

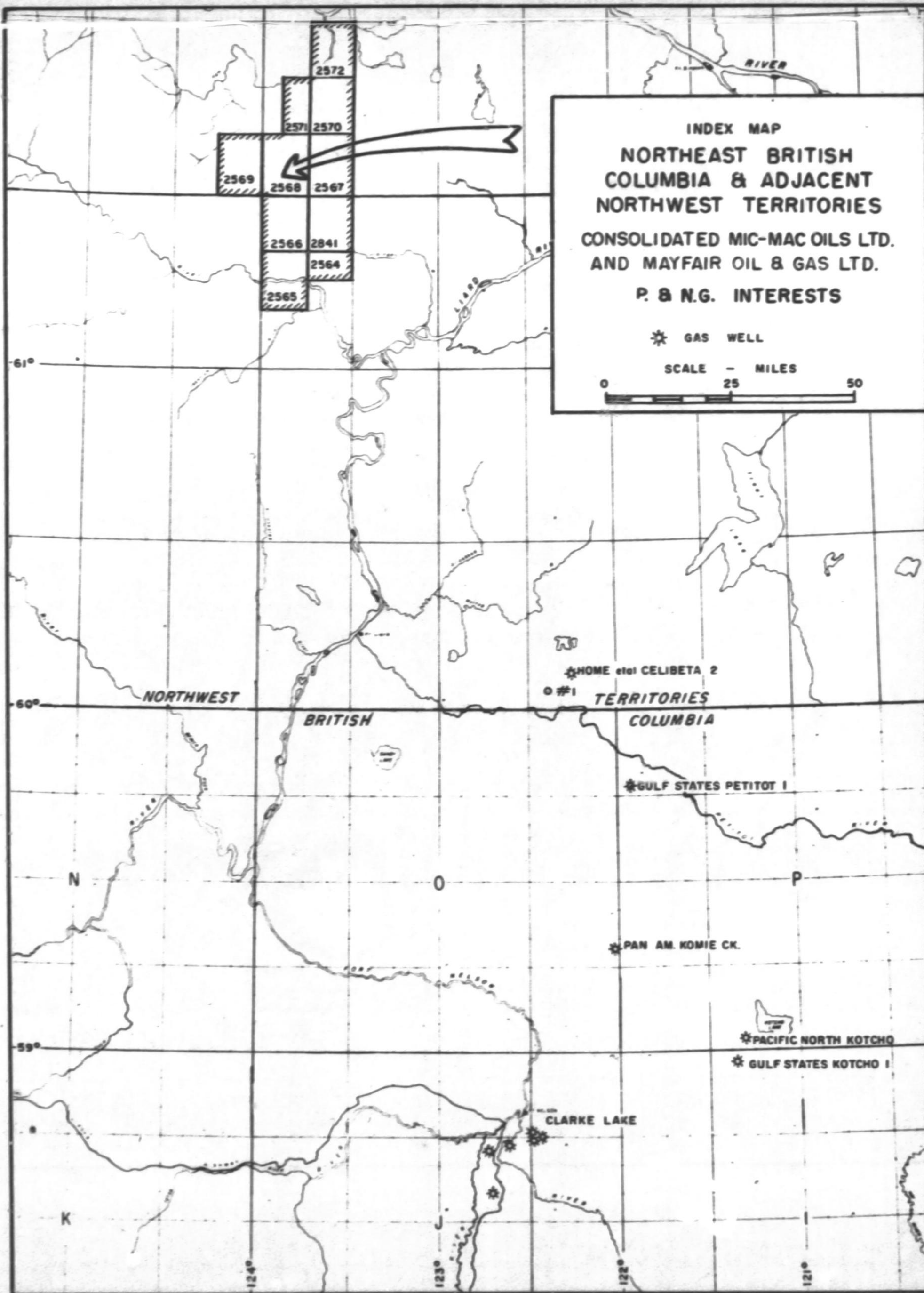
GEOLOGY OF THE AREA
BETWEEN THE SOUTH AND NORTH NAHANNI RIVERS
WEST OF THE NAHANNI RANGE

RELATED TO
CONSOLIDATED MIC MAC OILS LTD.
AND
MAYFAIR OIL & GAS LTD.

PERMITS 2564 TO 2572, INCLUSIVE, AND PERMIT 2841

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INTRODUCTION AND CONCLUSIONS

THE FOLLOWING REPORT IS BASED ON A GEOLOGICAL RECONNAISSANCE CONDUCTED BETWEEN SEPTEMBER 3 AND SEPTEMBER 10, 1959.

A BELL HELICOPTER CHARTERED FROM FOOTHILLS AVIATION OF CALGARY WAS UTILIZED FROM A BASE CAMP AT THE WEST END OF LITTLE DOCTOR LAKE. THE PARTY CONSISTED OF THREE COMPANY GEOLOGISTS, THE HELICOPTER PILOT AND ENGINEER, AND A COOK.

FROM A STUDY OF AERIAL MOSAICS AND PUBLISHED MAPPING TO THE SOUTH, IT APPEARED THAT PERMITS 2564 TO 2572, INCLUSIVE, AND PERMIT 2841, (HEREINAFTER CALLED "THE MIC MAC-MAYFAIR PERMITS") ARE MOSTLY LOCATED IN A LARGE SYNCLINE BETWEEN THE NAHANNI RANGE ON THE EAST AND ANOTHER LARGE UPLIFT ON THE WEST. THERE ARE A NUMBER OF SUBSIDIARY FOLDS WITHIN THIS BROAD SYNCLINE EXPRESSED BY MISSISSIPPIAN AND PENNSYLVANIAN BEDS TO THE SOUTH IN THE VICINITY OF THE SOUTH NAHANNI RIVER. A LARGE DOUBLY PLUNGING DOME WAS OBSERVED ON AERIAL MOSAICS ON THE WEST SIDE OF THE MIC MAC-MAYFAIR PERMITS.

THE PURPOSE OF THE GEOLOGIC SURVEY WAS TO ACCOMPLISH THE FOLLOWING:

1. TO TRAVERSE, BY HELICOPTER, ALL STREAMS AND RIDGES IN THE SHALE COVERED VALLEY BETWEEN THE TWO LARGE UPLIFTS AND EXAMINE ALL OUTCROPS TO DISCOVER THE PRESENCE OF POSSIBLE SUBSIDIARY FOLDS IN THE SYNCLINAL VALLEY.
2. TO EXAMINE THE STRUCTURE AND STRATIGRAPHY OF THE LARGE DOME ON THE RAM RIVER ON THE WEST SIDE OF THE MIC MAC-MAYFAIR PERMITS AND FIND OUT THE AGE OF THE INCISED BEDS AND FROM THIS TO INFER THE PROSPECTIVE RESERVOIRS REMAINING BURIED.
3. TO EXAMINE THE HIGH FLAT LYING BLUFFS ON THE NORTH SIDE OF NORTH NAHANNI RIVER BELOW THE MOUTH OF RAM RIVER TO DETERMINE THEIR STRATIGRAPHIC POSITION.

THE CONCLUSIONS MAY BE SUMMARIZED AS FOLLOWS:

THE VALLEY BETWEEN THE NAHANNI RANGE AND THE RAM RIVER UPLIFT IS PHYSIOGRAPHICALLY AND STRUCTURALLY CONTINUOUS WITH THE MACKENZIE PLAIN TO THE NORTH. IT IS UNDERLAIN FOR THE MOST PART BY SOFT, EASILY ERODED UPPER DEVONIAN AND MISSISSIPPIAN SHALES. THE VALLEY FLOOR HAS BEEN COVERED WITH A MANTLE OF GLACIAL AND LACUSTRIAN SILTS AND CLAYS. FOR THIS REASON THERE IS PRACTICALLY NO OUTCROP IN THE SMALL STREAMS ON THE VALLEY FLOOR. OUTCROP IS CONFINED TO MISSISSIPPIAN BEDS ON RIDGES IN THE AXIAL PORTION OF THE SYNCLINE AND THE MIDDLE DEVONIAN AND OLDER CARBONATES IN THE NAHANNI RANGE ON THE EAST AND MIDDLE DEVONIAN CARBONATES IN THE RAM RIVER UPLIFT TO THE WEST. NO SUBSIDIARY STRUCTURES COULD BE ASCERTAINED FROM DIRECT OUTCROP EVIDENCE BUT THE POSSIBILITY OF THEIR OCCURRENCE CAN BE DEMONSTRATED BY PROJECTION OF DIPS FROM THE UPLIFTS ON EITHER SIDE AND THE AXIAL BEDS OF THE SYNCLINE.

THE LARGE UPLIFT TRAVERSED BY THE RAM RIVER WAS CONFIRMED AS A LARGE DOUBLY PLUNGING ANTICLINE OR DOME. THIS DOME HAS A CLOSURE OF ABOUT 1,500 FEET, A LENGTH OF 25 MILES AND A WIDTH OF 8 MILES. UNFORTUNATELY, THE MIDDLE DEVONIAN NAHANNI FORMATION, WHICH IS GENERALLY CONSIDERED THE MOST PROSPECTIVE RESERVOIR FORMATION IN THIS AREA, HAS BEEN DEEPLY INCISED IN THE CORE OF THIS STRUCTURE. THE THICKNESS OF THESE BEDS MEASURED AND DESCRIBED IS 1,643 FEET AND THE LOWER BEDS ARE CONSIDERED STILL IN THE MIDDLE DEVONIAN NAHANNI FORMATION. THIS THICKNESS, PLUS THE NATURE OF THE BEDS, INDICATES THIS SECTION IS TRANSITIONAL BETWEEN THE SECTION OF THE NAHANNI RANGE AND THAT MEASURED BY KINGSTON AT VIRGINIA FALLS TO THE WEST. PROSPECTIVE RESERVOIR BEDS REMAINING BURIED UNDER THE RAM RIVER DOME ARE ORGANIC BEDS IN THE LONE MOUNTAIN FORMATION, THE BIOSTROMAL HALYSITES CORAL BEDS OF THE RONNING FORMATION FOUND AT VIRGINIA FALLS AND BELIEVED TO BE PRESENT IN THE NAHANNI RANGE, AND POROUS FRIABLE CAMBRIAN SANDSTONES DESCRIBED BY KINGSTON AT VIRGINIA FALLS AND THOUGHT TO BE PRESENT ALSO IN RED ROCK CANYON IN THE NAHANNI RANGE.

THE SOUTH FACING SCARP ON THE NORTH SIDE OF NORTH NAHANNI RIVER BELOW THE MOUTH OF THE RAM RIVER WAS MEASURED AND DESCRIBED. THE BLUFFS WERE FOUND TO BE CAUSED BY FOUR CLIFF FORMING MEMBERS OF SILTY LIMESTONE, SILTSTONE AND SANDSTONE, ALL OF A CHARACTERISTIC OLIVE DRAB OR KHAKI COLOUR. THROUGH FOSSIL IDENTIFICATIONS MADE BY C. R. STELCK, THESE BEDS CAN BE ASSIGNED TO THE IMPERIAL FORMATION. THIS IS OF SOME INTEREST AS THIS IS THE MOST SOUTHERLY EXPOSURE KNOWN TO THE WRITER WHICH CAN BE DEFINITELY ASSIGNED TO THE IMPERIAL FORMATION. IT IS THOUGHT THAT THE BEDS CHANGE FACIES RAPIDLY IN THE MIC MAC-MAYFAIR PERMIT AREA AND THAT IN THE CENTRAL PART OF THE PERMITS THE SAME BEDS ARE REPRESENTED BY A ROW OF KNOB LIKE HILLS MIDWAY BETWEEN THE MISSISSIPPIAN RIDGE TOPS AND THE VALLEY FLOOR. THESE KNOBS ARE MADE UP LITHOLOGICALLY OF SILTY PETROLIFEROUS SHALES.

A DRILLABLE LOCATION COULD BE CHOSEN ON THE RAM RIVER DOME WITH INFORMATION AT HAND IF THE POTENTIAL RESERVOIRS STILL BURIED WARRANT SUCH A TEST. NO SUBSIDIARY STRUCTURES CAN BE PROVED IN THE SYNCLINAL VALLEY AND SOME SORT OF GEOPHYSICAL SURVEY WOULD BE REQUIRED TO DEFINE ANY POSSIBLE STRUCTURE THERE. THE NAHANNI FORMATION CONTAINS POROUS REEFAL BEDS AND THERE IS EVIDENCE OF A SHALIER FACIES TO THE WEST. STRATIGRAPHIC TRAP POSSIBILITIES EXIST IN THIS FORMATION.

PHYSIOGRAPHY

THE MIC MAC-MAYFAIR PERMITS OCCUPY THE SOUTHERN END OF THE MACKENZIE PLAIN PHYSIOGRAPHIC DIVISION OF BOSTOCK (1948).

THE NAHANNI RANGE ON THE EAST SIDE IS A REMARKABLY UNIFORM AND CONTINUOUS MOUNTAIN RANGE. THE RANGE TRENDS IN A NORTH SOUTH DIRECTION BETWEEN THE NORTH AND SOUTH NAHANNI RIVERS, A DISTANCE OF SOME 75 MILES. OVER THIS ENTIRE LENGTH THE RANGE HAS A REMARKABLY UNIFORM WIDTH OF ABOUT FOUR MILES. THE ACTUAL OUTLINE OF THE RANGE IS SOMEWHAT SINUOUS BUT MEANDERS VERY LITTLE IN AN EAST WEST DIRECTION AS THE ENTIRE RANGE IS CONFINED BETWEEN LONGITUDE 123°15' AND 123°30', OR A DISTANCE OF ABOUT EIGHT MILES.

THE EAST SIDE IS ALMOST CERTAINLY A FAULT SCARP OVER THE ENTIRE LENGTH OF THE RANGE. TOWARDS THE NORTH END, IN THE VICINITY OF CLILAKE, THE BEDS CAN BE SEEN TO DROP VERTICALLY FROM THE CREST OF THE MOUNTAIN DOWN TO PLAINS LEVEL.

EVEN HERE THE CONFIGURATION OF THE BEDS SUGGESTS BASEMENT BLOCK FAULTING AND THERE IS NOTHING TO SUGGEST THE INTENSE COMPRESSIONAL FORCES WHICH LED TO THE TYPICAL OVERTHRUST TYPE STRUCTURE IN THE ROCKIES. THE WEST SIDE OF THE NAHANNI RANGE APPROXIMATES A DIP SLOPE ON THE TOP OF THE MIDDLE DEVONIAN NAHANNI FORMATION. THE WEST DIP OF THE NAHANNI RANGE IS BETWEEN 20° AND 30° AND FROM A NUMBER OF MEASUREMENTS TAKEN WOULD APPEAR TO AVERAGE 23° . THE SLOPE OF THE WEST SIDE OF THE RANGE AVERAGES SOMETHING LESS THAN THIS.

THERE ARE FOUR PROMINENT GAPS IN THE NAHANNI RANGE. THESE ARE FROM SOUTH TO NORTH: (1) THE VALLEY OCCUPIED BY BLUEFISH LAKE, (2) GRAINGER CREEK GAP, (3) LITTLE DOCTOR LAKE, AND (4) CLI LAKE. IT IS INTERESTING TO NOTE THAT THREE OF THESE GAPS ARE PRESENTLY OCCUPIED BY LAKES WHICH COMPLETELY TRANSECT THE NAHANNI RANGE. ANOTHER NOTEWORTHY FEATURE OF THESE GAPS IS THE FACT THAT THE VALLEY WALLS ON EITHER SIDE FALL PRECIPITOUSLY TO LAKE LEVEL AND IN SOME CASES THERE IS NO BREAK IN THE PRECIPITOUS WALLS AT LAKE LEVEL. THIS IS ESPECIALLY NOTICEABLE AT LITTLE DOCTOR AND CLI LAKES. THESE REMARKABLE GAPS IMMEDIATELY SUGGEST OLD RIVER VALLEYS. IT IS PROBABLE THAT THE OLD VALLEYS ACCOMMODATED LARGER RIVERS THAN THE PRESENT DRAINAGE THROUGH THEM. THE WAY THE RANGE IS TRANSECTED COMPLETELY, AT RIGHT ANGLES TO ITS TREND, SUGGESTS THE RIVERS WERE ANTECEDENT TO THE UPLIFT OF THE RANGE. ALSO THE FACT THAT BLUEFISH, LITTLE DOCTOR AND CLI LAKES OCCUPY THREE OF THESE GAPS AT ELEVATIONS LOWER THAN THE PLAINS ON EITHER END OF THE LAKES SUGGEST THAT THE OLD VALLEY FLOOR WAS FORMERLY SEVERAL HUNDRED FEET LOWER THAN THE PRESENT PLAINS LEVEL. IT IS SUGGESTED THAT THESE GAPS ARE REMNANTS OF A PREGLACIAL ANTECEDENT DRAINAGE SYSTEM.

A FURTHER RAMIFICATION OF THIS ANTECEDENT SYSTEM MAY BE SEEN IN THE RAM RIVER CANYON SOME TWENTY MILES WEST OF LITTLE DOCTOR LAKE. HERE THE RAM RIVER GOES OUT OF ITS WAY, AS IT WERE, TO CUT THROUGH THE COMPETENT MIDDLE DEVONIAN CARBONATES ALONG THE AXIS OF THE RAM RIVER DOME WHILE A CONSEQUENT DRAINAGE COURSE WOULD CERTAINLY HAVE GONE AROUND THE NORTHERN PLUNGE OF THE STRUCTURE IN THE SOFT UPPER DEVONIAN SHALES, ONLY TWO OR THREE MILES NORTH OF ITS PRESENT COURSE.

DRAWING A LINE FROM THE COURSE OF THE RAM RIVER WHERE IT DISGORGES FROM THE MACKENZIE MOUNTAINS AND THROUGH ITS COURSE ON THE RAM RIVER DOME LINES UP WITH THE GAP IN THE NAHANNI RANGE OCCUPIED BY LITTLE DOCTOR LAKE. IT IS SUGGESTED THAT THIS IS THE TRUE ANTECEDENT COURSE OF RAM RIVER.

THE GENERAL GEOMORPHIC CYCLE IS THOUGHT TO BE AS FOLLOWS: A GENERALLY EASTERLY CONSEQUENT DRAINAGE SYSTEM WAS ESTABLISHED BY EPICONTINENTAL UPLIFT PRIOR TO THE FOLDING OF THE MOUNTAIN RANGES. DURING THE OROGENIC PERIOD OF FOLDING AND FAULTING, MANY OF THESE STREAMS MAINTAINED THEIR CHANNELS AS ANTECEDENT DRAINAGE. DURING THE GLACIAL PERIOD THE LOWER REACHES OF THESE STREAMS WERE DAMMED AND BECAME AREAS OF AGGRADATION, AS ON THE MACKENZIE PLAINS AND THE AREA EAST OF NAHANNI RANGE, THROUGH THE PROCESSES OF CONTINENTAL AND VALLEY GLACIATION, AND LACUSTRIAN DEPOSITION. THE OLD ANTECEDENT CANYONS IN THE NAHANNI RANGE WERE TOO SMALL TO ACCOMMODATE MOVEMENTS OF LARGE MASSES OF ICE AND SO WERE THE SITES OF STATIC ICE BOUND LAKES RECEIVING RELATIVELY LITTLE ICE TRANSPORTED DEBRIS.

AFTER THE GLACIAL PERIOD A NEW CONSEQUENT DRAINAGE WAS ESTABLISHED SEEKING THE LEVEL OF THE NORTHERLY MACKENZIE DRAINAGE. IN THE HIGHER UNGLACIATED AREAS THE ANTECEDENT COURSES WERE MAINTAINED BUT A NEW STAGE OF DOWNCUTTING WAS INAUGURATED THERE AS IS EVIDENCED BY THE ABANDONED MEANDERS AND STRATHS HIGH UP IN THE CANYONS OF THE SOUTH NAHANNI RIVER.

THE DRAINAGE IN THE MACKENZIE PLAIN IN THE MIC MAC-MAYFAIR PERMIT AREA IS NOW SOUTH TOWARDS THE SOUTH NAHANNI, AND NORTH TOWARDS THE NORTH NAHANNI. THE STREAMS ARE SLUGGISH AND MEANDER ON THE GLACIAL AND LAKE BEDS WITH VERY LITTLE DOWNCUTTING.

THE DRAINAGE ON THE RAM RIVER DOME, ON THE OTHER HAND, IS IN AN EXTREMELY YOUTHFULL STAGE. ALL MEANDERS ARE INCISED AND THIS LEADS TO REMARKABLE CANYONS WITH RELIEF OF UP TO 2,000 FEET.

THE SYNCLINAL RIDGE IN THE CENTRAL PART OF THE PLAIN IS BEING RAPIDLY ERODED ON ITS SOUTH END BY TRIBUTARY DRAINAGE TO THE SOUTH NAHANNI RIVER. THIS CAUSES PRECIPITOUS SCREE SLOPES IN THIS AREA. FURTHER NORTH THE RIDGES ARE MORE ROUNDED AND LARGELY COVERED WITH VEGETATION.

STRATIGRAPHY

THE OLDEST ROCKS EXAMINED IN DETAIL WERE LIMESTONES OF THE NAHANNI FORMATION IN THE CANYON OF THE RAM RIVER WHERE IT CUTS THROUGH THE RAM RIVER DOME. CURSORY EXAMINATIONS WERE MADE ON THE GROUND OF THE NAHANNI FORMATION AND OLDER ROCKS IN THE NAHANNI RANGE AND SEVERAL MORE SECTIONS WERE EXAMINED HERE ONLY FROM THE AIR. SCATTERED EXPOSURES OF THE DEVONIAN-MISSISSIPPIAN SHALE SECTION WERE EXAMINED BUT NO CONTINUOUS SECTION IS EXPOSED IN THIS AREA. INTERESTING EXPOSURES OF BEDS THOUGHT TO BE EQUIVALENT TO THE IMPERIAL FORMATION WERE EXAMINED ON THE NORTH SIDE OF NORTH NAHANNI RIVER BELOW THE MOUTH OF THE RAM RIVER, OUTSIDE OF THE AREA OF THE PERMITS.

THE SYNCLINAL RIDGES IN THE SOUTH END OF THE PERMITS COMPRISING BEDS OF MISSISSIPPIAN AND PENNSYLVANIAN AGES WERE SEEN FROM THE AIR BUT NOT EXAMINED IN DETAIL AS THESE BEDS HAVE BEEN ADEQUATELY DESCRIBED BY PATTON (1958) AND ARE NOT BURIED IN A STRUCTURALLY FAVORABLE POSITION ANYWHERE IN THE MIC MAC-MAYFAIR PERMIT AREA.

BECAUSE OF THE POSSIBLE ECONOMIC SIGNIFICANCE OF THE LARGE DOME ON RAM RIVER, AN ATTEMPT HAS BEEN MADE TO EXTRAPOLATE THE BEDS OLDER THAN MIDDLE DEVONIAN NAHANNI FORMATION FROM INFORMATION AVAILABLE OUTSIDE THE PERMIT AREA. THIS CAN BE DONE SATISFACTORILY IN A GENERAL WAY AND FOR THIS REASON THESE BEDS ARE INCLUDED IN THE TABLE OF FORMATIONS AND DESCRIPTIONS FOLLOWING:

TABLE OF FORMATIONS

ERA	PERIOD OF EPOCH	GROUP OR FORMATION	MEMBER OR UNIT	DESCRIPTION	THICKNESS
CENOZOIC	PLEISTOCENE AND RECENT			GLACIAL-FLUVIAL DEPOSITS	
	UNCONFORMITY				
C O D E S K	MISSISSIPPIAN	MATTSON FM.	UNIT 4	SANDSTONE, FINE TO MEDIUM GRAINED WITH MINOR COAL AND SHALY INTERVALS AT TOP.	3734'
			UNIT 3	CALCAREOUS, DARK GREY SHALES AND ARGILLACEOUS LIMESTONES.	1646'
			UNIT 2	BLACK FISSILE NON-CALCAREOUS SHALES WITH IRONSTONE NODULES	436'
	MISSISSIPPIAN AND/OR UPPER DEVONIAN		UNIT 1	FINE GRAINED, PLATY SANDSTONE AND SHALE GRADING UP TO NON-CALCAREOUS SHALE.	714'
			DEVONIAN MISSISSIPPIAN SHALE UNIT	DARK GREY SHALE, POORLY EXPOSED, CONTAINS SILTY BITUMINOUS SHALY MEMBER WHICH GRADES TO SANDSTONE AND SILTSTONE OF IMPERIAL FORMATION TO THE NORTH.	5000'±
	MIDDLE DEVONIAN	NAHANNI FM.	UPPER MASSIVE LIMESTONE UNIT	GREY CRYSTALLINE, VUGGY, DOMOMITES AND DENSE LIMESTONES IN NAHANNI RANGE GRADING TO SHALE, SHALY LIMESTONES AND MASSIVE CRYPTOCRYSTALLINE LIMESTONE ON RAM RIVER DOME.	1250'
			STROMATOPOROIDAL UNIT SHALE UNIT LOWER LIMESTONE UNIT		-1650'±
UNCONFORMITY					
	MIDDLE DEVONIAN OR SILURIAN	LONE MOUNTAIN FM.	CYCLIC DOLOMITE UNIT	CYCLIC SEQUENCE OF ORGANIC POROUS DOLOMITE, LIGHT EVAPORITIC DOLOMITE AND DARK SILTY DOLOMITE	2000'±

G I O Z O E L A P	MIDDLE DEVONIAN OR SILURIAN	LONE MOUNTAIN FM.	LIGHT BUFF DOLOMITE UNIT SANDY UNIT	LIGHT GREY-BUFF DENSE MASSIVE DOLOMITE. LIGHT GREY-BUFF SANDY DOLOMITE, PURE QUARTZOSE SANDSTONE 20', SILTY DOLOMITE AND SHALY DOLOMITE.	600' 300'
	UNCONFORMITY?				
	SILURIAN		DENSE DOLOMITE	DARK GREY, FINE CRYSTAL- LINE TO DENSE, NON-POROUS	900'
		RONNING- FM.		LIMESTONE DOLOMITIC ABUNDANCE OF CORALLINE MATERIAL, SOME SILICIFIED, GOOD VUGGY AND INTER- GRANULAR POROSITY	750'
	ORDOVICIAN	SUNBLOOD FM.		LIMESTONE, DARK GREY, FINELY CRYSTALLINE, THIN BEDDED NODULAR, ALTERNAT- ING WITH MASSIVE BEDS	550' (EST.)
	CAMBRIAN			SANDSTONES, RED SHALES, SILTY LIMESTONES, SOME POROUS FRIABLE SANDS.	1000'±
	UNCONFORMITY				
	PRECAMBRIAN				

CAMBRIAN

ON THE SOUTH NAHANNI RIVER NEAR VIRGINIA FALLS KINGSTON (1951) DESCRIBED 2160 FEET OF CLASTIC BEDS ASSIGNED TO THE CAMBRIAN. THIS GROUP OF STRATA CONSISTS OF A CYCLIC SEQUENCE OF TAN QUARTZ SANDSTONES, MAROON SHALES AND SILTY ARGILLACEOUS LIMESTONES. SOME OF THE SANDSTONES ARE QUITE FRIABLE AND POROUS AND COULD FORM EXCELLENT RESERVOIR BEDS.

FROM AERIAL RECONNAISSANCE AND PERSONAL COMMUNICATION WITH OTHER GEOLOGISTS WORKING IN THE AREA, IT IS BELIEVED SIMILAR BEDS ARE EXPOSED IN RED ROCK CANYON IN THE NAHANNI RANGE AND THEY WOULD PRESUMABLY UNDERLIE THE MIC MAC-MAYFAIR PERMIT AREA.

ORDOVICIAN

BELOW THE RONNING FORMATION AT VIRGINIA FALLS, KINGSTON (1951) REPORTS 2800 FEET OF DARK, THIN BEDDED NODULAR LIMESTONES ALTERNATING WITH MASSIVE BLACK MEDIUM GRAINED LIMESTONE WHICH HE NAMED THE ~~SUNBLOOD~~ FORMATION. IT IS NOT KNOWN WHETHER EQUIVALENTS OF THESE STRATA ARE PRESENT IN THE NAHANNI RANGE. IF THEY ARE PRESENT, HOWEVER, THEY ARE MUCH THINNER THAN THE VIRGINIA FALLS AREA AS AERIAL RECONNAISSANCE HAS SHOWN THAT THE CAMBRIAN CLASTICS MENTIONED ABOVE OCCUR AT THE BASE OF SOME OF THE CLIFFS ON THE EAST SIDE OF THE NAHANNI RANGE AND THERE IS NOT ROOM FOR SUCH A THICKNESS AS FOUND AT VIRGINIA FALLS BETWEEN THESE CLASTIC BEDS AND BEDS WHICH CAN BE DEFINITELY IDENTIFIED AS THE CYCLIC CARBONATES OF THE LONE MOUNTAIN FORMATION.

NO POTENTIAL RESERVOIR BEDS ARE KNOWN IN THIS SEQUENCE.

SILURIAN RONNING FORMATION

AT VIRGINIA FALLS, KINGSTON (1951) DESCRIBED 750 FEET OF ORGANIC DOLOMITIC LIMESTONES ASSIGNED TO THE RONNING FORMATION. THESE BEDS CONTAIN MUCH SILICIFIED ORGANIC MATERIAL AND ARE COMMONLY CALLED THE HALYSITES BEDS. THEY HAVE A WIDE DISTRIBUTION BEING PRESENT ALONG THE ALASKA HIGHWAY TO THE SOUTH AND IN THE MACKENZIE MOUNTAINS IN THE VICINITY OF NORMAN WELLS TO THE NORTH. THIS WIDESPREAD DISTRIBUTION OF ORGANIC STRATA SUGGESTS A MAJOR BIOSTROME. THESE BEDS HAVE GOOD VUGGY AND INTERGRANULAR POROSITY AND COULD FORM AN EXCELLENT RESERVOIR.

THESE BEDS WERE NOT IDENTIFIED IN THE NAHANNI RANGE BUT IT IS THOUGHT THERE IS AN EXCELLENT CHANCE THAT THEY ARE PRESENT AND WOULD UNDERLIE THE MIC MAC-MAYFAIR PERMITS.

SILURIAN OR MIDDLE DEVONIAN LONE MOUNTAIN FORMATION

BEDS ASSIGNED TO THE LONE MOUNTAIN FORMATION CAN BE DIVIDED INTO THREE UNITS IN THE NAHANNI RANGE.

SANDY UNIT:

THE LOWEST UNIT CONSISTS OF INTERBEDDED LIGHT GREY, SILTY DOLOMITE AND DARK GREY SHALY DOLOMITE, A WHITE PURE QUARTZOSE, FINE GRAINED SANDSTONE ABOUT 20 FEET THICK, AND LIGHT GREY-BUFF SANDY DOLOMITE IN ASCENDING ORDER. THE OVER ALL THICKNESS OF THE UNIT IS ABOUT 300 FEET.

LIGHT BUFF DOLOMITE UNIT:

THE SANDY UNIT IS overlain BY LIGHT GREY-BUFF, DENSE TO VERY FINELY CRYSTALLINE DOLOMITE. THE UNIT IS MASSIVE WEATHERING. THE THICKNESS OF THIS UNIT IS ABOUT 600 FEET.

CYCLIC DOLOMITE:

THE REMAINDER OF THE LONE MOUNTAIN FORMATION CONSISTS OF A CYCLIC SEQUENCE OF LIGHT AND DARK GREY DOLOMITES. THE DARK GREY BANDS ARE SILTY CRYSTALLINE DOLOMITE AND DARK ORGANIC DOLOMITE CONTAINING INDETERMINATE TUBULAR CORALS OR AMPHIPORA. THE LIGHTER BANDS ARE A LIGHT GREY-BUFF DOLOMITE WHICH APPEARS EVAPORITIC.

NO SECTION OF THIS FORMATION WAS EXAMINED OR MEASURED IN DETAIL, BUT IT APPEARS TO THICKEN FROM SOUTH TO NORTH. AT THE SOUTH END OF THE NAHANNI RANGE IT IS ESTIMATED TO BE 1500 FEET THICK, IN THE VICINITY OF LITTLE DOCTOR LAKE IT WOULD APPEAR TO BE OVER 2000 FEET THICK AND FURTHER NORTH AT CLY LAKE AND LONE MOUNTAIN THE THICKNESS MAY BE OVER 3000 FEET.

MIDDLE DEVONIAN NAHANNI FORMATION

AT THE SOUTH END OF NAHANNI RANGE THE NAHANNI FORMATION CONSISTS MOSTLY OF MEDIUM TO COARSE CRYSTALLINE DOLOMITES. REEFAL STRUCTURES ARE PROBABLE AS BEDS CAN BE SEEN TO CHANGE FACIES Laterally FROM LIMESTONE TO CRYSTALLINE DOLOMITE IN RELATIVELY SHORT DISTANCES. AT LITTLE DOCTOR LAKE, WHERE THE MIC MAC CAMP WAS LOCATED, THE NAHANNI FORMATION IS PREDOMINANTLY LIMESTONE WITH CRYSTALLINE DOLOMITE ONLY IN THE LOWER PART. THERE ARE SEVERAL QUITE SHALY MEMBERS WHICH WERE NOT OBSERVED AT THE SOUTH END OF THE RANGE. THE THICKNESS OF THE NAHANNI FORMATION BY ALTIMETER READINGS WAS FOUND TO BE BETWEEN 1000 AND 1200 FEET IN THE NAHANNI RANGE.

THE NAHANNI FORMATION WAS EXAMINED IN DETAIL ONLY IN THE CANYON OF THE RAM RIVER IN THE RAM RIVER DOME. THE DETAILED DESCRIPTION IS INCLUDED AS SECTION #1 IN APPENDIX #1.

HERE THE NAHANNI FORMATION DIVIDES QUITE NATURALLY INTO FIVE LITHOLOGIC UNITS WHICH ARE DESCRIBED BELOW FROM THE BASE UPWARDS.

LOWER LIMESTONE UNIT:

THE LOWEST EXPOSURES FOUND IN THE CORE OF THE RAM RIVER UPLIFT CONSIST OF GREY TO DARK GREY VERY FINELY CRYSTALLINE LIMESTONE. THIS IS A RELATIVELY HARD COMPETENT MEMBER OVER WHICH FLOWS THE WATERFALL ON RAM RIVER. THE MOST REMARKABLE FEATURE OF THE UNIT IS THE EXTREMELY ERRATIC BEDDING WHICH, DUE TO ITS SOMETIMES ANGULAR RELATIONSHIP TO THE UPPER CONTACT OF THE UNIT, SUGGESTS AT FIRST AN ANGULAR UNCONFORMITY AT THAT CONTACT. THE NATURE OF THE CONTACT ITSELF ALSO LENDS TO THIS BELIEF AS THE BOUNDARY BETWEEN THE COMPETENT LIMESTONE BELOW AND THE FINELY BEDDED BLACK SHALES ABOVE IS HAIRLINE THIN WITH ABSOLUTELY NO GRADATION WHATSOEVER IN EITHER THE ROCKS ABOVE OR BELOW. ON CLOSER EXAMINATION, HOWEVER, THE BEDDING, RATHER THAN HAVING A CONSISTENT ANGULAR RELATIONSHIP TO THE CONTACT, APPEARS TO BE ERRATIC, SUGGESTING SOME SORT OF DEPOSITIONAL SLUMP OR FLOW ROLL PHENOMENON. ALSO THE ROCKS SEEM MUCH MORE CLOSELY AKIN LITHOLOGICALLY TO THE NAHANNI FORMATION, WHICH CONTAINS MUCH GREY LIMESTONES IN EVEN THE DOLOMITIC SECTIONS, THAN TO THE LONE MOUNTAIN FORMATION WHICH HAS NO LIMESTONE.

FOR THIS REASON IT WAS CONCLUDED THAT THE LOWERMOST EXPOSURES IN THE RAM CANYON ARE PROBABLY MIDDLE DEVONIAN AND A PART OF THE NAHANNI FORMATION SEDIMENTARY SEQUENCE.

SHALE UNIT: THICKNESS 346 FEET

THE CHARACTERISTIC LITHOLOGY OF THIS UNIT IS A LIMEY, GREY TO DARK GREY PLATY SHALE. A MOST NOTICEABLE FEATURE IS THE WEATHERING CHARACTER WHICH CAUSES THE SHALE TO WEATHER IN SLATE-LIKE PLATES 1/8 INCH TO 1/4 INCH THICK. THIS AGREES EXACTLY IN TYPE WITH THE SHALES DESCRIBED IN THE LOWER 1000 FEET OF THE RAMPARTS BY KINGSTON ABOVE VIRGINIA FALLS. THE LITHOLOGY AND WEATHERING CHARACTER ARE SO DISTINCTIVE THAT IT IS CERTAIN THAT THE SAME FACIES IS NOT PRESENT IN THE NAHANNI RANGE IN ANY OF THE SECTIONS OBSERVED THERE.

ARGILLACEOUS LIMESTONE UNIT: THICKNESS 431 FEET

THIS UNIT IS TRANSITIONAL IN TYPE BETWEEN THE PLATY SHALES BELOW AND THE MORE MASSIVE LIMESTONES ABOVE. IT CONSISTS PREDOMINANTLY OF THINLY BEDDED DARK GREY, ARGILLACEOUS LIMESTONES. THERE ARE NUMEROUS SHALE INTERBEDS AND OCCASIONAL MASSIVE COMPETENT LIMESTONE BEDS.

TWO FOSSIL SUITES WERE COLLECTED FROM THESE BEDS WHICH WERE IDENTIFIED BY C. R. STELCK AS MIDDLE DEVONIAN. (SEE APPENDIX #2).

STROMATOPOROIDAL UNIT: THICKNESS 298 FEET

THIS UNIT IS CHARACTERIZED BY MASSIVE LENTICULAR BEDS RICH IN STROMATOPORIDS ALTERNATING WITH THIN BEDDED GREY LIMESTONES. THE LENTICULAR NATURE OF THE MASSIVE BEDS PLUS THE HIGH PROPORTION OF LARGE STROMATOPORIDS WITH MINOR CORALS SUGGESTS THAT THIS IS A REEFAL INTERVAL.

UPPER MASSIVE LIMESTONE UNIT: THICKNESS 560 FEET

THIS UNIT IS THE DOMINANT CLIFF FORMING UNIT WHICH RESULTS IN THE SPECTACULAR CANYONS IN THE REGION OF THE RAM RIVER DOME AND THE MACKENZIE MOUNTAINS TO THE WEST.

THE CLIFFS ARE FORMED OF GREY TO DARK GREY LIMESTONE WHICH WEATHERS A GREY BUFF TO LIGHT BUFF COLOR. THE UNIT IS THICK BEDDED AND THE TEXTURE IS MOSTLY DENSE AND FINELY CRYSTALLINE WITH BANDS OF FINELY CRYSTALLINE LIMESTONE AND OCCASIONAL INFILLS AND REPLACEMENTS OF WHITE COARSELY CRYSTALLINE LIMESTONE.

REGIONAL VARIATIONS IN NAHANNI FORMATIONS:

THE NATURE OF THE SECTION IN THE RAM RIVER CANYON COMPARED TO THOSE SEEN AT LITTLE DOCTOR LAKE AND THE SOUTH END OF THE NAHANNI RANGE SUGGEST SOME PROFOUND FACIES CHANGES IN THE NAHANNI FORMATION. FROM A DOLOMITIC SECTION AT THE SOUTH END OF NAHANNI RANGE THE LITHOLOGY CHANGES TO A MORE NORMAL MARINE LIMESTONE AT LITTLE DOCTOR LAKE TO THE NORTH. THE LOWER PART OF THE SECTION AT THE RAM RIVER DOME IS A SHALE AND THE MIDDLE PORTION MORE SHALEY SUGGESTING STILL DEEPER MARINE CONDITIONS THERE. THIS IS ALSO SUGGESTED BY THE INCREASE IN THE THICKNESS AT THAT SECTION. THE INCREASE IN SHALE CONTENT AND STRATIGRAPHIC THICKENING PROBABLY CONTINUES TOWARD VIRGINIA FALLS AND THE SECTION DESCRIBED BY KINGSTON (1951).

DEVONIAN-MISSISSIPPIAN SHALE UNIT

NO GOOD SECTION OF THIS INTERVAL IS EXPOSED IN THE MIC MAC-MAYFAIR PERMIT AREA. SCATTERED OUTCROPS INDICATE ONLY THAT IT IS A UNIFORM DARK GREY SHALE SEQUENCE. BY PROJECTION OF DIPS FROM THE TOP OF THE RAMPARTS ON THE FLANK OF RAM RIVER DOME TO MISSISSIPPIAN SAND OUTCROPS IN THE VALLEY THE THICKNESS OF THE SHALE SEQUENCE IS ESTIMATED TO BE 5000 FEET. (SEE SECTIONS A-A1 AND B-B1).

IMPERIAL FORMATION

THE CONTINUOUS DEVONIAN-MISSISSIPPIAN SHALE SEQUENCE IS INTERRUPTED IN THE REGION OF THE NORTH NAHANNI RIVER BY A SEQUENCE OF SANDSTONES AND SILTSTONES ASSIGNED TO THE IMPERIAL FORMATION BASED ON FOSSIL COLLECTIONS IDENTIFIED BY C. R. STELCK. THE ARENACEOUS BEDS ARE CHARACTERIZED BY AN OVERALL OLIVE DRAB OR KHAKI COLOR AND ARE INTERBEDDED WITH GREY AND GREY BROWN SILTY SHALES AND MUDSTONES. SOME OF THE BEDS CONTAIN AN ABUNDANCE OF BRACHIOPODS SOME OF WHICH HAVE BEEN IDENTIFIED BY C. R. STELCK AND ARE LISTED IN APPENDIX 11. THE TOTAL THICKNESS MEASURED IS 494 FEET. THE SAME BEDS CAN BE SEEN IN A NUMBER OF RIDGES SOUTH OF THE NORTH NAHANNI RIVER BUT SHORTLY FURTHER SOUTH LOSE THEIR OUTCROP EXPRESSION ALMOST ENTIRELY PRESUMABLY DUE TO THE LOSS OF THE SANDY MEMBERS IN THE SECTION. A SERIES OF KNOB LIKE HILLS WERE NOTICED MIDWAY BETWEEN THE MISSISSIPPIAN SYNCLINAL RIDGES AND THE VALLEY FLOOR BUT WHEN EXAMINED ON THE GROUND THESE WERE FOUND TO CONSIST OF A MORE RESISTANT WEATHERING SILTY PETROLIFEROUS SHALE. IT IS PROBABLE THAT THIS IS A FACIES EQUIVALENT OF THE SANDY BEDS FURTHER NORTH BUT THAT THE IMPERIAL FORMATION AS A MAPPABLE UNIT DISAPPEARS IN THE NORTH END OF THE MIC MAC-MAYFAIR PERMIT AREA. I.E. JUST SOUTH OF LATITUDE 62°.

MISSISSIPPIAN UNITS 1, 2, 3 AND 4 (MATTSON FORMATION)

ALL OF THESE UNITS OF PATTON (1958) ARE PROBABLY REPRESENTED IN THE HIGHER RIDGES OF THE SOUTH END OF THE MIC MAC-MAYFAIR PERMIT BLOCK. THESE BEDS WERE NOT EXAMINED ON THE GROUND AS THEY HAVE BEEN DESCRIBED BY PATTON AND DOUGLAS AND NORRIS (1959) AND THE GENERAL STRUCTURE IS EVIDENT FROM AERIAL PHOTOGRAPHS.

THE YOUNGEST CONSOLIDATED SEDIMENTS EXPOSED IN THE MIC MAC-MAYFAIR PERMITS ARE THOUGHT TO BE THE LOWER BEDS OF THE MISSISSIPPIAN MATTSON FORMATION.

STRUCTURE

AS CAN BE SEEN ON THE GEOLOGIC MAP, THE PRINCIPAL STRUCTURAL FEATURE OF THE MIC MAC-MAYFAIR PERMIT AREA IS A MAJOR SYNCLINE BETWEEN THE NAHANNI RANGE ON THE EAST AND RAM RIVER DOME ON THE WEST. IN THE SOUTHERN END, SOUTH OF THE DOWNPLUNGE END OF THE RAM RIVER DOME THE SYNCLINE BROADENS OUT CONSIDERABLY AND THE THREE SUBSIDIARY ANTICLINAL TRENDS ARE EXPRESSED IN THE MISSISSIPPIAN BEDS THERE. FURTHER NORTH NO EXPRESSION OF THESE FOLDS CAN BE SEEN EITHER BY REASON OF THEIR PLUNGING OUT OR BECAUSE THEIR EXPRESSION IS LOST AT THE SURFACE WHERE THE UNDERLYING BEDROCK IS THE DEVONIAN-MISSISSIPPIAN SHALE SEQUENCE. TO TRY TO DISCOVER WHETHER ANY OF THESE FOLDS, OR SIMILAR FOLDS ARE PRESENT BETWEEN THE MAIN SYNCLINAL AXIS AND THE MAIN UPLIFTS ON EITHER SIDE, ALL STREAMS WERE TRAVERSED WITH THE HELICOPTER FOR OUTCROPPING BEDROCK. NO SIGNIFICANT OUTCROPS WERE FOUND TO ADD TO THE STRUCTURAL PICTURE AS MAPPED FROM AERIAL PHOTOGRAPHS. A NUMBER OF ATTITUDES WERE TAKEN, HOWEVER, ON THE BEDS IN THE SYNCLINAL RIDGES AND ON THE FLANKS OF THE NAHANNI RANGE AND THE RAM RIVER DOME. THESE LED TO A STRUCTURAL INTERPRETATION AS DEPICTED ON SECTIONS A-A1 AND B-B1.

NOTE THAT ON THE EAST LIMB OF THE SYNCLINE PROJECTION OF DIPS FROM THE NAHANNI RANGE UNDER THE MISSISSIPPIAN RIDGES WOULD GIVE AN EXCESSIVE THICKNESS OF ABOUT 15,000 FEET FOR THE DEVONIAN-MISSISSIPPIAN SHALE SEQUENCE. THIS SUGGESTS THE PROBABILITY OF SOME MODIFYING STRUCTURE ON THIS LIMB AS SHOWN ON THE SECTIONS.

IT WAS CONCLUDED THAT ANY FURTHER STRUCTURAL DATA CONCERNING THE SYNCLINAL AREA WOULD REQUIRE SOME TYPE OF GEOPHYSICAL SURVEY.

THE RAM RIVER DOME WAS GONE AROUND COMPLETELY IN THE HELICOPTER AND TRAVERSED AT SEVERAL POINTS.

IT WAS FOUND TO BE A LARGE DOUBLY PLUNGING ANTICLINE. IT WAS NOTED THAT THE TOPS OF ALL THE RIDGES AND MESAS ARE CAPPED BY APPROXIMATELY THE TOP OF THE UPPER MASSIVE LIMESTONE UNIT OF THE NAHANNI FORMATION. THE ACCOMPANYING STRUCTURE CONTOUR MAP WAS MADE BY UTILIZING THIS INTERPRETATION IN CONJUNCTION WITH THE ARMY SURVEY TOPOGRAPHIC MAPS AND THE R.C.A.F. AERIAL MOSAICS.

FROM THIS MAP IT CAN BE SEEN THAT THE STRUCTURE IS A WELL DEFINED DOUBLY PLUNGING ANTICLINE. THE PLUNGE TO THE NORTH IS QUITE SHARP AND IS ACCOMPLISHED BY THE PLUNGING OF TWO PRONGS WHICH JOIN AT THE APEX OF THE STRUCTURE. TO THE SOUTH THE PLUNGE IS MORE GRADUAL BUT IS QUITE WELL DEFINED AND DEFINITE DOWN TO AT LEAST THE 3500 FOOT LEVEL. TO THE SOUTH OF THIS, PLUNGE IS EVEN MORE GENTLE BUT FROM OBSERVATIONS FROM THE HELICOPTER IT IS BELIEVED THERE IS CLOSURE IN THIS DIRECTION DOWN TO THE 3000 FOOT LEVEL. FROM THIS POINT THE TOP OF THE NAHANNI FORMATION MAINTAINS A FAIRLY CONSTANT ELEVATION UNTIL IT STARTS TO RISE AGAIN TO THE WEST IN THE MAIN MACKENZIE RANGES.

THE 3500 FOOT STRUCTURE CONTOUR, WHICH OUTLINES THE AREA WITH AT LEAST 1000 FEET OF CLOSURE, ENCLOSES AN AREA WITH A LENGTH OF SIXTEEN MILES AND A WIDTH OF SEVEN MILES. THE 3000 FOOT CONTOUR, ENCLOSING THE AREA WITH 1500 FEET OF CLOSURE, EXTENDS THE LENGTH TO 25 MILES WITH A WIDTH OF EIGHT MILES.

PETROLEUM POSSIBILITIES

UNFORTUNATELY, NO FAVORABLE STRUCTURES WERE PROVED IN THE SYNCLINAL VALLEY WHERE THE PROSPECTIVE MIDDLE DEVONIAN NAHANNI FORMATION IS BURIED. IT IS THOUGHT THAT THE NEXT STEP IN THE EXPLORATION OF THE VALLEY AREA WOULD BE TO RUN SOME TYPE OF GEOPHYSICAL SURVEY TO DETERMINE WHETHER THE SUBSIDIARY FOLD POSTULATED ON THE EAST LIMB OF THE SYNCLINE ACTUALLY DOES EXIST.

IT SHOULD BE BORNE IN MIND ALSO THAT THE REEF TO OFF REEF RELATIONSHIPS SUGGESTED BY THE CHANGING FACIES IN THE NAHANNI FORMATION MAY BE MORE IMPORTANT TO THE TRAPPING OF PETROLEUM THAN THE STRUCTURE AND THAT STRATIGRAPHIC TRAPS COULD BE FOUND IN THIS FORMATION IN SPITE OF ADVERSE STRUCTURE.

LITTLE MORE WORK WOULD BE REQUIRED IN THE DEFINITION OF THE STRUCTURE OF THE RAM RIVER DOME. MORE DETAILED WORK COULD BE DONE ON EXAMINATION OF THE UNDERLYING PROSPECTIVE RESERVOIR BEDS IN SURROUNDING AREAS. SUCH WORK WOULD STILL REQUIRE EXTRAPOLATIONS OVER LONG DISTANCES AND IT IS PROBABLY AS READY FOR THE DRILL NOW AS IT EVER WILL BE AS FAR AS GEOLOGICAL CONSIDERATIONS ARE CONCERNED. THE PRIMARY CONCERN IS THE DEGREE OF PROSPECTIVENESS OF THESE POTENTIAL RESERVOIRS WHICH ARE AS YET UNPRODUCTIVE BUT RELATIVELY UNTESTED IN NORTHERN CANADA, PLUS THE PROBLEM OF LOGISTICS IN MOVING DRILLING EQUIPMENT INTO THIS AREA.

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APPENDIX #1
STRATIGRAPHIC SECTION NUMBER ONE
RAM RIVER, NORTHWEST TERRITORIES

61°48'N 123°58'W

NAHANNI FORMATION - UPPER MASSIVE LIMESTONE UNIT

THICKNESS - 560 FEET

GENERAL DESCRIPTION:

THE UPPER MASSIVE LIMESTONE MEMBER OF THE NAHANNI FORMATION IS THE MAIN CLIFF FORMER IN THIS AREA. IT CAPS ALL THE MAJOR MOUNTAINS AND CANYON RIMS AND IS ALWAYS CHARACTERIZED BY VERTICAL CLIFFS FALLING AWAY FOR NEARLY THE TOTAL THICKNESS OF THE UNIT. BECAUSE OF THIS CLIFF FORMING NATURE, NO PLACE WAS FOUND IN THIS AREA WHERE THE UNIT IS ACCESSIBLE FOR DIRECT MEASUREMENT AND DETAILED DESCRIPTION IN THE HIGHER CANYONS AND RANGES. ON THE FLANKS OF THE DOME THE UNIT WAS EXAMINED AT A NUMBER OF DIFFERENT LOCATIONS BUT DUE TO HIGH WATER IN THE CANYONS AND THE FACT THAT THE VERTICAL CLIFFS CAME DOWN TO WATER LEVEL, NO CONTINUOUS TRAVERSE OF THE FORMATION COULD BE MADE. HELICOPTER ALTIMETER READINGS IN A NUMBER OF DIFFERENT PLACES, OF THE TOP AND BOTTOM OF THE MEMBER, GAVE FAIRLY CONSTANT THICKNESS AND A THICKNESS OF 560 FEET IS ASSIGNED TO THE UNIT. THE REMARKABLE SIMILARITY IN LITHOLOGY OF PORTIONS OF THE SECTIONS WHICH WERE EXAMINED AT VARIOUS STRATIGRAPHIC LEVELS PLUS THE UNIFORM WEATHERING CHARACTER OVER THE ENTIRE THICKNESS LEAD US TO BELIEVE THAT THE LITHOLOGIC DESCRIPTION BELOW IS REPRESENTATIVE OF THE UNIT AS A WHOLE.

0' - 560'

LIMESTONE: GREY TO DARK GREY, WEATHERS GREY BUFF AND LIGHT BUFF, MASSIVE THICK BEDDED, MOSTLY DENSE AND MICROCRYSTALLINE, SOME FINELY CRYSTALLINE BANDS WITH OCCASIONAL REPLACEMENTS AND INFILL OF WHITE COARSELY CRYSTALLINE CALCITE.

THE NUMBER OF INTERMITTANT FINELY CRYSTALLINE BANDS WITH COARSE CRYSTALLINE CALCITE INFILL AND REPLACEMENT INCREASES NEAR THE BASE OF THE UNIT. THIS PORTION IS ALSO CHARACTERIZED BY DIVERGENT UNDULATORY BEDDING PLANES SUGGESTING REEFAL BANKS.

THE BASE OF THE UNIT IS MARKED BY A PROMINENT NICHE IN THE CLIFF FACES BELOW WHICH THE ROCK WEATHERS A DARKER COLOR AND THE SLOPES ARE MORE RECESSIONAL. THE DETAILED DESCRIPTIONS BELOW BEGIN AT THIS POINT STRATIGRAPHICALLY AND START ONE-QUARTER MILE EAST OF A LARGE WATERFALL IN A TRIBUTARY ON THE NORTH SIDE OF THE RAM RIVER WHICH TRIBUTARY ENTERS THE RAM RIVER ABOUT ONE-QUARTER MILE EAST (DOWNSTREAM) FROM THE WATERFALL ON THE RAM RIVER.

STROMATOPOROIDAL UNIT

THICKNESS - 298 FEET

- 560'-572' (12') LIMESTONE: DARK GREY, FINELY CRYSTALLINE, MUCH ORGANIC MATERIAL, THIN BEDDED, RUBBLY WEATHERING.
- 572'-580' (8') COVERED
- 580'-610' (30') LIMESTONE: LIGHT GREY VERY FINELY CRYSTALLINE, EXTREMELY FOSSILIFEROUS, (STROMATOPORIDS AND CORALS,) MUCH ORIGINAL POROSITY WITH WHITE COARSE CRYSTALLINE CALCITE INFILL, MASSIVE BEDDED.

NOTE: THIS IS PROBABLY A BIOHERMAL LENS AS INDICATED BY CHANGES IN THICKNESS AND DIVERGENCE OF BEDDING AS THE UNIT IS FOLLOWED Laterally.

- 610'-613' (3') LIMESTONE: FINELY CRYSTALLINE, THIN BEDDED RUBBLY WEATHERING.
- 613'-626' (13') LIMESTONE: GREY, VERY FINELY CRYSTALLINE, MASSIVE WEATHERING, MANY STROMATOPORIDS AND CALCITE INFILLS, (STROMATOPOROIDAL REEF).
- 626'-631' (5') LIMESTONE: AS ABOVE, BUT THINNER BEDDED.
- 631'-663.5' (32.5') LIMESTONE: VERY DARK GREY, MICROCRYSTALLINE, SPARSELY FOSSILIFEROUS WITH SIMPLE CORALS AND BRACHIOPODS, REGULAR BEDDING 6 TO 8 INCHES THICK.

FOSSIL SUITE F-1 AT TOP

- 663.5-674.5 (11') LIMESTONE: AS ABOVE, BUT BEDDING IS UNDULATORY.
- 674.5-694 (19.5') LIMESTONE: AS ABOVE, BUT WITH THICKER BEDS UP TO 18 INCHES.
- 694'-713' (19') LIMESTONE: GREY, MICROCRYSTALLINE, WITH IRREGULAR REPLACEMENT OF GREY FINELY CRYSTALLINE EARTHY TEXTURED LIMESTONE, THIS LATTER IS A REPLACEMENT LIMESTONE WHICH REPLACES PART OF THE VERY NUMEROUS STROMATOPOROIDAL "NIGGERHEADS". (STROMATOPOROIDAL REEF BAND.)
- 713'-729.5 (16.5') LIMESTONE: DARK GREY, AS ABOVE, MUCH STROMATOPOROIDAL MATERIAL.
- 729.5-730' (0.5') LIMESTONE: GREY, DENSE, VERY FINE, THIN BEDDING, ALMOST A SHALTY HABIT.
- 730'-733' (3') LIMESTONE: DARK GREY, FINE CRYSTALLINE TO EARTHY MATRIX IN A SIMPLE CORAL AND BRACHIOPOD COQUINA, FOETID ODOR.
- 733'-737' (4') LIMESTONE: DARK GREY, FINELY CRYSTALLINE WITH SCATTERED STROMATOPORIDS (SIZE OF A MAN'S HEAD), MASSIVE WEATHERING, UNBEDDED.

737'-746' (9') LIMESTONE: DARK GREY, MICROCRYSTALLINE AND SOME EARTHY WITH LARGE STROMATOPORIDS.

746'-776' (30') COVERED: UPPER 2' SCATTERED OUTCROP.

LIMESTONE: DARK GREY, VERY FINELY CRYSTALLINE, BUFF RUBBLY WEATHERING.

776'-803' (27') LIMESTONE: DARK GREY, MICROCRYSTALLINE, MASSIVE BEDDED, NUMEROUS STROMATOPOROIDAL "HEADS" AND SOME AMPHIPORA AND SIMPLE CORALS.

803'-828' (25') COVERED

828'-858' (30') LIMESTONE: GREY, CORALLINE (SIMPLE CORALS) AND SOME STROMATOPORIDS, WEATHERS VERY MASSIVE AND LIGHT BUFF COLOR.

NOTE: THIS FORMS THE SCARP FOR THE UPPER FALLS.

ARGILLACEOUS LIMESTONE UNIT

THICKNESS - 431 FEET

858'-884' (26') LIMESTONE: DARK GREY, VERY FINELY CRYSTALLINE, RUBBLY RECESSIONALLY WEATHERING.

NOTE: THIS UNIT FORMS THE FIRST UNDERCUT OF THE UPPER FALLS.

884'-956' (72') LIMESTONE: ARGILLACEOUS, DARK GREY, DENSE, THIN REGULARLY BEDDED, 4 TO 8 INCHES THICK, NODULAR BANDED CHERT AND SOME REPLACEMENT CHERT, NON-FOSSILIFEROUS, RUBBLY WEATHERING.

956'-974' (18') LIMESTONE: ARGILLACEOUS, DARK GREY, DENSE, EVEN BEDS 8 TO 12 INCHES THICK WITH THIN SHALY LIMESTONE INTERBEDS.

974'-976' (2') LIMESTONE: ARGILLACEOUS, DARK GREY, DENSE, MASSIVE WEATHERING.

FOSSIL SUITE F-2

976'-985' (9') LIMESTONE: ARGILLACEOUS, DARK GREY, DENSE, WITH SOME SHALY INTERBEDS.

985'-992' (7') LIMESTONE: DARK GREY, DENSE, MASSIVE WEATHERING.

992'-999' (7') LIMESTONE: ARGILLACEOUS, DARK GREY, DENSE, THIN BEDDED, 3 INCHES THICK WITH SHALY LIMESTONE INTERBEDS.

999'-1017' (18') LIMESTONE, GREY, FINELY CRYSTALLINE, VERY MASSIVE WEATHERING.

NOTE: UPPER FALLS HAS A VERTICAL DROP FROM THE POINT NOTED ABOVE TO ABOUT 15' BELOW THE BASE OF THIS UNIT, A FALL OF 204 FEET.

- 1017'-1079' (62') LIMESTONE: ARGILLACEOUS, DARK GREY, DENSE, VERY EVEN PARALLEL BEDDING 1 TO 1.5 INCHES THICK, PLATY WEATHERING.
- 1079'-1110' (31') LIMESTONE: ARGILLACEOUS, DARK GREY, DENSE, INTERNALLY LIKE UNIT ABOVE BUT BEDDING IS UNDULATORY GIVING AN ALMOST NODULAR APPEARANCE.
- 1110'-1112' (2') LIMESTONE: GREY, DENSE, VERY FOSSILIFEROUS, MASSIVE.

FOSSIL SUITE F-3

NOTE: THIS BED FORMS THE LIP OF THE SECOND FALLS. THE GORGE BELOW THE LIP OF THE SECOND FALLS HAS A GOOD SECTION EXPOSED BUT WAS FOUND TO BE INACCESSIBLE FOR CLIMBING. FOR THIS REASON THE MEASUREMENTS WERE CONTINUED ON THE MOUNTAIN FACE ACROSS THE VALLEY ON THE SOUTH SIDE OF RAM RIVER. HERE THE SAME FOSSILIFEROUS BED WAS NOT FOUND BUT MEASUREMENTS WERE STARTED ABOUT 95 FEET BELOW THE SAME 18 FOOT MASSIVE WEATHERING BED MEASURED ABOVE.

- 1112'-1188' (76') LIMESTONE: ARGILLACEOUS, BLACK, DENSE, INTERBEDDED WITH LIMY BLACK SHALE; THE BEDS ARE EVENLY BEDDED, THE LIMESTONE BANDS BEING 2" TO 8" THICK AND THE SHALIER BEDS ABOUT 1" THICK, THE INTERBEDDING IS CYCLIC.
- 1188'-1192' (4') SHALE: LIMY, FISSILE, INTERBEDDED WITH LIMESTONE, ARGILLACEOUS, BLACK PYRITIC, WEATHERS DARK GREY, UNDULATORY BEDDING.
- 1192'-1199' (7') COVERED
- 1199'-1242' (43') LIMESTONE: ARGILLACEOUS, DARK GREY TO BLACK, PLATY HABIT, INTERBEDDED WITH SHALE, LIMY, BLACK, FISSILE; LIMESTONE BEDS ARE 2" TO 6" THICK.
- 1242'-1268' (26') LIMESTONE: ARGILLACEOUS, DARK GREY, DENSE, MASSIVE WEATHERING.
- 1268'-1276' (8') LIMESTONE: ARGILLACEOUS, DARK GREY, PLATY WEATHERING, THIN EVEN BEDDING.
- 1276'-1289' (13') LIMESTONE: ARGILLACEOUS, DARK GREY TO BLACK, DENSE, IRREGULAR BEDDING, IN DISCREET LENSES ONE FOOT THICK TO THREE FEET LONG SEPARATED BY MORE SHALY INTERBEDS, THE LENSES INTERLOCK GIVING A PILLOW LIKE EFFECT TO THE WEATHERED SURFACE.

SHALE UNIT

THICKNESS - 346 FEET

- 1289'-1353' (64') COVERED
- 1353'-1360' (7') SHALE: LIMY, PYRITIC, GREY TO DARK GREY, THIS SHALE HAS A VERY REGULAR BEDDING HABIT GIVING PLATY OR SLATE-LIKE SHEETS

1/8 TO 1/4 INCH THICK ON WEATHERING.

1260'-1277' (17') LIMESTONE: VERY ARGILLACEOUS, DARK GREY, DENSE, PYRITIC, IRREGULAR MASSIVE BEDDING.

1277'-1315' (38') SHALE: LIGHT, GREY TO DARK GREY, PLATY. THE PLATY HABIT CAUSES THE SHALE TO BREAK OFF IN THIN PLATES 1/8 TO 1/4 INCH THICK, VERTICAL FRACTURES PLUS THE PLATY HABIT GIVE A SLATE-LIKE APPEARANCE TO THE SHALE ON WEATHERING; THE FLAGSTONES WEATHER A YELLOW BUFF COLOR WHICH IS VERY APPARENT ON THE SLOPES.

NOTE: THIS IS THE BASE OF THE OUTCROP AT THE POINT WHERE THIS SECTION WAS MEASURED. BY PROJECTION OF DIPS IT WAS CONCLUDED THAT THIS POINT IS STRATIGRAPHICALLY WITHIN 20 FEET OF A VERY STRIKING CONTACT SEEN AT RAM FALLS ABOUT 300 YARDS TO THE WEST. AT THE FALLS THE SHALE DESCRIBED ABOVE overlies A MASSIVE DARK GREY LIMESTONE WITH VERY IRREGULAR BEDDING. THE CONTACT IS VERY SHARP AND SHOWS NO GRADATION WHATSOEVER EITHER IN THE SHALE ABOVE OR IN THE LIMESTONE BELOW. THE IRREGULAR ROLLING STRATIFICATION OF THE LIMESTONE BELOW THE CONTACT IS A MOST NOTABLE FEATURE AND IN SOME PLACES THERE IS A DEFINITE ANGULAR DISCORDANCE BETWEEN BEDDING PLANES IN THE LIMESTONE AND THE CONTACT. THE SHARPNESS OF THE CONTACT SUGGESTS A DISCONFORMITY AND THE ANGULAR RELATIONSHIP OF THE BEDDING BELOW THE CONTACT SUGGESTS THE POSSIBILITY OF AN ANGULAR UNCONFORMITY. THE ERRATIC BEDDING IN THE UNDERLYING BEDS, HOWEVER, LEADS US TO BELIEVE THAT THE ANGULAR DISCORDANCE IS MORE PROBABLY DUE TO DEPOSITIONAL DIPS RATHER THAN SEVELLING OF TILTED STRATA. THIS IS SUPPORTED BY THE LITHOLOGY OF THE BEDS BELOW THE CONTACT ALSO AS THEY APPEAR MORE TYPICAL OF THE NAMANI FORMATION THAN SILURIAN BEDS IN SURROUNDING AREAS. IT IS CONCLUDED THAT THIS CONTACT IS A VERY MARKED SEDIMENTARY DISCONFORMITY.

LOWER LIMESTONE UNIT

THICKNESS - 20+ FEET

1315'-1325' (10') LIMESTONE: GREY TO DARK GREY, DENSE TO MICROCRYSTALLINE, CHARACTERIZED BY ERRATIC BEDDING, SOME BRACHIOPODS WERE OBSERVED NEAR THE TOP BUT THESE COULD NOT BE RECOVERED DUE TO THE HARD COMPACT NATURE OF THE LIMESTONE, MASSIVE RESISTANT WEATHERING CAUSING A FALL ON THE RAM RIVER.

STRATIGRAPHIC SECTION NUMBER TWO
NORTH NAHANNI RIVER, NORTHWEST TERRITORIES

SECTION IS EXPOSED ON A SOUTH FACING SCARP ON THE NORTH SIDE
OF THE NORTH NAHANNI RIVER BELOW THE CONFLUENCE OF THE RAM AND NORTH NAHANNI RIVERS.

0'-25' (25') LIMESTONE: BROWN, DENSE TO VERY FINELY GRANULAR, NODULAR
HABIT WITH SHALY INTERBEDS AND INTERLAMINAE, LIMESTONE BEDS
ARE 1/2 INCH TO 2 INCHES THICK, WEATHERS LIGHT BUFF.

25'-48' (23') LIMESTONE: AS ABOVE BUT SLIGHTLY MORE SHALY WITH SOME SHALE
BANDS, TRACE CARBONACEOUS MATTER, THICKER BEDDED THAN ABOVE.

FOSSIL SUITE F-10

12 FEET FROM BASE

48'-121' (73') INTERMITTANT OUTCROP, SHALE: LIMY, GREY BROWN FISSILE TO PLATY.

121'-152' (31') SILTSTONE: VERY LIMY, GRADING TO SILTY ARGILLACEOUS LIMESTONE,
GREY BROWN, THIN UNDULATORY BEDDING, BUFF WEATHERING.

152'-170' (18') SANDSTONE: VERY ARGILLACEOUS, SOME LIMY, GREY AND GREY BROWN,
THIN BEDDED.

FOSSIL SUITE F-11

1.5 FEET ABOVE BASE

170'-176' (6') SANDSTONE: ARGILLACEOUS, OLIVE BROWN, WEATHERS MASSIVE, LIGHT
BUFF COLOR, FOSSIL BEDS SIMILAR TO F-11.

NOTE: THIS BED FORMS THE BASE OF THE SECOND MASSIVE CLIFF ON
SCARP AND THE ENTIRE SECTION ABOVE CAN BE COMBINED INTO THE
UPPERMOST MAIN CLIFF FORMING PART OF THE SECTION.

176'-215' (39') SANDSTONE: VERY ARGILLACEOUS, OLIVE BROWN TO GREY BROWN, VERY
FINE GRAINED, WITH THIN SHALE LAMINAE AND SHALY PARTINGS,
RECESSIONAL WEATHERING.

215'-251' (36') SCATTERED OUTCROP, SHALE: GREY BROWN AND MUDSTONE, SILTY.

251'-267' (16') SHALE: GREY BROWN, FISSILE.

267'-314' (47') SANDSTONE: ARGILLACEOUS, VERY FINE GRAINED, INCREASINGLY SHALY
TOWARDS BASE, SOME LIMY CONCRETIONARY BEDS, FOSSILIFEROUS.

314'-327' (13') SANDSTONE: VERY ARGILLACEOUS, GREY BROWN, WITH SHALY BREAKS.

327'-336' (9') SHALE: SANDY, INTERBEDDED WITH ARGILLACEOUS SANDSTONE, OLIVE
BROWN.

336'-352' (16') MOSTLY COVERED, SHALE: DARK GREY, SOME SILTY BANDS AND SANDSTONE
NODULES.

352'-356' (4') SANDSTONE: ARGILLACEOUS, OLIVE BROWN, FINE GRAINED, MASSIVE BEDDED.

FOSSIL SUITE F-12

2 FEET BELOW TOP

356'-377' (21') SHALE: SANDY AND SANDSTONE: SHALY, GREY BROWN AND OLIVE BROWN, THIN BEDDED.

377'-389' (12') AS ABOVE: BUT WITH A HIGHER PROPORTION OF OLIVE BROWN SHALE.

389'-397' (8') SANDSTONE: ARGILLACEOUS, LIMY, OLIVE BROWN, FINE GRAINED, MASSIVE WEATHERING, THICK BEDDED.

397'-410.5' (13.5) SHALE: SANDY AND SILTY, GREY, SOME VERY FINE GRAINED SANDSTONE BANDS, SLIGHTLY LIMY.

410.5-414.5' (4') SANDSTONE: ARGILLACEOUS, GREY.

414'-455.5' (41') INTERMITTANT OUTCROP, SHALE: SILTY, GREY, INTERBEDDED WITH ARGILLACEOUS GREY BROWN SANDSTONE.

455.5'-457' (1.5) SANDSTONE: VERY LIMY, ARGILLACEOUS, GREY BROWN. (THIS IS THE TOP OF THE LOWER MAIN CLIFF FORMING MEMBER OF THE SCARP.)

457'-478.5' (21.5) SANDSTONE: VERY ARGILLACEOUS, GREY AND OLIVE BROWN, INTERBEDDED WITH SILTY SHALE.

478.5-494.5' (16') SANDSTONE: ARGILLACEOUS, KHAKI COLORED, VERY FINE GRAINED, WITH SILTY SHALE INTERBEDS, SOME LIMY BANDS.

NOTE: THIS IS THE BASE OF THE CONTINUOUS OUTCROP.

352'-356' (4') SANDSTONE: ARGILLACEOUS, OLIVE BROWN, FINE GRAINED, MASSIVE BEDDED.

FOSSIL SUITE F-12

2 FEET BELOW TOP

356'-377' (21') SHALE: SANDY AND SANDSTONE: SHALY, GREY BROWN AND OLIVE BROWN, THIN BEDDED.

377'-389' (12') AS ABOVE: BUT WITH A HIGHER PROPORTION OF OLIVE BROWN SHALE.

389'-397' (8') SANDSTONE: ARGILLACEOUS, LIMY, OLIVE BROWN, FINE GRAINED, MASSIVE WEATHERING, THICK BEDDED.

397'-410.5' (13.5) SHALE: SANDY AND SILTY, GREY, SOME VERY FINE GRAINED SANDSTONE BANDS, SLIGHTLY LIMY.

410.5-414.5' (4') SANDSTONE: ARGILLACEOUS, GREY.

414'-455.5' (41') INTERMITTANT OUTCROP, SHALE: SILTY, GREY, INTERBEDDED WITH ARGILLACEOUS GREY BROWN SANDSTONE.

455.5'-457' (1.5) SANDSTONE: VERY LIMY, ARGILLACEOUS, GREY BROWN. (THIS IS THE TOP OF THE LOWER MAIN CLIFF FORMING MEMBER OF THE SCARP.)

457'-478.5' (21.5) SANDSTONE: VERY ARGILLACEOUS, GREY AND OLIVE BROWN, INTERBEDDED WITH SILTY SHALE.

478.5-494.5' (16') SANDSTONE: ARGILLACEOUS, KHAKI COLORED, VERY FINE GRAINED, WITH SILTY SHALE INTERBEDS, SOME LIMY BANDS.

NOTE: THIS IS THE BASE OF THE CONTINUOUS OUTCROP.

A P P E N D I X #2
FOSSIL IDENTIFICATIONS
By: C. R. STELCK
UNIVERSITY OF ALBERTA

SECTION I:

SUITE F 1

AMPHIPORA SP.
PRODUCTELLA? SP.

DEV. HORIZON INDEFINITE

SUITE F 2

ATRYPA CF. ARCTICA
SCHIZOPHORIA CF. MCFARLANEI
PROETUS CF. HALDEMANI

M. DEVONIAN

SUITE F 3

ATRYPA

SECTION II:

LARGE SLABS IN BAG,
LOOSE FROM BASE OF
CLIFF

LEIORHYNCHUS WALCOTTI
CYRTOSPIRIFER WHITNEYI

IMPERIAL FORMATION

SUITE F 10

CYRTOSPIRIFER WHITNEYI
ATHYRIS ANGELICA

IMPERIAL FORMATION

SUITE 11

MEGAMBONA SP.
ATHYRIS SP.
LEIORHYNCHUS WALCOTTI

IMPERIAL FORMATION

SUITE F 12

CYRTOSPIRIFER AFF. MONTICOLA

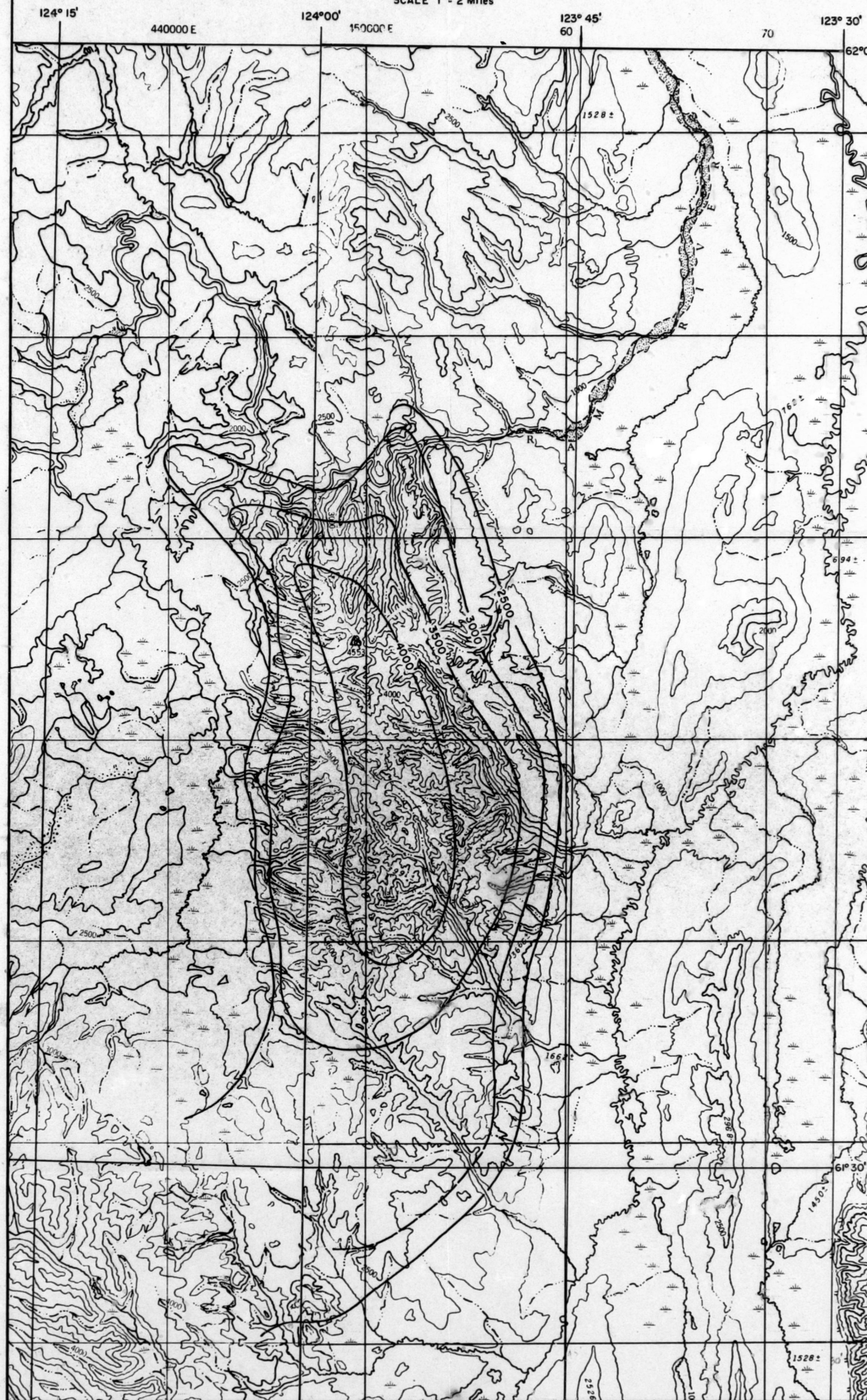
LATE U. DEVONIAN

204

38-1-4-16

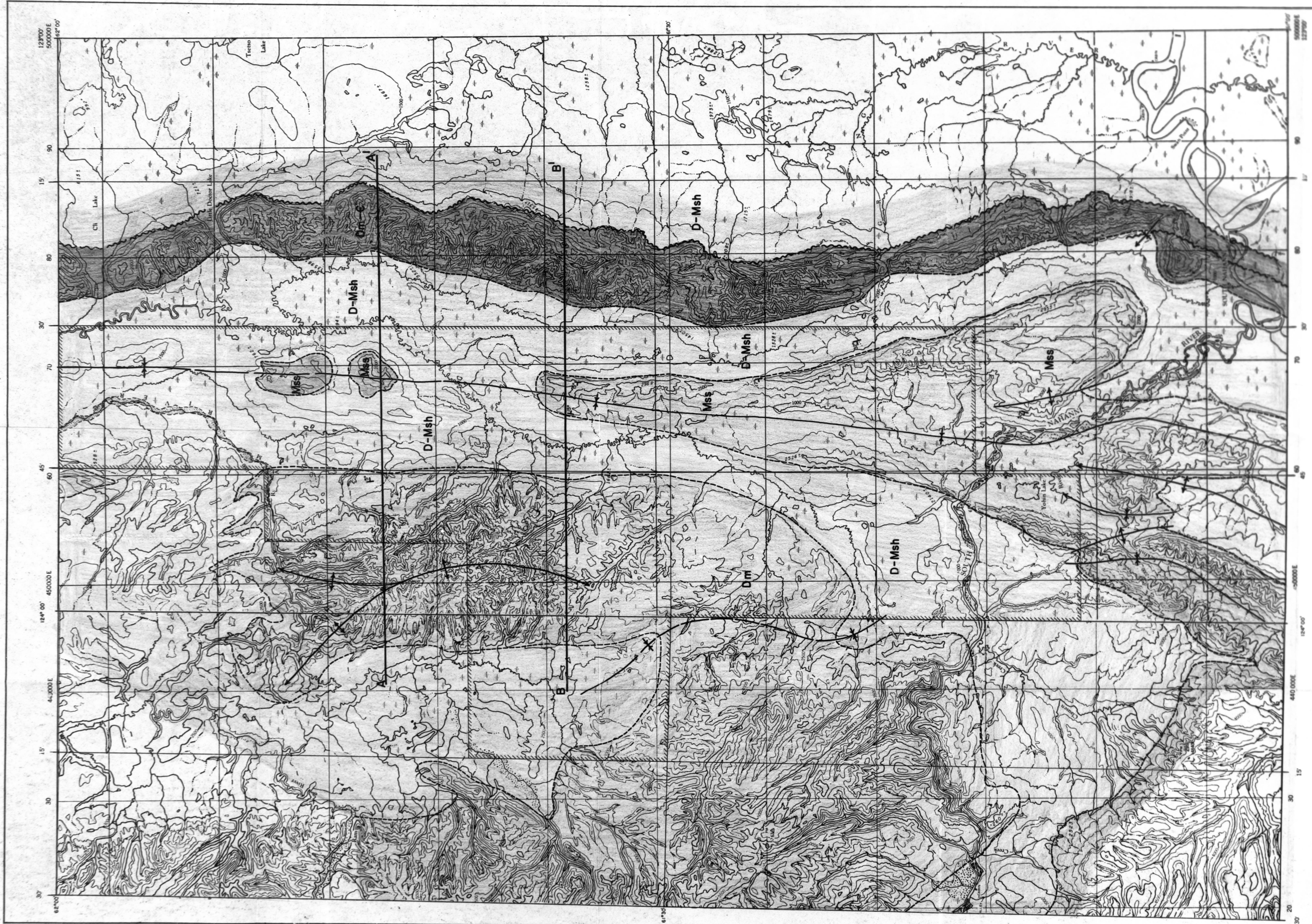
STRUCTURE CONTOURS TOP NAHANNI FORMATION
CONTOUR INTERVAL 500 FEET

SCALE 1" = 2 Miles



30x

West Canadian Graphic Industries Ltd.



GEOLOGY OF THE AREA BETWEEN THE SOUTH AND NORTH NAHANNI RIVERS, WEST OF NAHANNI RANGE

(RELATED TO CONSOLIDATED MIC-MAC AND MAYFAIR OIL AND GAS LTD. PERMITS 2564 TO 2572 INCLUSIVE AND 2841)

SCALE 1" = 2 Miles

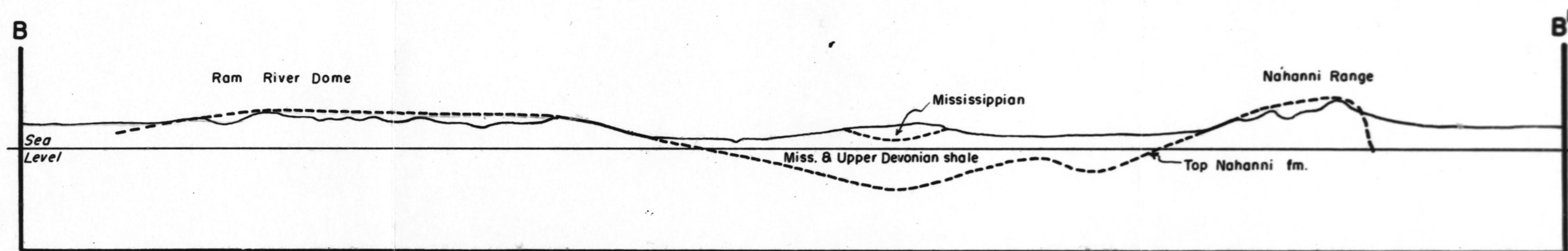
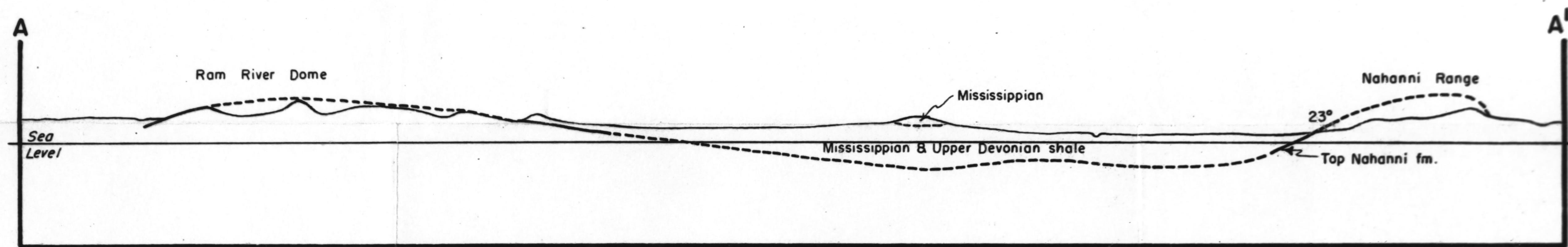
LEGEND

- PALEOZOIC** 36-1-4-1/2
- Mss** MISSISSIPPIAN ARGENTIFEROUS BEDS UNITS 1, 2, 3 & 4 OF PATTON
 - D-Msh** UPPER DEVONIAN - MISSISSIPPIAN SHALE UNIT
 - Dm** MIDDLE DEVONIAN NAHANNI FORMATION
 - Dm-c** INCLUDED BEDS RANGING FROM CARBONIFEROUS TO MIDDLE DEVONIAN IN AGE

- FAULT**
- APPROXIMATE GEOLOGICAL BOUNDARY**
- ANTICLINE**
- SINKHOLE**
- CONSOLIDATED MIC-MAC OIL AND GAS LTD. PERMITS 2564 TO 2572 INCLUSIVE AND 2841**



30x



38-1-4-16
 SCALES VERTICAL AND HORIZONTAL - ONE INCH EQUALS TWO MILES
 0 5 10 20 30
 FEET (THOUSANDS)

GEOLOGIC CROSS SECTIONS A-A' AND B-B'