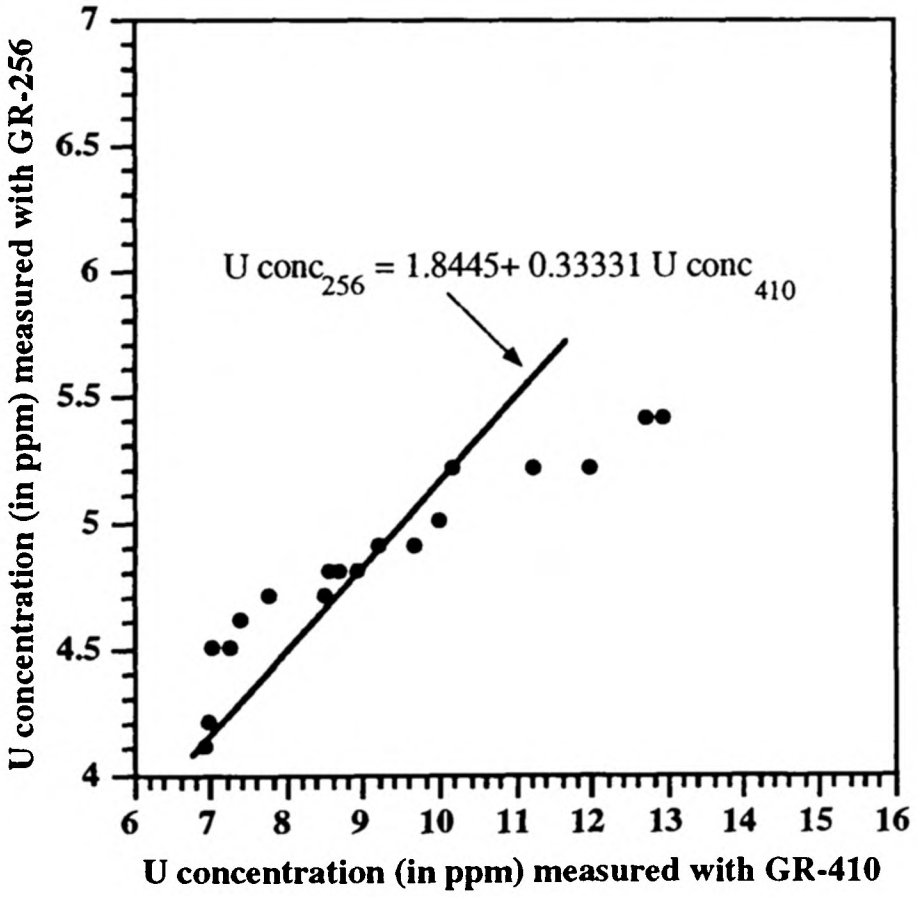


FIGURE 2.09 B Positive covariant relationship between U concentration calculated from total counts detected with the GR-410 and U concentration detected by the GR-256. Readings were taken in the horizontal plane on Iron Ledge. (Correlation significant at the 95 % level for a coefficient of 0.628)

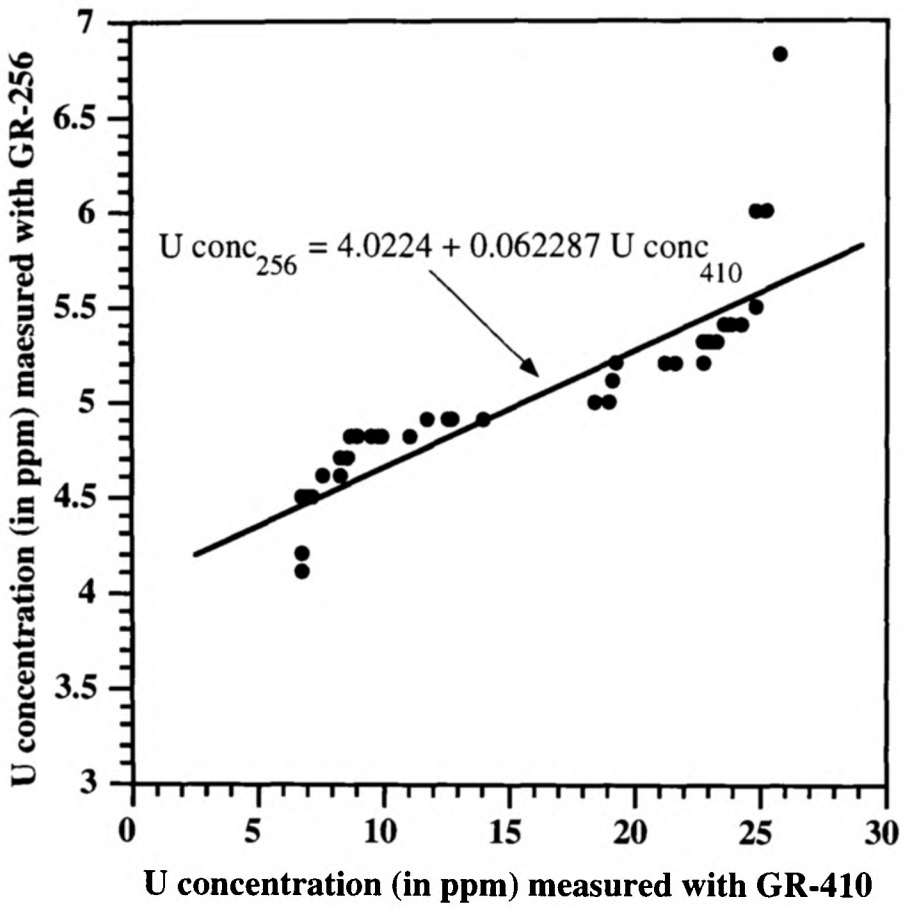


FIGURE 2.09 C Positive covariant linear relationship between U concentration calculated from total counts detected with the GR-410 and U concentration detected by the GR-256. The data-set of 40 measurements represents readings taken on both Iron Ledge and the Belemnite Bed. (Correlation significant at the 95 % level for a coefficient of 0.741)

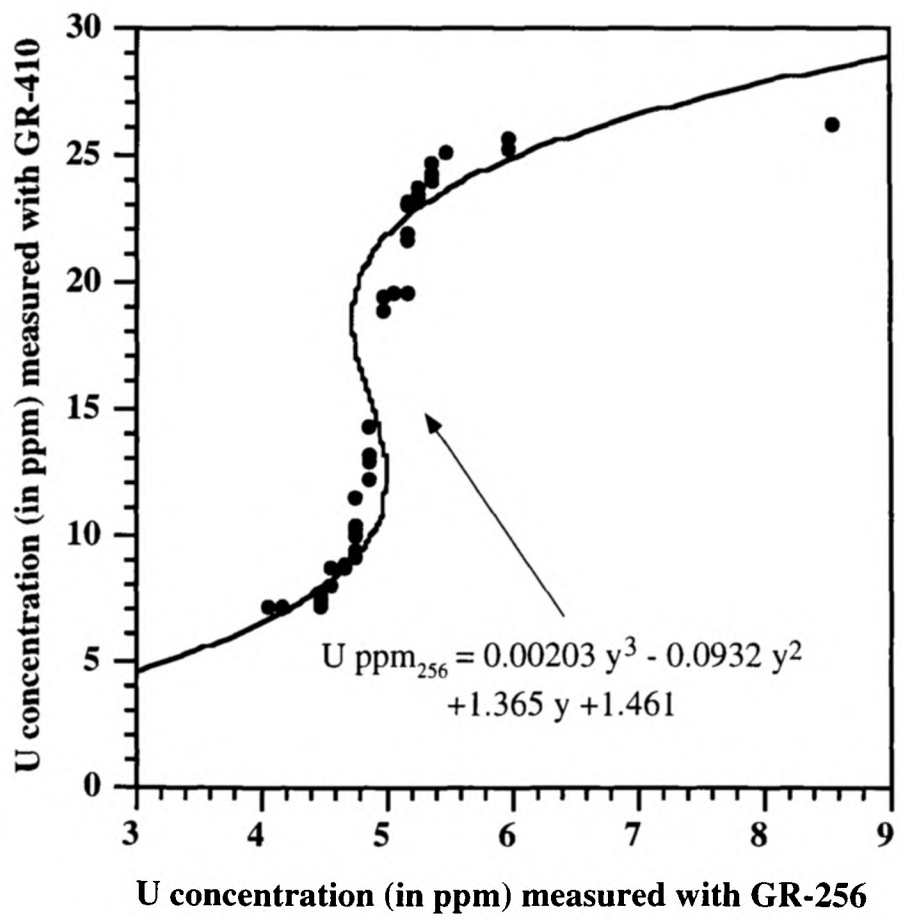


FIGURE 2.09 D Three degree polynomial relationship between U concentration calculated from total counts detected with the GR-410 and U concentration detected by the GR-256. The relationship is given as U ppm $_{256}$ as a function of U ppm $_{410}$. The data-set of 40 measurements represents readings taken on both Iron Ledge and the Belemnite Bed. The best-fit curve shows a backward trend over the mid-field which is not supported by the individual data points.

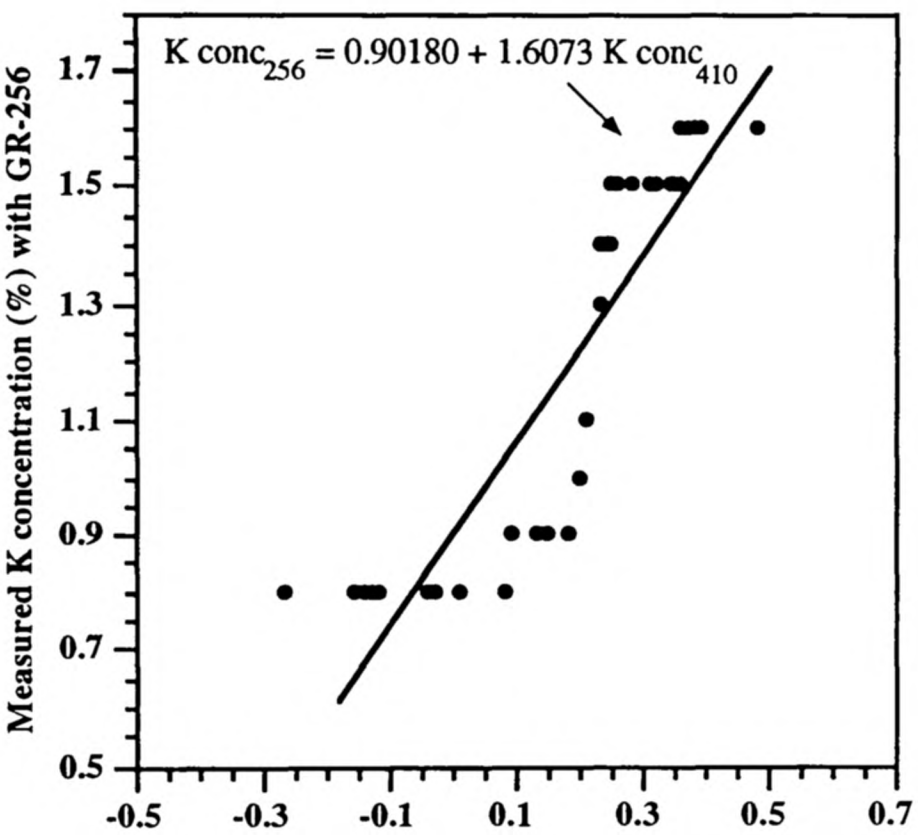


FIGURE 2.10 Positive covariant linear relationship between K concentration calculated from total counts detected with the GR-410 and K concentration detected by the GR-256. The data-set of 40 measurements represents readings taken on both Iron Ledge and the Belemnite Bed. (Correlation significant at the 95 % level for a coefficient of 0.792)

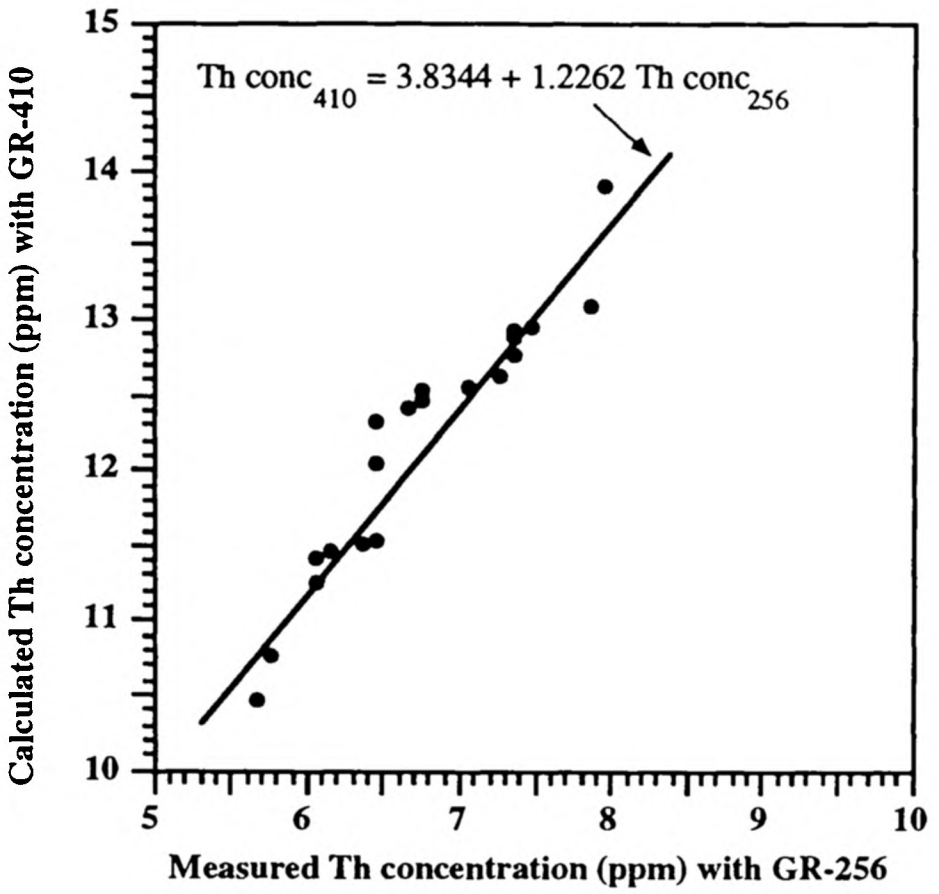


FIGURE 2.11 A Positive covariant linear relationship between Th concentration calculated from total counts detected with the GR-410 and Th concentration detected by the GR-256. Readings were taken in the horizontal plane on the Belemnite Bed. (Correlation significant at the 95 % level for a coefficient of 0.913)

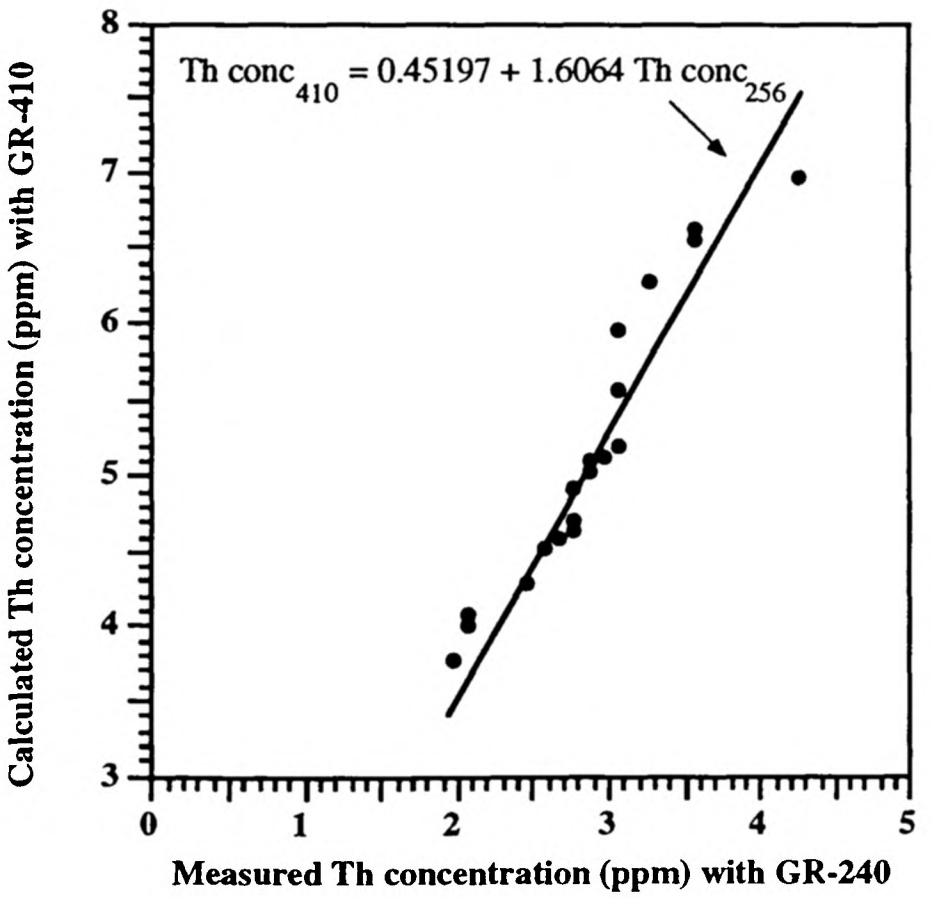


FIGURE 2.11 B Positive covariant linear relationship between Th concentration calculated from total counts detected with the GR-410 and Th concentration detected by the GR-256. Readings were taken in the horizontal plane on Iron Ledge. (Correlation significant at the 95 % level for a coefficient of 0.954)

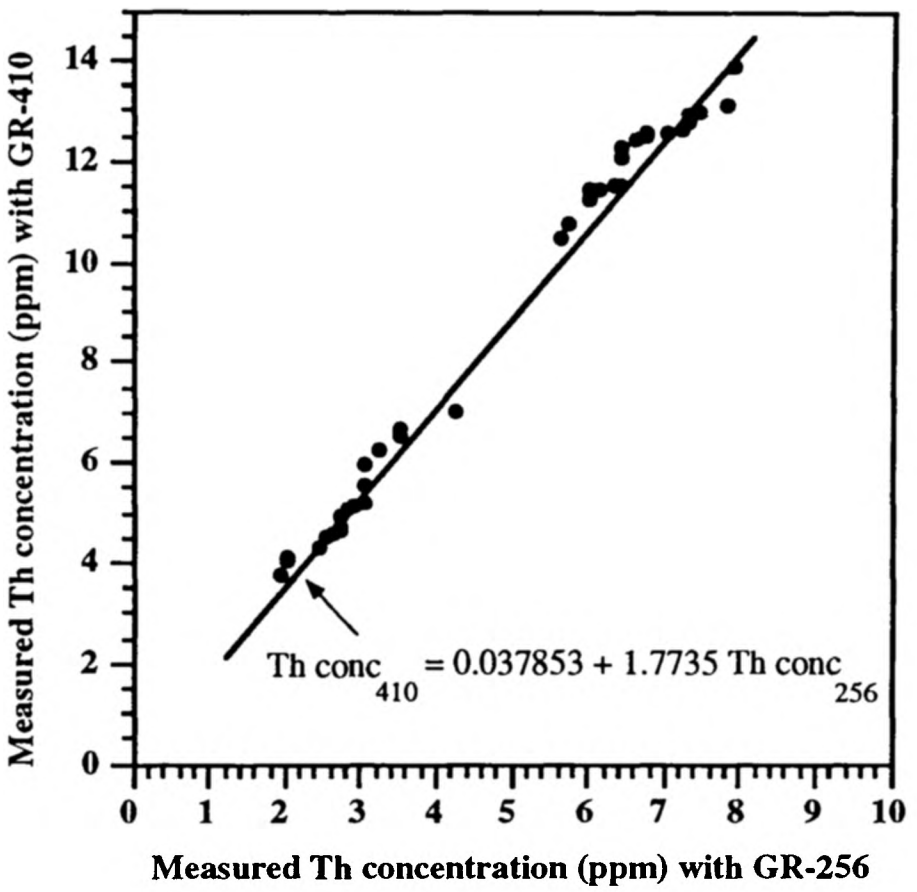
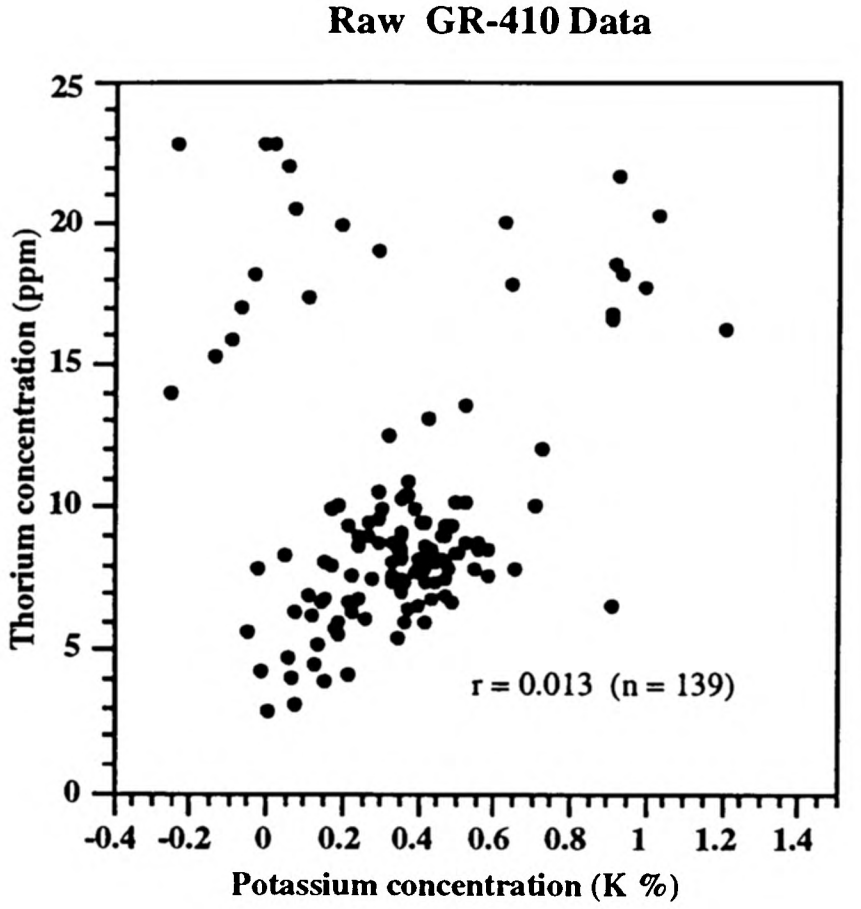


FIGURE 2.12 Positive covariant linear relationship between Th concentration calculated from total counts detected with the GR-410 and Th concentration detected by the GR-256. The data-set of 40 measurements represents readings taken on both Iron Ledge and the Belemnite Bed. (Correlation significant at the 95 % level for a coefficient of 0.792)



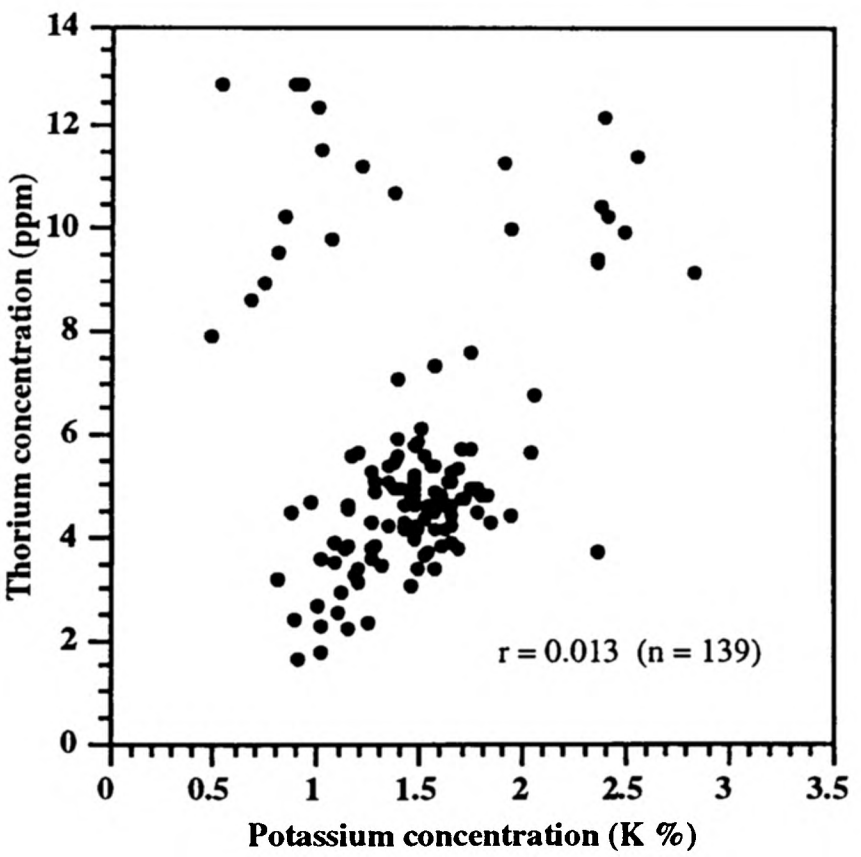


FIGURE 2.13 Part of the Unreliable GR-410 Data-Set.

ABOVE Numerical relationship between calculated K and Th concentration and calculated U and Th concentration from raw data collected with the GR-410. A positive covariant relationship between Th and K is not shown, as would be expected. This indicates that the data-set is not robust.

BELOW Numerical relationship between realigned K and Th concentration and realigned U and Th concentration using realignment formulae given in Chapter 2, Section 2.05. Again a positive covariant relationship between Th and K is not shown, as would be expected.

The data-set comprises 139 measured samples from west of Kilve Pylle, Somerset (*bucklandi* Zone, *bucklandi* Subzone, to *semicostatum* Zone, *lyra* Subzone).

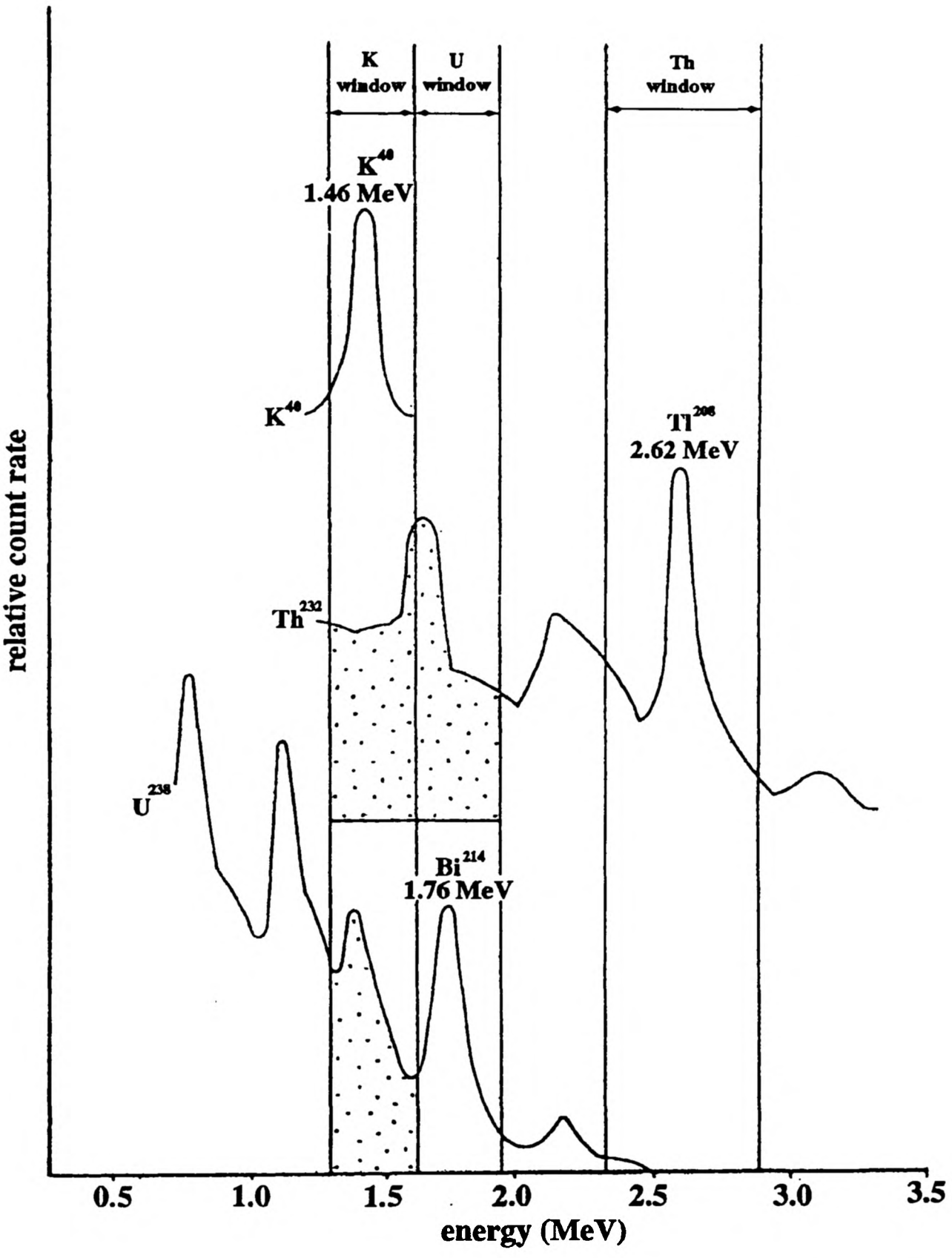


FIGURE 2.14 The individual energy windows used in the determination of K, U and Th concentrations in portable gamma-ray spectrometers. The use of broad energy windows (In order to take account of energy spreading away from the discrete peak) results in an overlapping of energy spectra measured from the different decay series. This phenomenon can be removed by the accurate determination of stripping constants. The stripping constant represent the ratio of counts detected in one window to those in another from pure sources of U and Th.

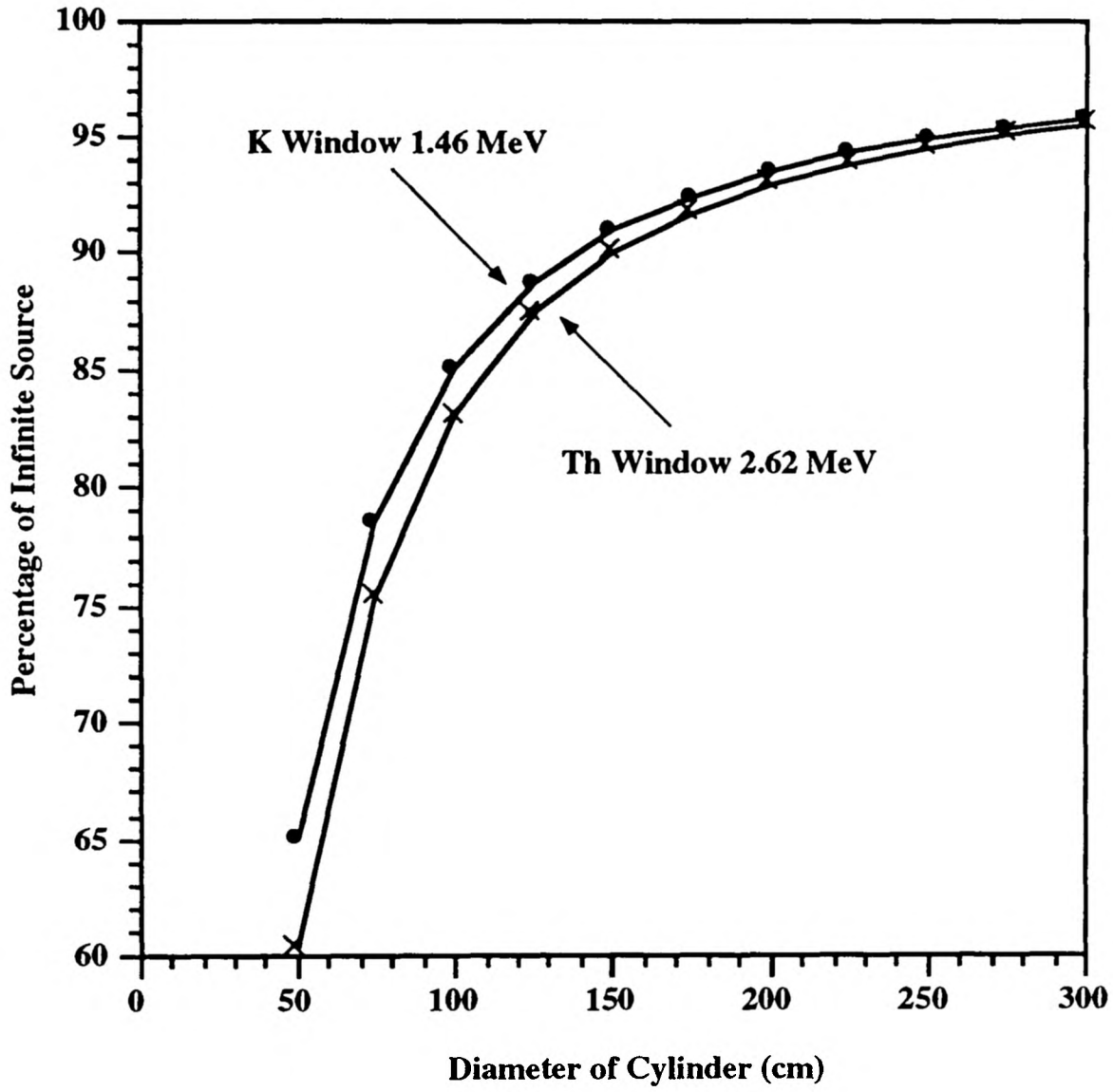


FIGURE 2.15 Response of a typical portable gamma-ray spectrometer to cyclindrical calibration pads of varying diameter. the diameter is increased by 25 cm for each data point from 50 cm at the base of the curve to 300 cm at the top of the curve. The pads conform to the specifications oulined in Appendix 1, Table 1.17. Data are plotted from Grasty *et al.* (1991).

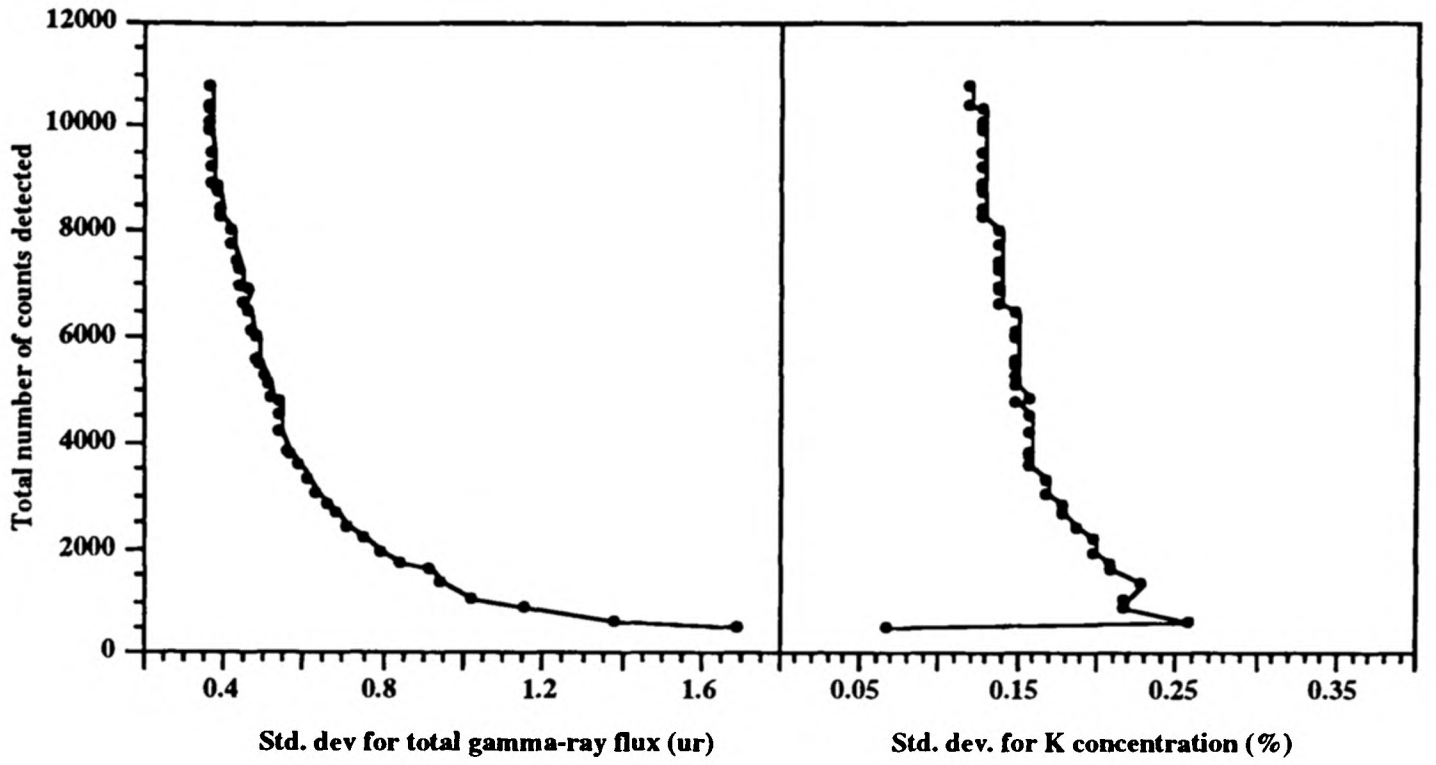
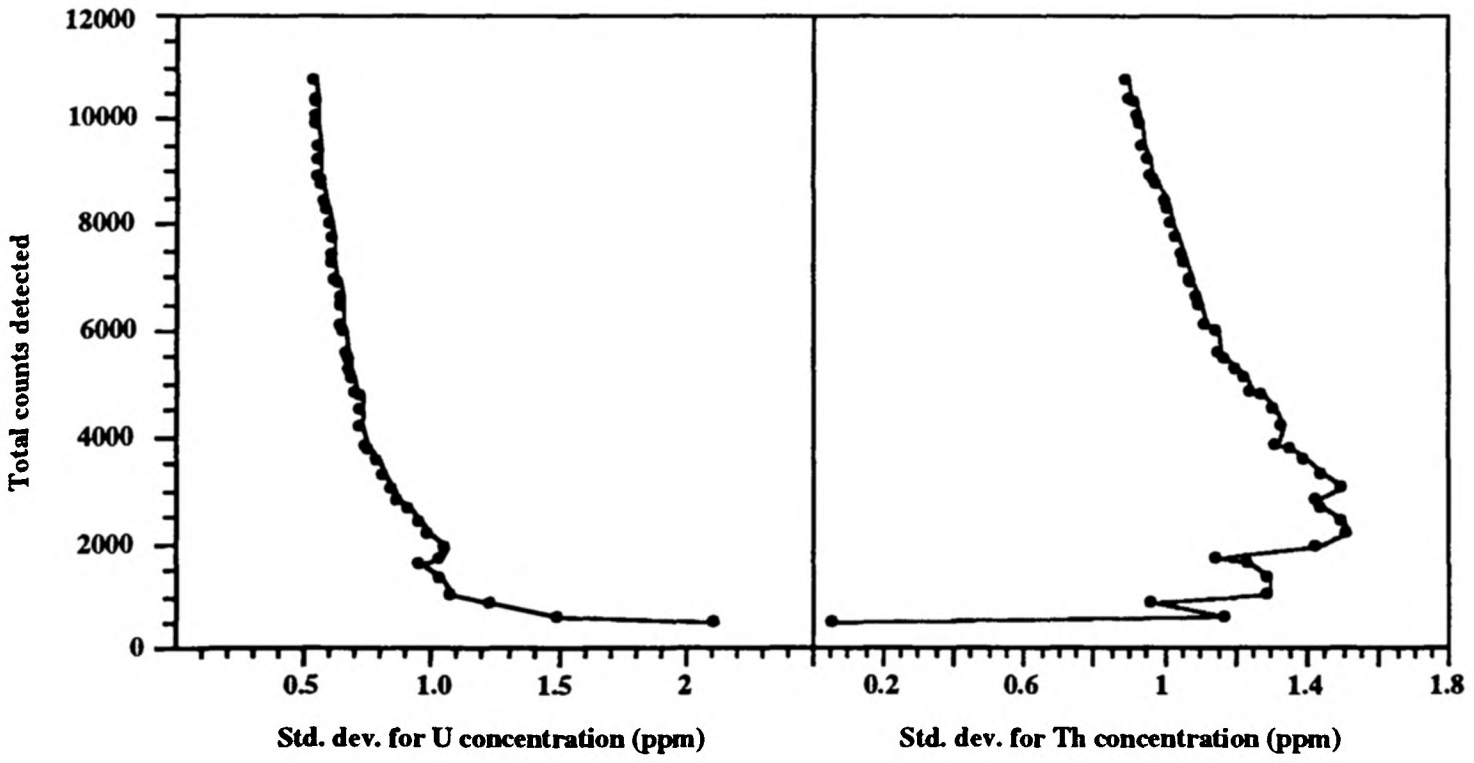
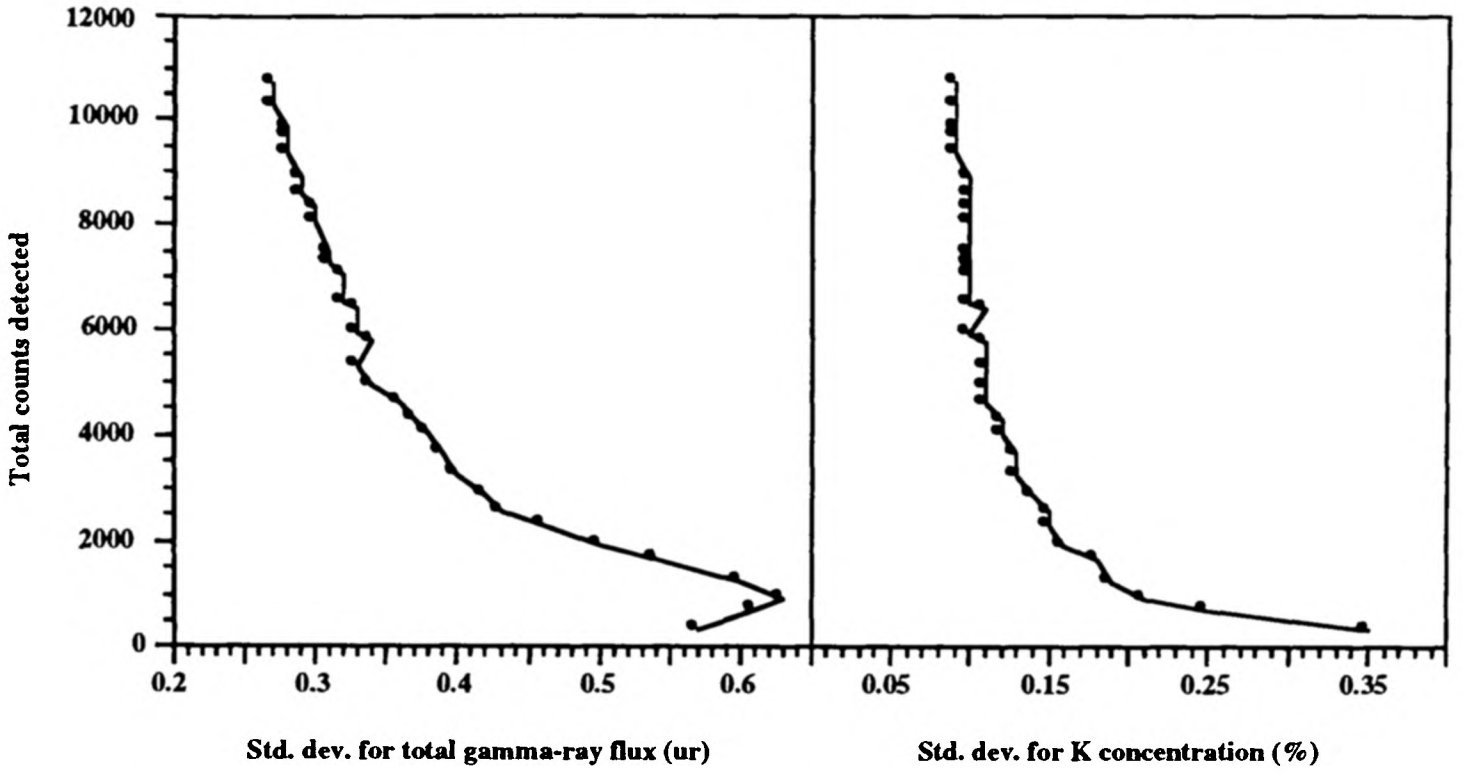


FIGURE 2.16 Standard deviation curves for 48 repeated readings taken from a single point on the Belemnite Bed. The measurements were taken with the GR-256 gamma-ray spectrometer in the horizontal plane with 5-second increments in measurement time up to a maximum of 240 seconds.





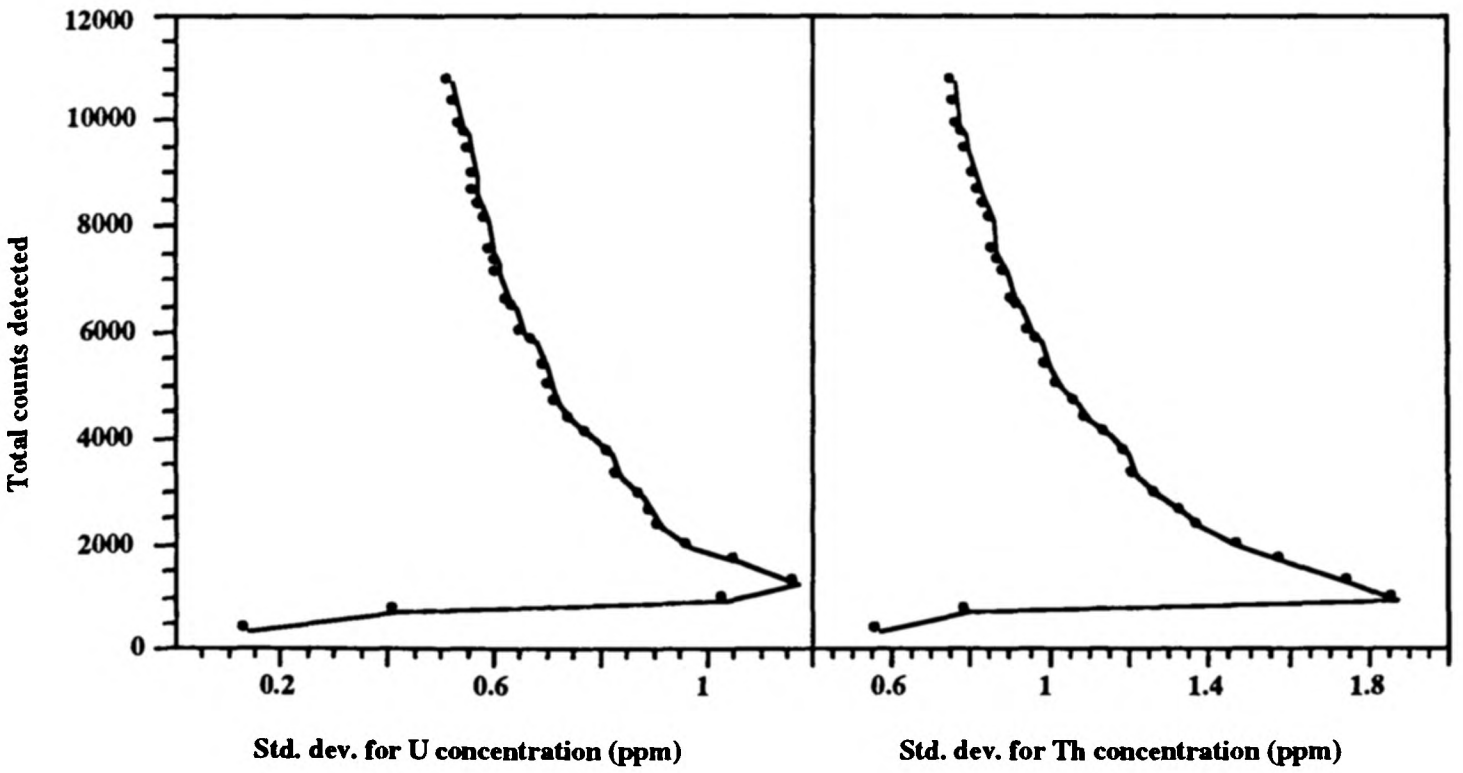


FIGURE 2.17 Standard deviation curves for 33 repeated readings taken from a single point on Iron Ledge. The measurements were taken with the GR-256 gamma-ray spectrometer in the horizontal plane with 10-second increments in measurement time up to a maximum of 320 seconds.

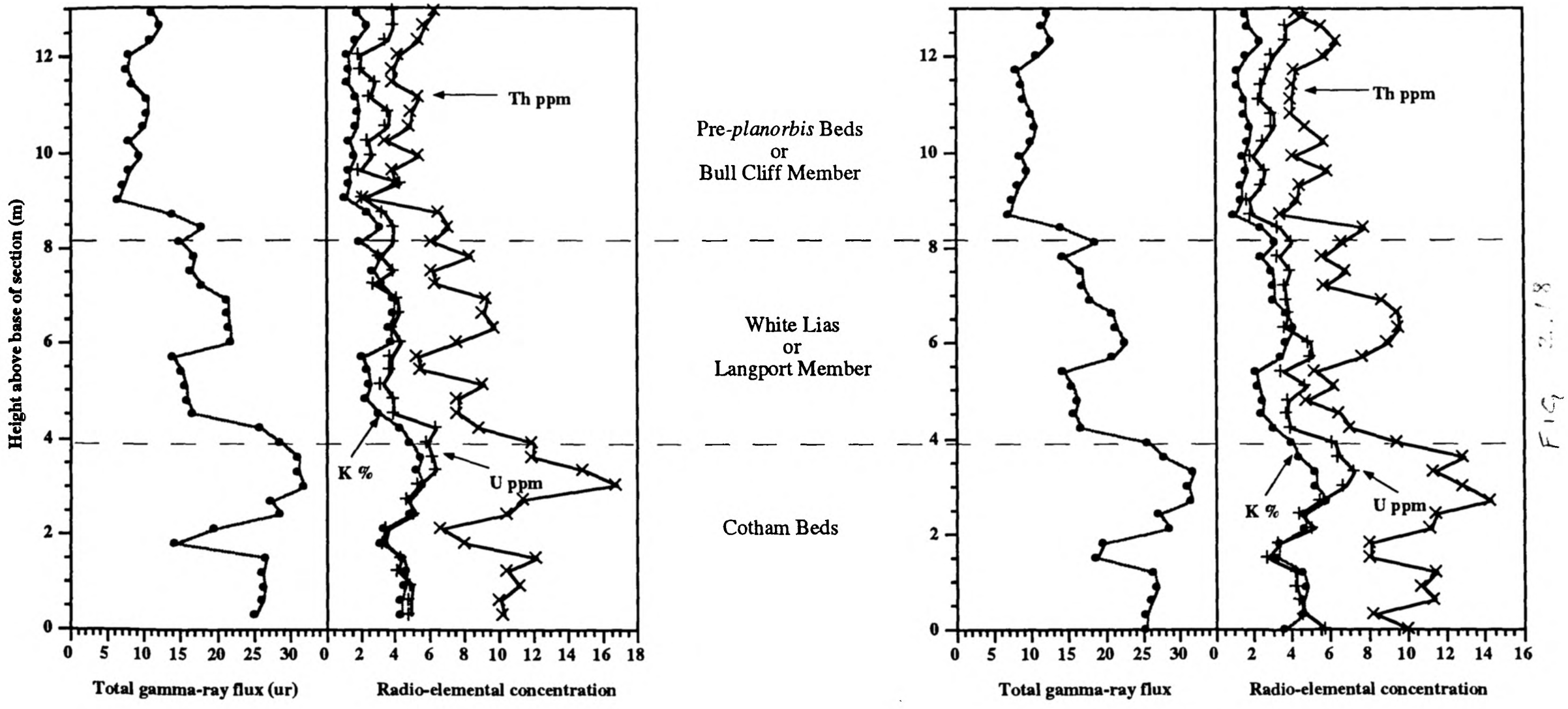


FIGURE 2.18

FIGURE 2.18 Comparison of gamma-ray measurements collected from identical points exactly five hours apart from each other. The measurements were taken from the Rhaetian succession exposed in St. Mary's Well Bay, South Glamorgan (ST 180680). All data collected with the GR-256 spectrometer on the 11 th and 12th September 1995.

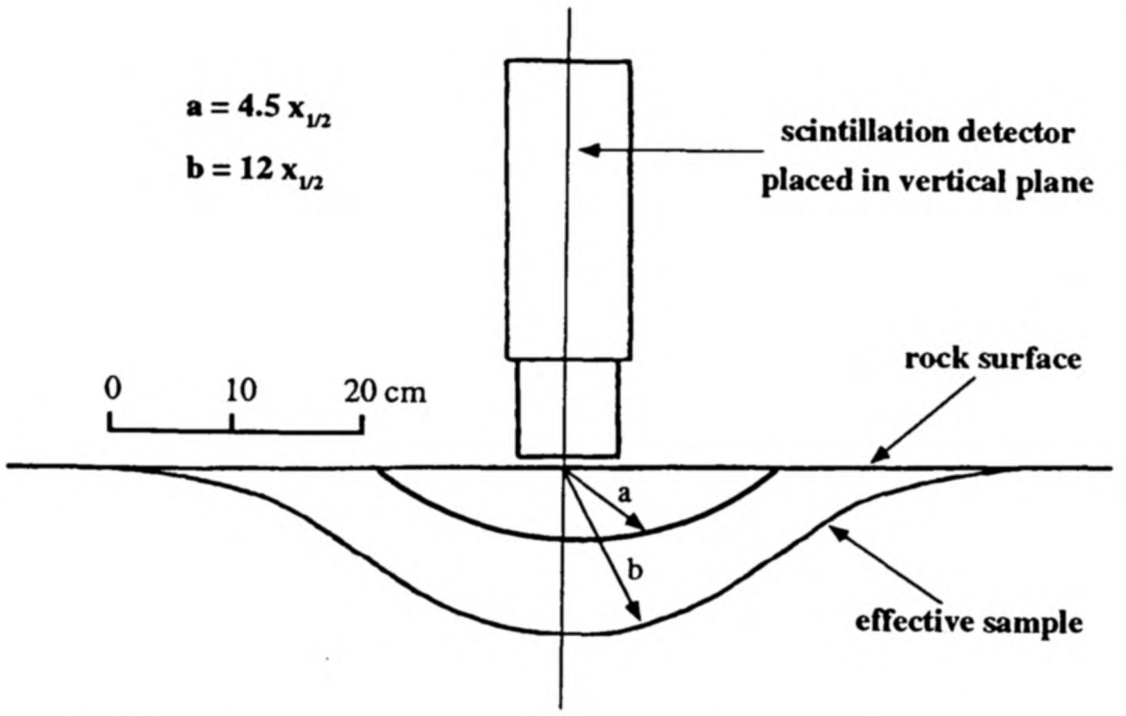


FIGURE 2.19 A Sample geometry for an uncollimated GR-256 or GR-410 gamma-ray spectrometer. Hemispheres a and b provide 60 % and 99 % of the sample. Half-thickness ($x_{1/2}$) is given by 0.639/mu *p* where mu is mass absorption coefficient and *p* is the density. (Adapted from Heath 1982).

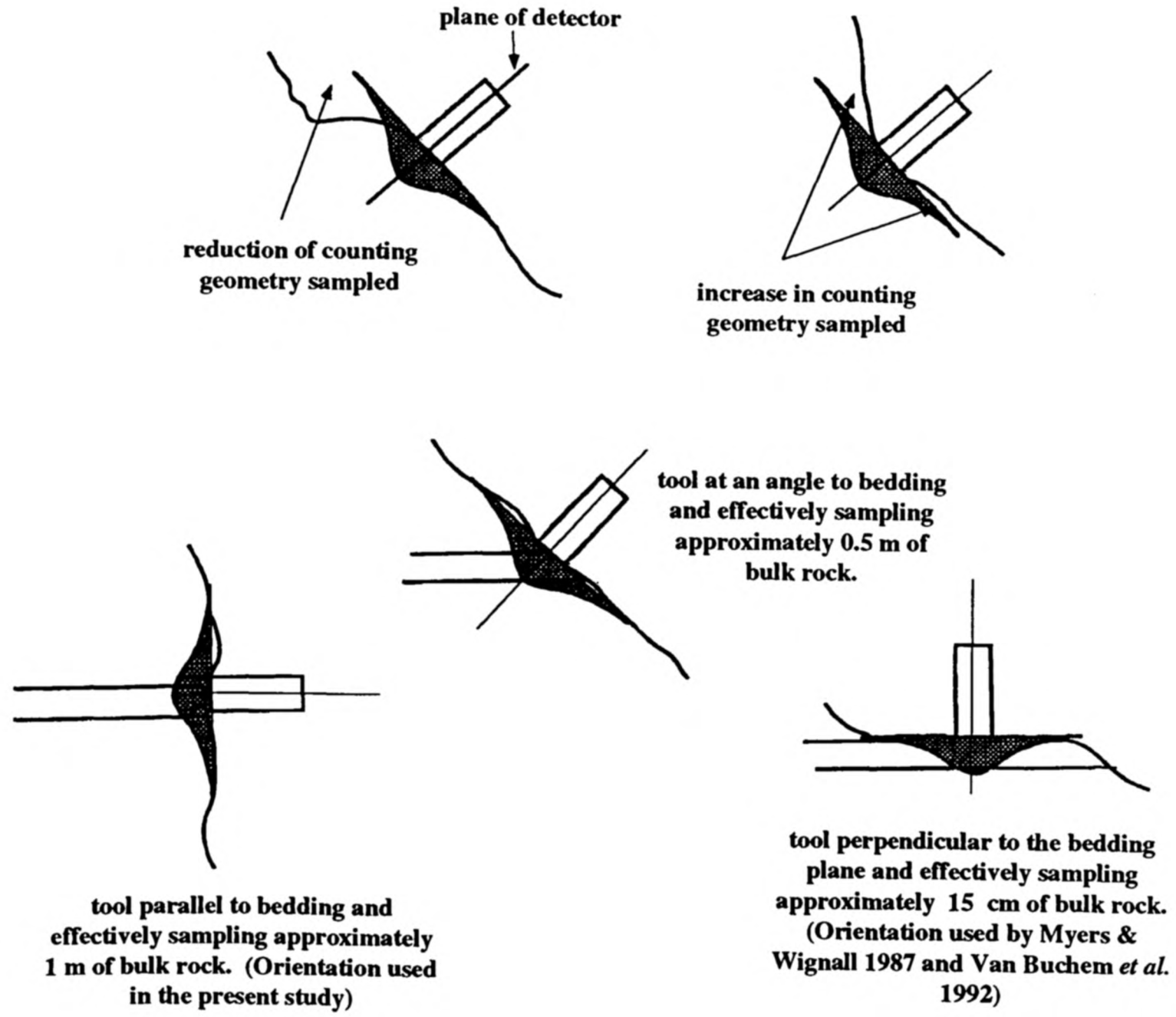


FIGURE 2.19 Relationship between counting geometry and stratigraphical bedding surfaces. Tool resolution is greatly effected by the orientation at which the scintillation detector is placed upon the fresh outcrop surface. (Modified from Parkinson 1994).

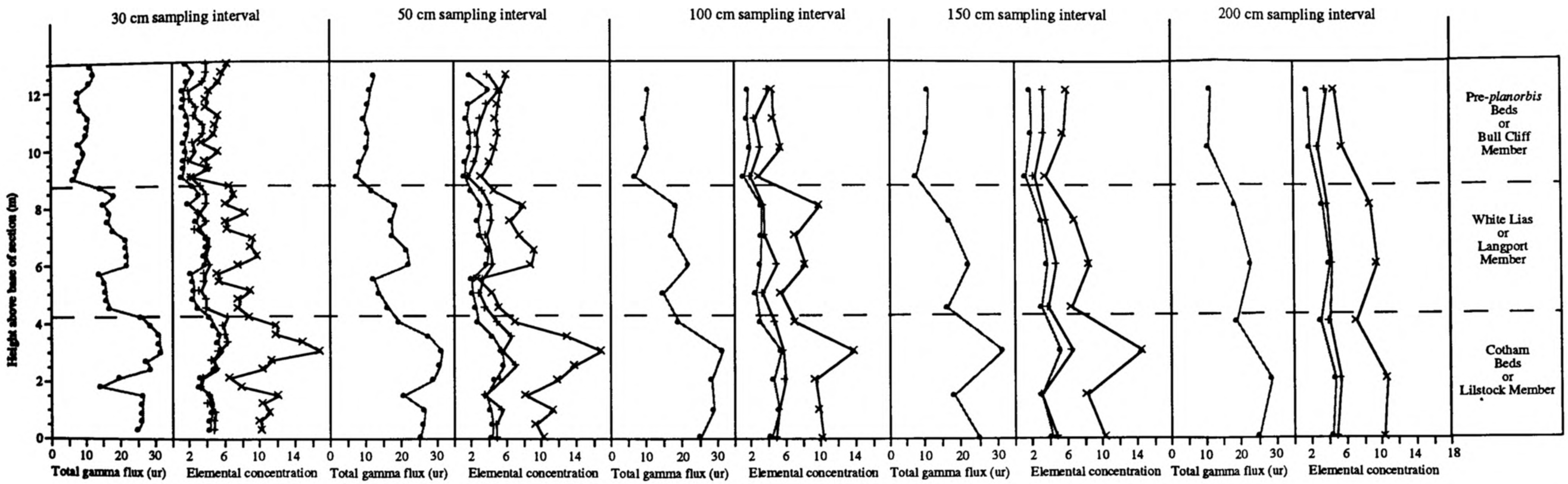


Figure 2.20

FIGURE 2.20 Loss of high-frequency information with successive increases in sampling interval. The trends that are developed within the 30 cm sampled gamma-ray logs can be convincingly identified in the 50 cm, 100 cm and 150 cm sampled logs. The 200 cm sampled gamma-ray logs do not accurately reflect the stratigraphic gamma-ray trends demonstrated at a higher frequency of scale. Each set of gamma-ray readings were measured from St. Mary's Well Bay, Glamorgan (ST 180680) and are of Rhaetian (Upper Triassic) age.

Chapter 3
Figure 3.01 to Figure 3.60

The Gamma-Ray Characteristics of the Lower Lias in Southern Britain

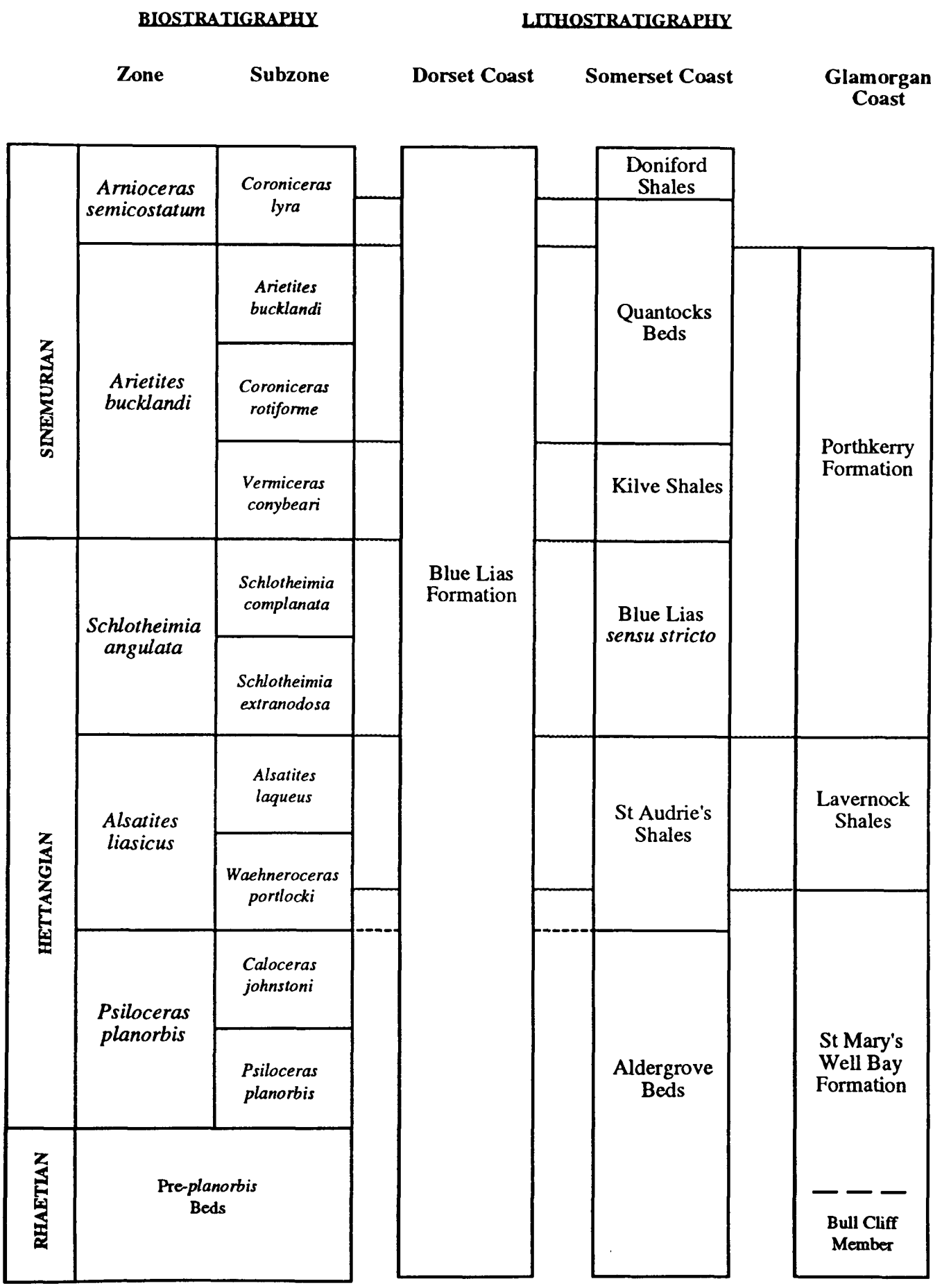


FIGURE 3.01 A comparison of the lithostratigraphic and biostratigraphic divisions of the Rhaetian - Lower Sinemurian succession in southern Britain. Based upon Trueman (1920), Lang (1924), Dean *et al.* (1961), Palmer (1972) and Ivimey-Cook & Donovan (1983). The informal term "Blue Lias" typically refers to high frequency limestone-marl alternations that characterise the exposure at Lyme Regis, Dorset (SY 328910). In this present study the term "Blue Lias" is used for all Lower Lias sedimentary rocks in southern Britain of pre-*planorbis* to *semicostatum* Zone (*lyra* Subzone) age.

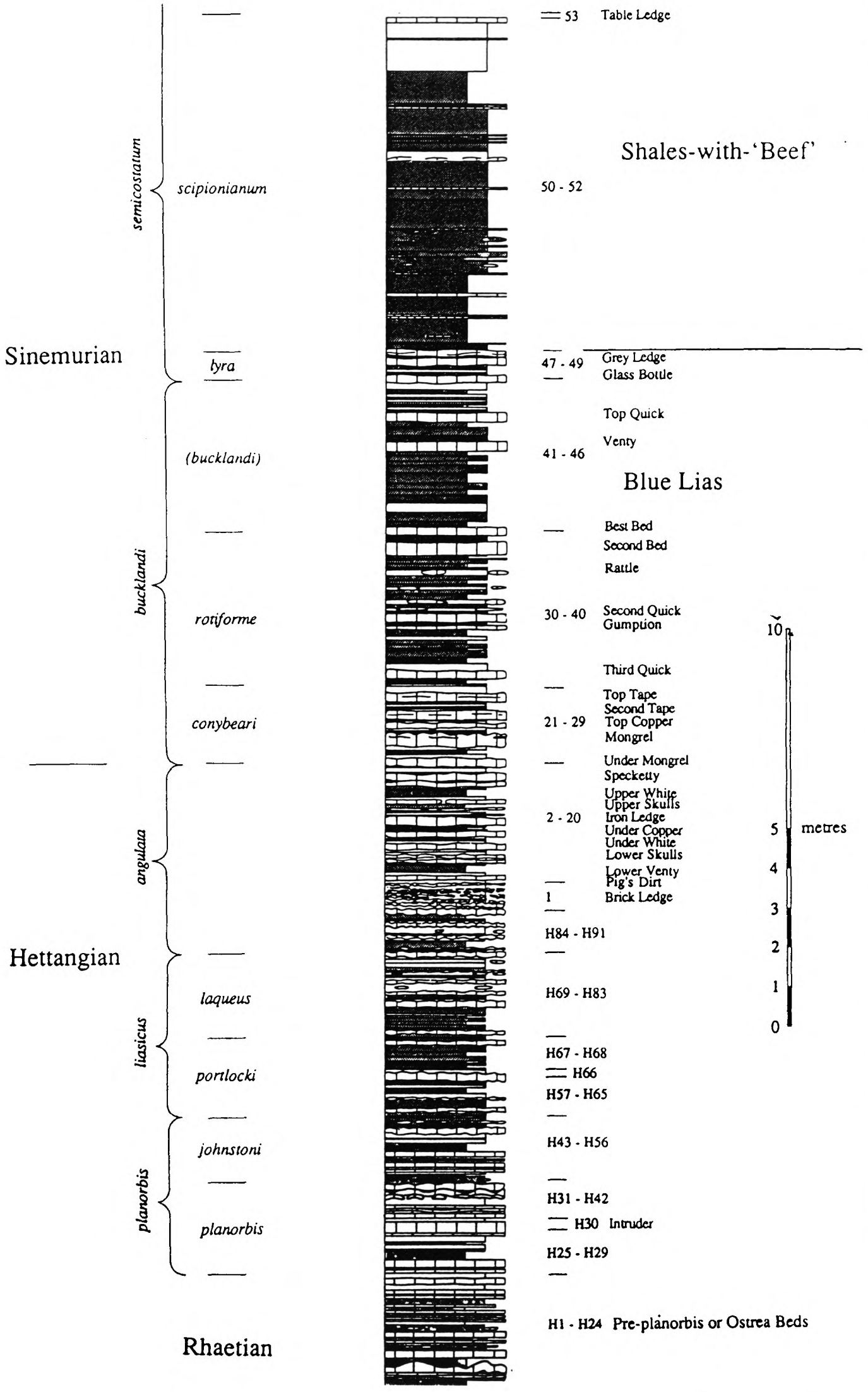


FIGURE 3.02 Stratigraphic log for the Blue Lias and lower part of the Shales-with-Beef (from Hesselbo & Jenkyns 1995a). Bed numbers are taken from Lang *et al.* (1922) and Lang (1924). Biostratigraphy based on Lang *et al.* (1922), Lang (1924), Dean *et al.*. (1961) and Ivimey-Cook & Donovan (1983). Section measured between Pinhay Bay (SY 318908) and Seven Rock Point, Lyme Regis, Dorset (SY 328910).

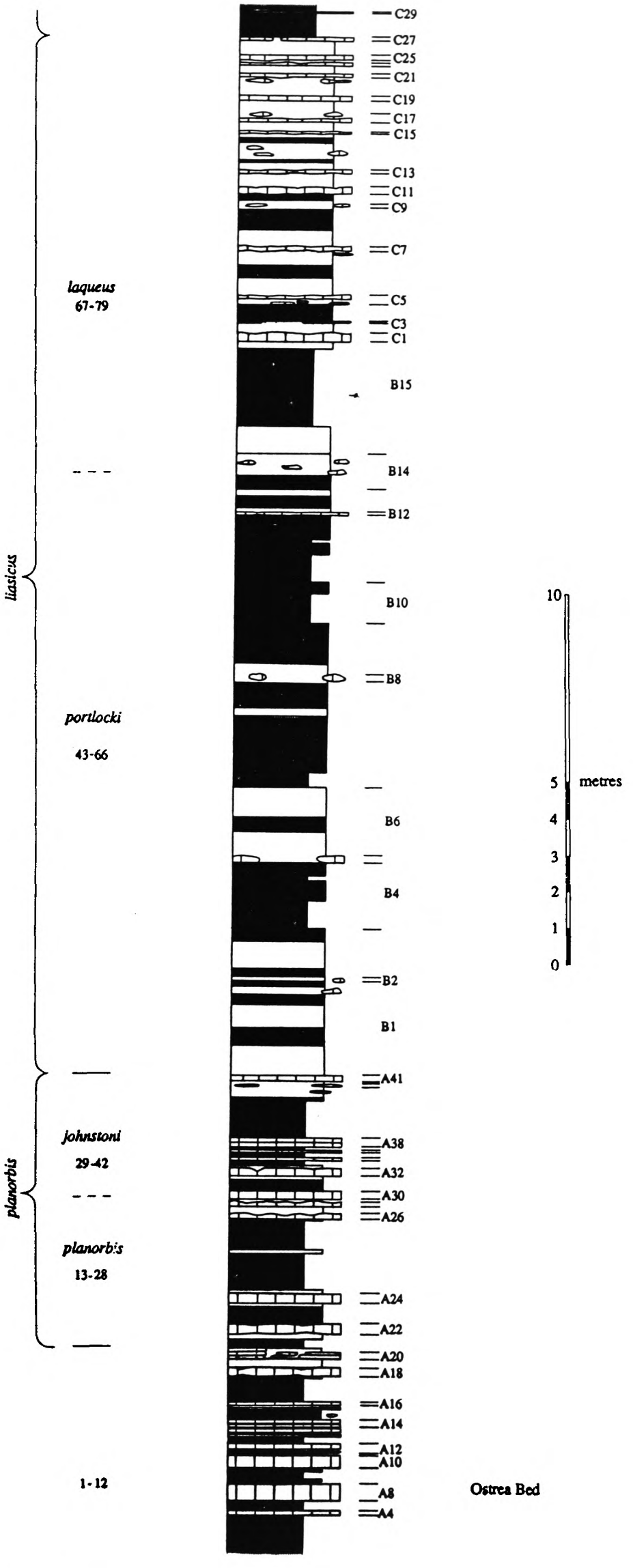


FIGURE 3.03 Stratigraphic log for the Blue Lias at St Audrie's Bay, Somerset ST 102433 (Unpublished, courtesy of Hesselbo & Jenkyns.) Bed numbers are taken from Palmer (1972). Biostratigraphy based upon Dean *et al.* (1961) and Ivimey-Cook & Donovan (1983).

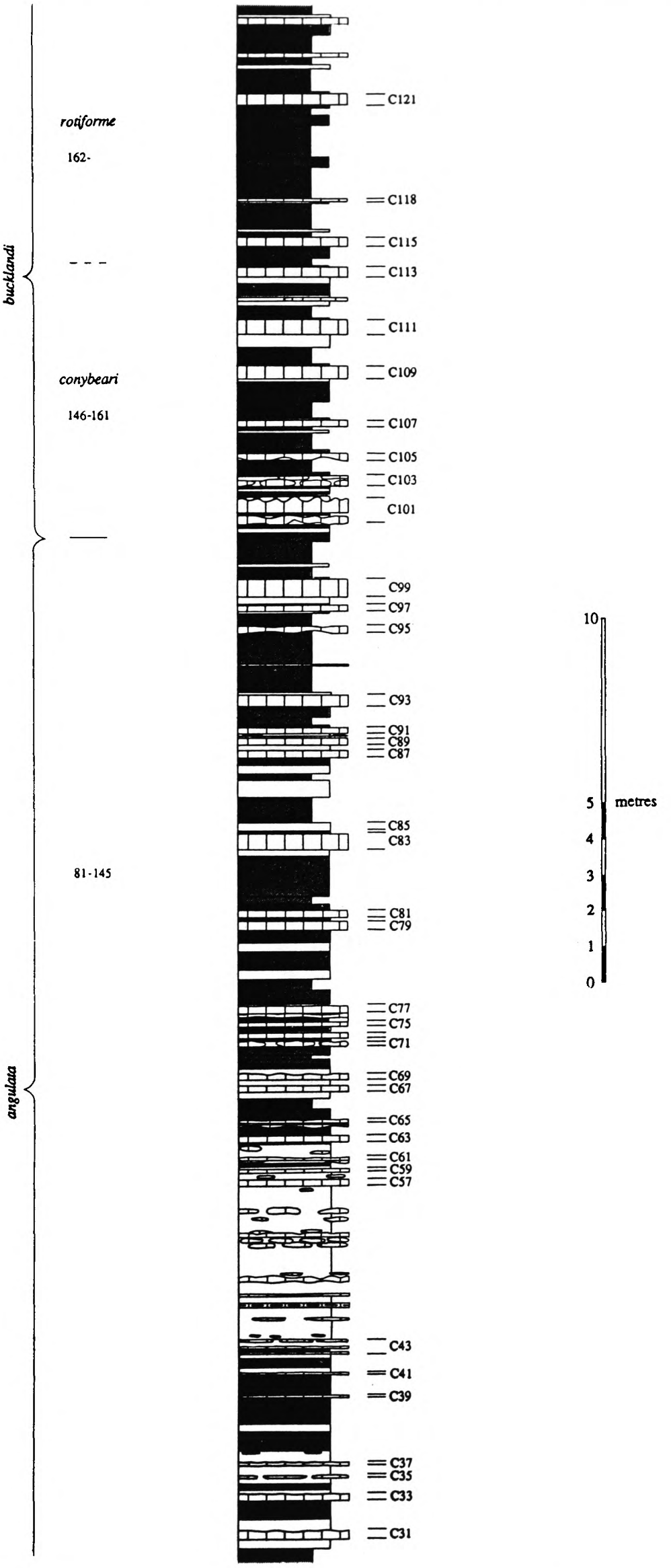


FIGURE 3.04 Stratigraphic log for the Blue Lias at Kilve Pill, Somerset. (Unpublished, courtesy of Hesselbo & Jenkyns.) Bed numbers are taken from Palmer (1972). Biostratigraphy based upon Dean *et al.* (1961) and Ivimey-Cook & Donovan (1983). Measured from ST144455 to ST 153452.

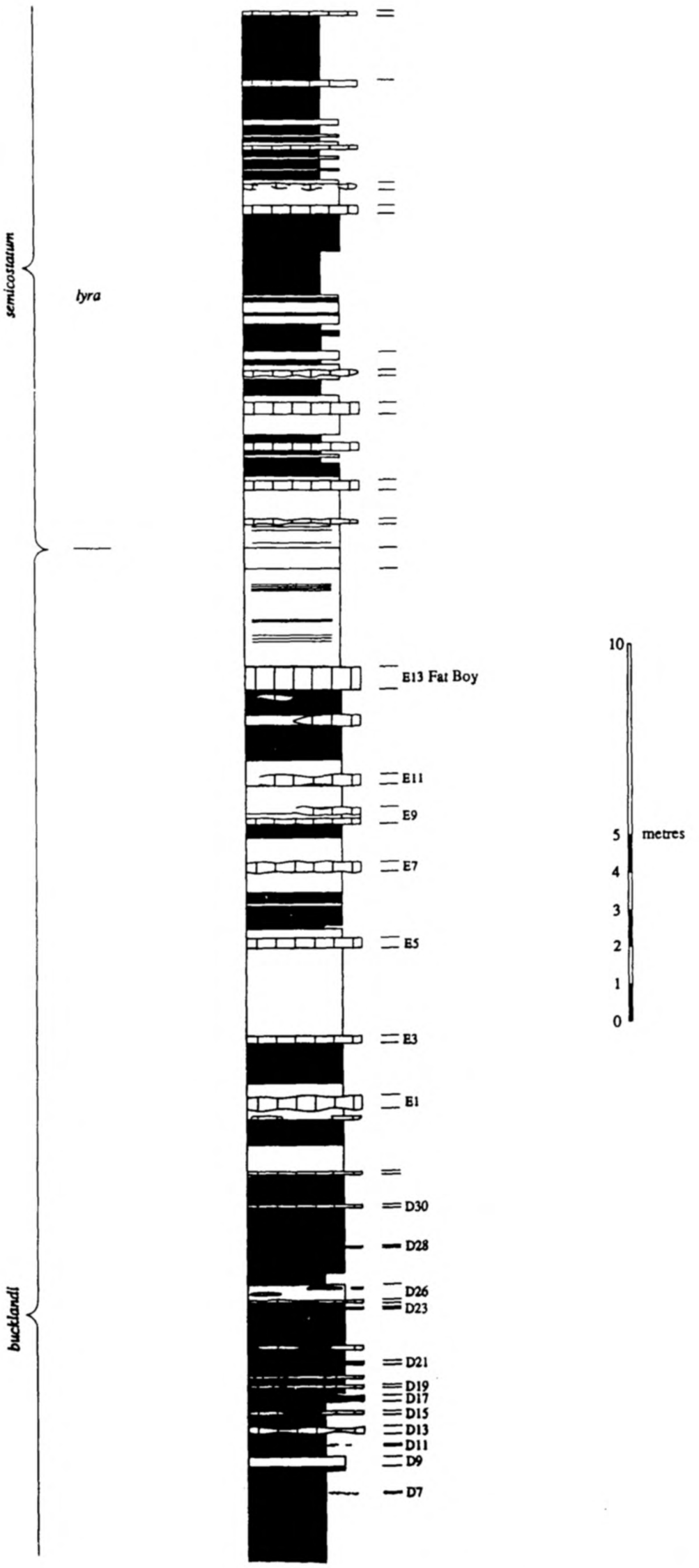


FIGURE 3.05 Stratigraphic log for the Blue Lias at Kilve Pill, Somerset (ST 139457 - ST 144455) and Hinkley Point, Somerset (ST 210465). (Unpublished, courtesy of Hesselbo & Jenkyns). Bed numbers are taken from Palmer (1972). Biostratigraphy based upon Dean *et al.* (1961) and Ivimey-Cook & Donovan (1983).

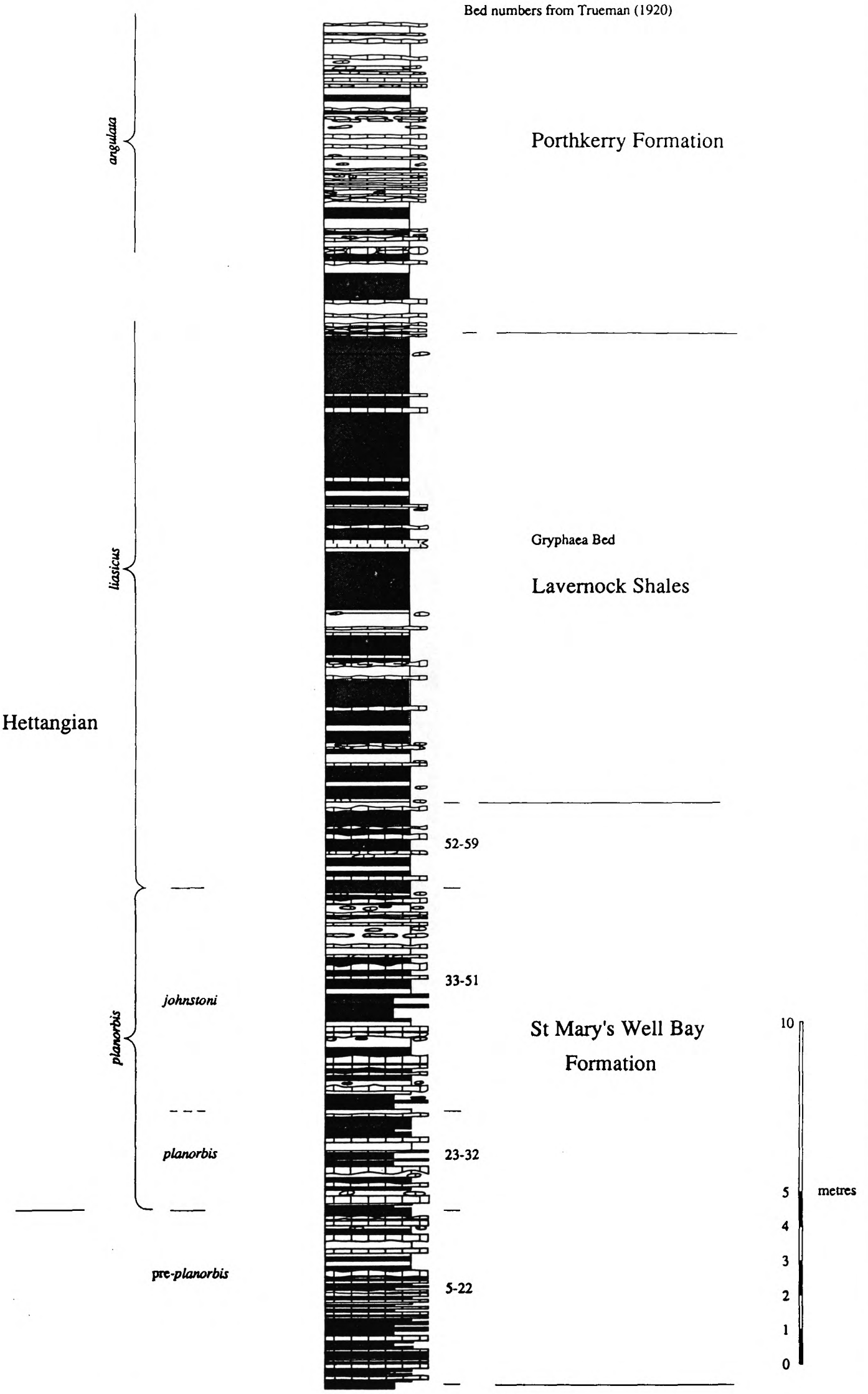


FIGURE 3.06 Stratigraphic log for the Blue Lias at St. Mary's Well Bay, Glamorgan (ST 176677 to ST 187681). (Unpublished, courtesy of Hesselbo & Jenkyns). Bed numbers are taken from Trueman (1920). Biostratigraphy based upon Trueman (1920), Cope *et. al.* (1980), Waters & Lawrence (1987) and Wilson *et al.* (1990).

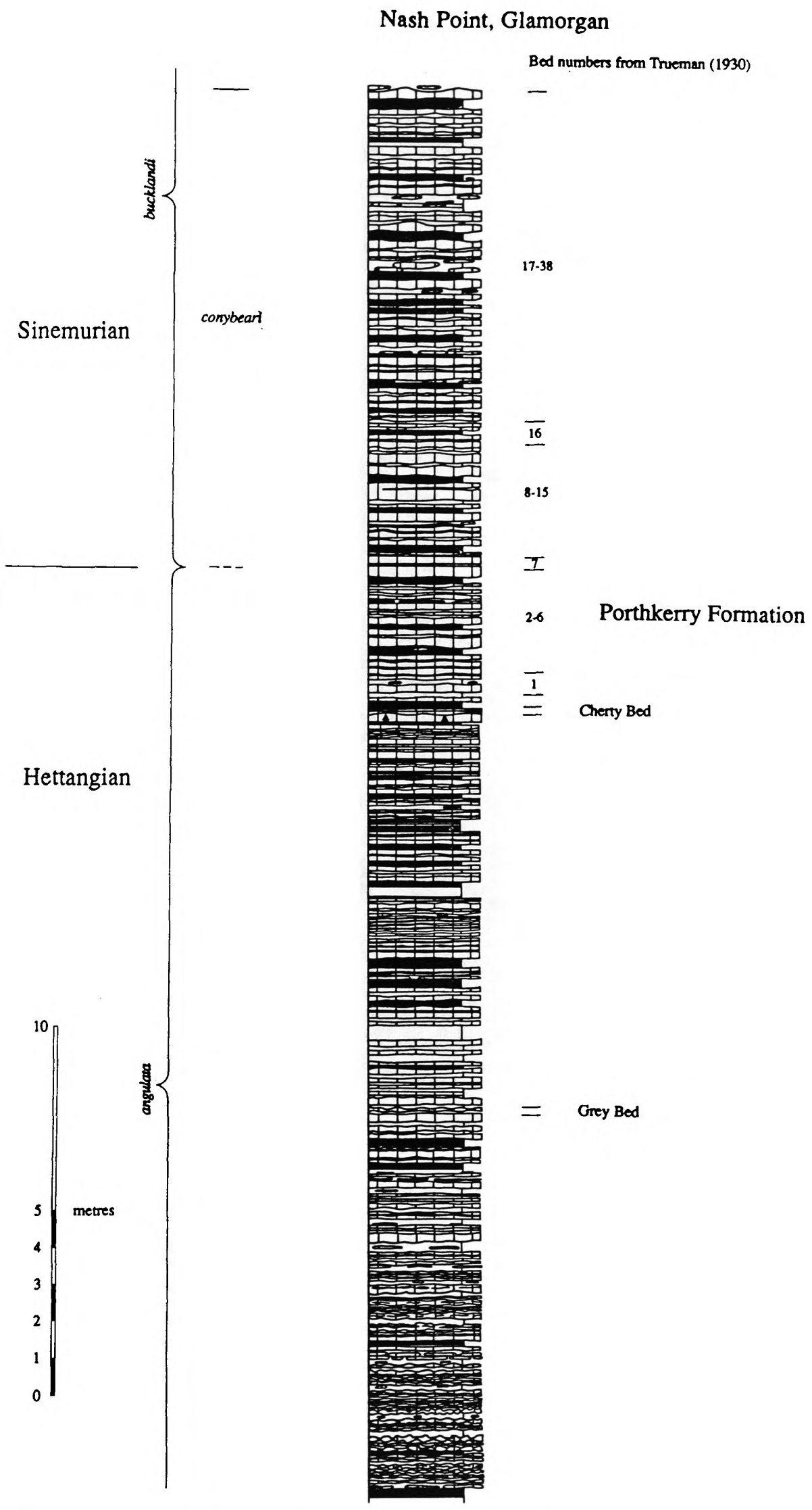


FIGURE 3.07 Stratigraphic log for the Blue Lias at Nash Point, Glamorgan (SS 914684). (Unpublished, courtesy of Hesselbo & Jenkyns). Bed numbers are taken from Trueman (1930). Biostratigraphy based upon Trueman (1930), Cope *et. al.* (1980), Waters & Lawrence (1987) and Wilson *et al.* (1990).

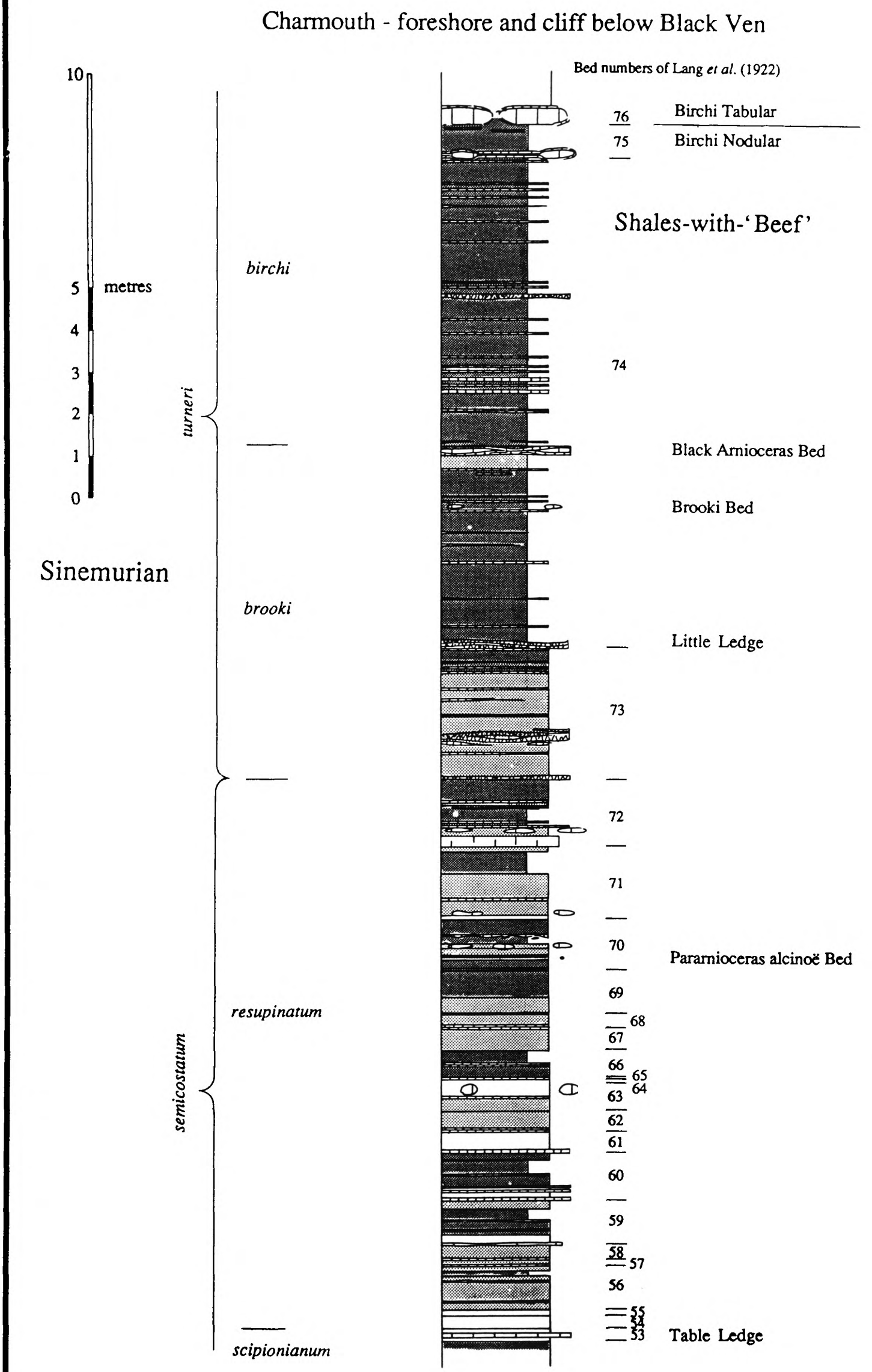


FIGURE 3.08 A Stratigraphic log for the upper Shales-with-'Beef' (from Hesselbo & Jenkyns 1995a). Bed numbers are taken from Lang *et al.* (1922) and biostratigraphy based on Lang *et al.* (1922) and Dean *et al.* (1961).

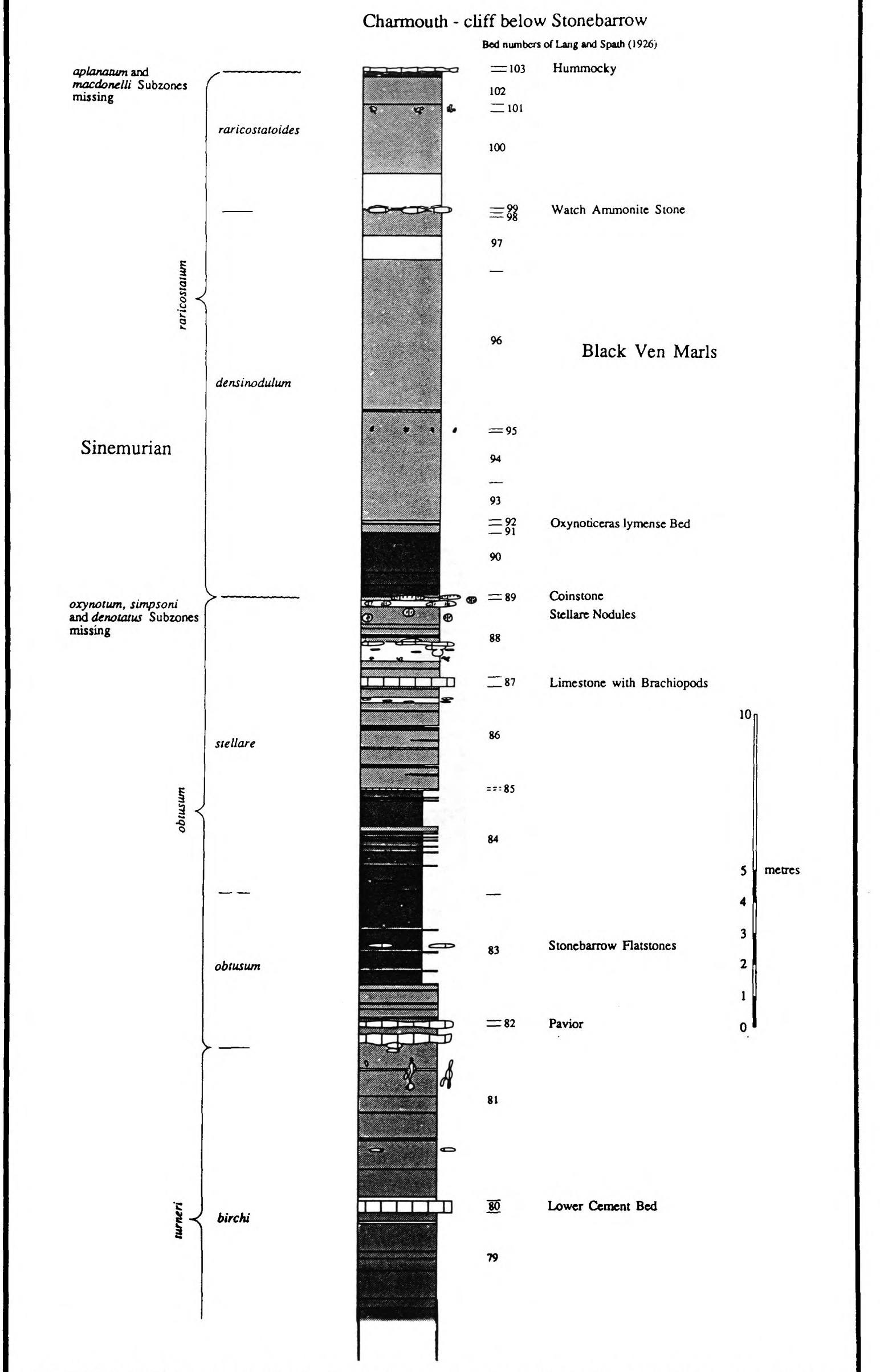


FIGURE 3.08 B Stratigraphic log for the Black Ven Marls (from Hesselbo & Jenkyns 1995a). Bed numbers are taken from Lang & Spath (1926) and biostratigraphy based on Lang & Spath (1926) and Dean *et al.* (1961).

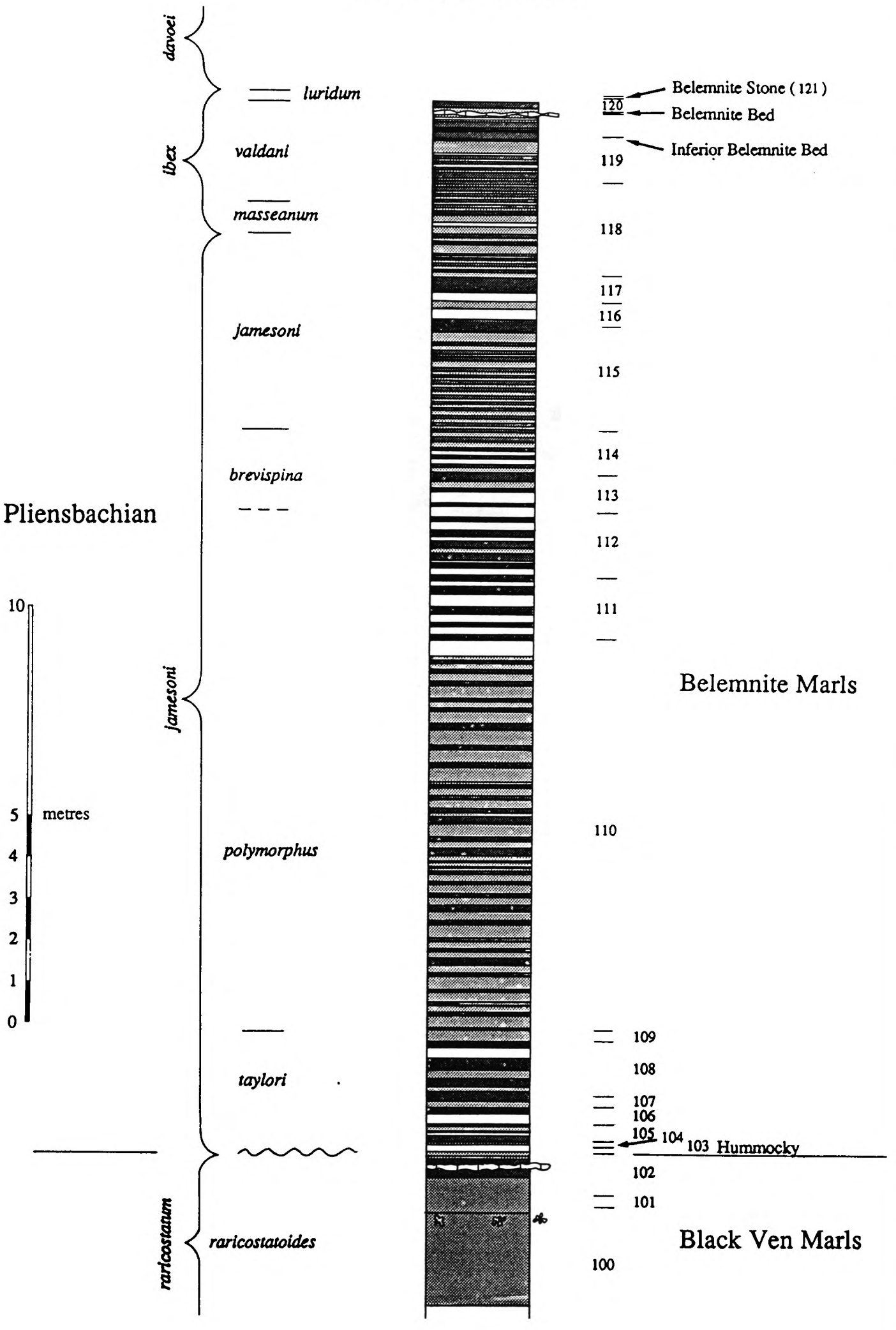
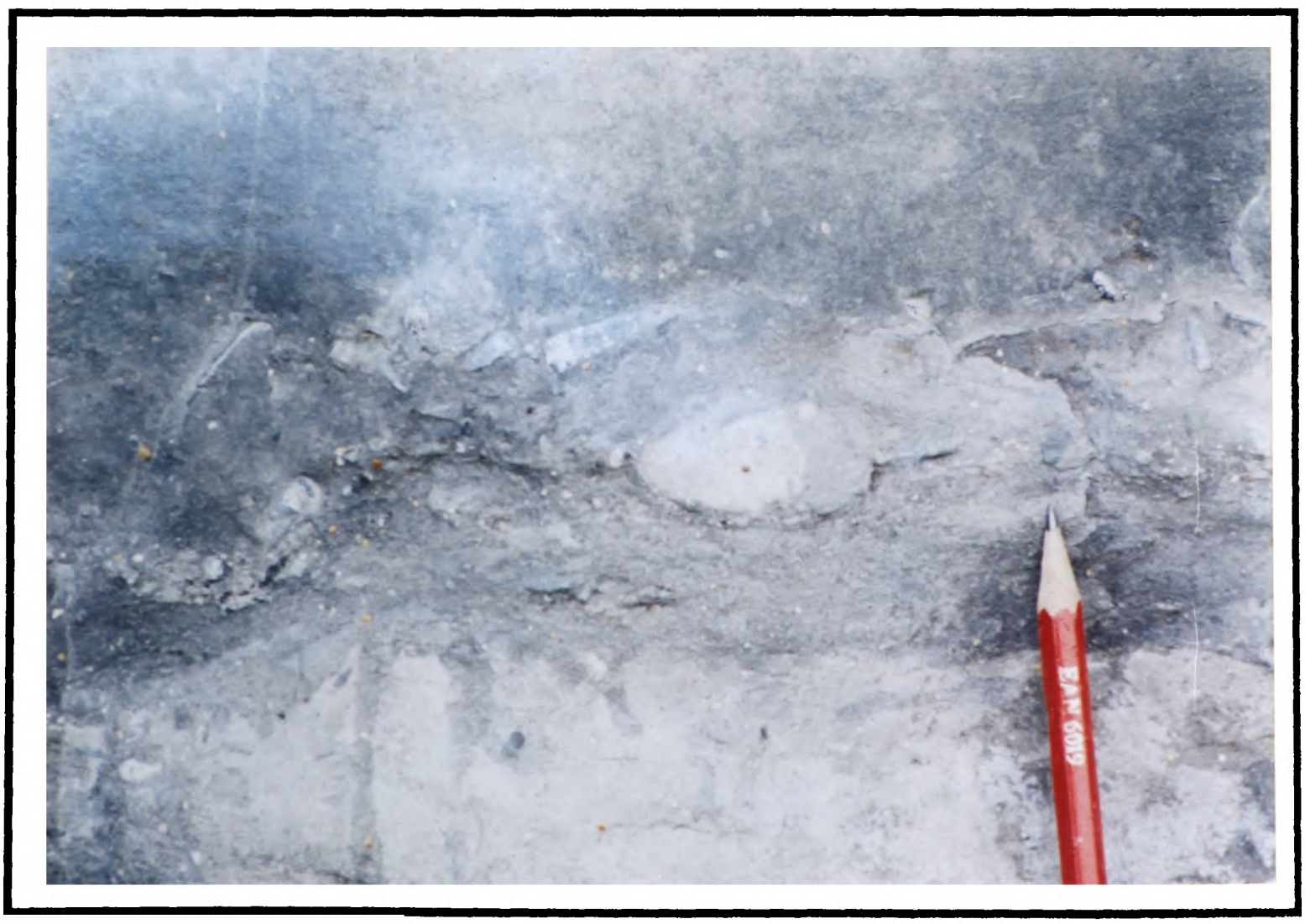


FIGURE 3.09 Stratigraphic log for the Belemnite Marls based on a number of exposures along the Dorset coast, stretching from beneath Stonebarrow in the west (SY 380927) to Seatown in the east (SY 415918). Bed numbers are taken from Lang *et al.* (1928) with biostratigraphy based mainly upon the work of on Lang *et al.* (1928) and Dean *et al.* (1961) . (Taken from Hesselbo & Jenkyns 1995a).

FIGURE 3.10 <u>Sinemurian - Pliensbachian Stage boundary, Dorset (SY 380927)</u>

(ABOVE) The top of the Hummocky limestone (bed 103) , an erosional disconformity at which the two highest subzones of the *raricostatum* Zone are absent; it represents the boundary between the Sinemurian and Pliensbachian Stages in Dorset. There is a distinct change in depositional style in the Lower Pliensbachian away from dominantly argillaceous style of deposition (typified by the Black Ven Marls) to a more pelagic style of deposition and the development of light marl - dark marl couplets. Geological hammer is 35 cm in length.

(BELOW) *Skolithos* in the Hummocky limestone. The base of the Hummocky limestone is probably the deepest level to which Pliensbachian burrowers penetrated (Hesselbo & Jenkyns 1995a). Pencil is 6 cm in length.



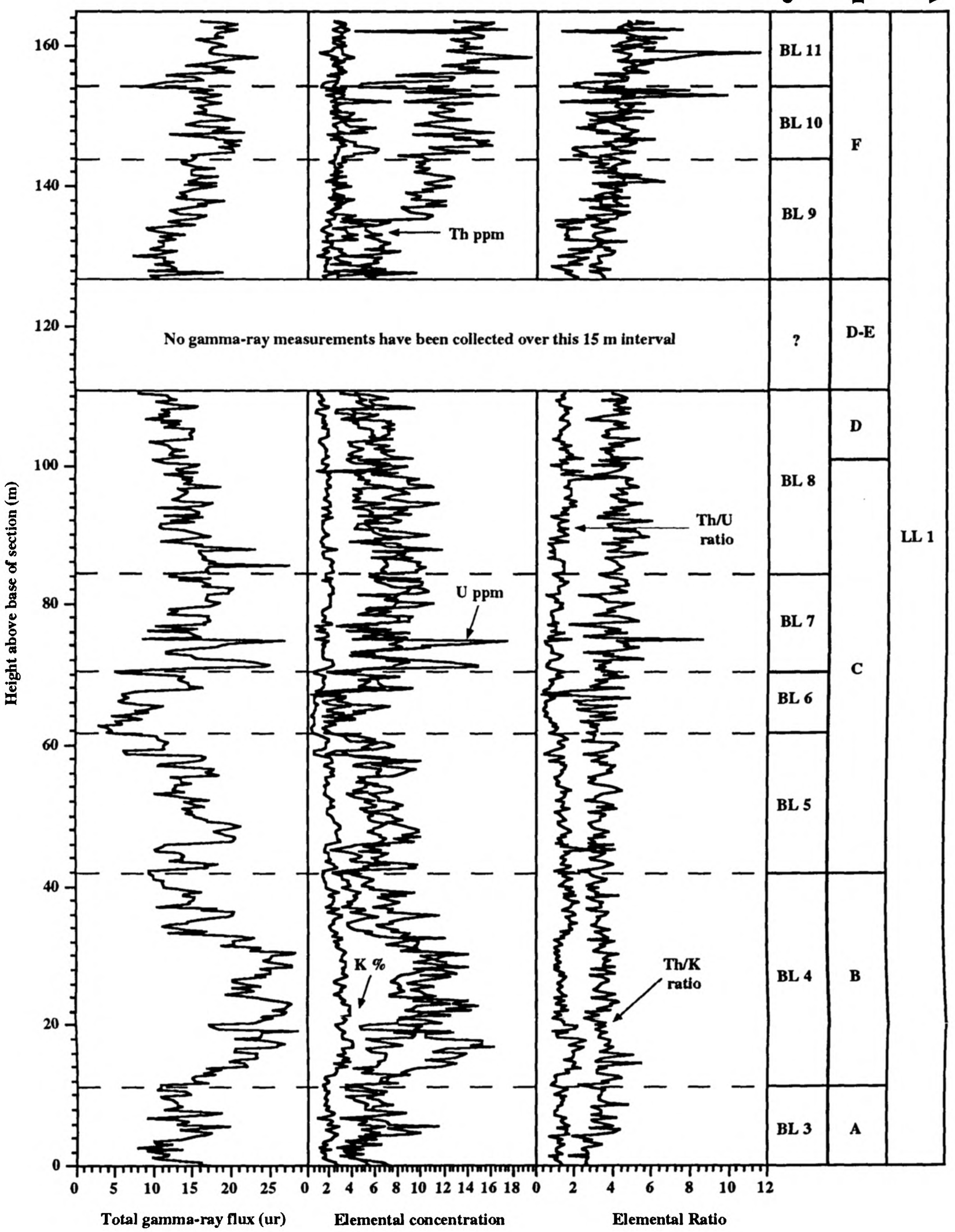


FIGURE 3.11 Gamma-ray logs for the Lower Lias of the Somerset coast based on 501 individual measurements. The Blue Lias has been subdivided on the basis of total gamma-ray signature and elemental log signature into 9 gamma-ray units, Bl 3 to BL 11. These gamma-ray units are at an equal or higher resolution than the lithostratigraphic divisions proposed by Palmer (1972). The units of Whittaker *et al.* (1985), identified from the same sequence from the Burton Row borehole in Somerset, are also shown. Clearly, much finer subdivision of the Whittaker *et al.* gamma-ray units is possible.

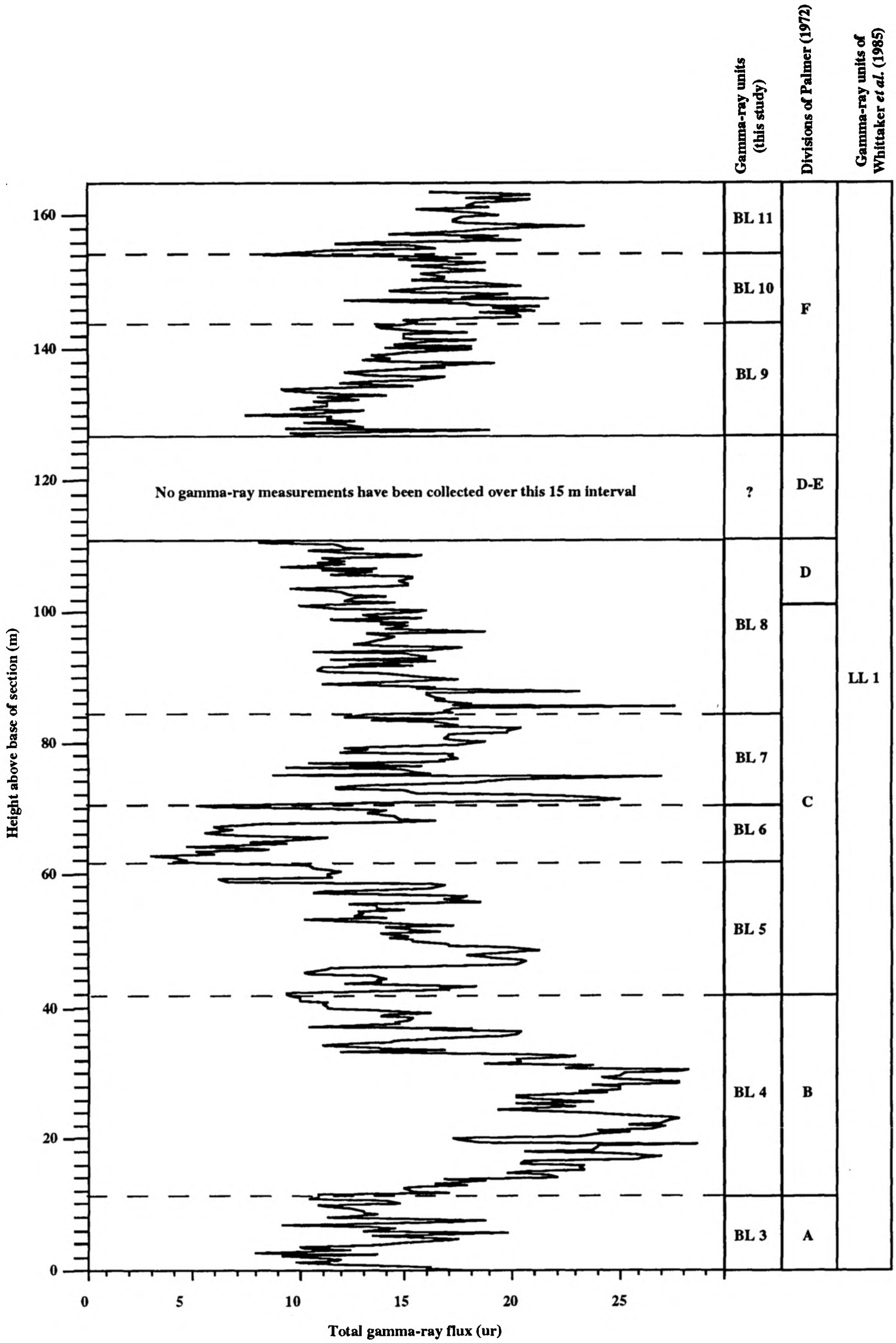


FIGURE 3.12 Stratal packaging within the Lower Lias of the Somerset coast based on total gamma-ray signature. The gamma-ray units, defined in this study, can be enhanced by altering the aspect ratio of the total gamma-ray flux scale to exaggerate the low frequency component of the total gamma-ray signature. The units of Whittaker *et al.* (1995), identified for the same sequence from the Burton Row borehole in Somerset, are also shown.

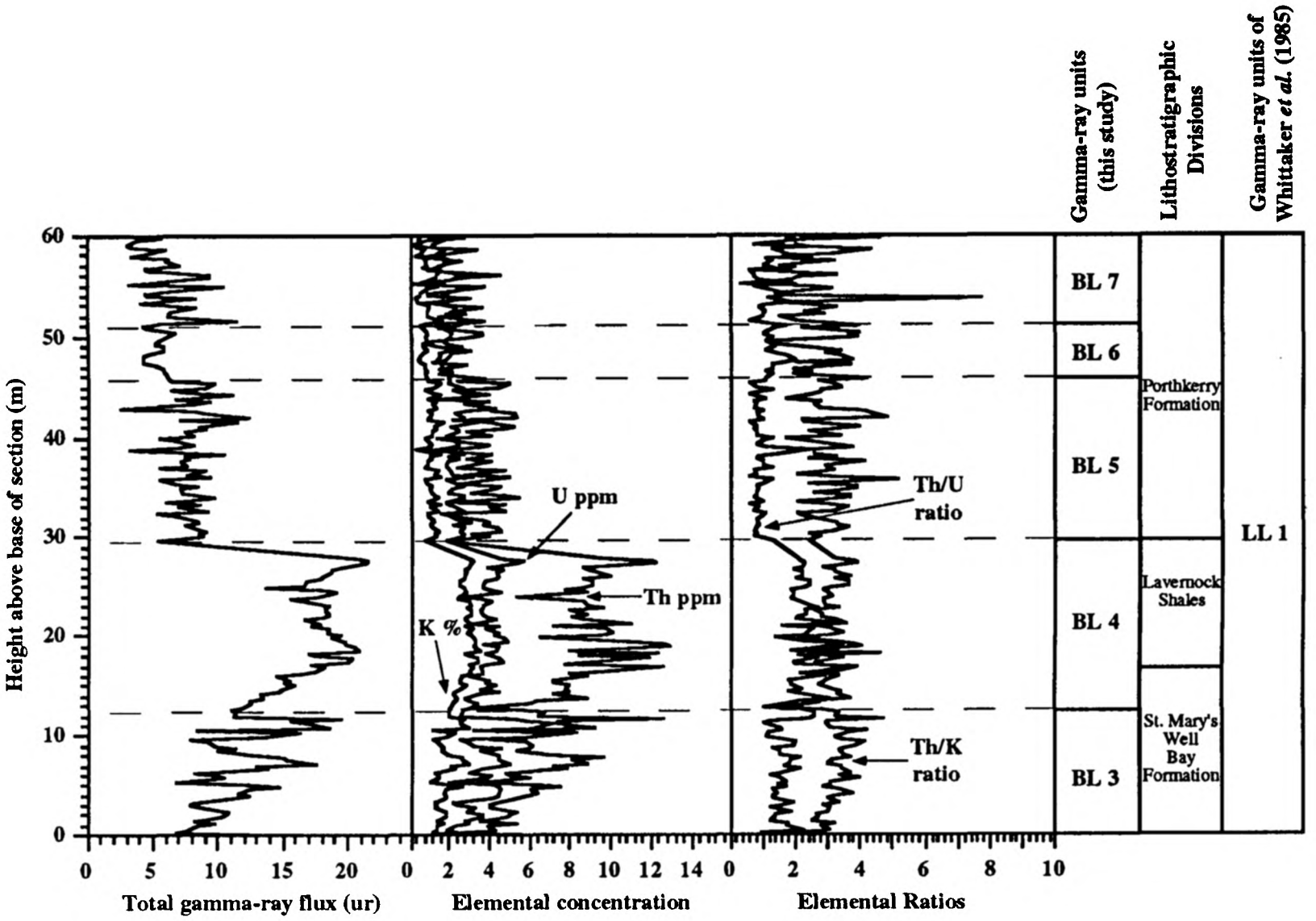


FIGURE 3.13A Gamma-ray logs for the Lower Lias succession of the Glamorgan coast based upon 196 sets of measurements. The St. Mary's Well Bay Formation, Lavernock Shales and Porthkerry Formation have been subdivided on the basis of total gamma-ray signature and elemental-log signature into 5 gamma-ray units. These are equivalent to the single unit identfied by Whittaker *et al.* (1995) for the same sequence from the Burton Row borehole in Somerset. Clearly, finer subdivision of the Lower Lias gamma-ray signature is possible. The vertical scale is identical to that used in Figures 3.11 and 3.12.

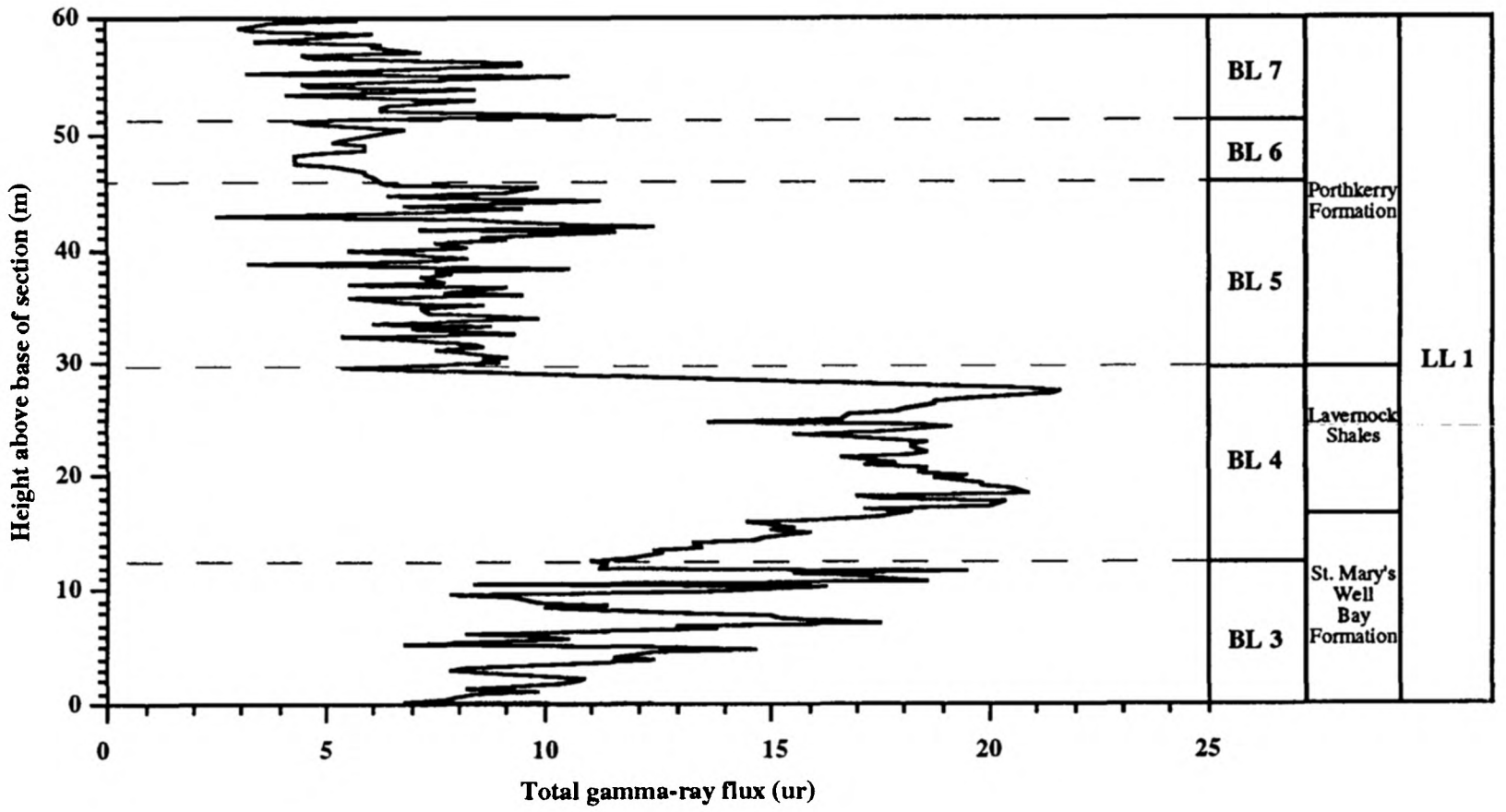


FIGURE 3.13B Stratal packaging within the Lower Lias of the Somerset coast based on total gamma-ray signature. The gamma-ray units, defined in this study, can be enhanced by altering the aspect ratio of the total gamma-ray flux scale to exaggerate the low frequency component of the total gamma-ray signature. The vertical scale is identical to that used in Figures 3.11 and 3.12.

FIGURE 3.14 The Blue Lias, St Audrie's Bay, Somerset

(ABOVE) The yellow field notebook is placed at the horizon currently recognised at which ammonites of the genus *Psiloceras* first appear and which delinate the boundary between the Rhaetian (Triassic) and Hettangian (Jurassic). The first appearance occurs six metres above the base of the Blue Lias. The section (ST 102433) has been recently proposed as a candidate Global Stratotype Section for the base of the Jurassic System (Warrington *et al.* 1994). (Dimensions of notebook 20 cm x 13 cm).

(BELOW) Field aspect of the *liasicus* Zone at St Audrie's Cliff (St. Audrie's Shales of Palmer 1972). The *liasicus* Zone is dominantly argillaceous, a consistent character over southern Britain. The series of limestones in the middle of the cliff are Palmer's beds C1 to C29. (Cliff approximately 18 m in height).

FIGURE 3.15 <u>The Blue Lias, East of Kilve Pylle, Somerset</u>

(ABOVE) Field aspect of the *angulata* Zone and lowermost *bucklandi* Zone exposed east of Kilve Pylle (ST 153452). The section is typified by high-frequency alternations between limestone and marl and is equivalent to beds C31 to C121 of Palmer (1972). The boundary between the *angulata* Zone and *conybeari* Subzone (*bucklandi* Zone) is located just below the base of limestone C101 as indicated. (Cliff is approximately 40 m in height)

(BELOW) The *bucklandi* Zone at Kilve Pylle (ST 144455). The section represents the *rotiforme* Subzone with the thick limestone above the dark marl unit being C121 of Palmer 1972. (Field assistant is 1.82 m high).

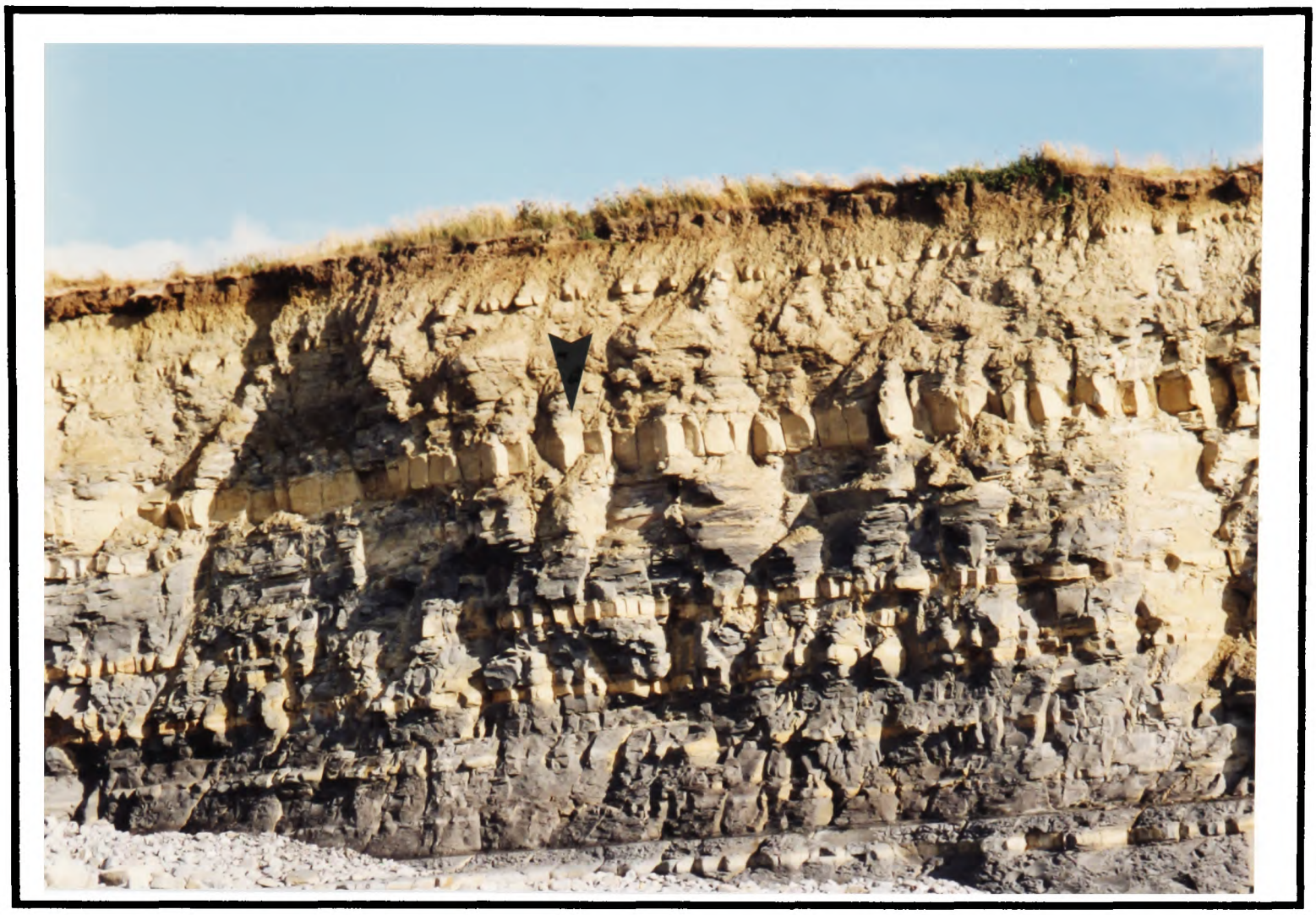


FIGURE 3.16 <u>The Blue Lias, West of Kilve Pylle and at Hinkley Point, Somerset</u>

(ABOVE) Field aspect of the *bucklandi* Subzone of the *bucklandi* Zone, west of Kilve Pylle (ST 139457 - ST 14455). The section corresponds to Division D of Palmer (1972). The thick prominent limestone running through the cliff is known as Fat Boy (bed number E13). Cliff is 8.6 m in height.

(BELOW) Field aspect at Hinkley Point (ST 210465) of the *lyra* Subzone of the *semicostatum* Zone. The section is entirely exposed as foreshore and corresponds to the Doniford Shales of Palmer (1972).

Figure 3.17 <u>The Blue Lias at Doniford Bay, Somerset</u>

Field aspect of the *lyra* Subzone of the *semicostatum* Zone at the west end of Doniford Bay (ST 079433 to ST 082430). The section exposed corresponds to the Doniford Shales of Palmer (1972). The *lyra* Subzone is dominantly argillaceous and is expanded by a factor of 38.3 relative to the time equivalent strata exposed at Seven Rock Point, Lyme Regis (ST 328910). Dimensions of yellow field-notebook are 20 cm x 13 cm.

FIGURE 3.18 <u>The Blue Lias at St. Mary's Well Bay and Lavernock Point, Glamorgan</u>

(ABOVE) The yellow field notebook is placed at the horizon at which ammonites of the genus *Psiloceras* first appear and which therefore delineates the boundary between the Rhaetian (Triassic) and Hettangian (Jurassic). The first appearance is 5 m above the base of the Blue Lias (St. Mary's Well Bay Formation of Richardson 1905). Dimensions of notebook 20 cm x 13 cm. Grid Reference ST 176677.

(BELOW) The yellow field notebook is placed on the boundary between the underlying argillaceous Langport Member (Lilstock Formation) and the Bull Cliff Member of the Blue Lias. The Bull Cliff Member (pre-*planorbis*) is characterised by a 4 m sequence of planar bedded limestones with minor mudstone horizons. Section exposed at Lavernock Point (ST 187681).

FIGURE 3.19 <u>The Blue Lias at St. Mary's Well Bay , Glamorgan</u>

(ABOVE) Field aspect of the *liasicus* Zone (Lavernock Shales of Strahan & Cantrill 1902) at the designated type locality (Waters & Lawrence 1987) between St. Mary's Well Bay and Lavernock Point (ST 176677 - ST 187681). The *liasicus* Zone is characterised by a series of dark grey, calcareous, bioturbated mudstones with subordinate beds of nodular limestone and correspond in Somerset to the St. Audrie's Shales of Palmer (1972). Cliff is approximately 37 m in height.

(BELOW) The yellow field notebook is placed above the boundary between the underlying St Mary's Well Bay Formation and the overlying Lavernock Shales. The lithostratigraphic contact occurs within the *liasicus* Zone. (Dimensions of field notebook 20 cm x 13 cm).

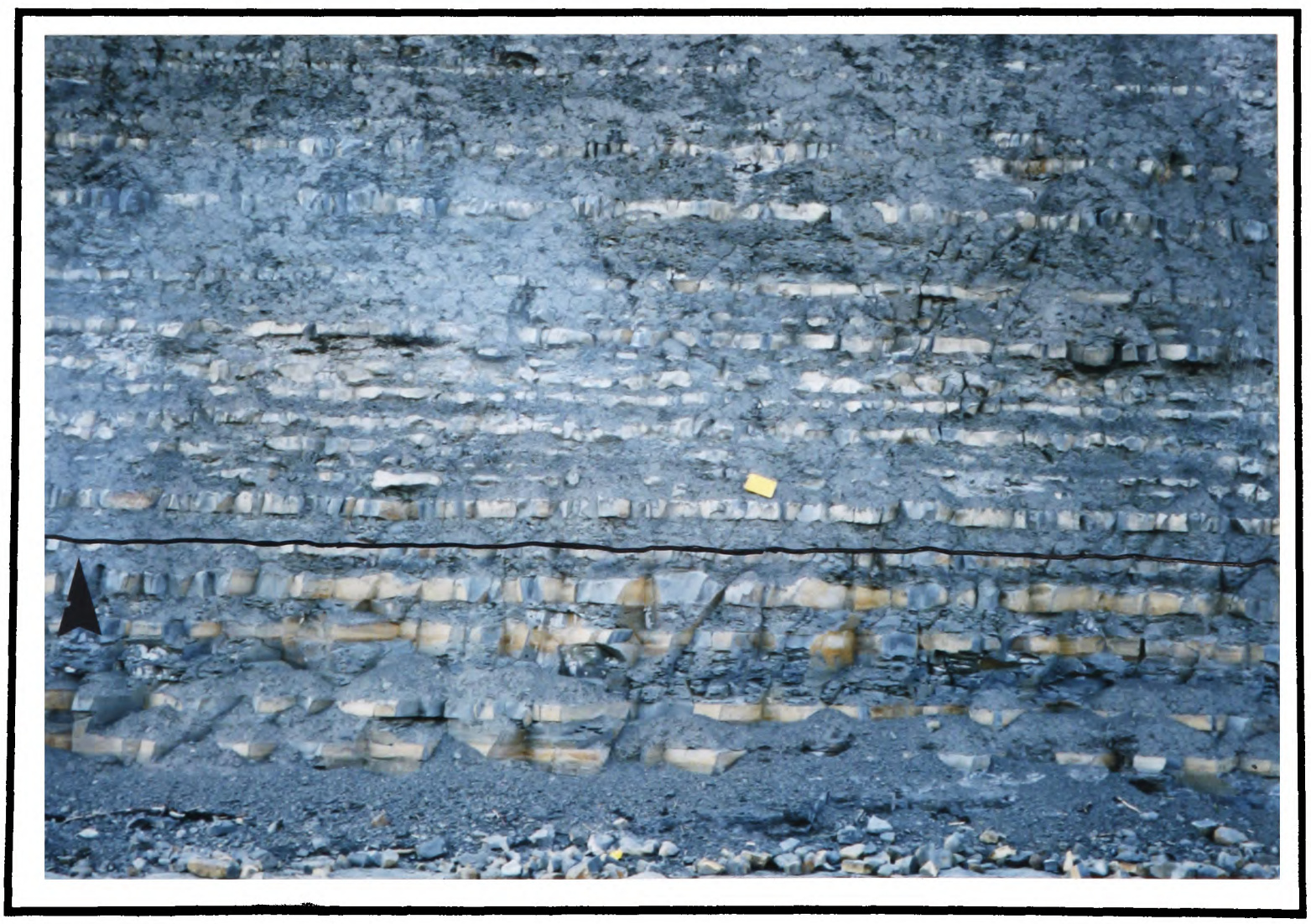
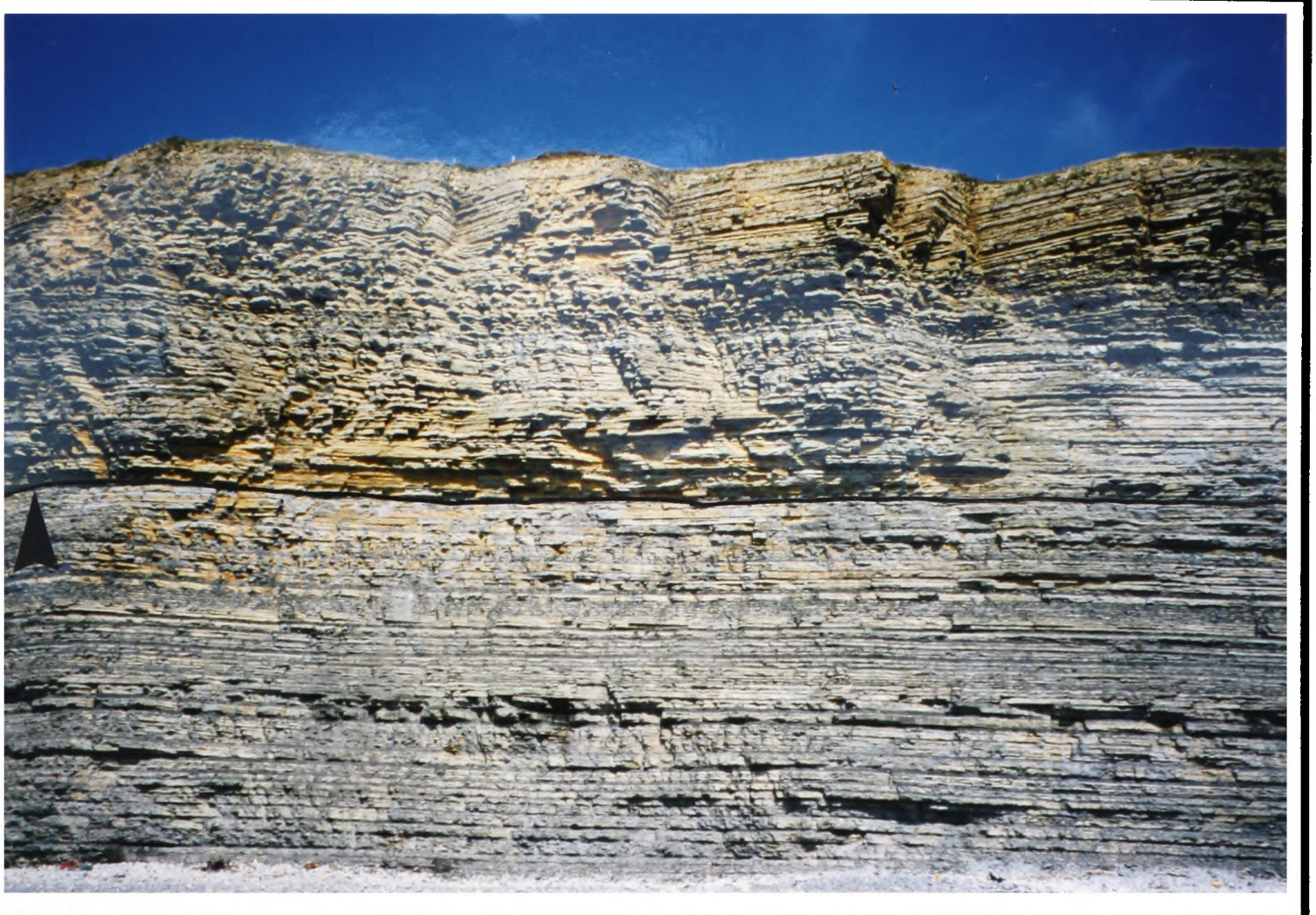


FIGURE 3.20

<u>The Blue Lias at St. Mary's Well Bay and Nash Point, Glamorgan</u>

(LEFT) Contact between the Lavernock Shales (*liasicus* Zone) and the Porthkerry Formation (*angulata* Zone) between St Mary's Well Bay and Lavernock Point (ST 176677 - ST 187681). The boundary is taken at the base of the first continuous group of limestone beds which contrast with the argillaceous nature to the underlying Lavernock Shales. The high - frequency alternations between limestone and marl are typical of the *angulata* Zone in the Bristol Channel Basin and correspond in Somerset to the Blue Lias (*sensu stricto*) of Palmer (1972). Cliff is approximately 37 m high.

(BELOW) The Porthkerry Formation (Trueman 1920) at Nash Point (SS 914684). The section is biostratigraphically equivalent to the *angulata* Zone and *conybeari* Subzone of the *bucklandi* Zone. The boundary between the two ammonite Zones runs mid-way through the cliff, above which the limestone beds become markedly thicker and less concretionary. Cliff is 38 m high.



Stratigraphic log (unpublished, courtesy of Hesselbo & Jenkyns)

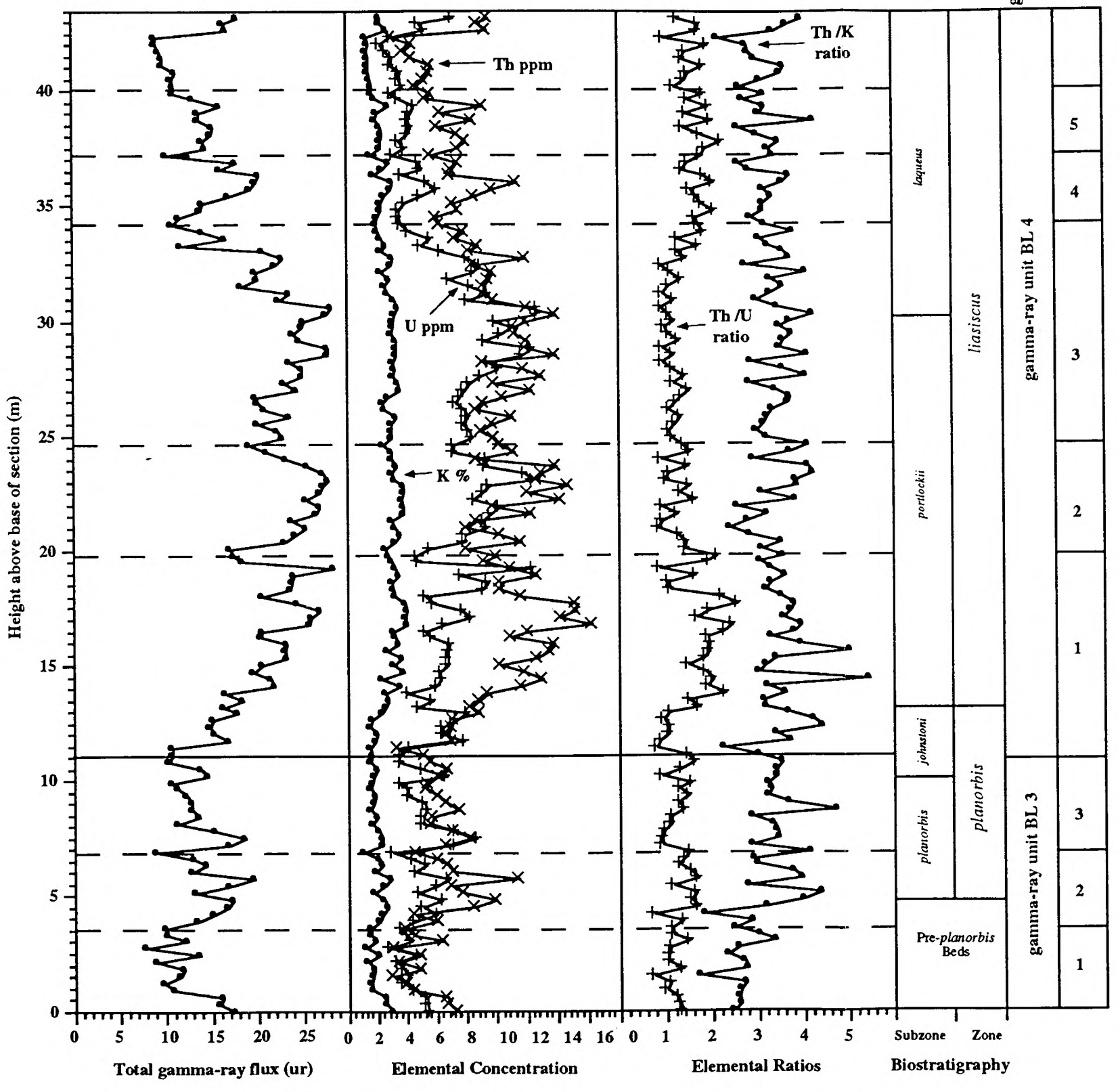


FIGURE 3.21 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the Blue Lias exposed at St. Audrie's Bay, Somerset (ST 102433). Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 145 sets of measurements.

Figure 3.21

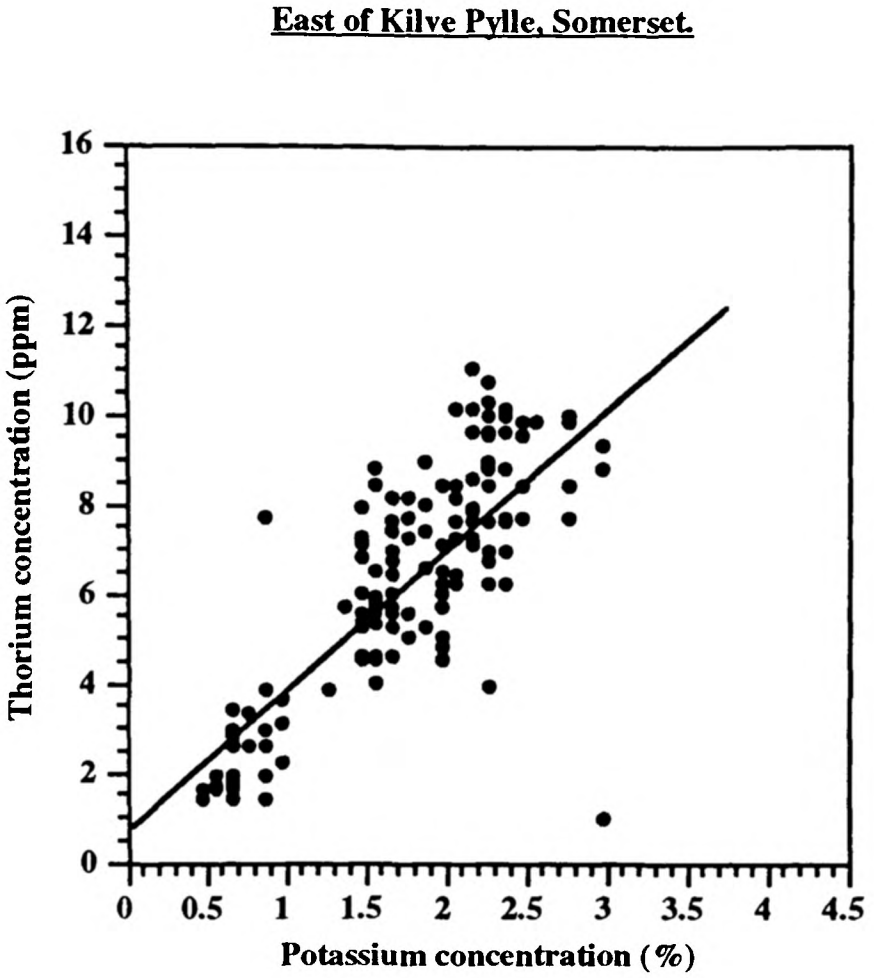


FIGURE 3.24A Linear regression correlation between Th concentration and K concentration. A correlation coefficient of 0.63 suggests a statistically robust correlation at the 95 % significance level (n = 154). The relationship between the two elements can be described by the linear equation : Th ppm = 3.17 K % + 0.066

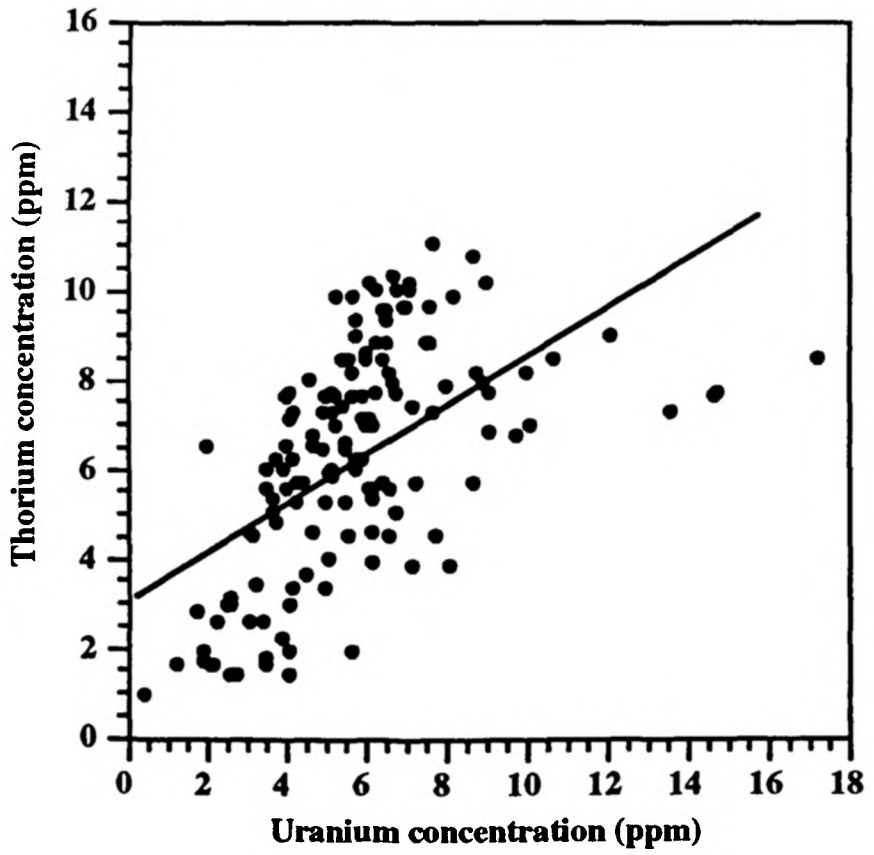
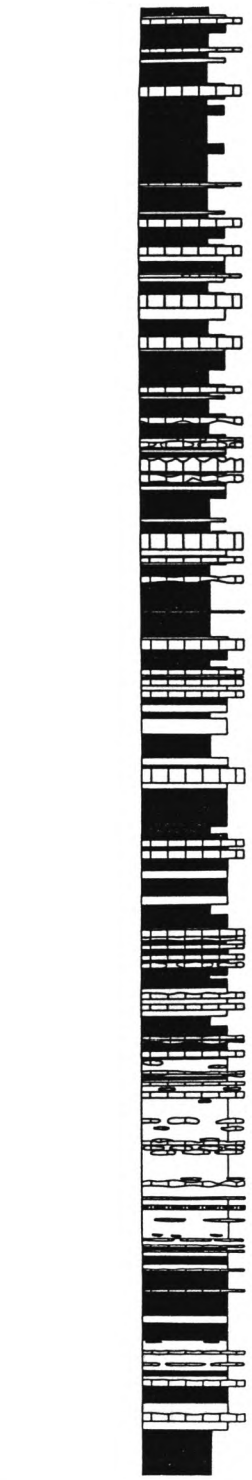


FIGURE 3.24B Linear regression correlation between Th concentration and U concentration. A correlation coefficient of 0.36 suggests a weak but statistically robust correlation at the 95 % significance level (n = 154). The relationship between the two elements can be described by the linear equation : Th ppm = 0.550 U ppm + 3.051



Stratigraphic log (unpublished, courtesy of Hesselbo & Jenkyns)

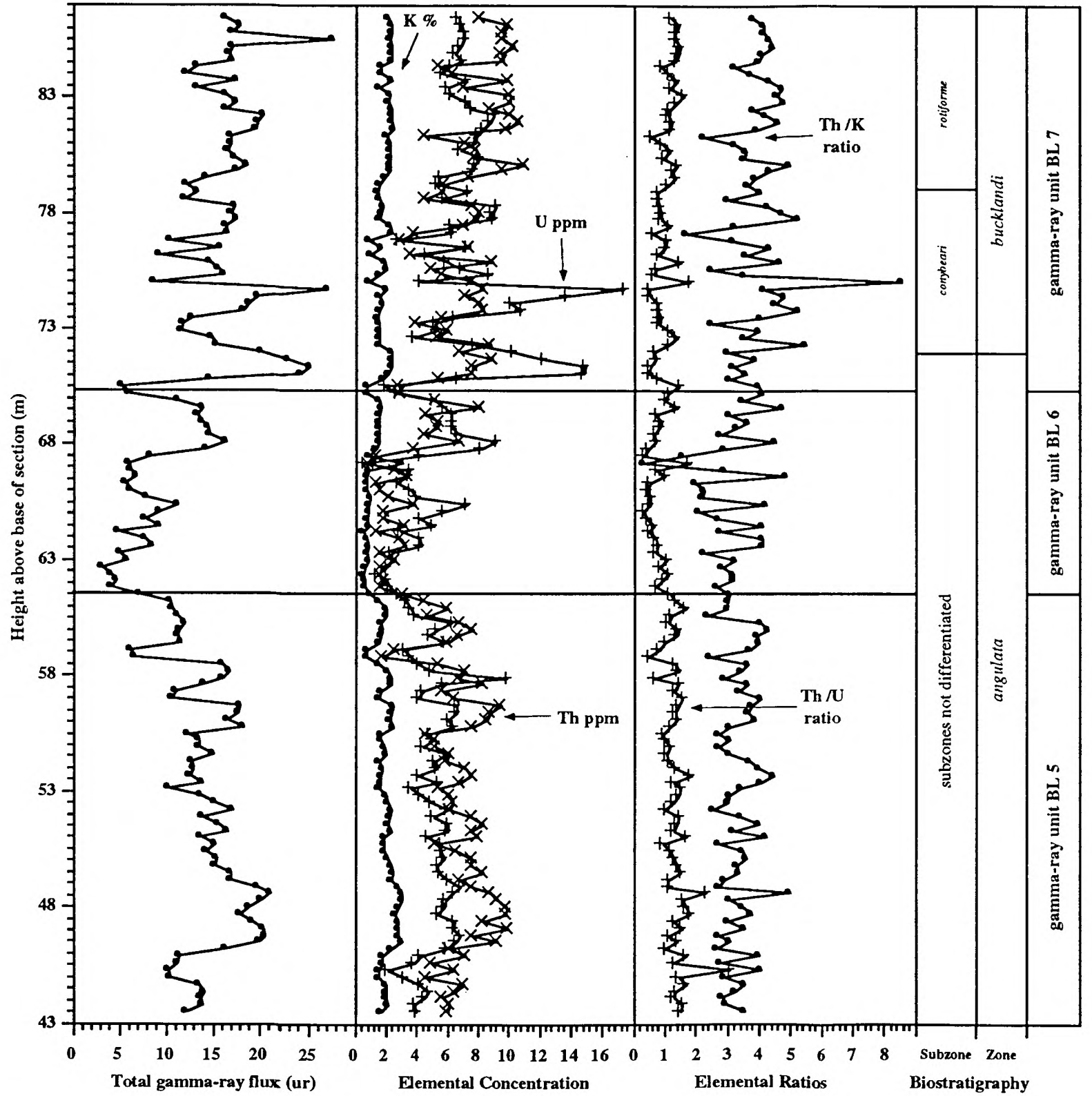


FIGURE 3.23 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the Blue Lias exposed east of Kilve Pylle, Somerset (ST 144455 to ST 153452). Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 154 sets of measurements.

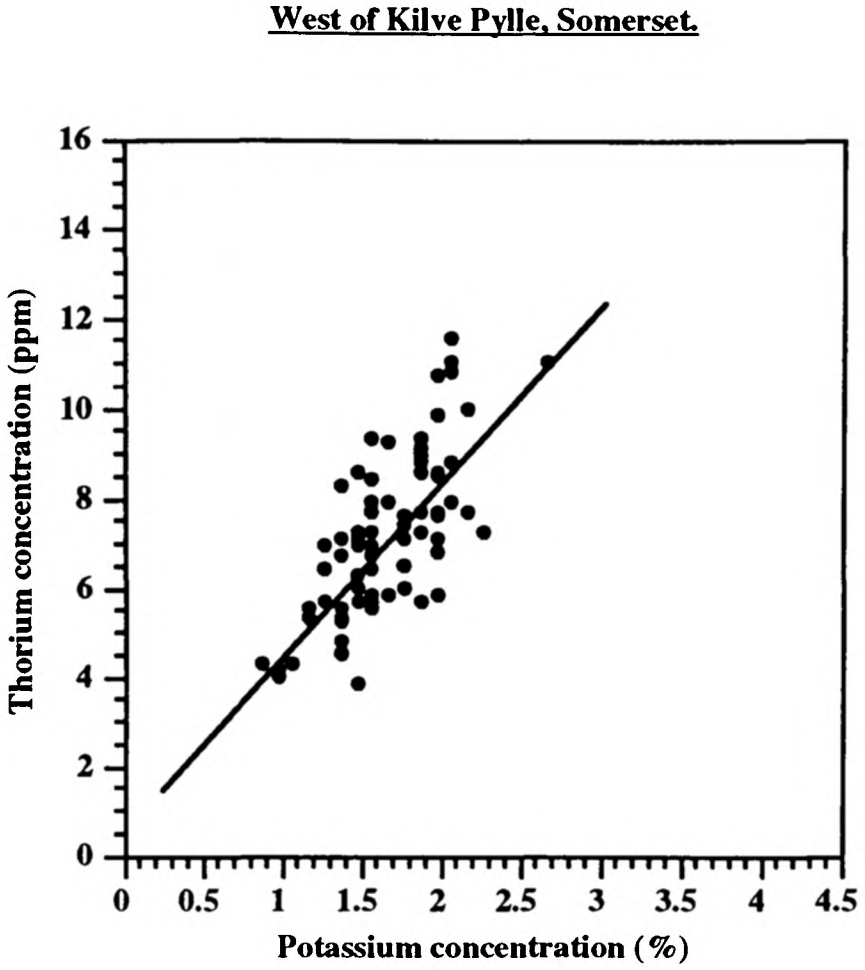


FIGURE 3.26A Linear regression correlation between Th concentration and K concentration. A correlation coefficient of 0.59 suggests a statistically robust correlation at the 95 % significance level (n = 80). The relationship between the two elements can be described by the linear equation : Th ppm = 3.916 K %+ 0.567

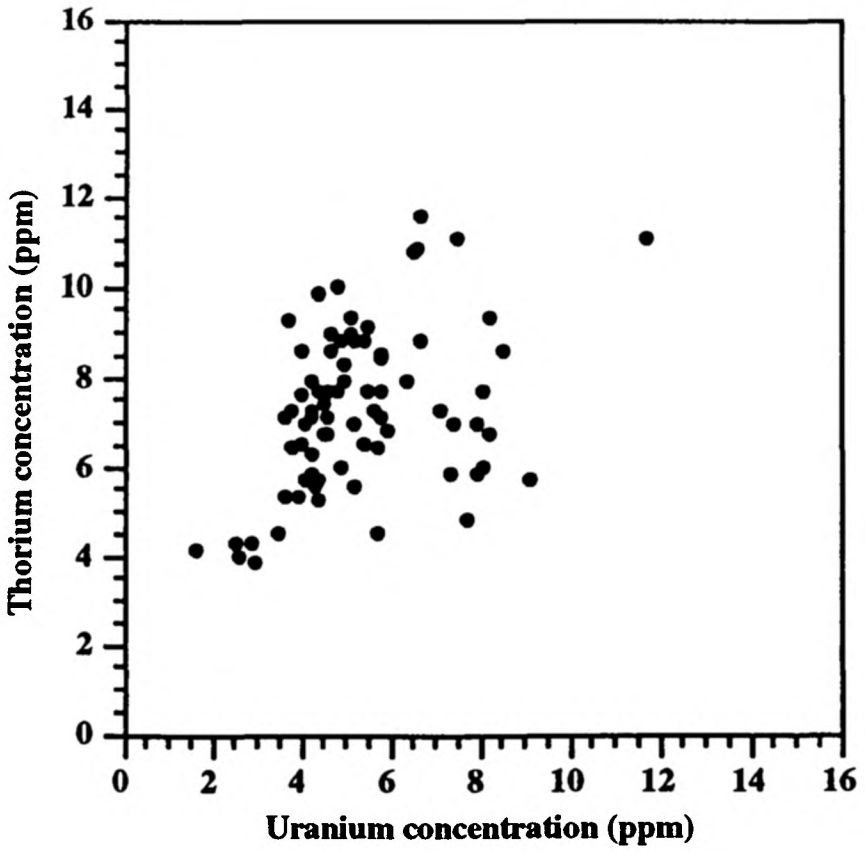


FIGURE 3.26B Linear regression correlation between Th concentration and U concentration. A correlation coefficient of 0.15 indicates that no statistically robust relationship is between the two elements (n=80).

Stratigraphic log (unpublished, courtesy of Hesselbo & Jenkyns)

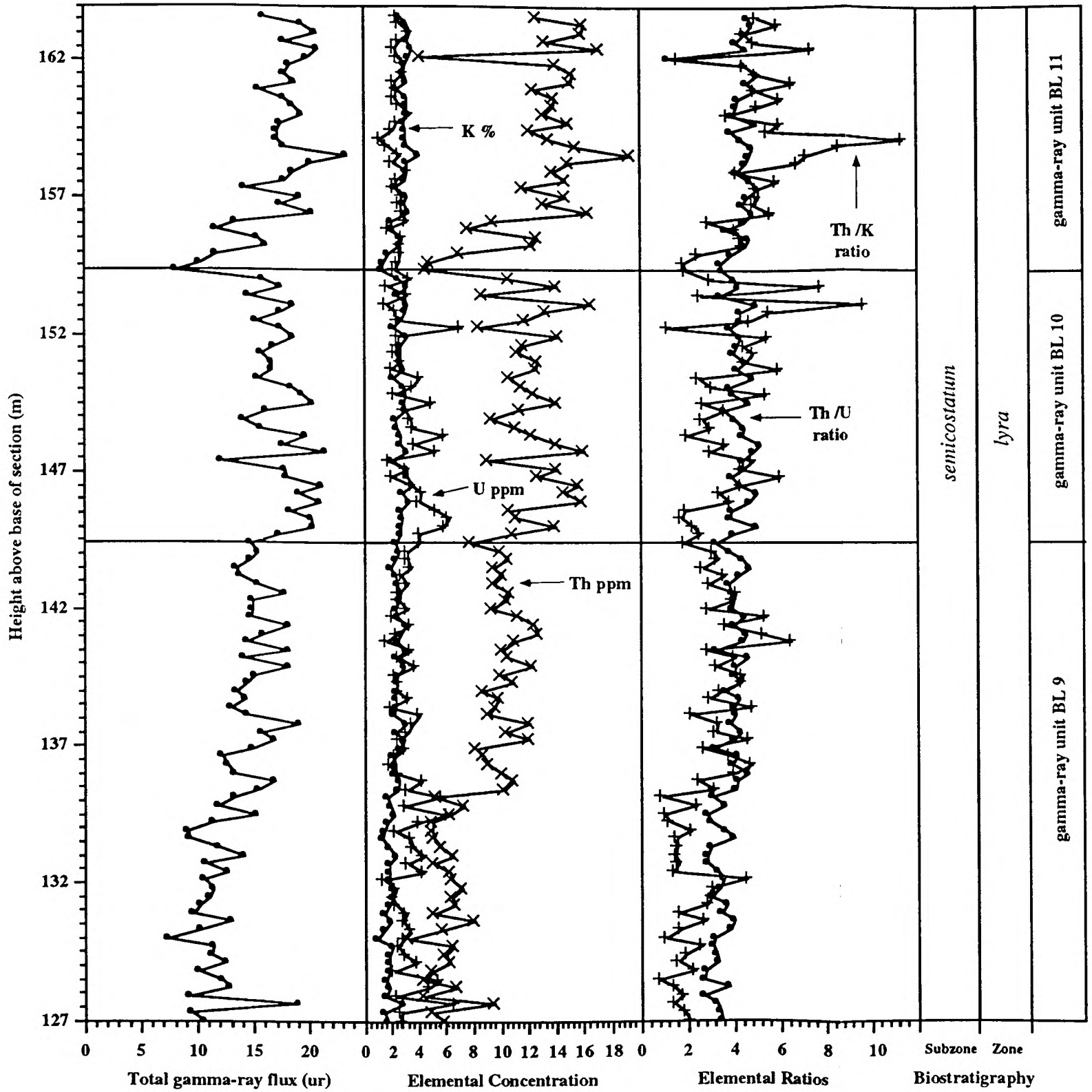


FIGURE 3.27 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the Blue Lias exposed on the foreshore and as cliff section at the west end of Doniford Bay (Helwell Bay), Somerset (ST 079433 to ST 082430). Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 123 measured samples.

Figure 3.27

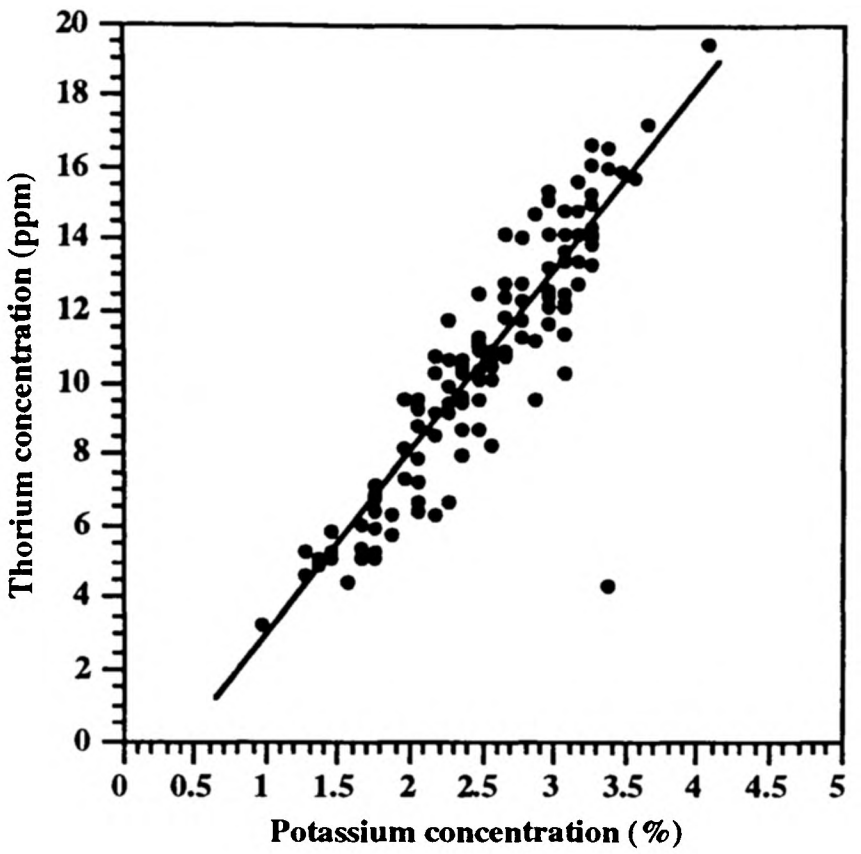


FIGURE 3.28A Linear regression correlation between Th concentration and K concentration. A correlation coefficient of 0.81 suggests a strong, statistically robust correlation at the 95 % significance level (n = 123). The relationship between the two elements can be described by the linear equation : Th ppm = 5.190 K % - 2.727

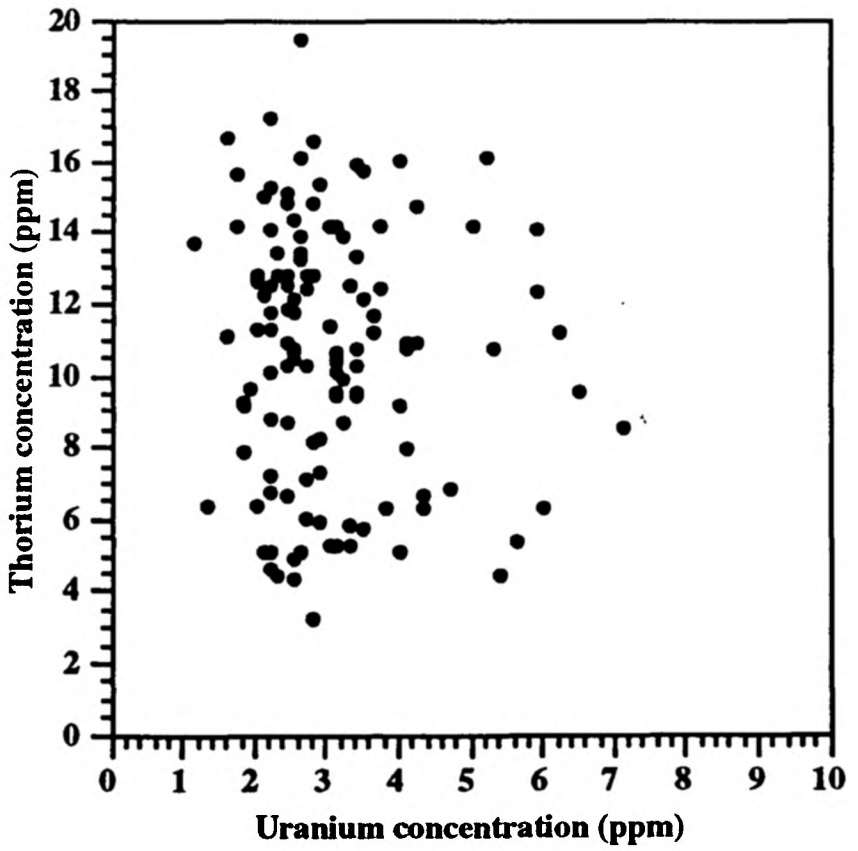


FIGURE 3.28B Linear regression correlation between Th concentration and U concentration. A correlation coefficient of 0.01 indicates that there is no linear covariant relationship between the two elements.

Stratigraphic log (unpublished, courtesy of Hesselbo & Jenkyns)

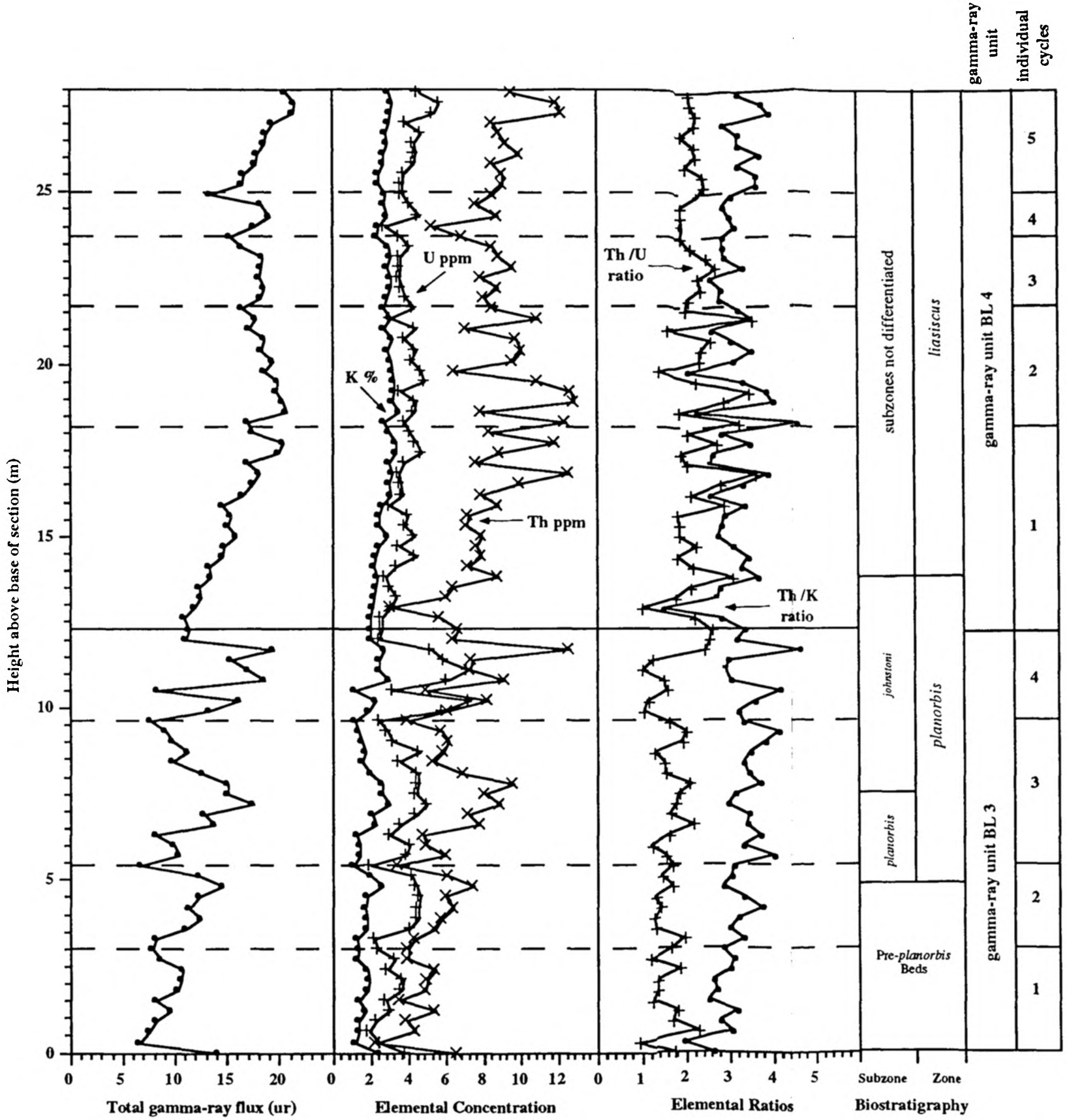


FIGURE 3.29 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the Blue Lias Formation (St. Mary's Well Bay Formation and Lavernock Shales) exposed at St. Mary's Well Bay, Glamorgan (ST 176677 - ST 187681). Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 96 sets of measurements.

Figure 3.29

St. Mary's Well Bay, South Glamorgan.

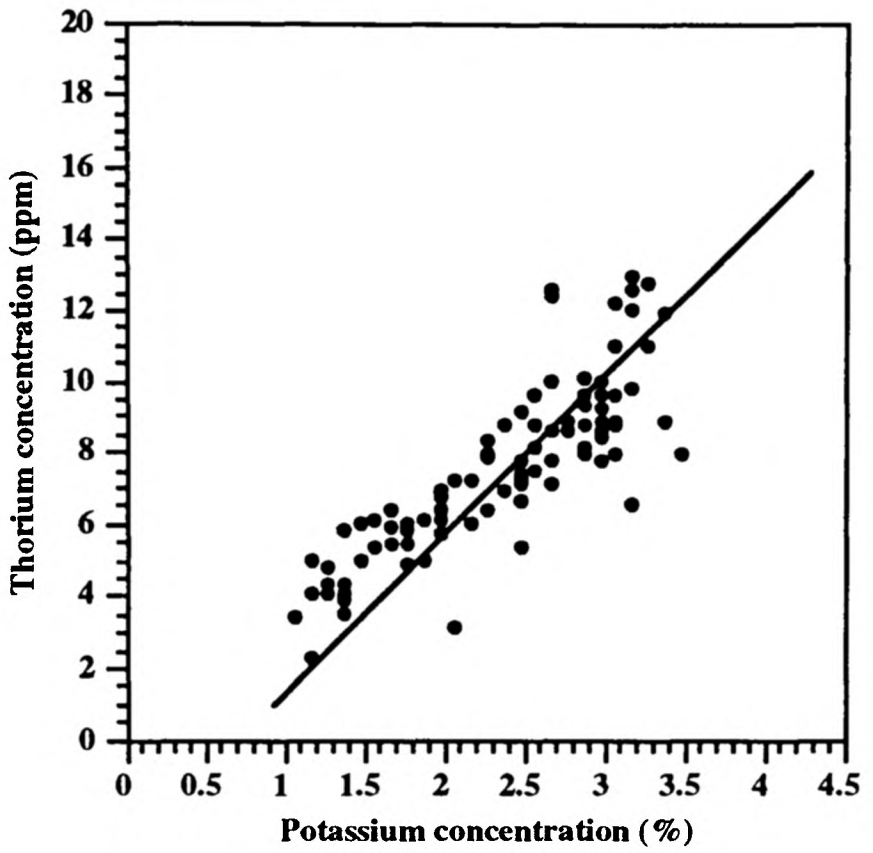


FIGURE 3.30A Linear regression correlation between Th concentration and K concentration. A correlation coefficient of 0.73 suggests a statistically robust correlation at the 95 % significance level (n = 96). The relationship between the two elements can be described by the linear equation : Th ppm = 3.061 K% - 0.225

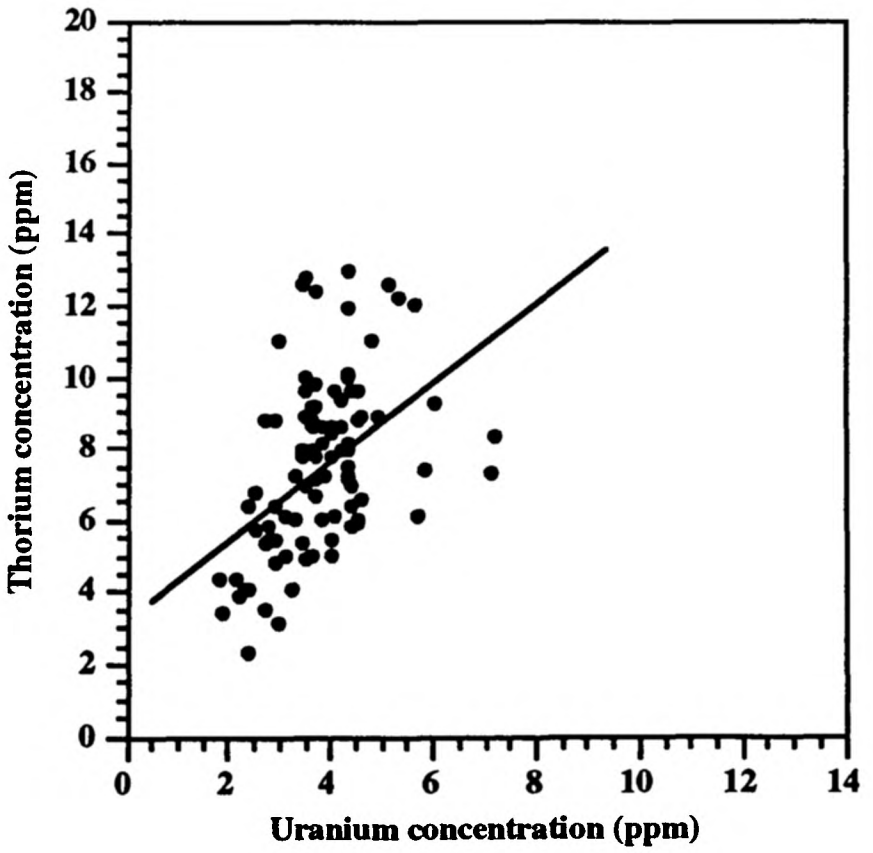


FIGURE 3.30B Linear regression correlation between Th concentration and U concentration. A correlation coefficient of 0.25 indicates that there is no covariant linear relationship between the two elements. A correlation coefficient of 0.30 or more is required for a statistically robust correlation at the 95 % significance level for n =96.

Stratigraphic log (unpublished, courtesy of Hesselbo & Jenkyns)

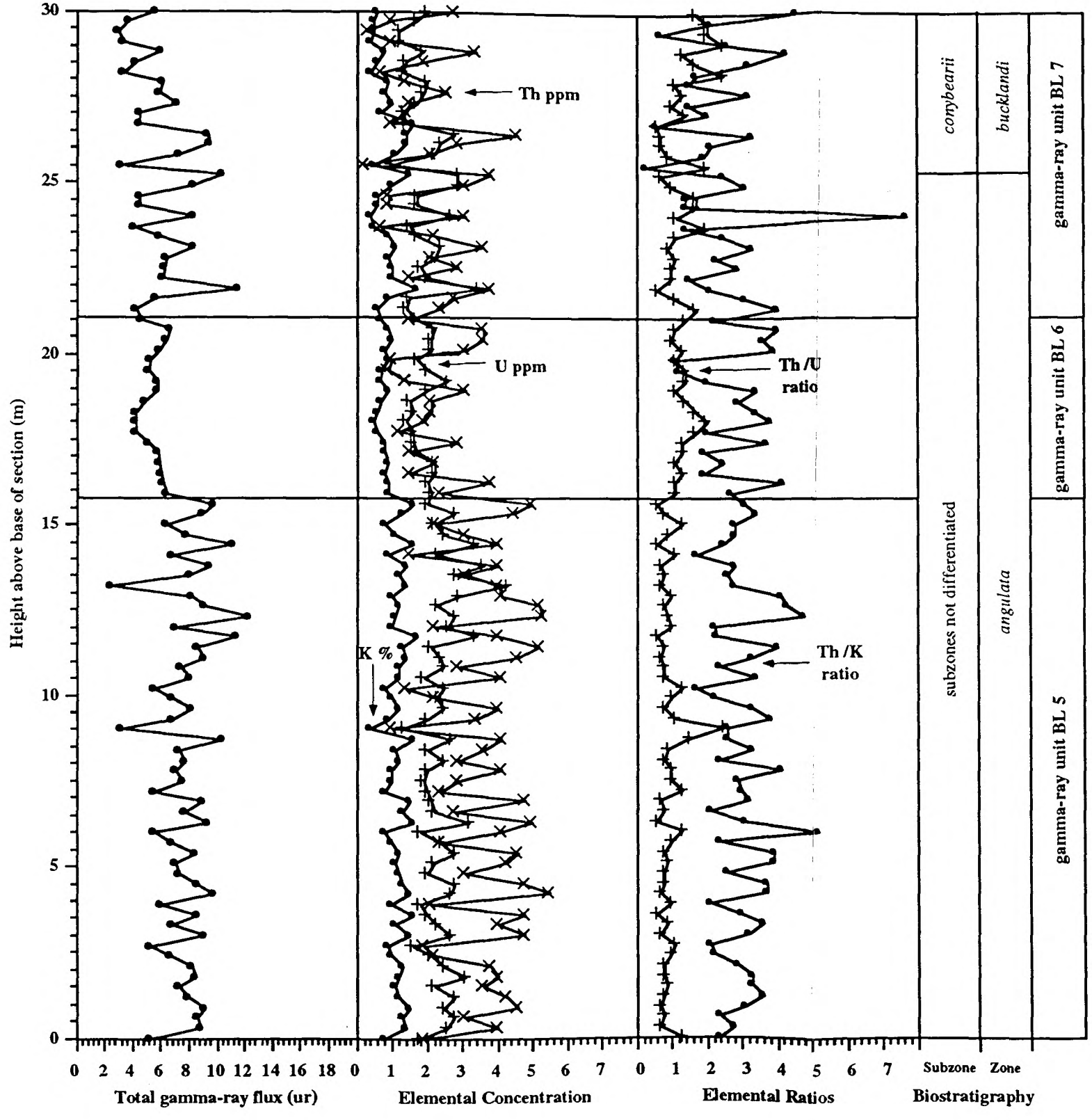


Figure 3.31

FIGURE 3.31 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the Blue Lias (Porthkerry Formation) exposed at Nash Point, Glamorgan (ST 914684). Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 100 sets of measurements.

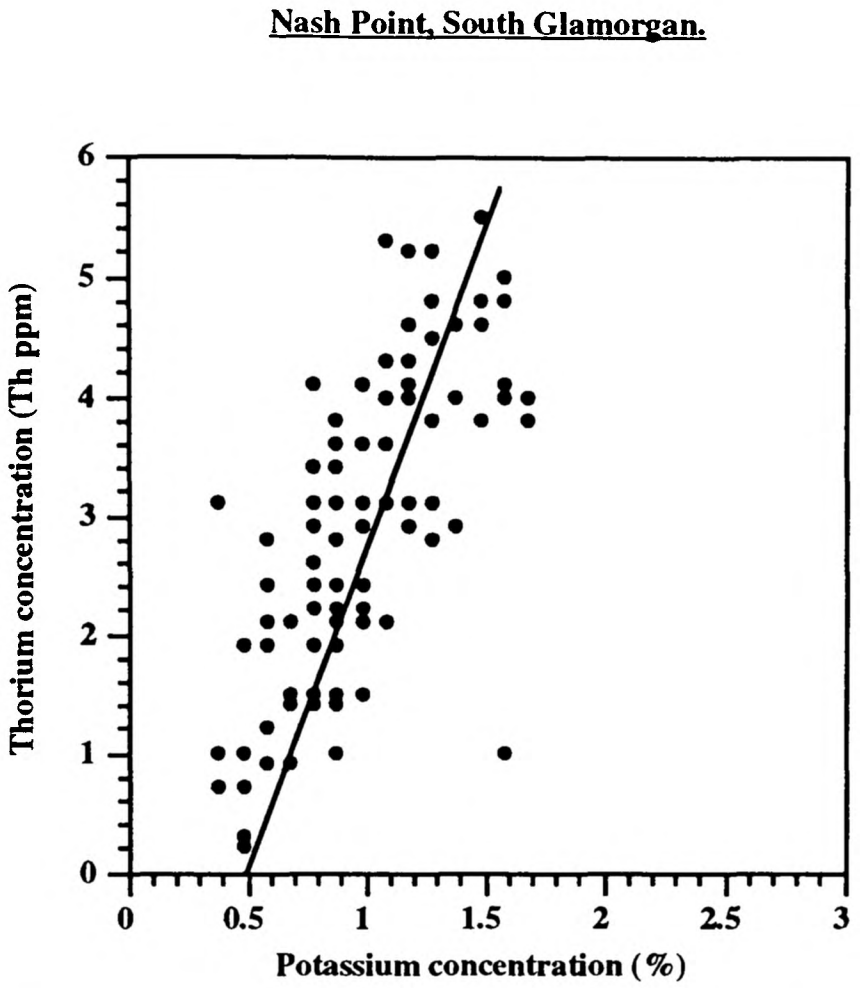


FIGURE 3.32A Linear regression correlation between Th concentration and U concentration. A correlation coefficient of 0.54 suggests a weak but statistically robust correlation at the 95 % significance level (n = 100). The relationship between the two elements can be described by the linear equation : Th ppm = 2.93 K % - 0.067

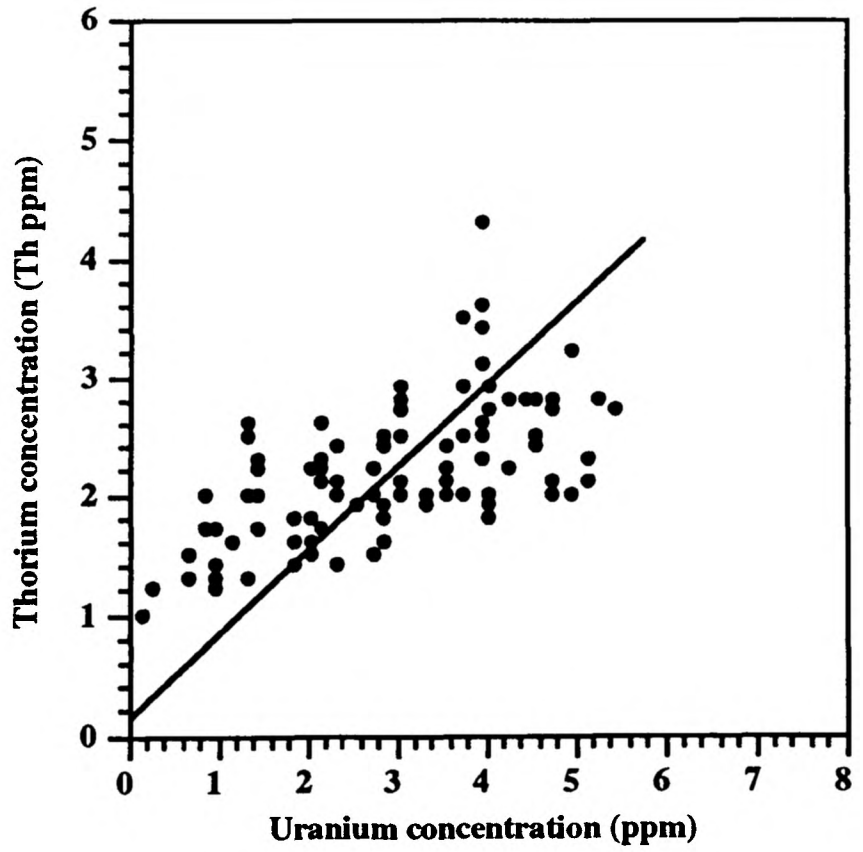


FIGURE 3.32B Linear regression correlation between Th concentration and K concentration. A correlation coefficient of 0.62 suggests a weak but statistically robust correlation at the 95 % significance level (n = 100). The relationship between the two elements can be described by the linear equation : Th ppm = 1.42 U ppm + 0.195

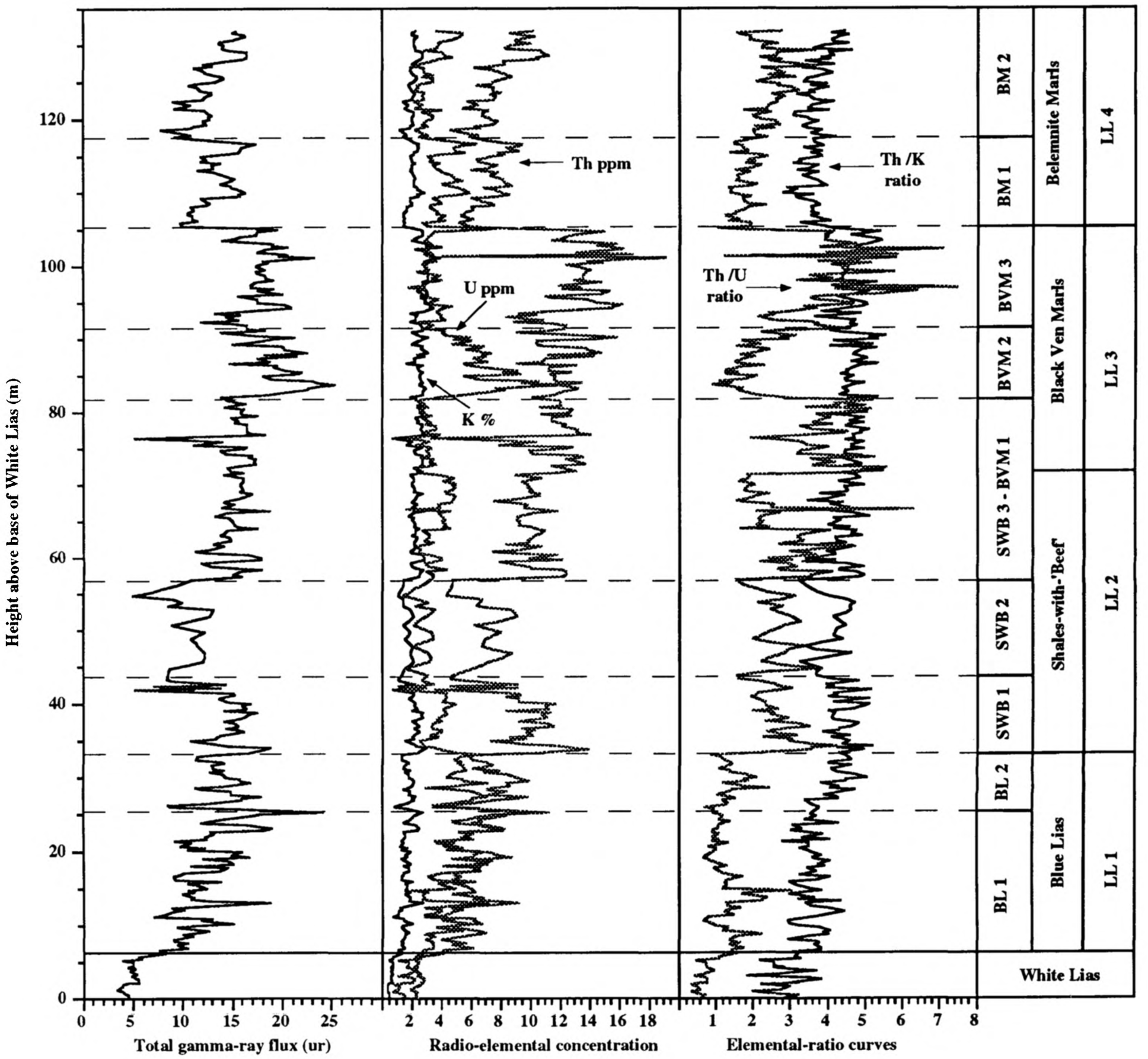


FIGURE 3.33 Gamma-ray logs for the Lower Lias succession of the Dorset coast based upon 421 measurements. The Blue Lias to Belemnite Marls have been subdivided on the basis of total gamma-ray signature and elemental-log signature into 10 gamma-ray units. Gamma-ray units SWB 3 and BVM 1 can be viewed as a single gamma-ray unit since there is essentially little difference in total gamma-ray signature between the Shales-with-'Beef' and Black Ven Marls over this interval. However, there is a very great change in Th/U ratio at the boundary between these two formations. The pronounced increase in Th/U ratio in the Black Ven marls arises from a decrease in U concentration and an increase in Th concentration. These two logs destructively interfere and result in essentially little change in total gamma-ray flux across the boundary between the Shales-with-'Beef' and Black Ven Marls. The units of Whittaker *et al.* (1985), identified for the same sequence from the Burton Row borehole in Somerset, are also shown. Clearly, finer sub-division of the Whittaker *et al.* gamma-ray units is possible.

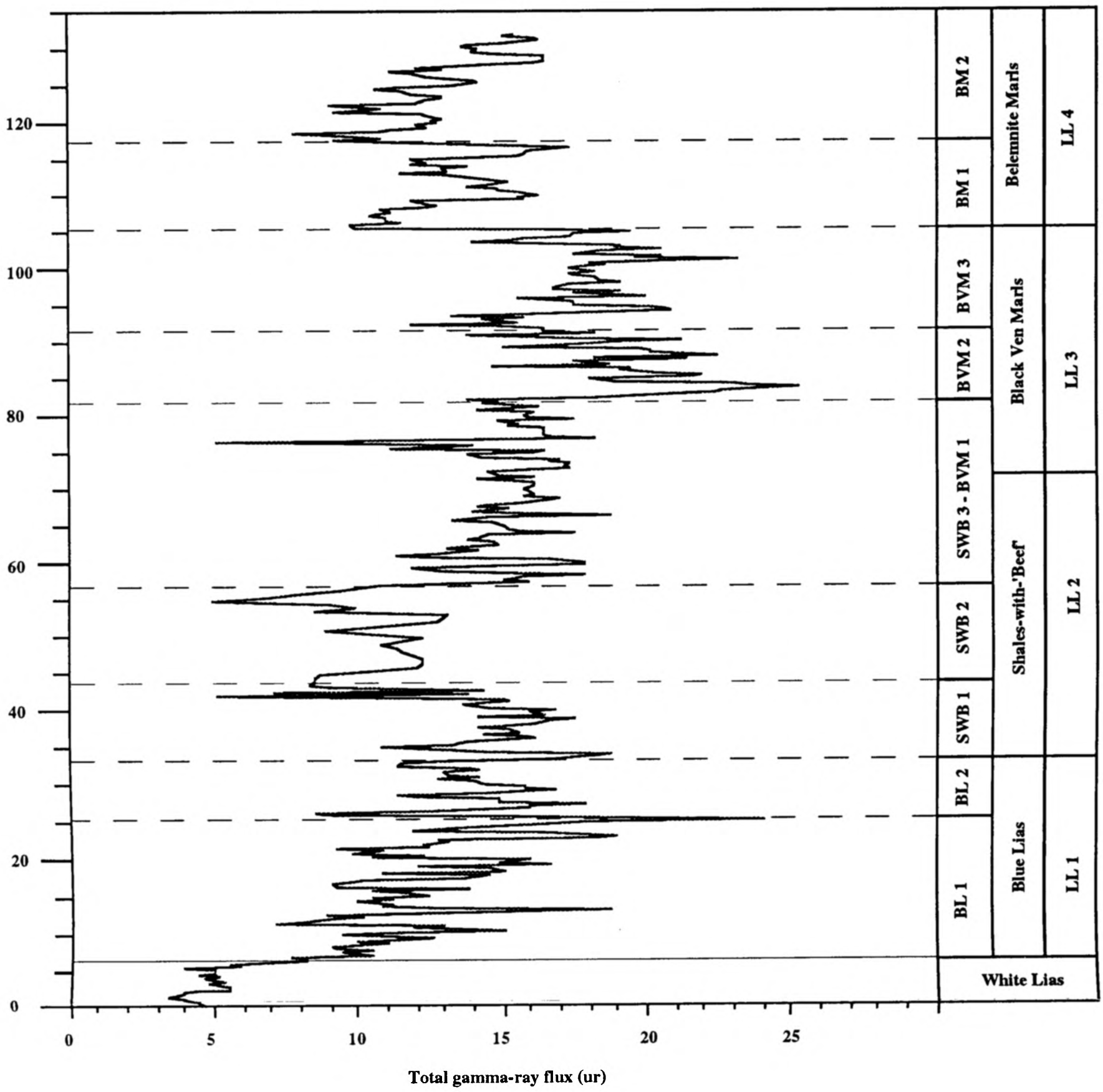
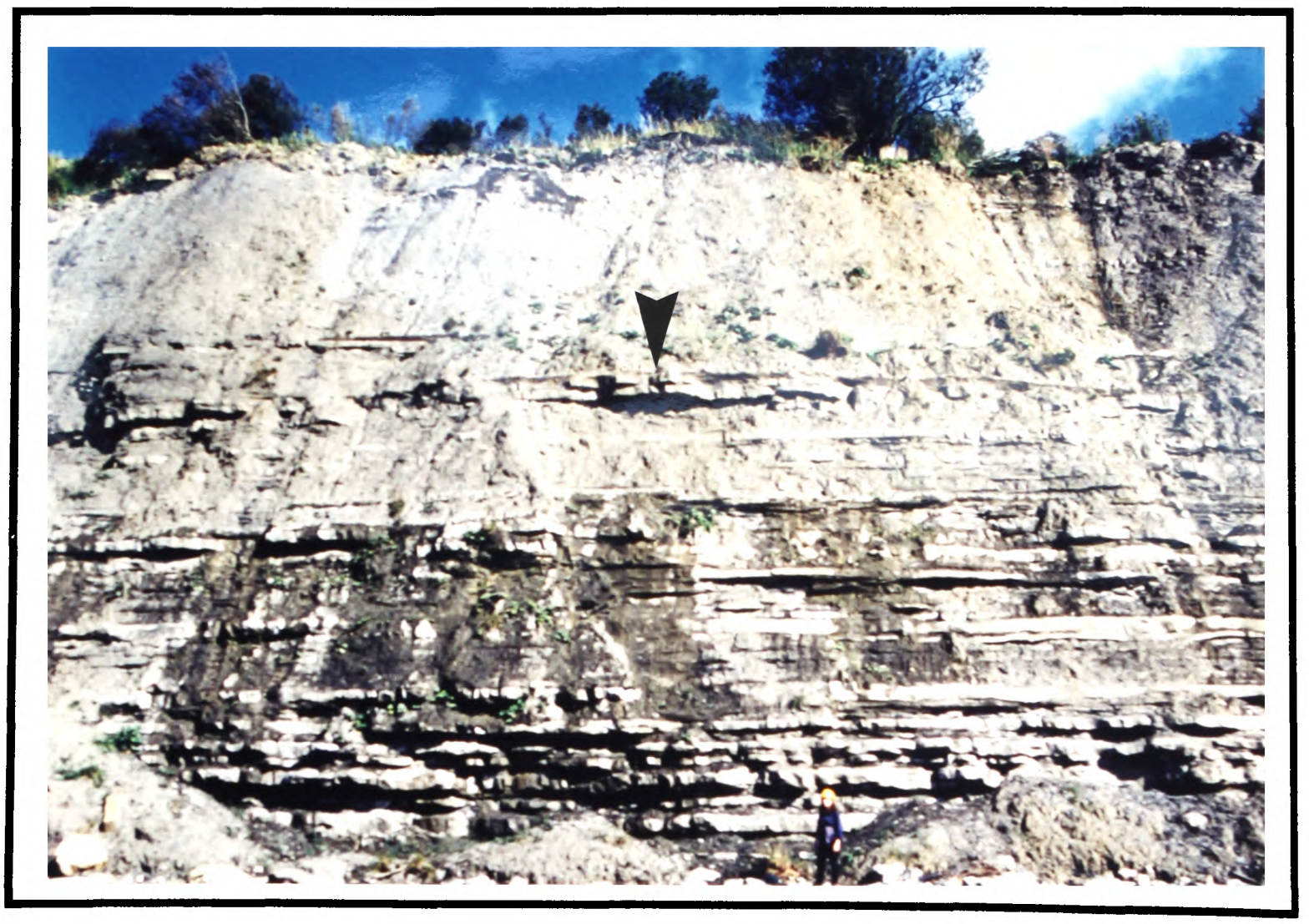


FIGURE 3.34 Stratal packaging within the Lower Lias of the Dorset coast based upon total gamma-ray signature. The gamma-ray units defined in this study can be enhanced by altering the aspect ratio of the gamma-ray flux scale. The gamma-ray units can clearly be identified by enhancing the low frequency component of the total gamma-ray signature in this way. The units of Whittaker *et al.* (1985), identified for the same sequence from the Burton Row borehole in Somerset, are also shown.

FIGURE 3.35 <u>The Blue Lias Formation, Dorset.</u>

(ABOVE) Boundary between the White Lias and the Pre-*planorbis* Beds of the Blue Lias at Pinhay Bay (SY 318908). The White Lias is composed of a series of redeposited carbonate-mud flows as inferred from the matrix-supported intraclastic nature of most beds. These contrast with the high-frequency limestone-marl alternations characteristic of the Blue Lias. Height of cliff approximately 16 m.

(BELOW) Contact between the Blue Lias and the Shales-with-Beef at Seven Rock Point, Lyme Regis (SY 328910). In contrast to the Blue Lias, the Shales-with-Beef are dominantly argillaceous with minor concretionary or tabular limestones. The prominant uppermost limestone in the foreground is Grey Ledge which represents the boundary between the two formations. Height of cliff approximately 17 m.



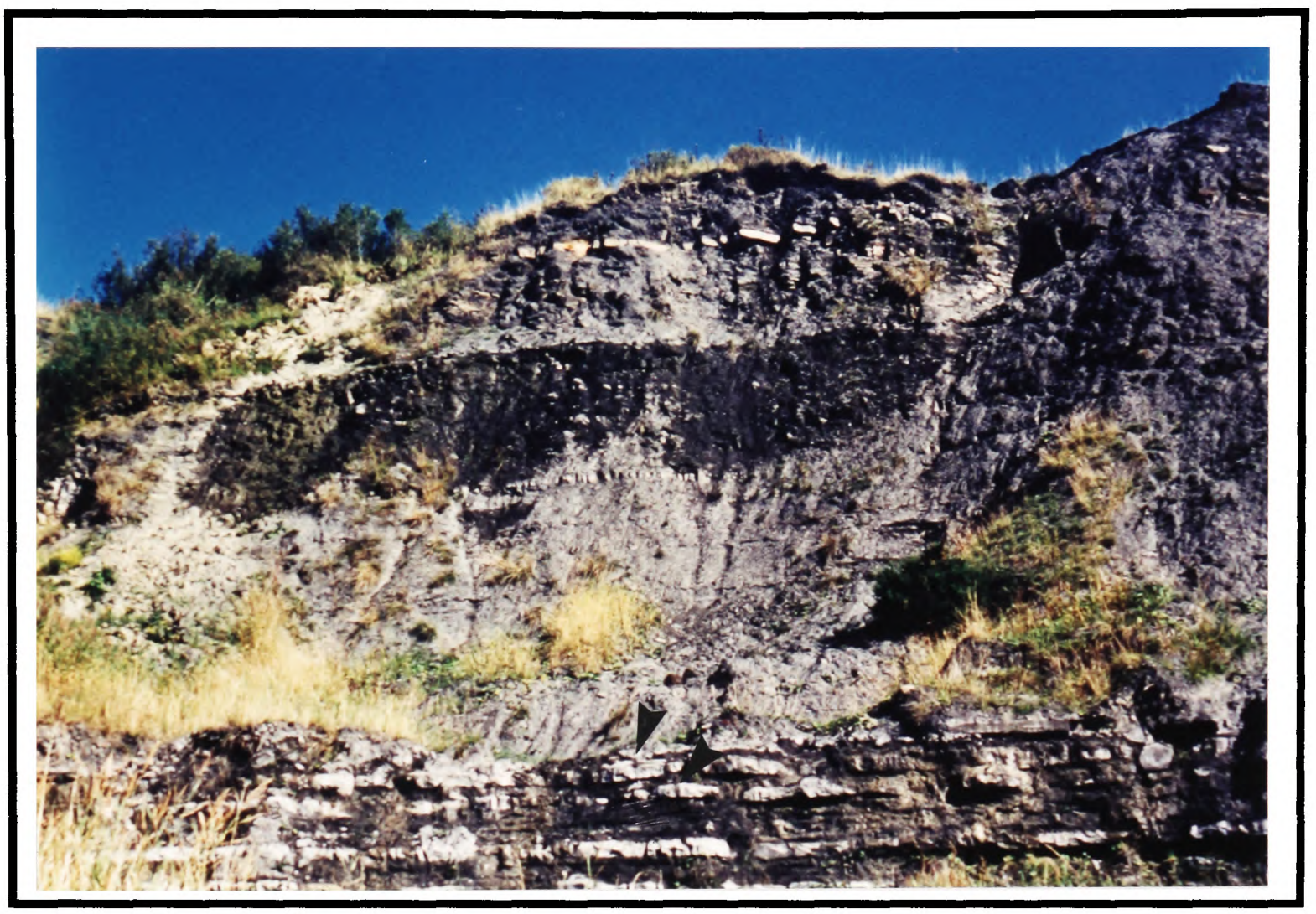


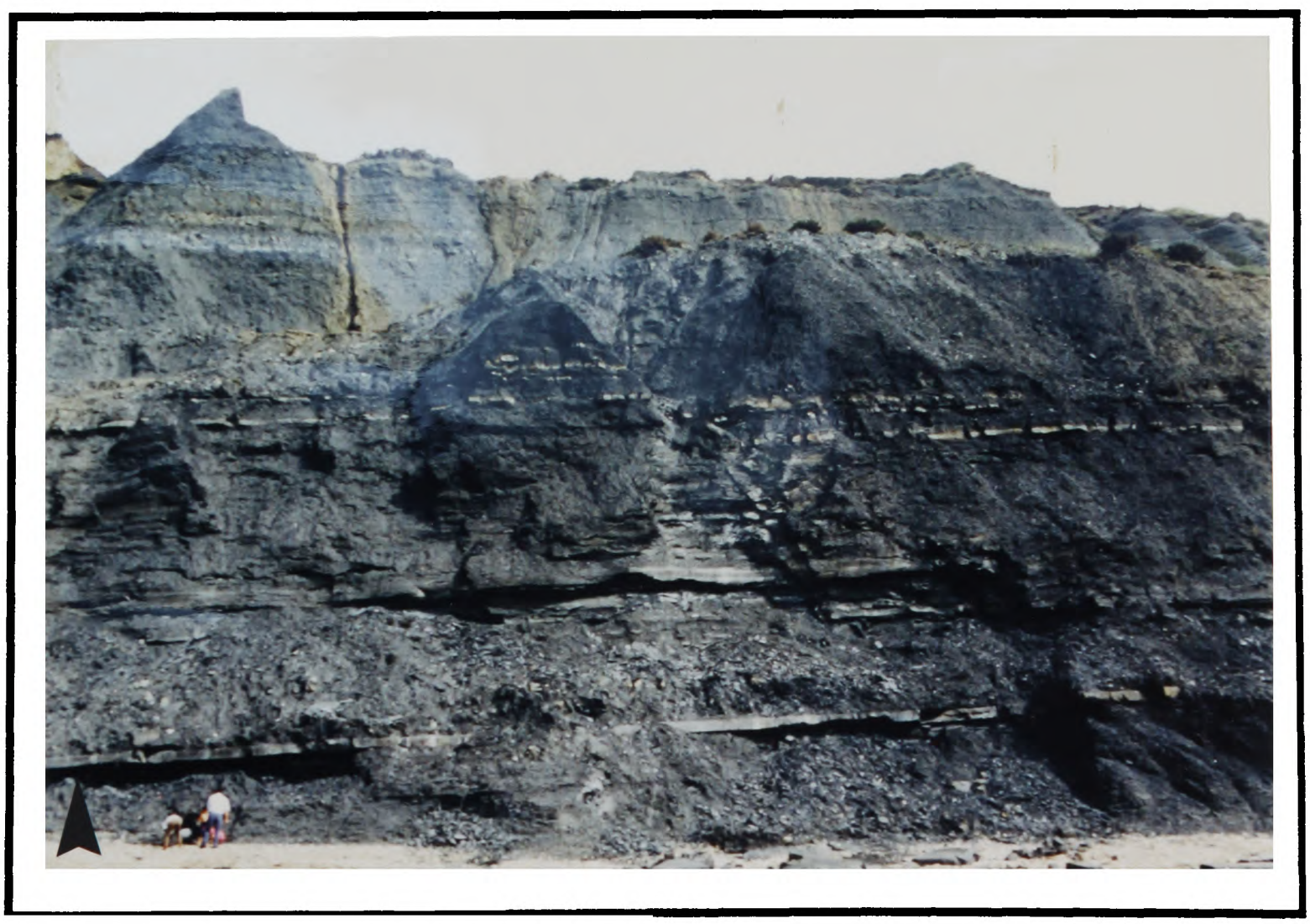
FIGURE 3.36 **Shales-with-'Beef' at Seven Rock Point, Lyme Regis, Dorset**

Field aspect of the lower Shales-with-'Beef' at Seven Rock Point, Lyme Regis (SY 328910). The exposure is representative of the *scipionianum* Subzone of the *semicostatum* Zone. The argillaceous nature of the Shales-with-'Beef' contrasts with the limestone-marl cycles developed in the Blue Lias. In the foreground, the top two limestones of the Blue Lias (known as Grey Ledge, and Glass Bottle) are biostratigraphically equivalent to the condensed *lyra* Subzone of the *semicostatum* Zone. The condensed *lyra* Subzone of the Blue Lias clearly contrasts with the expanded *scipionianum* Subzone of the Shales-with-'Beef'. (Height of cliff is approximately 12 m).

FIGURE 3.37 <u>The Black Ven Marls, Charmouth, Dorset</u>

(ABOVE) Field aspect of the Black Ven Marls west of Charmouth at Black Ven (SY 364930). The formation, together with the Shales-with-'Beef' below, comprises a package of predominantly dark laminated shales and dark marls with occasional concretionary and tabular limestone horizons. The Belemnite Marls are exposed towards the top of the cliff. (Ciff approximately 50 m in height).

(BELOW) Black Ven Marls below Stonebarrow cliff, east of Charmouth (SY 380927). The lowermost limestone is known as the Lower Cement Bed (bed 80). The Black Ven Marls at Stonebarrow are slightly condensed with respect to the section exposed on Black Ven and the first recorded *Asteroceras* (Lang & Spath 1926) occurs slightly lower at Stonebarrow. These observations are compatible with synsedimentary activity on the intervening Char Fault during the late Sinemurian. (Cliff approximately 30 m in height).



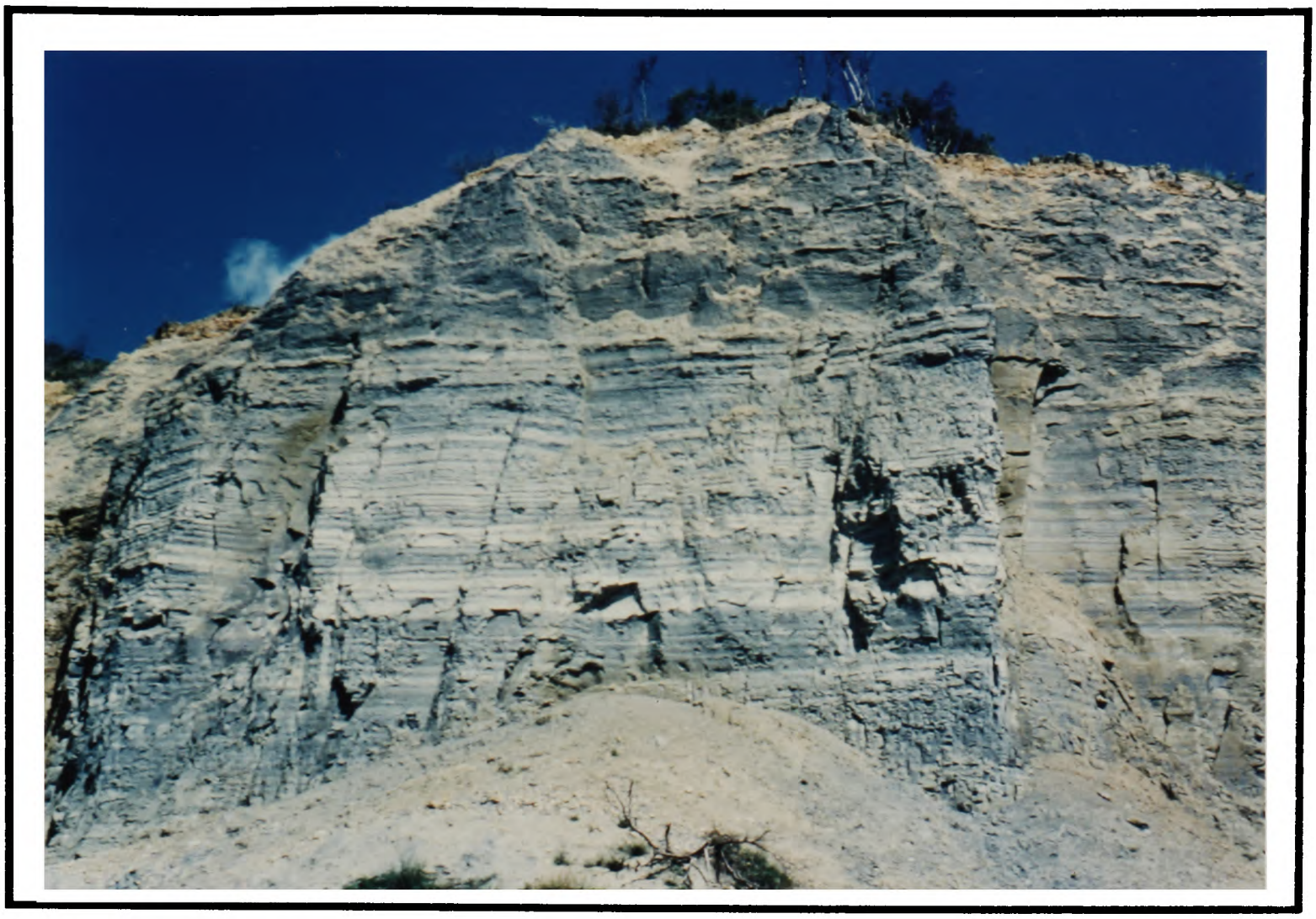
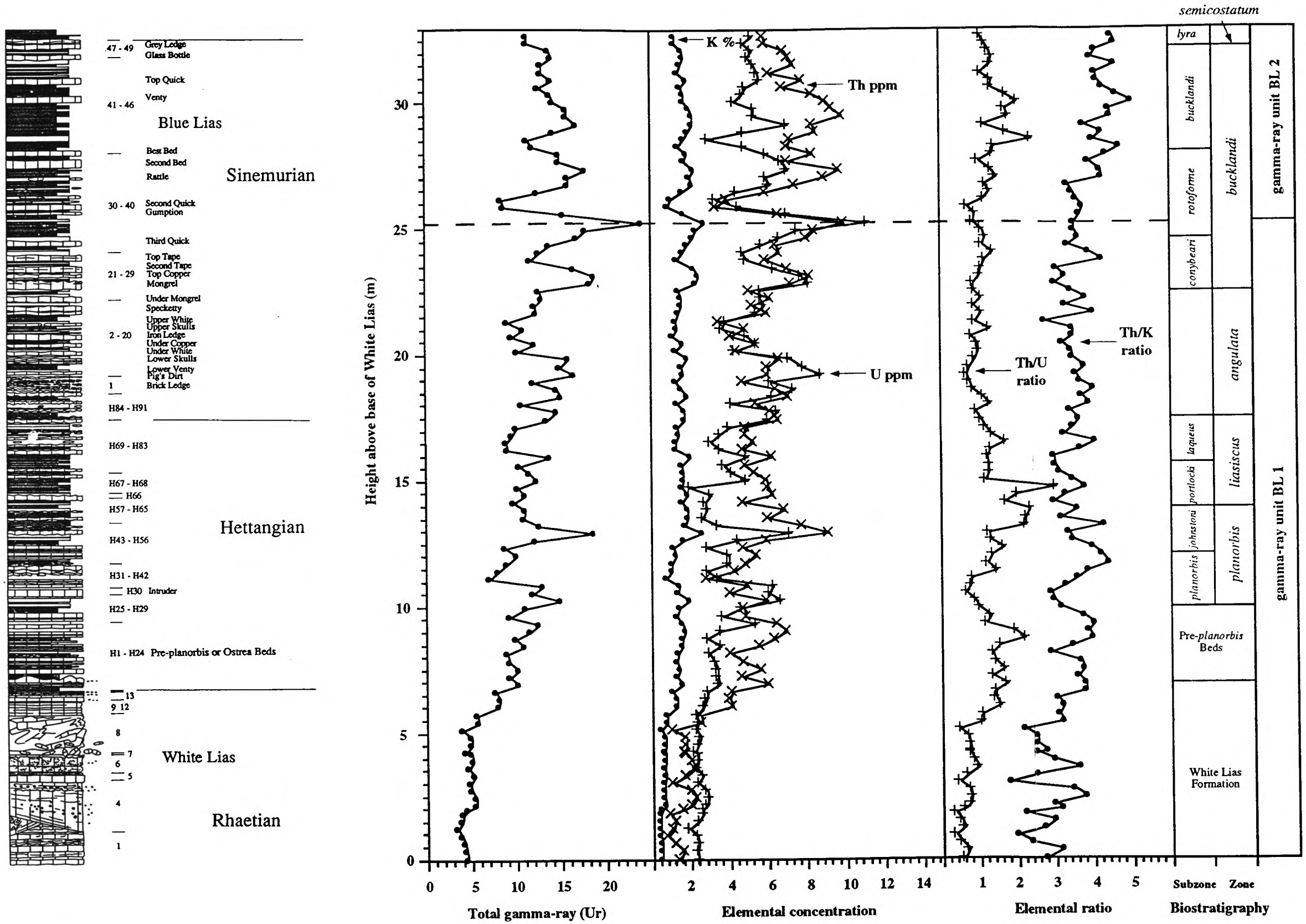


FIGURE 3.38 Belemnite Marls exposed east of Charmouth, Dorset (SY 380927-SY 415918)

(ABOVE) The Belemnite Marls that outcrop beneath Stonebarrow, east of the village of Charmouth (SY 380927). The series of light marl - dark marl couplets are a striking feature of the formation and less strongly overprinted by diagenesis than comparable cycles developed in the Blue Lias. The formation as a whole can be considered as a sedimentary cycle of first progressively increasing and then progressively decreasing bed-couplet thickness. (Height of cliff approximately 23 m).

(BELOW) The Belemnite Stone (SY 415918). Biostratigraphic condensation at the top of the Belemnite Marls culminates in a condensed 5 cm light grey-brown concretionary horizon known as the Belemnite Stone. (bed 121) The nodular limestone contains abundant belemnites, bivalves and *Chondrites*. Above bed 121, the strata belong to the Green Ammonite Beds (*davoei* Zone). Hammer is 35 cm in length.



Stratigraphic log of Hesselbo & Jenkyns (1995a)

FIGURE 3.39 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the Blue Lias Formation. Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 87 sets of measurements that were collected between Pinhay Bay, Devon (SY 318908) and Seven Rock Point, Dorset (SY 328910). The underlying White Lias (Langport Member of the Lilstock Formation) is also shown.

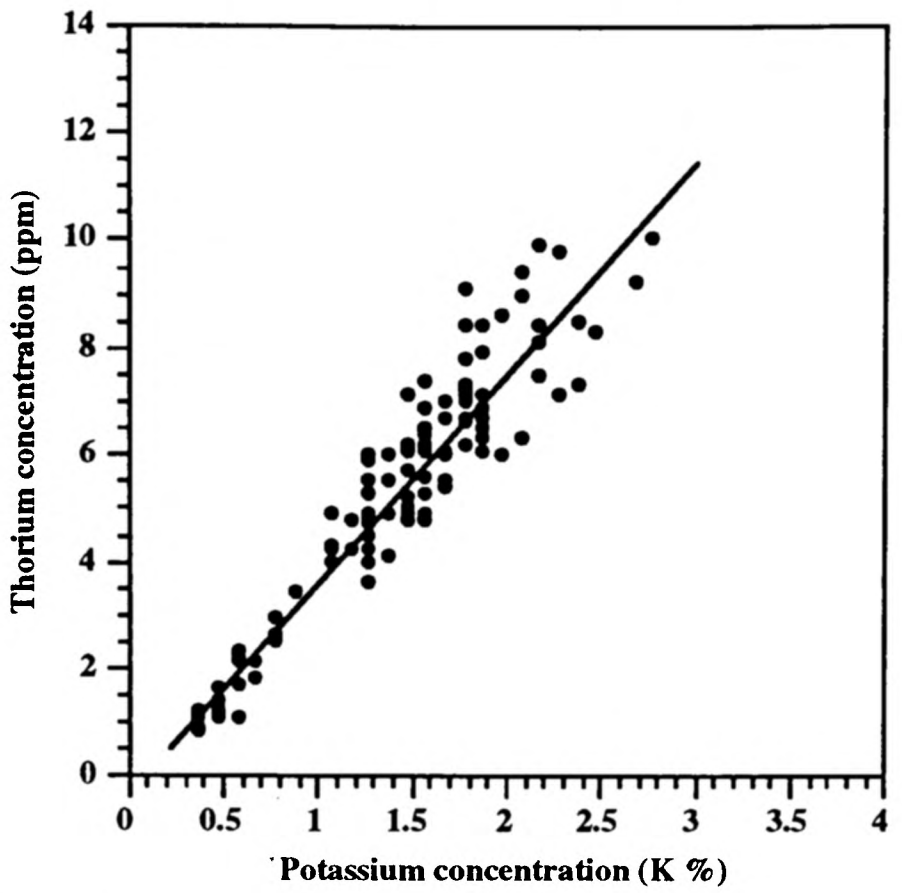


FIGURE 3.40A Linear regression correlation between Th concentration and K concentration. A correlation coefficient of 0.889 suggests a statistically robust correlation at the 95 % significance level (n = 87). The relationship between the two elements can be described by the linear equation : Th ppm = 3.9485 K % - 0.40727

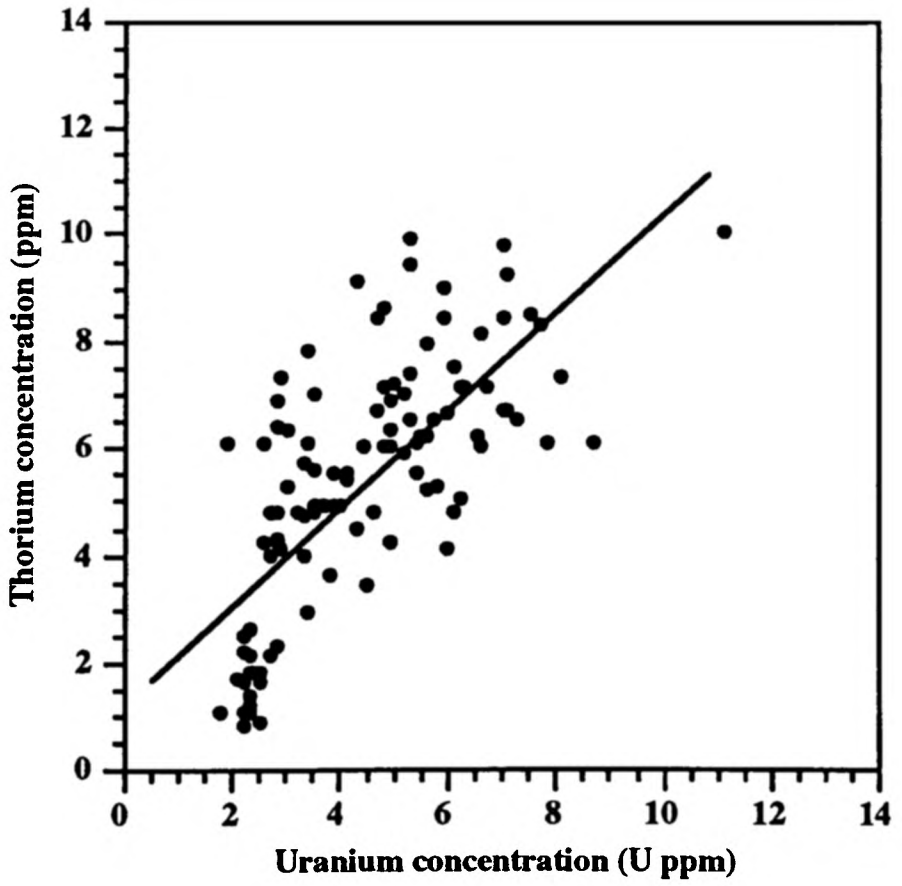
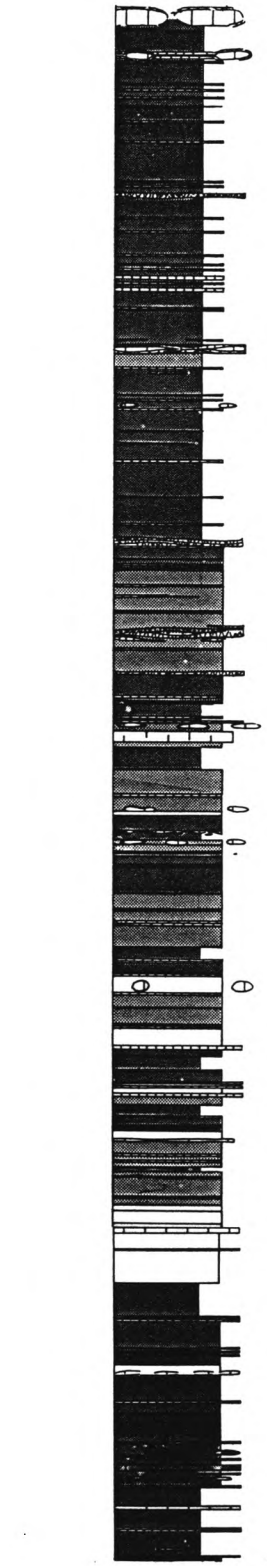


FIGURE 3.40B Linear regression correlation between Th concentration and U concentration. A correlation coefficient of 0.509 suggests a weak but statistically robust correlation at the 95 % significance level (n = 87). The relationship between the two elements can be described by the linear equation : Th ppm = 0.9119 U ppm + 1.2337



Stratigraphic log of Hesselbo & Jenkyns (1995a)

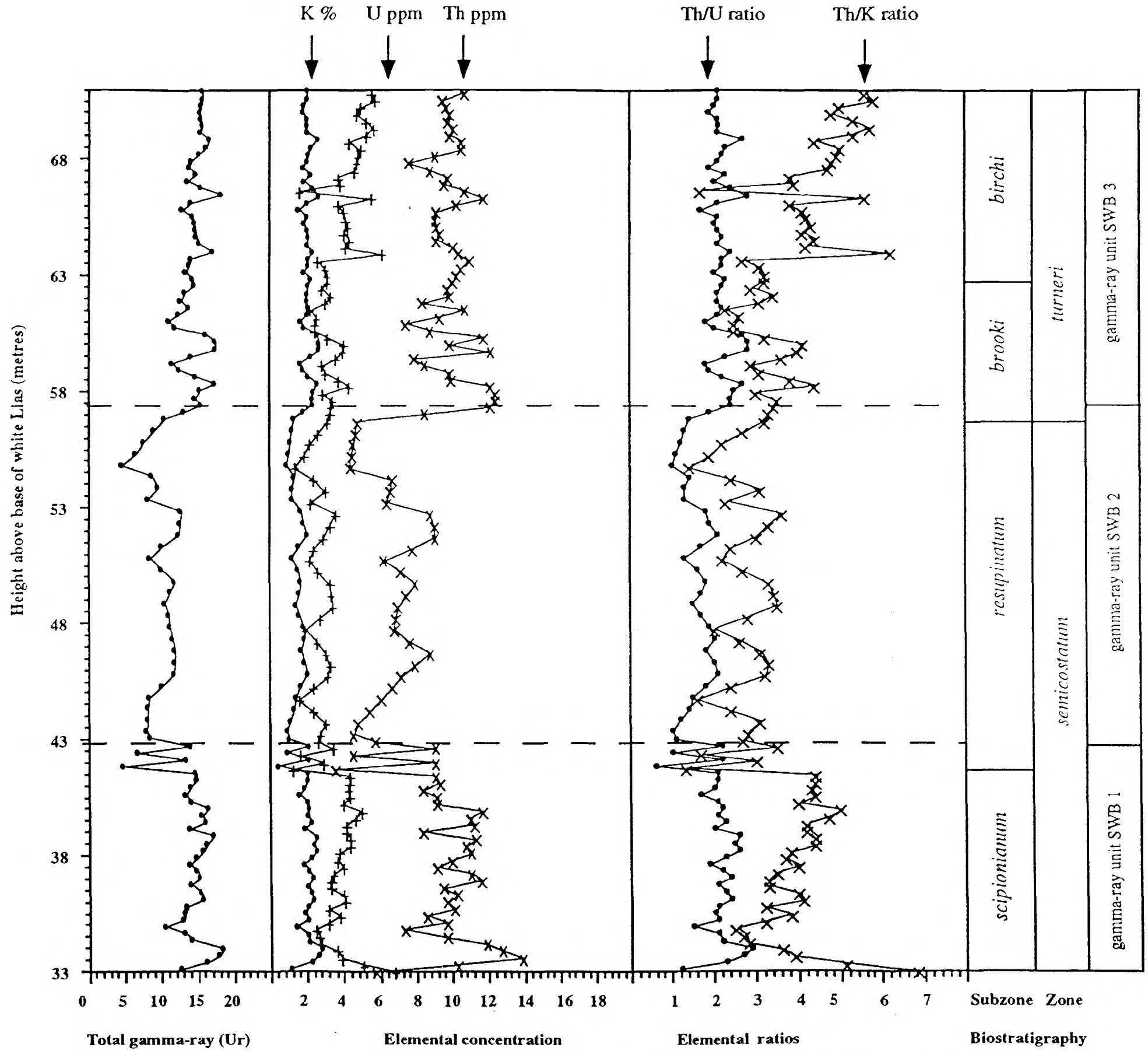


FIGURE 3.41 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the Shales-with-'Beef'. Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 108 sets of measurements.

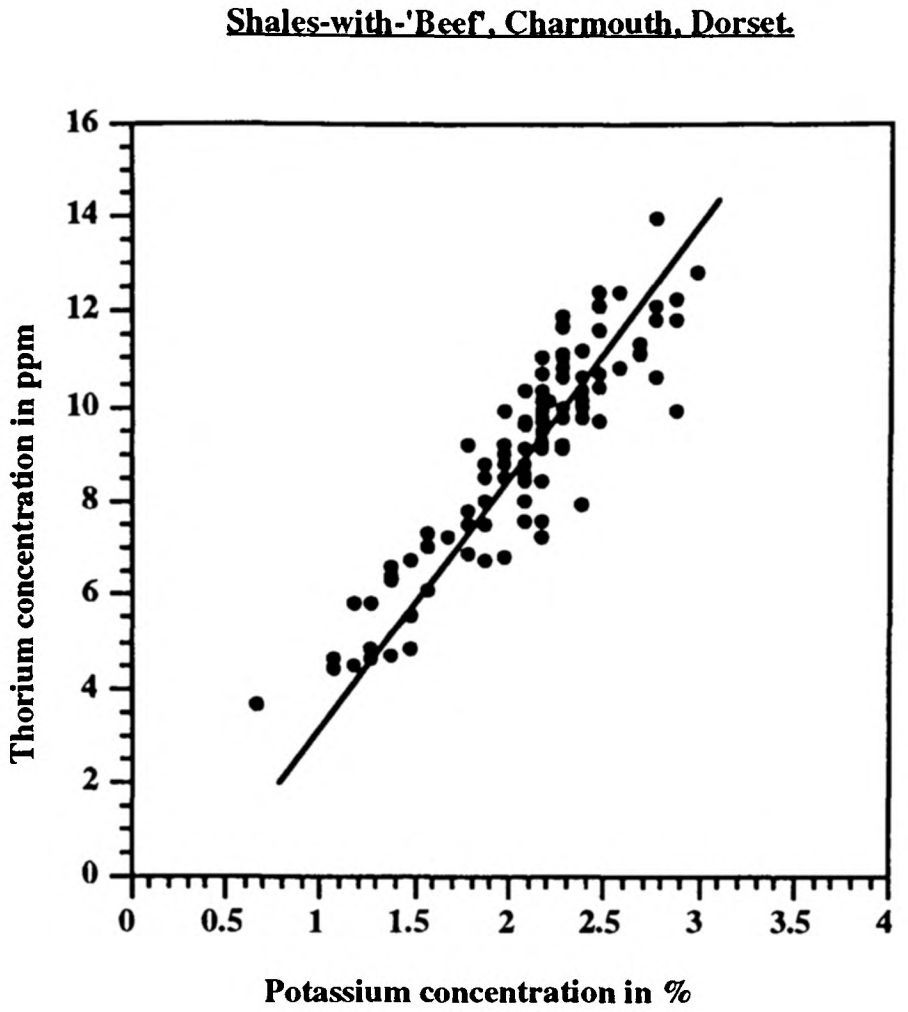


FIGURE 3.42A Linear-regression correlation between Th concentration and K concentration. A correlation coefficient of 0.87 suggests a statistically robust correlation at the 95 % significance level (n = 108). The relationship between the two elements can be described by the linear equation :

$$\text{Th ppm} = 3.95\ \text{K \%} + 0.943$$

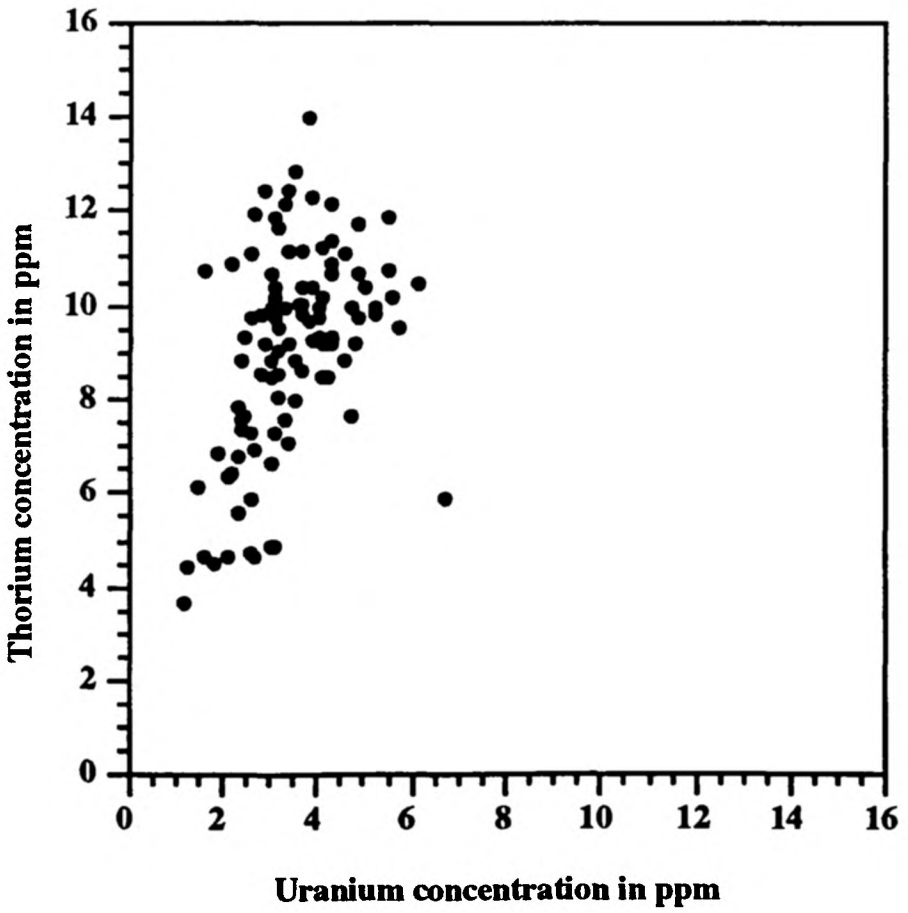


FIGURE 3.42B Linear-regression correlation between Th concentration and U concentration. A correlation coefficient of 0.14 indicates that no statistically robust relationship is shown by the two elements (n = 108).

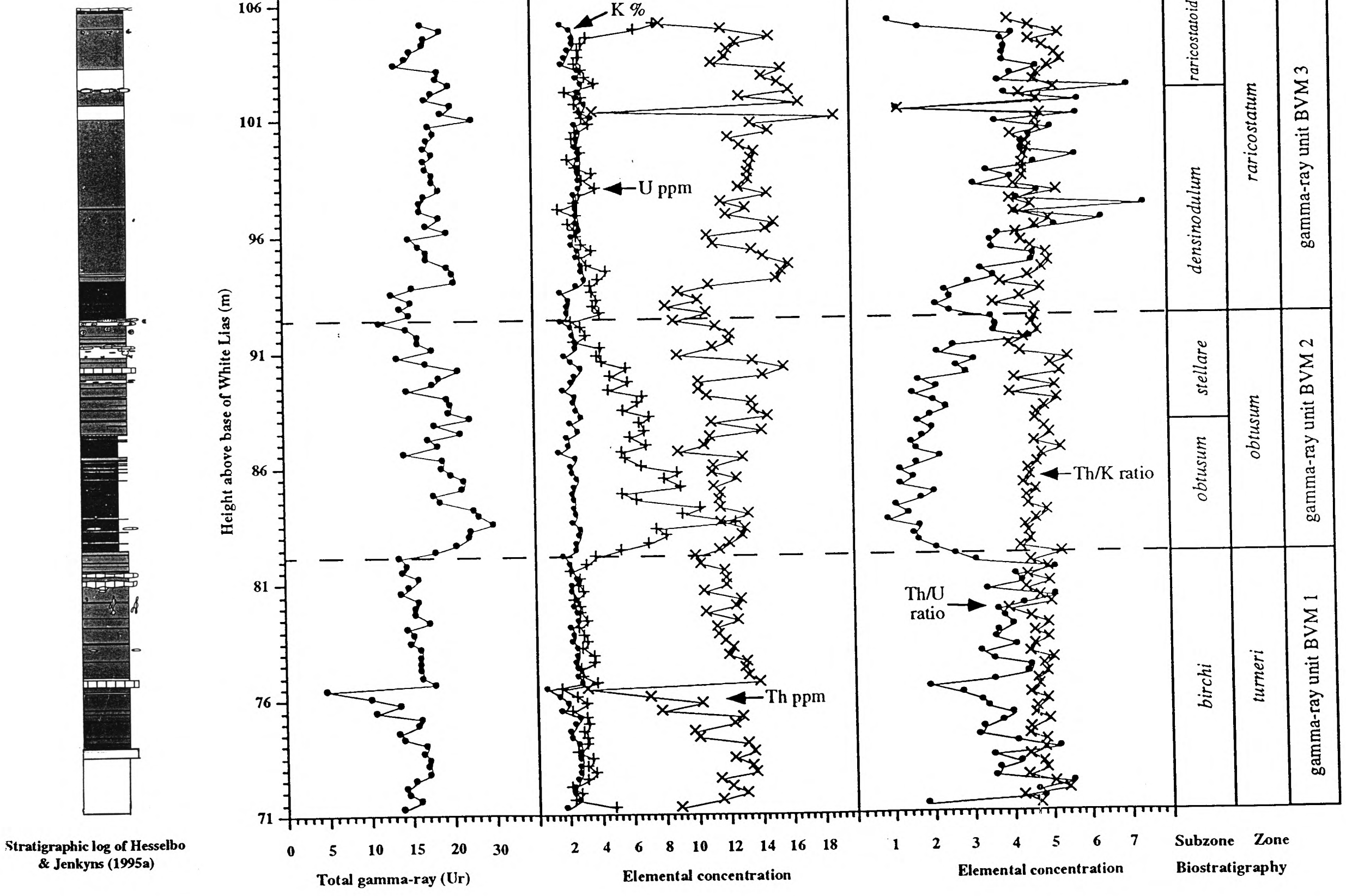


FIGURE 3.43 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the Black Ven Marls. Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 114 sets of measurements.

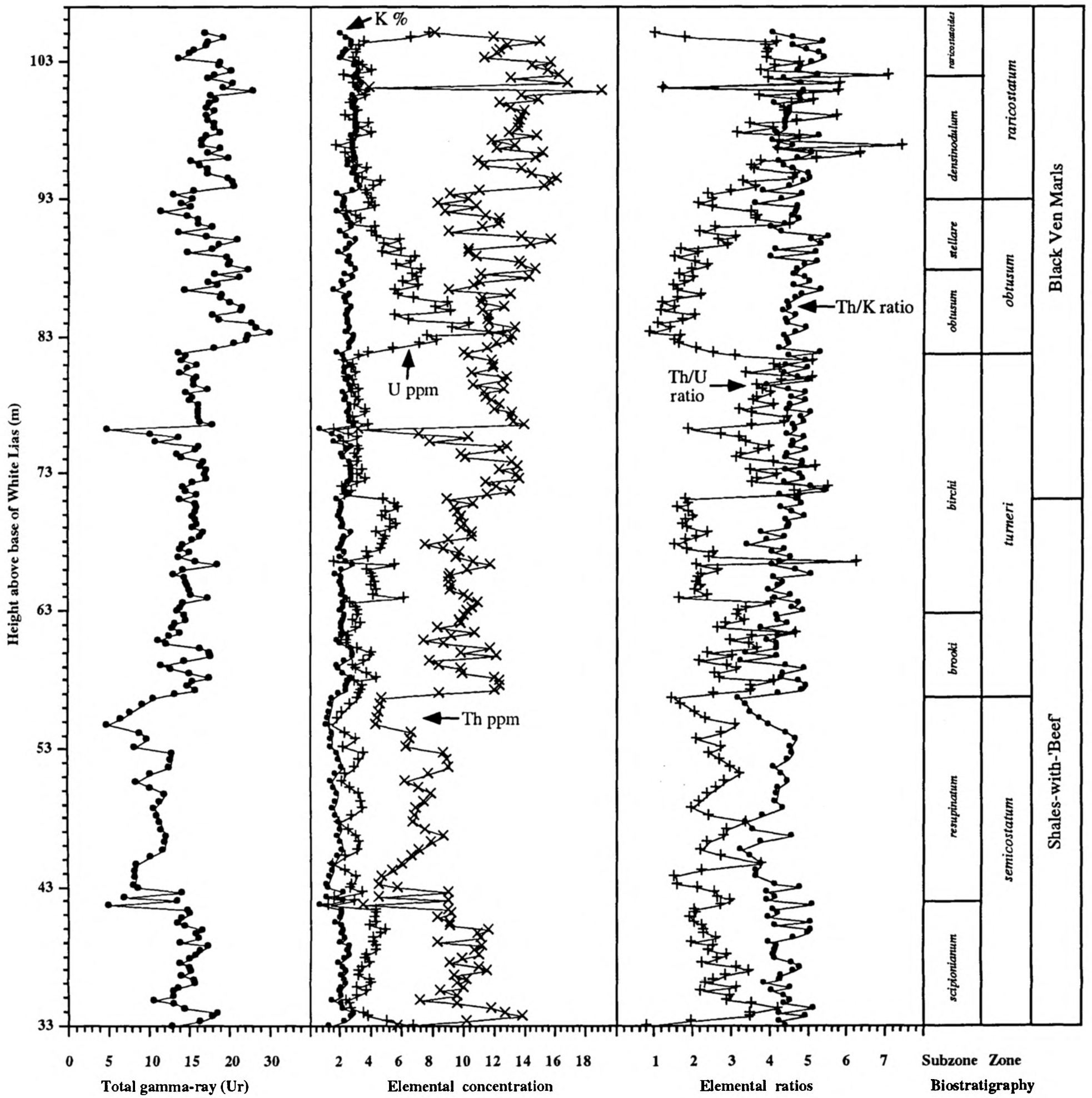


FIGURE 3.44 Total gamma-ray log, elemental-concentration logs and elemetal-ratio curves for Shales-with-'Beef' and Black Ven Marls. Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 222 sets of gamma-ray measurements.

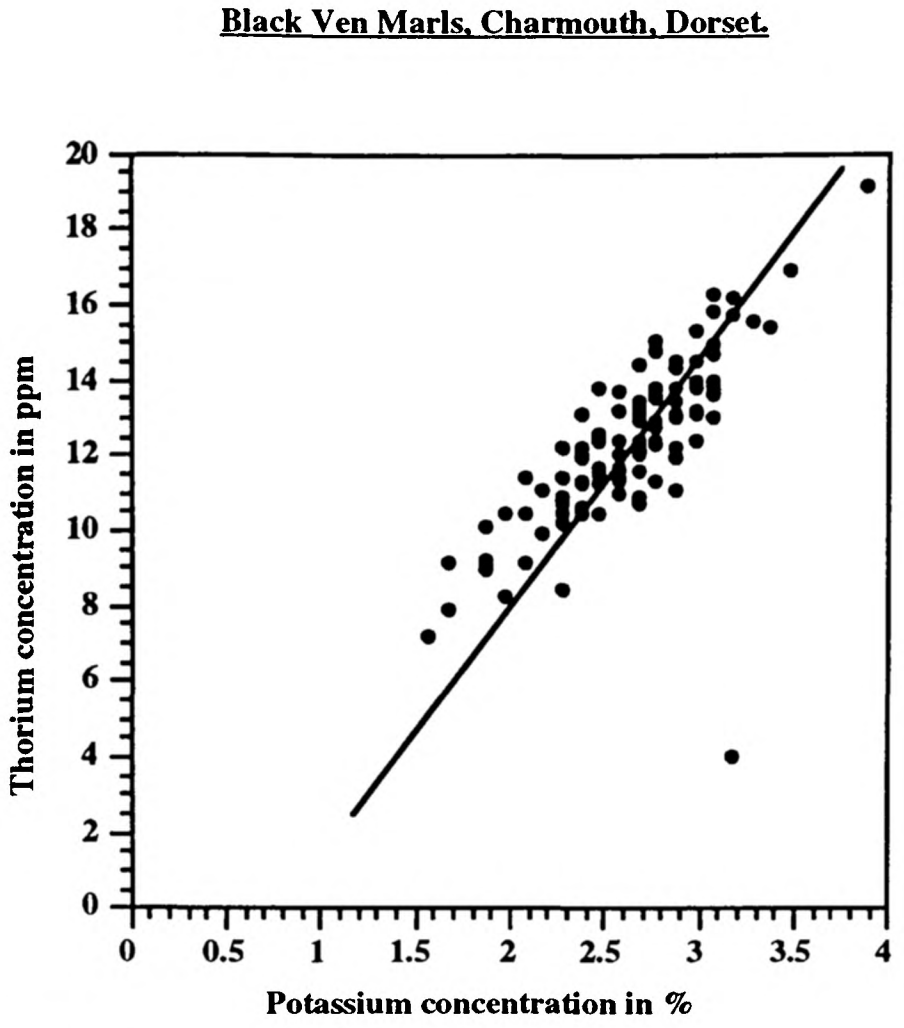


FIGURE 3.45A Linear-regression correlation between Th concentration and K concentration. A correlation coefficient of 0.64 suggests a statistically robust correlation at the 95 % significance level (n = 114). The relationship between the two elements can be described by the linear equation :

Th ppm = 4.24 K % + 1.083

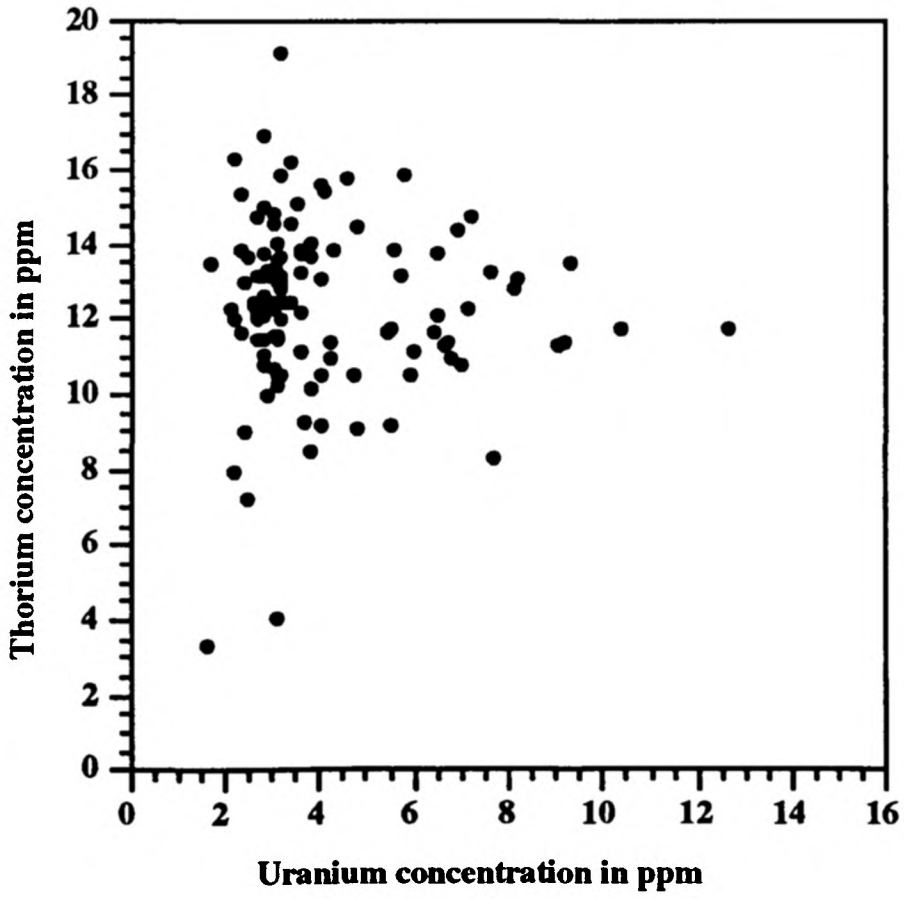


FIGURE 3.45B Linear-regression correlation between Th concentration and U concentration. A correlation coefficient of 0.01 indicates that no statistically robust relationship is shown by the two elements (n = 114).

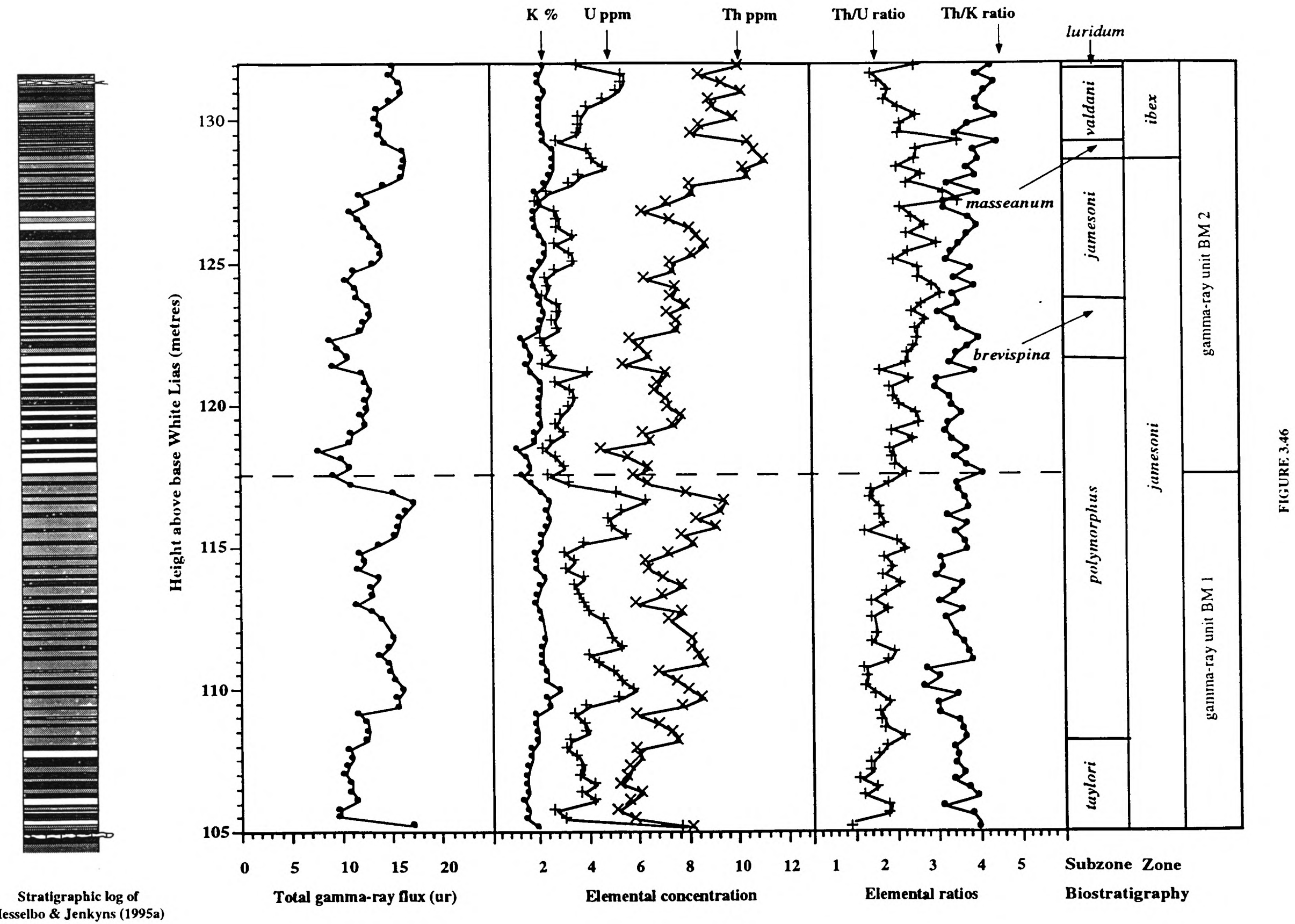


FIGURE 3.46 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the Belemnite Marls. Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 89 sets of measurements.

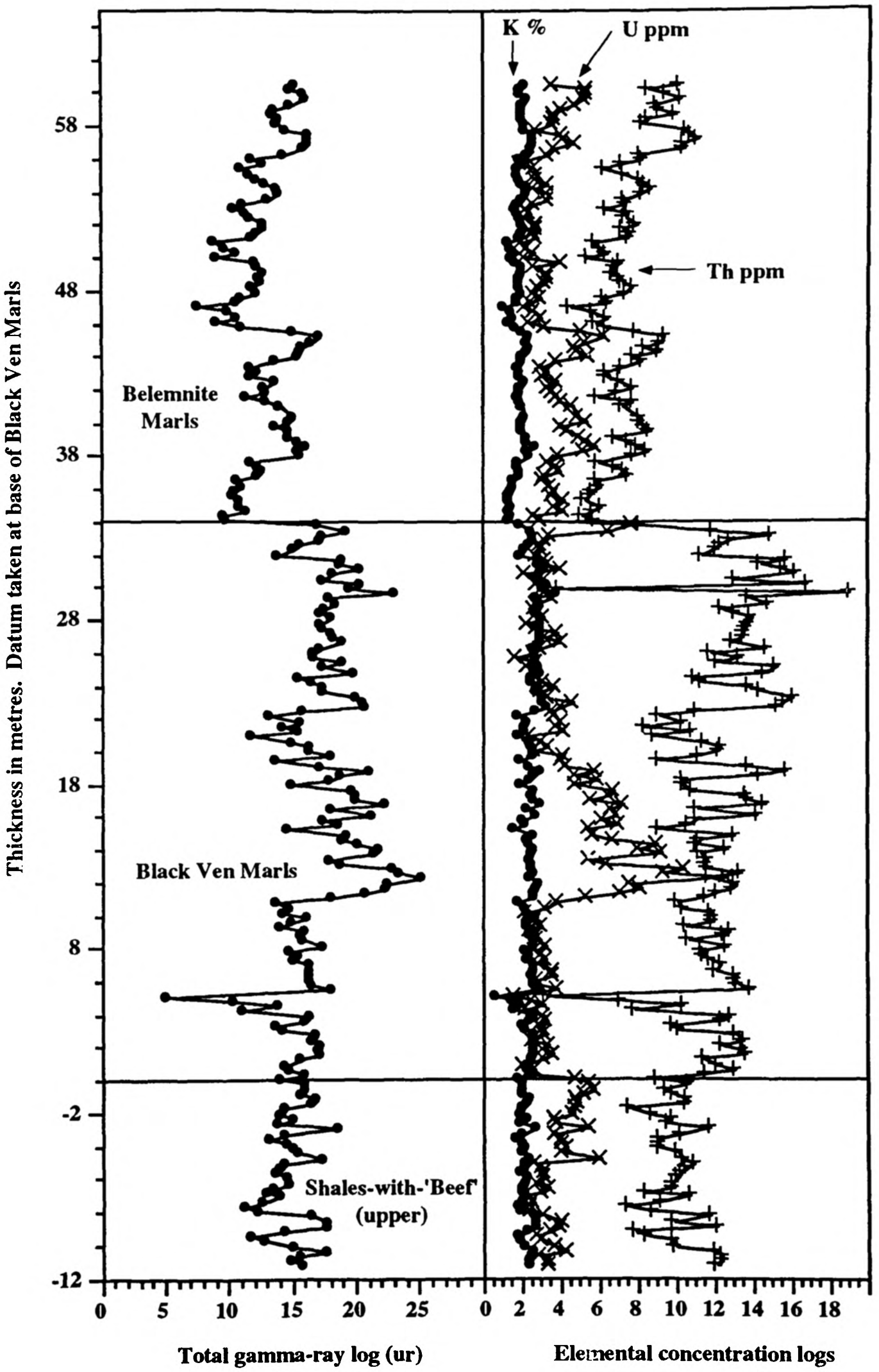


FIGURE 3.47 Total gamma-ray logs and elemental-concentration logs for the Shales-with-'Beef' and the entire Black Ven Marls and Belemnite Marls. The reduction in total gamma-ray flux and Th concentration within the Belemnite Marls (in contrast to the formations below) is clearly displayed.

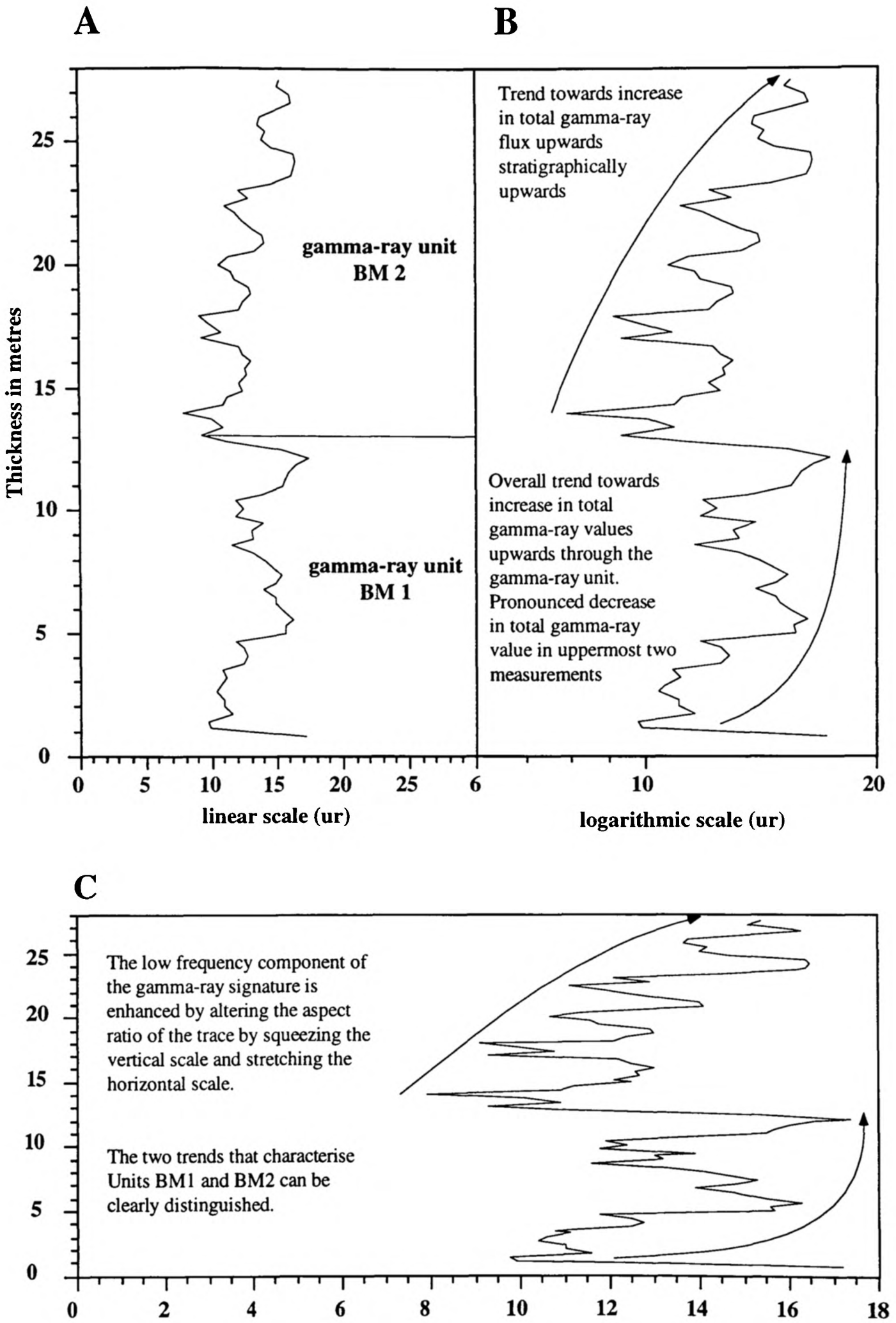


FIGURE 3.48 Stratal packaging within the Belemnite Marls. Each gamma-ray unit is characterised by a trend in the low frequency component of the signature. This can be enhanced by either altering the aspect ratio of the X and Y axis, as in case B, or by normalising the horizontal axis to a range of log values, as in case C.

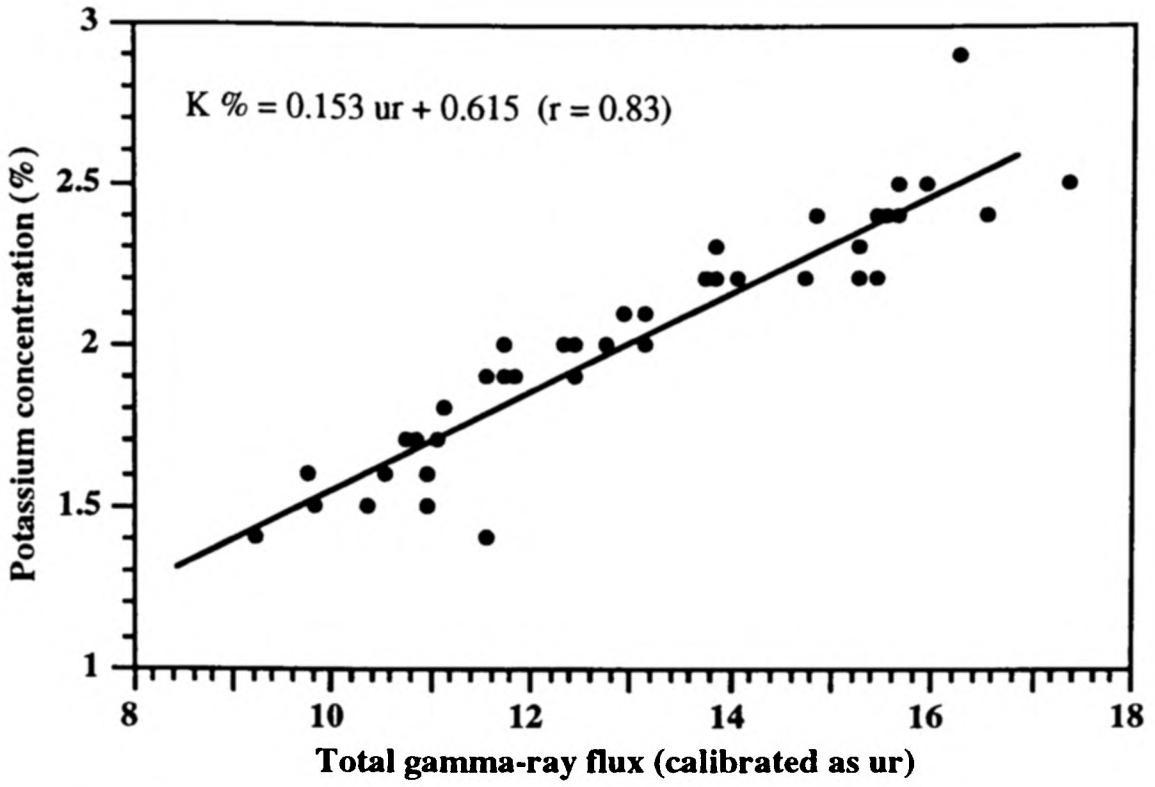


FIGURE 3.49 Positive linear regression between total gamma-ray flux and radio-elemental concentration within gamma-ray unit BM 1. Correlation coefficients are indicated.

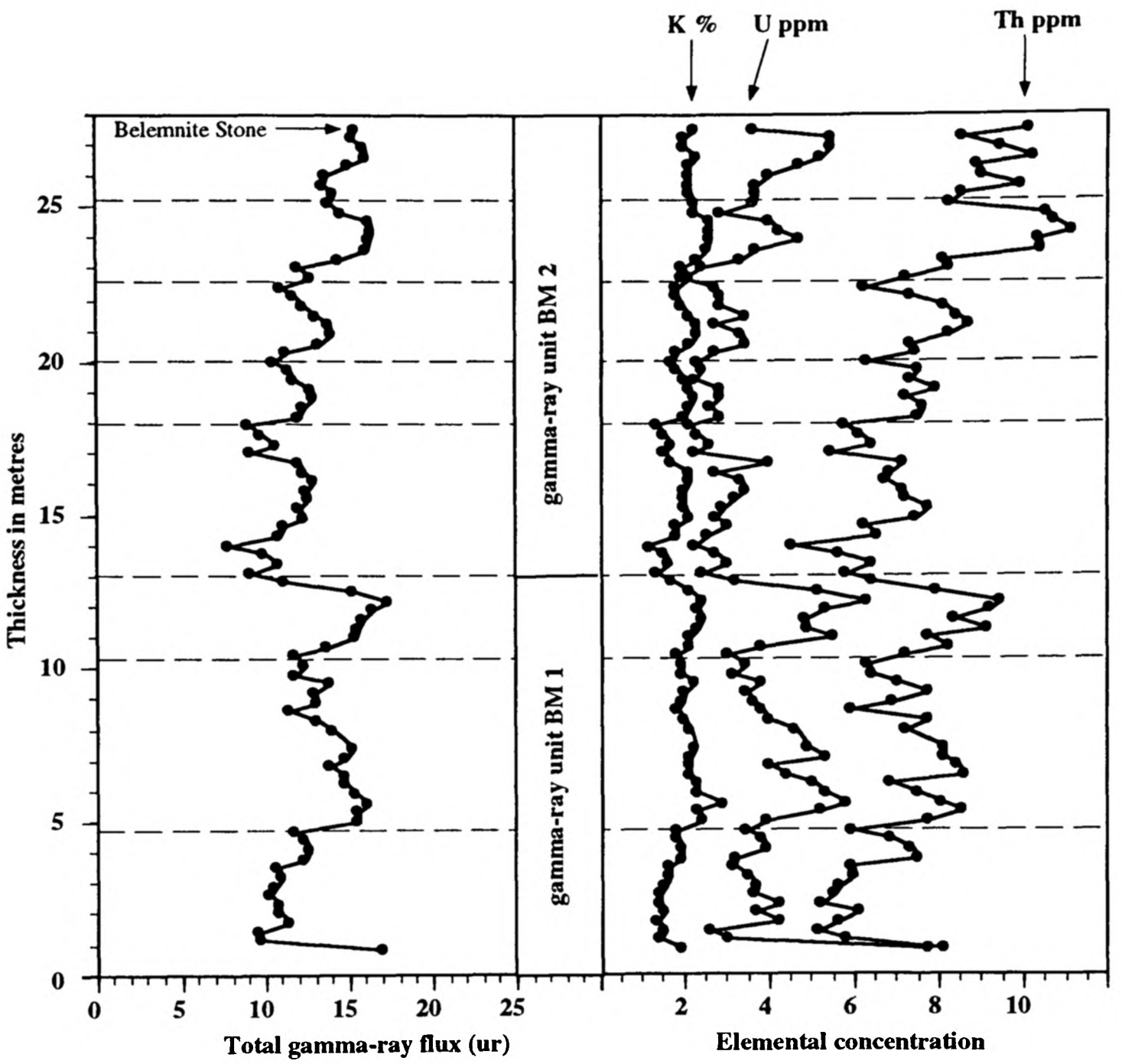
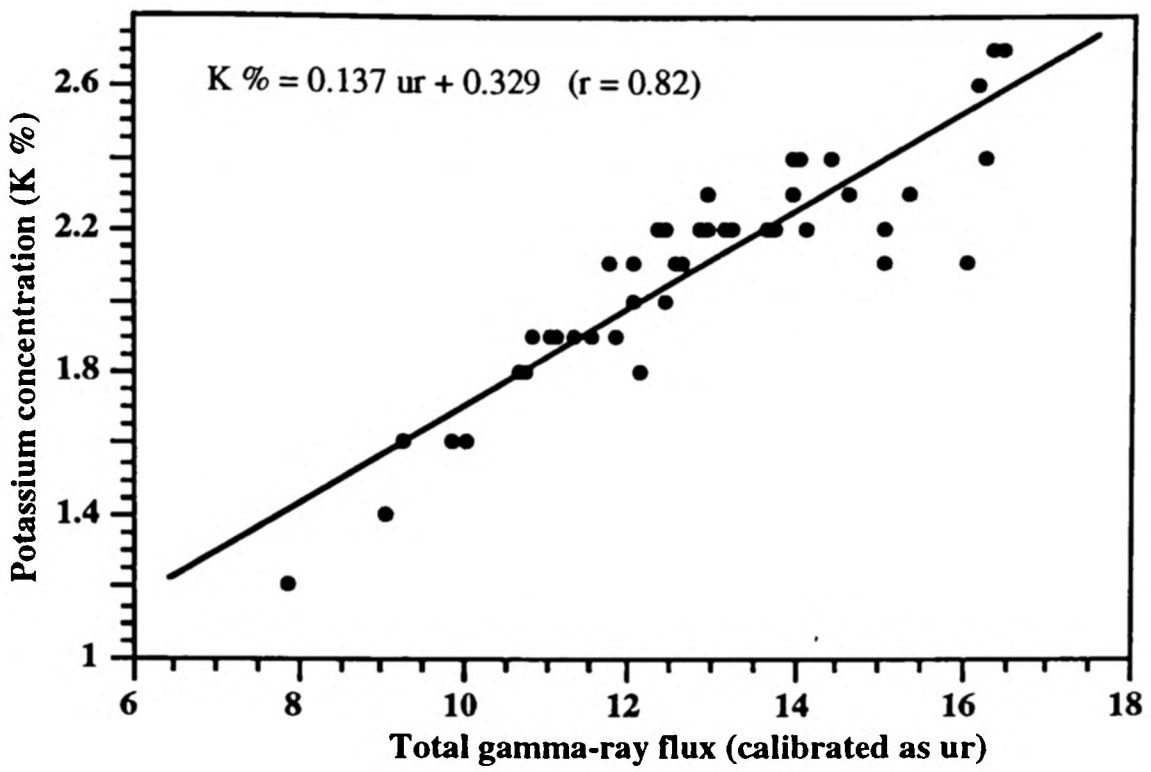
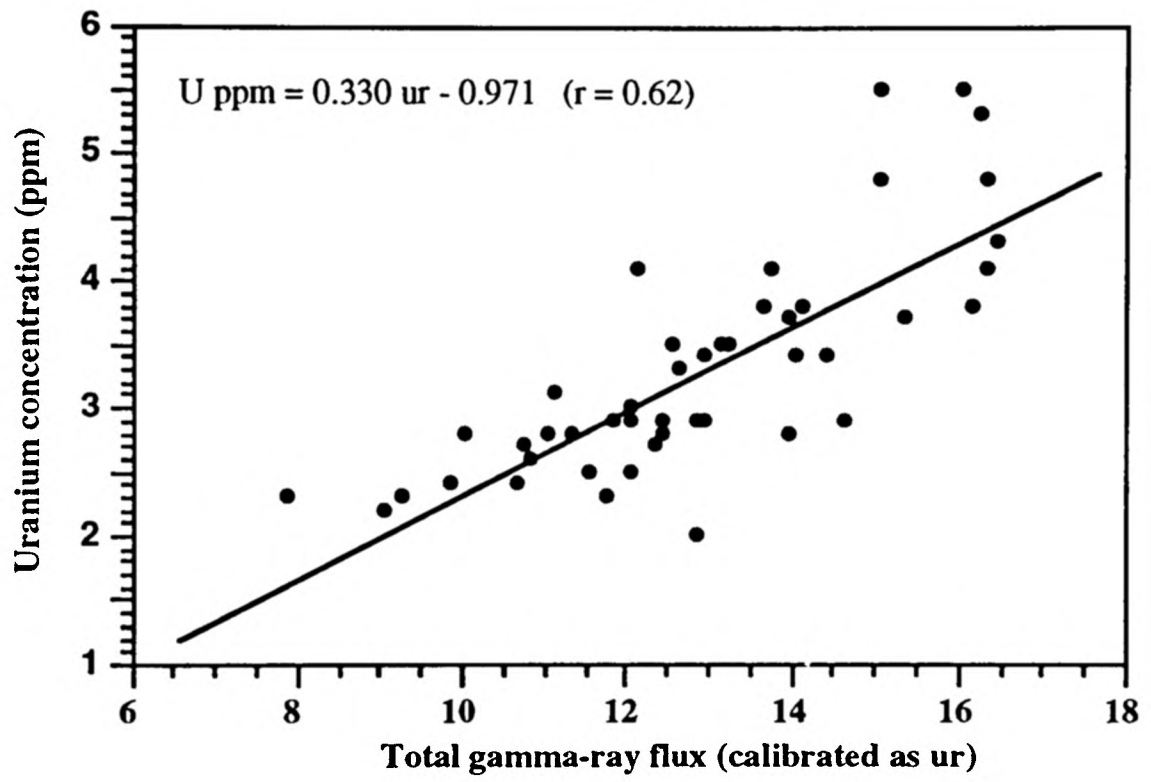


FIGURE 3.50 Discrete carbonate cycles evident in the gamma-ray signature for the Belemnite Marls. These cycles are strongly mirrored in the Th concentration log. Total gamma-ray signature lacks the high-frequency variation evident within the Black Ven Marls and Shales-with-'Beef'. The lack of high-frequency variation allows these cycles to be clearly identified.





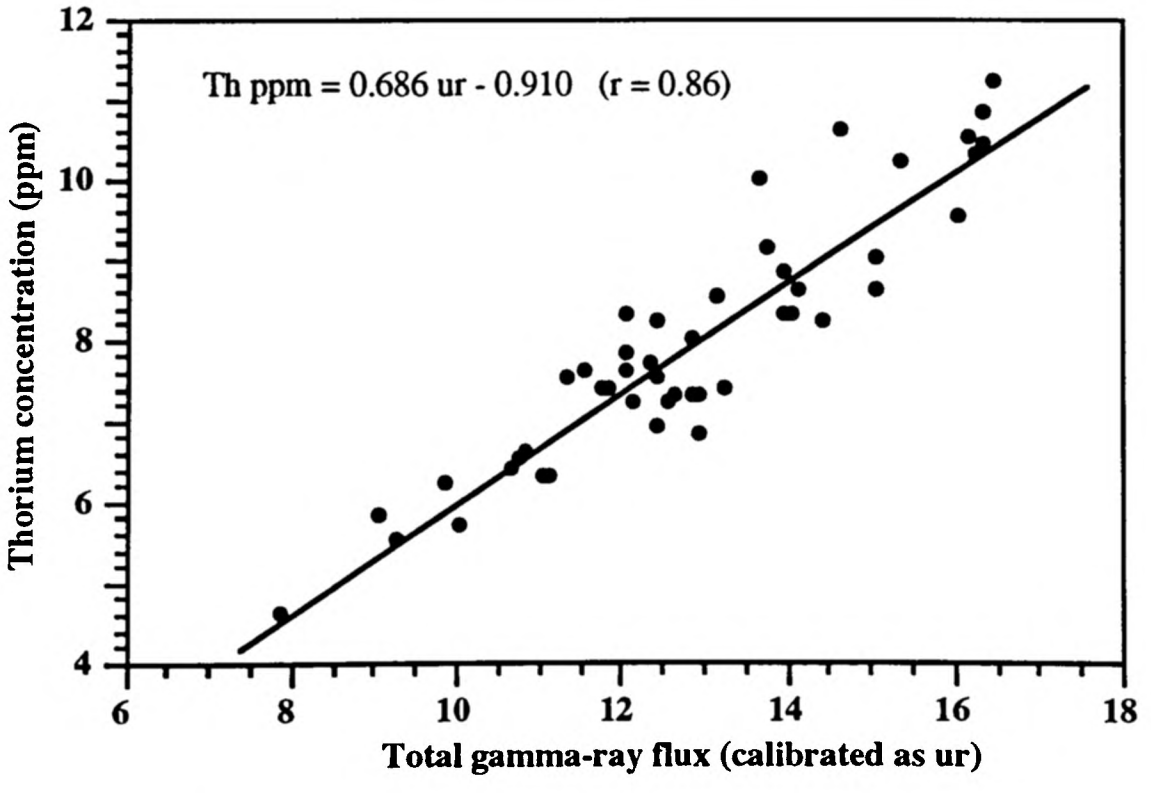


FIGURE 3.51 Positive linear regression between total gamma-ray flux and radio-elemental concentration within gamma-ray unit BM 2. Correlation coefficients are indicated.

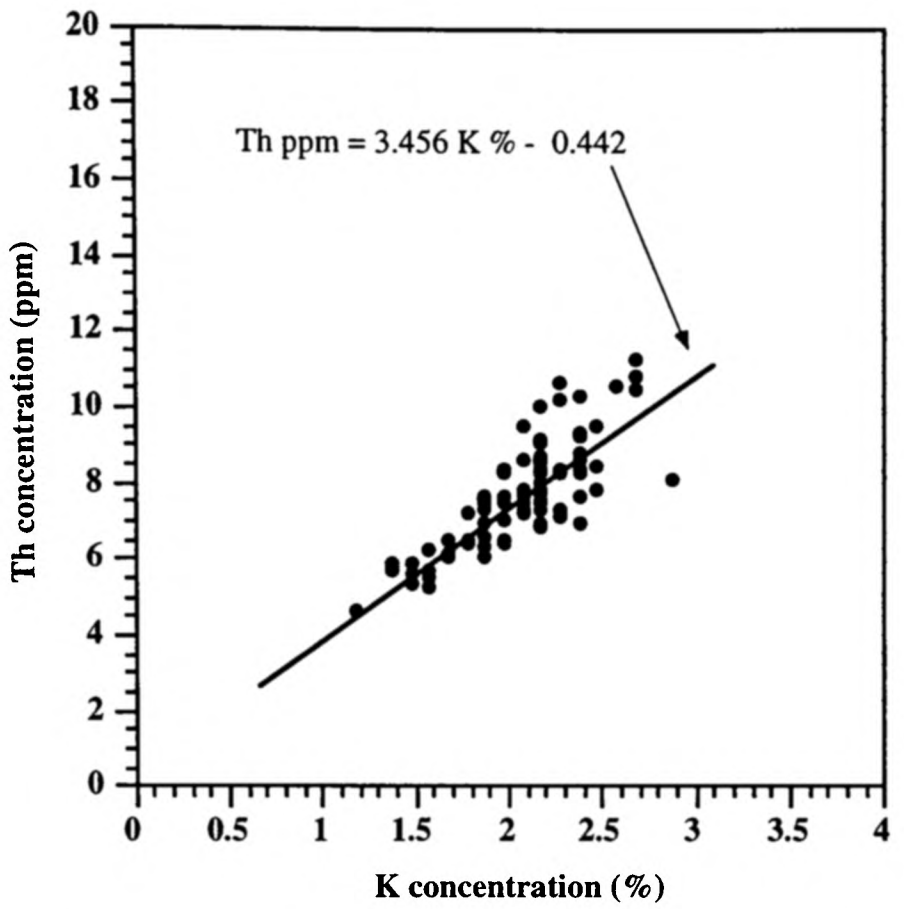


FIGURE 3.52A Positive linear regression between Th concentration and K concentration. A correlation coefficient of 0.66 suggests a statistically robust relationship at the 95 % significance level (n = 89). The relationship between the two elements is given with reference to the formula of the linear regression.

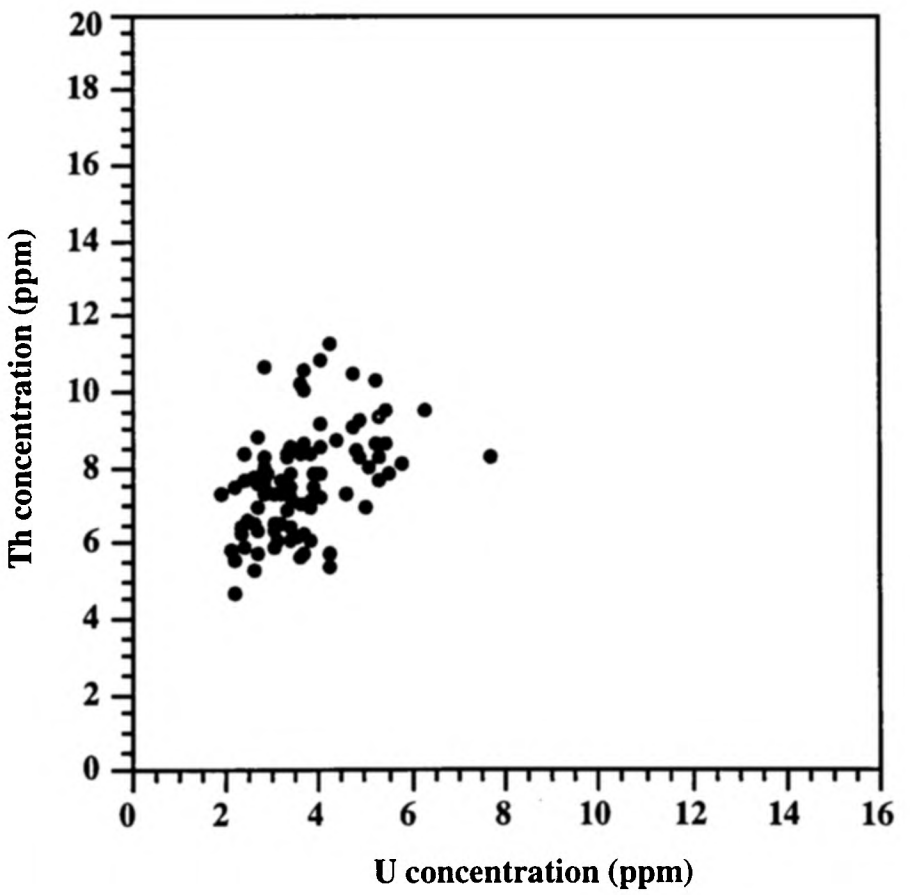


FIGURE 3.52B Positive linear regression between Th concentration and U concentration. A correlation coefficient of 0.19 indicates that no statistically robust relationship is shown between the two elements (n = 89).

FIGURE 3.53
<u>The *luridum* Subzone at Blockley Pit, Gloucestershire (SP 182369)</u>.

(ABOVE) Field aspect of Blockley Pit, currently owned and managed by Northcot Brick Co.

(LEFT) The lowermost 4.2 m thick fresh section exposed at the SE end of the pit. The section is argillaceous in character and shows no evidence for the development of light marl - dark marl couplets that are clearly displayed within the Belemnite Marls at Stonebarrow, Dorset (SY 380927). Lithologically, the section exposed at Blockley Pit shows more similarities to the Shales-with-'Beef' and Black Ven Marls, in Dorset, than the time-equivalent Belemnite Marls. The thickness of the *luridum* Subzone is expanded by a factor of 324 at Blockley Pit relative to the Belemnite Stone in Dorset.

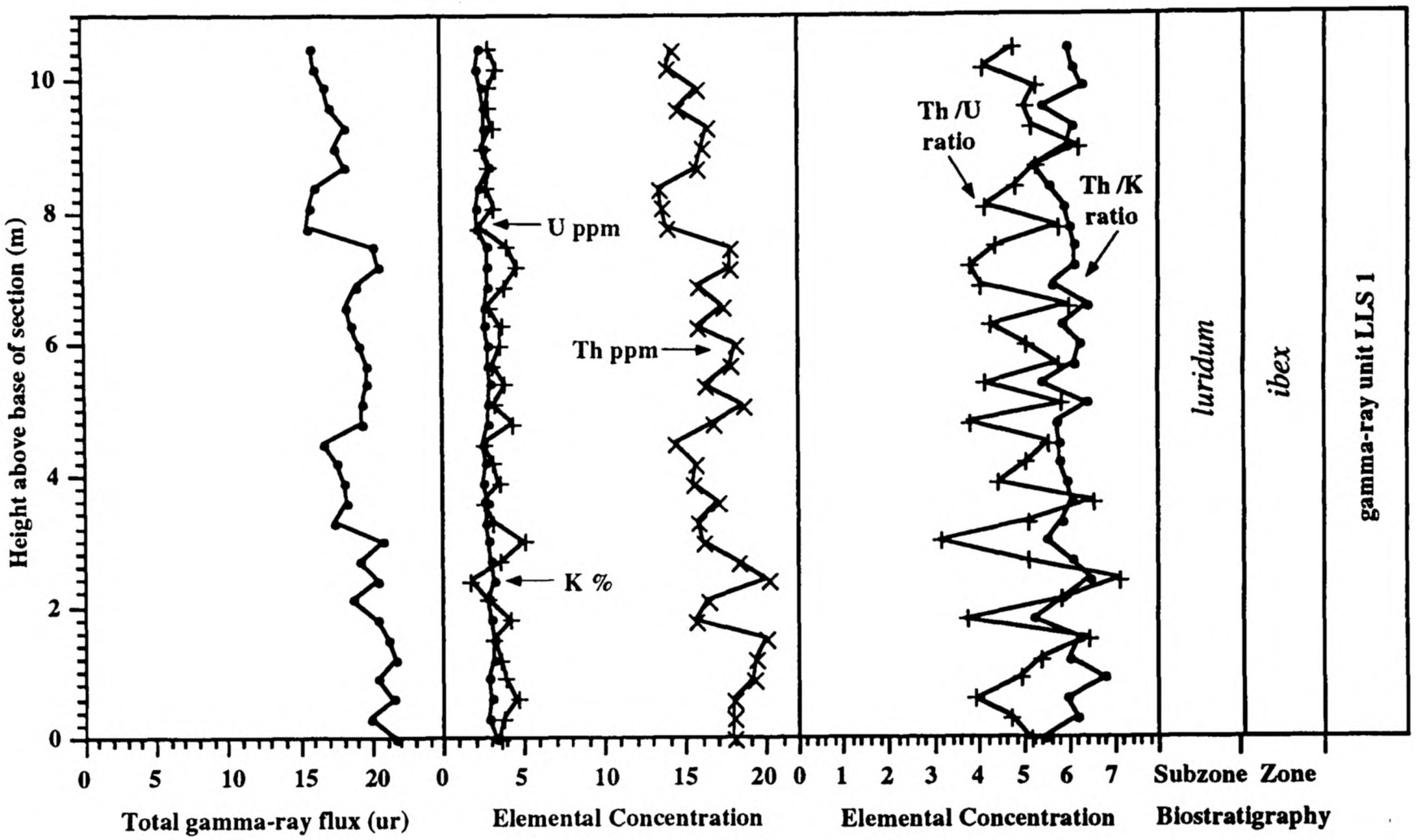


FIGURE 3.54 Total gamma-ray log, elemental concentration logs and elemental ratio curves for the series of sections exposed at Blockley Pit, Gloucestershire (SP 182369). The argillaceous expanded section is the lateral time equivalent of the Belemnite Stone found at the top of the Belemnite Marls at Seatown, Dorset (SY 415918). Biostratigraphic boundaries are indicated. The gamma-ray logs are based on 36 measured samples. (LLS = Lower Lias shale).

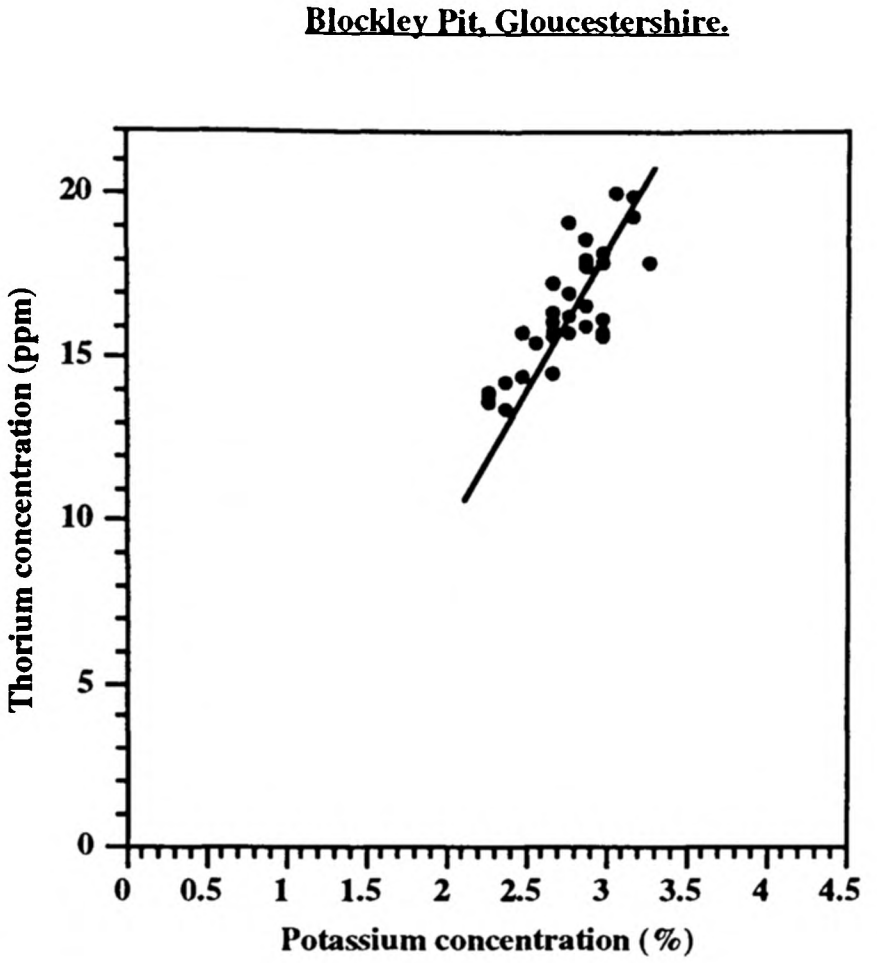


FIGURE 3.55A Linear regression correlation between Th concentration and K concentration. A correlation coefficient of 0.75 suggests a strong, statistically robust correlation at the 95 % significance level (n = 36). The relationship between the two elements can be described by the linear equation : Th ppm = 5.695 K %+ 0.649

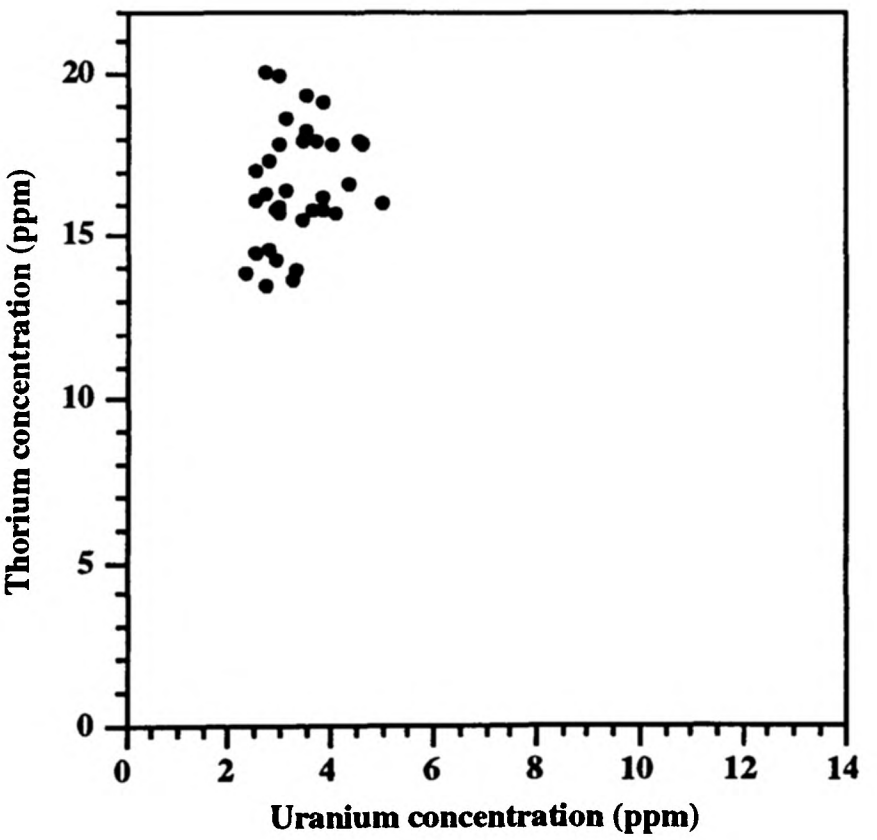


FIGURE 3.55B Linear regression correlation between Th concentration and U concentration. A correlation coefficient of 0.02 indicates that there is no linear covariant relationship between the two elements.

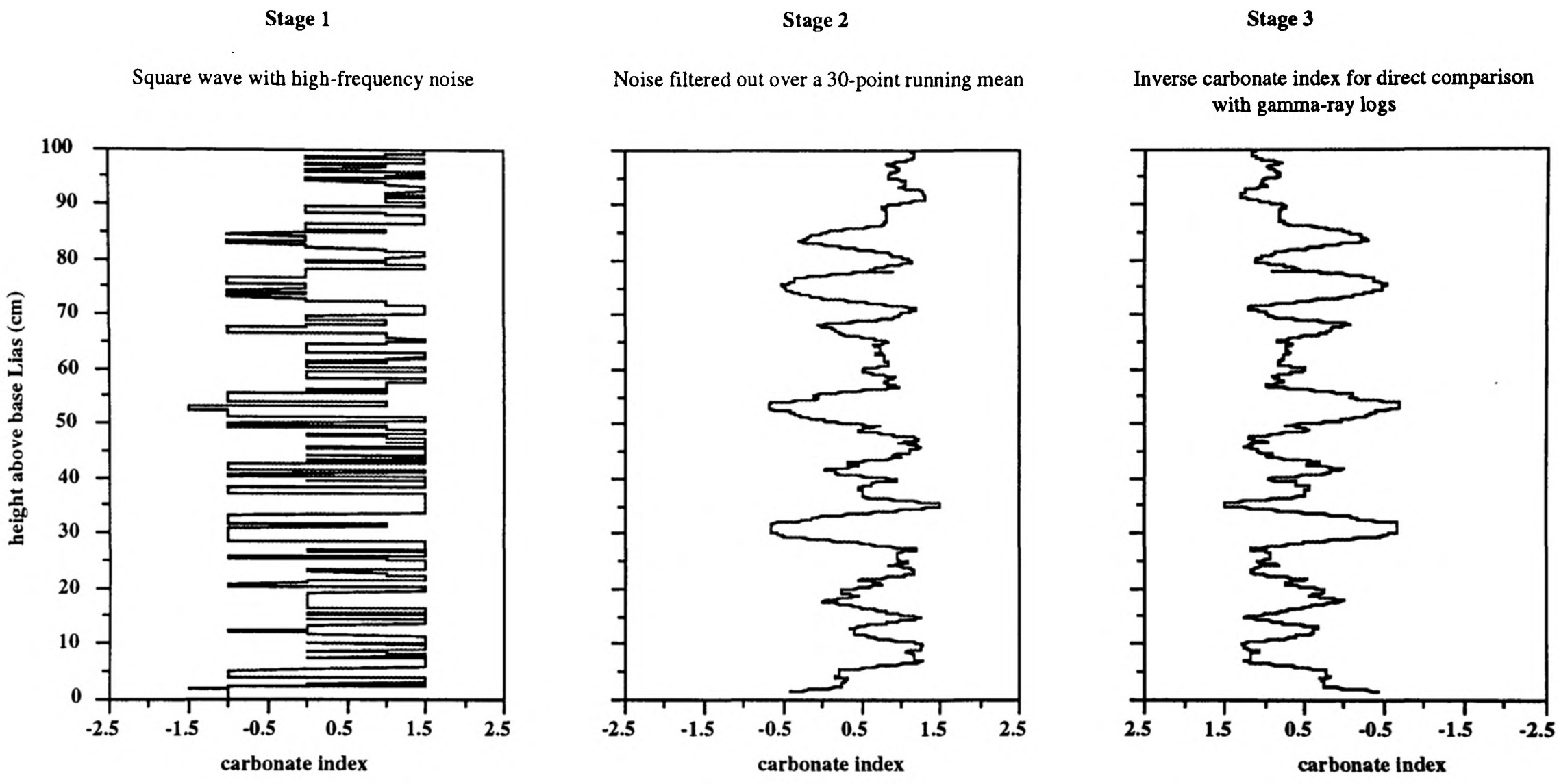


FIGURE 3.56 The production of a synthetic gamma-ray log using bed thickness data from measured stratigraphic sections.

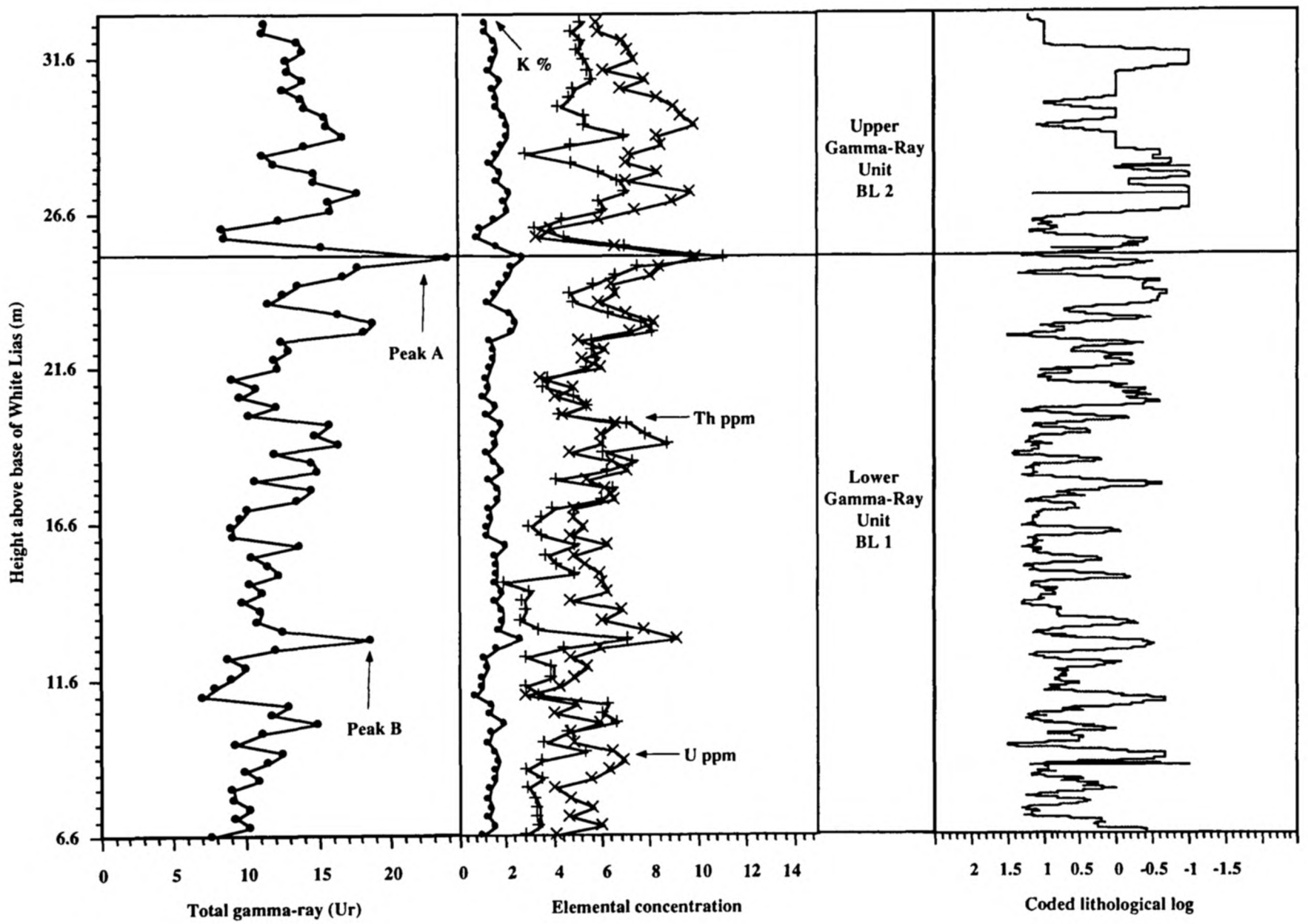


FIGURE 3.57 Comparison of the outcrop gamma-ray log with the coded-lithological log for the Blue Lias of the Dorset coast. Important information shown by the gamma-ray log cannot be obtained from the synthetic coded lithological log. For the coded lithological-log to be used as a proxy gamma-ray log, identical concentrations of K, U and Th have to be assumed for each horizon of the same lithology. The outcrop gamma-ray log clearly shows that this is an invalid assumption, with fluctuations in each of the radio-elemental logs (for an identical lithology) evident.

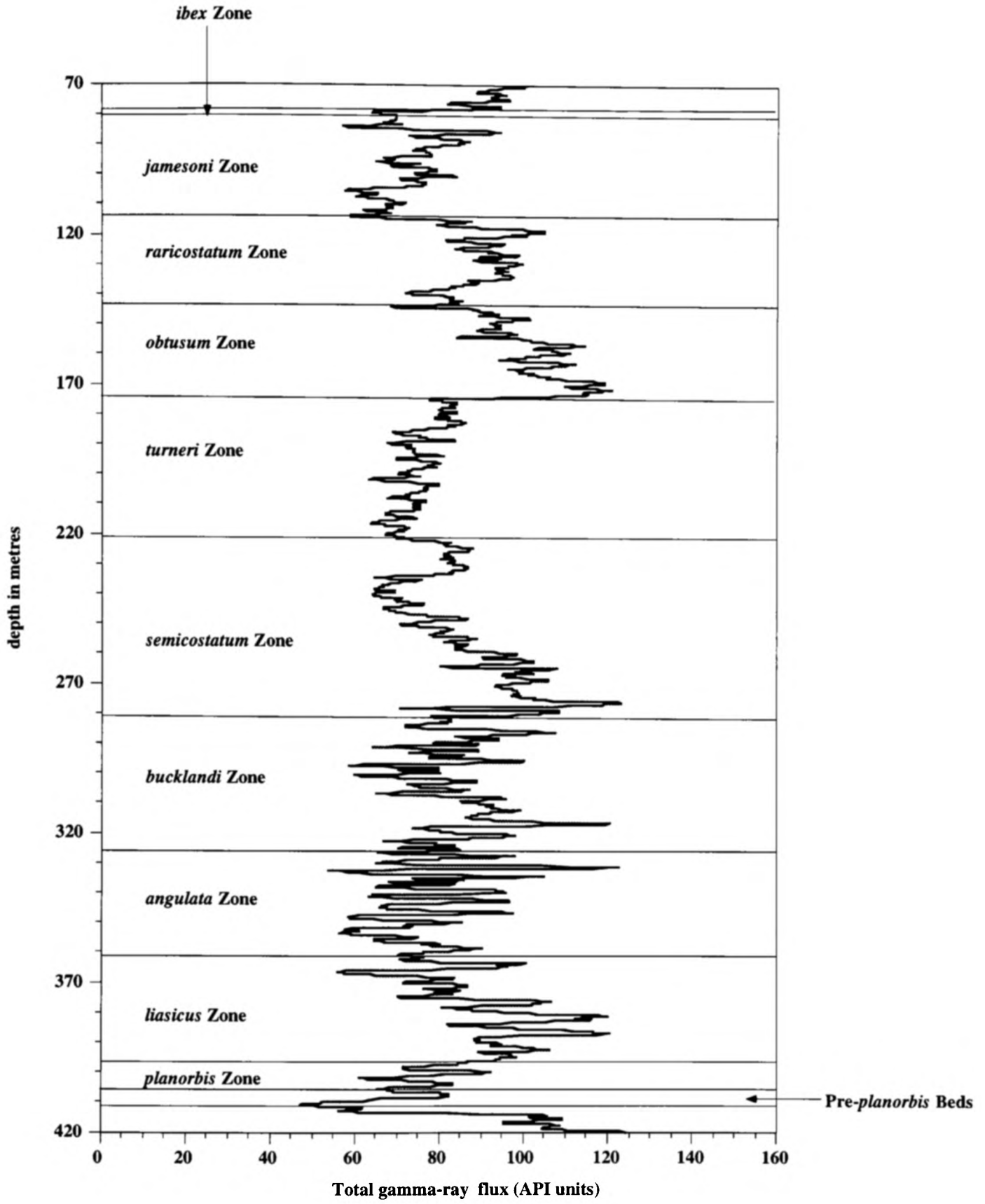


FIGURE 3.58 A Biostratigraphic divisions of the Burton Row borehole at the zonal level of resolution. The biostratigraphy in Burton Row is accurately known to the resolution of ammonite subzones between 404.68 m and 232.87 m, base *planorbis* Subzone to top *scipionianum* Subzone (Whittaker 1983). Thereafter, resolution is at the level of the ammonite zone (see Ivimey-Cook & Donovan 1983).

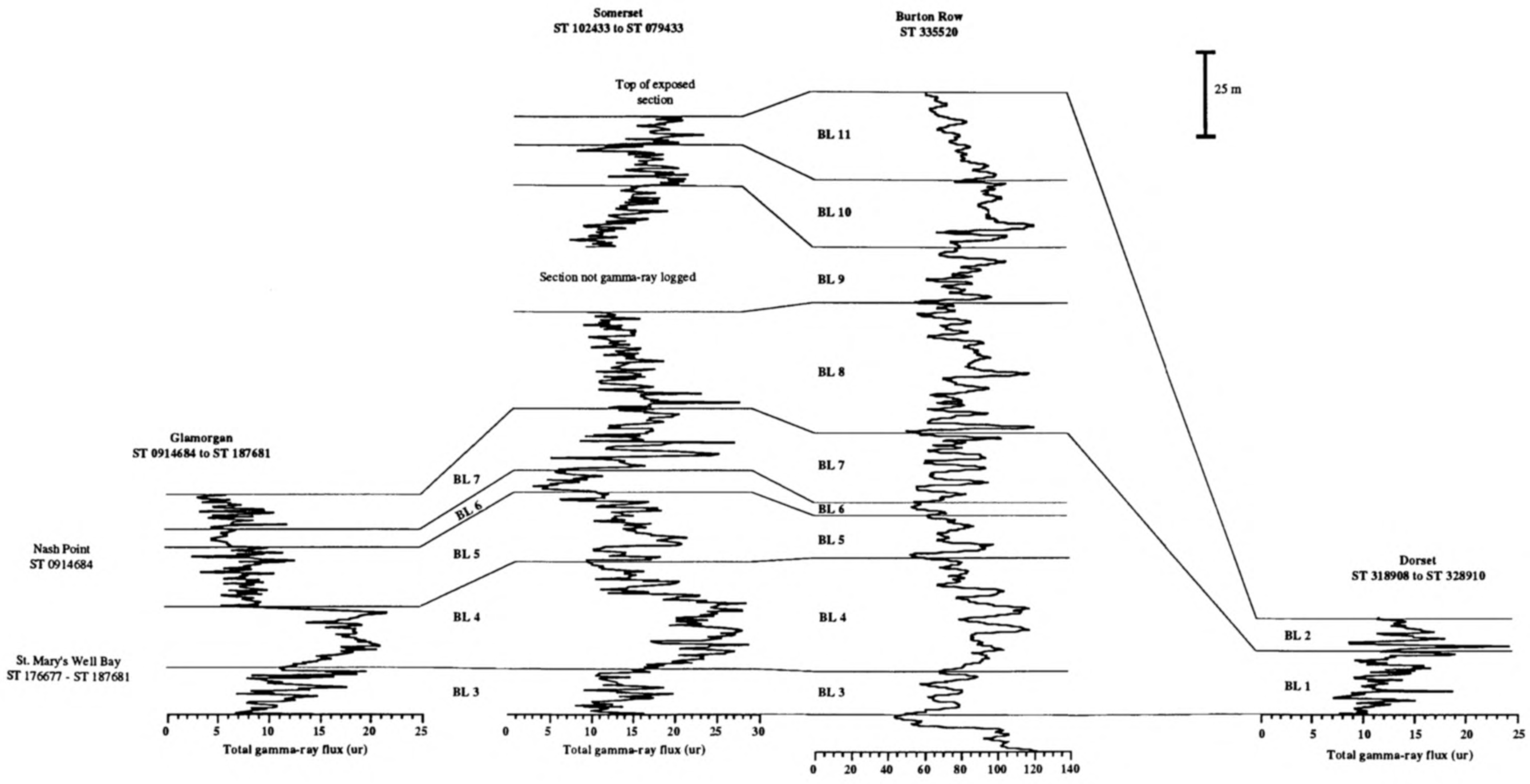


Figure 3.58 B

FIGURE 3.58 B Correlation of the Hettangian to Lower Sinemurian succession across southern Britain.

The outcrop total gamma-ray log for the Glamorgan coast was collected from St. Mary's Well Bay to Lavernock Point (ST 176677 to ST 187681) for the Pre-*planorbis* Beds to basal 12.3 m of the *liasicus* Zone and at Nash Point, ST 102433, for the *angulata* and *bucklandi* Zones. Total gamma-ray logs for the Somerset coast were collected from St. Audrie's Bay, ST 102433, for the Pre-*planorbis* Beds to *angulata* Zone, east of Kilve Pill, ST 144455 to ST 153452, for the *angulata* and *bucklandi* Zones, west of Kilve Pill, ST139457 to ST 144455, for the *bucklandi* Zone and lowermost 5.4 m of the *semicostatum* Zone and from the west end of Doniford Bay, ST 079433 to 082430, for the remainder of the *semicostatum* Zone. The section measured from Hinkley Point, ST 210465, was found to be artificially contaminated with radionuclides. The total gamma-ray log for the Dorset coast was collected from sections exposed between Pinhay Bay (SY318908) and Seven Rock Point, Lyme Regis (SY 328910).

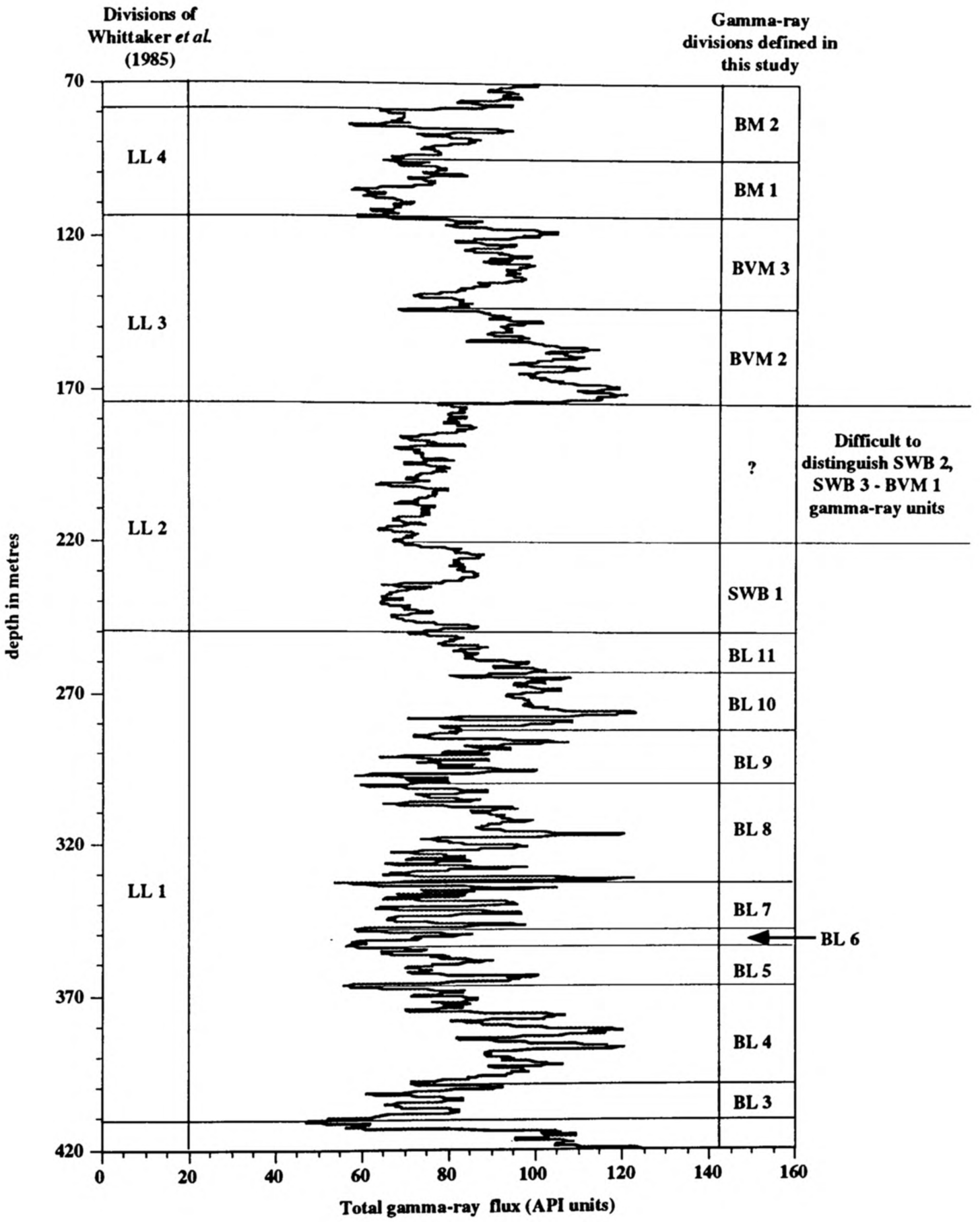


FIGURE 3.59 Divisions of the Burton Row borehole. The gamma-ray units originally identified by Whittaker *et al.* (1985) from this borehole are shown. Comparison with the gamma-ray units defined in this study are shown. Gamma-ray units BL 3 to BL 11, defined from coastal exposure in the Bristol Channel Basin, can be identified in Burton Row. Gamma-ray units BVM 2 to BM 2, defined from the exposure along the Dorset coast in the Wessex Basin, can also be identified in the Burton Row borehole. It is difficult to distinguish gamma-ray units SWB 2 and SWB 3-BVM 1 in Burton Row between the depths 199.8 m and 154.63 m. It is probable that the Black Ven Marls are thicker than Whittaker's (1985) division would suggest.

Biostratigraphy in Burton Row is accurately known to the resolution of ammonite subzones between 404.68 m and 232.87 m (base *planorbis* Subzone to top *sciponianum* Subzone). Thereafter, resolution is at the level of the ammonite zone (see Ivimey-Cook & Donovan 1983). Within Burton Row, the gamma-ray unit BVM 2 additionally includes the *oxynotum* Zone that is represented by the Coinstone disconformity in Dorset. The *oxynotum* Zone is represented between the depths 137.50 m and 154.63 m (Whittaker 1983).

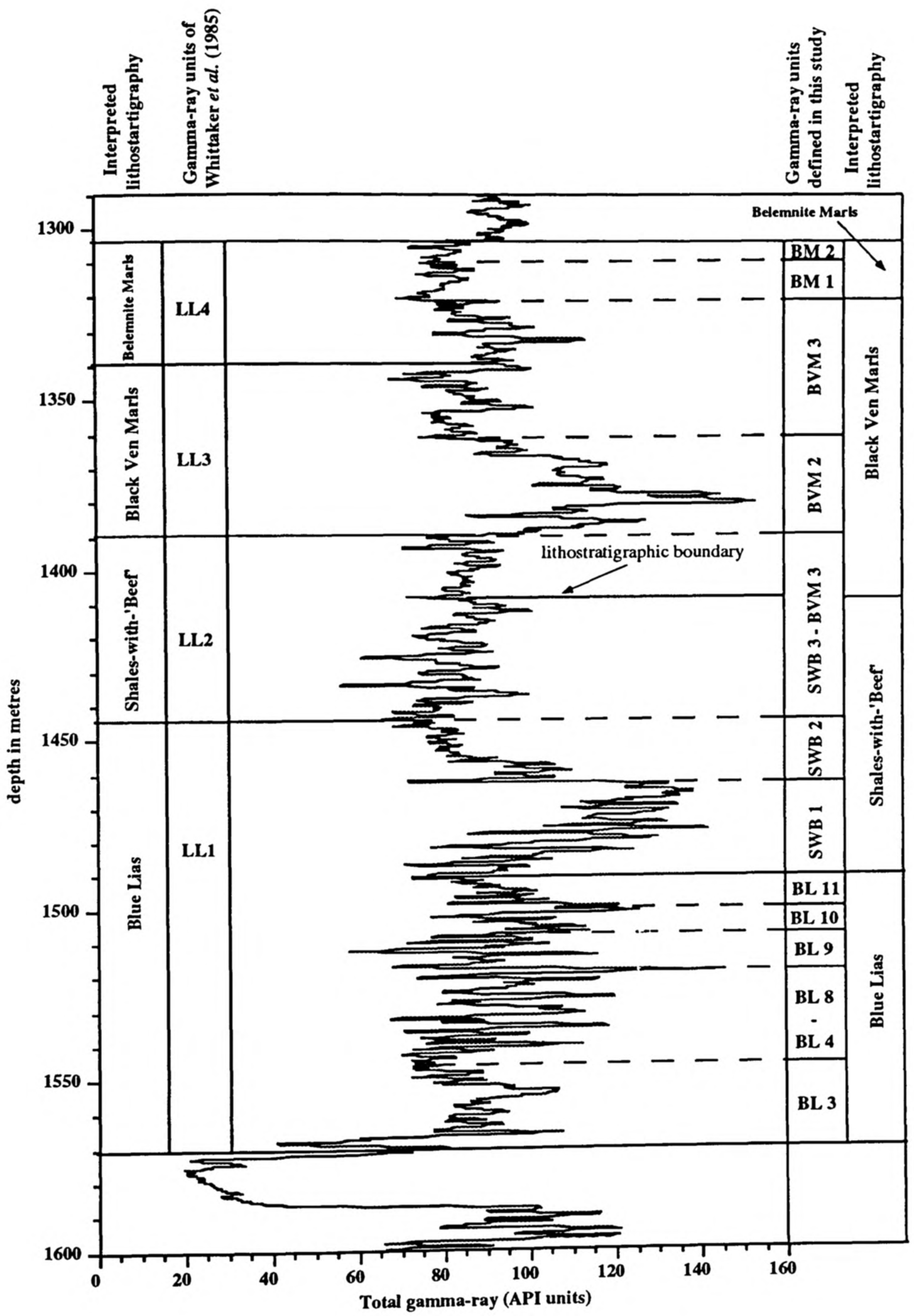


FIGURE 3.60 Division of the uncored Winterborne Kingston borehole into total gamma-ray units. A comparison of the divisions made by Whittaker *et al.* (1985) and those based on this study is shown. There are considerable differences in the identification of formation boundaries and the thickness of the recognised formations. All the gamma-ray units defined from the Dorset outcrop gamma-ray log can be identified in the Winterborne Kingston borehole.

Chapter 4
Figure 4.01 to Figure 4.22

Interpretation of the Gamma-Ray Characteristics shown by the Lower Lias in Southern Britain

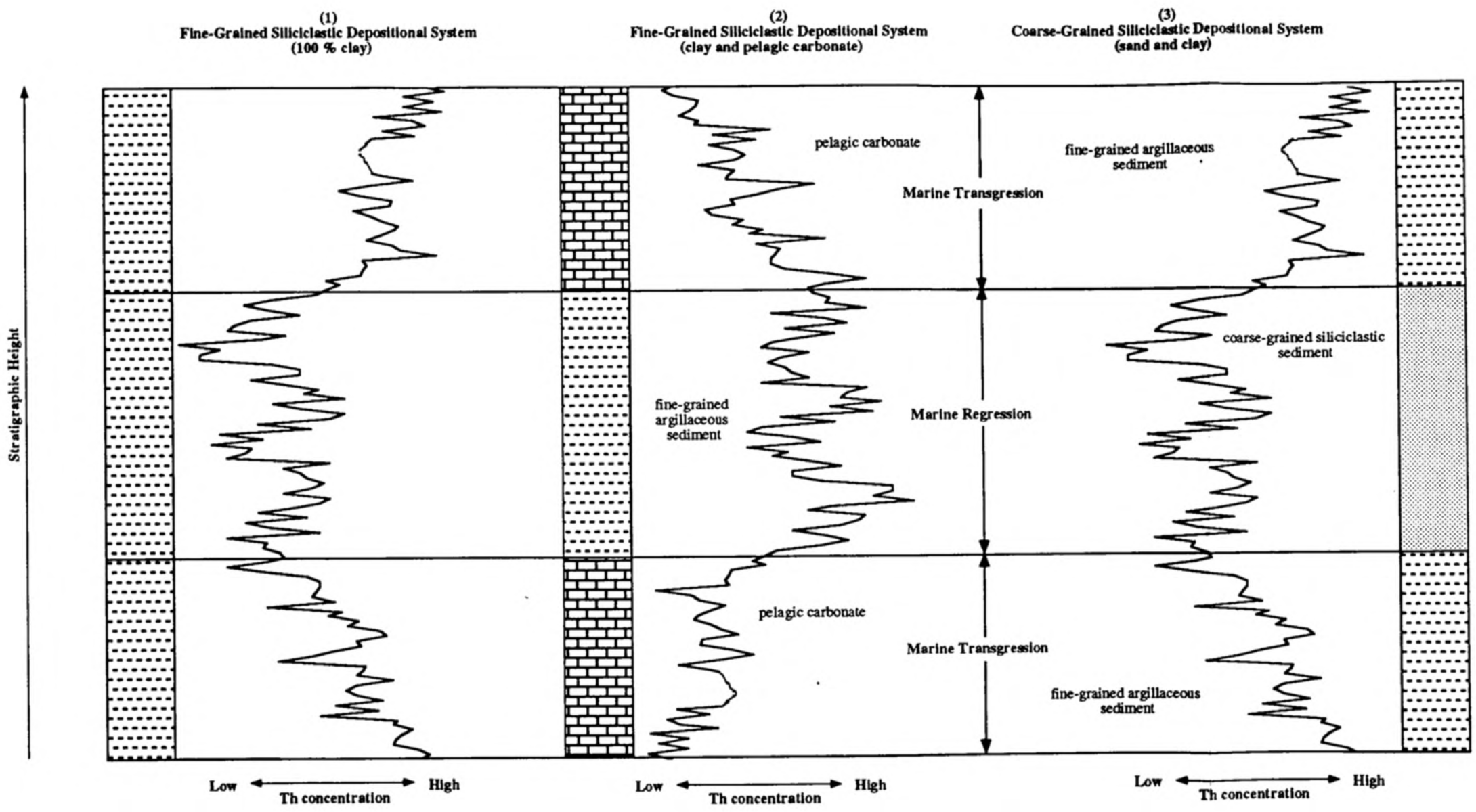
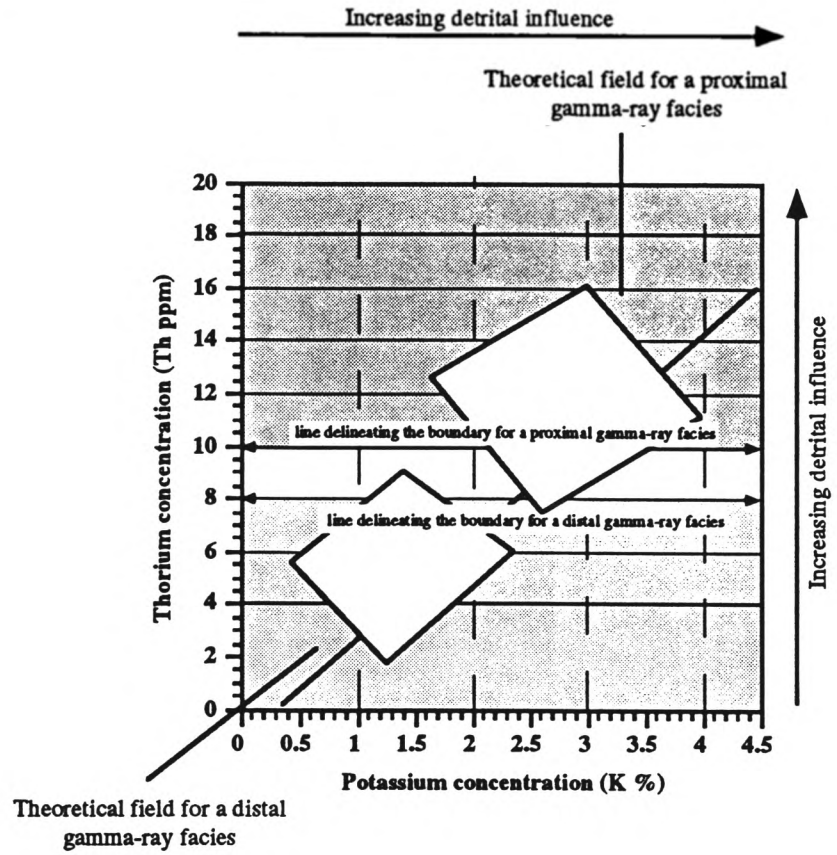


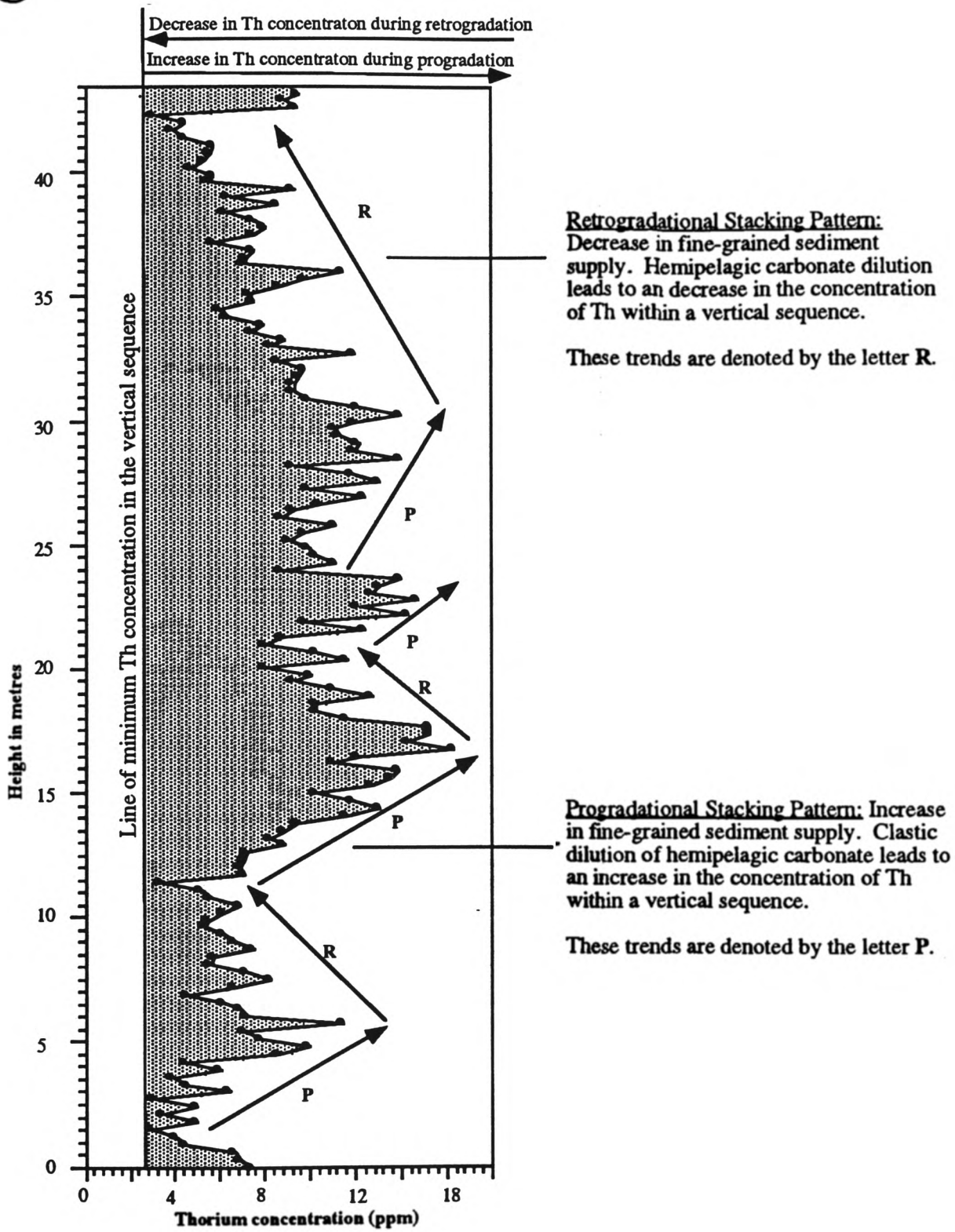
Figure 4.01 A

FIGURE 4.01 A Typical signatures that would be expected to be shown by the Th gamma-ray log for (1) a fine-grained depositional system of 100 % clay, (2) a fine-grained depositional system characterised by clay and pelagic carbonate and, (3) a coarse-grained depositional system. The Th concentration log for the 100 % clay depositional system is theoretical, whereby Th concentration increases with decreasing particle size due to the higher surface area-to-volume ratio shown by smaller grains. Th is adsorped on to the surfaces of these grains. In the mixed pelagic carbonate and clay depositional system (2), during conditions of marine regression, the deposition of clay correlate with the deposition of sand in the coarse-grained depositional system. A high Th concentration in the former therefore equates with a low Th concentration in the latter(3). During marine transgression pelagic carbonate may be the dominant component of marine sediment in the fine-grained clay-pelagic carbonate depositional system giving rise to a low Th concentration. In contrast during periods of transgression, argillaceous material may be the dominant component of marine sediment which gives rise to high Th concentrations on the gamma-ray log for the coarse-grained depositional system.

B



C



Retrogradational Stacking Pattern: Decrease in fine-grained sediment supply. Hemipelagic carbonate dilution leads to an decrease in the concentration of Th within a vertical sequence.

These trends are denoted by the letter **R**.

Progradational Stacking Pattern: Increase in fine-grained sediment supply. Clastic dilution of hemipelagic carbonate leads to an increase in the concentration of Th within a vertical sequence.

These trends are denoted by the letter **P**.

FIGURE 4.01 Facies Analysis Using the Th Gamma-Ray Log

ABOVE (A) For all sets of measurements that have been collected in this study there is a strong linear positive correlation between soluble K and insoluble Th. The delineation between a proximal and a distal facies is taken at a Th concentration of 8 ppm to 10 ppm which commonly coincides with a K concentration of 2.25, although the actual K concentration will be determined by fluctuations within the detrital clay mineralogy. Distal mudrock facies, defined by low detrital elemental concentrations, (Th < 8ppm) will fall in the lower left hand corner of the regression plot and a proximal mudrock facies (Th > 10 ppm) will fall in the upper right hand corner of the regression plot. Allowance has to be made for the degree of scatter away from the regression line, which is probably an indication of diagenetic alteration (*i.e.* degree of K mobility).

RIGHT (B) The Th concentration log, collected from a marine mudrock sequence can also be used to determine intervals of mudrock progradation (denoted P on the curve) and intervals of mudrock retrogradation (denoted R on the curve). Increases in Th concentration, over a sufficient vertical interval, indicate the progressive clastic dilution of hemipelagic carbonate as fine-grained clastics prograde basinward. Conversely, decreases in Th concentration would therefore represent periods of retrogradation wherein deposition would become increasingly dominated by hemipelagic carbonate as fined-grained clastic deposition is confined to the basin margin.

This argument assumes that pelagic carbonate productivity does not increase during periods of regression but productivity may increase during periods of transgression or highstand. This is in accordance with Berger (1976) for coccolith distribution in the Recent and Schlager (1990).

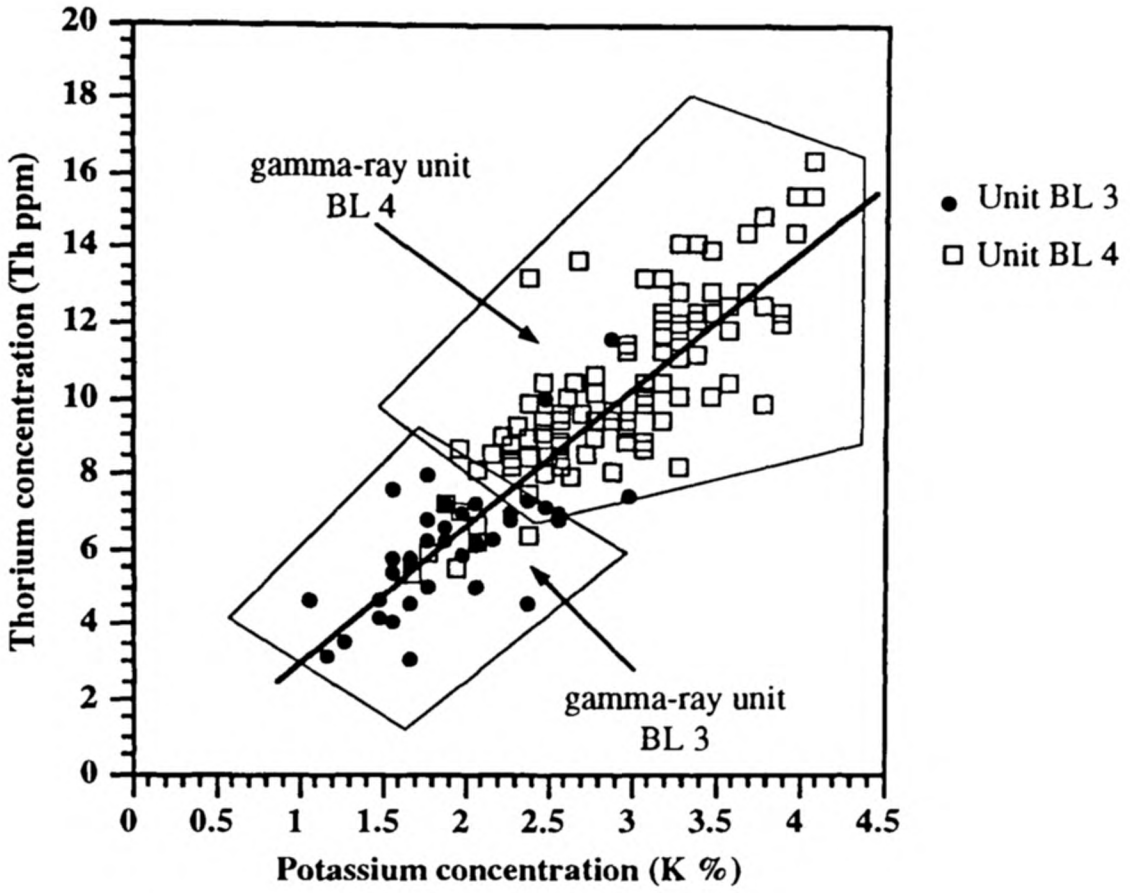


FIGURE 4.02 Th-K fields shown by each gamma-ray unit for the Pre-*planorbis* Beds to *bucklandi* Zone in Somerset. Units BL 3 and BL 6 have Th-K concentrations that are characteristic of a distal gamma-ray facies in contrast to unit BL 4 that has Th-K concentrations that are characteristic of a proxmal gamma-ray facies. The other units that are show have detrital element concentrations that are typical of both gamma-ray facies.

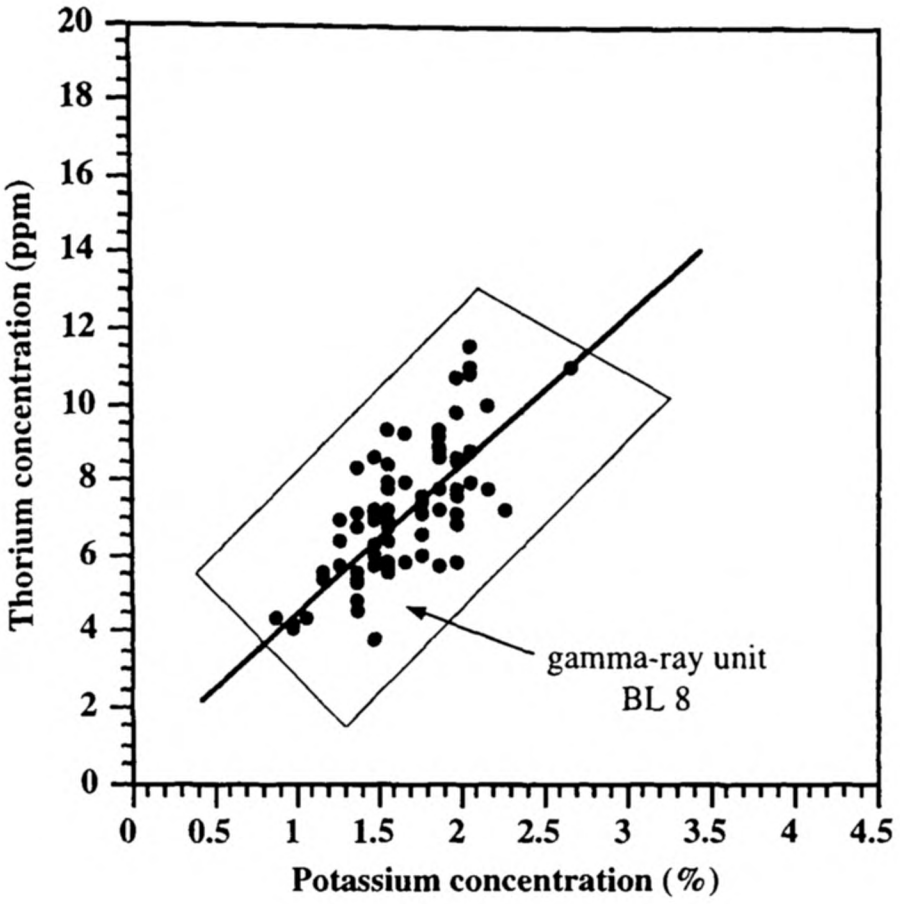


FIGURE 4.03 **Th-K fields shown by each gamma-ray unit for the upper *bucklandi* Zone and lower *semicostatum* Zone in Somerset. Units BL 10 and BL 11 have Th-K concentrations that are characteristic of a proximal gamma-ray facies. The other units that are shown have detrital element concentrations that are typical of both gamma-ray facies.**

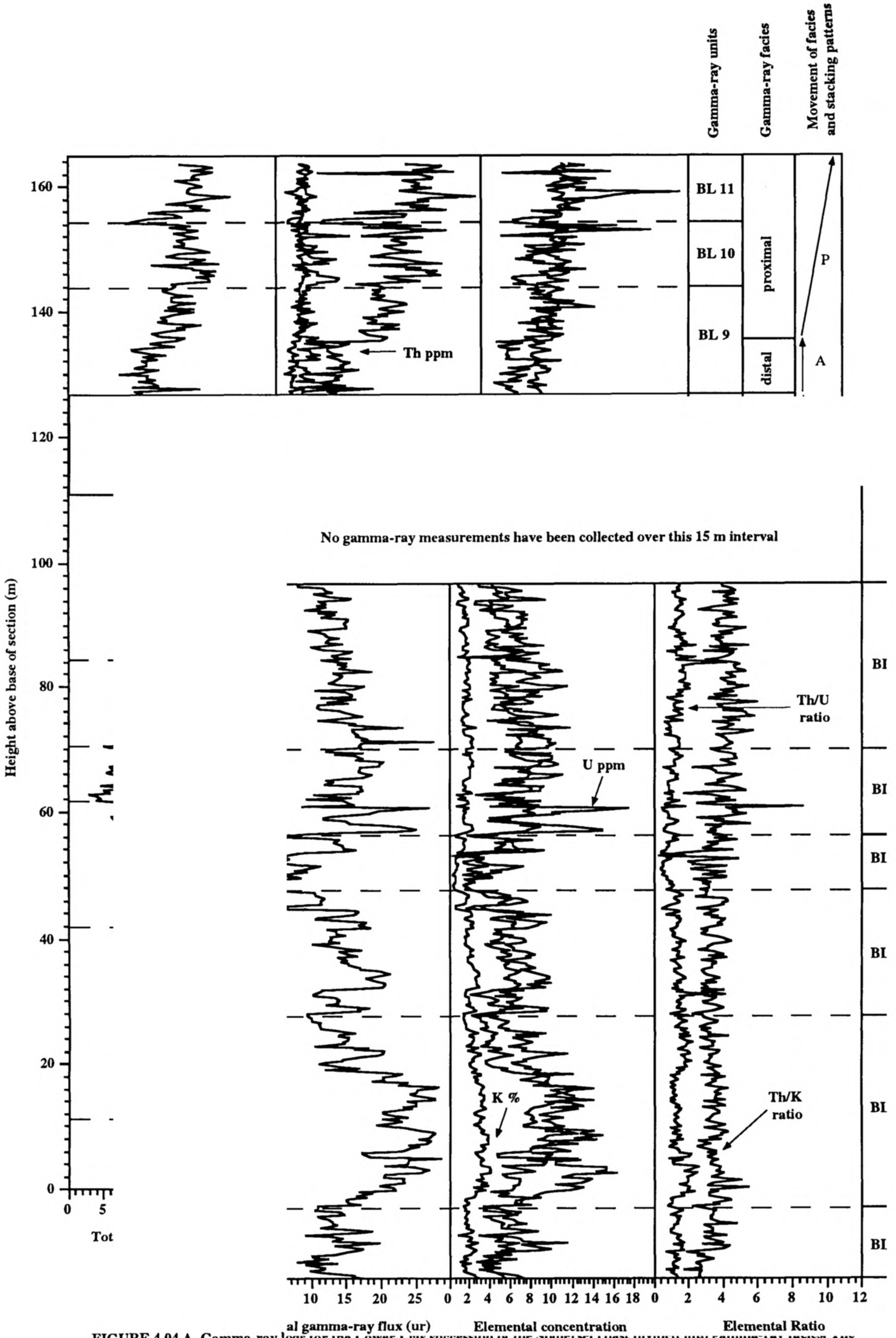


FIGURE 4.04 A Gamma-ray logs for the Lower Lias succession of the Somerset coast divided into gamma-ray facies. The direction of detrital influence and migration of facies, as inferred from the Th concentration log, is shown for each gamma-ray unit. Stacking patterns within each gamma-ray unit are also indicated (P = progradation, A = aggradation and R = retrogradation).

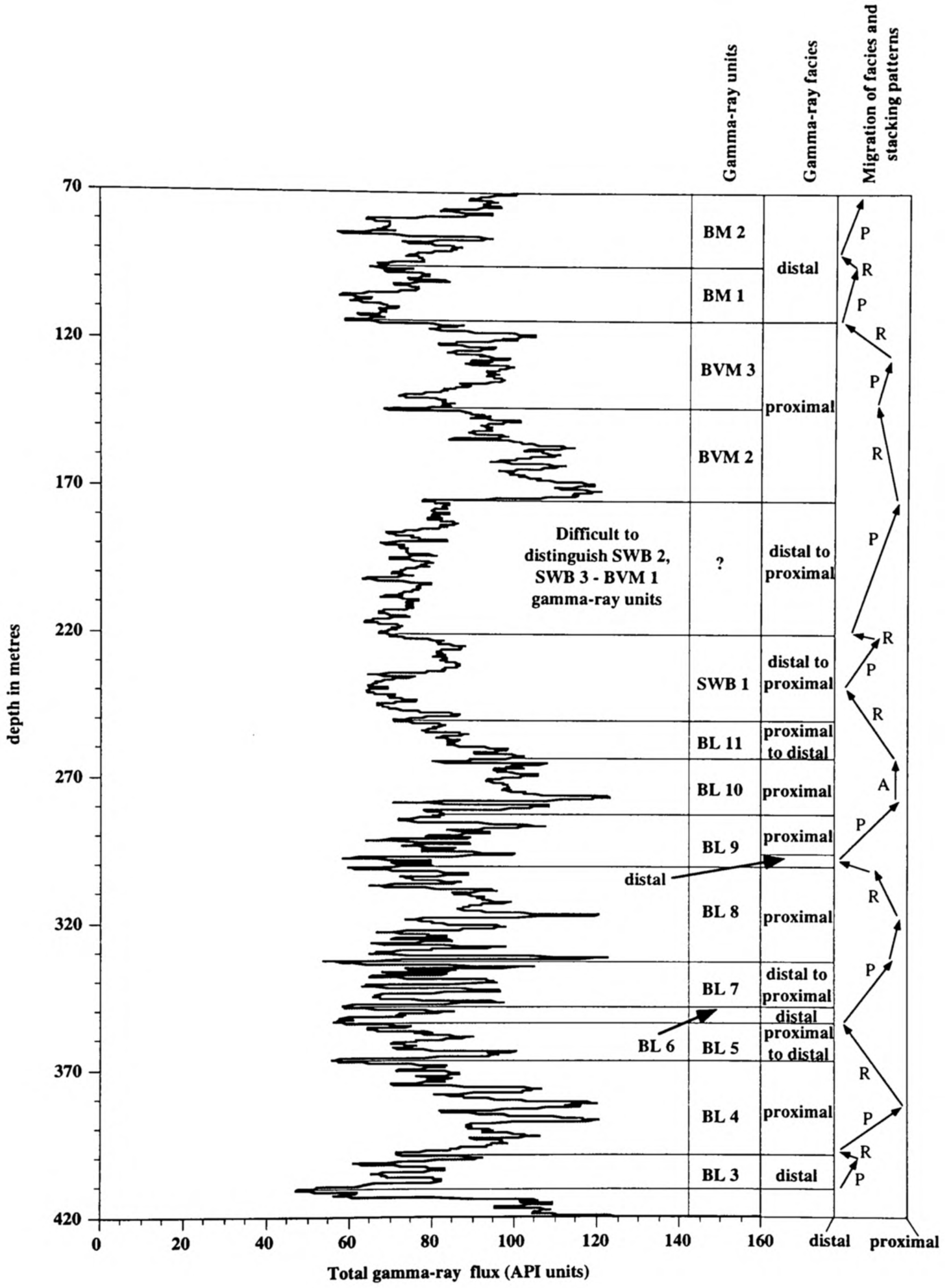


FIGURE 4.04 B The total gamma-ray log of the Burton Row borehole divided into gamma-ray facies based on the spectral gamma-ray data collected from the Dorset and Somerset coasts. The direction of detrital influence and migration of facies is shown for each gamma-ray unit. Stacking patterns within each gamma-ray unit are also indicated (P = progradation, A = aggradation and R = retrogradation).

This interpretation assumes that the total gamma-ray log for Burton Row reflects Th content. This assumption is only valid by comparison with the outcrop spectral gamma-ray log data and cannot be made on the basis of total gamma-ray flux alone.

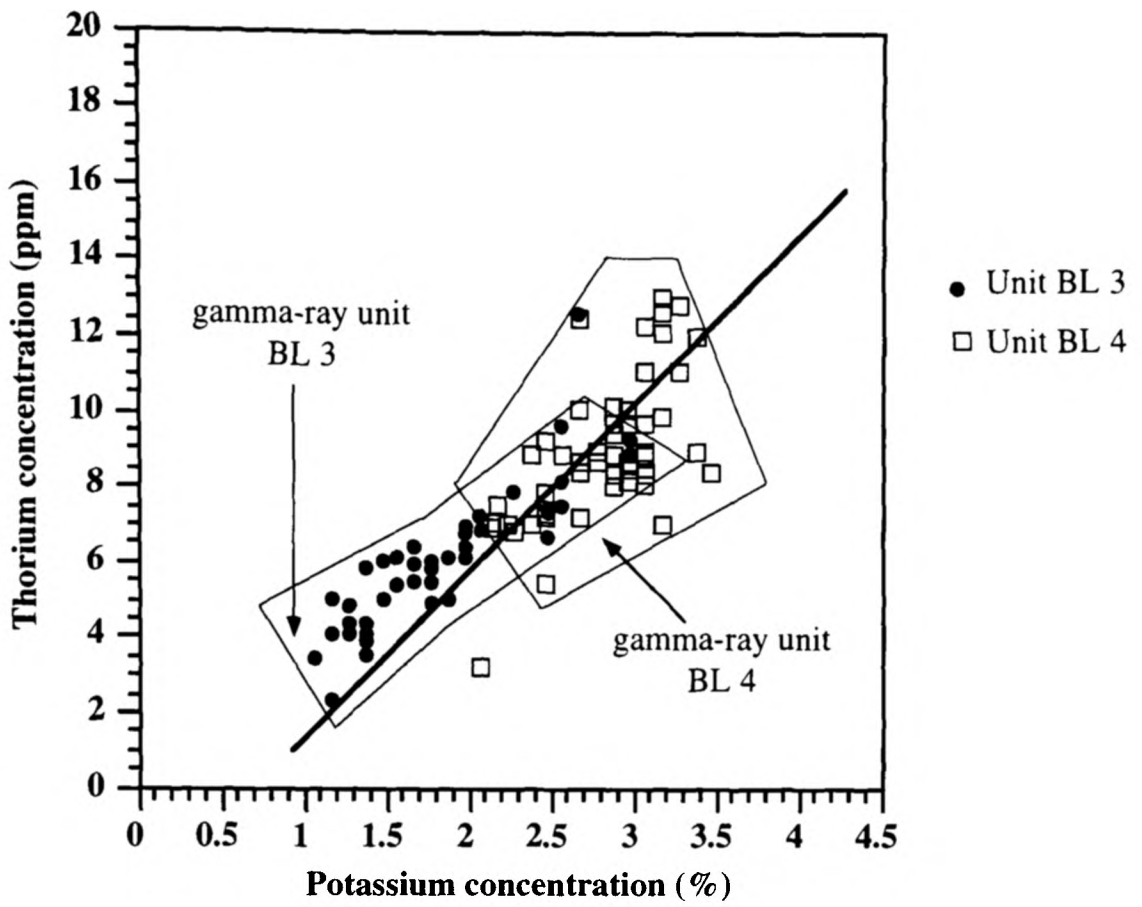


FIGURE 4.05 Th-K fields shown by each gamma-ray unit for the Pre-*planorbis* Beds to *bucklandi* Zone in Glamorgan. Units BL 3, BL 5, BL 6 and BL 7 have Th-K concentrations that are characteristic of a distal gamma-ray facies in contrast to unit BL 4 that has Th-K concentrations that are characteristic of a proxmal gamma-ray facies.

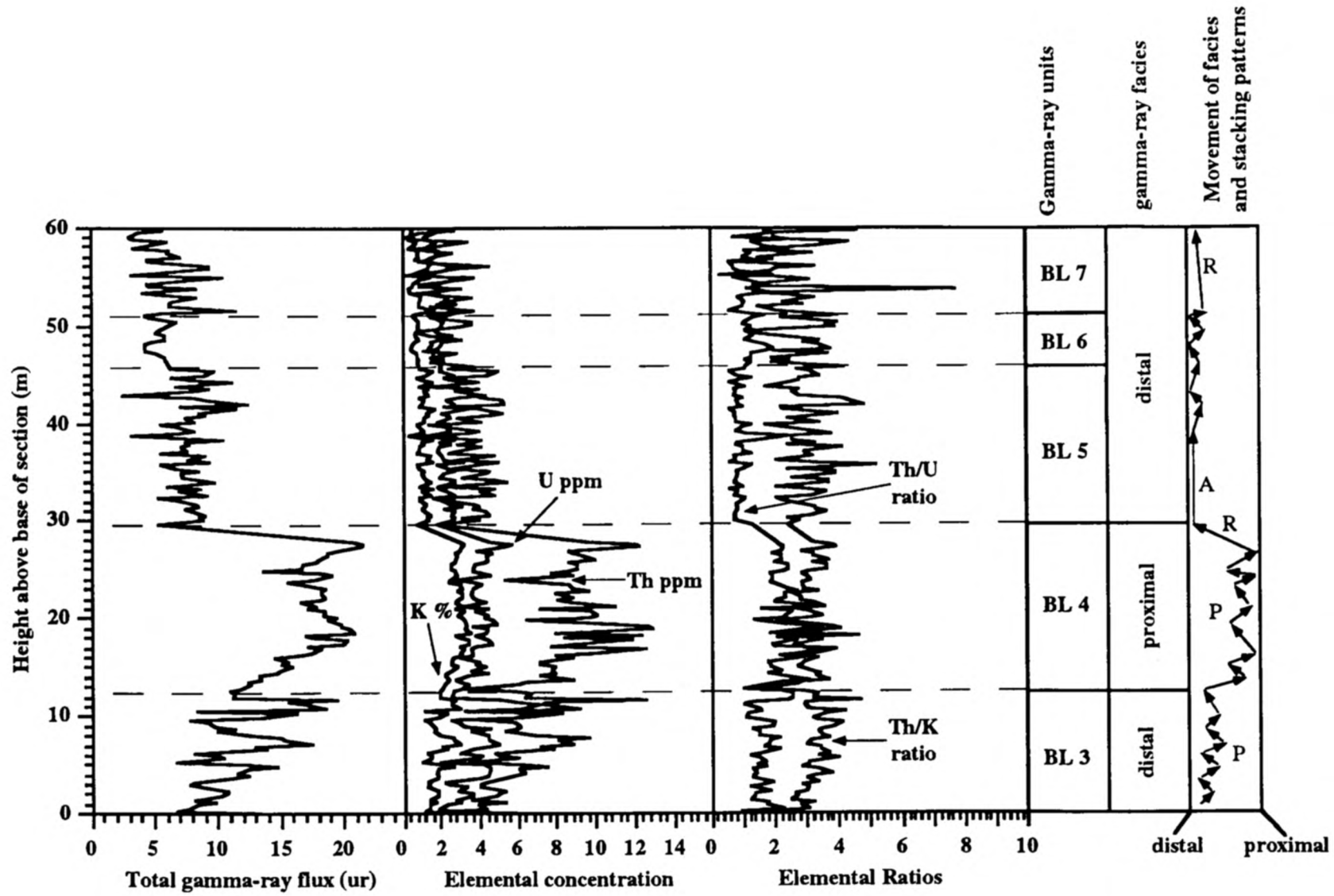
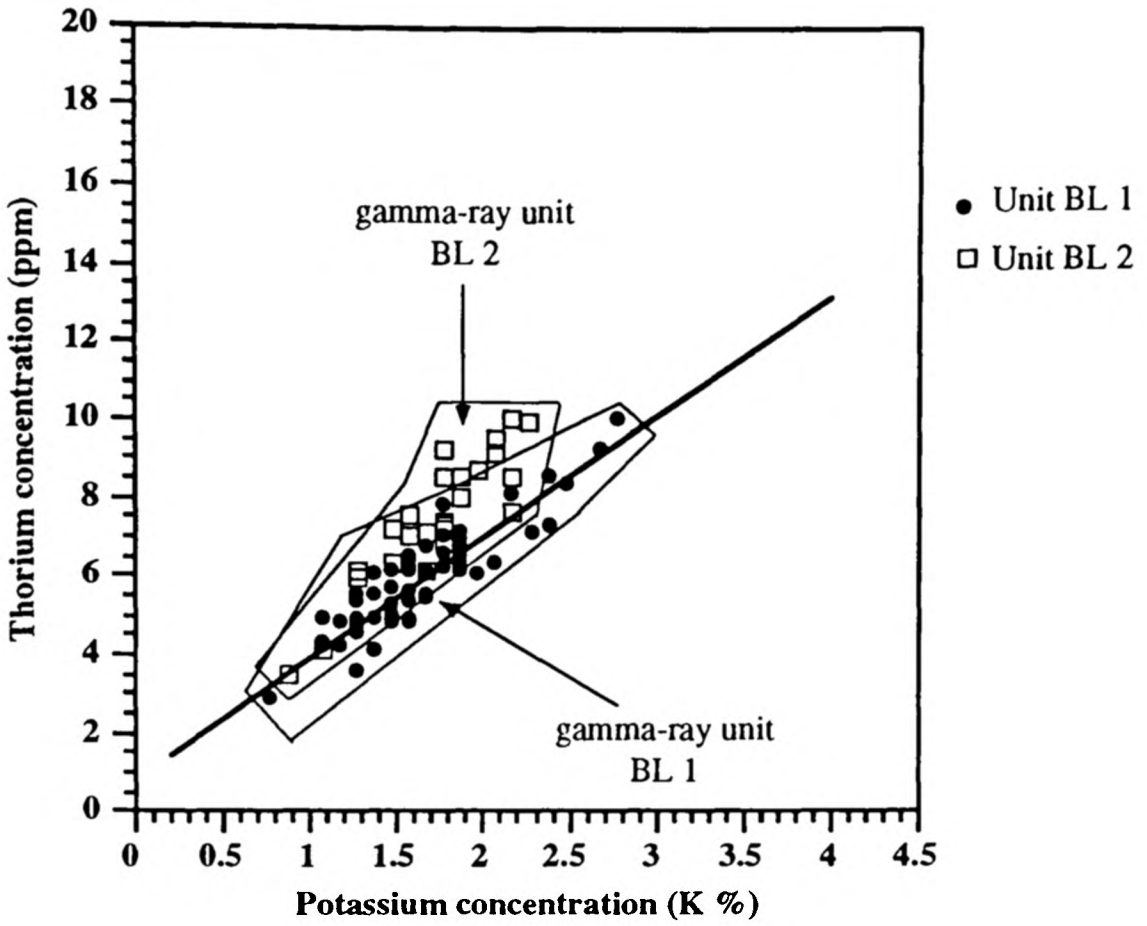


FIGURE 4.06 Gamma-ray logs for the Lower Lias succession of the Glamorgan coast divided into gamma-ray facies. The direction of detrital influence and migration of facies, as inferred from the Th concentration log, is shown for each gamma-ray unit. Stacking patterns within each gamma-ray unit are also indicated (P = progradation, A = aggradation and R = retrogradation).



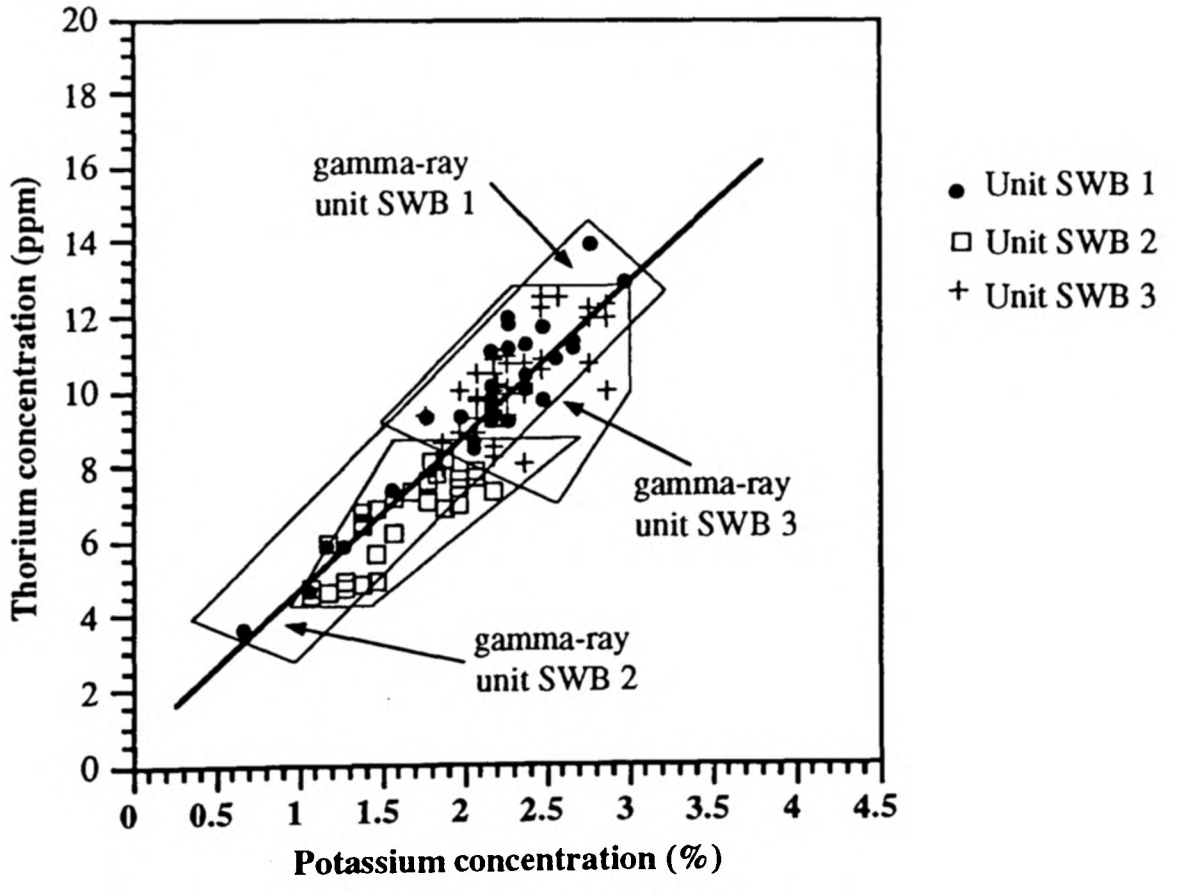
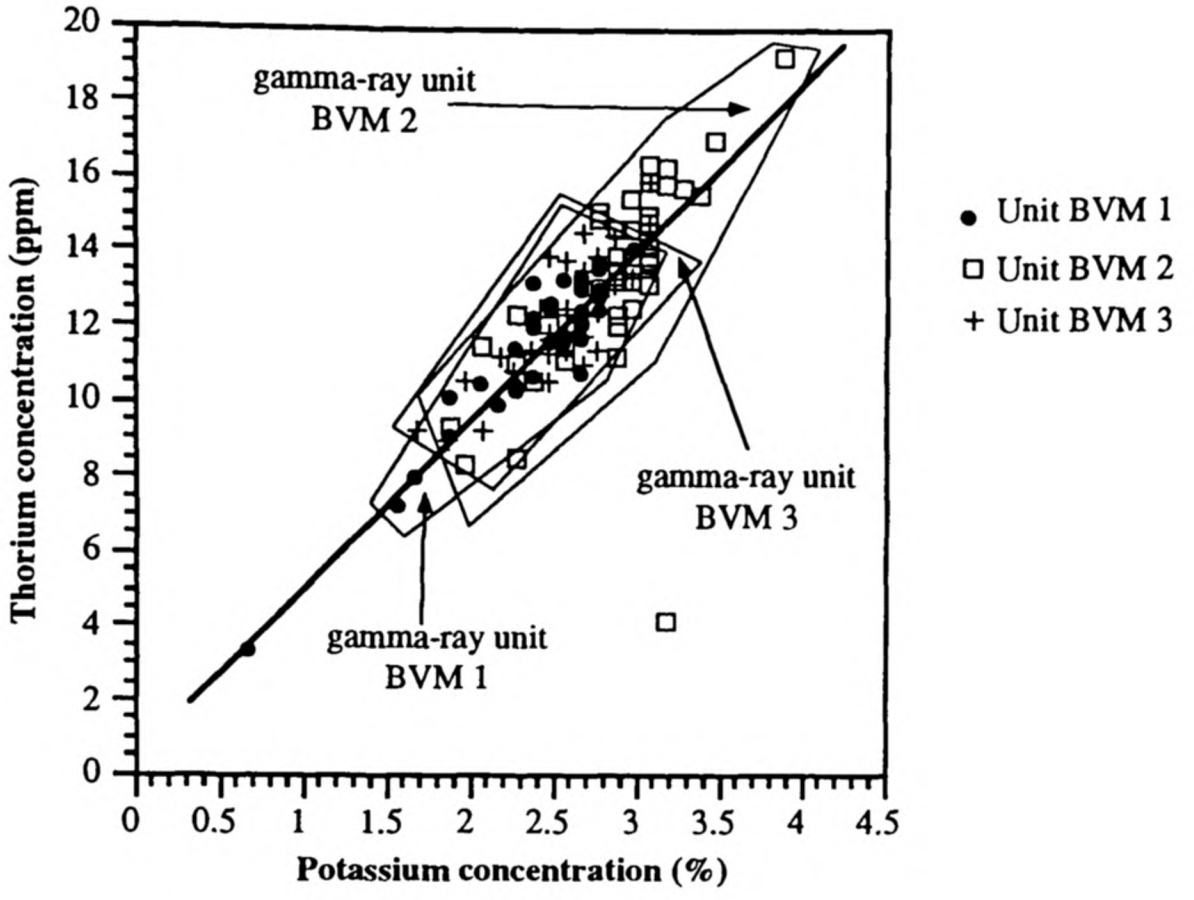


FIGURE 4.07 Th-K fields shown by each gamma-ray unit for the Pre-*planorbis* Beds to the *turneri* Zone in Dorset. Units BL 1, BL 2 and and SWB 2 have Th-K concentrations that are characteristic of a distal gamma-ray facies in contrast to units SWB 1 and SWB 3 that have Th-K concentrations that are characteristic of a proxmal gamma-ray facies.



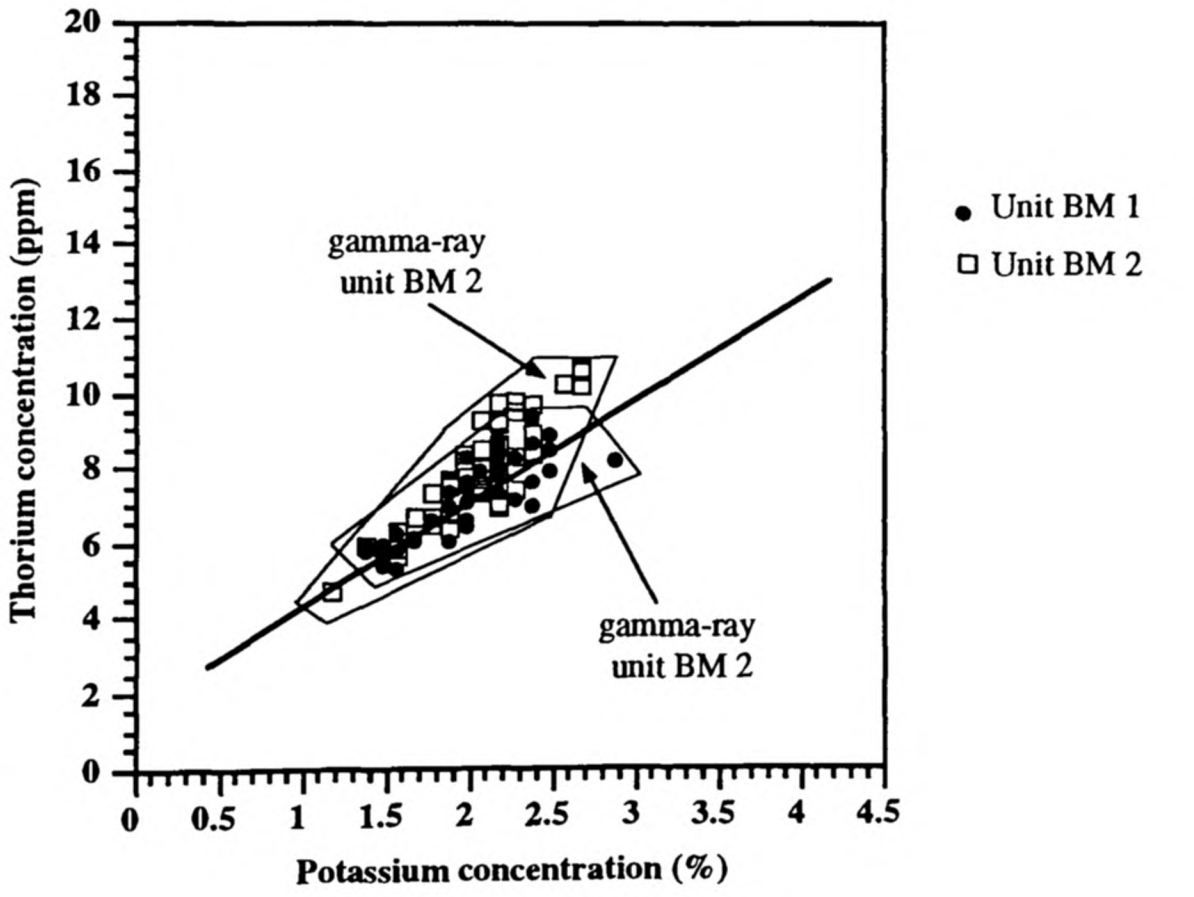
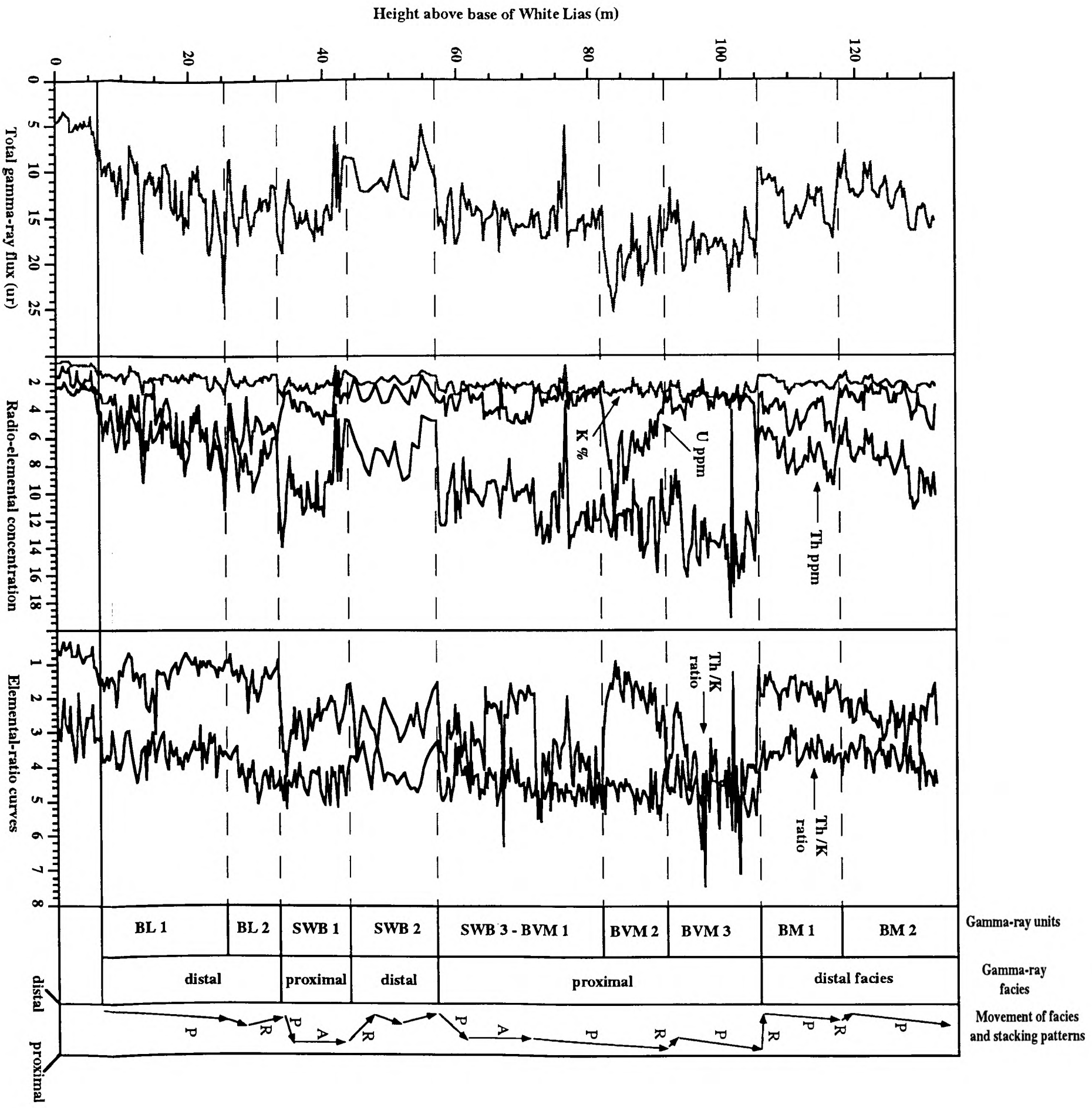


FIGURE 4.08 Th-K fields shown by each gamma-ray unit for the *turneri* Zone ito *ibex* Zone in Dorset. Units BM 1 and BM 2 have Th-K concentrations that are characteristic of a distal gamma-ray facies in contrast to units BVM 1, BVM 2 and BVM 3 that have Th-K concentrations that are characteristic of a proxmal gamma-ray facies.


Height above base of White Lias (m)
0
20
40
60
80
100
120
Total gamma-ray flux (ur)
0
5
10
15
20
25
Radio-elemental concentration
2
4
6
8
10
12
14
16
18
K %
U ppm
Th ppm
Elemental-ratio curves
1
2
3
4
5
6
7
8
Th /K ratio
Th /K ratio
BL 1
BL 2
SWB 1
SWB 2
SWB 3 - BVM 1
BVM 2
BVM 3
BM 1
BM 2
Gamma-ray units
distal
proximal
distal
proximal
distal facies
Gamma-ray facies
distal
proximal
P
R
P
A
R
P
A
P
R
P
R
P
P
R
P
Movement of facies and stacking patterns

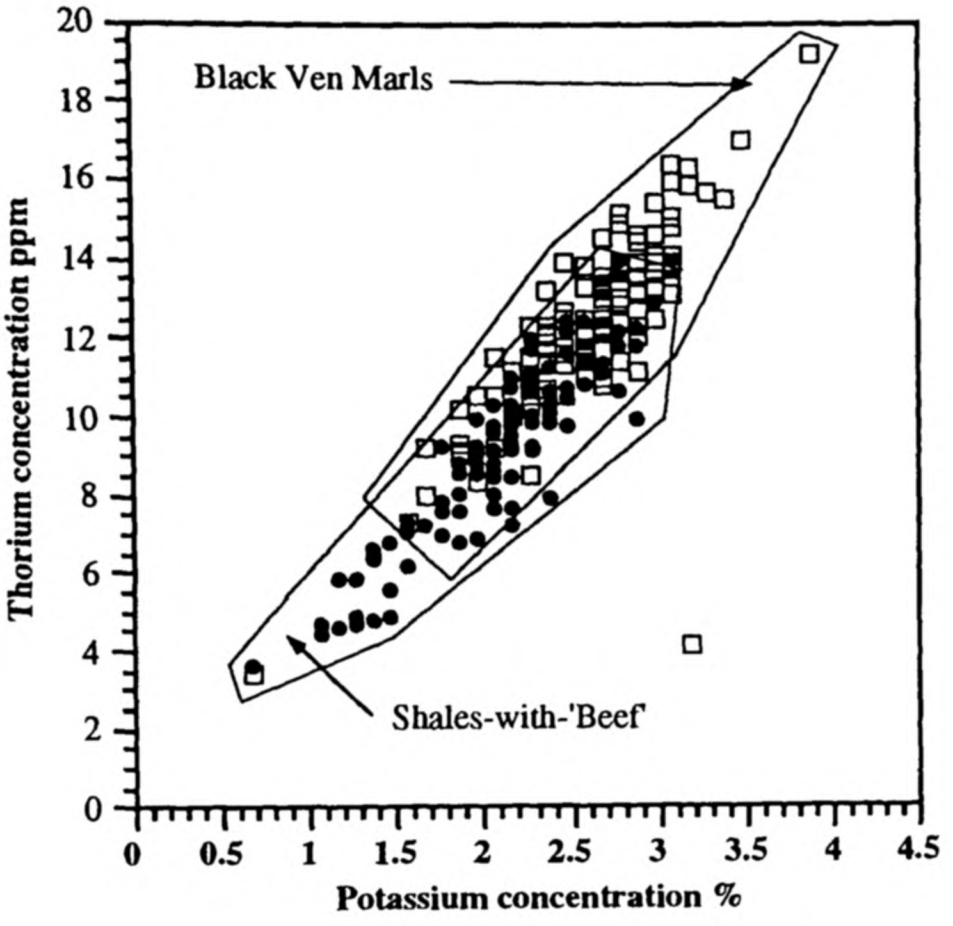


FIGURE 4.10 A Linear regression between Th concentration and K concentration for the Shales-with-'Beef' and Black Ven Marls. The Black Ven Marls are characterised by higher Th and K concentrations and are interpreted as the most proximal of the two formations.

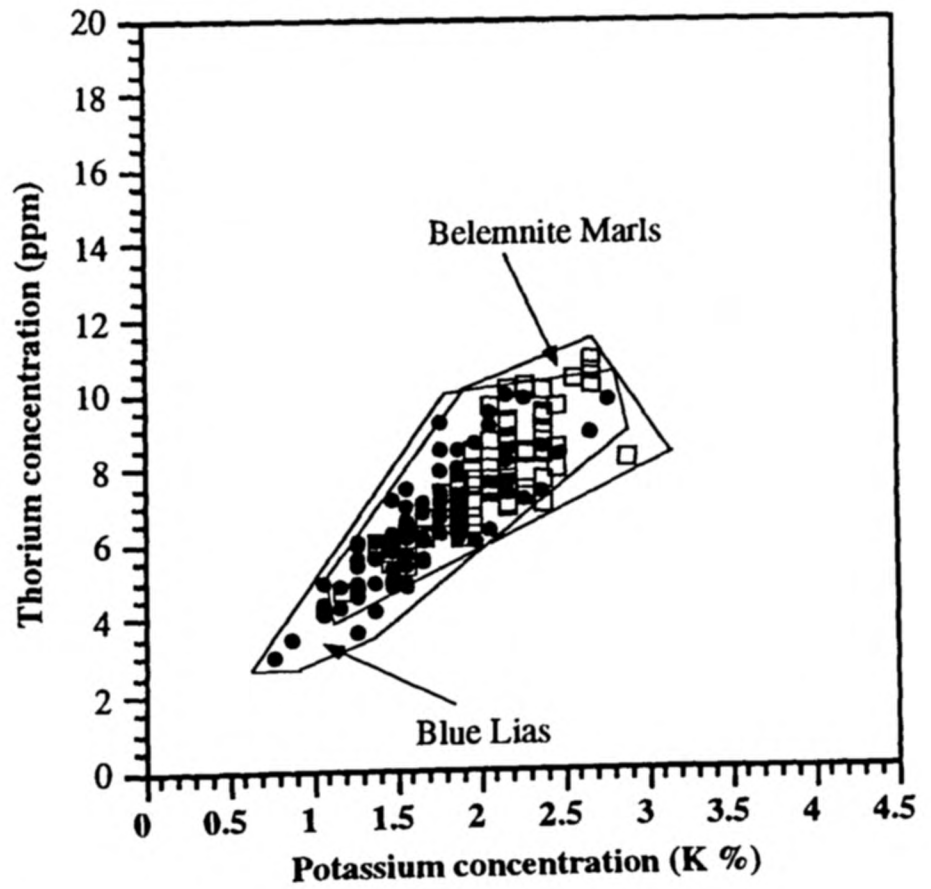


FIGURE 4.10 B Linear regression between Th concentration and K concentration for the Blue Lias and Belemnite Marls.

FIGURE 4.11 The *obtusum* Shales (gamma-ray unit BVM 2) at Stonebarrow, Charmouth, Dorset.

(ABOVE) Field aspect of the *obtusum* Shales that outcrop at Stonebarrow (SY 3780927). The *obtusum* Shales form a distinctive stratal package that comprises organic-rich 'paper shales' with a maximum TOC of 11.68 %. Maximum measured U concentration is 12.7 ppm. In the photograph, the *obtusum* Shales are the sediment package that runs mid-way through the cliff above the scree slope and are bound by two concretionary limestone horizons. The lowermost, bed 82, is known as Pavior (P) and the uppermost, bed 89, is known as the Coinstone (C). Ciff is approximately 30 m in height.

(BELOW) The laminated nature of the *obtusum* Shales can clearly be seen in the small headlands below Stonebarrow (SY 384926). The yellow field notebook rests on the Pavior limestone (P) at which there is evidence for a small stratal gap (*e.g. Diplocraterion* and *Thalassinoides*). Notebook is 20 cm x 13 cm.

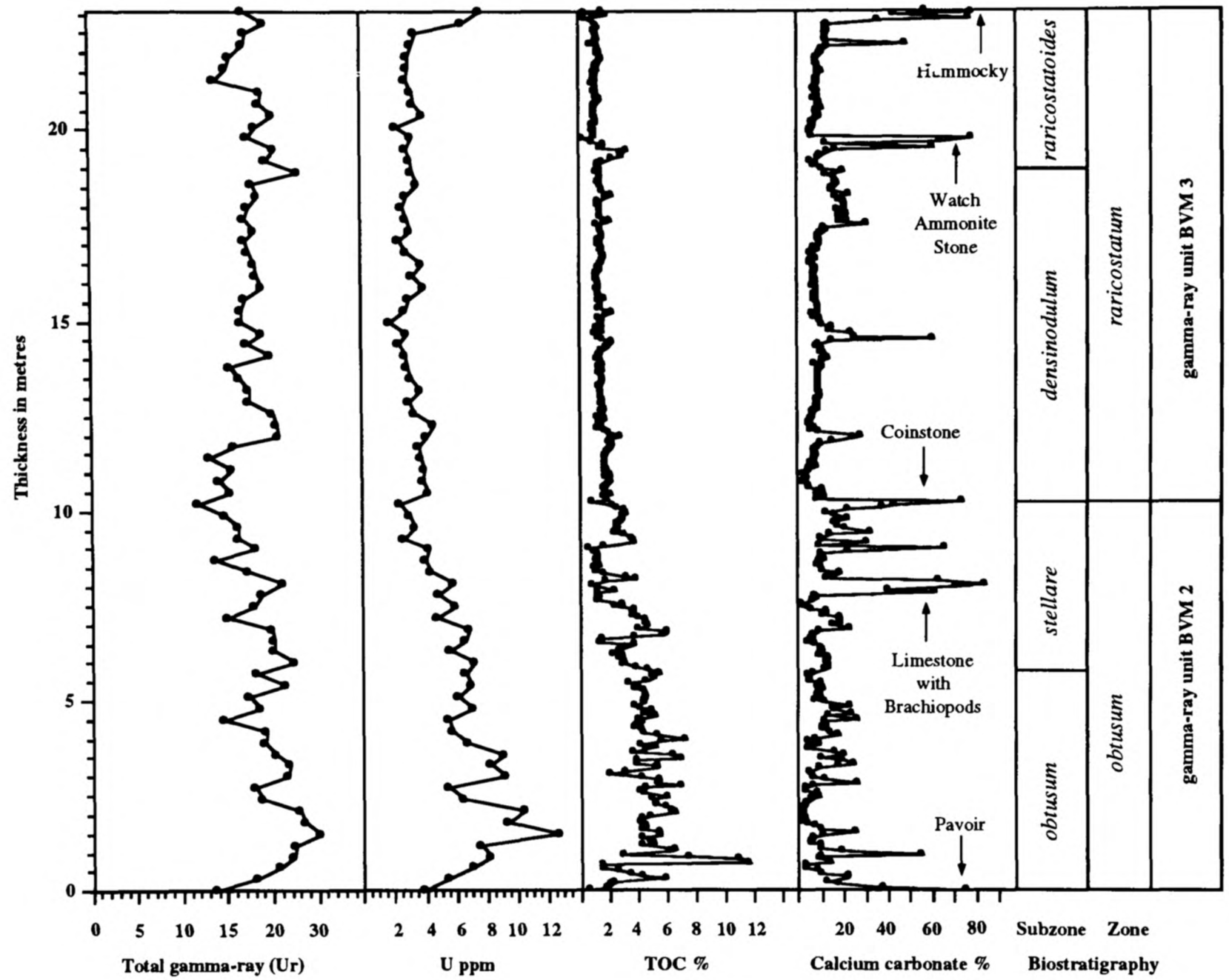


FIGURE 4.12 Comparison between total gamma-ray flux and U concentration for the *obtusum* Shales. Calcium carbonate data is also given. (Unpublished TOC and calcium carbonate data is reproduced courtesy of Jenkyns & Weedon).

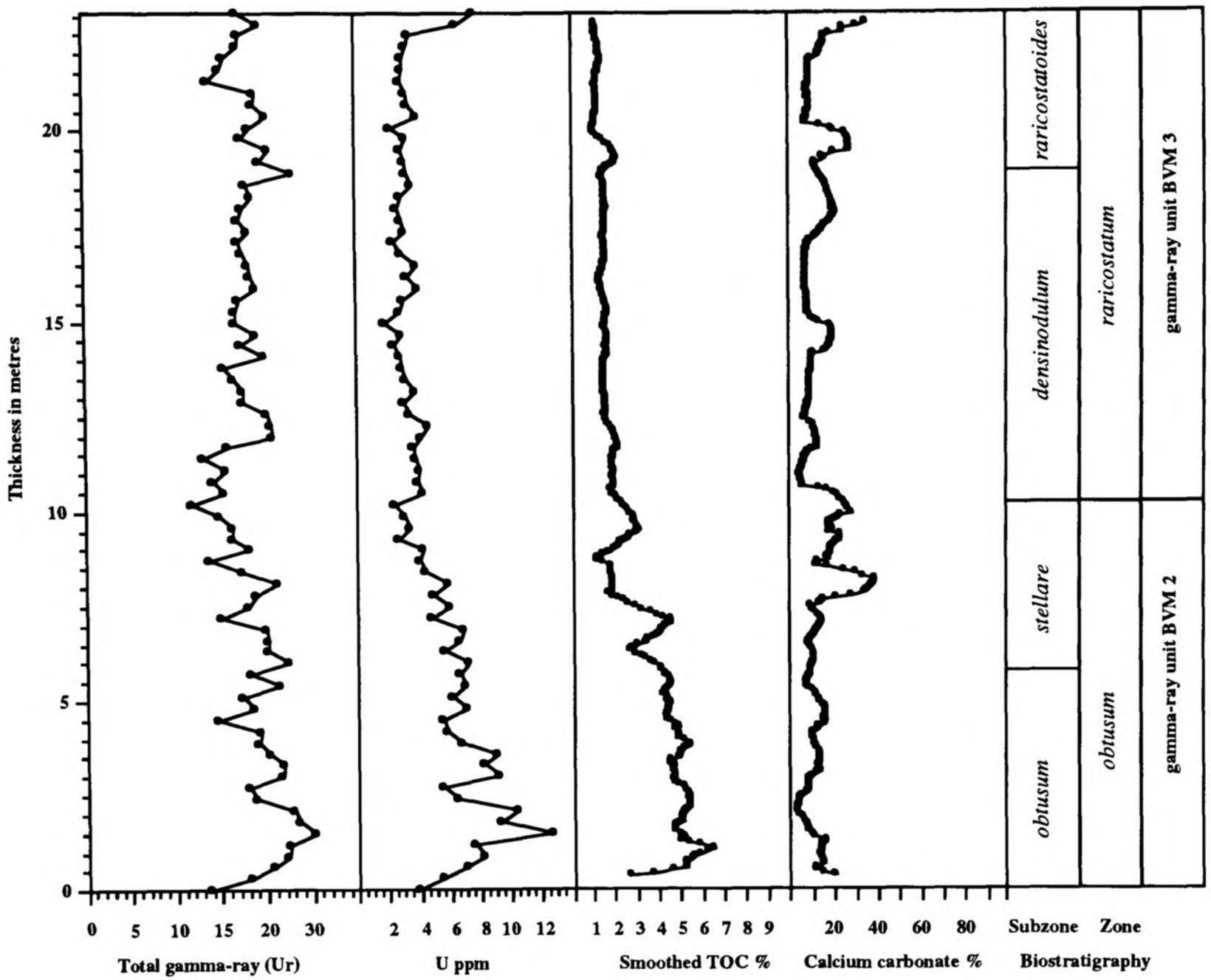


FIGURE 4.13 Comparison between total gamma-ray flux and U concentration for the *obtusum* Shales with TOC and calcium carbonate data. The latter two data-sets were collected using a 30 cm sampling interval. Thus for direct comparison with the gamma-ray data the TOC and calcium carbonate data-sets have to be smoothed over a 10 cm sampling interval. The U log signature closely resembles the TOC profile for the same interval. (Unpublished TOC and calcium carbonate data is reproduced courtesy of Jenkyns & Weedon).

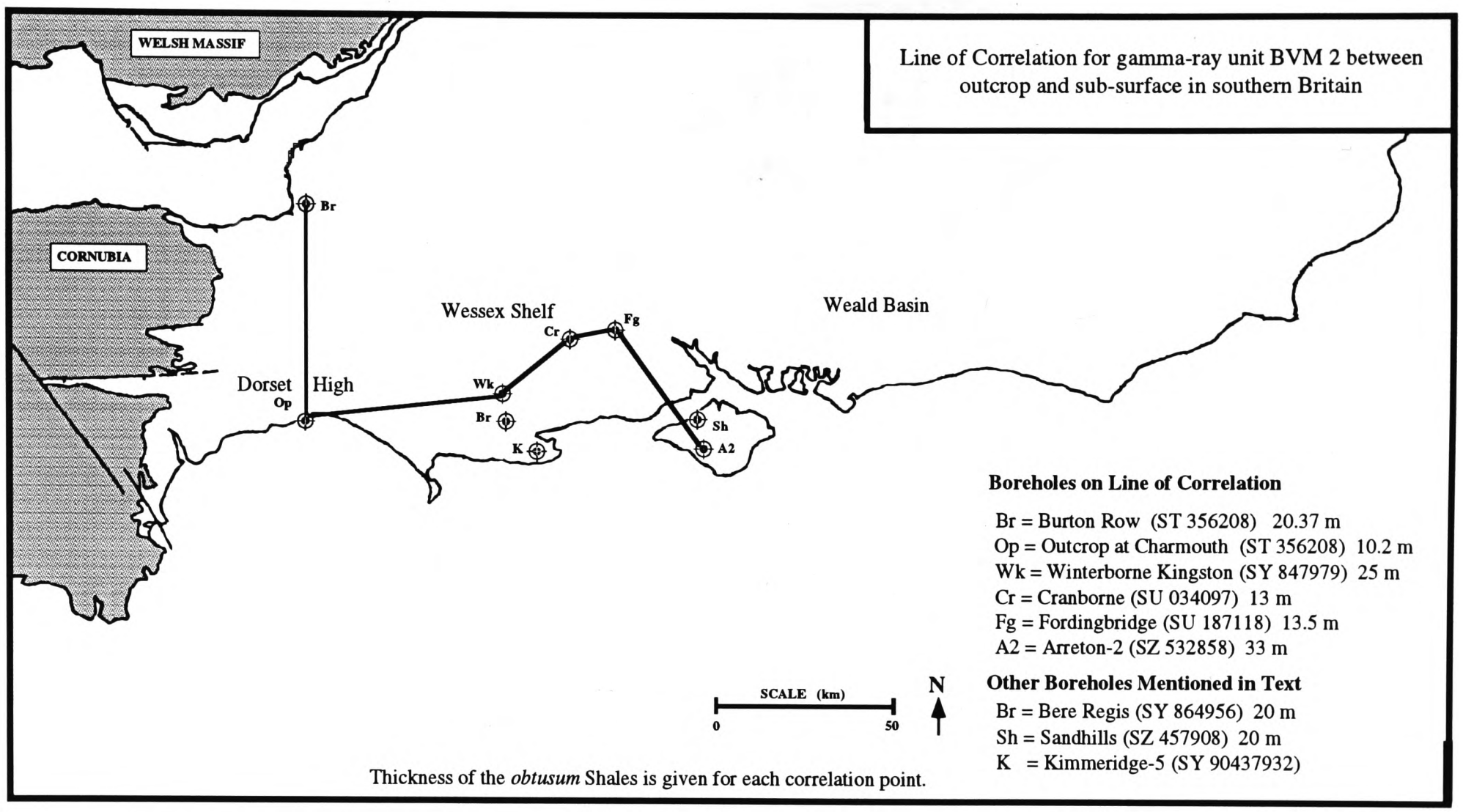


FIGURE 4.14 The *obtusum* Shales exposed along the coastline of south Dorset (SY 3780927) were deposited on the Mid-Dorset High on the northern footwall side of the major Abbotsbury-Ridgeway Fault System. Faults with an east-west orientation were characterised by an early to Mid-Late Jurassic downthrow to the south, an inference based on evidence of synsedimentary fissures in sandstones and limestones or changes in stratal thickness and facies (Jenkyns & Senior 1991, Hesselbo & Jenkyns 1995a). Faults with an approximate north-south orientation generally had an Early to Mid Jurassic downthrow to the west, evidenced by stratal thinning and the development of hiatus-concretions on fault-block crests (Hesselbo & Palmer 1992).

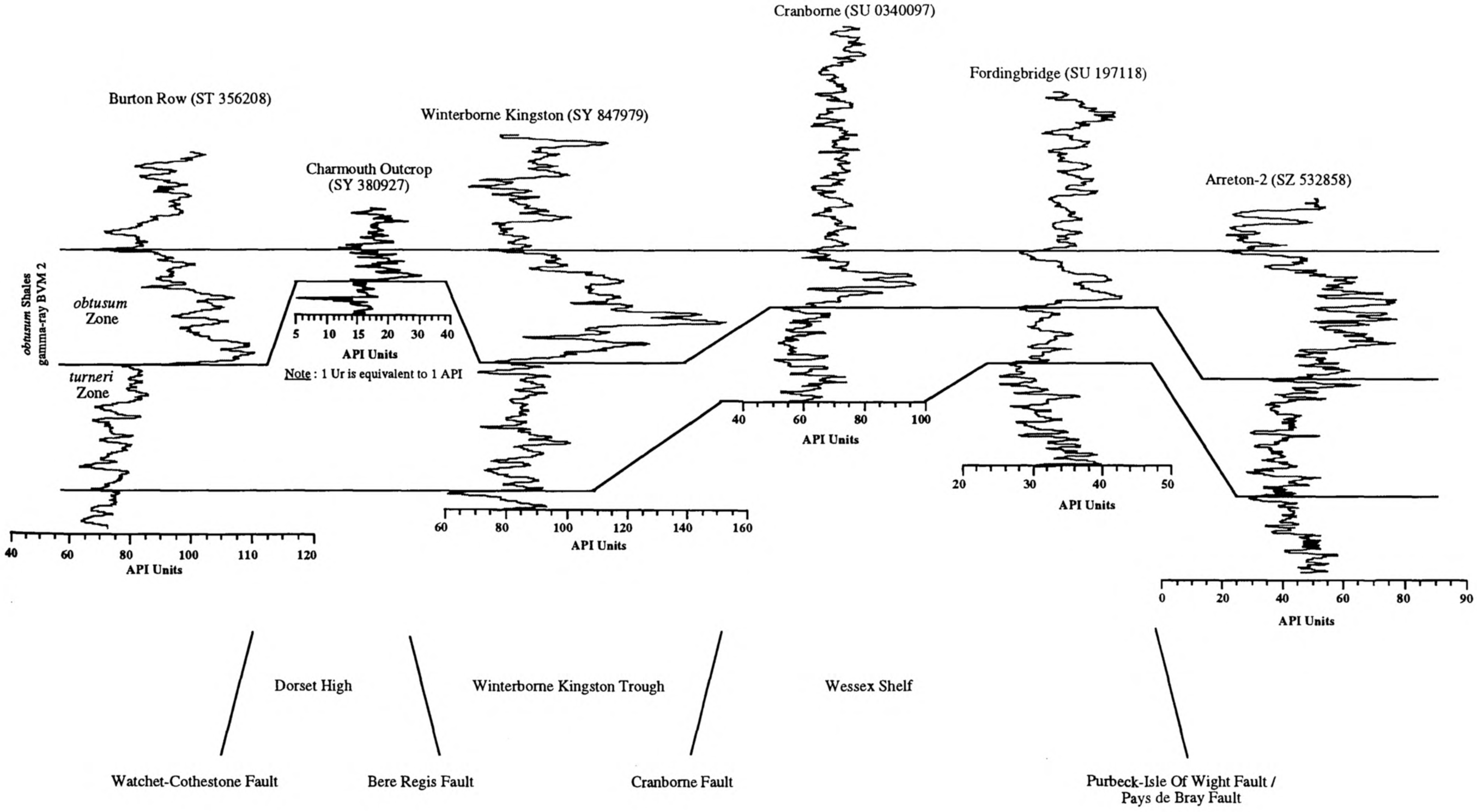


FIGURE 4.15

FIGURE 4.15 A correlation of the *obtusum* Shales (gamma-ray unit BVM 2) from outcrop into the subsurface away from the coastal area. At outcrop the *obtusum* Shales represent the *stellare* and the *obtusum* Subzones of the *obtusum* Zone. In the fully cored Burton Row borehole, the organic-rich shales also include the *denotatus* Subzone of the *obtusum* Zone. Correlation in the other boreholes shown on the line of section can only be made upon the basis of total gamma-ray signature.

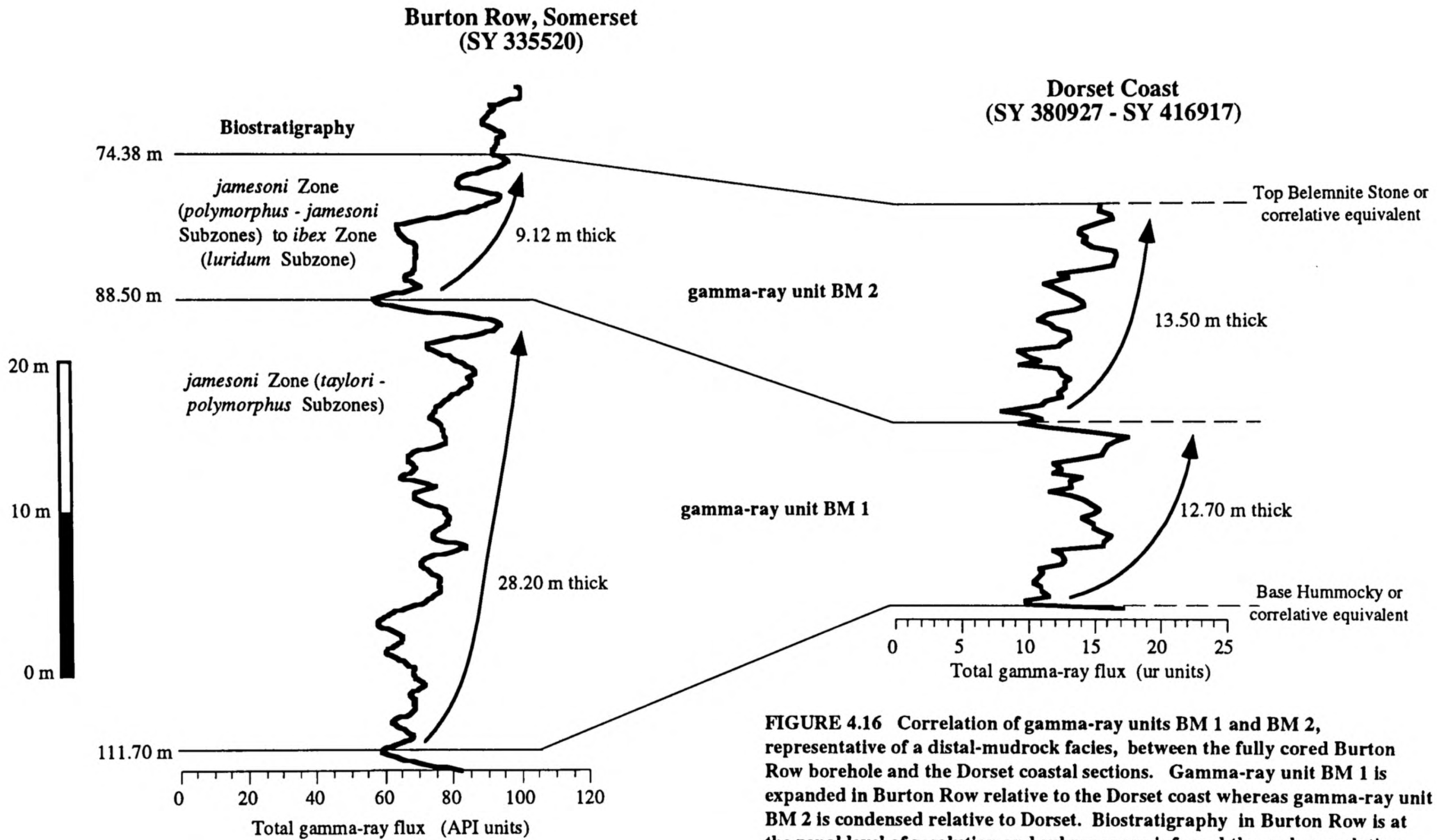


FIGURE 4.16 Correlation of gamma-ray units BM 1 and BM 2, representative of a distal-mudrock facies, between the fully cored Burton Row borehole and the Dorset coastal sections. Gamma-ray unit BM 1 is expanded in Burton Row relative to the Dorset coast whereas gamma-ray unit BM 2 is condensed relative to Dorset. Biostratigraphy in Burton Row is at the zonal level of resolution and subzones are inferred through correlation with the outcrop gamma-ray log.

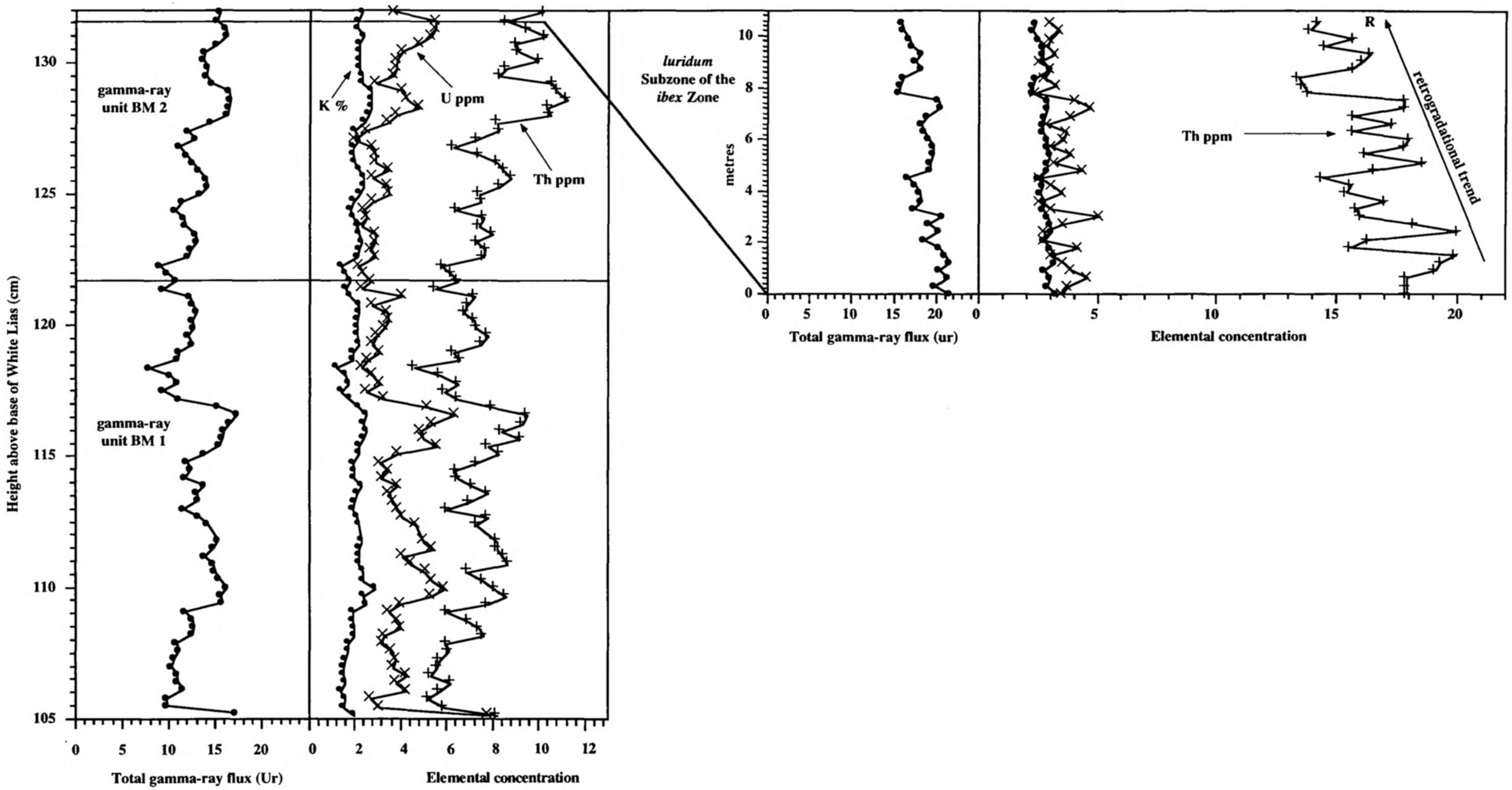


FIGURE 4.17

FIGURE 4.17 Comparison of the gamma-ray signatures for a distal gamma-ray fcaies and a proximal gamma-ray facies. Stratigraphic condensation of the distal facies in the *luridum* Subzone coincides with stratigraphic expansion of the proximal facies at the basin margin. The x-axis for radio-element concentration is scaled.

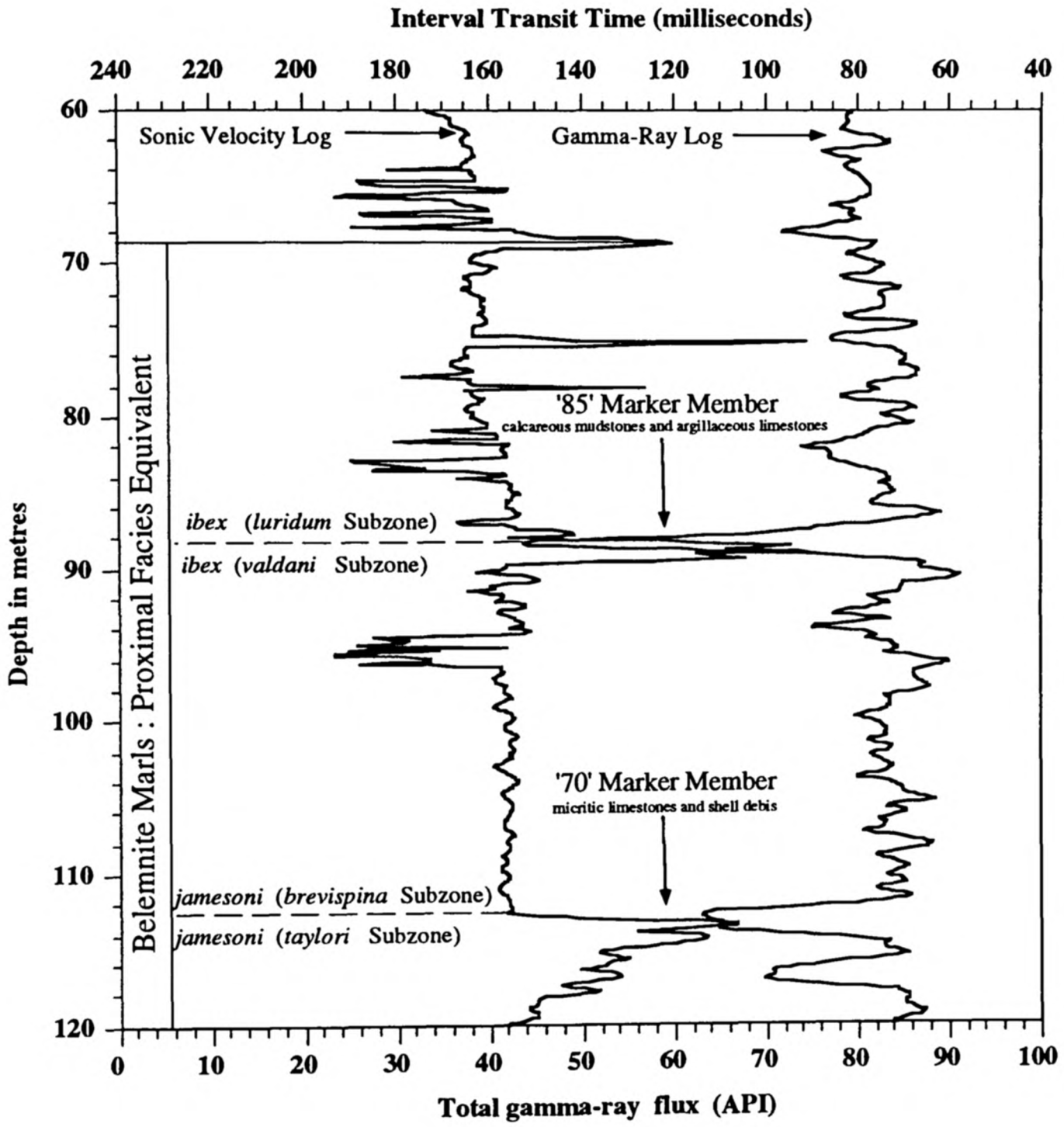
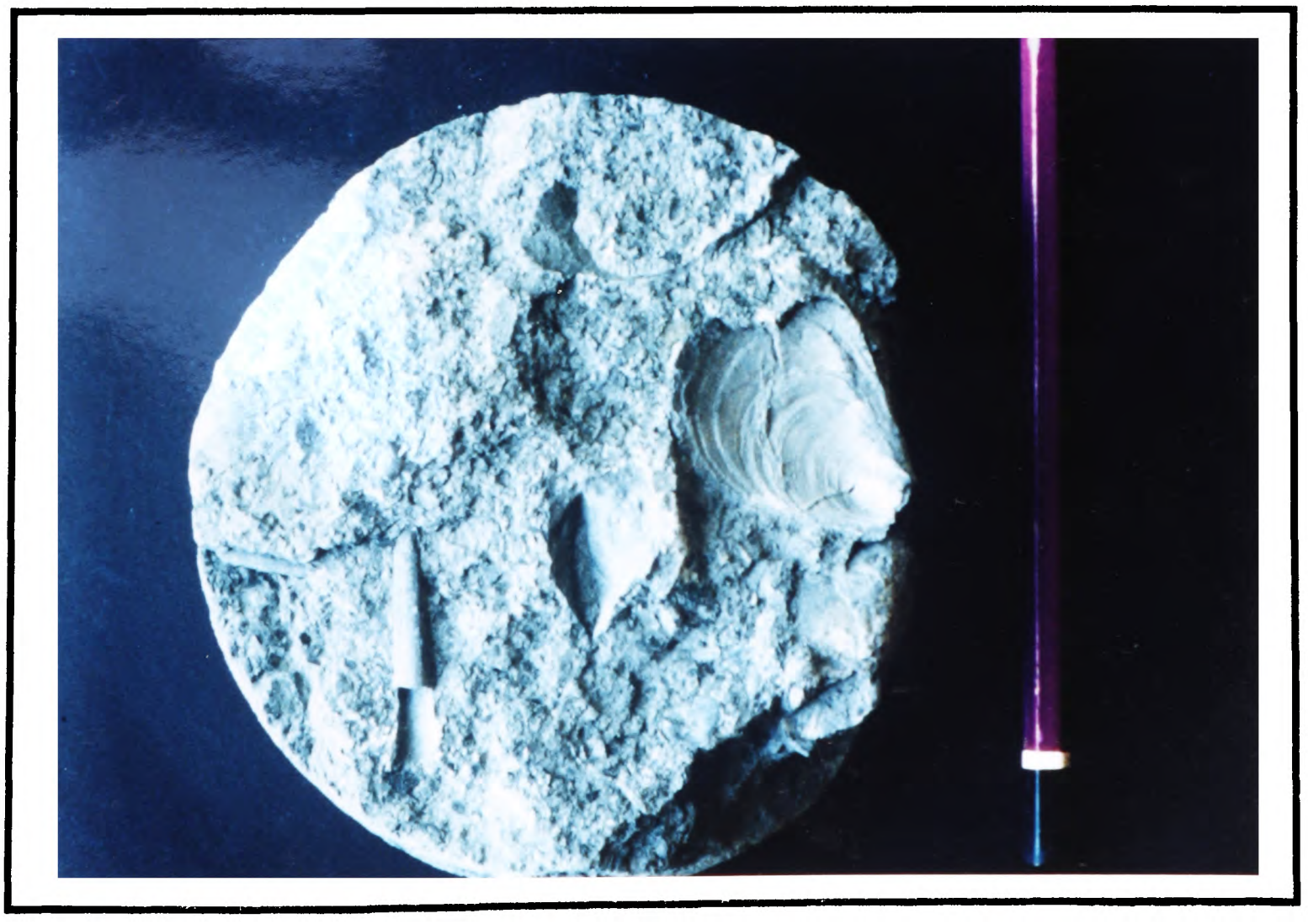


FIGURE 4.18 The wireline-log trace of two laterally persistent geophysical marker horizons recognised within the Lower Lias of Oxfordshire. The '70' and '85' Markers are considered to be sufficiently distinct to be defined as lithological members within the Lias sequence (Horton & Poole 1977) and can easily be distinguished using the sonic-velocity and total-gamma-ray logs. The '70' Marker Member is a moderate to low gamma-ray radioactive feature and lies within the *jamesoni* Zone. The '85' Marker Member is a low-radioactive feature of between 35-45 API on the total gamma-ray log and lies within the *ibex* Zone.

FIGURE 4.19 The '70' and '85' Marker Member, East Midland Shelf.

(ABOVE) Core representative of the '70' Marker Member from the Steeple Aston borehole (depth 114.45 m). The '70' Marker Member comprises micritic limestones and bioclastic (bivalve) debris and is a moderate to low radioactive feature on the total gamma-ray log. The marker is taken to represent the boundary between the *brevispina* Subzone and the *taylori* Subzone (*jamesoni* Zone). Pencil is 16 cm long.

(BELOW) Core representative of the '85' Marker Member from the Steeple Aston borehole (depth 89.35 m). The '85' Marker Member comprises calcareous mudstones and argillaceous limestones and is taken to represent the boundary between the *valdani* and *luridum* Subzones (*ibex* Zone). The marker is a distinctive low radioactive feature of 35-45 API on the total gamma-ray log. Pencil is 16 cm in length.



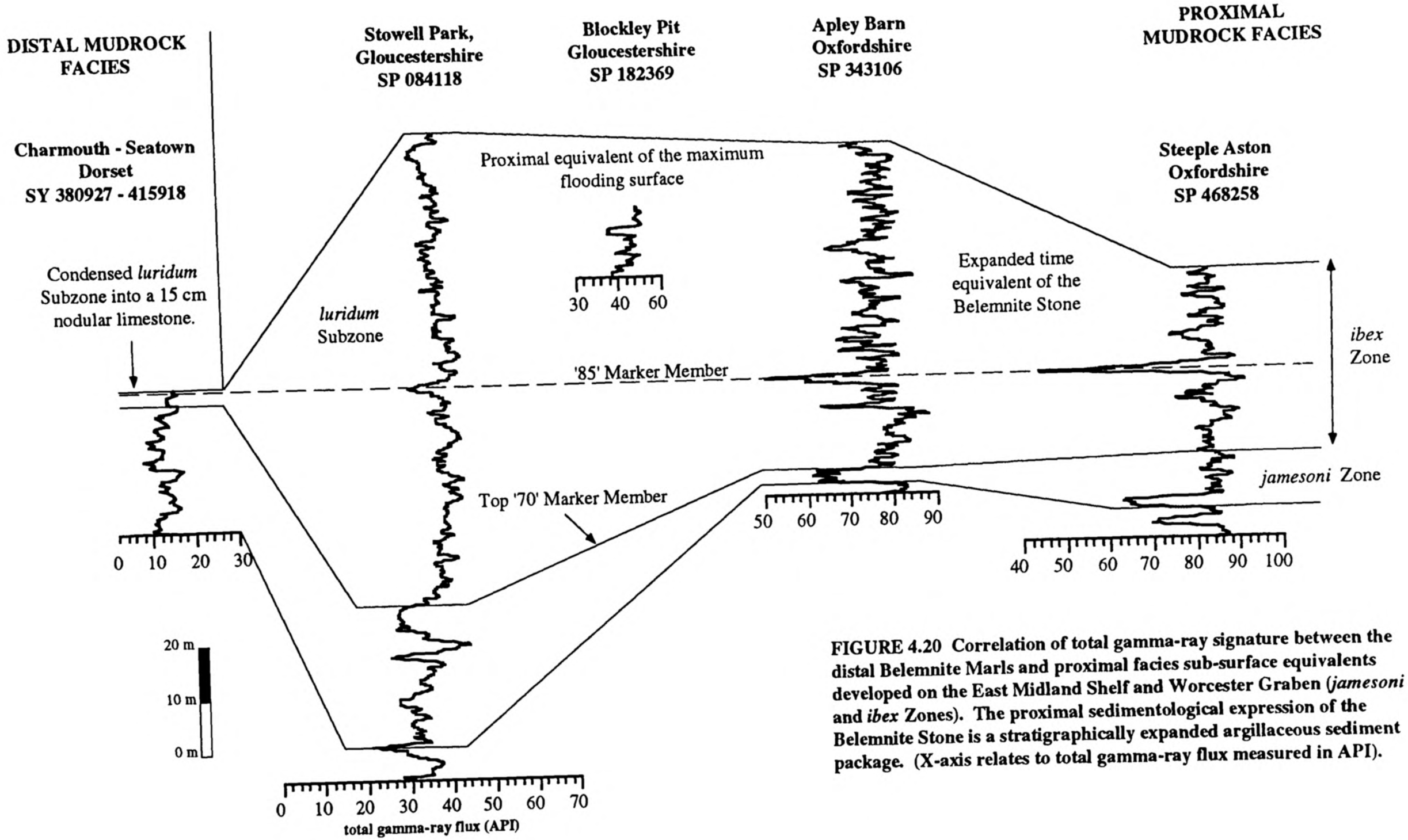


FIGURE 4.20 Correlation of total gamma-ray signature between the distal Belemnite Marls and proximal facies sub-surface equivalents developed on the East Midland Shelf and Worcester Graben (*jamesoni* and *ibex* Zones). The proximal sedimentological expression of the Belemnite Stone is a stratigraphically expanded argillaceous sediment package. (X-axis relates to total gamma-ray flux measured in API).

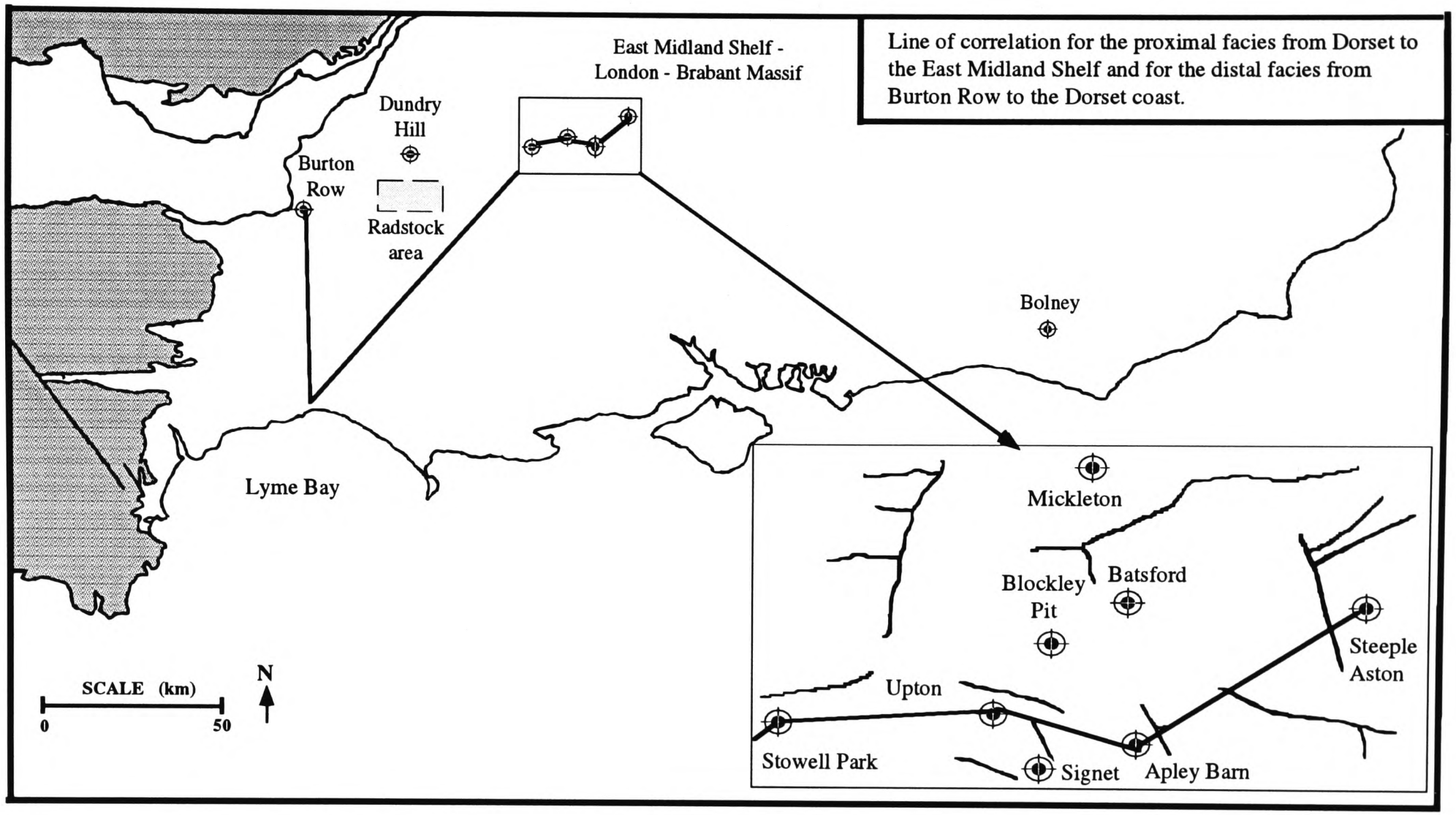


FIGURE 4.21 The Belemnite Marls and lateral time equivalents elsewhere in southern Britain (*jamesoni* to *ibex* Zones). A proximal mudrock facies is identified in the Stowell Park, Apley Barn and Steeple Aston boreholes on the basis of total gamma-ray signature and inferred in the Dundry Hill and Upton boreholes. The proximal facies outcrops at Blockley Pit Gloucestershire. A distal facies is identified in the Burton Row borehole and on the Dorset Coast. Locally, within the Radstock area the sequence becomes considerably condensed. Grid References for localities : Apley Barn (SP 343106), Burton Row, Brent Knoll (ST 335520), Elton Farm, Dundry Hill (ST 563658), Steeple Aston (SP 468258), Stowell Park (SP 084118), Upton, Witney (SP 231131), Blockley Pit section (SP 182369), Dorset coastal sections (SY 380927 - SY 415918), Bolney borehole, Sussex (TQ 280442).

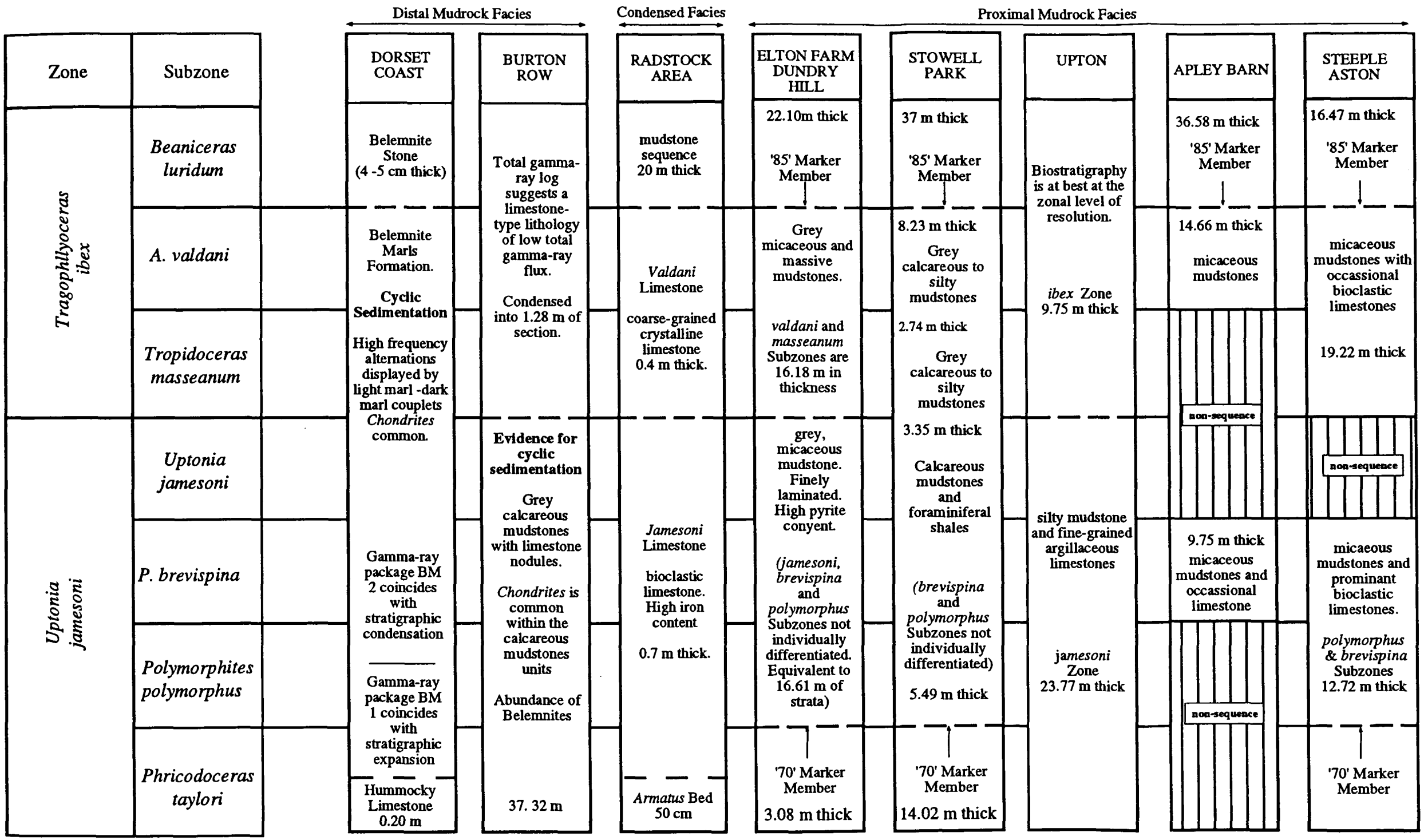


FIGURE 4.22

FIGURE 4.22 Correlation panel for the Lower Pliensbachian in southern Britain. Data from Green & Melville 1956, Worssam 1963, Poole 1977, Whittaker & Green 1983 and Donovan & Kellaway 1984. Disconformities are shown. Thickness of ammonite subzones are given where possible.

Chapter 5
Figure 5.01 to Figure 5.15

A Sequence Stratigraphic Synthesis for the Lower Lias in Southern Britain and Final Conclusions

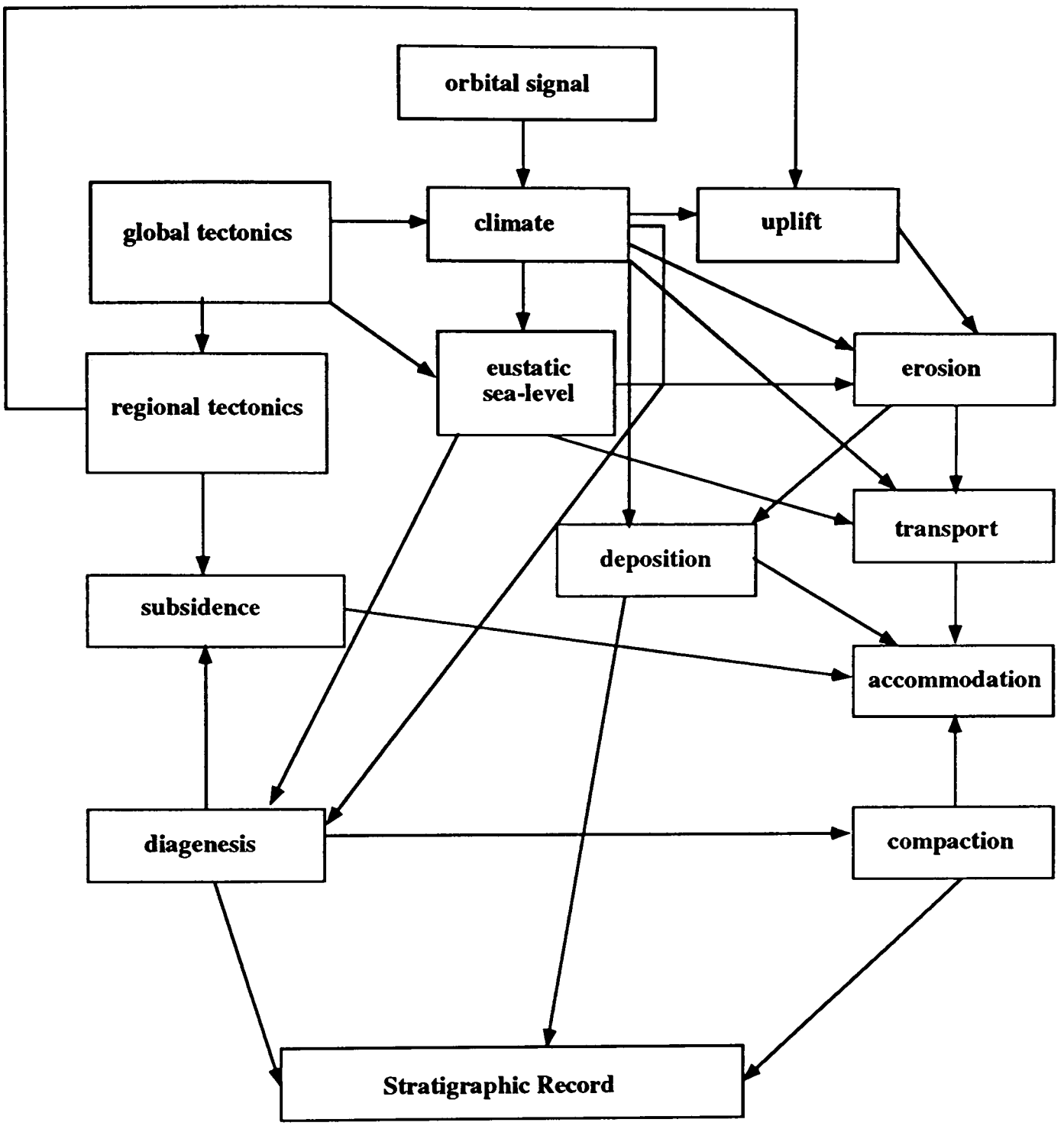


FIGURE 5.01 The complex system of interactions and feedbacks which influence the stratigraphic record. Sea-level is influenced by climate and global or regional tectonics. Deposition is influenced by accommodation space (the space available beneath base level which may be sea-level itself or storm wave-base). There is a negative feedback loop between accommodation and deposition but a positive feedback loop involving sediment compaction as a result of loading. Loading also acts to increase subsidence and hence accommodation. (Based on Smith 1994.)

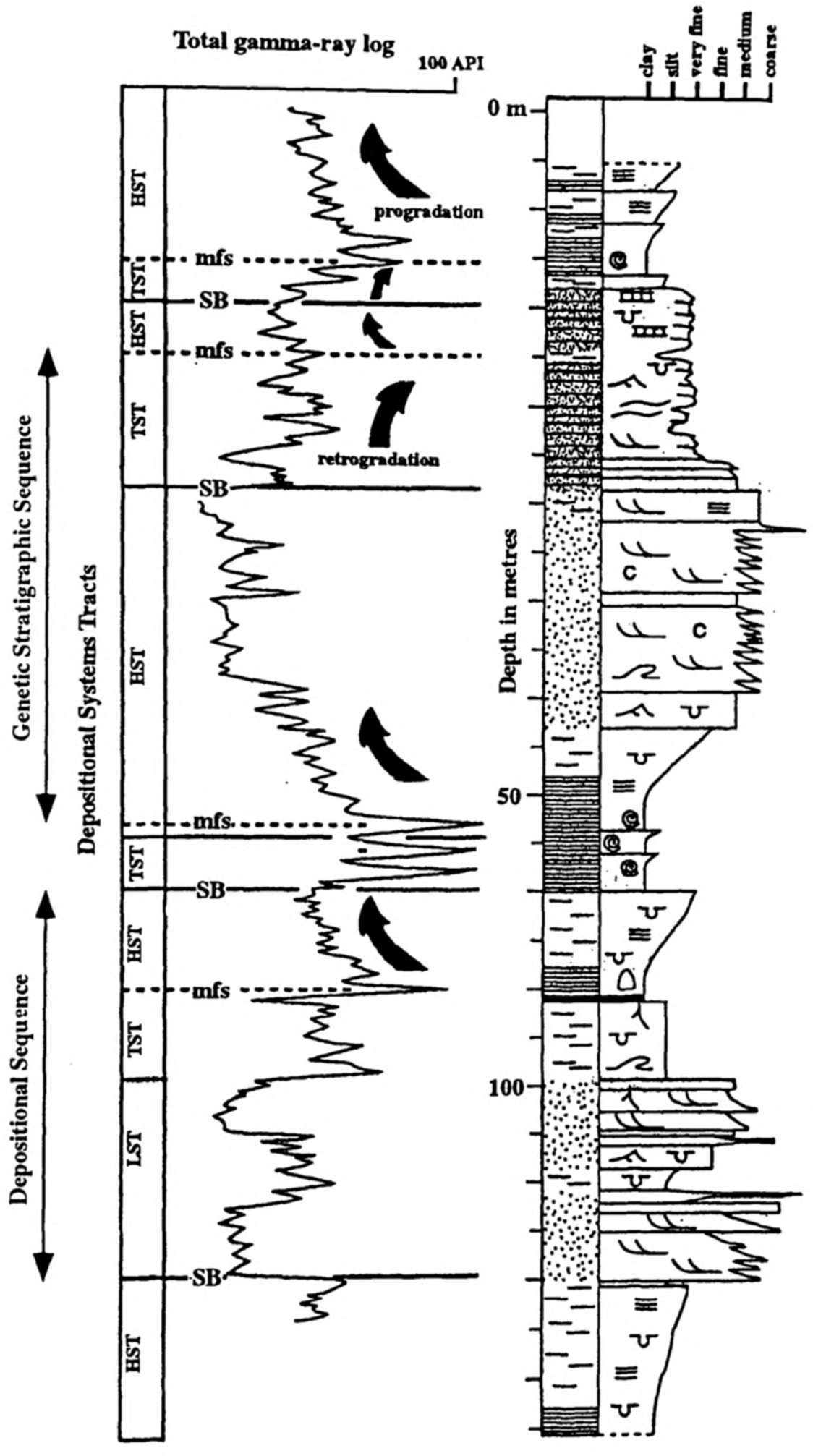
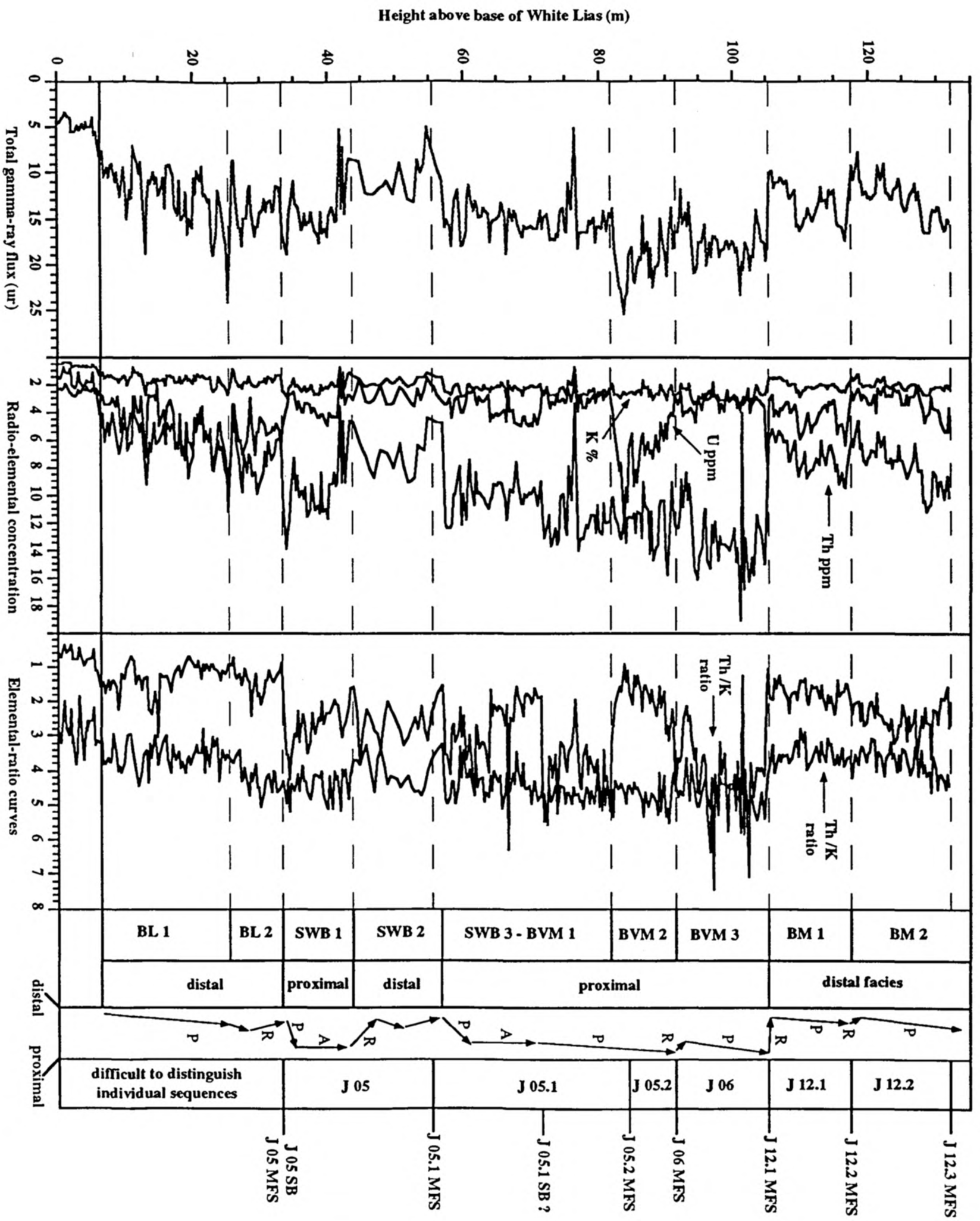


FIGURE 5.02 Depositional sequence stratigraphic interpretation of a total gamma-ray log for a coarse-grained siliciclastic system. The associated lithological log is also given. The inferred maximum flooding surface is denoted mfs and the inferred sequence boundary SB. Inferred depositional systems tracts are also given although system tract terminology is not applicable to the Lower Lias of southern Britain as there is no pronounced change in depositional system away from the open marine environment. (Based upon Gawthorpe *et al.* 1994)


Height above base of White Lias (m)
0
20
40
60
80
100
120
Total gamma-ray flux (ur)
0
5
10
15
20
25
Radio-elemental concentration
2
4
6
8
10
12
14
16
18
K %
U ppm
Th ppm
Elemental-ratio curves
1
2
3
4
5
6
7
8
Th /K ratio
Th /K ratio
BL 1
BL 2
SWB 1
SWB 2
SWB 3 - BVM 1
BVM 2
BVM 3
BM 1
BM 2
Gamma-ray uni
distal
proximal
distal
proximal
distal facies
Gamma-ray facies
distal
proximal
P
R
P
A
R
P
A
P
R
P
R
P
R
P
Movement of f and stacking pa
difficult to distinguish individual sequences
J 05
J 05.1
J 05.2
J 06
J 12.1
J 12.2
Genetic stratigr sequences
J 05 MFS
J 05 SB
J 05.1 MFS
J 05.1 SB ?
J 05.2 MFS
J 06 MFS
J 12.1 MFS
J 12.2 MFS
J 12.3 MFS
Sequence strati surfaces

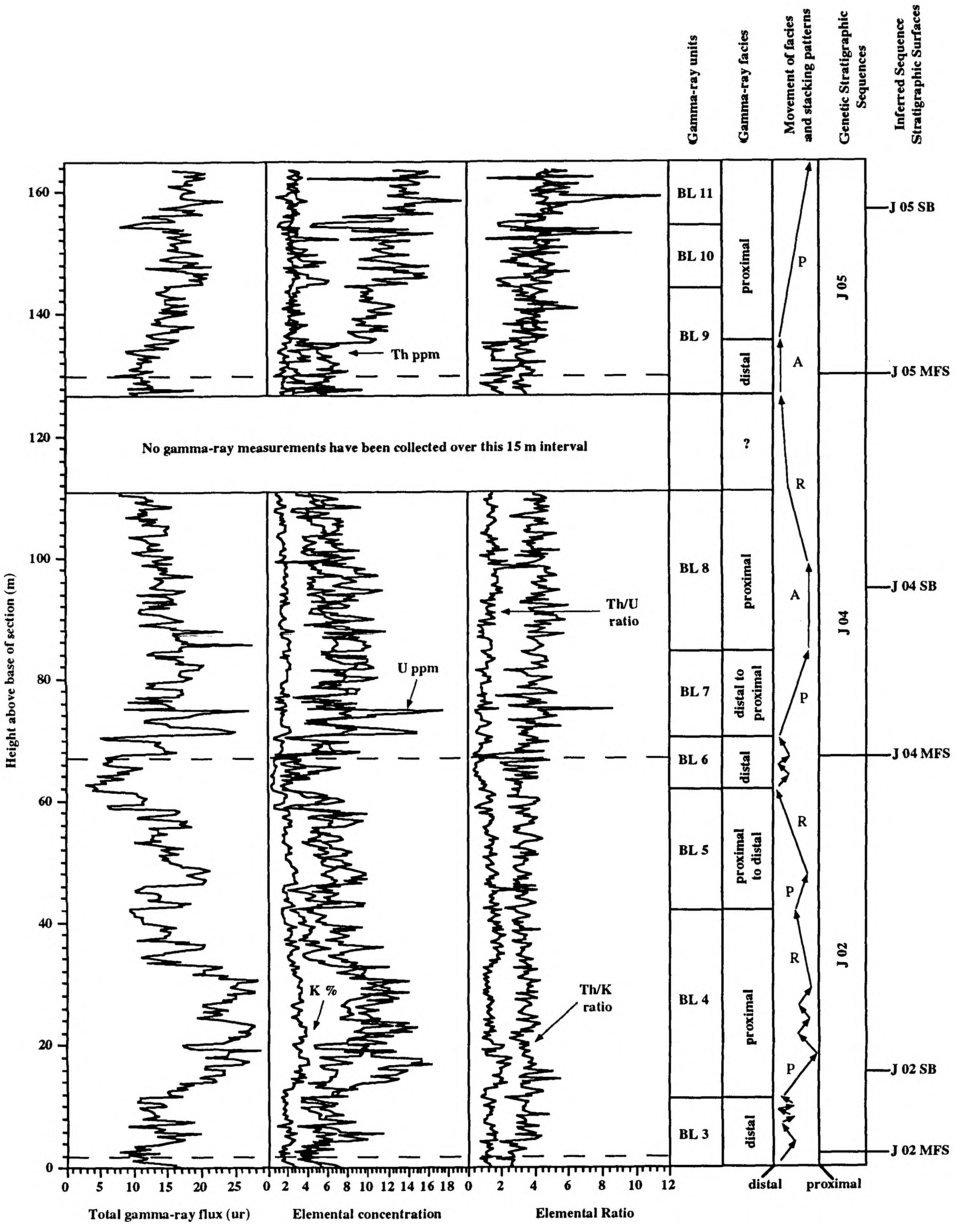


FIGURE 5.03 Gamma-ray logs for the Lower Lias succession of the Somerset coast divided into genetic stratigraphic sequences (*sensu* Galloway 1989). Inferred maximum flooding surfaces are denoted MFS and inferred sequence boundaries are denoted SB.

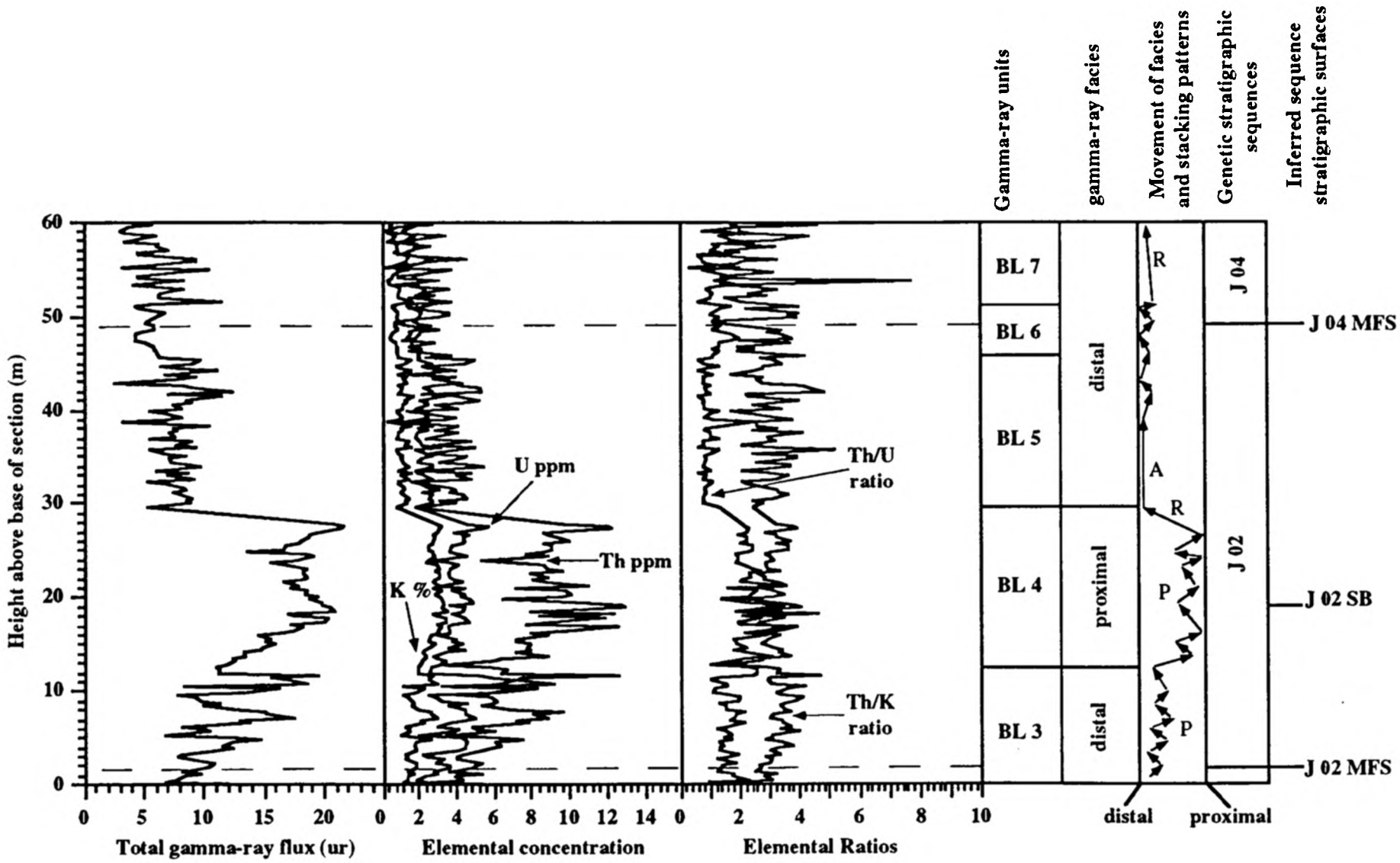
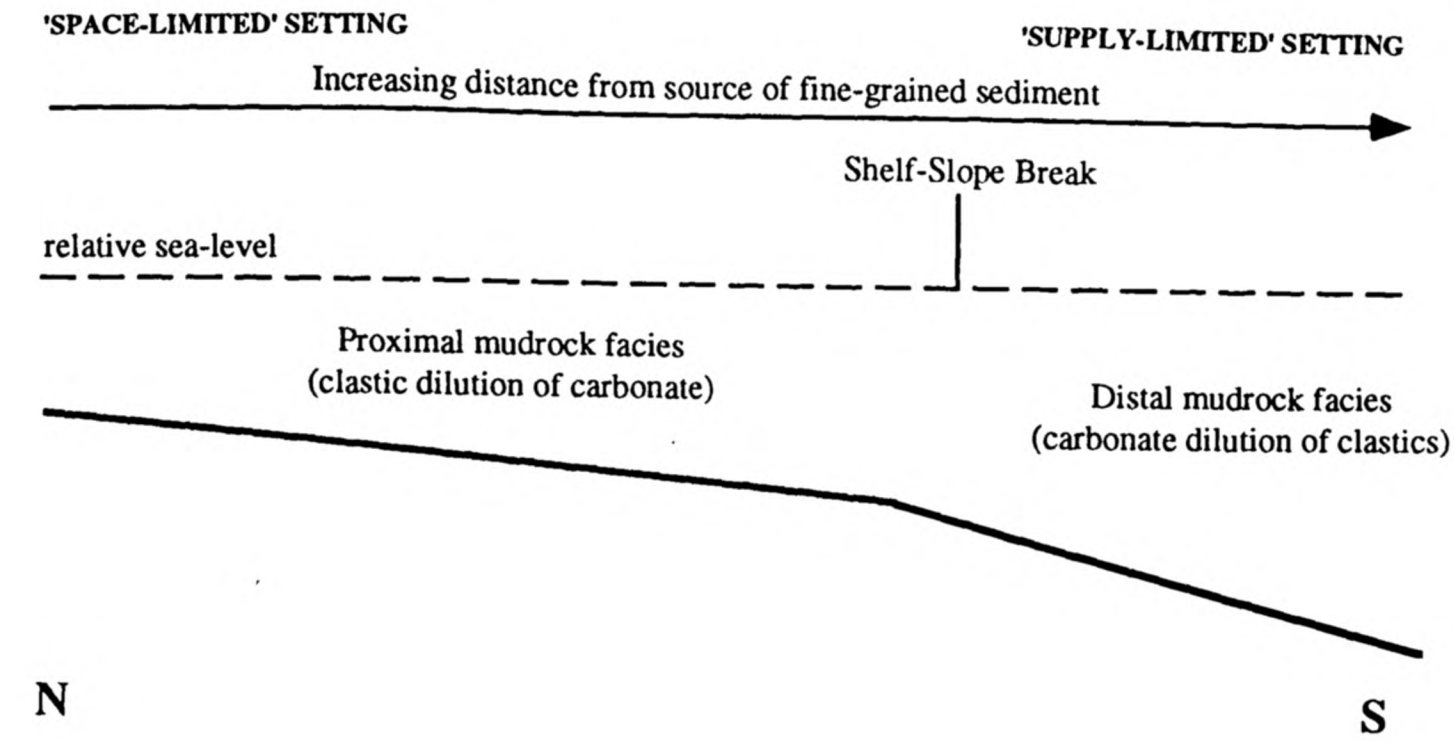
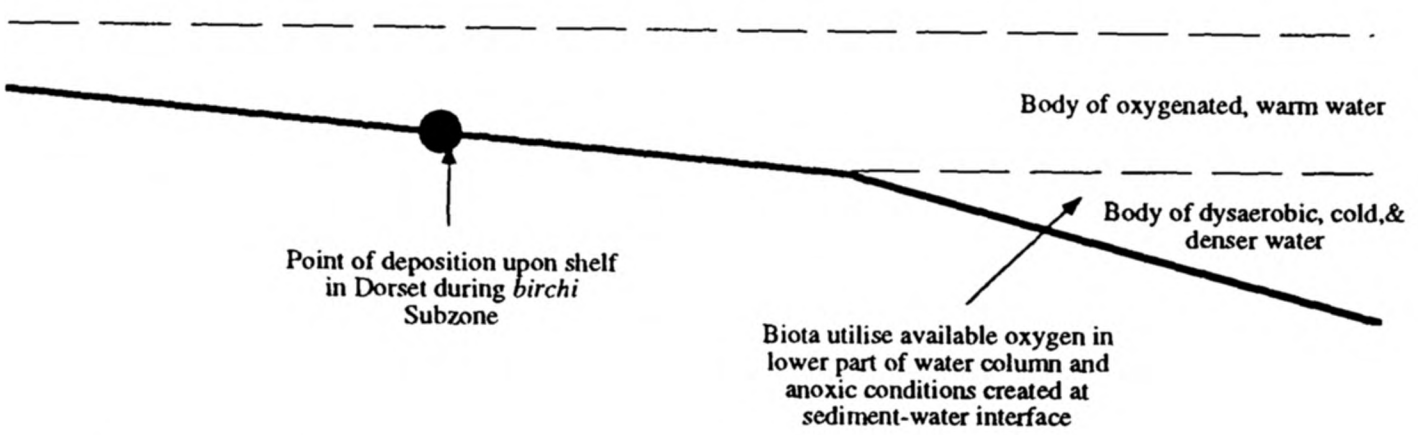


FIGURE 5.04 Gamma-ray logs for the Lower Lias succession of the Glamorgan coast divided into genetic stratigraphic sequences (*sensu* Galloway 1989). Inferred maximum flooding surfaces are denoted MFS and inferred sequence boundaries are denoted SB.



A) Water-Mass Stratification Developed (*birchi* Subzone)



B) Relative Sea-Level Rise (*obtusum* Subzone)

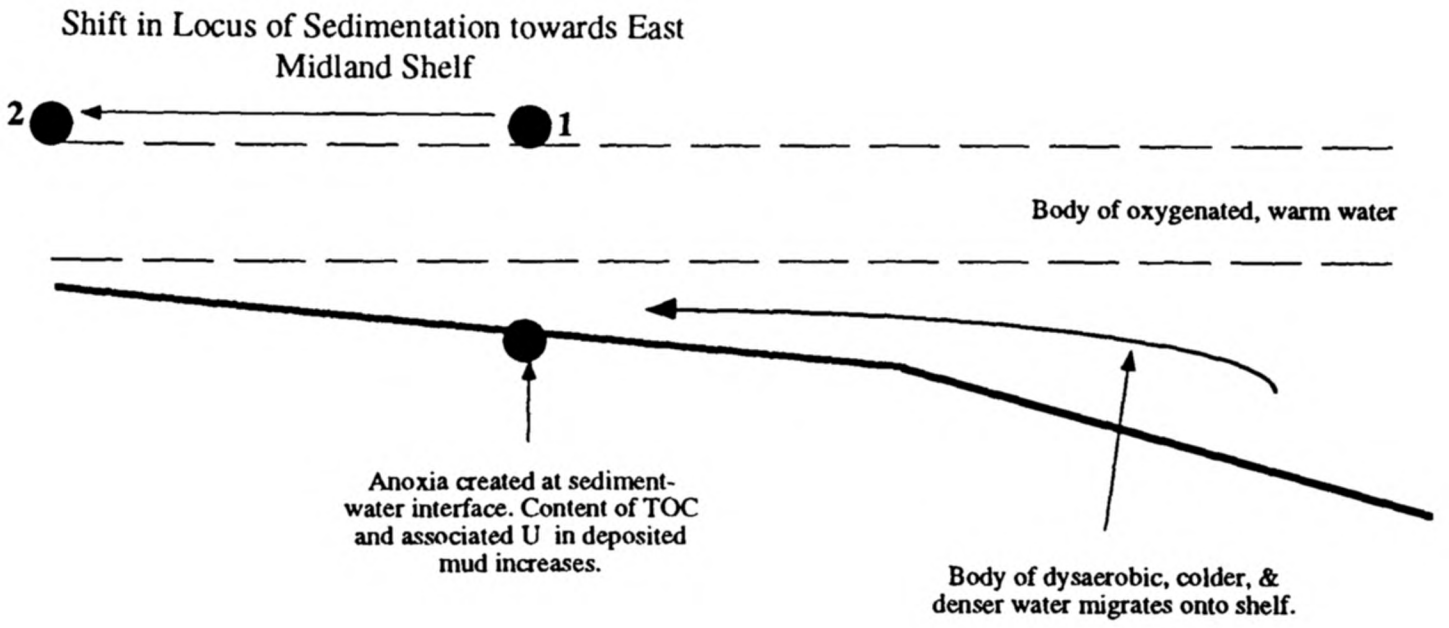
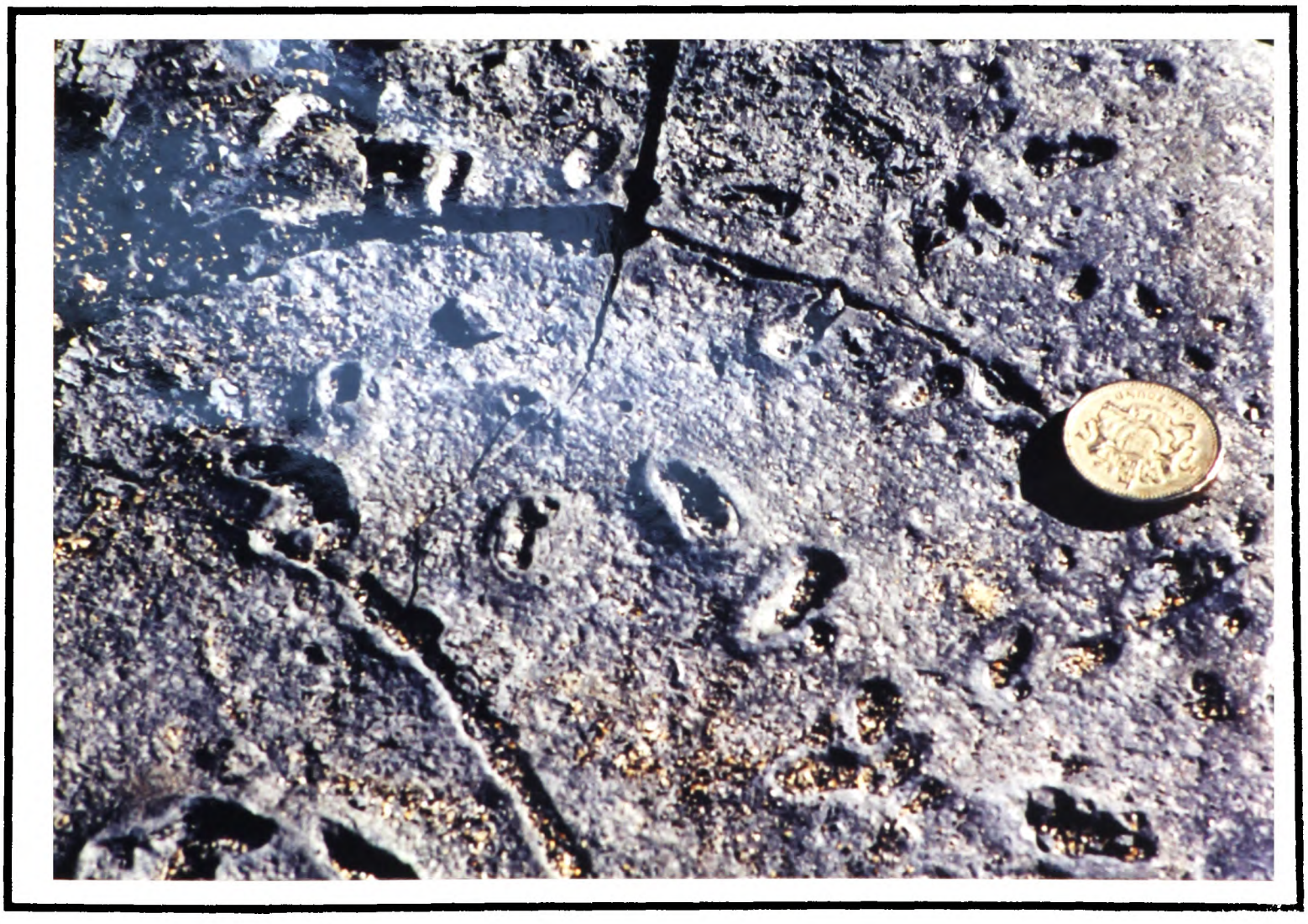


FIGURE 5.06 Possible interpretation of the *obtusum* Shales (gamma-ray unit BVM 2). The development of regional anoxia during the *obtusum* Zone is attributed to migration of dense, dysaerobic water onto the shelf during relative sea-level rise. Anoxic conditions persist on the shelf during subsequent progradation but are destroyed by mixing of the water masses, possibly during the associated relative sea-level fall. Immediately following relative sea-level rise, the shelf may have beome starved (below the resolution of the ammonite subzone) to create the stratal gap at the horizon known as Pavior, prior to sediment progradation back into Dorset.

FIGURE 5.07 <u>The Coinstone at Stonebarrow, Charmouth, Dorset.</u>

(ABOVE) Field aspect of the Coinstone, which consists of a horizon of bored and encrusted early diagenetic, clay-hosted septarian concretions coincident with a biostratigraphic gap of three ammonite subzones. Several types of concretion of variable complexity have been distinguished (Hesselbo & Palmer 1992), of which two, probably derived from slightly different stratigraphic levels, have been juxtaposed by condensation at the erosion surface. (Field assistant is 1.62 m in height).

(BELOW) Exhumation above the sediment-water interface is evident in several Coinstone concretions due to intense surface boring. A mechanism of stratal erosion has been proposed by Hesselbo & Palmer (1992) in which burrowing by crustaceans is inferred to have caused resuspension and increased bed roughness, thus facilitating erosion by relatively weak bottom currents.



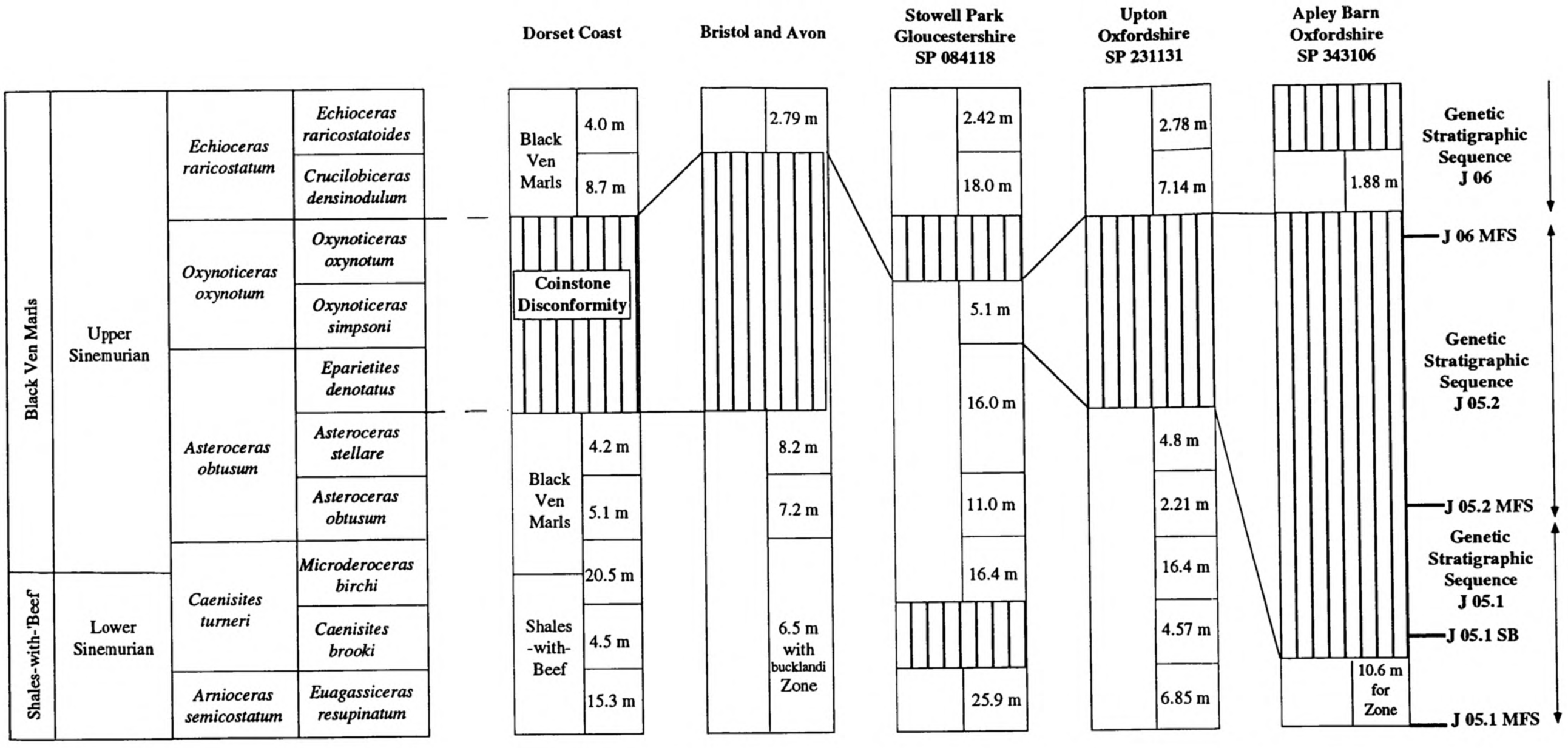


FIGURE 5.08

FIGURE 5.08 The Coinstone disconformity as evident at outcrop in Dorset (SY 380927) shows a variation in ammonite subzonal duration across southern Britain. Only surface exposure and sub-surface data with a subzonal biostratigraphic resolution is shown. The disconformity developed within the Shales-with-'Beef 'is extremely local in geographical extent and is likely to be independent of processes that produced the Coinstone disconformity and may be due to erosion from waves impinging upon the shallow East Midland Shelf. Based upon Green & Melville (1956), Worssam (1963), Poole (1969), Cope *et al.* (1981) and Donovan & Kellaway (1984). The Coinstone disconformity cannot be identified from outcrop or subsurface gamma-ray data without a corresponding ammonite subzonal biostratigraphic data-set. Inferred candidate maximum-flooding surfaces (MSF) and candidate correlative conformities of sequence boundaries (SB) are shown. Subzonal thicknesses are indicated.

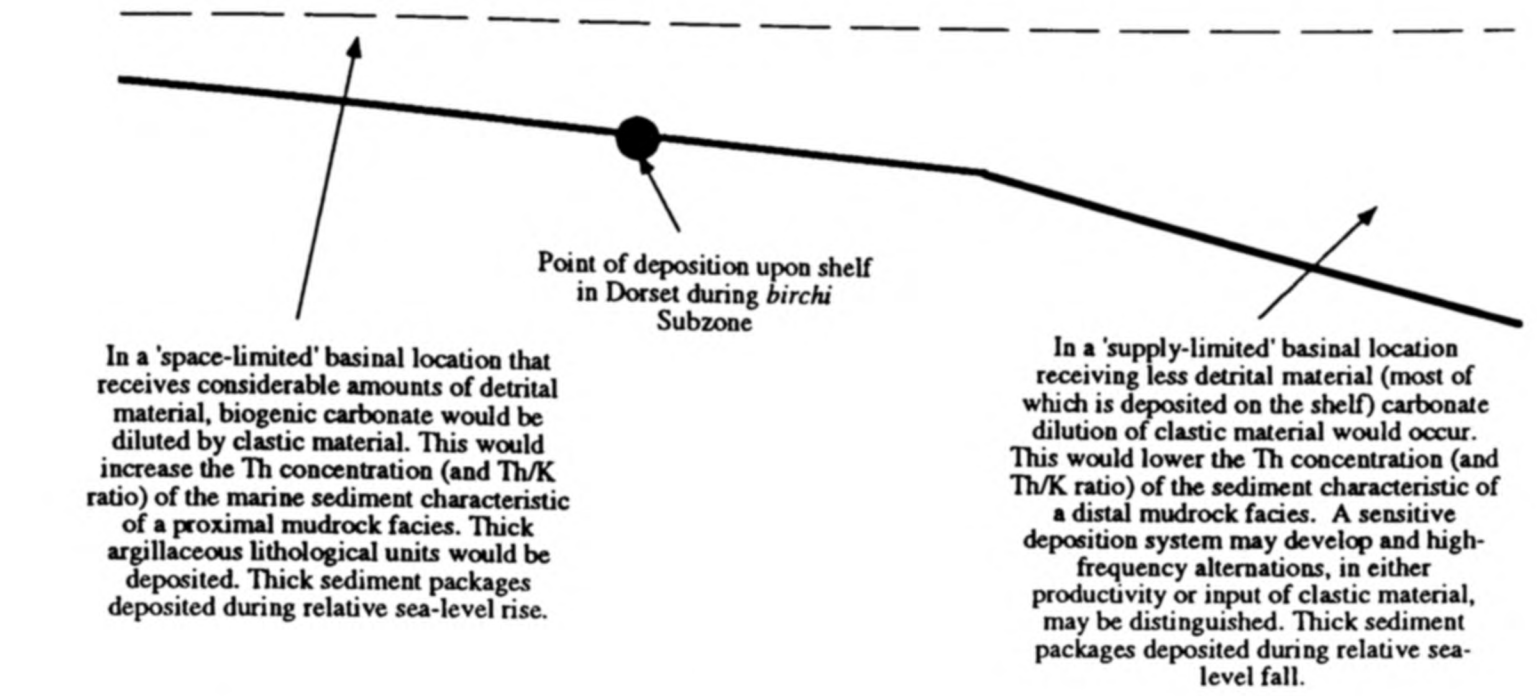
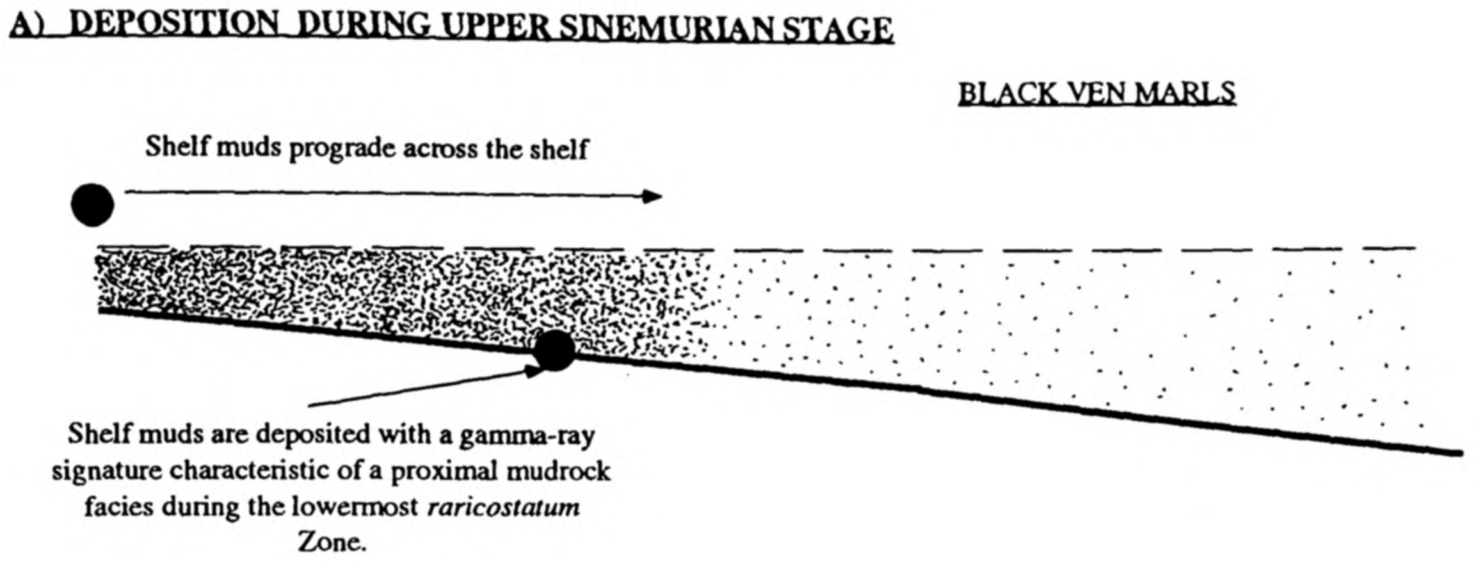


FIGURE 5.09 Possible interpretation of the Coinstone in terms of relative sea-level change.

FIGURE 5.10
Migration of mudrock facies at the Sinemurian - Pliensbachian boundary



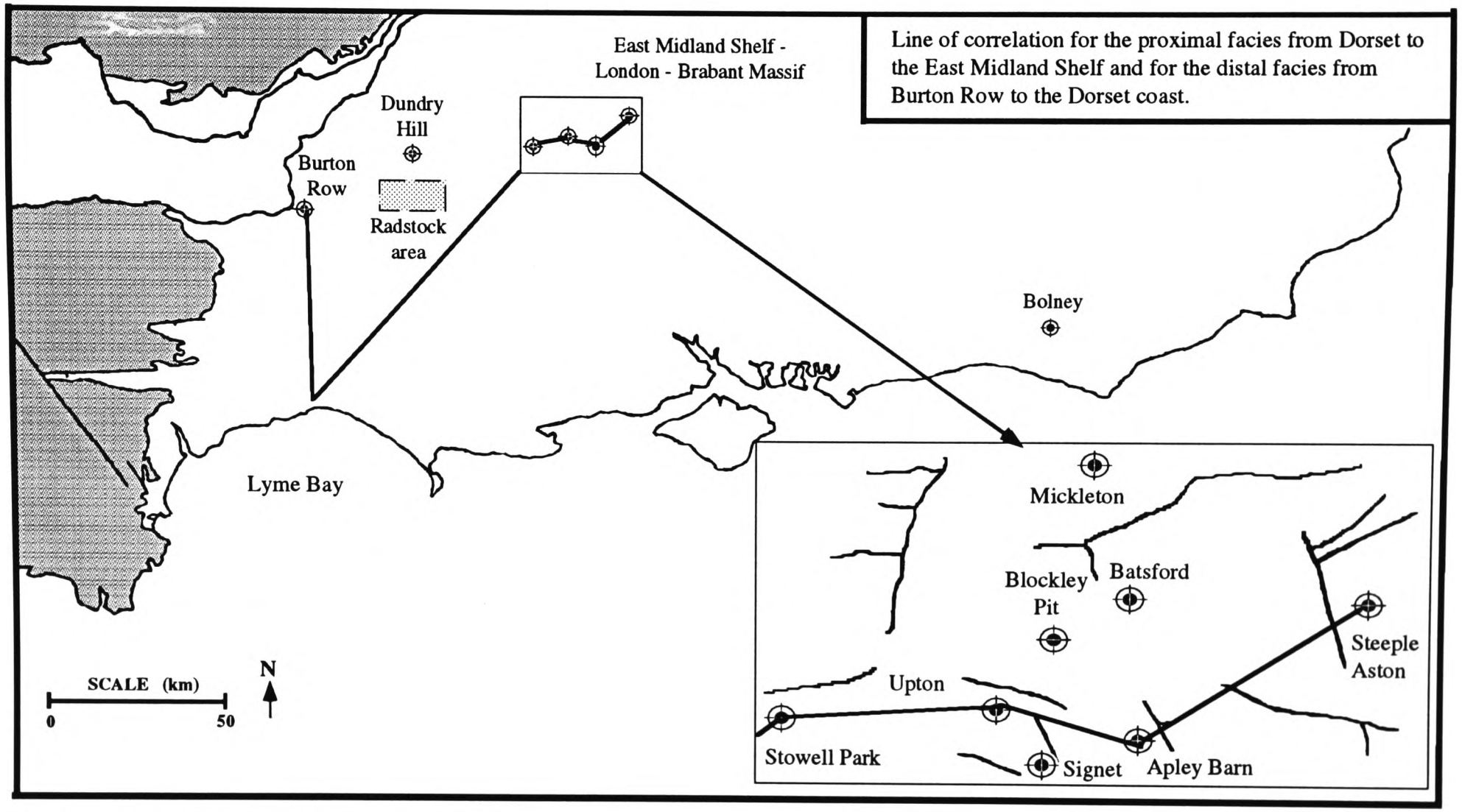


FIGURE 5.11 The Belemnite Marls and lateral time equivalents elsewhere in southern Britain (*jamesoni* to *ibex* Zones). A proximal mudrock facies is identified in the Stowell Park, Apley Barn and Steeple Aston boreholes on the basis of total gamma-ray signature and inferred in the Dundry Hill and Upton boreholes. The proximal facies outcrops at Blockley Pit Gloucestershire. A distal facies is identified in the Burton Row borehole and on the Dorset Coast. Locally, within the Radstock area the sequence becomes considerably condensed. Grid References for localities : Apley Barn (SP 343106), Burton Row, Brent Knoll (ST 335520), Elton Farm, Dundry Hill (ST 563658), Steeple Aston (SP 468258), Stowell Park (SP 084118), Upton, Witney (SP 231131), Blockley Pit section (SP 182369), Dorset coastal sections (SY 380927 - SY 415918), Bolney borehole, Sussex (TQ 280442).

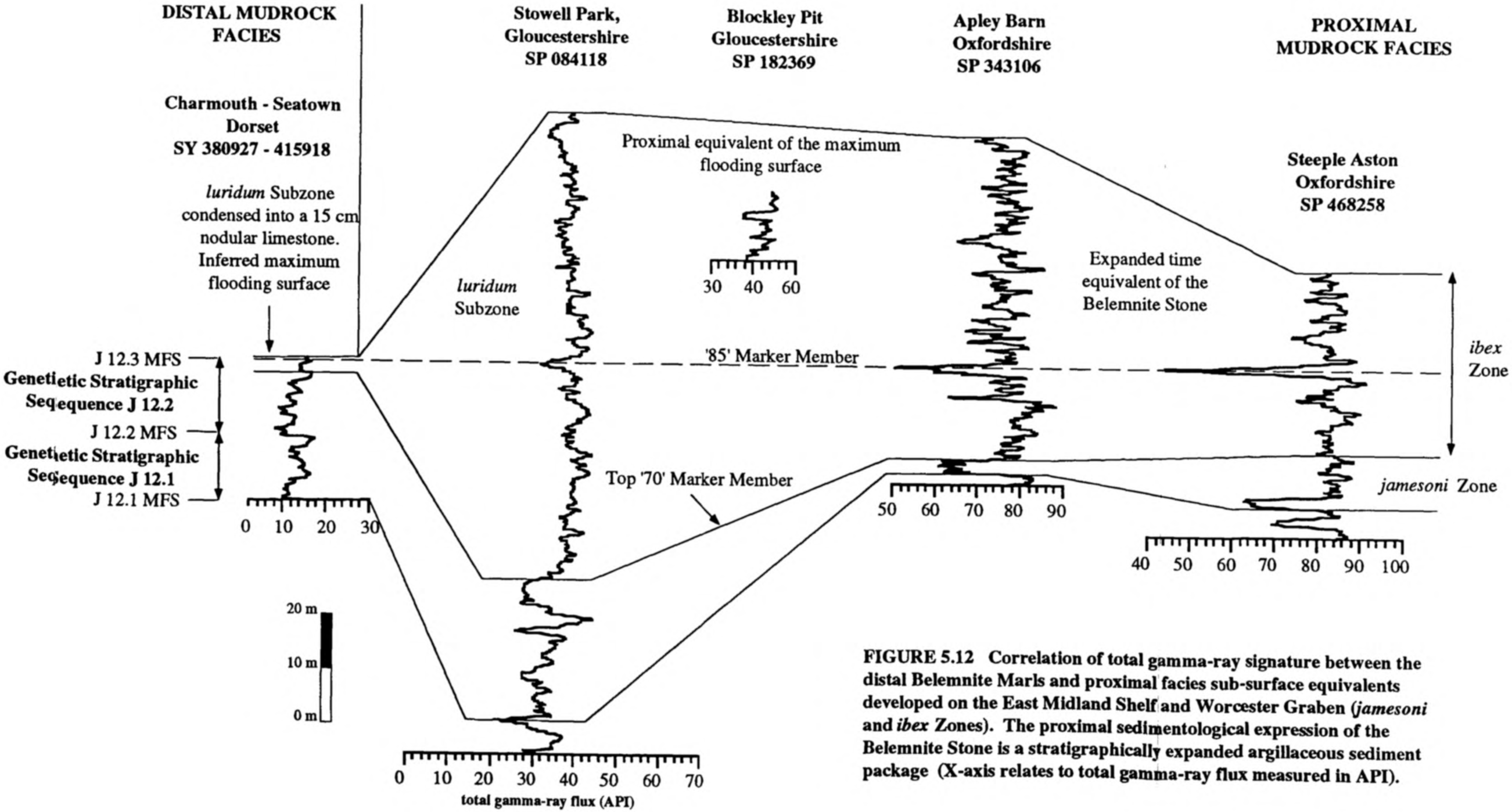


FIGURE 5.12 Correlation of total gamma-ray signature between the distal Belemnite Marls and proximal facies sub-surface equivalents developed on the East Midland Shelf and Worcester Graben (*jamesoni* and *ibex* Zones). The proximal sedimentological expression of the Belemnite Stone is a stratigraphically expanded argillaceous sediment package (X-axis relates to total gamma-ray flux measured in API).

FIGURE 5.12

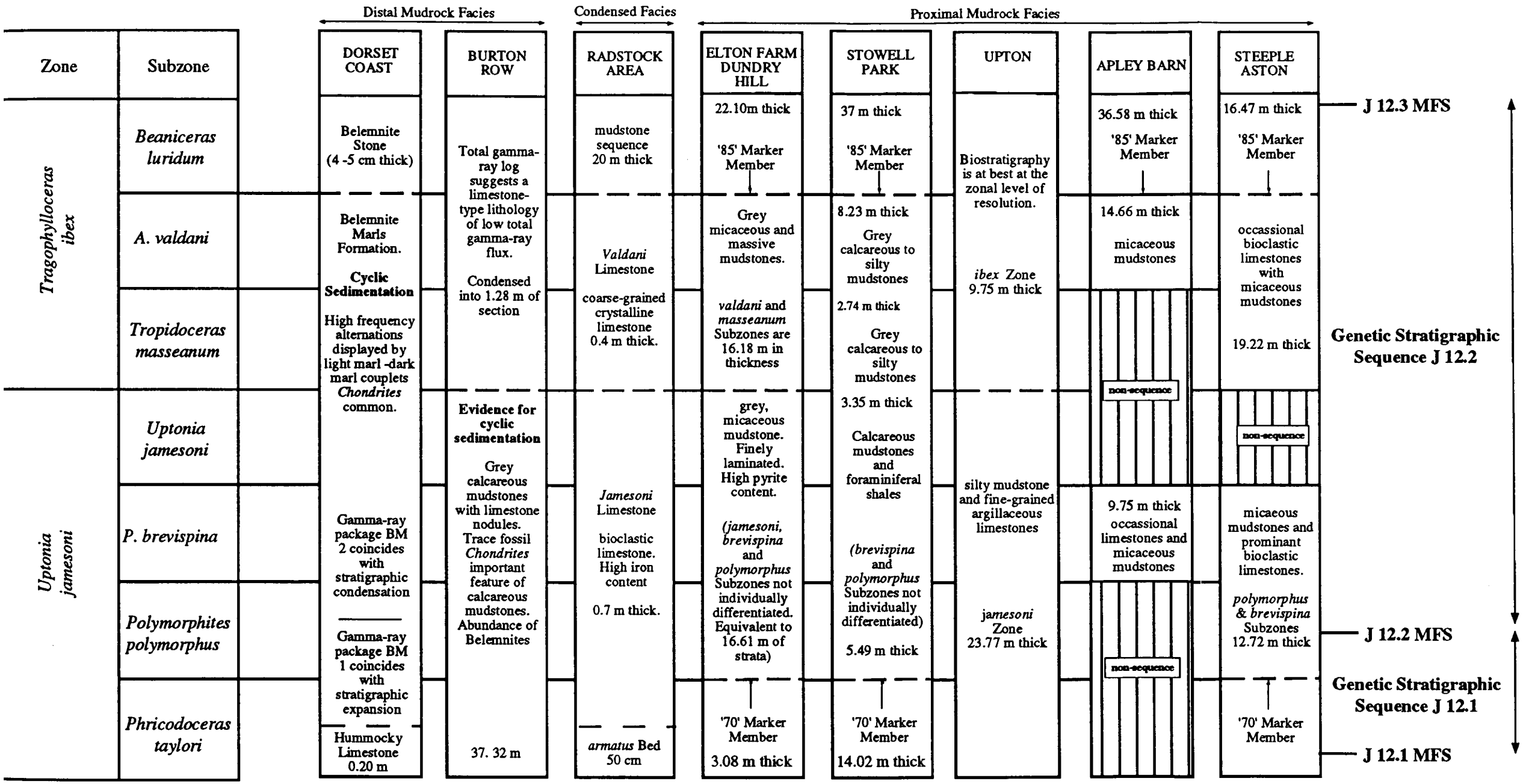


FIGURE 5.13

FIGURE 5.13 Sequence stratigraphic correlation panel for the Lower Pliensbachian in southern Britain. Data from Green & Melville 1956, Worssam 1963, Poole 1977, Whittaker & Green 1983 and onovan & Kellaway 1984. Disconformities are shown. Thickness of ammonite subzones are given where possible. Inferred maximum-flooding surfaces and genetic stratigraphic sequences are shown.

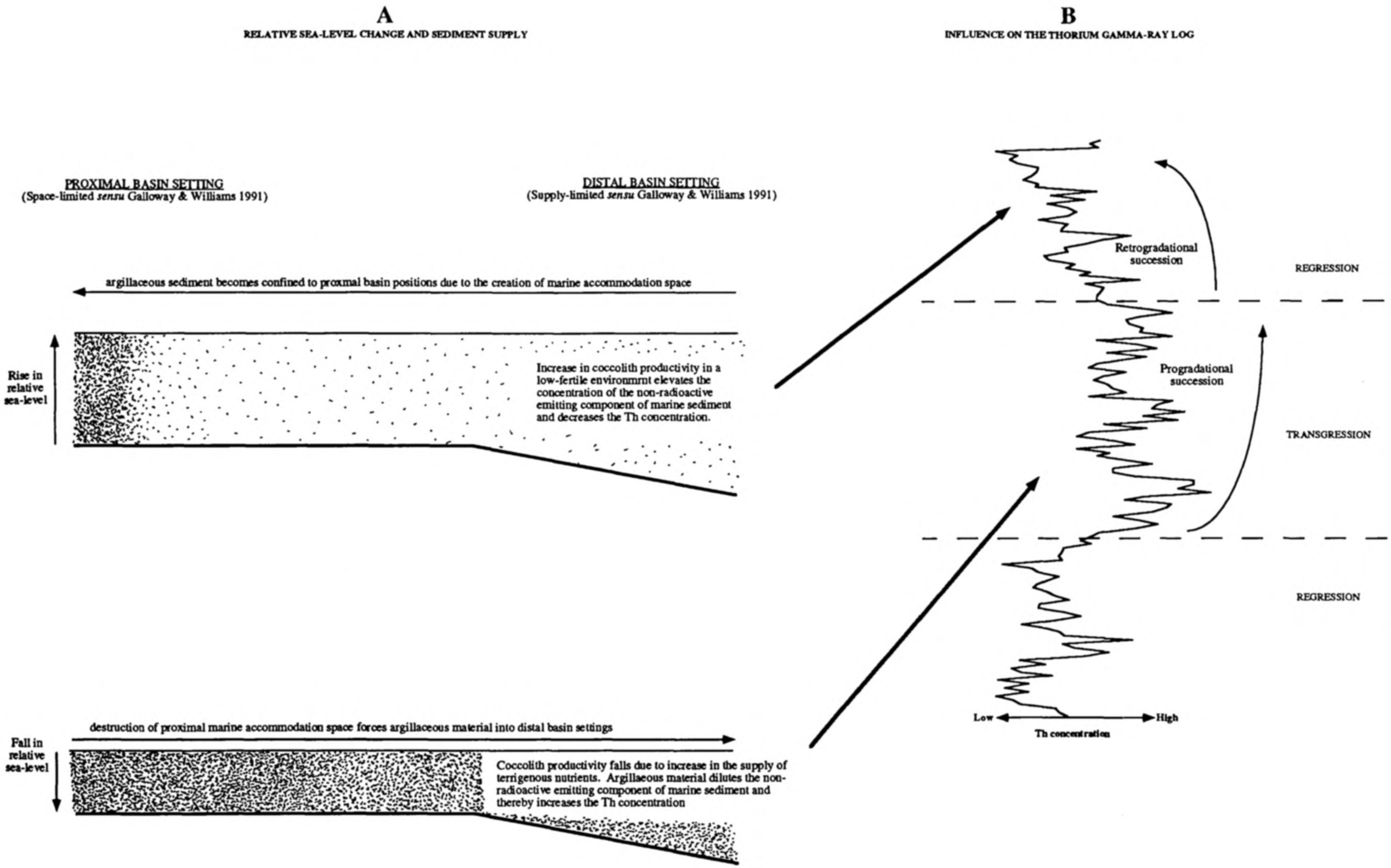
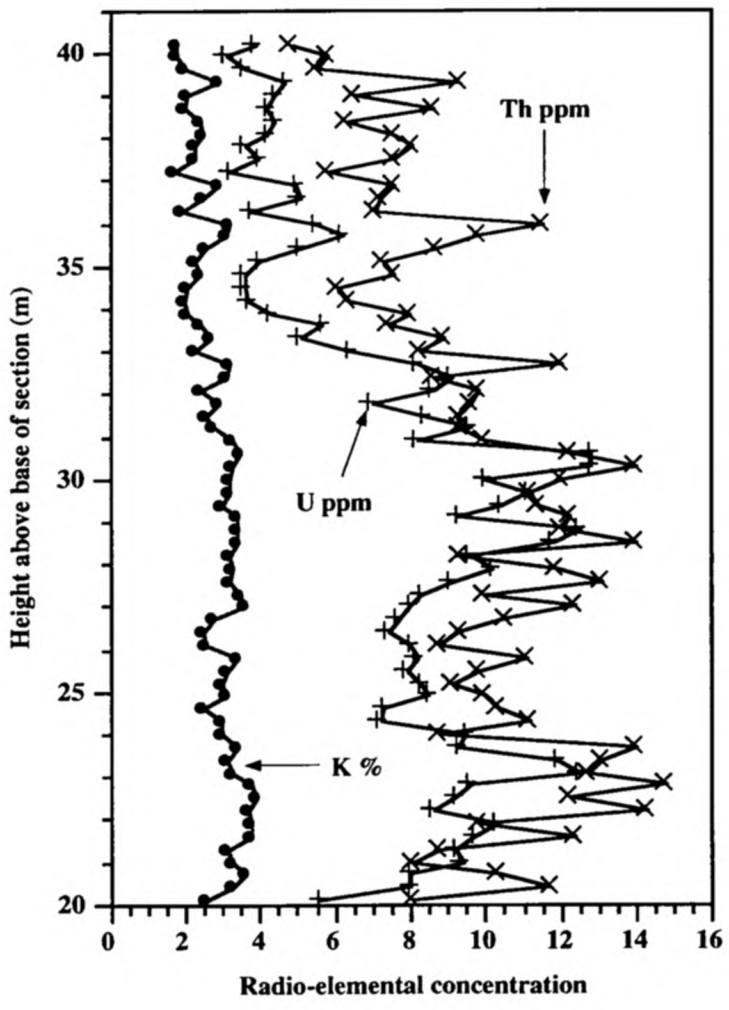


FIGURE 5.14

FIGURE 5.14 A model for the deposition of the Lower Lias and the influence of sediment supply on the Th gamma-ray log. The argillaceous intervals are principally regressive in character and the carbonate-rich intervals are principally transgressive in character.

A

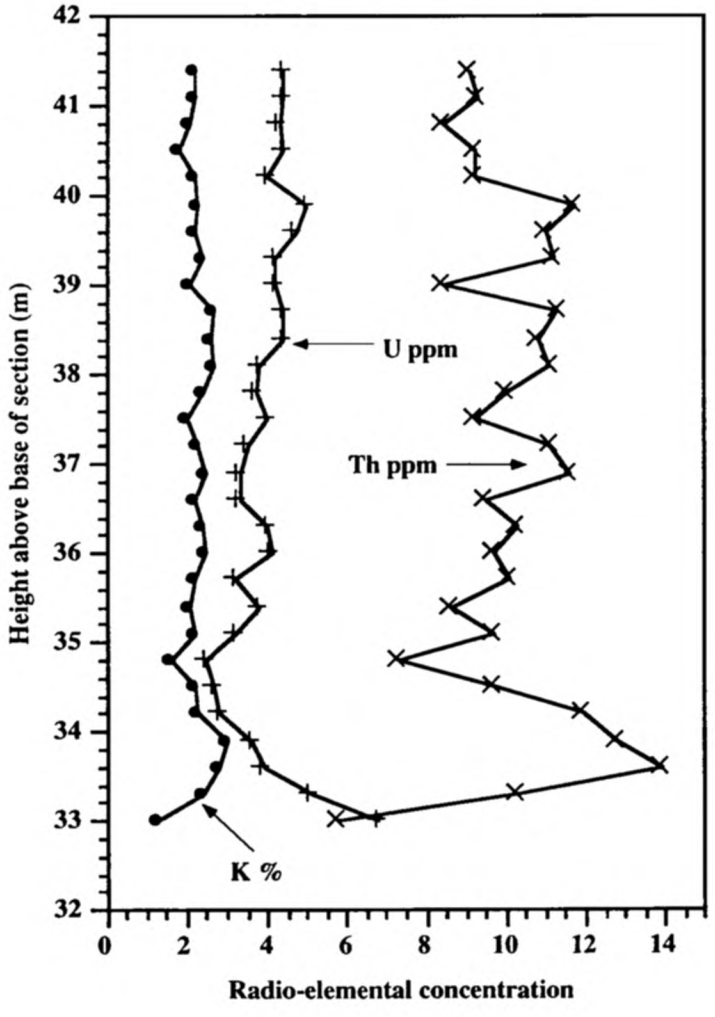
liasicus Shales, Bristol Channel Basin.
Gamma-ray unit BL 4



High U - High Th
(positive covariant relationship between U and Th at 95 % significance level)

B

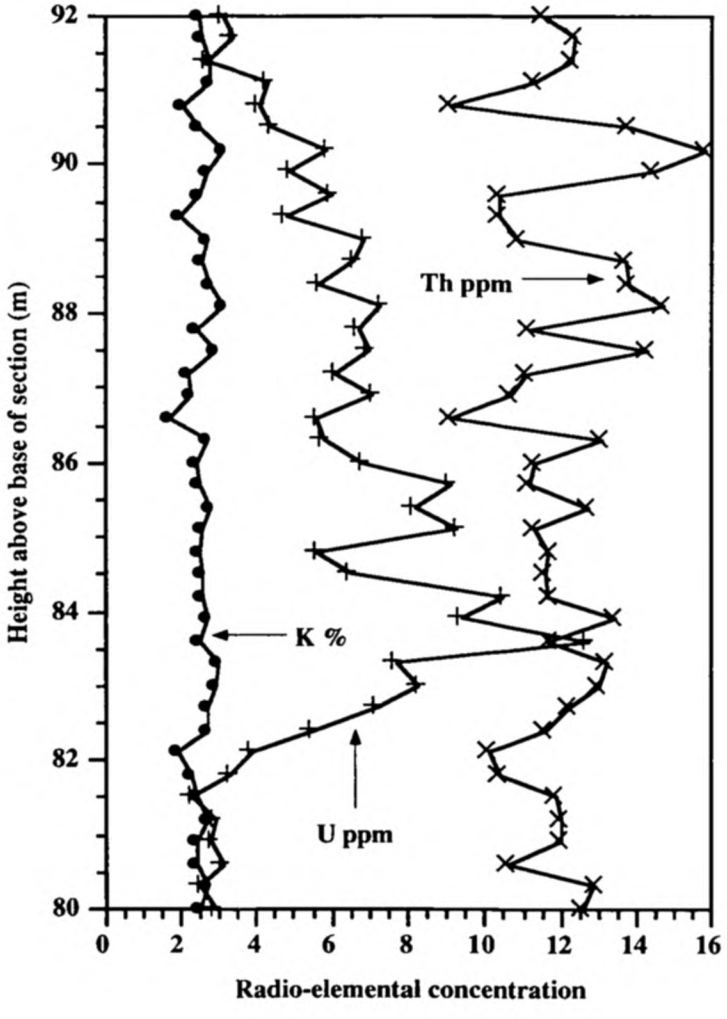
scipionianum Shales, Wessex Basin.
Gamma-ray unit SWB 1



Low U - High Th
(no covariant relationship between U and Th at 95 % significance level)

C

obtusum Shales, Wessex Basin.
Gamma-ray unit BVM 2



Increasing, then decreasing U - High Th
(no covariant relationship between U and Th at 95 % significance level)

FIGURE 5.15

FIGURE 5.15 Three types of shale can be distinguished in the Lower Lias in southern Britain, primarily based on the U concentration log as Th concentration for all argillaceous intervals is high. In case A anoxia appears to have developed during a fall in relative sea-level as the supply of terrigenous nutrients to the marine environment increased. This may have led to an increase in productivity and oxygen-depletion of the water column, resulting in bottom-water anoxia. In case B, the *sciponianum* Shales are also interpreted as having been deposited during a fall in relative sea-level, but anoxia appears to have not been extensively developed, as indicated by a low concentration of U. In case C, the U concentration log shows an increase followed by a progressive decrease in U, which is interpreted as the result of a rise in relative sea-level with the migration of anoxic basinal-waters on to the shelf. The development of anoxia in the Lower Lias is not diagnostic of any one particular part of the relative sea-level curve.

Appendix 1

Methodology and Experimentation Data Required for Outcrop Based Gamma-Ray Spectrometry.

Plane Taken	Horizon	Sample time	Total Number of Counts Recorded				Elemental Concentrations			
		Secs	Total	K	U	Th	K %	U ppm	Th ppm	Total ur
Vertical Plane	Iron Ledge	280	9073	1402	558	127	0.90	4.50	2.80	08.40
Vertical Plane	Iron Ledge	280	9104	1409	594	132	0.80	4.90	2.90	08.50
Vertical Plane	Iron Ledge	280	9043	1384	588	141	0.80	4.80	3.10	08.40
Vertical Plane	Iron Ledge	280	9237	1409	598	140	0.80	4.80	3.10	08.60
Vertical Plane	Iron Ledge	280	8905	1307	500	106	0.80	4.10	2.10	07.60
Vertical Plane	Iron Ledge	280	8910	1374	520	127	0.90	4.10	2.00	08.20
Vertical Plane	Iron Ledge	280	8863	1393	556	105	0.90	4.70	2.10	08.20
Vertical Plane	Iron Ledge	280	9549	1511	626	125	0.90	5.20	2.60	09.00
Vertical Plane	Iron Ledge	280	9288	1383	626	127	0.80	5.20	2.70	08.70
Vertical Plane	Iron Ledge	280	9008	1383	582	139	0.80	4.70	3.00	08.90
Vertical Plane	Iron Ledge	280	8785	1340	557	129	0.80	4.50	2.80	08.10
Vertical Plane	Iron Ledge	280	8981	1401	566	133	0.90	4.60	2.90	08.30
Vertical Plane	Iron Ledge	280	8907	1378	579	118	0.80	4.80	2.50	08.20
Vertical Plane	Iron Ledge	280	8895	1384	526	130	0.90	4.20	2.80	08.20
Vertical Plane	Iron Ledge	280	11975	1729	783	141	0.80	6.80	2.90	12.10
Vertical Plane	Iron Ledge	280	10359	1717	656	145	1.10	5.40	3.30	10.10
Vertical Plane	Iron Ledge	280	9951	1558	639	140	1.00	5.20	3.10	09.50
Vertical Plane	Iron Ledge	280	11331	1941	726	186	1.30	5.00	4.30	11.30
Vertical Plane	Iron Ledge	280	10282	1649	616	166	1.10	4.90	3.60	10.00
Vertical Plane	Iron Ledge	280	11191	1920	670	161	1.30	5.40	3.60	11.10
						Mean	0.92	4.98	2.91	9.07

Table 1.10 **Data-set representing 20 samples taken at different locations on the Iron Ledge limestone (Blue Lias Formation) that outcrops at Seven Rock Point, Lyme Regis, Dorset (SY 335916). The data were collected with the B.P. GR-256 gamma-ray spectrometer on October 25th 1993 with the detector placed perpendicular to bedding (*i.e.* in the vertical plane). All field calibration and experimental data in this study were collected with the detector placed in the vertical plane, unless otherwise stated, to be consistent with the data collected from the calibration facility at the British Geological Survey, Keyworth.**

Plane Taken	Horizon	Sample Time Secs	Total Number of Counts Recorded Total	K	U	Th	Calculated Elemental Concentrations K %	U ppm	Th ppm	Total ur
Vertical Plane	Iron Ledge	360	41360	1685	1641	312	0.21	12.02	6.25	24.29
Vertical Plane	Iron Ledge	360	38390	1507	1393	258	0.25	10.23	5.17	22.55
Vertical Plane	Iron Ledge	360	39240	1481	1357	234	0.49	10.06	4.69	23.04
Vertical Plane	Iron Ledge	360	41820	1689	1519	253	0.32	11.30	5.07	24.56
Vertical Plane	Iron Ledge	360	45480	1883	1754	347	0.29	12.77	6.96	26.71
Vertical Plane	Iron Ledge	360	47280	2046	1913	330	0.33	14.18	6.61	27.77
Vertical Plane	Iron Ledge	360	44060	1802	1768	326	0.22	13.00	6.53	25.88
Vertical Plane	Iron Ledge	360	50490	1638	1356	296	0.36	09.74	5.93	29.65
Vertical Plane	Iron Ledge	360	48530	1478	1191	253	0.35	08.59	5.07	28.50
Vertical Plane	Iron Ledge	360	48190	1560	1271	250	0.37	09.26	5.01	28.30
Vertical Plane	Iron Ledge	360	47700	1431	1234	244	0.29	08.99	4.89	28.01
Vertical Plane	Iron Ledge	360	49690	1575	1224	276	0.40	08.74	5.53	29.18
Vertical Plane	Iron Ledge	360	48770	1480	1191	254	0.35	08.58	5.09	28.64
Vertical Plane	Iron Ledge	360	45770	1191	1022	224	0.24	07.33	4.49	26.88
Vertical Plane	Iron Ledge	360	50980	1202	0990	230	0.26	07.04	4.61	29.94
Vertical Plane	Iron Ledge	360	44590	1157	0969	202	0.25	07.01	4.05	26.19
Vertical Plane	Iron Ledge	360	45030	1151	0973	213	0.24	06.98	4.27	26.44
Vertical Plane	Iron Ledge	360	44320	1143	0974	199	0.24	07.06	3.99	26.03
Vertical Plane	Iron Ledge	360	45410	1234	1056	187	0.27	07.80	3.75	26.67
Vertical Plane	Iron Ledge	360	46400	1292	1040	228	0.24	07.46	4.57	27.25
						Mean	**0.30**	**9.41**	**5.13**	**26.82**

Table 1.11 **Data-set representing 20 samples taken at different locations on the limestone horizon known as Iron Ledge of the Blue Lias Formation that outcrops at Seven Rock Point, Lyme Regis, Dorset (SY 335916). Data collected with the GR-410 gamma-ray spectrometer. Raw data shown. Reallignment formulae for comparison with radio-elemental concentration data collected with the GR-256 gamma-ray spectrometer are given in Chapter 2 (Section 2.05). The data were collected on July 17th 1994. The radio-elemental data were retrospectively found to be unreliable and cannot be used for interpretation.**

Plane Taken	Horizon	Sample Time Secs	Total Number of Counts Recorded Total	K	U	Th	Elemental Concentrations K %	U ppm	Th ppm	Total ur
Vertical Plane	Belemnite Bed	215	9450	1677	547	182	1.50	5.30	5.70	12.50
Vertical Plane	Belemnite Bed	215	9487	1704	608	202	1.50	6.00	6.50	12.60
Vertical Plane	Belemnite Bed	215	9564	1666	546	202	1.50	5.20	6.50	12.70
Vertical Plane	Belemnite Bed	215	9506	1667	561	204	1.50	5.40	6.50	12.60
Vertical Plane	Belemnite Bed	215	9183	1574	569	195	1.40	5.50	6.20	12.10
Vertical Plane	Belemnite Bed	215	9576	1634	557	208	1.50	5.30	6.80	12.70
Vertical Plane	Belemnite Bed	215	9748	1748	542	229	1.60	4.90	7.50	13.00
Vertical Plane	Belemnite Bed	215	9650	1724	524	238	1.60	4.60	7.90	12.90
Vertical Plane	Belemnite Bed	215	9098	1593	543	223	1.40	5.00	7.30	11.90
Vertical Plane	Belemnite Bed	215	9407	1657	521	191	1.50	4.90	6.10	12.50
Vertical Plane	Belemnite Bed	215	9520	1656	560	227	1.50	5.20	7.40	12.60
Vertical Plane	Belemnite Bed	215	9436	1645	548	209	1.50	5.10	6.80	12.50
Vertical Plane	Belemnite Bed	215	9680	1725	576	226	1.60	5.40	7.40	12.90
Vertical Plane	Belemnite Bed	215	9248	1538	502	181	1.40	4.80	5.80	12.20
Vertical Plane	Belemnite Bed	215	9223	1564	524	216	1.40	4.80	7.10	12.20
Vertical Plane	Belemnite Bed	215	9340	1580	548	190	1.40	5.30	6.10	12.40
Vertical Plane	Belemnite Bed	215	9506	1647	493	199	1.60	4.50	6.40	12.60
Vertical Plane	Belemnite Bed	215	9406	1640	570	227	1.50	5.30	7.40	12.50
Vertical Plane	Belemnite Bed	215	9804	1722	612	208	1.50	6.00	6.70	13.10
Vertical Plane	Belemnite Bed	215	9617	1693	540	241	1.60	4.80	8.00	12.80
						Mean	**1.50**	**5.17**	**6.81**	**12.57**

Table 1.12 **Data-set representing 20 samples taken at different locations on the dark laminated-shale horizon known as the Belemnite Bed (Belemnite Marls Formation) that outcrops west of Seatown, Dorset (SY 318908). The data were collected with the B.P. GR-256 gamma-ray spectrometer on May 16th 1993. The detector was placed perpendicular to bedding (*i.e.* in the vertical plane).**

Plane Taken	Horizon	Sample Time Secs	Total Number of Counts Recorded Total	K	U	Th	Calculated Elemental Concentrations K %	U ppm	Th ppm	Total ur
Vertical Plane	Belemnite Bed	240	43360	2035	2266	414	0.10	25.02	12.45	38.20
Vertical Plane	Belemnite Bed	240	43870	1936	2141	400	0.10	23.57	12.03	38.65
Vertical Plane	Belemnite Bed	240	44650	1895	2013	424	0.16	21.80	12.75	39.33
Vertical Plane	Belemnite Bed	240	45580	1921	1982	419	0.22	21.45	12.60	40.15
Vertical Plane	Belemnite Bed	240	47200	1887	1788	374	0.39	19.38	11.24	41.58
Vertical Plane	Belemnite Bed	240	48120	1820	1814	409	0.26	19.44	12.30	42.39
Vertical Plane	Belemnite Bed	240	48580	1832	1739	379	0.37	18.73	11.40	42.79
Vertical Plane	Belemnite Bed	240	48250	1871	1779	382	0.38	19.21	11.49	42.50
Vertical Plane	Belemnite Bed	240	40610	1806	2132	358	-0.02	23.78	10.76	35.77
Vertical Plane	Belemnite Bed	240	41490	1793	2109	383	-0.03	23.30	11.52	36.55
Vertical Plane	Belemnite Bed	240	42310	1945	2076	381	0.19	22.91	11.46	37.27
Vertical Plane	Belemnite Bed	240	41780	1793	2140	462	-0.11	23.09	13.89	36.80
Vertical Plane	Belemnite Bed	240	43940	2017	2239	435	0.09	24.52	13.08	38.71
Vertical Plane	Belemnite Bed	240	44940	2019	2316	430	0.02	25.52	12.93	39.59
Vertical Plane	Belemnite Bed	240	42350	1806	2194	417	-0.12	24.10	12.54	37.31
Vertical Plane	Belemnite Bed	240	42260	1940	2098	412	0.14	22.94	12.39	37.23
Vertical Plane	Belemnite Bed	240	42000	1915	2105	416	0.10	23.00	12.51	37.00
Vertical Plane	Belemnite Bed	240	40080	1825	2358	429	-0.26	26.05	12.90	35.31
Vertical Plane	Belemnite Bed	240	40420	1789	2224	348	-0.13	24.99	10.46	35.61
Vertical Plane	Belemnite Bed	240	40440	1819	2237	428	-0.15	24.55	12.87	35.62
						Mean	**0.09**	**22.87**	**12.18**	**38.42**

Table 1.13 **Data-set representing 20 samples taken at different locations on the dark laminated-shale horizon known as the Belemnite Bed (Belemnite Marls Formation) that outcrops west of Seatown, Dorset (SY 318908). Data collected with the GR-410 gamma-ray spectrometer. Raw data shown. Reallignment formulae for comparison with radio-elemental concentration data collected with the GR-256 gamma-ray spectrometer are given in Chapter 2 (Section 2.05). The data were collected on July 24th 1994. The radio-elemental data were retrospectively found to be unreliable and cannot be used for interpretation.**

A) Readings for a single point on Belemnite Bed on high voltage

Plane	Horizon	Sample Time Secs	Total Number of Counts Recorded					Calculated Elemental Concentrations		
			Total	K	U	Th	Total ur	K %	U ppm	Th ppm
Vertical	Belemnite Bed	240	43360	2035	2266	414	38.20	0.10	25.02	12.45
Vertical	Belemnite Bed	240	43870	1936	2141	400	38.65	0.10	23.5	12.03
Vertical	Belemnite Bed	240	44650	1895	2013	424	39.33	0.16	21.80	12.75
Vertical	Belemnite Bed	240	45580	1921	1982	419	40.15	0.22	21.45	12.60
Vertical	Belemnite Bed	240	47200	1887	1788	374	41.58	0.39	19.38	11.24
Vertical	Belemnite Bed	240	48120	1820	1814	409	42.39	0.26	19.44	12.30
Vertical	Belemnite Bed	240	48580	1832	1739	379	42.79	0.37	18.73	11.40
Vertical	Belemnite Bed	240	40610	1806	2132	358	35.77	-0.02	23.78	10.76
Vertical	Belemnite Bed	240	41490	1793	2109	383	36.55	-0.03	23.30	11.52
Vertical	Belemnite Bed	240	42310	1945	2076	381	37.27	0.19	22.91	11.46
Vertical	Belemnite Bed	240	41780	1793	2140	462	36.80	-0.11	23.09	13.89
Vertical	Belemnite Bed	240	43940	2017	2229	435	38.71	0.10	24.40	13.08
Vertical	Belemnite Bed	240	44940	2019	2316	430	39.59	0.02	25.52	12.93
Vertical	Belemnite Bed	240	42350	1806	2194	417	37.31	-0.12	24.10	12.54
Vertical	Belemnite Bed	240	42260	1940	2098	412	37.23	0.14	22.94	12.39
Vertical	Belemnite Bed	240	48250	1871	1779	382	42.50	0.38	19.21	11.49
Vertical	Belemnite Bed	240	42000	1915	2105	416	37.00	0.10	23.00	12.51
Vertical	Belemnite Bed	240	40080	1873	2250	381	35.31	-0.07	25.07	11.46
Vertical	Belemnite Bed	240	40420	1789	2224	348	35.61	-0.13	24.99	10.46
Vertical	Belemnite Bed	240	40440	1819	2237	428	35.62	0.15	24.55	12.87
					Mean		**38.42**	**0.09**	**22.81**	**12.10**

Table 1.14 **Comparison between data collected under conditions of high battery voltage (11 V) and low battery voltage (below 11 V) with the GR-410 gamma-ray spectrometer. Data collected on the dark laminated-shale horizon known as the Belemnite Bed (Belemnite Marls Formation) that outcrops west of Seatown, Dorset (SY 318908). Raw data are shown. Reallignment formulae for comparison with radio-elemental concentration data collected with the GR-256 gamma-ray spectrometer are given in Chapter 2 (Section 2.05). Collected on July 23rd 1993. (1 of 2).**

B) Readings for a single point on Belemnite Bed on low voltage

Plane	Horizon	Sample Time Secs	Total Number of Counts Recorded Total	K	U	Th	Calculated Elemental Concentrations Total ur	K %	U ppm	Th ppm
Vertical	Belemnite Bed	240	51590	1983	1782	384	45.45	0.51	19.23	11.55
Vertical	Belemnite Bed	240	53730	1964	1812	379	47.33	0.46	19.64	11.40
Vertical	Belemnite Bed	240	50030	1916	1742	359	44.07	0.48	18.92	10.79
Vertical	Belemnite Bed	240	51160	1955	1733	355	45.07	0.54	18.84	10.67
Vertical	Belemnite Bed	240	50970	1949	1684	374	44.90	0.57	18.09	11.24
Vertical	Belemnite Bed	240	51280	1991	1692	366	45.17	0.62	18.25	11.00
Vertical	Belemnite Bed	240	51160	1907	1712	405	45.07	0.47	18.20	12.18
Vertical	Belemnite Bed	240	51840	1954	1640	405	45.67	0.60	17.31	12.18
Vertical	Belemnite Bed	240	51850	1932	1630	391	45.67	0.59	17.29	11.76
Vertical	Belemnite Bed	240	54080	1947	1606	387	47.64	0.63	17.02	11.64
						Mean	**45.60**	**0.55**	**18.28**	**11.44**
						Percentage Difference	**18.70**	**474.51**	**-19.87**	**-5.49**

Table 1.14 (2 of 2). The radio-elemental data that were collected with the GR-410 was retrospectively found to be unreliable. Only total gamma-ray flux can therefore be confidently used for interpretation (see Section 2.05).

Calibration Pad	Sample Time	Total counts	K counts	U counts	Th counts
K3-88	120 seconds	16180	772	1200	66
K3-88	120 seconds	16520	776	1404	84
K3-88	120 seconds	16530	775	1537	44
K3-88	120 seconds	16180	772	1200	66
K3-88	60 seconds	8050	386	417	40
K3-88	60 seconds	8370	385	878	44
U8-89	120 seconds	30050	1816	1353	183
U8-89	120 seconds	28820	2032	1632	211
U8-89	120 seconds	30400	1735	1183	167
U8-89	120 seconds	31070	1649	1221	208
U8-89	60 seconds	15500	795	591	84
U8-89	60 seconds	15760	814	624	118
T3-88	120 seconds	38680	1151	2103	1473
T3-88	120 seconds	33690	1435	1439	1499
T3-88	120 seconds	36380	1304	1818	1274
T3-88	120 seconds	33740	1473	1462	1458
T3-88	60 seconds	16390	854	661	823
T3-88	60 seconds	15480	819	635	816
B3-88	120 seconds	7320	270	575	67
B3-88	120 seconds	7360	333	664	99
B3-88	120 seconds	7760	334	767	74
B3-88	120 seconds	7570	316	768	80
B3-88	60 seconds	3850	174	406	52
B3-88	60 seconds	3820	179	419	54
		Summed Results			
K3-88	600 seconds	82160	3882	6490	369
U8-89	600 seconds	151600	8841	6604	971
T3-88	600 seconds	174360	7040	8118	7343
B3-88	600 seconds	37680	1606	3599	426

Table 1.15 **Temperature drift during calibration of the GR-410 gamma-ray spectrometer. The number of U counts on U8-89 pad are only approximately double those detected on the background radiation pad B3-88. Similarly the number of K counts on U8-89 pad are actually greater than the number of U counts detected on the same pad. This indicates drift of the gamma-ray spectra with the K-energy window recording a significant proportion of counts from a pure U source. On the K3-88 pad the number of U counts are actually greater than the number of K counts indicating drift of the K gamma-ray spectra into the U energy window. In this case the U window is recording a significant proportion of gamma-ray counts from a pure K source. (See Chapter 2, Section 2.03).**
The calibration data were collected on the 9th January 1995.

Plane Taken	Horizon	Sample Time Secs	Total Number of Counts Recorded Total	K	U	Calculated Elemental Concentrations Th	K %	U ppm	Th ppm	Total ur
Horizontal (S)	Lower Cement Bed	480	35940	1671	2712	466	-0.40	15.08	7.01	15.83
Horizontal (S)	Lower Cement Bed	480	37560	1727	2657	424	-0.33	14.90	6.37	16.54
Horizontal (S)	Lower Cement Bed	480	38020	1623	2641	443	-0.39	14.73	6.66	16.75
Horizontal (S)	Lower Cement Bed	480	37990	1650	2462	412	-0.28	13.73	6.19	16.73
Horizontal (S)	Lower Cement Bed	480	37650	1622	2643	434	-0.39	14.77	6.52	16.58
Horizontal (S)	Lower Cement Bed	480	37390	1574	2626	389	-0.40	14.84	5.85	16.47
Horizontal (S)	Lower Cement Bed	480	36540	1575	2603	410	-0.39	14.62	6.16	16.09
Horizontal (S)	Lower Cement Bed	480	37170	1606	2661	415	-0.40	14.96	6.24	16.37
Horizontal (S)	Lower Cement Bed	480	37250	1508	2559	414	-0.41	14.33	6.22	16.41
Horizontal (S)	Lower Cement Bed	480	37780	1627	2663	409	-0.39	14.99	6.15	16.64
Horizontal (D)	Lower Cement Bed	480	37810	1643	2510	428	-0.31	13.97	6.43	16.65
Horizontal (D)	Lower Cement Bed	480	39540	1679	2383	437	-0.23	13.15	6.57	17.42
Horizontal (D)	Lower Cement Bed	480	44480	1870	2567	485	-0.22	14.11	7.29	19.59
Horizontal (D)	Lower Cement Bed	480	44240	1759	2439	470	-0.22	13.37	7.07	19.49
Horizontal (D)	Lower Cement Bed	480	43330	1653	2327	423	-0.22	12.85	6.36	19.08
Horizontal (D)	Lower Cement Bed	480	44320	1744	2366	433	-0.18	13.06	6.51	19.52
Horizontal (D)	Lower Cement Bed	480	44250	1715	2342	403	-0.18	13.02	6.06	19.49
Horizontal (D)	Lower Cement Bed	480	47410	1785	2023	457	0.00	10.84	6.87	20.88
Horizontal (D)	Lower Cement Bed	480	46830	1704	1966	421	-0.01	10.62	6.33	20.63
Horizontal (D)	Lower Cement Bed	480	48310	1760	1962	455	0.01	10.46	6.84	21.28
Vertical (S)	Lower Cement Bed	480	46100	1495	1577	355	0.06	8.45	5.34	20.30
Vertical (S)	Lower Cement Bed	480	47470	1434	1488	342	0.07	7.95	5.14	20.91

Table 1.16 **Comparison between data collected with the detector of the gamma-ray spectrometer placed in the horizontal plane (parallel to bedding) and the detector placed in the vertical plane (perpendicular to bedding). The data were collected on the limestone known as the Lower Cement Bed (Black Ven Marls Formtion) that outcrops east of Charmouth, Dorset (SY 368930) with the GR-410 gamma-ray spectrometer. Raw data shown. Same location denoted as (S) and different locations as (D). The data were collected on July 15th 1994. Only total gamma-ray flux can be reliably interpreted. (1 of 2.)**

Plane Taken	Horizon	Sample Time	Total Number of Counts Recorded			Calculated Elemental Concentrations				Total
		Secs	Total	K	U	Th	K %	U ppm	Th ppm	ur
Vertical (S)	Lower Cement Bed	480	46900	1510	1496	350	0.11	7.97	5.26	20.66
Vertical (S)	Lower Cement Bed	480	46470	1405	1530	382	0.02	8.06	5.74	20.47
Vertical (S)	Lower Cement Bed	480	46390	1463	1548	336	0.06	8.34	5.05	20.43
Vertical (S)	Lower Cement Bed	480	46410	1443	1526	356	0.05	8.13	5.35	20.44
Vertical (S)	Lower Cement Bed	480	46510	1446	1544	366	0.04	8.20	5.50	20.49
Vertical (S)	Lower Cement Bed	480	46510	1434	1501	323	0.07	8.10	4.86	20.49
Vertical (S)	Lower Cement Bed	480	46520	1406	1545	378	0.02	8.17	5.68	20.49
Vertical (S)	Lower Cement Bed	480	44890	1414	1562	373	0.01	8.29	5.60	20.52
Vertical (D)	Lower Cement Bed	480	39720	1017	999	256	0.07	05.24	3.85	17.49
Vertical (D)	Lower Cement Bed	480	38590	1087	1176	249	0.03	06.36	3.74	17.00
Vertical (D)	Lower Cement Bed	480	38410	1085	1100	280	0.06	05.77	4.21	16.92
Vertical (D)	Lower Cement Bed	480	50680	1743	2089	460	-0.06	11.23	6.92	22.32
Vertical (D)	Lower Cement Bed	480	44600	1518	1600	364	0.06	08.56	5.47	19.64
Vertical (D)	Lower Cement Bed	480	57190	1999	1945	448	0.17	10.38	6.73	25.19
Vertical (D)	Lower Cement Bed	480	49010	1484	1418	340	0.14	07.52	5.11	21.59
Vertical (D)	Lower Cement Bed	480	53870	1572	1426	380	0.17	07.42	5.71	23.73
Vertical (D)	Lower Cement Bed	480	51400	1151	945	261	0.18	04.88	3.92	22.64
Vertical (D)	Lower Cement Bed	480	55070	1250	1811	425	-0.22	09.64	6.39	24.26
					Mean horizontal		**-0.27**	**13.62**	**6.49**	**17.92**
					Mean vertical		**0.06**	**07.93**	**5.28**	**20.76**

Table 1.16 (2 of 2). Realignment formulae for comparison with radio-elemental concentration data collected with the GR-256 gamma-ray spectrometer are given in Chapter 2 (Section 2.05).

Specifications Of Transportable Calibration Pads

Dimensions 1 m x 1 m x 0.3 m

Weight		
	B-Pad	(B3-88) 680 Kg
	K-Pad	(K3-88) 670 Kg
	U-Pad	(U8-89) 670 Kg
	T-Pad	(T3-88) 680 Kg

Density		
	B-Pad	2.28 g/cm^3
	K-Pad	2.23 g/cm^3
	U-Pad	2.24 g/cm^3
	T-Pad	2.28 g/cm^3

Composition		
	B-Pad	Standard concrete with 3/8 inch limestone aggregate
	K-Pad	Feldspar crushed to 3/4 inch with cement in the ratio 4 feldspar to 1 cement
	U-Pad	Concrete with 3/8 inch limestone aggregate + phosphate slag crushed to 1/4 inch
	T-Pad	Concrete with 3/8 inch limestone aggregate + thorium ore crushed

Perecentage of infinite source

K-Pad	86.5 % for 1.46 MeV potassium gamma-rays
U-Pad	85.8 % for 1.76 MeV uranium gamma-rays
T-Pad	84.2 % for 2.62 MeV thorium gamma-rays

Concentration of Transportable Pads

	K (%)	U (ppm)	Th (ppm)
B-Pad	1.43 +/- 0.01	0.94 +/- 0.02	2.32 +/- 0.06
K-Pad	7.57 +/- 0.05	1.22 +/- 0.09	1.40 +/- 0.12
U-Pad	1.07 +/- 0.01	46.93 +/- 0.32	2.75 +/- 0.07
T-Pad	1.43 +/- 0.02	1.74 +/- 0.16	121.6 +/- 1.66

(errors are at the one sigma level)

Table 1.17 Specifications of the calibration pads used at the British Geological Survey, Keyworth to determine stripping ratios and sensitivity constants for portable gamma-ray spectrometers.

Program PADWIN

The calibration program called PADWIN was originally written by Leif Lovborg and his associates at the Riso National Laboratory in Denmark. The program has been modified by the British Geological Survey to allow for the non-infinite size of the transportable pads. Calibration constants and associated errors are calculated. These errors take into consideration Poisson counting errors as well as uncertainties in the concentration of the pads.

The program is in executable form for an IBM-PC or AT compatible computer and will run with or without a math coprocessor. The program assumes that the gamma-ray spectrometer has a typical 7.6 cm x 7.6 cm sodium iodide scintillation crystal within the detector assembly.

The following data are input into the program for any new calibration being processed :

1) number of pads
2) counting time in minutes on the Blank Pad
3) accumulated counts in the K-window on the Blank Pad
4) accumulated counts in the U-window on the Blank Pad
5) accumulated counts in the Th-window on the Blank Pad

The sequence is repeated for counting time and window counts for the potassium, uranium and thorium pads. The count time needs to be the same for each pad but can be a summation of separate count times. The program automatically determines, from the known radioelemental concentrations of the four pads, the errors in concentration and the geometric correction factors.

PADWIN first calculates the potassium, uranium and thorium window sensitivities for small pad-size sources from the total count and pad-concentration data. The geometric correction factors are then applied to these small source sensitivities to give infinite source sensitivities.

Table 1.18 Details of the BGS gamma spectrometer software program known as PADWIN (v1.1). The program is used determine stripping ratios and sensitivity constants for portable gamma-ray spectrometers from raw data obtained on transportable calibration pads.

(A) Calibration of GR-256 S/No. 1560 owned by B.P.

11th January 1991	Test 1	Test 2	Channels
Total counts	2829	2822	70 - 255
K counts	410	443	110 - 124
U counts	158	164	131 - 149
Th counts	63	66	194 - 216

25th March 1992	Test 1	Test 2	Channels
Total counts	2947	2927	70 - 255
K counts	461	469	111 - 125
U counts	249	255	133 - 151
Th counts	87	77	197 - 219

13th May 1992	Test 1	Test 2	Channels
Total counts2826	2927	2846	70 - 255
K counts	426	407	110 - 124
U counts	269	183	113 - 149
Th counts	99	51	194 - 216

19th October 1992	Test 1	Test 2	Channels
Total counts	2744	2709	70 - 255
K counts	431	423	110 - 124
U counts	143	157	113 - 149
Th counts	84	86	194 - 216

(B) Calibration of GR-256 S/No. 1521 owned by Leeds University

16th August 1995	Test 1	Test 2	Channels
Total counts	2951	3083	70 - 255
K counts	447	453	110 - 124
U counts	172	205	113 - 149
Th counts	45	51	194 - 216

31st August 1995	Test 1	Test 2	Channels
Total counts	2885	2991	70 - 255
K counts	428	424	116 - 130
U counts	169	169	140 - 189
Th counts	71	74	210 - 232

Table 1.19 Calibration data for the GR-256 gamma-ray spectrometer owned by Leeds University using identical count rates and constants to those previously used by the B.P. machine. The Leeds University machine was subject to spectral drift which often brought the machine out of tolerance (as shown by the channels on the 31st August 1995). No measurements could be taken with the machine when this occurred and the spectrometer had to be sent away in order for the problem to be rectified.
Data supplied by David Skinner & Partners Ltd.

CALIBRATION OF TRANSPORTABLE PADS
(Data Processed and Obtained from PADWIN Program)

WINDOW COUNTS

	Time (minutes)	K counts	U counts	Th counts
B Pad	10.0	4808	691	551
K Pad	10.0	15622	942	517
U Pad	10.0	6213	8603	701
T Pad	10.0	6903	5916	8888

A-MATRIX FROM NONLINEAR REGRESSION

176.0	(2.7570)	13.33	(0.3257)	3.377	(0.11470)
3.943	(0.7142)	17.19	(0.3000)	4.265	(0.04265)
0.4812	(0.5545)	0.2646	(0.3023)	6.988	(0.12690)

INVERSE A-MATRIX

0.005782	(2.7570)	-0.004480	(0.0001142)	-0.00005969	(-0.0001019)
-0.001239	(-0.0002646)	0.05967	(0.0008612)	-0.3582	(0.0008875)
-0.0003512	(0.0004591)	-0.001951	(0.002569)	-0.1445	(0.003043)

WINDOW SENSITIVITIES FOR SMALL SOURCES

K Sensitivity	=	217.00 (2.757) counts per minute per % K
U Sensitivity	=	19.74 (0.3007) counts per minute per ppm U
Th Sensitivity	=	8.32 (0.1269) counts per minute per ppm Th

WINDOW SENSITIVITIES FOR INFINITE SOURCES

K Sensitivity	=	265.20 (3.213) counts per minute per % K
U Sensitivity	=	22.60 (0.3518) counts per minute per ppm U
Th Sensitivity	=	9.21 (0.1510) counts per minute per ppm Th

Table 1.20 **Calculated window sensitivities and stripping ratios for the Edinburgh University GR-256 gamma-ray spectrometer using the PADWIN (BGS gamma spectrometer software v1.1) program and CAL-256 program. Individual counts times have been summed into a single measurement taken over a 10 minute interval. This is the input into the program. The data were collected on the 10th October 1995. (1 of 2.)**

STRIPPING RATIOS

Th into U	(alpha)	=	0.6104	(0.0125)
Th into K	(beta)	=	0.4833	(0.0160)
U into K	(gamma)	=	0.7751	(0.0188)
U into Th	(A)	=	0.0154	(0.0174)
K into Th	(B)	=	0.0027	(0.0031)
K into U	(C)	=	0.0224	(0.0041)

(numbers in parentheses are estimated standard deviations).

Table 1.20 (2 of 2). The forward stripping ratios (alpha, beta, gamma) should be less than 1 whilst the backward stripping ratios (A, B, C) should be near to 0.

	Time seconds	Total counts	5.68 CPS/ur	4.14 CPS/ur	4.73 CPS/ur	Range in ur
Iron Ledge	300	36420	21.37	29.322	5.67	3.66
Iron Ledge	300	37650	22.10	30.31	26.53	3.78
Iron Ledge	300	38030	22.32	30.62	26.80	3.82
Iron Ledge	300	38360	22.51	30.89	27.24	3.88
Iron Ledge	300	38410	22.54	30.93	27.07	3.86
Iron Ledge	300	37880	22.23	30.50	26.69	3.80
Iron Ledge	300	38410	22.54	30.93	27.07	3.86
Iron Ledge	300	37840	22.21	30.47	26.67	3.80
Iron Ledge	300	37510	22.01	30.20	26.43	3.77
Iron Ledge	300	38340	22.50	30.87	27.02	3.85
Iron Ledge	300	39320	23.08	31.66	27.71	3.95
Iron Ledge	300	39540	23.20	31.84	27.86	3.97
Iron Ledge	300	40100	23.53	32.29	28.26	4.03
Iron Ledge	300	40380	23.70	32.51	28.46	4.06
Iron Ledge	300	40670	23.87	32.75	28.66	4.08
Iron Ledge	300	40810	23.95	32.86	28.76	4.10
Iron Ledge	300	41090	24.11	33.08	28.96	4.13
Iron Ledge	300	39910	23.42	32.13	28.13	4.01
Iron Ledge	300	39290	23.06	31.63	27.69	3.95
Lower Cement Bed	480	35940	21.09	18.09	15.83	2.26
Lower Cement Bed	480	37560	22.04	18.90	16.54	2.36
Lower Cement Bed	480	38020	22.31	19.13	16.75	2.39
Lower Cement Bed	480	37990	22.29	19.12	16.73	2.38
Lower Cement Bed	480	37650	22.10	18.95	16.58	2.36
Lower Cement Bed	480	37390	21.94	18.82	16.47	2.35
Lower Cement Bed	480	36540	21.44	18.39	16.09	2.29
Lower Cement Bed	480	37170	21.81	18.70	16.37	2.33
Lower Cement Bed	480	37250	21.86	18.74	16.41	2.34
Lower Cement Bed	480	37780	22.17	19.01	16.64	2.37
Lower Cement Bed	480	37810	22.19	19.03	16.65	2.37
Lower Cement Bed	480	39540	23.20	19.90	17.42	2.48
Lower Cement Bed	480	44480	26.10	22.38	19.59	2.79
Lower Cement Bed	480	44240	25.96	22.26	19.49	2.78
Lower Cement Bed	480	43330	25.43	21.80	19.08	2.72
Lower Cement Bed	480	44320	26.01	22.30	19.52	2.78
Lower Cement Bed	480	44250	25.97	22.27	19.49	2.78
Lower Cement Bed	480	47410	27.82	23.86	20.88	2.98
Lower Cement Bed	480	46830	27.48	23.57	20.63	2.94
Lower Cement Bed	480	48310	28.35	24.31	21.28	3.03
Belemnite Bed	240	43990	25.82	44.27	38.75	5.52
Belemnite Bed	240	43170	25.33	43.45	38.03	5.42
Belemnite Bed	240	43670	25.63	43.95	38.47	5.48
Belemnite Bed	240	43650	2.56	4.39	3.85	0.55
Belemnite Bed	240	44270	25.98	44.56	39.00	5.56
Belemnite Bed	240	44320	26.01	44.61	39.04	5.56
Belemnite Bed	240	44210	25.94	44.49	38.94	5.55
Belemnite Bed	240	44450	26.09	44.74	39.16	5.58
Belemnite Bed	240	45420	26.65	45.71	40.01	5.70
Belemnite Bed	240	45670	26.80	45.96	40.23	5.73
Belemnite Bed	240	45990	26.99	46.29	40.51	5.77
Belemnite Bed	240	46000	27.00	46.30	40.52	5.77
Belemnite Bed	240	46400	27.23	46.70	40.87	5.83
Belemnite Bed	240	46510	27.29	46.81	40.97	5.84
Belemnite Bed	240	46640	27.37	46.94	41.09	5.86
Belemnite Bed	240	46350	27.20	46.65	40.83	5.82
Belemnite Bed	240	47070	27.62	47.37	41.46	5.91
Belemnite Bed	240	47280	27.75	47.58	41.65	5.94
Belemnite Bed	240	47300	27.76	47.60	41.67	5.94

Table 1.21 **Calibration of total gamma-ray flux to ur using each of the total gamma ray sensitivity constants determined from the BGS transportable calibration pads. Range in total gamma-ray flux (ur units) between each of the constants is given.**

The Mann-Whitney Statistical Test
(Procedure for Calculation)

Step 1

Rank the data (taking both data-sets together) giving rank 1 to the lowest score and so on. If there are tied observations the mean rank is given to each of the tied observations.

Step 2

Find the sum of the ranks for the smaller sample or if both samples are the same size find the sum of the ranks of sample A. Call this value T.

Step 3

Find U where :

$$U = N_A N_B + (N_A (N_A+1) / 2) - T$$

where N_A is the number of scores in the smaller sample or if both samples are the same size the sample for which ranks were totalled to find T.

Step 4

Find the standard deviation of U where :

$$SD_U = [N_A N_B (N_A + N_B +1) / 12]^{0.5}$$

Step 5

Find the Z-score :

$$Z = [(U - (N_A N_B / 2) / SD_U]$$

For a two-tailed non-directional test, the alternative hypothesis (*i.e.* there is a difference) is significant at the 95 % level if the observed Z if it exceeds 1.96. For a one-tailed directional test 95 % significance is attained if Z exceeds 1.64

Reference

Mann, H.B. & Whitney, D.R. 1947 On a test of whether one or two random variables is stochastically larger than the other, *Annals of Mathematical Statistics* , **18**, 52-54.

TABLE 1.22 Mathematical Execution of the Mann-Whitney Statistical Test.

Sample time	Total Number of Counts Recorded				Total	Elemental Concentrations			Standard Deviations			
Secs	Total	K	U	Th	ur	K %	U ppm	Th ppm	ur	K	U	Th
5	206	37	10	5	11.6	1.6	3.6	7.1				
10	482	81	31	10	14	1.5	6.6	7.0	1.70	0.07	0.07	2.12
15	620	94	36	11	11.6	1.1	5.2	5	1.39	0.26	1.18	1.50
20	846	140	53	19	11.9	1.3	5.5	6.6	1.16	0.22	0.97	1.24
25	1048	198	57	16	11.8	1.6	4.9	4.2	1.03	0.22	1.30	1.08
30	1342	244	67	31	12.8	1.7	4.2	7.4	0.95	0.23	1.30	1.04
35	1598	270	85	35	13.1	1.5	4.7	7.1	0.92	0.21	1.24	0.96
40	1735	284	120	38	12.3	1.2	6.5	6.6	0.85	0.21	1.15	1.04
45	1928	313	102	57	12.1	1.4	3.9	9.2	0.80	0.20	1.43	1.06
50	2209	395	131	62	12.6	1.6	4.9	8.9	0.76	0.20	1.52	1.00
55	2408	375	139	44	12.5	1.3	5.4	5.5	0.72	0.19	1.50	0.96
60	2648	444	144	63	12.6	1.5	4.6	7.5	0.69	0.18	1.45	0.92
65	2802	506	154	53	12.2	1.6	4.9	5.5	0.67	0.18	1.43	0.88
70	3038	541	178	88	12.3	1.5	4.6	9.0	0.64	0.17	1.50	0.85
75	3295	579	186	72	12.5	1.5	5.0	6.7	0.62	0.17	1.45	0.82
80	3543	610	191	75	12.7	1.5	4.8	6.6	0.60	0.16	1.40	0.80
85	3763	683	214	87	12.6	1.6	5.0	7.2	0.58	0.16	1.36	0.77
90	3841	708	232	86	12.5	1.6	5.2	6.7	0.57	0.16	1.32	0.75
95	4205	754	229	73	12.6	1.6	5.1	5.2	0.55	0.16	1.34	0.73
100	4508	766	281	106	12.9	1.4	5.7	7.4	0.55	0.16	1.31	0.73
105	4759	757	290	102	13	1.3	5.7	6.8	0.55	0.15	1.28	0.73
110	4836	858	287	99	12.5	1.5	5.4	6.3	0.53	0.16	1.25	0.71

Table 1.23 **Data-set representing 48 samples taken at a single point on the Belemnite Bed (Belemnite Marls Formation) that outcrops west of Seatown, Dorset (SY 318908). The data were collected with the B.P. GR-256 gamma-ray spectrometer placed perpendicular to bedding with 5 second increments in measurement time up to a maximum of 240 seconds. The data were collected on October 23rd 1993. (1 of 2.)**

Sample time Secs	Total Number of Counts Recorded				Total	Elemental Concentrations				Standard Deviations		
	Total	K	U	Th	ur	K %	U ppm	Th ppm	ur	K	U	Th
115	5099	903	297	117	12.7	1.6	5.1	7.2	0.52	0.15	1.23	0.70
120	5264	946	278	125	12.5	1.6	4.4	7.4	0.51	0.15	1.21	0.69
125	5480	886	334	123	12.5	1.3	5.5	6.9	0.50	0.15	1.18	0.69
130	5594	985	352	128	12.2	1.6	5.6	6.9	0.49	0.15	1.16	0.68
135	6011	1063	327	119	12.7	1.6	5.0	6.0	0.49	0.15	1.15	0.67
140	6133	1105	355	134	12.5	1.6	5.2	6.7	0.48	0.15	1.12	0.66
145	6487	1192	397	134	12.8	1.6	5.8	6.4	0.47	0.15	1.11	0.66
150	6615	1177	359	128	12.6	1.6	4.9	5.9	0.46	0.14	1.10	0.65
155	6912	1210	398	153	12.8	1.5	5.2	6.9	0.47	0.14	1.08	0.64
160	6957	1174	402	178	12.4	1.4	4.8	7.9	0.45	0.14	1.08	0.63
165	7289	1199	412	146	12.6	1.4	5.1	6.1	0.45	0.14	1.07	0.62
170	7429	1254	472	178	12.4	1.4	5.7	7.3	0.44	0.14	1.06	0.62
175	7752	1375	481	171	12.7	1.5	5.7	6.8	0.43	0.14	1.04	0.62
180	8007	1326	455	176	12.7	1.4	5.1	6.8	0.43	0.14	1.03	0.61
185	8282	1365	484	191	12.8	1.4	5.2	7.2	0.40	0.13	1.02	0.60
190	8445	1442	473	172	12.7	1.5	5.1	6.3	0.40	0.13	1.01	0.59
195	8729	1575	478	187	12.8	1.6	4.9	6.7	0.39	0.13	0.99	0.58
200	8841	1525	496	197	12.6	1.5	4.9	6.9	0.39	0.13	0.98	0.58
205	8889	1561	532	187	12.3	1.5	5.4	6.3	0.38	0.13	0.97	0.57
210	9236	1605	550	222	12.5	1.5	5.2	6.8	0.38	0.13	0.96	0.57
215	9513	1646	598	204	12.6	1.4	5.8	6.5	0.38	0.13	0.95	0.57
220	9914	1702	537	213	12.9	1.6	4.8	6.8	0.37	0.13	0.94	0.56
225	10093	1779	592	207	12.9	1.6	5.4	6.4	0.37	0.13	0.93	0.56
230	10319	1826	561	209	12.9	1.6	5.0	6.3	0.37	0.13	0.92	0.55
235	10380	1766	608	220	12.6	1.4	5.2	6.8	0.37	0.12	0.91	0.55
240	10764	1917	639	225	12.9	1.6	5.5	6.5	0.37	0.12	0.9	0.54

Table 1.23 **(2 of 2).**

Sample time	Total Number of Counts Recorded				Total	Elemental Concentrations			Standard Deviations			
Secs	Total	K	U	Th	ur	K %	U ppm	Th ppm	ur	K	U	Th
5	170	31	12	2	9.0	1.1	5.7	2.3				
10	319	47	25	5	8.2	0.6	5.9	3.1	0.57	0.35	0.14	0.57
20	702	96	42	6	9.4	0.8	5.1	1.5	0.61	0.25	0.42	0.80
30	943	140	57	25	8.1	0.8	3.6	5.8	0.63	0.21	1.04	1.87
40	1255	209	60	12	8.1	1.0	3.4	1.6	0.60	0.19	1.17	1.76
50	1659	254	112	27	8.7	0.8	5.1	3.4	0.54	0.18	1.06	1.59
60	1950	301	123	34	8.5	0.9	4.5	3.7	0.50	0.16	0.97	1.48
70	2287	365	158	32	8.5	0.9	5.3	2.7	0.46	0.15	0.92	1.38
80	2582	429	154	50	8.4	1.0	4.0	4.1	0.43	0.15	0.90	1.34
90	2856	445	161	37	8.2	0.9	4.0	2.4	0.42	0.14	0.88	1.28
100	3271	482	200	46	8.5	0.8	4.6	2.8	0.40	0.13	0.84	1.22
110	3678	575	214	67	8.8	0.9	4.1	4.0	0.39	0.13	0.82	1.20
120	4019	643	246	56	8.8	0.9	4.7	2.9	0.38	0.12	0.78	1.15
130	4327	678	272	71	8.7	0.9	4.6	3.4	0.37	0.12	0.75	1.10
140	4609	729	285	74	8.6	0.9	4.5	3.3	0.36	0.11	0.72	1.07
150	4950	762	338	75	8.6	0.8	5.2	3.1	0.34	0.11	0.71	1.03
160	5323	830	355	87	8.7	0.9	5.0	3.4	0.33	0.11	0.70	1.00
170	5786	820	364	98	9.0	0.8	4.7	3.7	0.34	0.11	0.68	0.98
180	5928	912	371	79	8.6	0.9	4.7	2.6	0.33	0.10	0.66	0.96
190	8411	1044	383	92	8.9	1.0	4.5	3.0	0.33	0.11	0.64	0.93
200	6513	1049	414	117	8.5	0.9	4.5	3.8	0.32	0.10	0.63	0.92
210	7057	1061	461	115	8.9	0.8	4.9	3.4	0.32	0.10	0.61	0.90

Table 1.24 **Data-set representing 33 samples taken at a single point on Iron Ledge (Blue Lias Formation) that outcrops at Seven Rock Point, Lyme Regis, Dorset (SY 335916). The data were collected with the B.P. GR-256 gamma-ray spectrometer with the detector placed perpendicular to bedding using 10 second increments in measurement time up to a maximum of 360 seconds. The data were collected on October 23rd 1993. (1 of 2.)**

Sample time	Total Number of Counts Recorded				Total	Elemental Concentrations			Standard Deviations			
Secs	Total	K	U	Th	ur	K %	U ppm	Th ppm	ur	K	U	Th
220	7296	1154	495	105	8.7	0.9	5.2	2.8	0.31	0.10	0.61	0.88
230	7495	1227	433	101	8.5	1.0	4.2	2.6	0.31	0.10	0.60	0.87
240	8042	1253	501	101	8.8	0.9	4.8	2.5	0.30	0.10	0.59	0.86
250	8339	1367	510	114	8.8	1.0	4.6	2.8	0.30	0.10	0.58	0.85
260	8590	1362	516	132	8.7	0.9	4.4	3.2	0.29	0.10	0.57	0.83
270	8904	1379	509	131	8.6	0.9	4.2	3.0	0.29	0.10	0.57	0.82
280	9373	1496	583	140	8.8	0.9	4.7	3.1	0.28	0.09	0.56	0.80
290	9726	1566	620	152	8.8	0.9	4.8	3.3	0.28	0.09	0.55	0.79
300	9879	1550	613	170	8.6	0.9	4.5	3.7	0.28	0.09	0.54	0.78
310	10312	1649	630	145	8.7	0.9	4.6	2.9	0.27	0.09	0.53	0.77
320	10693	1663	681	177	8.8	0.9	4.7	3.5	0.27	0.09	0.52	0.76

Table 1.24 **(2 of 2).**

Plane	Horizon	Sample Time	Total Number of Counts Recorded				Calculated Elemental Concentrations			
		Secs	Total	K	U	Th	K %	U ppm	Th ppm	Total ur
Vertical Plane	Belemnite Stone	240	9513	1646	598	204	1.40	5.80	6.50	12.60
Vertical Plane	Belemnite Stone	240	9467	1589	554	183	1.40	5.40	5.90	12.60
Vertical Plane	Belemnite Stone	240	9360	1670	520	193	1.60	4.90	6.10	12.40
Vertical Plane	Belemnite Stone	240	9577	1743	545	224	1.60	5.00	7.30	12.70
Vertical Plane	Belemnite Stone	240	9485	1702	557	219	1.60	5.20	7.20	12.60
Vertical Plane	Belemnite Stone	240	9505	1634	513	201	1.50	4.80	6.60	12.60
Vertical Plane	Belemnite Stone	240	9556	1631	559	194	1.50	5.40	6.20	12.70
Vertical Plane	Belemnite Stone	240	9417	1681	528	184	1.60	5.10	5.90	12.50
Vertical Plane	Belemnite Stone	240	9591	1701	530	192	1.60	5.00	6.10	12.80
Vertical Plane	Belemnite Stone	240	9378	1659	537	207	1.50	5.00	6.70	12.40
Vertical Plane	Belemnite Stone	240	9403	1657	556	199	1.50	5.30	6.40	12.50
Vertical Plane	Belemnite Stone	240	9512	1602	549	204	1.40	5.20	6.50	12.60
Vertical Plane	Belemnite Stone	240	9539	1693	529	239	1.60	4.70	7.90	12.70
Vertical Plane	Belemnite Stone	240	9379	1634	522	201	1.50	4.90	6.50	12.40
Vertical Plane	Belemnite Stone	240	9455	1633	541	169	1.50	5.30	5.30	12.50
Vertical Plane	Belemnite Stone	240	9570	1657	512	209	1.60	4.70	6.80	12.70
Vertical Plane	Belemnite Stone	240	9669	1674	547	218	1.50	5.10	7.10	12.90
Vertical Plane	Belemnite Stone	240	9527	1633	547	205	1.50	5.20	6.70	12.70
Vertical Plane	Belemnite Stone	240	9558	1729	541	213	1.60	5.00	6.90	12.70
Vertical Plane	Belemnite Stone	240	9344	1674	558	197	1.50	5.40	6.30	12.40
						Mean	**1.53**	**5.12**	**6.55**	**12.60**

Table 1.25 **Data-set representing 20 repeated samples taken for the same point (*i.e.* constant counting geometry) on the dark laminated-shale horizon known as the Belemnite Bed (Belemnite Marls Formation) that outcrops west of Seatown, Dorset (SY 318908). The data were collected with the B.P. GR-256 gamma-ray spectrometer with the detector placed perpendicular to bedding (*i.e.* in the vertical plane) The data were collected on October 25th 1993.**

Plane Taken	Horizon	Sample time	Total Number of Counts Recorded				Elemental Concentrations			
		Secs	Total	K	U	Th	K %	U ppm	Th ppm	Total ur
Vertical Plane	Iron Ledge	280	9248	1440	590	145	0.90	4.70	3.30	8.60
Vertical Plane	Iron Ledge	280	9492	1467	598	136	0.90	4.90	3.00	9.00
Vertical Plane	Iron Ledge	280	9415	1515	614	147	0.90	5.00	3.30	8.90
Vertical Plane	Iron Ledge	280	9391	1523	578	151	1.00	4.60	3.40	8.80
Vertical Plane	Iron Ledge	280	9494	1489	584	158	0.90	3.40	3.50	9.00
Vertical Plane	Iron Ledge	280	9370	1436	613	142	0.80	5.00	3.10	8.80
Vertical Plane	Iron Ledge	280	9498	1523	591	159	1.00	4.60	3.70	9.00
Vertical Plane	Iron Ledge	280	9418	1457	605	149	0.90	4.90	3.30	8.90
Vertical Plane	Iron Ledge	280	9330	1472	610	157	0.90	4.90	3.50	8.80
Vertical Plane	Iron Ledge	280	9417	1483	582	147	0.90	4.60	3.30	8.90
Vertical Plane	Iron Ledge	280	9307	1492	589	138	0.90	4.80	3.00	8.70
Vertical Plane	Iron Ledge	280	9336	1418	570	146	0.90	4.50	3.30	8.90
Vertical Plane	Iron Ledge	280	9282	1467	587	140	0.90	4.70	3.10	8.70
Vertical Planee	Iron Ledge	280	9282	1436	600	134	0.90	4.90	2.90	8.70
Vertical Plane	Iron Ledge	280	9455	1523	594	116	1.00	5.00	2.30	8.90
Vertical Plane	Iron Ledge	280	9438	1472	602	128	0.90	5.00	2.70	8.90
Vertical Plane	Iron Ledge	280	9556	1525	599	128	1.00	4.90	2.70	9.00
Vertical Plane	Iron Ledge	280	9403	1462	616	163	0.90	4.90	3.70	8.80
Vertical Plane	Iron Ledge	280	9352	1423	614	130	0.80	5.10	2.70	8.80
Vertical Plane	Iron Ledge	280	9298	1467	541	144	1.00	4.20	3.30	8.70
						Mean	**0.92**	**4.73**	**3.16**	**8.84**

Table 1.26 **Data-set representing 20 repeated samples taken at the same point (*i.e.* constant counting geometry) on the Iron Ledge limestone (Blue Lias Formation) that outcrops at Seven Rock Point, Lyme Regis, Dorset (SY 335916). The data were collected with the B.P. GR-256 gamma-ray spectrometer on October 26th 1993 with the detector placed perpendicular to bedding in the vertical plane.**

Total (ur)	K %	U ppm	Th ppm
(A) Multiple readings at the same location			
0.00	-8.50	+13.28	-0.76
0.00	-8.50	+5.47	-9.92
-1.59	+4.58	-4.30	-6.87
+0.79	+4.58	-2.34	+11.45
0.00	+4.58	+1.56	+9.92
0.00	-1.96	-6.25	+0.76
+0.79	-1.96	+5.47	-5.34
-0.79	+4.58	-0.39	-9.92
+1.59	+4.58	-2.34	-6.87
-1.59	-1.96	-2.34	+2.29
-0.79	-1.96	+3.52	-2.29
0.00	-8.50	+1.56	-0.76
+0.79	+4.58	-8.20	+20.61
-1.59	-1.96	-4.30	-0.76
-0.79	-1.96	+3.52	-19.08
+0.79	+4.58	-8.20	+3.82
+2.38	-1.96	-0.39	+8.40
+0.79	-1.96	+1.56	+2.29
+0.79	+4.58	-2.34	+5.34
-1.59	-1.96	+5.47	-3.82
(B) Readings taken at different locations			
-0.56	0.00	+2.51	-16.30
+0.24	0.00	+16.05	-4.55
+1.03	0.00	+0.58	-4.55
+0.24	0.00	+4.45	-4.55
-3.74	-6.67	+6.38	-8.96
+1.03	0.00	+2.51	-0.15
+3.42	+6.67	-5.22	+10.13
+2.63	+6.67	-11.03	+16.01
-5.33	-6.67	-3.29	+7.20
-0.56	0.00	-5.22	-10.43
+0.24	0.00	+0.58	+8.66
-0.56	0.00	-1.35	-0.15
+2.63	+6.67	+4.45	+8.66
-2.94	-6.67	-7.16	-14.83
-2.94	-6.67	-7.16	+4.26
-1.35	-6.67	+2.51	-10.43
+0.24	+6.67	-12.96	-6.02
-0.56	0.00	+2.51	+8.66
+4.22	0.00	+16.05	-1.62
+1.83	+6.67	-7.16	+17.47

Table 1.27 **The percentage error calculated for total gamma-ray flux and radio-elemental concentration for measurements collected at the same location and different locations on the Belemnite Bed. The Belemnite Bed outcrops west of Seatown, Dorset (SY 318908). The percentage error is calculated from the data given in Tables 1.12 and 1.25.**

Total (ur)	K %	U ppm	Th ppm
(A) Multiple readings at the same location			
-2.71	-2.2	-0.63	+4.43
+1.81	-2.2	+3.59	-5.06
+0.68	-2.2	+5.71	+4.43
-0.45	+8.7	-2.75	+7.59
+1.81	-2.2	-28.12	+10.76
-0.45	-13.0	+5.71	-1.90
+1.81	+8.7	-2.75	+17.09
+0.68	-2.2	+3.59	+4.43
-0.45	-2.2	+3.59	+10.76
+0.68	-2.2	-2.75	+4.43
-1.58	-2.2	+1.48	-5.06
+0.68	-2.2	-4.86	+4.43
-1.58	-2.2	-0.63	-1.90
-1.58	-2.2	+3.59	-8.23
+0.68	+8.7	+5.71	-27.22
+0.68	-2.2	+5.71	-14.56
+1.81	+8.7	+3.59	-14.56
-0.45	-2.2	+3.59	+17.09
-0.45	-13.0	+7.82	-14.56
-1.58	+8.7	-11.21	+4.43
(B) Readings taken at different locations			
-7.39	-2.17	-9.64	-3.78
-6.28	-13.04	-1.61	-0.34
-7.39	-13.04	-3.61	+6.53
-5.18	-13.04	-3.61	+6.53
-16.21	-13.04	-17.67	-27.84
-9.59	-2.17	-17.67	-31.27
-9.59	-2.17	-5.62	-27.84
-0.77	-2.17	+4.42	-10.65
-4.08	-13.04	+4.42	-7.22
-1.87	-13.04	-5.62	+3.09
-10.69	-13.04	-9.64	-3.78
-8.49	+2.17	-7.63	-0.34
-9.59	-13.04	-3.61	-14.09
-9.59	-2.17	-15.66	-3.78
+33.41	-13.04	+72.69	-0.34
+11.36	+19.57	+8.43	+13.40
+4.74	+8.70	+4.42	+6.53
+24.59	+41.30	+0.40	+47.77
+10.25	+19.57	-1.61	+23.71
+22.38	+41.30	+8.43	+23.71

Table 1.28 **The percentage error calculated for total gamma-ray flux and radio-elemental concentration for measurements collected at the same location and different locations on the Iron Ledge. The Iron Ledge limestone outcrops at Seven Rock Point, Lyme Regis, Dorset (SY 335916). The percentage error is calculated from the data given in Tables 1.11 and 1.26.**

Lithostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Ur	Elemental Concentration K %	U ppm	Th ppm
First Set of Measurements (first reading taken at 9 am).										
Cotham Beds	0.0	120	9720	2255	348	157	25.2	4.4	4.9	10.3
Cotham Beds	0.3	120	10067	2236	347	153	26.3	4.4	4.9	10.1
Cotham Beds	0.6	120	10101	2312	350	168	26.4	4.6	5.0	11.2
Cotham Beds	0.9	120	10052	2327	315	156	26.2	4.7	4.2	10.5
Cotham Beds	1.2	120	10239	2271	337	177	26.8	4.5	4.4	12.2
Cotham Beds	1.5	240	15462	3334	518	256	14.3	3.2	3.4	8.1
Cotham Beds	1.8	240	15848	3532	524	222	19.9	3.4	3.6	6.7
Cotham Beds	2.1	120	10929	2441	365	160	28.8	4.9	5.2	10.5
Cotham Beds	2.4	120	10513	2425	349	169	27.6	4.9	4.7	11.5
Cotham Beds	2.7	120	11950	2830	415	232	31.9	5.7	5.4	16.9
Cotham Beds	3.0	120	11646	2648	408	213	31.3	5.3	6.4	15.0
Cotham Beds	3.3	120	11776	2757	424	177	31.3	5.5	6.2	12.0
Cotham Beds	3.6	120	10907	2478	409	177	28.8	4.9	5.9	12.0
Cotham Beds	3.9	120	9761	2295	417	144	26.0	4.4	6.4	8.9
White Lias	4.2	240	13872	2814	568	248	17.0	3.1	4.0	7.7
White Lias	4.5	240	13344	2728	568	251	16.2	2.4	4.0	7.7
White Lias	4.8	240	13079	2814	520	280	15.9	2.6	3.3	9.1
White Lias	5.1	240	12834	2734	512	198	15.4	2.5	3.8	5.5
White Lias	5.4	240	11940	2496	524	195	14.1	2.2	3.8	5.3
White Lias	5.7	240	17222	3832	638	290	22.0	3.8	4.4	7.7
White Lias	6.0	120	9106	2984	294	148	21.9	3.7	3.9	9.8
White Lias	6.3	240	16972	5308	620	280	21.6	4	4.3	9.1
White Lias	6.6	240	16724	3900	616	285	21.6	4	4.2	9.3

Table 1.29 **Collection of data from identical positions within the Rhaetian succession exposed in St. Mary's Well Bay, Glamorgan (ST 18060) that includes the Cotham Beds (Lilstock Member), the White Lias (Langport Member) and the Pre-*planorbis* Beds (Bull Cliff Member). The first and second set of gamma-ray measurements were collected exactly five hours apart on the 16th September 1995 using the Edinburgh University GR-256. (1 of 4.)**

Lithostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Ur	Elemental Concentration K %	U ppm	Th ppm
White Lias	6.9	240	14572	3396	500	216	18.0	3.3	2.8	6.4
White Lias	7.2	240	13600	3052	558	211	16.6	2.8	4.0	6.2
White Lias	7.5	240	13852	3342	502	264	17.1	3.2	3.2	8.4
White Lias	7.8	240	12680	2904	552	214	15.2	2	4.0	6.2
White Lias	8.1	240	14694	3392	590	259	18.2	3.2	4.0	7.1
Pre-*planorbis*	8.4	240	12382	1465	520	293	14.2	2.5	3.4	6.6
Pre-*planorbis*	8.7	360	10677	1170	465	182	6.7	1.2	2.2	2.3
Pre-*planorbis*	9.0	360	15658	1303	453	301	7.6	1.4	4.4	4.1
Pre-*planorbis*	9.3	360	12341	1357	492	281	8.3	1.4	2.0	3.9
Pre-*planorbis*	9.6	360	13896	1679	630	372	9.7	1.7	2.7	5.4
Pre-*planorbis*	9.9	240	12189	1340	549	238	8.2	1.4	2.5	3.5
Pre-*planorbis*	10.2	240	9594	1160	464	230	10.3	1.8	3.6	4.9
Pre-*planorbis*	10.5	240	9950	1208	468	232	10.7	1.9	3.7	5.0
Pre-*planorbis*	10.8	240	10008	1127	418	248	10.8	1.8	2.6	5.4
Pre-*planorbis*	11.1	360	12777	1369	627	297	8.7	1.3	2.9	4.0
Pre-*planorbis*	11.4	360	11883	1345	410	285	7.9	1.4	2.1	4.0
Pre-*planorbis*	11.7	360	12264	1251	489	313	8.2	1.3	2.0	4.3
Pre-*planorbis*	12.0	240	10290	1167	512	256	11.2	1.8	3.6	5.4
Pre-*planorbis*	12.3	240	11178	1211	562	269	12.5	2.5	4.0	5.8
Pre-*planorbis*	12.6	240	10472	1144	568	296	11.5	1.7	4.0	6.4
Pre-*planorbis*	12.9	240	11094	1221	572	280	12.4	1.8	4.1	6.0
Second Set of Measurements (first reading taken at 2 pm).										
Cotham Beds	0.0	120	9818	1979	390	157	25.5	3.7	5.8	10.1
Cotham Beds	0.3	120	9834	2290	328	133	25.6	4.6	4.7	8.3
Cotham Beds	0.6	120	10036	2309	337	168	26.2	4.6	4.5	11.4
Cotham Beds	0.9	120	10327	2393	321	161	27.0	4.8	4.3	10.8
Cotham Beds	1.2	120	10139	2310	327	169	26.6	4.6	4.3	11.5
Cotham Beds	1.5	240	14704	3268	468	253	18.8	3.3	2.8	8.1

Table 1.29 **(2 of 4). All data were collected with the detector placed in the horizontal plane parallel to bedding.**

Lithostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Ur	Elemental Concentration K %	U ppm	Th ppm
Cotham Beds	1.8	240	15836	3518	520	256	19.9	3.4	3.4	8.1
Cotham Beds	2.1	120	10929	2401	373	166	28.8	4.7	5.2	11.2
Cotham Beds	2.4	120	10387	2354	337	169	27.2	4.7	4.5	11.5
Cotham Beds	2.7	120	11870	2920	406	203	31.6	5.9	5.5	14.3
Cotham Beds	3.0	120	11770	2694	456	187	31.3	5.3	6.8	12.9
Cotham Beds	3.3	120	11964	2743	476	173	31.9	5.3	7.3	11.4
Cotham Beds	3.6	120	10654	2363	442	187	28.0	4.5	6.5	12.9
Cotham Beds	3.9	120	9892	2179	409	149	25.8	4.1	6.2	9.5
White Lias	4.2	240	13804	2802	586	232	16.9	3.1	4.0	7.1
White Lias	4.5	240	14770	2768	540	224	16.0	2.5	3.8	6.5
White Lias	4.8	240	13506	2874	530	182	16.4	2.6	3.9	4.8
White Lias	5.1	240	12932	2678	636	140	15.6	2.3	4.8	6.2
White Lias	5.4	240	12034	2476	496	193	14.3	2.2	3.6	5.3
White Lias	5.7	240	16710	3684	680	98	21.2	3.5	5.1	7.7
White Lias	6.0	120	9069	1990	344	144	22.7	3.8	5.0	9.1
White Lias	6.3	240	17006	4170	574	290	21.6	4.2	3.7	9.6
White Lias	6.6	240	16724	3900	616	285	21.2	3.8	3.9	9.5
White Lias	6.9	240	14628	3308	594	275	18.1	3.1	3.8	8.8
White Lias	7.2	240	13796	3226	530	206	17.1	3.1	3.7	5.8
White Lias	7.5	240	13830	3234	562	230	16.9	3	4.0	6.9
White Lias	7.8	240	12154	2684	484	203	14.4	2.5	3.4	5.7
White Lias	8.1	240	15092	3366	578	227	18.8	3.2	4.1	6.7
Pre-*planorbis*	8.4	240	12402	1552	534	319	14.2	2.5	3.4	7.8
Pre-*planorbis*	8.7	360	10160	1141	474	261	7.2	1.1	2.0	3.5
Pre-*planorbis*	9.0	360	11805	1350	468	313	7.8	1.4	1.8	4.4
Pre-*planorbis*	9.3	360	12591	1421	579	317	8.5	1.4	2.5	4.5
Pre-*planorbis*	9.6	360	13962	1652	657	412	9.8	1.7	2.7	6.0
Pre-*planorbis*	9.9	240	12855	1483	551	305	8.8	1.5	2.0	4.2
Pre-*planorbis*	10.2	240	9572	1126	420	264	10.2	1.8	2.6	5.8

Table 1.29 (3 of 4).

Lithostratigraphy	Height	Time	Total Number of Counts				Ur	Elemental Concentration		
	m	Secs	Total	K	U	Th		K %	U ppm	Th ppm
Pre-*planorbis*	10.5	240	9976	1199	454	172	10.8	1.9	3.1	4.8
Pre-*planorbis*	10.8	240	9536	1057	432	195	10.2	1.6	3.1	4.1
Pre-*planorbis*	11.1	360	13314	1506	549	293	9.2	1.6	2.4	4.1
Pre-*planorbis*	11.4	360	12183	1276	561	305	9.0	1.3	2.5	4.2
Pre-*planorbis*	11.7	360	12234	1328	621	313	8.2	1.3	2.8	4.3
Pre-*planorbis*	12.0	240	10046	1109	478	480	10.9	1.7	3.1	5.8
Pre-*planorbis*	12.3	240	11460	1356	556	290	12.9	2.5	3.8	6.4
Pre-*planorbis*	12.6	240	10590	1184	540	267	11.7	1.8	3.8	5.7
Pre-*planorbis*	12.9	240	11308	1166	604	219	12.5	1.7	4.8	4.4

Table 1.29 **(4 of 4).**

Total Number of Counts			Elemental Concentration		
K	U	Th	K %	U ppm	Th ppm
1562	469	125	1.2	4.3	3.4
1801	523	238	1.3	4.2	6.5
1502	601	199	1.0	5.3	5.4
1851	519	207	1.4	4.3	5.6
1605	519	147	1.2	4.7	4.0
1481	507	181	1.0	4.4	4.9
1510	448	267	1.0	3.2	7.3
1616	605	271	1.1	4.9	7.4
1455	561	208	1.0	4.8	5.7
1692	516	173	1.2	4.5	4.7
1540	573	239	1.0	4.7	6.5
1479	532	210	1.0	4.5	5.7
1540	601	146	1.1	5.7	4.0
1820	589	224	1.3	5.0	6.1
1833	433	227	1.4	3.3	6.2
1677	429	146	1.3	3.8	4.0
1770	451	217	1.3	3.5	5.9
1692	634	191	1.2	5.7	5.2
1793	469	261	1.3	3.4	7.1
1573	436	203	1.1	3.5	5.5

Table 1.30 Randomised total gamma-ray and radio-elemental data generated for the Belemnite Bed within the EXCEL software for the Macintosh. The range in total counts for K, U and Th were specified to be double those actually shown within the observed data-set. The radio-elemental concentrations were calculated using the equations given in Section 2.12 and the stripping factors and window sensitivities given in Secton 2.16.

Total Number of Counts			Elemental Concentration		
K	U	Th	K %	U ppm	Th ppm
1537	501	157	1.1	4.5	4.3
1575	542	183	1.1	4.8	5.0
1484	546	141	1.0	5.1	3.8
1539	466	101	1.2	4.5	2.7
1553	679	198	1.0	6.2	5.4
1595	675	136	1.1	6.5	3.7
1469	528	151	1.1	5.3	2.0
1408	577	94	1.0	5.7	2.6
1334	659	188	0.8	6.0	5.1
1445	656	132	1.0	6.4	3.6
1442	512	85	1.1	5.1	2.3
1396	602	148	0.9	5.7	4.0
1344	574	154	0.9	5.3	4.2
1627	486	164	1.2	4.3	4.5
1332	673	172	0.8	6.3	4.7
1470	661	115	1.0	6.5	3.1
1384	642	70	1.0	6.6	1.9
1382	522	113	1.0	5.0	3.1
1319	481	180	0.9	4.1	4.9
1369	610	210	0.9	5.3	5.7

Table 1.31 **Randomised total gamma-ray and radio-elemental data generated for the Iron Ledge within the EXCEL software for the Macintosh. The ranges in total counts for K, U and Th were specified to be double those actually shown within the observed data-set. The radio-elemental concentrations were calculated using the equations given in Section 2.12 and the stripping factors and window sensitivities given in Secton 2.16.**

Orientation	Time	Total Number of Counts				Ur	Elemental Concentration		
	Secs	Total	K	U	Th		K %	U ppm	Th ppm
perpendicular	360	8841	1740	333	190	5.2	0.9	1.1	2.8
perpendicular	360	8541	1587	330	147	4.9	0.8	1.2	3.1
perpendicular	360	8622	1626	426	131	4.9	0.8	1.6	2.8
perpendicular	360	8898	1677	318	143	5.9	0.9	1.2	3.1
perpendicular	360	8805	1602	306	166	5.1	0.8	1.0	2.2
perpendicular	360	8547	1620	342	166	4.9	0.8	1.2	2.2
perpendicular	360	8658	1548	318	178	5.0	0.8	1.1	2.4
perpendicular	360	9267	1788	372	150	5.6	0.9	1.5	2.6
perpendicular	360	9171	1737	441	150	5.5	0.8	1.8	3.3
perpendicular	360	8625	1596	336	170	4.9	0.8	1.2	2.1
perpendicular	360	9126	1749	351	154	5.0	0.8	1.2	2.6
perpendicular	360	8679	1614	324	170	5.0	0.8	1.1	2.1
					mean	**5.2**	**0.8**	**1.3**	**2.6**
parallel	360	14124	2754	591	293	10.2	1.6	3.0	3.4
parallel	360	13905	1611	642	249	10.2	1.5	3.0	4.1
parallel	360	14670	2979	576	289	10.9	1.7	2.4	5.3
parallel	360	13890	2775	711	257	10.1	1.5	3.4	4.3
parallel	360	13980	2757	630	222	10.2	1.5	3.0	3.4
parallel	360	14829	2784	597	238	11.1	1.6	2.7	4.0
parallel	360	12966	2427	570	194	9.2	1.3	2.7	2.6
parallel	360	14376	2721	678	257	10.6	1.4	3.2	4.5
parallel	360	12228	2298	435	190	8.5	1.3	1.8	2.8
parallel	360	12153	2286	417	234	8.4	1.3	2.3	3.1
parallel	360	12234	2349	531	198	8.5	1.2	2.4	2.9
parallel	360	13773	596763	594	265	10.0	1.5	2.6	4.6
					mean	**9.8**	**1.5**	**2.7**	**3.8**

Table 1.32 Data collected in order to investigate the influence of sample geometry on total gamma-ray flux and radio-elemental concentration. All data were collected with the detector placed parallel to bedding or perpendicular to bedding. Measurements were collected from bed 23 at St. Mary's Well Bay, Glamorgan (ST 180680) on the 4th September 1995 using the Leeds University GR-256 spectrometer.

Total (ur)	K %	U ppm	Th ppm
- 46.94	- 40.00	- 60.49	- 27.58
- 50.00	- 46.67	- 53.91	- 18.53
- 50.00	- 46.67	- 40.74	- 27.58
- 39.80	- 40.00	- 57.20	- 18.53
- 47.96	- 46.67	- 63.79	- 41.16
- 50.00	- 46.67	- 53.91	- 41.16
- 48.98	- 46.67	- 60.49	- 36.63
- 42.86	- 40.00	- 44.03	- 32.11
- 43.88	- 46.67	- 34.16	- 14.00
- 50.00	- 46.67	- 57.20	- 45.68
- 48.98	- 46.67	- 53.91	- 32.11
- 48.98	- 46.67	- 60.49	- 45.68
- 47.36	- 45.00	- 53.36	- 31.73

Table 1.33 **The percentage error calculated for total gamma-ray flux and radio-elemental concentration due to the orientation of the detector (*e.g.* parallel or perpendicular to bedding) during gamma-ray data collection. The errors given in this table are for measurements taken with the detector placed perpendicular to bedding in the vertical plane relative to measurements taken with the detector placed parallel to bedding in the horizontal plane.**

Lithostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Ur	Elemental Concentration K %	U ppm	Th ppm
30 cm sampling Interval										
Cotham Beds	0	120	9720	2255	348	157	25.2	4.4	4.9	10.3
Cotham Beds	0.3	120	10067	2236	347	153	26.3	4.4	4.9	10.1
Cotham Beds	0.6	120	10101	2312	350	168	26.4	4.6	5.0	11.2
Cotham Beds	0.9	120	10052	2327	315	156	26.2	4.7	4.2	10.5
Cotham Beds	1.2	120	10239	2271	337	177	26.8	4.5	4.4	12.2
Cotham Beds	1.5	240	15462	3334	518	256	14.3	3.2	3.4	8.1
Cotham Beds	1.8	240	15848	3532	524	222	19.9	3.4	3.6	6.7
Cotham Beds	2.1	120	10929	2441	365	160	28.8	4.9	5.2	10.5
Cotham Beds	2.4	120	10513	2425	349	169	27.6	4.9	4.7	11.5
Cotham Beds	2.7	120	11950	2830	415	232	31.9	5.7	5.4	16.9
Cotham Beds	3.0	120	11646	2648	408	213	31.3	5.3	6.4	15.0
Cotham Beds	3.3	120	11776	2757	424	177	31.3	5.5	6.2	12.0
Cotham Beds	3.6	120	10907	2478	409	177	28.8	4.9	5.9	12.0
Cotham Beds	3.9	120	9761	2295	417	144	26.0	4.4	6.4	8.9
White Lias	4.2	240	13872	2814	568	248	17.0	3.1	4.0	7.7
White Lias	4.5	240	13344	2728	568	251	16.2	2.4	4.0	7.7
White Lias	4.8	240	13079	2814	520	280	15.9	2.6	3.3	9.1
White Lias	5.1	240	12834	2734	512	198	15.4	2.5	3.8	5.5
White Lias	5.4	240	11940	2496	524	195	14.1	2.2	3.8	5.3
White Lias	5.7	240	17222	3832	638	290	22.0	3.8	4.4	7.7
White Lias	6.0	120	9106	2984	294	148	21.9	3.7	3.9	9.8
White Lias	6.3	240	16972	5308	620	280	21.6	4	4.3	9.1
White Lias	6.6	240	16724	3900	616	285	21.6	4	4.2	9.3
White Lias	6.9	240	14572	3396	500	216	18.0	3.3	2.8	6.4

Table 1.34 **Collection of data at different sampling intervals (*e.g.* 30 cm, 50 cm, 100 cm, 150 cm and 250 cm). Three lithostratigraphic intervals were logged (Pre-*planorbis* Beds, White Lias and Cotham Beds). The data were collected from St. Mary's Well Bay, Glamorgan, South Wales (ST 180680) during the period 15th September - 17th September 1995. The Edinburgh University GR-256 gamma-ray spectrometers was used to obtain the data. (1 of 4.)**

Lithostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Ur	Elemental Concentration K %	U ppm	Th ppm
White Lias	7.2	240	13600	3052	558	211	16.6	2.8	4.0	6.2
White Lias	7.5	240	13852	3342	502	264	17.1	3.2	3.2	8.4
White Lias	7.8	240	12680	2904	552	214	15.2	2	4.0	6.2
White Lias	8.1	240	14694	3392	590	259	18.2	3.2	4.0	7.1
Pre-*planorbis*	8.4	240	12382	1465	520	293	14.2	2.5	3.4	6.6
Pre-*planorbis*	8.7	360	10677	1170	465	182	6.7	1.2	2.2	2.3
Pre-*planorbis*	9.0	360	15658	1303	453	301	7.6	1.4	4.4	4.1
Pre-*planorbis*	9.3	360	12341	1357	492	281	8.3	1.4	2.0	3.9
Pre-*planorbis*	9.6	360	13896	1679	630	372	9.7	1.7	2.7	5.4
Pre-*planorbis*	9.9	240	12189	1340	549	238	8.2	1.4	2.5	3.5
Pre-*planorbis*	10.2	240	9594	1160	464	230	10.3	1.8	3.6	4.9
Pre-*planorbis*	10.5	240	9950	1208	468	232	10.7	1.9	3.7	5.0
Pre-*planorbis*	10.8	240	10008	1127	418	248	10.8	1.8	2.6	5.4
Pre-*planorbis*	11.1	360	12777	1369	627	297	8.7	1.3	2.9	4.0
Pre-*planorbis*	11.4	360	11883	1345	410	285	7.9	1.4	2.1	4.0
Pre-*planorbis*	11.7	360	12264	1251	489	313	8.2	1.3	2.0	4.3
Pre-*planorbis*	12	240	10290	1167	512	256	11.2	1.8	3.6	5.4
Pre-*planorbis*	12.3	240	11178	1211	562	269	12.5	2.5	4.0	5.8
Pre-*planorbis*	12.6	240	10472	1144	568	296	11.5	1.7	4.0	6.4
Pre-*planorbis*	12.9	240	11094	1221	572	280	12.4	1.8	4.1	6.0
50 cm Sampling Interval										
Cotham Beds	0.0	120	9720	2255	348	157	25.2	4.4	4.9	10.3
Cotham Beds	0.5	120	10001	2268	341	145	26.3	4.5	4.9	9.5
Cotham Beds	1.0	120	10236	2211	393	173	26.8	4.2	5.6	11.5
Cotham Beds	1.5	240	16510	1878	540	259	20.8	3.7	3.6	8.3

Table 1.34 **(2 of 4). All measurements were collected with the detector placed in the horizontal plane parallel to bedding.**

Lithostratigraphy	Height m	Time Secs	Total Number of Counts				Ur	Elemental Concentration		
			Total	K	U	Th		K %	U ppm	Th ppm
Cotham Beds	2.0	120	10002	2404	390	178	29.0	4.7	5.5	12.0
Cotham Beds	2.5	120	11661	2864	398	198	31.0	5.7	7.2	13.9
Cotham Beds	3.0	120	11182	2768	421	232	31.5	5.5	5.6	16.9
Cotham Beds	3.5	120	10619	2380	441	168	27.9	4.5	6.7	13.1
White Lias	4.0	240	15556	3136	670	240	19.5	2.8	5.0	7.2
White Lias	4.5	240	13640	2788	518	190	16.6	2.6	3.7	5.3
White Lias	5.0	240	11820	2506	440	172	13.9	2.2	3.0	4.5
White Lias	5.5	240	10838	2324	456	135	12.5	2.1	3.4	2.8
White Lias	6.0	120	9015	2019	322	140	22.2	3.9	4.5	8.9
White Lias	6.5	240	17130	4066	1414	285	21.8	4.0	4.2	9.3
White Lias	7.0	240	14310	3272	558	219	17.6	3.1	3.8	7.6
White Lias	7.5	240	13564	3068	600	222	17.5	2.8	4.4	6.5
White Lias	8.0	240	14900	3440	610	261	18.5	3.2	4.3	8.1
Pre-*planorbis*	8.5	360	10862	1307	478	222	12.0	2.1	3.4	4.8
Pre-*planorbis*	9.0	360	14829	1251	423	242	7.8	1.3	1.7	3.2
Pre-*planorbis*	9.5	360	12714	1350	564	301	8.7	1.4	2.5	4.2
Pre-*planorbis*	10.0	360	14745	1790	657	333	10.6	1.9	2.9	4.8
Pre-*planorbis*	10.5	240	10008	1206	418	235	10.8	1.9	2.7	5.1
Pre-*planorbis*	11.0	240	9234	1057	426	227	9.7	1.6	3.2	4.9
Pre-*planorbis*	10.5	240	10018	1172	488	238	10.9	1.8	3.9	5.1
Pre-*planorbis*	12.0	240	10094	1130	408	17	1.5	4.1	5.2	5.4
Pre-*planorbis*	12.5	240	11328	1255	578	298	12.7	1.9	4.1	6.1
100 cm Sampling Interval										
Cotham Beds	0	120	9720	2255	348	157	25.2	4.4	4.9	10.3
Cotham Beds	1.0	120	10049	2636	373	153	29.2	5.3	5.3	10.0
Cotham Beds	2.0	120	10796	2383	482	149	28.4	4.6	6.0	9.5
Cotham Beds	3.0	120	11878	2739	415	199	31.6	5.5	5.8	13.9

Table 1.34 **(3 of 4).**

Lithostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Ur	Elemental Concentration K %	U ppm	Th ppm
Cotham Beds	4.0	240	15346	3244	1446	240	19.2	3.1	4.8	7.2
White Lias	5.0	240	12514	2778	488	198	15.0	2.6	3.4	5.5
White Lias	6.0	120	9151	1989	341	132	22.0	3.1	5.0	8.3
White Lias	7.0	240	14146	3326	526	235	17.4	3.2	3.6	7.1
White Lias	8.0	240	14894	3322	546	304	18.5	3.2	3.5	10.0
Pre-planorbis	9.0	360	11280	1149	459	226	7.3	1.2	2.0	2.9
Pre-planorbis	10.0	360	13964	1820	696	384	10.7	1.9	3.1	5.5
Pre-planorbis	11.0	240	9310	1019	386	219	9.8	1.6	2.5	4.6
Pre-planorbis	12.0	240	10116	1167	520	219	11.0	1.7	4.1	4.5
150 cm Sampling Interval										
Cotham Beds	0.0	120	9720	2255	348	157	25.2	4.4	4.9	10.3
Cotham Beds	1.5	240	16250	3528	504	253	18.2	3.1	3.1	8.3
Cotham Beds	3.0	120	11952	2709	709	210	31.6	5.3	6.6	14.6
White Lias	4.5	240	13036	2798	610	223	16.4	3.1	3.9	6.5
White Lias	6.0	120	9152	1924	332	135	22.3	3.7	4.8	8.6
White Lias	7.5	240	13906	3238	522	230	17.0	9.1	3.6	6.9
Pre-*planorbis*	9.0	360	11784	1303	419	261	7.8	1.3	2.3	3.6
Pre-*planorbis*	10.5	240	10076	1216	496	259	11.0	1.9	3.4	5.6
Pre-*planorbis*	12.0	240	10280	1194	506	275	11.2	1.8	3.4	6.0
200 cm sampling Interval										
Cotham Beds	0	120	9720	2255	348	157	25.2	4.4	4.9	10.3
Cotham Beds	2.0	120	10890	2397	395	214	28.7	4.7	5.4	10.7
Cotham Beds	4.0	240	15070	3096	582	238	18.8	3.1	4.1	7.2
White Lias	6.0	120	9212	2077	323	149	23.1	4.1	4.4	9.6
White Lias	8.0	240	14996	3454	580	275	18.7	3.3	3.9	8.8
Pre-planorbis	10.0	240	9992	1216	454	256	10.8	1.9	2.9	5.6
Pre-planorbis	12.0	240	10390	1117	516	230	11.4	1.7	3.8	4.8

Table 1.34 (4 of 4).

Plane Taken	Horizon	Sample Time	Total Number of Counts Recorded				Total	Elemental Concentrations		
		Secs	Total	K	U	Th	ur	K %	U ppm	Th ppm
Vertical Plane	Belemnite Bed	215	10113	1753	597	205	13.2	1.4	5.2	6.7
Vertical Plane	Belemnite Bed	215	9795	1805	565	201	12.6	1.5	4.8	6.5
Vertical Plane	Belemnite Bed	215	9455	1750	588	206	12.1	1.4	5.1	6.7
Vertical Plane	Belemnite Bed	215	9596	1730	570	215	12.3	1.5	4.8	7.2
Vertical Plane	Belemnite Bed	215	12744	1910	621	180	17.5	1.6	5.5	5.3
Vertical Plane	Belemnite Bed	215	9595	1751	576	203	12.3	1.4	4.9	6.5
Vertical Plane	Belemnite Bed	215	9561	1734	580	234	12.2	1.4	4.8	8.1
Vertical Plane	Belemnite Bed	215	9988	1801	652	211	12.9	1.4	5.7	6.9
Vertical Plane	Belemnite Bed	215	9331	1778	574	215	11.9	1.5	4.8	7.2
Vertical Plane	Belemnite Bed	215	9280	1709	598	210	11.8	1.3	5.1	6.9
Vertical Plane	Belemnite Bed	215	9459	1766	586	209	12.1	1.4	5.0	6.9
Vertical Plane	Belemnite Bed	215	9696	1771	593	235	12.5	1.4	4.9	8.1
Vertical Plane	Belemnite Bed	215	9401	1738	603	174	12.0	1.4	5.3	5.0
Vertical Plane	Belemnite Bed	215	9420	1740	583	150	12.0	1.4	5.1	6.0
Vertical Plane	Belemnite Bed	215	9584	1777	570	211	12.3	3.1	4.8	6.9
Vertical Plane	Belemnite Bed	215	9526	1751	612	202	12.2	1.4	5.3	6.4
Vertical Plane	Belemnite Bed	215	9670	1765	602	224	12.4	1.4	5.1	7.6
Vertical Plane	Belemnite Bed	215	9623	1810	587	216	12.3	1.5	5.0	7.1
Vertical Plane	Belemnite Bed	215	9677	1722	630	198	12.4	1.3	5.6	6.2
Vertical Plane	Belemnite Bed	215	9674	1746	669	228	12.4	1.3	5.8	7.7
						Mean	**12.6**	**1.5**	**5.1**	**6.8**

Table 1.35 **Data-set representing 20 samples taken at different locations on the dark laminated-shale horizon known as the Belemnite Bed (Belemnite Marls Formation) that outcrops west of Seatown, Dorset (SY 318908). The data were collected using the Leeds University GR-256 gamma-ray spectrometer on 21st August 1995. The detector was placed perpendicular to bedding (*i.e.* in the vertical plane).**

Plane Taken	Horizon	Sample Time Secs	Total Number of Counts Recorded Total	K	U	Th	Elemental Concentrations K %	U ppm	Th ppm	Total ur
Vertical Plane	Belemnite Bed	215	9600	959	621	251	12.2	1.4	5.5	5.9
Vertical Plane	Belemnite Bed	215	9870	993	549	272	12.6	1.6	4.5	6.6
Vertical Plane	Belemnite Bed	215	9819	989	577	252	12.5	1.5	5.0	6.0
Vertical Plane	Belemnite Bed	215	10098	995	568	293	13.0	1.6	4.6	7.2
Vertical Plane	Belemnite Bed	215	9974	987	564	302	12.8	1.5	4.5	7.4
Vertical Plane	Belemnite Bed	215	9908	1007	619	293	12.7	1.5	5.2	7.1
Vertical Plane	Belemnite Bed	215	10076	1094	619	259	13.0	1.7	5.4	6.3
Vertical Plane	Belemnite Bed	240	10175	1029	589	333	13.2	1.6	4.6	8.3
Vertical Plane	Belemnite Bed	215	9798	996	591	267	12.5	1.5	5.0	6.4
Vertical Plane	Belemnite Bed	215	9750	1016	579	293	12.5	1.6	4.7	7.2
Vertical Plane	Belemnite Bed	215	9804	964	596	275	12.5	1.5	5.1	6.6
Vertical Plane	Belemnite Bed	215	9859	1008	629	302	12.6	1.5	5.3	7.4
Vertical Plane	Belemnite Bed	215	9637	999	585	272	12.3	1.6	5.0	6.5
Vertical Plane	Belemnite Bed	215	9822	966	598	315	12.5	2.5	4.8	7.8
Vertical Plane	Belemnite Bed	215	9861	1016	589	282	12.6	1.6	4.9	6.9
Vertical Plane	Belemnite Bed	215	9872	975	563	268	12.6	1.5	4.6	6.3
Vertical Plane	Belemnite Bed	215	10058	1011	574	308	12.9	1.6	4.6	7.6
Vertical Plane	Belemnite Bed	215	9694	998	567	277	12.4	1.6	4.7	6.8
Vertical Plane	Belemnite Bed	215	9889	1012	570	308	12.6	1.6	4.5	7.6
Vertical Plane	Belemnite Bed	215	10049	1011	556	289	12.9	1.6	4.5	7.1
						Mean	**12.7**	**1.6**	**4.8**	**7.0**

Table 1.36 **Data-set representing 20 samples taken at different locations on the dark laminated-shale horizon known as the Belemnite Bed (Belemnite Marls Formation) that outcrops west of Seatown, Dorset (SY 318908). The data were collected using the Edinburgh University GR-256 gamma-ray spectrometer on 15th September 1995. The detector was placed perpendicular to bedding (*i.e.* in the vertical plane).**

Appendix 2

Gamma-Ray Data for the Lower Lias in Southern Britain.

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
Pre-*planorbis* Beds	180	0.00	10710	2461	432	184	17.60	3.00	5.50	7.40	2.47	1.35
Pre-*planorbis* Beds	180	0.30	9835	2185	479	176	15.90	2.60	5.30	6.90	2.65	1.30
Pre-*planorbis* Beds	180	0.60	9990	2206	471	170	16.20	2.60	5.30	6.70	2.58	1.26
Pre-*planorbis* Beds	240	0.90	9899	2066	534	178	11.10	1.70	4.50	4.50	2.65	1.00
Pre-*planorbis* Beds	240	1.20	9125	184	461	165	9.90	1.50	3.70	4.10	2.73	1.11
Pre-*planorbis* Beds	240	1.50	10296	2057	489	161	11.70	1.70	4.10	3.00	1.76	0.73
Pre-*planorbis* Beds	240	1.80	10511	2146	468	184	12.00	1.80	3.70	5.00	2.78	1.35
Pre-*planorbis* Beds **	240	2.10	9002	1691	410	145	9.10	1.30	3.30	3.50	2.69	1.06
Pre-*planorbis* Beds **	240	2.40	9052	1856	422	182	13.70	2.10	4.70	5.00	2.38	1.06
Pre-*planorbis* Beds	240	2.70	9017	1566	367	179	8.00	1.20	2.80	3.10	2.58	1.11
Pre-*planorbis* Beds	240	3.00	10761	2239	540	225	12.40	1.90	4.30	6.50	3.42	1.51
Pre-*planorbis* Beds	240	3.30	9385	1906	496	228	10.30	1.50	4.00	4.60	3.07	1.15
Pre-*planorbis* Beds	240	3.60	9138	1991	438	160	10.00	1.60	3.50	4.00	2.50	1.14
Pre-*planorbis* Beds	240	3.90	11500	3499	572	256	13.50	2.10	4.50	6.10	2.90	1.36
Pre-*planorbis* Beds	240	4.20	13433	2869	712	256	15.30	2.40	6.10	4.50	1.88	0.74
Pre-*planorbis* Beds	180	4.50	10336	2257	477	204	16.90	2.70	5.10	8.60	3.19	1.69
Pre-*planorbis* Beds	180	4.80	10606	2233	572	232	17.40	2.50	6.40	10.00	4.00	1.56
Pre-*planorbis* Beds	180	5.10	9162	1688	452	193	13.40	1.80	4.80	7.90	4.39	1.65
Pre-*planorbis* Beds	180	5.40	10458	2178	531	180	17.10	2.50	6.10	7.10	2.84	1.16
Pre-*planorbis* Beds	180	5.70	11801	2530	617	257	19.70	2.90	6.80	11.50	3.97	1.69
planorbis - planorbis	240	6.00	11218	2315	571	238	13.00	1.90	4.60	7.20	3.79	1.57
planorbis - planorbis	180	6.30	9157	1980	472	176	14.50	2.30	5.30	6.90	3.00	1.30
planorbis - planorbis	180	6.60	9122	1821	408	160	13.10	2.10	4.40	6.20	2.95	1.41
planorbis - planorbis	240	6.90	9052	1431	398	174	9.20	1.10	3.00	4.60	4.18	1.53
planorbis - planorbis	180	7.20	10441	2117	597	177	17.10	2.30	7.20	6.70	2.91	0.93
planorbis - planorbis	140	7.50	9152	1757	551	120	18.70	2.40	8.70	8.30	3.46	0.95

Table 2.01 **Gamma-ray data-set for the Pre-*planorbis* Beds to the lowermost 90 cm of the *angulata* Zone exposed in St. Audrie's Bay, Somerset (ST 102433). The 145 sets of measurements were collected from cliff section. All readings were taken with the Leeds University GR-256 during the period 22nd August - 25th August 1995. Measurements were taken with the detector placed perpendicular to the cliff and parallel to bedding, except for readings denoted by ** which indicates a poor sample geometry. (1 of 5).**

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
planorbis - planorbis	140	7.80	9012	1572	472	144	15.50	2.10	7.30	7.20	3.43	0.99
planorbis - planorbis	140	8.10	9019	1236	352	123	11.40	1.70	5.10	5.70	3.35	1.12
planorbis - planorbis	140	8.40	9042	1330	353	120	13.70	2.00	5.10	5.80	2.90	1.14
planorbis - planorbis	140	8.70	9095	1241	330	145	13.00	1.60	5.40	7.60	4.75	1.41
planorbis - planorbis	240	9.00	11205	2299	623	229	13.00	1.80	5.20	6.70	3.72	1.29
planorbis - planorbis	240	9.30	10725	2257	522	211	12.30	1.90	4.10	6.20	3.26	1.51
planorbis - planorbis	240	9.60	10089	1995	587	190	11.40	1.60	4.10	5.30	3.31	1.29
planorbis - planorbis	240	9.90	9763	2052	460	199	10.90	1.70	3.50	5.50	3.24	1.57
planorbis - johnstoni	200	10.20	10219	1963	620	181	14.60	1.80	6.70	6.20	3.44	0.93
planorbis - johnstoni	200	10.50	9864	2010	510	194	14.00	2.00	5.10	6.90	3.45	1.35
planorbis - johnstoni	200	10.80	9151	1603	336	170	10.50	1.60	3.50	5.70	3.56	1.63
planorbis - johnstoni	200	11.10	9090	1670	379	154	10.80	1.70	3.50	5.20	3.06	1.49
planorbis - johnstoni	240	11.40	9780	1926	495	151	10.90	1.50	4.20	3.40	2.27	0.81
planorbis - johnstoni	240	11.70	13852	2571	860	245	17.00	1.90	7.90	7.10	3.74	0.90
planorbis - johnstoni	180	12.00	9606	1876	547	176	15.40	2.00	6.40	6.90	3.45	1.08
planorbis - johnstoni	180	12.30	9294	1672	551	179	14.80	1.60	6.50	7.10	4.44	1.09
planorbis - johnstoni	180	12.60	9556	1775	612	185	15.30	1.70	7.40	7.20	4.24	0.97
planorbis - johnstoni	180	12.90	10889	2230	676	215	17.90	2.40	8.10	8.90	3.71	1.10
liasicus - portlocki	180	13.20	10102	2153	457	198	16.40	2.60	4.80	8.30	3.19	1.73
liasicus - portlocki	180	13.50	11203	2340	524	212	18.60	2.80	5.80	8.90	3.18	1.53
liasicus - portlocki	180	13.80	10249	2153	422	219	16.70	2.60	4.10	9.50	3.65	2.32
liasicus - portlocki	180	14.10	12922	2884	567	257	22.00	3.60	6.10	11.70	3.25	1.92
liasicus - portlocki **	180	14.40	12719	2788	603	285	21.60	2.40	6.40	13.10	5.46	2.05
liasicus - portlocki **	180	14.70	11800	2606	585	264	19.70	3.90	6.30	11.90	3.05	1.89
liasicus - portlocki **	180	15.00	12268	2659	608	237	20.70	3.20	6.80	10.30	3.22	1.51
liasicus - portlocki	180	15.30	13612	2988	628	277	23.30	3.70	6.80	12.70	3.43	1.87
liasicus - portlocki	180	15.60	13492	3002	637	293	23.10	2.70	6.90	13.60	5.04	1.97
liasicus - portlocki	180	15.90	13589	2878	646	300	23.30	3.50	7.00	13.90	3.97	1.99
liasicus - portlocki	180	16.20	12160	2685	535	248	20.50	3.30	5.70	11.00	3.33	1.93

Table 2.01 (2 of 5).

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
liasicus - portlocki	180	16.50	1290	2612	519	268	20.70	3.20	5.30	12.20	3.81	2.30
liasicus - portlocki	180	16.80	14909	3260	645	343	25.90	4.10	6.60	16.30	3.98	2.47
liasicus - portlocki	180	17.10	15025	3278	745	311	26.10	4.00	8.40	14.30	3.58	1.70
liasicus - portlocki	180	17.40	15470	3316	714	327	27.00	4.10	7.80	15.30	3.73	1.96
liasicus - portlocki **	180	17.70	14276	3142	538	244	24.60	4.00	5.90	15.30	3.83	2.59
liasicus - portlocki	180	18.00	12233	2696	518	259	20.60	3.30	5.30	11.70	3.55	2.21
liasicus - portlocki	180	18.30	13777	2830	761	244	23.70	3.20	9.20	10.30	3.22	1.12
liasicus - portlocki	180	18.60	13880	2792	782	244	23.90	3.10	9.50	10.30	3.32	1.08
liasicus - portlocki	180	18.90	14008	2913	683	283	24.10	3.50	7.70	12.70	3.63	1.65
liasicus - portlocki	120	19.20	10837	2039	650	223	28.60	3.30	12.40	11.00	3.33	0.89
liasicus - portlocki	120	19.50	9006	1615	308	142	18.50	3.00	4.80	9.30	3.10	1.94
liasicus - portlocki	120	19.80	9112	1535	310	153	17.50	2.80	4.70	10.10	3.61	2.15
liasicus - portlocki	120	20.10	9018	1487	335	129	17.20	2.60	5.60	8.10	3.12	1.45
liasicus - portlocki	120	20.40	9003	1890	465	175	23.10	3.30	8.00	11.70	3.55	1.46
liasicus - portlocki	120	20.70	9418	2000	455	160	24.30	3.60	8.00	10.30	2.86	1.29
liasicus - portlocki	120	21.00	9759	1923	507	134	25.40	3.30	9.40	8.10	2.45	0.86
liasicus - portlocki	120	21.30	9256	1843	499	143	23.90	3.10	9.20	8.80	2.84	0.96
liasicus - portlocki	120	21.60	10193	2152	545	187	26.60	3.80	9.70	12.40	3.26	1.28
liasicus - portlocki **	120	21.90	10356	2167	557	157	27.10	3.80	10.30	9.80	2.58	0.95
liasicus - portlocki **	120	22.20	9819	2098	506	207	25.50	3.70	8.60	14.30	3.86	1.66
liasicus - portlocki	120	22.50	10299	2166	521	182	27.00	3.90	9.20	12.20	3.13	1.33
liasicus - portlocki	120	22.80	10412	2156	542	192	27.30	3.80	9.60	14.80	3.89	1.54
liasicus - portlocki	120	23.10	10633	2047	664	192	27.90	3.30	12.50	12.70	3.85	1.02
liasicus - portlocki	120	23.40	10431	1953	642	195	27.30	3.10	11.90	13.10	4.23	1.10
liasicus - portlocki	120	23.70	9860	1968	534	204	25.70	3.40	9.30	14.00	4.12	1.51
liasicus - portlocki	120	24.00	9114	1785	510	144	23.40	3.00	9.50	8.80	2.93	0.93
liasicus - portlocki	120	24.30	9371	1722	427	170	21.20	3.00	7.20	11.20	3.73	1.56
liasicus - portlocki	120	24.60	9443	1512	424	158	19.40	2.50	7.30	10.30	4.12	1.41
liasicus - portlocki	120	24.90	9962	1809	477	156	23.00	3.10	8.50	10.00	3.23	1.18

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
liasicus - portlocki	120	25.20	9766	1759	463	146	22.40	3.00	8.30	9.10	3.03	1.10
liasicus - portlocki	120	25.50	9096	1835	458	147	20.20	3.10	7.90	9.80	3.16	1.24
liasicus - portlocki	120	25.80	9240	1925	469	168	23.80	3.40	8.20	11.10	3.26	1.35
liasicus - portlocki	120	26.10	9311	1633	430	144	21.10	2.60	8.00	8.80	3.38	1.10
liasicus - portlocki	120	26.40	9013	1537	422	147	20.20	2.50	7.40	9.30	3.72	1.26
liasicus - portlocki	120	26.70	9112	1638	444	161	20.10	2.80	7.70	10.50	3.75	1.36
liasicus - portlocki	120	27.00	2028	2028	468	182	24.50	3.60	8.00	12.40	3.44	1.55
liasicus - portlocki	120	27.30	9986	1956	466	156	23.10	3.50	8.30	10.00	2.86	1.20
liasicus - portlocki	120	27.60	9627	1896	521	193	25.00	3.20	9.10	13.10	4.09	1.44
liasicus - portlocki	120	27.90	9636	1951	558	178	25.00	3.30	10.20	11.90	3.61	1.17
liasicus - portlocki	120	28.20	9291	1908	518	182	23.80	3.20	9.60	9.30	2.91	0.97
liasicus - portlocki	120	28.50	10620	2086	642	207	27.90	3.40	11.80	14.00	4.12	1.19
liasicus - portlocki	120	28.80	10621	2085	663	193	27.90	3.40	12.50	12.00	3.53	0.96
liasicus - portlocki	120	29.10	9601	1996	524	198	24.90	3.40	9.30	12.20	3.59	1.31
liasicus - portlocki	120	29.40	9359	1850	564	183	24.20	3.00	10.40	11.40	3.80	1.10
liasicus - portlocki	120	29.70	9641	1935	588	166	25.00	3.20	11.10	11.20	3.50	1.01
liasicus - laqueus	120	30.00	9707	1939	553	184	25.20	3.20	10.00	12.00	3.75	1.20
liasicus - laqueus	120	30.30	10583	2073	685	206	27.80	3.30	12.80	14.00	4.24	1.09
liasicus - laqueus	120	30.60	10741	2147	678	187	28.30	3.50	12.80	12.20	3.49	0.95
liasicus - laqueus	120	30.90	9161	1868	462	157	22.60	3.30	8.20	10.00	3.03	1.22
liasicus - laqueus	120	31.20	9196	1708	521	149	23.70	2.80	9.60	9.30	3.32	0.97
liasicus - laqueus	120	31.50	9114	1600	467	149	18.60	2.60	8.40	9.30	3.58	1.11
liasicus - laqueus	120	31.80	9061	1675	409	150	20.30	2.90	7.00	9.60	3.31	1.37
liasicus - laqueus	120	32.10	9008	1506	478	154	20.10	2.40	8.60	9.80	4.08	1.14
liasicus - laqueus	120	32.40	9041	1815	489	140	22.20	3.10	9.10	8.60	2.77	0.95
liasicus - laqueus	120	32.70	9032	1868	473	180	22.90	3.20	8.20	12.00	3.75	1.46
liasicus - laqueus	120	33.00	9574	1560	371	132	20.90	2.30	6.40	8.30	3.61	1.30
liasicus - laqueus	120	33.30	9219	1525	320	141	12.00	2.70	5.10	8.90	3.30	1.75
liasicus - laqueus	120	33.60	9010	1399	337	121	16.80	2.40	5.70	7.40	3.08	1.30
liasicus - laqueus	120	33.90	9043	1929	277	127	14.30	2.10	4.30	8.00	3.81	1.86

Table 2.01 **(4 of 5).**

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
liasicus - laqueus	120	34.20	9008	1700	360	164	11.10	2.00	3.70	6.40	3.20	1.73
liasicus - laqueus	120	34.50	9351	1760	352	157	11.90	2.10	3.60	6.10	2.90	1.69
liasicus - laqueus **	120	34.80	11013	2382	450	223	14.20	2.40	3.60	7.60	3.17	2.11
liasicus - laqueus **	220	35.10	10107	2177	434	201	14.40	2.30	4.00	7.30	3.17	1.83
liasicus - laqueus **	200	35.40	11697	2463	527	224	17.20	2.60	5.10	8.70	3.35	1.71
liasicus - laqueus	200	35.70	13615	2895	620	253	19.60	3.10	6.20	9.80	3.16	1.58
liasicus - laqueus	200	36.00	13304	2907	584	282	20.10	3.20	5.50	11.50	3.59	2.09
liasicus - laqueus	200	36.30	9049	1854	423	195	20.50	1.90	3.80	7.10	3.74	1.87
liasicus - laqueus	180	36.60	10018	2140	467	178	16.20	2.50	5.10	7.20	2.88	1.41
liasicus - laqueus	120	36.90	10912	2366	467	189	18.00	2.90	5.00	7.60	2.62	1.52
liasicus - laqueus	120	37.20	9005	1499	321	153	10.50	1.70	3.20	5.80	3.41	1.81
liasicus - laqueus	120	37.50	9197	1967	396	185	14.60	2.30	4.00	7.60	3.30	1.90
liasicus - laqueus	120	37.80	9108	1946	373	193	14.40	2.30	3.60	8.10	3.52	2.25
liasicus - laqueus	120	38.10	9497	2103	409	185	15.20	2.50	4.20	7.60	3.04	1.81
liasicus - laqueus	120	38.40	9594	2023	414	166	15.40	2.40	4.40	6.30	2.63	1.43
liasicus - laqueus	120	38.70	9049	1793	413	205	13.90	2.00	4.20	8.60	4.30	2.05
liasicus - laqueus	120	39.00	9036	1827	407	168	14.00	2.10	4.40	6.50	3.10	1.48
liasicus - laqueus	120	39.30	10526	2341	468	215	16.20	2.90	4.70	9.30	3.21	1.98
liasicus - laqueus	120	39.60	9006	3486	680	149	13.30	2.00	3.60	5.50	2.75	1.53
liasicus - laqueus	360	39.90	15030	3172	636	304	11.30	1.80	3.10	5.80	3.22	1.87
liasicus - laqueus	360	40.20	14966	3262	722	272	11.20	1.80	3.90	4.80	2.67	1.23
liasicus - laqueus	360	40.50	14788	2998	700	290	11.00	1.70	3.60	5.30	3.12	1.47
liasicus - laqueus	360	40.80	15120	2986	514	301	11.40	1.60	3.70	5.70	3.56	1.54
liasicus - laqueus	360	41.10	13694	2890	638	230	10.00	1.60	3.10	5.80	3.63	1.87
liasicus - laqueus	360	41.40	13736	2792	634	256	10.00	1.50	3.20	4.50	3.00	1.41
liasicus - laqueus	360	41.70	13294	2632	684	238	9.60	1.40	2.70	4.00	2.86	1.48
liasicus - laqueus	360	42.00	13180	2720	510	256	9.40	1.60	2.30	4.50	2.81	1.96
liasicus - laqueus	240	42.30	9126	1618	396	140	9.40	1.40	3.10	3.10	2.21	1.00
angulata	240	42.60	13174	3086	652	304	17.10	2.80	5.40	9.50	3.39	1.76
angulata	240	42.90	13478	2786	634	280	16.60	2.40	5.00	8.90	3.71	1.78
angulata	120	43.20	9136	1431	419	152	18.20	2.40	7.30	9.60	4.00	1.32

Table 2.01 **(5 of 5)**

Biostratigraphy	Time Secs	Height m	Total Number of Counts				Total ur	Elemental Concentration			Ratios	
			Total	K	U	Th		K %	U ppm	Th ppm	Th/K	Th/U
angulata Zone	240	43.50	10558	2098	500	208	12.10	1.70	4.00	6.00	3.53	1.50
angulata Zone	240	43.80	10812	1280	500	214	13.90	2.10	3.90	6.20	2.95	1.59
angulata Zone	240	44.10	11660	1250	450	203	13.70	2.00	4.50	5.70	2.85	1.27
angulata Zone	240	44.40	11940	2418	594	224	14.10	2.00	4.80	6.50	3.25	1.35
angulata Zone	240	44.70	10540	2356	536	232	13.50	2.00	4.20	7.10	3.55	1.69
angulata Zone	240	45.00	9432	1898	422	177	10.40	1.60	3.20	4.60	2.88	1.44
angulata Zone	240	45.30	9992	1914	428	219	10.20	1.60	2.10	6.50	4.06	3.10
angulata Zone	240	45.60	10048	2112	480	185	11.30	1.80	3.80	5.00	2.78	1.32
angulata Zone	240	45.90	10876	2190	546	238	11.50	1.80	4.30	7.20	4.00	1.67
angulata Zone	240	46.20	13508	2728	686	219	16.40	2.30	6.00	6.20	2.70	1.03
angulata Zone	240	46.50	15980	3396	778	290	20.10	3.00	6.60	9.30	3.10	1.41
angulata Zone	120	46.80	9175	1625	390	127	20.70	2.80	6.90	7.70	2.75	1.12
angulata Zone	120	47.10	9100	1592	385	154	20.40	2.80	6.40	10.00	3.57	1.56
angulata Zone	240	47.40	15428	3088	758	272	19.30	2.80	6.50	8.40	3.00	1.29
angulata Zone	240	47.70	14474	2956	676	156	17.90	2.60	5.40	9.80	3.77	1.81
angulata Zone	240	48.00	15224	3202	714	167	19.00	2.80	5.80	9.80	3.50	1.69
angulata Zone	120	48.30	9005	1670	354	145	20.20	3.00	5.90	9.30	3.10	1.58
angulata Zone	120	48.60	9102	1693	408	213	21.30	3.00	6.40	15.00	5.00	2.34
angulata Zone	240	48.90	15780	3892	780	256	19.80	2.80	6.90	7.70	2.75	1.12
angulata Zone	240	49.20	13936	2804	700	232	17.10	2.40	6.10	6.90	2.88	1.13
angulata Zone	240	49.50	13920	2842	666	272	17.10	2.50	5.50	8.40	3.36	1.53
angulata Zone	240	49.80	12740	2562	650	251	15.30	2.30	5.40	7.60	3.30	1.41
angulata Zone	240	50.10	12812	2568	686	255	15.40	2.10	5.80	7.60	3.62	1.31
angulata Zone	240	50.40	12792	2396	670	222	14.30	1.90	5.60	6.60	3.47	1.18
angulata Zone	240	50.70	12000	3546	640	190	15.20	1.90	5.60	5.20	2.74	0.93

Table 2.02 Gamma-ray data-set for the *angulata* Zone and *bucklandi* Zone (*conybeari* and *rotiforme* Subzones) exposed east of Kilve Pylle, Somerset (ST 144455 to ST 153452). The 154 sets of measurements were collected from cliff section apart from the stratigraphic interval represented between 51.90 m and 63.30 m, which was measured on the foreshore. All readings were taken with the Leeds University GR-256 during the period 26th August - 30th August 1995. Measurements were taken with the detector parallel to bedding except for readings taken on the foreshore where the detector was placed perpendicular to bedding. Sets of measurements denoted by ** indicate a poor sample geometry. (1 of 5).

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
angulata Zone	240	51.00	12304	2326	590	256	13.80	1.90	4.70	8.00	4.21	1.70
angulata Zone	240	51.30	13596	2804	696	248	16.60	2.40	6.00	7.60	3.17	1.27
angulata Zone	240	51.60	12944	2596	720	204	15.60	2.10	6.10	8.40	4.00	1.38
angulata Zone **	240	51.90	12540	2568	624	248	14.00	2.20	5.10	7.60	3.45	1.49
angulata Zone **	240	52.20	14018	2836	790	219	17.20	2.40	6.00	6.20	2.58	1.03
angulata Zone	240	52.50	12696	2476	602	219	15.20	2.10	5.00	6.40	3.05	1.28
angulata Zone **	240	52.80	11650	2340	534	214	13.70	2.00	4.30	6.20	3.10	1.44
angulata Zone **	240	53.10	10028	1932	460	195	10.30	1.60	3.60	5.50	3.44	1.53
angulata Zone **	240	53.40	11872	2230	640	232	14.00	1.70	5.40	6.90	4.06	1.28
angulata Zone	240	53.70	10828	2104	430	243	12.50	1.70	4.10	7.60	4.47	1.85
angulata Zone	240	54.00	11894	2246	618	201	12.90	1.80	5.30	7.20	4.00	1.36
angulata Zone	240	54.30	11060	2078	608	206	12.80	1.60	5.20	5.90	3.69	1.13
angulata Zone	240	54.60	12532	2408	418	219	15.00	2.00	5.90	6.20	3.10	1.05
angulata Zone	240	54.90	11578	2286	536	193	13.60	1.90	4.40	5.20	2.74	1.18
angulata Zone	240	55.20	11614	2110	592	193	13.60	1.70	5.10	5.20	3.06	1.02
angulata Zone	240	55.50	10758	2086	566	182	12.40	1.70	4.80	4.60	2.71	0.96
angulata Zone	240	55.80	14816	29190	738	243	18.40	2.50	6.40	7.70	3.08	1.20
angulata Zone	240	56.10	13652	2686	722	278	16.70	2.20	6.10	8.60	3.91	1.41
angulata Zone	240	56.40	14378	2878	766	280	17.70	2.40	6.60	8.80	3.67	1.33
angulata Zone **	240	57.00	10274	1958	516	224	10.70	1.60	4.10	6.50	4.06	1.59
angulata Zone **	240	57.30	10592	2112	538	201	11.10	1.70	4.40	5.70	3.35	1.30
angulata Zone **	240	57.60	13302	2761	682	269	14.10	2.30	5.70	8.40	3.65	1.47
angulata Zone **	240	57.90	13276	2714	640	177	16.10	2.30	9.90	6.70	2.91	0.68
angulata Zone **	240	58.20	12365	2522	304	240	16.90	2.10	5.00	7.20	3.43	1.44
angulata Zone	240	58.50	9916	1938	508	195	16.10	1.50	4.10	5.50	3.67	1.34
angulata Zone	360	58.80	10317	1770	633	158	6.60	0.70	3.60	1.72	2.46	0.48
angulata Zone	360	59.10	9981	1704	570	182	6.30	0.70	3.20	2.60	3.71	0.81
angulata Zone	240	59.40	11572	4064	340	427	11.60	1.50	5.90	6.00	4.00	1.02
angulata Zone	240	59.70	14274	2512	1022	240	11.20	1.70	4.80	6.70	3.94	1.40
angulata Zone	240	60.00	16156	2766	1168	266	11.40	1.80	5.30	7.70	4.28	1.45

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
angulata Zone	240	60.30	15918	2692	246	248	12.00	1.70	6.30	6.90	4.06	1.10
angulata Zone	240	60.60	14314	2680	946	190	11.30	2.00	3.90	4.80	2.40	1.23
angulata Zone	240	60.90	14006	2638	882	224	10.60	2.00	3.60	6.00	3.00	1.67
angulata Zone	240	61.20	10846	1998	802	176	10.50	1.50	3.30	4.50	3.00	1.36
angulata Zone	360	61.50	10821	2049	528	268	7.10	1.00	2.70	3.10	3.10	1.15
angulata Zone	480	61.80	10532	1632	548	132	4.20	0.60	2.20	1.60	2.67	0.73
angulata Zone **	480	62.10	11184	1864	560	200	4.70	0.60	2.00	1.90	3.17	0.95
angulata Zone **	480	62.40	10552	1700	432	174	4.20	0.50	1.40	1.60	3.20	1.14
angulata Zone **	480	62.70	10396	1876	552	195	3.10	0.60	2.00	1.70	2.83	0.85
angulata Zone	360	63.00	9576	1701	480	174	5.90	0.80	2.40	2.60	3.25	1.08
angulata Zone	480	63.30	11804	2064	596	233	5.10	0.70	2.30	1.60	2.29	0.70
angulata Zone	240	63.60	9043	1346	494	145	8.50	0.80	4.30	3.30	4.13	0.77
angulata Zone	360	63.90	9261	1800	720	206	7.70	0.70	4.20	2.90	4.14	0.69
angulata Zone	480	64.20	11264	1824	688	158	4.80	0.50	2.90	1.40	2.80	0.48
angulata Zone	240	64.50	9006	1266	474	301	9.40	0.80	5.10	3.30	4.13	0.65
angulata Zone	360	64.80	11445	1779	705	170	7.70	0.70	4.20	1.90	2.71	0.45
angulata Zone	240	65.10	9009	1478	618	119	9.30	0.90	5.80	1.90	2.11	0.33
angulata Zone	240	65.40	10040	1640	768	166	11.30	0.90	7.30	3.80	4.22	0.52
angulata Zone	360	65.70	11655	2118	687	182	7.90	1.00	4.00	2.20	2.20	0.55
angulata Zone	360	66.00	9984	1719	621	150	6.30	0.70	3.60	1.60	2.29	0.44
angulata Zone	360	66.30	9306	1620	495	139	5.60	0.70	2.70	1.40	2.00	0.52
angulata Zone	360	66.60	10500	1743	612	226	6.80	0.70	3.40	3.40	4.86	1.00
angulata Zone	360	66.90	11028	192	627	194	6.30	0.90	3.50	2.60	2.89	0.74
angulata Zone	360	67.20	9816	1650	531	115	6.10	3.00	0.50	0.90	0.30	1.80
angulata Zone	360	67.50	11985	2016	705	154	8.30	0.90	4.20	1.40	1.56	0.33
angulata Zone	240	67.80	12114	2026	844	163	14.40	1.30	8.20	3.80	2.92	0.46
angulata Zone	240	68.10	13454	2330	960	216	16.40	1.50	9.20	6.80	4.53	0.74
angulata Zone	240	68.40	12324	2198	730	182	14.70	1.60	6.70	4.50	2.81	0.67
angulata Zone **	240	68.70	12174	2172	702	195	14.50	1.60	6.30	5.30	3.31	0.84
angulata Zone **	240	69.00	11810	2114	698	198	13.90	1.50	6.30	5.50	3.67	0.87

Table 2.02 (3 of 5).

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
angulata Zone **	240	69.30	11410	2082	692	180	13.30	1.50	6.30	4.60	3.07	0.73
angulata Zone **	240	69.60	12536	2256	690	259	14.00	1.70	5.80	8.10	4.76	1.40
angulata Zone	240	69.90	10720	2014	588	193	11.30	1.50	5.10	5.20	3.47	1.02
angulata Zone	480	70.20	13096	2244	1088	204	6.10	0.70	2.60	2.90	4.14	1.12
angulata Zone	480	70.50	11868	2152	560	196	5.20	0.70	1.90	2.80	4.00	1.47
angulata Zone	240	70.80	13322	3596	732	203	14.70	1.80	6.70	5.50	3.06	0.82
angulata Zone	120	71.10	9362	1649	735	267	24.20	2.10	14.80	7.60	3.62	0.51
angulata Zone	120	71.40	9665	1756	740	271	25.10	2.40	14.90	7.70	3.21	0.52
angulata Zone	120	71.70	9006	1602	632	285	22.80	2.30	12.20	8.90	3.87	0.73
angulata Zone	120	72.00	9015	1543	530	251	20.30	2.30	10.20	6.90	3.00	0.68
bucklandi - conybeari	240	72.30	12892	2310	852	293	15.50	1.60	7.70	8.80	5.50	1.14
bucklandi - conybeari	240	72.60	12278	2234	908	198	14.80	1.50	3.80	5.30	3.53	1.39
bucklandi - conybeari	240	72.90	10312	2020	620	214	11.70	1.50	5.30	6.00	4.00	1.13
bucklandi - conybeari	240	73.20	10378	2024	584	166	11.80	1.60	5.20	4.00	2.50	0.77
bucklandi - conybeari	240	73.50	11038	2038	720	206	12.80	1.40	6.50	5.70	4.07	0.88
bucklandi - conybeari	240	73.80	14736	2564	1128	280	18.30	1.60	10.80	8.40	5.25	0.78
bucklandi - conybeari	240	74.10	15260	2568	1064	270	19.00	1.80	10.10	8.10	4.50	0.80
bucklandi - conybeari	240	74.40	15788	2676	1344	238	19.80	1.50	13.70	7.20	4.80	0.53
bucklandi - conybeari	240	74.70	10298	1690	854	148	27.00	2.00	17.40	8.40	4.20	0.48
bucklandi - conybeari	240	75.00	9254	1410	886	127	8.70	0.90	4.20	7.70	8.56	1.83
bucklandi - conybeari	240	75.30	13352	2360	926	211	16.20	1.60	8.80	5.70	3.56	0.65
bucklandi - conybeari	240	75.60	12964	2550	750	193	15.60	2.00	6.90	5.00	2.50	0.72
bucklandi - conybeari	240	75.90	12272	2394	690	282	14.60	1.90	5.90	8.90	4.68	1.51
bucklandi - conybeari	240	76.20	9122	1518	402	156	9.30	1.00	4.60	3.60	3.60	0.78
bucklandi - conybeari	240	76.50	13080	2382	812	221	15.80	1.70	7.30	7.40	4.35	1.01
bucklandi - conybeari	240	76.80	9692	1260	356	134	10.40	0.90	2.70	2.90	3.22	1.07
bucklandi - conybeari	240	77.10	13684	2666	678	224	16.70	2.30	6.30	3.90	1.70	0.62
bucklandi - conybeari	240	77.40	13468	2686	714	240	16.50	2.20	6.20	7.10	3.23	1.15
bucklandi - conybeari	240	77.70	14358	2614	1022	348	17.50	1.50	9.00	7.90	5.27	0.88

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
bucklandi - conybeari	240	78.00	14178	2570	1048	275	17.10	1.70	8.90	8.10	4.76	0.91
bucklandi - conybeari	240	78.30	14052	2598	978	259	17.30	1.80	9.20	7.70	4.28	0.84
bucklandi - conybeari	240	78.60	10512	2036	632	177	12.00	1.50	5.70	4.50	3.00	0.79
bucklandi - conybeari	240	78.90	11379	2089	796	206	13.30	1.40	7.40	5.70	4.07	0.77
bucklandi - conybeari	240	79.20	10652	2070	622	210	12.20	1.60	5.30	5.80	3.63	1.09
bucklandi - conybeari	240	79.50	12134	2337	725	246	14.40	1.90	5.50	7.40	3.89	1.35
bucklandi - conybeari	240	79.80	14210	2830	871	304	17.50	2.20	7.70	9.60	4.36	1.25
bucklandi - conybeari	240	80.10	15031	2831	892	335	18.70	2.20	7.80	11.00	5.00	1.41
bucklandi - conybeari	240	80.40	14143	2806	889	263	17.40	2.20	8.10	7.80	3.55	0.96
bucklandi - conybeari	240	80.70	13683	2732	777	263	16.70	2.20	6.80	7.90	3.59	1.16
bucklandi - conybeari	240	81.00	13930	2719	845	236	17.10	2.20	7.80	7.20	3.27	0.92
bucklandi - conybeari	240	81.30	13853	2677	869	260	17.00	2.00	7.90	4.50	2.25	0.57
bucklandi - conybeari	240	81.60	15709	3087	925	306	19.70	2.50	8.30	9.80	3.92	1.18
bucklandi - conybeari	240	81.90	15752	2962	976	329	19.80	2.30	8.80	10.70	4.65	1.22
bucklandi - conybeari	240	82.20	16153	3120	996	308	20.40	2.40	9.10	10.10	4.21	1.11
bucklandi - conybeari	240	82.50	10615	2132	640	213	16.40	2.30	7.60	8.80	3.83	1.16
bucklandi - conybeari	240	82.80	10674	2042	626	234	17.50	2.10	7.20	10.10	4.81	1.40
bucklandi - conybeari	240	83.10	10103	2030	559	236	16.40	2.20	6.20	10.10	4.59	1.63
bucklandi - conybeari	240	83.40	9009	1575	517	181	13.40	1.50	6.00	7.10	4.73	1.18
bucklandi - conybeari	240	83.70	10682	2155	624	259	17.50	2.30	7.20	10.00	4.35	1.39
bucklandi - conybeari	240	84.00	9433	1639	491	166	12.10	1.70	5.60	6.40	3.76	1.14
bucklandi - conybeari	240	84.30	11410	2257	696	203	13.30	1.70	6.20	5.50	3.24	0.89
bucklandi - conybeari	240	84.60	14021	2898	610	304	17.20	2.40	7.00	9.60	4.00	1.37
bucklandi - conybeari	240	84.90	13828	2738	771	297	16.90	2.30	6.50	9.50	4.13	1.46
bucklandi - conybeari	240	85.20	13993	2863	800	319	17.20	2.30	6.80	10.30	4.48	1.51
bucklandi - conybeari	240	85.50	14264	2782	621	302	27.60	2.20	7.10	9.60	4.36	1.35
bucklandi - conybeari	240	85.80	10493	2137	613	227	17.20	2.30	7.10	9.60	4.17	1.35
bucklandi - conybeari	240	86.10	10925	2172	606	232	18.00	2.40	6.90	10.00	4.17	1.45
bucklandi - conybeari	240	86.40	10111	1989	575	198	16.40	2.10	6.70	8.10	3.86	1.21

Table 2.02 **(5 of 5)**

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
bucklandi - bucklandi	240	86.70	13702	2352	962	214	16.70	1.60	9.20	5.70	3.56	0.62
bucklandi - bucklandi	240	87.00	13480	2340	888	261	16.40	1.60	8.20	7.70	4.81	0.94
bucklandi - bucklandi	240	87.30	13224	2314	934	282	16.00	1.50	8.60	8.60	5.73	1.00
bucklandi - bucklandi **	240	87.60	13182	2388	848	211	16.00	1.60	8.00	5.80	3.63	0.73
bucklandi - bucklandi	240	87.90	9005	1543	624	172	23.10	2.70	11.80	11.00	4.07	0.93
bucklandi - bucklandi	240	88.20	13934	2214	864	82	15.60	1.50	8.00	6.90	4.60	0.86
bucklandi - bucklandi	240	88.50	13406	2356	894	235	16.30	1.60	8.30	6.70	4.19	0.81
bucklandi - bucklandi	240	88.80	10944	2130	824	190	14.10	1.40	7.80	4.80	3.43	0.62
bucklandi - bucklandi	240	89.10	9844	1722	502	219	11.00	1.30	3.90	6.40	4.92	1.64
bucklandi - bucklandi	240	89.40	12822	2200	870	219	15.40	1.50	8.20	6.00	4.00	0.73
bucklandi - bucklandi	240	89.70	14166	2370	920	298	17.40	1.60	8.30	9.30	5.81	1.12
bucklandi - bucklandi	240	90.00	13490	2532	790	296	16.40	2.00	6.60	10.70	5.35	1.62
bucklandi - bucklandi	240	90.30	12258	2144	700	272	14.60	1.60	5.90	8.40	5.25	1.42
bucklandi - bucklandi	240	90.60	11838	2140	668	222	14.00	1.60	5.80	6.40	4.00	1.10
bucklandi - bucklandi	240	90.90	10072	1868	556	220	11.30	1.40	4.30	7.10	5.07	1.65
bucklandi - bucklandi	240	91.20	9770	1884	532	195	10.90	1.40	4.40	5.50	3.93	1.25
bucklandi - bucklandi **	240	91.50	9926	1890	536	193	11.10	1.40	4.50	5.20	3.71	1.16
bucklandi - bucklandi	240	91.80	12798	2228	748	261	15.40	1.60	6.50	7.90	4.94	1.22
bucklandi - bucklandi	240	92.10	10746	1866	628	264	12.40	1.40	5.10	8.30	5.93	1.63
bucklandi - bucklandi	240	92.40	13474	2824	804	243	16.40	2.30	7.20	7.20	3.13	1.00
bucklandi - bucklandi	240	92.70	10898	1982	648	177	11.60	1.40	5.80	4.50	3.21	0.78
bucklandi - bucklandi	240	93.00	13120	2424	770	285	15.90	1.90	5.60	9.10	4.79	1.63
bucklandi - bucklandi	240	93.30	13108	2618	692	253	15.90	2.20	5.90	7.70	3.50	1.31
bucklandi - bucklandi	240	93.60	12410	2366	650	277	14.80	1.90	5.30	8.80	4.63	1.66
bucklandi - bucklandi	240	93.90	9626	1944	516	200	10.70	1.50	4.20	5.70	3.80	1.36
bucklandi - bucklandi	240	94.20	13264	2568	632	301	16.10	2.20	4.90	10.00	4.55	2.04

Table 2.03 Gamma-ray data-set for the *bucklandi* Zone (*bucklandi* Subzone) exposed west of Kilve Pylle, Somerset (ST 139457 - ST 144455). The 80 sets of measurements were collected from cliff section. All readings were taken with the Leeds University GR-256 during the period 1st September - 3rd September 1995. Measurements were taken with the detector placed perpendicular to the cliff and parallel to bedding, except for readings denoted by ** which indicates a poor sample geometry. (1 of 3).

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
bucklandi - bucklandi	240	94.50	14254	2644	810	346	17.60	2.10	6.80	11.50	5.48	1.69
bucklandi - bucklandi	240	94.80	10764	2320	542	269	13.90	2.00	4.10	8.60	4.30	2.10
bucklandi - bucklandi	240	95.10	10876	2108	556	256	12.50	1.70	4.30	7.90	4.65	1.84
bucklandi - bucklandi	240	95.40	11296	2054	578	230	13.20	1.60	4.70	6.70	4.19	1.43
bucklandi - bucklandi	240	95.70	11752	2308	532	243	13.80	2.00	4.10	7.60	3.80	1.85
bucklandi - bucklandi	240	96.00	12040	2342	614	283	14.30	1.90	4.80	8.90	4.68	1.85
bucklandi - bucklandi	240	96.30	12168	2346	608	272	14.50	1.90	4.80	8.60	4.53	1.79
bucklandi - bucklandi	240	96.60	11226	2192	534	246	13.10	1.80	4.10	7.60	4.22	1.85
bucklandi - bucklandi	240	96.90	15012	2726	882	333	18.70	2.10	7.60	11.00	5.24	1.45
bucklandi - bucklandi	240	97.20	14388	2798	802	330	16.80	2.10	6.70	10.80	5.14	1.61
bucklandi - bucklandi	240	97.50	11956	2328	640	282	14.10	1.90	5.20	8.90	4.68	1.71
bucklandi - bucklandi	240	97.80	12702	2338	664	277	15.20	1.90	5.50	8.80	4.63	1.60
bucklandi - bucklandi	240	98.10	11786	2354	590	298	13.90	2.00	4.50	9.80	4.90	2.18
bucklandi - bucklandi	240	98.40	12650	2504	628	277	15.20	2.10	5.00	5.80	2.80	1.16
bucklandi - bucklandi	240	98.70	10876	2250	528	201	11.50	1.90	4.30	5.70	3.00	1.33
bucklandi - bucklandi	240	99.00	13016	2538	624	253	15.70	2.10	5.10	7.90	3.76	1.55
bucklandi - bucklandi **	240	99.30	11158	1356	423	249	13.40	1.00	1.70	4.10	4.10	2.41
bucklandi - bucklandi **	240	99.60	10146	2098	638	232	12.90	1.60	5.30	6.90	4.31	1.30
bucklandi - bucklandi **	240	99.90	12838	2848	657	150	15.50	1.90	6.80	8.80	4.63	1.29
bucklandi - bucklandi **	240	100.20	13118	2556	806	162	15.90	2.00	7.40	5.80	2.90	0.78
bucklandi - bucklandi	240	100.50	10252	1918	544	238	11.80	1.50	4.30	7.20	4.80	1.67
bucklandi - bucklandi	240	100.80	9198	1794	452	172	10.10	1.40	3.60	4.50	3.21	1.25
bucklandi - bucklandi	240	101.10	10760	2084	522	283	12.40	1.70	3.80	9.20	5.41	2.42
bucklandi - bucklandi	240	101.40	12214	2406	602	251	14.50	2.00	4.90	7.70	3.85	1.57
bucklandi - bucklandi	240	101.70	10540	2104	488	232	12.10	1.80	3.70	7.10	3.94	1.92
bucklandi - bucklandi	240	102.00	10914	2138	526	222	12.60	1.80	4.10	6.50	3.61	1.59
bucklandi - bucklandi	240	102.30	11904	2306	586	251	14.10	1.90	4.70	7.70	4.05	1.64
bucklandi - bucklandi	240	102.60	11398	226	592	211	12.30	1.80	5.00	6.00	3.33	1.20

Table 2.03 **(2 of 3).**

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
bucklandi - bucklandi	240	102.90	10504	2006	514	237	12.00	1.60	3.90	7.20	4.50	1.85
bucklandi - bucklandi	240	103.20	9872	1778	492	191	11.10	1.40	4.00	5.30	3.79	1.33
bucklandi - bucklandi	240	103.50	8978	776	470	193	9.70	1.20	3.70	5.30	4.42	1.43
bucklandi - bucklandi	240	103.80	10935	2994	516	356	15.20	1.30	7.50	6.90	5.31	0.92
bucklandi - bucklandi	240	104.10	12634	2292	644	221	15.10	1.80	5.50	6.50	3.61	1.18
bucklandi - bucklandi	240	104.40	12464	2466	688	230	14.90	2.00	6.00	6.80	3.40	1.13
bucklandi - bucklandi	240	104.70	12390	2304	576	238	14.70	1.90	5.70	7.20	3.79	1.26
bucklandi - bucklandi	240	105.00	12772	2248	684	238	15.40	2.00	5.90	7.10	3.55	1.20
bucklandi - bucklandi	240	105.30	12796	2470	664	253	15.40	2.00	5.60	7.70	3.85	1.38
bucklandi - bucklandi	240	105.60	10142	1888	568	227	11.50	1.40	4.60	6.70	4.79	1.46
bucklandi - bucklandi	240	105.90	11514	2260	570	248	13.50	1.90	4.50	7.70	4.05	1.71
bucklandi - bucklandi	240	106.20	9076	1932	530	227	11.10	1.50	4.20	6.90	4.60	1.64
bucklandi - bucklandi	240	106.50	10356	2236	578	245	13.60	1.80	4.60	7.40	4.11	1.61
bucklandi - bucklandi	240	106.80	12882	2658	594	235	9.20	1.50	3.10	3.80	2.53	1.23
bucklandi - bucklandi	240	107.10	10580	2086	528	203	12.10	1.70	4.30	5.80	3.41	1.35
bucklandi - bucklandi	240	107.40	9738	1928	532	216	10.90	1.50	4.30	6.30	4.20	1.47
bucklandi - bucklandi	240	107.70	11508	2160	402	226	12.20	0.90	2.60	4.30	4.78	1.65
bucklandi - bucklandi	240	108.00	9908	213	555	238	11.10	1.00	2.70	4.00	4.00	1.48
bucklandi - bucklandi	240	108.30	12764	2634	734	293	15.30	1.90	5.20	9.30	4.89	1.79
bucklandi - bucklandi	240	108.60	13104	2634	634	240	15.80	2.00	5.90	8.50	4.25	1.44
bucklandi - bucklandi	240	108.90	10960	2010	474	214	12.70	1.50	5.00	6.00	4.00	1.20
bucklandi - bucklandi	240	109.20	9514	1646	430	198	10.50	1.20	4.40	5.50	4.58	1.25
bucklandi - bucklandi	240	109.50	11134	2198	618	200	12.90	1.60	5.30	5.50	3.44	1.04
bucklandi - bucklandi **	240	109.80	10564	2038	578	232	12.10	1.50	4.70	7.10	4.73	1.51
bucklandi - bucklandi **	240	110.10	10356	1784	544	201	11.80	1.30	4.50	5.70	4.38	1.27
bucklandi - bucklandi **	240	110.40	11922	2166	591	250	8.10	1.10	3.00	4.30	3.91	1.43

Table 2.03 (3 of 3).

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
semicosatum-lyra	240	127.0	11335	2105	523	271	10.7	1.7	2.8	6.0	3.53	2.14
semicosatum-lyra	240	127.3	10360	1847	493	234	9.6	1.5	2.7	5.1	3.40	1.89
semicosatum-lyra	240	127.6	21942	4479	1235	489	19.0	2.9	6.6	9.5	3.28	1.44
semicosatum-lyra	240	127.9	10224	1862	448	229	9.4	1.6	2.4	4.4	2.75	1.83
semicosatum-lyra	240	128.2	13184	2407	760	303	12.9	1.8	4.8	6.8	3.78	1.42
semicosatum-lyra	240	128.5	12561	2225	778	217	12.2	1.6	5.5	4.4	2.75	0.80
semicosatum-lyra	240	128.8	13062	2533	533	277	10.2	1.8	2.2	5.1	2.83	2.32
semicosatum-lyra	240	129.1	15404	2862	786	336	12.5	1.9	3.9	6.3	3.32	1.62
semicosatum-lyra	240	129.4	11780	2222	546	265	11.3	1.8	3.0	5.9	3.28	1.97
semicosatum-lyra	240	129.7	14350	2935	612	346	11.5	2.1	2.5	6.6	3.14	2.64
semicosatum-lyra	240	130.0	10232	1593	562	191	7.4	1.0	2.9	3.2	3.20	1.10
semicosatum-lyra **	240	130.3	13305	2322	712	314	10.4	1.5	3.4	5.8	3.87	1.71
semicosatum-lyra **	240	130.6	15883	2955	703	413	13.0	2.0	2.9	8.1	4.05	2.79
semicosatum-lyra	240	130.9	10482	1852	538	240	9.7	1.5	3.1	5.2	3.47	1.68
semicosatum-lyra	240	131.2	10935	2140	486	294	10.3	1.8	2.3	6.7	3.72	2.91
semicosatum-lyra	240	131.5	14138	2933	556	340	11.2	2.1	2.1	6.4	3.05	3.05
semicosatum-lyra	240	131.8	14319	3002	605	373	11.4	2.1	2.3	7.2	3.43	3.13
semicosatum-lyra	240	132.1	13584	2623	575	336	10.7	1.8	1.4	6.4	3.56	4.57
semicosatum-lyra	240	132.4	15605	2916	856	339	12.7	1.9	4.4	6.3	3.32	1.43
semicosatum-lyra	240	132.7	9117	1538	435	198	10.8	1.8	3.2	5.2	2.89	1.63
semicosatum-lyra	240	133.0	12788	2571	643	269	14.1	2.3	4.4	6.6	2.87	1.50
semicosatum-lyra	240	133.3	11111	2129	544	235	11.9	1.9	3.6	5.7	3.00	1.58
semicosatum-lyra	240	133.6	12254	2091	679	281	9.4	1.3	3.4	5.2	4.00	1.53

Table 2.04 **Gamma-ray data-set for the *semicostatum* Zone (*lyra* Subzone) exposed at the west end of Doniford Bay, Somerset (ST 1079433 - ST 082430). The 122 sets of measurements were collected from cliff section. All readings were taken with the Edinburgh University GR-256 during the period 19th September - 21st September 1995. Measurements were taken with the detector placed perpendicular to the cliff and parallel to bedding, except for readings denoted by ** which indicates a poor sample geometry. (1 of 5).**

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
semicosatum-lyra	240	133.9	12021	2086	544	277	9.2	1.4	2.3	5.1	3.64	2.22
semicosatum-lyra	240	134.2	11972	2175	649	239	11.5	1.7	4.1	5.1	3.00	1.24
semicosatum-lyra	240	134.5	15190	2958	897	291	15.3	2.2	6.1	6.3	2.86	1.03
semicosatum-lyra	240	134.8	12339	2426	572	321	11.9	2.0	3.0	7.3	3.65	2.43
semicosatum-lyra	240	135.1	13487	2335	828	248	13.3	1.7	5.7	5.3	3.12	0.93
semicosatum-lyra **	240	135.4	12260	2374	534	353	15.5	2.5	3.2	10.3	4.12	3.22
semicosatum-lyra **	200	135.7	11024	2148	477	316	16.9	2.6	4.3	10.9	4.19	2.53
semicosatum-lyra **	240	136.0	10753	2115	469	348	13.3	2.2	2.5	10.2	4.64	4.08
semicosatum-lyra	240	136.3	10415	2118	393	312	12.7	2.3	1.9	9.1	3.96	4.79
semicosatum-lyra	240	136.6	10076	2016	423	303	12.2	2.1	2.3	8.8	4.19	3.83
semicosatum-lyra	200	136.9	9875	2047	394	243	14.9	2.6	3.0	8.2	3.15	2.73
semicosatum-lyra **	240	137.2	13216	2784	514	405	16.9	3.0	2.6	12.1	4.03	4.65
semicosatum-lyra	200	137.5	10407	2000	475	313	15.8	2.4	3.2	10.4	4.33	3.25
semicosatum-lyra **	200	137.8	12261	2544	483	344	19.1	3.1	3.6	12.1	3.90	3.36
semicosatum-lyra **	200	138.1	9649	1861	488	268	14.5	2.2	4.1	9.1	4.14	2.22
semicosatum-lyra **	240	138.4	10597	2195	418	329	13.0	2.4	2.0	9.6	4.00	4.80
semicosatum-lyra	200	138.7	9534	1891	443	287	14.3	2.3	3.3	9.9	4.30	3.00
semicosatum-lyra	180	139.0	9086	1854	366	256	13.5	2.4	2.5	8.7	3.63	3.48
semicosatum-lyra	180	139.3	9660	1962	401	310	14.5	2.5	2.5	10.9	4.36	4.36
semicosatum-lyra	180	139.6	9998	1935	372	292	15.1	2.5	2.3	10.1	4.04	4.39
semicosatum-lyra	240	139.9	14032	2883	625	416	18.1	3.0	3.8	12.4	4.13	3.26
semicosatum-lyra	180	140.2	9430	1797	397	306	14.1	2.3	2.6	10.6	4.61	4.08
semicosatum-lyra	240	140.5	13996	2962	557	350	18.1	3.1	3.5	10.2	3.29	2.91
semicosatum-lyra	180	140.8	9651	1934	344	314	14.5	2.5	1.7	11.1	4.44	6.53
semicosatum-lyra	180	141.1	9428	1933	373	324	16.0	2.8	2.4	12.7	4.54	5.29
semicosatum-lyra	180	141.4	10529	2197	444	322	18.2	3.1	3.4	12.5	4.03	3.68
semicosatum-lyra	180	141.7	9840	1956	378	321	14.8	2.5	2.1	11.3	4.52	5.38
semicosatum-lyra	200	142.0	9928	1983	458	273	15.0	2.4	3.2	9.4	3.92	2.94

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
semicosatum-lyra	180	142.3	9908	2006	400	297	15.0	2.6	2.6	10.4	4.00	4.00
semicosatum-lyra	180	142.6	10366	2040	444	282	17.8	2.7	2.6	10.7	3.96	4.12
semicosatum-lyra	200	142.9	10206	2009	476	278	15.5	2.5	3.2	9.5	3.80	2.97
semicosatum-lyra	180	143.2	9294	1880	408	295	13.9	2.4	2.8	10.2	4.25	3.64
semicosatum-lyra	200	143.5	9147	1694	449	279	13.6	2.0	3.5	9.5	4.75	2.71
semicosatum-lyra	200	143.8	9809	1910	446	306	14.8	2.4	3.2	10.6	4.42	3.31
semicosatum-lyra	200	144.1	10228	2073	440	292	15.5	2.6	3.2	10.1	3.88	3.16
semicosatum-lyra	200	144.4	9803	1950	476	239	14.8	2.4	4.2	7.9	3.29	1.88
semicosatum-lyra	200	144.7	11251	2200	525	315	17.3	2.7	4.2	10.9	4.04	2.60
semicosatum-lyra	180	145.0	11689	2175	631	356	20.5	2.8	6.0	14.0	5.00	2.33
semicosatum-lyra	180	145.3	11549	2246	615	293	20.2	2.9	6.3	11.2	3.86	1.78
semicosatum-lyra	180	145.6	10651	2056	546	282	18.4	2.7	5.4	10.7	3.96	1.98
semicosatum-lyra	180	145.9	13292	2751	597	445	21.0	3.4	4.1	16.0	4.71	3.90
semicosatum-lyra	180	146.2	11074	2138	529	371	19.2	2.9	4.3	14.7	5.07	3.42
semicosatum-lyra	180	146.5	16140	3399	671	517	21.2	3.6	3.6	15.7	4.36	4.36
semicosatum-lyra	180	146.8	10452	2228	363	323	18.0	3.2	2.1	12.7	3.97	6.05
semicosatum-lyra	180	147.1	10423	2267	442	349	17.9	3.2	3.2	14.1	4.41	4.41
semicosatum-lyra **	180	147.4	17610	3401	705	538	12.2	2.1	1.9	9.2	4.38	4.84
semicosatum-lyra	180	147.7	12295	2451	614	406	21.6	3.3	5.3	16.1	4.88	3.04
semicosatum-lyra	180	148.0	13742	2661	659	467	17.7	2.7	3.8	14.1	5.22	3.71
semicosatum-lyra	180	148.3	11351	2155	609	318	19.8	2.8	6.0	12.3	4.39	2.05
semicosatum-lyra	180	148.6	10385	2045	489	321	15.8	2.5	3.7	11.2	4.48	3.03
semicosatum-lyra	180	148.9	11423	2267	540	325	14.2	2.3	3.5	9.4	4.09	2.69
semicosatum-lyra	180	149.2	12767	2624	552	384	16.2	3.1	3.1	11.4	3.68	3.68
semicosatum-lyra	180	149.5	11685	2239	574	359	20.4	3.0	5.1	14.1	4.70	2.76
semicosatum-lyra	180	149.8	11227	2174	372	318	19.5	3.1	2.3	12.5	4.03	5.43
semicosatum-lyra	180	150.1	10715	2150	449	301	18.5	3.0	3.7	11.6	3.87	3.14
semicosatum-lyra	180	150.4	9112	1648	462	280	15.4	2.2	4.2	10.7	4.86	2.55

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
semicosatum-lyra	180	150.7	9796	2047	359	320	16.7	3.0	2.1	12.6	4.20	6.00
semicosatum-lyra	180	151.0	9771	2015	401	324	16.7	2.8	2.8	12.7	4.54	4.54
semicosatum-lyra	180	151.3	9317	1923	350	290	15.8	2.8	2.3	11.3	4.04	4.91
semicosatum-lyra	180	151.6	9899	1997	381	304	16.9	2.8	2.6	11.7	4.18	4.50
semicosatum-lyra	180	151.9	10735	2322	417	361	18.6	3.3	2.6	14.3	4.33	5.50
semicosatum-lyra	180	152.2	10172	1803	631	235	17.5	2.2	7.2	8.5	3.86	1.18
semicosatum-lyra	180	152.5	11138	2331	454	366	15.3	2.7	2.5	11.8	4.37	4.72
semicosatum-lyra	180	152.8	10221	2175	385	339	17.6	3.1	2.4	13.4	4.32	5.58
semicosatum-lyra	180	153.1	10828	2290	389	412	18.7	3.3	1.7	16.6	5.03	9.76
semicosatum-lyra	180	153.4	9711	1989	425	261	14.6	2.5	3.3	8.7	3.48	2.64
semicosatum-lyra	180	153.7	10260	2239	360	355	17.6	3.3	1.8	14.1	4.27	7.83
semicosatum-lyra	180	154.0	10472	2114	472	309	16.0	2.6	3.5	10.7	4.12	3.06
semicosatum-lyra	360	154.3	9258	1547	433	213	8.3	1.3	2.3	4.6	3.54	2.00
semicosatum-lyra	360	154.6	9994	1568	498	243	10.4	1.4	2.6	4.9	3.50	1.88
semicosatum-lyra	360	154.9	12240	2281	527	310	11.7	1.8	2.8	7.1	3.94	2.54
semicosatum-lyra	180	155.2	9562	1889	397	318	16.3	2.7	2.8	12.4	4.59	4.43
semicosatum-lyra	180	155.5	9133	1921	409	324	15.4	2.7	2.9	12.7	4.70	4.38
semicosatum-lyra	240	155.8	9708	1952	374	273	11.7	2.1	1.9	7.8	3.71	4.11
semicosatum-lyra	180	156.1	9142	1748	427	278	13.6	2.1	3.2	9.5	4.52	2.97
semicosatum-lyra	180	156.4	11671	2426	463	410	20.4	3.4	2.9	16.5	4.85	5.69
semicosatum-lyra	180	156.7	10234	2118	403	336	17.6	3.0	2.7	13.2	4.40	4.89
semicosatum-lyra	180	15.07	12357	2511	492	411	19.3	3.2	2.9	14.8	4.63	5.10
semicosatum-lyra	180	157.3	9521	1790	397	332	14.3	2.3	2.3	11.7	5.09	5.09
semicosatum-lyra	180	157.6	10393	2159	413	373	17.9	3.1	2.5	14.8	4.77	5.92
semicosatum-lyra	180	157.9	10770	2321	451	352	18.6	3.3	3.3	13.9	4.21	4.21
semicosatum-lyra	180	158.2	11620	2315	395	376	20.3	3.3	2.2	15.0	4.55	6.82
semicosatum-lyra	180	158.5	13164	2834	493	476	23.4	4.1	2.7	19.4	4.73	7.19
semicosatum-lyra	180	158.8	10341	2199	379	391	17.8	3.2	1.8	15.6	4.88	8.67

Biostratigraphy	Time	Height	Total Number of Counts				Total	Elemental Concentration			Ratios	
	Secs	m	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
semicosatum-lyra	180	159.1	10041	2122	310	345	17.2	3.1	1.2	13.7	4.42	11.42
semicosatum-lyra	180	159.4	10061	2134	356	313	17.2	3.1	2.2	12.2	3.94	5.55
semicosatum-lyra **	180	159.7	10236	2118	419	377	17.6	3.0	2.5	15.1	5.03	6.04
semicosatum-lyra	180	160.0	11182	2344	462	340	19.4	3.3	3.5	13.3	4.03	3.80
semicosatum-lyra	180	160.3	10786	2282	412	351	18.7	3.3	2.7	13.9	4.21	5.15
semicosatum-lyra	180	160.6	10400	2258	390	353	17.9	3.3	2.3	14.0	4.24	6.09
semicosatum-lyra **	180	160.9	10259	1993	422	352	15.6	2.5	2.5	12.5	5.00	5.00
semicosatum-lyra **	180	161.2	10905	2294	406	381	18.9	3.3	2.3	15.2	4.61	6.61
semicosatum-lyra **	180	161.5	10338	2127	452	384	17.8	3.0	3.0	15.3	5.10	5.10
semicosatum-lyra **	180	161.8	10576	2209	444	357	18.3	3.1	3.1	14.1	4.55	4.55
semicosatum-lyra	180	162.1	11417	2362	426	378	19.9	3.4	2.6	4.3	1.26	1.65
semicosatum-lyra	180	162.4	11924	2559	434	427	20.9	3.7	2.3	17.2	4.65	7.48
semicosatum-lyra	180	162.7	10388	2228	408	338	17.9	3.2	2.7	13.4	4.19	4.96
semicosatum-lyra	180	163.0	13169	2796	558	440	20.8	3.5	3.5	15.9	4.54	4.54
semicosatum-lyra	180	163.3	12439	2564	500	545	19.5	3.3	2.7	16.1	4.88	5.96
semicosatum-lyra	180	163.6	9496	1890	383	323	16.1	2.7	2.5	12.7	4.70	5.08

Table 2.04 (5 of 5)

Biostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Total ur	Elemental Concentration K %	U ppm	Th ppm	Ratios Th/K	Th/U
Pre-*planorbis* Beds	0.0	240	12382	1465	520	222	14.2	2.5	3.8	6.6	2.64	1.74
Pre-*planorbis* Beds	0.3	360	10677	1170	465	138	6.7	1.2	2.5	2.3	1.92	0.92
Pre-*planorbis* Beds	0.6	360	15658	1303	453	228	7.6	1.4	1.9	4.3	3.07	2.26
Pre-*planorbis* Beds	0.9	360	12341	1357	492	213	8.3	1.4	2.3	3.9	2.79	1.70
Pre-*planorbis* Beds	1.2	360	13896	1679	630	282	9.7	1.7	3.0	5.4	3.18	1.80
Pre-*planorbis* Beds	1.5	360	12189	1340	549	180	8.2	1.4	2.8	3.5	2.50	1.25
Pre-*planorbis* Beds	1.8	240	9594	1160	464	174	10.3	1.8	3.6	4.9	2.72	1.36
Pre-*planorbis* Beds	2.1	240	9950	1208	468	176	10.7	1.9	3.7	5.0	2.63	1.35
Pre-*planorbis* Beds	2.4	240	10008	1127	418	188	10.8	1.8	2.9	5.4	3.00	1.86
Pre-*planorbis* Beds	2.7	360	12777	1369	627	225	8.7	1.3	3.3	4.0	3.08	1.21
Pre-*planorbis* Beds	3.0	360	11883	1345	410	216	7.9	1.4	2.4	4.0	2.86	1.67
Pre-*planorbis* Beds	3.3	360	12264	1251	489	237	8.2	1.3	2.2	4.3	3.31	1.95
Pre-*planorbis* Beds	3.6	240	10290	1167	512	194	11.2	1.8	4.1	5.4	3.00	1.32
Pre-*planorbis* Beds	3.9	240	11178	1211	562	204	12.5	1.8	4.5	5.8	3.22	1.29
Pre-*planorbis* Beds	4.2	240	10472	1144	568	224	11.5	1.7	4.5	6.4	3.76	1.42
Pre-*planorbis* Beds	4.5	240	11094	1221	572	212	12.4	1.8	4.6	6.0	3.33	1.30
planorbis - planorbis	4.8	240	12768	1608	590	252	14.7	2.6	4.4	7.5	2.88	1.70
planorbis - planorbis	5.1	240	11100	1301	536	212	12.4	2.0	4.2	6.1	3.05	1.45
planorbis - planorbis	5.4	360	10815	1101	441	192	6.8	1.1	2.0	3.4	3.09	1.70
planorbis - planorbis	5.7	240	9826	1011	508	214	10.5	1.5	3.9	6.0	4.00	1.54
planorbis - planorbis	6.0	240	9406	1051	506	180	10.0	1.5	4.1	5.0	3.33	1.22
planorbis - planorbis	6.3	240	9006	890	408	174	8.2	1.3	3.0	4.8	3.69	1.60

Table 2.05 **Gamma-ray data-set for the Pre-*planorbis* Beds to the *liasicus* Zone exposed in St. Mary's Well Bay, Glamorgan (ST 176677 - ST 187681). The 96 sets of measurements were collected from cliff section. All readings were taken with the Edinburgh University GR-256 during the period 23rd September - 27th September 1995. Measurements were taken with the detector placed perpendicular to the cliff and parallel to bedding, except for readings denoted by ** which indicates a poor sample geometry. (1 of 4).**

Biostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Total ur	Elemental Concentration K %	U ppm	Th ppm	Ratios Th/K	Th/U
planorbis - planorbis	6.6	240	12198	1471	528	262	13.9	2.3	3.6	7.8	3.39	2.17
planorbis - planorbis	6.9	240	11468	1374	582	246	12.9	2.1	4.4	7.2	3.43	1.64
planorbis - planorbis	7.2	240	14722	1873	682	294	17.5	3.0	5.0	8.9	2.97	1.78
planorbis - planorbis	7.5	240	13040	1654	600	268	15.2	2.6	4.4	8.1	3.12	1.84
planorbis - johnstoni	7.8	240	12980	1645	644	316	15.1	2.6	4.5	9.6	3.69	2.13
planorbis - johnstoni	8.1	240	11392	1345	582	236	12.8	2.0	4.5	6.9	3.45	1.53
planorbis - johnstoni	8.4	240	9352	1057	464	188	9.9	1.6	3.5	5.3	3.31	1.51
planorbis - johnstoni	8.7	240	10338	1158	566	210	11.3	1.7	4.6	5.9	3.47	1.28
planorbis - johnstoni	9.0	240	9326	1054	454	212	9.8	1.6	3.2	6.1	3.81	1.91
planorbis - johnstoni	9.3	360	13323	1448	639	306	9.2	1.4	2.9	5.8	4.14	2.00
planorbis - johnstoni	9.6	360	11844	1217	519	225	7.8	1.2	2.5	4.0	3.33	1.60
planorbis - johnstoni	9.9	240	11832	1300	672	216	13.4	1.9	5.8	6.1	3.21	1.05
planorbis - johnstoni	10.2	240	13902	1602	852	294	16.3	2.3	7.3	8.3	3.61	1.14
planorbis - johnstoni	10.5	360	12447	1288	642	270	8.4	1.2	3.2	5.0	4.17	1.56
planorbis - johnstoni	10.8	240	15484	1913	774	356	18.6	3.0	6.1	9.2	3.07	1.51
planorbis - johnstoni	11.1	240	14370	1671	820	254	17.0	2.5	7.2	7.3	2.92	1.01
planorbis - johnstoni	11.4	240	13334	1618	718	254	15.5	7.5	5.9	7.4	0.99	1.25
planorbis - johnstoni	11.7	240	13764	3046	702	327	19.4	2.7	5.2	12.6	4.65	2.44
planorbis - johnstoni	12.0	240	9968	2202	404	214	11.2	2.0	2.5	6.4	3.18	2.56
planorbis - johnstoni	12.3	240	10820	2354	416	224	11.4	2.0	2.6	6.7	3.35	2.60
planorbis - johnstoni	12.6	240	9684	2210	408	195	11.0	2.0	2.6	5.7	2.84	2.20
planorbis - johnstoni	12.9	240	10454	2350	434	140	11.9	2.1	3.1	3.1	1.47	1.00
planorbis - johnstoni	13.2	240	10924	2562	490	209	12.6	2.2	3.4	6.0	2.74	1.78
planorbis - johnstoni	13.5	240	10786	2538	460	214	12.4	2.3	3.0	6.4	2.77	2.11
planorbis - johnstoni	13.8	240	11522	2624	466	269	13.5	2.4	2.8	8.8	3.66	3.08
planorbis - johnstoni	14.1	240	11378	2482	510	240	13.3	2.2	3.4	7.2	3.28	2.14
liasicus Zone	14.4	240	12340	2666	604	253	14.7	2.3	4.4	7.9	3.44	1.82
liasicus Zone	14.7	240	12368	2736	538	251	14.8	2.5	3.5	7.7	3.10	2.23

Biostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Total ur	Elemental Concentration K %	U ppm	Th ppm	Ratios Th/K	Th/U
liasicus Zone	15.0	240	13202	3154	606	256	16.0	2.9	4.3	7.9	2.73	1.85
liasicus Zone	15.3	240	12634	2614	546	235	15.1	2.5	3.8	7.1	2.82	1.85
liasicus Zone	15.6	240	12884	2792	570	238	15.5	2.5	4.0	7.2	2.89	1.81
liasicus Zone	15.9	240	12264	2824	484	269	14.6	2.6	3.0	8.8	3.37	2.90
liasicus Zone	16.2	240	13532	3240	550	253	16.5	3.1	3.7	7.9	2.55	2.12
liasicus Zone	16.5	240	14204	3214	558	304	17.5	3.0	3.6	10.0	3.33	2.81
liasicus Zone	16.8	240	14676	3368	574	359	18.2	3.2	3.5	12.6	3.92	3.62
liasicus Zone	17.1	240	13980	3054	556	251	17.1	3.0	3.8	7.7	2.58	2.03
liasicus Zone	17.4	240	15906	3612	658	282	20.0	3.4	4.7	8.9	2.63	1.90
liasicus Zone	17.7	240	16154	3624	658	348	20.4	3.4	4.4	11.9	3.49	2.72
liasicus Zone	18.0	240	14312	3236	588	267	17.6	3.0	4.1	8.4	2.81	2.06
liasicus Zone	18.3	240	13900	2972	606	359	17.0	2.7	3.8	12.4	4.59	3.24
liasicus Zone	18.6	240	16426	3646	644	346	20.8	3.5	4.3	7.9	2.26	1.85
liasicus Zone	18.9	240	16274	3470	798	372	20.5	3.2	4.4	12.9	4.03	2.90
liasicus Zone	19.2	240	15792	3434	592	525	19.8	3.3	3.6	12.7	3.86	3.49
liasicus Zone	19.5	240	15824	3540	700	330	19.9	3.3	4.9	11.0	3.34	2.25
liasicus Zone	19.8	240	15062	3394	632	222	18.7	3.2	4.7	6.5	2.04	1.39
liasicus Zone	20.1	240	15534	3292	616	298	19.4	3.1	4.2	9.6	3.11	2.31
liasicus Zone	20.4	240	14836	3190	632	309	18.4	2.9	4.4	10.1	3.50	2.33
liasicus Zone	20.7	240	14964	3338	578	296	18.6	3.2	3.8	9.8	3.06	2.57
liasicus Zone	21.0	240	14032	2876	612	261	17.2	2.7	4.4	7.1	2.61	1.59
liasicus Zone	21.3	240	14400	3364	524	322	17.8	3.1	3.1	11.0	3.55	3.54
liasicus Zone	21.6	240	13608	2990	606	272	16.6	2.7	4.3	8.6	3.19	2.02
liasicus Zone	21.9	240	14742	3138	572	100	18.3	2.9	3.9	8.1	2.79	2.07
liasicus Zone	22.2	240	14966	3280	564	275	18.6	3.1	3.7	8.8	2.83	2.35
liasicus Zone	22.5	240	14684	3248	506	256	18.2	3.1	3.5	7.9	2.55	2.28
liasicus Zone	22.8	240	14664	3096	544	293	18.3	2.9	3.6	9.6	3.32	2.71
liasicus Zone	23.1	240	14862	3230	550	275	18.5	3.1	3.6	8.9	2.89	2.45

Biostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Total ur	Elemental Concentration K %	U ppm	Th ppm	Ratios Th/K	Th/U
liasicus Zone	23.4	240	14948	3206	596	285	16.6	3.0	4.1	8.6	2.87	2.10
liasicus Zone	23.7	240	12846	2698	524	227	15.5	2.4	3.6	6.9	2.87	1.89
liasicus Zone	24.0	240	15660	2930	592	198	17.7	2.5	2.8	5.3	2.13	1.94
liasicus Zone	24.3	240	15296	3156	646	275	19.1	2.9	4.6	8.8	3.02	1.90
liasicus Zone	24.6	240	14832	2980	584	251	18.4	2.7	4.1	7.7	2.87	1.89
liasicus Zone	24.9	240	14972	3026	558	272	13.6	2.8	3.7	8.6	3.07	2.30
liasicus Zone	25.2	240	13600	2802	556	282	16.6	2.5	3.7	9.1	3.65	2.44
liasicus Zone **	25.5	240	13748	2768	564	280	16.8	2.5	3.8	9.1	3.65	2.39
liasicus Zone **	25.8	240	14442	3010	608	269	17.8	2.7	4.3	8.6	3.19	2.02
liasicus Zone **	26.1	240	14538	3048	644	301	18.0	2.7	4.4	10.0	3.69	2.24
liasicus Zone **	26.4	240	15048	3120	618	285	18.7	2.9	4.3	9.3	3.20	2.18
liasicus Zone **	26.7	240	15070	3072	658	280	18.8	2.8	4.7	8.9	3.19	1.90
liasicus Zone **	27.0	120	9405	1596	288	135	19.4	3.0	3.9	8.6	2.87	2.20
liasicus Zone **	27.3	120	9126	1736	381	180	21.4	3.1	5.4	12.2	3.94	2.25
liasicus Zone **	27.6	120	9126	1777	396	177	21.5	3.2	5.7	12.0	3.76	2.12
liasicus Zone **	27.9	120	9010	1648	328	149	20.8	3.0	4.6	9.6	3.21	2.08

Table 2.05 (4 of 4)

Biostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Total ur	Elemental Concentration K %	U ppm	Th ppm	Ratios Th/K	Th/U
angulata Zone	0.0	400	9966	1918	472	177	5.3	0.8	1.8	1.9	2.4	1.1
angulata Zone	0.3	400	14024	2886	652	267	8.9	1.4	2.6	4.0	2.8	1.5
angulata Zone	0.6	400	13748	2730	674	230	8.6	1.3	2.8	3.1	2.4	1.1
angulata Zone	0.9	360	14262	2982	648	293	9.1	1.5	2.5	4.6	3.1	1.9
angulata Zone	1.2	360	11732	2344	604	251	8.0	1.2	2.8	4.3	3.6	1.6
angulata Zone	1.5	360	11140	2196	520	224	7.4	1.1	2.2	3.6	3.3	1.6
angulata Zone	1.8	360	13076	2678	680	238	8.5	1.2	3.1	4.0	3.3	1.3
angulata Zone	2.1	360	12018	2424	568	235	8.3	1.3	2.5	3.8	2.9	1.5
angulata Zone	2.4	360	10350	2040	486	185	6.7	1.0	2.1	2.2	2.2	1.0
angulata Zone	2.7	360	9006	1762	390	158	5.3	0.9	1.6	1.9	2.1	1.2
angulata Zone	3.0	360	12898	2728	616	275	9.2	1.5	2.7	4.8	3.2	1.8
angulata Zone	3.3	360	10608	2122	536	243	6.9	1.1	2.3	4.0	3.6	1.7
angulata Zone	3.6	360	12470	2748	506	267	8.7	1.6	2.0	4.8	3.0	2.5
angulata Zone	3.9	360	9826	1902	430	158	6.1	1.0	1.8	2.1	2.1	1.2
angulata Zone	4.2	360	13526	2758	616	298	9.8	1.5	2.7	5.5	3.7	2.1
angulata Zone	4.5	360	12410	2435	628	272	8.7	1.3	2.8	4.8	3.7	1.7
angulata Zone	4.8	360	11032	2182	474	211	7.3	1.2	2.0	3.1	2.6	1.6
angulata Zone	5.1	360	10826	2194	524	246	7.1	1.1	2.2	4.3	3.9	1.9
angulata Zone **	5.4	360	12206	2382	618	261	8.5	1.2	2.8	4.6	3.9	1.7
angulata Zone **	5.7	360	10548	2060	522	187	6.8	1.0	2.4	2.4	2.4	1.0
angulata Zone **	6.0	360	9340	1782	450	243	5.6	0.8	1.8	4.1	5.2	2.3
angulata Zone	6.3	360	13150	2904	694	282	9.4	1.6	3.2	5.0	3.1	1.6
angulata Zone	6.6	360	11406	2348	500	195	7.7	1.3	2.2	2.8	2.1	1.2
angulata Zone	6.9	360	12744	2667	522	261	9.0	1.5	2.1	4.8	3.2	2.3
angulata Zone	7.2	360	9324	1788	462	182	5.6	0.8	2.0	2.4	3.0	1.2

Table 2.06 Gamma-ray data-set for the *angulata* Zone and *bucklandi* Zone (*conybeari* Subzone) exposed at Nash Point, South Glamorgan (SS 914684). The 100 sets of measurements were collected from cliff section. All readings were taken with the Leeds University GR-256 during the period 7th September - 10th September 1995. Measurements were taken with the detector placed perpendicular to the cliff and parallel to bedding, except for readings denoted by ** which indicates a poor sample geometry. (1 of 4.)

Biostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Total ur	Elemental Concentration K %	U ppm	Th ppm	Ratios Th/K	Th/U
angulata Zone	7.5	360	10344	2019	486	242	7.6	1.0	1.9	2.9	2.9	1.6
angulata Zone	7.8	360	10785	2043	498	242	7.1	1.0	2.0	4.1	4.1	2.0
angulata Zone	8.1	360	11550	2328	543	198	7.8	1.2	2.5	2.9	2.4	1.2
angulata Zone	8.4	360	11118	2130	504	226	7.4	1.1	2.0	3.6	3.3	1.8
angulata Zone	8.7	360	14358	2898	717	313	10.4	1.6	2.7	4.1	2.6	1.5
angulata Zone	9.0	480	9284	1432	452	169	3.3	0.4	1.3	1.0	2.6	0.8
angulata Zone	9.3	360	10617	1926	486	214	6.9	0.9	2.0	3.4	3.8	1.7
angulata Zone	9.6	360	11728	2277	561	242	8.2	1.2	2.5	4.0	3.3	1.6
angulata Zone	9.9	360	10455	2010	510	174	6.8	1.0	2.3	2.2	2.2	1.0
angulata Zone	10.2	360	9297	1755	516	147	5.6	0.8	2.5	1.4	1.7	0.6
angulata Zone	10.5	360	11862	2268	474	242	8.1	1.2	1.9	4.1	3.4	2.2
angulata Zone	10.8	360	11160	2298	546	202	7.5	1.2	2.5	2.9	2.4	1.2
angulata Zone	11.1	360	12831	2547	567	261	9.1	1.4	2.4	4.6	3.3	1.9
angulata Zone	11.4	360	12312	2448	528	281	8.6	1.3	2.1	5.2	4.0	2.4
angulata Zone	11.7	240	10174	2056	470	161	11.5	1.7	3.4	4.0	2.3	1.2
angulata Zone	12.0	360	10803	2061	549	178	7.1	1.0	2.6	2.2	2.2	0.9
angulata Zone	12.3	240	10750	2148	430	193	12.4	1.1	2.8	5.3	4.8	1.9
angulata Zone	12.6	360	12813	2364	558	281	9.1	1.2	2.3	5.2	4.3	2.2
angulata Zone	12.9	360	11898	2067	630	246	8.2	1.0	2.9	4.1	4.1	1.4
angulata Zone	13.2	240	9470	1818	504	158	2.5	1.4	4.3	4.0	2.8	0.9
angulata Zone	13.5	360	11976	2388	582	210	8.1	1.2	2.8	3.1	2.6	1.1
angulata Zone	13.8	240	9502	1824	500	158	9.5	1.4	3.6	4.0	2.8	1.1
angulata Zone	14.1	360	10443	1866	501	154	6.8	0.9	2.3	1.5	1.7	0.7
angulata Zone	14.4	240	9946	1982	462	161	11.2	1.6	3.4	4.0	2.5	1.2
angulata Zone	14.7	360	11604	2187	552	140	7.9	1.1	2.5	3.1	2.8	1.2
angulata Zone	15.0	360	11298	1764	498	174	6.4	0.8	2.2	2.2	2.8	1.0
angulata Zone	15.3	240	9005	1720	472	172	9.0	1.3	2.8	4.5	3.4	1.6
angulata Zone	15.6	240	9030	1822	334	180	9.8	1.6	2.0	5.0	3.1	2.6

Biostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Total ur	Elemental Concentration K %	U ppm	Th ppm	Ratios Th/K	Th/U
angulata Zone	15.9	360	10095	954	486	182	6.4	0.9	2.1	2.4	2.7	1.1
angulata Zone	16.2	360	9432	1720	490	158	6.2	0.9	2.0	3.8	4.2	1.9
angulata Zone	16.5	360	9758	1790	484	150	6.1	0.8	2.2	1.5	1.9	0.7
angulata Zone	16.8	360	9610	1874	496	177	5.9	0.9	2.2	2.2	2.5	1.0
angulata Zone	17.1	360	9530	1676	213	209	5.8	0.8	1.7	1.5	1.9	0.9
angulata Zone	17.4	540	13251	2460	612	297	5.2	0.8	1.6	2.9	3.7	1.8
angulata Zone	17.7	540	11976	2208	576	202	4.3	0.6	1.6	1.2	2.0	0.8
angulata Zone	18.0	540	11919	1944	546	242	4.3	0.5	1.4	1.9	3.8	1.3
angulata Zone	18.3	540	11943	2196	588	249	4.3	0.6	1.6	2.1	3.4	1.3
angulata Zone	18.6	540	12894	2361	552	202	4.9	0.7	1.5	2.1	2.9	1.4
angulata Zone	18.9	360	9486	1802	462	209	5.8	0.9	2.0	3.1	3.4	1.6
angulata Zone	19.2	360	9502	1722	522	143	5.8	0.7	2.6	1.4	2.0	0.5
angulata Zone	19.5	360	89067	1644	438	108	5.2	0.7	2.0	0.9	1.2	0.4
angulata Zone	19.8	360	9006	1794	392	129	5.3	0.9	1.7	1.0	1.1	0.6
angulata Zone	20.1	360	9702	1802	502	209	6.0	0.8	2.1	3.1	3.9	1.5
angulata Zone	20.4	360	10230	2052	508	222	6.5	1.0	2.1	3.6	3.6	1.7
angulata Zone	20.7	360	10414	1930	518	224	6.7	0.9	2.2	3.6	4.0	1.6
angulata Zone	21.0	540	12639	2403	606	230	4.7	0.7	1.7	1.5	2.2	0.9
angulata Zone	21.3	540	11571	2019	486	226	4.3	0.6	1.4	2.4	4.0	1.7
angulata Zone	21.6	360	9364	1784	404	190	5.7	0.9	1.5	2.8	3.1	1.8
angulata Zone	21.9	360	15340	3116	760	338	11.6	1.7	3.5	3.9	2.3	1.1
angulata Zone	22.2	360	9946	1986	438	150	6.2	1.0	2.0	1.5	1.5	0.8
angulata Zone	22.5	360	9966	1916	438	201	6.3	1.0	1.8	2.9	2.9	1.6
angulata Zone	22.8	360	10182	1912	486	169	6.5	0.9	2.2	2.1	2.3	0.9
angulata Zone	23.1	360	12156	2122	428	222	8.4	1.1	2.4	3.6	3.3	1.5
angulata Zone	23.4	540	14405	2661	612	261	6.0	0.9	1.7	2.2	2.5	1.3
angulata Zone	23.7	540	11640	1848	534	186	4.1	0.5	1.5	0.7	1.4	0.5

Table 2.06 **(3 of 4).**

Biostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Total ur	Elemental Concentration K %	U ppm	Th ppm	Ratios Th/K	Th/U
angulata Zone	24.0	360	12120	2354	576	206	8.4	0.4	2.7	3.1	7.7	1.2
angulata Zone	24.3	540	12450	2142	300	198	4.6	0.6	1.7	0.9	1.4	0.5
angulata Zone	24.6	540	12186	2091	594	194	4.5	0.6	1.7	0.9	1.4	0.5
bucklandi - conybeari	24.9	360	12092	2168	612	209	8.4	1.0	2.9	3.1	3.1	1.1
bucklandi - conybeari	25.2	360	14168	2726	630	235	10.4	1.5	2.9	3.8	2.5	1.3
bucklandi - conybeari	25.5	540	10296	1728	408	150	3.2	0.5	1.0	0.2	0.3	0.2
bucklandi - conybeari	25.8	360	11036	2176	486	172	7.3	1.1	2.2	2.1	1.9	0.9
bucklandi - conybeari	26.1	360	13200	2604	544	198	9.5	1.4	2.4	2.9	2.1	1.2
bucklandi - conybeari	26.4	360	13154	2566	634	235	9.4	1.4	2.8	4.6	3.3	1.6
bucklandi - conybeari	26.7	540	12357	2139	222	190	4.6	1.6	1.4	1.0	0.6	0.7
bucklandi - conybeari	27.0	540	12318	2301	525	222	4.5	0.7	1.3	1.4	2.0	1.0
bucklandi - conybeari	27.3	360	9884	1986	404	156	7.2	1.0	1.7	1.5	1.5	0.9
bucklandi - conybeari **	27.6	360	9642	1764	438	187	6.0	0.8	1.9	2.6	3.2	1.4
bucklandi - conybeari **	27.9	360	9920	1852	490	209	6.2	0.9	2.0	1.4	1.5	0.7
bucklandi - conybeari **	28.2	540	10620	1731	471	139	3.4	0.4	1.3	0.7	1.7	0.5
bucklandi - conybeari **	28.5	540	11937	2175	552	238	4.3	0.6	1.4	1.9	3.2	1.3
bucklandi - conybeari **	28.8	360	9808	1750	460	214	6.1	0.8	1.9	3.4	4.3	1.8
bucklandi - conybeari **	29.1	540	10539	1752	477	198	3.4	0.4	1.2	1.0	2.6	0.8
bucklandi - conybeari **	29.4	540	10062	1782	477	162	3.0	0.5	1.2	0.3	0.7	0.3
bucklandi - conybeari **	29.7	540	11262	1875	576	190	3.8	0.5	1.7	1.0	2.1	0.6
bucklandi - conybeari **	30.0	360	9430	1548	474	195	5.7	0.6	2.0	2.8	4.6	1.3

Table 2.06 (4 of 4).

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
Langport Member	Bed1	0.0	480	10377	1427	526	130	4.6	0.5	2.4	1.4	2.80	0.58
Langport Member	Bed1	0.3	480	10122	1473	514	138	4.4	0.5	2.3	1.6	3.20	0.70
Langport Member	Bed1	0.6	480	9835	1403	512	115	4.2	0.5	2.4	1.2	2.40	0.50
Langport Member	Bed1	0.9	480	9461	1303	489	93	3.9	0.4	2.3	0.8	2.00	0.35
Langport Member	Bed1	1.2	500	9067	1216	451	116	3.4	0.4	1.9	1.1	2.75	0.58
Langport Member	Bed1	1.5	540	10702	1425	589	130	3.9	0.4	2.4	1.2	3.00	0.50
Langport Member	Bed1	1.8	540	10829	1498	605	113	4.0	0.4	2.6	0.9	2.25	0.35
Langport Member	Bed1	1.9	540	11471	1627	642	155	4.5	0.5	2.6	1.6	3.20	0.62
Langport Member	Bed 4	2.1	520	12631	1986	672	189	5.5	0.7	2.8	2.1	3.00	0.75
Langport Member	Bed 4	2.4	500	12085	1830	676	199	5.5	0.6	2.9	2.3	3.83	0.79
Langport Member	Bed 4	2.7	480	11134	1615	616	168	5.1	0.6	2.8	2.1	3.50	0.75
Langport Member	Bed 4	3.0	480	10639	1583	540	148	4.8	0.6	2.4	1.1	1.83	0.46
Langport Member	Bed 5	3.3	480	11540	1763	586	156	5.4	0.7	2.6	1.8	2.57	0.69
Langport Member	Bed 6	3.6	480	10569	1614	549	178	4.7	0.6	2.3	2.2	3.67	0.96
Langport Member	Bed 6	3.9	480	11258	1734	561	175	5.2	0.7	2.4	2.1	3.00	0.88
Langport Member	Bed 6	4.2	480	10983	1722	639	153	5.0	0.7	2.4	1.8	2.57	0.75
Langport Member	Bed 6	4.2	480	10164	1500	503	147	4.4	0.6	2.2	1.7	2.83	0.77
Langport Member	Bed 8	4.5	480	10983	1722	539	153	5.0	0.7	2.4	1.8	2.57	0.75
Langport Member	Bed 8	4.8	480	10928	1720	571	158	5.0	0.7	2.5	1.8	2.57	0.72
Langport Member	Bed 8	5.1	480	9569	1358	491	108	4.0	0.5	2.3	1.1	2.20	0.48
Langport Member	Bed 8	5.4	480	11964	1936	579	204	5.8	0.8	2.4	2.6	3.25	1.08
Langport Member	Bed 8	5.7	480	11801	1900	555	198	5.6	0.8	2.3	2.5	3.13	1.09
Langport Member **	Bed 8	6.0	360	15079	2855	695	297	8.1	1.3	2.7	4.2	3.23	1.56
Langport Member **	Bed 8	6.3	360	15252	2831	707	288	8.2	1.3	2.8	4.0	3.08	1.43
Pre-*Planorbis* Beds		6.6	360	10925	1933	542	225	7.7	1.1	2.9	4.2	3.82	1.45

Table 2.07 **Gamma-ray data-set for the White Lias and Blue Lias Formations that outcrop between Pinhay Bay, Devon and Seven Rock Point, Lyme Regis, Dorset (SY 318908 - SY 328910). A total number of 109 sets of measurements were collected. All readings were taken with the B.P. GR-256. The White Lias (Langport Member) was measured during the period 10th February - 12th February 1992. The remaining sets of measurements were collected during the period February 15th - March 4th 1993. Measurements denoted by ** indicate a poor sample geometry on cliff section. (1 of 4.)**

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
Pre-*Planorbis* Beds		6.9	330	13714	2684	684	315	10.4	1.6	3.5	6.1	3.81	1.74
Pre-*Planorbis* Beds		7.2	300	11567	2058	582	227	9.4	1.3	3.4	4.7	3.62	1.38
Pre-*Planorbis* Beds		7.5	300	11411	2139	546	248	10.4	1.5	3.4	5.7	3.80	1.68
Pre-*Planorbis* Beds		7.8	300	10436	1881	516	211	9.3	1.3	3.3	4.8	3.69	1.45
Pre-*Planorbis* Beds		8.1	300	10300	1896	471	206	9.1	1.4	3.0	4.1	2.93	1.37
Pre-*Planorbis* Beds		8.4	300	11856	2256	569	242	11.0	1.6	3.6	5.6	3.50	1.56
Pre-*Planorbis* Beds		8.7	300	11011	2174	509	271	10.0	1.6	2.9	6.4	4.00	2.21
Pre-*Planorbis* Beds		9.0	300	12415	2460	595	298	11.6	1.8	3.6	7.0	3.89	1.94
Pre-*Planorbis* Beds		9.3	300	13260	2441	783	280	12.6	1.6	5.4	6.5	4.06	1.20
Pre-*Planorbis* Beds		9.6	300	10558	1886	561	217	9.4	1.3	3.7	4.9	3.77	1.32
planorbis - planorbis	H25-H29	9.9	300	12048	2209	672	216	11.2	1.5	4.7	4.8	3.20	1.02
planorbis - planorbis	H25-H29	10.2	300	15266	2992	920	268	15.0	2.0	6.7	6.0	3.00	0.90
planorbis - planorbis	H30	10.5	300	12637	2259	801	194	11.9	1.4	6.1	4.1	2.93	0.67
planorbis - planorbis	H31-H42	10.8	300	13563	2369	851	225	13.0	1.5	6.3	5.0	3.33	0.79
planorbis - planorbis	H31-H42	11.1	360	10308	1627	585	168	7.1	0.8	3.5	2.9	3.63	0.83
planorbis - planorbis	H31-H42	11.4	300	9334	1581	456	190	8.0	1.1	2.9	4.3	3.91	1.48
planorbis - planorbis	H31-H42	11.7	300	12330	2125	702	258	9.1	1.1	4.0	4.9	4.45	1.23
planorbis - johnstoni	H31-H42	12.0	300	13381	2356	735	291	10.1	1.3	4.0	5.5	4.23	1.38
planorbis - johnstoni	H43-H56	12.3	300	12097	2120	567	254	8.9	1.2	2.9	4.8	4.00	1.66
planorbis - johnstoni	H43-H56	12.6	300	15480	2896	809	313	12.2	1.7	4.5	6.0	3.53	1.33
planorbis - johnstoni	H43-H56	12.9	300	22018	4513	1258	466	18.7	2.7	7.2	9.2	3.41	1.28
planorbis - johnstoni	H43-H56	13.2	300	15959	2989	726	390	12.7	1.8	3.5	7.8	4.33	2.23
planorbis - johnstoni	H43-H56	13.5	300	14214	2967	579	317	10.9	1.9	2.7	6.1	3.21	2.26
planorbis - johnstoni	H43-H56	13.8	300	14395	3036	628	350	11.1	1.9	2.9	6.9	3.63	2.38
planorbis - johnstoni	H43-H56	14.1	300	13138	2567	556	254	9.9	1.6	2.8	4.8	3.00	1.71
liasicus - portlocki	H57-H65	14.4	300	14426	2969	635	323	11.2	1.9	3.1	6.3	3.32	2.03
liasicus - portlocki	H57-H65	14.7	300	13660	2657	598	313	10.4	1.6	2.0	6.1	3.81	3.05
liasicus - portlocki	H57-H65	15.0	300	15681	2950	879	316	12.4	1.7	5.0	6.0	3.53	1.20
liasicus - portlocki	H57-H65	15.3	370	11187	2163	567	212	11.6	1.7	4.2	5.4	3.18	1.29

Table 2.07 **(2 of 4).**

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
liasicus - portlocki	H66	15.6	370	9193	1572	458	175	10.5	1.6	3.8	4.9	3.06	1.29
liasicus - portlocki	H67-H68	15.9	270	12864	2605	666	246	13.8	2.1	5.0	6.3	3.00	1.26
liasicus - laqueus	H69-H83	16.2	270	9332	1679	491	193	9.2	1.3	3.6	4.8	3.69	1.33
liasicus - laqueus	H69-H83	16.5	300	10290	1834	501	234	9.1	1.3	3.1	5.3	4.08	1.71
liasicus - laqueus	H69-H83	16.8	300	10777	2062	550	216	9.7	1.5	3.6	4.9	3.27	1.36
liasicus - laqueus	H69-H83	17.1	270	10130	1826	547	197	10.2	1.4	4.1	4.9	3.50	1.20
liasicus - laqueus	H69-H83	17.4	270	12687	2404	176	260	13.6	1.8	6.1	6.6	3.67	1.08
angulata Zone	H84-H91	17.7	270	13441	2508	815	245	14.6	1.8	6.6	6.2	3.44	0.94
angulata Zone	H84-H91	18.0	270	10513	1890	560	216	10.8	1.4	4.2	5.5	3.93	1.31
angulata Zone	H84-H91	18.3	270	13812	2561	808	276	15.1	1.9	6.3	7.1	3.74	1.13
angulata Zone	H84-H91	18.6	240	11969	2119	804	229	14.6	1.6	7.4	6.5	4.06	0.88
angulata Zone	1	18.9	240	10246	1763	663	174	12.1	1.3	6.2	4.8	3.69	0.77
angulata Zone	1	19.2	240	13280	2285	923	218	16.6	1.7	8.8	6.1	3.59	0.69
angulata Zone	1	19.5	200	10144	1766	698	181	14.9	1.6	7.9	6.1	3.81	0.77
angulata Zone	Lower Venty	19.8	200	10676	1964	661	195	15.9	1.9	7.2	6.7	3.53	0.93
angulata Zone	Lower Venty	20.1	300	11368	1957	631	201	10.4	1.3	4.4	4.5	3.46	1.02
angulata Zone	Lower Skulls	20.4	300	12993	2487	771	242	12.3	1.7	5.5	5.5	3.24	1.0
angulata Zone	Under White	20.7	300	10779	1894	625	191	9.7	1.2	5.0	4.2	3.50	0.84
angulata Zone	2-20	21.0	300	11008	2044	562	219	10.9	1.4	3.7	4.9	3.50	1.32
angulata Zone	Iron Ledge	21.3	300	10366	1855	549	166	9.2	1.3	3.9	3.6	2.77	0.92
angulata Zone	Upper Skulls	21.6	300	13030	2353	783	265	12.4	1.5	5.5	6.1	4.07	1.11
angulata Zone	2-20	21.9	270	11602	2193	737	215	12.2	1.6	5.9	5.3	3.31	0.90
angulata Zone	Speckety	22.2	270	12270	2180	731	245	13.1	1.6	5.7	6.2	3.88	1.09
angulata Zone	Speckety	22.5	270	12003	2132	708	210	12.7	1.5	5.7	5.2	3.47	0.91
bucklandi - conybeari	21-29	22.8	270	16217	3142	1000	285	18.3	2.4	8.2	7.3	3.04	0.89
bucklandi - conybeari	21-29	23.1	270	16693	3257	988	320	18.9	2.5	7.8	8.3	3.32	1.06
bucklandi - conybeari	21-29	23.4	240	13215	2588	730	247	16.5	2.3	6.4	7.1	3.09	1.11
bucklandi - conybeari	Second Tape	23.7	240	10031	1756	583	208	11.8	1.4	5.0	6.0	4.29	1.20
bucklandi - conybeari	21-29	24.0	240	10749	1979	581	229	12.8	1.7	4.8	6.7	3.94	1.40
bucklandi - rotiforme	21-29	24.3	240	11378	2237	664	224	13.8	1.9	5.8	6.5	3.42	1.12

Table 2.07 (3 of 4).

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total					Elemental Concentrations			Ratios	
				Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
bucklandi - rotiforme	Third Quck	24.6	240	13513	2574	777	277	16.9	2.2	6.7	8.1	3.68	1.21
bucklandi - rotiforme	21-29	24.9	240	14163	2773	867	290	17.9	2.4	7.6	8.5	3.54	1.12
bucklandi - rotiforme	30-40	25.2	240	18341	3398	1204	343	24.1	2.8	11.2	10	3.57	0.89
bucklandi - rotiforme	30-40	25.5	240	12450	2267	785	235	15.4	1.8	7.1	6.7	3.72	0.94
bucklandi - rotiforme	Gumption	25.8	360	11057	1751	690	176	8.8	0.9	4.6	3.4	3.78	0.74
bucklandi - rotiforme	Second Quick	26.1	330	10836	1871	551	203	8.6	1.1	3.4	4.0	3.64	1.18
bucklandi - rotiforme	30-40	26.4	240	10524	1939	538	209	12.5	1.7	4.5	6.0	3.53	1.33
bucklandi - rotiforme	30-40	26.7	240	12918	2518	723	257	16.0	2.2	6.2	7.5	3.41	1.21
bucklandi - rotiforme	30-40	27.0	240	12832	2474	731	301	15.9	2.1	6.0	9.0	4.29	1.50
bucklandi - rotiforme	30-40	27.3	240	14145	2694	844	329	17.9	2.3	7.1	9.8	4.26	1.38
bucklandi - rotiforme	Second Bed	27.6	240	12132	2187	763	247	14.9	1.8	6.8	7.1	3.94	1.04
bucklandi - rotiforme	30-40	27.9	240	12174	2242	720	287	14.9	1.9	6.0	8.4	4.42	1.40
bucklandi - rotiforme	Best Bed	28.2	240	10287	1796	598	241	12.1	1.5	4.9	7.1	4.73	1.45
bucklandi - rotiforme	41-45	28.5	300	12197	2356	541	308	11.4	1.8	3.0	7.3	4.06	2.43
bucklandi - bucklandi	41-46	28.8	240	11720	2248	627	288	14.3	2.0	4.9	8.6	4.30	1.76
bucklandi - bucklandi	41-46	29.1	240	13521	2574	817	284	16.9	2.2	7.1	8.4	3.82	1.18
bucklandi - bucklandi	41-46	29.4	200	10623	2044	580	274	15.8	2.2	5.4	9.9	4.50	1.83
bucklandi - bucklandi	41-46	29.7	200	10558	2021	574	260	15.7	2.1	5.4	9.4	4.48	1.74
bucklandi - bucklandi	41-46	30.0	200	9783	1752	494	253	14.3	1.8	4.4	9.1	5.06	2.07
bucklandi - bucklandi	41-46	30.3	240	11507	2109	615	280	14.0	1.8	4.8	8.4	4.67	1.75
bucklandi - bucklandi	41-46	30.6	240	10749	1892	604	239	12.8	1.6	5.0	6.9	4.31	1.38
bucklandi - bucklandi	41-46	30.9	240	11658	2197	686	268	14.2	1.9	5.7	7.9	4.16	1.39
bucklandi - bucklandi	Top Quick	31.2	240	10922	1830	643	217	13.1	1.5	5.6	6.2	4.13	1.11
bucklandi - bucklandi	41 - 46	31.5	240	10878	1974	646	254	13.0	1.6	5.4	7.4	4.63	1.37
bucklandi - bucklandi	41 - 46	31.8	240	11591	2120	615	244	14.1	1.8	5.1	7.2	4.00	1.41
bucklandi - bucklandi	41 - 46	32.1	240	11394	2008	635	242	13.8	1.7	5.3	7.0	4.12	1.32
semicostatum - lyra	47 - 49	32.4	240	9803	1627	579	211	11.4	1.3	4.9	6.0	4.62	1.22
semicostatum - lyra	Grey Ledge	32.7	240	9846	1659	605	206	11.5	1.3	5.3	5.9	4.54	1.11

Table 2.07 (4 of 4).

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
semicostatum-scipionianum	50 - 52	33.00	240	10966	1777	738	205	13.2	1.3	6.8	5.8	4.46	0.85
semicostatum-scipionianum	50 - 52	33.30	240	11075	2181	567	286	16.6	2.4	5.1	10.3	4.29	2.02
semicostatum-scipionianum	50 - 52	33.60	240	11982	2418	538	376	18.2	2.8	3.9	13.9	4.96	3.56
semicostatum-scipionianum	50 - 52	33.90	240	11908	2536	497	346	18.7	3.0	3.6	12.8	4.27	3.56
semicostatum-scipionianum	50 - 52	34.20	240	9963	1997	417	321	14.6	2.3	2.8	11.9	5.17	4.25
semicostatum-scipionianum	50 - 52	34.50	240	9293	1873	380	265	13.4	2.2	2.7	9.7	4.41	3.59
semicostatum-scipionianum	50 - 52	34.80	240	9388	1743	395	247	10.8	1.6	2.5	7.3	4.56	2.92
semicostatum-scipionianum	50 - 52	35.10	240	9198	1897	412	265	13.3	2.2	3.2	9.7	4.41	3.03
semicostatum-scipionianum	50 - 52	35.40	240	9272	1883	440	237	13.4	2.1	3.8	8.6	4.10	2.26
semicostatum-scipionianum	50 - 52	35.70	240	9546	1933	418	276	13.9	2.2	3.2	10.1	4.59	3.16
semicostatum-scipionianum	50 - 52	36.00	240	10805	2209	483	267	16.1	2.5	4.1	9.7	3.88	2.37
semicostatum-scipionianum	50 - 52	36.30	240	10599	2110	482	251	15.8	2.4	4.0	10.3	4.29	2.58
semicostatum-scipionianum	50 - 52	36.60	240	9860	1930	419	261	14.4	2.2	3.3	9.5	4.32	2.88
semicostatum-scipionianum	50 - 52	36.90	240	10480	2193	455	314	15.5	2.5	3.3	11.6	4.64	3.52
semicostatum-scipionianum	50 - 52	37.20	240	10345	2043	463	300	15.3	2.3	3.5	11.1	4.83	3.17
semicostatum-scipionianum	50 - 52	37.50	240	9740	1862	464	256	14.2	2.0	4.0	9.2	4.60	2.30
semicostatum-scipionianum	50 - 52	37.80	240	10330	2140	462	274	15.3	2.4	3.7	10.0	4.17	2.70
semicostatum-scipionianum	50 - 52	38.10	240	10805	2290	483	303	16.1	2.7	3.8	11.1	4.11	2.92
semicostatum-scipionianum	50 - 52	38.40	240	11075	2265	525	294	16.6	2.6	4.4	10.8	4.15	2.45
semicostatum-scipionianum	50 - 52	38.70	240	11642	2362	530	308	17.6	2.7	4.4	11.3	4.19	2.57
semicostatum-scipionianum	50 - 52	39.00	240	9656	1917	470	234	14.1	2.1	4.2	8.4	4.00	2.00
semicostatum-scipionianum	50 - 52	39.30	240	11019	2173	512	304	16.5	2.4	4.2	11.2	4.67	2.67
semicostatum-scipionianum	50 - 52	39.60	240	10710	2065	548	300	16.0	2.2	4.7	11.0	5.00	2.34
semicostatum-scipionianum	50 - 52	39.90	240	11185	2134	576	318	16.8	2.3	5.0	11.7	5.09	2.34
semicostatum-scipionianum	50 - 52	40.20	240	9941	1940	469	256	14.6	2.2	4.0	9.2	4.18	2.30

Table 2.08 **Gamma-ray data-set for the Shales-with-'Beef' that outcrop between Seven Rock Point, Lyme Regis and Stonebarrow, Charmouth (SY 328910 - SY 364390). A total number of 109 sets of measurements were collected. All readings were taken with the B.P. GR-256. The *sciponianum* Subzone was measured during the period 20th March - March 23rd 1993. The remaining sets of measurements were collected during the period April 24th - April 27th 1993 (41.70 m to 61.20 m) and 19th May - 24th May 1993 (61.50 m to 70.80 m). Measurements denoted by ** indicate a poor sample geometry. (1 of 4.)**

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
semicostatum-scipionianum	50 - 52	40.50	240	9469	1695	490	235	13.7	1.8	4.4	9.2	5.11	2.09
semicostatum-scipionianum	50 - 52	40.80	240	9762	1881	474	236	14.3	2.1	4.3	8.4	4.00	1.95
semicostatum-scipionianum	50 - 52	41.10	240	10372	2008	498	258	15.3	2.2	4.4	9.3	4.23	2.11
semicostatum-scipionianum	50 - 52	41.40	240	10222	1999	493	251	15.1	2.2	4.4	9.1	4.14	2.07
semicostatum-resupinatum	53 - 73	41.70	420	9815	1518	377	228	5.2	0.7	1.3	3.6	5.14	2.77
semicostatum-resupinatum	53 - 73	42.00	420	20004	4187	478	531	13.8	2.3	3.0	9.1	3.96	3.03
semicostatum-resupinatum	53 - 73	42.30	420	12095	2154	469	283	7.1	1.1	1.7	4.6	4.18	2.71
semicostatum-resupinatum	53 - 73	42.60	420	20526	4198	499	527	14.3	2.3	3.5	9.1	3.96	2.60
semicostatum-resupinatum	53 - 73	42.90	300	10080	1770	469	245	8.9	1.2	2.7	5.8	4.83	2.15
semicostatum-resupinatum **	53 - 73	43.20	300	9696	1634	454	204	8.4	1.1	2.8	4.6	4.18	1.64
*semicostatum-resupinatum***	53 - 73	43.70	300	9890	1931	502	212	8.5	1.3	3.1	4.8	3.69	1.55
semicostatum-resupinatum **	53 - 73	44.20	300	9995	2234	389	243	8.6	1.5	2.4	5.5	3.67	2.29
semicostatum-resupinatum **	53 - 73	44.70	300	10100	1931	259	270	8.7	1.6	1.6	6.1	3.81	3.81
semicostatum-resupinatum **	53 - 73	45.20	300	11023	2234	389	297	10.4	1.9	2.4	6.7	3.53	2.79
semicostatum-resupinatum **	53 - 73	45.70	300	13980	2376	518	319	12.0	2.2	3.2	7.2	3.27	2.25
semicostatum-resupinatum **	53 - 73	46.20	240	13996	2822	534	354	12.2	2.1	3.3	8.0	3.81	2.42
semicostatum-resupinatum **	53 - 73	46.70	240	13965	3276	502	390	12.3	1.9	3.1	8.8	4.63	2.84
semicostatum-resupinatum **	53 - 73	47.20	240	13876	2829	421	337	11.9	2.1	2.6	7.6	3.62	2.92
semicostatum-resupinatum **	53 - 73	47.70	240	13862	3127	324	301	11.6	2.0	2.0	6.8	3.40	3.40
semicostatum-resupinatum **	53 - 73	48.20	240	13823	2814	453	305	11.3	1.8	2.8	6.9	3.83	2.46
semicostatum-resupinatum **	53 - 73	48.70	240	11054	2501	567	310	10.9	1.6	3.5	7.0	4.38	2.00
semicostatum-resupinatum **	53 - 73	49.20	240	9152	2820	551	333	11.6	1.8	3.4	7.5	4.17	2.21
semicostatum-resupinatum **	53 - 73	49.70	240	13954	1563	534	355	12.2	1.9	3.3	8.0	4.21	2.42
semicostatum-resupinatum **	53 - 73	50.20	240	11065	1398	437	319	10.5	1.7	2.7	7.2	4.24	2.67
semicostatum-resupinatum **	53 - 73	50.70	240	9987	1287	356	279	8.8	1.4	2.2	6.3	4.50	2.86
semicostatum-resupinatum **	53 - 73	51.20	240	10980	1654	388	345	10.5	1.8	2.4	7.8	4.33	3.25
semicostatum-resupinatum **	53 - 73	51.70	240	13054	2022	486	403	12.8	2.2	3.0	9.1	4.14	3.03
semicostatum-resupinatum **	53 - 73	52.20	240	11056	2045	534	399	13.0	2.0	3.3	9.0	4.50	2.73

Table 2.08 (2 of 4).

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
semicostatum-resupinatum **	53 - 73	52.70	240	12270	1745	583	390	13.2	1.9	3.6	8.8	4.63	2.44
semicostatum-resupinatum **	53 - 73	53.20	240	9965	1286	372	283	8.6	1.4	2.3	6.4	4.57	2.78
semicostatum-resupinatum **	53 - 73	53.70	240	1067	1290	502	292	10.0	1.4	3.1	6.6	4.71	2.13
semicostatum-resupinatum **	53 - 73	54.20	240	11040	1378	388	297	9.1	1.5	2.4	6.7	4.47	2.79
semicostatum-resupinatum **	53 - 73	54.70	240	9779	1010	226	195	5.0	1.1	1.0	4.4	4.00	3.14
semicostatum-resupinatum **	53 - 73	55.20	240	9876	1101	307	199	6.9	1.2	1.9	4.5	3.75	2.37
semicostatum-resupinatum **	53 - 73	55.70	240	9976	1193	356	204	8.0	1.3	2.2	4.6	3.54	2.09
semicostatum-resupinatum **	53 - 73	56.20	180	10980	1285	437	208	9.5	1.4	2.7	4.7	3.40	1.74
semicostatum-resupinatum	53 - 73	56.70	180	11070	1713	518	208	10.9	1.5	3.2	4.8	3.20	1.50
semicostatum-resupinatum	53 - 73	57.00	180	9272	2002	534	369	13.5	2.0	3.3	8.5	4.25	2.58
turneri - brooki	Bed 74	57.30	180	10296	1923	420	295	16.0	2.5	3.4	12.1	4.84	3.56
turneri - brooki	Bed 74	57.60	180	10202	1955	432	301	15.1	2.5	3.5	12.4	4.96	3.54
turneri - brooki	Bed 74	57.90	180	10504	1967	396	301	15.7	2.6	3.0	12.4	4.77	4.13
tunreri - brooki	Bed 74	58.20	240	14108	2917	648	393	17.8	2.8	4.4	12.1	4.32	2.75
turneri - brooki	Bed 74	58.50	240	12336	2408	557	330	15.2	2.3	3.8	10.0	4.35	2.63
turneri - brooki	Bed 74	58.80	240	9289	2149	492	325	13.0	2.0	3.1	9.9	4.95	3.19
turneri - brooki	Bed 74	59.10	240	9152	2050	446	280	11.9	1.9	2.9	8.5	4.47	2.93
turneri - brooki	Bed 74	59.40	200	9951	2081	417	220	14.6	2.4	3.6	7.9	3.29	2.19
turneri - brooki	Bed 74	59.70	180	10605	2231	467	299	17.9	2.9	4.0	12.2	4.21	3.05
turneri - brooki	Bed 74	60.00	200	14072	2996	580	327	17.8	2.9	4.1	9.9	3.41	2.41
turneri - brooki	Bed 74	60.30	200	13292	2818	537	382	16.6	2.8	3.2	11.8	4.21	3.69
turneri - brooki	Bed 74	60.60	200	10491	2152	416	289	12.4	2.1	2.5	8.0	4.19	3.52
turneri - brooki	Bed 74	60.90	200	9784	1986	397	250	11.4	1.9	2.5	7.5	3.95	3.00
turneri - brooki	Bed 74	61.20	200	10673	2229	441	306	12.7	2.2	2.6	9.3	4.23	3.58
turneri - birchi	Bed 74	61.50	200	9727	1968	367	291	14.2	2.3	2.3	10.8	4.70	4.70
turneri - birchi	Bed 74	61.80	200	9162	1888	389	233	13.2	2.2	3.1	8.4	3.82	2.71
turneri - birchi	Bed 74	62.10	200	9370	1914	431	272	13.6	2.2	3.4	9.9	4.50	2.91
turneri - birchi	Bed 74	62.40	200	10074	1969	395	269	14.0	2.3	2.9	9.8	4.26	3.38
turneri - birchi	Bed 74	62.70	200	9984	2040	423	274	14.7	2.4	3.2	10.1	4.21	3.16

Table 2.08 **(3 of 4).**

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
turneri - birchi	Bed 74	63.00	200	9506	1831	420	283	13.8	2.1	3.2	10.3	4.90	3.22
turneri - birchi	Bed 74	63.30	200	9736	1996	424	287	14.2	2.3	3.1	10.6	4.61	3.42
turneri - birchi	Bed 74	63.60	200	9916	1990	401	298	14.5	2.3	2.7	11.0	4.78	4.07
turneri - birchi	Bed 74	63.90	180	10442	2074	582	259	17.5	2.5	6.2	10.4	4.16	1.68
turneri - birchi	Bed 74	64.20	200	10483	2034	506	290	15.5	2.2	4.2	10.1	4.59	2.40
turneri - birchi	Bed 74	64.50	200	10282	2043	499	255	15.2	2.3	4.4	9.2	4.00	2.09
tunreri - birchi	Bed 74	64.80	200	10176	487	469	265	15.1	2.2	4.1	9.3	4.23	2.27
turneri - birchi	Bed 74	65.10	200	9972	1917	392	251	14.9	2.1	4.3	9.2	4.36	2.13
turneri - birchi	Bed 74	65.40	200	10004	2017	481	250	14.7	2.2	4.2	9.1	4.14	2.17
turneri - birchi	Bed 74	65.70	200	9223	1728	472	256	13.3	1.8	4.1	9.2	5.11	2.24
turneri - birchi	Bed 74	66.00	200	9885	1944	469	283	14.5	2.2	3.8	10.3	4.68	2.71
turneri - birchi	Bed 74	66.30	200	12337	2578	629	321	18.8	2.9	5.6	11.8	4.07	2.11
turneri - birchi	Bed 74	66.60	200	10730	2117	620	292	16.0	2.5	1.7	10.7	4.28	6.29
turneri - birchi	Bed 74	66.90	200	9610	1925	466	264	14.0	2.1	3.9	9.6	4.57	2.46
turneri - birchi	Bed 74	67.20	200	9304	2107	463	269	15.2	2.4	3.8	9.8	4.08	2.58
turneri - birchi	Bed 74	67.50	200	9725	1895	511	245	14.2	2.0	4.7	8.8	4.40	1.87
turneri - birchi	Bed 74	67.80	200	9879	1984	499	216	14.5	2.2	4.8	7.6	3.45	1.58
turneri - birchi	Bed 74	68.10	200	10549	2043	506	249	15.6	2.3	4.9	9.1	3.96	1.86
turneri - birchi	Bed 74	68.40	200	11100	2182	564	293	16.6	2.4	5.0	10.6	4.42	2.12
turneri - birchi	Bed 74	68.70	200	11327	2234	548	292	17.0	2.8	4.4	10.6	3.79	2.41
turneri - birchi	Bed 74	69.00	200	10555	2075	630	265	15.7	2.2	5.3	9.9	4.50	1.87
turneri - birchi	Bed 75	69.30	200	10798	2084	603	282	16.2	2.2	5.7	10.1	4.53	1.77
turneri - birchi	Bed 75	69.60	200	10710	2073	601	270	16.0	2.2	5.3	9.8	4.45	1.85
turneri - birchi	Bed 75	69.90	200	10548	2032	575	276	15.7	2.0	4.8	9.9	4.95	2.06
turneri - birchi	Bed 75	70.20	200	10702	2057	589	270	16.0	2.1	5.0	9.7	4.62	1.94
turneri - birchi	Bed 75	70.50	200	10857	2082	604	264	16.2	2.2	5.8	9.5	4.32	1.64
turneri - birchi	bed 75	70.80	200	10780	2075	606	295	16.1	2.2	5.6	10.7	4.86	1.91

Table 2.08 **(4 of 4).**

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
turneri - birchi	Bed 76	71.20	200	9734	1804	530	251	14.2	1.9	4.9	9.0	4.74	1.84
turneri - birchi	Bed 76	71.50	220	11957	2530	513	345	16.2	2.7	2.4	11.6	4.30	4.83
turneri - birchi	Bed 76	71.80	220	11093	2264	483	386	14.8	2.4	2.8	13.1	5.46	4.68
turneri - birchi	Bed 76	72.10	220	10900	2204	422	362	14.5	2.4	2.2	12.2	5.08	5.55
turneri - birchi	Bed 76	72.40	220	11629	2459	489	344	15.7	2.6	3.2	11.5	4.42	3.59
turneri - birchi	Bed 76	72.70	220	12707	2623	565	406	17.4	2.8	3.7	13.7	4.89	3.70
turneri - birchi	Bed 79	73.00	220	12548	2610	523	399	17.2	2.8	3.2	13.5	4.82	4.22
turneri - birchi	Bed 79	73.30	220	12606	2655	530	369	17.3	2.8	3.5	12.4	4.43	3.54
turneri - birchi	Bed 79	73.60	220	12246	2536	477	400	16.7	2.8	2.6	13.6	4.86	5.23
turneri - birchi	Bed 79	73.90	220	12405	2514	517	389	17.1	2.7	3.2	13.2	4.89	4.13
turneri - birchi	Bed 79	74.20	220	10765	2177	469	305	14.3	2.3	3.2	10.2	4.43	3.19
turneri - birchi	Bed 79	74.50	220	10424	2130	441	299	13.8	2.2	3.0	9.9	4.50	3.30
turneri - birchi	Bed 79	74.80	220	14008	2854	604	436	16.1	2.5	3.3	12.4	4.96	3.76
turneri - birchi	Bed 79	75.10	260	14339	3070	609	453	16.5	2.8	3.2	12.9	4.61	4.03
turneri - birchi	Bed 79	75.40	240	9564	1781	383	263	11.1	1.7	2.3	7.9	4.65	3.43
turneri - birchi	Bed 79	75.70	240	11530	2262	508	343	14.0	2.1	3.2	10.4	4.95	3.25
turneri - birchi	Bed 80	76.00	420	15975	2974	689	422	10.4	1.6	2.6	7.2	4.50	2.77
turneri - birchi	Bed 80	76.30	420	9658	1553	418	216	5.1	0.7	1.7	3.3	4.71	1.94
turneri - birchi	Bed 81	76.60	220	13143	2810	590	414	18.2	3.0	3.9	14.0	4.67	3.59
turneri - birchi	Bed 81	76.90	220	12263	2535	505	395	16.7	2.7	3.0	13.3	4.93	4.43
turneri - birchi	Bed 81	77.20	220	12145	2530	492	385	16.5	2.7	2.9	13.1	4.85	4.52
turneri - birchi	Bed 81	77.50	220	12509	2492	556	391	16.5	2.6	3.7	13.2	5.08	3.57
turneri - birchi	Bed 81	77.80	220	12031	2529	538	362	16.4	2.7	3.7	12.1	4.48	3.27
turneri - birchi	Bed 81	78.10	220	12048	2484	494	271	16.4	2.7	3.0	12.4	4.59	4.13
turneri - birchi	Bed 81	78.40	220	11305	2337	504	354	15.2	2.4	3.3	11.9	4.96	3.61

Table 2.09 **Gamma-ray data-set for the Black Ven Marls that outcrop beneath Stonebarrow, Charmouth (SY 368930 - SY 380927). The 114 sets of measurements were collected from cliff section. All readings were taken with the B.P. GR-256 spectrometer. The stratigraphy represented between 71.20 m and 82.30 m was logged during the period 15th October - 20 th October 1993. The remainder of the formation was gamma-ray logged during the period 6th February - 16th February 1993. Measurements denoted by ** indicate a poor sample geometry. (1 of 4.)**

Biostratigraphy Th/U	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K
turneri - birchi	Bed 81	78.70	200	10510	2198	479	311	15.6	2.5	3.1	11.5	4.60	3.71
turneri - birchi	Bed 81	79.00	200	10093	1942	413	308	14.8	2.3	2.8	11.4	4.96	4.07
turneri - birchi **	Bed 81	79.30	200	11612	2379	470	343	17.6	2.8	3.3	12.7	4.54	3.85
turneri - birchi	Bed 81	79.60	180	9601	2056	374	261	15.9	2.7	2.9	10.7	3.96	3.69
turneri - birchi	Bed 81	79.90	180	9541	1963	397	305	15.8	2.5	2.9	12.6	5.04	4.34
turneri - birchi	Bed 81	80.20	180	9168	2040	374	309	16.2	2.7	2.5	12.9	4.78	5.16
turneri - birchi	Bed 81	80.50	220	10731	2253	466	316	14.2	2.4	3.1	10.6	4.42	3.42
turneri - birchi	Bed 81	80.80	220	11282	2238	467	357	15.1	2.4	2.8	12.0	5.00	4.29
turneri - birchi	Bed 81	81.10	220	11994	2484	478	358	16.3	2.7	2.9	12.0	4.44	4.14
turneri - birchi	Bed 81	81.40	220	10771	2218	424	352	14.3	2.4	2.3	11.9	4.96	5.17
turneri - birchi	Bed 81	81.70	220	11113	2237	478	312	14.9	2.3	3.3	10.4	4.52	3.15
turneri - birchi	Pavoir	82.00	220	10536	1972	517	306	13.9	1.9	3.9	10.1	5.32	2.59
obtusum - obtusum	Bed 83	82.30	220	13219	2658	676	349	18.3	2.7	5.5	11.6	4.30	2.11
obtusum - obtusum	Bed 83	82.60	220	14825	2855	828	370	20.9	2.7	7.2	12.2	4.52	1.69
obtusum - obtusum	Bed 83	82.90	220	15772	3088	926	394	22.4	2.9	8.3	13.0	4.48	1.57
obtusum - obtusum	Bed 83	83.20	220	15898	3120	887	399	22.6	3.0	7.7	13.2	4.40	1.71
obtusum - obtusum	Bed 83	83.50	220	17586	3041	1255	364	25.3	2.5	12.7	11.7	4.68	0.92
obtusum - obtusum	Bed 83	83.80	220	16532	2993	1022	406	23.6	2.7	9.4	13.4	4.96	1.43
obtusum - obtusum	Bed 83	84.10	180	13228	2457	884	294	23.0	2.6	10.5	11.7	4.50	1.11
obtusum - obtusum	Bed 83	84.40	180	11147	2192	619	286	18.9	2.6	6.5	11.6	4.46	1.78
obtusum - obtusum	Bed 83	84.70	180	10733	2076	552	273	18.1	2.5	5.6	11.7	4.68	2.09
obtusum - obtusum	Bed 83	85.00	180	12508	2340	797	283	21.6	2.6	9.3	11.3	4.35	1.22
obtusum - obtusum **	Bed 84	85.30	180	12654	2409	746	312	21.9	2.8	8.2	12.7	4.54	1.55
obtusum - obtusum	Bed 84	85.60	180	11845	2255	784	280	20.3	2.5	9.1	11.2	4.48	1.23
obtusum - obtusum	Bed 84	85.90	180	11277	2094	634	281	19.2	2.4	6.8	11.3	4.71	1.66
obtusum - obtusum	Bed 84	86.20	180	11395	2205	593	319	19.4	2.7	5.8	13.1	4.85	2.26
obtusum - obtusum	Bed 84	86.50	180	9020	1567	523	230	14.7	1.7	5.6	9.1	5.35	1.63
obtusum - obtusum	Bed 84	86.80	180	11024	2023	645	268	18.7	2.3	7.1	10.7	4.65	1.51
obtusum - obtusum	Bed 84	87.10	180	10438	1928	582	273	17.5	2.2	6.1	11.1	5.05	1.82

Table 2.09 (2 of 4).

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
obtusum - obtusum	Bed 84	87.40	180	12394	2470	691	348	21.4	2.9	7.0	14.3	4.93	2.04
obtusum - stellare	Bed 86	87.70	180	10847	2100	625	278	18.3	2.4	6.7	11.2	4.67	1.67
obtusum - stellare	Bed 86	88.00	180	12938	2598	716	358	22.5	3.1	7.3	14.7	4.74	2.01
obtusum - stellare	Bed 86	88.30	180	11761	2273	597	336	20.1	2.8	5.7	13.8	4.93	2.42
obtusum - stellare	Bed 86	88.60	180	11765	2209	654	333	20.2	2.6	6.6	13.7	5.27	2.08
obtusum - stellare	Bed 86	88.90	180	11625	2280	638	270	19.9	2.7	6.9	10.9	4.04	1.58
obtusum - stellare	Bed 86	89.20	180	9188	1682	485	257	15.1	2.0	4.8	10.4	5.20	2.17
obtusum - stellare	Bed 86	89.50	180	10727	2090	569	259	18.1	2.5	6.0	10.4	4.16	1.73
obtusum - stellare	Bed 86	89.80	180	11150	2172	552	348	18.9	2.7	4.9	14.4	5.33	2.94
obtusum - stellare	Bed 86	90.10	180	12371	2485	637	383	21.3	3.1	5.9	15.8	5.10	2.68
obtusum - stellare	Bed 87	90.40	240	13818	2695	682	444	17.4	2.5	4.4	13.8	5.52	3.14
obtusum - stellare	Bed 87	90.70	240	11499	2301	563	302	13.9	2.1	4.1	9.1	4.33	2.22
obtusum - stellare	Bed 88	91.00	180	10791	2184	472	278	18.2	2.8	4.3	11.3	4.04	2.63
obtusum - stellare	Bed 88	91.30	180	9872	2081	382	297	16.4	2.8	2.7	12.3	4.39	4.56
obtusum - stellare	Bed 88	91.60	180	9847	2049	424	301	16.4	2.6	3.4	12.4	4.77	3.65
obtusum - stellare	Bed 88	91.90	220	11214	2365	477	343	15.0	2.5	3.1	11.5	4.60	3.71
non sequence	Coinstone	92.20	420	17686	3435	728	515	11.9	1.9	2.5	8.9	4.68	3.56
raricostatum - densinodulum	Bed 90	92.50	200	10461	2079	512	298	15.5	2.3	4.3	10.9	4.74	2.53
raricostatum - densinodulum	Bed 90	92.80	200	9787	2023	448	238	14.3	2.3	3.9	8.4	3.65	2.15
raricostatum - densinodulum	Bed 90	93.10	200	10548	2148	495	286	15.7	2.4	4.1	10.4	4.33	2.54
raricostatum - densinodulum	Bed 90	93.40	200	9218	1782	450	255	13.3	1.9	3.8	9.2	4.84	2.42
raricostatum - densinodulum	Bed 90	93.70	240	12843	2658	575	361	15.9	2.9	3.7	11.1	3.83	3.00
raricostatum - densinodulum	Bed 92	94.00	240	16216	3433	694	494	20.9	3.4	4.2	15.4	4.53	3.67
raricostatum - densinodulum	Bed 93	94.30	200	13368	2785	620	422	20.7	3.2	4.7	15.7	4.91	3.34
raricostatum - densinodulum	Bed 94	94.60	180	11747	2460	486	387	20.1	3.2	3.5	16.2	5.06	4.63
raricostatum - densinodulum	Bed 94	94.90	180	10469	2193	436	350	17.6	2.9	3.1	14.5	5.00	4.68
raricostatum - densinodulum	Bed 94	95.20	180	10499	2301	465	326	17.6	3.0	3.8	13.8	4.60	3.63
raricostatum - densinodulum	Bed 96	95.50	180	9975	2031	404	281	16.6	2.6	3.2	11.4	4.38	3.56
raricostatum - densinodulum	Bed 96	95.80	180	9393	1957	373	267	15.5	2.6	2.9	11.0	4.23	3.79

Table 2.09 **(3 of 4).**

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
raricostatum - densinodulum	Bed 96	96.10	180	11696	2349	418	353	20.0	3.1	2.8	14.7	4.74	5.25
raricostatum - densinodulum	Bed 96	96.40	180	10417	2233	402	368	17.5	3.0	2.4	15.3	5.10	6.38
raricostatum - densinodulum	Bed 96	96.70	180	11303	2208	395	295	19.2	2.9	2.9	12.2	4.21	4.21
raricostatum - densinodulum	Bed 96	97.00	180	10117	2156	333	322	16.9	2.9	1.8	13.4	4.62	7.44
raricostatum - densinodulum	Bed 96	97.30	180	10137	2168	379	290	16.9	2.9	2.8	11.9	4.10	4.25
raricostatum - densinodulum	Bed 96	97.60	180	10312	2152	442	354	17.3	2.8	3.1	14.8	5.29	4.77
raricostatum - densinodulum	Bed 96	97.90	180	11258	2378	485	317	19.1	3.1	4.1	13.0	4.19	3.17
raricostatum - densinodulum	Bed 96	98.20	180	10862	2316	435	328	18.4	3.1	3.3	13.6	4.39	4.12
raricostatum - densinodulum	Bed 96	98.50	180	10846	2355	474	329	18.3	3.1	3.9	13.6	4.39	3.49
raricostatum - densinodulum	Bed 96	98.80	180	10476	2292	413	330	17.6	3.1	2.9	13.7	4.42	4.72
raricostatum - densinodulum	Bed 96	99.10	180	10336	2273	383	332	17.3	3.1	2.4	13.8	4.45	5.75
raricostatum - densinodulum	Bed 97	99.40	180	10811	2356	440	338	18.3	3.1	3.2	14.0	4.52	4.38
raricostatum - densinodulum	Bed 97	99.70	180	10297	2209	408	316	17.3	2.9	3.0	13.1	4.52	4.37
raricostatum - densinodulum	Bed 97	100.00	180	10528	2262	386	300	17.7	3.0	2.7	12.4	4.13	4.59
raricostatum - densinodulum	Bed 97	100.30	180	10981	2328	429	358	18.6	3.1	2.9	14.9	4.81	5.14
raricostatum - densinodulum	Bed 97	100.60	180	10652	2243	467	334	18.0	2.9	3.7	13.8	4.76	3.73
raricostatum - densinodulum	Bed 97	100.90	180	13240	2868	516	453	23.1	3.9	3.3	19.1	4.90	5.79
raricostatum - densinodulum	Bed 99	101.20	180	11493	2396	449	355	19.6	3.2	3.2	4.0	1.25	1.25
raricostatum - raricostatoides	Bed 100	101.50	180	12000	2593	457	404	20.6	3.5	2.9	16.9	4.83	5.83
raricostatum - raricostatoides	Bed 100	101.80	180	10464	2262	431	315	17.6	3.0	3.3	13.1	4.37	3.97
raricostatum - raricostatoides	Bed 100	102.10	180	10904	2324	412	389	18.4	3.1	2.3	16.3	5.26	7.09
raricostatum - raricostatoides	Bed 100	102.40	200	13245	2830	581	417	20.5	3.3	4.1	15.6	4.73	3.80
raricostatum - raricostatoides	Bed 100	102.70	200	12433	2545	515	388	19.0	3.0	3.5	14.5	4.83	4.14
raricostatum - raricostatoides	Bed 100	103.00	200	12515	2598	523	522	19.2	3.1	3.3	15.8	5.10	4.79
raricostatum - raricostatoides	Bed 100	103.30	200	9597	1824	420	309	14.0	2.1	2.9	11.4	5.43	3.93
raricostatum - raricostatoides	Bed 100	103.60	200	10335	2027	445	329	15.3	2.3	3.1	12.2	5.30	3.94
raricostatum - raricostatoides	Bed 102	103.90	180	9572	1924	406	300	15.8	2.5	3.1	12.4	4.96	4.00
raricostatum - raricostatoides	Bed 102	104.20	180	10310	2152	426	313	17.3	2.8	3.3	12.9	4.61	3.91
raricostatum - raricostatoides	Bed 103	104.50	180	10414	2161	475	361	17.5	2.8	3.6	15.0	5.36	4.17
raricostatum - raricostatoides	Bed 103	104.80	180	11427	2189	632	295	19.5	2.6	6.6	12.0	4.62	1.82
raricostatum - raricostatoides	Hummocky	105.10	180	10248	1837	654	212	17.2	2.0	7.8	8.2	4.10	1.05

Table 2.09 **(4 of 4).**

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
Hummocky	bed103	105.2	180	10248	1837	654	212	17.2	2.0	7.8	8.2	4.10	1.05
jamesoni - taylori	bed 105	105.5	260	9534	1786	447	217	9.9	1.5	3.1	5.9	3.93	1.90
jamesoni - taylori	bed 106	105.8	300	9412	1832	400	198	9.8	1.6	2.7	5.2	3.25	1.93
jamesoni - taylori	bed 107	106.1	300	12377	2108	647	247	11.6	1.4	4.3	5.7	4.07	1.33
jamesoni - taylori	bed 108	106.4	300	11924	2258	606	268	11.0	1.6	3.8	6.2	3.88	1.63
jamesoni - taylori **	bed 108	106.7	300	11896	2183	638	230	11.0	1.5	4.3	5.3	3.53	1.23
jamesoni - taylori **	bed 108	107.0	300	11396	2126	583	240	10.4	1.5	3.7	5.6	3.73	1.51
jamesoni - taylori **	bed 108	107.3	300	11521	2208	592	247	10.6	1.6	3.8	5.7	3.56	1.50
jamesoni - taylori	bed 108	107.6	300	11975	2343	576	262	11.1	1.7	3.6	6.1	3.59	1.69
jamesoni - taylori **	bed 108	107.9	300	11763	2315	539	255	10.8	1.7	3.2	6.0	3.53	1.88
jamesoni - taylori	bed 108	108.2	300	13138	2631	583	319	12.5	2.0	3.3	7.6	3.80	2.30
jamesoni - taylori	bed 109	108.5	240	10724	2159	521	249	12.8	2.0	4.0	7.4	3.70	1.85
jamesoni - polymorphus	bed 110	108.8	240	10559	2084	504	235	12.5	1.9	3.9	6.9	3.63	1.77
jamesoni - polymorphus	bed 110	109.1	240	10068	2047	456	207	11.8	1.9	3.5	6.0	3.16	1.71
jamesoni - polymorphus	bed 110	109.4	240	12674	2617	539	262	15.7	2.5	4.0	7.8	3.12	1.95
jamesoni - polymorphus	bed 110	109.7	240	12650	2597	662	289	15.6	2.4	5.3	8.6	3.58	1.62
jamesoni - polymorphus	bed 110	110.0	200	10891	2262	589	228	16.3	2.9	5.9	8.1	2.79	1.37
jamesoni - polymorphus	bed 110	110.3	200	10450	2177	544	215	15.5	2.4	5.4	7.6	3.17	1.41
jamesoni - polymorphus	bed 110	110.6	200	10103	2074	510	199	14.9	2.4	5.1	6.9	2.88	1.35
jamesoni - polymorphus	bed 110	110.9	200	10061	1998	493	242	14.8	2.2	4.5	8.7	3.95	1.93
jamesoni - polymorphus	bed 110	111.2	200	9535	1946	456	224	13.9	2.2	4.1	8.5	3.86	2.07
jamesoni - polymorphus	bed 110	111.5	200	10065	2025	556	233	14.8	2.2	5.4	8.2	3.73	1.52
jamesoni - polymorphus	bed 110	111.8	200	10345	2118	521	230	15.3	2.3	5.0	8.2	3.57	1.64
jamesoni - polymorphus	bed 110	112.4	240	11604	2364	583	250	14.1	2.2	4.7	7.3	3.32	1.55
jamesoni - polymorphus	bed 110	112.7	240	10967	2226	536	261	13.2	2.1	4.1	7.8	3.71	1.90
jamesoni - polymorphus	bed 110	113.0	240	9949	2028	433	206	11.6	1.9	3.9	6.0	3.16	1.54
jamesoni - polymorphus **	bed 110	113.3	200	9146	1776	409	198	13.2	2.0	3.7	7.0	3.50	1.89

Table 2.10 **Gamma-ray data-set for the Belemnite Marls that outcrop between Stonebarrow and Seatown, Dorset (SY 380927 - SY 415918). Beds 103-110 were measured from the cliff exposure east of Westhay Water (SY 386925 - SY 391924). Measurements for beds 116-121 were obtained from the exposure between Golden Cap and Seatown (SY 410918 - SY 416917). A total number of 89 sets of measurements were collected in all. All readings were taken with the B.P. GR-256 during the period 20th October - 27th October 1993. (1 of 3.)**

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
jamesoni - polymorphus	bed 110	113.6	200	9057	1845	406	217	13.0	2.1	3.5	7.8	3.71	2.23
jamesoni - polymorphus	bed 110	113.9	240	11456	2373	515	242	13.9	2.3	3.9	7.1	3.09	1.82
jamesoni - polymorphus	bed 110	114.2	240	10022	2053	432	221	11.8	2.0	3.2	6.5	3.25	2.03
jamesoni - polymorphus	bed 110	114.5	240	10452	2148	460	219	12.4	2.0	3.5	6.4	3.20	1.83
jamesoni - polymorphus	bed 110	114.8	200	10147	2017	442	244	11.9	1.9	3.1	7.3	3.84	2.35
jamesoni - polymorphus **	bed 110	115.1	200	9492	1940	445	230	13.8	2.2	3.9	8.3	3.77	2.13
jamesoni - polymorphus **	bed 110	115.4	200	10442	2086	566	222	15.5	2.2	5.6	7.8	3.55	1.39
jamesoni - polymorphus **	bed 110	115.7	200	10544	2154	539	254	15.7	2.4	5.0	9.2	3.83	1.84
jamesoni - polymorphus	bed 110	116.0	200	10722	2205	523	236	16.0	2.5	4.9	8.4	3.36	1.71
jamesoni - polymorphus	bed 110	116.3	200	11093	2203	573	258	16.6	2.4	5.4	9.3	3.88	1.72
jamesoni - polymorphus	bed 110	116.6	200	11522	2334	644	264	17.4	2.5	6.4	9.5	3.80	1.48
jamesoni - polymorphus	bed 110	116.9	240	12441	2451	637	269	15.3	2.2	5.2	8.0	3.64	1.54
jamesoni - polymorphus	bed 110	117.2	240	9681	1912	444	220	11.2	1.8	3.3	6.5	3.61	1.97
jamesoni - polymorphus	bed 110	117.5	300	10427	1923	456	253	9.3	1.4	2.5	5.9	4.21	2.36
jamesoni - polymorphus	bed 110	117.8	240	9452	1863	426	223	10.9	1.7	3.1	6.5	3.82	2.10
jamesoni - polymorphus	bed 111	118.1	300	11140	2197	487	247	10.1	1.6	2.8	5.7	3.56	2.04
jamesoni - polymorphus	bed 111	118.4	300	9290	1687	396	201	7.9	1.2	2.3	4.6	3.83	2.00
jamesoni - polymorphus	bed 111	118.7	300	11787	2457	475	275	10.9	1.9	2.6	6.6	3.47	2.54
jamesoni - polymorphus	bed 111	119.0	240	9631	2032	422	213	11.2	1.9	3.1	6.3	3.32	2.03
jamesoni - polymorphus	bed 111	119.3	240	10521	2287	420	251	12.5	2.2	2.8	7.5	3.41	2.68
jamesoni - polymorphus	bed 111	119.6	240	10252	2196	447	261	12.1	2.1	3.0	7.8	3.71	2.60
jamesoni - polymorphus	bed 112	119.9	240	10629	2215	465	245	12.7	2.1	3.3	7.3	3.48	2.21
jamesoni - polymorphus	bed 112	120.2	240	10607	2174	474	241	12.6	2.1	3.5	7.2	3.43	2.06
jamesoni - polymorphus	bed 112	120.5	240	10873	2317	466	231	13.0	2.2	3.4	6.8	3.09	2.00
jamesoni - polymorphus	bed 112	120.8	240	10522	2270	415	235	12.5	2.2	2.8	6.9	3.14	2.46
jamesoni - polymorphus	bed 113	121.1	240	10341	2043	535	246	12.2	1.8	4.1	7.2	4.00	1.76
jamesoni - brevispina	bed 113	121.4	300	10446	2067	428	238	9.3	1.6	2.3	5.5	3.44	2.39
jamesoni - brevispina	bed 113	121.7	300	11739	2402	497	277	10.8	1.8	2.7	6.5	3.61	2.41
jamesoni - brevispina	bed 113	122.0	300	10945	2149	446	264	9.9	1.6	2.4	6.2	3.88	2.58
jamesoni - brevispina	bed 114	122.3	300	10260	1881	411	247	9.1	1.4	2.2	5.8	4.14	2.64
jamesoni - brevispina	bed 114	122.6	300	12799	2707	538	319	12.1	2.1	2.9	7.6	3.62	2.62

Table 2.10 **(2 of 3).**

Biostratigraphy	Horizon	Thick. (m)	Time Secs	Total Number of Counts Recorded Total	K	U	Th	Total ur	Elemental Concentrations K %	U ppm	Th ppm	Ratios Th/K	Th/U
jamesoni - brevispina	bed 114	122.9	300	13085	2763	527	320	12.4	2.2	2.7	7.7	3.50	2.85
jamesoni - brevispina	bed 114	123.2	200	9029	1977	357	206	13.0	2.3	2.9	7.3	3.17	2.52
jamesoni - jamesoni	bed 115	123.5	200	9007	1860	378	242	12.9	2.2	2.9	8.0	3.64	2.76
jamesoni - jamesoni	bed 115	123.8	240	10038	2165	376	244	11.8	2.1	2.3	7.4	3.52	3.22
jamesoni - jamesoni	bed 115	124.1	240	9895	1965	397	254	11.6	1.9	2.5	7.6	4.00	3.04
jamesoni - jamesoni	bed 115	124.4	240	9340	1899	365	217	10.7	1.8	2.4	6.4	3.56	2.67
jamesoni - jamesoni	bed 115	124.7	240	9798	2002	423	248	11.4	1.9	2.8	7.5	3.95	2.68
jamesoni - jamesoni	bed 115	125.0	240	11045	2317	483	248	13.3	2.2	3.5	7.4	3.36	2.11
jamesoni - jamesoni	bed 115	125.3	200	9650	2055	409	230	14.1	2.4	3.4	8.3	3.46	2.44
jamesoni - jamesoni	bed 115	125.6	200	9603	2038	374	240	14.0	2.4	2.8	8.8	3.67	3.14
jamesoni - jamesoni	bed 115	125.9	200	9187	1932	420	236	13.2	2.2	3.5	8.5	3.86	2.43
jamesoni - jamesoni	bed 116	126.2	200	10539	2094	446	272	12.5	2.0	2.9	8.2	4.10	2.83
jamesoni - jamesoni	bed 116	126.5	200	10132	1978	424	250	11.9	1.9	2.9	7.4	3.89	2.55
jamesoni - jamesoni **	bed 117	126.8	200	9603	1949	403	214	11.1	1.9	2.8	6.3	3.32	2.25
jamesoni - jamesoni **	bed 117	127.1	200	10773	2259	419	246	12.9	2.2	2.0	7.3	3.32	3.65
jamesoni - jamesoni **	bed 118	127.4	200	10236	2091	404	275	12.1	2.0	2.5	8.3	4.15	3.32
jamesoni - jamesoni **	bed 118	127.7	200	9903	2066	406	227	14.5	2.4	3.4	8.2	3.42	2.41
jamesoni - jamesoni	bed 118	128.0	200	10841	2264	474	287	16.2	2.6	3.8	10.5	4.04	2.76
jamesoni - jamesoni	bed 118	128.3	200	10976	2360	547	285	16.4	2.7	4.8	10.4	3.85	2.17
ibex - masseanum	bed 118	128.6	200	11046	2362	518	304	16.5	2.7	4.3	11.2	4.15	2.60
ibex - masseanum	bed 118	128.9	200	10963	2346	501	296	16.4	2.7	4.1	10.8	4.00	2.63
ibex - masseanum	bed 118	129.2	200	10031	2013	413	289	14.7	2.3	2.9	10.6	4.61	3.66
ibex - valdani	bed 118	129.5	200	9611	2017	431	232	14.0	2.3	3.7	8.3	3.61	2.24
ibex - valdani	bed 118	129.8	200	9718	1954	443	239	14.2	2.2	3.8	8.6	3.91	2.26
ibex - valdani	bed 119	130.1	200	9453	1951	460	276	13.7	2.2	3.8	10.0	4.55	2.63
ibex - valdani	bed 119	130.4	200	9505	1953	467	251	13.8	2.2	4.1	9.1	4.14	2.22
ibex - valdani	bed 119	130.7	200	10209	2000	520	240	15.1	2.2	4.8	9.0	4.09	1.88
ibex - valdani	bed 120	131.0	200	10880	2182	578	286	16.3	2.4	5.3	10.3	4.29	1.94
ibex - valdani	bed 120	131.3	200	10800	2020	582	265	16.1	2.1	5.5	9.5	4.52	1.73
ibex - valdani	bed 120	131.6	200	10209	1994	568	240	15.1	2.1	5.5	8.6	4.10	1.56
ibex - luridum	bed 121	131.9	200	10413	2054	460	277	15.4	2.3	3.7	10.2	4.43	2.76

Table 2.10 **(3 of 3).**

Biostratigraphy	Height m	Time Secs	Total Number of Counts Total	K	U	Th	Total ur	Elemental Concentration K %	U ppm	Th ppm	Ratios Th/K	Th/U
ibex - luridum	0.0	140	10234	1978	435	335	21.6	3.3	3.5	17.9	5.42	5.11
ibex - luridum	0.3	140	9550	1819	451	337	19.8	2.9	3.8	17.9	6.17	4.71
ibex - luridum	0.6	140	10166	1914	489	336	21.4	3.0	4.6	17.9	5.97	3.89
ibex - luridum	0.9	140	9727	1856	436	326	20.4	2.8	3.9	19.1	6.82	4.90
ibex - luridum	1.2	140	10229	1978	460	361	21.5	3.2	3.6	19.3	6.03	5.36
ibex - luridum	1.5	180	12881	2518	570	477	21.1	3.2	3.1	19.9	6.22	6.42
ibex - luridum	1.8	140	9740	1862	442	294	20.4	3.0	4.2	15.6	5.20	3.71
ibex - luridum **	2.1	140	9036	1685	381	307	18.6	2.8	2.8	16.3	5.82	5.82
ibex - luridum **	2.4	140	9763	1835	376	373	20.4	3.1	1.7	20.0	6.45	11.76
ibex - luridum	2.7	140	9290	1835	444	342	19.2	3.0	3.6	18.2	6.07	5.06
ibex - luridum	3.0	140	9905	1853	489	304	20.7	2.9	5.1	16.0	5.52	3.14
ibex - luridum	3.3	140	9006	1639	386	298	17.4	2.7	3.1	15.8	5.85	5.10
ibex - luridum	3.6	180	11374	2172	491	408	18.2	2.8	2.6	17.0	6.07	6.54
ibex - luridum	3.9	180	11299	2081	517	376	18.0	2.6	3.5	15.4	5.92	4.40
ibex - luridum	4.2	180	11057	2118	495	380	17.5	2.7	3.1	15.6	5.78	5.03
ibex - luridum	4.5	180	10595	1970	446	350	16.7	2.5	2.6	14.4	5.76	5.54

Table 2.11 Gamma-ray data-set for the *luridum* Subzone of the *ibex* Zone that is exposed in Blockley Pit, Gloucestershire. (SP 182369). The gamma-ray logs were measured from a series of fresh sections in the pit. The measurements taken between 0 m and 4.2 m were obtained from a section exposed at the north end of the pit, measurements taken between 4.2 m and 9.3 m were obtained from a section exposed at the south east end of the pit and the remainder of measurements were obtained from a section at the south-south west end of the pit. The 36 sets of measurements were collected with the Edinburgh University GR-256 on the 10th October 1995. Measurements were taken with the detector placed perpendicular to the section and parallel to bedding, except for readings denoted by ** which indicates a poor sample geometry. (1 of 2).

Biostratigraphy	Height	Time	Total Number of Counts				Total	Elemental Concentration			Ratios	
	m	Secs	Total	K	U	Th	ur	K %	U ppm	Th ppm	Th/K	Th/U
ibex - luridum	4.8	180	11957	2319	595	403	19.3	2.9	4.4	16.6	5.72	3.77
ibex - luridum	5.1	180	11970	2313	553	447	19.3	2.9	3.2	18.6	6.41	5.81
ibex - luridum	5.4	180	12194	2356	556	392	19.7	3.0	3.9	16.2	5.40	4.15
ibex - luridum	5.7	180	12127	2290	534	430	19.6	2.9	3.1	17.8	6.14	5.74
ibex - luridum	6.0	180	11865	2313	570	436	19.1	2.9	3.6	18.0	6.21	5.00
ibex - luridum	6.3	180	11560	2175	534	382	18.5	2.7	3.7	15.7	5.81	4.24
ibex - luridum **	6.6	180	11479	2172	514	419	18.3	2.7	2.9	17.3	6.41	5.97
ibex - luridum **	6.9	180	11804	2219	549	383	18.9	2.8	3.9	15.7	5.61	4.03
ibex - luridum **	7.2	180	12648	2374	598	431	20.6	2.9	4.7	17.8	6.14	3.79
ibex - luridum **	7.5	180	12440	2320	591	429	20.2	2.9	4.1	17.8	6.14	4.34
ibex - luridum	7.8	180	9970	1838	419	338	15.5	2.3	2.4	13.8	6.00	5.75
ibex - luridum	8.1	180	10072	1899	476	333	15.7	2.3	3.3	13.6	5.91	4.12
ibex - luridum	8.4	180	10269	1920	443	328	16.1	2.4	2.8	13.4	5.58	4.79
ibex - luridum	8.7	180	11455	2302	940	378	18.3	3.0	3.0	15.7	5.23	5.23
ibex - luridum	9.0	180	11008	2096	472	388	17.5	2.7	2.6	16.1	5.96	6.19
ibex - luridum	9.3	180	11484	2183	516	397	18.3	2.7	3.2	16.4	6.07	5.13
ibex - luridum	9.6	180	10830	2134	465	353	17.1	2.7	2.9	14.5	5.37	5.00
ibex - luridum	9.9	180	10685	2001	492	382	16.8	2.5	3.0	15.7	6.28	5.23
ibex - luridum	10.2	180	10342	1882	484	341	16.2	2.3	3.4	13.9	6.04	4.09
ibex - luridum	10.5	180	10203	1936	364	345	16.0	2.4	3.0	14.2	5.92	4.73

Table 2.11 (2 of 2)

ARTIFICIAL RADIOACTIVE CONTAMINATION AS A POSSIBLE ADDITIONAL SOURCE OF ERROR

The uppermost part of the *bucklandi* Subzone and the lowermost part of the *lyra* Subzone, between 110.4 m and 127.0 m, exposed at Hinkley Point, Somerset (ST 210465) was not measured. It is represented by foreshore which was entirely covered by *Fucus* (order Phaeophycophyta) during August and September 1995. This made gamma-ray measurements impractical.

Additionally, the GR-410 data-set, previously collected from this locality during August 1994, suggests artificial radioactive contamination of the foreshore released from the outflow pipe from the nucleur power station. Sets of gamma-ray measurement were collected from the foreshore just west of the outflow pipe (Figure 6.01, overleaf). The minimum distance from the outflow pipe was 80 cm. The gamma-ray signature (Figure 6.01) shows an increase in U and Th concentration within the raw data-set with the concentration of the radionuclides being similar (*e.g.* mean Th ppm = 20.01 and mean U ppm = 20.70 ppm). This gamma-ray signature is unusual and records the highest Th concentration in the raw GR-410 data-set for the Somerset coast (This data-set can be obtained from the author on request). The lower boundary of the signature collected from Hinkley Point foreshore occurs 60 cm below the dramatic increase in U and Th concentration with the lowermost two readings taken from the base of the cliff rather than from foreshore. The upper boundary coincides with highest stratigraphic sample collected from the foreshore at Hinkley Point. It is likely that the calculated increase in U and Th concentration is due to radioactive contamination from an artificial radionuclide released in the outflow pipe from the nucleur power station onto the foreshore and emits gamma-radiation that can be recorded in the U and Th energy windows in the GR-410 spectrometer (1.76 MeV to 2.62 MeV). Thus, even with robust GR-256 data, it is possible that any gamma-ray log collected from Hinkley Point cannot be reliably interpreted in terms of depositional stratigraphic trends.

****

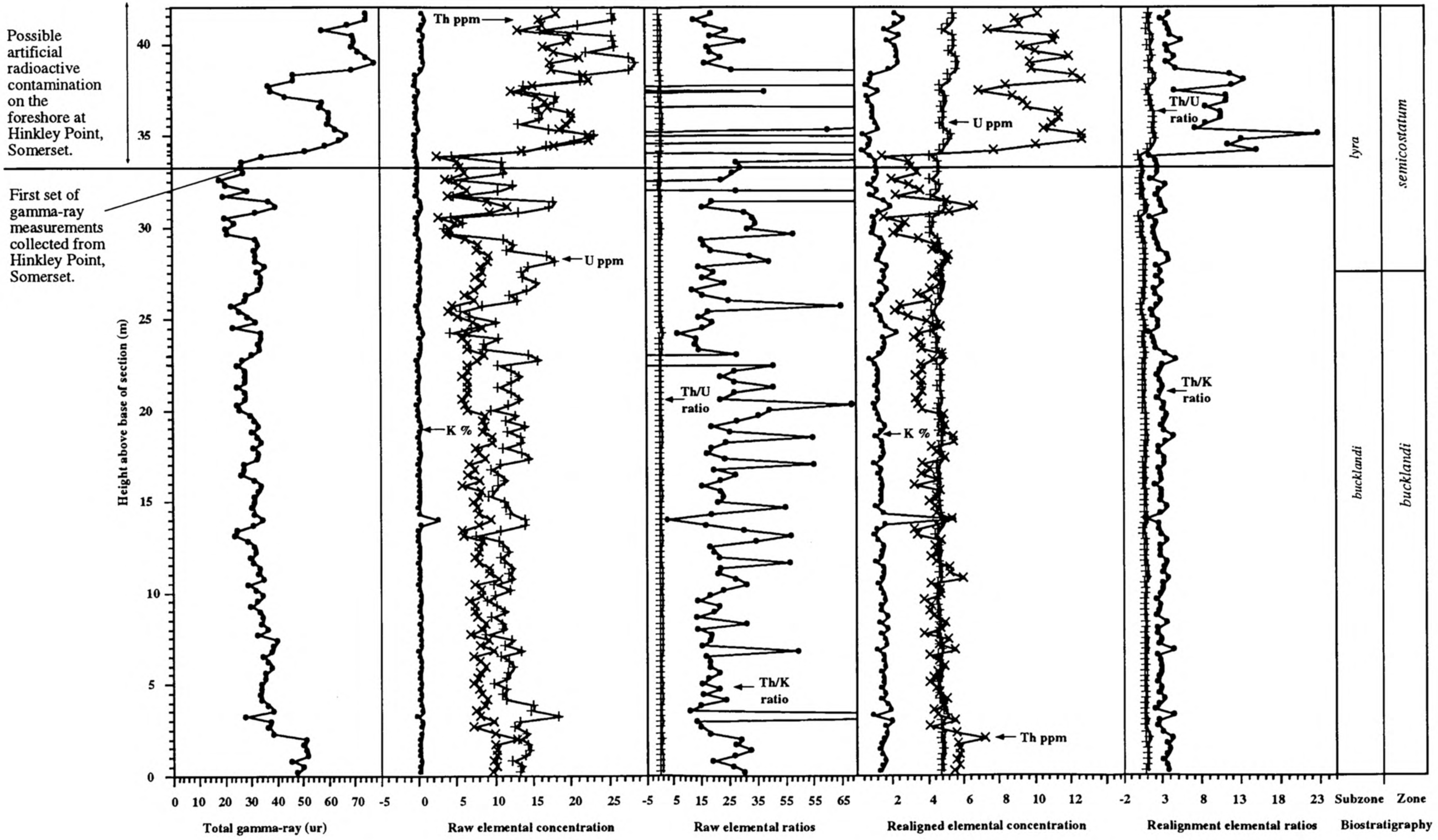


Figure 6.01

FIGURE 6.01 Total gamma-ray log, elemental-concentration logs and elemental-ratio curves for the Blue Lias exposed west of Kilve Pill, Somerset (ST 139457 to ST 445144) and foreshore from Hinkley Point, Somerset (ST 210465). Raw data collected with the GR-410.