BIOSTRATIGRAPHY OF THE FAIRHOLME GROUP AND ITS TIME EQUIVALENT IN THE SOUTHERN ALBERTA SUBSURFACE (Paleontology by G.O.Raasch)

DFR 12

VANDERGRACHTELLA SCOPULORUM ZONE

Vandergrachtella keeni Crickmay.
Vandergrachtella scopulorum Crickmay.
Spinatrypa sp.
Schizophoria sp.
Productella sp.
Gypidula cf. cornuta
Devonoproductus Walcotti.
Cyrtospirifer owenensis.
Cyrtina sp.
Athyris sp.
Atrypa ciliipes Crickmay.
Cranaena Calvini.
Chonetes aff. scitulus Hall.

Alveolites sp.
Cladopora (Coenites ?)
Hexagonaria
Placellophyllum fenense
P. tructense Mclaren
Thamnopora sp.
Cup corals
Spongophyllum
Phillipsastraea sp.

Amphipora sp.
Stromatoporoids
Sponge spicules
Crinoids
Ostracods
Fish remains

Corresponding Stratigraphic units in surface sections of the Canadian Rocky Mountains.

CLASTICS: MOUNT HAWK FM.
CARBONATE: SOUTHESK FORMATION

LITHOLOGIC COLUMN: CL. / CARB.

Corresponding Stratigraphic units in subsurface of the Southern Alberta Interior Plains.

CLASTICS / CARBONATES: NISKU FM.

LITHOLOGIC COLUMN: CL. / CARB.

NOTES — SURFACE — CLASTICS: Argillaceous nodular LS. with calcareous shale partings, rich fauna.

NOTES — SURFACE — CARBONATES: Upper light grey and basal brown Dol. member (Resp Arcs and Grotto Mbr.)

NOTES — SUBSURFACE: Anhydrite and primary sublithographic dolomite (caprock member) overlie Light grey restricted and dark grey-brownish black fossiliferous dolomite (coral-amphipora assemblage.)

DFR 11

CYRTOSPIRIFER WHITNEYI ZONE

Atrypa ciliipes Crickmay.
Atrypa devoniana Webster.
Atrypa hackberryensis.
Atrypa rubromitra.
Atrypa aff. varicostata Stainbrook.
Chonetes aff. scitulus Hall.
Cranaena amana Stainbrook.
Cranaena navicella Hall.
Devonoproductus Walcotti.
Douvillina cf. maxima Stainbrook.
Gypidula cornuta Var.
Indospirifer Kobayashi.
Nervostrophia Mclareni Pedder.
Productella thomasi Stainbrook.
Cyrtospifer Whitneyi.

Syringopora sp.
Aulopora iowaensis
A. Modulata fenton
A. Repens.
Cladopora (Coenites)
Hexagonaria
Macgeea proteus Smith
Phillipsastraea
Thamnopora
Tabulophyllum

Amphipora aff. Rudis
Lecompte.
Stromatoporoids
Crinoids
Fenestella sp.
Bryozoa
Ostracods

IRETON FM.

I R E T O N F O R M A T I O N

L E D U C F O R M A T I O N

U P P E R M E M B E R

Assemblage consisting of brachiopods, crinoids, bryozoa, gastropods, and solitary corals.

CRIPPLE TONGUE

Light grey to white, very fine to coarse dolomite. Resistant cliff-former.

ARGILL. DOL. & Ls, SHALE

Argillaceous and silty very finely crystalline dolomite. and calcilutite. Shale interbeds.

Light grey to white very fine to very coarse.

DFR 10

CYRTOSPIRIFER PLACITUS ZONE

Atrypa ciliipes Crickmay.
Atrypa devoniana Webster.
Atrypa cf. hackberryensis
Atrypa varicostata Stainbrook
Cyrtospirifer occidentalis.
Devonoproductus vulgaris Stainbrook.
Gruenwaldtia americana Stainbrook.
Leiorhynchus albertense Warren.
Leiorhynchus variabile.
Nervostrophia calvini Stainbrook
Productella rugatula Stainbrook
Tenticostirifer cyrtiniformis Var.
Thomasaria rockymontana Warren

Aulopora
Alveolites
Hexagonaria parvula
Phillipsastraea
Thamnopora
Spongophyllum
Rugose corals

Stromatoporoids
Gastropods
Tentaculites sp.
Nautiloid cephalopod
Crinoids
Bryozoa

Exfoliation is common Thick-bedded to massive. Vuggy porosity predominates.

Greenish grey to dark grey calcareous shale with argillaceous Ls interbeds.

Dolomite. Vuggy, intercrystalline and (local) fracture porosity.

DFR 9

LEIORHYNCHUS ALBERTENSE ZONE

Leiorhynchus albertense Warren.
Atrypa devoniana Webster.
Atrypa varicostata Stainbrook.
Cyrtina inulta Stainbrook.
Devonoproductus vulgaris Stainbrook.
Gruenwaldtia americana Stainbrook.
Schuchertella prava Hall.
Thomasaria rockymontana Warren.
Warrenella nevadensis Walcott.

Alveolites sp.

Stromatoporoids
Fish remains
"Orthoceras" sp.
Paracyclas sp.

Sedimentary texture is largely destroyed by complete dolomitization. Terrigenous clastics are absent or negligible.

Sedimentary texture is largely destroyed by complete dolomitization.

DFR 8

LEIORHYNCHUS CARYA ZONE

Gypidula cf. munda Stainbrook.
Leiorhynchus carya Stainbrook.
Productella rugatula Stainbrook.
Warenella nevadensis Walcott.

NOTE = Leiorhynchus carya = Calvinaria ? inelegant (Mclaren 1954)

Thamnopora cervicornis
Thamnopora digitatus
Raminger.

Gastropod
Tentaculites mackenziensis —Kindle.
Stromatoporoids
Crinoid remains

P E R D R I X F M.

Dark grey to greenish grey calcareous shale, recessive unit. Low fauna content.

Major reservoir in Western Canada

DFR 7

RECEPTACULITES ZONE

Atrypa devoniana Webster.
Cyrtina inulta.
Gypidula munda Stainbrook.
Monelasmina besti Pedder.
Pugnoides sp.
Productella cf. rugatula Stainbrook.
Spinatrypa planosulcata Webster.
Warrenella nevadensis Walcott.

Alveolites sp
A. cf. parvus lecompte
Cladopora
Rugose corals
Phacellophyllum
Aulocystis sp.

Receptaculites sp.
Gastropods
Ostracods.
Sponge spicules
Stromatoporoids
Bryozoa
Crinoids
Tentaculites

C A I R N F M.

D U V E R N A Y FM.

L O W E R M B R.

Dark brown dolomite with amphipora — stromatoporoid assemblage.

Rhythmic deposition is indicated by thin light grey resticted dolomite intervals. Minor black bituminous shale parting.

Dark brown to black bituminous shale and calcilutite intervals.

Dark grey and brown dolomite. Minor black bituminous shale partings.

DFR 6

LEIORHYNCHUS INSCULPTUM ZONE

Leiorhynchus insculptum Mclaren.
Leiorhynchus cf. athabaskense Kindle.

Tentaculites sp.
Stromatoporoids
Fish remains

DFR 5

LEIORHYNCHUS ATHABASKENSE ZONE

Eleutherokomma leducensis Crickmay.
Eleutherokomma jasperensis Warren.
Leiorhynchus athabaskense Kindle.
Atrypa pronis.
Allanaria minutilla Crickmay.
Calvinaria variabilis athabaskensis.

Stromatoporoids

MALIGNE FM.

MAJEAU LAKE FM.

COOKING LAKE FORMATION

Interbedded argillaceous Ls and calcareous shale.

Threefold division in south central Alberta : Upper and lower particulate limestone member, separated by calcareous, shale - argillaceous Ls member.

DFR 4

ALLANARIA ALLANI ZONE

Allanaria allani Warren.
Allanaria minutilla Crickmay.
Eleutherokomma cf. hamiltoni Crickmay.
Atrypa multicostellata Kottlowski.
Atrypa gregeri Rowley
Cyrtina triquetra Hall.
Atrypa devoniana Webster.

Thamnopora sp.

Stromatoporoids
Ostracods
Gastropods
"Orthoceras"
Pelecypods

FLUME FM.

FLUME FM.

BEAVERHILL LAKE FORMATION

Cherty argillaceous Ls and calcareous shale.

Cherty dark brown dol. with amphipora-stromatoporoid assemblage.

Rhythmically interbedded calcareous shale - argillaceous limestone and lutitic-skeletal limestone intervals.

DFR 3

LAGODIOIDES KAKWAENSIS ZONE

Eleutherokomma impennis Crickmay.
Schizophoria allani Warren.
Schizophoria athabaskensis Warren.
Ladogioides kakwaensis Mclaren.
Atrypa bentonensis Stainbrook.
Athyris occidentalis Whiteaves.
Athyris cedarensis Stainbrook.

Alveolites sp.

Paracyclas sp. Undet.
Pteronites sp.
Spirorbis sp.
Leptodesma sp.
Hederella sp.
Tentaculites sp.
Elasmonoma sp.

ABSENT IN MAP AREA.

DFR 2

LAGODIOIDES PAX ZONE

STATUS OF LOWERMOST FRASNIAN ZONE IN WESTERN CANADA IS STILL TENTATIVE. ZONE IS ABSENT IN AREA OF STUDY.

ABSENT IN MAP AREA.

LITHOLOGY LEGEND

- Anhydrite
- Anhydritic Dolomite
- Dolomite
- Limestone
- Argillaceous Limestone
- Shale
- Cherty Dolomite
- Cherty Limestone

J-60

BIOSTRATIGRAPHY OF THE FAMENNIAN

(Paleontology by G.O.Raasch)

ZONAL CLASSIFICATION	BIOTA: BRACHIOPODS	BIOTA: MISCELLANEOUS	CORRESPONDING STRATIGRAPHIC UNITS IN SURFACE SECTIONS OF SOUTHERN ROCKY MOUNTAINS.	SCHEMATIC LITHOLOGIC COLUMN	CORRESPONDING UNITS IN SUBSURFACE OF SOUTHERN ALBERTA.	SCHEMATIC LITHOLOGIC COLUMN	NOTES: SURFACE	NOTES: SUBSURFACE
DFA-2	LEIORHYNCHUS VENTRICOSUM ZONE NUDIROSTRA UTAHENSIS VENTRICOSA ZONE OF McLAREN (1954) Cyrtospirfer kindlei STAINBROOK Pauorhynchus cascadensis WARREN. (Leiorhynchus ventricosum ?) Productella plicata KINDLE. Strophopleura notabilis KINDLE.	CRINOIDS BRYOZOA PELECYPODS GASTROPODS	COSTIGAN MEMBER — PALLISER FM.		BIG VALLEY FM. — WABAMUN GROUP		THIN BEDDED TO PLATY, RECESSIVE UNIT. ARGILLACEOUS AND/OR SILTY LIMESTONE AND DOLOMITE. RICH BRACHIOPOD ASSEMBLAGE.	OPEN PLATFORM LIMESTONE WITH BRACHIOPODS AND BRYOZOA. THIN INTERCALATIONS OF GREENISH-GRAY CALCAREOUS SHALE.
DFA-1	LEIORHYNCHUS SEVERSONI ZONE NUDIROSTRA GIBBOSA SEVERSONI ZONE OF McLAREN (1954) Leiorhynchus (former Nudirostra) seversoni McLAREN. Athyris angelica HALL. Camarotoechia banffensis WARREN Leioproductus coloradoensis KINDLE. Petrocrania ourayensis KINDLE. Cyrtiopsis normandvillana CRICKMAY.	PELECYPODS GASTROPODS OSTRACODS CALCISPHERES	MORRO MEMBER — PALLISER FM.		STETTLER FM. — WABAMUN GROUP		THICK BEDDED AND MASSIVE CLIFF-FORMER, CALCILUTITE-RUDITE, PELLETAL AND PARTLY BIOCLASTIC, DOLOMITIZED IN PARTS.	MASSIVE UNIT ON GAMMA RAY LOG.
DFA-1A	LEIORHYNCHUS BASILICUM ZONE Camarotoechia Banffensis WARREN. Camarotoechia nordeggi KINDLE. Cyrtiopsis nahanniensis CRICKMAY. Leiorhynchus basilicum CRICKMAY. Schizophoria aff. australis CRICKMAY Tenticospirifer keleticus CRICKMAY. } ABSENT IN SOUTHERN ROCKY MOUNTAINS	GASTROPODS OSTRACODS CRINOIDS FISH REMAINS	UPPER SILT MEMBER BLUE RIDGE MEMBER LOWER SILT MEMBER — ALEXO FM.		CALMAR FM. GRAMINIA FM. — WINTERBURN GROUP		UNFOSSILIFEROUS IN SOUTHERN ROCKIES. LAMINATED SILTSTONE AND SHALE. BLUE RIDGE CONSISTS OF PELLETAL RESTRICTED LIMESTONE	UNFOSSILIFEROUS WHITE AND PALE GREEN SILT AND SANDSTONES.
FRASNIAN			MOUNT HAWK FM. / SOUTHESK FM. — FAIRHOLME		NISKU FM. — WINTERBURN GROUP			

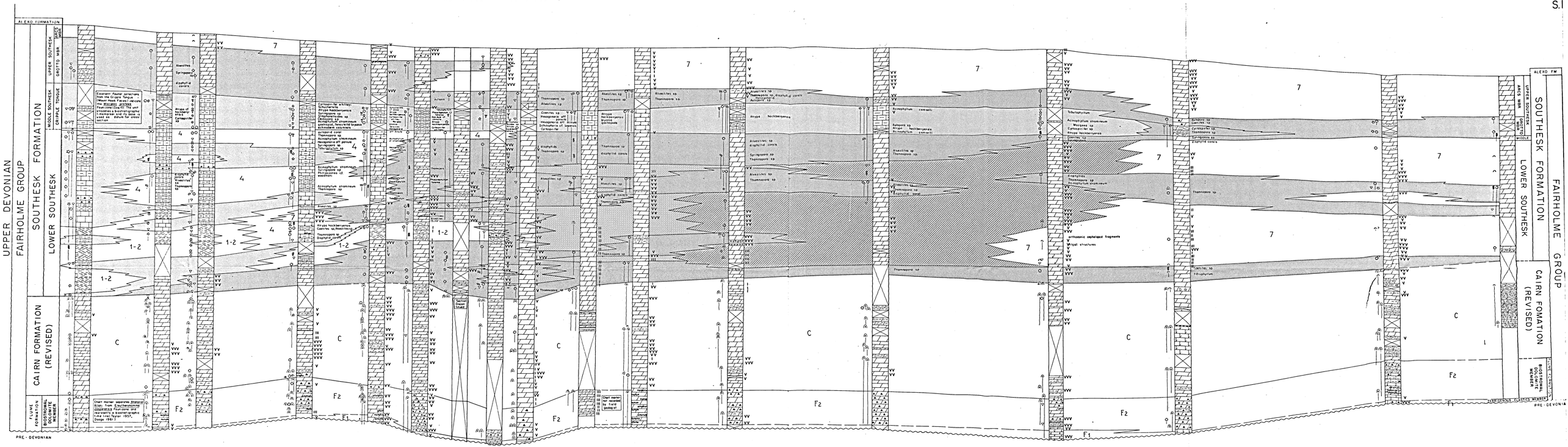
LITHOLOGY LEGEND

- ANHYDRITE
- ANHYDRITIC DOLOMITE
- LIMESTONE
- ARGILLACEOUS / SILTY LIMESTONE
- DOLOMITE
- SILT-SANDSTONE
- SHALE

NORTH RAM R. JD-13-F60 JD-13A-F60 | JOAN'S RIDGE JD-15-F60 JD-15A-F60 | DISASTER CK JD-16-F60 | PENNY CK. JD-9-F60 | TINA CK. N. JD-8-F60 | TINA CK. S. JD-7-F60 | N. CRIPPLE CK. JD-6A-F60 | GERTIE CK. JD-10-F60 | ANN CK. JD-18-F60 | DOUGLAS CK. JD-11-F60 | NELL CK. JD-4-F60 JD-5-F60 | DEADFALL CK. JD-3-F60 | BOUNDARY CK. JD-1-F60 JD-2-F60 | S. RAM RIDGE JD-12-F60 | S. RAM RIVER JD-14-F60

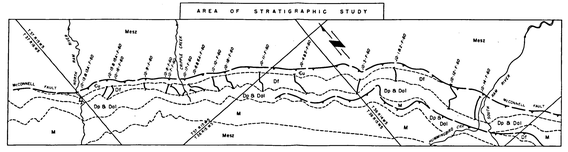
TINA-CRIPPLE JD-17-F60 | CRIPPLE CK. JD-6-F60

N.W. S.E.

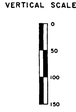


DETAILED STRATIGRAPHIC CROSS-SECTION OF FAIRHOLME GROUP BETWEEN THE NORTH AND SOUTH RAM RIVERS

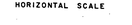
AREA OF STRATIGRAPHIC STUDY



VERTICAL SCALE



HORIZONTAL SCALE



7 Facies 7: Light grey, laminated dolomite with an Algal-Gastropod-Ostracod assemblage

Facies 6: Light grey, slightly fossiliferous dolomite with a mixed Coral-Gastropod-Ostracod fauna

Facies 5: Dark brown or light grey biostromal dolomite of southesk formation predominant coralline fauna

4 Facies 4: Light to medium grey, coralline limestone

Facies 3: Medium grey to buff, nodular, argillaceous limestone - calcareous shale

1-2 Facies 1-2 Dark brown to black, bituminous shale. Greenish grey to dark grey, calcareous shale barren or with a sparse pelagic fauna

C CAIRN FORMATION (REVISED) Biostromal dolomite with Amphipora - Stromatoporoid assemblage. Thin intercalations of light grey, barren dolomite

F2 FLUME FORMATION BIOSTROMAL DOLOMITE Amphipora - Stromatoporoid assemblage

F1 FLUME FORMATION TERRIGENOUS CLASTICS Silty dolomite and dolomitic siltstone

FAUNAL CONTENT

- Alveolites (Platy variety)
- Stromatoporoid
- Amphipora
- Brachiopod
- Coral (undifferentiated)
- Algal texture
- Crinoid
- Bryozoan
- Gastropod
- Chert: lens or nodule
- Oncolith
- Biodrome

interval poorly exposed and partially covered

Covered interval

LITHOLOGY

- Dolomite
- Limestone
- Argillaceous dolomite
- Argillaceous limestone
- Dolomitic limestone
- Calcareous dolomite
- Breccia
- Shale
- Dolomite laminated (Algal in part)
- Siltstone
- Biostromal limestone
- Fragmental texture

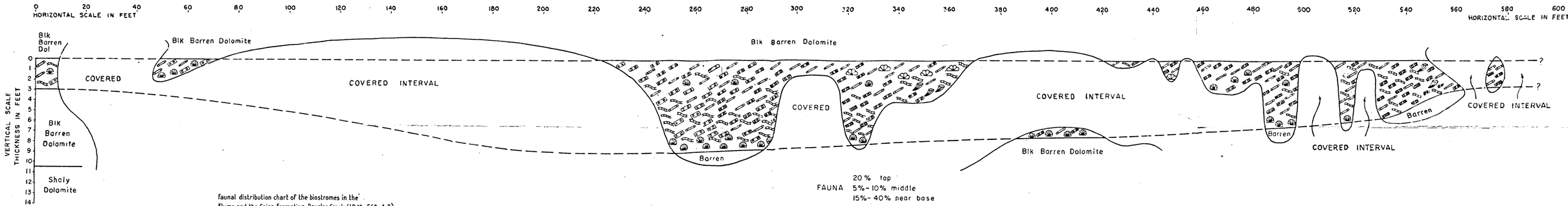
POROSITY

1 Intercrystalline porosity, controlled by sucrose texture of matrix
- i poor
- ii fair
- iii good

2 Vuggular porosity controlled by leaching of fossil shell or birdseyes of biotic of unidentifiable origin
- v poor
- vv fair
- vvv good

NW

SE



Faunal distribution chart of the biostromes in the Flume and the Cairn Formation, Douglas Creek (JD19-F60-A,B)

FAUNA
20% top
5%-10% middle
15%-40% near base

LEGEND

NOTE UPPER SURFACE OF BIOSTROME IS USED AS DATUM.

- DISPHYLLID CORALS
- THAMNOPORIDS
- ALVEOLITES SP (PLATY VARIETY)
- ALVEOLITES SP (GLOBULAR VARIETY)
- SOLITARY RUGOSE CORAL
- HEXAGONARIA (COLONIAL RUGOSE CORALS)

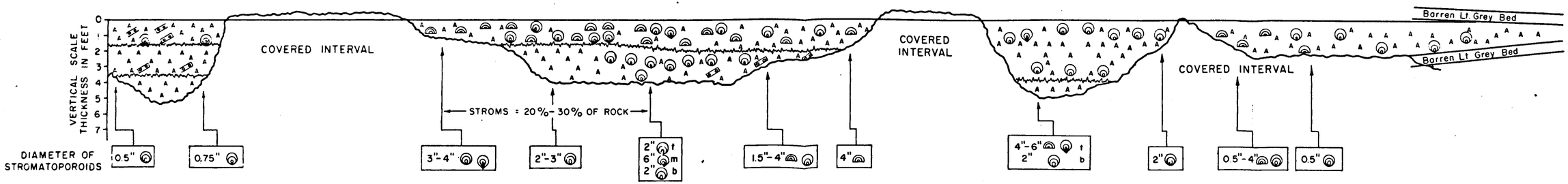
SE

BIOSTROME JD19 A-F60

NW

HORIZONTAL SCALE IN FEET 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360

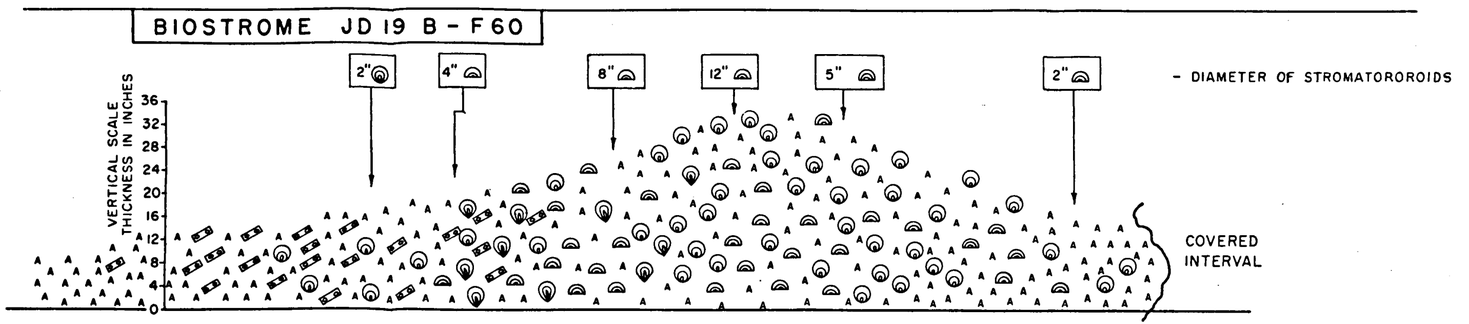
OVERHANGING CLIFF, WITH DETAILS OBSCURED BY BLACK COATING ON ROCK.



LEGEND

- AMPHIPORA SP. PARAMPHIPORA SP. — UNDIFFERENTIATED
- THAMNOPORA SP. CLADOPORA SP. COENITES SP. — UNDIFFERENTIATED
- STROMATOPOROIDAE
- STROMATOPOROIDS WITH TURBINATE SHAPE, 2"-3" DIAMETER. LETTERS ON RIGHT INDICATE POSITION OF ORGANISMS IN BIOSTROME, (t-TOP, m-MIDDLE, b-BASAL PORTION)
- SPHERICAL FORM
- HEMISPHEROIDAL FORM
- STYLOLITIC BEDDING PLANE

BIOSTROME JD19 B-F60



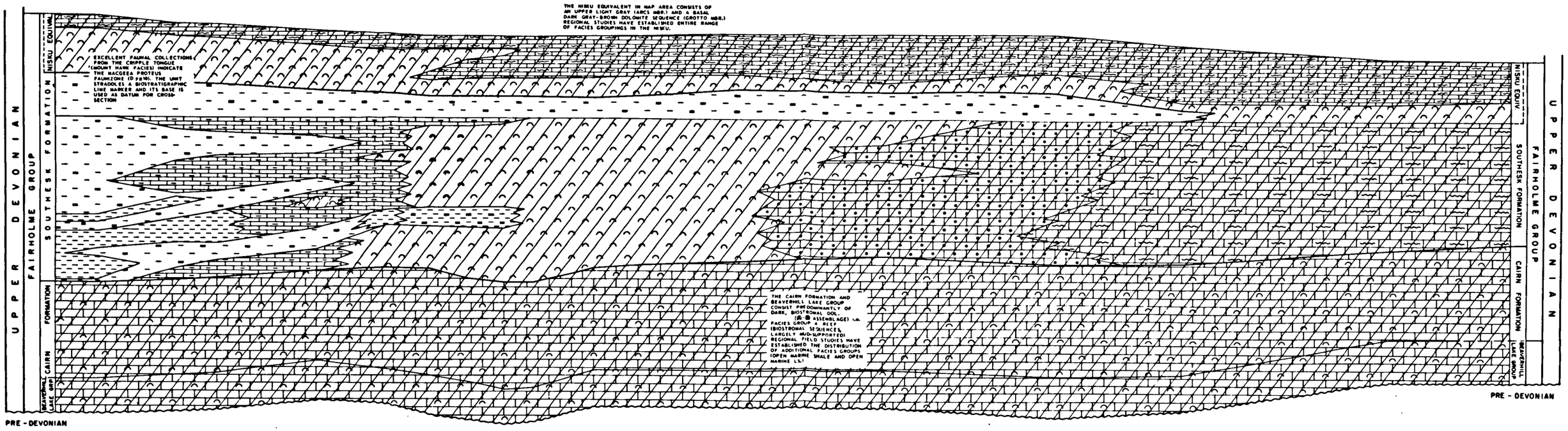
LT. GREY WEATHERING UNIT, UNFOSSILIFEROUS

HORIZONTAL SCALE IN FEET 0 10 20 30 40

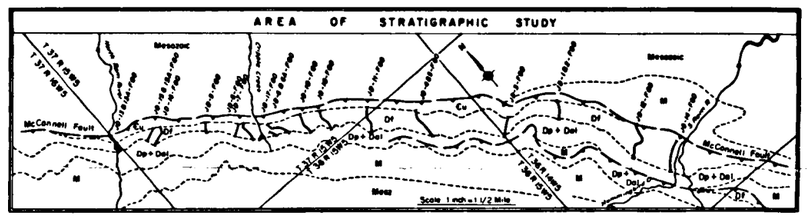
Faunal distribution chart of biostromes in the lower portion of the Southesk formation at Tina/Cripple section (JD19-F60-D)

N.W. S.E.

DISASTER CREEK JD-16-F60 | TINA CREEK N. JD-8-F60 | TINA-CRIPPLE CREEK JD-17-F60 | CRIPPLE CREEK JD-6-F60 | ANN CREEK JD-18-F60 | N.RAM RIVER JD-13-F60, JD-13A-F60 | JOAN'S RIDGE JD-15-F60, JD-15A-F60 | PENNY CREEK JD-9-F60 | TINA CREEK S. JD-7-F60 | N.CRIPPLE CREEK JD-6A-F60 | GERTIE CREEK JD-10-F60 | DOUGLAS CREEK JD-11-F60 | NELL CREEK JD-4-F60, JD-5-F60 | DEADFALL CREEK JD-3-F60 | BOUNDARY CREEK JD-1-F60, JD-2-F60 | S.RAM RIDGE JD-12-F60 | S.RAM RIVER JD-14-F60



VERTICAL SCALE in feet 0 50 100 150 — HORIZONTAL SCALE in feet 0 750 1500 2250 3000



FACIES NAME / NUMBER & THICKNESS	RESTRICTED MARINE SHALE (EUXINIC) 1 ___ft	OPEN MARINE SHALE 2 ___ft	OPEN MARINE CARBONATE-SHALE 3 ___ft	ONE OR A COMBINATION OF THESE FACIES MAY BE PRESENT: OPEN MARINE CARBONATES 4 ___ft	OR → BARRIER EDGE or DETRITUS 4A ___ft	ORGANIC ECOLOGIC or REEF 5A ___ft	BARRIER EDGE or SANDS 5B ___ft	BARRIER EDGE or MUDS 5C ___ft	SEMI-RESTRICTED CARBONATES 6 ___ft	RESTRICTED CARBONATES 7 ___ft	EVAPORITIC CARBONATES 8 ___ft	EVAPORITES 9 ___ft	TERRIGENOUS CLASTICS 10 ___ft
FACIES SYMBOL													
LITHOLOGY	CALCAREOUS TO NON-CALCAREOUS SHALE LOCALLY PYRITIC	CALCAREOUS SHALE LOCALLY PYRITIC	INTERBEDDED SEQUENCES OF CALCAREOUS SHALE AND ARGILLACEOUS CALCILUTITE	LIMESTONE OR DOLOMITE CALCILUTITE, PELLETAL OR GRUMULOUS TEXTURE, VARYING AMOUNTS OF BIOCLASTIC DEBRIS (5-25%)	ABSENT IN AREA OF STUDY, BUT OBSERVED 22 MILES TO THE NORTHWEST AT WAPIABI CREEK TRANSPORTED BIOCLASTIC DEBRIS IN CALCILUTITE MATRIX OOLITIC-OOLITHIC ADMIXTURE.	FACIES GROUPS 5A AND 5B ARE COMBINED WITHIN THIS DEPOSITIONAL SEQUENCE. DOLOMITE, SKELETAL CALCIRUDITE, GRAIN TO MUD SUPPORTED, INTERBEDDED WITH ARENITES AND LUTITES, RIGID FRAME MARK IN PARTS		ABSENT IN THE DEPOSITIONAL SEQUENCE OF AREA OF STUDY BUT PRESENT ELSEWHERE IN THE ROCKY MOUNTAINS, FOOTHILLS AND ALBERTA PLAINS (e.g. WAPIABI CRK. N.W. (LSD 8, 1/4 MILE FROM TIME EQUIVALENT OPEN MARINE SHALE)	DOLOMITE, VF-VERY COARSE, UNDOLOMITIZED PORTIONS SHOW PELLETAL AND GRUMULOUS TEXTURE WITH MINOR BIOCLASTIC ADMIXTURE	DOLOMITE, VF-COARSELY CRYSTALLINE, PELLETAL AND GRUMULOUS TEXTURE IN UNDOLOMITIZED SEQUENCE, BIROSEYES	ABSENT IN THIS DEPOSITIONAL SEQUENCE AND NOT OBSERVED ELSEWHERE IN THE ROCKY MOUNTAINS FACIES SPECTRUM OCCURS IN THE SUBSURFACE. TIME EQUIVALENT OF THE FOOTHILLS AND SOUTH ALBERTA PLAINS (i.e. DUPEROW FORMATION)		
COLOR	BROWN TO BLACK	GREENISH GRAY TO BLACK	MEDIUM GRAY TO BUFF	LIGHT TO MEDIUM GRAY	LIGHT GRAY	MEDIUM GRAY TO BROWNISH BLACK		LIGHT GRAY - WHITE	LIGHT GRAY WITH MEDIUM-DARK GRAY INTERCALATIONS	LIGHT GRAY WITH MEDIUM-DARK GRAY INTERCALATIONS			
GRAIN TYPE AND DEPOSITIONAL TEXTURE	MUDSTONE	MUDSTONE	WACKESTONE, WHOLE FOSSIL COQUINAS ARE COMMON, CRINOID PACKSTONE	WACKESTONE - PACKSTONE	GRAIN AND PACKSTONE	CORAL BOUNDSTONE, CORAL GRAINSTONE ALL GRADATIONS TO WHOLE FOSSIL WACKESTONE		CRYSTAL SIZE IS NOT RELATED TO ORIGINAL TEXTURE RELICTS SUGGEST MUDSTONE ORIGIN THROUGHOUT	DOLOMITE CRYSTAL SIZE IS UNRELATED TO ORIGINAL TEXTURE MUDSTONE AND WHOLE FOSSIL WACKESTONE	CRYSTAL SIZE (DOL.) UNRELATED TO ORIGINAL TEXTURE RELICTS INDICATE MUDSTONE AND STROMATOLITIC BOUNDSTONE			
BEDDING	CENTIMETER BEDDING MILLIMETER LAMINATION	CENTIMETER BEDDING MILLIMETER LAMINATION	THIN BEDDING	MEDIUM BEDDING	THIN - MEDIUM BEDDED	THIN TO THICK BEDDED, EXFOLIATION WEATHERING IS COMMON		MASSIVE BUT WELL BEDDED, LOCALLY CAMOUFLAGED BY RECRYSTALLIZATION	THIN TO MASSIVE, WELL BEDDED	WELL BEDDED (DM) WELL LAMINATED			
SEDIMENTARY STRUCTURES	SLUMP STRUCTURE, EVEN LAMINATION, NON-BURROWED	SLUMP STRUCTURE, EVEN LAMINATION	PROMINENT NODULAR TEXTURE SEDIMENTARY BOUDINAGE	CALCILUTITE MATRIX WITH MINOR BURROWING INCOME OF BIOSTROMES (BOTH GRAIN AND MUD SUPPORTED)	FORESET BEDDING	SUPERIMPOSED BIOSTROMES SEPARATED BY THIN AND LAMINATED, RESTRICTED CARBONATE INTERVALS CORAL COLONIES OCCUR BOTH IN GROWTH AND OVERTURNED POSITION DEFINITE FAUNAL ZONATION WITHIN BIOSTROMES		LAMINATED IN PARTS (PROBABLE STROMATOLITES)	MINOR ZONES WITH LAMINATIONS (PROBABLE STROMATOLITES)	WELL LAMINATED BRECCIATED IN PARTS WITH LITTLE OR NO TRANSPORT) STROMATOLITES, SACCHAMS HEMISPHEROIDAL ALGAL NODULES DESICCATION CRACKS		
TERRIGENOUS CLASTICS ADMIXED OR INTERBEDDED	ESSENTIALLY ARGILLACEOUS. LOCAL HIGH QUARTZ SILT CONTENT.	ESSENTIALLY ARGILLACEOUS LOCAL HIGH QUARTZ SILT CONTENT	INTERBEDDED LITHOLOGIES WITH VARYING AMOUNTS OF ARGILLACEOUS MATERIAL	ARGILLACEOUS CONTENT IS NEGLIGIBLE OR ABSENT	ARGILLACEOUS CONTENT IS NEGLIGIBLE OR ABSENT	TERRIGENOUS CONTENT IS ABSENT OR NEGLIGIBLE		TERRIGENOUS CONTENT IS ABSENT OR NEGLIGIBLE	TERRIGENOUS CONTENT IS ABSENT OR NEGLIGIBLE	TERRIGENOUS CONTENT IS ABSENT OR NEGLIGIBLE			
BIOTA a) GENERAL DESCRIPTION b) DISTRIBUTION Dominant ——— Accessory - - -	RARE PELAGIC FAUNA TO BARREN.	RARE PELAGIC FAUNA TO BARREN, TRACE OF MARINE ALGAE AND FORAMINIFERA	FACIES IS CHARACTERIZED BY ABUNDANT FAUNA	MIXED FAUNA DECREASE OF CRINOID-BRACHIOPOD ASSEMBLAGE INCREASE OF CORAL COMPONENT	MIXED AND ABRADED FAUNA	EXTREMELY FOSSILIFEROUS AND BIOSTROMAL		RARE FAUNA POSSIBLE STROMATOPOROID CONTENT IS BASED ON SHAPE OF LARGE VUGS STROMATACTOIDS, BIROSEYES, STROMATOLITES AND ALGAL BALLS ARE INDICATED	PROMINENT DECREASE IN FAUNAL CONTENT CORAL COMPONENT GIVES WAY TO GASTROPOD-OSTRACOD ASSEMBLAGE.	NUMEROUS STROMATACTOID AND ALGAL ZONES			
TENTACULITES/STYLIOLINA													
CONODONTS													
BRACHIOPODS													
BRYOZOA													
SOLITARY CORALS													
CORAL COLONIES													
STROMATOPOROIDS				STROMATOPOROIDS OCCUR ABUNDANTLY IN UNDERLYING CAIRN FM, PRESENT IN SOUTHESK FM IS GREATLY REDUCED									
AMPHIPORA				AMPHIPORA OCCUR ABUNDANTLY IN UNDERLYING CAIRN FM, PRESENCE IN SOUTHESK FM IS GREATLY REDUCED									
GASTROPODS													
CRINOIDS													
OSTRACODS													
CALCISPHERES													
GEOCHEMICAL DATA	X-RAY DIFFRACTION Sr, Rb, Mn, Ni, Fe, K MAXIMA					X-RAY DIFFRACTION Sr, Rb, Mn, Ni, Fe, K MINIMA; RELATIVE HIGH KEROGEN CONTENT → MINIMUM KEROGEN CONTENT							
DIAGENETIC FEATURES POROSITY DEVELOPMENT	FOSSILS PARTIALLY PYRITIZED NO POROSITY DEVELOPMENT	FOSSILS PARTIALLY PYRITIZED NO POROSITY DEVELOPMENT	SECONDARY CHERT NODULES AND LENSES ARE COMMON NO POROSITY DEVELOPMENT	VUGGY POROSITY DEVELOPMENT IN DOLOMITIZED PORTIONS IS DUE TO FOSSIL LEACHING	NO POROSITY AT WAPIABI CREEK DUE TO NON-DOLOMITIZATION	TINA CK N 75' WITH 3% AV POR TINA CK S 105' WITH 3% AV POR CRIPPLE CK 185' WITH 2.5% AV POR GERTIE CK 68' WITH 2.5% AV POR ANN CK 123' WITH 1% AV POR			NELL CK 30' WITH 3% AV POR	BOUNDARY CK 13' WITH 3% AV POR			
RECORDED VELOCITIES	14,000 - 18,000 FT/SEC DEPENDING ON CALCAREOUS CONTENT		17,000 - 19,000 FT/SEC DEPENDING ON ARGILLACEOUS CONTENT			20,000 - 22,000 FT/SEC							
RESERVOIR DATA	NO RESERVOIR DEVELOPMENT	NO RESERVOIR DEVELOPMENT	NO RESERVOIR DEVELOPMENT	NO INFORMATION		SHELL PANTHER RIVER NO.1 SOUTHESK FM 39 FT NET POROUS INTERVAL WITH 4.7% AV POR				SHELL PANTHER RIVER NO.2 SOUTHESK FM 115 FT NET POROUS INTERVAL WITH 7.4% AVERAGE POROSITY			

ENVIRONMENTAL CARBONATE FACIES GROUPING

AUTHOR	AREA AND INTERVAL OF STUDY	GROUP 1 RESTRICTED MARINE SHALE (EUXINIC)	GROUP 2 OPEN MARINE SHALE	GROUP 3 OPEN MARINE CARBONATE-SHALE	GROUP 4 OPEN MARINE CARBONATES	GROUP 4A BARRIER EDGE DETRITUS	GROUP 5 ORGANIC (ECOLOGIC) REEF	GROUP 6 SEMI-RESTRICTED CARBONATES	GROUP 7 RESTRICTED CARBONATES	GROUP 8 EVAPORITIC CARBONATES	GROUP 9 EVAPORITES	GROUP 10 TERRIGENOUS CLASTICS	REMARKS
DOOGE 1966	ROCKY MOUNTAINS CANADA UPPER DEVONIAN FRASNIAN	Dark brown - black bituminous shale facies.	Greenish-grey to dark grey calcareous shale facies.	Medium grey-buff argillaceous limestone-Calcareous shale facies.	Light-medium grey coralline limestone facies.	Absent in Cripple Creek area but observed locally (e.g. Waplabi Creek 22 miles to the northwest).	Dark brown biostromal dolomite facies. Amphipora-stromatoporoid assemblage in Lower Fairholme versus predominantly coralline assemblage in upper part. Light grey biostromal dolomite.	Light grey, slightly fossiliferous dolomite facies. Mixed coral-gastropod-ostracod fauna.	Light grey laminated dolomite facies. Algal-gastropod-ostracod fauna.	Absent in this depositional sequence. Facies Groups 8, 9, 10 occur in time-equivalent sequences of the subsurface Duperow Formation of the Interior Plains.			Based on carbonate-shale transition occurring between North and South Ram Rivers.
PRICE 1964	ROCKY MOUNTAINS CANADA UPPER DEVONIAN FRASNIAN	Perdrix Formation (undifferentiated)		Mount Hawk Formation.	Absent in this depositional sequence.	Tapering wedges of light grey dolomite, reported as coarse skeletal detritus.	1) Dark 'organic' transitional facies of the Lower Southesk Formation. 2) Biostromal dolomite in Upper Southesk. 3) Dark organic biostromal dolomite of Borsato Formation.	Insufficient detail precludes definition of Facies Groups 5, 6 and 7 in the light grey dolomite sequences of the Southesk Formation of the carbonate complex in this area.		Absent in Upper Fairholme (i.e. Southesk-and Borsato Formation). Presence in Hollebeke Formation is primarily based on occurrence of solution-collapse breccias due to leaching of intercalated evaporites.			Refer to pages of this thesis for more detailed descriptions.
KLOVAN 1964	ALBERTA BASIN (SUBSURFACE) CANADA UPPER DEVONIAN FRASNIAN	"Off-reef equivalents" not reported on in this publication.		1) Klovan's Megalodon Facies is reported as very argillaceous bioclastic limestone, crudely bedded, and with occasional dips of 20 degrees. The mixed fauna consists of both indigenous and transported components. Primarily, the barrier edge detritus facies (4A) is indicated with probable open marine carbonate-shale (3), and possible open marine carbonate (4) sequences. 2) Tabular stromatoporoid facies.			1) Klovan's organic reef facies. 2) Massive stromatoporoid detritus facies. 3) Skeletal calcarenite facies. (Partially).	1) Skeletal calcarenite facies (partially). 2) Cream to white, predominantly non-skeletal, calcarenite facies.	1) Laminite facies. 2) Dense, bored calcarenite facies. 3) Non-skeletal calcirudite facies.	Not established within this depositional sequence.		Green calcareous shale facies. Thin bedded shale, partly occurring as matrix of limestone-breccia indicative of solution and/or disruption at exposed surface.	The excellent preservation of sedimentary texture and faunal content in the limestones of the Redwater reef complex permits a detailed facies analysis.
MURRAY 1965	ALBERTA BASIN (SUBSURFACE) CANADA MIDDLE-UPPER DEVONIAN FRASNIAN-GIVETIAN	1) Dark brown calcareous shale with dwarf brachiopod fauna, indicative of restricted marine, stagnant environment, predominantly Facies 1. 2) Dark green calcareous shale; probably transitional between Groups 1 and 2.		Nodular argillaceous limestone with prominent benthonic fauna.	Light grey, slightly argillaceous limestone. Faunal assemblage (10-30%) consists predominantly of corals, lamellar stromatoporoids and amphipora, with minor crinoid-bryozoa admixture.	Thin beds of barrier edge detrital carbonate occur along windward side of complex (northeast). Dips range from 5-15 degrees.	1) "Black Reef", 75% stromatoporoid-Amphipora content, organic lattice. 2) Light buff limestone 60-100% stromatoporoid-Amphipora-coral content.	1) Light buff lime mud, 5-30% Amphipora-ostracod-gastropod admixture. 2) Dark brown lime mud, 10-40% Amphipora.		Absent in this depositional sequence.			Limestone buildups composed of superimposed layers of toll-like deposits, the areal extent of which decreased gradually with continuing subsidence.
EDIE 1961	ALBERTA BASIN (SUBSURFACE) CANADA	Grey brown, and black, very slightly calcareous shale. Trace fossil content consisting of Tentaculites, Lingula and crinoid ossicles.		Dark brown, argillaceous and cherty limestone. Predominantly crinoid-brachiopod assemblage.									
		EDIE'S "OFF-REEF SEQUENCE"		"SKELETAL" LIMESTONES				"PRECIPITATED" LIMESTONES					
JUX 1960	RHEINISCHES SCHIEFERGEBIRGE GERMANY MIDDLE-UPPER DEVONIAN COUVINIAN-FRASNIAN	Dark grey-brown Styliolina shales.	"Tentaculites-shales" sandy, calcareous shales with Tentaculites-Styliolina-Brachiopod-Pelecypod assemblage.	"Kalk-Mergel Schiefer". Rubbly, nodular, limestone. Shale sequences. Crinoid-brachiopod assemblage.	Absent in this depositional sequence.	Transported Hexagonaria-bearing limestone blocks and strata encased by, or intercalated with, open marine carbonate-shale sequences.	Dome-shaped (biohermal) accumulation of Hexagonaria-, Alveolites-, Amphipora-, stromatoporoid-, and Caespitosum Biostromes.	Absent in this depositional sequence.					These reefs are placed in the zone of turbulence. Open marine coralline limestones (Group 4) occur in Frasnian
DOOGE 1966	YUKON AND NORTHWEST TERRITORIES, CANADA LOWER DEVONIAN	Brown to black, slightly calcareous to non-calcareous shales, evenly laminated and non-burrowed quartz silt and kerogen admixture, sparse (locally pyritized) pelagic fauna or non-fossiliferous, Tentaculites-Styliolina assemblage.	Medium grey to black calcareous shale and mudstone, evenly laminated and non-burrowed, varying amounts of quartz, silt admixture, sparse (locally pyritized) pelagic fauna consisting of Styliolites, Tentaculites with brachiopod admixture, secondary chert nodules and lenses.	Interbedded sequences of calcareous shale and nodular argillaceous calcilutite, with varying amounts of bioclastic debris (wackestones predominate). Light to dark grey, churned and burrowed, very fossiliferous Faunal assemblage consists of brachiopods, crinoids, bryozoa, trilobites and gastropods.	Light to dark grey, very fossiliferous limestone, wacke-, pack-, and grainstones, well-bedded in medium to thick units, churned and burrowed, slightly argillaceous in parts, very fossiliferous, mixed fauna consisting of crinoid brachiopod - coral stromatoporoid assemblage.	Not clearly defined in depositional sequence.	Stromatoporoid-coral biostromes occur intercalated with open marine limestones at the Lower Devonian shelf edge in the Royal Creek area (Northern Yukon).	Light to dark grey, brown to black, very fine to coarse dolomite with varying amounts of bioclastic debris (wackestone), well-bedded in thin to thick units, laminated in parts, burrowed in parts, negligible amount of silt-clay admixture, marked decrease in faunal content, brachiopod coral stromatoporoid - ostracod calcisphere assemblage.	Light and dark grey (locally thinly interbedded: zebra-rock), pelletal to grumulous calcilutite (extensively dolomitized), very fine to very coarse dolomite, well-bedded, laminated, minor burrowing, silt-and clay content is negligible or absent. Birdseyes, stromatolites, dasycladacea are common. Ostracod-calcispheres are dominant.	Light grey and brown, subilthographic, evaporitic dolomite. Even and undisturbed deposition, well-bedded and extensively laminated, practically non-burrowed, desiccation cracks occur. Slight admixture of wind-blown quartz silt and argillaceous material.	Grey, brown and variicolored bedded anhydrite and "primary dolomite", laminated, non-burrowed, extensive occurrence of solution-collapse breccias, carbonate intercalations contain ostracod calcisphere assemblage.	Light grey, brown, red, yellow and green mudstone, shale, silt-and sandstone. Floating sand grains, argillaceous admixture and conglomerates are common. Indigenous fauna has not been observed.	Abrupt (wedge-shaped) carbonate-shale transition occurs at Royal Creek (Northern Yukon).
LECOMPTE 1957-59	ARDENNES MOUNTAINS BELGIUM UPPER DEVONIAN FRASNIAN	Dark grey to black shales, calcareous in parts, barren or with sparse pelagic and/or dwarfed fauna.		"Calcaire Nodulaire et Subnodulaire" argillaceous limestone with brachiopod-crinoid-bryozoa assemblage.	1) Limestones of the coralline zone, occurring in basal portions of F-2-D, F-2-H, and all of F-2-J reef levels. 2) Limestone in "Zone of Transition" Mixed fauna: Lamellar stromatoporoids and Alveolites with prominent brachiopod admixture.	Detrital talus carbonates on the flanks of F-2-D and F-2-H reefs.	Limestones in Zone of Turbulence characterized by massive stromatoporoids, branched stromatoporoids, tabulate corals, and massive tetra corals.	Absent in this depositional sequence.					Lecompte stresses bathymetric pattern of the dominant faunal assemblages. Deep coral reefs versus shallow stromatoporoidal reefs are indicated.

DIAGRAM ILLUSTRATING APPLICATION OF UNIFIED FACIES MODEL CONCEPT TO VARIOUS CARBONATE SEQUENCES IN CANADA AND ABROAD, BY JASPER DOOGE