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MEASURED SECTIONS AND ENVIRONMENTAL INTERPRETATIONS OF THE ENDICOTT GROUP (MISSISSIPPIAN), NORTHEASTERN ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA

by

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INTRODUCTION

The Upper Devonian to Upper Mississippian Endicott Group crops out extensively in the Brooks Range from the Canadian border westward to the Lisburne Peninsula (Gryc et al., 1967; and Tailleur et al., 1967). The Endicott Group is organized into two distinct successions: an allochthonous succession crops out in the eastern, central , and western Brooks Range, and an autochthonous or parautochthonous succession cropping out in the northeastern Brooks Range and continues in to the subsurface of the North Slope (Nilsen, 1981; Moore and Nilsen, 1984; and Moore and Mull, 1989). The Endicott Group was named by Tailleur et al. (1967, p. 1354) for an allochthonous succession of Upper Devonian to Lower Mississippian clastic rocks situated unconformably above carbonates of the Baird Group and a locally occurring unnamed succession of carbonate and clastic rocks, and gradationally below carbonate rocks of the Lisburne Group in the Endicott Mountains. The Endicott Group of Tailleur et al. (1967) also included a stratigraphically equivalent but younger (Lower to Upper Mississippian) succession of autochthonous or parautochthonous clastic rocks in the northeastern Brooks Range. Nilsen (1981, p. 194) summarizes the differences between the two Endicott sequences.

The allochthonous Endicott Group consists, in ascending order, of the Hunt Fork Shale, Noatak Sandstone, Kanayut Conglomerate, and the Kayak Shale (Tailleur et al., 1967 and Moore and Nilsen, 1984) and defines a major regressive-transgressive sedimentary wedge (Tailleur et al., 1967). The autochthonous or parautochthonous Endicott Group is a transgressive succession consisting of the Kekiktuk Conglomerate and Kayak Shale and rests discordantly above sub-Mississippian rocks. Mull and Mangus (1972) named a discontinuous calcareous conglomerate, breccia, sandstone, and limestone unit below the Lisburne Group in the northeastern Brooks Range and the North Slope subsurface the Itkilyariak Formation and included it at the top of the autochthonous or parautochthonous Endicott succession.

The Endicott Group in the subsurface at Endicott Field differs slightly from its surface counterpart in the northeastern Brooks Range. It is relatively undeformed, entirely autochthonous, and contains thicker Kekiktuk and Itkilyariak sections (up to 323m and 209m respectively; Woidneck et al., 1987). In addition, the Kekiktuk is much finer-grained (referred to as the Kekiktuk Formation). Published data from Endicott Field suggest syn-sedimentary normal and/or strike-slip faulting contributed to the increased thicknesses in this region (Woidneck et al., 1987, see their Figures 11 and 12). Further west, in the National Petroleum Reserve, seismic data indicate the presence of thick Endicott successions in fault-bounded basins (Hubbard et al., 1987).

The relationship between the two Endicott successions is poorly understood due to uncertainties in the palinspastic restoration of the allochthonous Endicott Group and a lack of conclusive data on the geographic position of northern Alaska during the Late Paleozoic. The allochthonous sequence has been studied in detail in the central Brooks Range by the U.S. Geological Survey and appears to represent sedimentation contemperaneous with the Ellesmerian Orogeny (Nilsen, 1981) . This sequence provides a glimpse of the nature of the Late Devonian basin margin. The character of the autochthonous Endicott is less well-known but appears to suggest early post-orogenic sedimentation on a newly evolving, south-facing passive(?) continental margin that persisted from Mississippian through Late Triassic time.

This report presents preliminary results from the 1990 field season on the autochthonous or parautochthonous Endicott Group exposed in the northeastern Brooks Range. It is part of a doctoral dissertation by LePain on the sedimentology of the Endicott Group in the northern Arctic National Wildlife Refuge. Fifteen lithostratigraphic sections were measured at six camps located along two east-west trending outcrop belts of the Endicott Group east of the Okpilak Batholith (Figure 1). The detailed lithostratigraphic sections are presented in the appendix. Preliminary results from the 1988 and 1989 seasons are presented in LePain and Crowder (1989 and 1990). After a brief discussion of the regional geologic setting, the vertical and lateral relationships and environmental interpretations for the Endicott Group at each locality is summarized.

REGIONAL GEOLOGIC SETTING

The northeastern Brooks Range and the North Slope constitute the North Slope subterrane, which is one of six subterranes comprising the Arctic Alaska terrane (Jones et al., 1987). The North Slope subterrane can be divided in to three plate sequences (Hubbard et al., 1987): (1) Lower (?) Mississippian (Visean) through Upper Triassic sedimentary rocks of the Ellesmerian plate sequence, (2) Lower Jurassic through Lower Cretaceous sedimentary rocks of the Beaufortian plate sequence, and (3) Lower Cretaceous through Holocene sedimentary rocks of the Brookian plate sequence. Sub-Mississippian rocks of the Franklinian assemblage consist of a thick and structurally complex succession of Proterozoic through Middle Devonian sedimentary, metasedimentary, and igneous extrusive and intrusive rocks. The lithologic diversity of the Franklinian assemblage and its complex structural relationships suggest that it

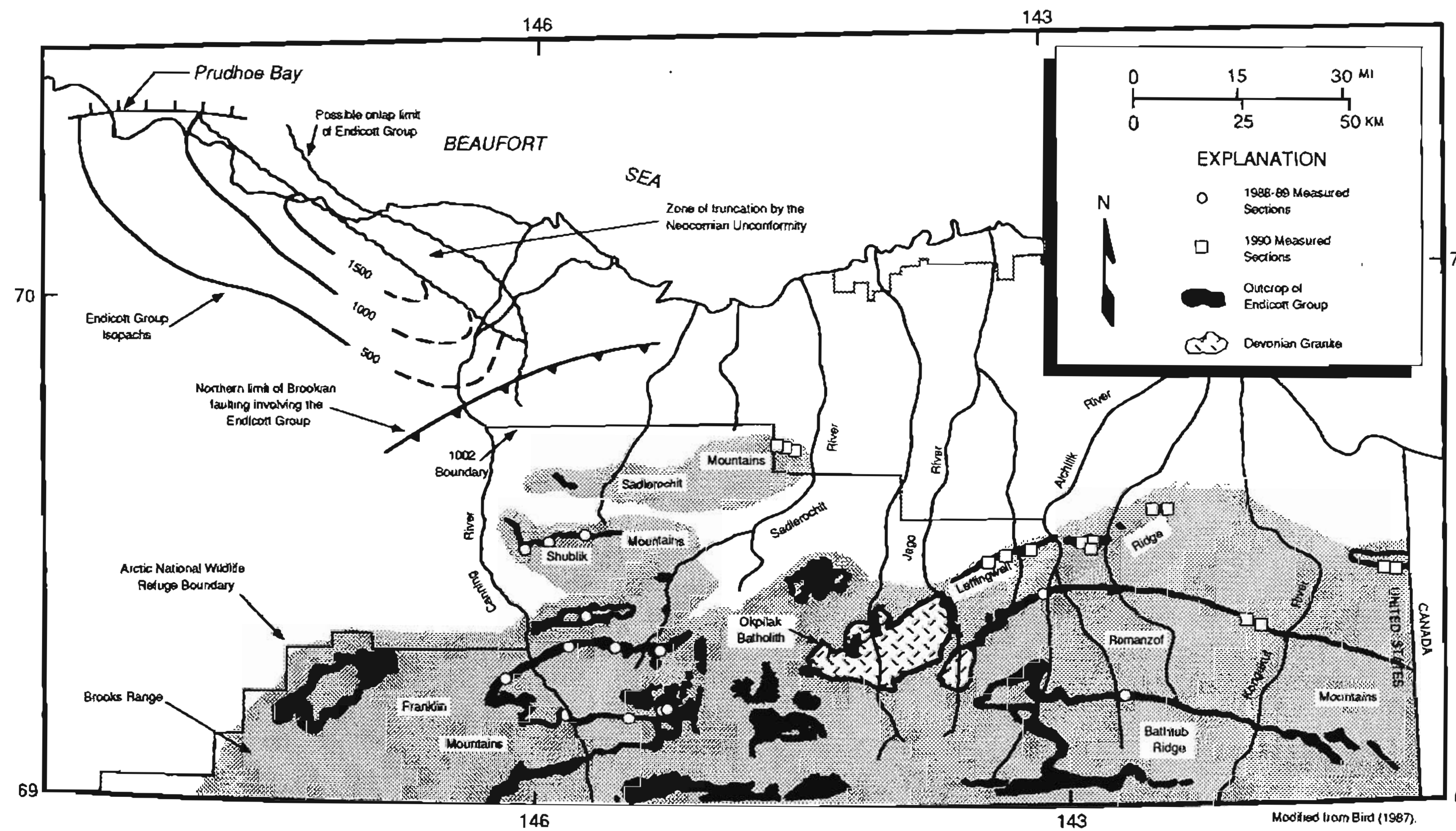

Figure 1 - Distribution of major Endicott Group outcrop belts in the northeastern Brooks Range, north of the continental divide.

consists of several different plate sequences, with each representing a different tectonic setting (Hubbard et al., 1987). All three plate sequences and elements of the Franklinian assemblage are exposed in the northeastern Brooks Range.

The plate sequences of Hubbard et al. (1987) correspond loosely with Lerand's (1973) sequences. Lerand (1973) identified three sequences in the Canadian Arctic and the north Slope of Alaska on the basis of lithostratigraphic character and sediment provenance: (1) lithologically diverse and structurally complex rocks of the sub-Mississippian Franklinian sequence derived from northern sources, (2) Mississippian through Lower Cretaceous quartzose clastic and carbonate rocks of the Ellesmerian sequence derived from northern sources, and (3)Lower Cretaceous through Holocene compositionally and texturally immature clastic rocks of the Brooklan sequence derived from south sources. Each of Lerand's sequences contain several unconformity-bounded package (sequences in the sense of Vail (1977) and Van Wagoner et al., 1988).

In the northeastern Brooks Range the Endicott Group crops out on the flanks of several regional, east-west trending anticlinoria (Reiser et al., 1980; Bader and Bird, 1986). Each anticlinorium is cored by sub-Mississippian rocks of the Franklinian assemblage with younger Paleozoic and Mesozoic rocks of the Ellesmerian, Beaufortian, and Brookian plate sequences exposed on the flanks (Bader and Bird, 1986). Each anticlinorium is a structural duplex with thrust repetition of the sub-Mississippian Franklinian sequence rocks forming south-dipping horses or fault-bounded blocks. Wallace and Hanks (1990) have subdivided the northeastern Brooks Range into three structural provinces on the basis of the number of horses in each duplex and the structural style of overlying younger cover rocks. Thrust transport and formation of regional duplexes in the northeastern Brooks Range is ascribed to Cenozoic Brookian orogenesis (Wallace and Hanks, 1990).

The Endicott and Lisburne Groups make up the oldest of three unconformity-bounded sequences (in the sense of Vail, 1977 and Van Wagoner et al., 1988) in the Ellesmerian plate sequence (upper, middle, and lower Ellesmerian plate sequence of Hubbard et al., 1987). The Endicott forms the base of this sequence and records initial transgressive sedimentation patterns following the Devonian Ellesmerian Orogeny.

PRELIMINARY RESULTS

Most of the field work for this study was carried out during the 1989 and 1990 seasons. Exposures located west of the Okpilak Batholith were investigated during the 1989 season. With the exception of work carried out in the northeastern Sadlerochit Mountains at the beginning of the season (sections 90ADL1, 90ADL2, and 90ADL3), the 1990 season concentrated on exposures east of the batholith, in the range front region and along the next outcrop belt located south of the range front (Figure 1). Measured sections from the 1990 season and location maps (Figures A-1 through A-6) are included in the appendix of this report.

Northeastern Sadlerochit Mountains

Stratigraphy

Three lithostratigraphic sections were measured east of the Itkilyariak River at the type locality for the Itkilyariak Formation (Figure 1 and A-1). The Itkilyariak Formation was named by Mull and Mangus (1972) for discontinuous exposures of a red and maroon weathering, calcareous conglomerate, breccia, sandstone, and limestone and interbedded greenish-gray shale in the northeastern Sadlerochit Mountains and the northern Romanzof Mountains (north side of West Fork of Aichilik River). As defined, it constitutes the stratigraphically highest unit in the Endicott Group. Robinson et al. (1989) map the Itkilyariak in this area as a narrow but continuous belt extending approximately three kilometers along strike. Section 90ADL3 was measured near the type section. Two additional sections, one offset to the east (90ADL1) and one to the west (90ADL2) of the type section were measured. Lateral facies relations are summarized in Figure 2.

The Itkilyariak Formation (?) in section 90ADL3 consists of light tan to orange-brown weathering sandy and silty lime mudstone or calcareous sandstone with several thin (<10cm) interbeds of pelmatozoan (?) grainstone, light gray-to-tan weathering sandy ooid (?) grainstone, and light gray weathering, siliceous lime mudstone. In this section the unit is 44-50m thick, rests discordantly on the Katakturuk Dolomite, and is in sharp contact with light gray-to tan-brown weathering siliceous lime mudstone of the Alapah Limestone. The sub-Mississippian unconformity is not exposed and individual beds can not be trace laterally due to adjacent talus cover.

Section 90ADL1, measured ~3/4km east of 90ADL3, consists of a poorly exposed succession of light gray-to-white weathering, siliceous, algal laminated (?) lime mudstone and packstone, and tabular-planar cross-bedded, light gray weathering, siliceous, ooid (?) grainstone.

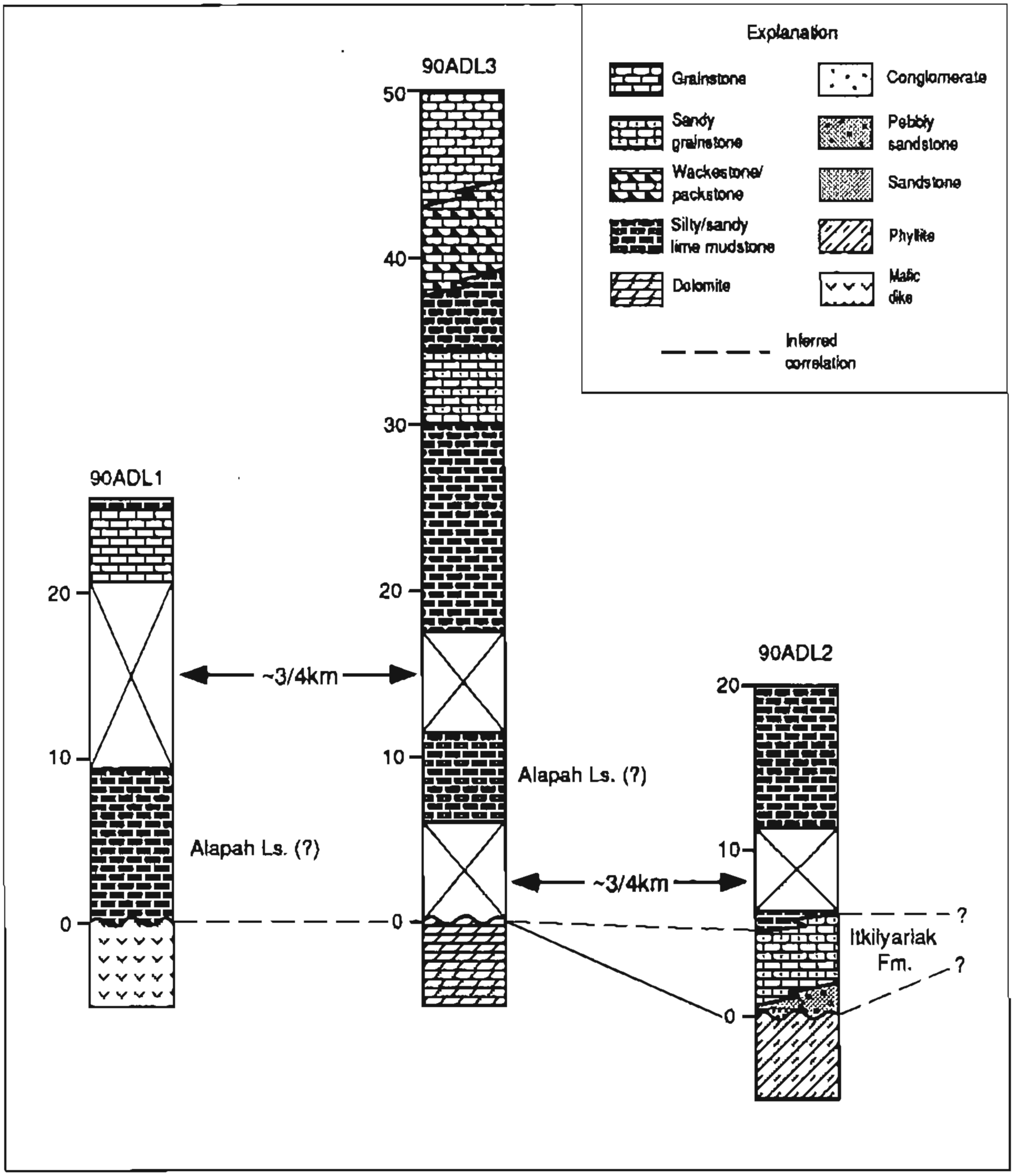

Figure 2 - Lithostratigraphic correlation diagram for the Endicott Group in the northeastern Sadlerochit Mountains.

This section is ~26m thick, rests discordantly on a dark red-to green-black weathering mafic dike and is overlain by talus composed primarily of light gray weathering lime mudstone of the Alapah Limestone. Because of the siliceous lime mudstone , packstone and possible algal laminite, this succession is more typical of the basal Alapah Limestone rather than the red-to-maroon weathering, calcareous sandstone, conglomerate, breccia, limestone and greenish-gray shale of the Mull and Mangus' (1972) Itkilyariak.

Section 90ADL2, measured ~ 3/4km west of 90ADL3, consists of interbedded dark red-to-maroon weathering, calcareous granule conglomerate and pebbly sandstone at its base. Pebbles consist of red phyllite, white vein quartz, and a dark gray-black unidentified material (fragments of mafic rock ?). Conglomerate and sandstone grade up section to silty/sandy lime mudstone with distinctive red-brown and tan-brown laminae. The basal conglomerate and pebbly sandstone contain low-relief (<3cm) scour surfaces and the arenaceous limestone contains some cross-laminated horizons. Cross-laminae are form-discordant and occur in discrete bundle-like packagessimilar to the wave ripple cross-laminae illustrated by De Raaf et al. (1977) and Reineck and Singh (1980). Silty/sandy limestone grade up section in to light gray-to tan-weathering, siliceous lime mudstone of the Alapah Limestone. This section contains a thin (<5m) succession of Itkilyariak similar to that described by Mull and Mangus (1972).

The conglomeratic and pebbly sandstone horizon at the base thins laterally over several meters distance from ~1.5mto <0.5m. If viewed from a distance, a distinctive narrow talus stream of red and maroon weathering rocks mixed in with light gray limestone can be seen to extend several tens of meters below the base of the section. This feature and the lateral thinning of the basal unit suggest that the succession encountered in section 90ADL2 is a localized deposit that pinches out within a few tens of meters east and west of the line of section. Sections 90ADL1 and 90ADL3 contain lithologies typical of the Alapah Limestone and, thus may not be Itkilyariak (Figure 2).

Environmental Interpretation

The Itkilyariak Formation records deposition in very shallow, marginal marine conditions. Broad, low-relief scours, the occurrence of conglomerate and pebbly sandstone, and arenaceous limestone with wave ripple cross-laminae suggest deposition in and adjacent to shallow tidal channels that developed on the sub-Mississippian unconformity - possibly in a localized tidal flat setting. The localized occurrence of this unit further suggests that its deposition was controlled by relief on the sub-Mississippian unconformity - tidal channels and associated deposits forming in shallow depressions on a mature (peneplaned) erosional surface. This interpretation is consistent with Mull and Mangus' (1972) interpretation of the Itkilyariak as representing deposition at the Mississippian shoreline.

Leffingwell Ridge

Stratigraphy

Okerokovik River, Western Leffingwell Ridge -

Three lithostratigraphic sections were measured along the south side of Leffingwell Ridge, near the Okerokovik River (Figures 1 and A-2). These represent the first three of ten sections measured along the Leffingwell Ridge and Clarence River outcrop belts during the 1990 season to characterize Endicott lithofacies in the range-front region. Sections 90ADL4 and 90ADL5 are thin, partial sections from the lower undivided Endicott Group west of the Okerokovik River. Section 90ADL5 is shown in Figure 3 and is not included in the appendix. Section 90ADL6 is a thick, partial section from the upper undivided Endicott east of Okerokovik River.

Section 90ADL4 consists of ~19m of black, organic-rich shale with abundant plant fragments and rests unconformably above quartzose semi-schist of the pre-Mississippian Franklinian assemblage. Shale passes upward into lenticular-laminated, dark gray sandy siltstone; siltstone is abruptly overlain by a coarse-grained, chert (?)-quartzose sandstone body (Figure 3 and section 90ADL4 in appendix). The sandstone is horizontally stratified in the lower 3.5m and contains tabular-planar cross-stratification and log impressions in the upper 2m. Tundra cover immediately above the sand body extends up the south side of Leffingwell Ridge and gradually passes into limestone talus. Black shale occurs beneath the tundra cover. No sandstone was observed in the talus above the tundra cover. Section 90ADL5 consists of black, organic-rich (abundant plant fragments) shale and siltstone and differs from 90ADL4 in that it contains two thin sand bodies and coal (Figure 3). Poorly exposed shale and silty shale and float of coralline-brachiopod-bryozoan, very coarse-grained , cherty quartzose sandstone occur between sections 90ADL4 and 90ADL5. Sandstone is a distinctive orange-brown color. Discontinuous exposures of interbedded dark gray wackestone and packstone occur up the slope from the poorly exposed shale and siltstone and appear to be part of a thick limestone interval that is present in the upper Endicott in this area (see sections 90ADL6, 90ADL7, 90ADL8, 90ADL9, and 90ADL10 in the appendix).

Section 90ADL6 was measured east of the Okerokovik River and consists of 165m of

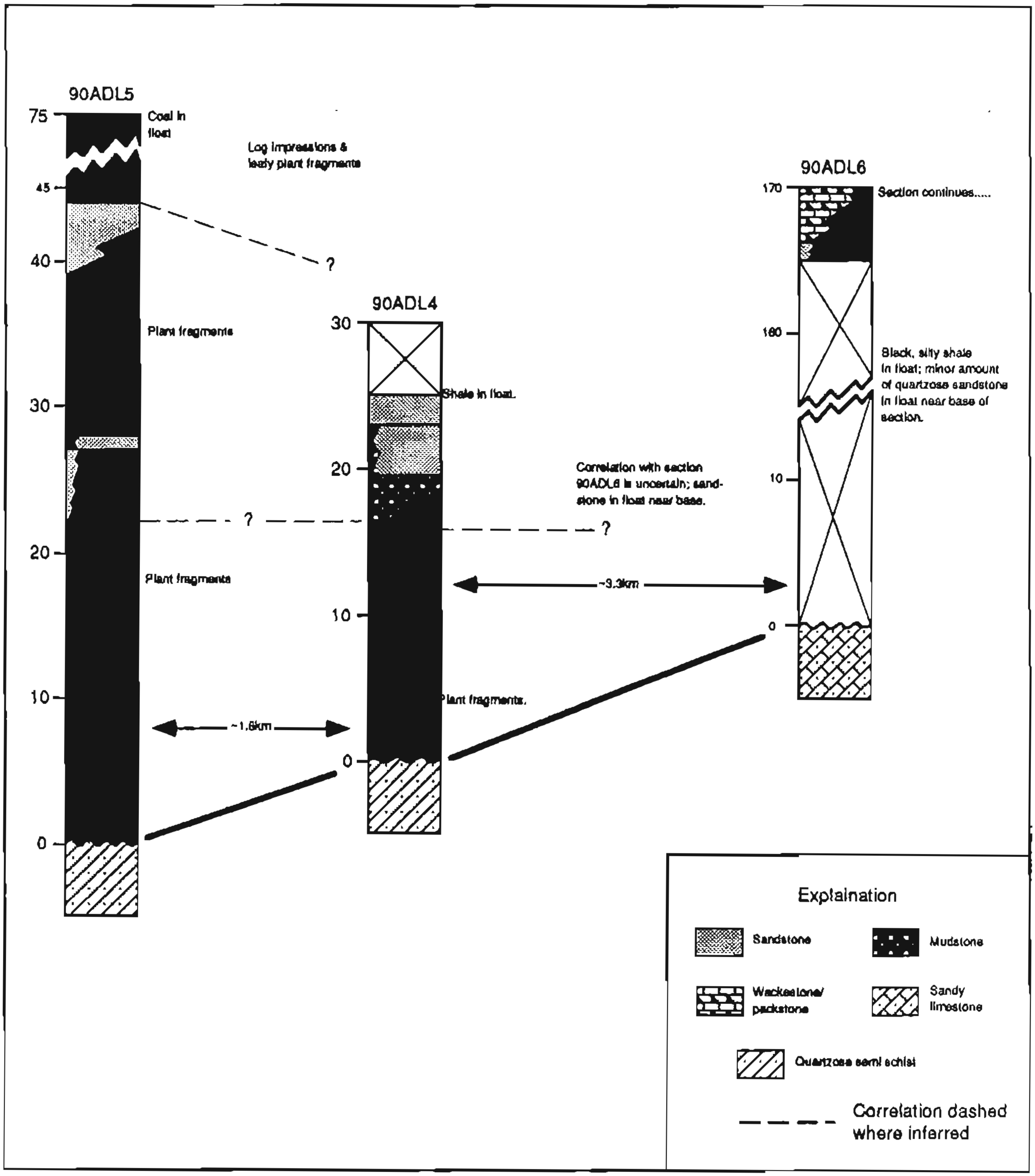

Figure 3 - Lithostratigraphic correlation diagram showing inferred lateral relationships between sections 90ADL4, 90ADL5, and the base of section 90ADL6.

tundra and talus cover at its base followed by ~107m of moderately exposed, interbedded black shale, maroon and red-brown weathering silty/sandy lime mudstone, wackestone, packstone, grainstone, and locally occurring coralline boundstone. The section is organized in to at least six cycles consisting of, in ascending order, black shale, lime mudstone, wackestone, packstone, and grainstone. Some cycles are capped by packstone instead of grainstone, and coralline boundstone occurs locally in lime mudstone and packstone horizons. Grainstone units have erosive bases and contain locally occurring tabular-planar and trough cross-bedding and internal scour surfaces (up to 20cm of relief). Grainstone units between 225 and 233m have a channelized appearance - thicken and cut down-section toward the west. The contact with dark gray weathering lime mudstone of the Alapah Limestone is concealed; it is arbitrarily placed at ~272m (mid-point between highest exposure of Endicott and lowest exposure of Alapah).

This thick limestone dominated succession probably correlates with the thick limestones mapped in the upper Endicott further east along Leffingwell Ridge by Hanks (1987 and 1988) and discussed by Wallace and Hanks (1990). Hanks (1987 and 1988) mapped these as the Endicott Limestone. A preliminary environmental interpretation for the Leffingwell Ridge outcrop belt will be presented later in this report.

West Aichilik River, central Leffingwell Ridge -

Three lithostratigraphic sections were measured in the undivided Endicott Group between the Aichilik and Egaksrak Rivers (Figures 1 and A-3). Sections 90ADL7 and 90ADL8 traverse a **relatively** complete succession of undivided Endicott. Relatively is stressed here because exposures are poor and the sections lie in thrust contact above the rocks of the Sadlerochit Group. Section 90ADL9 is incomplete and structurally disrupted. It may represent a detached fragment of the Endicott Limestone that is present in sections 90ADL7 and 90ADL8. Hanks (1988) has completed detailed mapping of this area as part of a structural transect down the Aichilik River, from the range front south to the north flank of Bathtub Ridge. The Endicott and Lisburne strata are mapped as a klippe overlying Permian-Triassic rocks of the Sadlerochit Group.

The lower 141-145m of sections 90ADL7 and 90ADL8 are poorly exposed and consist of, in ascending order, black siltstone and shale with lenticular-laminated sandstone and thin-bedded, red weathering sandstone with conspicuous mudstone drapes (flasers). Sandstone and siltstone in both sections have burrow-mottled appearance. Cross-lamination is preserved in the sandstone in some places. Cross-laminae are form discordant and appear in bundle-like clusters suggesting that they formed due to wave or combined flow currents (Reineck and Singh, 1980; De Raaf, 1977). Small (<5mm), poorly preserved plant fragments are present in the lower 10m of section 90ADL8; no plant fragments were observed in section 90ADL7.

The upper 20m of sections 90ADL7 and 90ADL8 consist of poorly exposed, light tan-gray weathering lime mudstone, wackestone, packstone, and grainstone that Hanks (1988) mapped as Endicott Limestone. Locally occuring coralline boundstone is present in lime mudstone in section 90ADL7 and in grainstone in 90ADL8. Bed at the top of 90ADL7 may be recrystallized carbonate and not a true grainstone. Sections 90ADL7 and 90ADL8 do not include strata of the Lisburne Group. The top of sections 90ADL7 and 90ADL8 are located at the top of north dipping slopes covered with packstone and grainstone rubble from the Endicott Limestone. An additional 60m of Endicott Limestone is concealed beneath talus cover above the top of 90ADL7. The next exposures occur near the base of the north dipping slope and consists of light-to-medium gray weathering lime mudstone of the Alapah Limestone of the Lisburne Group. In 90ADL8, similar exposures of the Alapah Limestone occur above approximately 50m (rough estimate)of talus cover, immediately north of the base of the talus covered slope.

Section 90ADL9 consists of 99m of, in ascending order, black shale, black shale with lenticular-laminated sandstone, siliceous lime mudstone, wackestone, packstone, and grainstone. This section appears similar to the upper parts of sections 90ADL7 and 90ADL8 except for a distinctive 2.5m thick coralline-pelmatozoan-gigantoproductid packstone bed at 69.5m. All brachiopods are oriented with their convex sides facing north, indicating the succession is not over turned (bedding dips toward the north). The base of the section is not exposed due to tundra cover (and possible structural complications). Exposures of quartzose sandstone and shale typical of the lower Kayak Shale (or undivided Endicott) occur above the grainstone unit at the top of the section (structural contact ?). Exposures of Lisburne Group carbonates are present across the creek on a south facing slope. The relationship between this section and sections 90ADL7 and 90ADL8 is uncertain (Figure 4).

Redwacke Creek, western Leffingwell Ridge -

Two lithostratigraphic sections from the Endicott Group were measured near Redwacke Creek (Figures 1 and A-4). Section 90ADL10 was measured through a relatively well exposed succession of undivided Endicott east of Redwacke Creek. Section 90ADL11 is a partial section through the lower Endicott Group in poor exposures west of Redwacke Creek.

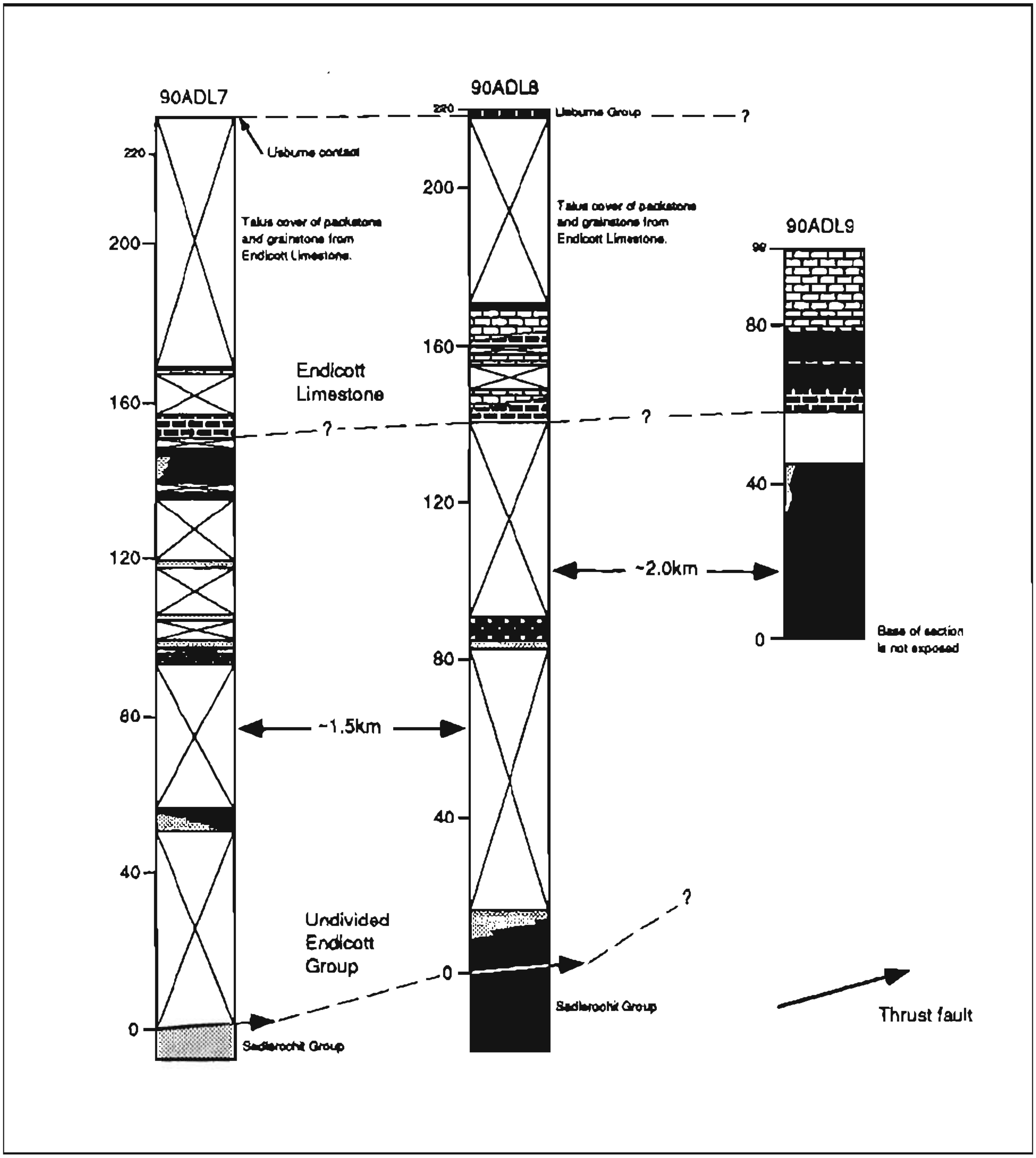

Figure 4 - Lithostratigraphic correlation diagram showing inferred lateral relationships between90ADL7, 90ADL8, and 90ADL9. Lithologica symbals are defined in Figures 2 and 3.

Section 90ADL10 consists of 285m of black shale, fine-grained sandstone, lime mudstone, wackestone, packstone, and grainstone. The section is in thrust contact with quartz semi schist and sandy limestone of the Franklinian Sequence (Hanks, 1988). The lower 140m consists of black, organic-rich shale (small plant fragments in lower 40m) that passes gradually upward in to black shale with millimeter-to-centimeter scale lenticular laminae of orange-brown to-light gray weathering sandstone. This shale dominated succession is abruptly overlain by a thin-bedded, fine-grained sandstone unit at140m. The sandstone laminae contain abundant bed-parallel trace fossils as well as traces oriented oblique to bedding. Most bed-parallel traces have a disorganized appearance and appear to represent grazing traces made by organisms living and/or feeding at the sediment-water interface. Most traces oriented oblique to bedding are <1cm in diameter and are back-filled with a contrasting sediment type, usually shale or siltstone. Traces oriented oblique to bedding appear in hand sample as burrows or elliptically shaped spots (both <1.5cm in diameter), depending on the orintation of the rock face. Approximately 1/4km west along strike from 90ADL10 in the 50-100m interval, abundant float of bioturbated, orange-brown weathering, calcareous sandstone was observed in the float .

The upper 126m of section 90ADL10 consists primarily of packstone and grainstone with minor lime mudstone and wackestone. Distinctive, thin (0.4-3m) cycles of wackestone-packstone are present between 180-193.2m. The packstone intervals appear to thicken and the wackestones thin along strike toward the east (over distance of ~10m). A ~37m thick succession of interbedded, wackestone and packstone with thinly interbedded, cross-laminated quartzose sandstone overlies the cyclic carbonates. Cross-laminae are form-discordant and occur in bundle-like packages similar to the wave ripple cross-laminae illustrated by De Raaf et al. (1977) and Reineck and Singh (1980). The upper 55m of the section consists of interlaminated orange-brown-to tan-brown weathering, dolomitic sandstone, orange-brown weathering dolomitic grainstone (?) and black shale. The dolomitic grainstone may actually be dolomitized lime mudstone. Cross-lamination is accentuated by the recessive weathering dolomitic laminae and is similar in form to that observed lower in the section. Fifteen meters of black shale containing small (<2cm long) rugose corals and gastropods lies beneath the Alapah Limestone.

Section 90ADL11 is shown in Figure 5 (not included in appendix). This section consists of 62m of black shale, medium gray siltstone, and very coarse-grained, chert-quartzose sandstone, granule conglomerate, and minor pebble conglomerate. Sandstone and conglomerate ocurr in large blocks sticking out of tundra. Clasts consist primarily of white vein quartz with some gray and black chert. Sandstone occurs interbedded (beds 7-14cm thick) with

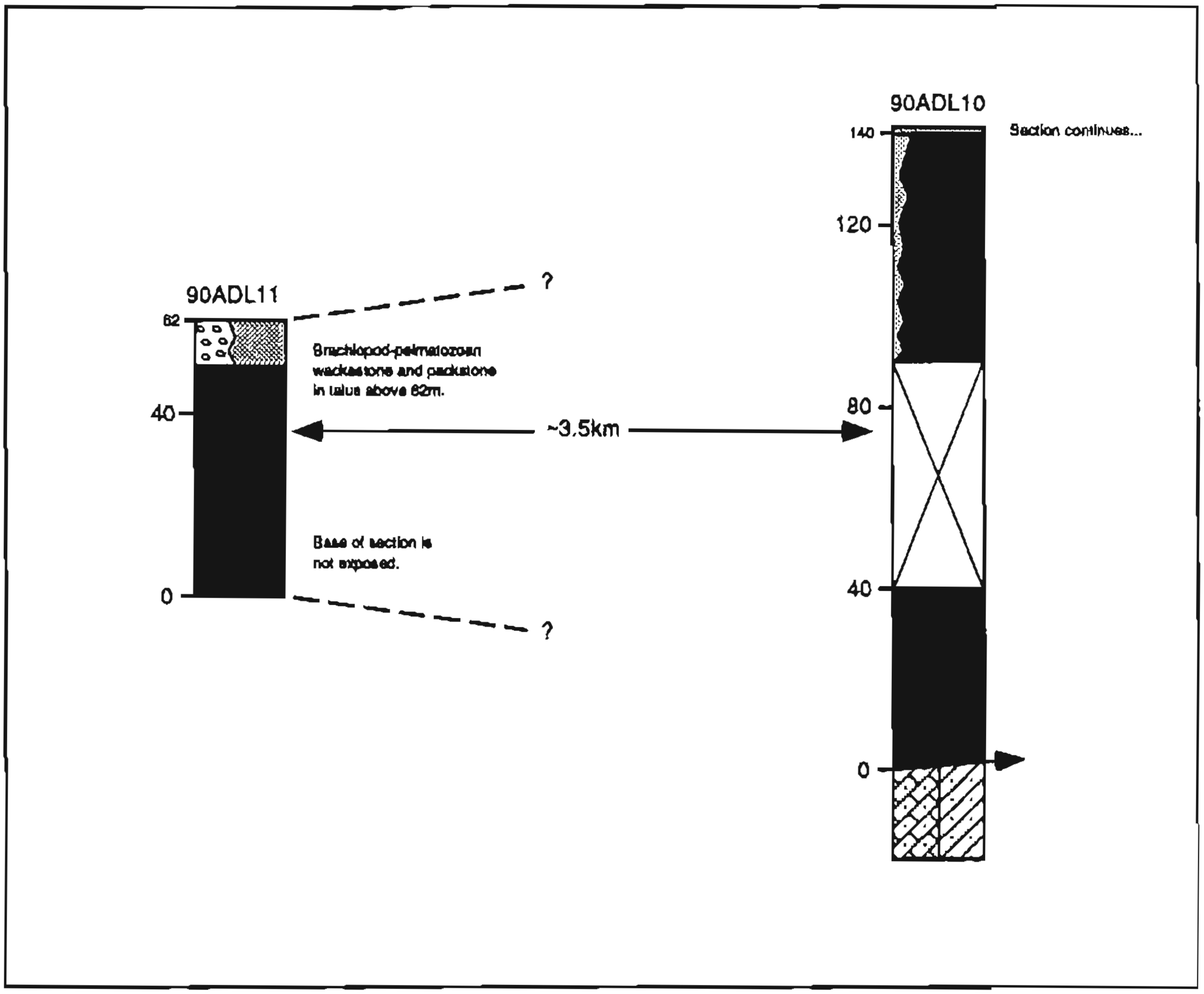

Figure 5 - Lithostratigraphic correlation diagram showing uncertain lateral relationship between sections 90ADL10 and 90ADL11. Lithologic symbols are defined in Figures 2 and 3.

granule and pebble conglomerate. Some blocks consist of normally graded pebble and granule conglomerate (at least 1-1.5m thick). The true stratigraphic position of these coarser-grained clastic rocks is uncertain. A minor amount of float of coarse-grained sandstone and granule conglomerate (typical of that observed in the lower Kayak Shale and Kekiktuk Conglomerate in western ANWR) was observed in the saddle at the base of section 90ADL10. The sandstone and conglomerate in section 90ADl11 may be related to the float observed at the base of 90ADL10. Their jumbled attitude in section 90ADL11 suggests that they have been structurally disrupted and possibly detached from underlying pre-Mississippian rocks (detached Kekiktuk Conglomerate?).

Environmental Interpretation of the Endicott Group at Leffingwell Ridge Outcrop Belt

Exposures of the Endicott Group along Leffingwell Ridge have been mapped by Reiser et al. (1980) as undivided Endicott. The lower 60-70m Endicott along this trend consists of black siltstone and shale containing abundant small plant fragments and thin (<4-5cm), discontinuous coal seams. The argillaceous rocks commonly contain indistinct lenticular laminae of fine-grained sandstone and prominent bodies of sharp-based, medium-to coarse-grained sandstone encased in finer-grained lithologies. Log impressions have been observed in these coarser-grained sandstones in a few places (90ADL4 and 90ADL5).

These observations suggest deposition in a marginal marine setting. The abundant plant detritus and coal may indicate deposition in coastal swamps in a temperate climatic setting. This interpretation is consistent with palynological data collected from the Endicott Group west of the Okpilak Batholith (Utting, 1990). Lenticular-laminated, fine-grained sandstone within argillaceous rocks indicates fluctuating energy conditions in an otherwise low energy setting such as might be found landward of a barred coastline or coastal embayment. Fluctuating energy conditions suggests a tidal influence - probably micro-to low meso-tidal.

The significance of the coarse-grained sand bodies is more difficult to assess. Several possibilities exist, including distributary channel-fills in a muddy tidal flat setting, offshore bars, bedload dominated streams, and shallow marine storm deposits. Sandstones cannot be traced laterally for more than several hundred meters due to poor exposures. Where there are no exposures, sandstone is not always present in the float, indicating that these bodies are not laterally extensive and may have a lenticular geometry. Other than the normally graded conglomerate present in section 90ADL11, only section 90ADL4 contains preserved physical sedimentary structures . Sandstone in the lower half of sections 90ADL5 and 90ADL10 are extensively bioturbated. Extensive biogenic reworking is a strong indicator of depostion in marine or marginal marine setting.

Due to the lack of suitable exposures and extensive bioturbation, a more detailed interpretation of the sandstones is not possible other than they appear to have deposited in a marginal marine (distributary channel-fill and/or offshore bar deposits) or inner shelf (proximal storm deposits) setting. Sharp-based sand bodies attributed to deposition from storm generated turbidity currents in shallow shelf settings (Walker, 1984; Duke, 1990) and as beach and barrier-bar deposits formed during abrupt falls in relative sealevel (Plint, 1988) are commonly observed features in marine shales.

A thick (85-126m) succession of biostromal carbonates including lime mudstone, wackestone, packstone, grainstone, and local coralline boundstone extends at least from the Okerokovik River to Redwacke Creek. These have been mapped by Hanks (1987 and 1988) as the Endicott Limestone between the Aichilik River and Redwacke Creek. The range of lithologies represented indicate depostion associated with an evolving carbonate buildup. Carbonates found lower in the sections typically consist of lime mudstone, wackestone, and local coralline boundstone, indicating depostion in a shallow low energy setting within the photic zone. Packstone and grainstone are more abundant higher in the sections, indicating higher energy conditions. Carbonate interlaminated with sandstone in the upper 55m of section 90ADL10 may not be grainstone; it may be dolomitized lime mudstone deposited in an tertidal setting. Thorough petrographic analysis is necessary before a more detailed interpretation of these carbonate rocks is possible.

Clarence River

Stratigraphy

Two lithostratigraphic sections were measured near the Clarence River, immediately west of the Canadian border (Figures 1 and A-5). Sections 90ADL12 and 90ADL13 are located in two saddles ~2.5km apart where the siltstone/shale dominated successions are best exposed. Section 90ADL12 consists predominantly of ~185m of black siltstone, silty shale, and shale. A thin (13m) succession of snow-white weathering quartzite with interbedded black, plant fragment bearing siltstone rests unconformably above quartz semischist and sandy limestone of the

Franklinian assemblage and comprises the Kekiktuk Conglomerate. Extensively bioturbated white quartzite with thinly interbedded siltstone occurs in the upper 2-3m of the Kekiktuk. This was the first section measured in the 1990 season that had Kekiktuk unequivocably at its base. Siltstone in this interval contains abundant well preserved plant fragments and at least four thin (<5cm) coal seams.

Armstrong and Mamet (1975) measured a section of the Endicott Group ~5-6km west of section 90ADL3 and reported coal as high as100m above the base. They placed the Kekiktuk-Kayak contact at the top of the highest coal seam (100m). We did not observe coal above 11m in section 90ADL12 and placed the Kekiktuk-Kayak contact above the next highest quartzite bed (at ~13m). Where a contact is gradational, it is necessary to establish some sort of criteria allowing the contact to be identified in a consistent manner from section to section. Eleven out of 28 sections measured through the Endicott Group as part of this study contain Kekiktuk Conglomerate at their bases. In all of these we have placed the Kekiktuk-Kayak contact at a level above which argillaceous lithologies comprise >50% of the section. This convention is easy to apply and therefore useful.

Approximately 104m of black siltstone, silty shale, and shale are exposed above the Kekiktuk Conglomerate. Thin interbeds of quartzite, silty sandstone, lime mudstone, and wackestone occur in this interval. At least two coarsening and/or thickening upward cycles are present. The silty lime mudstone at ~52m contains forams and may be laterally equivalent to a packstone horizon recognized by Armstrong and Mamet (1975) in their section 71A-1,2 (at ~37m) that contains middle Visean age forams (Mamet's microfaunal zone 12). The upper 75m is poorly exposed and appears to consist of black shale with interbedded red weathering, burrow-mottled sandstone, silty lime mudstone and packstone. In some places the sandstone contains wave ripple cross-stratification similar to that described in section 90ADL7 and 90ADL10. The contact with the overlying Alapah Limestone is arbitrarily placed at 185m, which is in the center of talus covered interval below exposures of light gray weathering lime mudstone.

Section 90ADL13 contains a succession of rocks similar to those observed in 90ADL12 with the exception that no coal was observed and there appears to be less carbonate in the upper half of the section. The Endicott Group is better exposed in section 90ADL13, however, the rocks have an extremely weathered appearance which may explain the apparent lack of carbonate rocks. Figure 6 summarizes lateral relationships between sections 90ADL12 and 90ADL13.

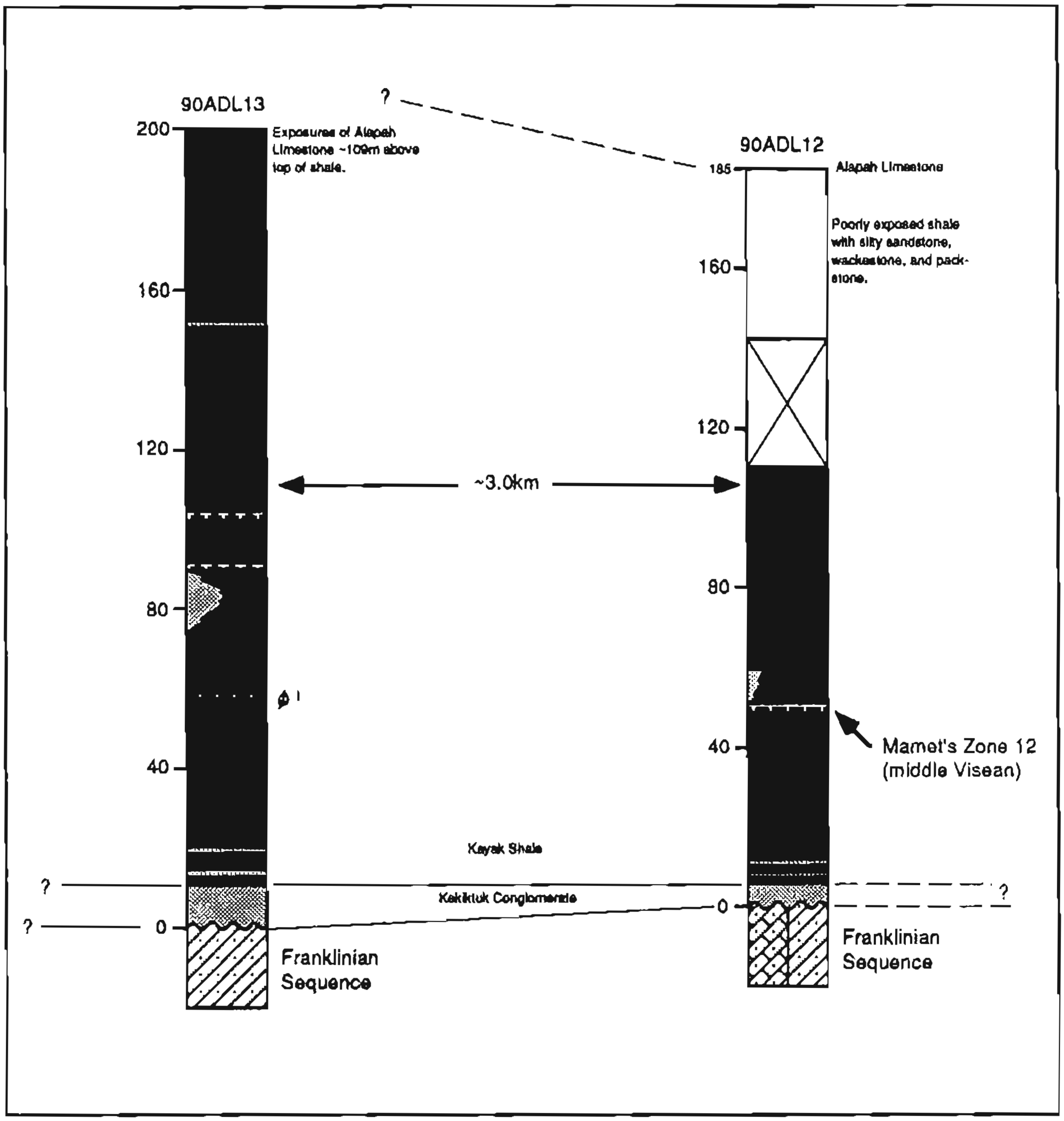

Figure 6 - Lithostratigraphic correlation diagram showing lateral relationships between sections 90ADL12 and 90ADL13. Symbols are defined in Figures 2 and 3.

Environmental Interpretation of the Endicott Group at Clarence River

The character of the basal Kekiktuk Conglomerate (thin-to medium-bedded, fine-medium grained quartzite with minor interbedded siltstone) suggests deposition in fine-grained, low sinuosity streams with sediment transported predominantly as bedload. Similar sandstone reported by Armstrong and Mamet (1975) from a section ~5-6km west of section 90ADL13 suggest that the Kekiktuk was deposited as a thin, possibly continuous sheet of sandstone unconformably above sandy limestone and quartz semischist of the Franklinian assemblage. This supports the idea that the Kekiktuk Conglomerate was deposited on a surface of very low relief. The top of the basal Kekiktuk in sections 90ADL12 and 90ADL13 (at ~2 and 11.5m respectively) is interpreted as a transgressive surface that marks the end of fluvial deposition and the onset of marine conditions and flooding of the Kekiktuk dispersal system. This surface can be identified where ever Kekiktuk is present. Where Kekiktuk is depositionally absent, the sub-Mississippian unconformity is the transgressive surface.

The overlying plant fragement and coal bearing siltstone with interbedded silty sandstone and white quartzite records deposition in coastal swamps characterized by poorly oxygenated bottom waters. Silty sandstone and quartzite may record deposition in distributary channels crossing the coastal swamps and/or deposition from sheet floods extending in to the swamps from adjacent stream or distributary channels during rainy seasons. Extensive biogenic reworking supports a marginal marine (coastal) setting for these deposits. This part of the Endicott succession is likely correlative with the lower, plant fragment and coal bearing undivided Endicott Group present along Leffingwell Ridge.

The remainder of sections 90ADL12 and 90ADL13 record deposition in progressively deeper water (marginal marine to shallow shelf) as the transgression continued. The relative lack of carbonate compared to sections measured along Leffingwell Ridge suggests a steady influx of fine-grained clastic material (silt and clay).

West Kongakut River

Stratigraphy

Two lithostratigraphic sections were measured ~16km west of the Kongakut River (Figures 1 and A-6). These sections were measured along the next major Endicott outcrop belt south of Leffingwell Ridge. The Kekiktuk Conglomerate and Kayak Shale are recognized in the Endicott Group along this belt. Section 90ADL14 is a partial section from the lower Endicott

Group (Kekiktuk Conglomerate) and consists at its base of dark red-brown-to green-brown weathering, matrix-supported chert cobble conglomerate and breccia with some interbedded dark green-gray mudstone. Angular clasts of gray, white, and black bedded chert occur in a matrix of dark green-gray, sandy mudstone. Clast size ranges from 45cm at the base to 7cm at the 15m level and from 4cm at the 19m level to 15cm at the 36m level. Clast size variations define two cycles: 1. an upward fining cycle from 0-15m, and 2. an upward coarsening cycle from 15-36m. Interbedded mudstone contains abundant coarse sand and granule sized chert grains and resembles the matrix in the associated conglomerate and breccia. The coarse-grained units are pervasively sheared. Conglomerate and breccia unconformably overly light tan-brown-to green-brown weathering quartz semischist of the pre-Mississippian Franklinian assemblage. Thin beds of granule conglomerate occurr in the semischist.

Twenty meters of black sitly shale and light gray and red weathering coarse-grained sandstone cap section 90ADL14. The sandstone body contains interbeds of granule conglomerate and thin shale partings. Individual sandstone beds appear massive. Additional exposures of shale and silstone are present above section 90ADL14.

Within ~0.4km along strike to the east of section 90ADL14, the conglomerate and breccia beds pinch out against pre-Mississippian semischist of the Franklinian assemblage. Further east, beyond the conglomerate and breccia, distinctive snow-white quartzite with thinly interbedded black siltstone lies directly above sub-Mississippain rocks. Siltstone beds are highly disrupted and in places thoroughly mixed with white quartzite. Vertical and oblique burrows are abundant.

Section 90ADL15 consists of ~364m of conglomerate, sandstone, shale, skeletal carbonate, and dolomite. In section 90ADL15 the Kekiktuk Conglomerate is >5m thick and consists of dark gray weathering, massive, clast-supported, chert-quartz pebble conglomerate. Approximately 150-200m east along strike the Kekiktuk is ~10-15m thick and consists of a basal conglomerate (as described above) abruptly overlain by horizontally bedded and trough cross-bedded chert-quartz pebbly sandstone and snow-white weathering quartzite. White quartzite contains interbedded black siltstone, is extensively bioturbated, and resembles quartzite observed east of section 90ADL14. Small, broken plant fragments and log impressions are present on bedding surfaces in the interbedded quartzite and siltstone.

Black, organic-rich, shaly siltstone of the Kayak Shale is directly above the Kekiktuk Conglomerate and contains abundant large (up to 20cm long) plant fragments. A nine meter thick sandstone body abruptly overlies basal mudstone of the Kayak Shale. The sand body contains at least three varieties of cross-stratification. Large and medium scale planar tangential cross-bedding occurs through out the unit; medium scale (~50cm thick) epsilon style (lateral accretion) cross-bedding is present at ~18m; and ow-angle cross-bedding is present at ~19m. Approximately 215m of black shale with interbedded and interlaminated quartzose sandstone, lime mudstone, wackestone, and packstone. Interstratified lithologies occur as sharp-based units and in coarsening- and thickening-upward cycles. Sandstone is interstratified throughout this interval but decreases in abundance gradually upward as it is replaced by skeletal carbonate lithologies.

A 98m thick succession of sandy and silty dolomite comprises the stratigraphically highest exposures of the Kayak Shale. This succession consists of tan-gray-to tan-brown weathering sandy and silty dolomite and interlaminated dolomitic siltstone and sandstone. Arenaceous horizons are commonly current ripple cross-laminated; starved ripples are a common feature in lenticular-laminated siltstone and sandstone. Thin wavy laminae of possible algal origin occur at several places in the succession. Black chert nodules are particularly abundant in the lower 18m and in the upper 28m of the succession. A 53m covered interval separates carbonates of the upper Kayak Shale from dark gray weathering lime mudstones of the Alapah Limestone. Black and dark gray shale occur beneath the covered interval. Figure 7 summarizes lateral facies relations between sections 90ADL14 and 90ADL15.

Environmental Interpretation

Matrix-supported conglomerate and breccia at the base of section 90ADL14 resulted from debris flows that were transported into topographic low areas on the sub-Mississippian unconformity. Debris flow deposits pinch out laterally toward the east where quartzite and interbedded siltstone form a thin veneer above pre-Mississippian rocks. Quartzite and siltstone record deposition in a low energy, marginal marine setting. Deposition of muds may have been periodically interrupted by an influx of quartz sand, possibly as sheet floods during rainy seasons. Extensive bioturbation in the interbedded quartizite and siltstone supports a marginal marine interpretation.

Debris flow deposits of section 90ADL14 grade laterally toward the west into braided stream deposits forming the base of section 90ADL15. The sandstone bodies at 44.5m and 16m in sections 90ADL14 and 90ADL15 respectively may be correlative. Preserved sedimentary

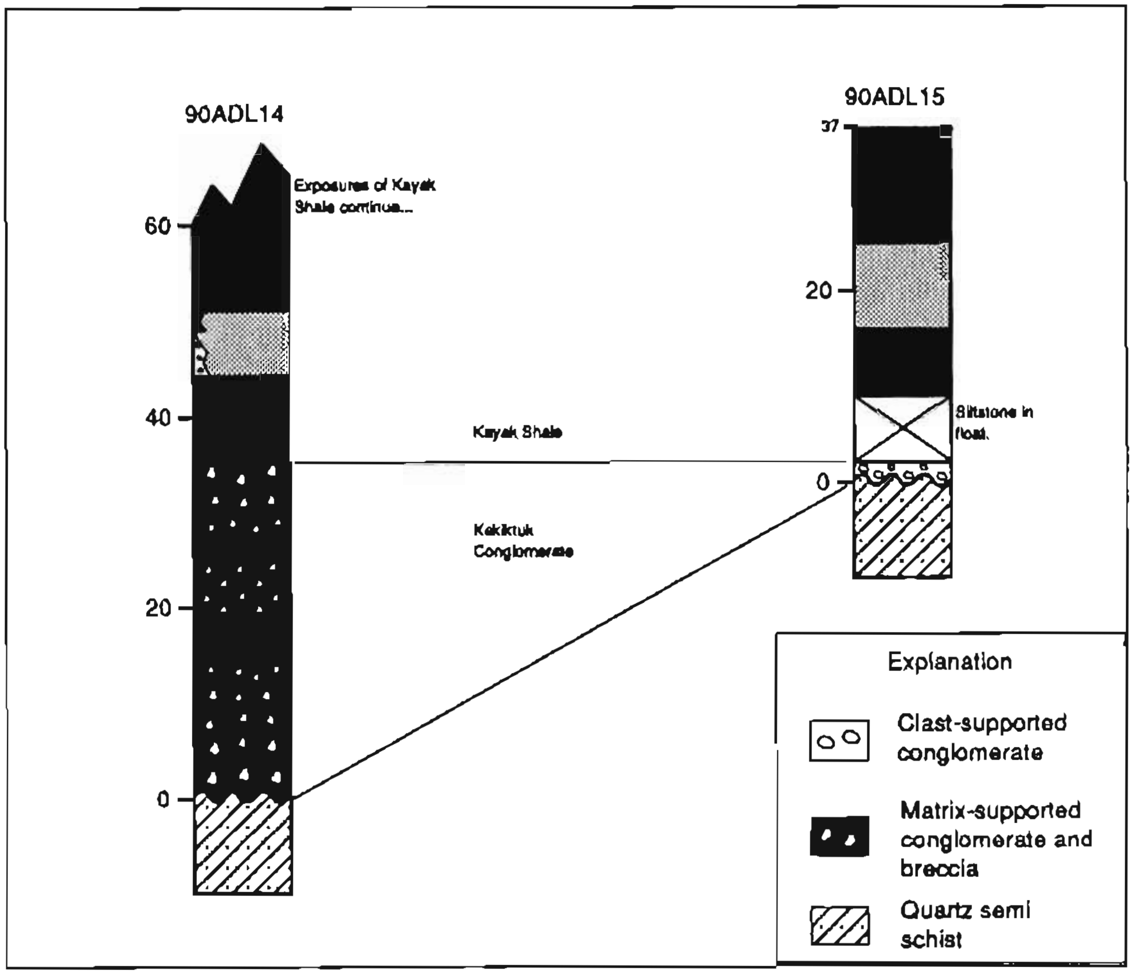

Figure 7 - Lithostratigraphic correlation diagram showing lateral relationships between sections 90ADL14 and 90ADL15. Symbols not defined in diagram have been defined in Figures 2 and 3.

structures in the sand body at 16m in section 90ADL15 suggest deposition as a migrating barrier bar complex . Low angle cross-bedding and planar-tabular cross-bedding suggest deposition in an upper shoreface-to-foreshore setting. The epsilon cross-bedding represent lateral sediment accretion, possibly in to very shallow tidal channels.

The thick shale-dominated succession above the sand body at 16m in section 90ADL15 records depostion under deepening water conditions on a slowly subsiding, shallow shelf. Sharp-based sandstone and packstone beds and laminae suggest deposition from waning episodic flows, most likely from waning storm-generated flows. Sharp-based, storm-generated sandstones and carbonates are a commonly observed feature in marine shales deposited in shallow shelf settings (Walker, 1984; Duke, 1990).

The thick silty/sandy dolomite succession near the top of the Kayak Shale appears to record depostion in shallow conditions. Dolomite may represent early diagenetic replacement of an original lime mud precursor. Algal laminae, abundant irregularly shaped vugs (fenestrae ?), and the ubiquitous presence of dolomite suggest deposition on an intertidal-to-supratidal carbonate mud flat. Kayak carbonate deposition was terminated by a rapid rise in relative sealevel as indicated by the 53m of covered section (black and dark gray shale) that lies abruptly above this interval. Preliminary examination of thin sections from this succession indicate that it contains several meter scale shallowing upward cycles. Thorough petrographic analysis is required to assess the nature and significance of these cycles.

ACKNOWLEDGEMENTS

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NORTHEASTERN SADLEROCHIT MOUNTAINS, MT. MICHELSON (C-1 & C-2) QUADRANGLES

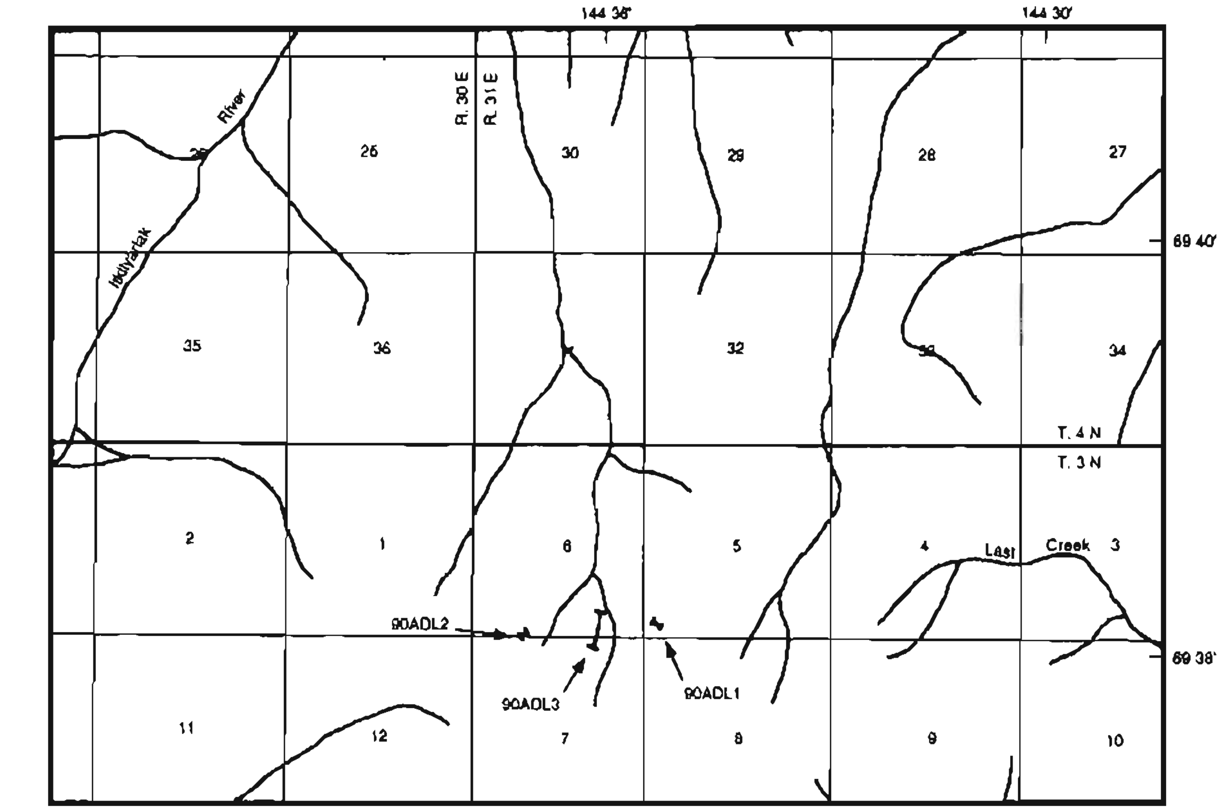


Figure A-1 - Map showing location of sections 90ADL1, 90ADL2, and 90ADL3.

OKEROKOVIK RIVER, DEMARCATION POINT (B-4) QUADRANGLE

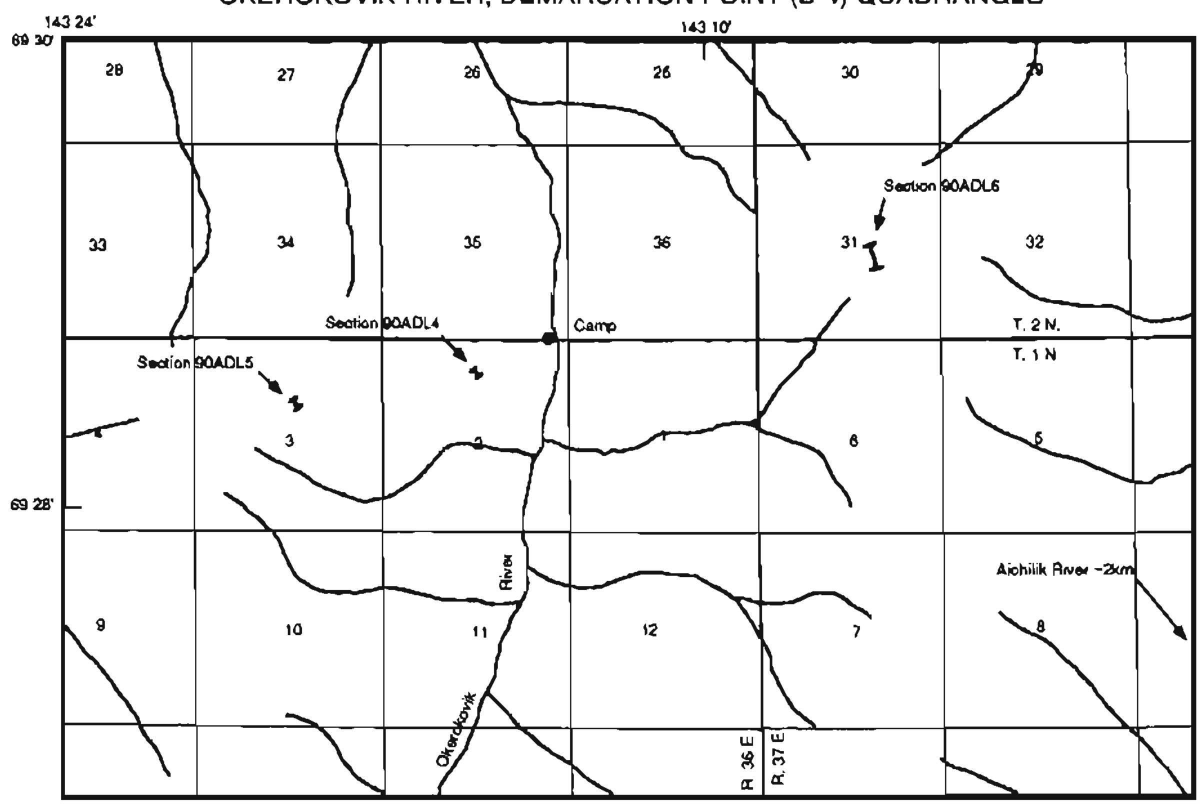


Figure A-2 - Map showing location of sections 90ADL4, 90ADL5, and 90ADL6.

EGAKSRAK RIVER, LEFFINGWELL RIDGE, DEMARCATION POINT (C-3 and C-4) QUADRANGLES

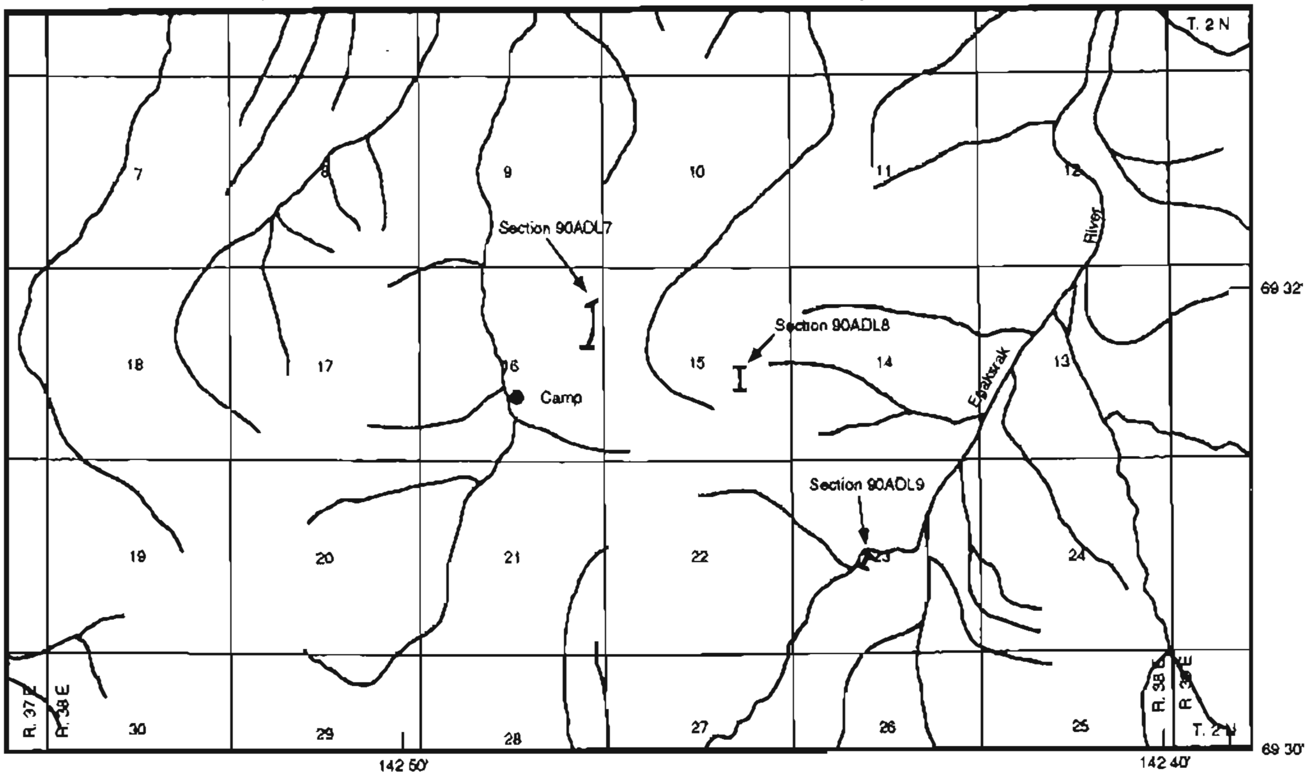


Figure A- 3 - Map showing location of sections 90ADL7, 90ADL8, and 90ADL9.

REDWACKE CREEK, LEFFINGWELL RIDGE, DEMARCATION POINT (C-3) QUADRANGLE

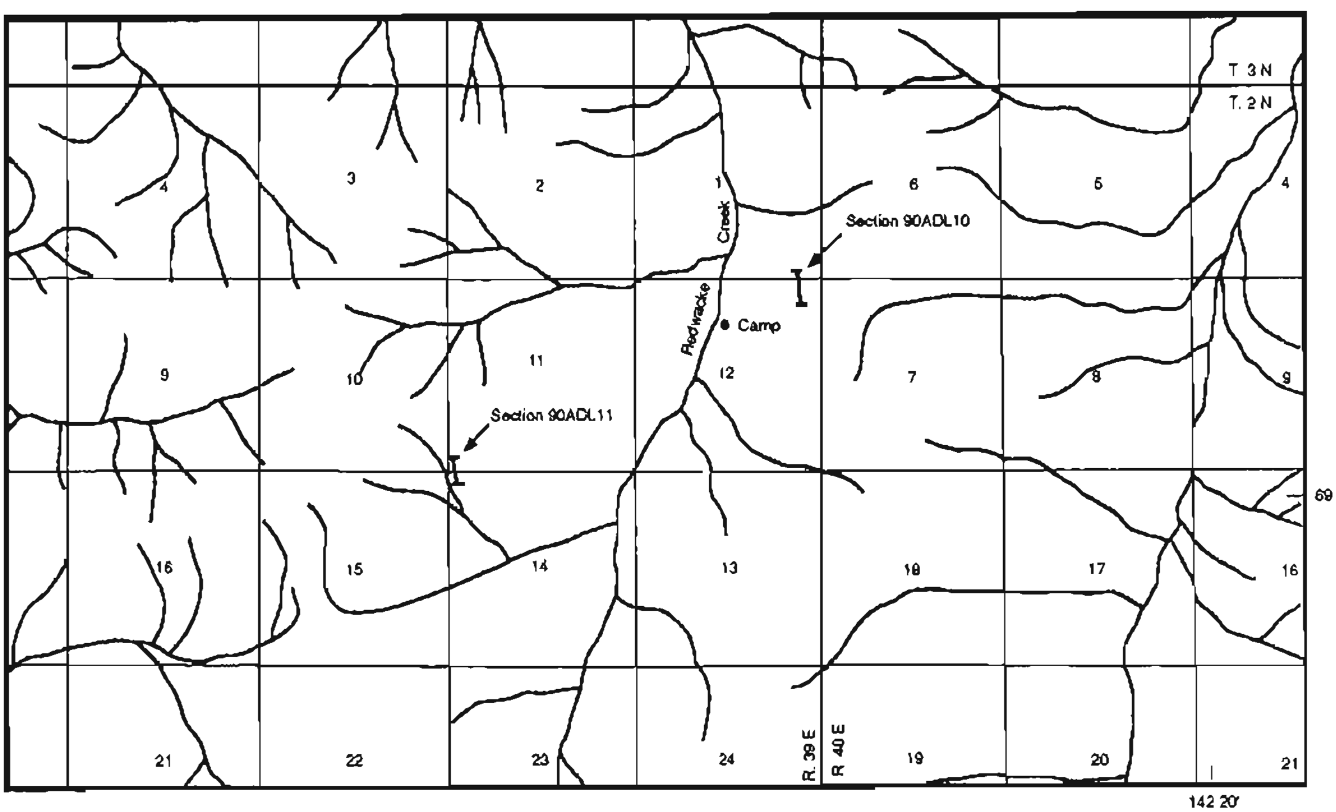


Figure A-4 - Map showing location section 90ADL10 and 90ADL11

CLARENCE RIVER, DEMARCATION POINT (B-1) QUADRANGLE

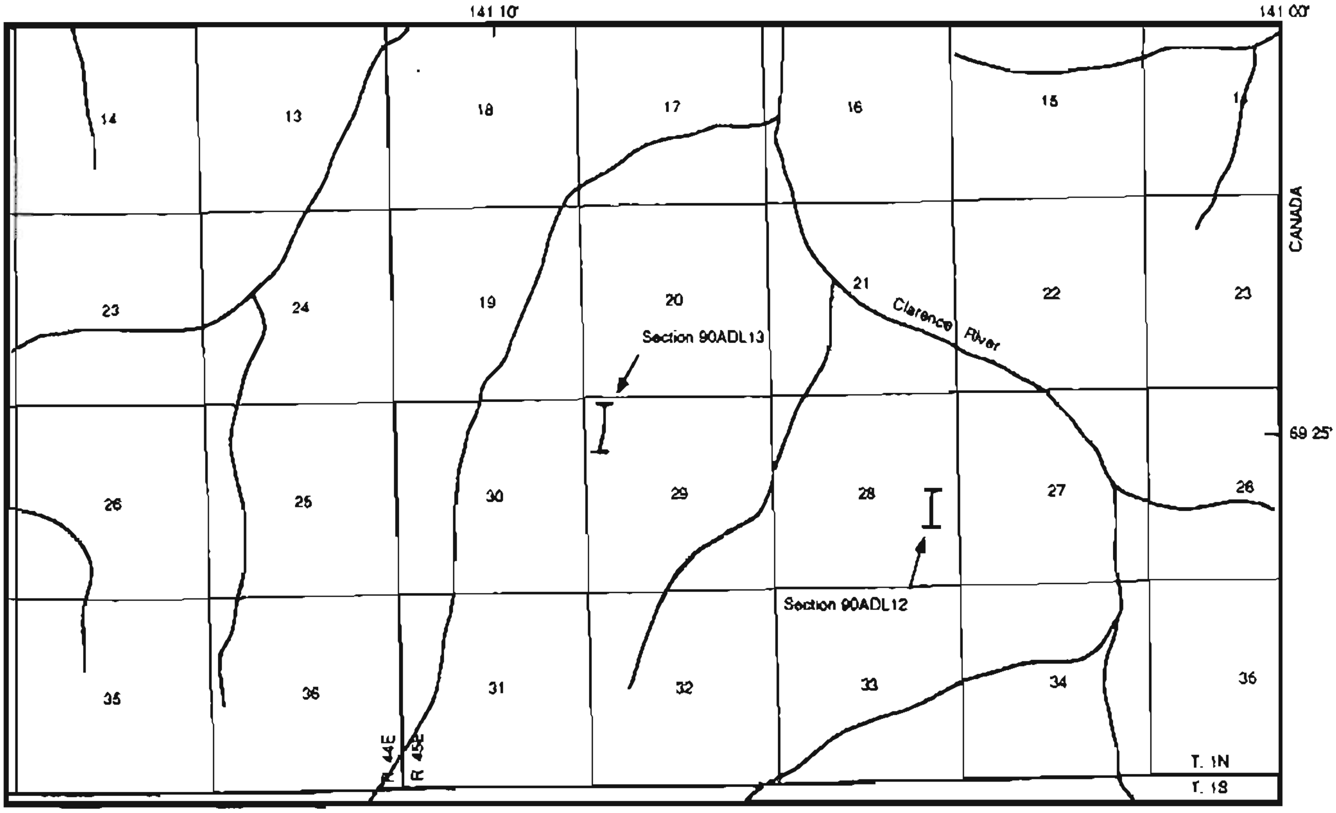


Figure A-5 - Map showing locations of section 90ADL12 and 90ADL13 west of the Clarence River.

WEST KONGAKUT RIVER, NORTHERN ROMANZOF MOUNTAINS, DEMARCATION POINT (B-2) QUADRANGLE

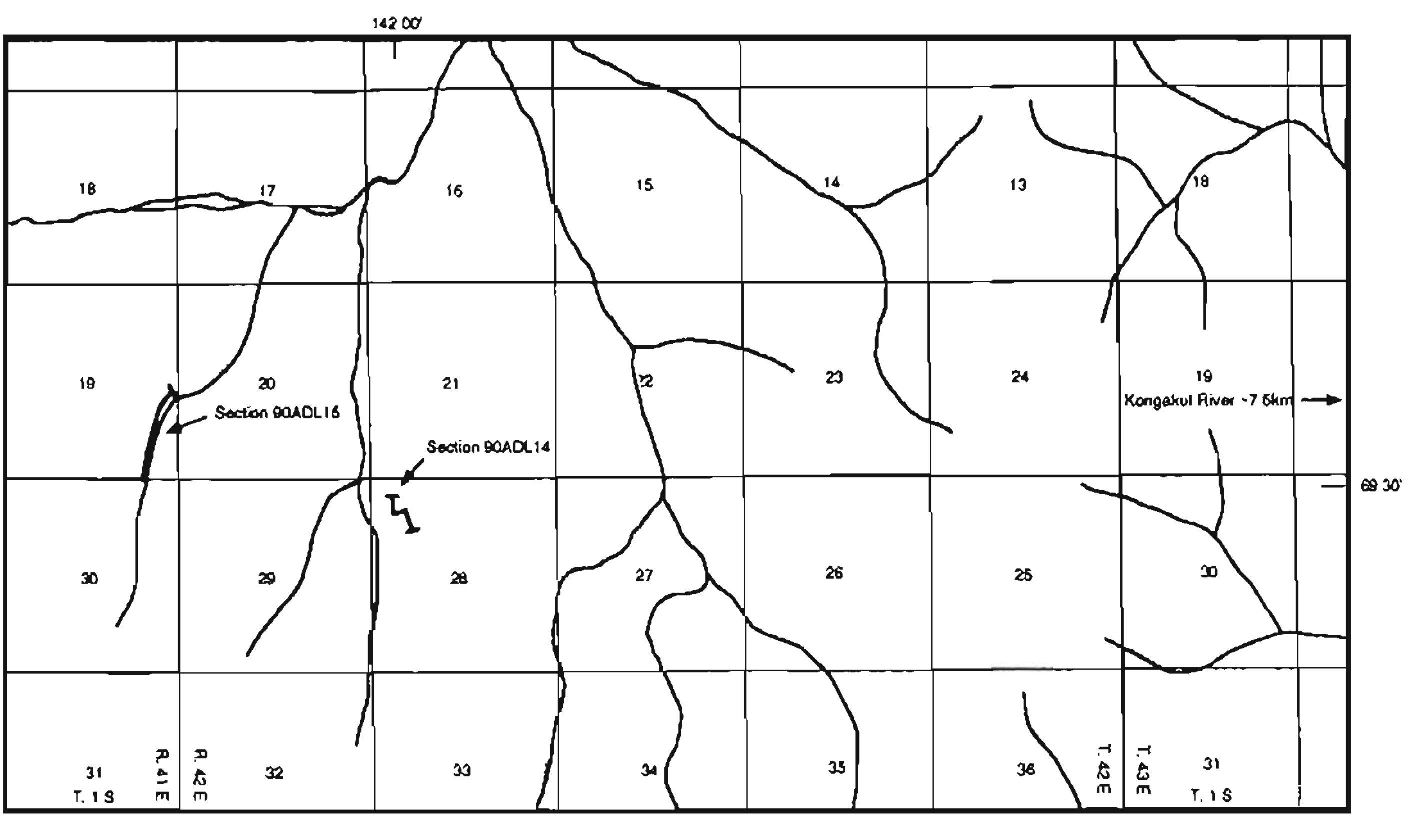


Figure A-6 - Map showing locations of section 90ADL14 and 90ADL15.

MEASURED SECTION SYMBOL KEY

Rock Types

- Sandstone
- Clast-supported conglomerate
- Matrix-supported conglomerate
- Mudstone
- Sandy mudstone
- Calcareous Mud-stone
- Limestone
- Sandy/silty limestone
- Dolostone
- Sandy/silty dolostone

Pre-Mississippian Rock Types

- Mafic volcanics
- Sandy/silty limestone
- Dolostone
- Quartzose semischist
- Phyllite

Gradational Contact

Rock type column displays relative abundances of rock types; abundance increases toward the right.

Skeletal Grains

- Coral in growth position
- Reworked coral
- Pelecypod
- Crinoid
- Gastropod
- Brachiopod
- Bryozoa
- Sponge spicules

Plant Fossils

- Plant fragment
- Log impression

Sedimentary Structures

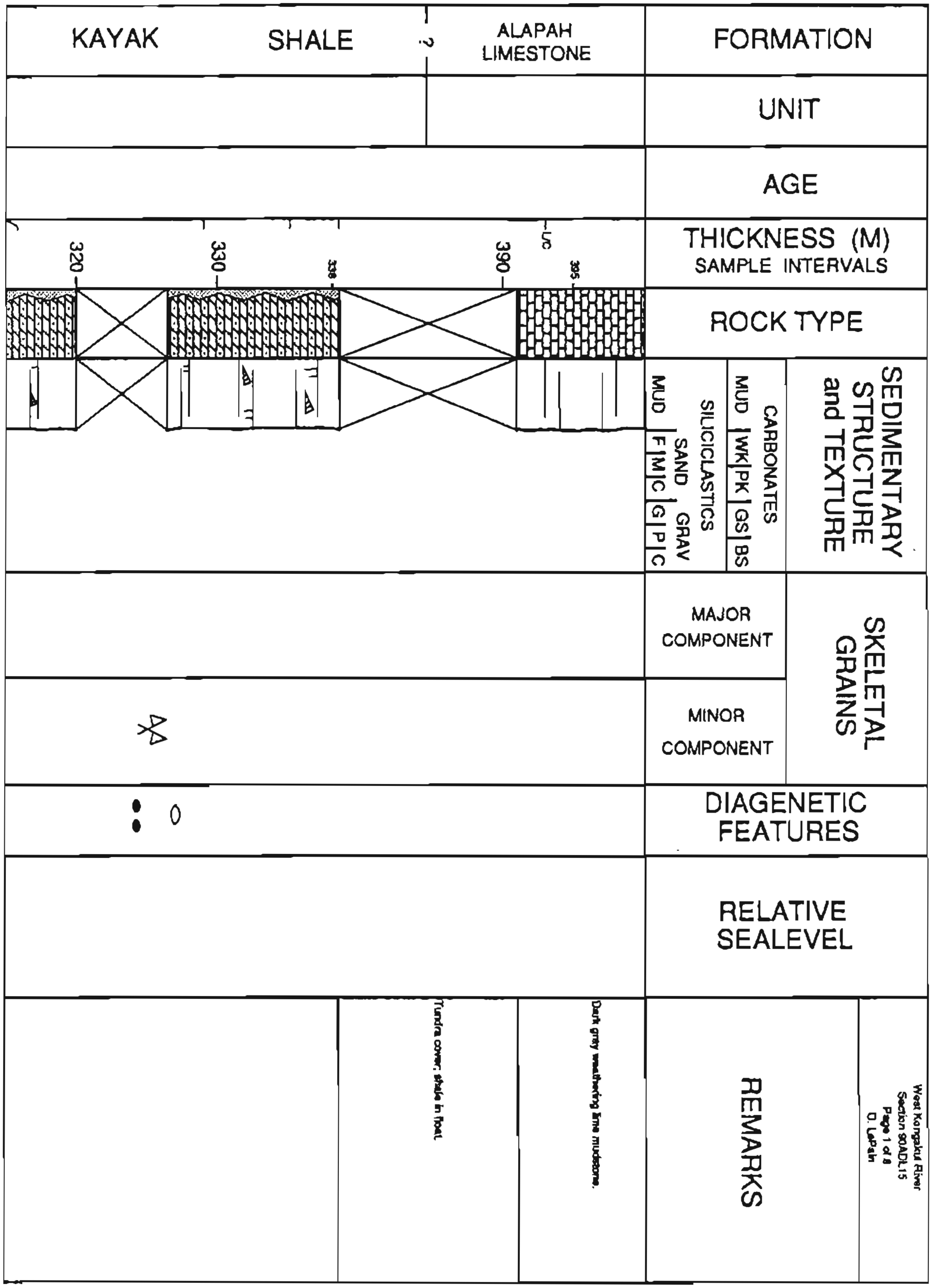
Thick Bedded
- Planar
- Wavy/irregular

Medium Bedded
- Planar
- Wavy/irregular

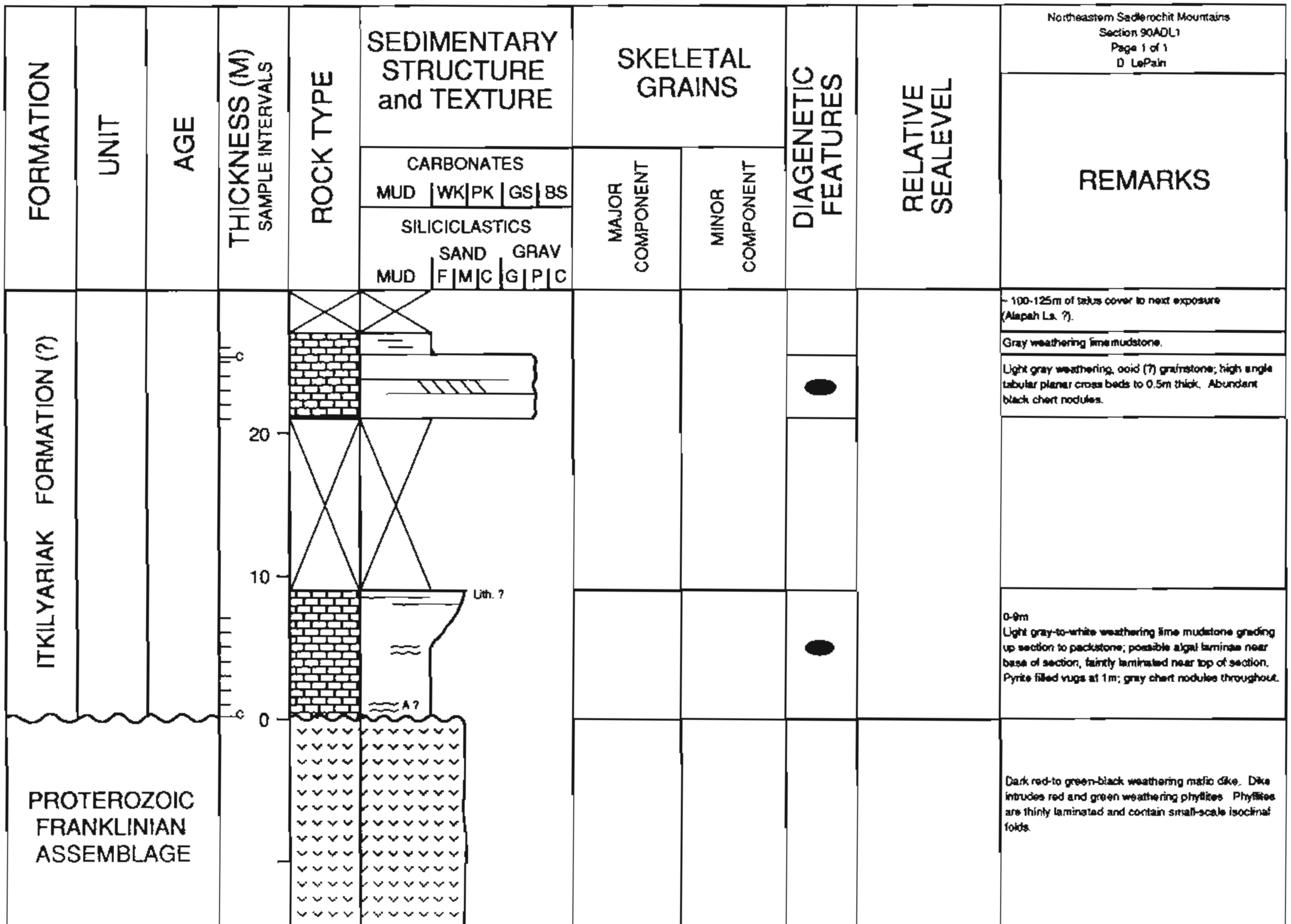
Thin Bedded
- Planar
- Wavy/irregular

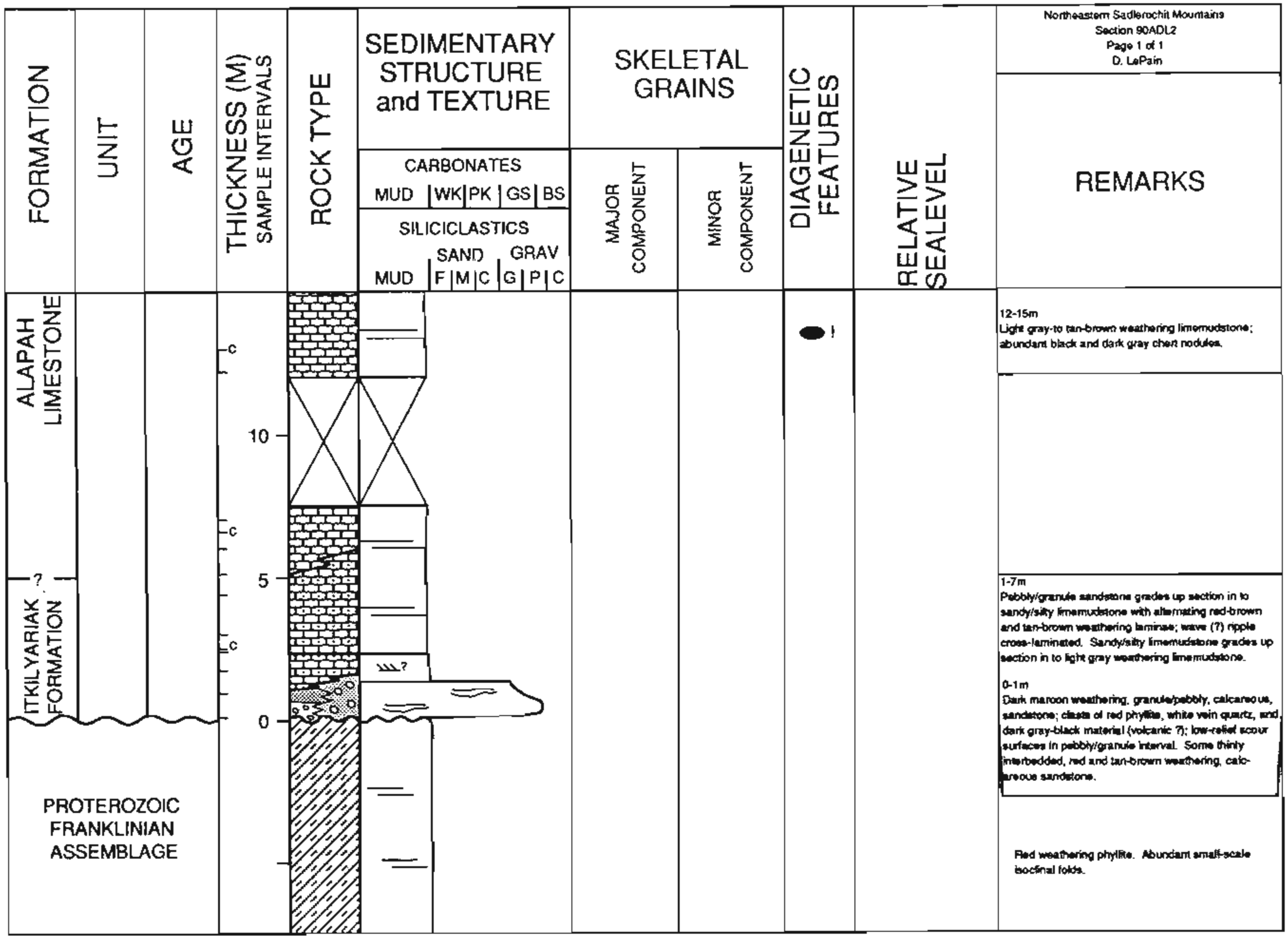
Lamination
- Planar
- Wavy/irregular

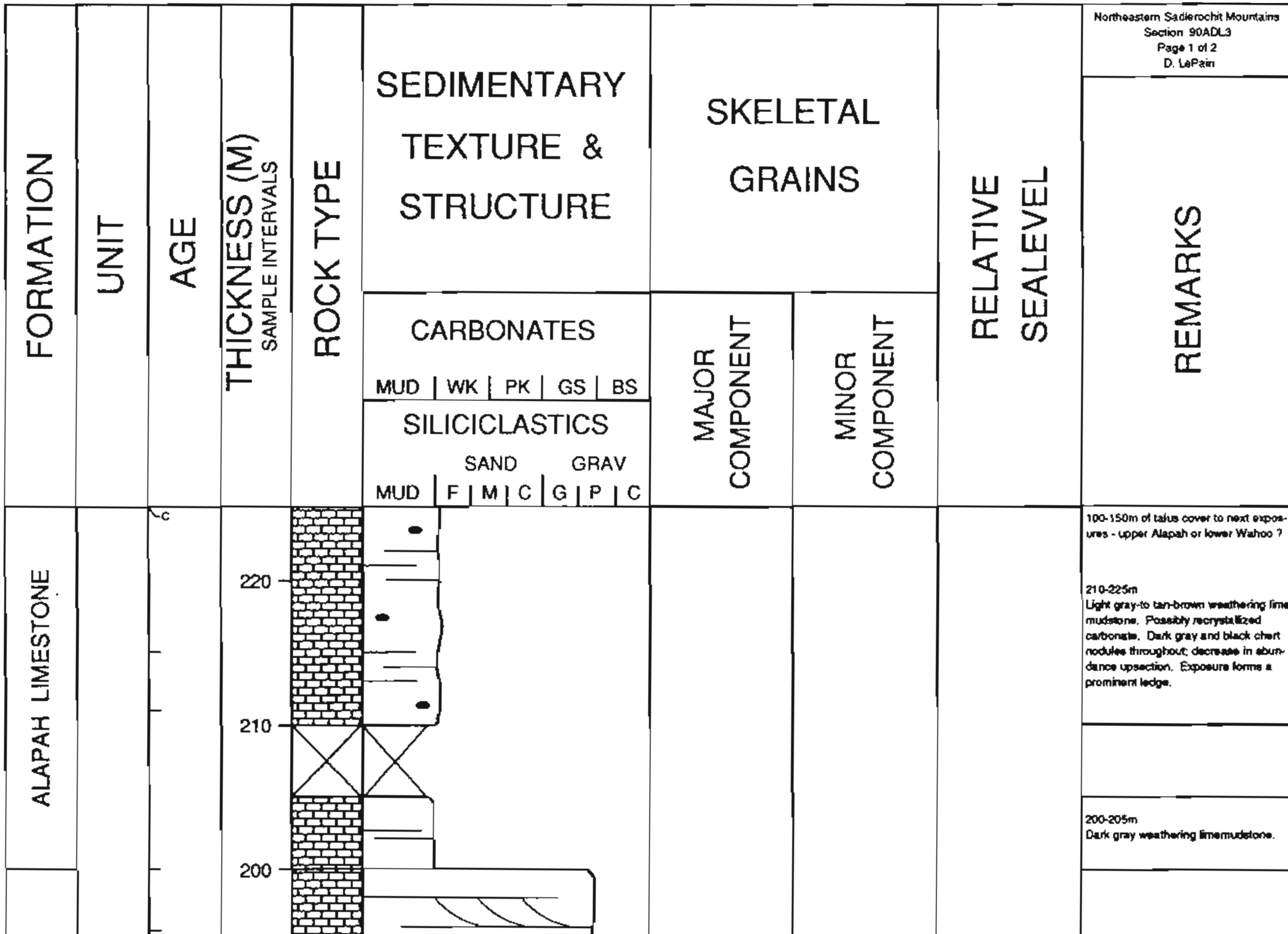
- Tabular tangential cross-bedded
- Tabular planar cross-bedded
- Trough cross-bedded
- L Lenticular-laminated
- Current ripple cross-lamination
- Wave ripple cross-lamination
- Scour surface
- Bioturbation



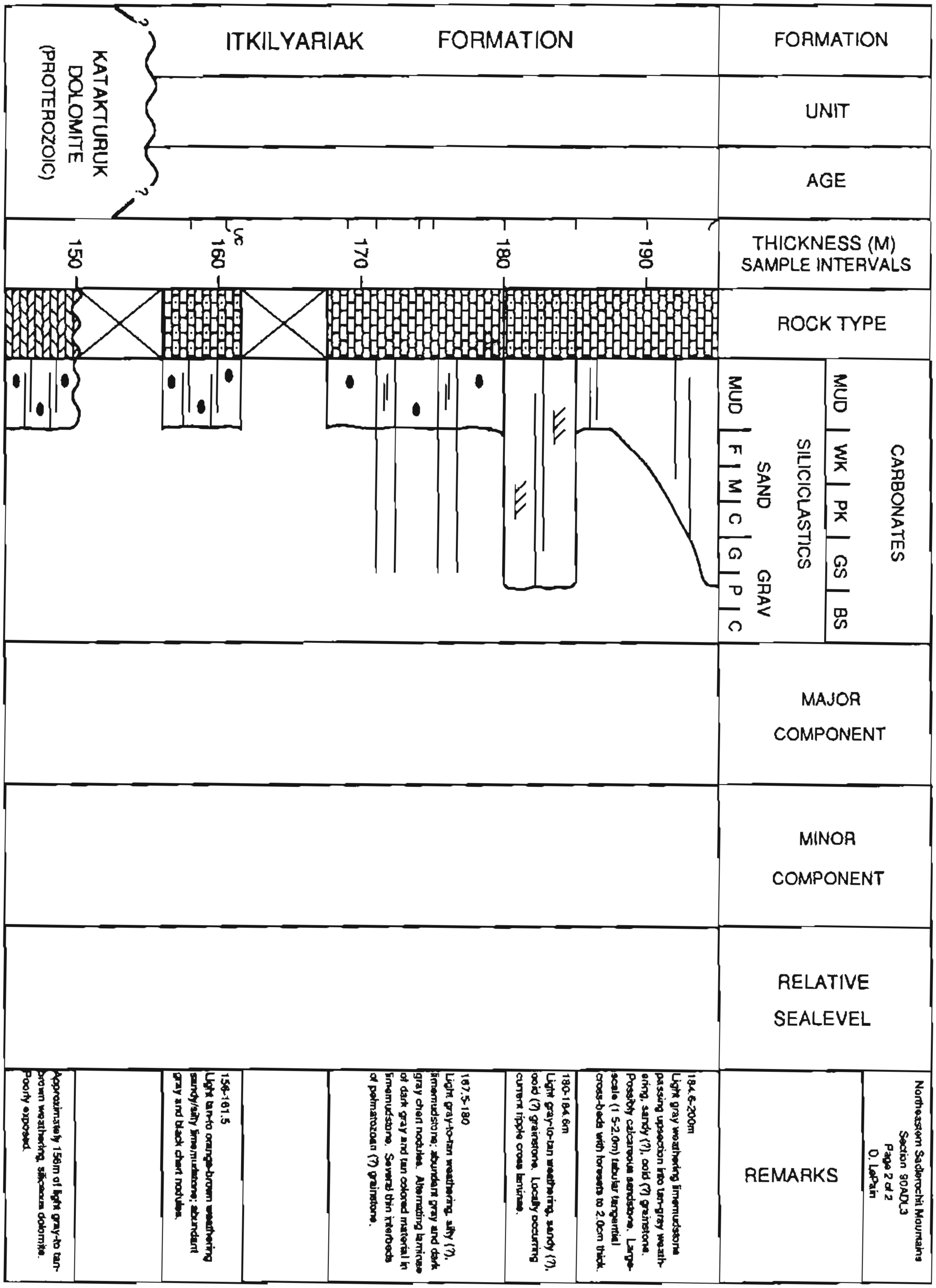
KAYAK
SHALE
?
ALAPAH LIMESTONE
FORMATION
UNIT
AGE
320
330
338
390
395
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
MUD
F M C
SAND
G P C
GRAV
SILICICLASTICS
MUD WK PK GS BS
CARBONATES
SEDIMENTARY STRUCTURE and TEXTURE
MAJOR COMPONENT
MINOR COMPONENT
SKELETAL GRAINS
DIAGENETIC FEATURES
RELATIVE SEALEVEL
Tundra cover, shale in float
Dark gray weathering lime mudstone.
REMARKS
West Kongakut River
Section 90ADL15
Page 1 of 8
D. LePain


FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SEDIMENTARY STRUCTURE and TEXTURE
CARBONATES
MUD WK PK GS BS
SILICICLASTICS
MUD SAND F M C GRAV G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
Northeastern Sadlerochit Mountains
Section 90ADL1
Page 1 of 1
D LePain
REMARKS
ITKILYARIAK FORMATION (?)
PROTEROZOIC FRANKLINIAN ASSEMBLAGE
20
10
0
c
c
Lith. ?
A ?
~ 100-125m of talus cover to next exposure (Alapah Ls. ?).
Gray weathering limemudstone.
Light gray weathering, ooid (?) grainstone; high angle tabular planar cross beds to 0.5m thick. Abundant black chert nodules.
0-9m
Light gray-to-white weathering lime mudstone grading up section to packstone; possible algal laminae near base of section, faintly laminated near top of section. Pyrite filled vugs at 1m; gray chert nodules throughout.
Dark red-to green-black weathering mafic dike. Dike intrudes red and green weathering phyllites Phyllites are thinly laminated and contain small-scale isoclinal folds.


Northeastern Sadlerochit Mountains
Section 90ADL2
Page 1 of 1
D. LePain
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SEDIMENTARY STRUCTURE and TEXTURE
CARBONATES
MUD WK PK GS BS
SILICICLASTICS
SAND GRAV
MUD F M C G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
ALAPAH LIMESTONE
ITKILYARIAK FORMATION
?
PROTEROZOIC FRANKLINIAN ASSEMBLAGE
c
c
c
10
5
0
?
12-15m
Light gray-to tan-brown weathering limemudstone; abundant black and dark gray chert nodules.
1-7m
Pebbly/granule sandstone grades up section in to sandy/silty limemudstone with alternating red-brown and tan-brown weathering laminae; wave (?) ripple cross-laminated. Sandy/silty limemudstone grades up section in to light gray weathering limemudstone.
0-1m
Dark maroon weathering, granule/pebbly, calcareous, sandstone; clasts of red phyllite, white vein quartz, and dark gray-black material (volcanic ?); low-relief scour surfaces in pebbly/granule interval. Some thinly interbedded, red and tan-brown weathering, calcareous sandstone.
Red weathering phyllite. Abundant small-scale isoclinal folds.



Northeastern Sadlerochit Mountains
Section 90ADL3
Page 1 of 2
D. LePain
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SEDIMENTARY TEXTURE & STRUCTURE
CARBONATES
MUD | WK | PK | GS | BS
SILICICLASTICS
SAND GRAV
MUD F M C G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
RELATIVE SEALEVEL
REMARKS
ALAPAH LIMESTONE
C
220
210
200
100-150m of talus cover to next exposures - upper Alapah or lower Wahoo ?
210-225m
Light gray-to tan-brown weathering lime mudstone. Possibly recrystallized carbonate. Dark gray and black chert nodules throughout; decrease in abundance upsection. Exposure forms a prominent ledge.
200-205m
Dark gray weathering limemudstone.



KATAKTURUK DOLOMITE (PROTEROZOIC)
ITKILYARIAK FORMATION
FORMATION
UNIT
AGE
150
160
uc
170
180
190
THICKNESS (M) SAMPLE INTERVALS
ROCK TYPE
CARBONATES
MUD | WK | PK | GS | BS
SILICICLASTICS
MUD | SAND F | M | C | GRAV G | P | C
MAJOR COMPONENT
MINOR COMPONENT
RELATIVE SEALEVEL
REMARKS
Approximately 156m of light gray-to tan-brown weathering, siliceous dolomite. Poorly exposed.
156-161.5
Light tan-to orange-brown weathering sandy/silty limemudstone; abundant gray and black chert nodules.
167.5-180
Light gray-to-tan weathering, silty (?), limemudstone; abundant gray and dark gray chert nodules. Alternating laminae of dark gray and tan colored material in limemudstone. Several thin interbeds of pelmatozoan (?) grainstone.
180-184.6m
Light gray-to-tan weathering, sandy (?), ooid (?) grainstone. Locally occurring current ripple cross laminae.
184.6-200m
Light gray weathering limemudstone passing upsection into tan-gray weathering, sandy (?), ooid (?) grainstone. Possibly calcareous sandstone. Large-scale (1.5-2.0m) tabular tangential cross-beds with foresets to 2.0cm thick.
Northeastern Sadlerochit Mountains
Section 90ADL3
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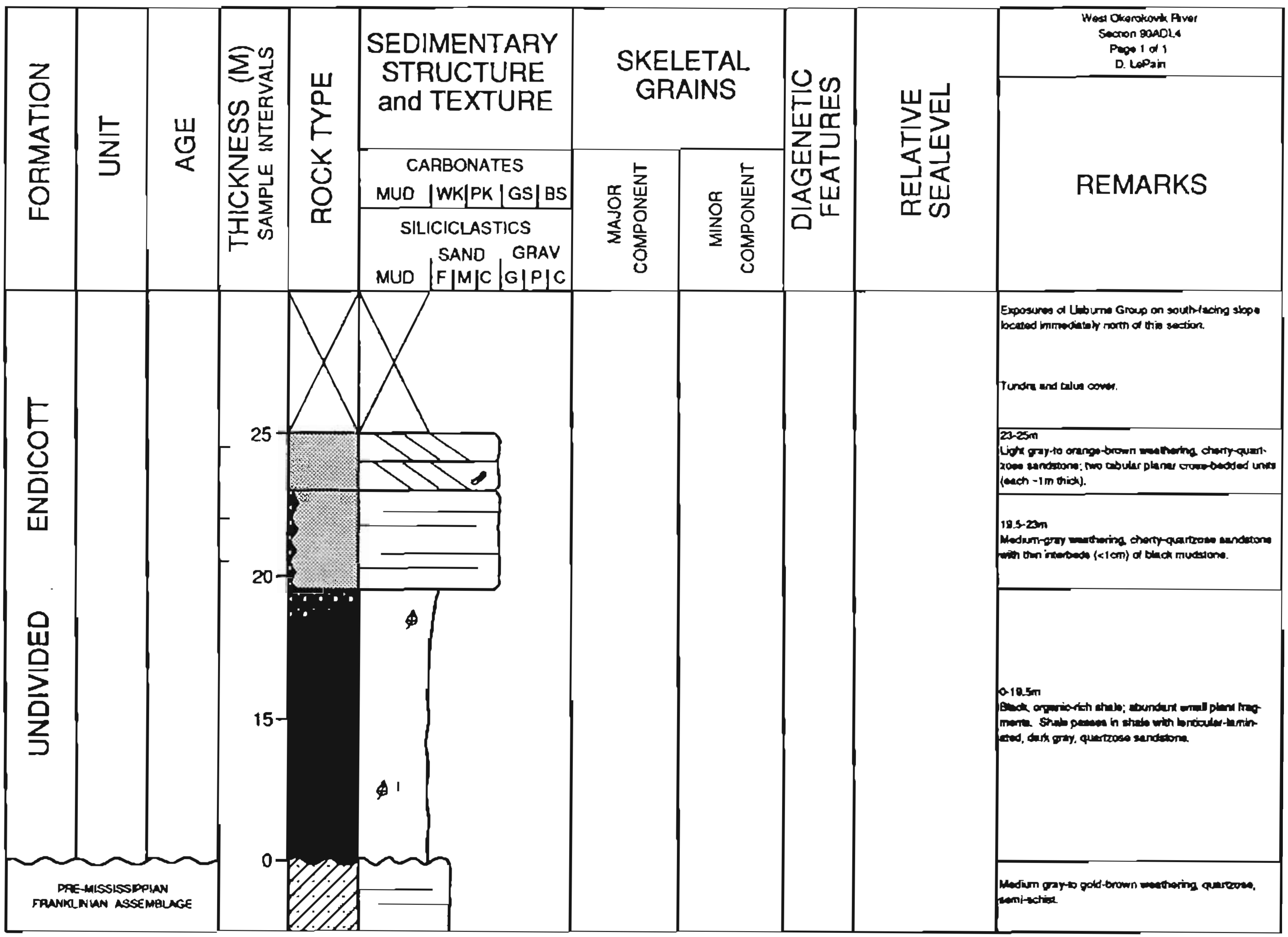
West Okerokovik River
Section 90ADL4
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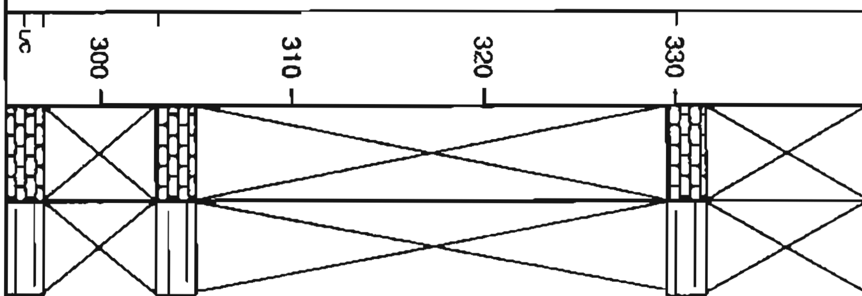
D. LePain
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SEDIMENTARY STRUCTURE and TEXTURE
CARBONATES
MUD | WK | PK | GS | BS
SILICICLASTICS
MUD
SAND F | M | C
GRAV G | P | C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
ENDICOTT
UNDIVIDED
PRE-MISSISSIPPIAN FRANKLINIAN ASSEMBLAGE
25
20
15
0
Exposures of Lisburne Group on south-facing slope located immediately north of this section.
Tundra and talus cover.
23-25m
Light gray-to orange-brown weathering, cherty-quartzose sandstone; two tabular planar cross-bedded units (each ~1m thick).
19.5-23m
Medium-gray weathering, cherty-quartzose sandstone with thin interbeds (<1cm) of black mudstone.
0-19.5m
Black, organic-rich shale; abundant small plant fragments. Shale passes in shale with lenticular-laminated, dark gray, quartzose sandstone.
Medium gray-to gold-brown weathering, quartzose, semi-schist.

ALAPAH LIMESTONE	FORMATION
ENDICOTT LIMESTONE	UNIT
	AGE
	THICKNESS (M) SAMPLE INTERVALS
	ROCK TYPE
	SEDIMENTARY STRUCTURE and TEXTURE CARBONATES: MUD | WK | PK | GS | BS SILICICLASTICS: MUD | SAND F | M | C | GRAV G | P | C
	SKELETAL GRAINS — MAJOR COMPONENT
	SKELETAL GRAINS — MINOR COMPONENT
	DIAGENETIC FEATURES
	RELATIVE SEALEVEL
296-332m Small, isolated exposures of light gray weathering lime mudstone; light gray weathering lime mudstone as talus cover. ~30m of talus cover to next exposure.	REMARKS



East Okerokovik River
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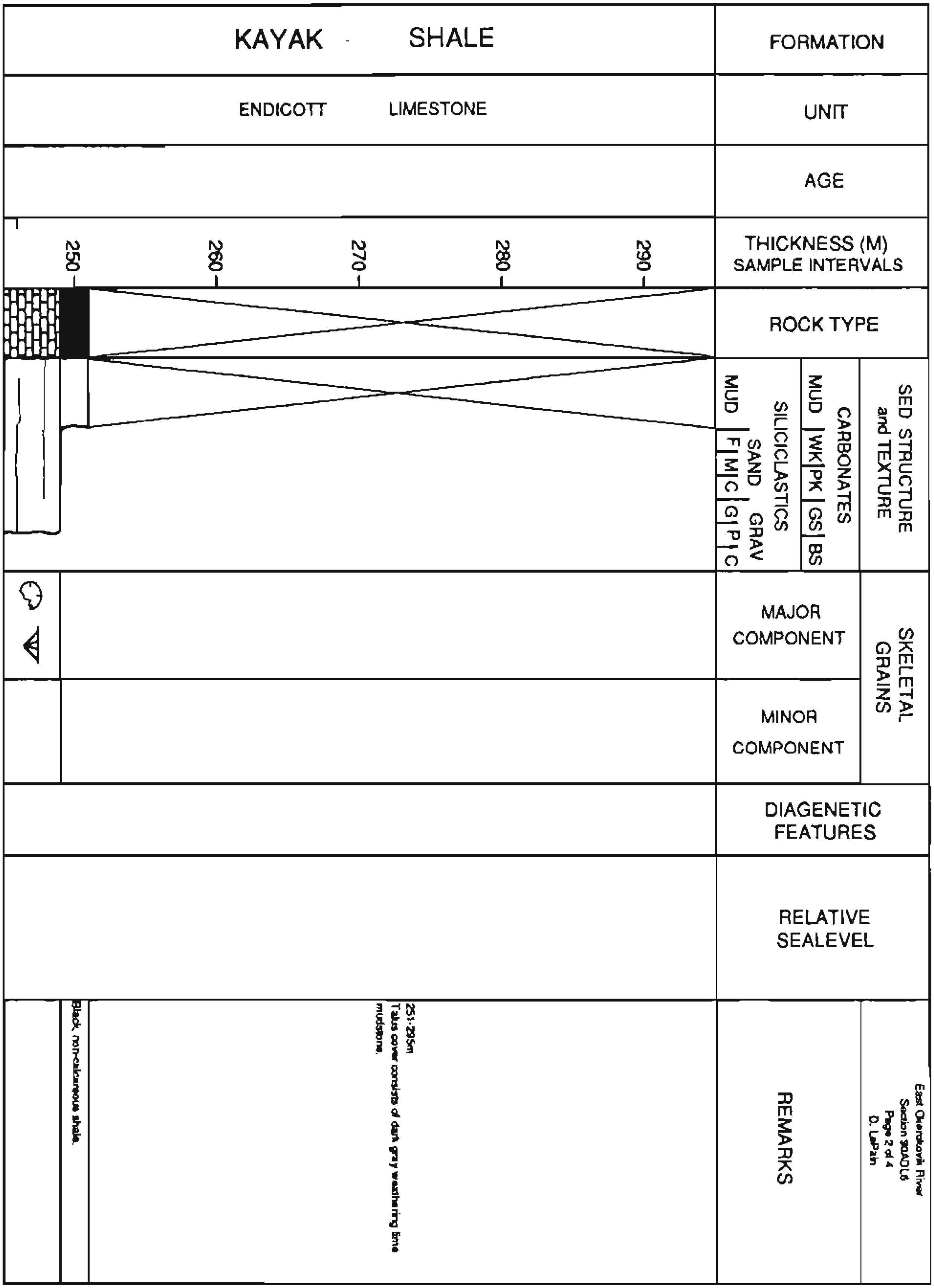
KAYAK SHALE
FORMATION
ENDICOTT LIMESTONE
UNIT
AGE
250
260
270
280
290
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
SILICICLASTICS
MUD
SAND
F
M
C
GRAV
G
P
C
CARBONATES
MUD
WK
PK
GS
BS
MAJOR COMPONENT
MINOR COMPONENT
SKELETAL GRAINS
DIAGENETIC FEATURES
RELATIVE SEALEVEL
Black, non-calcareous shale.
251-295m
Talus cover consists of dark gray weathering lime mudstone.
REMARKS
East Okerokovik River
Section 90ADL6
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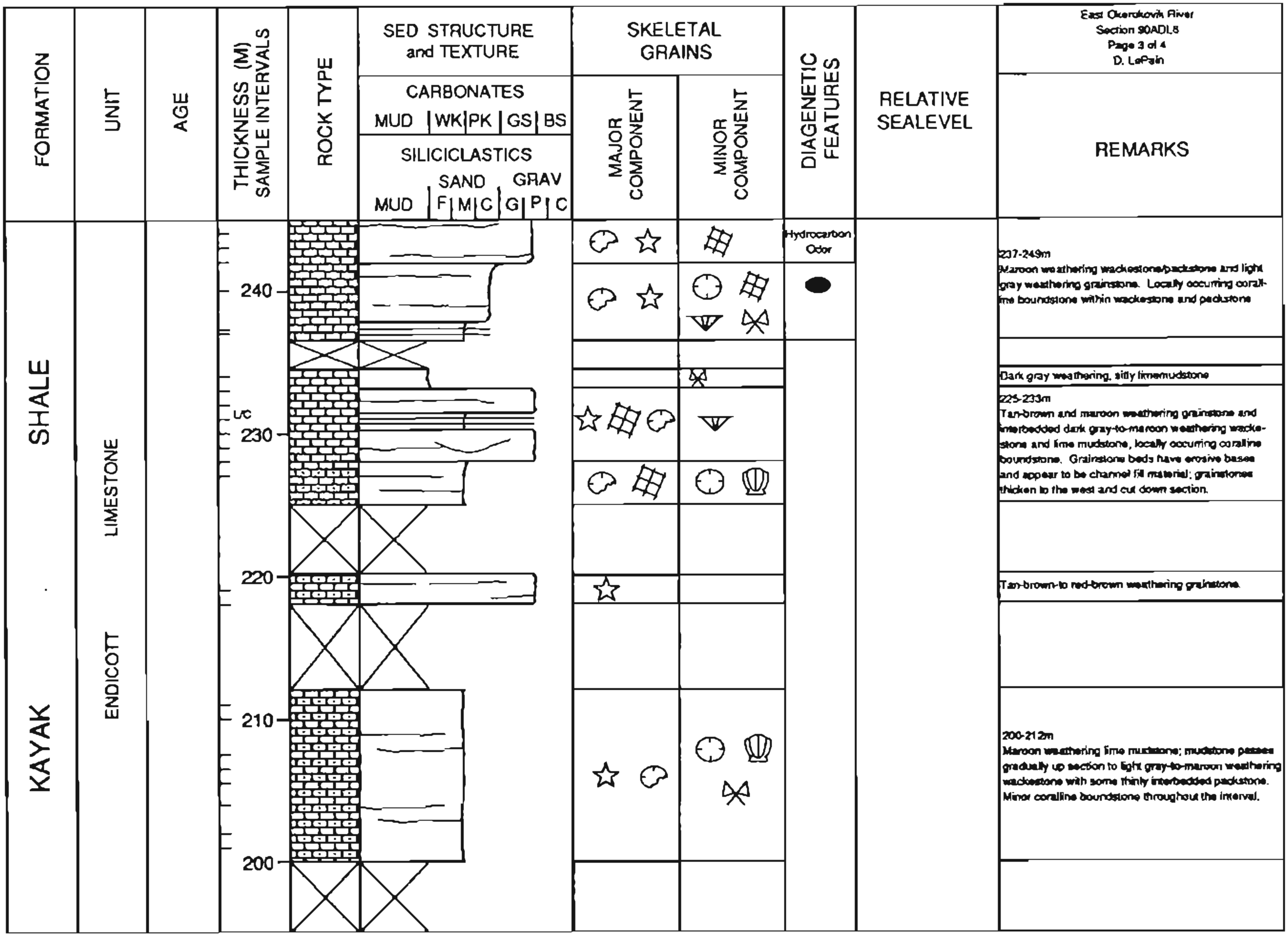

FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD | WK | PK | GS | BS
SILICICLASTICS
SAND
GRAV
MUD | F | M | C | G | P | C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
East Okerokovik River
Section 90ADL8
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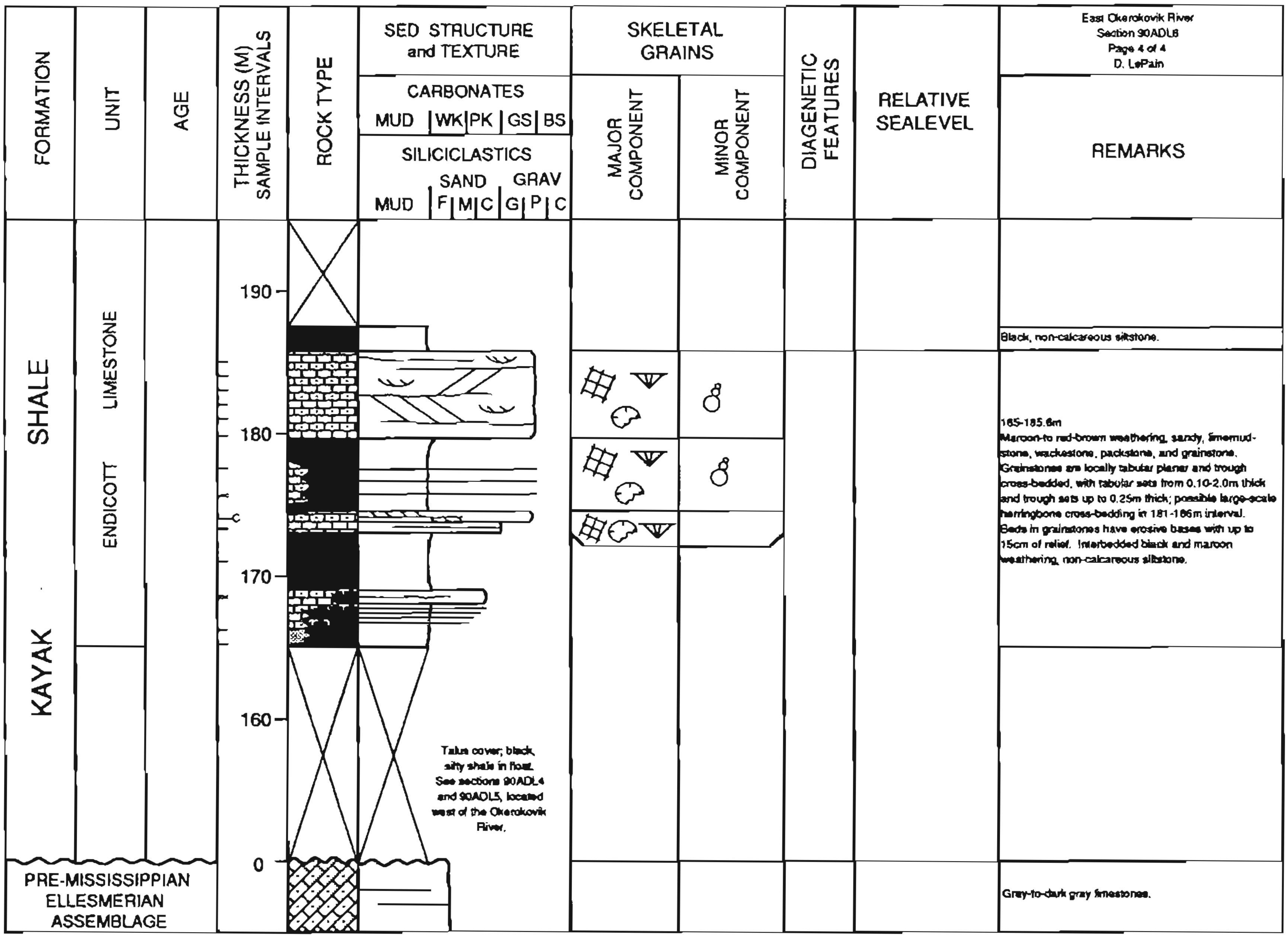
D. LePain
REMARKS
KAYAK
SHALE
ENDICOTT
LIMESTONE
200
210
220
230
240
L/C
Hydrocarbon Odor
237-249m
Maroon weathering wackestone/packstone and light gray weathering grainstone. Locally occurring coralline boundstone within wackestone and packstone
Dark gray weathering, silty limemudstone
225-233m
Tan-brown and maroon weathering grainstone and interbedded dark gray-to-maroon weathering wackestone and lime mudstone, locally occurring coralline boundstone. Grainstone beds have erosive bases and appear to be channel fill material; grainstones thicken to the west and cut down section.
Tan-brown-to red-brown weathering grainstone.
200-212m
Maroon weathering lime mudstone; mudstone passes gradually up section to light gray-to-maroon weathering wackestone with some thinly interbedded packstone. Minor coralline boundstone throughout the interval.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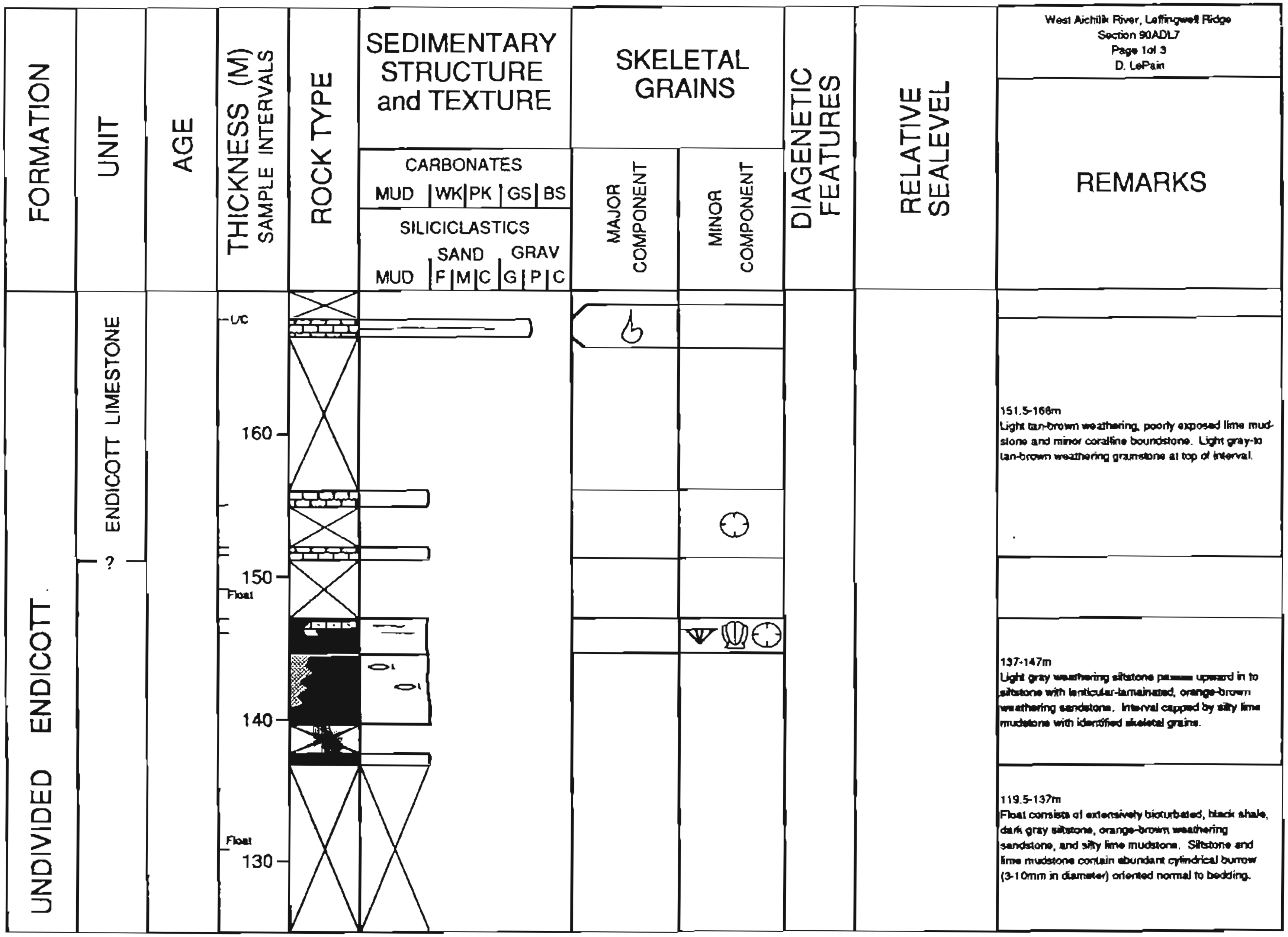
FORMATION
UNIT
AGE
THICKNESS (M) SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD WK PK GS BS
SILICICLASTICS
SAND GRAV
MUD F M C G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
KAYAK SHALE
ENDICOTT LIMESTONE
PRE-MISSISSIPPIAN ELLESMERIAN ASSEMBLAGE
190
180
170
160
0
Black, non-calcareous siltstone.
165-185.6m
Maroon-to red-brown weathering, sandy, limemud-stone, wackestone, packstone, and grainstone. Grainstones are locally tabular planar and trough cross-bedded, with tabular sets from 0.10-2.0m thick and trough sets up to 0.25m thick; possible large-scale herringbone cross-bedding in 181-186m interval. Beds in grainstones have erosive bases with up to 15cm of relief. Interbedded black and maroon weathering, non-calcareous siltstone.
Talus cover; black, silty shale in float. See sections 90ADL4 and 90ADL5, located west of the Okerokovik River.
Gray-to-dark gray limestones.



West Aichilik River, Leffingwell Ridge
Section 90ADL7
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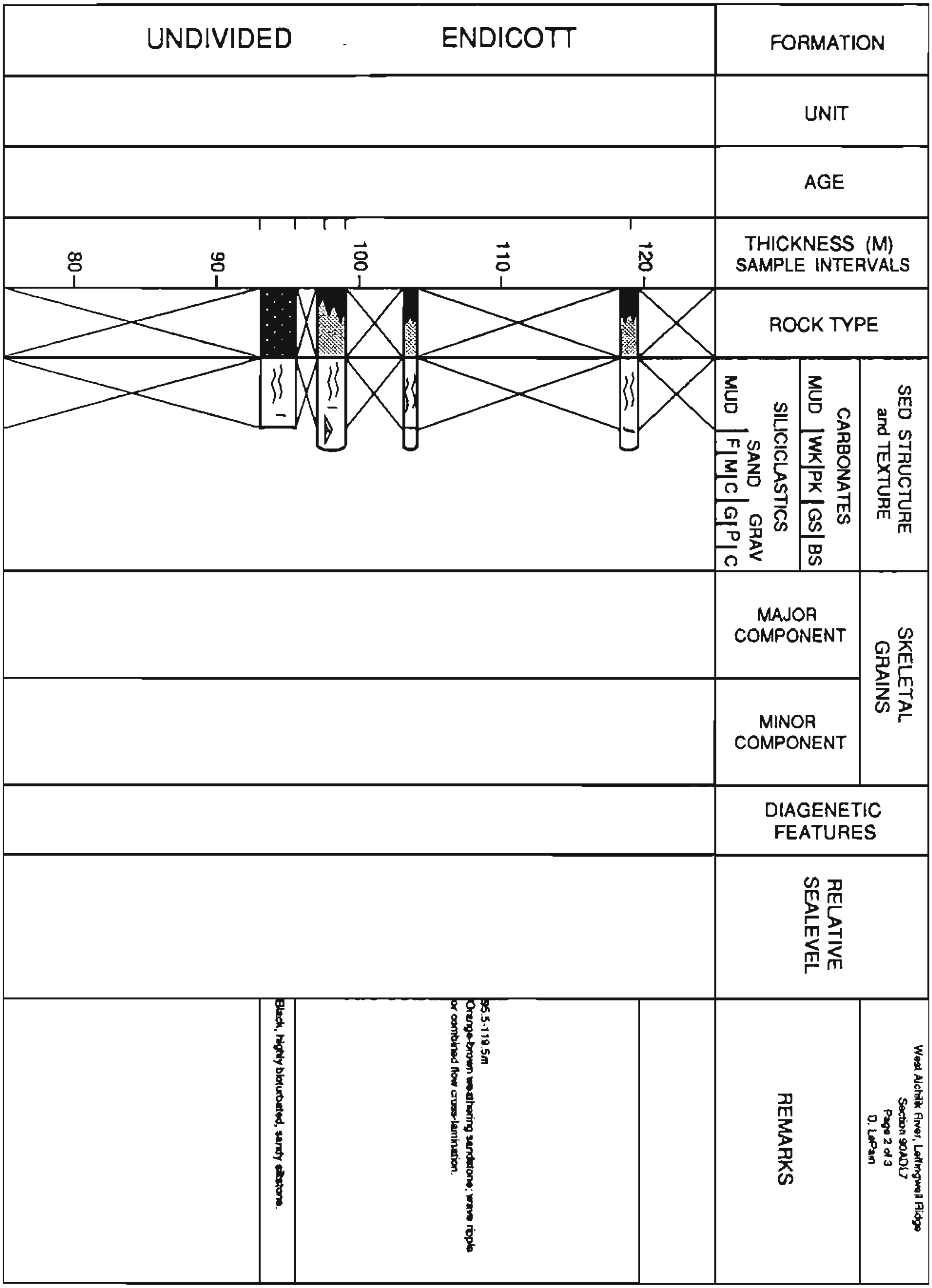
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SEDIMENTARY STRUCTURE and TEXTURE
CARBONATES
MUD WK PK GS BS
SILICICLASTICS
SAND GRAV
MUD F M C G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
UNDIVIDED ENDICOTT
ENDICOTT LIMESTONE
?
U/C
160
150
Float
140
Float
130
151.5-166m
Light tan-brown weathering, poorly exposed lime mudstone and minor coralline boundstone. Light gray-to tan-brown weathering grainstone at top of interval.
137-147m
Light gray weathering siltstone passes upward in to siltstone with lenticular-laminated, orange-brown weathering sandstone. Interval capped by silty lime mudstone with identified skeletal grains.
119.5-137m
Float consists of extensively bioturbated, black shale, dark gray siltstone, orange-brown weathering sandstone, and silty lime mudstone. Siltstone and lime mudstone contain abundant cylindrical burrow (3-10mm in diameter) oriented normal to bedding.



UNDIVIDED
ENDICOTT
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
80
90
100
110
120
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD
WK
PK
GS
BS
SILICICLASTICS
MUD
SAND
F
M
C
GRAV
G
P
C
MAJOR COMPONENT
MINOR COMPONENT
SKELETAL GRAINS
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
Black, highly bioturbated, sandy siltstone.
95.5-119.5m
Orange-brown weathering sandstone; wave ripple or combined flow cross-lamination.
West Aichilik River, Leffingwell Ridge
Section 90ADL7
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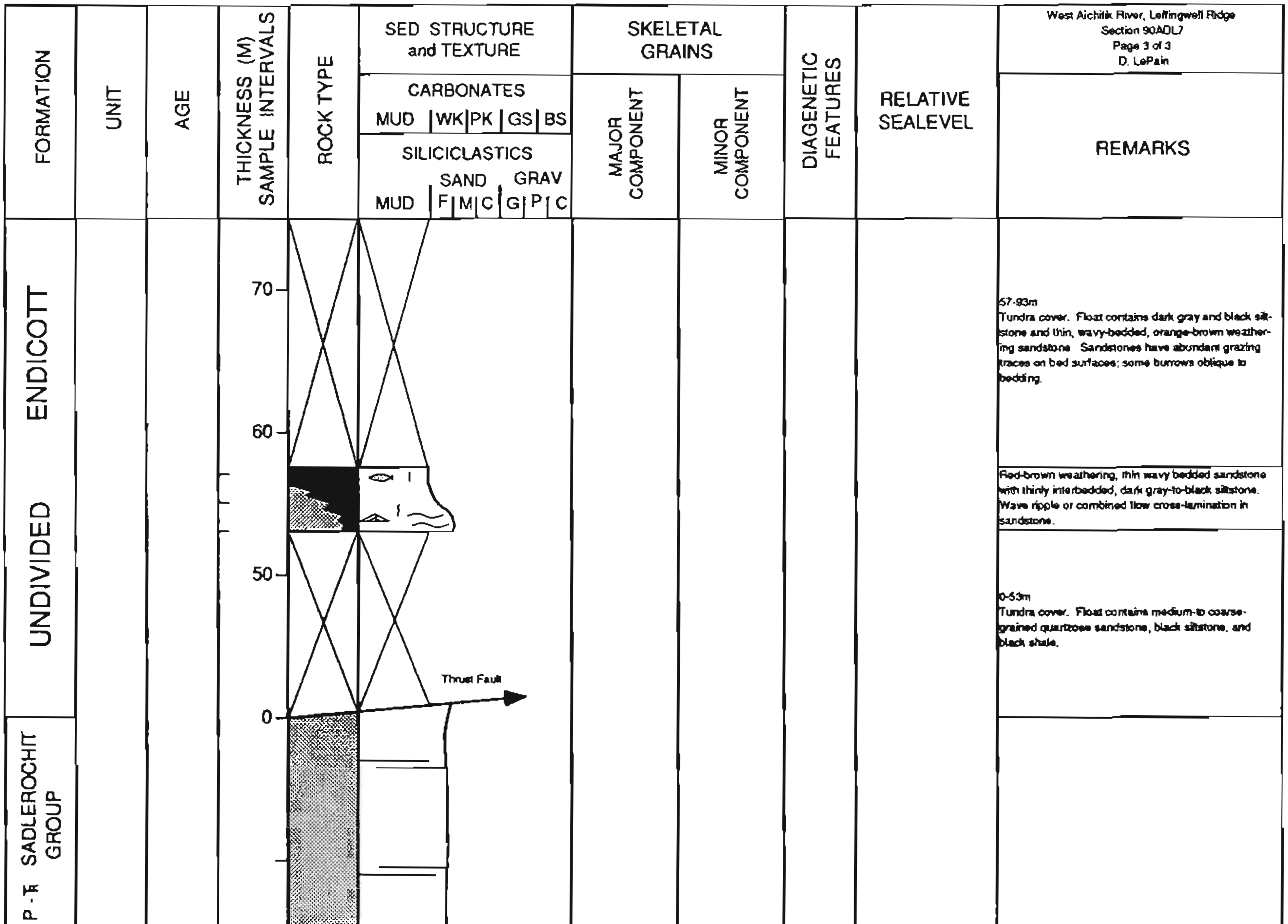

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Section 90ADL7
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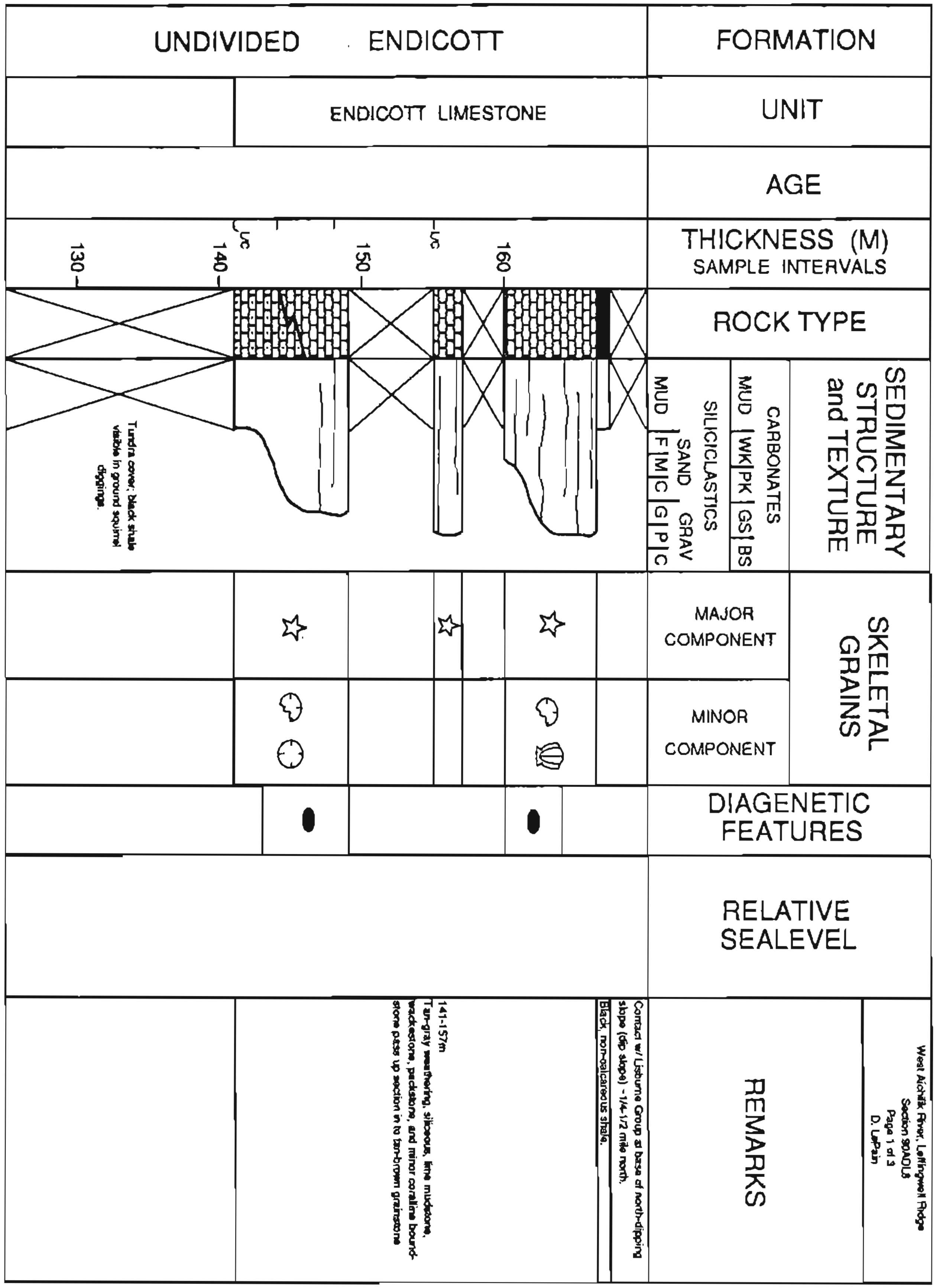
FORMATION
UNIT
AGE
THICKNESS (M) SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD | WK | PK | GS | BS
SILICICLASTICS
MUD | SAND F | M | C | GRAV G | P | C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
ENDICOTT
UNDIVIDED
P - TR SADLEROCHIT GROUP
70
60
50
0
Thrust Fault
57-93m
Tundra cover. Float contains dark gray and black siltstone and thin, wavy-bedded, orange-brown weathering sandstone Sandstones have abundant grazing traces on bed surfaces; some burrows oblique to bedding.
Red-brown weathering, thin wavy bedded sandstone with thinly interbedded, dark gray-to-black siltstone. Wave ripple or combined flow cross-lamination in sandstone.
0-53m
Tundra cover. Float contains medium-to coarse-grained quartzose sandstone, black siltstone, and black shale.


UNDIVIDED
ENDICOTT
FORMATION
ENDICOTT LIMESTONE
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
130
140
150
160
ROCK TYPE
SEDIMENTARY STRUCTURE and TEXTURE
CARBONATES
MUD | WK | PK | GS | BS
SILICICLASTICS
MUD | SAND F | M | C | GRAV G | P | C
Tundra cover; black shale visible in ground squirrel diggings.
MAJOR COMPONENT
MINOR COMPONENT
SKELETAL GRAINS
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
141-157m
Tan-gray weathering, siliceous, lime mudstone, wackestone, packstone, and minor coralline bound-stone pass up section in to tan-brown grainstone
Black, non-calcareous shale.
Contact w/ Lisburne Group at base of north-dipping slope (dip slope) ~1/4-1/2 mile north.
West Aichilik River, Leffingwell Ridge
Section 90ADL8
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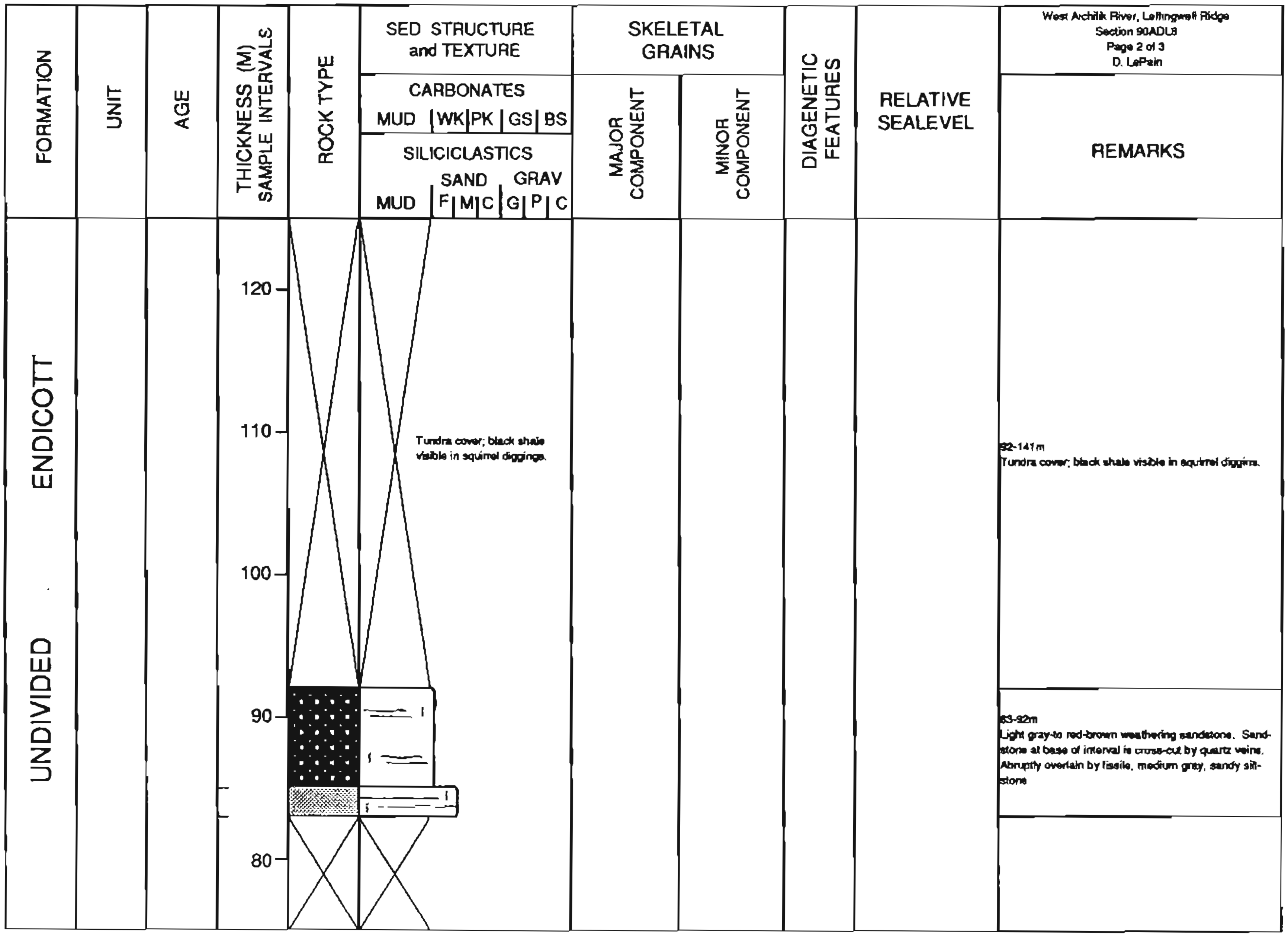
West Archilik River, Leffingwell Ridge
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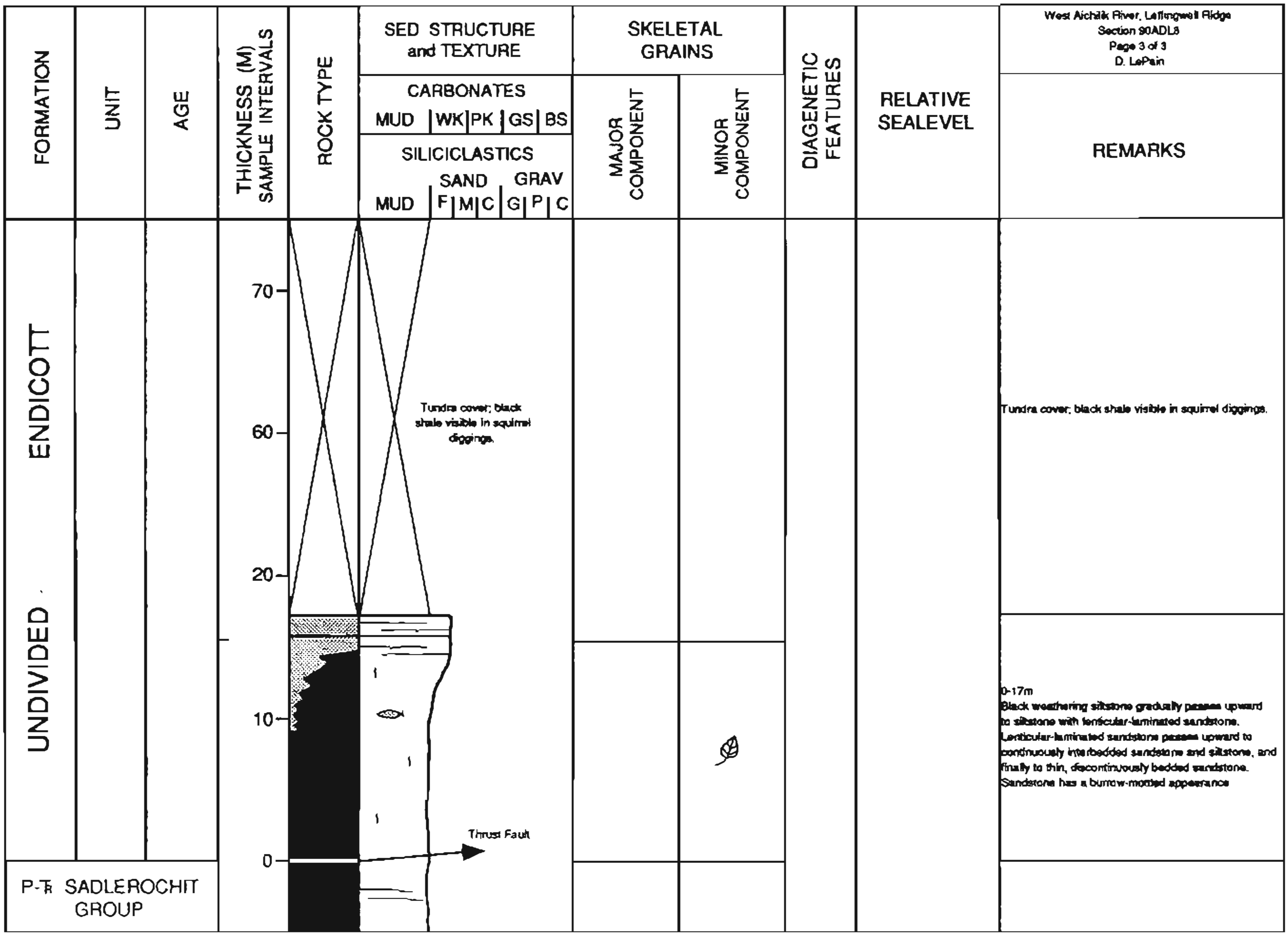
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD WK PK GS BS
SILICICLASTICS
MUD
SAND F M C
GRAV G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
UNDIVIDED
ENDICOTT
120
110
100
90
80
Tundra cover; black shale visible in squirrel diggings.
92-141m
Tundra cover; black shale visible in squirrel diggins.
83-92m
Light gray-to red-brown weathering sandstone. Sandstone at base of interval is cross-cut by quartz veins. Abruptly overlain by fissile, medium gray, sandy siltstone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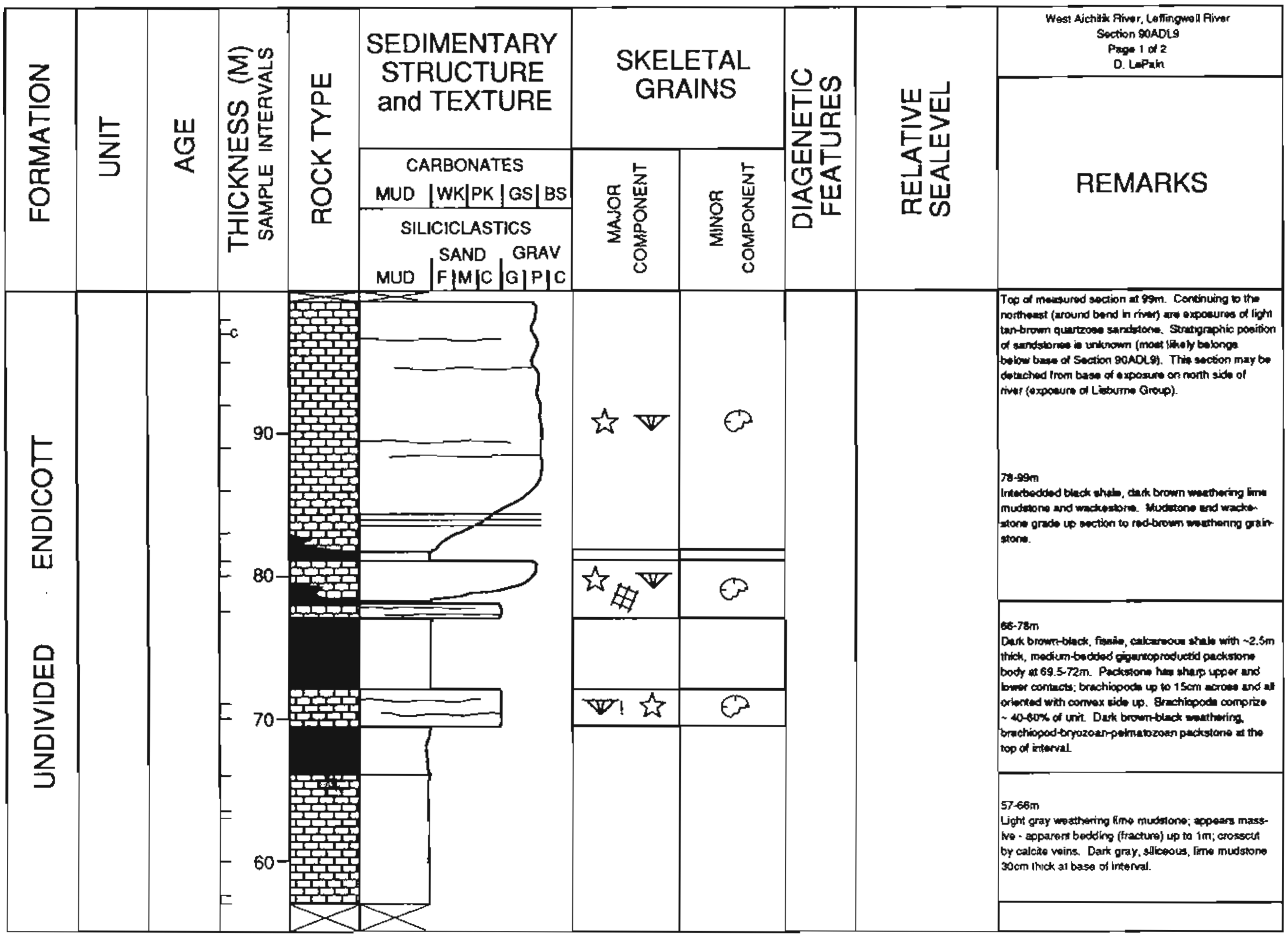
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD
WK
PK
GS
BS
SILICICLASTICS
MUD
SAND
F
M
C
GRAV
G
P
C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
ENDICOTT
UNDIVIDED
P-Ŧ SADLEROCHIT GROUP
70
60
20
10
0
Tundra cover; black shale visible in squirrel diggings.
Thrust Fault
Tundra cover; black shale visible in squirrel diggings.
0-17m
Black weathering siltstone gradually passes upward to siltstone with lenticular-laminated sandstone. Lenticular-laminated sandstone passes upward to continuously interbedded sandstone and siltstone, and finally to thin, discontinuously bedded sandstone. Sandstone has a burrow-mottled appearance


West Aichilik River, Leffingwell River
Section 90ADL9
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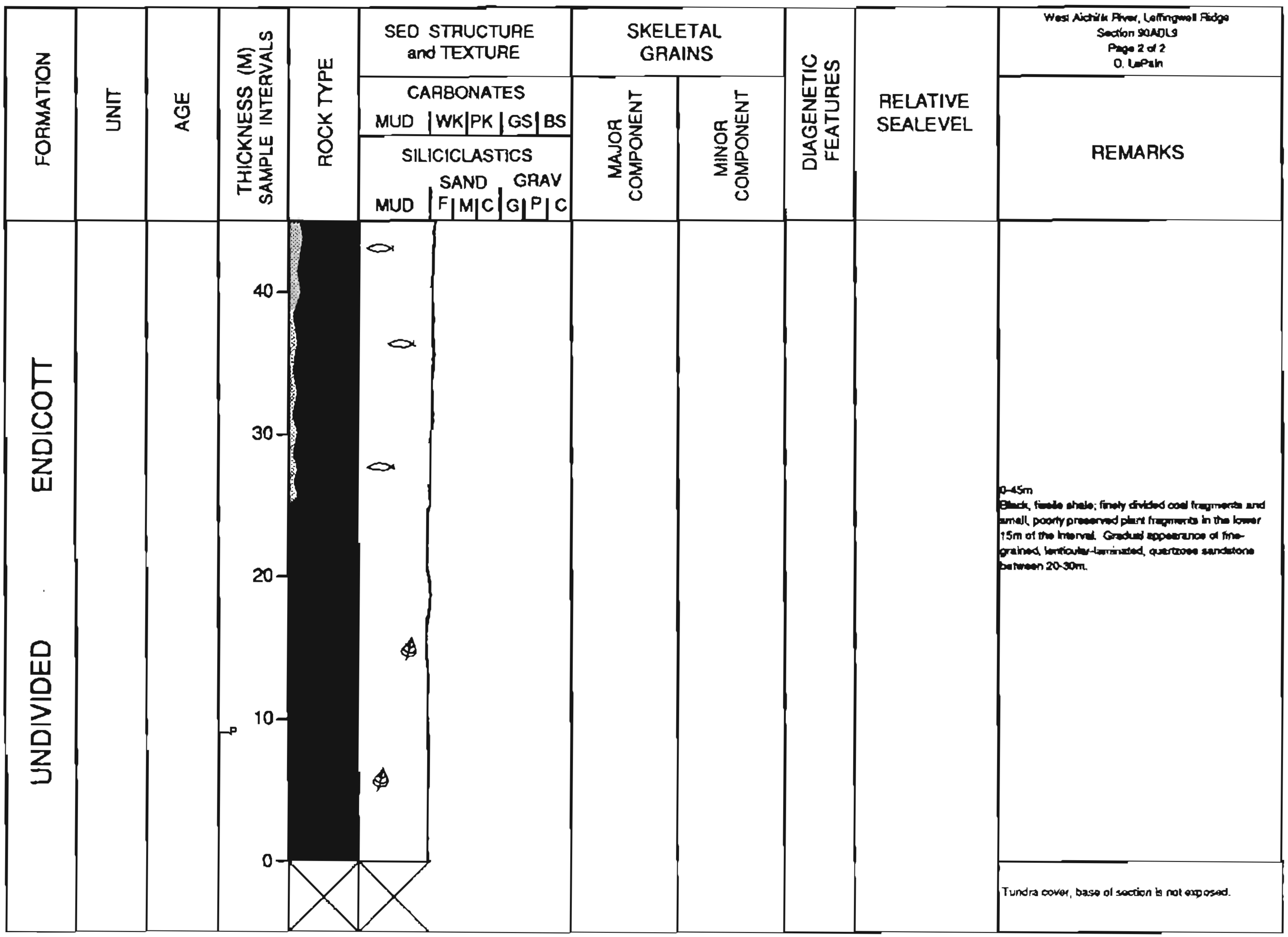
D. LePain
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SEDIMENTARY STRUCTURE and TEXTURE
CARBONATES
MUD WK PK GS BS
SILICICLASTICS
SAND GRAV
MUD F M C G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
UNDIVIDED ENDICOTT
c
90
80
70
60
Top of measured section at 99m. Continuing to the northeast (around bend in river) are exposures of light tan-brown quartzose sandstone. Stratigraphic position of sandstones is unknown (most likely belongs below base of Section 90ADL9). This section may be detached from base of exposure on north side of river (exposure of Lisburne Group).
78-99m
Interbedded black shale, dark brown weathering lime mudstone and wackestone. Mudstone and wacke-stone grade up section to red-brown weathering grain-stone.
66-78m
Dark brown-black, fissile, calcareous shale with ~2.5m thick, medium-bedded gigantoproductid packstone body at 69.5-72m. Packstone has sharp upper and lower contacts; brachiopods up to 15cm across and all oriented with convex side up. Brachiopods comprize ~ 40-60% of unit. Dark brown-black weathering, brachiopod-bryozoan-pelmatozoan packstone at the top of interval.
57-66m
Light gray weathering lime mudstone; appears mass-ive - apparent bedding (fracture) up to 1m; crosscut by calcite veins. Dark gray, siliceous, lime mudstone 30cm thick at base of interval.


West Aichilik River, Leffingwell Ridge
Section 90ADL9
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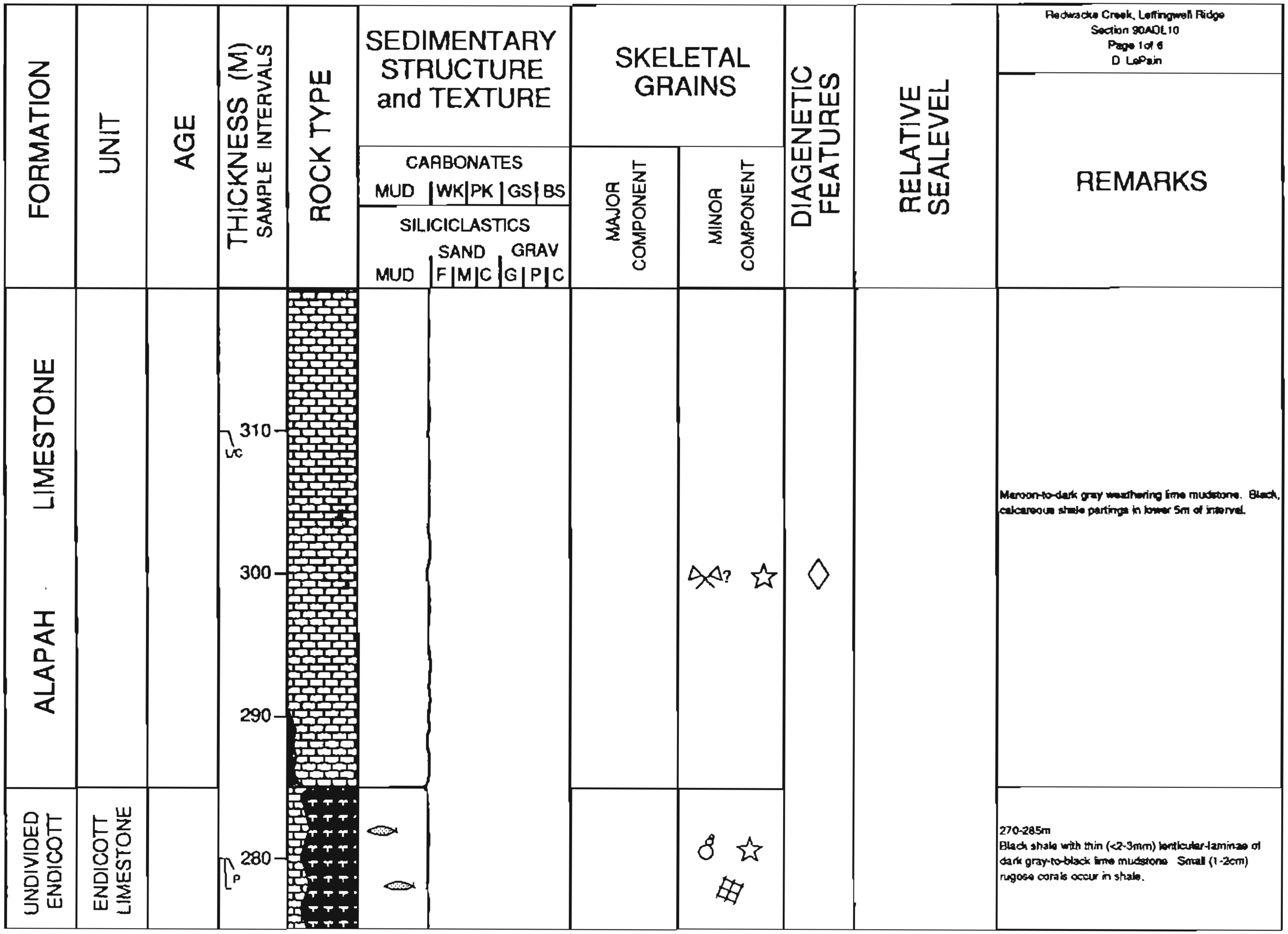
O. LePain
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD | WK | PK | GS | BS
SILICICLASTICS
MUD
SAND F | M | C
GRAV G | P | C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
ENDICOTT
UNDIVIDED
0
10
20
30
40
0-45m
Black, fissile shale; finely divided coal fragments and small, poorly preserved plant fragments in the lower 15m of the interval. Gradual appearance of fine-grained, lenticular-laminated, quartzose sandstone between 20-30m.
Tundra cover, base of section is not exposed.


FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SEDIMENTARY STRUCTURE and TEXTURE
CARBONATES
MUD | WK | PK | GS | BS
SILICICLASTICS
MUD
SAND
F | M | C
GRAV
G | P | C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
Redwacke Creek, Leffingwell Ridge
Section 90ADL10
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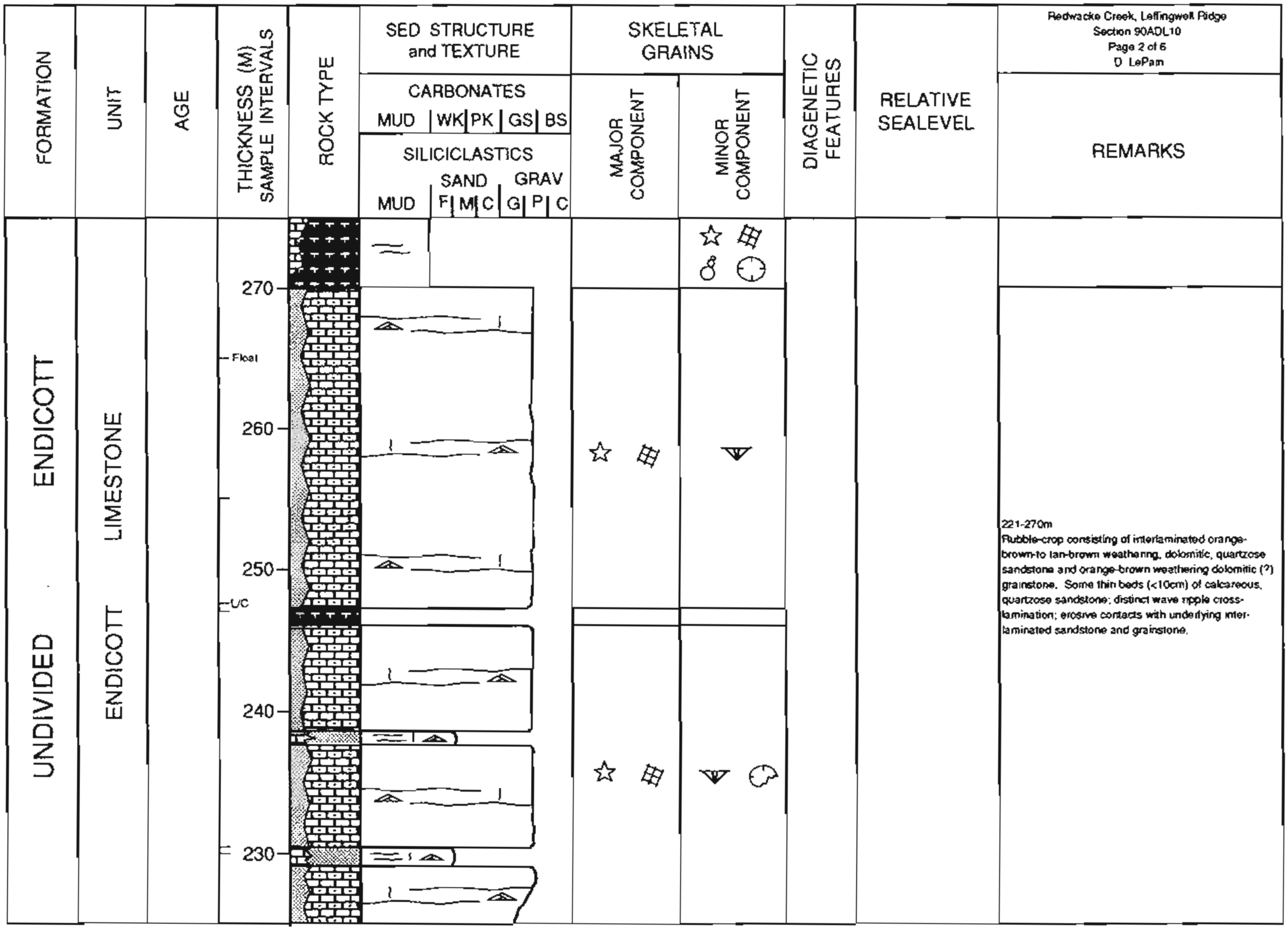
REMARKS
ALAPAH LIMESTONE
UNDIVIDED ENDICOTT
ENDICOTT LIMESTONE
310
300
290
280
LC
P
?
Maroon-to-dark gray weathering lime mudstone. Black, calcareous shale partings in lower 5m of interval.
270-285m
Black shale with thin (<2-3mm) lenticular-laminae of dark gray-to-black lime mudstone. Small (1-2cm) rugose corals occur in shale.


FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD
WK
PK
GS
BS
SILICICLASTICS
MUD
SAND
F
M
C
GRAV
G
P
C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
Redwacke Creek, Leffingwell Ridge
Section 90ADL10
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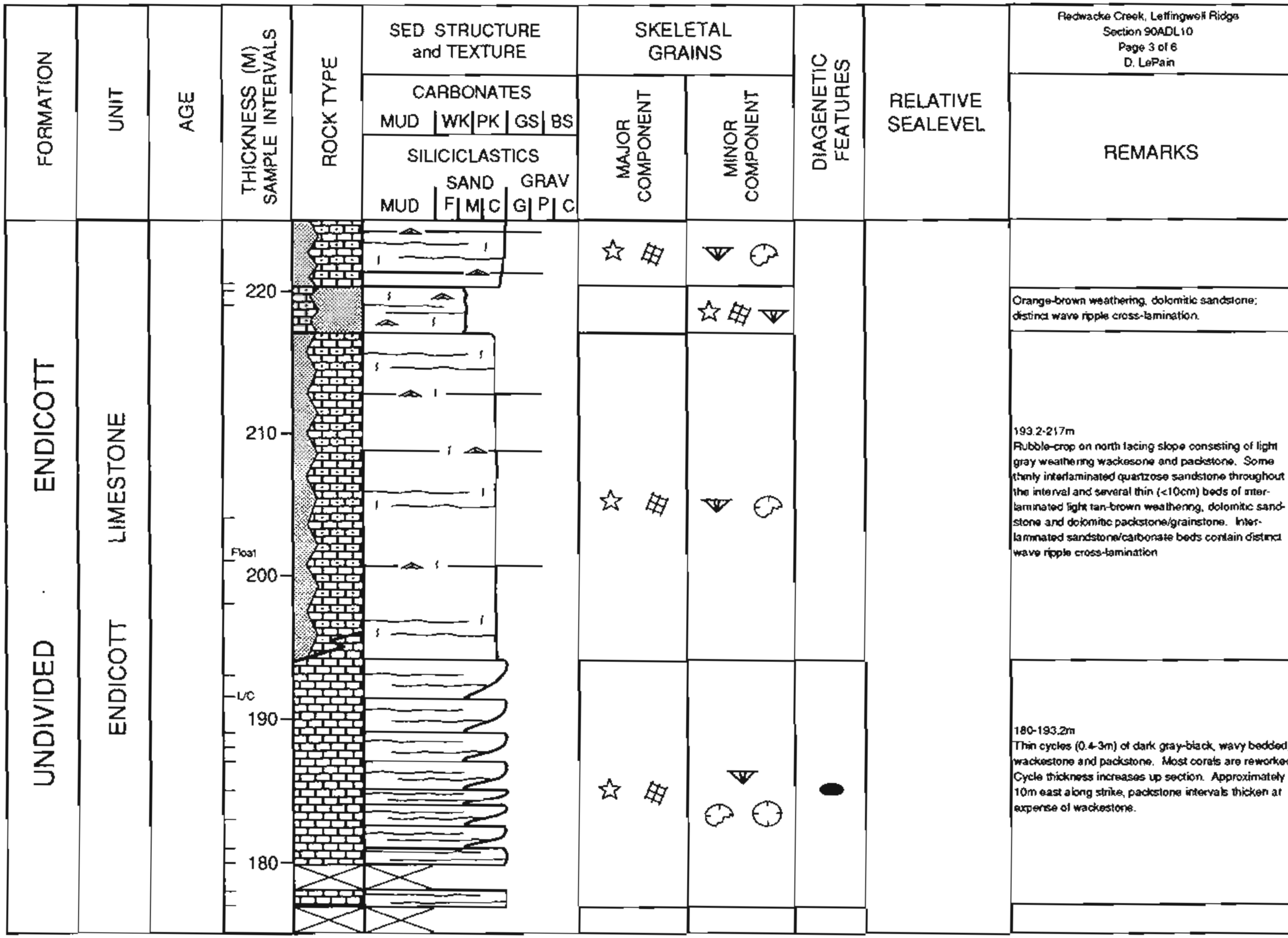
D LePain
UNDIVIDED ENDICOTT
ENDICOTT LIMESTONE
270
Float
260
250
U/C
240
230
221-270m
Rubble-crop consisting of interlaminated orange-brown-to tan-brown weathering, dolomitic, quartzose sandstone and orange-brown weathering dolomitic (?) grainstone. Some thin beds (<10cm) of calcareous, quartzose sandstone; distinct wave ripple cross-lamination; erosive contacts with underlying interlaminated sandstone and grainstone.


FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD
WK
PK
GS
BS
SILICICLASTICS
MUD
SAND
F
M
C
GRAV
G
P
C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
Redwacke Creek, Leffingwell Ridge
Section 90ADL10
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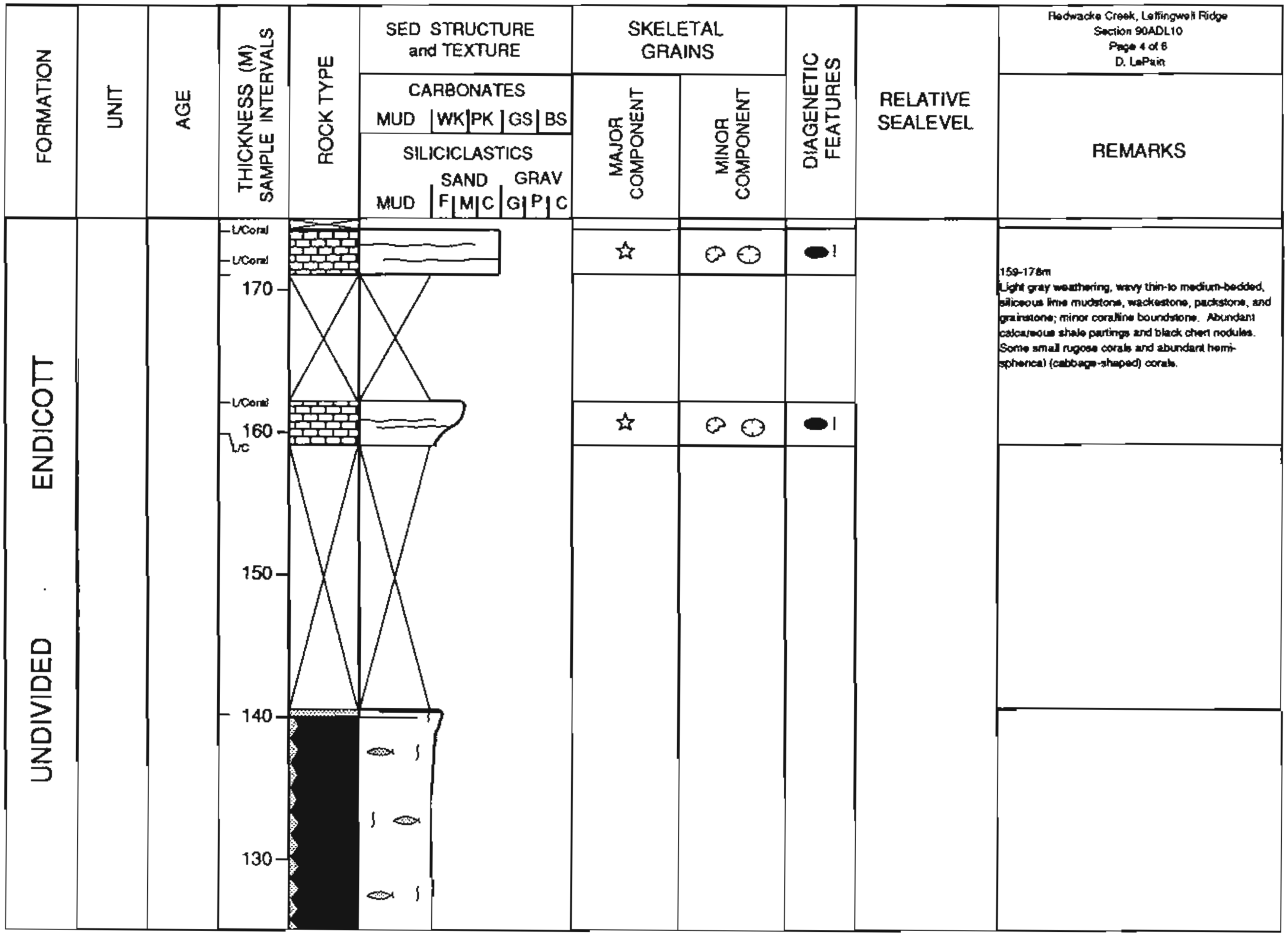
REMARKS
UNDIVIDED ENDICOTT
ENDICOTT LIMESTONE
220
210
Float
200
L/C
190
180
Orange-brown weathering, dolomitic sandstone; distinct wave ripple cross-lamination.
193.2-217m
Rubble-crop on north facing slope consisting of light gray weathering wackesone and packstone. Some thinly interlaminated quartzose sandstone throughout the interval and several thin (<10cm) beds of inter-laminated light tan-brown weathering, dolomitic sand-stone and dolomitic packstone/grainstone. Inter-laminated sandstone/carbonate beds contain distinct wave ripple cross-lamination
180-193.2m
Thin cycles (0.4-3m) of dark gray-black, wavy bedded, wackestone and packstone. Most corals are reworked. Cycle thickness increases up section. Approximately 10m east along strike, packstone intervals thicken at expense of wackestone.



Redwacke Creek, Leffingwell Ridge
Section 90ADL10
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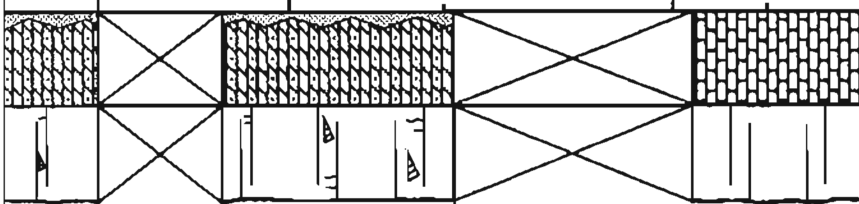
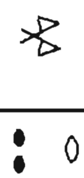
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD WK PK GS BS
SILICICLASTICS
MUD
SAND F M C
GRAV G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
UNDIVIDED ENDICOTT
L/Coral
L/Coral
170
L/Coral
160
L/C
150
140
130
159-176m
Light gray weathering, wavy thin-to medium-bedded, siliceous lime mudstone, wackestone, packstone, and grainstone; minor coralline boundstone. Abundant calcareous shale partings and black chert nodules. Some small rugose corals and abundant hemi-spherical (cabbage-shaped) corals.

KAYAK SHALE	?	ALAPAH LIMESTONE	FORMATION
			UNIT
			AGE
320, 330, 338, 390, 395		L/C	THICKNESS (M) SAMPLE INTERVALS
			ROCK TYPE
			SEDIMENTARY STRUCTURE and TEXTURE (CARBONATES: MUD, WK, PK, GS, BS; SILICICLASTICS: MUD, SAND F, M, C, GRAV G, P, C)
			SKELETAL GRAINS: MAJOR COMPONENT
			SKELETAL GRAINS: MINOR COMPONENT
			DIAGENETIC FEATURES
			RELATIVE SEALEVEL
Tundra cover; shale in float		Dark gray weathering lime mudstone.	REMARKS





West Kongakut River
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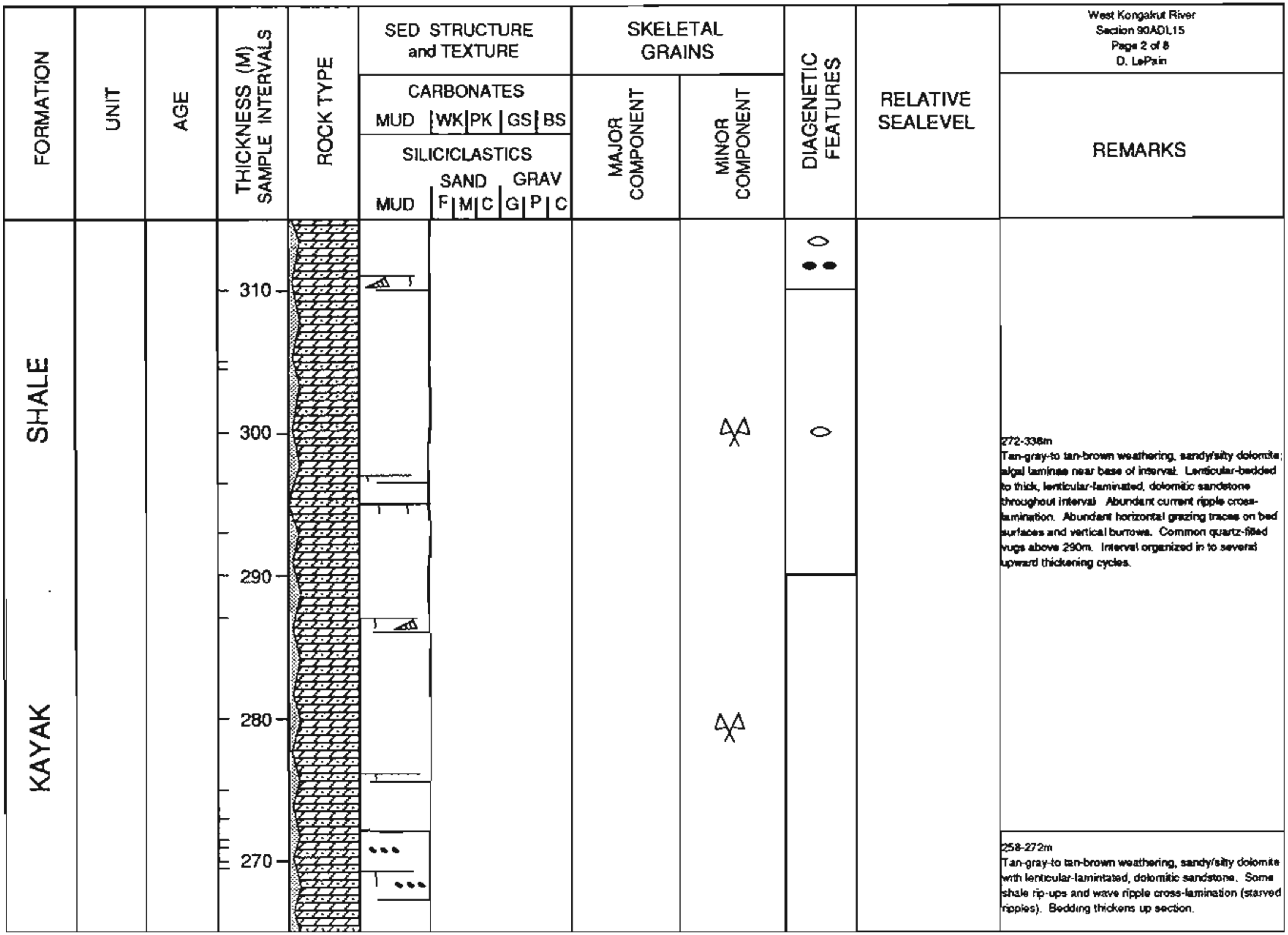

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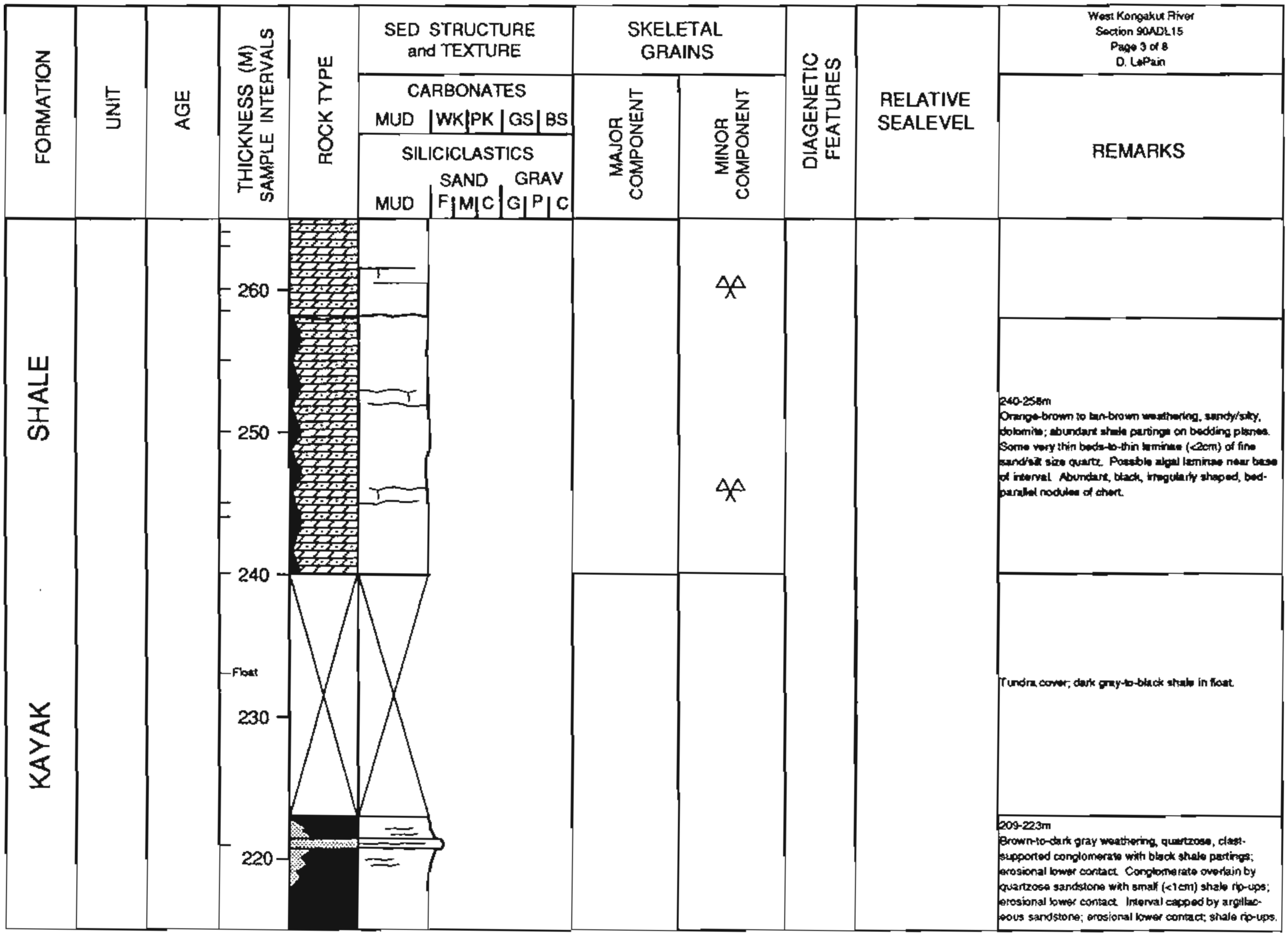
SILICICLASTICS
SAND GRAV
MUD F M C G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
KAYAK SHALE
310
300
290
280
270
272-338m
Tan-gray-to tan-brown weathering, sandy/silty dolomite; algal laminae near base of interval. Lenticular-bedded to thick, lenticular-laminated, dolomitic sandstone throughout interval. Abundant current ripple cross-lamination. Abundant horizontal grazing traces on bed surfaces and vertical burrows. Common quartz-filled vugs above 290m. Interval organized in to several upward thickening cycles.
258-272m
Tan-gray-to tan-brown weathering, sandy/silty dolomite with lenticular-lamintated, dolomitic sandstone. Some shale rip-ups and wave ripple cross-lamination (starved ripples). Bedding thickens up section.



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F
M
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GRAV
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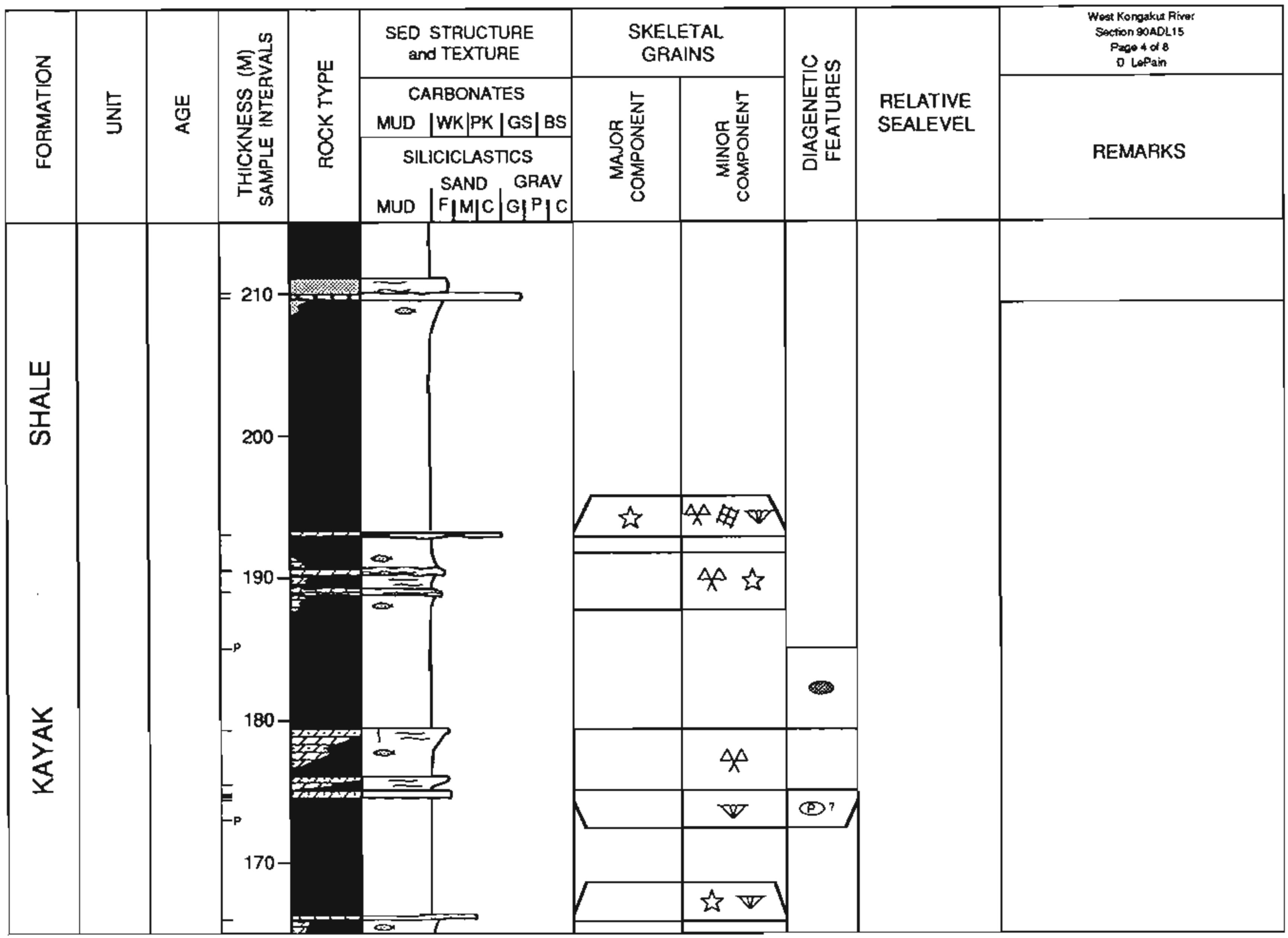
P
C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
SHALE
KAYAK
260
250
240
230
220
Float
240-258m
Orange-brown to tan-brown weathering, sandy/silty, dolomite; abundant shale partings on bedding planes. Some very thin beds-to-thin laminae (<2cm) of fine sand/silt size quartz. Possible algal laminae near base of interval. Abundant, black, irregularly shaped, bed-parallel nodules of chert.
Tundra cover; dark gray-to-black shale in float.
209-223m
Brown-to-dark gray weathering, quartzose, clast-supported conglomerate with black shale partings; erosional lower contact. Conglomerate overlain by quartzose sandstone with small (<1cm) shale rip-ups; erosional lower contact. Interval capped by argillaceous sandstone; erosional lower contact; shale rip-ups.



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UNIT
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THICKNESS (M) SAMPLE INTERVALS
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD WK PK GS BS
SILICICLASTICS
MUD SAND F M C GRAV G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
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REMARKS
SHALE
KAYAK
210
200
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180
170
P
P

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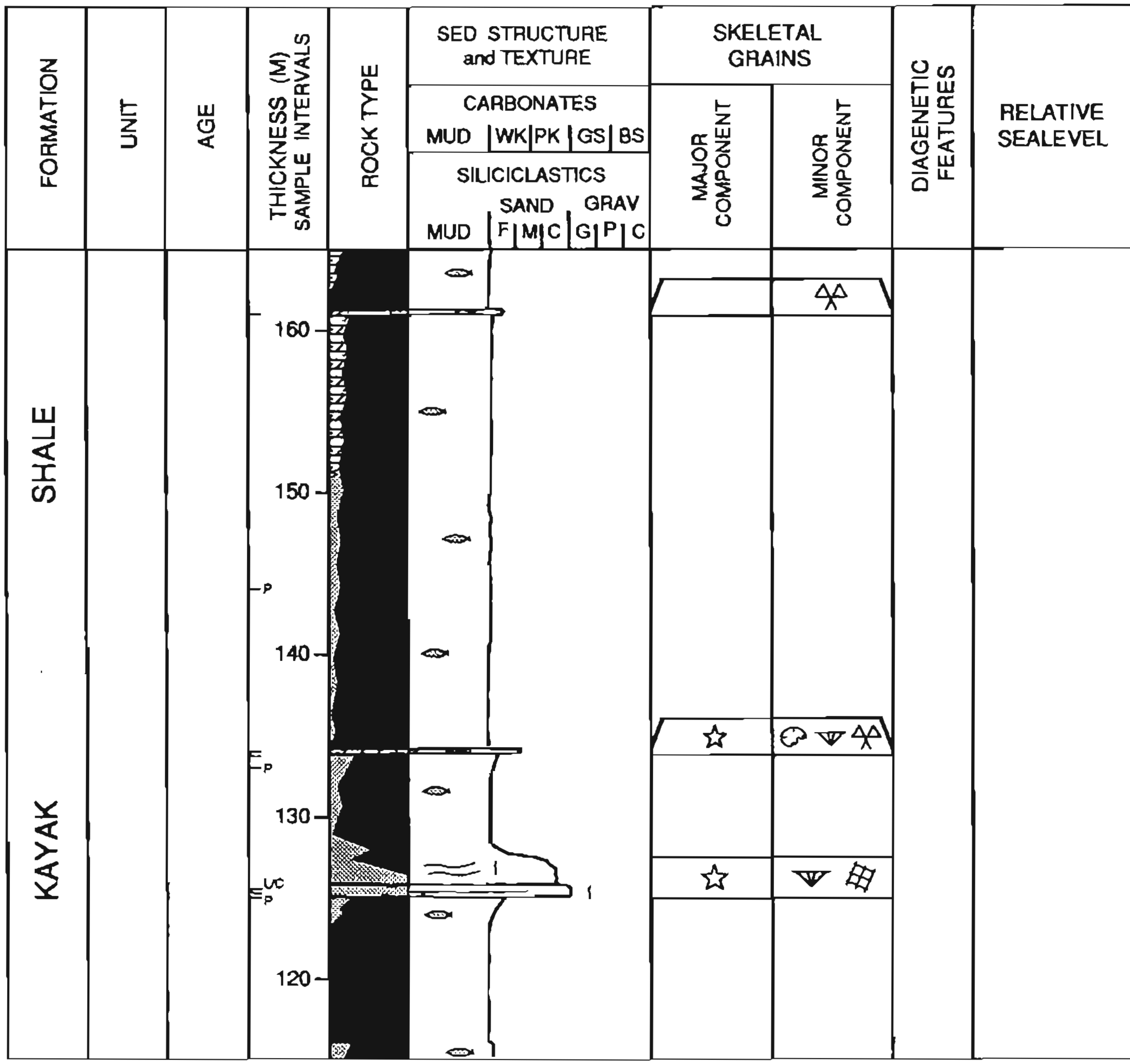

REMARKS

133.7-209m
Black, organic-rich shale with lenticular-laminated, silty, quartzose sandstone; sandstone grades up section to lenticular-laminated, silty lime mudstone/wackestone/packstone. At least seven upward coarsening and/or thickening cycles in this interval - some capped by wackestone/packstone beds with irregular lower contacts.

125.5-133.7m
Orange-brown weathering, dolomitic, quartzose sandstone at base; erosional lower contact and several internal erosional surfaces; sharp upper contact. Burrow-mottled appearance. Basal sandstone overlain by interbedded, dark orange-brown weathering, dolomitic, quartzose sandstone and black shale.

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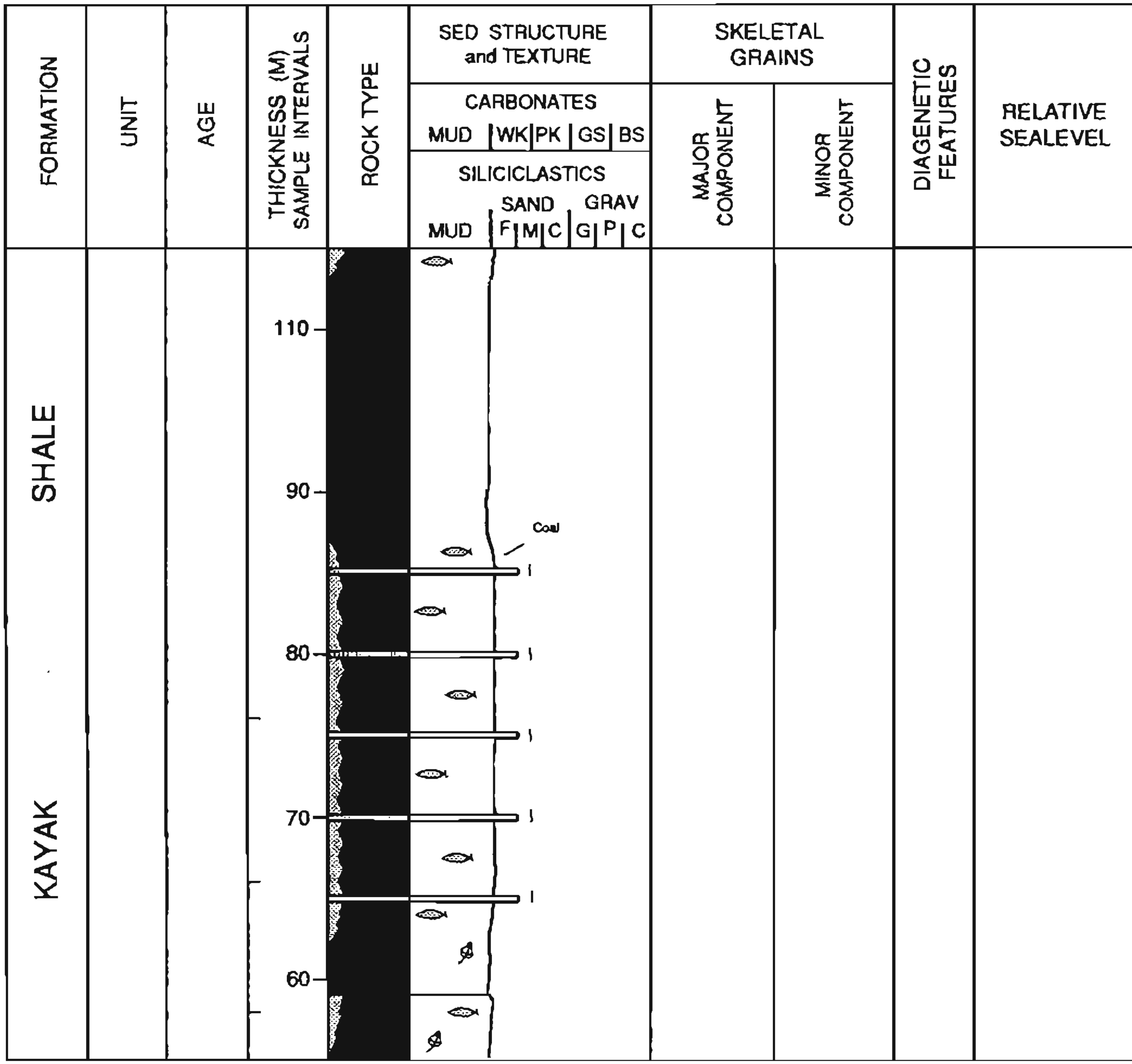

REMARKS

87-125.5m
Dark black, red-brown weathering, silty shale. Interval contains at least two upward coarsening/thickening cycles defined by upward increase in lenticular-laminated sandstone.

59–67m
Structurally disrupted zone of clayey siltstone and several thin beds of light gray weathering, bioturbated, fine-grained quartzose sandstone. Stratigraphic position of sands within this interval is approximate due to structural disruption. No visible plant remains except for scattered, small pieces of coal near top of interval.

51-59m
Black, organic-rich shale with small, broken plant fragments. Grades up section to shale with lenticular-laminated sandstone.

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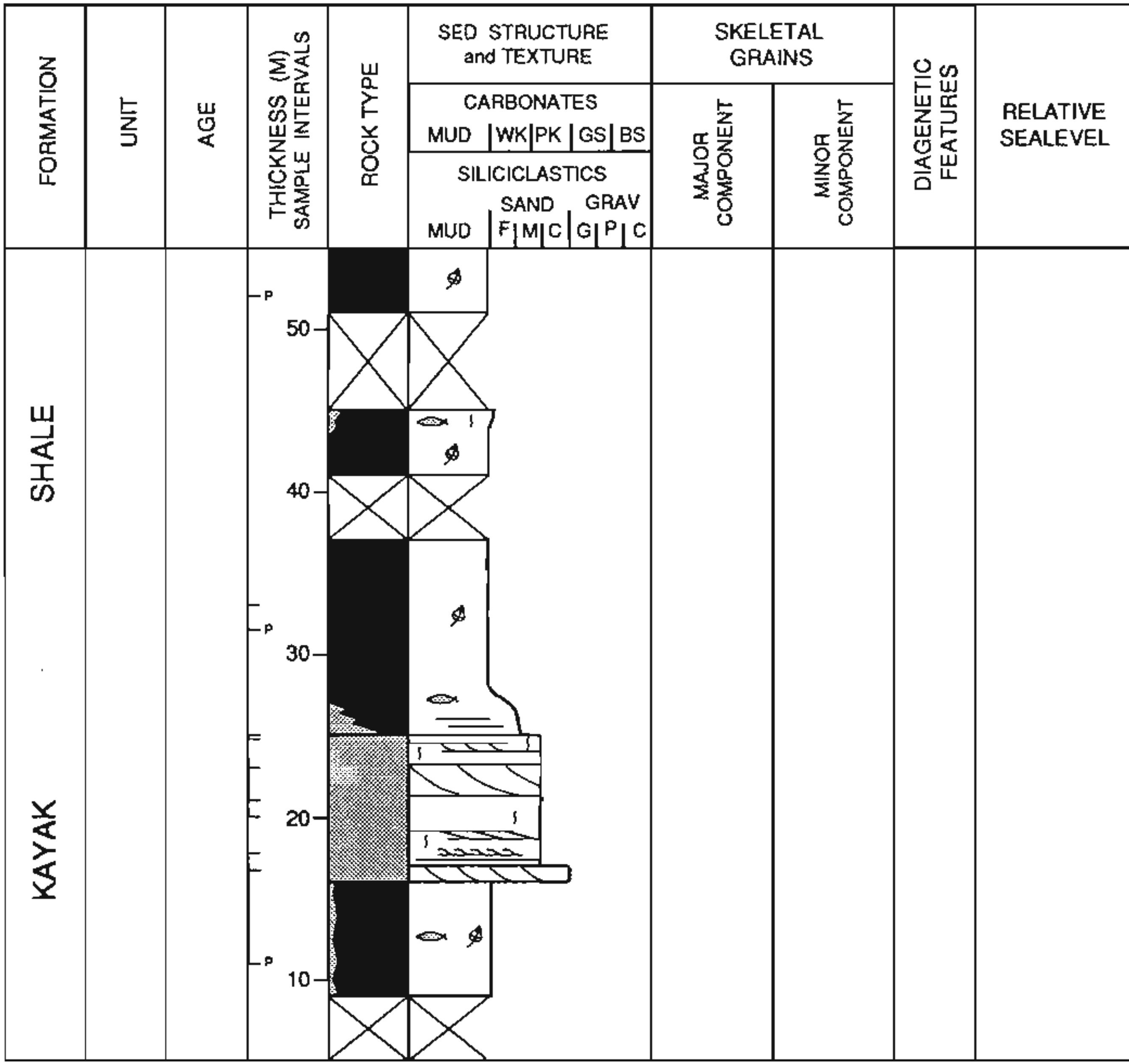
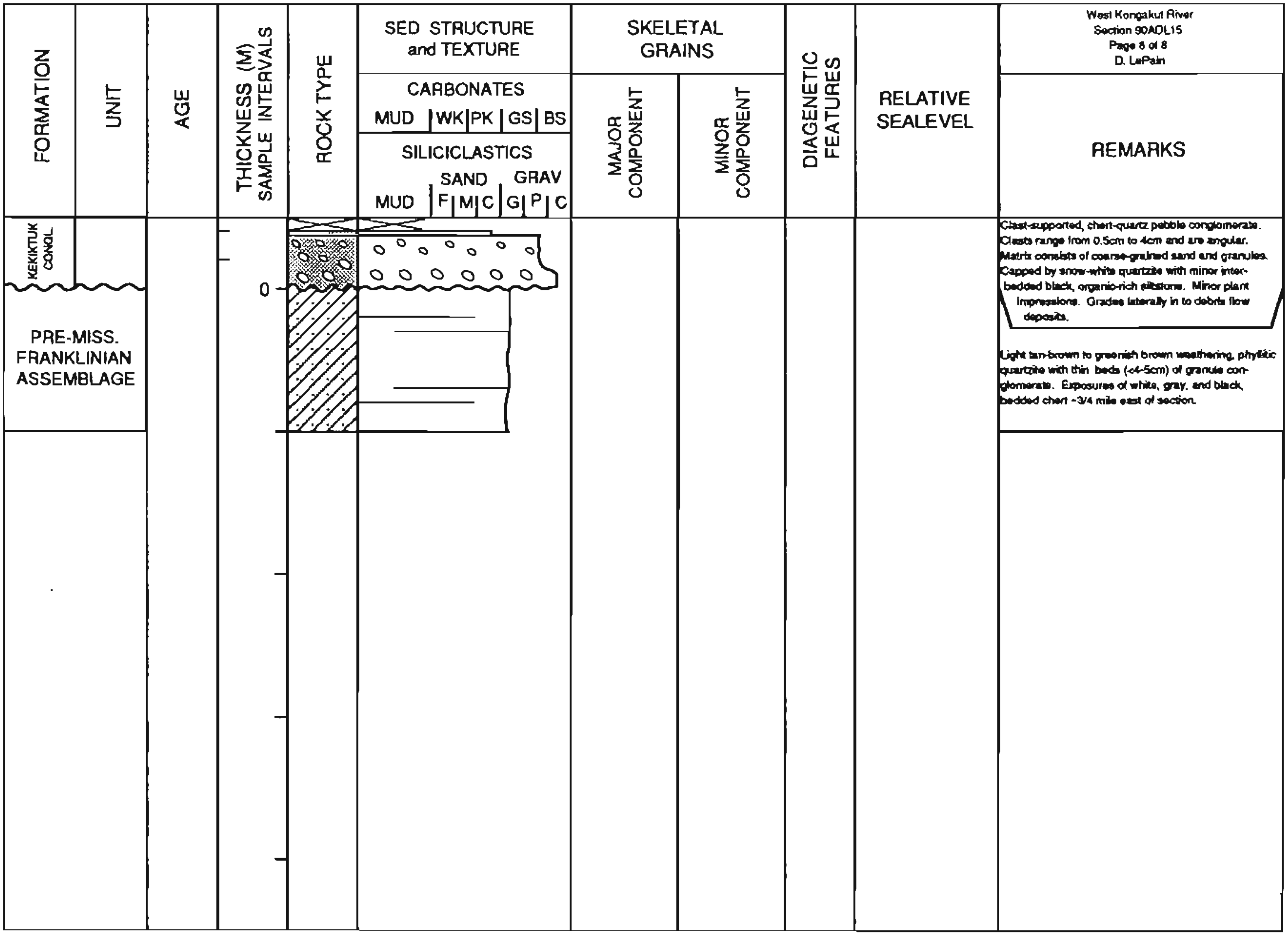


REMARKS

25-51m
Black, organic-rich shale with interbedded fine-grained quartzose sandstone grading upward into black, organic-rich shale. Abundant small (2-6cm) coalified plant fragments. Sandstone is moderately bioturbated. Several thin (4-6cm), discontinuous beds of resistant, well-indurated siltstone within shale.

16-25m
Light tan-brown to dark red-brown weathering, quartzose sandstone. Bedding within the 23-25m interval thickens toward the southwest from 3-15cm to 40-80cm over a distance of <10m.

5-16m
Dark black, organic-rich, clayey siltstone with abundant coalified plant fragments. Some plant fragments up to 20cm long and consists primarily of narrow, frond-like leaves. Some thin (<5mm)lenticular laminae of bioturbated, snow-white, fine-grained quartzite.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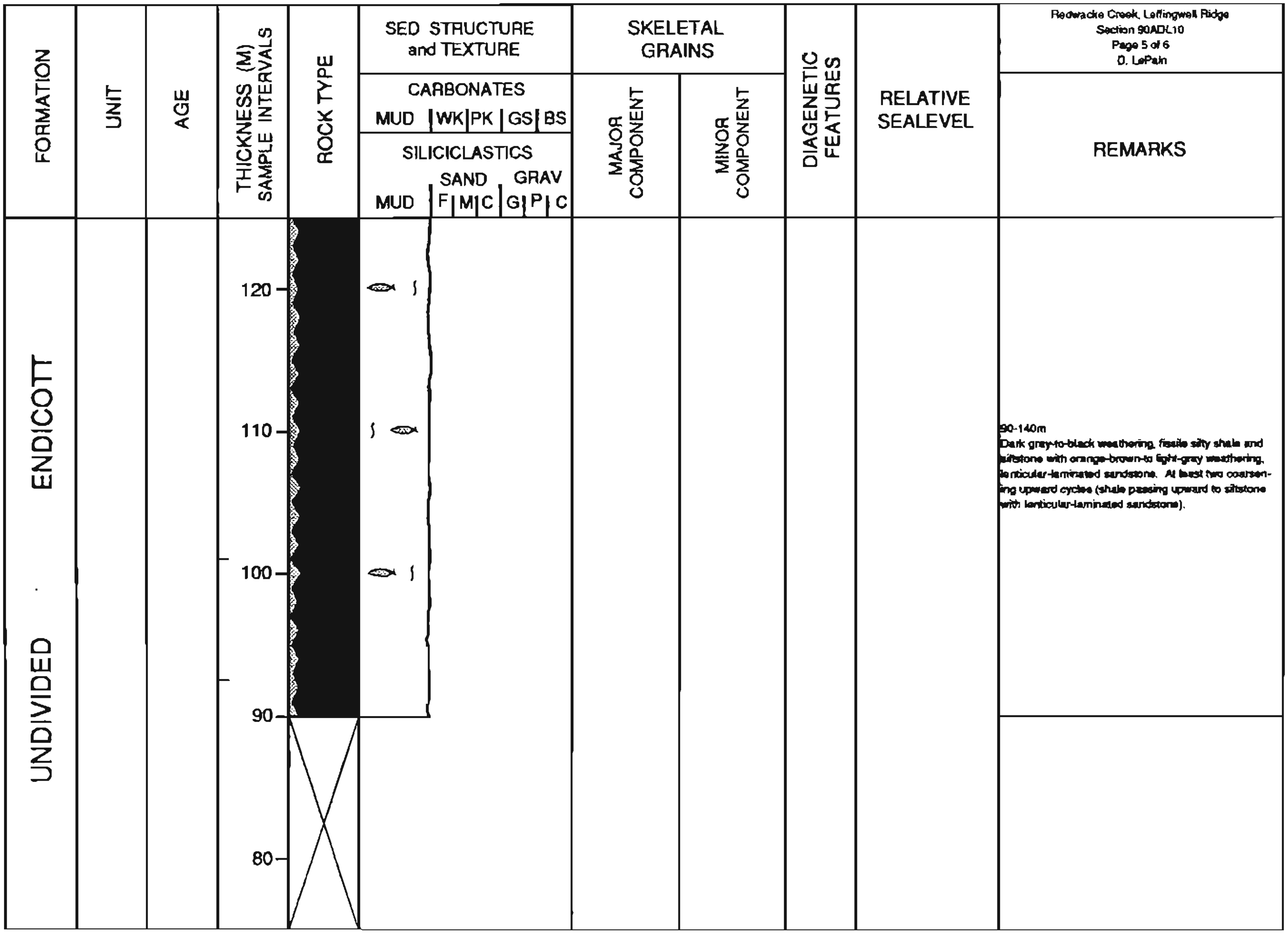
GS
BS
SILICICLASTICS
MUD
SAND
F
M
C
GRAV
G
P
C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
KEKIKTUK CONGL.
PRE-MISS. FRANKLINIAN ASSEMBLAGE
0
Clast-supported, chert-quartz pebble conglomerate. Clasts range from 0.5cm to 4cm and are angular. Matrix consists of coarse-grained sand and granules. Capped by snow-white quartzite with minor interbedded black, organic-rich siltstone. Minor plant impressions. Grades laterally in to debris flow deposits.
Light tan-brown to greenish brown weathering, phyllitic quartzite with thin beds (<4-5cm) of granule conglomerate. Exposures of white, gray, and black, bedded chert ~3/4 mile east of section.



Redwacke Creek, Leffingwell Ridge
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C
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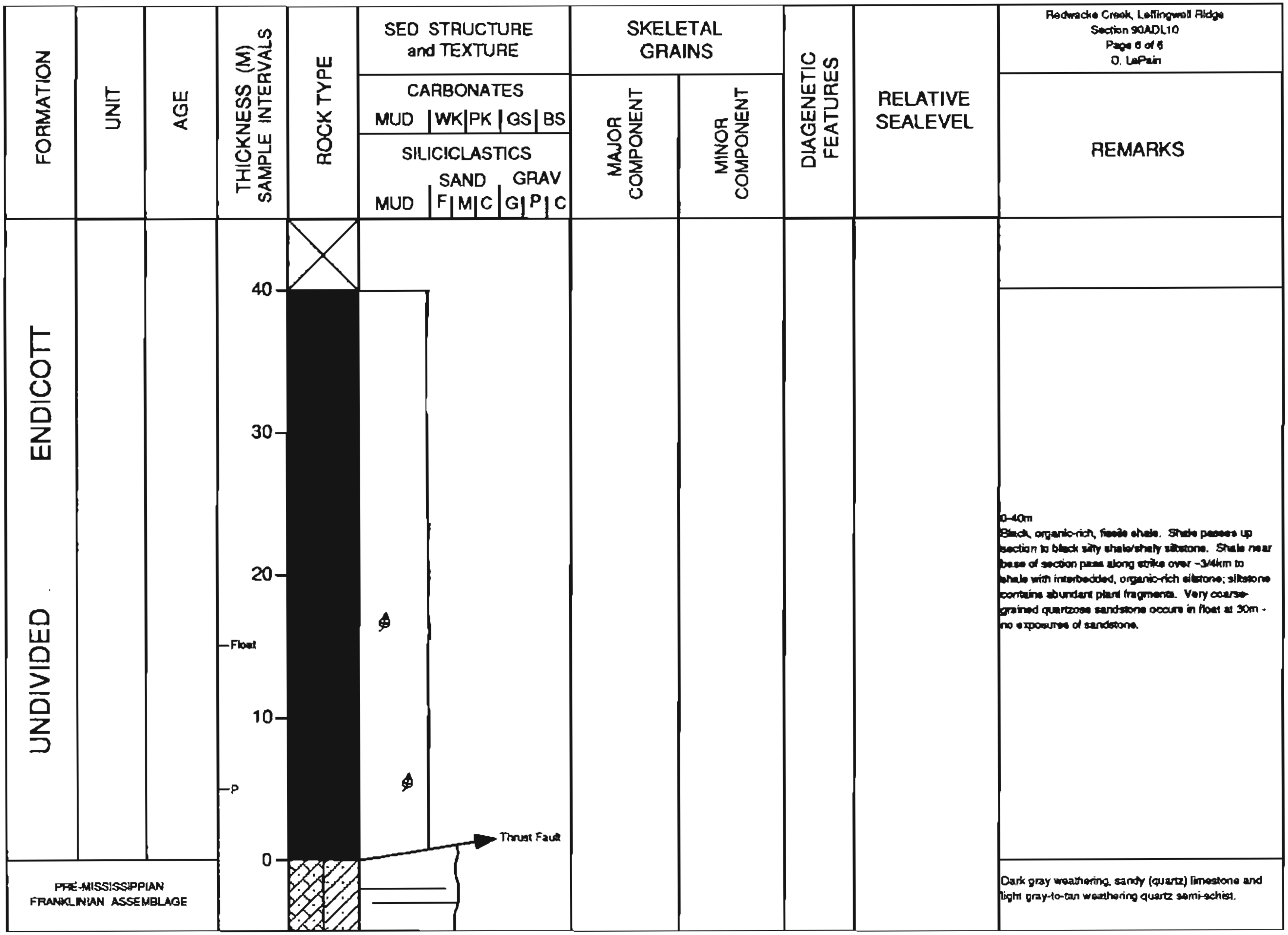
P
C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
ENDICOTT
UNDIVIDED
120
110
100
90
80
90-140m
Dark gray-to-black weathering, fissile silty shale and siltstone with orange-brown-to light-gray weathering, lenticular-laminated sandstone. At least two coarsening upward cycles (shale passing upward to siltstone with lenticular-laminated sandstone).



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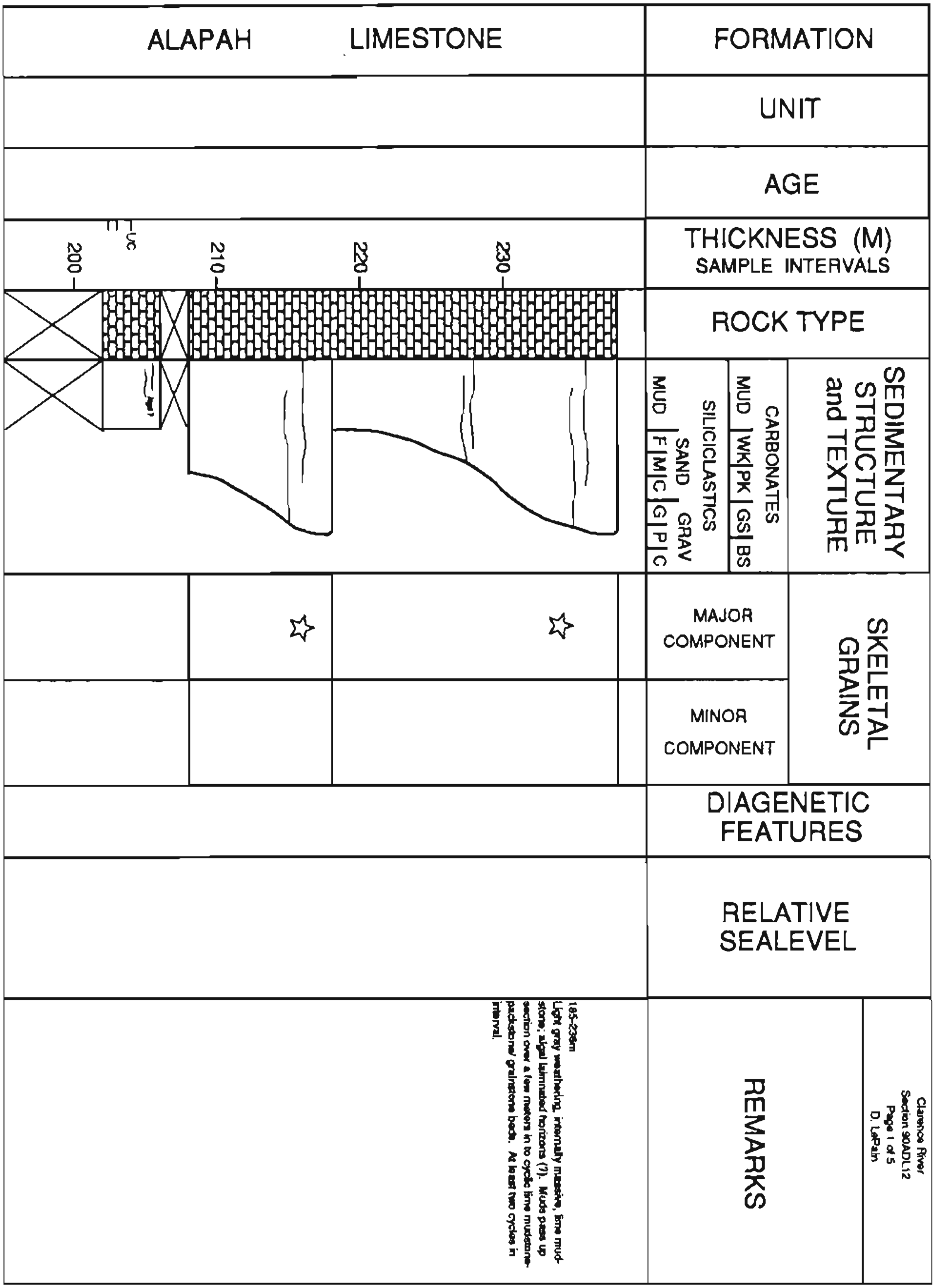
SILICICLASTICS
SAND GRAV
MUD F M C G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
ENDICOTT
UNDIVIDED
PRE-MISSISSIPPIAN FRANKLINIAN ASSEMBLAGE
40
30
20
Float
10
P
0
Thrust Fault
0-40m
Black, organic-rich, fissile shale. Shale passes up section to black silty shale/shaly siltstone. Shale near base of section pass along strike over ~3/4km to shale with interbedded, organic-rich siltstone; siltstone contains abundant plant fragments. Very coarse-grained quartzose sandstone occurs in float at 30m - no exposures of sandstone.
Dark gray weathering, sandy (quartz) limestone and light gray-to-tan weathering quartz semi-schist.


ALAPAH LIMESTONE
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
200
UC
210
220
230
ROCK TYPE
SEDIMENTARY STRUCTURE and TEXTURE
CARBONATES
MUD
WK
PK
GS
BS
SILICICLASTICS
MUD
SAND
F
M
C
GRAV
G
P
C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
185-238m
Light gray weathering, internally massive, lime mudstone; algal laminated horizons (?). Muds pass up section over a few meters in to cyclic lime mudstone-packstone/ grainstone beds. At least two cycles in interval.
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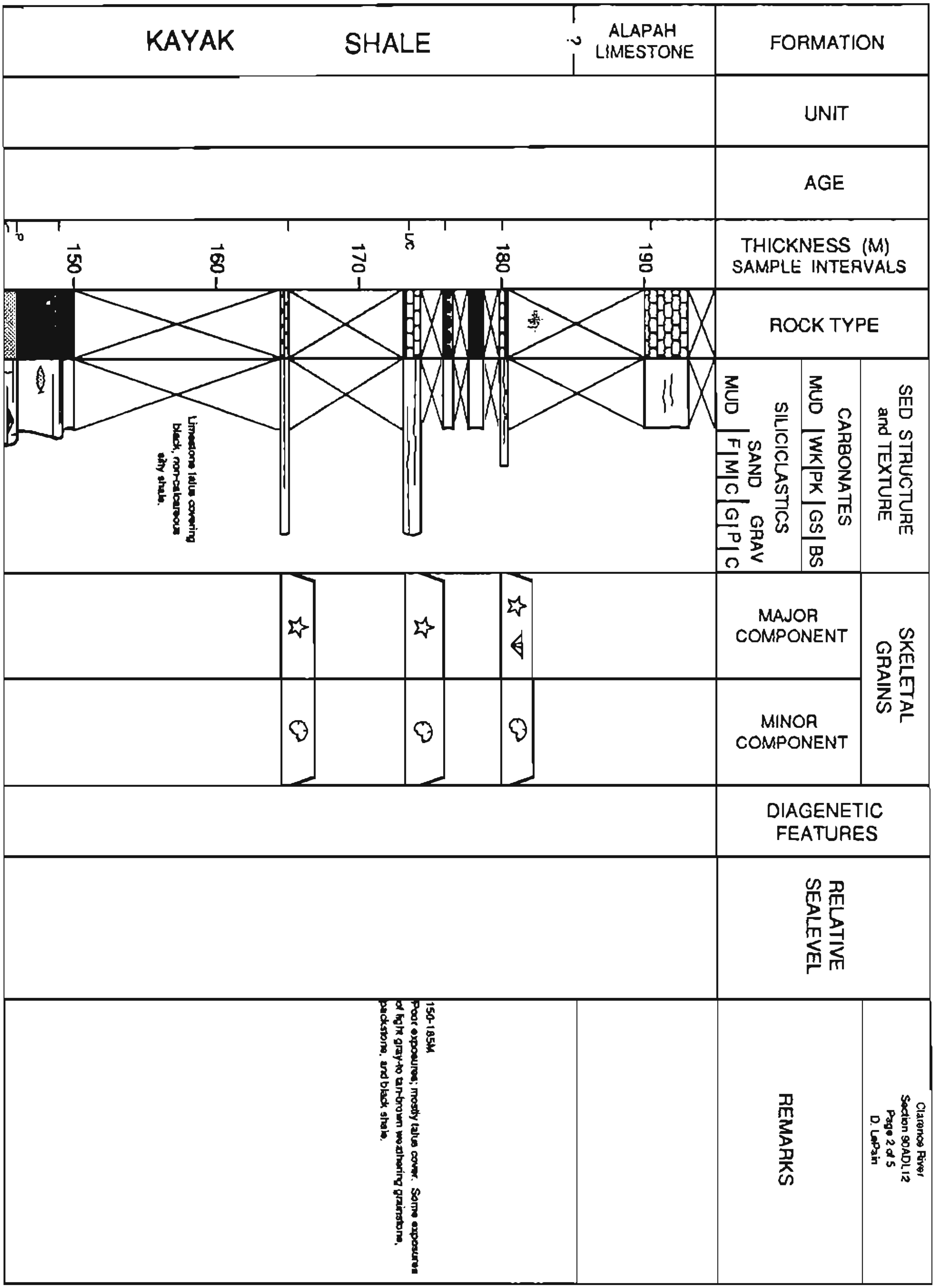

KAYAK SHALE
?
ALAPAH LIMESTONE
FORMATION
UNIT
AGE
THICKNESS (M)
SAMPLE INTERVALS
150
160
170
180
190
ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD
WK
PK
GS
BS
SILICICLASTICS
MUD
SAND
F
M
C
GRAV
G
P
C
Limestone talus covering black, non-calcareous silty shale.
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
150-185M
Poor exposures; mostly talus cover. Some exposures of light gray-to tan-brown weathering grainstone, packstone, and black shale.
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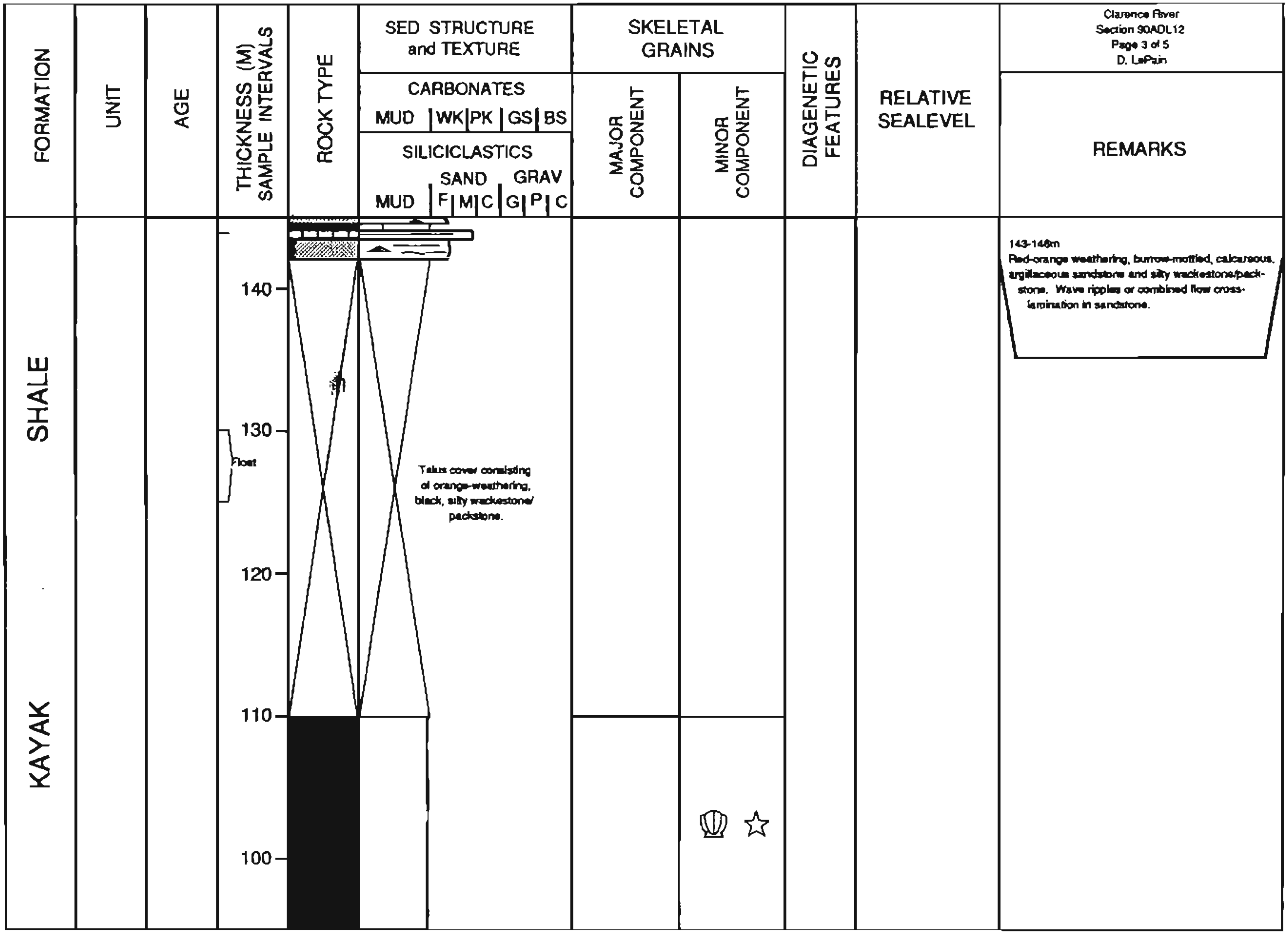
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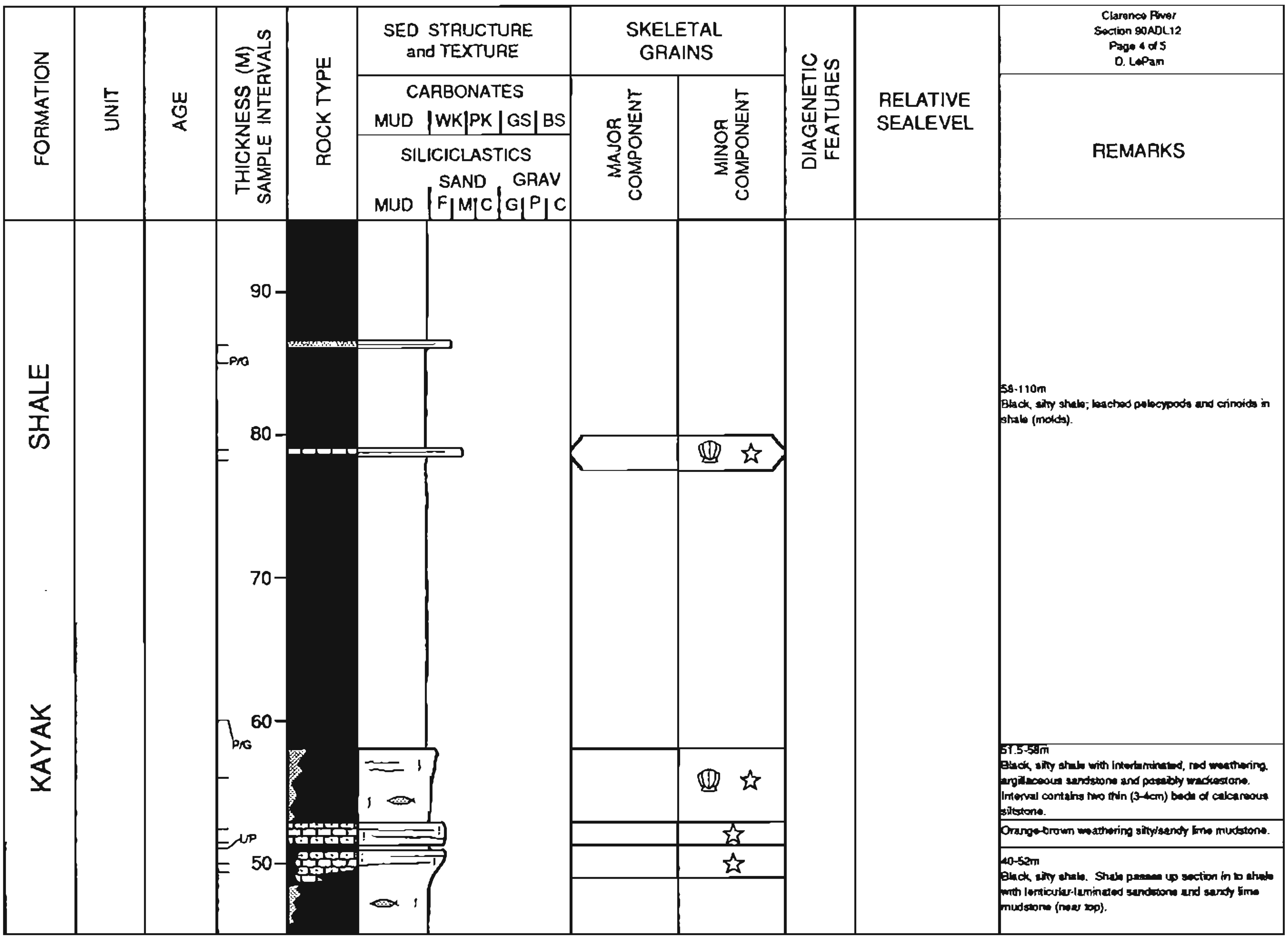
MUD WK PK GS BS
SILICICLASTICS
MUD SAND F M C GRAV G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
KAYAK SHALE
100
110
120
130
140
Float
Talus cover consisting of orange-weathering, black, silty wackestone/packstone.
143-146m
Red-orange weathering, burrow-mottled, calcareous, argillaceous sandstone and silty wackestone/packstone. Wave ripples or combined flow cross-lamination in sandstone.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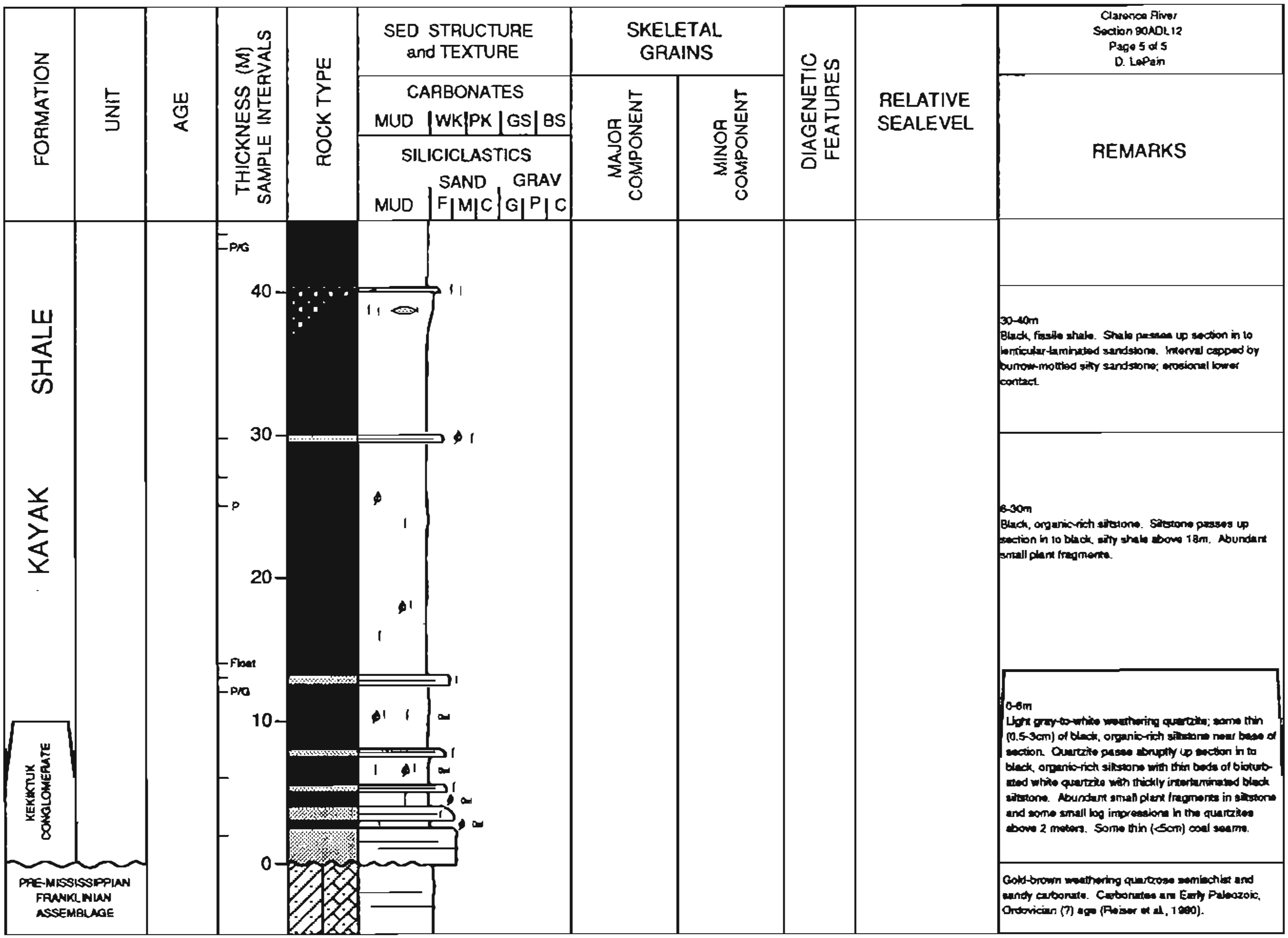
SILICICLASTICS
SAND GRAV
MUD F M C G P C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
KAYAK SHALE
90
P/G
80
70
60
P/G
UP
50
58-110m
Black, silty shale; leached pelecypods and crinoids in shale (molds).
51.5-58m
Black, silty shale with interlaminated, red weathering, argillaceous sandstone and possibly wackestone. Interval contains two thin (3-4cm) beds of calcareous siltstone.
Orange-brown weathering silty/sandy lime mudstone.
40-52m
Black, silty shale. Shale passes up section in to shale with lenticular-laminated sandstone and sandy lime mudstone (near top).

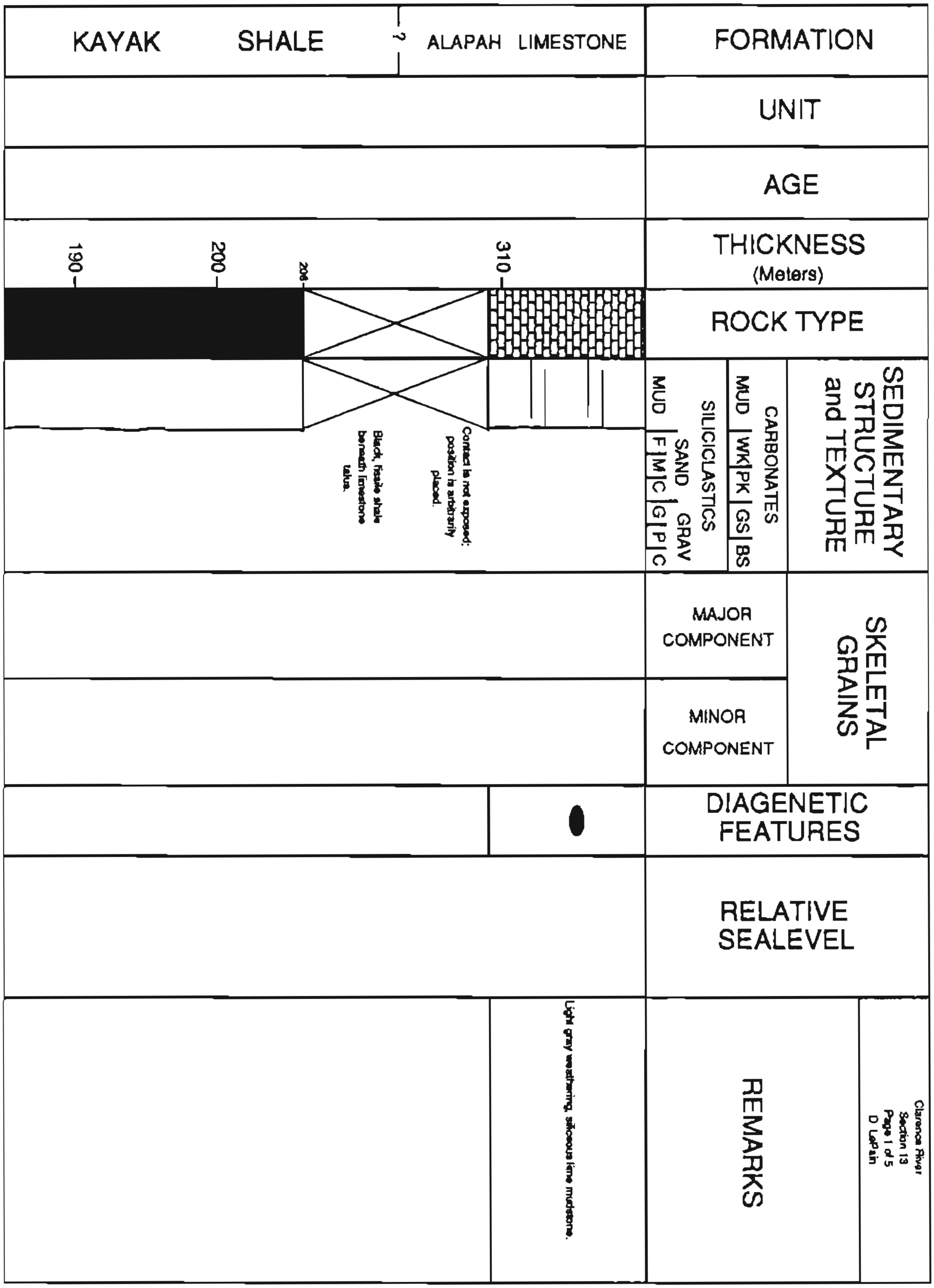


30-40m
Black, fissile shale. Shale passes up section in to lenticular-laminated sandstone. Interval capped by burrow-mottled silty sandstone; erosional lower contact.

6-30m
Black, organic-rich siltstone. Siltstone passes up section in to black, silty shale above 18m. Abundant small plant fragments.

0-6m
Light gray-to-white weathering quartzite; some thin (0.5-3cm) of black, organic-rich siltstone near base of section. Quartzite passe abruptly up section in to black, organic-rich siltstone with thin beds of bioturbated white quartzite with thickly interlaminated black siltstone. Abundant small plant fragments in siltstone and some small log impressions in the quartzites above 2 meters. Some thin (<5cm) coal seams.

Gold-brown weathering quartzose semischist and sandy carbonate. Carbonates are Early Paleozoic, Ordovician (?) age (Reiser et al., 1980).



KAYAK SHALE
?
ALAPAH LIMESTONE
FORMATION
UNIT
AGE
190
200
206
310
THICKNESS (Meters)
ROCK TYPE
Contact is not exposed; position is arbitrarily placed.
Black, fissile shale beneath limestone talus.
MUD
SAND F M C
GRAV G P C
SILICICLASTICS
MUD WK PK GS BS
CARBONATES
SEDIMENTARY STRUCTURE and TEXTURE
MAJOR COMPONENT
MINOR COMPONENT
SKELETAL GRAINS
DIAGENETIC FEATURES
RELATIVE SEALEVEL
Light gray weathering, siliceous lime mudstone.
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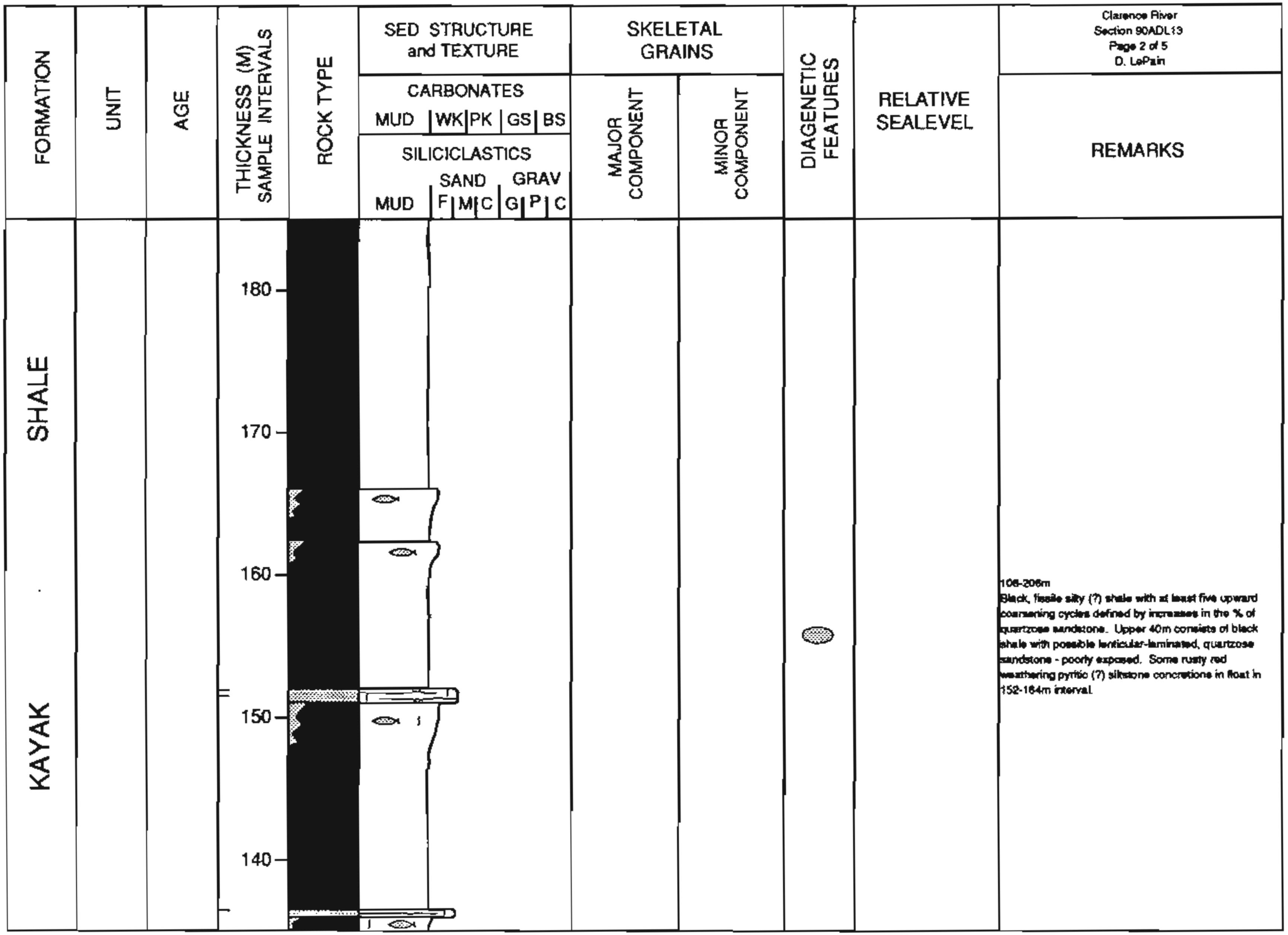
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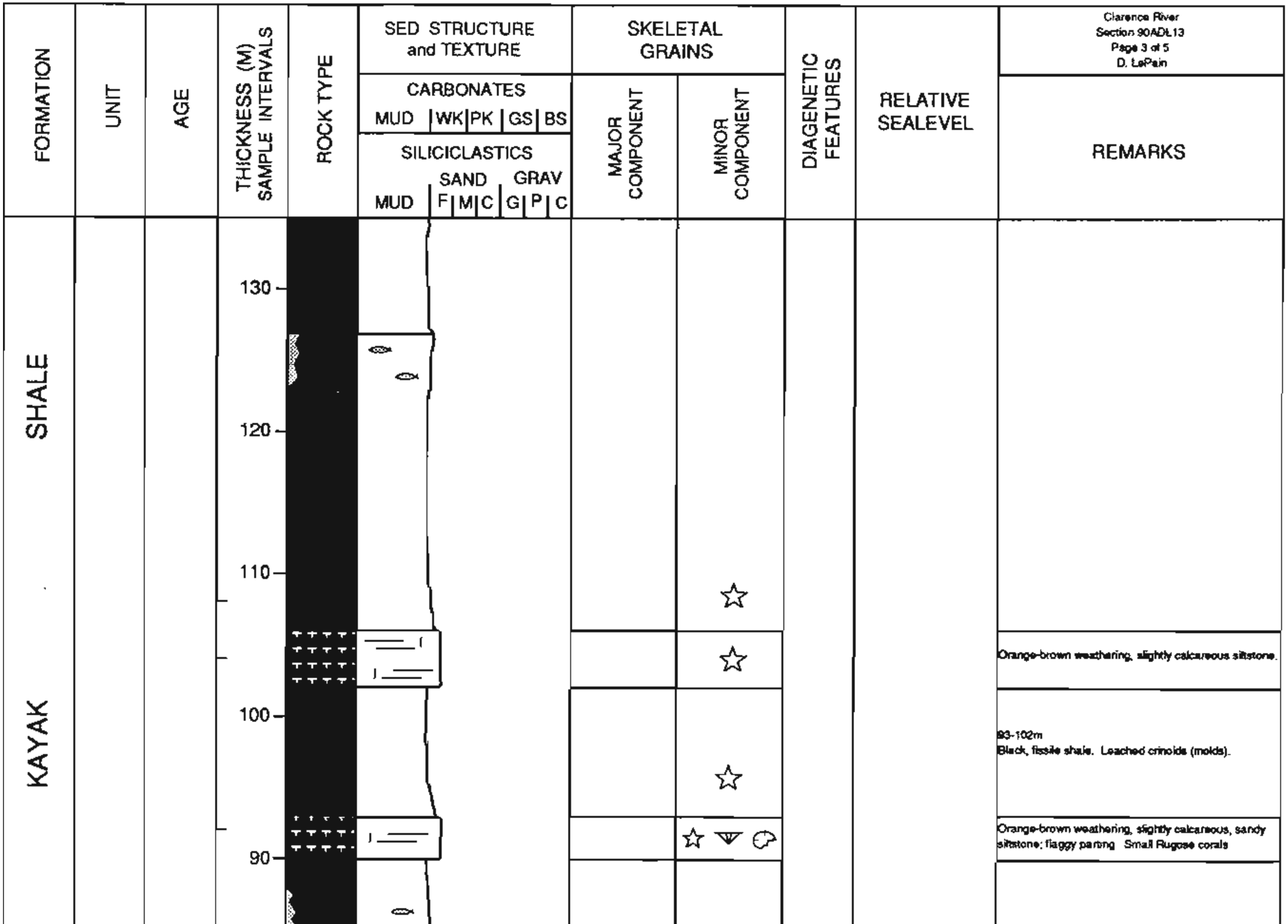
GS
BS
SILICICLASTICS
MUD
SAND
F
M
C
GRAV
G
P
C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
KAYAK SHALE
180
170
160
150
140
106-206m
Black, fissile silty (?) shale with at least five upward coarsening cycles defined by increases in the % of quartzose sandstone. Upper 40m consists of black shale with possible lenticular-laminated, quartzose sandstone - poorly exposed. Some rusty red weathering pyritic (?) siltstone concretions in float in 152-164m interval.


FORMATION
UNIT
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THICKNESS (M)
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ROCK TYPE
SED STRUCTURE and TEXTURE
CARBONATES
MUD WK PK GS BS
SILICICLASTICS
SAND GRAV
MUD F M C G P C
SKELETAL GRAINS
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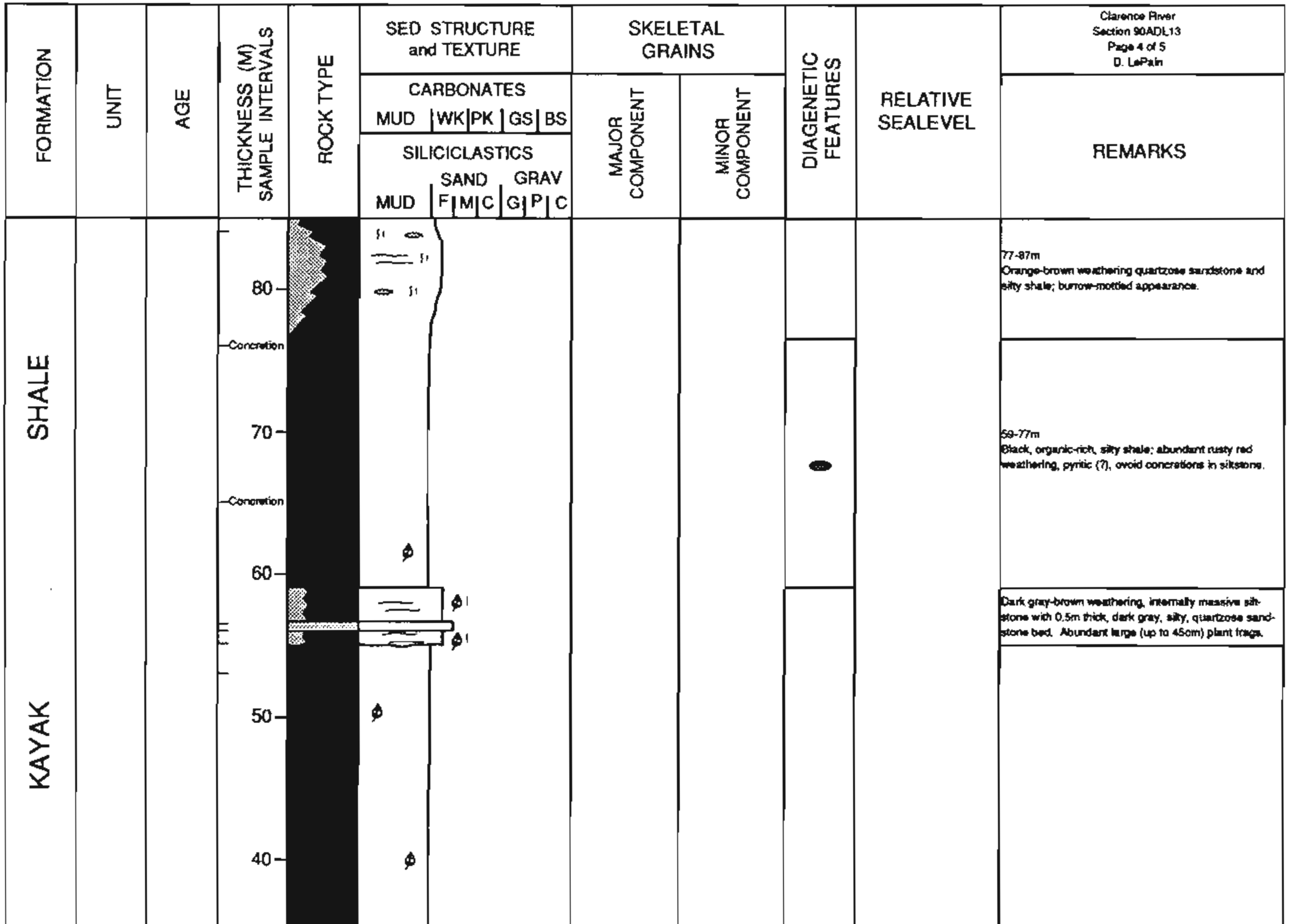
REMARKS
SHALE
KAYAK
130
120
110
100
90
Orange-brown weathering, slightly calcareous siltstone.
93-102m
Black, fissile shale. Leached crinoids (molds).
Orange-brown weathering, slightly calcareous, sandy siltstone; flaggy parting Small Rugose corals



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CARBONATES
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SILICICLASTICS
SAND GRAV
MUD F M C G P C
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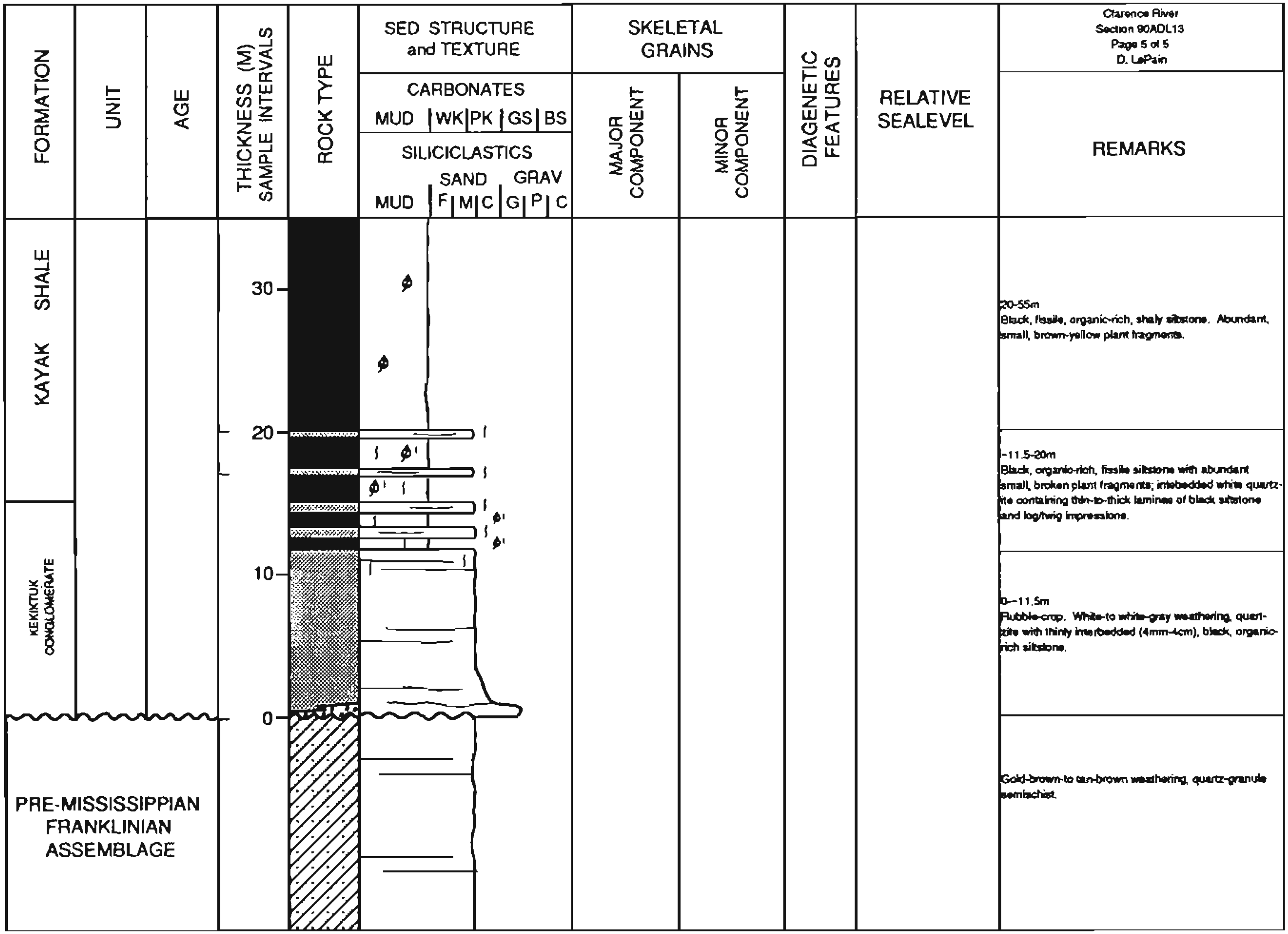
REMARKS
KAYAK SHALE
80
Concretion
70
Concretion
60
50
40
77-87m
Orange-brown weathering quartzose sandstone and silty shale; burrow-mottled appearance.
59-77m
Black, organic-rich, silty shale; abundant rusty red weathering, pyritic (?), ovoid concretions in siltstone.
Dark gray-brown weathering, internally massive siltstone with 0.5m thick, dark gray, silty, quartzose sandstone bed. Abundant large (up to 45cm) plant frags.



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SILICICLASTICS
SAND
GRAV
MUD | F | M | C | G | P | C
SKELETAL GRAINS
MAJOR COMPONENT
MINOR COMPONENT
DIAGENETIC FEATURES
RELATIVE SEALEVEL
REMARKS
KAYAK SHALE
KEKIKTUK CONGLOMERATE
PRE-MISSISSIPPIAN FRANKLINIAN ASSEMBLAGE
30
20
10
0
20-55m
Black, fissile, organic-rich, shaly siltstone. Abundant, small, brown-yellow plant fragments.
-11.5-20m
Black, organic-rich, fissile siltstone with abundant small, broken plant fragments; interbedded white quartzite containing thin-to-thick laminae of black siltstone and log/twig impressions.
0–11.5m
Rubble-crop. White-to white-gray weathering, quartzite with thinly interbedded (4mm-4cm), black, organic-rich siltstone.
Gold-brown-to tan-brown weathering, quartz-granule semischist.

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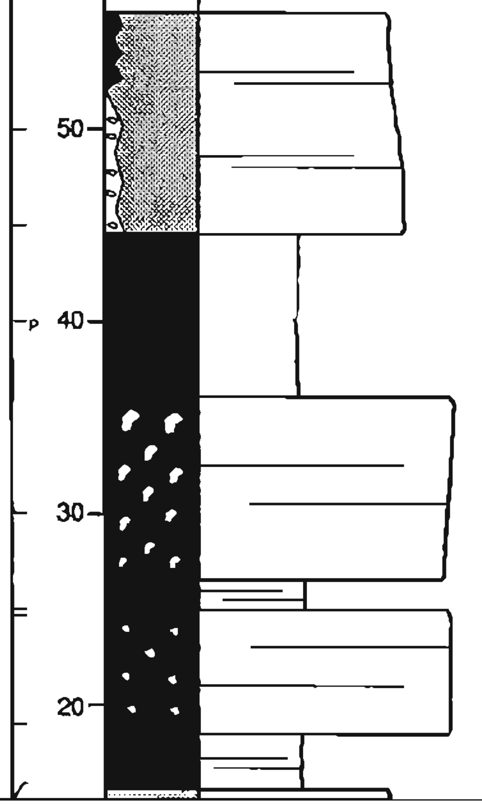
FORMATION	UNIT	AGE	THICKNESS (M) SAMPLE INTERVALS	ROCK TYPE	SEDIMENTARY STRUCTURE and TEXTURE	SKELETAL GRAINS: MAJOR COMPONENT	SKELETAL GRAINS: MINOR COMPONENT	DIAGENETIC FEATURES	RELATIVE SEALEVEL	REMARKS

SEDIMENTARY STRUCTURE and TEXTURE: CARBONATES — MUD | WK | PK | GS | BS; SILICICLASTICS — MUD | SAND F | M | C | GRAV G | P | C

KAYAK SHALE

?

KEKIKTUK CONGLOMERATE



REMARKS

Exposures of black, organic-rich silty shale continue south, down north side of saddle; Lisburne on south side.

44.5-56m
Medium-to-light gray, locally red weathering, very coarse-grained, chert-quartz sandstone and granule conglomerate. Distinct salt & pepper appearance on fresh surfaces. Some thin, black, silty shale partings on bedding planes. Individual beds appear internally structureless.

36-44.5m
Black, shaly siltstone. Poorly exposed.

15.5-36m
Dark gray, green-gray, and tan weathering, matrix-supported, chert-pebble conglomerate; angular clasts of white, gray, and black bedded chert from 4-15cm across. Interbedded, dark green-gray mudstone with floating granule size clasts of chert. Pervasively sheared. Upper conglomerate body coarsens up section from maximum clast size of 6cm to 15cm. Matrix is green-gray, sandy mudstone.

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FORMATION	UNIT	AGE	THICKNESS (M) SAMPLE INTERVALS	ROCK TYPE	SED STRUCTURE and TEXTURE (CARBONATES: MUD, WK, PK, GS, BS; SILICICLASTICS: MUD, SAND F, M, C, GRAV G, P, C)	SKELETAL GRAINS: MAJOR COMPONENT	SKELETAL GRAINS: MINOR COMPONENT	DIAGENETIC FEATURES	RELATIVE SEALEVEL	REMARKS
KEKIKTUK CONGLOMERATE			0–10							0-15m Dark red-brown-to green-brown weathering, matrix-supported, chert-cobble conglomerate; angular clasts of white, gray, and black bedded chert up to 45cm in diameter. Internally massive near base; thickly bedded near top of interval. Matrix is dark green-gray sandy mudstone. Forms upward fining sequence (maximum clast size at top of interval is 7cm).
PRE-MISSISSIPPIAN FRANKLINIAN ASSEMBLAGE										Light tan-brown-to green-brown weathering, quartz semischist; contains thin beds (405cm) of quartz-granule conglomerate. Exposures of white-gray and black, thinly bedded (1-3cm) chert ~1/2 mile east of section.