

## APPENDIX



APPENDIX 1

**LIST OF STUDY WELLS**

**Grey boxes:** maximum S10 interval (VJ/VI dinocyst subzones).

**Bold letters:** SD subdivisions; SD5 horizon has been reassigned to SE horizon (McAfee 1993)

**Bold italics:** cored intervals

All thickness given in feet TST (True Stratigraphic Thickness).

|            | 14/19-20      | 14/19-21             | 14/19-E1             | 14/19-E2             | 14/19-E3            | 14/19-E4             | 14/19-E5Y           | 14/19-E7            |
|------------|---------------|----------------------|----------------------|----------------------|---------------------|----------------------|---------------------|---------------------|
|            | TST<br>(feet) | TST<br>(feet)        | TST<br>(feet)        | TST<br>(feet)        | TST<br>(feet)       | TST<br>(feet)        | TST<br>(feet)       | TST<br>(feet)       |
| SF2        | -             | 143,26               | -                    | -                    | -                   | 59,35                | -                   | -                   |
| SF1        | -             | 30,70                | -                    | -                    | -                   | 57,37                | -                   | -                   |
| SE         | 96            | 63,80                | 19,44                | 81,39                | 8,61                | 31,21                | 24,54               | 72,21               |
| SD5        | 28            | -                    | 15,47                | 35,51                | 21,17               | 30,22                | 33,52               | 14,52               |
| <b>SD4</b> | <b>78</b>     | <b><i>105,80</i></b> | <b><i>104,76</i></b> | <b><i>107,32</i></b> | <b><i>35,53</i></b> | <b><i>112,21</i></b> | <b><i>77,41</i></b> | <b><i>71,28</i></b> |
| <b>SD3</b> | <b>35</b>     | -                    | <b><i>49,21</i></b>  | <b><i>52,47</i></b>  | <b><i>51,68</i></b> | -                    | <b><i>62,44</i></b> | <b><i>49,87</i></b> |
| <b>SD2</b> | <b>16</b>     | -                    | <b><i>47,22</i></b>  | <b><i>48,47</i></b>  | -                   | -                    | <b><i>47,01</i></b> | <b><i>20,1</i></b>  |
| <b>SD1</b> | -             | <b><i>56,45</i></b>  | -                    | -                    | -                   | <b><i>100,36</i></b> | -                   | -                   |
| S10        | 176           | 47.5                 | 175-193              | no record            | 113                 | 131                  | 246                 | no record           |
| SC4        | 72            | -                    | -                    | -                    | -                   | -                    | -                   | 79,21               |
| SC3        | 54            | -                    | 53,08                | 41,49                | 110,9               | -                    | 47,01               | 30,52               |
| SC2        | 44            | -                    | 58,71                | 55,46                | 62,45               | 30,23                | 76,65               | 61,42               |
| SC1        | 100           | -                    | 45,9                 | -                    | 42,71               | 82,58                | -                   | 91,38               |
| SA2        | 144           | -                    | 84,87                | -                    | 320,74              | -                    | -                   | 185,35              |
| SA1        | -             | -                    | -                    | -                    | 112,54              | -                    | -                   | -                   |
| LV/CG      | not calc.     | not calc.            | not calc.            | not calc.            | not calc.           | not calc.            | not calc.           | not calc.           |



## APPENDIX 2

### ELECTROSEQUENCE ANALYSIS and LITHOFACIES

Table of differentiated trend lines for S10 interval of study wells. Sequences are listed from base to top, thicknesses given in feet log depth.

#### Well 14/19-20

- 1 - 12 ft: GR: 70-40 (2x); CL: little WO; SL: 80-60; RL:- ; DL: 2.45; NL: 0.15-0.25:** 2 smaller 6-9 ft thick shaling-down (c-up?; SH/SM-srS; SH/SM-srS)
- 2 - 18 ft: GR: 45-100-40; CL: WO; SL: 80; RL:-; DL: 2.35; NL: 0.3, some negative separation: srS-SM-SH-SM-srS**
- 3 - 15 ft: GR: 30; CL:- ; SL: 70-60; RT: 60; DL: 2.2 - 2.55; NL: 0.1:** SM-S/GS? (c-up).
- 4 - 23 ft: GR: 35; CL: -; SL: 80-60; RT: 90; DL: 2.35; NL: 0.13:** crude 5-8 feet c-ups (GS-SM, vcs S-BI)
- 5 - 36 ft: GR: 35; CL: -; SL: erratic 80; RT: 100; DL: 2.4; NL: 0.15:** mostly smaller subtle c-ups (vcs/gr S-GS, cs-ms S- rare GS)
- 6 - 30 ft: GR: 20-30; CL: -; SL: 70-90; RT: 100; DL: 2.35; NL: 0.15:** slight shale-up (S-SM facies)
- 7 - 6 ft: GR: 60; CL: WO; SL: 100; RT: 30; DL: 2.0-3.0; NL: 0.5-0.05: negative separation:** very shale-rich SM/Sh facies
- 8 - 14 ft: GR: 20-40; CL: -; SL: 60-80; RT: 200-50; DL: 2.2-25; NL: 0.15:** shale-up (SrS/SM-SM)
- 9 - 28 ft: GR: 20-80; CL: WO; SL: 80-100; RL: 80-10; DL: 2.4; NL: 0.15-0.45; occ. negative separation:** initial shale-down, then shale-up to very shale-rich SM/sH facies.
- 10 - 17 ft: GR: 80-50; CL: WO!; SL: 100; RL: -; DL: 2.4; NL: erratic up to 0.45, occ. negative separation:** shale-down: SH/SM-S?, top little shale-up

#### Well 14/19-21

- 1 - 13 ft: GR: 50-30; CL: -; SL: 75; RT: 60; DL: 2.45; NL: 0.75:** GS-vcs-ms S, f-up
- 2 - 4 ft: GR: 75; CL: little WO; SL: 90; RT: 20; DL: 2.3; NL: 3:** SM1-SM2/3-facies, f-up
- 3 - 15 ft: GR: 37-20; CL: -; SL: 70. RT: 50; DL: 2.4; NL: 0.125:** GS-S, 2 8 ft thick f-ups, erosive base
- 4 - 17 ft. GR: 20-40; CL: -; SL: 65; RT: 40; DL: 2.45; NL: 0.1:** (GS)-S-(SM), 3-5 ft f-ups; ms-fs S2/S3 facies, increase in SM
- 5 - 7 ft: GR: 45; CL: -; SL: 65; RT: 20; DL: 2.425; NL: 0.15:** S/SM - gradual shale-up

#### Well 14/19-E1

- 1 - 10 ft: GR: 55; CL: WO; SL: 70; CL: 2.75; NL: -0.025:** shale-rich,SM/S(?) facies, gradational base, sharp top
- 2 53 ft: GR: 50-20; CL: occ. WO; SL: 75-65; RL: 20, DL: 2.6; NL: wiggly/0.1/0.2:** shaling-down trend S-SM/shale-rich S to clean S
- 3 - 9 ft: GR: 20-60; CL: WO; SL: 75; RT: 30; DL: 2.55; NL: 2.45-2.95:** shale-up/f-up (S-SM/SH), top shale-down (SM-fs S); ~ 20% shale content; green shales
- 4 - 20 ft: GR: 40-30; CL: -; SL: 60-70; RT: 100-40; DL: 2.5; NL: 0.15:** smaller f-ups (G-S; GS-S), little shale content, rare bioturbation.
- 5 - 22 ft: GR: 30; CL -;SL: 70; RT: 40; DL: 2.45; NL: 0.15:** dominantly S facies, smaller f-ups, little shale overall shale content.
- 6 - 33 ft: GR: 20-40-30; CL: -; SL: 50-80; RT: 70; DL: 2.35; NL: 0.15:** basal shale-up, then shale-down: 3 8 – 14 ft. fining-ups (S-SM; GS-S-SM; S-SM) mod. to strong bioturbation (63% of beds); abundant shale clasts (45% of beds).
- 7 - 44 ft: GR: 50-20; CL: -; SL: 60-80;RT: 50; DL: variable 2.35-2.6: NL: erratic 0.05-0.30:** slight overall shale-down, smaller fining-upward sequences (GS/S-SM)

#### Well 14-19-E3

- 1 - 28 ft - GR: 55-35; CL: some WO; SL: 75-60; RT: -; DL: variable; NL: 0.2-0.05, occ. negative separation:** overall shale-down: 3 smaller 6-12 ft shale-downs (SH/SM; SM-srS)
- 2 - 31 ft: GR: 40-60, CL: -; SL: 60-90; RL: -; DL: 2.6; NL: 0.05, occ. negative separation:** overall shale-up srS-SM/srSM-SH
- 3 - 31 ft: GR: 60-20; CL: -; SL: 70; RT: 25; DL: 2.5; NL: 0.1:** overall shale-down (s-up) SM-S/GS
- 4 - 30 ft: GR: 20; CL: -; SL: 60; RT: 100; DL: 2.6; NL: 0.05:** c-up S?/GS-G (G1/GS5)
- 5 - 10 ft: GR: 20; CL: -; SL: 70-80-60; RL: 80; DL: 2.4; NL: 0.15:** GS/G or clean S

Well 14/19-E4

- 1 - 34 ft: GR: 35-50; CL: - top WO; SL: 70-65; RT: 20; DL: 2.45-2.55; NL: 0.125-0.1: GS-csS, csS-ms/fsS, f-ups, vcs S-fs (SM)-facies, 2 f-ups, abundant bioturb. (60% of beds), 3-5 ft thick f-ups of clean msS/rare GS-SM/SH-facies, small-scale f-rare GS and little SM1 and SH/SM facies, overall f-up, marl? (9645 ft)
- 2 - 9 ft: GR: 75; CL: WO; SL: 80; RT: 10-29; DL: 2.48; NL: 0.35: SH-Facies
- 3 - 16 ft: GR: 80-25; CL: little WO; SL: 70-80; DL/NL: basal neg. sep.: SH- clean GS/S-SM-Facies (4-6 ft, f-ups/c-up)
- 4 - 10 ft: GR: 60-25; CL: -; SL: 75; DL 2.5 (2.875); DL/NL: some neg. sep.: 5-8 ft thick c-ups SM-S -Marls? (9610 / 9604 ft)
- 5 - 13 ft: GR: 75; CL: little WO; SL: 75; DL/NL: neg. separation: SH/SM-S-Facies
- 6 - 13 ft: GR: 50-30; CL: -; SL: 75; DL/NL: some neg. separation: large c-up: SH/SM-S-Facies

Well 14/19-E5Y

- 1 - 33 ft: GR: 40-20; CL: -; SL: 70; RT: 20-80; DL: variable 2.4; NL: 0.15: subtle shale-down BI-SM-S-GS (c-up)
- 2 - 20 ft: GR: 20-30; CL: -; SL: 70-60; RT: 80; DL: 2.45-2.55; NL: 0.15-0.1: subtle shale-up, erosive base (G), f-ups G-ms S, GS-G-S
- 3 - 23 ft: GR: 30-25; CL: -; SL: 70-60; RT: 100; DL: 2.4; NL: 0.125: subtle shale-down but f-up (GS-ms S)
- 4 - 29 ft: GR: 20-30; CL: -; SL: 60-70; RT: 300-80; DL: variable 2.425; NL: 0.125: shale-up then shale down, but overall f-up, smaller f-ups (G- vcsS/ ms/fs S2/S3-SM2/SM3), erosion common (25% of beds) marking bases of smaller f-ups. Bioturbation (35%) and shale content (<10% increasing to 20%)
- 5 - 21 ft: GR: 20-35; CL: -; SL: 80-70; RT: 80-150-50; DL: 2.35; NL: 0.125: shale-up/f-up (GS-vcs/ms S facies)
- 6 - 26 ft: GR: 20-30-20; CL: -; SL: 60-80; RT: 400-70-100; DL: 2.42; NL: 0.15: shale-up/down (2 f-ups: GS-fsS; ms S-fs S/SM; GS-S-SM; c-up: csS-G; csS-vcsS)
- 7 - 8 ft: GR: 20-45; CL: little WO; SL: 60; RT: 100-30; DL: 2.6; NL: 0.1: shale-up/f-up (G-SH-SM)
- 8 - 16 ft: GR: 25; CL: -; SL: 60-90-60; RT: 90; DL: 2.4; NL: 0.1: f-up (Gs-S-SM)
- 9 - 19 ft: GR: 25-35; CL: -; SL: 90-60; RT: 150; DL: 2.2-2.5; NL: 0.2: shale-up/f-up: DWMS ms S to SM
- 10 - 20 ft: GR: 45-20; CL: -; SL: 75; RT: -; DL: 2.325; NL: 0.1-0.2: shale-down/Cup (SM-S; marl? (9300 ft)
- 11 - 15 ft: GR: 90-30; CL: little WO; SL: 80; RT: -; DL: 2.35; NL: 0.2: some negative separation: shale-down/c-up (SH/ very shale-rich SM-S)
- 12 - 22 ft: GR: 70-40; CL: WO; SL: 80-100; RL: -; DL: 2.6; NL: 0.25: negative separation: shale-down/c-up (SH/SM/Marl?-S), top shale-up/f-up (S-SM/SH)

Well 14/19-E2

- 1 - 30 ft: GR: 20/30-10; CL: -; SL: 7-80; RT: -; DL: 2.35, variable; NL: 0.15: clean GS/S, slight overall shale-down, smaller 4-8 ft shale-downs, occ. pyritisation?/ strong cementation.
- 2 - 21 ft: GR: 45-30(2x); CL: -; SL: 100-50; RT: 50-200; DL: 2.35; NL: 0.1: 2 shale-downs/c-up (S-SM)
- 3 - 10 ft: GR: 30; CL: -; SL: irr. 90-60; RT: 100; DL: 2.4; NL: 0.1: shale-up/f-up S-SM-BI-SM
- 4 - 23 ft: GR: 30-45-30; CL: -; SL: 80-60-90; RT: 90-40-90; DL: 2.5; NL: 0.05-0.2: shale-up-down (S/G-S/G-SM-S)
- 5 - 14 ft: GR: 30-60; CL: -; SL: 60-110-70; RL: 50; DL: 2.4; NL: 0.15: overall shale-up/f-up G/GS-vcS/SM
- 6 - 15 ft: GR: 45-30; CL: -; SL: 60; RL: 30-80; DL: 2.6; NL: 0.1: shale-down/C-up (S-G)
- 7 - 17 ft: GR: 45-60; CL: -; SL: 70-110; RL: 60; DL: 2.4; NL: 0.15-0.2: subtle shale-up ((G)-S-SM/S-SM)
- 8 - 35 ft: GR: 40-100; CL: WO, SL: wiggly 80-100; RL: ~ 30; DL/NL neg. separation: overall shale-up in smaller shale-ups (S-SM; S-SM-SH).
- 9 - 15 ft: GR: 100-10; CL: some WO, SL: 80; RL: -; DL: 2.65/NL: 0.45-0.1: neg. separation: shale-down (2) SM/SH-srS, srS;-S
- 10 - 28 ft: GR: 10-40-10; CL: occ. WO; SL: 80-90; RL: -; DL: 2.6 / NL: 0.25-0.3: neg. separation: basal shale-up (f-up), (S-SM), gradual shale-down (srSM-S 2x)

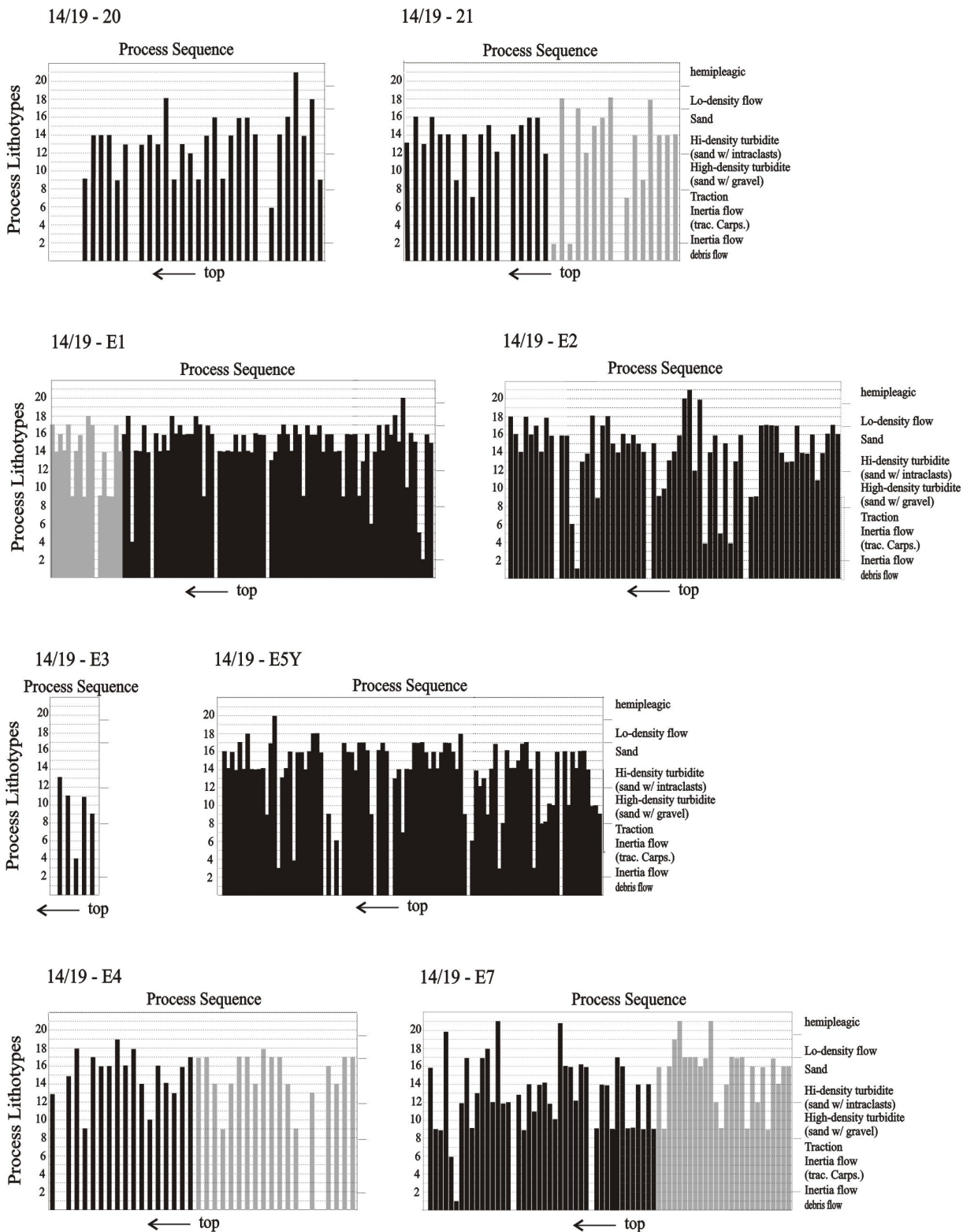
Well 14/19-E7

- 1 - 43 ft: GR: 25; CL: -; SL: 75; RT: 120; DL: 2.35; NL: 0.15: crude, smaller f-up/C-ups (GS dominated, rare S/SM)
- 2 - 30 ft: GR: 35; CL: -; SL: 75; RL: 120; DL: 2.35; NL: 0.15: small f-up (S-BI), c-up fs S-vcsGS, GS4-Gs3; vcs S - GS3
- 3 - 25 ft: GR: 40-20; CL: -; SL: 75; RT: 100; DL: 2.45; NL: 0.175: shale-down but f-up GS-vcs S, GS-SM
- 4 - 8 ft: GR: 30-20; CL: -; SL: 55; RT: 30-500; DL: 2.65; NL: 0.025: f-up/c-up: G6(6.4 cm)/G3(1.8 cm) -SH-Facies; top GS (max. clast size: 3.5 cm)
- 5 - 18 ft: GR: 20; CL: -; SL: 85; RT: 100; DL: 2.35; NL: 0.2: subtle 3-5 ft f-ups: vcs S-facies
- 6 - 42 ft: GR: 40-60; CL: distinct WO; SL: 60; DL: 2.7; NL: 0.15: distinct negative separation: 8-15 ft. shale-ups (srS-SM-SH).

### APPENDIX 3 Process Sequences

Process sequences: lithofacies types (n = 20) are transformed into qualified measures of flow power, using grain size and sedimentary structures as indicators of transport and depositional processes, arranged into descending order of energy (after Cronin 1994).

S10 deposits  
 S9/S11 deposits







APPENDIX 4

Bed thickness analysis by RUNS analysis (Davis 1986; Murray *et al.* 1996) for determination of asymmetry within successions:

RAM : runs about median

RUD: runs up and runs down

(Simple and two-bed moving average)

**14/19-E1**

RAM analysis: median 31.5 cm

001000101010100100000011100100010001-gap-0000111011-gap-1110100001001-gap-0110101111101111001 r: 40

RUD analysis:

1100010101010110011101010010101010-gap-0110101001-gap-0101011001010-gap-010110101101011 runs: 59

RUD analysis (2-bed moving average):

11001101010101100110110101101110101-gap-111001100-gap-1101011011010-gap-01010010111101 runs: 48

**14/19-E5Y**

RAM analysis: median 46.9 cm

0011110110111000001000100110111111001000100000101000000000000111100000010100111110101110 r: 34

RUD analysis:

0101001010101010011001101110101011011101011101001011100101010000101010101010101010 runs: 67

RUD analysis (2-bed moving average):

1101010001100011011100110111011101110111000111010010110001011100001110111101101001110101 runs: 48

Undifferentiated SD bed thickness analysis

**14/19-E2**

RAM analysis: median 23.9 cm

1011110111000011-gap-10100011000011110-gap-1000110000101111-gap-101010100 # of runs: 30

RUD analysis:

0110010111010010 - gap - 0101111010011010 - gap - 001100010101000 - gap - 01010100 # of runs: 44

RUD analysis (2-bed moving average):

011011011011011 - gap - 010111001011100 - gap - 00110011011100 - gap - 11011101 # of runs: 34

**14/19-E7**

RAM analysis: median 42.5 cm

0010101010000110010000011011101100111100-gap-110101111011-gap-1101001001000111 # of runs: 37

RUD analysis:

0010101010101110010010111010001101100100 - gap - 00101101010 - gap - 001011001010101 # of runs: 48

RUD analysis (2-bed moving average):

01101110100111001101111101000110110110 - gap - 0011100001 - gap - 00101101100110 # of runs: 34

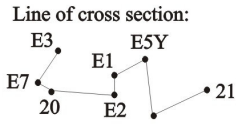
Summary statistics

|                               | E1     | E5Y    | E2     | E7     |
|-------------------------------|--------|--------|--------|--------|
| number of runs about median   | 40     | 34     | 30     | 37     |
| number of runs up and down    | 48(59) | 48(67) | 34(44) | 34(48) |
| number of long runs up (>3)   | 2      | 8      | 6      | 4      |
| number of long runs down (>3) | 0      | 4      | 0      | 2      |
| longest run up                | 3      | 5      | 4      | 6      |
| longest run down              | 2      | 4      | 2      | 4      |

() simple RUD, other 2-bedmoving average



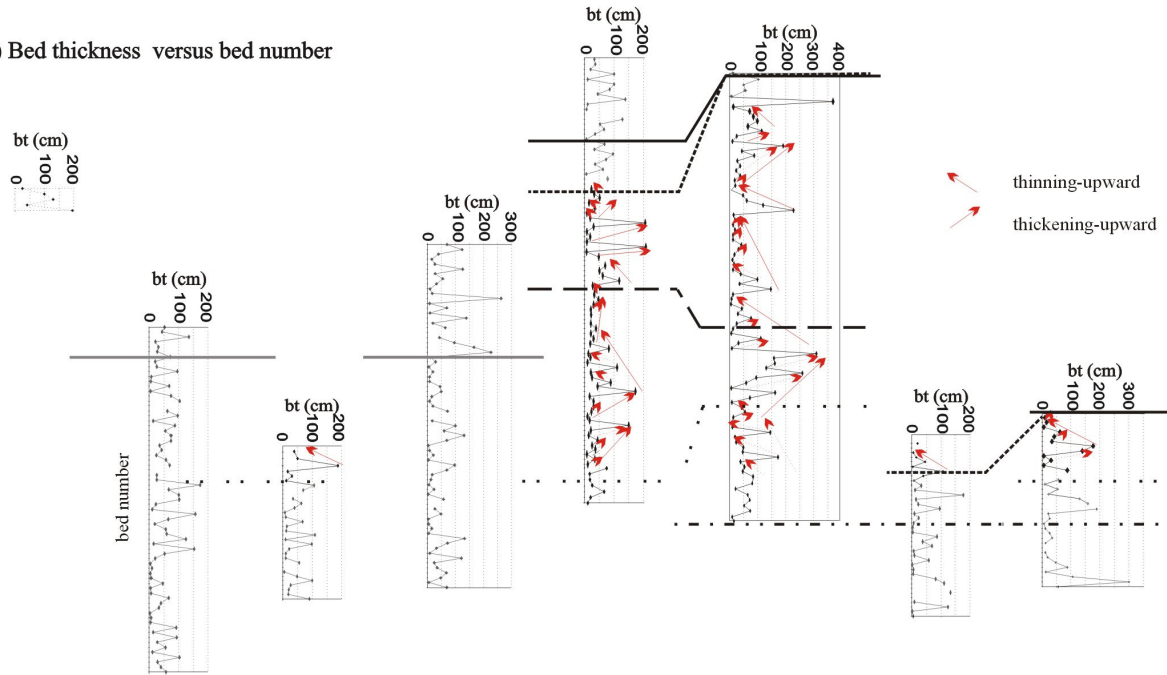
## APPENDIX 5



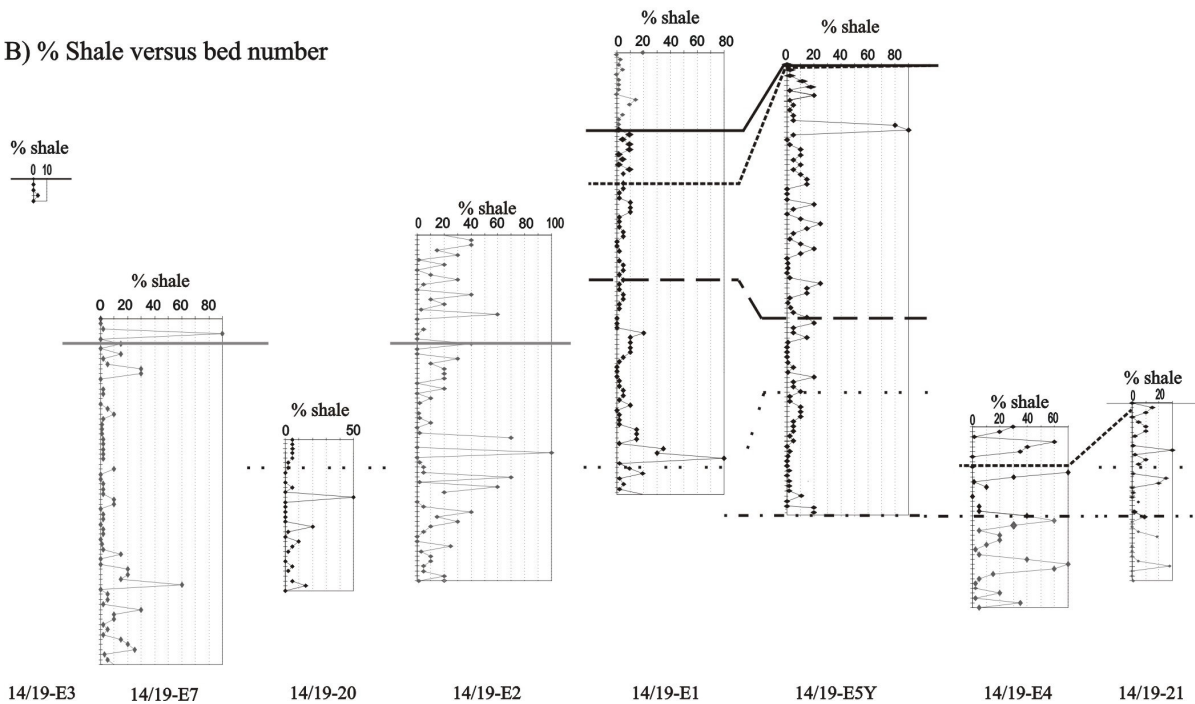
Sedimentary-based correlation between S10 study wells:  
 all graphs display bed number along the y-axis versus various measurable sedimentary features.  
 Graphs display bed numbers from base (bottom) to top of cored S10 interval (black data points) and the undifferentiated SD/SE (grey data points). The biostratigraphic correlation (*sensu* Riley *et al.* 1992 and CoreLab 1993) scheme is superimposed.

- ◆ individual bed
- (blank) Gap
- E2-E7 correlation
- Top S10
- - - Top VJ1
- - - Top VJ2
- · · Top VJ3
- · · Base S10

A) Bed thickness versus bed number



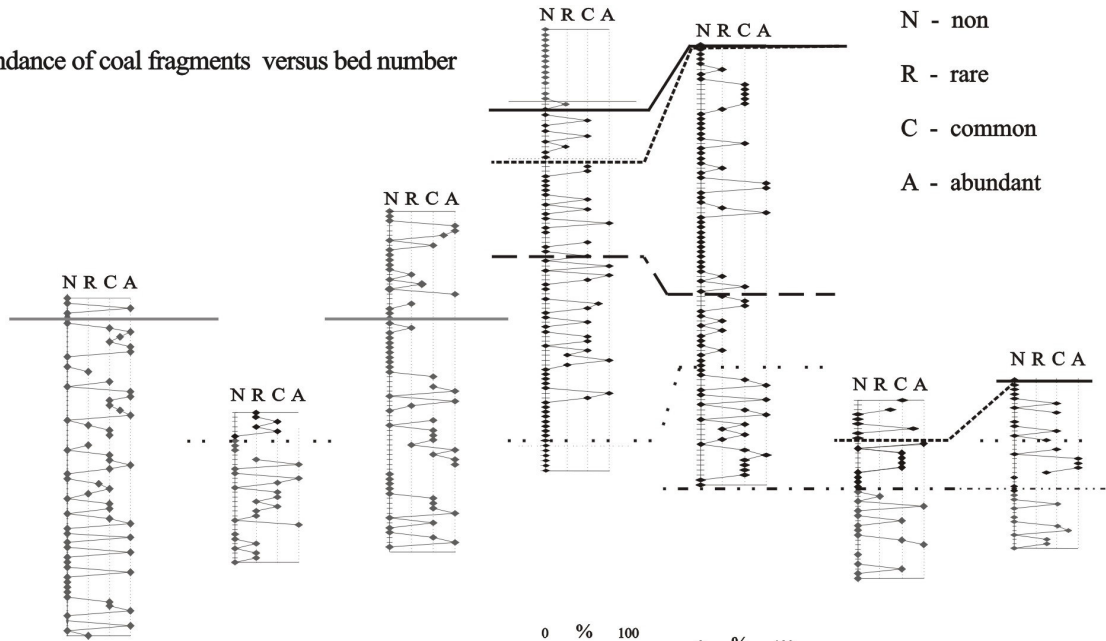
B) % Shale versus bed number



C) Abundance of coal fragments versus bed number

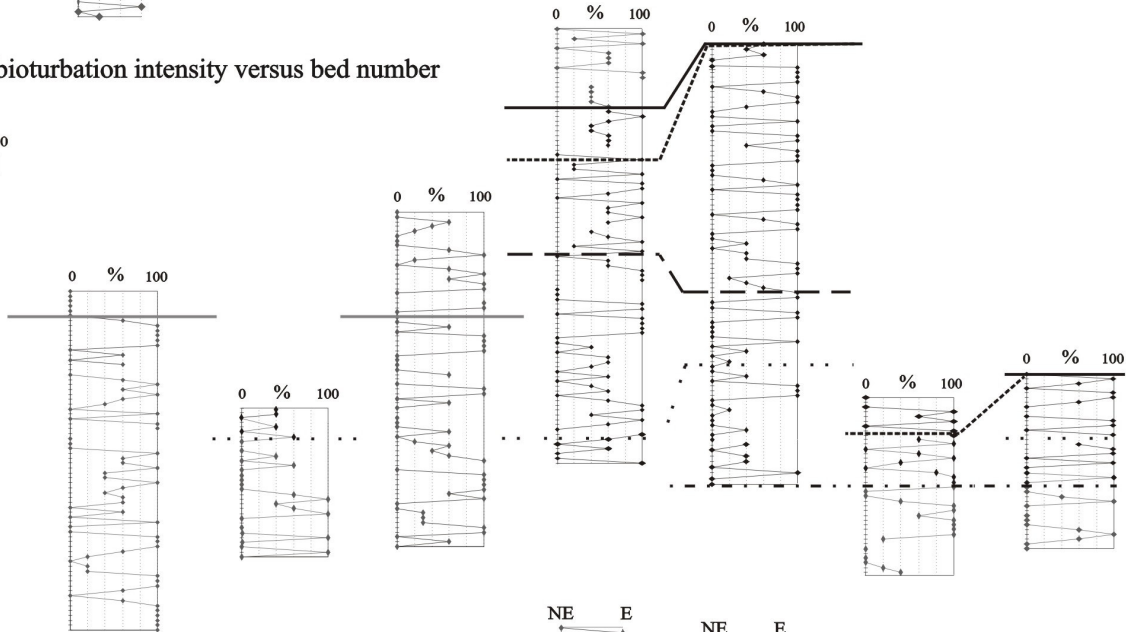
NRCA

N - non  
R - rare  
C - common  
A - abundant



D) % bioturbation intensity versus bed number

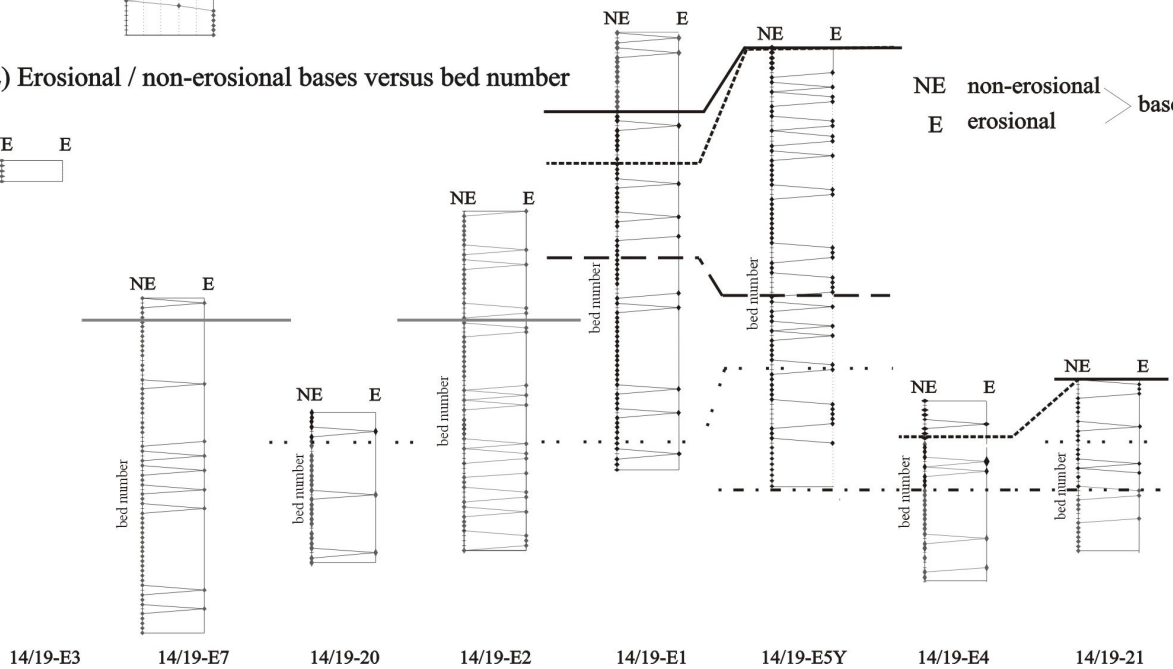
0 % 80



E) Erosional / non-erosional bases versus bed number

NE E

NE non-erosional bases  
E erosional bases



14/19-E3

14/19-E7

14/19-20

14/19-E2

14/19-E1

14/19-E5Y

14/19-E4

14/19-21

**ENCLOSURE**



## BILDUNGSGANG

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