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STRATIGRAPHIC CONSULTANTS

THE TROLL FIELD

Analysis of biostratigraphic data by RASC and STRATCOR

Summary

Ron Woollam

SUMMARY

- OBJECTIVE
  - review Jurassic and Lower Cretaceous palynostratigraphy of the Troll Field
  - achieved through application of quantitative techniques

- DATABASE
  - 28 wells / 5000 samples
  - 186 bioevents / 1479 event records

- JGR SCHEME
  - routine stratigraphic subdivision of wells
  - inconsistent correlation framework

- PC BASED RASC & STRATCOR
  - statistical and graphical techniques
  - testing of JGR scheme (RASC)
  - consistent high resolution correlation framework (STRATCOR)

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INTRODUCTION

The project was undertaken on behalf of A/S Norske Shell. The overall objective was to critically review palynological data from a total of twenty-eight wells in the Troll Field. The interval studied covers the Jurassic to lowermost Cretaceous. Data analysis was undertaken by computer-based quantitative methods (RASC and STRACOR).

The results of previous biostratigraphic work are embodied in the Joint Geological Review biozonation. The JGR scheme was developed from earlier zonations, through the collaborative efforts of the Troll Field operating companies, after almost a decade of independent work. The zonation comprises thirty-five events based on dinocyst inceptions, extinctions and abundance changes. A total of ten zones/subzones are recognized. While the JGR scheme allows routine subdivision of individual well sections, many inconsistencies exist when correlating from one section to another.

RASC

Statistical analysis using RASC highlights the limited geographic continuity of many of the bioevents as shown by the cumulative frequency curve and occurrence matrix. This situation is the norm rather than the exception - a characteristic of the fossil record. Despite the inconsistencies in correlating between sections, the succession of bioevents in the JGR scheme compares favourably with the optimum sequence derived by the RASC program.

STRATCOR

STRATCOR builds a biozonation by graphically compositing all wells in the database. The final composite standard sequence of bioevents is a probabilistic zonation similar to the RASC optimum sequence. Graphic correlation of the FCSS with each individual well, allows the zonation to be interpolated throughout the well database. The result is a high-resolution correlation framework. Plotting the deviations of observed from interpolated positions for each bioevent reveals a normal distribution of values, and illustrates the probabilistic nature of the technique. Reversing the correlation procedure from the individual well sections to the composite also enables data to be collected on the distributions of individual events, scaled in FCSS units.

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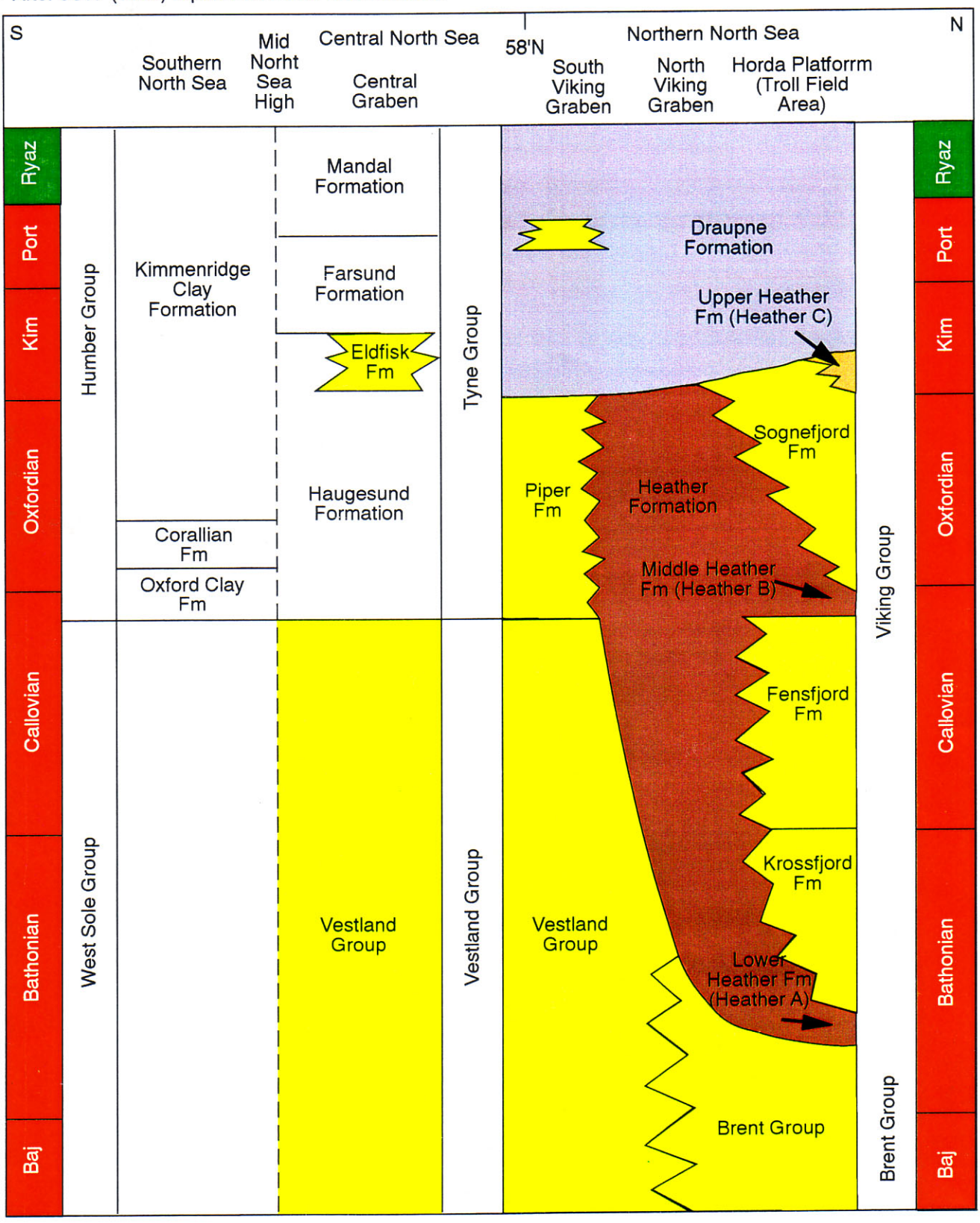
LITHOSTRATIGRAPHY

After JGR (1988) report with minor modifications



Note: Thicknesses are schematic

PREVIOUS BIOZONATIONS

- NORSKE SHELL SCHEME (1983)
- PL085 SCHEME (1984)
- AMALGAMATED INTO JGR SCHEME (1988)
  - 35 bioevents (dinocyst inceptions, extinctions and abundance changes)
  - 7 zones / 6 subzones = 10 divisions
  - 17 correlation lines (biohorizons)
- SUBSET OF TOTAL DATABASE
- BASIC SUBDIVISION OF STRATIGRAPHY
- INCONSISTENT CORRELATION FRAMEWORK (DUE TO FOSSIL RECORD - NOT ANALYSIS)
- PROBLEMS OF PICKING BIOZONES IN INDIVIDUAL WELLS DUE TO "OUT OF SEQUENCE" BIOEVENTS
- SUBJECTIVE BIOZONE CORRELATION

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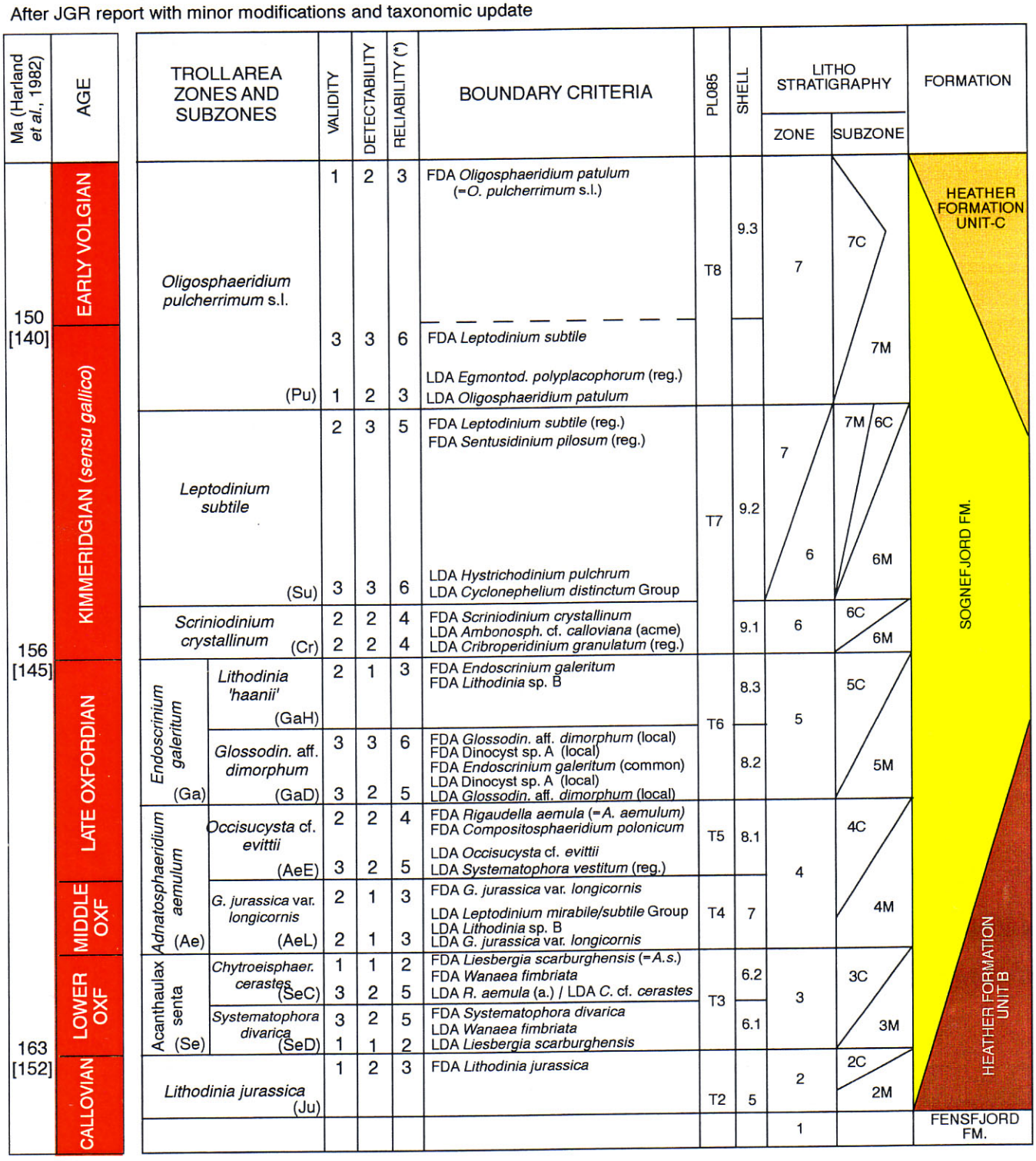
JGR BIOZONATION

After JGR report with minor modifications and taxonomic update



Haq *et al.*, (1987) ages in parentheses

REGIONAL BIOEVENT QUALITY			
VALIDITY (V)	1=High	2=Medium	3=Low
DETECTABILITY (D)	1=Good	2=Fair	3=Poor
RELIABILITY (V+D)	2/3=High	4=Medium	5/6=Low

DATABASE EVALUATION

- 28 WELLS
- LIST EVENTS
- 186 FDA/LDA BIOEVENTS (50% IN INTERVAL OF INTEREST)
- 1479 BIOEVENT RECORDS
- c. 5000 PALYNOLOGICAL SAMPLES (CC, SWC)
- c. 2-4m SAMPLE INTERVALS
- NUMEROUS ANALYSTS

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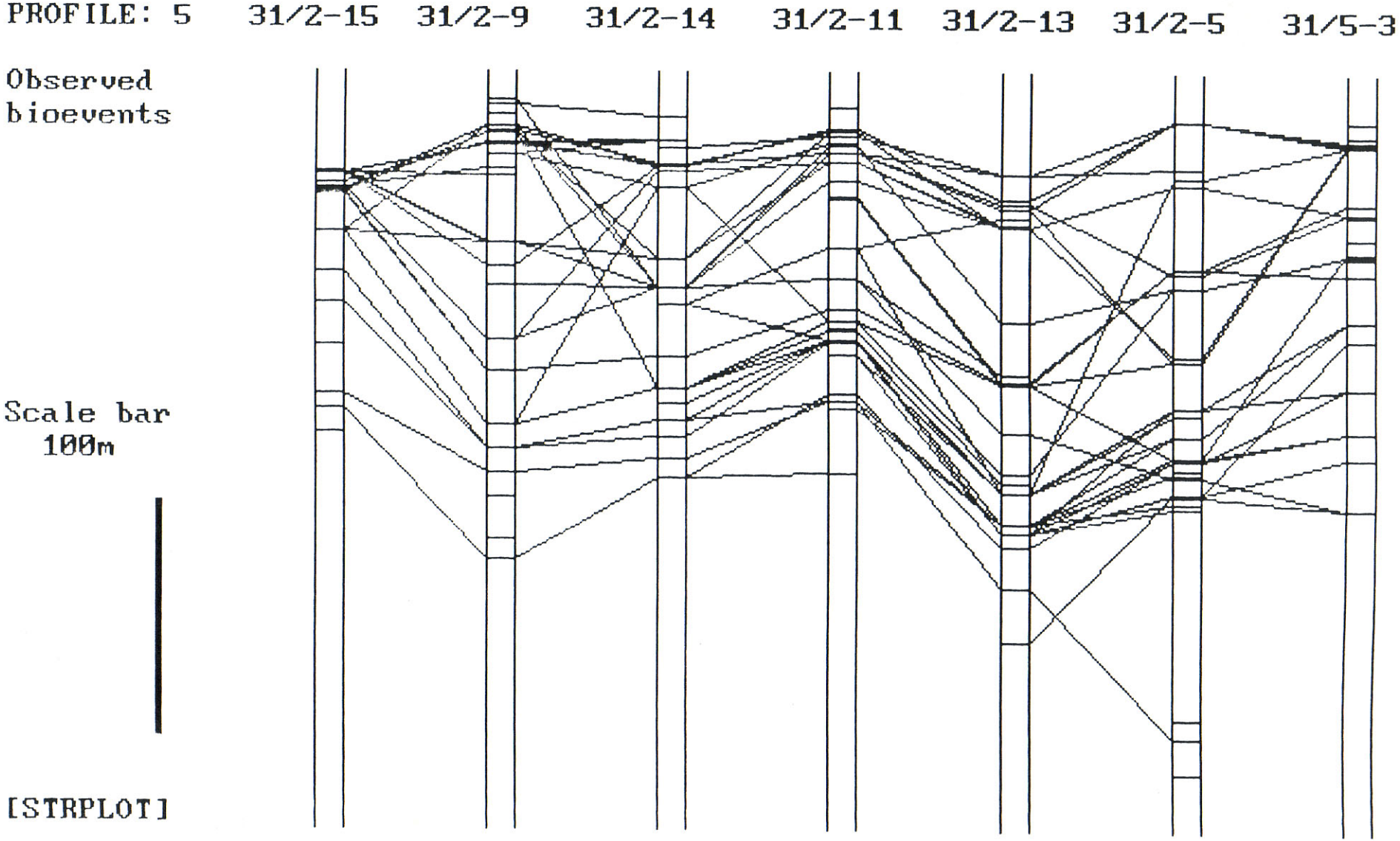
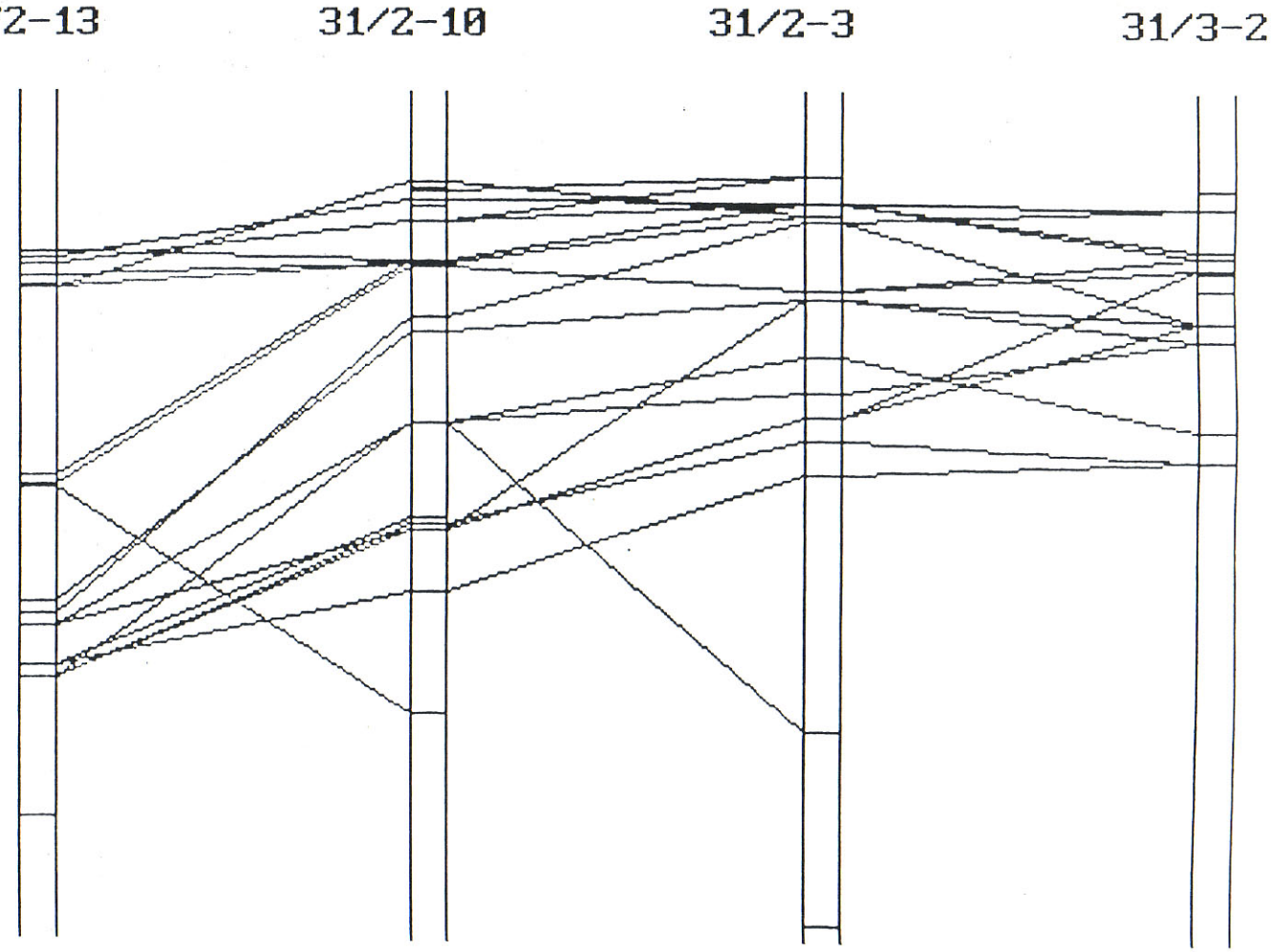

PROFILE: 5
31/2-15
31/2-9
31/2-14
31/2-11
31/2-13
31/2-5
31/5-3
Observed bioevents
Scale bar 100m
[STRPLOT]

PROFILE: 2

Observed
bioevents
(JGR)



Scale bar
100m

[STRPLOT]

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QUANTITATIVE METHODS

PC APPLICATIONS

- RASC (RANKING & SCALING)
  - statistical method
  - matrix transformations (ordering rows/columns) of cross-over frequencies for event pairs
  - scaling based on standardized normal distribution
  - scaled optimum sequence of events
  - 10 or more wells
  - short run time (RASC12 batch version)

- STRATCOR (STRATIGRAPHIC CORRELATION)
  - graphical interpolation method
  - composites well sections
  - final composite standard sequence
  - FCSS correlation in all wells
  - 2 or more wells
  - requires user input throughout (Version 1.6)

- BIOZONATIONS SHOWN AS DENDROGRAMS

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RASC

- INPUT DATA
  - event dictionary
  - event sequence file
  - depth not considered
- BIOEVENT DISTRIBUTION
  - cumulative frequency of events
  - event occurrence table
- SCALED OPTIMUM SEQUENCE (AVERAGE)
  - test JGR sequence (maximum)
  - average sequence = maximum sequence for robust, low variance bioevents
  - also true for widely spaced bioevents

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CUMULATIVE FREQUENCY DIDTRIBUTION OF JURASSIC BIOSTRATIGRAPHIC EVENTS IN THE TROLL FIELD AREA (MAINLY DINOCYSTS)

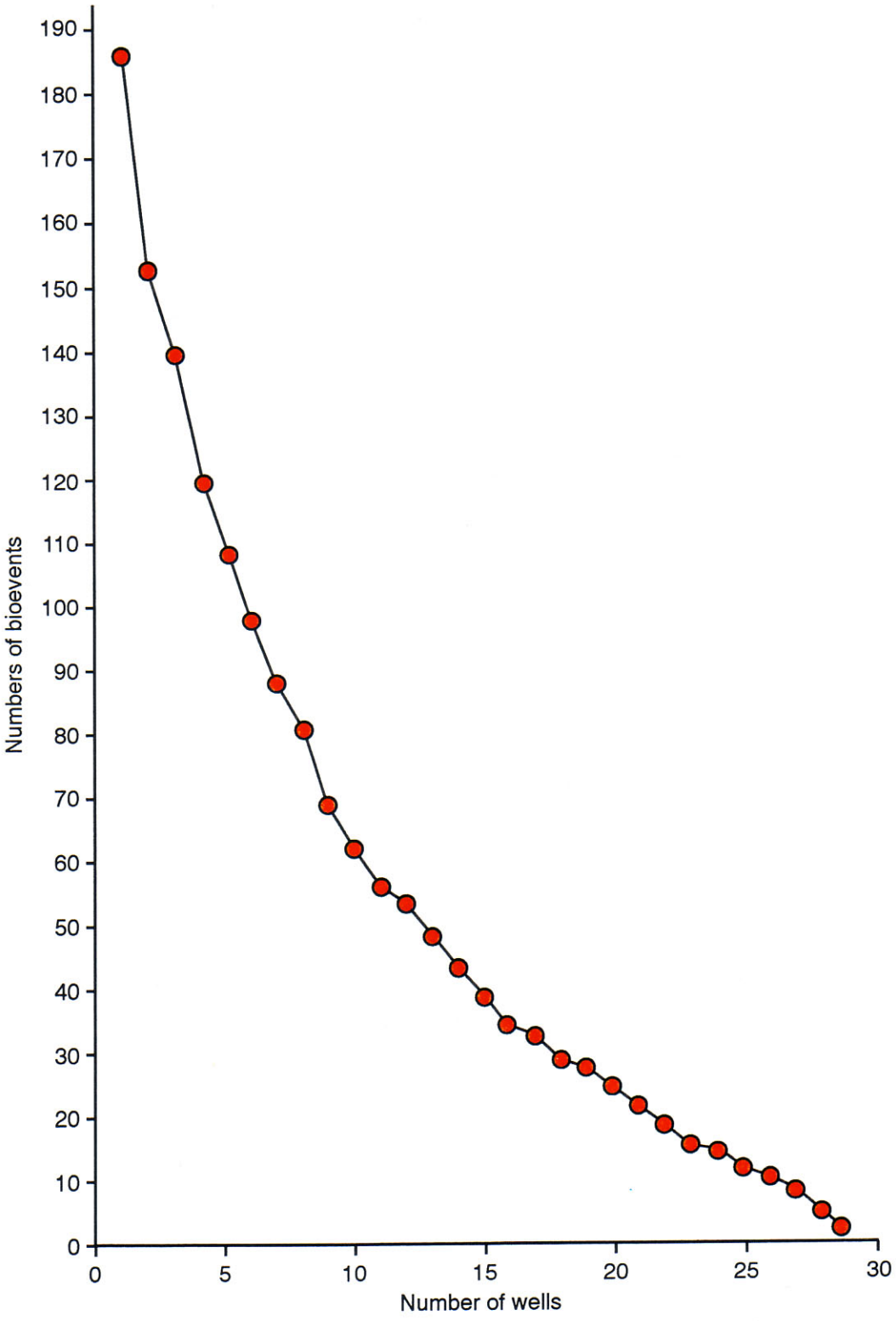
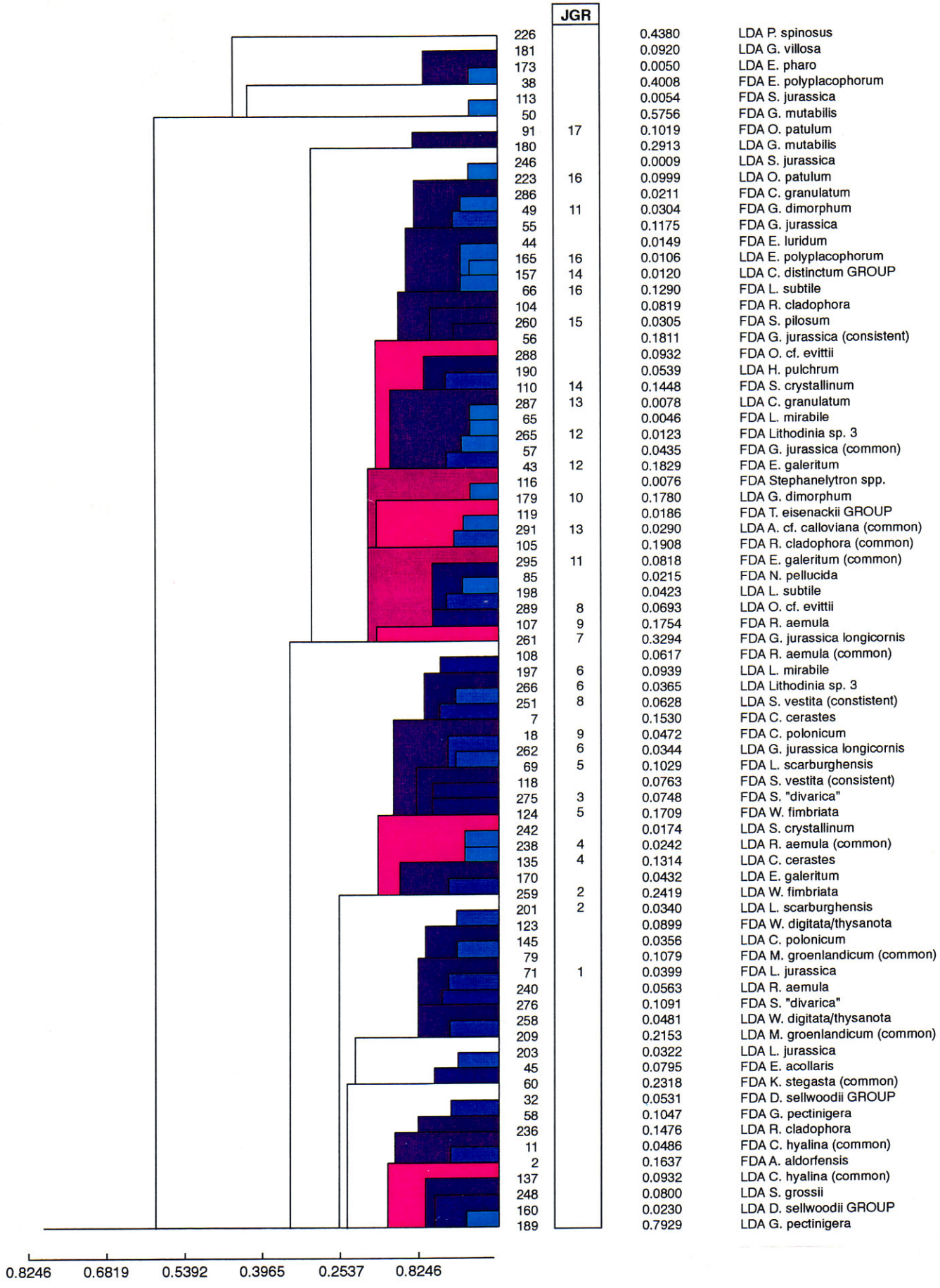
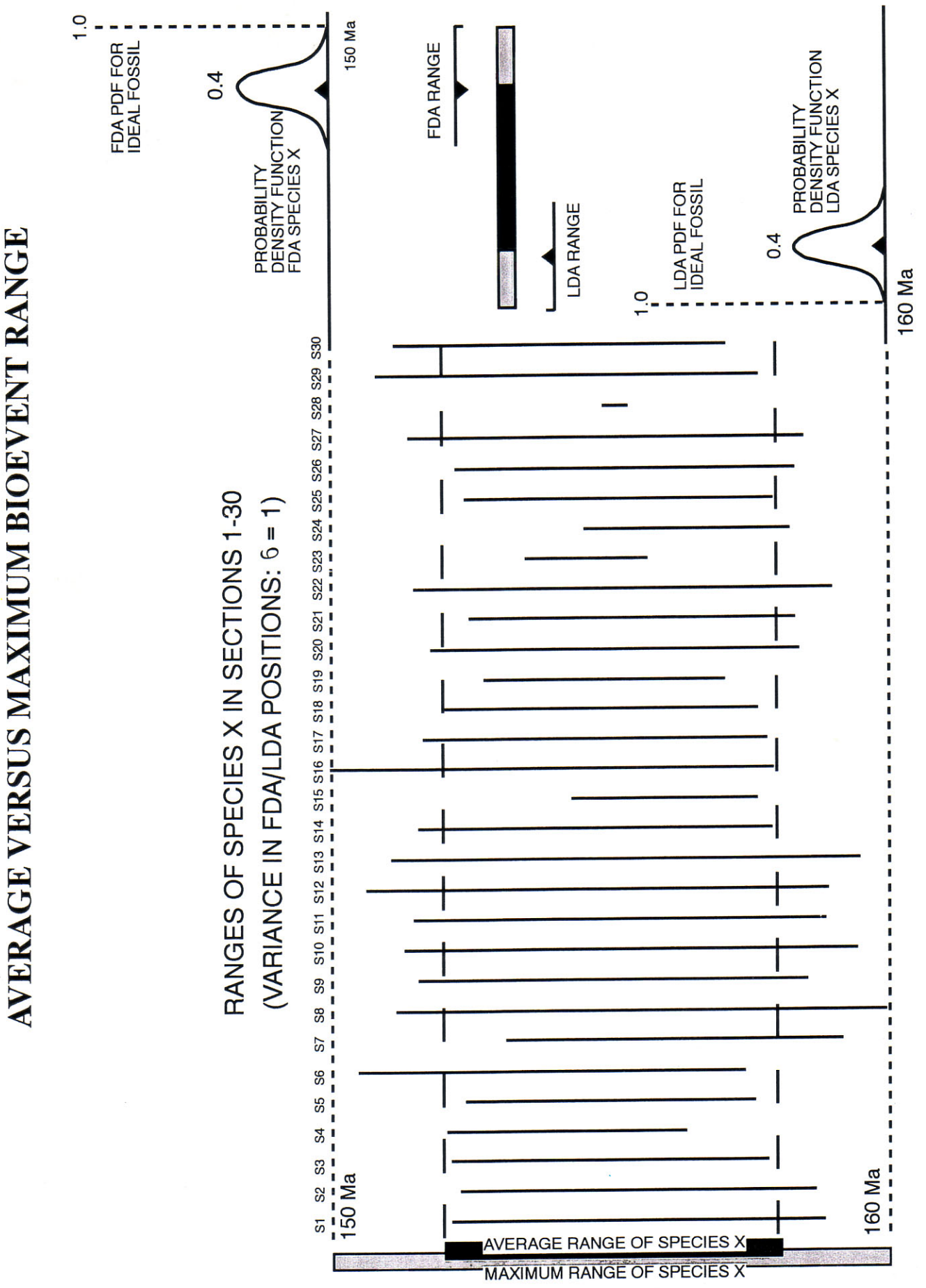


TABLE 4.1 EVENT OCCURRENCE MATRIX (RASC 8/1/4)

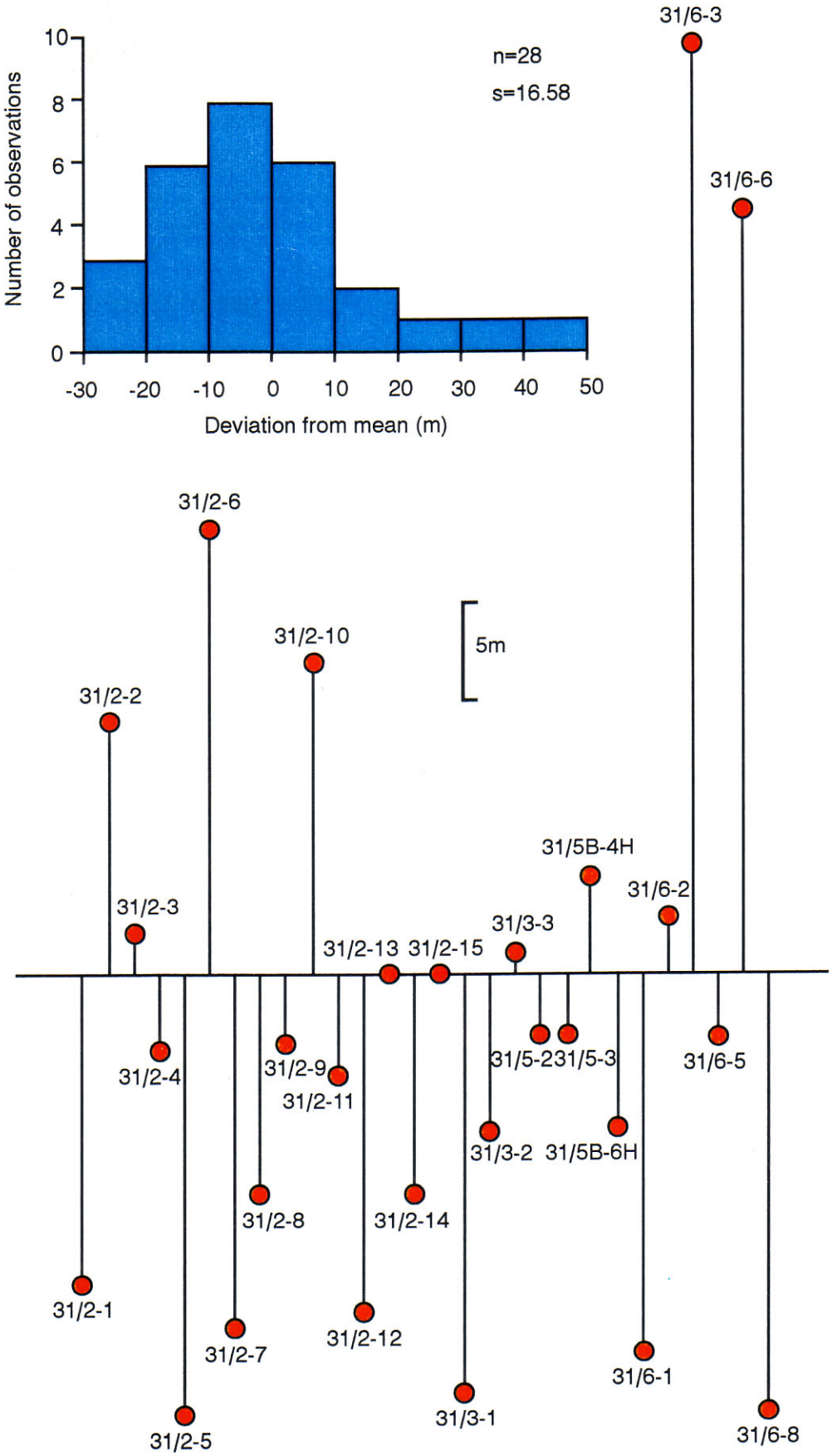
EVENT	DIC	WELL NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	JGR
LDA P. spinosus	226	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA G. villosa	181	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA E. pharo	173	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA E. polyplacophorum	38	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA S. jurassica	113	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA G. mutabilis	50	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA O. patulum	91	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA G. mutabilis	180	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	17
LDA S. jurassica	246	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA O. patulum	223	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA C. granulatum	286	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	16
FDA G. dimorphum	49	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA G. jurassica	55	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	11
FDA E. luridum	44	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA E. polyplacophorum	165	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA C. distinctum GROUP	157	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	16
FDA L. subtile	66	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	14
FDA R. cladophora	104	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	16
FDA S. pilosum	260	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA G. jurassica (consistent)	56	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	15
FDA O. cf. evittii	288	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA H. pulchrum	190	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA S. crystallinum	110	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	14
LDA C. granulatum	287	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	13
FDA L. mirabile	65	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA Lithodinia sp. 3	265	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	12
FDA G. jurassica (common)	57	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA E. galeritum	43	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	12
FDA Stephanelytron spp.	116	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA G. dimorphum	179	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	10
FDA T. eisenackii GROUP	119	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA A. cf. calloviana (common)	291	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	13
FDA R. cladophora (common)	105	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA E. galeritum (common)	295	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	11
FDA N. pellucida	85	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA L. subtile	198	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA O. cf. evittii	289	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	8
FDA R. aemula	107	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	9
FDA G. jurassica longicornis	261	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	7
FDA R. aemula (common)	108	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA L. mirabile	197	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	6
LDA Lithodinia sp. 3	266	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	6
LDA S. vestita (constistent)	251	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	8
FDA C. cerastes	7	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA C. polonicum	18	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	9
LDA G. jurassica longicornis	262	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	6
FDA L. scarburghensis	59	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	5
FDA S. vestita (consistent)	118	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA S. "divarica"	275	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	3
FDA W. fimbriata	124	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	5
LDA S. crystallinum	242	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA R. aemula (common)	238	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	4
LDA C. cerastes	135	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	4
LDA E. galeritum	170	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA W. fimbriata	259	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	2
LDA L. scarburghensis	201	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	2
FDA W. digitata/thysanota	123	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA C. polonicum	145	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA M. groenlandicum (common)	79	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA L. jurassica	71	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	1
LDA R. aemula	240	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA S. "divarica"	276	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA W. digitata/thysanota	258	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA M. groenlandicum (common)	209	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA L. jurassica	203	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA E. acollaris	45	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA K. stegasta (common)	60	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA D. sellwoodii GROUP	32	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA G. pectinigera	58	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA R. cladophora	236	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA C. hyalina (common)	11	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA A. aldorfensis	2	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA C. hyalina (common)	137	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA S. grossii	248	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA O. sellwoodii GROUP	160	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
LDA G. pectinigera	189	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA N. gracilis/senex GROUP	84	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA Chasmatosporites spp.	263	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA P. enigmatus/Q. aneliaeformis	264	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	
FDA M. semitabulatum	74	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	

DENDROGRAM OF WEIGHTED INTERFOSSIL DISTANCE (RASC 8/1/4)




AVERAGE VERSUS MAXIMUM BIOEVENT RANGE
RANGES OF SPECIES X IN SECTIONS 1-30
(VARIANCE IN FDA/LDA POSITIONS: 6 = 1)
1.0
FDA PDF FOR IDEAL FOSSIL
0.4
PROBABILITY DENSITY FUNCTION FDA SPECIES X
150 Ma
FDA RANGE
LDA RANGE
1.0
LDA PDF FOR IDEAL FOSSIL
0.4
PROBABILITY DENSITY FUNCTION LDA SPECIES X
160 Ma
S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19 S20 S21 S22 S23 S24 S25 S26 S27 S28 S29 S30
150 Ma
160 Ma
AVERAGE RANGE OF SPECIES X
MAXIMUM RANGE OF SPECIES X

DEVIATIONS OF OBSERVED EVENT POSITIONS FROM MEAN POSITION FOR FDA S. CRYSTALLINUM



STRATCOR

- **INPUT DATA**
  - event dictionary
  - event sequence file
  - event depth file

- **BIOZONATION (FCSS)**
  - average bioevent positions
  - 15 event clusters (biozones)
  - potential for subdivision
  - tie to sequences

- **CORRELATION**
  - 3000 interpolated event positions (over 2 x observed records)
  - c. 120 events per well
  - high resolution framework

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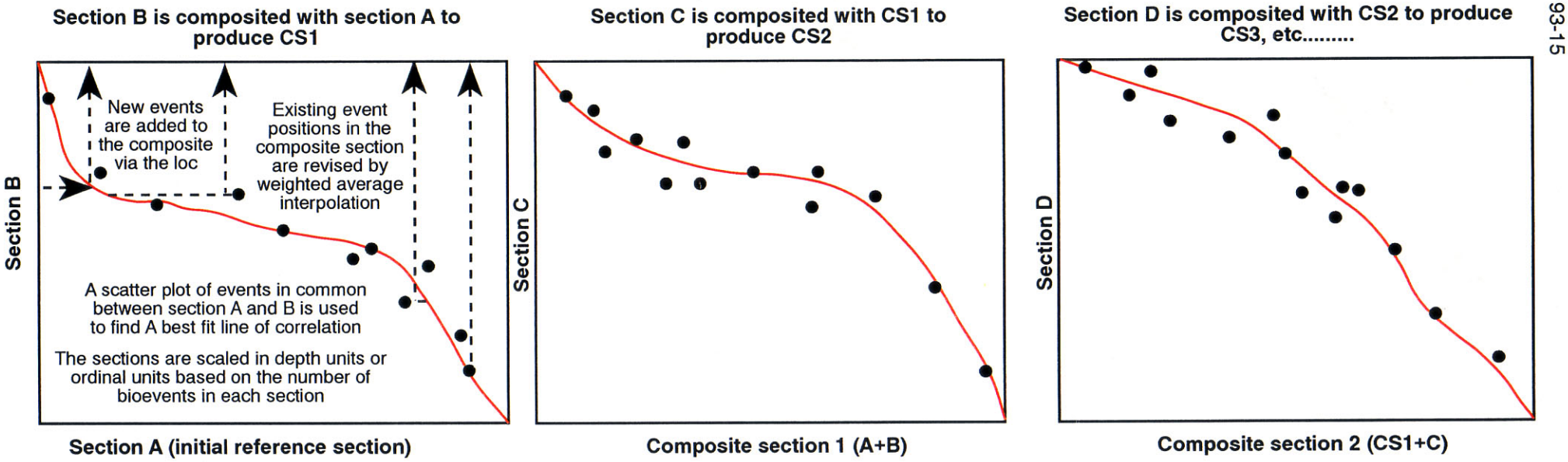
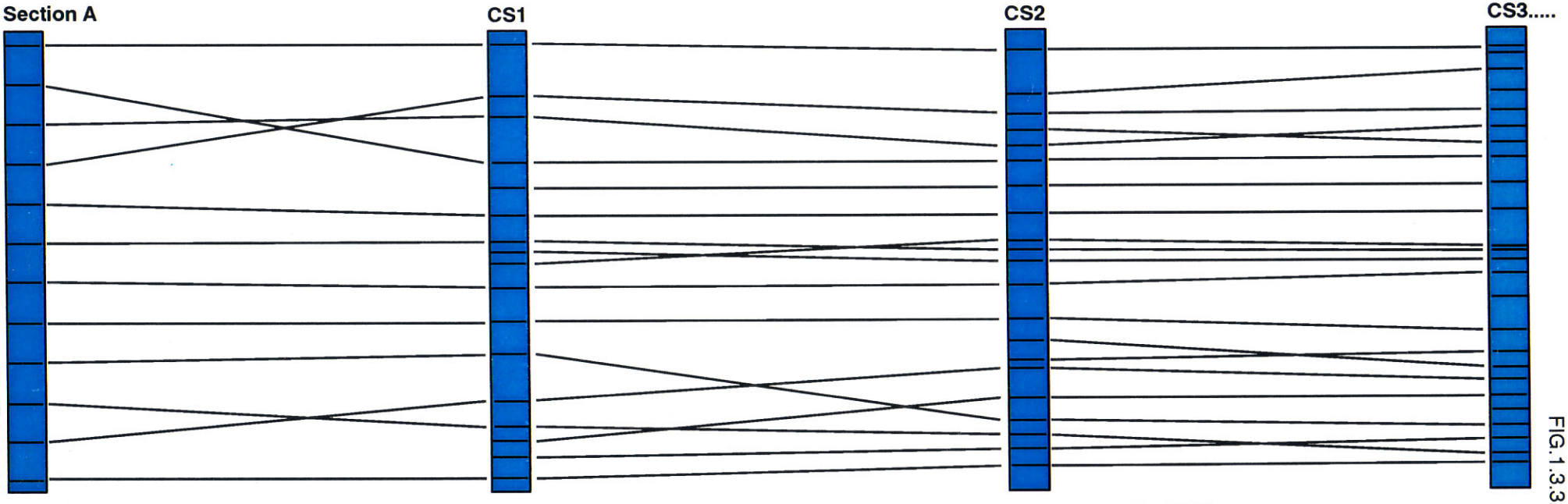
PROBABILISTIC BIOZONATION (STRATCOR)

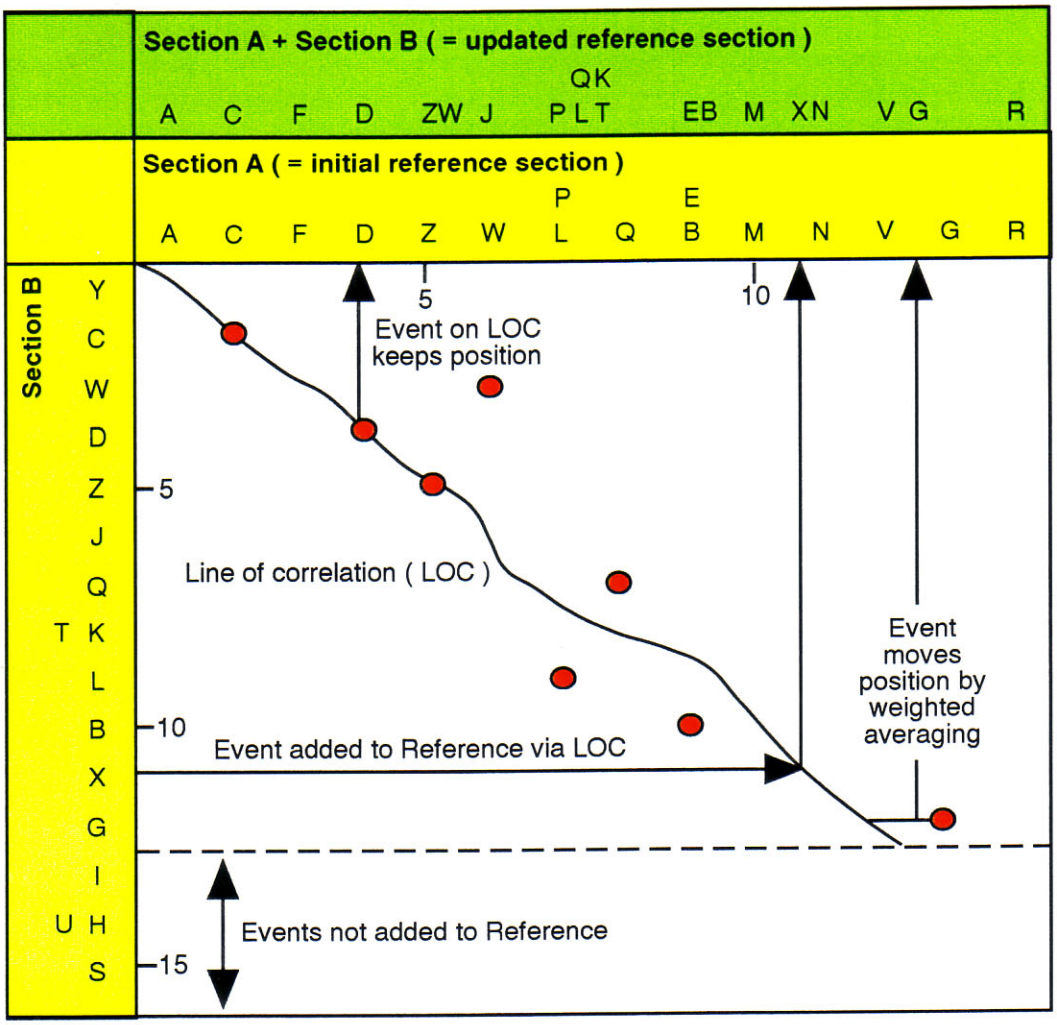




A STABLE SEQUENCE OF BIOEVENTS EMERGES AFTER ALL SECTIONS HAVE BEEN COMPOSITED

FIG. 1.3.3.3

INTERPOLATION METHOD IN GRAPHIC CORRELATION (STRATCOR)

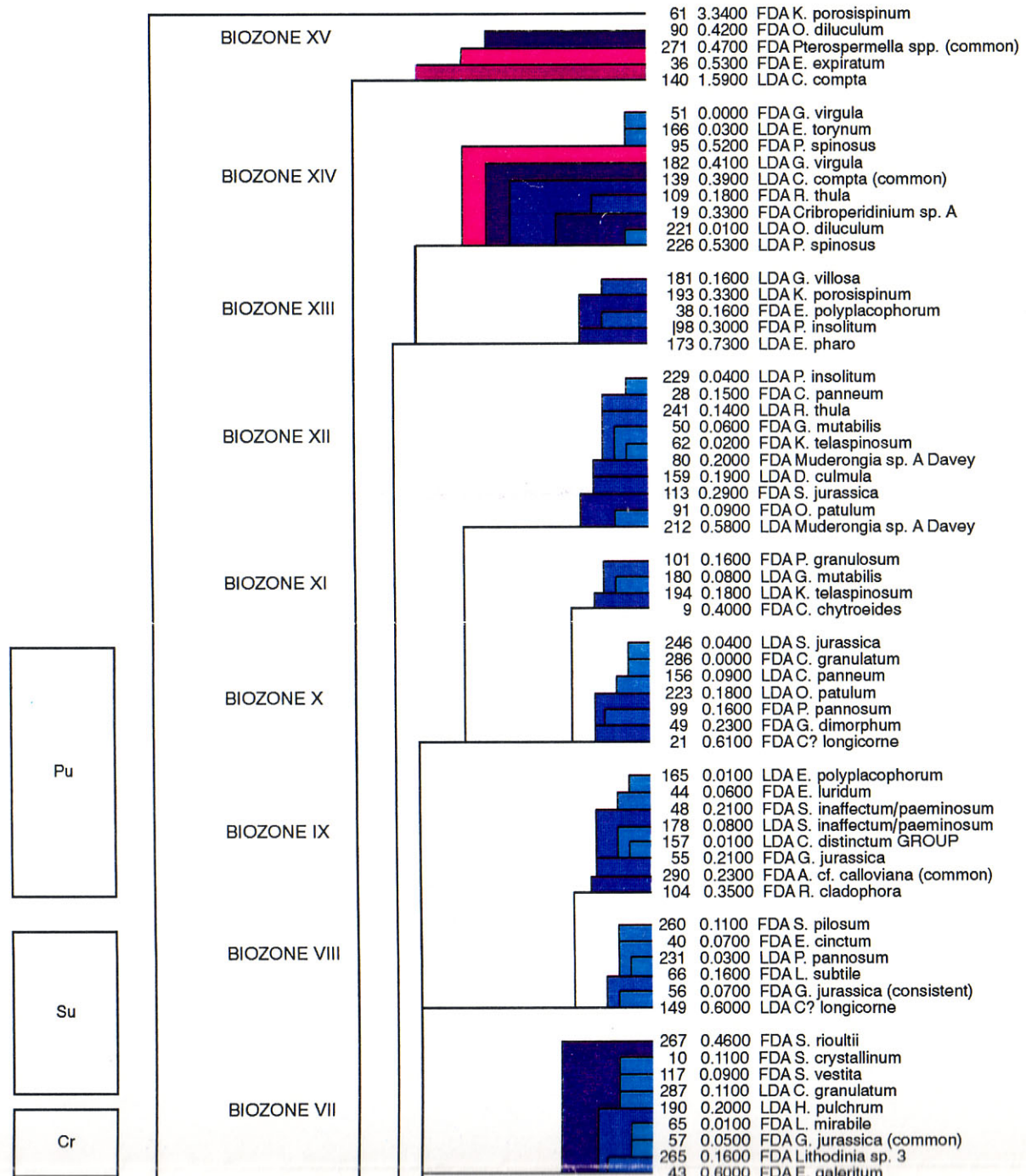


Initial Reference Section

Event	Position
A	1.00
C	2.00
F	3.00
D	4.00
Z	5.00
W	6.00
L	7.00
P	7.00
Q	8.00
B	9.00
E	9.00
M	10.00
N	11.00
V	12.00
G	13.00
R	14.00

Updated Reference Section

Event	Position
A	1.00
C	2.00
F	3.00
D	4.00
Z	5.00
W	5.50
J	5.75
P	7.00
L	7.50
Q	7.50
T	7.75
K	7.75
E	9.00
B	9.25
M	10.00
X	10.75
N	11.00
V	12.00
G	12.75
R	14.00


BIOZONE XV
61 3.3400 FDA K. porosispinum
90 0.4200 FDA O. diluculum
271 0.4700 FDA Pterospermella spp. (common)
36 0.5300 FDA E. expiratum
140 1.5900 LDA C. compta
BIOZONE XIV
51 0.0000 FDA G. virgula
166 0.0300 LDA E. torynum
95 0.5200 FDA P. spinosus
182 0.4100 LDA G. virgula
139 0.3900 LDA C. compta (common)
109 0.1800 FDA R. thula
19 0.3300 FDA Cribroperidinium sp. A
221 0.0100 LDA O. diluculum
226 0.5300 LDA P. spinosus
BIOZONE XIII
181 0.1600 LDA G. villosa
193 0.3300 LDA K. porosispinum
38 0.1600 FDA E. polyplacophorum
198 0.3000 FDA P. insolitum
173 0.7300 LDA E. pharo
BIOZONE XII
229 0.0400 LDA P. insolitum
28 0.1500 FDA C. panneum
241 0.1400 LDA R. thula
50 0.0600 FDA G. mutabilis
62 0.0200 FDA K. telaspinosum
80 0.2000 FDA Muderongia sp. A Davey
159 0.1900 LDA D. culmula
113 0.2900 FDA S. jurassica
91 0.0900 FDA O. patulum
212 0.5800 LDA Muderongia sp. A Davey
BIOZONE XI
101 0.1600 FDA P. granulosum
180 0.0800 LDA G. mutabilis
194 0.1800 LDA K. telaspinosum
9 0.4000 FDA C. chytroeides
BIOZONE X
246 0.0400 LDA S. jurassica
286 0.0000 FDA C. granulatum
156 0.0900 LDA C. panneum
223 0.1800 LDA O. patulum
99 0.1600 FDA P. pannosum
49 0.2300 FDA G. dimorphum
21 0.6100 FDA C? longicorne
BIOZONE IX
165 0.0100 LDA E. polyplacophorum
44 0.0600 FDA E. luridum
48 0.2100 FDA S. inaffectum/paeminosum
178 0.0800 LDA S. inaffectum/paeminosum
157 0.0100 LDA C. distinctum GROUP
55 0.2100 FDA G. jurassica
290 0.2300 FDA A. cf. calloviana (common)
104 0.3500 FDA R. cladophora
BIOZONE VIII
260 0.1100 FDA S. pilosum
40 0.0700 FDA E. cinctum
231 0.0300 LDA P. pannosum
66 0.1600 FDA L. subtile
56 0.0700 FDA G. jurassica (consistent)
149 0.6000 LDA C? longicorne
BIOZONE VII
267 0.4600 FDA S. rioultii
10 0.1100 FDA S. crystallinum
117 0.0900 FDA S. vestita
287 0.1100 LDA C. granulatum
190 0.2000 LDA H. pulchrum
65 0.0100 FDA L. mirabile
57 0.0500 FDA G. jurassica (common)
265 0.1600 FDA Lithodinia sp. 3
43 0.6000 FDA E. galeritum
Pu
Su
Cr

DENDROGRAM OF STRATCOR FCSS
DIC DIST BIOEVENT (FCSS)

NSEP 93-15

FIG. 1.4.2.1

Cr
GaH
GaD
AeE
AeL
SeC
SeD
Lj

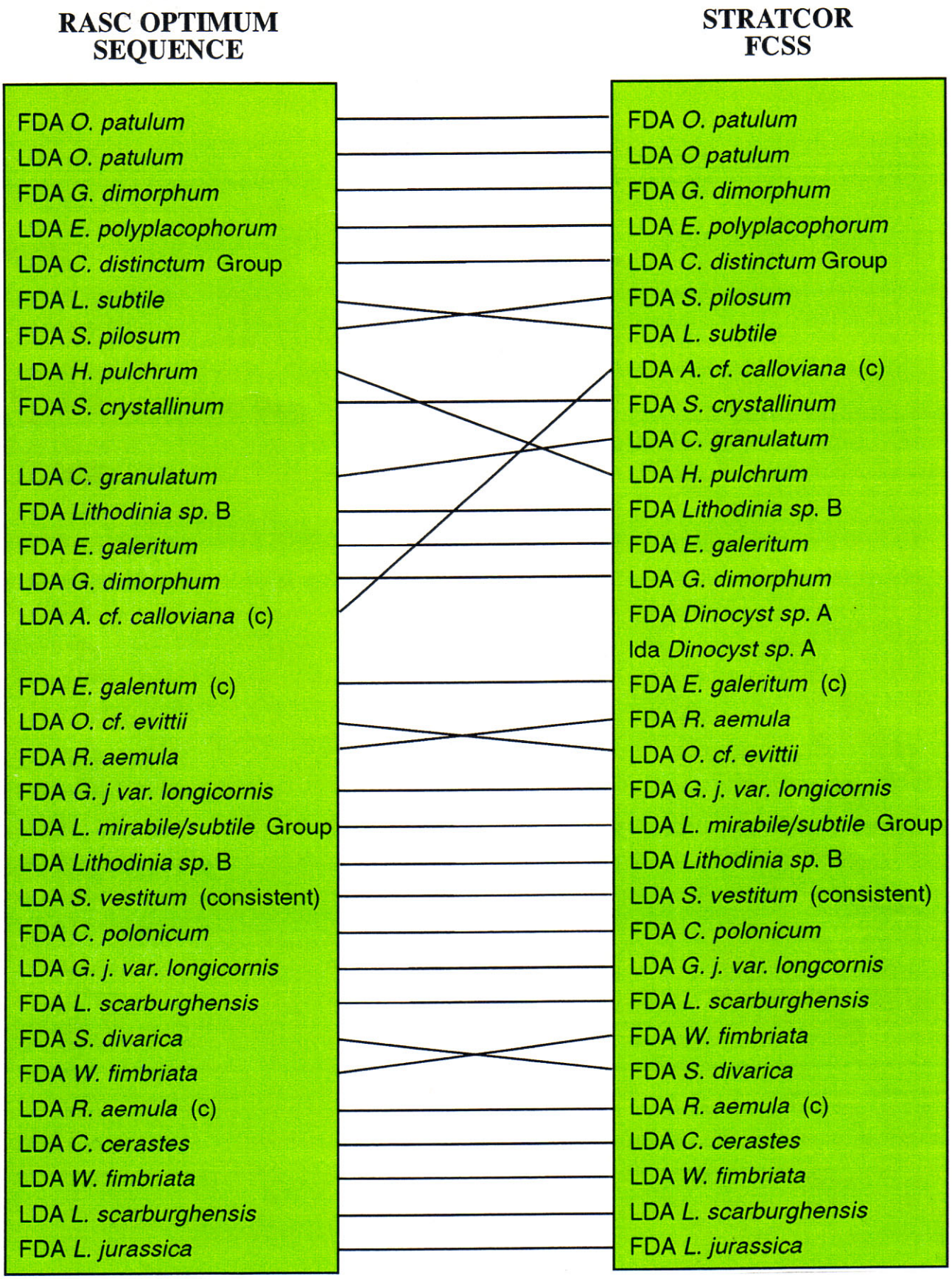
BIOZONE VI
BIOZONE V
BIOZONE IV
BIOZONE III
BIOZONE II
BIOZONE I (PARS)

65 0.0100 FDA L. mirabile
57 0.0500 FDA G. jurassica (common)
265 0.1600 FDA Lithodinia sp. 3
43 0.6000 FDA E. galeritum
292 0.2300 FDA L. subtile (consistent)
179 0.0900 LDA G. dimorphum
288 0.2600 FDA O. cf. evittii
105 0.0500 FDA R. cladophora (common)
119 0.0800 FDA T. eisenackii GROUP
116 0.1500 FDA Stephanelytron spp.
293 0.4400 FDA Dinocyst sp. A
294 0.0600 LDA Dinocyst sp. A
291 0.1900 LDA A. cf. calloviana (common)
295 0.9600 FDA E. galeritum (common)
85 0.0100 FDA N. pellucida
98 0.1300 LDA L. subtile
107 0.0100 FDA R. aemula
289 0.5800 LDA O. cf. evittii
261 1.0200 FDA G. jurassica longicornis
197 0.0300 LDA L. mirabile
108 0.0800 FDA R. aemula (common)
266 0.6600 LDA Lithodinia sp.
251 0.0500 LDA S. vestita (constistent)
7 0.0100 FDA C. cerastes
186 0.1900 LDA G. jurassica (common)
118 0.0300 FDA S. vestita (consistent)
47 0.7300 FDA F. tornatilis
18 0.0400 FDA C. polonicum
262 0.2700 LDA G. jurassica longicornis
69 0.6500 FDA L. scarburghensis
42 0.0400 FDA E. sarjeantii
124 0.0800 FDA W. fimbriata
10 0.1200 FDA C. hyalina
242 0.2700 LDA S. crystallinum
238 0.0000 LDA R. aemula (common)
8 0.2300 FDA C. cerastes (common)
135 0.4000 LDA C. cerastes
170 0.2300 LDA E. galeritum
259 0.6100 LDA W. fimbriata
201 0.3100 LDA L. scarburghensis
252 0.0200 LDA S. vestita
123 0.4200 FDA W. digitata/thysanota
240 0.0500 LDA R. aemula
79 0.2800 FDA M. groenlandicum (common)
71 0.1200 FDA L. jurassica
145 0.0700 LDA C. polonicum
232 0.0400 LDA P. granulosum
276 0.4600 LDA S. "divarica"
258 0.0800 LDA W. digitata/thysanota
277 0.1700 FDA N. gristhorpensis
209 0.7300 LDA M. groenlandicum (common)
203 0.6700 LDA L. jurassica
86 0.1500 FDA N. pellucida (common)
45 0.2700 FDA E. acollaris
60 0.3600 FDA K. stegasta (common)
236 0.1300 LDA R. cladophora
32 0.1300 FDA D. sellwoodii GROUP
75 0.0500 FDA M. caytonensis GROUP
33 0.2100 FDA D. sellwoodii GROUP (common)
191 0.2200 LDA K. stegasta (common)
58 0.4800 FDA G. pectinigera
187 0.0100 LDA G. jurassica (consistent)
177 0.0300 LDA F. tornatilis
206 0.1000 LDA M. caytonensis GROUP
2 0.0600 FDA A. aldorfensis
11 0.7200 FDA C. hyalina (common)
216 1.2000 LDA N. pellucida (common)
35 0.0800 FDA D. aspera/daveyi GROUP
248 0.0100 LDA S. grossii
94 0.0200 FDA P. prolongata (common)
87 0.1500 FDA N. spiculata

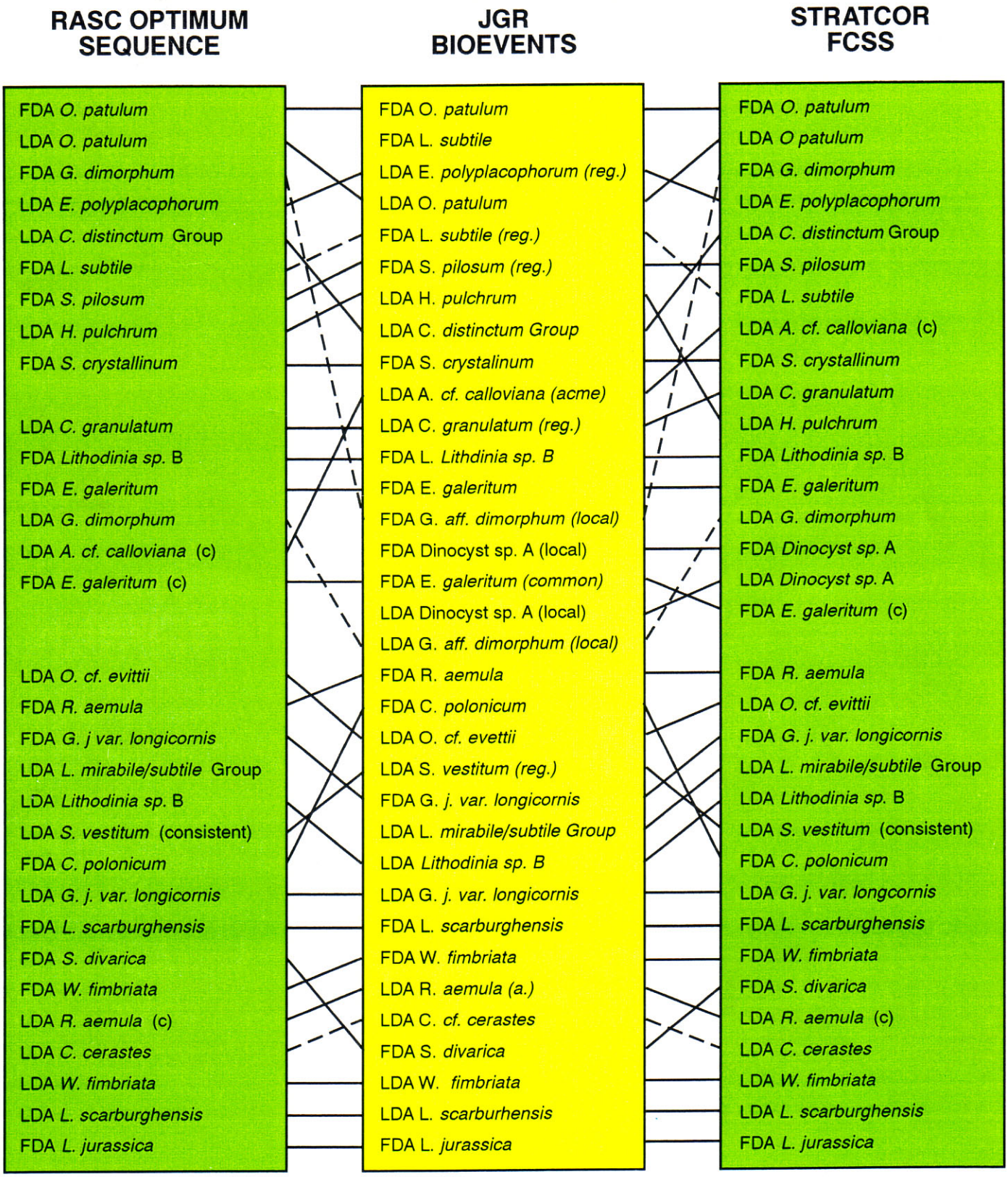
3.4354 2.8470 2.2585 1.6700 1.0815 0.4930

FIG. 1.4.2.3

BIOEVENT SEQUENCE COMPARISON
RASC - STRATCOR



BIOEVENT SEQUENCE COMPARISON
RASC-JGR-STRACTOR

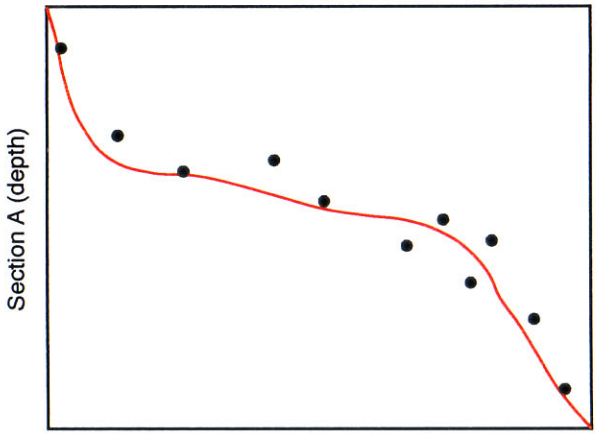


AGE CALIBRATION OF STRATCOR FCSS

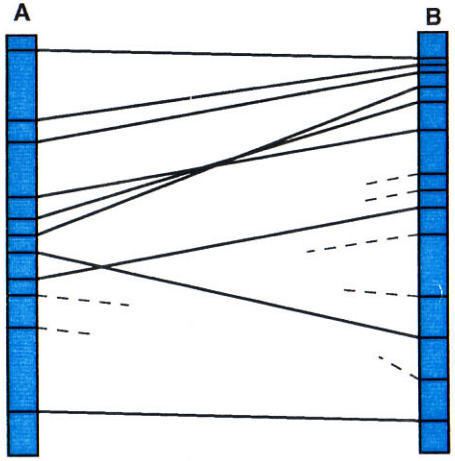
MA (Haq *et al.*, 1987)	AGE	TROLL AREA ZONES AND SUBZONES (JGR)	Estimated boundary age (Ma)	Nearest FCSS bioevent	DIC	FCSS position	FCSS Age (Ma±2σ)
	EARLY VOLGIAN	*Oligosphaeridium pulcherrimum* s.l. (Pu)					
140	KIMMERIDGIAN (*sensu gallico*)		141	FDA *R. cladophora*	104	17.50	140.73 ± 6.2
		Leptodinium subtile (Su)		FDA *S. pilosum*	260	17.85	141.32 ± 7.2
			144	LDA *C.* granulatum	287	19.55	144.00 ± 10.8
		Scriniodinium crystallinum (CR)		FDA *E. galeritum*	43	20.08	144.74 ± 5.8
145	LATE OXFORDIAN		145	FDA *L. subtile* (consistent)	292	20.68	145.51 ± 16.0
		Endoscrinium galeritum (Ga): *Lithodinia ´haanii´* (GaH)		FDA *O.* cf. *evittii*	288	21.00	145.89 ± 3.8
			146	FDA *R. cladophora* (C)	105	21.26	146.19 ± 4.0
		Endoscrinium galeritum (Ga): *Glossodin.aff. dimorphum* (GaD)		LDA Dinocyst sp. A	294	21.98	146.98 ± 2.0
			147	LDA *A.* cf. *calloviana*	291	22.04	147.05 ± 9.2
		Adnatosphaeridium aemulum (Ae): *Occisucysta* cf. *evittii* (AeE)		FDA *E. galeritum* (C)	295	22.23	147.25 ± 5.4
	MIDDLE OXF		148	FDA *N. pellucida*	85	23.19	148.24 ± 5.4
		Adnatosphaeridium aemulum (Ae): *G.jurassica* var. *longicornis* (AeL)		LDA *Lithodinia* sp. 3	266	25.05	149.83 ± 3.4
			150	LDA *S. vestitia* (consistent)	251	25.71	150.28 ± 8.6
	LOWER OXF	*Acanthaulax senta* (Se): *Chytroeisphaer. cerastes* (SeC)		LDA *G. jur. longicornis*	262	26.76	150.96 ± 2.4
			151	FDA *L. scarburghensis*	69	27.03	151.16 ± 2.0
		Acanthaulax senta (Se): *Systematophora divarica* (SeD)		FDA *W. fimbriata*	124	27.88	151.84 ± 2.4
152			152	LDA *S. crystallinum*	242	28.08	152.01 ± 6.4
	CALLOVIAN	*Lithodinia jurassica* (Ju)					

FCSS CORRELATION (STRATCOR)

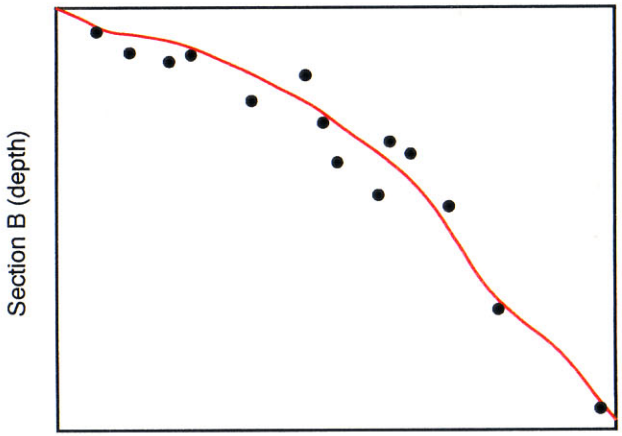
A scatter plot of events in common between the FCSS and section A is used to find A best line of correlation



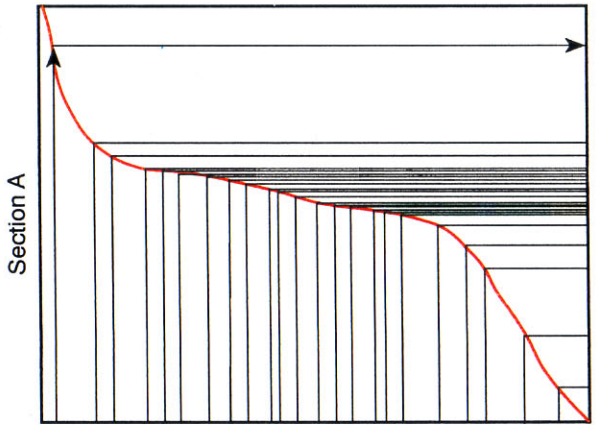
Tieing of observed bioevents often leads to ambiguites in correlations



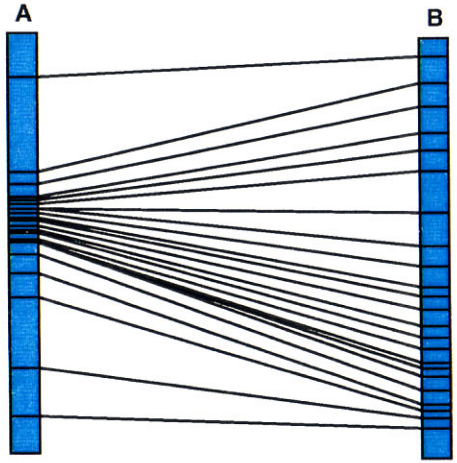
A scatter plot of events in common between the FCSS and section B is used to find A best line of correlation



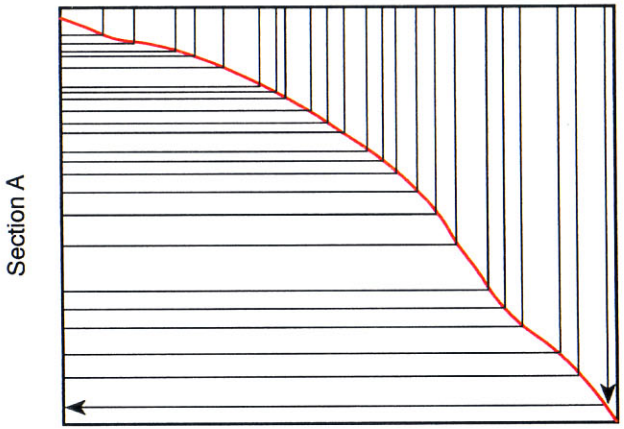
Final composite standard sequence (FCSS units or age in Ma)

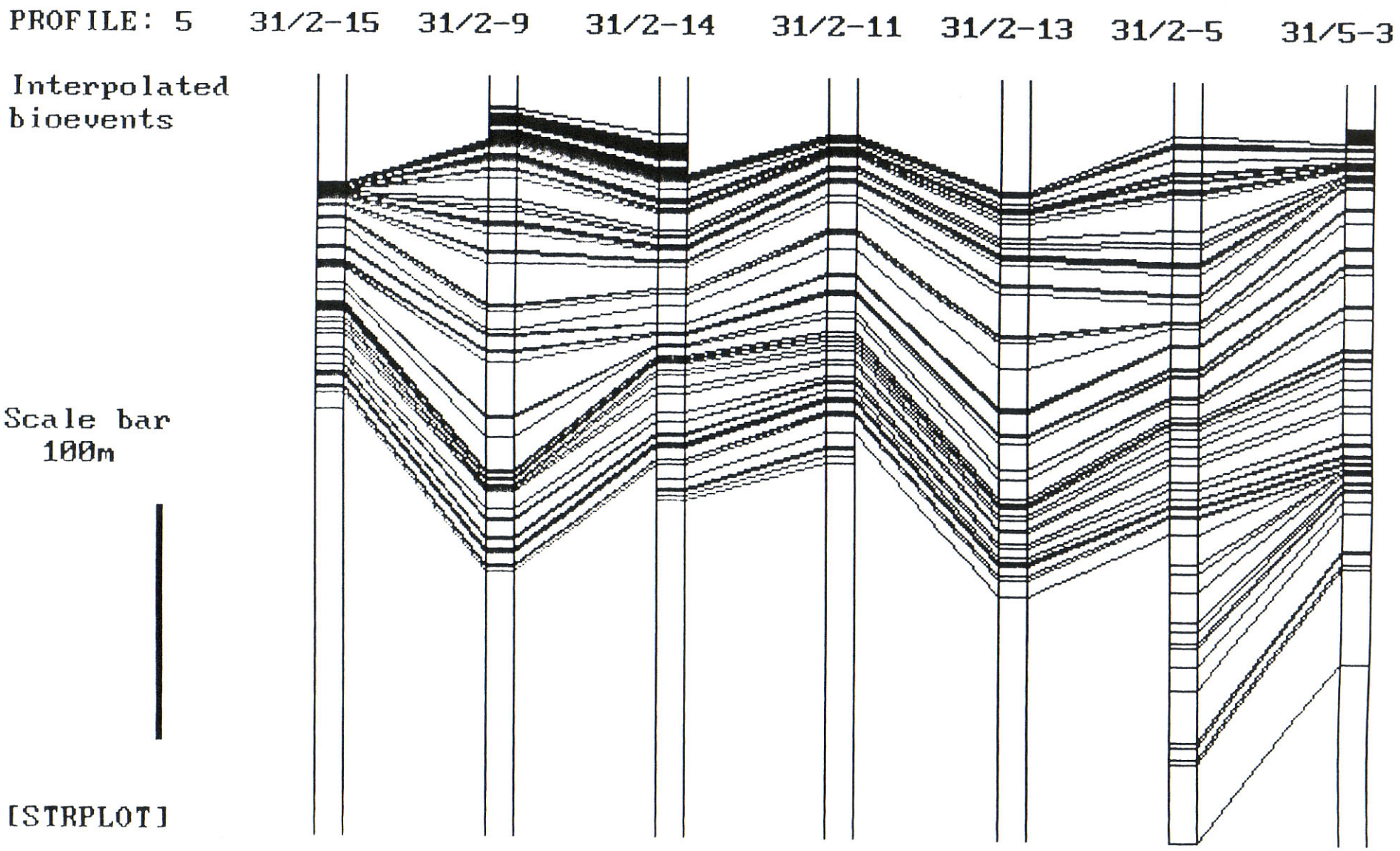


High-resolution correlation is achived by interpolating the FCSS biovent sequence via the line of correlation for each section



Final composite standard sequence (FCSS units or age in Ma)



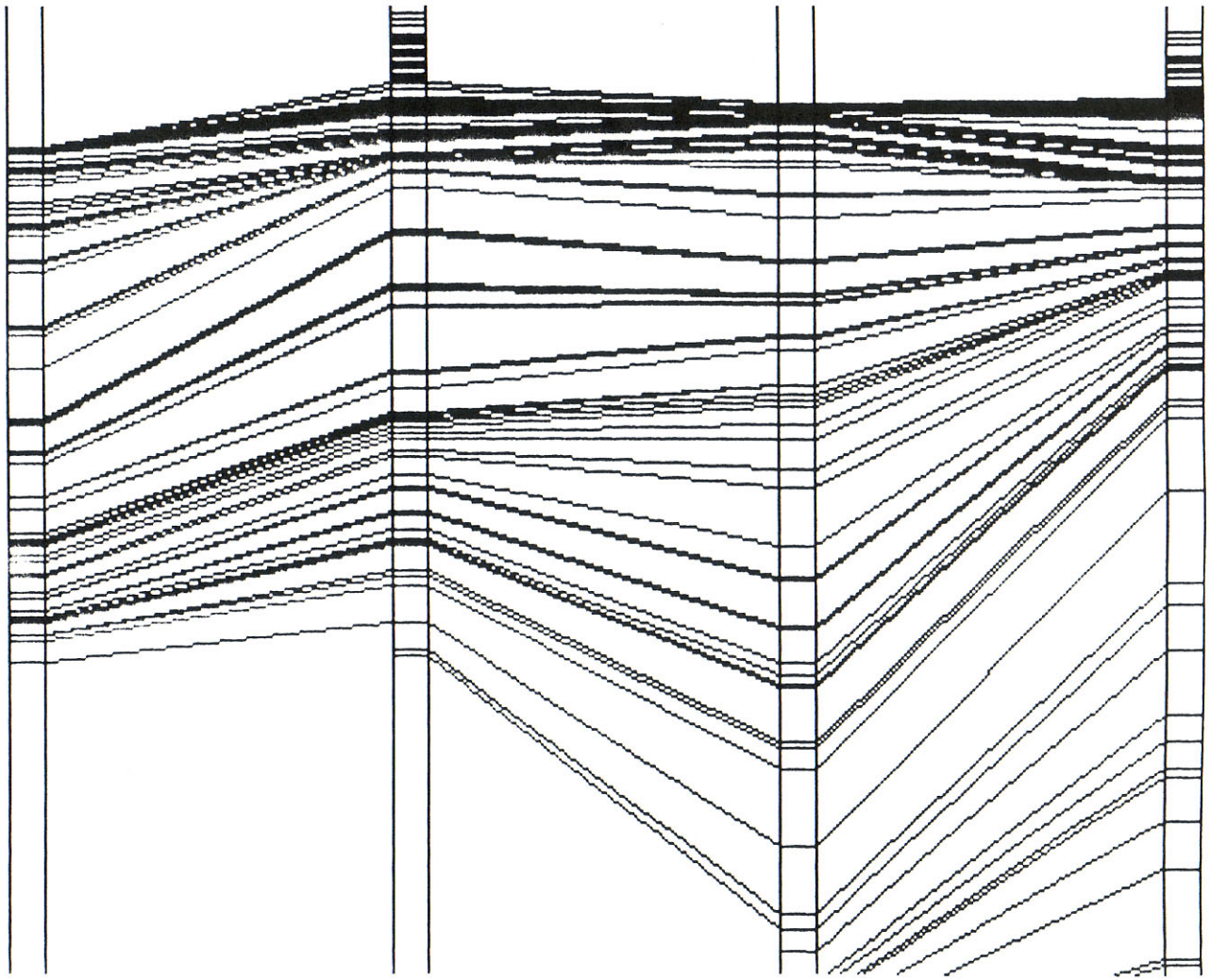

PROFILE: 5
31/2-15
31/2-9
31/2-14
31/2-11
31/2-13
31/2-5
31/5-3
Interpolated bioevents
Scale bar
100m
[STRPLOT]

PROFILE: 2

31/2-13 31/2-10 31/2-3 31/3-2

Interpolated
bioevents

Scale bar
100m



[STRPLOT]