ABSTRACT

The Sequence Stratigraphic Evolution of the Sturgeon Lake Bank,
Central Alberta, Canada and its Regional Implications

Julia A. Kahmann

Mentor: Stacy C. Atchley, Ph.D.

Sturgeon Lake South (SLS) is an isolated Devonian (Late Frasnian) platform located within the Western Canada Sedimentary Basin (WCSB). Stratigraphic correlation of the Leduc Formation across the WCSB reveals a dominantly backstepping stratal geometry. The Sturgeon Lake South bank complex is composed of 12 retrogradationally stacked depositional sequences. Sequences 1 and 2 prograde, and sequences 3-6 backstep. Bank formation and stratal geometries are controlled by eustatic sea level fluctuations in concert with: 1) a northeasterly paleowind direction that induced highly aggradational windward margins, 2) antecedent topographic highs (e.g., Peace River Arch) that induced progradational margins and, 3) sediments derived from the Antler Orogeny that increased marine turbidity and influenced the termination of platform growth. Within the Leduc Formation at SLS, dolomitization is pervasive and fabric destructive, enhances reservoir quality, and is not facies specific. Dolomitization most likely occurred within the burial environment.

The Sequence Stratigraphic Evolution of the Sturgeon Lake Bank, Central Alberta Canada and its Regional Implications

by

Julia A. Kahmann, B.S.

A Thesis

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Steven G. Driese, Ph.D., Chairperson

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Stacy C. Atchley, Ph.D., Chairperson

Steven I. Dworkin, Ph.D.

Darrell S. Vodopich, Ph.D.

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J. Larry Lyon, Ph.D., Dean

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CHAPTER ONE

Introduction

Purpose

This study presents a sequence stratigraphic interpretation for the Devonian (Frasnian) Leduc Formation at the Sturgeon Lake South bank complex, Central Alberta, Canada based upon an integrated dataset of core and wireline logs. The study includes a regional sequence stratigraphic interpretation that extends from the Peace River Arch to the Rimbey-Meadowbrook Trend in the Western Canada Sedimentary Basin.

The Western Canada Sedimentary Basin is a substantial hydrocarbon producer. Reserves primarily occur within large, reefal stratigraphic traps of Devonian age (Potma *et al.*, 2001). The porosity of hydrocarbon reservoirs within the Leduc is largely secondary and associated with dolomitization. The paragenetic history of diagenetic alteration within the Leduc Formation at Sturgeon Lake South provided in this study establishes the major controls and timing of reservoir enhancement and destruction.

This study has two primary objectives: 1) the interpretation of the sequence stratigraphy of the Leduc Formation within the Sturgeon Lake South region, and 2) the determination of the local and regional controls on carbonate sedimentation. Three controls, in tandem with composite fluctuations in sea level, likely influenced carbonate deposition: 1) antecedent topography, 2) windward-leeward effects, and 3) proximity to a continental landmass. These controls will be evaluated and summarized from stratigraphic cross-sections generated through the correlation of wire-line logs.

Regional Setting and Location

The Western Canada Sedimentary Basin is a 6 km thick northeast trending wedge of sedimentary rocks that extends from the Canadian shield southwest to the Cordilleran foreland thrust belt (Stoakes *et al*, 1992). The Western Canada Sedimentary Basin is underlain by Archean and Proterozoic crystalline basement (Stoakes *et al*, 1992). The major structural elements that served as antecedent paleotopographic highs during the Devonian are the Peace River Arch northwest of the basin, the Swan Hills High (Windfall area), and the Western Alberta Ridge extending south of the study area (fig. 1). During the Devonian and Mississippian, the Western Canada Sedimentary Basin

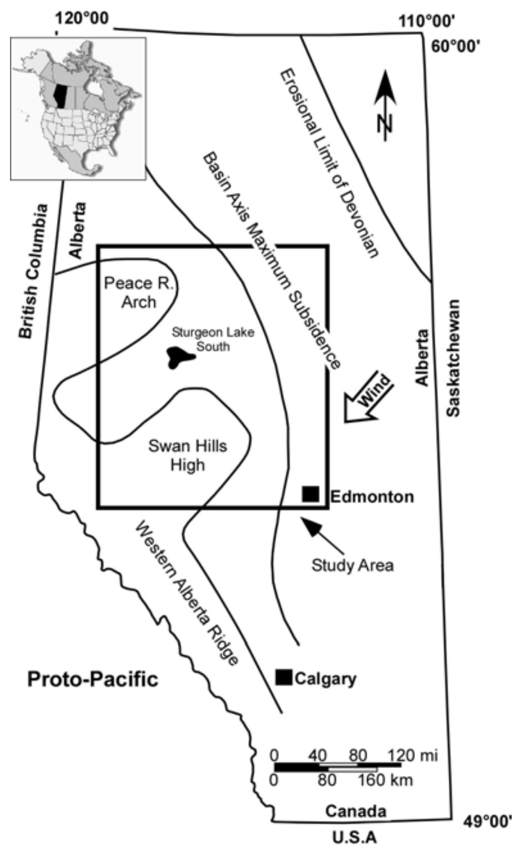


Figure 1. Structural provinces of the Western Canada Sedimentary Basin (modified from Potma et al 2001). The boxed region represents the study area. Sturgeon Lake South is placed in an approximate location and is not to precise scale.

is interpreted to have been a distal foreland basin to the Antler fold and thrust belt (Root, 2001).

During the Middle to Late Devonian the Western Canada Sedimentary Basin was located in the southern hemisphere and the paleo-equator trended NE through the present Canadian Arctic Archipelago (Witzke and Heckel 1988). This places the Western Canada Sedimentary Basin within the easterly trade wind belt (fig. 2). Facies distributions and stratal stacking patterns indicate a northeasterly paleo-wind direction for the Western Canada Sedimentary Basin (Potma *et al*, 2001).

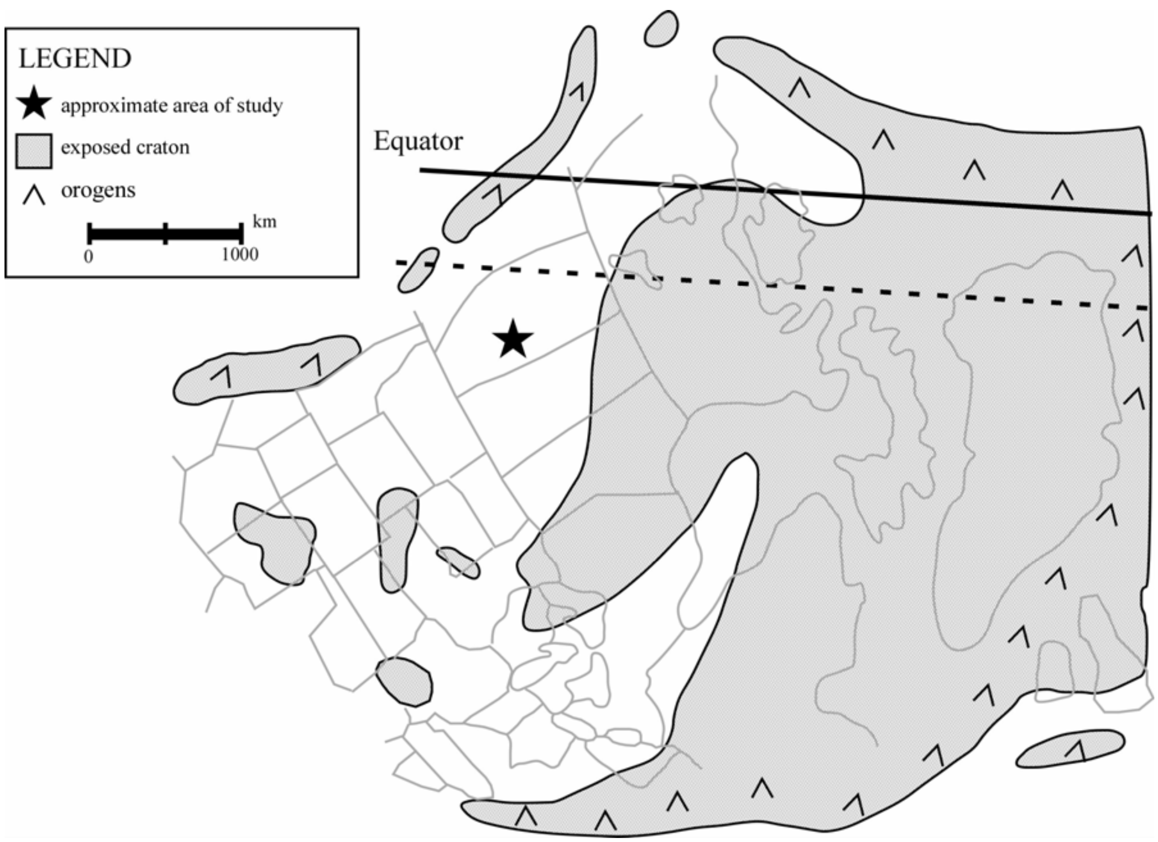


Figure 2. Paleogeographic map for the Late Devonian. The dashed line parallel to the equator is the interpreted climate boundary between arid and humid regions, humid to the north and arid to the south (Witzke, 1990).

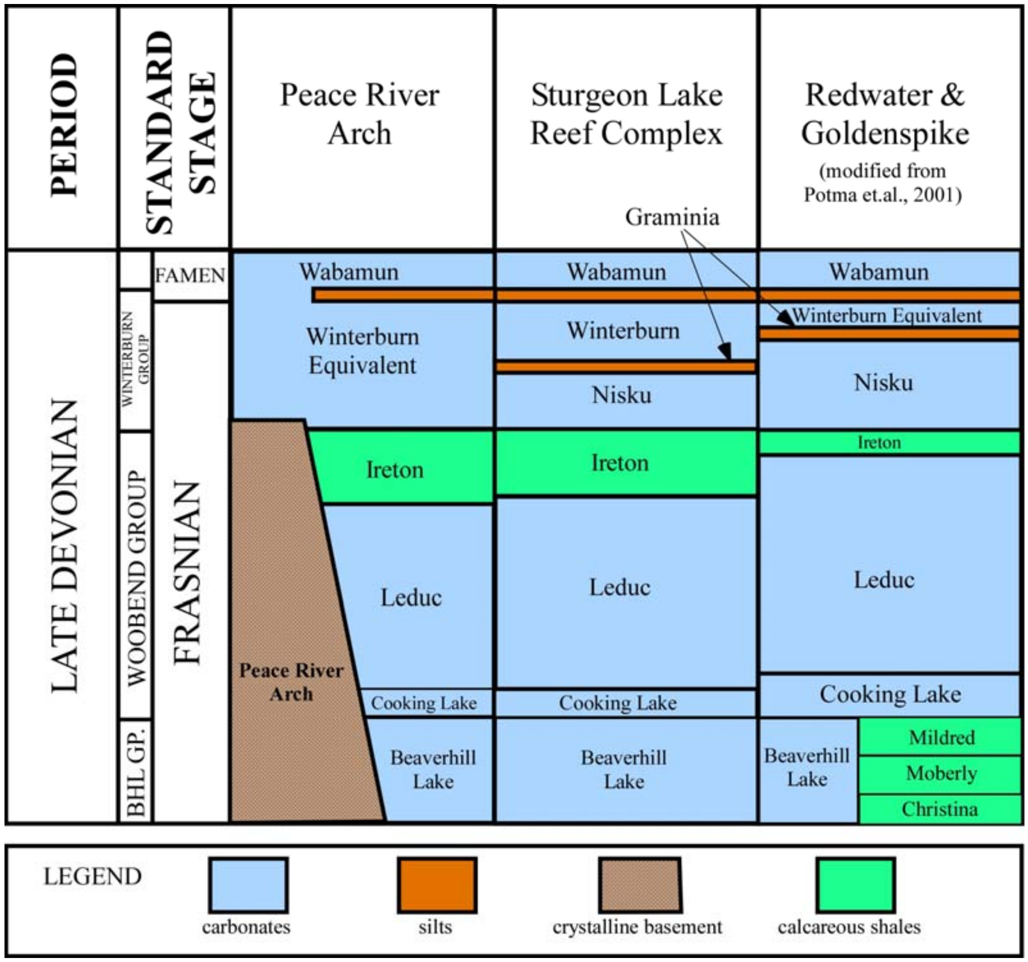


Figure 3. Generalized stratigraphic correlation chart for the Frasnian and early Famenian(modified from Potma et al, 2001; Weissenberger, 1994; and unpublished charts created by the Alberta Energy and Utilities Board).

During the mid-Frasnian, the Woodbend Group, including a majority of Leduc reef development, was deposited in the Western Canada Sedimentary Basin (fig. 3). From oldest to youngest, the Leduc formation in the Western Canada Sedimentary Basin spans the following standard conodont biozones: the Upper *assymmetricus* Zone, the *Ancyrognathus triangularis* Zone, and up to the base of or within the *Palmatolepis gigas* Zone (Weissenberger, 1988). The presence of the rugose coral *Smithiphyllum meridianum* places the Leduc Formation at Sturgeon Lake and the Rimbey-Meadowbrook Reef trend within the middle to late Frasnian (McLean and Klapper, 1998). To the west along the flanks of the Peace River Arch, carbonate accumulations occur as a fringing reef complex (Dix, 1990; Read, 1985; Stoakes *et al*, 1992), whereas further to the east carbonate accumulations occur as isolated banks (*sensu* Read, 1985). Sturgeon Lake is an isolated bank located between the Peace River Arch and Swan Hills High (fig. 1). Further to the east is a linear trend of isolated banks known as the Rimbey-Meadow Brook Trend that include the major hydrocarbon accumulations at Redwater and Golden Spike (fig. 4).

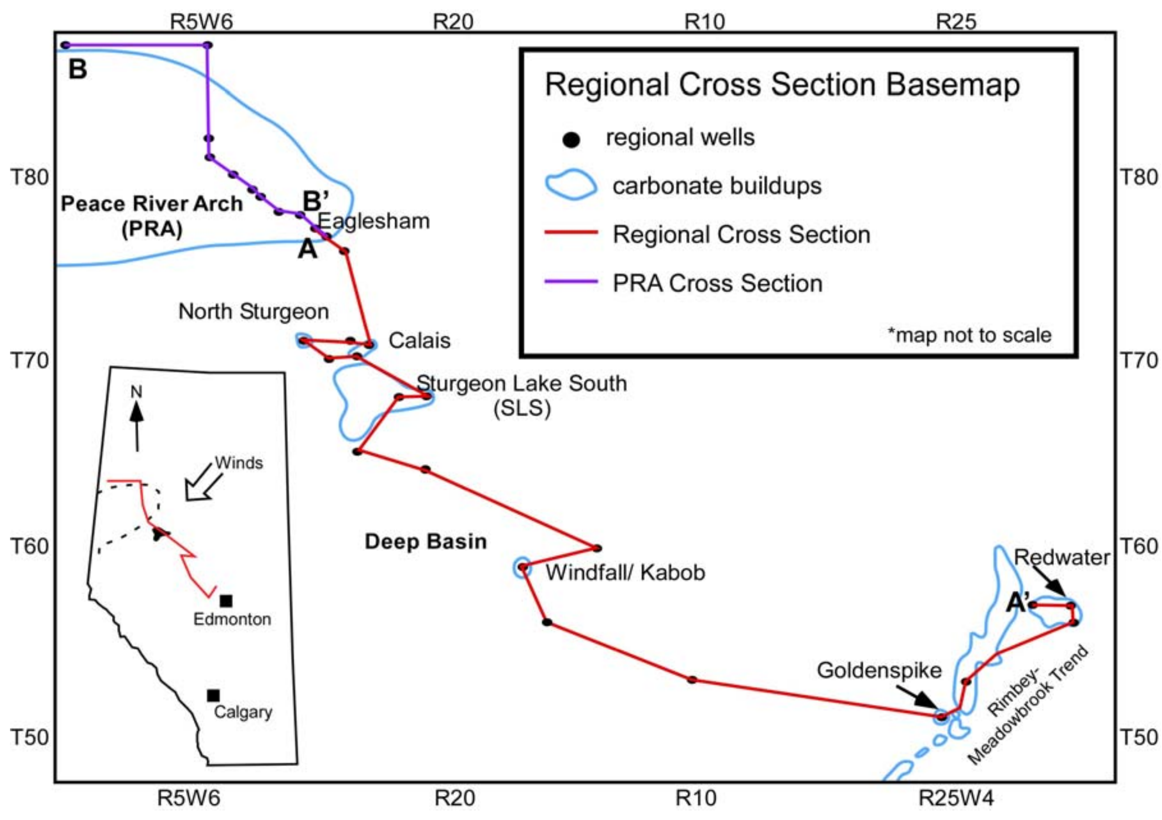


Figure 4. Basemap for the regional cross sections.

Methodology

Facies Determination

Facies were observed and determined through core description (Appendix A). The criteria by which the facies in Sturgeon Lake South were identified include grain type, texture, sedimentary structures, and the presence of organic binding. Unless otherwise stated, all grains and mud are replaced by dolomite throughout the study interval. The Dunham (1962) and Embry and Klovan (1971) classification schemes for carbonates were used to describe carbonate rock textures for each facies designation. Based upon the above criteria and the position of facies within a gradational succession depositional environments were interpreted (fig. 5, table 1).

Paleobathymetry was determined from core-calibrated stratigraphic cross sections at Sturgeon Lake South by documenting the vertical distance between decompacted facies transitions observed within individual sequences (Appendix C, L-15). The Interior Facies Association accumulated at or near seal level, and was used as a bathymetric datum from which the accumulation depth of coeval facies was measured. Facies thicknesses were decompacted using Goldhammer's (1997) graphical decompaction method for carbonate muds and sands. These solutions do not account for (1) porosity reduction by cementation, (2) diagenetic parameter changes due to time, temperature, and variations in fluid composition, or (3) chemical compaction (Goldhammer, 1997). An overburden of ~1800 m was assumed for the decompaction (Appendix C, L-15).

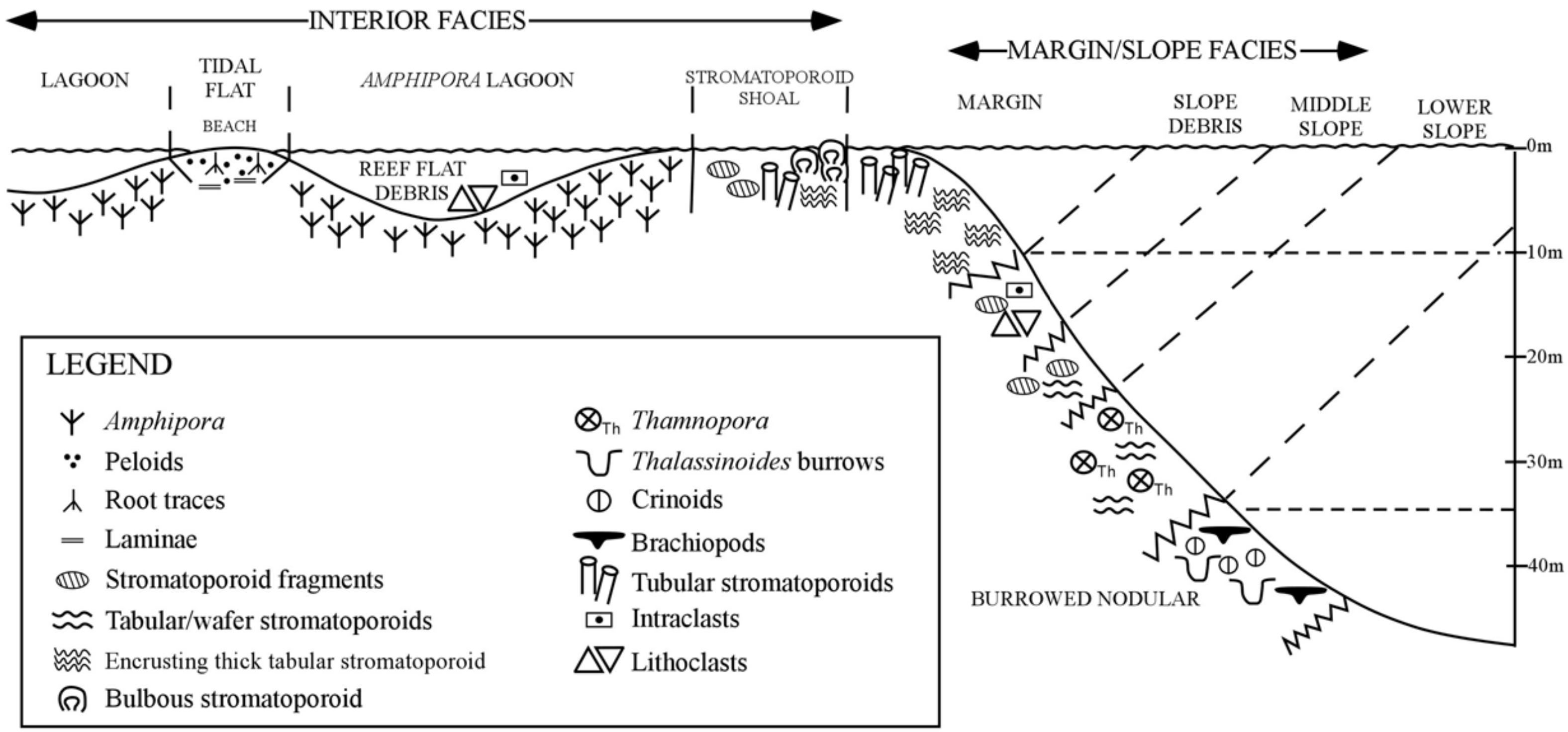


Figure 5. Sturgeon Lake South (SLS) facies model. A summary of facies attributes is provided in Table 1.

Table 1. Facies summary table to be used in conjuction with Figure 5.

FACIES	ALLOCHEMS	DIAGNOSTIC CHARACTERISTICS
BURROWED NODULAR	• Brachiopods • Crinoids • Rugose corals	*Thalassinoides* burrows pinching and swelling laterally, dark color and argillaceous
LOWER SLOPE	• *Thamnopora* • Thin wafer stromatporoids	Light/beige gray color, stomatoporoid moldic porosity
SLOPE SAND	Undifferentiated grains	Little to no mud matrix, rare burrowing
UPPER/ MIDDLE SLOPE	Sparse encrusting Stromatporoids	Increasing abundance of stromatoporoids
SLOPE DEBRIS	• Lithoclasts • Intraclasts	Green argillaceous clay or anhydrite matrix, sub-round to sub-angular clasts
MARGIN	Stromatoporoids	Bulbous, thick, encrusting and tabular stromatoporoids, growth frameworks porosity at times filled with anhydrite or other cement
STROMATOPOROID SHOAL	• Rare *Amphipora* • Stromatoporoids	Bulbous and tubular stromatoporoids, more mud in comparison to the margin
AMPHIPORA LAGOON	*Amphipora*	Either a light or dark color indicative of open vs. restricted conditions
BEACH	• Peloids • *Amphipora* • Undifferentiated grains	Low ratio of mud to grains, good interparticle porosity
TIDAL FLAT	Rare skeletal grains	Fine laminations, root traces
EXPOSURE	• Stromatoporoid fragments • Skeletal grains	Root traces, sub-angular/sub-rounded clasts floating in a matrix of green argillaceous clay

Stratigraphic Framework

Using the IHS AccuMap™ oil and gas database, wireline logs were acquired and incorporated into cross sections for Sturgeon Lake South, Calais and North Sturgeon (Sturgeon Lake Reef Complex). Sturgeon Lake South cross sections incorporate 243 wells (70 of which include a total of 1,258 m core) within a grid of 5 dip and 13 strike sections (Appendix C, L-1 and L-15). Stratal surfaces and facies distributions were loop-tied within the cross section grid. The North Sturgeon line of section incorporates 5 wells that include 6 m of core (Appendix C, C-C'). Wells 00/15-24-69-23W5 and 00/15-13-68-23W5 of the North Sturgeon line of section are tied to cross-sections L1 and L16 of Sturgeon Lake South respectively. The Calais line of section incorporates 5 wells and 114 m of core, and tied to North Sturgeon at well 00/9-72-24W5 (Appendix C, D-D'). Core descriptions for all wells include documentation of major allochems, sedimentary structures, fracture density, lithology, cement, and porosity types (Appendix A). The Beaverhill Lake Group platform top is known to have negligible depositional dip across a broad area and has been used as a datum in previous studies (e.g. Potma et al, 2001). In order to utilize the Beaverhill Lake Group as a stratigraphic datum, well penetrations must be deep. Deep penetrations rarely exist at Sturgeon Lake South, and therefore, the cross sections were stratigraphically datumed on the relatively flat-lying Graminia silts that overlie the Nisku Formation at Sturgeon Lake South (fig. 3).

The regional stratigraphic framework integrates the correlations at Sturgeon Lake South with data and interpretations published by Potma *et al* (2001), as well as other wells extending across the region (fig. 4). Twenty-one wire-line logs were incorporated into a regional cross section that extends from the fringing reef at Eaglesham, to the the

Rimbey-Meadowbrook Reef Trend (Appendix C, A-A'). Of the 21 wells, 5 wells include a total of 198 m of core. Cross section A-A' is tied to cross-sections at North Sturgeon (Appendix C, C-C'), Calais (Appendix C, D-D'), and Sturgeon Lake South. Wells with deep penetrations are available throughout the regional section, and the Beaverhill Lake platform top carbonates are used as a stratigraphic datum. For the Peace River Arch, a second cross-section was constructed (Appendix C, B-B'). Wire-line logs from 12 wells were correlated, and the Wabamun Group platform top carbonates were used as a stratigraphic datum (*sensu* Stoakes *et al*, 1992).

Sequence Stratigraphic Nomenclature

Lithostratigraphic terminology used for the Woodbend and Winterburn units in this study is consistent with the nomenclature used by Potma *et al* (2001), Stoakes *et al* (1992), and Weissenberger (1994) (fig. 3). Using the criteria of Van Wagoner *et al* (1989), decameter-scale, shallowing upward facies successions are observed and are described as sequences in this study. Each sequence is composed of meter-scale cycles a.k.a. parasequences *sensu* Van Wagoner *et al*, 1989. The criteria used to identify sequences in core include:

1. Evidence of prolonged subaerial exposure, including the presence of green shale (e.g. Potma *et al*, 2001; Stoakes *et al*, 1992).
2. Surfaces of pronounced facies backstep (deepening).

When core was not available, the following criteria were used in the analysis of wireline logs:

1. An abrupt gamma-ray increase of ≥ 10-15 API units relative to underlying and overlying clean carbonate (suggestive of green shale). Gamma ray spikes are thin (< 1 m).
2. An abrupt decrease in neutron/density porosity and no curve separation, suggestive of a possible flooding surface associated with deeper-water limestone facies.

Correlation of surfaces within the Ireton shale and its correlative units are based exclusively on wireline logs. *Cycles* of gamma ray activity and resistivity were correlated across the study area.

Diagenesis

The paragenetic history of the Leduc Formation within the study area was reconstructed by thin section petrography. Forty-three thin sections were cut from core samples representative of the facies interpreted at Calais, North Sturgeon and Sturgeon Lake South. Thin sections were also made from core samples adjacent sequence boundaries. To distinguish porosity, calcite, ferroan dolomite, and non-ferroan dolomite, thin sections were vacuum impregnated with blue epoxy and stained with Alizarin Red-S and potassium ferrocyanide as prescribed by Friedman (1959), Evamy (1963) and Lindholm and Finkelman (1972). Thin sections were described in detail, and diagenetic features that either enhanced or destroyed reservoir quality were systematically documented (Appendix B). The paragenetic reconstruction incorporates both petrographic and macromorphic observations in core, and is based upon the principle of cross-cutting relations.

Reservoir Quality Maps and Statistical Plots

A lithology distribution map for Sturgeon Lake South, along with facies-keyed statistical plots were used to evaluate reservoir quality (Appendix C). The lithology distribution map was generated from core descriptions and was augmented by lithological estimations from neutron-density well logs. Core analysis data complied via IHS Energy Accumap™ was used to generate the facies-calibrated statistical and lithology plots (Appendix C). Core analysis data provide depth calibrated values of porosity, permeability and grain density, and qualitative estimates of fracture density and anhydrite presence (Appendix C).

Facies Maps

Facies maps for each sequence were generated from core-calibrated stratigraphic cross sections (Appendix C). Facies distributions were established directly from core, and were interpolated via well log correlation into areas that lack core control. Structural contours for the top of each sequence were then superimposed upon each facies map at a contour interval of 25 m. The placement of structural contours was guided by 3D seismic data available across the eastern 2/3 of Sturgeon Lake South. Seismic data are industry proprietary, and were not released for presentation.

Previous Works

The Devonian period has been studied extensively in Western Canada. Witzke and Heckle (1988), and Witzke (1990) studied paleoclimate indicators to infer paleogeography throughout the Devonian. Global greenhouse climates were in effect throughout much of the Devonian (Sandberg, 1983; Boucot, 2001). During the

Devonian, the Western Canada Sedimentary Basin developed as a foreland basin to the Antler Orogeny (Cant, 1988; Edwards and Brown, 1999; and Root, 2001).

The age of the Leduc has been constrained by various biostratigraphic methods since 1965. Based on the occurrence and morphology of foraminifera at Redwater and Sturgeon Lake South, Toomey (1965) assigned an Upper Devonian (Frasnian) age for the Leduc reefs. In the Front ranges of Alberta, west-central Alberta, and the central Alberta subsurface, Weissenberger (1994) determined the conodont zonations for the Beaverhill Lake, Woodbend, and Winterburn groups. McLean and Klapper (1998) combined both conodont and rugose biostratigraphy to place the Leduc Formation at Sturgeon Lake South within the Frasnian Stage.

Diagenetic studies of the relationships between Leduc Formation reservoir quality are numerous. Studies of the Redwater and Golden Spike buildups document a complex history of calcite diagenesis and rare dolomitization (Carpenter and Lohmann, 1989; Walls *et al*, 1979). Mountjoy *et al* (1999), Drivet and Mountjoy (1997), Amthor *et al* (1993) provide detailed dolomitization studies of the Rimbey-Meadowbrook Reef Trend that document the textures and timing of various phases of dolomitization. In addition, Machel (1987, 1993) documents the timing of anhydrite emplacement in the Rimbey-Meadowbrook Reef Trend during Leduc deposition. All four studies are used for comparative analysis with the Leduc Formation within the Sturgeon Lake region.

Early studies of Devonian sea-level history within Alberta are those of Andrichuk (1958), Klovan (1964), and Mossop (1972) in the Redwater Reef, and McGillivray and Mountjoy (1975) at Golden Spike. An interpretation of global sea level history for the Phanerozoic is provided by Vail *et al* (1977), and is based upon reflection seismic data.

In Vail (1977), the Devonian is characterized by second order transgression. The hierarchy of Devonian cyclicity has been studied within the Beaverhill Lake Group/Cooking Lake Formation by Potma *et al* (2001), Wendte (1994), and Wong (1980) in productive hydrocarbon reservoirs throughout the Western Canada Sedimentary Basin. The Woodbend and Winterburn Group sea level history has been documented by Potma *et al* (2001), Stoakes *et al* (1992), and Stoakes (1980) through areas of the deep basin and the Rimbey-Meadowbrook Reef Trend.

Sequence stratigraphic studies of the Frasnian in the Western Canada Sedimentary Basin are limited. Stoakes *et al* (1992) identified *megasequences*, i.e. Woodbend Megasequence, Winterburn Megasequence, etc., during the Frasnian, but stratal surfaces associated with each megasequence were not correlated. Dix (1990) correlated sequences traversing the Peace River Arch for the Woodbend and Winterburn Groups, but did not correlate into the deep basin east of the Peace River Arch. Parasequences are observed as the stratal building blocks of the Peace River Arch (Dix, 1990). Potma *et al* (2001) in a study of the Frasnian within the deep basin, Swan Hills, West Pembina, Golden Spike, and Redwater areas provides the most detailed, comprehensive, and biostratigraphically constrained interpretation of second- and third-order sequences. Within each study, the relationship between sea-level history and facies distributions is documented. Despite such comprehensive study across much of the Western Canada Sedimentary Basin, the area of Sturgeon Lake South has received little attention.

CHAPTER TWO

Depositional Facies

The facies model at Sturgeon Lake South summarizes sedimentologic criteria by which each facies is recognized and their interpreted environments of deposition (fig. 5, table 1). The model for Sturgeon Lake South is adapted from Stoakes *et al*, (1992). Paleowater depth estimates for each facies appearing on Figure 5 are based depositional relief observed on stratigraphic cross sections (Appendix C, L-15), and the comparative modern-ancient paleoecologic reconstructions of Klovan (1974). The vertical association of gradational facies repeatedly observed in shallowing-upward, meter-scale depositional cycles is summarized on Figure 6. The interpretation of depositional environments is heavily reliant upon vertical facies associations within the context of "Walther's Law" (Soreghan, 1997).

Lower Slope-Burrowed Nodular Association

Facies: Burrowed Nodular

Criteria for Recognition. The dominant lithology for this facies is limestone. This mudstone/wackestone is extensively burrowed and commonly overlain by dark shales or lighter colored dolostone textures. Skeletal grains include disarticulated brachiopods, crinoid ossicles, and rugose corals (fig. 7a). Burrows are dominated by horizontal and branching *Thalassinoides* of the *Cruziana* ichnofacies. The dark color of this facies is likely due to higher organic content.

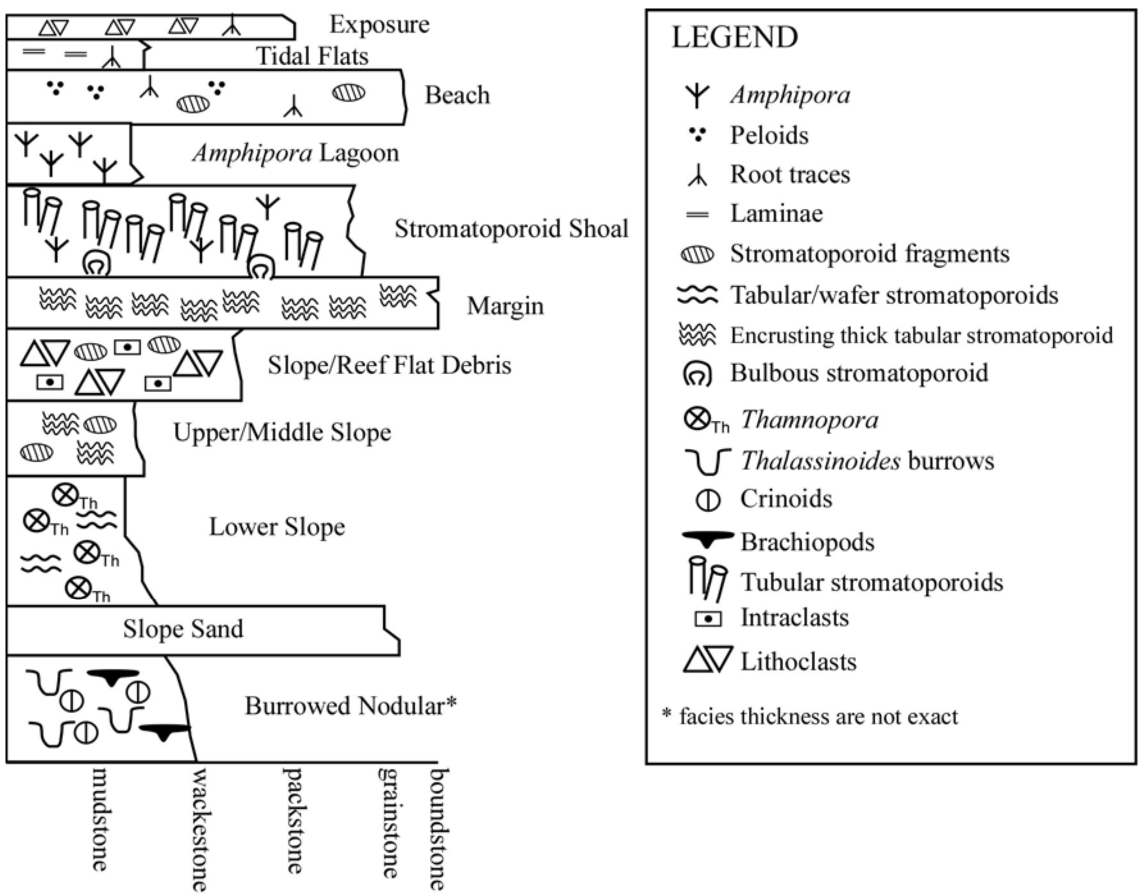


Figure 6. Idealized parasequence for Sturgeon Lake South.

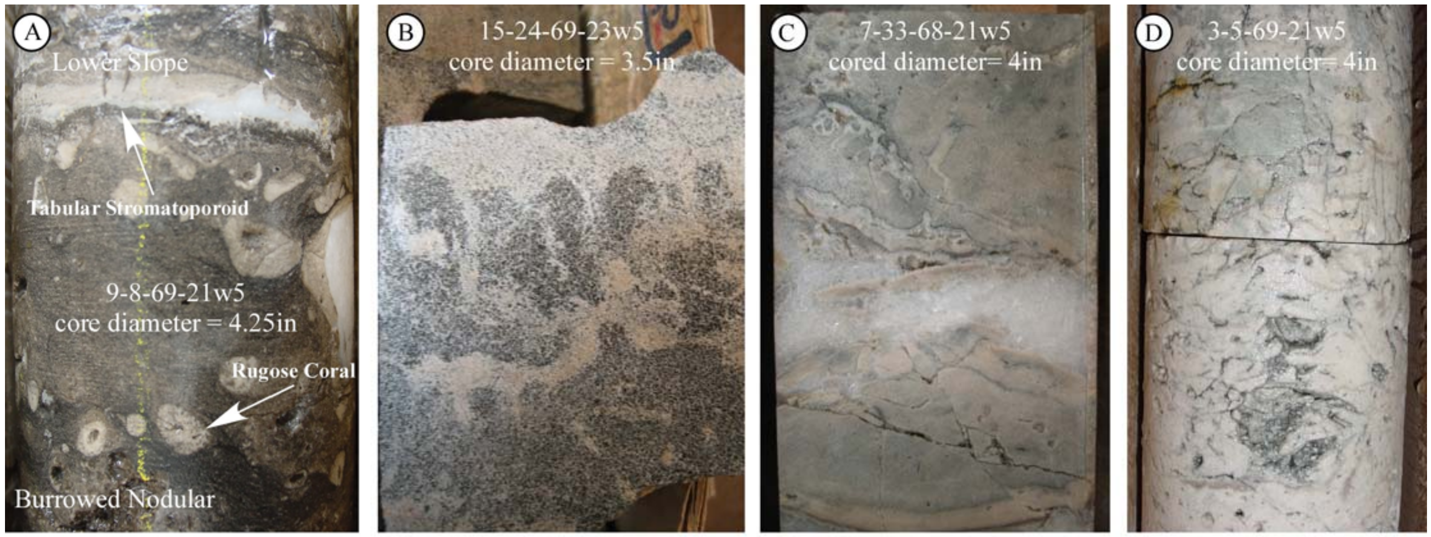


Figure 7. Core photographs representative of facies. (A) Burrowed Nodular facies overlain by Lower Slope facies. Note the tabular stromatoporoid in the Lower Slope and rugose coral in the Burrowed Nodular; (B) Burrowed Slope Sand facies, with grain-supported texture; (C) mud-supported Middle Slope facies containing few stromatoporoids; (D) Upper Slope facies with framework stromatoporoids; (E) Slope/Reef Flat debris. Angular clasts are suspended in an argillaceous matrix; (F) Margin characterized by massive encrusting stromatoporoids. Note vugular and growth framework pores.

Environmental Interpretation. The skeletal grain assemblage suggests open marine conditions, whereas the muddy texture suggests deposition below fairweather wave-base (Klovan, 1974). Oxygenated slopes may be intensively bioturbated (Coniglio and Dix, 1992).

Facies: Lower Slope

Criteria for Recognition. This facies is distinguished by a gray to light beige color, dolowackestone and dolopackstone texture, abundant *Thamnopora*, and thin wafer-like stromatoporoids (fig. 7a).

Environmental Interpretation. The light color suggests more oxygenated conditions than the burrowed nodular facies. The lack of discrete burrows and mechanical sedimentary structures suggests burrow homogenation within a favorable environment. Brachiopod and crinoid fragments suggest sediment accumulation basin-ward of the margin.

Facies: Slope Sand

Criteria for Recognition. The texture is a dolopackstone/dolograinstone and discrete *Thalassinoides* are occasionally observed in what is otherwise a massive rock fabric (fig. 7b). Grains are most likely recrystallized and replaced sand-sized skeletal fragments.

Environmental Interpretation. This facies is associated with both Lower and Middle Slope deposits within a vertical succession, and as such, suggests contemporaneous slope deposition. Unlined burrows indicate the presence of cohesive muddy sediment below wave base. The absence of coarse stromatoporoid debris fragments suggests that the reef front may be some distance away.

Margin-Slope Association

Facies: Middle Slope

Criteria for Recognition. The dominant texture is dolowackestone or doloboundstone composed of sparse encrusting stromatoporoids, wafer-like stromatoporoids and other undifferentiated stromatoporoid fragments (fig. 7c).

Environmental Interpretation. Although brachiopods and crinoids are not observed, the skeletal grain association still suggests open marine conditions. Increasing abundance and presence of encrusting stromatoporoids indicate closer proximity to the reef front (James and Bourque, 1992).

Facies: Upper Slope

Criteria for Recognition. Skeletal grains include thick, encrusting, tubular, and undifferentiated stromatoporoids within a dolopackstone or doloboundstone texture (fig. 7d).

Environment of Interpretation. This environment is well-circulated and high in energy. The increase in stromatoporoid abundance and diversity is similar to the stromatoporoid "reef front" zonation of James and Bourque (1992).

Facies: Slope Debris/Reef Flat Debris

Criteria for Recognition. Grains are dominated by gravel-sized sub-angular clasts derived from slope, margin, and/or interior facies (fig. 7e). The texture is classified as a dolofloatstone, because clasts are commonly suspended within an argillaceous matrix.

Environmental Interpretation. The angular shape of clasts suggests limited transport distance (basinward or bankward) from the bank. When crinoid fragments and/or wafer stromatoporoid fragments are present, this facies was likely deposited basinward of the margin. When such fauna are not present, this facies more likely accumulated as reef flat debris. A third possibility is that the "facies" may reflect post depositional fault gouge and/or karst collapse.

Facies: Margin

Criteria for Recognition. The rock fabric is a bound dolomitized framework of intergrown, massive-encrusting, bulbous and tubular stromatoporoids (fig. 7f). Within a shallowing facies succession, the margin overlies slope deposits and is overlain by the stromatoporoid shoal facies, or less commonly, the *Amphipora* Lagoon facies (fig. 6).

Environmental Interpretation. Bulbous, thick, tabular and encrusting stromatoporoids within a massive growth framework suggest high wave energy within an open-marine environment.

Interior Association

Facies: Stromatoporoid Shoal

Criteria for Recognition. Sediments within this facies are composed of *Amphipora*, bulbous and tubular stromatoporoids, coarse stromatoporoids, and lithoclast fragments (fig. 8e). Thick encrusting and tabular stromatoporoid are rare. Texture varies from dolopackstone to dolorudstone. In a shallowing upward facies succession the stromatoporoid shoal overlies the margin and is overlain by the *Amphipora* Lagoon facies (fig. 6).

Environmental Interpretation. Interior facies mark a change in wave energy, as indicated by the presence of less robust *insitu* stromatoporoid morphologies and mud-supported textures. The position within a vertical facies succession indicates an environment of deposition immediately bankward of the margin/reef front.

Facies: Amphipora Lagoon

Criteria for Recognition. This facies is dominated by *Amphipora* fragments as part of a dolowackestone to dolopackstone texture (fig. 8a). The color of the mud matrix can either be dark brown, light gray or tan. In a vertical succession this facies is overlain by the Beach facies and is underlain by the Stromatoporoid Shoal facies (fig. 6).

Environmental Interpretation. The variations in color suggest that the *Amphipora* lagoon facies was likely either well-circulated or restricted. The observation of a dark mud matrix suggests a restricted, less aerobic environment. A light gray color suggests more oxygenated conditions. Low faunal diversity may reflect variable conditions of salinity, temperature, and/or oxygen partial pressure. These conditions suggest an interior environment of deposition where water circulation is sluggish (Stoakes *et al*, 1992).

Facies: Beach

Criteria for Recognition. The texture ranges from a dolorudstone to dolograinstone (fig. 8b). Grains include peloids, *Amphipora* fragments, and other undifferentiated skeletal fragments. In a vertical facies succession this facies occurs in association with the Tidal Flat facies.

Environmental Interpretation. Within the interior facies association, the more grain rich and coarser texture of the beach facies indicates higher energy conditions of accumulation than the associated *Amphipora* lagoon facies.

Facies: Tidal Flat

Criteria for Recognition. The rock fabric consists of finely laminated and root modified peloid dolopackstones that at times includes fenestral fabric (fig. 8c). The Tidal Flat facies can be associated with the Beach facies

Environmental Interpretation. Evidence suggests a restricted, poorly circulated, low energy shoreline.

Facies: Exposure

Criteria for Recognition. The exposure complex is characterized by bedded as well as cavity filling green shale, and root traces (fig. 8d). Lithoclasts are sub-angular to.

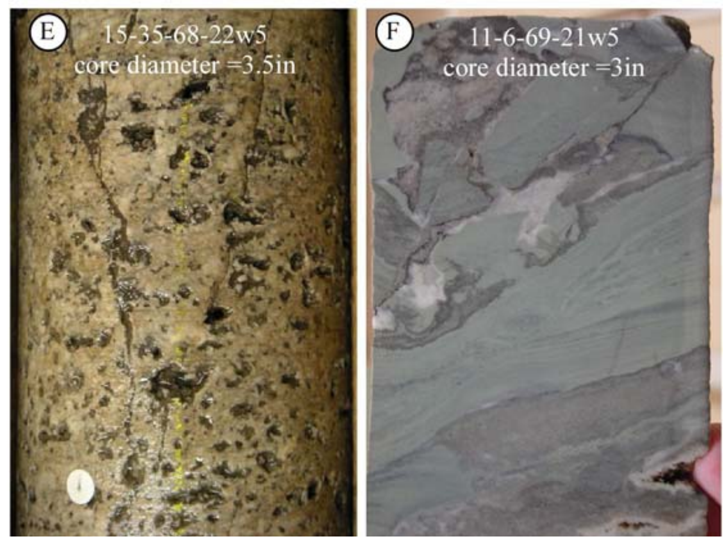


Figure 8. Core photographs representative of facies. (A) *Amphipora* Lagoon facies including *Amphipora* stromatoporoids within a dolomudstone/dolowackestone texture; (B) Beach facies skeletal rudstone; (C) Tidal flat with mechanical laminations; (D) Exposure facies with displacive anhydrite nodules suspended within an argillaceous matrix; (E) Stromatoporoid shoal facies dolorudstone. Stromatoporoids fragments are the dominant skeletal grain; (F) A sequence boundary characterized by laminated green shales and dolomite lithoclasts.

sub-rounded and are suspended within an argillaceous matrix. The rock matrix at times is highly oxidized and recrystallized.

Environmental Interpretation. Disseminated and bedded green shale, and root traces indicate prolonged exposure (fig. 8f) (Kerans, 1988). The associated sub-angular lithoclasts are similar to the karst-induced fracture and mosaic breccia described by Kerans (1988) in the Lower Ordovician Ellenburger Group of West Texas.

CHAPTER THREE

Diagenesis

Diagenetic Textures

The Leduc Formation at Sturgeon Lake South is pervasively dolomitized. Limestone is limited in abundance and is only observed in Sequences 4-6 (Appendix C).

Dolomite Textures

Drivet and Mountjoy (1997) observed six different dolomite-rock textures (*sensu* Sibley and Gregg, 1987) that are pervasive and fabric destructive in the Leduc Formation along the southern Rimbey-Meadowbrook Reef Trend. Amthor *et al* (1993) observed in the Rimbey-Meadowbrook Reef Trend that 90% of the dolomite has a replacement fabric that is followed by a later phase of dolomite cementation that comprises approximately 5% of the total rock volume. Two generations of dolomite cement followed replacement dolomitization: a coarse and planar-e(s) cement and a coarser nonplanar cement. The coarse planar-e(s) cement post-dates the non planar cement (Drivet and Mountjoy, 1997). The diagenesis of the Sturgeon Lake Reef Complex (i.e. Sturgeon Lake South, Calais, and North Sturgeon) has a similar crystal morphology and paragenetic history.

In the Sturgeon Lake Reef Complex five different dolomite-rock textures are observed. Dolomitization was fabric destructive, and precursor grains are poorly preserved. Replacement dolomite textures are classified according to the nomenclature of Sibley and Gregg (1987) as (1) fine unimodal planar-s, (2) coarse nonplanar, (3) coarse unimodal planar-e, (4) coarse unimodal planar-s, and (5) polymodal planar-s (fig. 9, a-d). Dolomite rhombs have curved crystal faces (saddle dolomite) and pronounced zoning that suggests increased temperature and burial (fig. 9e) (Machel, 1987). Saddle and zoned dolomite are only observed in the coarser-grained nonplanar and planar-s dolomites. Interparticle mud and intraparticle calcite were preferentially dolomitized because of the greater surface area for replacement (fig. 9f) (Sibley and Gregg, 1987).

Other Diagenetic Textures and Diagenetic Structures

Interparticle calcite cement is syntaxial and coarsely crystalline, and contains microcrystalline dolomite inclusions (fig. 10c). Meyers and Lohmann (1978) suggest that microdolomite inclusions within syntaxial calcite cement form within the marine-meteoric mixing zone. In contrast, Amthor *et al* (1993) found no evidence for meteoric recharge and associated cementation in the Rimbey-Meadowbrook Reef Trend. Calcite cements are most commonly coarse, equant, and blocky with rare bladed cements (fig. 10b). Anhydrite and pyrite occur as fracture, mold, and interparticle pore fill (fig. 10f and 11b). Fractures, anhydrite, and stylolites are common throughout the Leduc Formation (fig. 10d, 10f, and 11e).

Paragenesis

The paragenetic history for the Sturgeon Lake Reef Complex is summarized on Table 2 and is supported by the photomicrographs provided in Figures 10 and 11. Each stage is numbered on Table 2 and is correspondingly labeled on photomicographs. Although the timing of hydrocarbon emplacement could not be constrained petrographically at Sturgeon Lake South, Machel (1993) in a study of the Alberta “deep basin” suggests emplacement prior to anhydrite cementation.

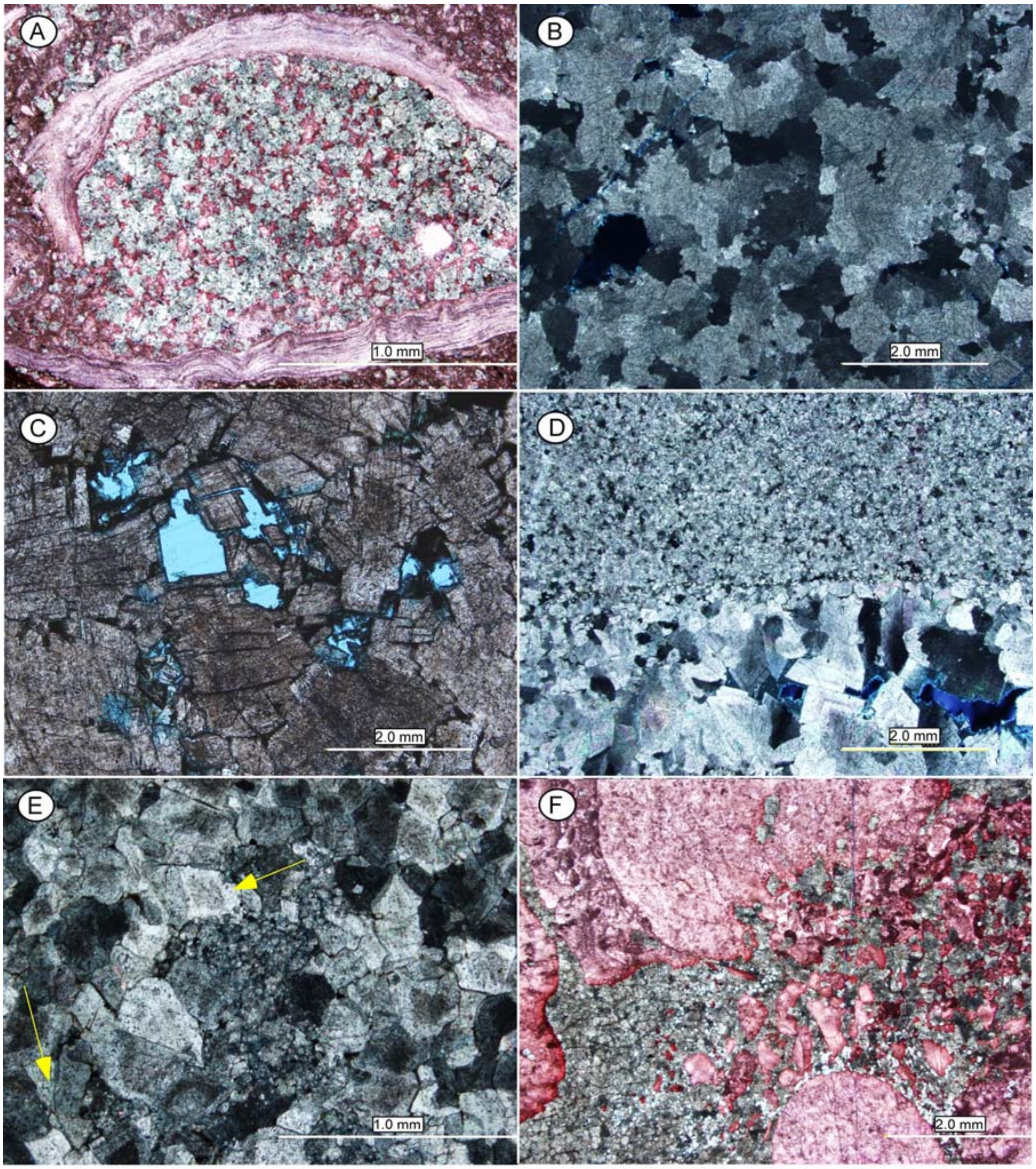


Figure 9. Polarized light photomicrographs. (A) Fine unimodal planar-s dolomite replacing micrite within shelter cavity; (B) Coarse nonplanar dolomite; (C) Coarse unimodal planar-s dolomite Note the associated intercrystalline porosity; (D) Polymodal planar-s dolomite. Fine mud burrow fill is replaced by finer-grained dolomite. (E) Zoned saddle dolomite (note yellow arrows); (F) Dolomite replacement of finer grained interparticle and growth framework fill.

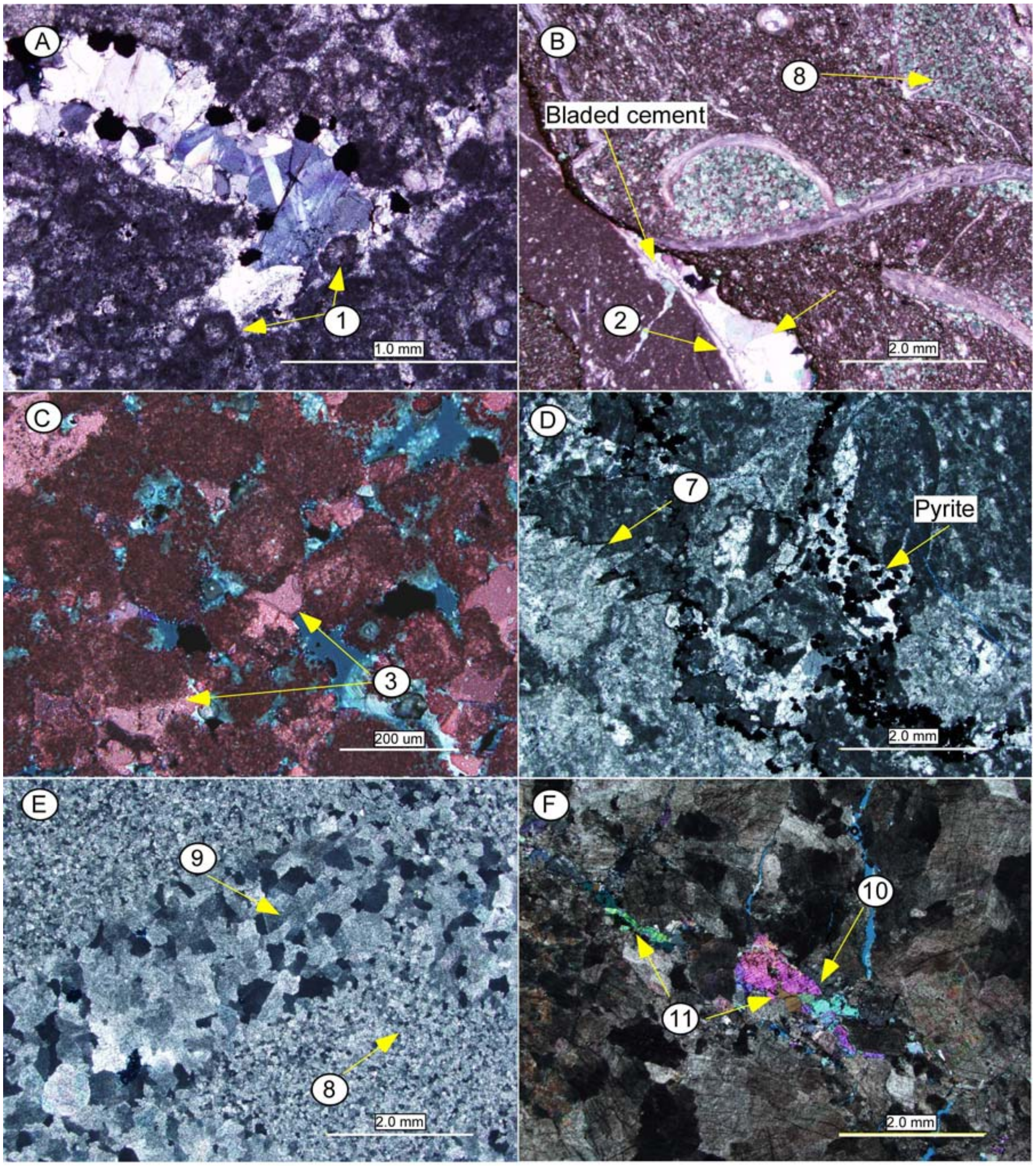


Figure 10. Polarized light photomicrographs. Numbered features correspond with the diagenetic products listed on Table 2. (A) Yellow arrows highlight possible micritization seen as darker halos around allochems. Opaque pyrite cross-cuts coarse calcite; (B) Bladed vadose spar lines mold and has terminal coarse blocky calcite fill. Microcrystalline dolomite matrix within shelter cavity; (C) Microcrystalline dolomite replacement of peloids with interparticle syntaxial calcite overgrowths; (D) Stylolites along allochem boundary; (E) Microcrystalline dolomite adjacent to macrocrystalline dolomite; (F) Anhdyrite filling fracture and intercrystalline pore space between saddle dolomite rhombs.

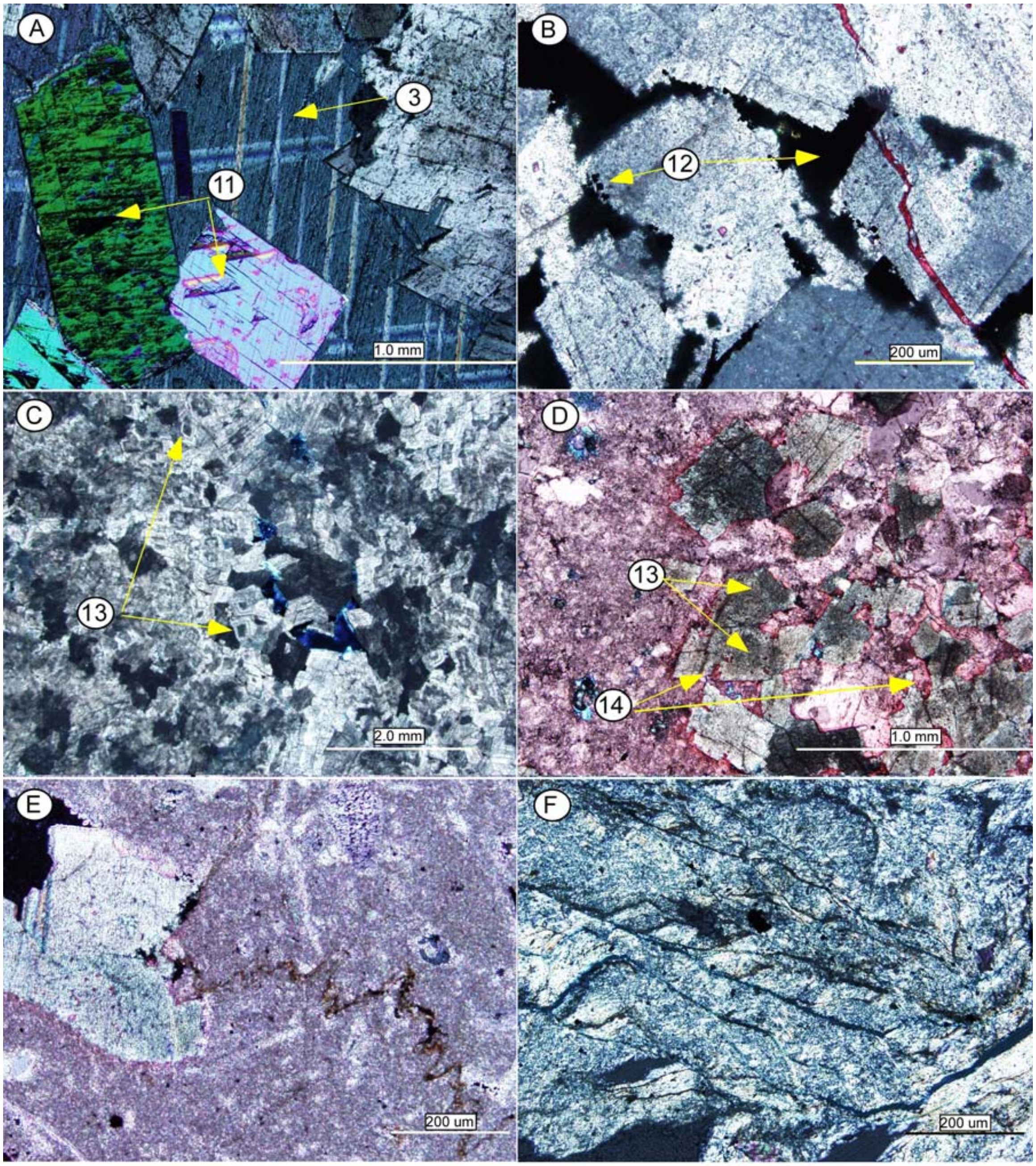


Figure 11. Polarized light photomicrographs. Numberd features correspond with the diagenetic products listed on Table 2. (A) Anhydrite cross-cutting syntaxial calcite; (B) Pyrite within intercrystalline pore space; (C) Zoned dolomite rhombs; (D) Calcite replacement of zoned dolomite rhombs; (E) Stylolite within calcite matrix and cross-cut by large calcite crystal; (F) Cavity filling clay within the beach facies associated with a sequence boundary.

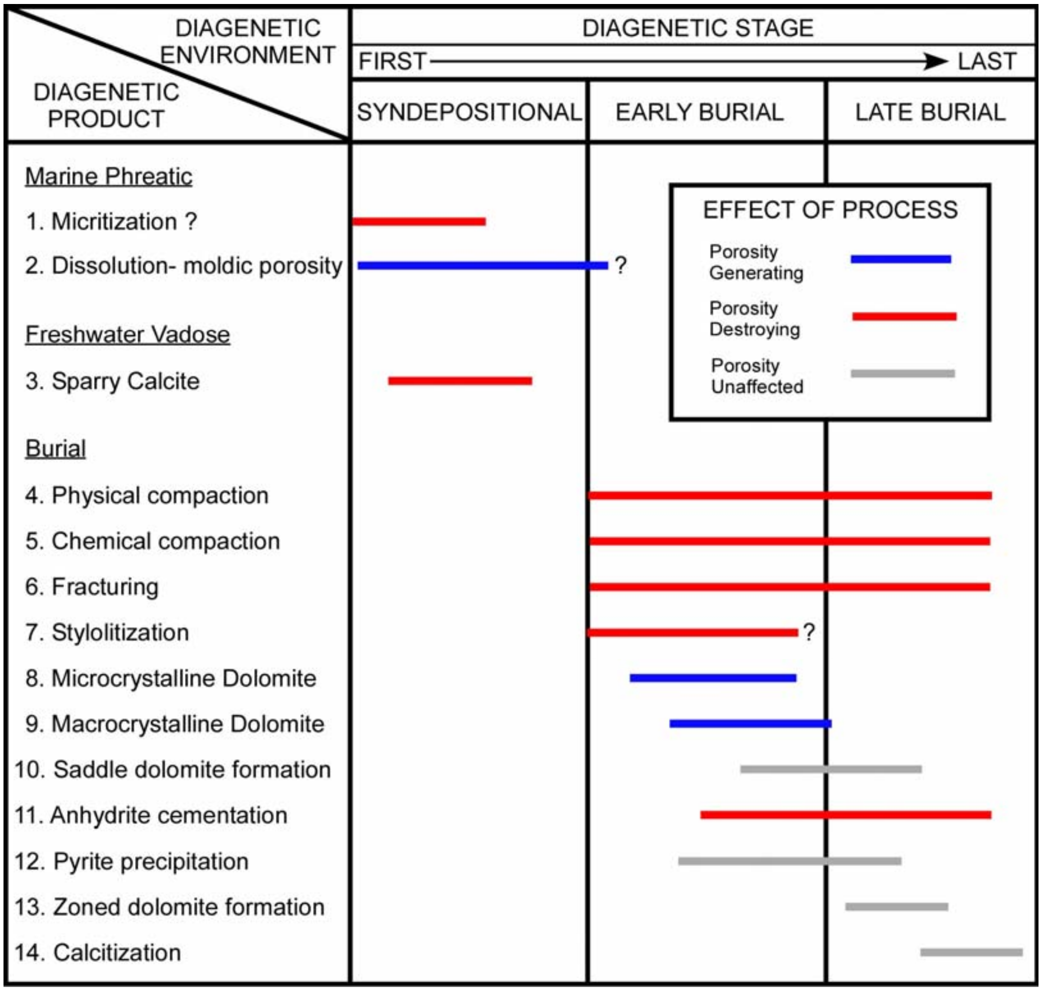


Table 1. Paragenesis summary table for Sturgeon Lake South. Paragenetic stages are numbered 1-14, and are annotated in corresponding photomicrographs on Figures 10 and 11.

Implications to Reservoir Quality

Fracturing and Stylolitization

Stylolitization and fracturing do not affect reservoir quality to the extent that other parameters such as dolomitization and anhydrite emplacement. The exact duration of stylolitization is not constrained in this study; however, Drivet and Mountjoy (1997) observed stylolite formation both prior and following dolomitization. At Sturgeon Lake South, stylolites occur in low density, and have no preferential facies association. Despite the potential for porosity reduction associated with localized calcite dissolution and reprecipitation adjacent to stylolites, the density of stylolites is not great enough to significantly reduce reservoir quality.

Fracturing may greatly influence the orientation and magnitude of fluid flow. Fracture density does not appear to be strongly controlled by facies (Appendix C). Lower slope facies are more commonly fracture-rubble (associated with core recovery from densely fractured rock), whereas other facies such as the Tidal Flat and Beach facies are not observed with a high fracture density. In thin section, fracture porosity is often reduced by sparry calcite, anhydrite, and/or pyrite cement (Appendix B) (fig. 9d, 9f, 10a, and 10b).

Anhydrite

Anhydrite occurs as nodules and fabric- and nonfabric-selective pore-fill that includes massive accumulations within vugular or cavernous porosity (fig. 12) (Appendix A). Anhydrite is not preferentially associated with a particular facies and is clearly porosity destructive (Appendix C).

Figure 12. Core photographs of anhydrite. Left: massive anhydrite filling vugular porosity. Right: anhydrite filling growth framework porosity.

Dolomitization

Replacement dolomite forms in the subsurface/burial environment at Sturgeon Lake South, as well as at the isolated platforms of the Rimbey-Meadowbrook Reef Trend (e.g. Machel and Mountjoy, 1987; Amthor *et al*, 1993, Drivet and Mountjoy, 1997). In thin-section, dolomitization enhances porosity (fig. 9c, 11c). Relative to limestone and anhydrite, dolomite is characterized by the highest porosity regardless of facies (Appendix C). During dolomitization crystalline volume is reduced, thereby producing secondary intercrystalline porosity (Warren, 2000; Murray, 1960; Weyl, 1960). Dissolution of calcitic fossils and matrix during and after replacement dolomitization accounts for some secondary porosity (Amthor and Mountjoy, 1992).

CHAPTER FOUR

Sequence Stratigraphy

Stratal Hierarchy

Devonian strata within the WCSB record a second-order cycle of global sea level, and are documented in the literature as the Kaskaskia Cratonic Sequence (Plint, *et al*, 1992; Vail *et al*, 1977; Sloss, 1966). Within Alberta, the transgressive to the early highstand portion of the Kaskaskia Supersequence includes the Beaverhill Lake, Woodbend, and Winterburn Groups (Potma *et al*, 2001; Atchley and McMurray, 2000; Stoakes *et al*, 1992). Deposition of the Woodbend Group marks the point of second-order maximum transgression. The basinal Ireton shale and its correlative units that blanket the Leduc reefs record an episode of second-order highstand that immediately follows the second-order maximum flooding event, culminating in deposition of the Winterburn Group platform carbonates (Atchley and McMurray, 2000; Stoakes, *et al*, 1992; Stoakes, 1980). The Beaverhill Lake, Woodbend, and Winterburn Groups are composite sequences within the Kaskaskia Supersequence (Potma *et al*, 2001; Atchley and McMurray, 2000; Stoakes *et al*, 1992). Each composite sequence is in turn partitioned into several third order sequences (Potma *et al*, 2001). A total of nine third-order sequences occur within the Beaverhill Lake, Woodbend, and Winterburn Groups (Potma *et al*, 2001).

Regional Correlations

Peace River Arch to the Rimbey-Meadowbrook Trend

Cross section B-B' extends from the Peace River Arch to the rimmed reef carbonate buildup at Eaglesham (fig. 13; Appendix C, B-B'). From Eaglesham, cross section A-A' includes the isolated platforms of Calais, Sturgeon Lake, North Sturgeon (Sturgeon Lake Reef Complex) and Windfall in the deep basin, and terminates at the isolated Redwater platform (fig. 13; Appendix C, B-B').

The observation that Leduc carbonates (13-13-78-26w5, 4-18-77-25w5, and 7-15-77-25w5) initially aggrade and onlap the Peace River Arch at Eaglesham is consistent with Dix (1990) who describes a similar pattern of onlap and aggradation within "Sequence II" (fig. 13, Appendix C, B-B'). Winterburn/Nisku strata that extend across the top of the Peace River Arch stack progradationally. This pattern is consistent with stratal relationships observed by Dix (1990) within "Sequence I". The section traversing the arch, however, is based exclusively upon well-log response. No core is available. Depositional cycle boundaries used in correlation are identified as spikes of high gamma ray activity that likely coincide with shales associated with marine transgression or subaerial exposure. This well log signature is consistently cited in the literature as diagnostic for cycle boundary recognition within the Western Canada Sedimentary Basin (Potma *et al*, 2001; Huebscher, 1996; Wendte, 1994; Stoakes *et al*, 1992; Dix, 1990; Andrichuk, 1958).

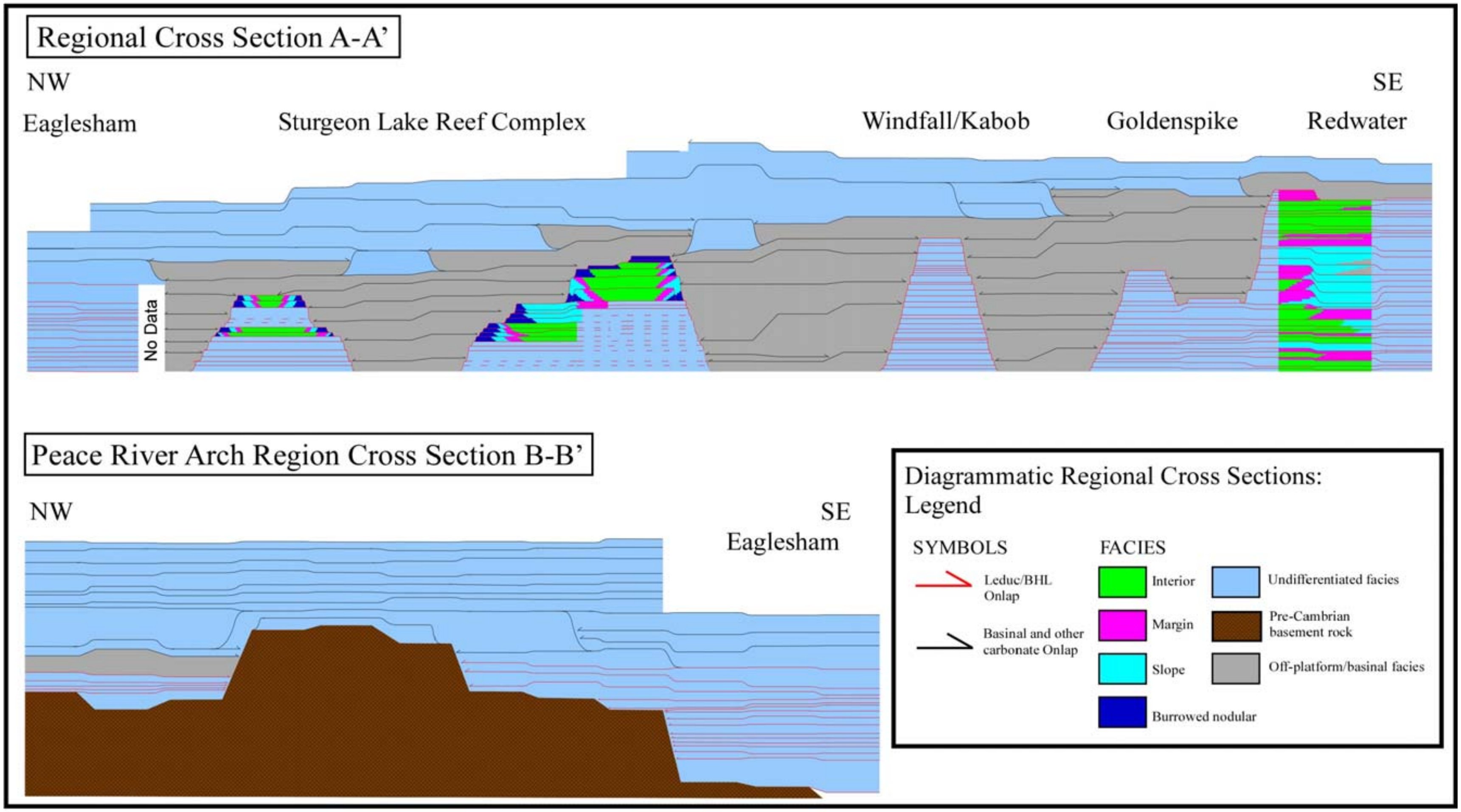


Figure 13. Diagrammatic cross-sections for the Region and Peace River Arch (PRA). Detailed facies distributions at the Sturgeon Lake Reef Complex are based upon core descriptions in this study. Detailed facies distributions at Redwater are from Potma *et al*, 2001. Figure 4 provides a basemap that highlights the lines of section.

Deep Basin and the Rimbey Meadowbrook Reef Trend

In the deep basin and Rimbey Meadowbrook Reef Trend, stratal geometries are substantially different from the ramp/rimmed shelf of the Peace River Arch. Sturgeon Lake, Windfall, Golden Spike and Redwater are all examples of isolated platforms (fig. 4). In the deep basin at Sturgeon Lake South and Windfall; however, (fig. 13; Appendix C, A-A') stacking patterns of the Winterburn are aggradational to retrogradational. Throughout the deep basin and Rimbey-Meadowbrook trend, stratal geometries backstep during Woodbend Group/Leduc deposition, and indicate long-term sea level rise exceeding the rate of carbonate deposition (fig. 13). Facies observed at Redwater by Potma *et al* (2001) occur within retrogradational sequences (Potma *et al* 2001) (Appendix C, A-A'). In wells lacking core control at Redwater, Windfall, Kaybob, and Golden Spike, sequence boundaries are often identified by a thin "spike" in gamma-ray activity (Appendix C, A-A'). The increase in gamma radiation reflects either argillaceous, deeper water facies above a parasequence or sequence boundary, or exposure-related clay enrichment at a sequence boundary (Appendix C, A-A'). Sequences observed at Sturgeon Lake South, Windfall/Kaybob, and Golden Spike are of similar vertical (and perhaps temporal) scale to those observed at Redwater (Appendix C, A-A'). All isolated platforms ultimately drown out, and are terminated prior to deposition of the basinal Ireton shale (fig. 13).

To better understand the controls on reef development throughout the region, both the off-platform basinal shales and Winterburn group platform carbonates were correlated. The Ireton shale and other age-equivalent basinal deposits are characterized by westward prograding clinoforms that onlap and/or downlap onto the Leduc isolated platforms (fig. 13; Appendix C, A-A'). Westward progradation of the Ireton shale within the Western Canada Sedimentary Basin is similarly documented by Potma *et al* 2001, Stoakes *et al* 1992, and Stoakes 1980. Winterburn carbonates prograde over both Leduc isolated platforms (e.g., Eaglesham) and the overlying Ireton shales (e.g., Sturgeon Lake Reef Complex), and appear to prograde off the Peace River Arch (fig. 13).

Sturgeon Lake South and Calais

The Leduc Formation at Sturgeon Lake South and Calais is composed of 12 retrogradationally stacked depositional sequences (fig. 14) (sequence stratigraphic terminology *sensu* Van Wagoner *et al* 1987). The uppermost six sequences occur within the reservoir interval at Sturgeon Lake South and have been extensively cored (Appendix C, Sturgeon Lake South basemap). From this detailed dataset, the six "reservoir" sequences at Sturgeon Lake South are correlated within a grid of 16 cross-sections to evaluate the history of sediment accumulation during the latter half of Leduc deposition (Appendix C, Sturgeon Lake South basemap). The following discussion of each sequence summarizes the depositional history.

Sequence 1

Sequence 1 is dominated by interior facies located bankward of a narrow, high-relief margin (Appendix C). The distribution of outer bank deposits (slope and burrowed nodular facies) is poorly constrained but likely occurs as a narrow zone of deposition (Appendix C).

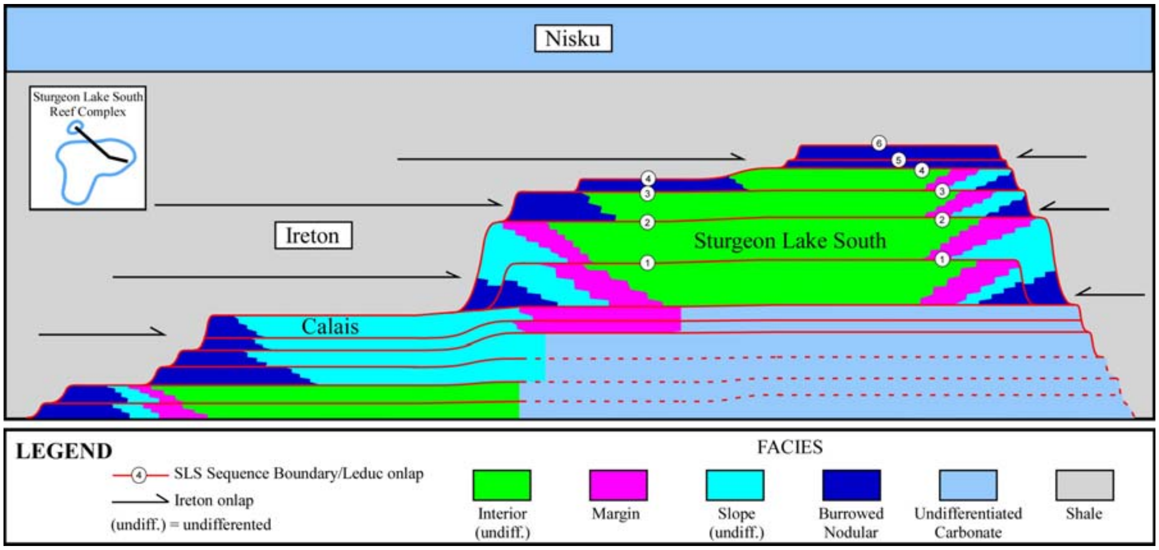


Figure 14. Diagrammatic cross-section of Sturgeon Lake South and Calais.

Sequence 2

Sequence 2 progrades beyond the downlap limit of Sequence 1 (fig. 14, Appendix C). This progradational geometry is unique to Sturgeon Lake South inasmuch as most sequences observed within other platforms backstep. Sequence 2 likely records a brief episode of decreased rate of sea level rise. Sequence 2 is also dominated by interior facies, but a higher-energy shoal occurs behind the margin (Appendix C). Along the northern portion of Sturgeon Lake South an embayment occurs, whereas the eastern prow of Sturgeon Lake South is characterized by a small, margin-rimmed interior lagoon (Appendix C).

Sequence 3

The bank area contracts in response to rising sea level, and facies backstep above sequence 2 (Appendix C and fig. 14). Slope/reef margin debris accumulates within an embayment adjacent to the southeastern margin of Sturgeon Lake South (Appendix C).

The eastern prow continues to aggrade as a small, margin-rimmed interior lagoon (Appendix C).

Sequence 4

The nature of carbonate deposition changes markedly during sequence 4. The aerial extent of the bank decreases substantially and outer bank deposits become more abundant across the bank top (Appendix C). Bank retreat and the widespread deposition of outer bank deposits indicate a substantial deepening across Sturgeon Lake South . The backstepping stratal geometry is apparent in cross section view (Appendix C, L15). Slope/Reef Debris continue to accumulate within the back-barrier embayment along the southeastern portion of the bank (Appendix C).

Within Sequence 4 an unusual lateral facies association is observed (Appendix C, L16). The interior *Amphipora* lagoon facies is laterally equivalent to burrowed nodular facies. A similar facies association (i.e., off-platform dark shale adjacent bank interior) is observed in the Redwater Reef Complex, and attributed to a sudden increase in subsidence rate (Klovan, 1964). This evidence leads Klovan (1964) to conclude that a disconformity exists between the off-platform and reef interior deposits. No evidence for such a disconfomity is observed at Sturgeon Lake South.

Sequences 5-6

Sequences 5 and 6 record the initial drowning of the Sturgeon Lake South bank and associated widespread deposition of relatively condensed off-platform burrowed nodular sediments. The equivalent margin to the off-platform deposits retreats (i.e.

backsteps) to the western portion of Sturgeon Lake South (Appendix C). Sequence 6 is disconformably overlain by the basinal Ireton shale (fig. 14).

Controls on Facies Distributions

Antecedent Topography

The effects of antecedent topography are best expressed in the region of the Peace River Arch (Appendix C, fig. 13). The Peace River Arch is thought to have developed as the result of differential uplift and subsidence associated with Late Silurian and Early Devonian subduction along the western continental margin (Root, 2001; Cant, 1988). The Winterburn and perhaps the Woodbend Groups are progradational across the Peace River Arch, whereas the Woodbend and Winterburn within the adjacent basin are largely retrogradational (Appendix C, B-B'). Woodbend progradation away from the Peace River Arch is also documented by Dix (1990) (fig. 13; Appendix C, B-B'). Given that regional stacking patterns within the Woodbend and Winterburn are largely retrogradational, local progradation of equivalent strata away from the Peace River Arch likely reflects an accommodation limit imposed by antecedent topography.

Isolated platforms within the Deep Basin and Rimbey Meadowbrook Reef Trend also nucleate on antecedent topographic highs (Stoakes *et al*, 1992). The Cooking Lake platform provided a bathymetric high onto which isolated Leduc banks such as Redwater and the Sturgeon Lake Reef Complex nucleated (Wendte, 1994). The linear nature of the Rimbey Meadowbrook Reef Trend suggests differential bathymetric relief that may have been produced by antecedent faulting at depth, but such structural evidence is speculative (Potma *et al* 2001; Wendte, 1994).

Windward/ Leeward Effects

During the Devonian, the paleowind direction was from the east-northeast (Potma *et* al, 2001). Evidence of windward/leeward effects are observed on the Sturgeon Lake South, Golden Spike, and Redwater isolated platforms. A northeasterly paleowind direction is supported by the presence of a wave-resistant barrier margin along the eastern flank of Sturgeon Lake South, whereas the northwestern flank is dominated by shoal deposits (Appendix C, Facies Maps 2 through 4). Modern barrier reefs also preferentially occur along the windward side of carbonate banks (Harris, 1996; James and Bourque, 1992; Halley *et al*, 1983, Hine and Neumann, 1977). The Woodbend Group isolated banks at Golden Spike and Redwater are highly aggradational and characterized by robust reef margins on the windward side, whereas the leeward side is dominated by an overall retrogradational stratal geometry (Appendix C, A-A'). Likewise, the Peace River Arch has a fringing carbonate buildup along its southeastern flank, and is dominated by calcareous shales along its northwestern flank (Appendix C, B-B'). The calcareous shales may reflect terrigenous sediments derived from the Peace River Arch that preferentially accumulated within a marine environment along the leeward flank.

Proximity to a Cratonic Landmass

The Ireton Shale and its equivalent deposits were derived from the Ellesmerian Fold and Thrust Belt in the Canadian Arctic Archipelago (Stoakes *et al*, 1992). Rates of sea-level rise were decreasing toward the end of Woodbend Group deposition, and subsequently, basinal shales prograded from the fold and thrust belt toward the southwest (fig. 13; Appendix C, B-B'). Southwest progradation likely reflects both the northeasterly source terrain, and northeasterly paleowind direction. The termination of reef development at Sturgeon Lake South may reflect both a relatively rapid rate of sea level rise associated with second-order maximum flooding, and marine contamination associated with an increase in turbidity from the craton-derived Ireton Shale. Stoakes (1980) in a study of the Ireton Shale and its effect on the growth and termination of the Leduc reefs reaches a similar conclusion.

CHAPTER FIVE

Conclusions

Analysis of the Devonian Leduc Formation and its stratal equivalents at Sturgeon Lake South and the region extending from the Peace River Arch to the Rimbey-Meadowbrook Reef Trend reveals the following:

1) Eleven depositional facies are recognized and interpreted: burrowed nodular, lower slope, slope sand, middle and upper slope, slope/reef flat debris, margin, stromatoporoid shoal, *Amphipora* lagoon, beach, tidal flat, and exposure complex.
2) Analysis of the lithologic distribution across Sturgeon Lake South indicates that dolomite is more common than limestone or anhydrite. Dolomitization is not facies specific.
3) Five replacive dolomite textures are observed in the Sturgeon Lake Reef Complex: fine unimodal planar-s, coarse non-planar, coarse unimodal planar-e, and coarse unimodal planar-s. Dolomitization is pervasive and fabric destructive, and enhances porosity.
4) Thirteen phases of diagenetic alteration are observed, and most took place within a burial environment.
5) Regional stratigraphic correlations suggest both progradational and aggradational geometries across the Peace River Arch during Woodbend and Winterburn Group deposition. Within in the Deep Basin, the isolated platforms of the Sturgeon Lake

6) Reef Complex, Windfall/Kaybob, Golden Spike and Redwater are characterized by backstepping stratal geometries.

7) The Leduc Formation at Sturgeon Lake South and Calais is composed of 12 retrogradationally stacked depositional sequences. Sequences 1 and 2 are progradational, and sequences 3 through 6 are retrogradational. Bank drowning occurred after the deposition of sequence 6, and was concomitant with the initial deposition of the Ireton Shale.

8) The evolution of Sturgeon Lake South, other isolated platforms, and the rimmed-shelf of the Peace River Arch was influenced by eustatic sea level change, antecedent topography, windward/leeward effects, and proximity to a cratonic landmass. Antecedent positive topography limited accommodation space and induced a progradational stratal style across the Peace River Arch. The northeasterly paleowind direction during the late Frasnian induced the growth of windward robust margins and barrier reefs at Sturgeon Lake South. Conversely, the leeward side of the bank is characterized by a less robust margin. Throughout the region, highly aggradational stratal stacking patterns occur along the windward margin, whereas retrogradational stacking occurs along the leeward margin. The Ireton Shale was likely derived from cratonic sediments associated with the Ellesmerian fold and thrust belt. The influx of fine clastics possibly contaminated marine water, thereby contributing to the demise of Leduc platforms within the Western Canada Sedimentary Basin.

APPENDICES

APPENDIX A

Core descriptions

STURGEON LAKE SOUTH: Core description legend

FACIES

EXP	Exposure Surface
TF	Tidal Flat
B	Beach
AL	*Amphipora* Lagoon
StSh	Stromatoporoid Shoal
M	Margin
SD	Slope Debris
MS	Middle Slope
SlSd	Slope Sand
BN	Burrowed Nodular
LS	Lower Slope

FRACTURE CODE

0	0	Fractures observed
1	1-10	Fractures observed
2	11-20	Fractures observed
3	21-30	Fractures observed
4	31-40	Fractures observed
5	41-50	Fractures observed
11		Rubbled yet reconizable
12		Rubbled beyond recognition; "poker-chip" recovery

GRAINS

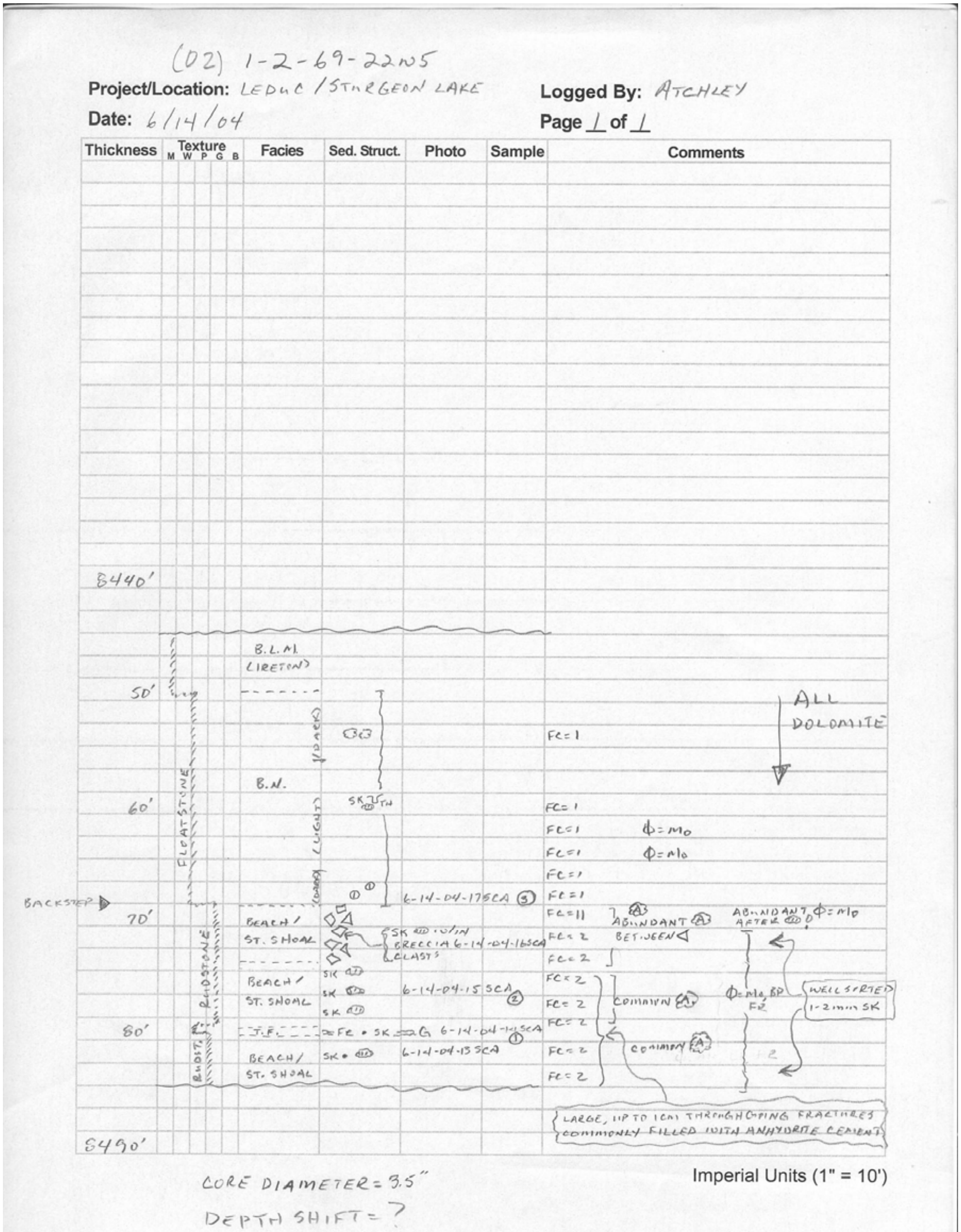
Peloid
Crinoid
Amphipora
Th *Thamnapora*
R Rugose coral
Tabulate coral
Bulbous stromatoporoid
Tabular stromatoporoid
Angular lithoclasts
Sub-angular lithoclasts
Intraclast
Gastropod
Bivalve
Crinoid
Oncoid
Stromatoporoid fragment
Brachiopod
SK Skeletal fragments: undifferentiated
Thick encrusting stromatoporoid
Tubular stromatoporoid

SEDIMENTARY STRUCTURES

mm-scale mechanical laminations
Root traces
Burrows
Fe Fenestral fabric
BB Beach bubbles

OTHER FEATURES

Anhydrite
ϕ Porosity
GS Green shale


(02) 1-2-69-22W5
Project/Location: LEDUC / STURGEON LAKE
Logged By: ATCHLEY
Date: 6/14/04
Page 1 of 1
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
8440'
50'
60'
70'
80'
8490'
BACKSTEP
FLOATSTONE
RUDSTONE
RUDST.
B.L.M.
(IRETON)
B.N.
(DARK)
(LIGHT)
(DARK)
BEACH / ST. SHOAL
BEACH / ST. SHOAL
J.F.
BEACH / ST. SHOAL
SK TH
SK W/IN BRECCIA CLASTS
SK
SK
SK
Fe • SK G
SK •
6-14-04-17SCA 5
6-14-04-16SCA
6-14-04-15SCA 2
6-14-04-14SCA 1
6-14-04-13SCA
FC=1
FC=1
FC=1
FC=1
FC=1
FC=1
FC=11
FC=2
FC=2
FC=2
FC=2
FC=2
FC=2
FC=2
Φ=Mo
Φ=Mo
ALL DOLOMITE
ABUNDANT A BETWEEN
ABUNDANT Φ=Mo AFTER
COMMON A
COMMON A
Φ=Mo, BP
WELL SORTED 1-2mm SK
LARGE, UP TO 1CM THROUGHGOING FRACTURES COMMONLY FILLED WITH ANHYDRITE CEMENT
Imperial Units (1" = 10')
CORE DIAMETER = 3.5"
DEPTH SHIFT = ?

(02) 10-5-69-21W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG

Date: 1/7/04 **Page** 1 **of** 3

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
48							
49							
2550							
51							
52							
53							
54							M.O. ϕ A
2555							M.O. ϕ STYOLITE * NO PRECISE WAY OF
56							IDENTIFING SEQ. BOUNDARIES
57						1	M.O. ϕ (SEE DIAGRAM ENCLOSED) INTRAPARTICLE ϕ
58		SLOPE		1-7-04-41JBK			M.O ϕ <KICK IN CORE ϕ ANALYSIS
59				1-7-04-42 JBK			M.O. ϕ W/ A LINING PORE
2560							
61						12 1	M.O. ϕ
62						12	M.O ϕ B.P. ϕ "HORSETAIL" STYOLITES M.O. ϕ
63		SLOPE				1	
64							
2565						11 1	STYOLITES B.P. ϕ
66		SLOPE		1-7-04-45 JBK			M.O. ϕ INTRAPARTICLE ϕ "HORSETAIL" STYOLITES
67						1	"HORSETAIL" STYOLITES "HORSE TAIL" STYOLITES
68		SLOPE				2	STYOLITES M.O ϕ
69						1 A A	M.O. ϕ M.O. ϕ
2570							
71		SI. Sd.	SK	1-7-04-43JBK		1	N.P. ϕ M.O. ϕ M.O. ϕ
2572		U. SLOPE?		1-7-04-44 JBK		11 1 11	M.O. ϕ
			BOTTOM OF CORE				

Metric Units (2.5cm = 3m)

CORE DIAMETER = 3½"

B

(02) 10-5-69-21 W5

Project/Location: LEDUC/STURGEON LAKE

Logged By: KOENIG

Date: 1/7/04

Page 2 **of** 3

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
21						1	M.O. ϕ PYRITE
22						11	< KICK IN CORE ANALYSIS
23				1-7-04-40JBK			M.O. ϕ
24		SLOPE				1	B.P. ϕ STYOLITES
2525						2	M.O. ϕ
26						1	M.O. ϕ
27						12; 1	
28							M.O. ϕ PYRITIZATION
29		SLOPE				1	
2530						1; 1	B.P. ϕ; M.O. ϕ
31							
32							
33							
34							
2535							
36							
37							
38							
39							
2540							
41							
42							
43							
44							
2545							
46							
47							

Metric Units (2.5cm = 3m)

CORE DIAMETER = 3½"

(02)10-5-69-21 W5

Project/Location: LEDUC/STURGEON LAKE

Logged By: KOENIG

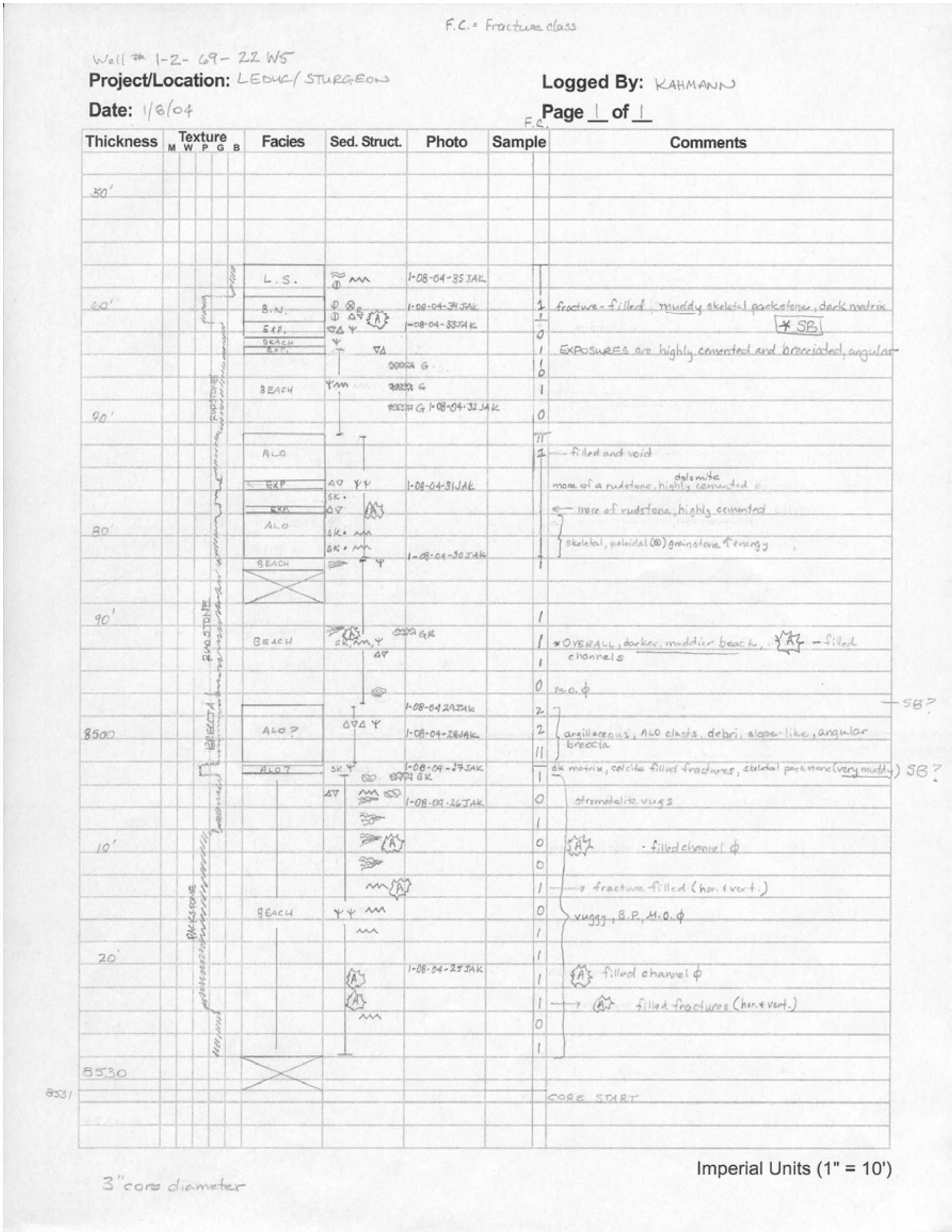
Date: 1/7/04

Page 3 **of** 3

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
2515						
16		TOP OF CORE				
17						
18			TH A	1-7-04-38 JBK	1	M.O. Φ
19		SLOPE			11	{A} FILLED PYRITIZED PORE SPACE PYRITE; *MAYBE MARGIN FACIES, THICK ENCRUSTING STROMATOPOROID DOMINATE ZONE
2520				1-7-04-39 JBK	1	

Metric Units (2.5cm = 3m)

CORE DIAMETER = 3½"



F.C. = Fracture class

Well # 1-2-69-22 W5

Project/Location: LEDUC/STURGEON

Logged By: KAHMANN

Date: 1/8/04

Page 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample (F.C.)	Comments
50'						
		L.S.		1-08-04-35JAK		
60'		B.N.		1-08-04-34JAK	1	fracture-filled, muddy skeletal packstone, dark matrix
				1-08-04-33JAK	1	✱ SB
		EXP.			0	
		BEACH				
		EXP.			1	EXPOSURES are highly cemented and brecciated, angular
				G	1	
					0	
		BEACH		G	1	
	RUDSTONE			G 1-08-04-32JAK		
70'					0	
					11	
		ALO			1	← filled and void
		EXP		1-08-04-31JAK		more of a rudstone, highly dolomite cemented
			SK.			
		EXP.				← more of rudstone, highly cemented
80'		ALO	SK.			skeletal, peloidal (®) grainstone ↑ energy
			SK.	1-08-04-30JAK		
		BEACH			1	
90'					1	
	RUDSTONE	BEACH	SK	GR	1	✱OVERALL, darker, muddier beach, Ⓐ - filled channels
					1	
					0	m.o. ϕ
				1-08-04-29JAK	2	— SB?
8500	BRECCIA	ALO?		1-08-04-28JAK	2	argillaceous, ALO clasts, debri, slope-like, angular breccia
					11	
		ALO?	SK	1-08-04-27JAK		dk matrix, calcite filled fractures, skeletal packstone (very muddy) SB?
				GK	1	
				1-08-04-26JAK	0	stromatolite vugs
					1	
10'					0	Ⓐ · filled channel ϕ
					0	
					1	→ fracture filled (hor. + vert.)
	PACKSTONE	BEACH			0	vuggy, B.P., M.O. ϕ
					1	
20'					1	
				1-08-04-25JAK	1	Ⓐ filled channel ϕ
					1	→ Ⓐ filled fractures (hor. + vert.)
					0	
					1	
8530						
8531						CORE START

Imperial Units (1" = 10')

3" core diameter

1-3-69-22W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** KAHMANN

Date: 6/15/04 **Page** 1 **of** 1

Thickness	Texture M W P G B	Facies	Sed. Struct.	Photo	Sample	Comments
16						
18						
8520				CORE END	FC	
22		BURROWED NODULAR	D,	6-15-24-34 JAK		
24				6-15-24-35 JAK		M.O.Φ
26					I	
28			(A) nodule			M.O.Φ * This is very ambiguous. The B.N. + slope are hard to nail-down positively
8530			D ?	6-15-04-33-JAK	II	
32				6-15-04-32-JAK	I	horizontal (bounded) mold
34		SLOPE middle?		6-15-04-31-JAK	II	M.O.Φ M.O.Φ
36					I	
38			(A) (A)	6-15-04-30 JAK		(A) filled fractures
8540		SL. SAND		6-15-04-29 JAK	I NI	M.O.Φ
8542						

Imperial Units (1" = 10')

CORE DIAMETER = 3½"

1-4-69-22W5

Project/Location: LEDUC/STURGEON

Logged By: ATCHLEY

Date: 6/14/04

Page 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8560'						
			①			
						ϕ = Mo
70'			⊗? ①	6-14-04-28SCA		
		B.N./	⊗?		FC=1	
		L. SLOPE				ϕ = HIGH Mo
80'			⊗?			ϕ = Mo
BACKSTEP		M. SLOPE	SK			
		SL. SANDS	SK FINE			
		M. SLOPE/	SK	6-14-04-27SCA 6-14-04-26SCA	FC=1	ϕ= G.F. ABUNDANT DOLOMITE
		MARGIN	SK	①	FC=1	CEMENT
90'			⊗R SK			
		B.N./	⊗R SK			ϕ= Mo
		L. SLOPE	SK			
8560'						

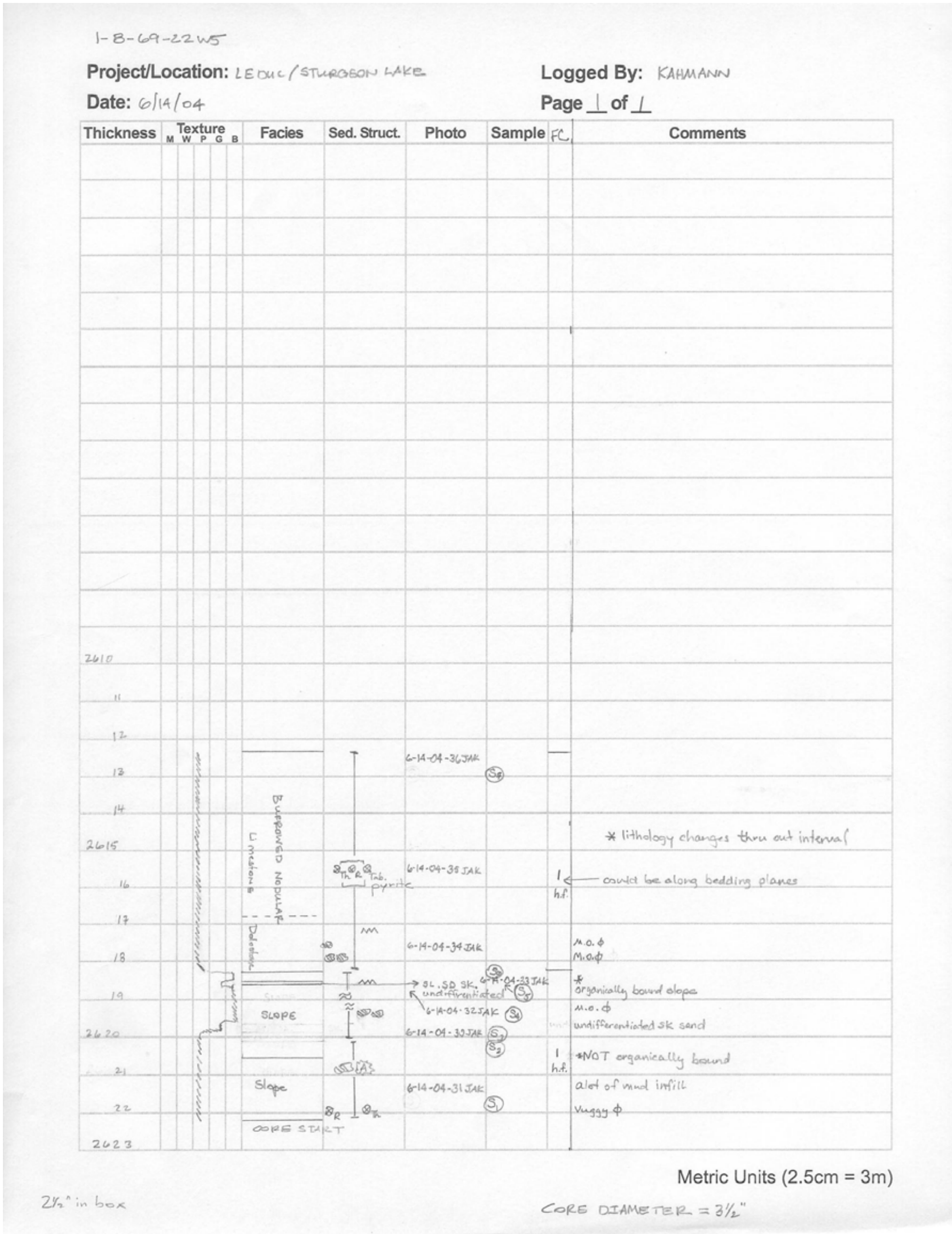
LIMESTONE

DOLOMITE

CORE DIAMETER = 3.5"

DEPTH SHIFT = ?

Imperial Units (1" = 10')


1-8-69-22W5

Project/Location: LEDUC/STURGEON LAKE

Logged By: KAHMANN

Date: 6/14/04

Page 1 **of** 1

Thickness | Texture (M W P G B) | Facies | Sed. Struct. | Photo | Sample | FC | Comments

2610
11
12
13 — 6-14-04-36JAK — S6
14
2615 — BURROWED NODULAR Limestone — * lithology changes thru out interval
16 — Th R Tab. pyrite — 6-14-04-35 JAK — I h.f. — could be along bedding planes
17
18 — Dolostone — 6-14-04-34 JAK — M.O. ϕ M.O.ϕ
19 — SL, SD SK, undiffrentiated — 6-14-04-33 JAK — S6 S5 — * organically bound slope
SLOPE — 6-14-04-32JAK — S4 — M.O. ϕ
2620 — 6-14-04-30JAK — S3 S2 — undifferentiated SK sand
21 — A — I h.f. — *NOT organically bound
Slope — 6-14-04-31 JAK — alot of mud infill
22 — R Th — S1 — Vuggy ϕ
CORE START
2623

Metric Units (2.5cm = 3m)

2½" in box

CORE DIAMETER = 3½"

1-9-69-21 W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG

Date: 1/7/04 **Page** 1 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
72		U.SLOPE	A	1-8-04-03JBK		1	M.O. ϕ M.O. ϕ *HAIRLINE FRACTURES ARE LESS APPARENT AND EVEN ABSENT THROUGH U.SLOPE (A/…)
73			A			0	
74		V-SLOPE	A	1-8-04-04JBK		1	OIL IN PLACE B.P. ϕ
2675						1	M.O. ϕ
76		U.SLOPE	A			1	M.O. ϕ
77				1-8-04-05JBK			G.F. ϕ
78		U.SLOPE	A	1-8-04-06JBK		1	M.O. ϕ INTRAPARTICLE ϕ
79			A A				M.O. ϕ M.O. ϕ
2680		U.SLOPE	A	1-8-04-07JBK		0	M.O. ϕ M.O. ϕ
81				1-8-04-08JBK			
82		U.SLOPE Sl. D U.SLOPE	*SK	1-8-04-09JBK		1	M.O. ϕ/B.P. ϕ FILLING B.P. ϕ
83		U.SLOPE U.SLOPE	A			0 1	B.P. ϕ M.O. ϕ
84		Sl. Sd		1-8-04-10JBK		1	B.P. ϕ STYOLITES M.O. ϕ
2685		U.SLOPE	A			1	B.P. ϕ M.O. ϕ
86		Sl. D U.Sl. Sl. Sd	*SK A	1-8-04-11JBK 1-8-04-12JBK		1 0 1	STYOLITES B.P. ϕ M.O. ϕ
87		U.SLOPE Sl. Sd.	*SK *SK	1-8-04-13JBK 1-8-04-14JBK		0 1	B.P. ϕ ARGILLACEOUS MUD B.P. ϕ
88		Sl. D Sl. Sd.		1-8-04-15JBK		2	M.O. ϕ ARGILLACEOUS MUD STYOLITES B.P. ϕ
89			A	1-8-04-16JBK 1-8-04-17JBK		1	M.O. ϕ ARGILLACEOUS MUD M.O. ϕ
90		Sl. D.	*SK				M.O. ϕ *UPPER SLOPE … MAY ALSO INDICATE MARGIN FACIES ARGILLACEOUS MUD
91				1-8-4-18JBK		0	STYOLITES ARGILLACEOUS MUD STYOLITES
92		U.SLOPE Sl. D U.SLOPE	A *SK	1-8-4-19JBK 1-8-4-20JBK			G.F. ϕ FILLED W/ … M.O. ϕ ARGILLACEOUS MUD STYOLITES
93		Sl. D	*SK			1	M.O. ϕ VERY HIGH M.O. ϕ ALTHOUGH FC = 1, FRACTURE THAT ALL PRESENT ARE HAIRLINE AND INCLINED
94		V.SLOPE		1-8-4-21JBK		12	M.O. ϕ STYOLITES
2695		BOTTOM OF CORE					

Metric Units (2.5cm = 3m)

CORE DIAMETER = 4"

1-9-69-21 W5

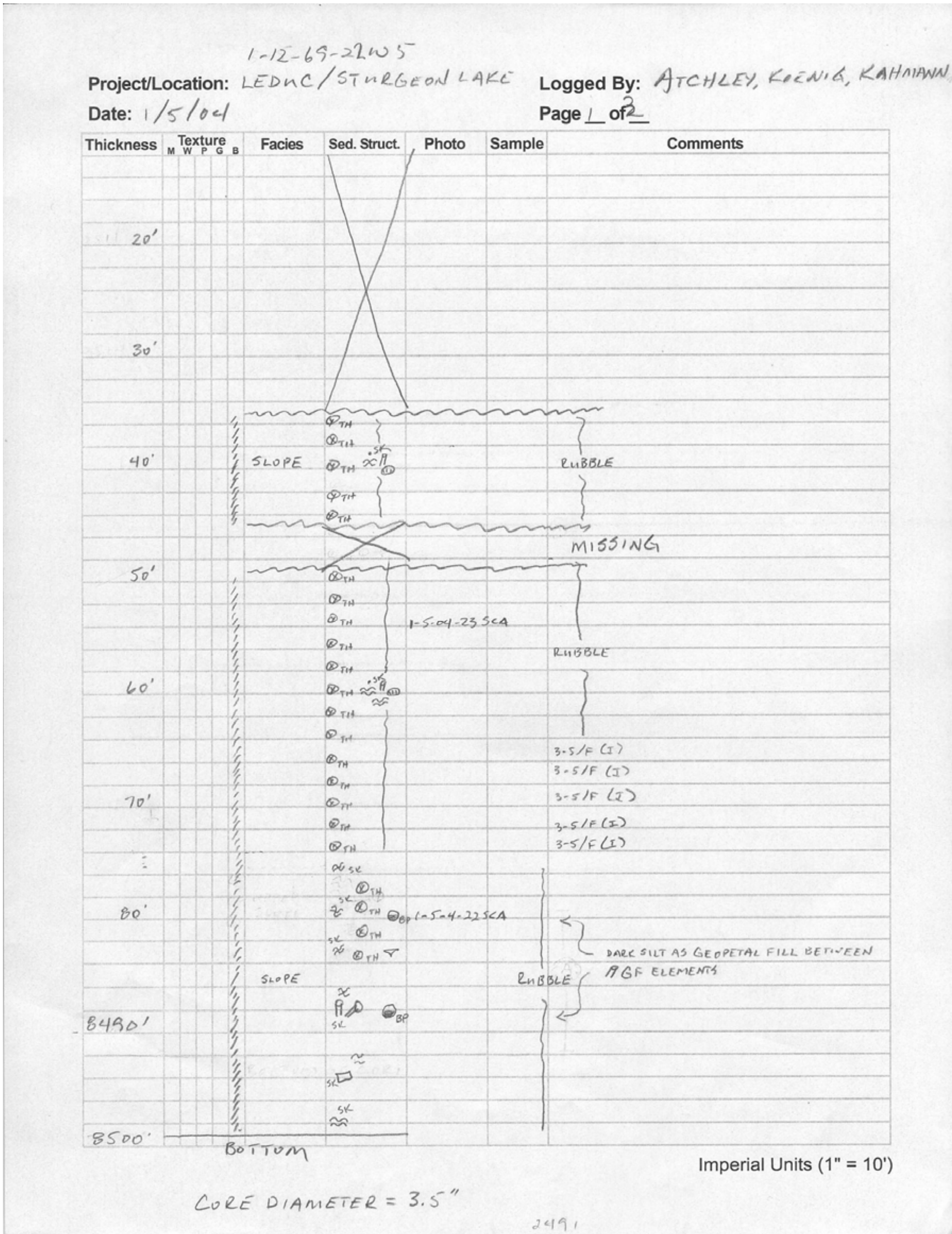
Project/Location: LEDUC/STURGEON LAKE **Logged By:** KOENIG

Date: 1/7/04 **Page** 1 **of** 2

Thickness	Texture M	W	P	G	B	Facies	Sed. Struct.	Photo	Sample	FC	Comments
68											
69						TOP OF CORE					
2670						V.SLOPE		1-8-04-01 JBK		11	MASSIVE STROMATOPOROID HEAD W/ OIL IN PLACE.
											STYLOLITES A LITTLE M.O. ϕ
71								1-8-04-02 JBK		0	M.O. ϕ

Metric Units (2.5cm = 3m)

CORE DIAMETER = 4"



1-12-69-22W5

Project/Location: LEDUC/STURGEON LAKE

Logged By: ATCHLEY, KOENIG, KAHMANN

Date: 1/5/04

Page 1 of 2

Thickness | Texture (M W P G B) | Facies | Sed. Struct. | Photo | Sample | Comments

20'

30'

40' SLOPE RUBBLE

MISSING

50'

1-5-04-23 SCA

RUBBLE

60'

3-5/F (I)

3-5/F (I)

70' 3-5/F (I)

3-5/F (I)

3-5/F (I)

80' 1-5-04-22 SCA

DARK SILT AS GEOPETAL FILL BETWEEN AGF ELEMENTS

SLOPE RUBBLE

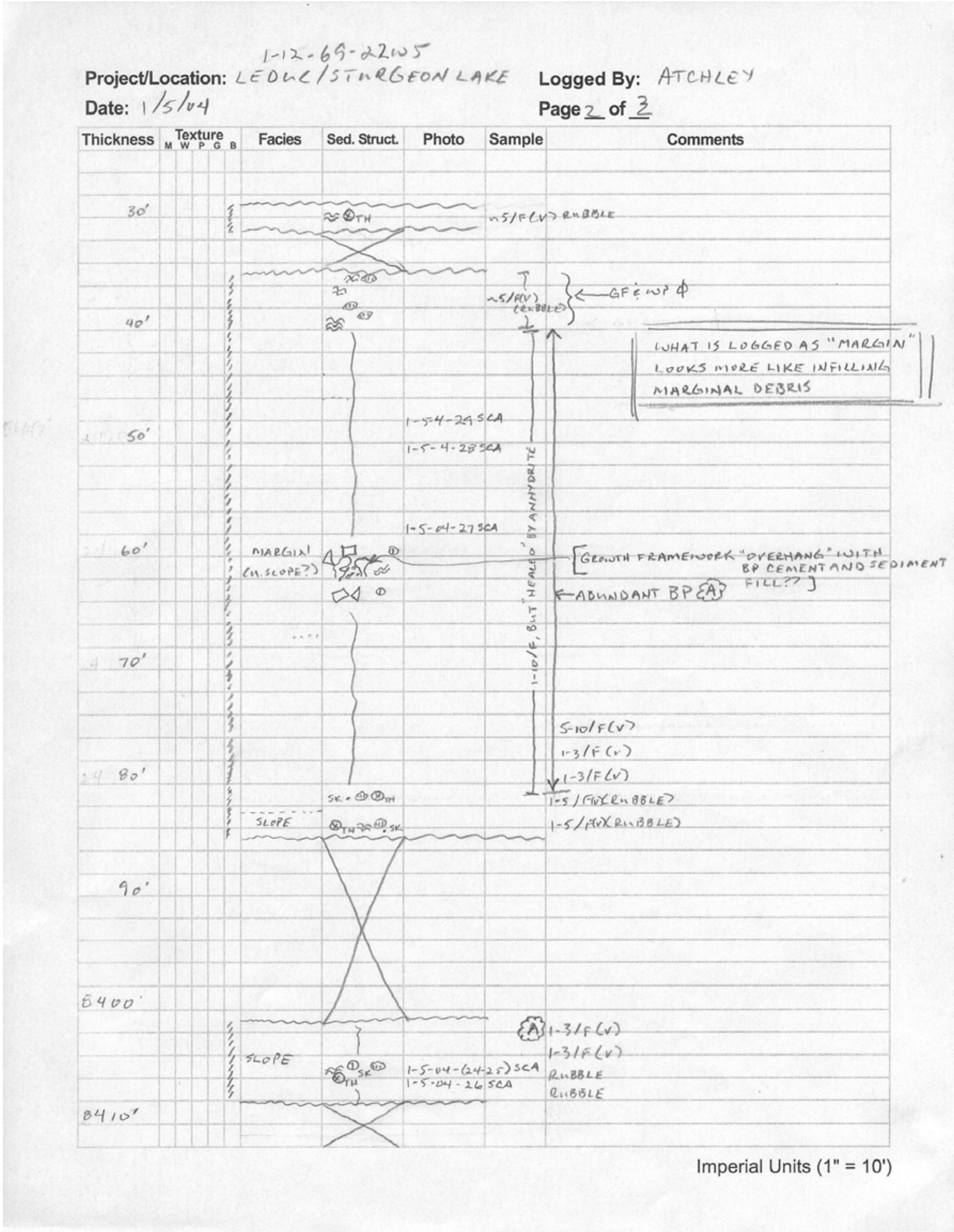
8490'

8500' BOTTOM

Imperial Units (1" = 10')

CORE DIAMETER = 3.5"

2491



1-12-69-22W5
Project/Location: LEDUC/STURGEON LAKE
Logged By: ATCHLEY
Date: 1/5/04
Page 2 of 3
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
30'
~5/F(V) RUBBLE
~5/F(V) (RUBBLE)
GF & WP Φ
40'
WHAT IS LOGGED AS "MARGIN" LOOKS MORE LIKE INFILLING MARGINAL DEBRIS
1-5-4-29 SCA
50'
1-5-4-28 SCA
1-5-04-27 SCA
60'
MARGIN (n. SLOPE?)
GROWTH FRAMEWORK "OVERHANG" WITH BP CEMENT AND SEDIMENT FILL??]
ABUNDANT BP
1-10/F, BUT "HEALED" BY ANHYDRITE
70'
5-10/F(V)
1-3/F(V)
80'
1-3/F(V)
1-5/F(V)(RUBBLE)
SLOPE
1-5/F(V)(RUBBLE)
90'
8400'
1-3/F(V)
1-3/F(V)
SLOPE
1-5-04-(24-25) SCA
1-5-04-26 SCA
RUBBLE
RUBBLE
8410'
Imperial Units (1" = 10')

Project/Location: 1-12-69-22W5 LEDUC / STURGEON

Logged By: ATCHLEY

Date: 1/5/04

Page 3 of 3

Thickness	Texture M	W	P	G	B	Facies	Sed. Struct.	Photo	Sample	Comments
8280'										
						TOP CORE				
8290'							SK			
							SK			
							SK	1-5-4-315CA		HIGH MO PHI (after)
8300'										
									1-10/F (V,I)	RUBBLE
8310										
								1-5-4-305CA		
									1-5/F(V)	ABUNDANT BP A
8320										ANHYDRITE "HEALED"

Imperial Units (1" = 10')

Project/Location: 1-23-68-22W5 LEDUC/STURGEON **Logged By:** ATCHLEY

Date: 1/8/84 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
2602		CORE TOP				
3	B	M. SLOPE	.SK	1-8-4-5SCA		FC=1 Φ= MO, GF, BP
		SL. SAND	.SK			FC=1 FC=1 Φ= Mo, BP
4						FC=2
5			.SK			FC=3
6						
7	B			1-8-4-4SCA 1-8-4-3SCA		FC=11 FC=2 FC=2 ← CAVITY-FILLING FIBROUS "BOTRYOIDAL-LIKE" DOLOMITE CEMENT
8		M. SLOPE	.SK .SK .SK			FC=2 FC=2
9				1-8-4-2SCA		FC=2 FC=5 Φ= Mo, Fr
2610	RHDSTONE		.SK			FC=5 FC=5
				1-8-4-1SCA		FC=5
11						
12				1-8-4-17SCA		
13						
14						Φ=Mo, Fc
15	B		.SK ??			FC=1
16				1-8-4-16SCA		
17		M. SLOPE				
18				1-8-4-15SCA		FC=11 COMMON BP ARGILLACEOUS MATERIAL
			SK	1-8-4-14SCA		FC=11
19			SK			FC=11
		CORE BOTTOM				
2620						

CORE DIAMETER = 4"

LIGHT COLOR — DARK

Metric Units (2.5cm = 3m)

ID# 1-31-68-21 W5

Project/Location: LEDUC / STURGEON

Logged By: KAHMANN

Date: 1/5/04

Page 1 **of** 3

	Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
	8413				1-06-04-3JAK		Φ due to WP ⊗Th AND vugs
				ΦΦ	1-06-04-12JAK		crinoid stem
	8423						
			SLOPE	⊗Th			10-15/ft v
				≈			WPΦ ⊗Th
	8433			≈			WPΦ ⊗Th * enrichment in ⊗Th
Box 6/55	8443			≈ ⊗Th A			
			SLOPE				
	8453			A ⊗Th			
				≈ ⊗Th	1-06-04-2JAK		WPΦ ⊗Th hi Φ due to vugs, BP, WP ⊗Th
				A ⊗Th			
	8463			≈			
					1-06-04-11JAK		Stachiotes Stem
				≈ ⊗Th			
			SLOPE	≈ A ⊗Th			2-6/ft v.
	8473			A			ANHYDRITE filled channels - 0/ft v.
							2-5/ft v. hi Φ due to stromt. vugs ĉ w.p. Φ ?
				⊗Th			
	8483	?					
				SK,			
	CORE START				1-06-04-1JAK		DOMINANTLY ANHY w/ STROM CLASTS - EMBAYMENT
Box 7/66	8493						

Imperial Units (1" = 10')

4 in diameter core

1 bar = 2 ft.

3.2808 ft/m

ID# 1-31-68-21W5

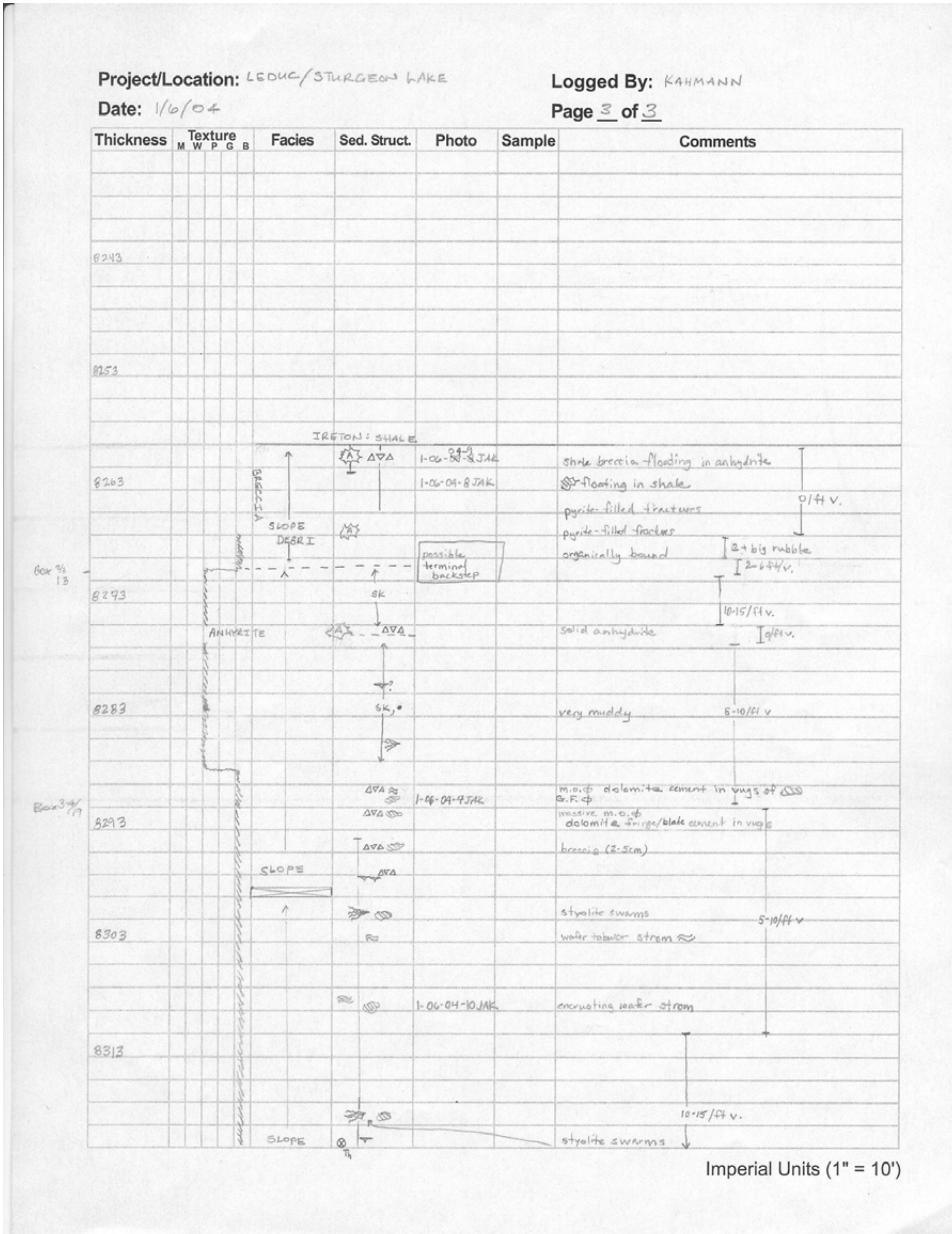
Project/Location: LEDUC/STURGEON **Logged By:** KAHMANN

Date: 1/5/04 – 1/6/04 **Page** 2 **of** 3

Thickness	Texture M W P G B	Facies	Sed. Struct.	Photo	Sample	Comments
8323						
8333						10-15/ft
		SLOPE				stylolite swarms
Box 4/31						
8343				1-06-04-4JAK		ϕ M.O.
? →						en-eschlon fractures ? low ϕ 10-15/ft v.
8353						dense stylolite swarms, encrusting wafer strom spotted around m.o. ϕ
			$\otimes_{Th}$?			crinoid - slope indicator
8363		SLOPE				m/o ϕ
						stylolite swarms, encrusting
						2-10/ft v.
				1-06-04-6JAK		large vugs (7cm) m.o. ϕ hi ϕ M.O./vuggy
8373	AN/DO					
	ANHY		AN	1-06-04-5JAK		lg. breccia clasts (3-6cm) floating in AN ↳ laminar muds? Possible GF overhang w/collapsed clasts
8383						
		SLOPE DEBRIS?	sk,			12/ft v., intraclasts amoungst stylolites 10/ft v.
Box 5/43 8393			AN			Dom. ANHY / Channel + vug ANHY Low ϕ @ 8392′ O/A
			$\otimes_{Th}$ AN			* $\otimes_{Th}$ dies out
8403		SLOPE	$\otimes_{Th}$			10-15/ft v
						* $\otimes_{Th}$ starts to wane, possible backstep

Imperial Units (1" = 10')

4" diameter core


Project/Location: LEDUC/STURGEON LAKE
Logged By: KAHMANN
Date: 1/6/04
Page 3 of 3
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
8243
8253
IRETON: SHALE
8263
BRECCIA
SLOPE
DEBRI
1-06-04-8 JAK
shale breccia floating in anhydrite
floating in shale
pyrite-filled fractures
pyrite-filled fractures
organically bound
0/ft v.
2+ big rubble
2-6 ft/v.
possible terminal backstep
Box 3/13
8273
SK
ANHYRITE
solid anhydrite
10-15/ft v.
0/ft v.
8283
SK,
very muddy
5-10/ft v
Box 3 4/17
m.o.φ dolomite cement in vugs of
Gr.F. φ
1-06-04-9 JAK
8293
massive m.o.φ
dolomite fringe/blade cement in vugs
breccia (2-5cm)
SLOPE
stylolite swarms
5-10/ft v
8303
wafer tabular strom
1-06-04-10 JAK
encrusting wafer strom
8313
10-15/ft v.
SLOPE
stylolite swarms
Imperial Units (1" = 10')

2-14-69-21 w5

Project/Location: LEDUC/STURGEON LAKE **Logged By:**

Date: 6/16/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Fc	Comments
2740							
41							
42							
43		TOP OF CORE					
44		BLM		6-16-04-87JBK 6-16-04-88JBK		11	BLACK LAMINATED MUD FISSILE 11 = VERY FISSILE
2745				6-16-04-89JBK			< LOG = CORE
46				6-16-04-90JBK			MUDDY CALCITE CEMENT FILLING PORES
47							STYOLITES MUDDY
48				6-16-04-91JBK	S1		
49							
2750		ST. SH		6-16-04-92JBK			
51				6-16-04-93JBK	S2		LIMESTONE
52				6-16-04-94JBK 6-16-04-95JBK			< SPIKE IN LOG (NOT BIG) ARGILLACEOUS ZONE
53				6-16-04-96JBK 6-16-04-97JBK			
54							
2755	FLOATSTONE					0	
56							< SPIKE IN LOG (NOT BIG) ARGILLACEOUS-RICH ZONE ~ 1-2" THICK
57				6-16-04-98JBK	S3		
58							
59						1 0	
2760				6-16-04-99JBK	S4	1	AMPHIP. AND BULBOUS STROMATOP (1-2")
61				6-16-04-100JBK			
62		BOTTOM OF CORE					
63							
64							

CORE DIAMETER = 4"

Metric Units (2.5cm = 3m)

3-2-69-22W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** KOENIG

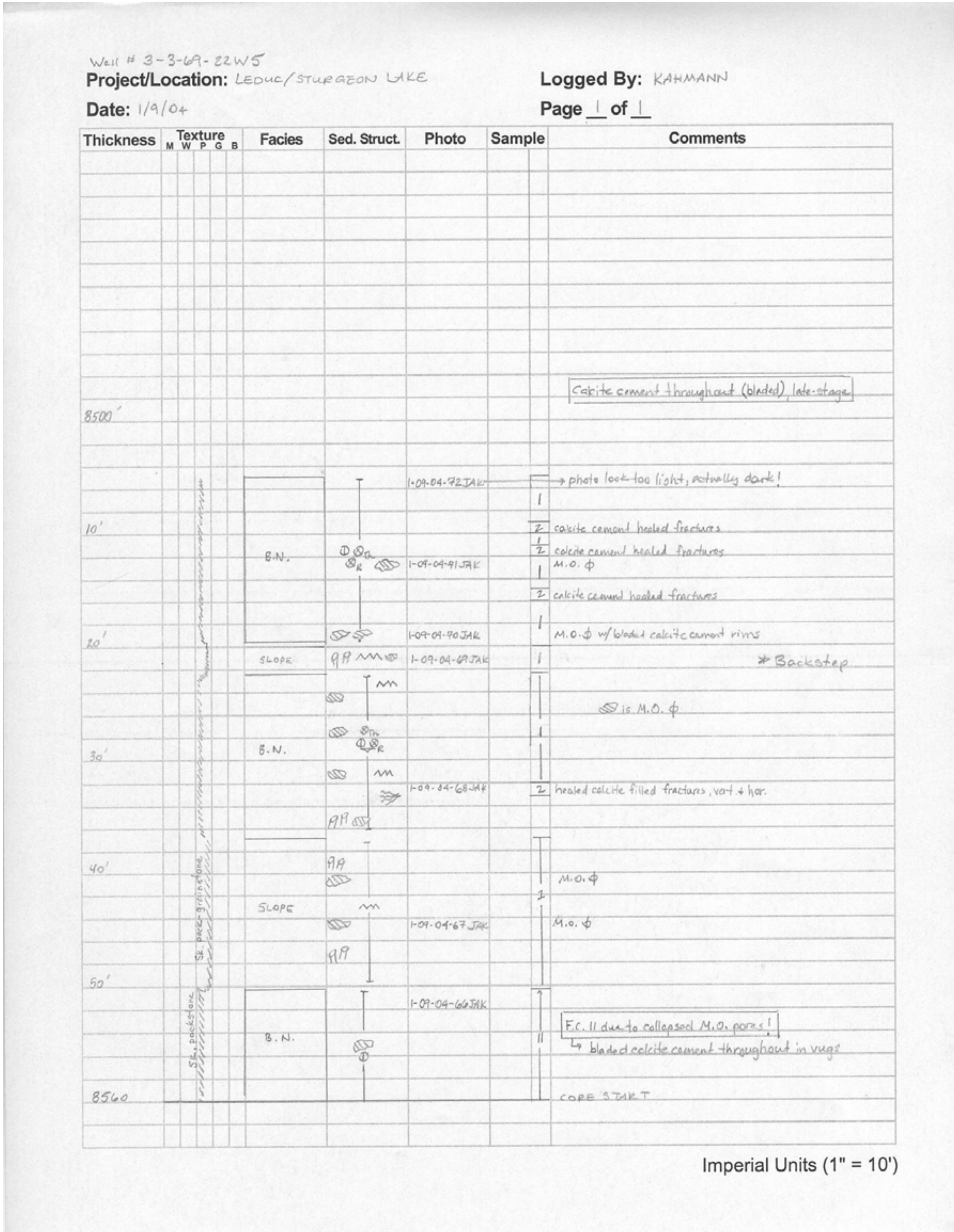
Date: 1/9/04 **Page** 1 **of** 1

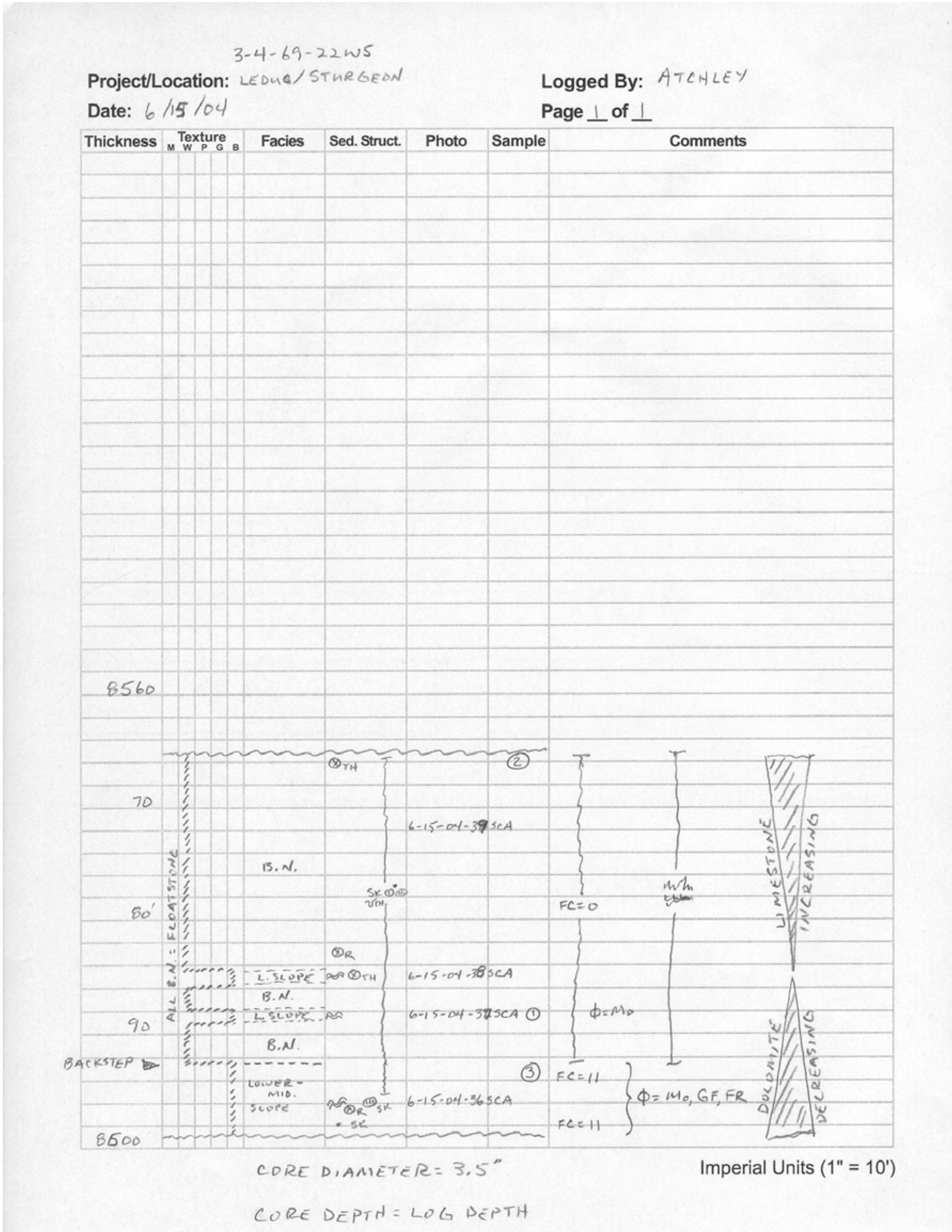
Thickness	Texture M W P G B	Facies	Sed. Struct.	Photo	Sample	FC	Comments
8470							
72							
74							
76		TOP	OF CORE				
78		IRETON		1-9-04-24JBK		0	
84 80				1-9-04-25JBK			
82							
84							
86							
88				1-9-04-26JBK			DK ARGILLACEOUS MUD
8490							STYOLITES THROUGHOUT B.N.
92		BURROWED				0	
94		NODULAR					
96			SK Φ	1-9-04-27JBK			
98			SK Φ				
8500							
02			SK				
04			SK Φ				
06			SK Φ	1-9-04-28JBK			M.O. Φ
08							M.O. Φ
8510			SK	1-9-04-29JBK			M.O. Φ ABUNDANT AMPHIPORA FRAGMENTS
12	RUDSTONE	ST. SH.				1	STYOLITES
14				1-9-04-30JBK			M.O. Φ ABRUPT GRAIN SIZE CHANGE MARKED BY ARGILLACEOUS MUD
16		BEACH		1-9-04-31JBK		1	
18						11	WHY ST.SH.? NO DEEP WATER FAUNA
85 20			SK				
22	RUDSTONE	ST SH		1-9-04-32JBK			ABUNDANCE OF DECREASES UP SECTION B.P. Φ THROUGHOUT
24						1	M.O. Φ DUE TO STROMATOPOROID FRAGMENTS
26				1-9-04-33JBK			AMPHIPORA FRAGMENTS THROUGHOUT
28							
8530		BOTTOM	OF CORE				

84785

Imperial Units (1" = 10')

CORE DIAMETER = 3½"


Well # 3-3-69-22W5
Project/Location: LEDUC/STURGEON LAKE
Logged By: KAHMANN
Date: 1/9/04
Page 1 of 1
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
Calcite cement throughout (bladed), late-stage
8500'
1-09-04-72JAK
photo look too light, actually dark!
10'
calcite cement healed fractures
B.N.
calcite cement healed fractures
1-09-04-91JAK
M.O. ϕ
calcite cement healed fractures
20'
1-09-04-90JAK
M.O. ϕ w/ bladed calcite cement rims
SLOPE
1-09-04-69JAK
* Backstep
is M.O. ϕ
30'
B.N.
1-09-04-68JAK
healed calcite filled fractures, vert + hor.
40'
M.O. ϕ
SLOPE
Sk. pack-grainstone
1-09-04-67JAK
M.O. ϕ
50'
1-09-04-66JAK
F.C. 11 due to collapsed M.O. pores!
bladed calcite cement throughout in vugs
B.N.
Sk. packstone
8560
CORE START
Imperial Units (1" = 10')



3-4-69-22W5

Project/Location: LEDUC/STURGEON

Logged By: ATCHLEY

Date: 6/15/04

Page 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8560						
			ⓧTH		②	
70				6-15-04-39SCA		
	ALL B.N. = FLOATSTONE	B.N.				LIMESTONE INCREASING
80'			SK ⓧ VTH			FC=0
			ⓧR			
		L. SLOPE	ⓧTH	6-15-04-38SCA		
		B.N.				
		L. SLOPE		6-15-04-37SCA	①	Φ=Mo
90		B.N.				
BACKSTEP					③	FC=11
		LOWER-MID. SLOPE	ⓧR SK • SK	6-15-04-36SCA		Φ= Mo, GF, FR; DOLOMITE DECREASING
8600						FC=11

CORE DIAMETER = 3.5"

Imperial Units (1" = 10')

CORE DEPTH = LOG DEPTH

Project/Location: 3-5-69-21W5 LEDUC/STURGEON LAKE **Logged By:** ATCHLEY/KOENIG/KAHMANN

Date: 1/5/04 **Page** __ **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
09		SL. SAND	SK SK	1-05-04-13	SCA	COMMON BP(Δ)(A)
2510						FRACTURES COMMONLY CEMENTED BY (A)
11						
12						
13						10-20/F(V-I) HIGH Φ = Mo, Fr AFTER
14				1-05-04-12	SCA	ABUNDANT PORE-LINING PYRITE CEMENT
15						
16						(A) (A)
17						
18		GFU. SL.				
19			SK			
2520						
21						
22						
23				1-05-04-11	SCA	
24						
25						10-30/F(V-I) FREQUENT HORIZONTAL HORSETAIL STYLOLITE SWARMS
26						(A)
27				1-05-04-8	SCA	
28		SL. SAND	SK	1-05-04-10	SCA	5/F(V) 30-40/F(V)
29		GFU. SL	SK	1-05-04-9	SCA	(A) 10/FT(V)
2530			SK			
31						
32						
33						
34						
2535m						

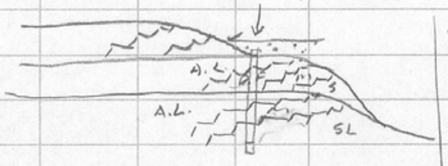
Metric Units (2.5cm = 3m)

CORE DIAMETER = 4"

Project/Location: 3-5-69-21W5 **Logged By:**

Date: 1/5/04 **Page** 2 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
					3-5-69-21W5 ?	
85						"MARGIN" FACIES HAVE THE HIGHEST PROPORTION OF ANHYDRITE CEMENT... FOLLOWED CLOSELY BY "SLOPE" FACIES. AMPH. LAGOON & STROM. SHOAL HAVE HIGHEST ϕ.
86						
87						
88						
89						
2490		TOP LEDUC				
91		SL SAND?	SK	1-05-04-21SCA 1-05-04-20SCA		< CORE - 3m = LOG DEPTH HIGH BP ϕ
92						
93						< POSSIBLE BACKSTEP (S.B.)
94		A.L.		1-05-04-19		0-15/F(V) + RUBBLE
95	R					
96	R			1-05-04-18SCA 1-05-04-17SCA		ABUNDANT FABRIC-REPLACING PYRITE
97	R	STROM. SHOAL	SK ?			HIGHLY RUBBLED... CORE ANALYSIS SAMPLES OCCUR IN LOW ϕ INTERVALS CHARACTERIZED BY HIGH BP DOLOMITE & ANHYDRITE CEMENT, THUS, CORE ANALYSIS RESULTS ARE BIASED!
98	R					
99	R					
2500	R			1-05-04-16SCA	A BP(A)	< POSSIBLE BACKSTEP (S.B.)
01	F					
02		A.L.	SK			3-8/F(V) ABUNDANT MO ϕ
03					PORE-LINING PYRITE CEMENT	RUBBLY RECOVERY
04			?	1-05-04-15SCA	A	
05	GF		SK	1-05-04-14SCA	A	
06	GF	MARGIN	SK			3-10/F(V) GF ϕ OCCLUDED BY A
07	GF		SK		A	
08						



Metric Units (2.5cm = 3m)

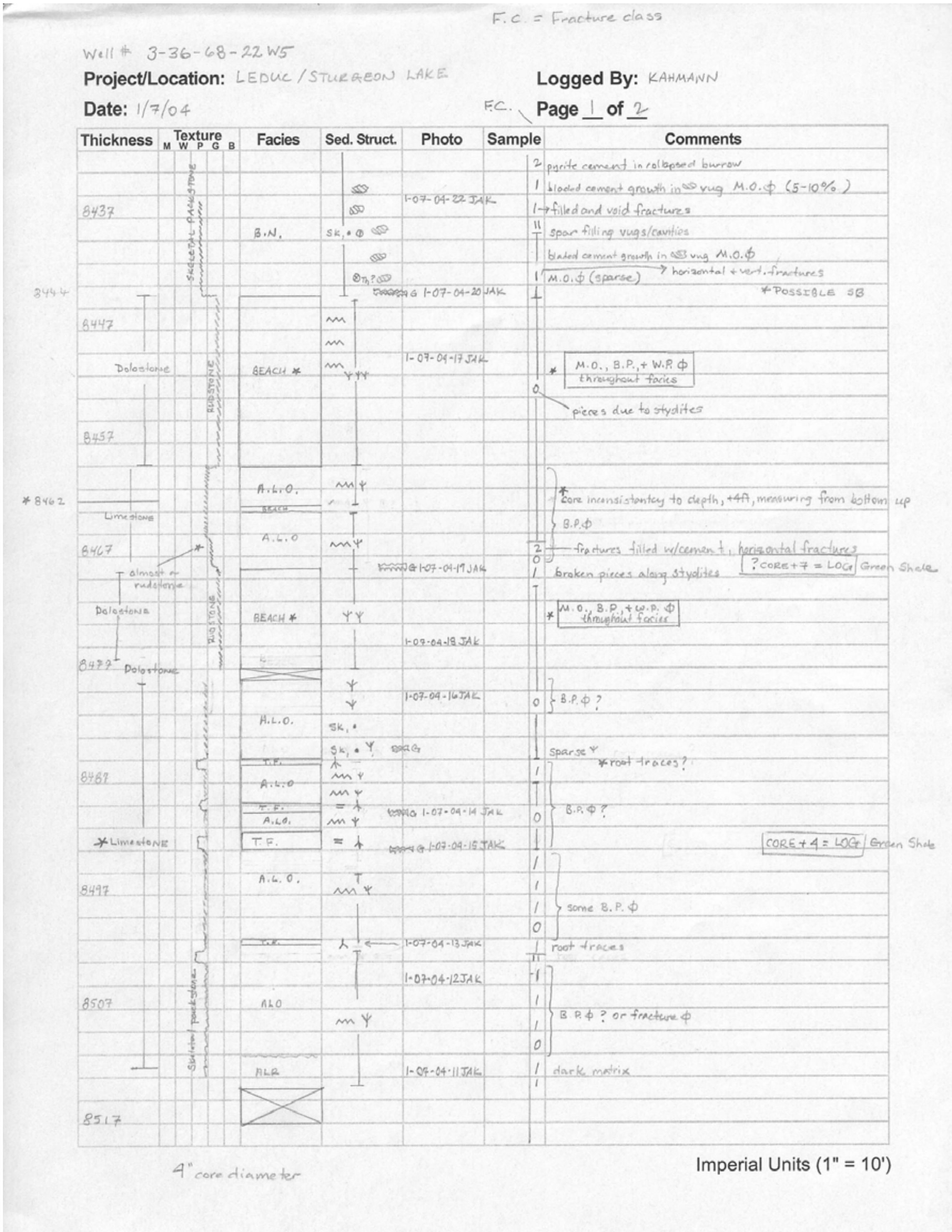
Project/Location: 3-7-69-21W5 LEDUC/STURGEON LAKE **Logged By:** ATCHLEY

Date: 1/8/04 **Page** 1 **of** 1

	Thickness	M	W	P	G	B	Facies	Sed. Struct.	Photo	Sample	Comments
8480?	8580						CORE TOP				
								⊗TH			
								⊗TH			
										FC=1	
8490	8590					B	M. SLOPE	SK	NO PHOTOS		Φ= Mo, GF, Fr
										FC=2	
8500?	8500						CORE BASE				

"SLABBED" CORE IN SMALL, 1" THICK, CARDBOARD BOXES... PROBLEMATIC FOR DESCRIPTION AND PRECISE DEPTH RECONCILIATION.

Imperial Units (1" = 10')



F.C. = Fracture class
Well # 3-36-68-22 W5
Project/Location: LEDUC / STURGEON LAKE
Logged By: KAHMANN
Date: 1/7/04
F.C.
Page 1 of 2
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
pyrite cement in collapsed burrow
bladed cement growth in vug M.O.ϕ (5-10%)
1-07-04-22 JAK
8437
filled and void fractures
B.N.
spar filling vugs/cavities
bladed cement growth in vug M.O.ϕ
horizontal + vert. fractures
M.O.ϕ (sparse)
1-07-04-20 JAK
*POSSIBLE SB
8444
8447
Dolostone
BEACH *
1-07-04-17 JAK
M.O., B.P., + W.P. ϕ throughout facies
pieces due to stylites
RUDSTONE
8457
A.L.O.
*8462
core inconsistency to depth, +4ft, measuring from bottom up
Limestone
B.P.ϕ
A.L.O
8467
fractures filled w/cement ↓, horizontal fractures
almost a rudstone
1-07-04-19 JAK
broken pieces along stylites
?CORE + 7 = LOG
Green Shale
Dolostone
BEACH *
M.O., B.P., + W.P. ϕ throughout facies
1-07-04-18 JAK
8477
Dolostone
1-07-04-16 JAK
B.P.ϕ ?
A.L.O.
Sk, •
sparse
*root traces?
8487
T.F.
A.L.O
B.P.ϕ ?
1-07-04-14 JAK
A.L.O.
*Limestone
T.F.
1-07-04-15 JAK
CORE + 4 = LOG
Green Shale
A.L.O.
8497
some B.P.ϕ
1-07-04-13 JAK
root traces
1-07-04-12 JAK
8507
ALO
B.P.ϕ ? or fracture ϕ
ALR
1-07-04-11 JAK
dark matrix
8517
4" core diameter
Imperial Units (1" = 10')

F.C. = fracture class

Well # 3-36-68-22W5

Project/Location: LEDUC/ STURGEON LAKE

Logged By: KAHMANN

Date: 1/7/04

Page 2 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8407		CORE END				
			ΔVΔ	1-07-04-24 JAK		due to collapsed burrows
8417				1-07-04-21 JAK		
Limestone	SKELETAL PACKSTONE	B.N.	SK, Φ		0	some rubble, due to stylolites
				✓		
8427						bladed cement in vugs, little M.O. Φ
Dolostone				1-07-04-28 JAK		small bladed cement in vugs, encrusted fabric

NOTE: Lithology in "Thickness"

Beach and parts of B.N. preferentially dolomitized

4" core diameter

Imperial Units (1" = 10')

Project/Location: 4-35-69-23W5 LEDUC/STURGEON LAKE

Logged By: ATCHLEY

Date: 1/9/4

Page 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
2660						
61						
62						
63						
64		CORE TOP				
65						BLACK LAMINATED MUDSTONE
66		B.L.M.		18		
67		IRETON SHALE		1-9-4-17 SCA	FC=1	
68				1-9-4-16 SCA	FC=1 FC=1 FC=1	Φ REDUCES SIGNIFICANTLY DUE TO MUDDIER TEXTURE
69					FC=0	
2670					FC=1 FC=1	
71					FC=0	
72				1-9-4-15 SCA	FC=1 FC=0	
73				1-9-4-15 SCA	FC=0 FC=1	
74			SK, 25TH		FC=1 FC=11	HIGH Φ DUE TO BP, MO TYPES
75					FC=0 FC=0	
76					FC=0	
77				1-9-4-14 SCA		
78						
79					FC=1	
2680				1-9-4-12 SCA		
81				1-9-4-13 SCA		
82			SK		FC=11	
2683		M.SL.	SK 19	1-9-4-11 SCA	FC=1	

WELL-DEVELOPED SLOPE SAND (OUTSIDE CHANCE IT IS STROMATOPOROID SHOAL)

THALASSINOIDES BURROWS WELL-DEVELOPED THROUGHOUT... CRUZIANA ICHNOFACIES

CORE BASE

Metric Units (2.5cm = 3m)

CORE DIAMETER = 3.75"

5-2-69-22 W5

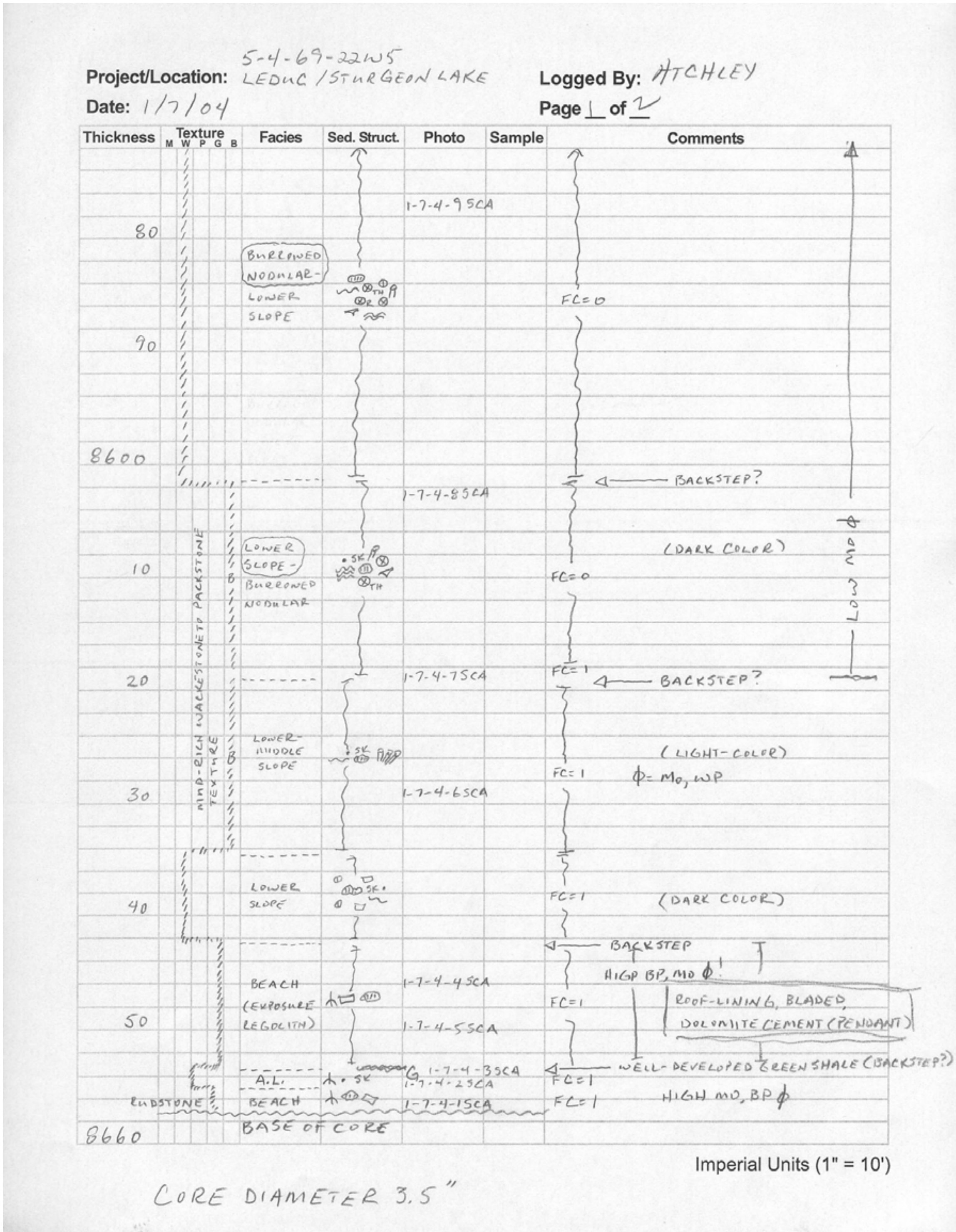
Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG

Date: 6/14/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8500						
02						
04						
06		TOP OF CORE			FC	
08		LOWER SLOPE?		6-14-04-33JBK		MO ϕ PYRITE
8510		BN		6-14-04-34JBK		STYLOLITES SA FILLING FRACTURES
12			•Sk			
14				6-14-04-35JBK	1	ABUNDANT MO ϕ $\boxed{\phi \text{ PLOT} + 3' = \text{DESCRIPTIONS}}$ $\boxed{\text{LOG} + 3 = \text{DESCRIPTIONS}}$
16						MO ϕ
18				6-14-04-36 JBK		<GREEN SHALE
8520		ST SH				
22				6-14-04-37JBK		MO ϕ
24				6-14-04-38JBK	1	
26				6-14-04-39JBK	0	MO ϕ (Fe ϕ ? ∴ TIDAL FLAT?)
28				6-14-04-40JBK		LARGE MO ϕ (SPIKE IN ϕ PLOT)
8530				6-14-04-41 JBK	II	<GREEN SHALE
		BOTTOM OF CORE				

Imperial Units (1" = 10')

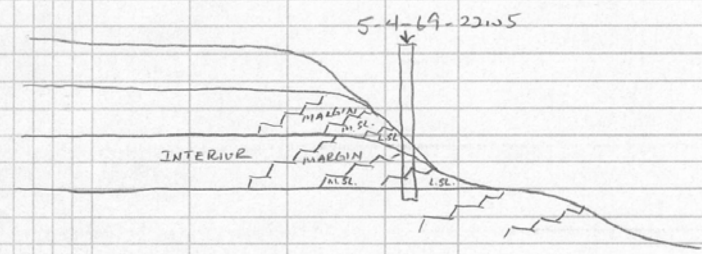
CORE DIAMETER = 3½"


5-4-69-22W5
Project/Location: LEDUC / STURGEON LAKE
Logged By: ATCHLEY
Date: 1/7/04
Page 1 of 2
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
80
90
8600
10
20
30
40
50
8660
BURROWED NODULAR- LOWER SLOPE
LOWER SLOPE - BURROWED NODULAR
LOWER- MIDDLE SLOPE
LOWER SLOPE
BEACH (EXPOSURE REGOLITH)
A.L.
BEACH
RUDSTONE
BASE OF CORE
MUD-RICH WACKESTONE TO PACKSTONE TEXTURE
1-7-4-9SCA
1-7-4-8SCA
1-7-4-7SCA
1-7-4-6SCA
1-7-4-4SCA
1-7-4-5SCA
1-7-4-3SCA
1-7-4-2SCA
1-7-4-1SCA
FC=0
BACKSTEP?
(DARK COLOR)
FC=0
FC=1
BACKSTEP?
(LIGHT-COLOR)
FC=1
ϕ= Mo, WP
FC=1
(DARK COLOR)
BACKSTEP
HIGH BP, MO ϕ!
ROOF-LINING, BLADED, DOLOMITE CEMENT (PENDANT)
FC=1
WELL-DEVELOPED GREEN SHALE (BACKSTEP?)
FC=1
FC=1
HIGH MO, BP ϕ
LOW MO ϕ
Imperial Units (1" = 10')
CORE DIAMETER 3.5"

Project/Location: 5-4-69-22W5 LEDUC / STURGEON LAKE **Logged By:** ATCHLEY

Date: 1/7/04 **Page** 2 **of** 2

Thickness	Texture M W P G B	Facies	Sed. Struct.	Photo	Sample	Comments



Thickness	Texture M W P G B	Facies	Sed. Struct.	Photo	Sample	Comments
8540						
	TOP OF CORE					
50						
		BURROWED NODULAR	twl			FC=0
60		LOWER SLOPE	R			
						LOW
8570			1-7-4-10SCA			

Imperial Units (1" = 10')

5-9-69-21 W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG

Date: 1/6/04 **Page** 1 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Fract Freq	Comments
59						2	B.P. Φ
2660		MARGIN					M.O. Φ
61				1-6-04-17JBK		11	M.O. Φ B.P. Φ W/ ANH CEMENT B/W
62				1-6-04-18JBK		1	M.O. Φ B.P. Φ W/ ANH CEMENT B/W M.O. Φ
63		SI. Sd	SK			0	B.P. Φ M.O. Φ STYOLITES
64		SI. Sd.	SK	1-6-04-19JBK		0	B.P. Φ / M.O. Φ LARGE MOLDS (Φ)
2665		MARGIN					A ABUNDANT = BP Φ
66				1-6-04-20 JBK		1	ABUNDANT = BPΦ STYOLITES ABUNDANT = BPΦ
67			SK	1-6-04-21JBK			M.O. Φ M.O. Φ
68		SLOPE		1-6-04-22 JBK			LARGE M.O. Φ FILLED W/ A < CORE ~.5M = LOG (GR KICK) INCREASE ABUNDANCY STYOLITES
69			SK			1	A FILLING MOLD = ZERO Φ ON CORE ANALYSIS STYOLITES GR KICK
2670				1-6-04-23 JBK 1-6-04-24 JBK			LARGE MOLDS FILLED W/ A M.O. Φ STYOLITES
71		SLOPE		1-6-04-25 JBK		1 0	B.G. Φ M.O. Φ
72		SI. Sd.	SK	1-6-04-26 JBK		0	B.G. Φ / LESSER M.O. Φ (ZERO Φ ON CORE ANALYSIS) GR KICK
73		SLOPE		1-7-04-27 JBK		0	M.O. Φ / B.G. Φ STYOLITES
74				1-7-04-28 JBK 1-7-04-29 JBK			Δ W/ A MTX M.O. Φ / BP. Φ, PYRITE XTALS A
2675		SL. D 6		1-7-04-30 JBK 1-7-04-31 JBK		1	A ΔΔ STYOLITES A ΔΔ 0 DEBRIS BRECCIA W/ PYRITE A ΔΔ M.O. Φ STYOLITES
76		SLOPE SI. D. 6	SK	1-7-04-32 JBK		0 0	Δ M.O. Φ BP. Φ Δ M.O. Φ
77		MARGIN		1-7-04-33 JBK 1-7-04-34 JBK			A STYOLITES M.O. Φ STYOLITES
78		SI. D. 6				1	Δ M.O. Φ STYOLITES
79		MARGIN		1-7-04-35 JBK		0	M.O. Φ FILLED W/ A
2680		MARGIN		1-7-04-36 JBK		0	LGF. Φ FILLED W/ A M.O. Φ (SPIKE IN CORE Φ ANALYSIS)
81				1-7-04-37 JBK			M.O. Φ STYOLITES M.O. Φ FILLED W/ A
82		BOTTOM OF CORE					
83							
84							
2685							

CORE DIAMETER = 4"

Metric Units (2.5cm = 3m)

* PHOTOS RIGHT IS UPSECTION ROTATE AFTERWARDS!

TOP BOTTOM

5-9-69-21 W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** KOENIG

Date: 1/6/04 **Page** 2 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Fract. Freq.	Comments
2650							
51							
52							
53							
54		TOP OF CORE					
2655				1-6-04-14 JBK			*B.P. Φ FILLED W/ ANH CEMENT THROUGHOUT MARGIN FACIES* PYRITE NODULE M.O. Φ
56				1-6-04-15 JBK		1	
57		MARGIN					
58				1-6-04-16 JBK		11 2	B.P. Φ ABUNDANT

Metric Units (2.5cm = 3m)

CORE DIAMETER = 4"

*PHOTOS: RIGHT IS UP SECTION, ROTATE AFTERWARDS.

5-19-69-22W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** KOENIG

Date: 1/8/04 **Page** 1 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
8714		TOP OF CORE					
16						12	VERY RUBBLED
18		Sl.Sd	•SK				
8720		Sl.D	SK				STYOLITES
22				1-9-04-1JBK		11	M.O. ϕ B.P. ϕ
24		Sl Sd					{A}
26			A				{A}
28							M.O. ϕ
8730							
32							
34							
36							
38							
8740							
42							
44							
46			A				M.O. ϕ
48							
8750							{A} MTX w/ CLASTS OF Sl.Sd CORE-2=LOG
52						11	{A}
54		ST SH	•SK				
56							INTRA CLASTS OF Sl.Sd w/ DOL CEMENT
58							
8760							M.O. ϕ
62							* MOLDIC ϕ THROUGHOUT SLOPE
64		ALO	A SK	1-9-04-2JBK		11	MAY BE ALO (FEATURES NOT DISTINCT) → NOT CONFIDENT
66			A				M.O. ϕ
68			ϕ A				FRACTURES HEALED BY DOL. CORE-2=LOG
8770		B.N.	A	1-9-04-3JBK		11	D.K. ARGILACEOUS MUD
72			ϕ				< BACKSTEP?
74			ϕ				{A}
76				1-9-04-4JBK			{A} M.O. ϕ CORE THAT IS NOT RUBBLE HAS
78		Sl Sd	•SK ϕ			11	FRACTURES HEALED BY {A}
8780			≈				
82							M.O ϕ {A}
84	F						{A} MTX SLOPE Sd CLASTS
86							
88				1-9-04-5JBK		11	BRECCIATED CLASTS OF SLOPE DEBRIS {A} MTX
8790		BRECCIA					CLASTS OF Sl.Sd
92							
94							
96				1-9-04-6JBK		11	DK COLORED BRECCIA CLASTS OF •SK SLOPE DEBRIS

IS B.N. INTERVAL IN PLACE? HAS IT BEEN FAULTED THERE?

POLYMICT BX

FAULT

KARST

Imperial Units (1" = 10')

CORE DIAMETER = 3½"

5-19-69-22 W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG

Date: 1/9/03 **Page** 2 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
98		BRECCIA	25	1-9-04-7 JBK		11	BRECCIA W/ [illegible] MTX. CLASTS OF SISd AND SK LIGHT COLORED CLASTS
8800							
		BOTTOM OF CORE					

Imperial Units (1" = 10')

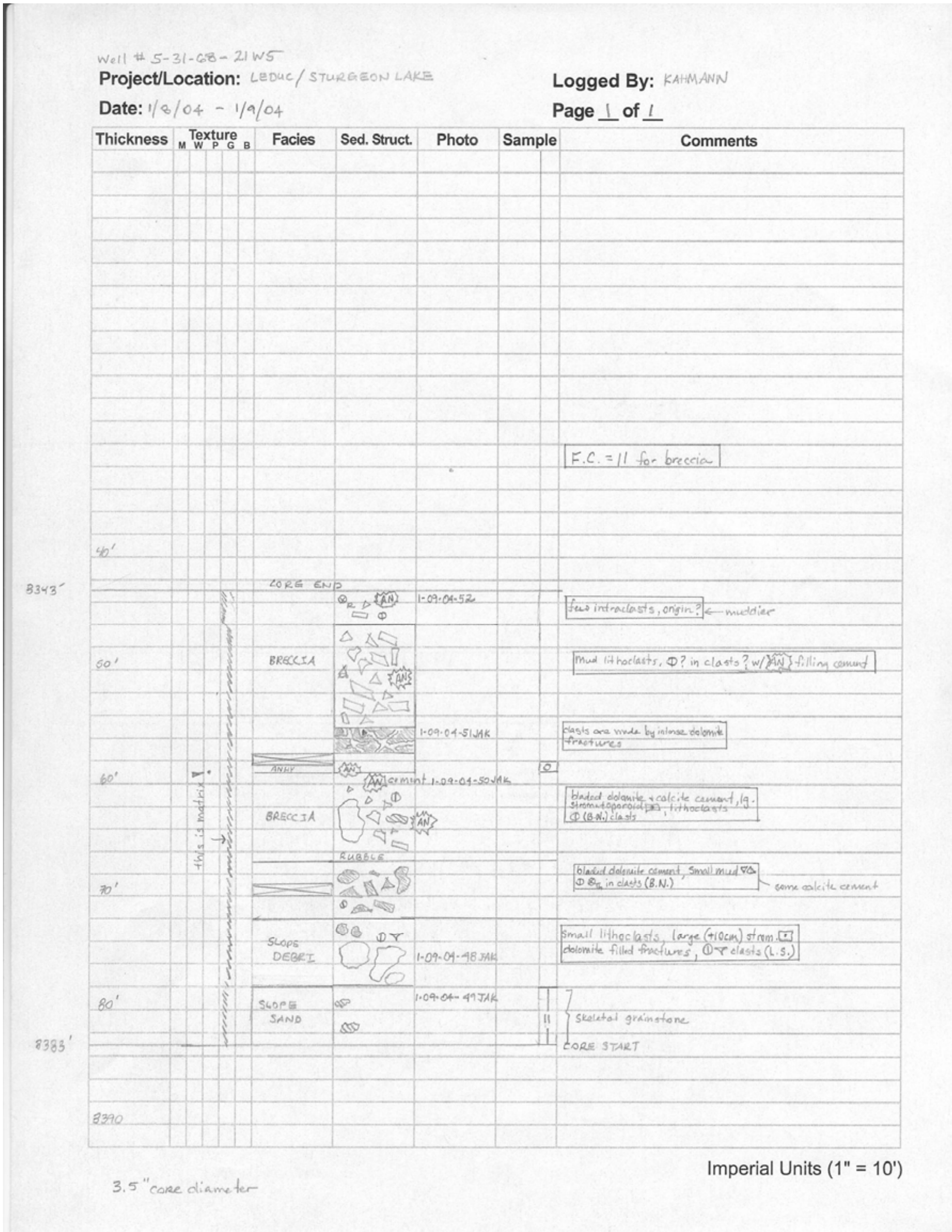
CORE DIAMETER = 3½"

Project/Location: 5-24-68-22 W5 LEDUC / STURGEON LAKE **Logged By:** ATCHLEY

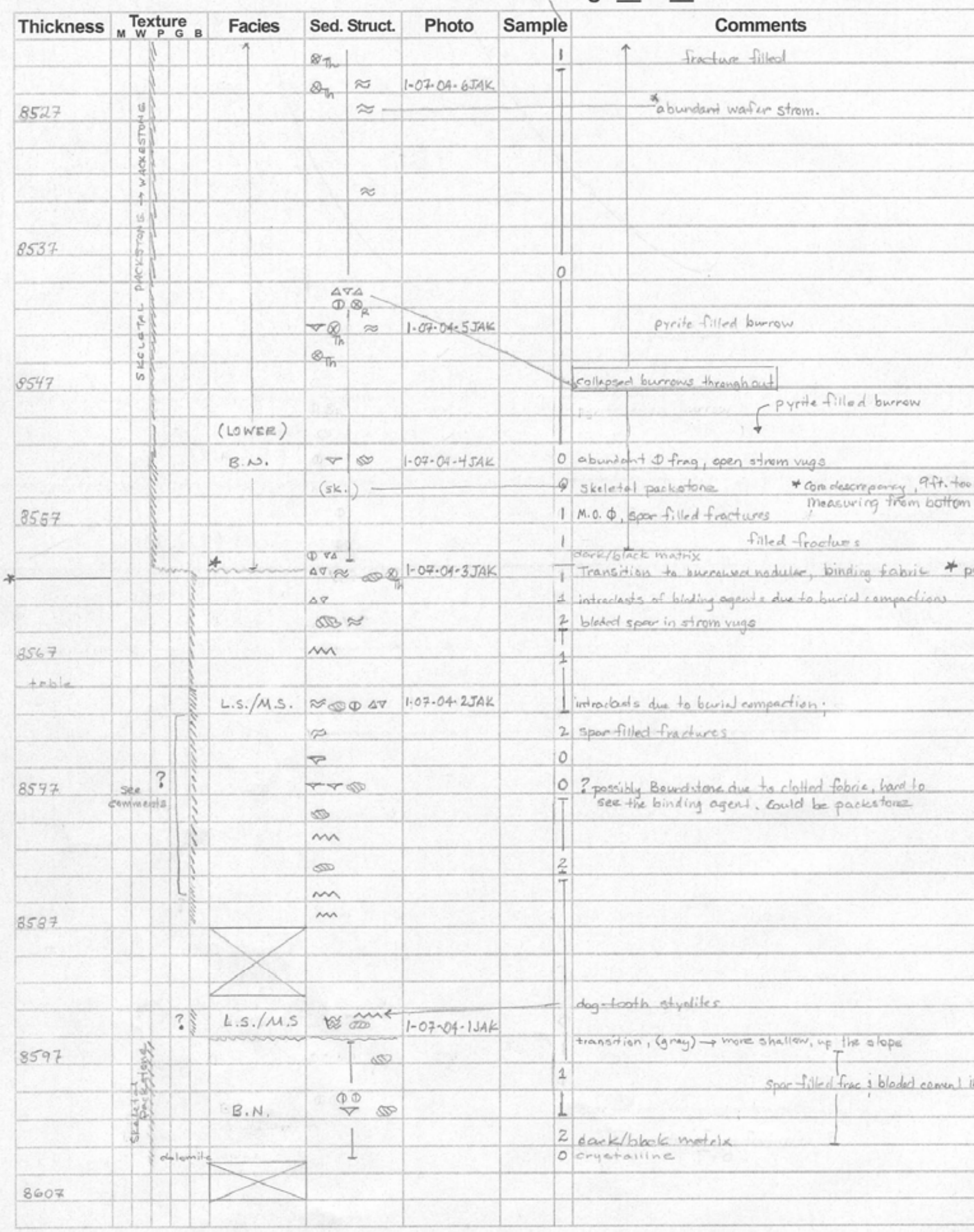
Date: 1/8/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8510						
		CORE TOP				
20				1-8-4-20SCA		
				1-8-4-A-SCA		
30	B	M. SLOPE	SK			FC=2 Φ= Mo, WP, BP, «FR
				1-8-4-21SCA		
40				1-8-4-18SCA		
			TH			
		CORE BASE				
8550						

Imperial Units (1" = 10')



Well # 5-31-68-21W5
Project/Location: LEDUC / STURGEON LAKE
Logged By: KAHMANN
Date: 1/8/04 - 1/9/04
Page 1 of 1
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
F.C. = 11 for breccia
50'
8343'
CORE END
1-09-04-52
few intraclasts, origin?
muddier
BRECCIA
60'
Mud lithoclasts, Φ? in clasts? w/ AN filling cement
AN
1-09-04-51JAK
clasts are made by intense dolomite fractures
ANHY
AN cement 1-09-04-50JAK
60'
bladed dolomite + calcite cement, lg. stromatoporoid, lithoclasts Φ (B.N.) clasts
BRECCIA
this is matrix
RUBBLE
bladed dolomite cement, Small mud Φ in clasts (B.N.)
some calcite cement
70'
SLOPE DEBRI
Small lithoclasts, large (+10cm) strom. dolomite filled fractures, Φ clasts (L.S.)
1-09-04-48JAK
80'
SLOPE SAND
1-09-04-49JAK
Skeletal grainstone
8383'
CORE START
8390
Imperial Units (1" = 10')
3.5" core diameter



5-34-68-22W5

Project/Location: LEDUC/STURGEON LAKE

Logged By: KAHMANN

Date: 1/6/04 – 1/7/04

F.C. **Page** 1 **of** 2

Thickness	Texture	Facies	Sed. Struct.	Photo	Sample	Comments
	SKELETAL PACKSTONE → WACKESTONE				1	fracture filled
				1-07-04-6JAK		
8527						*abundant wafer strom.
8537					0	
				1-07-04-5JAK		pyrite filled burrow
8547						collapsed burrows throughout
						pyrite filled burrow
		(LOWER)				
		B.N.		1-07-04-4JAK	0	abundant Φ frag, open strom vugs
			(sk.)		0	skeletal packstone
8557					1	M.O. Φ, spar filled fractures
					1	filled fractures
						dark/black matrix
*		*		1-07-04-3JAK	1	Transition to burrowed nodular, binding fabric
					1	intraclasts of binding agents due to burial compaction
					2	bladed spar in strom vugs
8567					1	
table						
		L.S./M.S.		1-07-04-2JAK	1	intraclasts due to burial compaction;
					2	spar filled fractures
					0	
8577	see comments ?				0	? possibly Boundstone due to clotted fabric, hard to see the binding agent. Could be packstone
					2	
8587						
						dog-tooth stylolites
	?	L.S./M.S		1-07-04-1JAK		
						transition, (gray) → more shallow, up the slope
8597	Skeletal Packstone				1	spar-filled frac; bladed cement in vugs
		B.N.				
					2	dark/black matrix
	dolomite				0	crystalline
8607						

* core descrepancy, 9ft. too much. Measuring from bottom up

* possible backstep

4" diameter core

Imperial Units (1" = 10')

3.2808 ft = 1m

Project/Location: 5-34-68-22W5 LEDUC / STURGEON LAKE

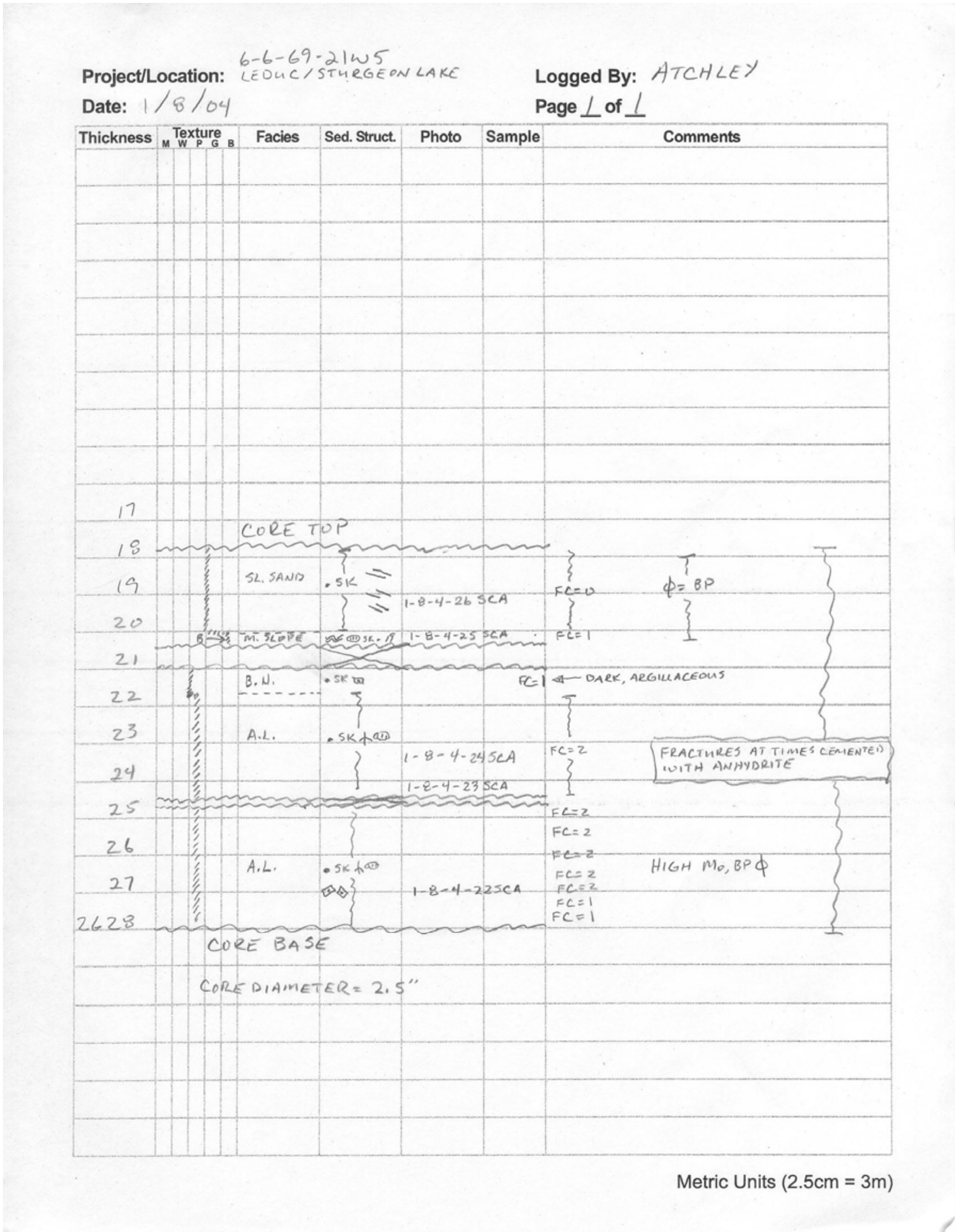
Logged By: KAHMANN

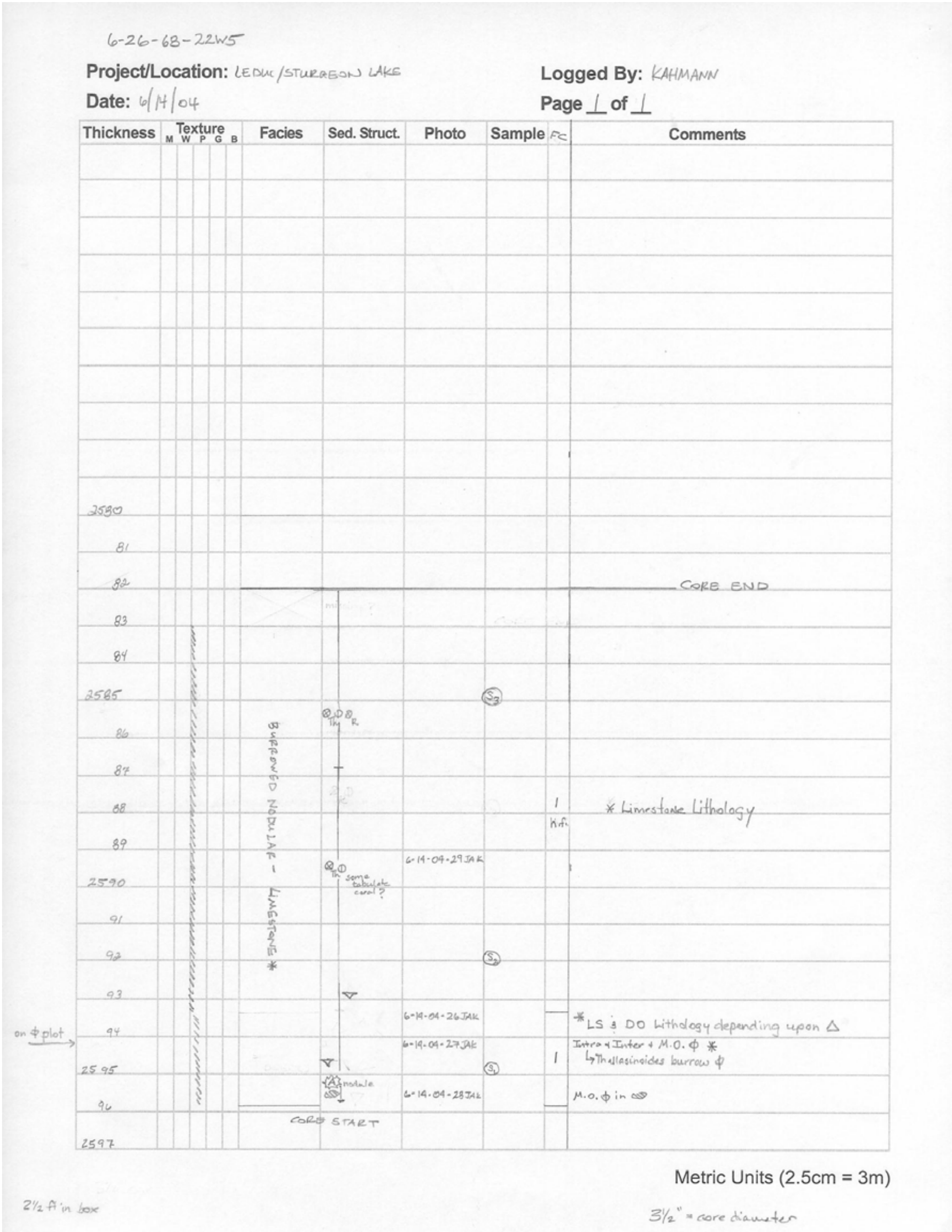
Date: 1/07/04

Page 2 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
		IRETON SHALE		1-07-04-10JAK		CORE + 7' = LOG
8503		L.S.		1-07-04-9JAK 1-07-04-7JAK	0	lighter gray matrix, large (+12cm)
8507	skeletal packstone		≈			large (+12cm)
			≈			
			≈		1	wafer/tabular strom. increase
		B.N.	≈	1-07-04-8JAK		
8517						large collapsed burrow
					1	spar-filled fracture
					0	

Imperial Units (1" = 10')


Project/Location: 6-6-69-21W5 LEDUC/STURGEON LAKE
Logged By: ATCHLEY
Date: 1/8/04
Page 1 of 1
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
17
CORE TOP
18
19
SL. SAND
• SK
1-8-4-26 SCA
FC=0
ϕ= BP
20
M. SLOPE
1-8-4-25 SCA
FC=1
21
B.N.
• SK
22
FC=1 DARK, ARGILLACEOUS
23
A.L.
• SK
1-8-4-24 SCA
FC=2
FRACTURES AT TIMES CEMENTED WITH ANHYDRITE
24
1-8-4-23 SCA
25
FC=2
FC=2
26
FC=2
A.L.
• SK
HIGH Mo, BP ϕ
27
FC=2
1-8-4-22 SCA
FC=2
FC=1
FC=1
2628
CORE BASE
CORE DIAMETER= 2.5"
Metric Units (2.5cm = 3m)



6-26-68-22W5
Project/Location: LEDUC/STURGEON LAKE
Logged By: KAHMANN
Date: 6/14/04
Page 1 of 1
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
FC
Comments
2580
81
82
CORE END
83
84
2585
86
87
88
89
2590
91
92
93
94
2595
96
2597
BURROWED NODULAR - LIMESTONE *
some tabulate coral?
nodule
CORE START
6-14-04-29JAK
6-14-04-26JAK
6-14-04-27JAK
6-14-04-28JAK
S3
S2
S1
Kf.
* Limestone Lithology
* LS & DO Lithology depending upon Δ
Intra & Inter + M.O. φ *
Thallasinoides burrow φ
M.O. φ in
on φ plot
Metric Units (2.5cm = 3m)
2½ ft in box
3½" = core diameter

7-2-69-22 W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG

Date: 6/14/04 **Page** 1 **of** 1

Thickness	Texture M W P G B	Facies	Sed. Struct.	Photo	Sample	Comments
					FC	
8450		BLM		6-14-04-23 JBK	0	
52		BN			1	PYRITE
54						
56		BLM			1	
58		BN		6-14-04-24 JBK	1	{A} MASSIVE FRACTURES FILLED PYRITE $\boxed{\phi \text{ PLOT} - 13' = \text{DESCRIPTIONS}}$ @ BN
8460			•SK			MO ϕ FILLED w/ {A} $\boxed{\text{LOG} - 13' = \text{DESCRIPTIONS}}$
62		ST. SH / Slope DEB.	•SK	6-14-04-25 JBK	1	MO ϕ FILLED w/ {A}
64				6-14-04-26 JBK		<GREEN SHALE MO. ϕ MUDDIER SLOPE SAND COARSER GRAINED
66		ST. SH / SI Sd	•SK	6-14-04-27 JBK	1	MO ϕ STYOLITES
68			•SK			CLEANER SLOPE SAND (WELL SORTED) MO ϕ FINER GRAINED
8470		ST. SH / SI. Sd	•SK	6-14-04-28 JBK	1	STYOLITES
72				6-14-04-29 JBK		LA MOLD ϕ
74						STYOLITE BRECCIA (SLOPE SAND CLASTS) w/ IN {A} MTX
76		SI Sd	SK	6-14-04-30 JBK	2	MO ϕ R SMALL (~1") STROMATOLITE FRAGMENTS (NOT ABUNDANT)
78		ST. SH / SI. Sd		6-14-04-31 JBK	1	STYOLITE MO ϕ FRACTURES HEALED BY ANH
8480		SI Sd	SK	6-14-04-32 JBK	2	BRECCIA w/ {A} MTX (SLOPE SAND CLASTS)
82						
84						
86						
88						
8490						
92						
94						
96						
98						
8500						

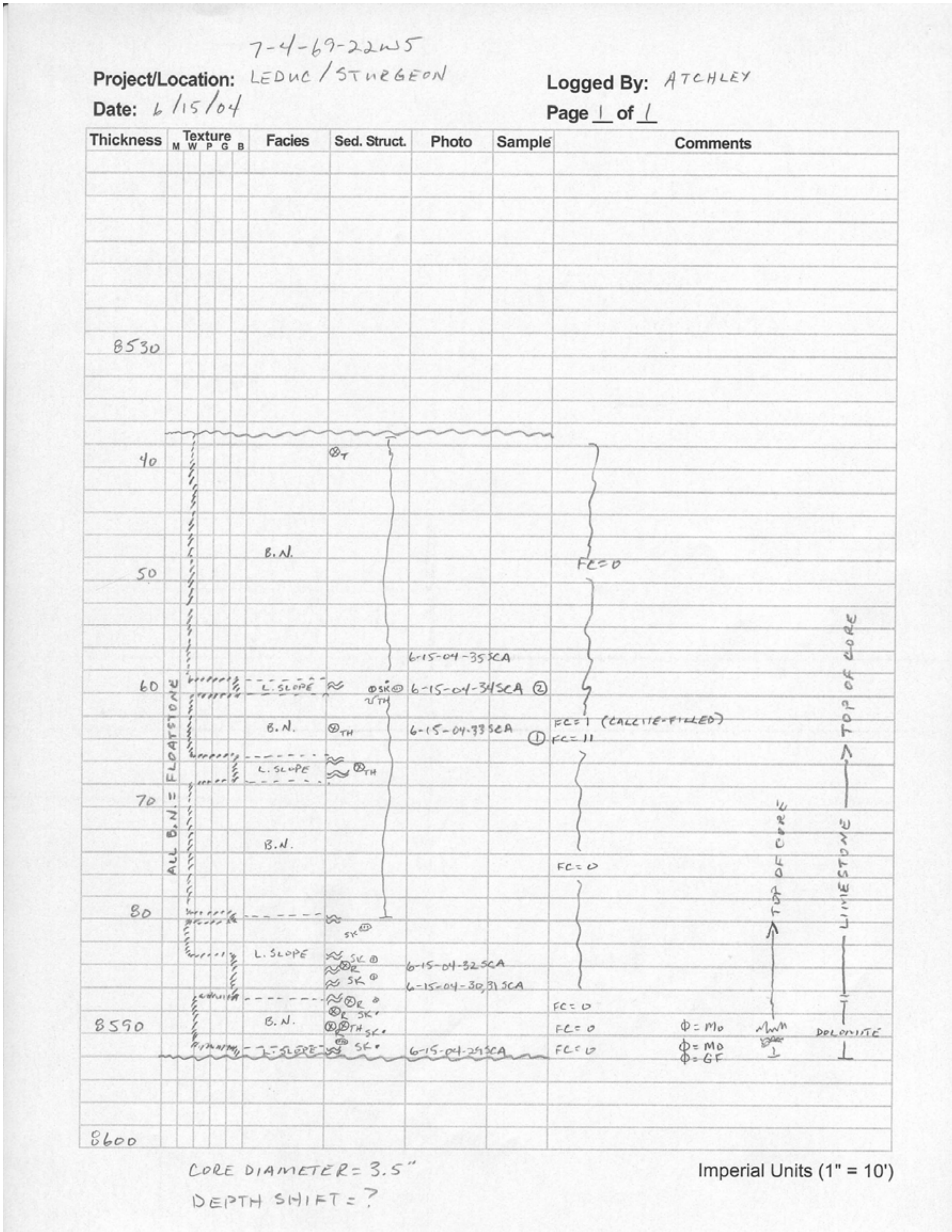
MUDDY SLOPE SAND

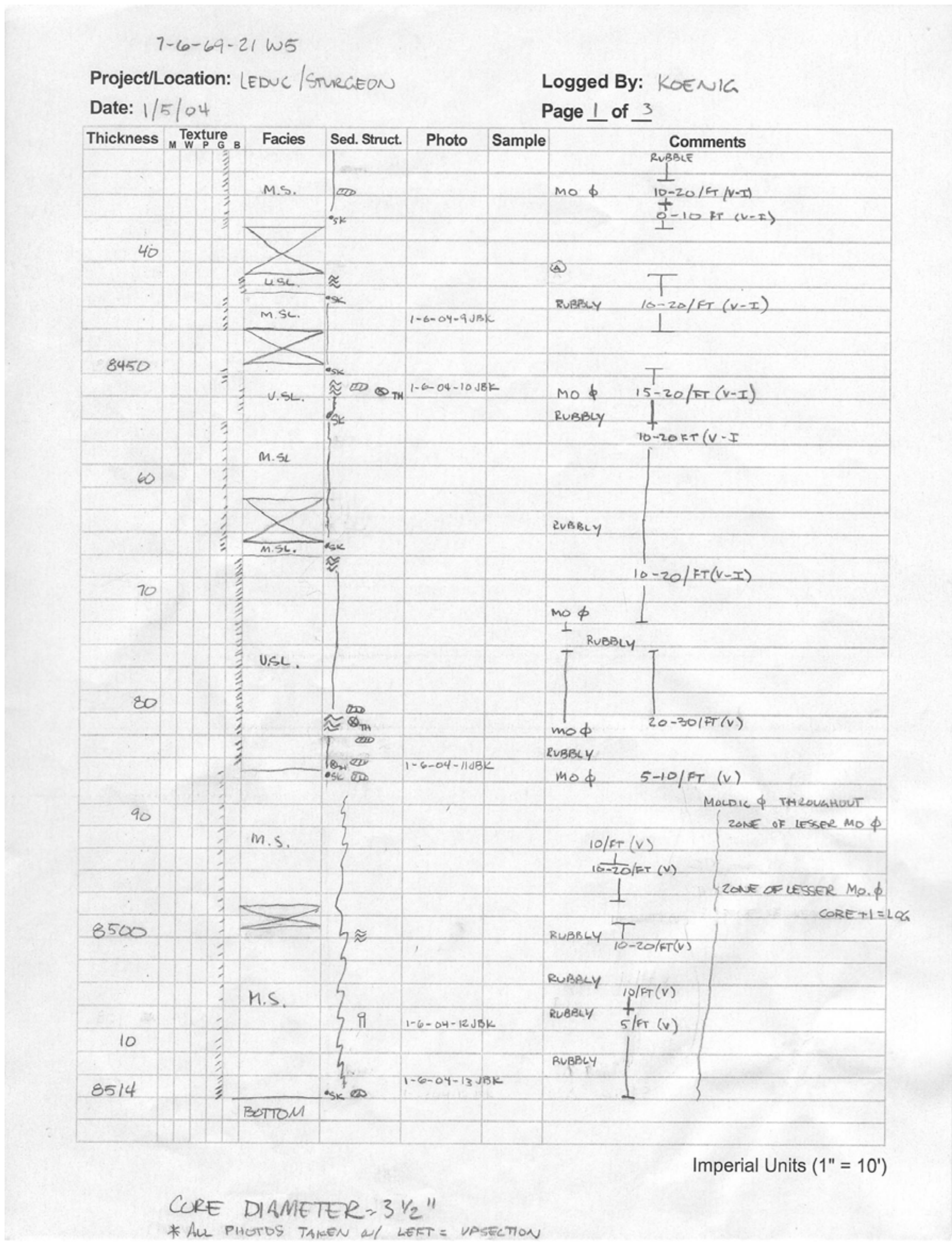
BOTTOM OF CORE

*LEFT SIDE FACIES CLASSIFICATION BASED ON WELL LOCATION W.R.T. MARGIN (BANK INTERIOR POSITION) AND FACT THAT NO OPEN MARINE FOSSILS FOUND (COINCIDES w/ 5-2-69-22 W5)

Imperial Units (1" = 10')

CORE DIAMETER = 3"


7-4-69-22W5
Project/Location: LEDUC / STURGEON
Logged By: ATCHLEY
Date: 6/15/04
Page 1 of 1
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
8530
40
50
60
70
80
8590
8600
B.N.
L. SLOPE
B.N.
L. SLOPE
B.N.
L. SLOPE
B.N.
L. SLOPE
ALL B.N. = FLOATSTONE
6-15-04-35SCA
6-15-04-34SCA
6-15-04-33SCA
6-15-04-32SCA
6-15-04-30,31SCA
6-15-04-29SCA
FC=0
FC=1 (CALCITE-FILLED)
FC=11
FC=0
FC=0
FC=0
FC=0
Φ=MO
Φ=MO
Φ=GF
TOP OF CORE
LIMESTONE
TOP OF CORE
DOLOMITE
Imperial Units (1" = 10')
CORE DIAMETER = 3.5"
DEPTH SHIFT = ?


7-6-69-21 W5
Project/Location: LEDUC / STURGEON
Logged By: KOENIG
Date: 1/5/04
Page 1 of 3
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
RUBBLE
M.S.
MO ϕ
10-20/FT (V-I)
0-10 FT (V-I)
40
U.SL.
RUBBLY
10-20/FT (V-I)
M.SL.
1-6-04-9JBK
8450
V.SL.
1-6-04-10JBK
MO ϕ
15-20/FT (V-I)
RUBBLY
10-20FT (V-I
M.SL
60
RUBBLY
M.SL.
10-20/FT(V-I)
70
MO ϕ
RUBBLY
U.SL.
80
MO ϕ
20-30/FT (V)
RUBBLY
1-6-04-11JBK
MO ϕ
5-10/FT (V)
MOLDIC ϕ THROUGHOUT
90
ZONE OF LESSER MO ϕ
M.S.
10/FT (V)
10-20/FT (V)
ZONE OF LESSER MO. ϕ
CORE +1 = LOG
8500
RUBBLY
10-20/FT(V)
RUBBLY
10/FT(V)
M.S.
RUBBLY
5/FT (V)
1-6-04-12JBK
10
RUBBLY
1-6-04-13JBK
8514
BOTTOM
Imperial Units (1" = 10')
CORE DIAMETER = 3 1/2"
* ALL PHOTOS TAKEN W/ LEFT = UPSECTION

7-6-69-21 W5

Project/Location: LEDUC / SPURGEON **Logged By:** KOENIG

Date: 1/5/04 **Page** 2 **of** 3

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
						RUBBLE
		A.L.O.				0-10/FT (V-I) RUBBLE STYOLITES
8350						
60						
		M.S.	•SK •SK			(A) RUBBLE 0-10/FT (V-I) M.O. ϕ
70						
80						
90						
8400						
10						
		M.S.	•SK •SK			M.O. ϕ 0-10/FT; 0-10/FT RUBBLE; M.O. ϕ 10-20/FT (V-I); RUBBLE ZONE OF LESSER MO. ϕ
20						
		M.S.				0-10/FT (V-I)
8430			•SK	1-6-04-08 JBK		RUBBLE

Imperial Units (1" = 10')

CORE DIAMETER = 3½"

7-6-69-21 W5

Project/Location: LEDUC / STURGEON **Logged By:** KOENIG

Date: 1/5/04 **Page** 3 **of** 3

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8290'		TOP				
		SLOPE?		1-6-04-01JBK		BP ϕ 0-10/FT (V) < POSSIBLE BACK STEP
			Ψ			Mo. ϕ RUBBLY
				1-6-04-02 JBK		0-10 FT (V)
			•SK			BPϕ
		A.L.O.	Ψ			Mo. ϕ 0-10/FT RUBBLY
8300			Ψ			Mo ϕ
			Ψ			0-10/FT RUBBLE
			Ψ			
		ALO				10-20 FT Mo. ϕ
			Ψ			0-10 FT (V-I) RUBBLE
10						
						10-20/FT (V-I) PROGRADATION
			Ψ	1-6-04-03 JBK		0-10/FT (V-I)
		ALO				RUBBLE
20			Ψ			MO ϕ
				1-6-04-04 JBK		
			A Ψ	1-6-04-05 JBK		STYOLITES
				1-6-04-06 JBK		STYOLITES
						0-10 FT (V-I)
30			A Ψ			RUBBLE
			Ψ			
						RUBBLE 0-10/FT (V-I)
			A Ψ			
		ALO	Ψ			STYOLITES
8340			A Ψ	1-6-04-07 JBK		Mo. ϕ

Imperial Units (1" = 10')

CORE DIAMETER = 3½"

* ALL PHOTOS TAKEN W/ LEFT = UPSECTION

7-19-69-22W5

Project/Location: LEDUC/STURGEON **Logged By:** ATCHLEY

Date: 6/14/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
						ALL DOLOMITE
8640'						
		B.N.	SK V_TH	6-14-04-25SCA		
			◁◁◁			FC=1 ◁— ACICULAR CEMENT LINING & WALLS
						FC=1
						FC=1
50'					2	FC=11
		SLOPE	• SK			FC=1
		SAND				FC=11
		(DARKER)				FC=1
						FC=1
				6-14-04-24SCA		FC=11 ϕ = MO, BP, FR
						FC=11
60'					1	FC=11
						FC=1
		SLOPE		6-14-04-23SCA		FC=1
		SAND	• SK			FC=11
		(LIGHTER)		6-14-04-22SCA		FC=1
70'					A	FC=1
						FC=11
8680'						

CORE DIAMETER = 3.5"

CORE + 4' = LOG DEPTH @ 8640'

Imperial Units (1" = 10')

7-23-68-22W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG

Date: 1/8/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
8444		TOP OF CORE					
46							
48							
8450		IRETON SHALE					
52							
54				1-8-04-22JBK			
56							
58							
8460							
62		B.N.					STYOLITES THROUGHOUT B.N.
64						1	
66							DK. ARGILACEOUS THROUGHOUT SHOWS KICK IN GR
68							
8470							INTRAPARTICLE ɸ ASSOCIATED w/
72							
74							
76		B.N.	SK				
78				1-8-04-23JBK			M.O. ɸ
8480				1-8-04-24JBK			M.O. ɸ
82				1-8-04-25JBK		2	FRACTURES HEALED BY A
84							
86							
88		B.N.				1	
8490				1-8-04-26JBK		2	FRACTURES FILLED w/ A
92				1-8-04-27JBK			A BRECCIATED
94						12	<< BACKSTEP
96		ALO / TF	SK, Fr	1-8-04-28JBK, 1-8-04-29JBK		1, 2	STYOLITES "CRINKLY" LAMINATIONS
98						11	CAUTION: ALO MAY BE BLOCK ENTRAINED IN S.D.!
8500		ALO		1-8-04-30JBK		12	
02						2	A FILLED FRACTURES
04						12	SHALLOWING?
06							
08		BRECCIATED	ALO	1-8-04-31JBK		1	LITHOCLASTS w/ A; *POSSIBLY BLOCK OF ALO IN S.D.*; LITHOCLASTS w/in A; FRACTS HEALED w/ A; *LARGE BX OF ALO
8510		S.D.	SK	1-8-04-32JBK		1	FRACTURES HEALED w/ A; GREEN SHALE
12							
14							FRACTURES HEALED BY A
16	RUDSTONE	SLOPE SAND	SK				M.O. ɸ
18						1	M.O. ɸ
8520				1-8-04-33JBK			STYOLITES < BACKSTEP
22		ALO		1-8-04-34JBK			
8524							
		BOTTOM OF CORE					

* FACIES RELATIONSHIP. (8494-END)

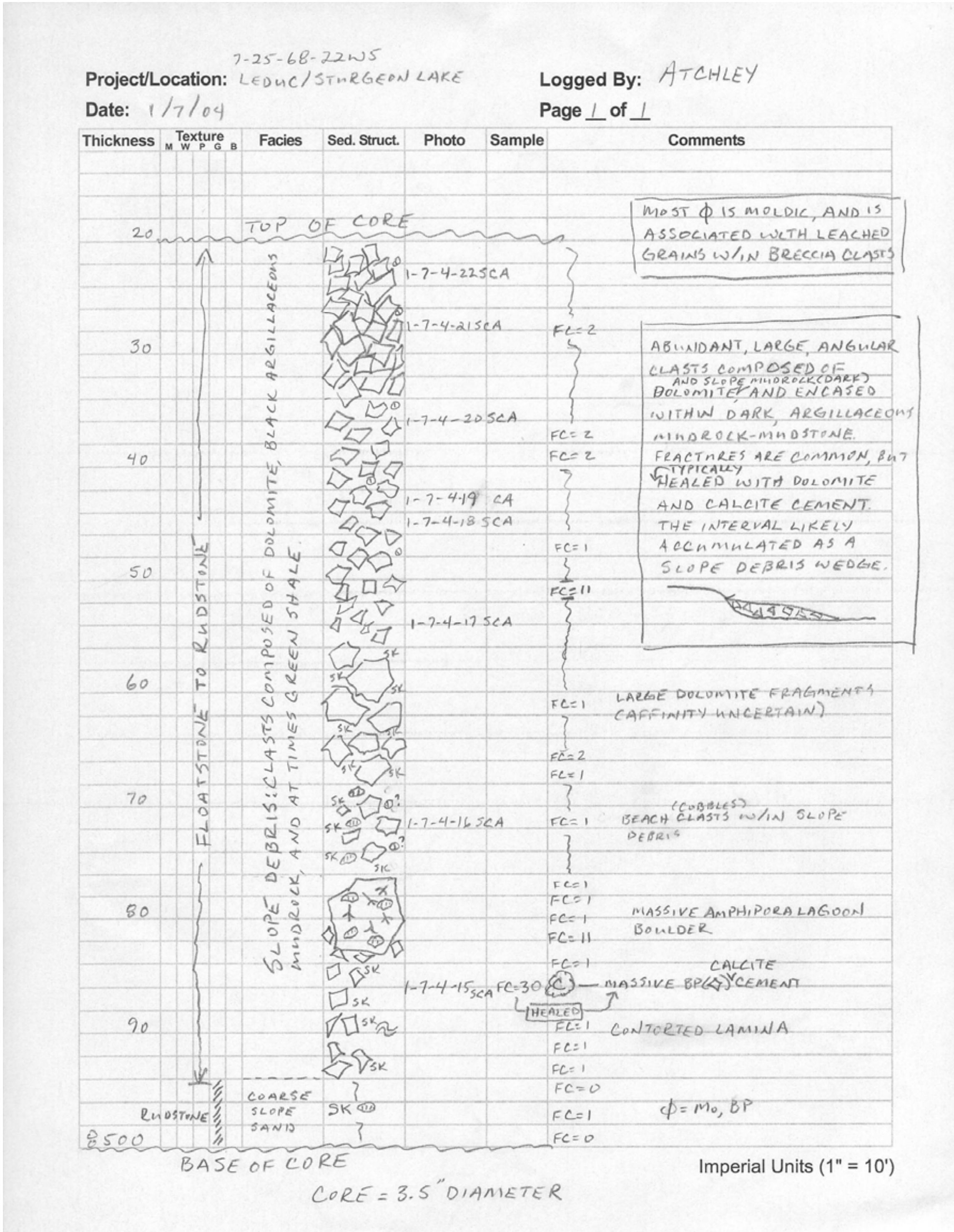
1 FAULTING (BX-8508)

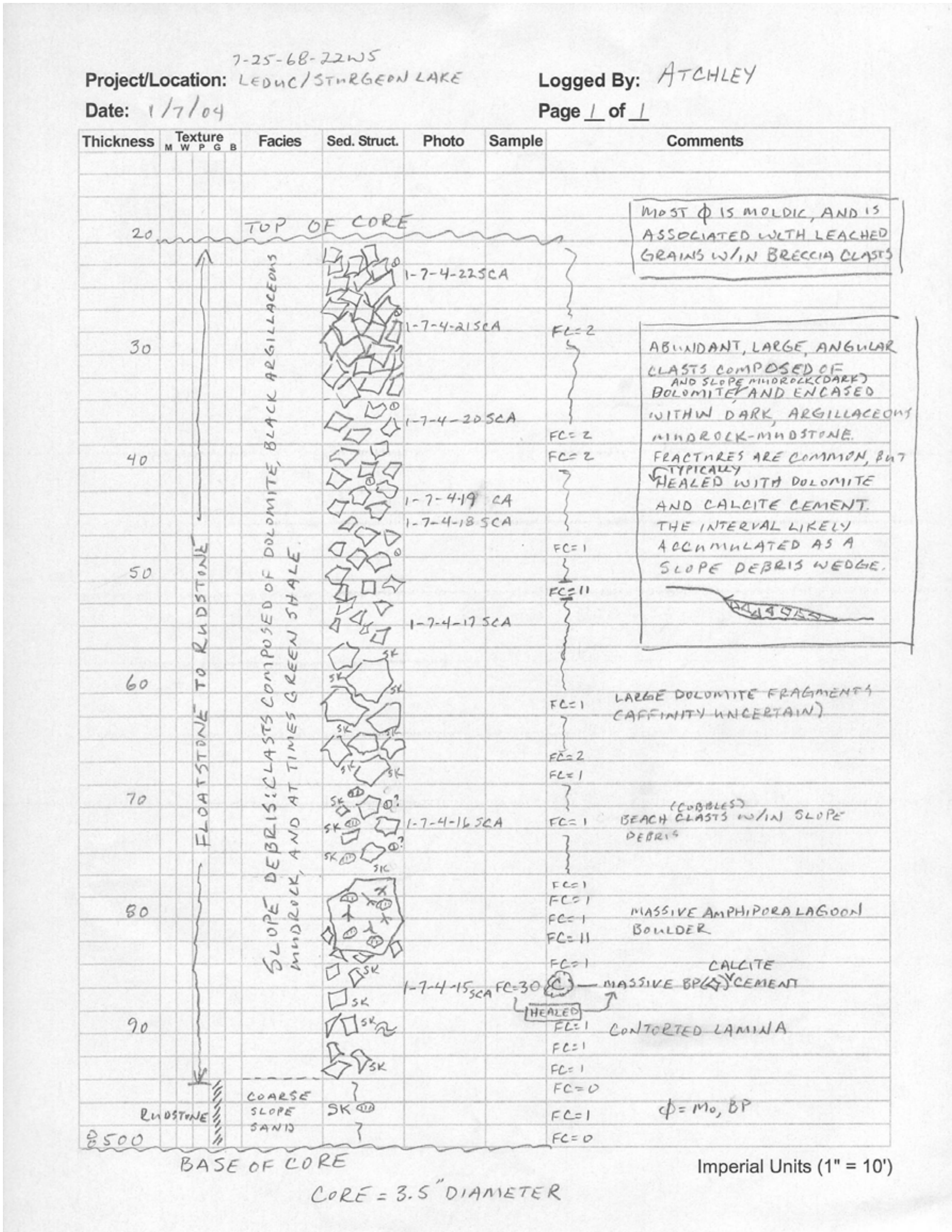
2 BACKSTEP - PROGRADE - BACKSTEP

↳ NOT PROBABLE IN RETROGRADATIONAL SYSTEM (DEV./W. CANADA)

Imperial Units (1" = 10')

CORE DIAMETER = 4.5"


7-25-68-22W5
Project/Location: LEDUC/STURGEON LAKE
Logged By: ATCHLEY
Date: 1/7/04
Page 1 of 1
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
20
TOP OF CORE
MOST φ IS MOLDIC, AND IS ASSOCIATED WITH LEACHED GRAINS W/IN BRECCIA CLASTS
1-7-4-22SCA
1-7-4-21SCA
FC=2
30
ABUNDANT, LARGE, ANGULAR CLASTS COMPOSED OF DOLOMITE AND SLOPE MUDROCK (DARK) AND ENCASED WITHIN DARK, ARGILLACEOUS MUDROCK-MUDSTONE. FRACTURES ARE COMMON, BUT TYPICALLY HEALED WITH DOLOMITE AND CALCITE CEMENT. THE INTERVAL LIKELY ACCUMULATED AS A SLOPE DEBRIS WEDGE.
1-7-4-20SCA
FC=2
FC=2
40
1-7-4-19 CA
1-7-4-18SCA
FC=1
50
FC=11
SLOPE DEBRIS: CLASTS COMPOSED OF DOLOMITE, BLACK ARGILLACEOUS MUDROCK, AND AT TIMES GREEN SHALE.
FLOATSTONE TO RUDSTONE
1-7-4-17SCA
SK
60
FC=1
LARGE DOLOMITE FRAGMENTS (AFFINITY UNCERTAIN)
FC=2
FC=1
70
1-7-4-16SCA
FC=1
BEACH (COBBLES) CLASTS W/IN SLOPE DEBRIS
FC=1
FC=1
80
FC=1
FC=11
MASSIVE AMPHIPORA LAGOON BOULDER
FC=1
1-7-4-15SCA
FC=30
HEALED
MASSIVE BP
CALCITE CEMENT
90
FC=1
CONTORTED LAMINA
FC=1
FC=1
FC=0
COARSE SLOPE SAND
RUDSTONE
SK
FC=1
φ = Mo, BP
8500
FC=0
BASE OF CORE
Imperial Units (1" = 10')
CORE = 3.5" DIAMETER



7-25-68-22W5
Project/Location: LEDUC/STURGEON LAKE
Logged By: ATCHLEY
Date: 1/7/04
Page 1 of 1
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
20
TOP OF CORE
30
40
50
60
70
80
90
8500
BASE OF CORE
FLOATSTONE TO RUDSTONE
RUDSTONE
SLOPE DEBRIS: CLASTS COMPOSED OF DOLOMITE, BLACK ARGILLACEOUS MUDROCK, AND AT TIMES GREEN SHALE.
COARSE SLOPE SAND
1-7-4-22SCA
1-7-4-21SCA
1-7-4-20SCA
1-7-4-19 CA
1-7-4-18 SCA
1-7-4-17 SCA
1-7-4-16 SCA
1-7-4-15SCA
FC=2
FC=1
FC=11
FC=0
FC=30
HEALED
MOST ϕ IS MOLDIC, AND IS ASSOCIATED WITH LEACHED GRAINS W/IN BRECCIA CLASTS
ABUNDANT, LARGE, ANGULAR CLASTS COMPOSED OF DOLOMITE AND SLOPE MUDROCK (DARK) AND ENCASED WITHIN DARK, ARGILLACEOUS MUDROCK-MUDSTONE. FRACTURES ARE COMMON, BUT TYPICALLY HEALED WITH DOLOMITE AND CALCITE CEMENT. THE INTERVAL LIKELY ACCUMULATED AS A SLOPE DEBRIS WEDGE.
LARGE DOLOMITE FRAGMENTS (AFFINITY UNCERTAIN)
BEACH CLASTS (COBBLES) W/IN SLOPE DEBRIS
MASSIVE AMPHIPORA LAGOON BOULDER
MASSIVE BP CALCITE CEMENT
CONTORTED LAMINA
ϕ = Mo, BP
Imperial Units (1" = 10')
CORE = 3.5" DIAMETER

7-26-69-23W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** KAHMANN

Date: 6/15/04 **Page** 1 **of** 1

Thickness	Texture M W P G B	Facies	Sed. Struct.	Photo	Sample	FC	Comments
2665							
66							
68			⊗R				
69	Limestone	BURROWED NODULAR	⊗R	6-15-04-19JAK 6-15-04-18JAK 6-15-04-17JAK			abundant brachiopods, lesser amt. of ⊗R VERY DARK MUD!
2670			*	6-15-04-16JAK			I.P.ϕ pyrite veins e top *BACKSTEP
71					O		clean, well-sorted, rounded grainstone
72		SL. SAND		6-15-04-15JAK 6-15-04-14JAK			I.P. ϕ
73							
2674							

Metric Units (2.5cm = 3m)

2½' in boxs * CORE DESCRIPTION NOT ON WIRELOG CORE DIAMETER = 2".

7-33-68-21 W5

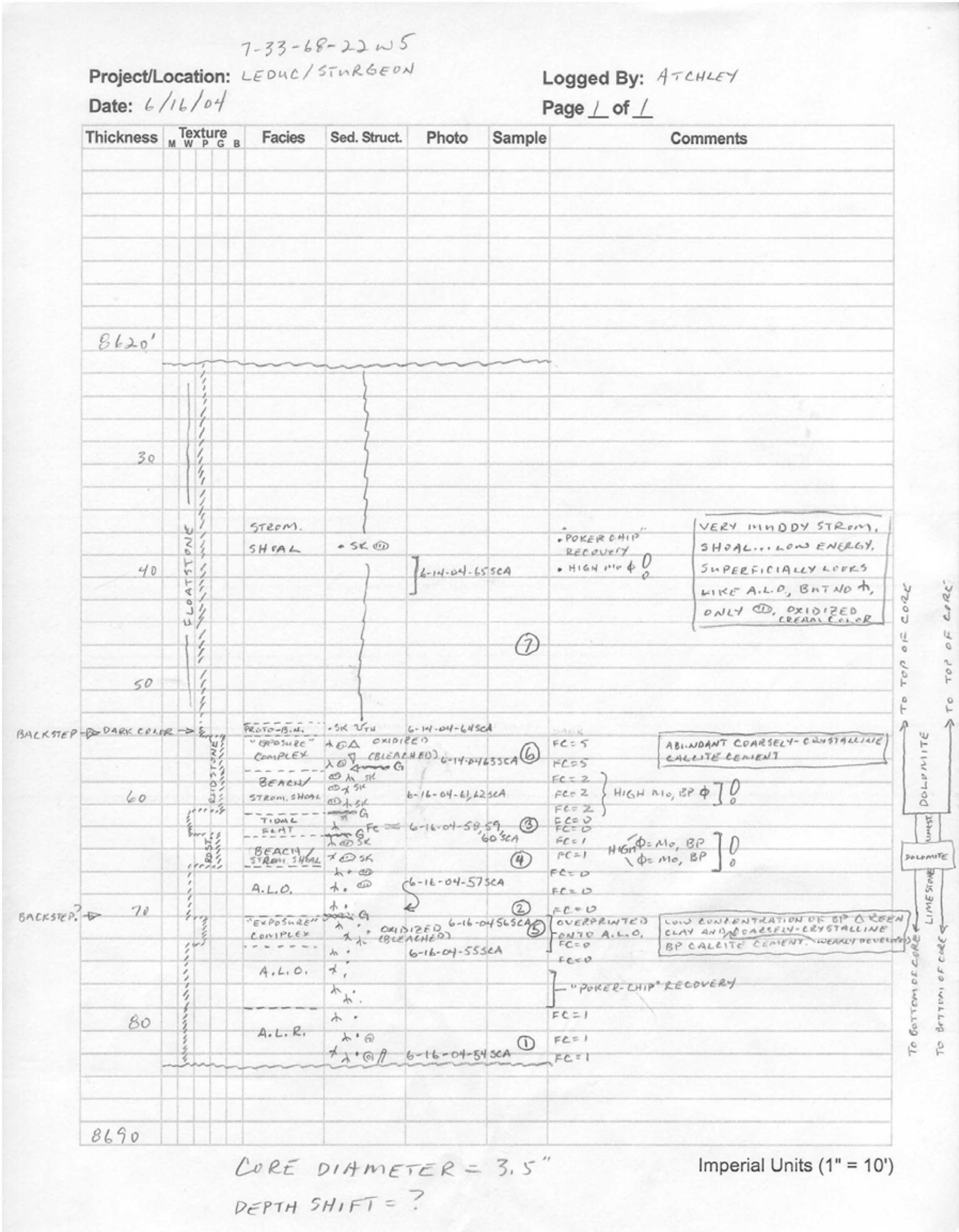
Project/Location: LEDUC/STURGEON LAKE **Logged By:** KOENIG

Date: 1/9/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Fo	Comments
48		TOP OF CORE					
49							
2750							LAMINATED ARGILLACEOUS SHALE
51				1-9-04-12JBK			MM'S SCALE LAMINATIONS
52							
53							
54		IRETON SHALE		1-9-04-13JBK			
2755		B.N.	SK	1-9-04-14JBK 1-9-04-15JBK		0	ABUNDANCE OF SK DECREASES A DARK ARGILLACEOUS FRACTURE FILL CORE - 2M = LOG
56			SK	1-9-04-16JBK			A MASSIVE SMALLER COBBLE SIZED CLASTS
57				1-9-04-17JBK		1	M.O.ϕ FROM STROMATOPOROID FRAGMENTS ↳ INTRA PARTICLE ϕ W/IN
58			A	1-9-04-18JBK		2	A MASSIVE A MASSIVE A
59			A A	1-9-04-19JBK		1	FRACTURES FILLED W/ A
2760		SLOPE DEBRIS					MOLDIC ϕ THROUGHOUT SLOPE DEBRIS DECREASE SIZE OF DEBRIS
61			A			12	
62							LARGE (BOULDER) PYRITE STYLOLITES
63			A			1	A FILLING G.F. ϕ
64			A A	1-9-04-20JBK 1-9-04-21JBK			A DK ARGILLACEOUS MTX
2765			A				M.O.ϕ LIGHT COLORED MASSIVE ENCRUSTING STROMAT.
66		MID:SLOPE		1-9-04-22JBK		1	A G.F.ϕ FILLED W/ A MID.-LOWER SLOPE
67		BOTTOM		1-9-04-23JBK			M.O. ϕ

CORE DIAMETER = 4"

Metric Units (2.5cm = 3m)


7-33-68-22W5
Project/Location: LEDUC/STURGEON
Logged By: ATCHLEY
Date: 6/16/04
Page 1 of 1
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
8620'
30
40
50
60
70
80
8690
FLOATSTONE
RUDSTONE
STROM. SHOAL
• SK
6-14-04-65SCA
• "POKER CHIP" RECOVERY
• HIGH Mo φ
VERY MUDDY STROM. SHOAL... LOW ENERGY, SUPERFICIALLY LOOKS LIKE A.L.O, BUT NO, ONLY, OXIDIZED CREAM COLOR
7
BACKSTEP
DARK COLOR
PROTO-B.H.
6-14-04-64SCA
"EXPOSURE" COMPLEX
OXIDIZED (BLEACHED)
6-14-04-63SCA
6
FC=5
FC=5
ABUNDANT COARSELY-CRYSTALLINE CALCITE CEMENT
BEACH/ STROM. SHOAL
6-16-04-61,62SCA
FC=2
FC=2
FC=2
HIGH Mo, BP φ
TIDAL FLAT
6-16-04-58,59, 60SCA
3
FC=0
FC=1
HIGH φ= Mo, BP
φ= Mo, BP
BEACH/ STROM. SHOAL
4
FC=1
FC=0
A.L.O.
6-16-04-57SCA
FC=0
BACKSTEP?
2
FC=0
"EXPOSURE" COMPLEX
OXIDIZED (BLEACHED)
6-16-04-56SCA
5
OVERPRINTED ONTO A.L.O.
LOW CONCENTRATION OF BP GREEN CLAY AND COARSELY-CRYSTALLINE BP CALCITE CEMENT, WEAKLY DEVELOPED
FC=0
FC=0
6-16-04-55SCA
A.L.O.
"POKER-CHIP" RECOVERY
FC=1
A.L.R.
1
FC=1
FC=1
6-16-04-54SCA
TO TOP OF CORE
TO TOP OF CORE
DOLOMITE
LIMEST.
DOLOMITE
LIMESTONE
TO BOTTOM OF CORE
TO BOTTOM OF CORE
CORE DIAMETER = 3.5"
DEPTH SHIFT = ?
Imperial Units (1" = 10')

* This core could be out of order

7-34-68-22 W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KAHMANN

Date: 6/14/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
36							CORE END
38				6-14-04-25JAK			
8540							
42							
44							muddy, dark packstone
46		B.N.	pyrite			1	
48						hf Vf	
8550				6-14-04-24JAK	S3		
52							
54							
56						11	
58							
8560		SLOPE DEBRIS BRECCIA	A			2	
62						1	
64				6-14-04-23JAK		1	
66						1	A healed breccia (tectonic?) sometimes 2" thick
68			TR?	6-14-04-21 JAK		1	
8570			A			2	
72		SLOPE			S2	11	* This is hard to interpret, △ have more, it is NOT BN., L.S., Possibly T.F.
74		DEBRIS/	A A			1	
76		BRECCIA		6-14-04-22JAK 6-14-04-20JAK		1	
78						1	
8580						1	
82					S1		
84		A.LO / ST SH	A	6-14-04-19JAK		1hf	
86							
88							
8590							

Imperial Units (1" = 10')

2" in box

CORE DIAMETER = 4 1/4"

7-35-68-22W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KAHMANN

Date: 6/16/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
2585							Shale@2586 (held) 6-16-04-16JAK 6-16-04-66 SCA 6-16-04-67 SCA
86				CORE END			
	LIMESTONE	BCH/ST.SH BCH	? GR.SH	6-16-04-14JAK			rudstone (A) cement? M.O.ϕ I.P.ϕ M.O.ϕ; grainstone
87		A.LO.					
				6-16-04-13JAK			
88		ALO-R		6-16-04-12JAK			darker restricted Lagoon, Thassinoides
		ALO					
89		BCH					M.O. ϕ
				6-16-04-11JAK			filled fracture
2590						v.f. + hf.	
		ALO					Light gray muddy wacke/packstone, calcite-filled frac. some (A)?
91		BCH ALO BCH		6-16-04-10JAK 6-16-04-9JAK	S1		M.O.ϕ, I.P.ϕ
2592		ALO		6-16-04-8JAK			

Metric Units (2.5cm = 3m)

2½' in box

CORE DIAMETER = 3"

9-2-69-22 W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** KAHMANN

Date: 6/15/04 **Page** 1 **of** 1

FACIES

* The St. SH above Gr. Shale @ 8460 up until the "margin", could all be one massive slope debris flow. No slope body fossils were identified. Green argillaceous clay was throughout. The margin facies is quite distal; the beginning of margin. With the present interpretation the St. SH backsteps into margin. If it is slope debris it is just a normal shallowing upward facies succession.

	Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
	8420							
	22							
	24							
	26				6-15-04-13JAK	S9	2	
	28		MARGIN ?	bound stroms	6-15-04-12JAK	S8	1	M.O.ϕ growth framework ϕ ?
	8430						11	
	32			A ΔV	6-15-04-11JAK			Δ Strom clasts (angular) broken by A diagenesis
CORE + 10	34			GR. SH			1	
	36				6-15-04-9JAK	S7		
	38		ST. SH	strom frag A				M.O. ϕ, very negligible ϕ A cement/nodules
	8440						0	* green argillaceous clay thru out interval
	42							
8444	44				6-15-04-8JAK*	S6		angular intraclasts of stroms., thin, branching/platey stroms
	46	RUDSTONE			6-15-04-7JAK	S5	1	
	48		ST. SH	strom frag A		S4	0	M.O.ϕ ▫ is a Rudstone
CORE-6 = LOG	8450	A		GR. SH	6-15-09-6JAK			GR. SH @ top of A
	52			GR. SH	6-15-04-5JAK	S3	1	thin branching/platey strom
	54	RUDSTONE		strom ▫	6-15-04-4JAK			M.O.ϕ
	56		ST. SH				0	thin whispy stroms binding w/green clay dispersed thru-out
	58							gr. shale is soft/clay Rudstone in between
SAME AS → LOG	8460			GR. SH GR. SH	6-15-04-3JAK	S2		gr. shale is thick and indurated *SB ?
	62							M.O. ϕ / vuggy ϕ in rudstone thick encrusting strom ▫
	64		ST. SH/	SK			l.v.f. h.R.	
	66	GRAINSTONE	BCH		6-15-04-2JAK			M.O. ϕ
	68				6-15-04-1JAK	S1		very grainy well-sorted grainstone
	8470							
	72							

CORE START

Imperial Units (1" = 10')

2½" in box

CORE DIAMETER = 3½"

9-4-69-22W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** KOENIG

Date: 6/15/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
8550							
52							
54							
56		TOP OF CORE					
58		BLM		6-15-04-78JBK			L.S.
8560			SK	6-15-04-79JBK			BURROWED NODULAR CONSISTS OF SKELETAL
62							FRAGMENTS OF CRINOIDS CORALS AND UNIDENT- 3½" CORE
64		BN	SK				IFIED FRAGS. W/ ARGILLACEOUS-RICH INTERVALS
66				6-14-04-80JBK			STYOLITES PYRITE ← SKELETAL GRAINS DISSOLVED (←ZONE IS ONLY 4" THICK)
68			SK •SK			1	MO
8570							
72							
74							
		BN/DEBRIS	ΔΔ	6-15-04-81JBK 6-15-04-82JBK		1	< BACKSTEP
76		MID. SLOPE		6-15-04-83JBK		11	MO Φ
78							
8580							2" CORE
82		SLOPE SAND	•SK			1	FINE SAND OILSTAINED
84		MID. SLOPE	•SK	6-15-04-84JBK 6-15-04-85JBK		1	BP Φ GREY
86							
88		BOTTOM OF CORE					
8590							

Imperial Units (1" = 10')

*CORE DIAMETER INDICATED IN "COMMENTS"

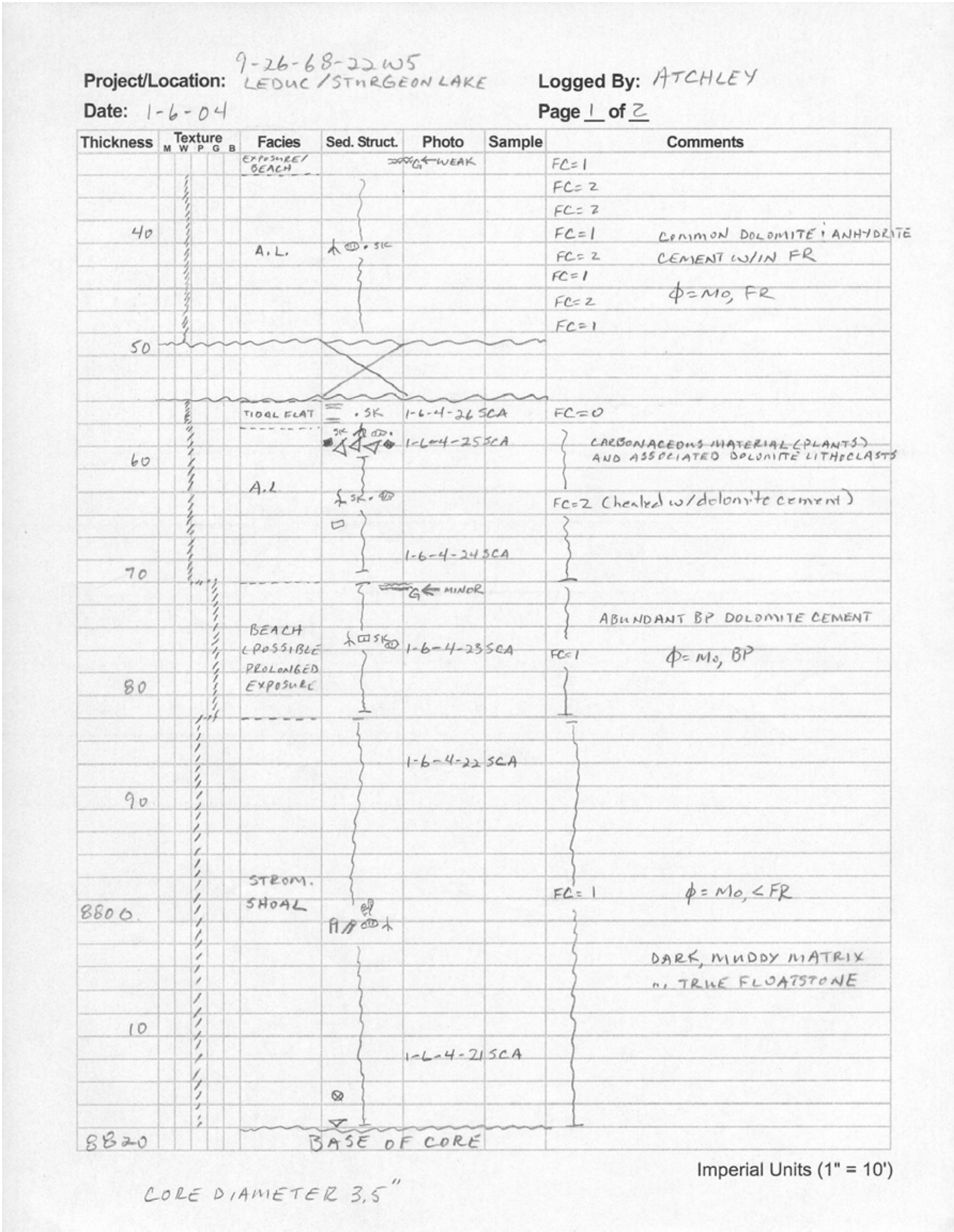
Project/Location: 9-8-69-21W5 LEDUC / STURGEON LAKE **Logged By:** ATCHLEY

Date: 1-9-04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
2680						
81						
82						
83		CORE TOP				
84						
85				1-9-4-10 SCA		FC≈11 ← BORDERLINE FC=11... CLASSIFY AS SUCH
86	RUDSTONE	SLOPE DEBRIS	• SK, SK •, TH	1-9-4-9 SCA	A	← THIN INTERVAL OF LAMINATED, BLACK MUDROCK
87				1-9-4-8 SCA	A	FC=1
87					A A	ϕ = MO, WP, BP, FR THROUGHOUT FACIES.
88					A A	COMMON BP, DARK ARGILLACEOUS MATERIAL.
89				1-9-4-7 SCA		
2690					A A	
91		COARSE SLOPE SAND/ DEBRIS	• SK TH	1-9-4-6 SCA		ϕ = MO, BP, FR THROUGHOUT FACIES
92						
93		L. SLOPE	TH, • SK, TH	1-9-4-5 SCA	A	ϕ = MO, BP, FR THROUGHOUT FACIES
94			G	1-9-4-4 SCA	A A	GEOPETAL FILL W/IN LARGE VUGS THAT HAVE TWO-STAGE
95		SLOPE SAND	• SK	1-9-4-3 SCA	A	CEMENT FILL: DOLOMITE (STAGE 1), ANHYDRITE (STAGE 2) FC=1
96					A A	 DOLOMITE ANHYDRITE
97						
98					A	FC=1
99		L. SLOPE	• SK		A	FC=1 ϕ = MO, WP, FR
				1-9-4-2 SCA	A	FC=11
2700		B.N.	SK TH	1-9-4-1 SCA	A	F2 FRATURES HEALED BY ANHYDRITE
		CORE BOTTOM				F12 ← ϕ = MO, FR

CORE DIAMETER = 4.25"

Metric Units (2.5cm = 3m)



Project/Location: 9-26-68-22W5 LEDUC / STURGEON LAKE
Logged By: ATCHLEY
Date: 1-6-04
Page 1 of 2
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
EXPOSURE/ BEACH
WEAK
FC=1
FC=2
FC=2
40
A.L.
FC=1
COMMON DOLOMITE : ANHYDRITE CEMENT W/IN FR
FC=2
FC=1
Φ=MO, FR
FC=2
FC=1
50
TIDAL FLAT
1-6-4-26 SCA
FC=0
1-6-4-25 SCA
CARBONACEOUS MATERIAL (PLANTS) AND ASSOCIATED DOLOMITE LITHOCLASTS
60
A.L
FC=2 (healed w/dolomite cement)
1-6-4-24 SCA
70
MINOR
BEACH (POSSIBLE PROLONGED EXPOSURE
ABUNDANT BP DOLOMITE CEMENT
1-6-4-23 SCA
FC=1
Φ=MO, BP
80
1-6-4-22 SCA
90
STROM. SHOAL
FC=1
Φ=MO, <FR
8800.
DARK, MUDDY MATRIX ∴ TRUE FLOATSTONE
10
1-6-4-21 SCA
8820
BASE OF CORE
Imperial Units (1" = 10')
CORE DIAMETER 3.5"

9-33-68-22W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** KOENIG

Date: 6/14/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
8540							
42		TOP OF CORE					
44		BLM				①	
46							
48							
8550							DIFFERENTIATED FROM B.N.
52		BN		6-15-04-42 JBK			LOWER SLOPE BY THIN LENSES
54		LOWER SLOPE		6-15-04-43 JBK 6-15-04-44 JBK			OF WAFER-LIKE STROMATOPOROIDS
56		BN LOWER SLOPE					~~(LOWER SLOPE)~~ W/IN DARKER/MUDDIER
58							MATERIAL W/ TH, AND SK CONCEN.
8560			SK	6-15-04-45 JBK			ALONG ARGILLACEOUS RICH HORIZONS
62							LIMESTONE
64							
66		BN	SK			0	
68							STYOLITES
85 70							
72							
74			TH	6-15-04-46 JBK 6-15-04-47 JBK			
76							
78				6-15-04-48 JBK			STYOLITES
8580			SK				
82							
84		LOWER SLOPE		6-15-04-49 JBK 6-15-04-50 JBK 6-15-04-51 JBK			
86		BN					
88		LOWER SLOPE		6-15-04-52 JBK 6-15-04-53 JBK			MO
8590			SK TH				CONCENTRATION OF THAM.
92		BN	SK			0	<BACKSTEP
94				6-15-04-54 JBK			MO ARGILLACEOUS-RICH · SHALLOWER THAN ABOVE (LIGHTER
96			TH		S1		
98		MID SLOPE?					MO EURY AMPHIPORA · THAN BN ∴ OXIDIZED)
8600			SK			1	MO TUBULAR STROMATOLITES
02				6-15-04-55 JBK	S2		MO
			SK	6-15-04-56 JBK			
		BUTTOM OF CORE					

Imperial Units (1" = 10')

CORE DIAMETER 3½"

9-35-68-22W5

Project/Location: LEDUC/STURGEON **Logged By:** ATCHLEY

Date: 6/14/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8440'						
						FC=1
		B.N.	SK • VTH			FC=1 — ϕ=Mo (LOWER THAN BELOW)
8450'						FC=1 A A FC=1
BACKSTEP						FC=11
						FC=1
				6-14-4-21SCA		FC=1 — INCREASES UPSECTION
		ST. SHOAL/ BEACH				FC=11
			SK •			ϕ= BP, Mo, WP
8460'				6-14-4-20SCA	3	FC=1
						FC=1
						FC=11
						FC=11
						FC=1
		A.L.D.	SK	6-14-4-19SCA	2	FC=1 — ϕ= WP, Mo
		ST. SHOAL/	SK •			FC=0 — ϕ= Mo, BP, WP [HIGH ϕ]
8470'		BEACH		6-14-4-18SCA	1	FC=0 — ϕ = Mo, BP, WP
		A.L.D.	SK			FC=0 — ϕ= WP, Mo
			SK			FC=0 — ϕ= WP, Mo
8480'						

—LIMESTONE— | —DOLOMITE—

Imperial Units (1" = 10')

CORE DIAMETER = 3.5"

DEPTH SHIFT = ?

10-11-69-22 W5

Project/Location: LEDUC/STURGEON LAKE

Logged By: KAHMANN

Date: 6/15/04

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Thickness	Texture M	W	P	G	B	Facies	Sed. Struct.	Photo	Sample	Comments
										FC
2555										
56							AA	6-16-04-3JAK		
57						MARGIN				V.F. M.O.ϕ some G.F.ϕ
								6-16-04-2JAK	S1	cavity filling mud
2558						A		6-16-04-1JAK		← CORE-2 = LOG

Metric Units (2.5cm = 3m)

2'ft. in box

CORE DIAMETER = 4"


11-3-69-22W5
Project/Location: LEDUC/STURGEON LAKE
Logged By: KAHMANN
Date: 6/16/04
Page 1 of 1
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
FC
Comments
34
36
CORE END
38
IRETON SHALE
8540
pyrite @ top
42
44
46
6-16-04-7JAK
48
8550
LIMESTONE
BURROWED NODULAR
52
54
0
56
58
8560
62
64
66
68
6-16-04-6JAK
cavity + fracture filling
pyrite @ bottom
8570
72
6-16-04-5JAK
M.O. ϕ
* BACKSTEP
74
A.L.O.
M.O. ϕ
light gray wack/packstone
8576
6-16-04-4JAK
M.O. ϕ
CORE START
CORE +6 = LOG
See log
Imperial Units (1" = 10')
2½' in box
CORE DIAMETER = 3½"

Project/Location: 11-6-69-21W5 LEDUC/STURGEON LAKE **Logged By:** ATCHLEY

Date: 1/7/04 **Page** 1 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8290						
		SLOPE DEBRIS				← GREEN CLAY BP
8300	RUDSTONE	BEACH				← BACKSTEP BP, Mo ϕ
				G 1-7-4-14SCA		
				1-7-4-13SCA		— COMMON Mo ϕ
	CLASTS W/IN BRECCIA	A.L.		BRECCIA		A ← COMMON BP CEMENT
8310						— COMMON Mo ϕ

Imperial Units (1" = 10')

THIN SIDEWAYS-STACKED CORE BOXES AS PARTIAL PRESERVATION... VERY INCOVENIENT!

11-6-69-21W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** ATCHLEY

Date: 1/7/04 **Page** 2 **of** 2

DEPTH RECONCILIATION W/LOG AND CORE ANALYSIS DATA PROBLEMATIC DUE TO UNCERTAIN DEPTH ASSIGNMENTS TO PARTIALLY PRESERVED CORE

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
		A.L.				ABUNDANT Mo ϕ
						(A) ← ABUNDANT
20 FRACTURES 10-30/F W/IN BRECCIATED ZONES	CLASTS W/IN BRECCIA			1-7-4-12 SCA		(A)
				1-7-4-11 SCA		(A) MASSIVE COMMON BP (A) AND DOLOMITE CEMENT
			BRECCIA			
30						COMMON BP; Mo ϕ THROUGHOUT BRECCIATED INTERVAL
		A.L.				
						(A) ← BP CEMENT
40						
	B					ϕ = BP, Mo
		SLOPE	• SK			BIOLOGICALLY CLOTTED FABRIC
50						
		SL. SAND	• SK			ϕ = Mo, BP
60			• SK			
			• SK			
	B	SLOPE	G	GEOPETAL FILL W/IN GF CAVITY		BIOLOGICALLY CLOTTED FABRIC
70						ϕ = GF, Mo
		SL. SAND	• SK			← ϕ = Mo.
	VERY MUDDY B	SLOPE	• SK			ϕ = WP, Mo IN ALL SLOPE DEPOSITS
80		SL. SAND	• SK			← ϕ = Mo, BP
			TH			
	B	SLOPE	• SK			
			• SK			
8390						
		CORE BOTTOM				

FRACTURE DENSITY INDEX NOT LOGGED BECAUSE ONLY PARTIAL CORE PRESERVATION, IMPOSSIBLE TO ESTABLISH PRESENCE OF RUBBLE.

Imperial Units (1" = 10')

CORE DIAMETER = 3"

Project/Location: 11-25-68-22W5 LEDUC / STURGEON LAKE

Logged By: ATCHLEY

Date: 1/8/04

Page 1 **of** 1

8440'

ϕ W/IN BEACH = BP, MO, FR

ϕ W/IN ALL OTHER ROCK TYPES = MO, FR

CORE TOP

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
50	RDST.	BRECCIA				A ← MASSIVE BP CEMENT
						FC = 1
						FC = 11
		B. N.	SK			FC = 1
						FC = 11
60						FC = 1
						FC = 1
		BRECCIA		1-8-4-13SCA		A ← MASSIVE BP CEMENT
	RUDST.					
70		B. N.	SK			FC = 1
						FC = 1
		BRECCIA				A FC = 11 → CEMENT ALONG WITH DOLOMITE
	RDST.	BRECCIA				A FC = 11
		B. N.	SK			FC = 11
80		BRECCIA		1-8-4-12SCA		A FC = 11 → MASSIVE BP CEMENT
		B. N.	SK			FC = 11
						← ~ BACKSTEP
						GREEN CLAY CLASTS? FRACTURE GOUGE?
90						
	RUDST.	BRECCIA		1-8-4-11SCA		A BRECCIA IS "POLYFACIES"... DOMINATED BY BEACH, BUT INCLUDES A.L. AND BURROWED NODULAR. ABUNDANT, MASSIVE BP A AND DOLOMITE CEMENT.
				1-8-4-10SCA		
8500						
	RUDST.	BEACH	• SK	1-8-4-9SCA		FC = 2 A
						A FC = 2 GREEN CLAY AS FRACTURE GOUGE
	RUDST.	BRECCIA	• SK			A BP BRECCIA CLASTS COMPOSED OF "BEACH" FACIES. ABUNDANT MASSIVE ANHYDRITE CEMENT
10				1-8-4-8SCA		
		BEACH	• SK			A FC = 1
		MASSIVE				
	RUDST.	BEACH	SK → G (WEAK)			HIGH MO, BP ϕ
		STROM. SHOAL	SK → G (DISSEMINATED)	1-8-4-7SCA		FC = 0
		MASSIVE				A
		BEACH	• SK			FC = 1
8520	RUDST.	BRECCIA		1-8-4-6SCA		← BRECCIA IS "POLYFACIES" AND INCLUDES BP GREEN CLAY AND GREEN CLAY INTRACLASTS *
		BEACH	• SK			FC = 1

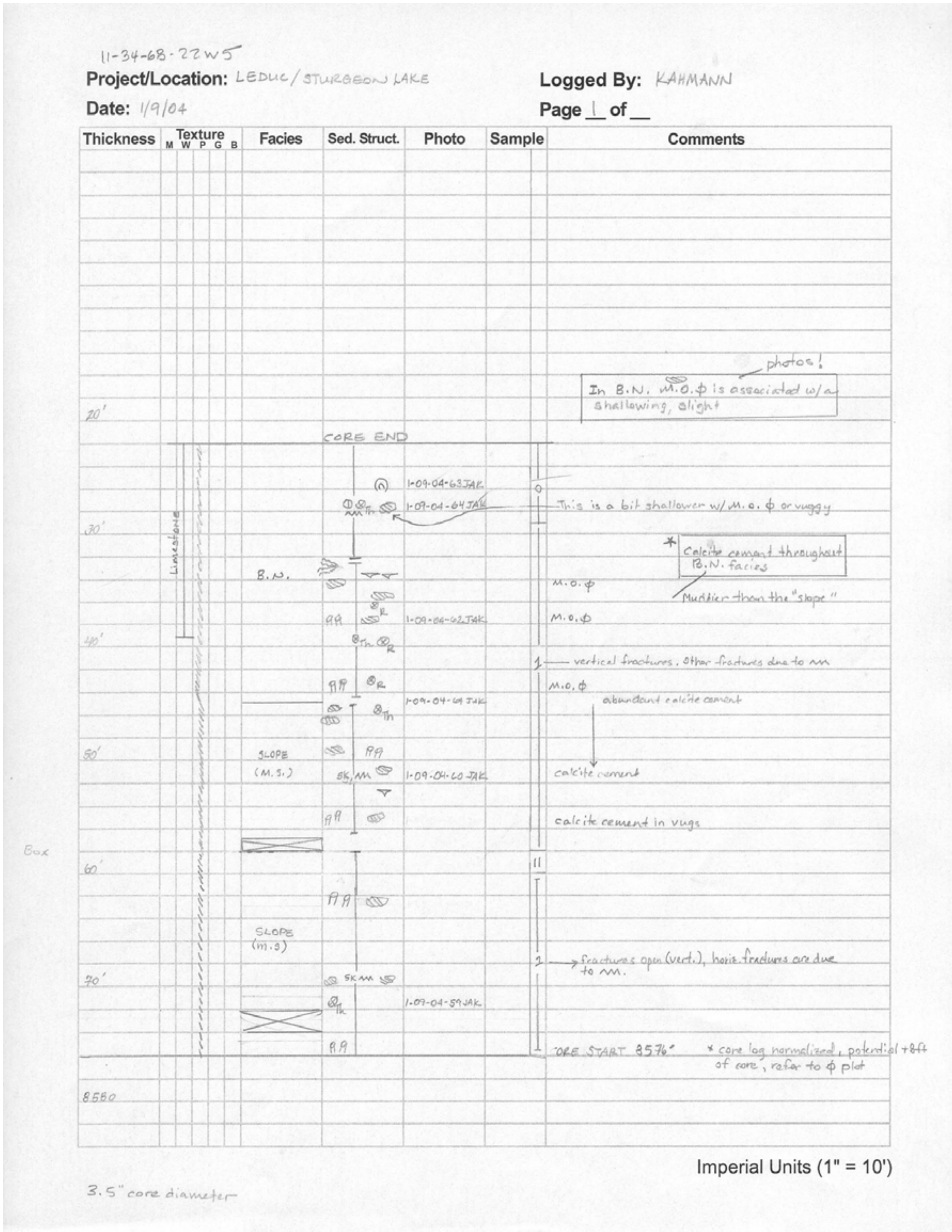
BRECCIA CLASTS ALL BURROWED NODULAR

BURROWED NODULAR FACIES COMPOSE BRECCIA CLASTS

CORE BOTTOM

Imperial Units (1" = 10')

CORE DIAMETER = 3.5"



11-34-68-22W5
Project/Location: LEDUC/STURGEON LAKE
Logged By: KAHMANN
Date: 1/9/04
Page 1 of __
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
photos!
In B.N. M.O.ϕ is associated w/a shallowing, slight
20'
CORE END
1-09-04-63JAK
1-09-04-64JAK
This is a bit shallower w/ M.O. ϕ or vuggy
30'
Limestone
* Calcite cement throughout B.N. facies
Muddier than the "slope"
B.N.
M.O.ϕ
1-09-04-62JAK
M.O.ϕ
40'
1
vertical fractures. Other fractures due to
M.O.ϕ
1-09-04-61JAK
abundant calcite cement
50'
SLOPE
(M.S.)
SK,
1-09-04-60JAK
calcite cement
calcite cement in vugs
Box
60'
11
SLOPE
(m.s)
2
fractures open (vert.), horiz. fractures are due to
70'
SK
1-09-04-59JAK
CORE START 8576'
* core log normalized, potential +8ft of core, refer to ϕ plot
8580
Imperial Units (1" = 10')
3.5" core diameter

11-35-68-22W5

Project/Location: LEDUC/STURGEON LAKE

Date: 6/15/04

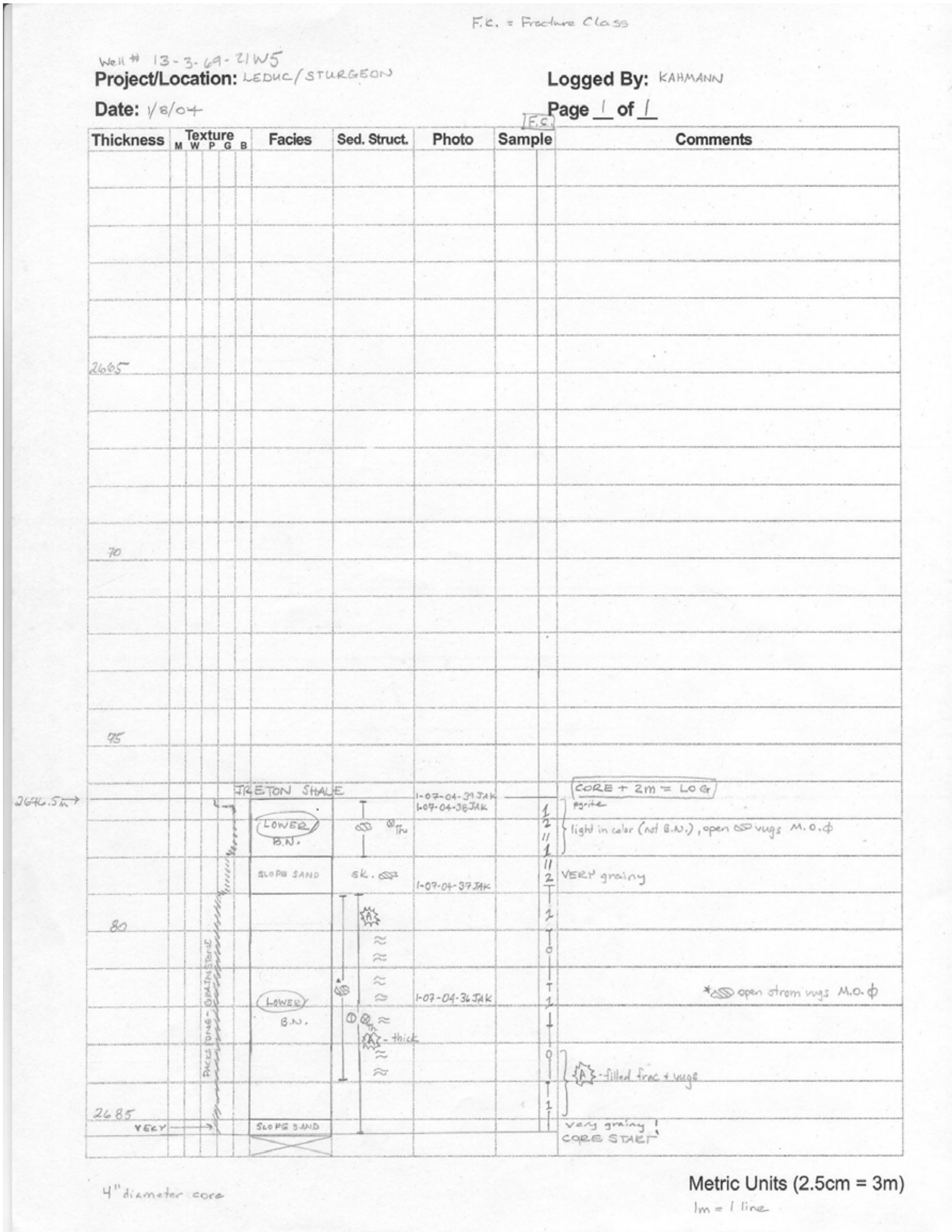
Logged By: KOENIG

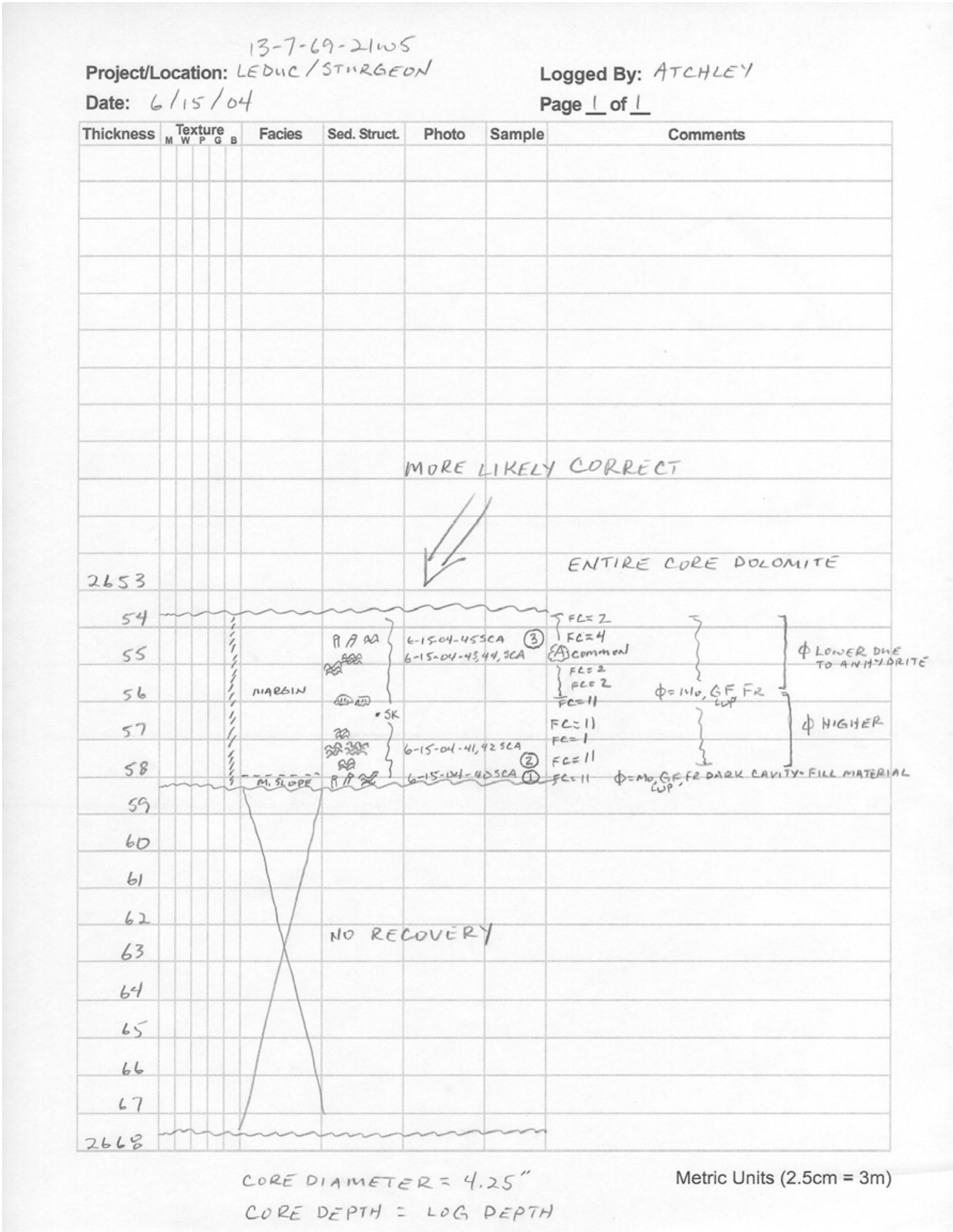
Page 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
8460							
62							
64							
66		TOP OF CORE					
68							STYOLITES
8470			Sk Φ	6-15-04-65 JBK			STYOLITES SKELETAL FRAGMENTS CONCEN.
72							LIMESTONE ALONG HORIZONS w/ ARGILLACEOUS
74			Sk	6-15-04-66 JBK			MATERIAL
76			Sk			0	↳ Sk, Φ BOTH SCATTERED
78							THROUGHOUT
8480			Φ				
82		BN					
84							
86			Φ				STYOLITES
88			Φ Sk	6-15-04-67 JBK		1	{A}
8490							
92		LOWER SLOPE?		6-15-04-68 JBK			LIGHTER IN COLOR MUDDY CLAST?
94		BN				12	LIMESTONE ← BACKSTEP
96		LAGOON	ΨΨ	6-15-04-69 JBK 6-15-04-70 JBK	S1	11 11	STYOLITES
98							
8500							
02							
06			BOTTOM OF CORE				
08							
8510							

Imperial Units (1" = 10')

CORE DIAMETER = 3½"


F.C. = Fracture Class
Well # 13-3-69-21W5
Project/Location: LEDUC/STURGEON
Logged By: KAHMANN
Date: 1/8/04
Page 1 of 1
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
F.C.
Comments
2665
70
75
2676.5m
IRETON SHALE
CORE + 2m = LOG
1-07-04-39JAK
1-07-04-38JAK
pyrite
LOWER B.N.
light in color (not B.N.), open vugs M.O. ϕ
SLOPE SAND
SK.
1-07-04-37JAK
VERY grainy
80
PACKSTONE - GRAINSTONE
LOWER B.N.
1-07-04-36JAK
*open strom vugs M.O. ϕ
thick
filled frac + vugs
2685
VERY
SLOPE SAND
very grainy!
CORE START
4" diameter core
Metric Units (2.5cm = 3m)
1m = 1 line



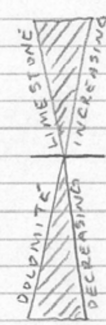
13-7-69-21W5
Project/Location: LEDUC / STURGEON
Logged By: ATCHLEY
Date: 6/15/04
Page 1 of 1
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
MORE LIKELY CORRECT
ENTIRE CORE DOLOMITE
2653
54
55
56
57
58
59
60
61
62
63
64
65
66
67
2668
MARGIN
M. SLOPE
SK
6-15-04-45SCA
6-15-04-43,44,SCA
6-15-04-41,42SCA
6-15-04-40SCA
3
2
1
FC=2
FC=4
A common
FC=2
FC=2
FC=11
FC=11
FC=1
FC=11
FC=11
Φ=MO, GF, FR LUP
Φ LOWER DUE TO ANHYDRITE
Φ HIGHER
Φ=MO, GF, FR DARK CAVITY-FILL MATERIAL LUP
NO RECOVERY
CORE DIAMETER = 4.25"
CORE DEPTH = LOG DEPTH
Metric Units (2.5cm = 3m)

13-14-63-22W5

Project/Location: LEDUC/STURGEON **Logged By:** ATCHLEY

Date: 6/15/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8470'						
		B.N.				
80'				NO PHOTOS		FC=1,
BACKSTEP						
		B.N./ L. SLOPE				Φ=Mo
8490'						



CORE DIAMETER = 4.25"

CORE DEPTH = LOG DEPTH

Imperial Units (1" = 10')

13-35-68-22 W5

Project/Location: LEDUC / STURGEON LAKE

Logged By: KAHMANN

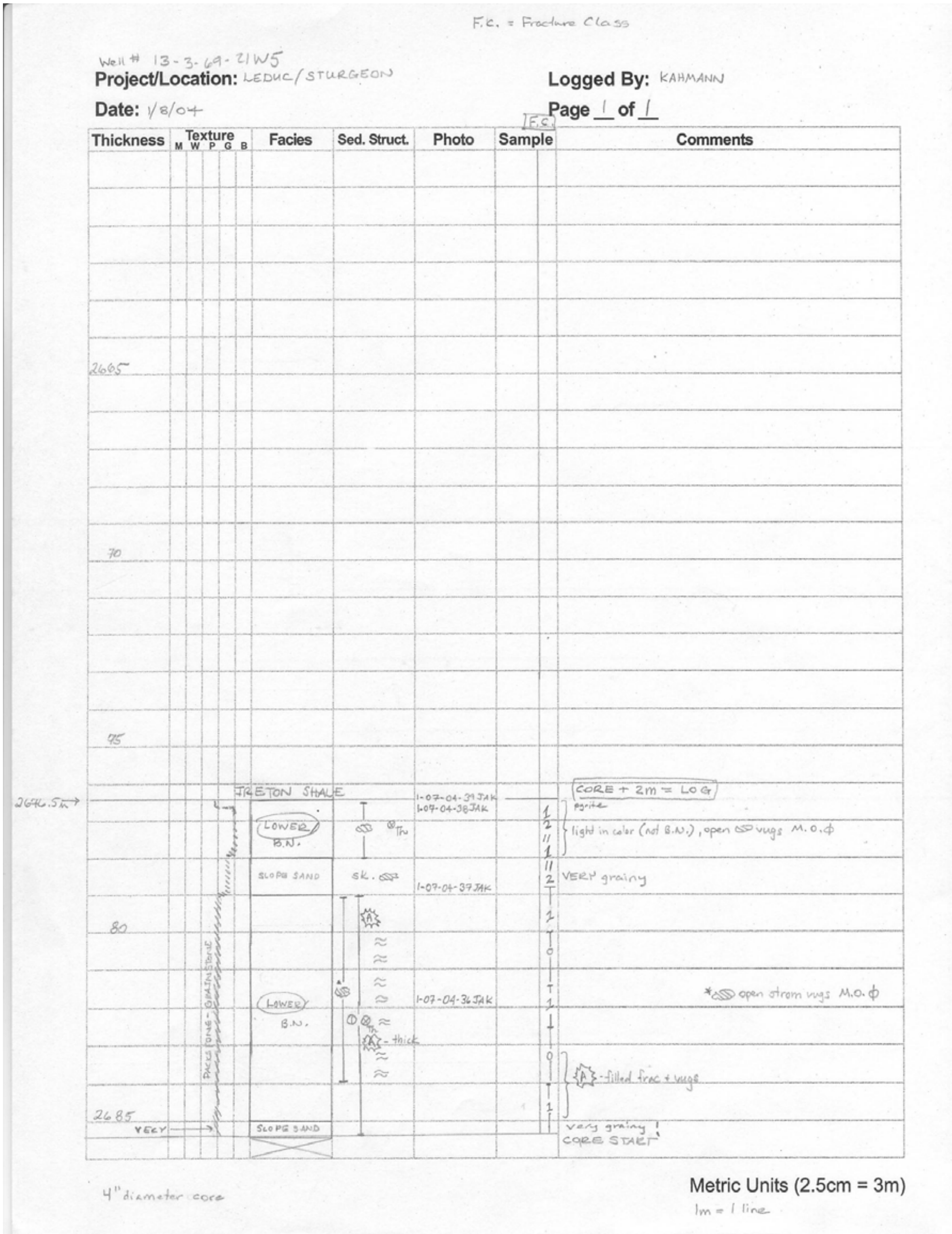
Date: 6/15/04

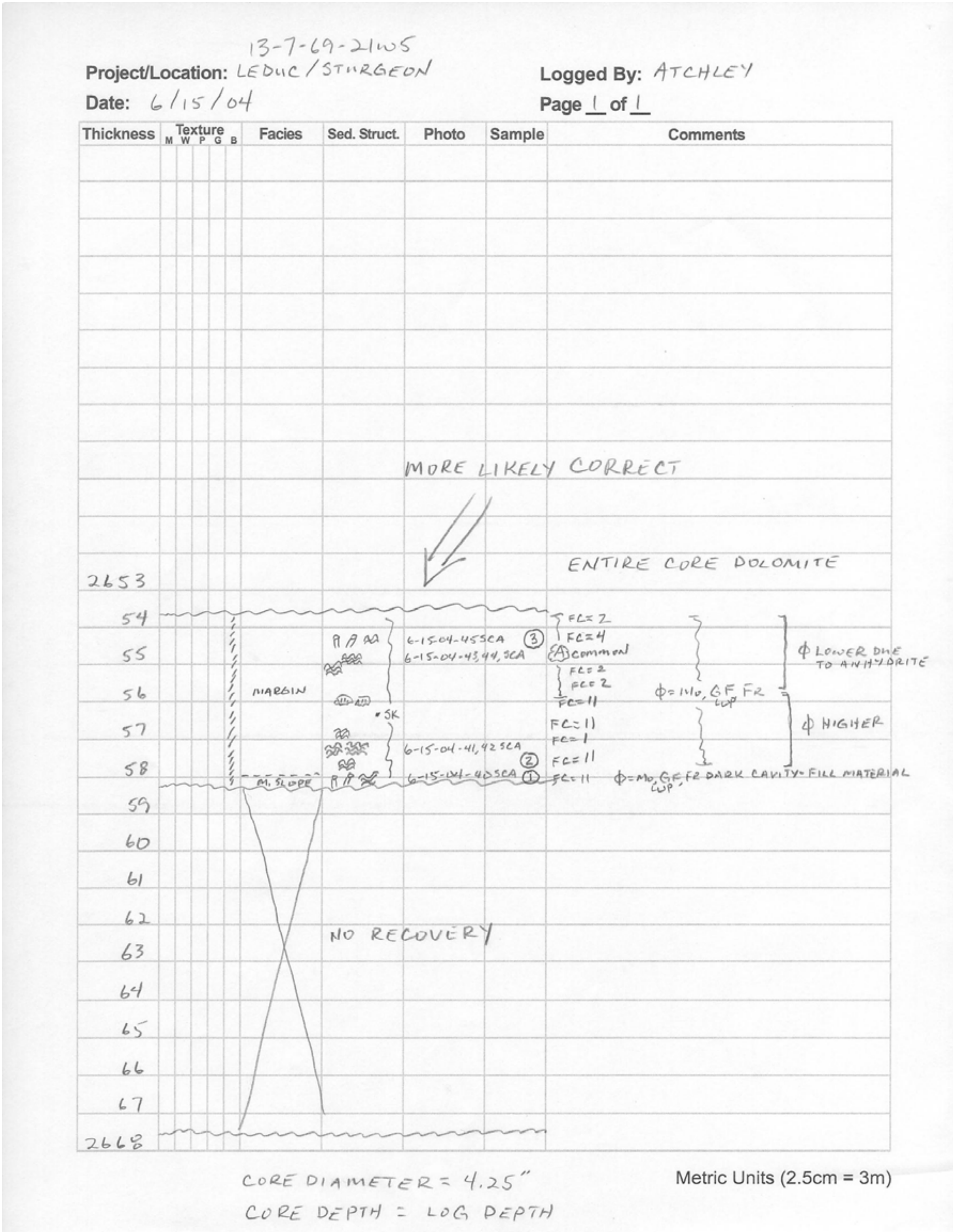
Page 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8500						
2						
4				6-15-04-26JAK		
6	LIMESTONE				1	
8		BURROWED NODULAR		6-15-04-28JAK	V.F.	fractures filled w/anhydrite
8510						
12			nodule ΦΦR	6-15-04-27JAK		whispy stylolites throughout B.N.
14			nodule			
16					0	
18						
8520				6-15-04-25JAK		
22		L.S.	Tabulate	6-15-04-24JAK		M.O.Φ clotted fabric
24					1	M.O.Φ
26					h.f.	
28		B.N.	L.S. Φ, Φ, coral L.S.	6-15-04-23JAK 6-15-04-22JAK	1 h.f.	clotted fabric dark clotted fabric *BACKSTED *BACKSTEP
8530		BEACH	stromatactis cement	6-15-04-21JAK	S2 S1	green clay throughout RUDSTONE *BACKSTED] EXP?
32				6-15-04-20JAK	1 h.f.	M.O.Φ
8534						

CORE DESCRIPTION NOT ON WIRE LOG

CORE DIAMETER = 3½" Imperial Units (1" = 10')


F.C. = Fracture Class
Well # 13-3-69-21W5
Project/Location: LEDUC/STURGEON
Logged By: KAHMANN
Date: 1/8/04
Page 1 of 1
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
F.C.
Comments
2665
70
75
2676.5m
IRETON SHALE
CORE + 2m = LOG
1-07-04-39 JAK
1-07-04-38 JAK
pyrite
LOWER B.N.
light in color (not B.N.), open vugs M.O. ϕ
SLOPE SAND
SK.
1-07-04-37 JAK
VERY grainy
80
PACKSTONE - GRAINSTONE
LOWER B.N.
1-07-04-36 JAK
* open strom vugs M.O. ϕ
- thick
- filled frac + vugs
2685
VERY
SLOPE SAND
very grainy!
CORE START
4" diameter core
Metric Units (2.5cm = 3m)
1m = 1 line



13-7-69-21W5
Project/Location: LEDUC / STURGEON
Logged By: ATCHLEY
Date: 6/15/04
Page 1 of 1
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
MORE LIKELY CORRECT
ENTIRE CORE DOLOMITE
2653
54
55
56
57
58
59
60
61
62
63
64
65
66
67
2668
MARGIN
M. SLOPE
SK
6-15-04-45SCA
6-15-04-43,44,SCA
6-15-04-41,42SCA
6-15-04-40SCA
3
2
1
FC=2
FC=4
A common
FC=2
FC=2
FC=11
FC=11
FC=1
FC=11
FC=11
Φ=Mo, GF, FR, CUP
Φ LOWER DUE TO ANHYDRITE
Φ HIGHER
Φ=Mo, GF, FR, CUP, DARK CAVITY-FILL MATERIAL
NO RECOVERY
CORE DIAMETER = 4.25"
CORE DEPTH = LOG DEPTH
Metric Units (2.5cm = 3m)

13-14-68-22W5

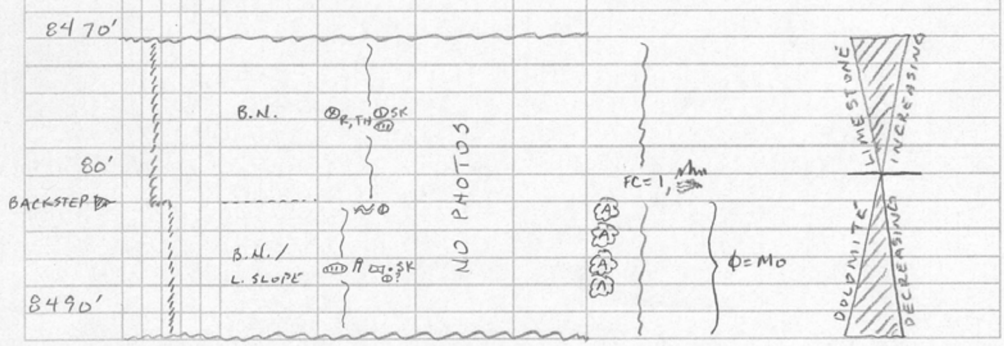
Project/Location: LEDUC / STURGEON

Logged By: ATCHLEY

Date: 6/15/04

Page 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments



Imperial Units (1" = 10')

CORE DIAMETER = 4.25"

CORE DEPTH = LOG DEPTH

13-35-68-22 W5

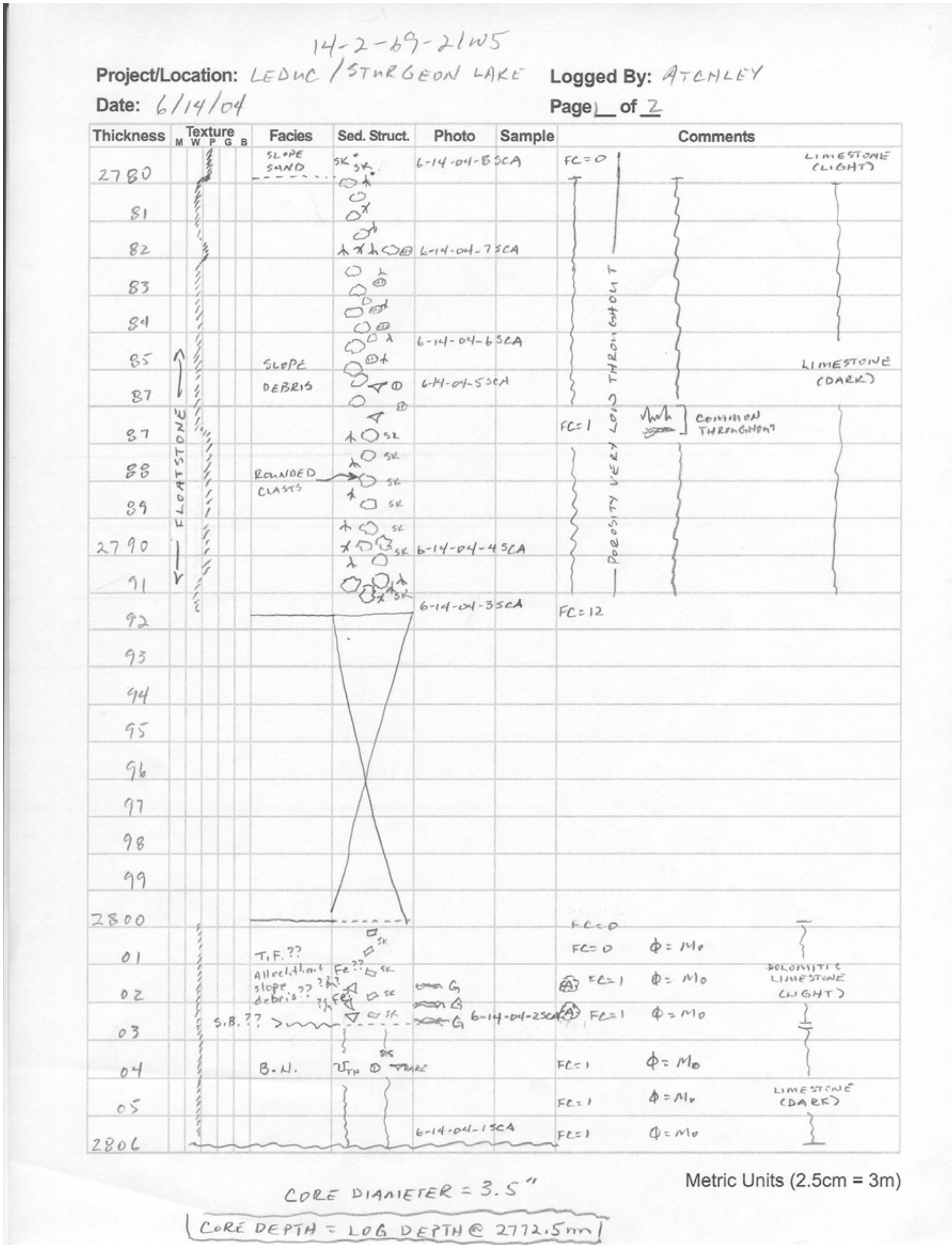
Project/Location: LEDUC / STURGEON LAKE **Logged By:** KAHMANN

Date: 6/15/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8500						
2						
4	LIMESTONE			6-15-04-26JAK		
6						
8		BURROWED NODULAR		6-15-04-28JAK	V.F.	fractures filled w/anhydrite
8510						
12			A nodule			whispy stylolites throughout B.N.
14			A nodule; Φ ⊗R	6-15-04-27JAK		
16					0	
18						
8520				6-15-04-25JAK		
22		L.S.	Tabulate	6-15-04-24JAK		M.O.Φ; clotted fabric
24					hf.	M.O.Φ
26			L.S.			clotted fabric
28		B.N.	Φ, Φ, coral; L.S.	6-15-04-23JAK; 6-15-04-22JAK	hf.	dark; clotted fabric
8530		BEACH	stromatactis cement	6-15-04-21JAK	S2, S1	green clay throughout; RUDSTONE; BACKSTEP; BACKSTEP; BACKSTEP; EXP?
32				6-15-04-20JAK	hf.	M.O.Φ
8534						

CORE DESCRIPTION NOT ON WIRE LOG

CORE DIAMETER = 3½" Imperial Units (1" = 10')


14-2-69-21W5
Project/Location: LEDUC / STURGEON LAKE
Logged By: ATCHLEY
Date: 6/14/04
Page 1 of 2
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
2780
81
82
83
84
85
87
87
88
89
2790
91
92
93
94
95
96
97
98
99
2800
01
02
03
04
05
2806
SLOPE SAND
SLOPE DEBRIS
ROUNDED CLASTS
FLOATSTONE
T.F.??
Allochthonous slope debris??
S.B.??
B.N.
6-14-04-8SCA
6-14-04-7SCA
6-14-04-6SCA
6-14-04-5SCA
6-14-04-4SCA
6-14-04-3SCA
6-14-04-2SCA
6-14-04-1SCA
FC=0
FC=1
FC=12
FC=1
Φ = Mo
POROSITY VERY LOW THROUGHOUT
COMMON THROUGHOUT
LIMESTONE (LIGHT)
LIMESTONE (DARK)
DOLOMITIC LIMESTONE (LIGHT)
LIMESTONE (DARK)
Metric Units (2.5cm = 3m)
CORE DIAMETER = 3.5"
CORE DEPTH = LOG DEPTH @ 2772.5m

14-2-69-21W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** ATCHLEY

Date: 6/14/04 **Page** 2 **of** 2

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
58						
59						
2760						
61						
62		IRETON SHALE		B.L.M.		
63						EITHER AN OVERALL PROGRADATIONAL
64						SUCCESSION, OR AMPH. LAGOON
65						AT TOP IS SLOPE DEBRIS
66						
67						
68						
69						CORE DEPTH = LOG DEPTH
2770						@ 2772.5m
71						
72						
73			SK			← ϕ = Mo (COMMON) DOLOMITE
74		A.L.R.		6-14-04-12 SCA		
75		A.L.D.	SK	6-14-04-11 SCA		
76		A.L.R.	SK SK			FC = 0 LIMESTONE
77			SK	6-14-04-10 SCA		
78		L. SLOPE		6-14-04-9 SCA		COMMON
79			SK			FC = 1 ϕ = Mo

Metric Units (2.5cm = 3m)

14-14-68-22W5

Project/Location: LEDUC/STURGEON LAKE

Logged By: KOENIG

Date: 6/14/04

Page 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
2575		TOP OF CORE					
76				6-14-04-14 JBK	5 1		BPφ THROUGHOUT SLOPE SAND
77		SLOPE SAND		6-14-04-15 JBK 6-14-04-16 JBK		1	MOφ A FILLED MOLDS
78			TH	6-14-04-17 JBK	5 2	0	A LARGE MOLDS FILLED W/ ANH
79				6-14-04-18 JBK		3	ABUNDANT MOφ (SPIKE IN φ PLOT)
2580							MASSIVE ENCRUSTING STROMAT. W/ MICRITE COMPONENT
81				6-14-04-18 JBK		2	A3 FILLING FRACTURES
82		MARGIN/ SLOPE DEBRIS					
83			≈	6-14-04-19 JBK			
84			≈		5 3	1	LARGE MOφ
2585				6-14-04-20 JBK		2	
86			≈	6-14-04-21 JBK	5 4	1	FILLED MOLD MOφ/INTERXTALLINE φ
87				6-14-04-22 JBK		11 0	MOφ (.5"–2") INTERXTALLINE φ (ABUNDANT)
		BOTTOM OF CORE					
88							
89							
2590							

Metric Units (2.5cm = 3m)

CORE DIAMETER = 3½"

Project/Location: 14-30-68-21W5 LEDUC/STURGEON

Date: 1/8/04

Logged By: ATCHLEY

Page 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
2530		CORE TOP				
31						FC = 1 Mo FR ϕ ABUNDANT
			Δ ∇	1-8-4-30 SCA		FC = 2 DOLOMITE CEMENT
32		B. N.	SK •	BRECCIATED		FC = 2 BPΔ AND W/IN
			Δ Δ	BURROWED		FC = 11 Mo, BPΔ FR ϕ FRACTURES
33			Δ ▷	NODULAR		FC = 11
			Δ			FC = 11
		CORE BASE				

Metric Units (2.5cm = 3m)

F.C. = Fracture Class

Well # 15-1-69-22 W5

Project/Location: LEDUC/STURGEON LAKE **Logged By:** KAHMANN

Date: 1/9/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample (F.C.)	Comments
						F.C. = 11 for entire interval → except for small areas *
						CORE END
8410'		BRECCIA		1-09-04-59JAK		some M.O.φ in ALO
						A.L.O., T.F.?, little argillaceous material, skeletal grainstone, G.P. clasts, Φ clasts (slope)
20'						Φ slope clasts
				1-09-04-56JAK		Thick argillaceous material
						A.L.O. + T.F.; sk. grainstone → possible Beach
			RUBBLE			A.L.O., sk grainstones, and M.O.Φ
30'					* 12	
						VERY argillaceous (infill), ALO, skeletal grainstones, a few B.N./SLOPE by Φ
40'		BRECCIA		1-09-04-53JAK		
						sk grainstones (slope sand), ΔV, ALO, M.O.Φ in, NOT so argillaceous
50'						
						lithoclasts, wafer ≈ in clasts, A.L.O. clasts, argillaceous infill, some in infill → ripple B.N.? fabric
60'		BRECCIA		1-08-04-53JAK		
						argillaceous in fill ALO, strom, grainstone
70'						
		(SLOPE DEBRIS) ?		1-08-04-53JAK		large of ALO, argillaceous in fill
						CORE START * 5f. too much core, measuring from bottom up.
8480						

Imperial Units (1" = 10')

3.5" core diameter

15-4-69-22w5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG

Date: 6/15/04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
8570							
72							
74		TOP OF CORE					
76				6-15-04-71JBK			LAMINATED MUD
78		BLM					
8580							SKELETAL FRAGMENTS CONCEN.
82			SK				LIMESTONE ALONG ARGILLACEOUS HORIZONS
84				6-15-04-72JBK		D	W/IN BN
86							SK FRAGMENTS INCLUDE CORALS, CRINOIDS
88		BN	SK	6-15-04-73JBK			BRACHIOPODS, THAMNOPORA
8590							AS NODULE
92			SK				
94							
96				6-15-04-74JBK			MD ϕ - SPIKE IN ϕ PLOT PORE WALL LINED W/ ANH
98			SK			1	MD ϕ
8600			SH	6-15-04-75JBK			<BACKSTEP PYRITE TAN COLOR CORE = LOG
02		SLOPE	D	6-15-04-76JBK		1	MD ϕ LAMINAE EXCESS STYOLITES PORE WALLS LINED
04			D	6-15-04-77JBK			MD ϕ LIGHTER GREY COLOR W/ AS SPIKE IN ϕ PLOT
06		BOTTOM OF CORE					
08							
8610							

Imperial Units (1" = 10')

CORE DIAMETER 3½"

Project/Location: 15-9-69-22W5 LEDUC/STURGEON **Logged By:** ATCHLEY

Date: 1/8/4 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8577		CORE TOP				
		BURROWED NODULAR	SK	1-8-4-29	SCA	FC=0
						FC=0
						FC=1
87		BURROWED NODULAR	SK	1-8-4-28	SCA	FC=1 FRACTURES CM'S IN DIAMETER AND CEMENTED WITH DOLOMITE (1ST PHASE) AND ANHYDRITE (2ND PHASE)
				1-8-4-27	SCA	
8597		SL. SAND	SK			FC=11 ϕ = Mv, BP
		CORE BASE				

CORE DIAMETER = 3.5"

LIGHT COLOR

DARK COLOR (ARGILLACEOUS)

Imperial Units (1" = 10')

15-17-69-22W5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG
Date: 6-14-04 **Page** 1 **of** 1

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	FC	Comments
8600							
2							
4							
6							
8							
8610							
12							
14							
16							
18							
8620							PYRITE
22			SK				
24						0	PYRITE
26		BN	SK	6-14-04-03 JBK			
28							
8630		BLM		6-14-04-04 JBK		1	FISSILE AND LESS FOSSILIFEROUS
32		BN	SK				
34			=				MM SCALE LAMINATIONS CONTORTED
36		BLM		6-14-04-05 JBK		0	BLM MORE ARGILLACEOUS THAN BN
38			=				
8640			= Δ			2	A FILLING FRACTURES — FRACTURES CROSSCUT Δ ∴ TECTONIC CORE & ϕ PLOT KR
42			Δ	6-14-04-06 JBK		11	LARGE Δ OF SK
44				6-14-04-07 JBK 6-14-04-08 JBK			MO ϕ — CONTINUED GRN SHALE OCCURING AS CLASTS AS WELL AS MTX — SLOPE DEBRIS NOTED BY ANGULAR CLASTS OF SK FRAGS.
46			ΔΔ			1	THROUGHOUT. LARGER (.5-3") CLASTS HAVE BEEN LEECHED (MO ϕ)
48			SK	6-14-04-09 JBK			MO ϕ
8650		SLOPE	ΔΔ				< GREEN SHALE (MASSIVE = 3" THICK)
52		DEBRIS		6-14-04-10 JBK		1	HEALED W/ A MO ϕ MP ϕ
54			ΔΔ □				ANGULAR CLASTS CONTAIN MO ϕ — SPIKE IN ϕ PLOT DUE TO MO ϕ
56				6-14-04-11 JBK			MATRIX CONTAINS SK LENTICULAR MUD DRAPES SD FILLING FRACTURES
58			ΔΔ □	6-14-04-12 JBK		1	FRACTURES CROSS-CUTTING LITHO CLASTS ∴ TECTONIC?
8660			ΔΔ	6-14-04-13 JBK			SD FILLING FRACTURES
62							

BOTTOM OF CORE

Imperial Units (1" = 10')

CORE DIAMETER = 3 1/2"

15-24-69-23w5

Project/Location: LEDUC / STURGEON LAKE **Logged By:** KOENIG

Date: 6/15/04 **Page** 1 **of** 1

Thickness	Texture M W P G B	Facies	Sed. Struct.	Photo	Sample	FC	Comments
2675							
76							
77							
78		TOP OF CORE					
79				6-15-04-57JBK 6-15-04-58JBK	S1	0	MOLDIC PORE FILLED W/ SA OIL STAINED •SK GRAINS IN FILLING
2680			•SK	6-15-04-59JBK 6-15-04-69JBK	S2		MO ϕ
			?	6-15-04-70JBK		1	BP ϕ
81		SLOPE SAND		6-15-04-71JBK	S3	12 1	DARKER, MUDDIER AND MORE GRAINY BP ϕ (MAY ALSO BE MARGIN BY INFRLING)
2682			?	6-15-04-72JBK 6-15-04-73JBK	S4	11	INTERPARTICLE ϕ (SPIKE IN ϕ PLOT) DP ϕ MO ϕ
83		BOTTOM OF CORE					

Metric Units (2.5cm = 3m)

CORE DIAMETER = 3½"

Project/Location: 15-31-68-21W5 LEDUC / STURGEON **Logged By:** ATCHLEY

Date: 1-6-04 **Page** 1 **of** 4

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
8260						
70						
80						
		TOP OF CORE				
8290			• SK			
		SLOPE SAND?	• SK			FC=1 Φ = MO, FR
			• SK	1-6-4-20SCA		
			• SK			
			• SK			
			• SK	1-6-4-19SCA		
8300	B	SLOPE				FC=1 Φ = MO, FR
						BACKSTEP A
		EXPOSURE REGOLITH	SK G			FC=1 A A Φ = MO
10				1-6-4-18SCA		
		A.L./				
8320		STROM. SHOAL	SK •			FC=1 Φ = MO, FR

Imperial Units (1" = 10')

Project/Location: 15-31-68-21W5 LEDUC / STURGEON LAKE **Logged By:** ATCHLEY

Date: 1-6-04 **Page** 2 **of** 4

Thickness	Texture (M W P G B)	Facies	Sed. Struct.	Photo	Sample	Comments
		EXPOSURE				FC=1
						FC=11
30		REGOLITH		1-6-4-17SCA		FC=1 OXIDIZED WITHIN BP PORE SPACE
						FC=1
40		A.L./ STROM. SHOAL	SK	1-6-4-16SCA		FC=1 ϕ= Mo, FR
50		EXPOSURE REGOLITH	SK G G	1-6-4-15SCA		FC=1
						FC=11
						◁— CLOSE TO TIDAL FLAT
60		A.L./STROM SHOAL	SK			FC=1 ϕ= Mo, FR
				1-6-4-14SCA		
						FC=11
70						
				1-6-04-13SCA		
		BEACH	SK			FC=1 ϕ= Mo, BP, FR
80		A.L./ STROM. SHOAL	SK			ϕ = Mo
				1-6-04-12SCA		
		BEACH	SK	1-6-04-11SCA		FC=1 ϕ= Mo, BP, FR
8390						
		A.L./ STROM. SHOAL	SK			
8400						ϕ= Mo, FR
						FC=11
						FC=1
						FC=11
8410						FC=1
						FC=11
						FC=1
						FC=1

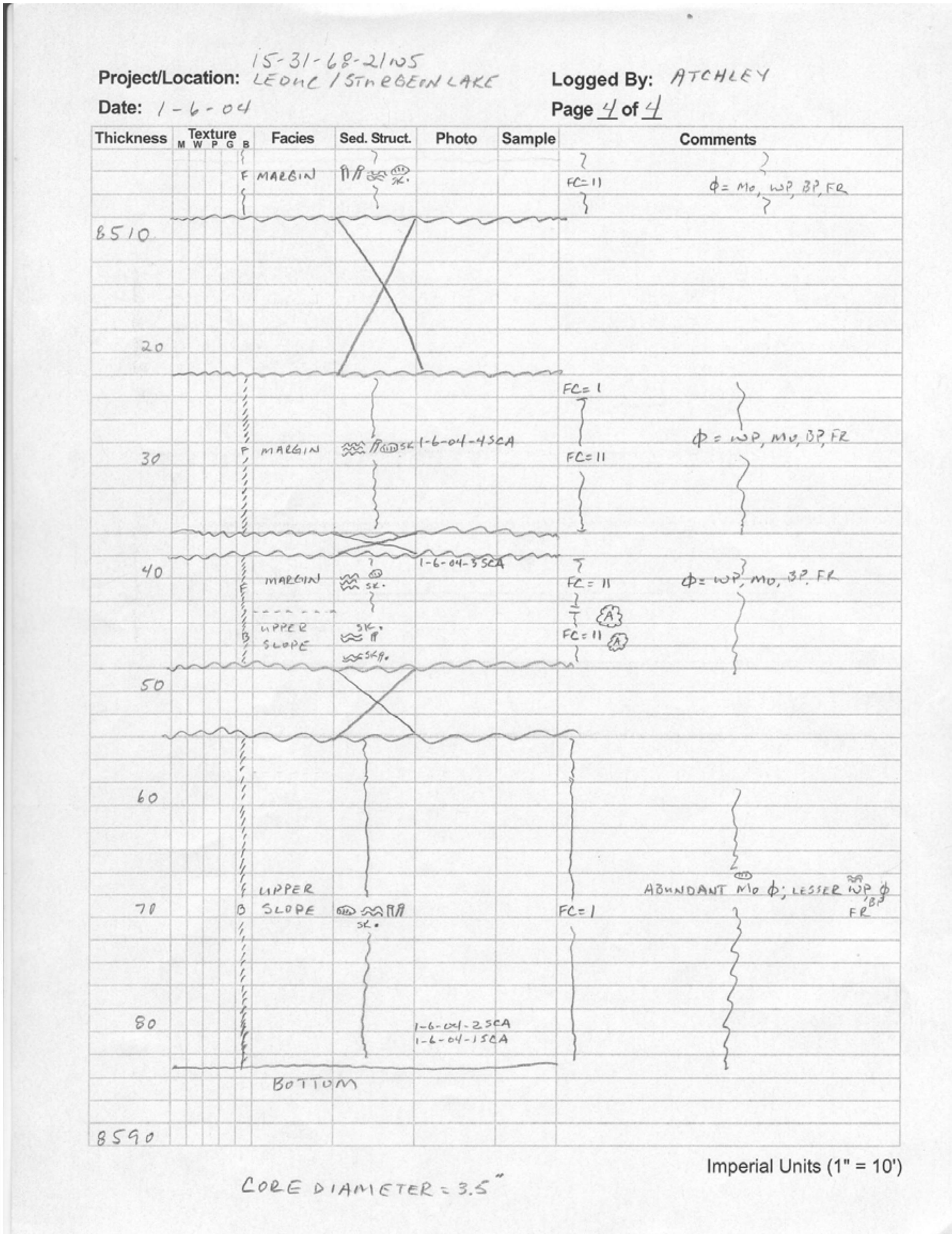
Imperial Units (1" = 10')

Project/Location: 15-31-68-21W5 LEDUC/STURGEON LAKE **Logged By:** ATCHLEY

Date: 1-6-04 **Page** 3 **of** 4

Thickness	Texture M W P G B	Facies	Sed. Struct.	Photo	Sample	Comments
		SEE ABOVE		1-6-04-10SCA	FC=1	
					FC=1	
8420					FC=1	
		A.L.			FC=11	ϕ = Mo, FR
					FC=12	
					FC=11	
					FC=11	
30						
40						
					FC=1	
50	B	MARGIN (U. SLOPE)	TH TH	1-6-04-9SCA	FC=11	
					FC=11	
					FC=1	POSSIBLE BACKSTEP?
60	F	MARGIN	SK		FC=1	ϕ = Mo, WP, BP, FR
					FC=1	
70	F	MARGIN		1-6-04-8SCA	FC=1	ϕ = Mo, WP, BP, FR
					FC=11	
					A	
80						
				1-6-04-6SCA 1-6-04-7SCA	A	
90	F	MARGIN	SK TH		FC=1	ϕ = Mo, WP, BP, FR
					FC=1 A	
8500	F	MARGIN	SK TH	1-6-04-5SCA	FC=1	ϕ = Mo, WP, BP, FR
					FC=11	

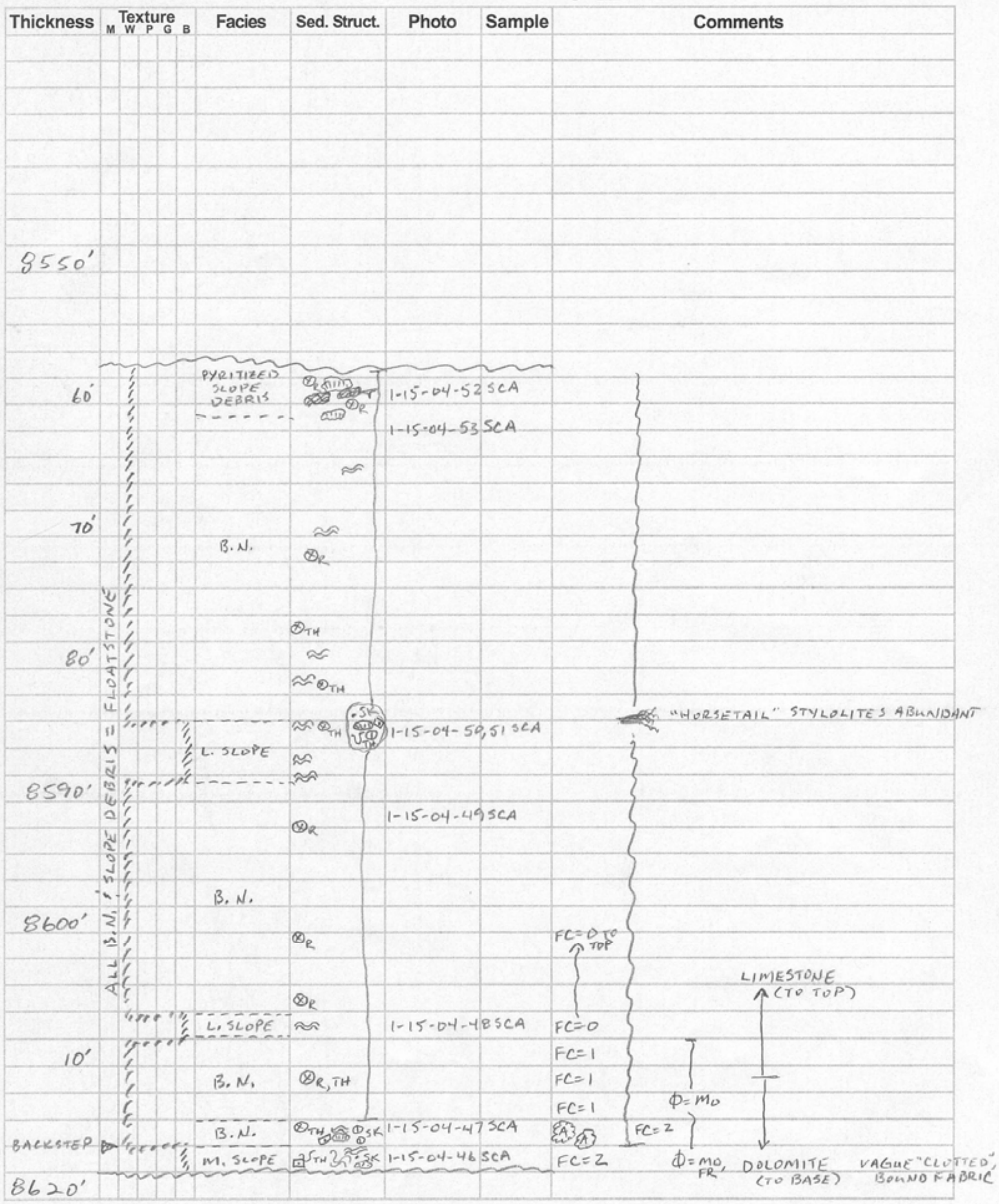
Imperial Units (1" = 10')


15-31-68-21W5
Project/Location: LEDUC / STURGEON LAKE
Logged By: ATCHLEY
Date: 1-6-04
Page 4 of 4
Thickness
Texture M W P G B
Facies
Sed. Struct.
Photo
Sample
Comments
F MARGIN
SK.
FC=11
ϕ = MO, WP, BP, FR
8510
20
FC=1
P MARGIN
SK 1-6-04-4SCA
30
FC=11
ϕ = WP, MO, BP, FR
1-6-04-3SCA
40
MARGIN
SK.
FC=11
ϕ = WP, MO, BP, FR
UPPER SLOPE
B
SK.
FC=11
A
50
60
UPPER SLOPE
B
SK.
70
FC=1
ABUNDANT MO ϕ; LESSER WP ϕ
BP FR
80
1-6-04-2SCA
1-6-04-1SCA
BOTTOM
8590
Imperial Units (1" = 10')
CORE DIAMETER = 3.5"

15-33-68-22W5

Project/Location: LEDUC / STURGEON **Logged By:** ATCHLEY

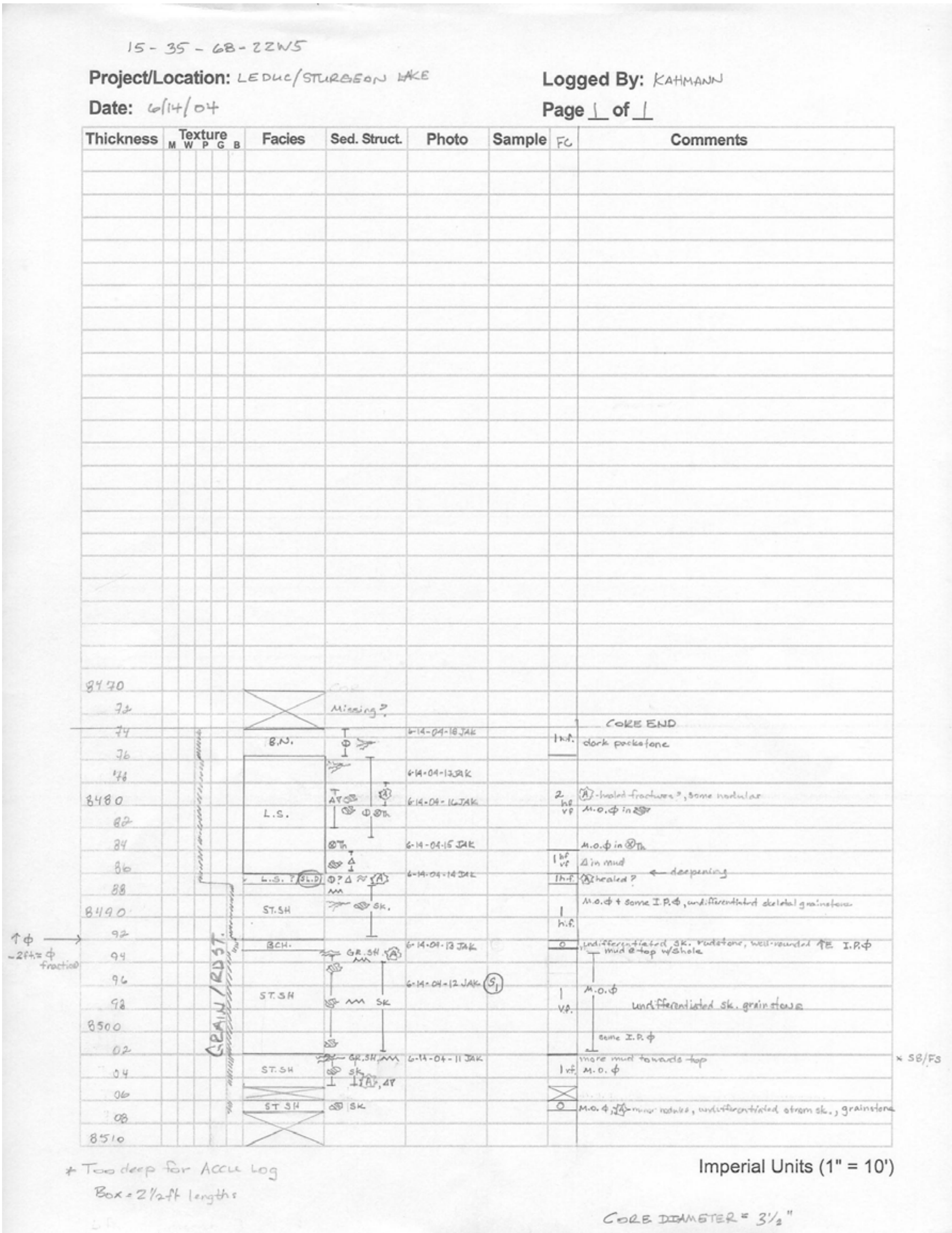
Date: 6/15/04 **Page** 1 **of** 1



Imperial Units (1" = 10')

CORE DIAMETER= 4.25"

CORE DEPTH = LOG DEPTH


15-35-68-22W5
Project/Location: LEDUC/STURGEON LAKE
Logged By: KAHMANN
Date: 6/14/04
Page 1 of 1
Thickness
Texture
M W P G B
Facies
Sed. Struct.
Photo
Sample
FC
Comments
8470
72
74
76
78
8480
82
84
86
88
8490
92
94
96
98
8500
02
04
06
08
8510
Missing?
CORE END
B.N.
L.S.
L.S.?
SL.D
ST.SH
BCH.
GR.SH
SK.
GRAIN/RDST.
6-14-04-18 JAK
6-14-04-17 JAK
6-14-04-16 JAK
6-14-04-15 JAK
6-14-04-14 JAK
6-14-04-13 JAK
6-14-04-12 JAK
6-14-04-11 JAK
S1
dark packstone
-healed fractures?, some nodular
M.O.ϕ in
Δ in mud
healed?
← deepening
M.O.ϕ + some I.P.ϕ, undifferentiated skeletal grainstone
undifferentiated SK. rudstone, well-rounded I.P.ϕ
mud @ top w/shale
undifferentiated sk. grainstone
some I.P.ϕ
more mud towards top
× SB/FS
M.O.ϕ, -minor nodules, undifferentiated strom sk., grainstone
↑ϕ
~2ft = ϕ fraction
* Too deep for Accu Log
Box = 2½ ft lengths
Imperial Units (1" = 10')
CORE DIAMETER = 3½"

APPENDIX B

Thin-Section Descriptions

STURGEON LAKE SOUTH cont.

Well ID/ Sample#	Facies	Pore Type	Pore fill?	Fractures	Stylolites	Clay	Limestone Matrix	Calcite spar	bladed/equant
7-33-68-22w5/7	St Shoal	frac, intc, diss/moldic	y	y	n	y	n	y	equant/isopacous
7-33-68-22w5/6	Exposure	intc	n	n	n	rare	n	y	blocky
2-14-69-21w5/2	St Shoal	GF, BP& IP	y	y	y	n	y	y	blocky
6-26-68-22W5/3	BN	moldic, frac & IP	y	y	n	n	y	y	blocky
6-26-68-22w5/1	BN	moldic, frac & IP	y	rare	y	n	y/partial	y	blocky
7-33-68-22w5/5	Exposure/SB	fracture induced	partial	rare	n	rare	y	y	blocky
7-33-68-22w5/1	ALR	BP, IP	y	n	n	n	y	y	blocky
9-33-68-22w5/1	Middle Slope	intc, very little	n	n	n	n	n	n	n/a
14-14-68-22w5/3	Margin/Slope debris	frac, intc	n	filled	n	n	n	n	n/a
9-2-69-22w5/2	St Shoal/BCH/SB	intc, frac	n	y	n	y	n	y	blocky
9-2-69-22w5/9	Margin	intc,	partial	n	n	n	n	n	n/a
1-2-69-22w5/1	TF	intc	n	y	n	n	n	n	n/a
9-2-69-22w5/6	St Shoal	intc	y	n	n	n	n	y	blocky
3-4-69-22w5/3	Lower/mid slope	moldic rare	partial	n	n	n	n	n	n/a
1-4-69-22w5/1	Middle Slope/Marg	intc-rare	partial	n	n	n	n	n	n/a
14-14-68-22w5/1	Sl Sand	intc	n	n	n	n	n	n	n/a
9-35-68-22w5/1	BCH	BP, frac?	partial	y	n	y	y	y	blocky
7-35-68-22w5/1	ALO/BCH	IP, BP	n	n	n	n	y	y	blocky
13-35-68-22w5/1	BCH	intc	y-w/pyrite	n	n	n	n	y-rare	blocky
1-2-69-22w5/2	BCH/ St Shoal	intc-large	n	filled	n	n	n	n/a	n/a
3-4-69-22w5/1	Lower Slope	intc-tight	y	n	n	n	n	y-rare	blocky
7-4-69-22w5/2	Lower Slope	BP, IP	y	y	n	n	y	y	blocky
7-19-69-22w5/2	Sl Sand	intc	n	y	n	n	n	n	n/a
7-14-69-22w5/1	Sl Sand	intc- rare, frac	n	n	y	n	n	y-rare	blocky
10-11-69-22w5/1	Margin	intc, frac, moldic	y	y	y-micro	n	n	n	n/a

ABBREVIATIONS

Pore type
frac = fracture
intc = intercrystalline
GF = growth framework
BP = interparticle
IP = intraparticle

Facies
BN = burrowed nodular
Sl Sand = slope sand
St Shoal = stromatoporoid shoal
BCH = tidal flat
ALO = *Amphipora* lagoon
TF = tidal flat

y = yes
n = no
SB = sequence boundary

CALAIS AND NORTH STURGEON

Well ID/ Sample#	Anhydrite	Pyrite	Dolomite y/n	Saddle	undulose	zoned	planar/non	-s/-e	# of phases	photos**
7-20-70-24w5/5	?	n	y	n	n	n	planar	s	1-do, 2-calc	9a, 10b
7-20-70-24w5/4	n	y	y	n	n	n	planar	s	1-do, 1-calc	
7-20-70-24w5/2	n	n	y	n	n	n	planar	s	1-do	9f
7-20-70-24w5/1	n	y	y	n	y	n	planar	s	1-do, 1-calc	11d
13-31-70-24w5/1	n	n	y- poly	y	y	n	planar	s	1-do	
13-31-70-24w5/2	y	n	y	rare	y	n	planar/non	s	1-do, an	
13-31-70-24w5/3	n	n	y	y	y	n	planar	s	1-do	
13-31-70-24w5/4	n	?	y	n	y	n	planar/non	s	1-do	9b
13-31-70-24w5/5	y	n	y	rare	y	n	planar	s	1-do, an	
13-31-70-24w5/6	n	n	y- poly	n	y	n	planar	s	1-do	10e
13-31-70-24w5/10	n	n	y	n	y	n	planar	s	1-do	
13-31-70-24w5/11	y	n	y-poly	y	y	n	planar	s	an, 1-do	
13-31-70-24w5/14	n	n	y	rare	y	n	planar	s	1-do	
15-13-68-23w5/1	n	n	y	n	y	n	non		1-do	
15-13-68-23w5/2	y	n	y	n	y	n	non		1-do, an, calc	
15-13-68-23w5/5	n	n	y	y	y	n	planar/non	s	1-do, calc?	
15-13-68-23w5/7	y	n	n						an, calc	

ABBREVIATIONS

y = yes	s = planar-s*
n = no	e = planar-e
do = dolomite	poly = polymodal
calc = calcite	non = non planar
pyr = pyrite	
an = anhydrite	

*nomenclature after Sibley and Gregg (1987)
** figure numbers for thin-section photomicrographs in document

CALAIS AND NORTH STURGEON cont.

Well ID/ Sample#	Facies	Pore Type	Pore fill?	Fractures	Stylolites	Clay	Limestone Matrix	Calcite spar	bladed/equant
7-20-70-24w5/5	BN	frac, shelter, IP, BP	y	y	n	y	y	y	blocky
7-20-70-24w5/4	BN	shelter, BP, IP	y	y	n	n	y	y	blocky
7-20-70-24w5/2	open marine	BP, IP	y	y	n	n	y	rare	
7-20-70-24w5/1	open marine	IP	y	n	y	n	n	y	blocky
13-31-70-24w5/1	TF	moldic, frac, intc	y	y	n	n	n	n	
13-31-70-24w5/2	ALO	moldic, intc	y	n	n	n	n	n	
13-31-70-24w5/3	BCH	intc	partial	n	n	n	n	n	
13-31-70-24w5/4	Margin	frace, moldic	partial	y	n	?-rare	n	n	
13-31-70-24w5/5	ALO	moldic, intc, frac	partial	y	n	y	n		
13-31-70-24w5/6	ALO	mold, intc, frac	partial	y	n	n	n	n	
13-31-70-24w5/10	Sl Debris	intc	partial	n	n	n	n	n	
13-31-70-24w5/11	Middle Slope	intc	y		n	n	n	n	
13-31-70-24w5/14	Middle Slope	intc, moldic	y	n	n	n	n	n	
15-13-68-23w5/1	Sl Debris	IP and BP-good	n	n	n	n	y	n	
15-13-68-23w5/2	Sl Debris	IP	rare	rare	n	n	y	y-rare	blocky
15-13-68-23w5/5	Sl Sand	BP, IP	y	n	n	n	y	?	equant
15-13-68-23w5/7	Sl Debris	BP, intc	y	y-filled	n	n	y	y	blocky

ABBREVIATIONS

Pore type
frac = fracture
intc = intercrystalline
GF = growth framework
BP = interparticle
IP = intraparticle

Facies
BN = burrowed nodular
Sl Sand = slope sand
St Shoal = stromatoporoid shoal
BCH = tidal flat
ALO = *Amphipora* lagoon
TF = tidal flat

y = yes
n = no
SB = sequence boundary

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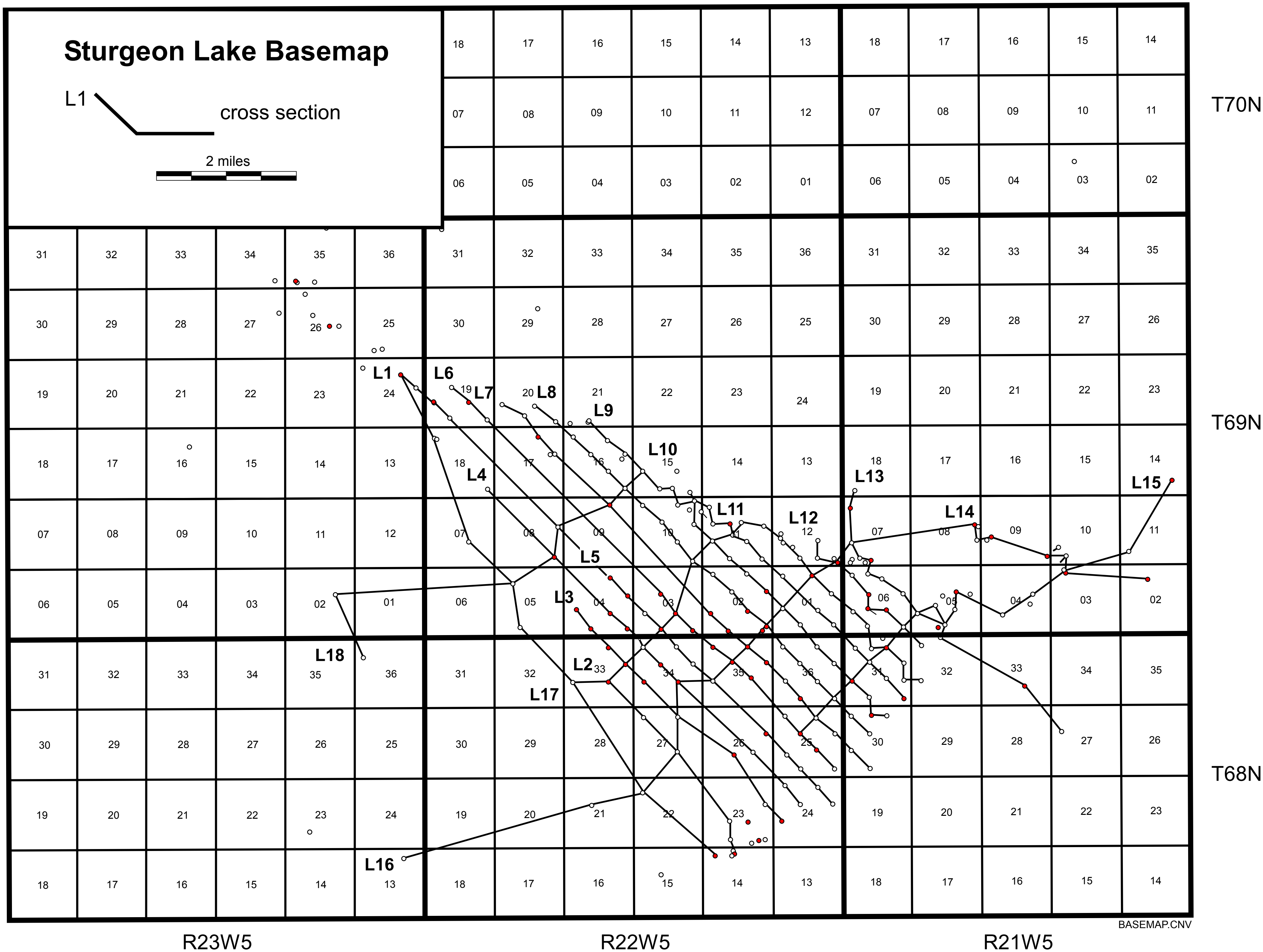
Sturgeon Lake Basemap
L1
cross section
2 miles
L1
L2
L3
L4
L5
L6
L7
L8
L9
L10
L11
L12
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L14
L15
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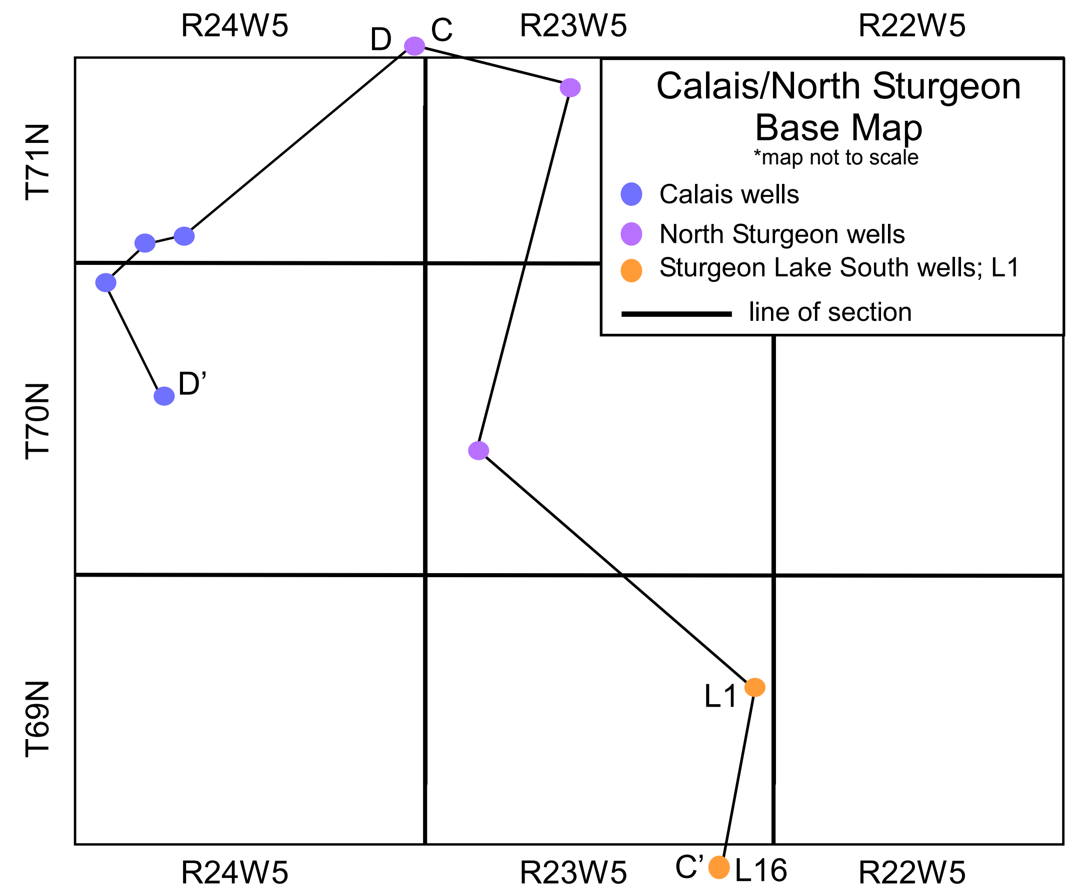
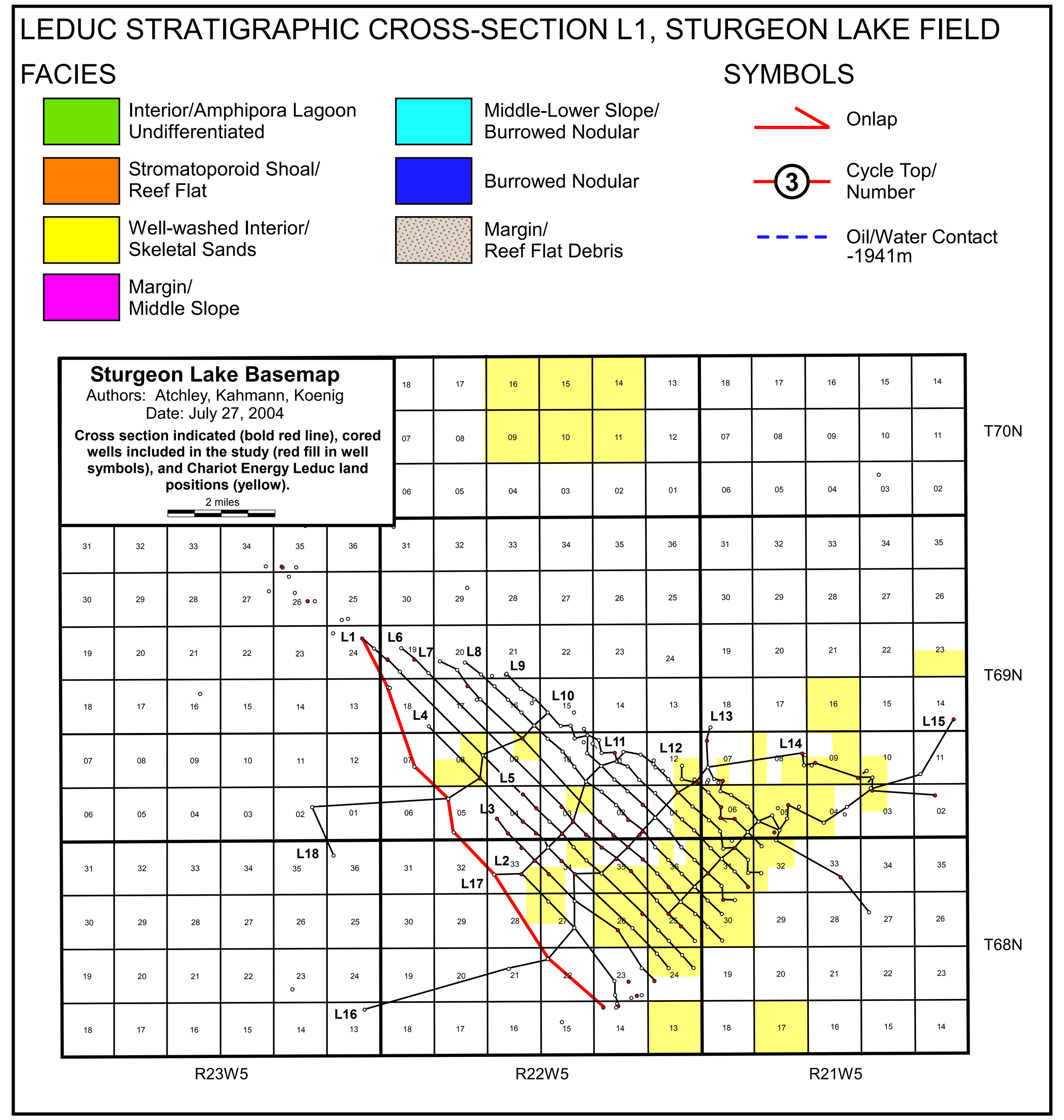
L17
L18
T70N
T69N
T68N
R23W5
R22W5
R21W5
BASEMAP.CNV


R24W5
D
C
R23W5
R22W5
Calais/North Sturgeon
Base Map
*map not to scale
Calais wells
North Sturgeon wells
Sturgeon Lake South wells; L1
line of section
T71N
T71N
T70N
T70N
T69N
T69N
D'
L1
C'
L16
R24W5
R23W5
R22W5

STURGEON LAKE LEDUC CROSS SECTION L15

STURGEON LAKE LEDUC CROSS SECTION L1

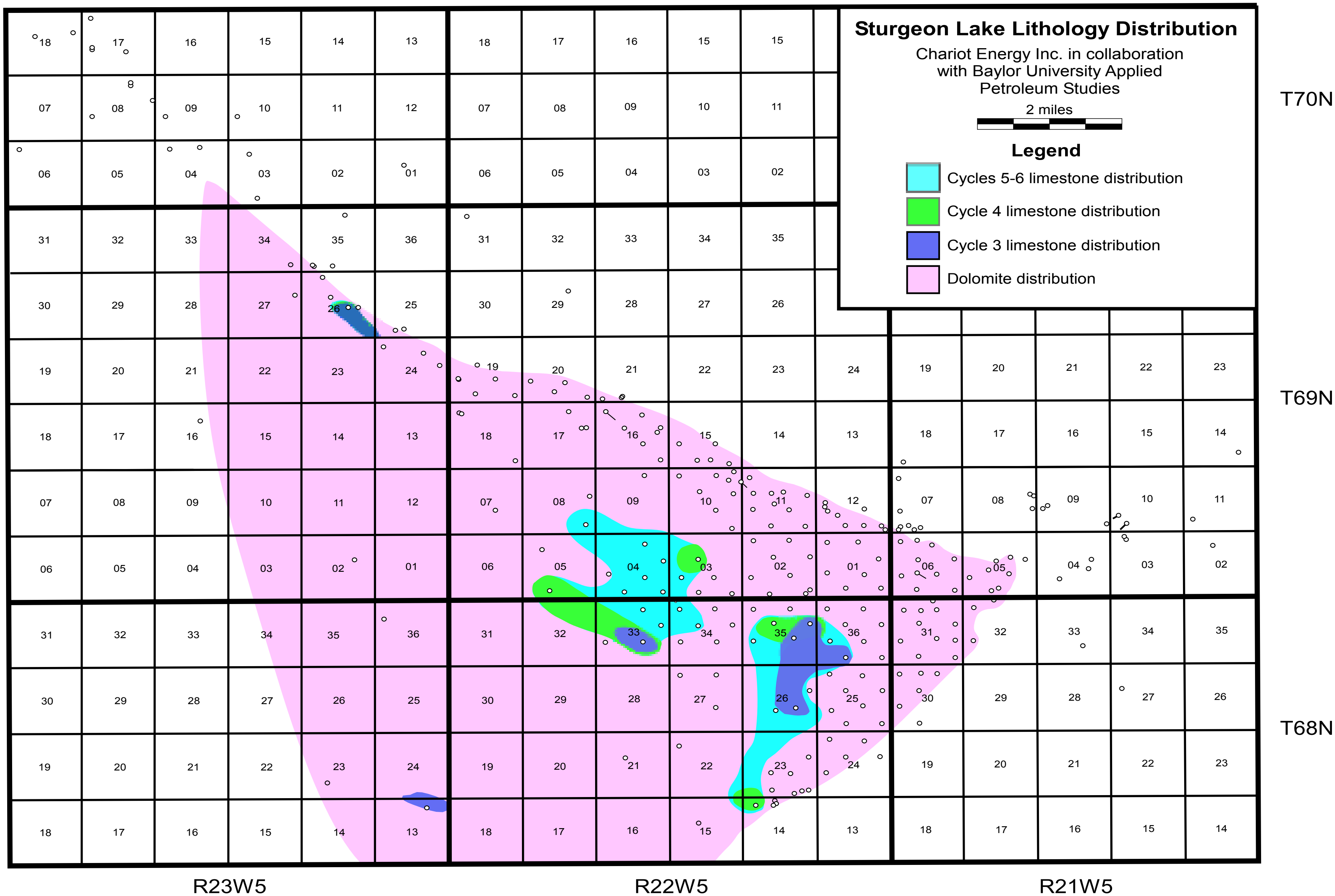


North Sturgeon Cross Section C-C'
SYMBOLS
Leduc onlap
Cycle Top/ Number
Other onlap
Vertical Scale = 25m
FACIES
interior
margin
slope
burrowed nodular
off-platform facies
undifferentiated facies
Calais/North Sturgeon Base Map
*map not to scale
Calais wells
North Sturgeon wells
SLS wells
line of section
R24W5
R23W5
R22W5
T71N
T70N
T69N
D
C
D'
L1
C'
L16
00/09-01-072-24W5/0
KB: 783.5m
TD: 2735.0m
Tie Regional A-A'
00/07-21-071-23W5/0
KB: 745.4m
TD: 2701.0m
00/09-18-070-23W5/0
KB: 705.0m
TD: 2656.0m
Tie L1 (SLS)
00/15-24-069-23W5/0
KB: 745.4m
TD: 2682.0m
Tie L16 (SLS)
00/15-13-068-23W5/0
KB: 721.5m
TD: 2740.0m
Winterburn
Nisku
Ireton

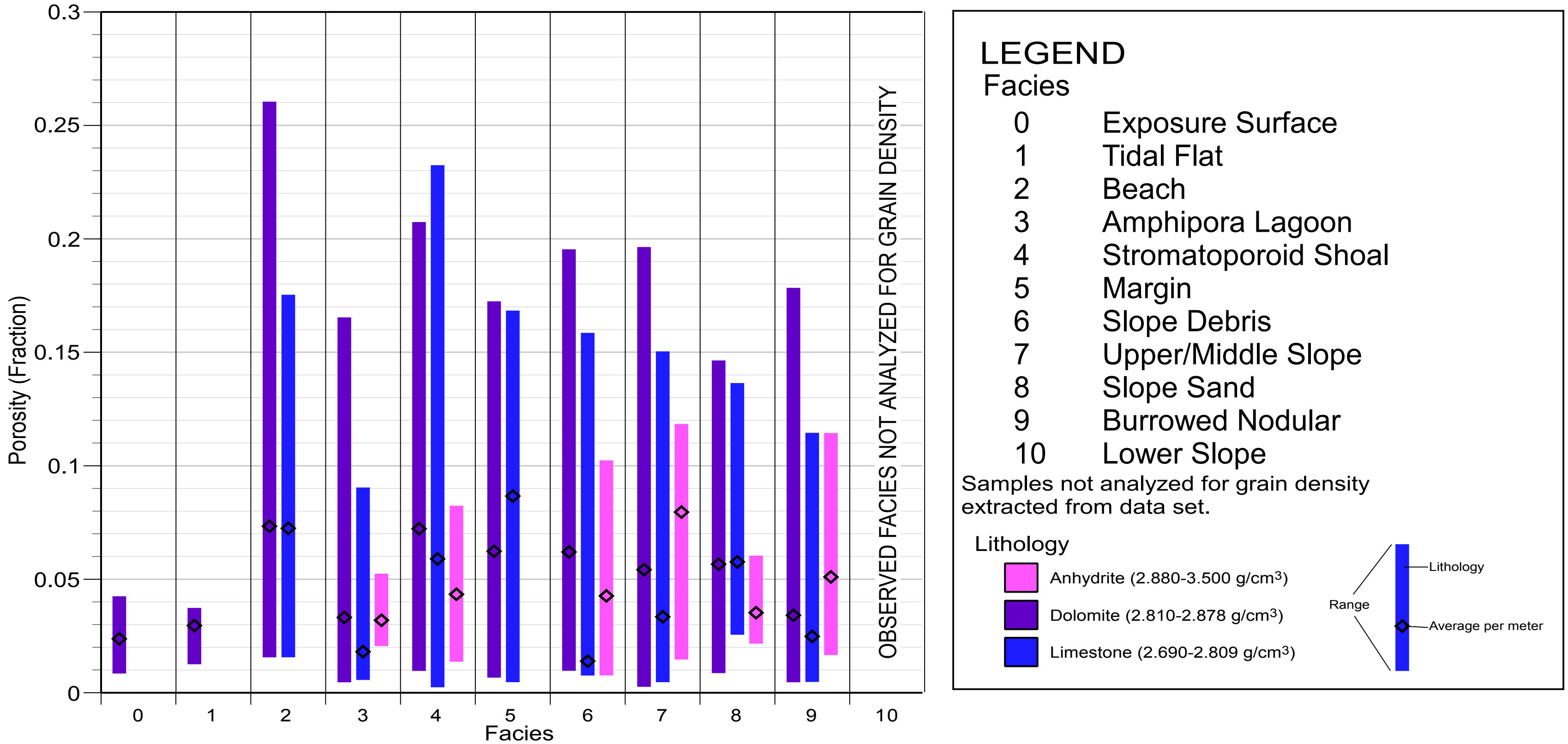
Calais Cross Section D-D'
SYMBOLS
FACIES
Leduc/Beaverhill Lake onlap
SLS Cycle Top/ Number
Other onlap
Vertical Scale = 25m
interior
margin
slope
burrowed nodular
off-platform facies
undifferentiated facies
Calais/North Sturgeon Base Map
Calais wells
North Sturgeon wells
SLS wells
line of section
R24W5
R23W5
R22W5
T71N
T70N
T69N
North
South
Tie NC 1
00/09-01-072-24W5/0
KB: 783.5m
TD: 2735.0m
00/09-05-071-24W5/0
KB: 697.8m
TD: 3130.0m
Tie Regional A-A'
00/05-05-071-24W5/0
KB: 702.5m
TD: 3126.0m
Tie Regional A-A'
00/13-31-070-24W5/0
KB: 697.4m
TD: 2891.2m
00/07-20-070-24W5/0
KB: 723.9m
TD: 2906.3m
Winterburn
Nisku?
Ireton
Ireton

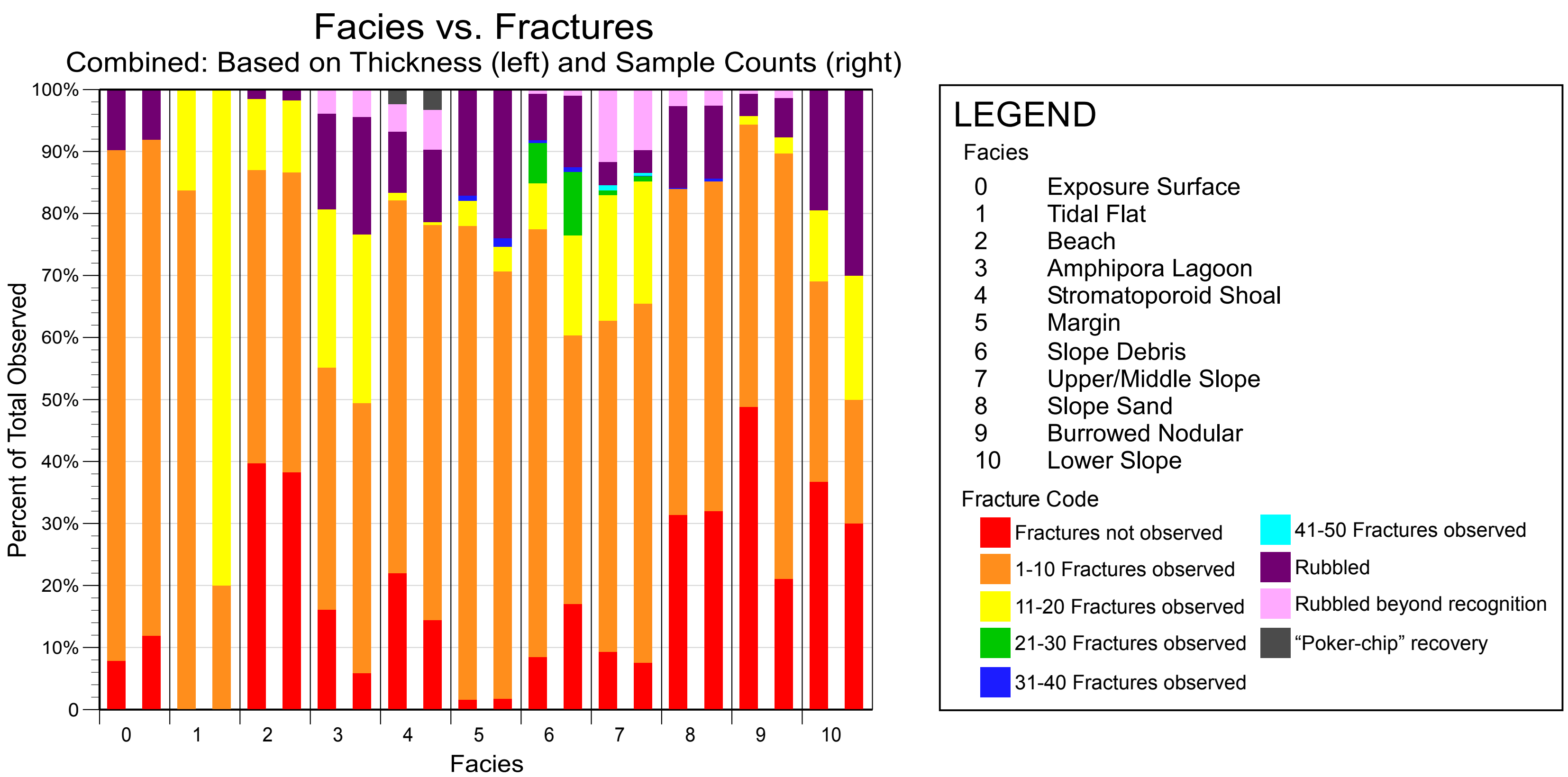
Eaglesham
North Sturgeon
Calais
Calais
Sturgeon Lake South
Windfall
Goldenspike
Redwater
(Potma et al, 2001)
Winterburn
Nisku
Ireton
Regional Cross Section NW - SE
A-A'
SYMBOLS
Leduc Reef /Cooking Lake onlap
SLS Sequences
Basinal and other carbonate onlap
Vertical Scale = 25m
FACIES
interior
slope
margin
burrowed nodular
undifferentiated facies
off platform/basinal facies
Regional Cross Section Basemap
regional wells
carbonate buildups
Regional Cross Section
PRA Cross Section
*map not to scale
Peace River Arch (PRA)
Deep Basin
Windfall/ Kabob
Rimbey-Meadowbrook Trend
Edmonton
Calgary

Peace River Arch Cross-Section B-B'
SYMBOLS
Leduc Reef /Cooking Lake onlap
3
SLS Sequences
Basinal and other carbonate onlap
Vertical Scale = 25m
FACIES
interior
slope
margin
burrowed nodular
undifferentiated facies
off platform/basinal facies
Regional Cross Section Basemap
regional wells
carbonate buildups
Regional Cross Section
PRA Cross Section
*map not to scale
R5W6
R20
R10
R25
T80
T70
T60
T50
R25W4
B
B'
A
A'
Peace River Arch (PRA)
Eaglesham
North Sturgeon
Calais
Sturgeon Lake South (SLS)
Deep Basin
Windfall/ Kabob
Goldenspike
Redwater
Rimbey-Meadowbrook Trend
N
Winds
Edmonton
Calgary
00/07-15-077-25W5/0
KB: 566.0m
TD: 2669.8m
Wabamun
Winterburn ?
Nisku?
Peace River Arch

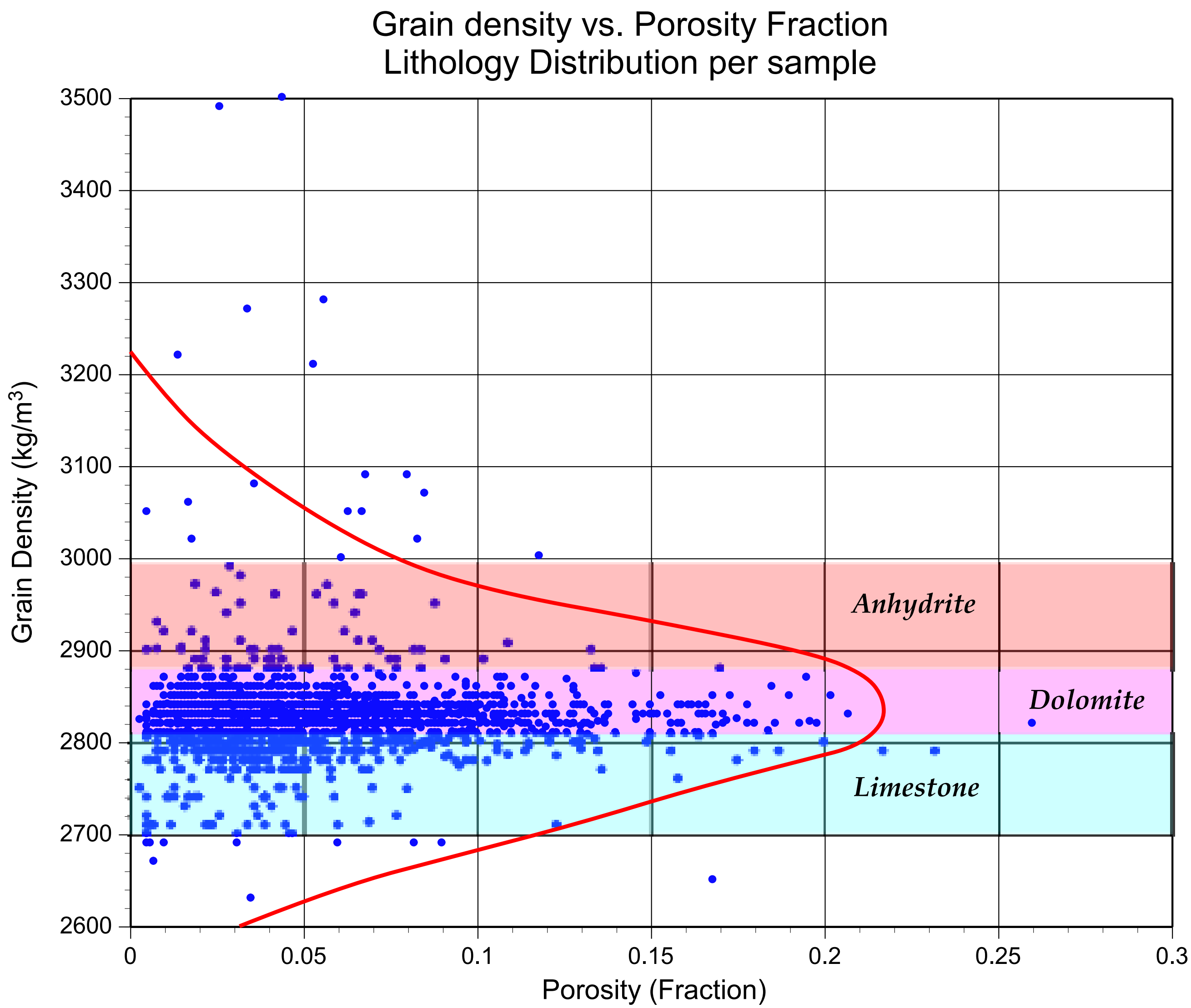

Sturgeon Lake Lithology Distribution
Chariot Energy Inc. in collaboration with Baylor University Applied Petroleum Studies
2 miles
Legend
Cycles 5-6 limestone distribution
Cycle 4 limestone distribution
Cycle 3 limestone distribution
Dolomite distribution
T70N
T69N
T68N
R23W5
R22W5
R21W5

Facies/Lithology vs. Porosity

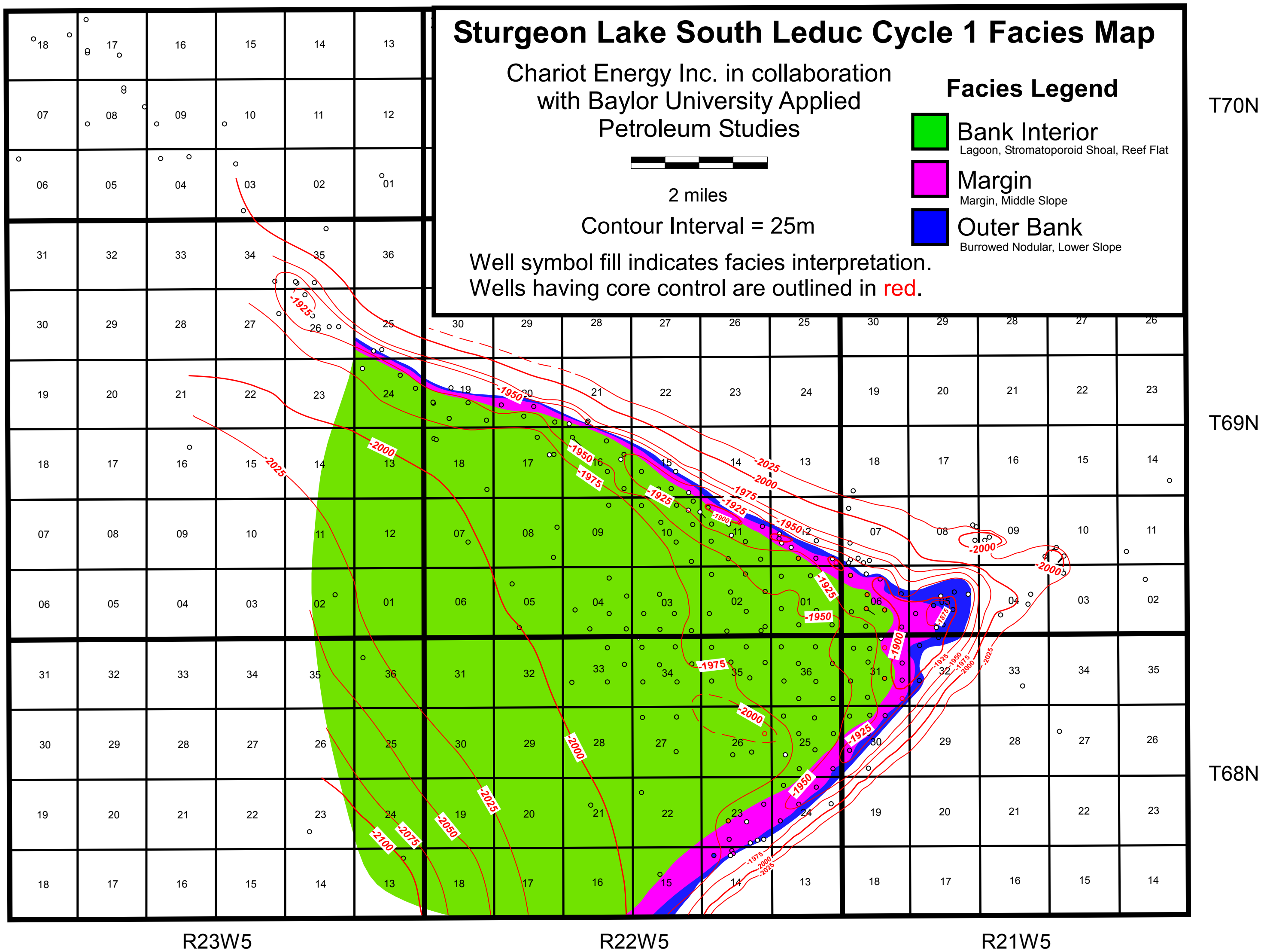




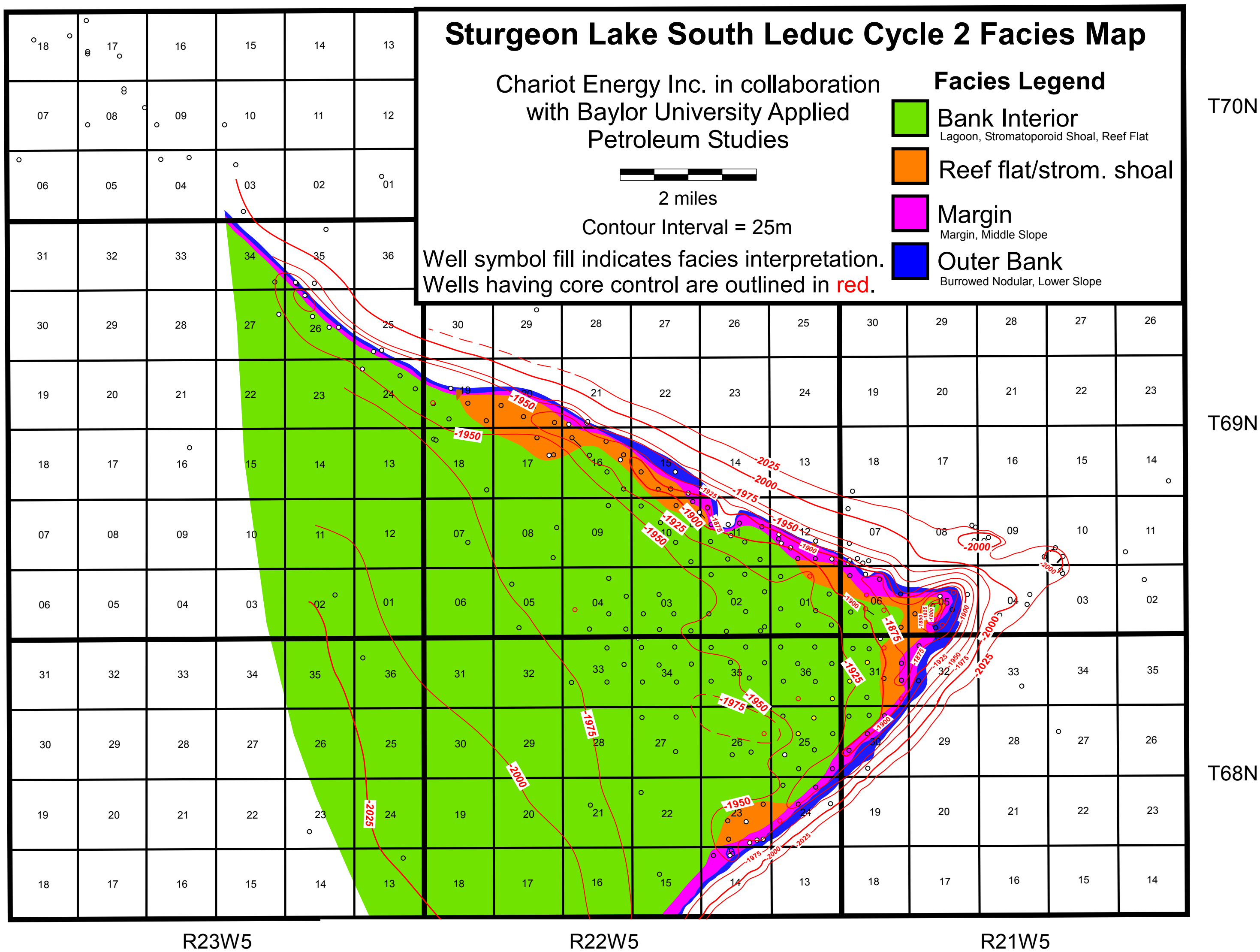
Facies vs. Fractures
Combined: Based on Thickness (left) and Sample Counts (right)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0
Percent of Total Observed
0
1
2
3
4
5
6
7
8
9
10
Facies
LEGEND
Facies
0 Exposure Surface
1 Tidal Flat
2 Beach
3 Amphipora Lagoon
4 Stromatoporoid Shoal
5 Margin
6 Slope Debris
7 Upper/Middle Slope
8 Slope Sand
9 Burrowed Nodular
10 Lower Slope
Fracture Code
Fractures not observed
1-10 Fractures observed
11-20 Fractures observed
21-30 Fractures observed
31-40 Fractures observed
41-50 Fractures observed
Rubbled
Rubbled beyond recognition
“Poker-chip” recovery



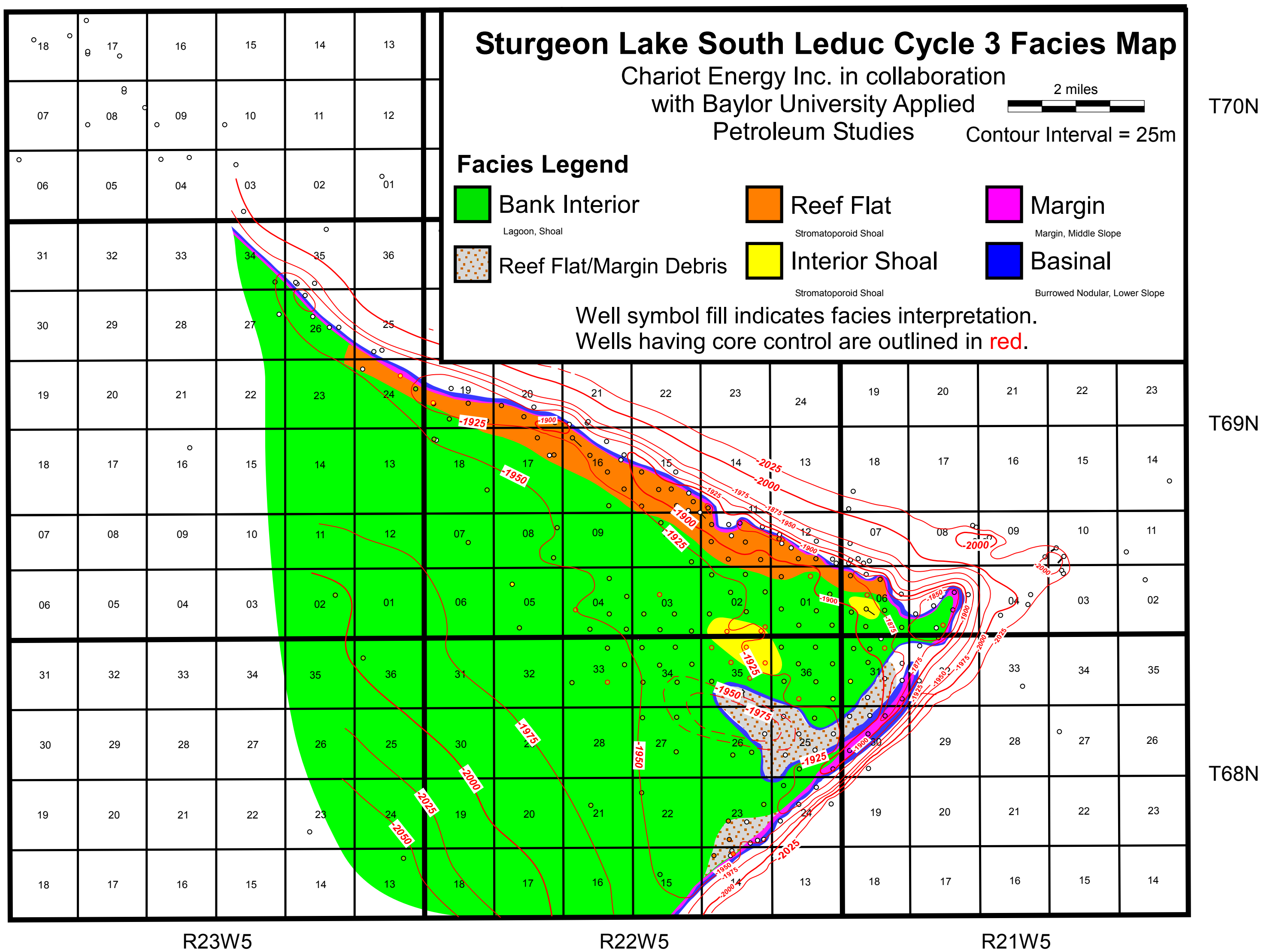
Grain density vs. Porosity Fraction
Lithology Distribution per sample
Grain Density (kg/m3)
3500
3400
3300
3200
3100
3000
2900
2800
2700
2600
Anhydrite
Dolomite
Limestone
0
0.05
0.1
0.15
0.2
0.25
0.3
Porosity (Fraction)



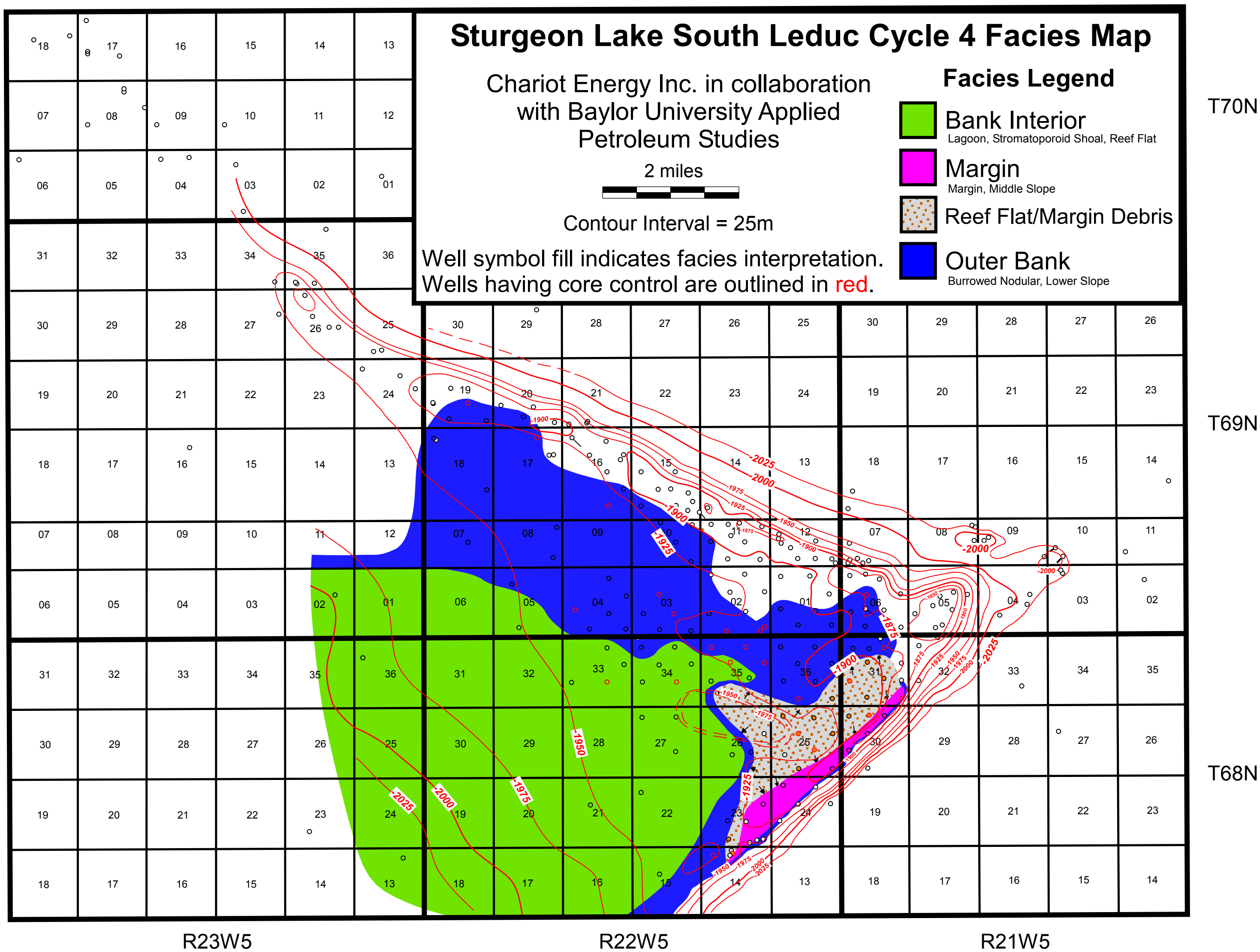
Sturgeon Lake South Leduc Cycle 1 Facies Map
Chariot Energy Inc. in collaboration with Baylor University Applied Petroleum Studies
2 miles
Contour Interval = 25m
Well symbol fill indicates facies interpretation.
Wells having core control are outlined in red.
Facies Legend
Bank Interior
Lagoon, Stromatoporoid Shoal, Reef Flat
Margin
Margin, Middle Slope
Outer Bank
Burrowed Nodular, Lower Slope
T70N
T69N
T68N
R23W5
R22W5
R21W5

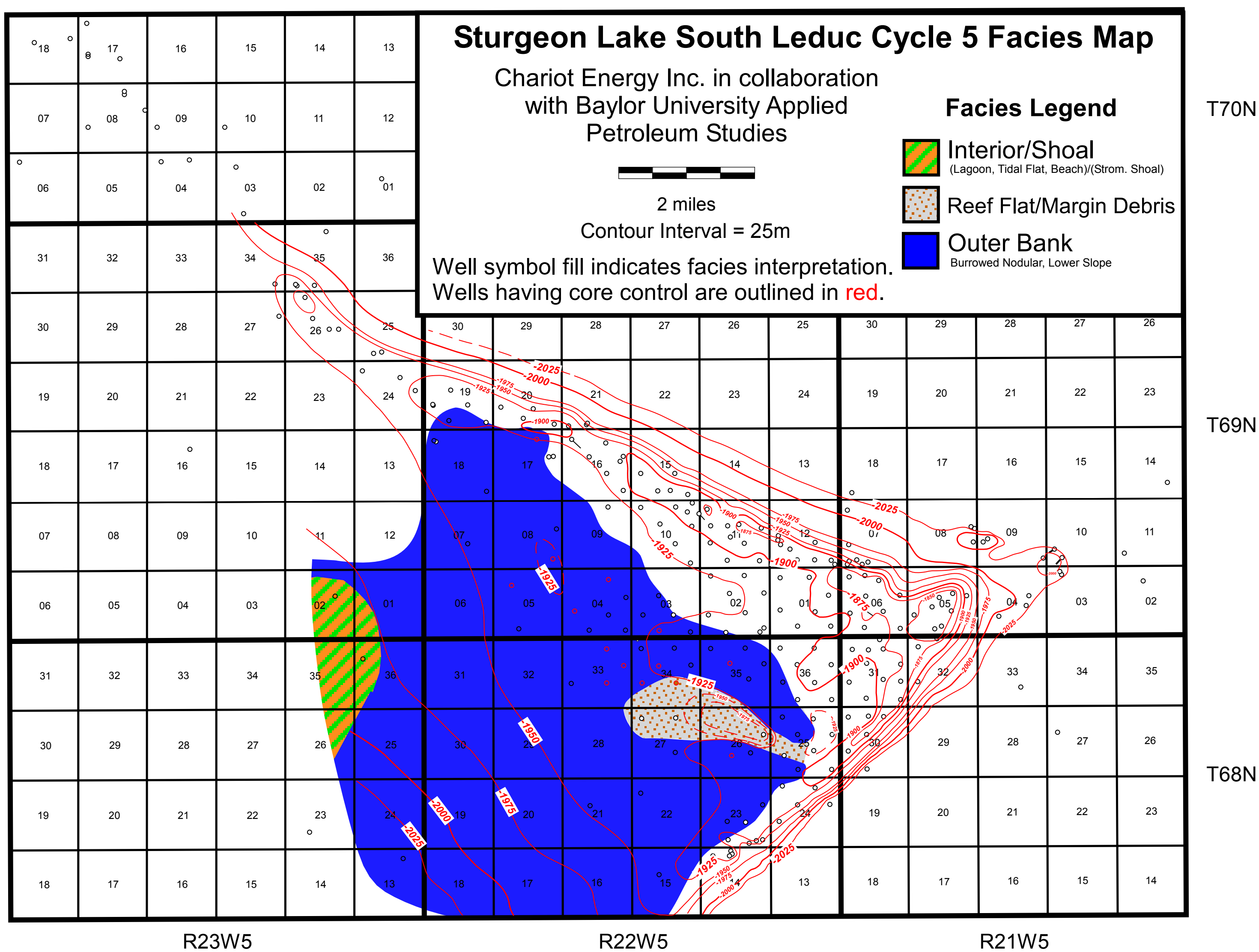


Sturgeon Lake South Leduc Cycle 2 Facies Map
Chariot Energy Inc. in collaboration with Baylor University Applied Petroleum Studies
2 miles
Contour Interval = 25m
Well symbol fill indicates facies interpretation.
Wells having core control are outlined in red.
Facies Legend
Bank Interior
Lagoon, Stromatoporoid Shoal, Reef Flat
Reef flat/strom. shoal
Margin
Margin, Middle Slope
Outer Bank
Burrowed Nodular, Lower Slope
T70N
T69N
T68N
R23W5
R22W5
R21W5

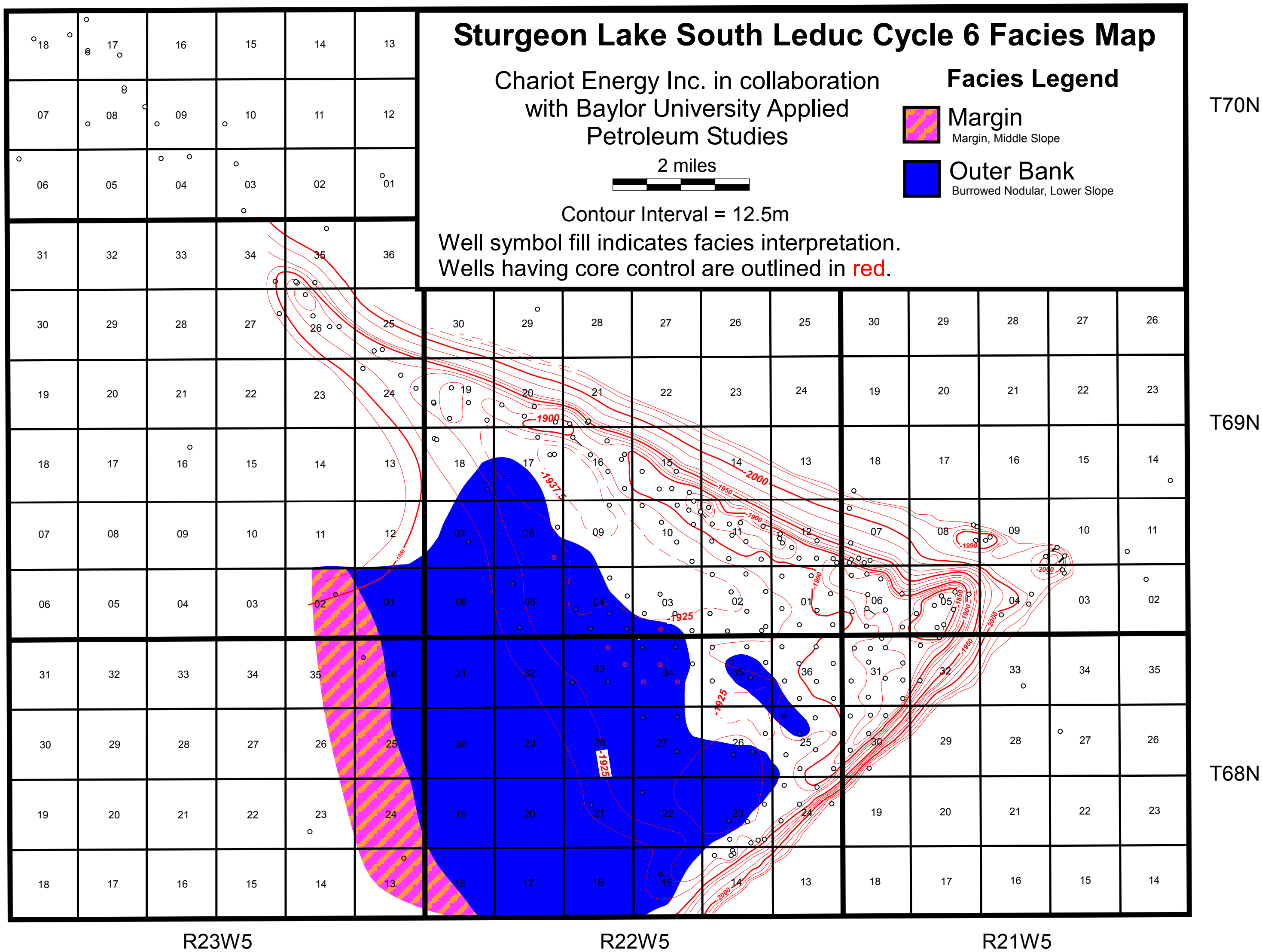


Sturgeon Lake South Leduc Cycle 3 Facies Map
Chariot Energy Inc. in collaboration with Baylor University Applied Petroleum Studies
2 miles
Contour Interval = 25m
Facies Legend
Bank Interior
Lagoon, Shoal
Reef Flat
Stromatoporoid Shoal
Margin
Margin, Middle Slope
Reef Flat/Margin Debris
Interior Shoal
Stromatoporoid Shoal
Basinal
Burrowed Nodular, Lower Slope
Well symbol fill indicates facies interpretation.
Wells having core control are outlined in red.
T70N
T69N
T68N
R23W5
R22W5
R21W5


Sturgeon Lake South Leduc Cycle 4 Facies Map
Chariot Energy Inc. in collaboration with Baylor University Applied Petroleum Studies
2 miles
Contour Interval = 25m
Well symbol fill indicates facies interpretation.
Wells having core control are outlined in red.
Facies Legend
Bank Interior
Lagoon, Stromatoporoid Shoal, Reef Flat
Margin
Margin, Middle Slope
Reef Flat/Margin Debris
Outer Bank
Burrowed Nodular, Lower Slope
T70N
T69N
T68N
R23W5
R22W5
R21W5



Sturgeon Lake South Leduc Cycle 5 Facies Map
Chariot Energy Inc. in collaboration with Baylor University Applied Petroleum Studies
2 miles
Contour Interval = 25m
Well symbol fill indicates facies interpretation.
Wells having core control are outlined in red.
Facies Legend
Interior/Shoal
(Lagoon, Tidal Flat, Beach)/(Strom. Shoal)
Reef Flat/Margin Debris
Outer Bank
Burrowed Nodular, Lower Slope
T70N
T69N
T68N
R23W5
R22W5
R21W5



Sturgeon Lake South Leduc Cycle 6 Facies Map
Chariot Energy Inc. in collaboration with Baylor University Applied Petroleum Studies
2 miles
Contour Interval = 12.5m
Well symbol fill indicates facies interpretation.
Wells having core control are outlined in red.
Facies Legend
Margin
Margin, Middle Slope
Outer Bank
Burrowed Nodular, Lower Slope
T70N
T69N
T68N
R23W5
R22W5
R21W5
-1900
-1937.5
2000
-1925