Manitoba
Energy and Mines
Geological Services
Geological Compilation Map Series
Winnipeg, NTS 62H
1: 250 000

MARGINAL NOTES

The Winnipeg area (NTS 62H) straddles the boundary between the Paleozoic and Precambrian "outcrop" areas. The Paleozoic strata represent a portion of the northeastern flank of the Williston/Elk Point Basin; the Precambrian rocks are part of the Superior Structural Province. Except for the abandoned Little Stony Mountain quarry in the northwest part of the City of Winnipeg, which exposes the Ordovician Stony Mountain Formation, no bedrock exposures are present in NTS 62H. The entire map sheet is covered by 2 to 130m of glacial till, lake sediments and outwash deposits (see Inserts A and E). A limited number of oil well test holes, mineral exploration core holes, and Water Resources Branch test holes provide sufficient data to estimate the regional structure of the sedimentary strata. Using these structural data, formation contacts were extrapolated from known well locations to their intersection with the buried bedrock surface (Insert D).

REGIONAL STRUCTURAL GEOLOGY

Regional strike of the sedimentary strata is approximately north-south, and regional dip increases gradually and uniformly from about 2.6m/km in the eastern part of the map sheet to 4.2m/km in the western part. Despite the regional structural dip to the west, isopachs of the Red River and Winnipeg formations all trend east-west (Inserts F3 and F4), with thickening to the south at up to 0.3m/km. This indicates a major change in tectonic framework subsequent to early Paleozoic time. The present north-south structural trend probably developed during late Paleozoic to early Mesozoic, due to uplift with associated erosion and eventual exposure of Precambrian bedrock in southeastern Manitoba. This first appearance of the "Precambrian Shield" as a paleophysiographic feature is evidenced by the tongue of Jurassic strata south of Winnipeg that extends eastward, progressively overstepping Silurian and Ordovician strata to lie directly on eroded Precambrian surface near the southeastern corner of the map area.

The dip of Jurassic strata preserved in the channel shows a pronounced flattening, if not reversal, of the "normal" southwesterly Jurassic dip, suggesting post-Jurassic subsidence in the same area that had been subjected to late Paleozoic uplift.

BEDROCK TOPOGRAPHY

Bedrock topography in the Winnipeg map sheet (Insert D) shows considerable irregularity. Two sharply defined lows are evident, one coincident with the erosional edge of the Mesozoic shales, and the other coincident with the Paleozoic erosional edge - the sands and shales of the Winnipeg Formation. Both lows apparently represent ancient river channels. Local relief is as much as 70m. The channels probably are much more irregular than shown on the map, particularly along the Paleozoic edge, where the Red River Formation locally forms a prominent, near vertical escarpment.

Within the Paleozoic outcrop belt, local bedrock relief is also associated with the soft, easily eroded shales of the Gunn Member of the Stony Mountain Formation. Adjacent strata of the Gunton Member tend to form a minor escarpment, which is evident in outcrop immediately north of the Winnipeg map sheet.

PRECAMBRIAN UNCONFORMITY

Deeply eroded Precambrian rocks are overlain with profound unconformity by basal Paleozoic sands and shales of the Middle Ordovician Winnipeg Formation. Available data show that the weathered Precambrian surface was extremely flat. However, immediately east of the present erosional edge of the Paleozoic strata, and just north of the Winnipeg map sheet, granite outcrops are encountered at an elevation considerably higher than would be expected on the basis of extrapolation of regional dips from the west. Furthermore, these Precambrian granites show no sign of weathering, indicating that a considerable thickness of weathered material must have been removed by glacial and/or pre-glacial erosion. This suggests that the present Paleozoic/Precambrian contact may be structurally fault controlled, rather than a purely erosional feature.

PALEOZOIC

ORDOVICIAN

Winnipeg Formation

The Winnipeg Formation consists of a complex sequence of interbedded sands and shales. Regionally, the formation thins and becomes increasingly sandy to the north (McCabe, 1978). The sand is poorly consolidated, medium grained, mature, well rounded and quartzose; the shales commonly are light olive-grey, kaolinitic, with variable sand and silt content. Pyritic and/or limonitic concretions and oolites are common in some zones. The normal sequence consists of a thin basal sandstone overlain by interbedded sand and shale, with the shale content increasing upward. In NTS 62H, however, the distribution of sand is anomalous, with a single thick massive sandstone bed, the "Carman Sand" (Andrichuk, 1959), occurring in the upper part of the formation (Insert F4). This sand attains a thickness of up to 30m and forms a well defined, bar-like body (McCabe, op.cit.). The maximum thickness of the Winnipeg Formation (ca. 63m) occurs in the area of the Carman Sand, and the formation thins to the south and north, largely due to the effects of differential compaction, which gives rise to a slight anticlinal flexure over the Carman Sand.

Red River Formation

Winnipeg Formation sandstones and shales are overlain conformably and transitionally by mottled dolomitic limestones of the Red River Formation, 150 - 175m in thickness (Insert F3). The transition zone consists of a thin sequence of interbedded limestones and shales, termed the "Hecla Beds" (Porter and Fuller, 1959). The Red River Formation consists of two principal subunits, the lower Red River and the upper Red River strata. The lower Red River (approximately equivalent to the Yeoman Formation in Saskatchewan) can be subdivided, in the Lake Winnipeg outcrop area, into three mappable members: a lower Dog Head Member, a medial Cat Head Member, and an upper Selkirk Member. However, in the Winnipeg map sheet, more uniform lithologies do not allow for the subdivision of the lower Red River strata.

Lower Red River strata consist of light grey to yellowish- and brownish-buff, prominently mottled, fossiliferous, dolomitic limestones. The darker brownish mottles consist of almost pure, finely crystalline, granular dolomite, whereas the lighter grey to buff patches are fossiliferous limestone (wackestone). Large, well preserved corals, gastropods, and cephalopods are common. Portions of the upper part of the unit (i.e. Selkirk Member) are quarried for building and decorative stone - the well known "Tyndall Stone" - in the Garson area, just north of NTS 62H, but the thicker overburden to the south (Insert E) has, to date, precluded quarry development in the area of the Winnipeg map sheet (62H).

The upper Red River strata consists of 40m of dolomite and argillaceous cherty dolomite, designated as the Fort Garry Member. These beds are approximately equivalent to the Herald Formation in Saskatchewan. The lower 20m of the unit consists of extremely fine grained sublithographic dolomite that is light brownish buff to slightly reddish and faintly laminated. Two thin argillaceous breccia zones occur near the top of the lower unit and are believed to represent zones where evaporite beds have been dissolved by subsurface solution. The upper 20m of the formation consists of a relatively coarse grained, granular, cherty dolomite. A thin, high calcium limestone bed occurs locally at the top of the Fort Garry Member, and a second limestone bed occurs sporadically near its middle.

Stony Mountain Formation

Red River Formation strata are overlain sharply, and possibly with slight disconformity, by shaly beds of the Stony Mountain Formation. In NTS 62H the Stony Mountain Formation ranges in thickness from 35 - 40m (Insert F2). It has previously been subdivided into four members, in ascending order: the Gunn, Penitentiary, Gunton and Williams. However, the position of the top of the Stony Mountain Formation is uncertain. Standardized correlations to be established for the new Atlas of Western Canada will probably place the contact at the base of the Williams Member, thereby including the Williams in the overlying Stonewall Formation rather than in the Stony Mountain as originally defined (Smith, 1963; 1964). This revised usage will be followed in Manitoba for this and subsequent maps.

The basal Gunn Member consists of greyish-red to purplish- and reddish-grey, fossiliferous, calcareous shale with interbeds of relatively clean, fossiliferous limestone. It is overlain by yellowish- to reddish-grey, fossiliferous, argillaceous dolomite of the Penitentiary Member. These two units together compose the lower Stony Mountain Formation (equivalent to the Stoughton Member in Saskatchewan), which maintains a relatively uniform thickness. However, the individual Gunn and Penitentiary members show marked variations in thickness, and are complete lateral or lithofacies equivalents. The Penitentiary Member represents a northern, shelfward, dolomitic and less argillaceous facies, whereas the Gunn Member represents a southern, more basinal limestone–shale facies. The Penitentiary Member is about 6m thick at the northern limit of NTS 62H, and probably thins rapidly to the south, pinching out within the map sheet.

The Gunton Member consists of a buff, finely crystalline, sparsely fossiliferous, nodular-bedded dolomite that is relatively uniform in thickness and lithology throughout the map area.

ORDOVICIAN/LOWER SILURIAN

Stonewall Formation

The Williams Member, herein placed as the basal unit of the Stonewall Formation, represents the oldest of a series of so-called "para-time-stratigraphic" markers; thin sandy and/or argillaceous beds that can be traced for many hundreds of kilometres, throughout most of the Williston/Elk Point Basin area. These marker beds provide the primary means for stratigraphic subdivision of Upper Ordovician and Silurian strata and probably represent deposits related to brief periods of shoaling or even slight uplift and erosion (i.e. non-sequences); (Porter and Fuller, 1959).

The lower Stonewall beds, above the Williams Member, consist of 7m of pale yellowish-grey to yellowish-brown, faintly mottled, medium- to thin-bedded, finely crystalline dolomite with sparse, poorly preserved fossils. These beds are separated by a sandy argillaceous marker bed, the "T-marker" from the upper Stonewall Formation (Porter and Fuller, 1959). The upper Stonewall beds consists of 6m of light brown to grey, laminated to thin bedded, sparsely fossiliferous microcrystalline dolomite. In NTS 62H, the Stonewall Formation can reach a thickness of ±15m (Insert F1). The top of the formation is placed at the base of yet another marker bed. The Ordovician/Silurian boundary occurs within the upper part of the Stonewall sequence, possibly at the medial "T-marker".

SILURIAN

Interlake Group

The Silurian succession in southern Manitoba comprises a 50 - 70m sequence of dolomite, ranging from variably fossiliferous and stromatolitic to predominantly finely crystalline and dense to sublithographic. Minor lithologic variations, along with the occurrence of several thin sandy, argillaceous marker beds, are used to subdivide the Interlake Group north of latitude 52° (Stearn, 1956). However, lack of outcrop or core holes in NTS 62H precludes the possibility of subdividing Silurian strata in this area.

DEVONIAN

Ashern Formation

Devonian rocks occur only in the northwestern corner of NTS 62H as a thin erosional wedge. The basal Ashern Formation consists of 3 - 10m of red to grey argillaceous dolomite and dolomitic shales that unconformably overlie eroded Interlake strata. Regional data indicate that the entire Upper Interlake Group is missing in southern Manitoba, suggesting erosion of as much as 50 - 100m of Upper Interlake Group strata.

The Ashern Formation is overlain, with a possible slight disconformity, by carbonates of the Elk Point Group, which may consist of either limestones of the Elm Point Formation or dolomites of the Winnipegosis Formation. These two formations are facies equivalents, but data are not sufficient to determine which lithology is present in the map area.

MESOZOIC

In the southwestern corner of the map area, the thin erosional wedge edge of a rapidly thickening sequence of Jurassic and Cretaceous strata overlies the eroded Paleozoic surface with slight angular unconformity. The regional rate of truncation of Paleozoic strata is approximately 3m/km, and the overlying Mesozoic strata dip gently to the southwest at 2m/km. The erosional edge of Mesozoic strata forms the Manitoba Escarpment. Although the topographic expression of the escarpment is not evident until a few kilometers west of the map area (i.e. Pembina Mountain), the thickened Mesozoic sequence and the associated rise in bedrock elevation reflects the buried portion of this escarpment. The most striking feature of the Mesozoic outcrop pattern is the major eastward-trending tongue of Lower Jurassic (Reston and Amaranth formations) that extends entirely across the map sheet, and is termed the "Dominion City Channel". This is the result of sedimentation in a deeply eroded channel (up to 100m in depth) in which a sequence of basal red beds and overlying evaporites and limestones were deposited. The channel cuts through the complete Paleozoic sequence so that, to the east, Jurassic strata rest directly on eroded Precambrian. The Precambrian Shield of southeastern Manitoba thus became a positive physiographic feature in late Paleozoic to early Mesozoic time. The bend in the structure contours on the Precambrian surface through the channel indicates that pre-Mesozoic erosion has also cut deeply into the Precambrian rocks.

McNeil and Caldwell (1981) have proposed a modified stratigraphic terminology for Cretaceous strata in Manitoba. Most formation and member names are retained, but the Vermillion River and Riding Mountain formations are replaced by the Pierre Shale and Niobrara formations, and the Morden Member is raised to formation status. This revised terminology will be used in Manitoba for this and subsequent maps.

QUATERNARY

The present day landscape in the Winnipeg region (NTS 62H) is the result of multiple glacial advances and inundation by glacial Lake Agassiz. Late Wisconsinan glaciation began with an advance of the Rainy Lobe from the northeast, depositing the Senkiw Formation (not exposed in NTS 62H). Subsequently, the Red River Lobe, advancing from the northwest, deposited the Roseau, Whitemouth Lake and the Marchand formations (Insert A - unit 1).

The Bedford Hills interlobate moraine, comprising in excess of 120m of glacial drift, was deposited between these two ice lobes early in Late Wisconsinan time (units 2a and 2b).

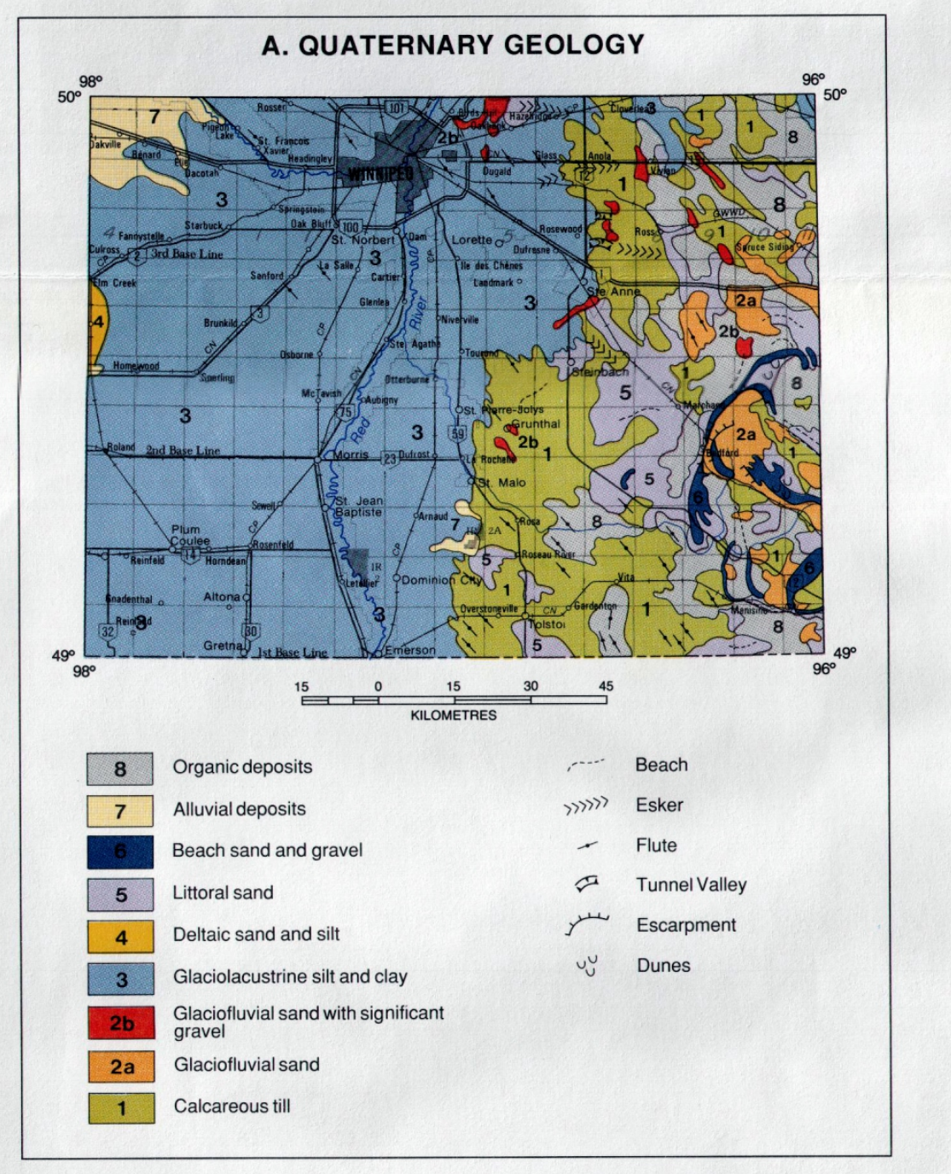
About 13 000 years BP, as glacial ice retreated, numerous ice-marginal lakes merged to form Lake Agassiz. Meltwater from western Manitoba and eastern Saskatchewan, flowing into Lake Agassiz, carried large quantities of sediments. Silt and clay were deposited in the deeper part of the Lake Agassiz basin (unit 3) and sand and gravel at the mouth of the Assiniboine spillway, forming the Assiniboine delta (in NTS 62G) which extended eastward far into the lake (unit 4).

The Bedford Hills interlobate moraine became an island early in the history of Lake Agassiz. Drumlinoid ridges (in unit 3) in the northeast, and fluted till plain (part of unit 1) in the southeast, are attributed to a late glacial surge into Lake Agassiz from the Interlake region. The interlobate moraine, rising 80 metres above the till plain, formed a nunatak within the very thin ice sheet. Final glacial retreat was rapid, as the thin glacial ice broke into large icebergs that scoured much of the lake bottom.

The final phases of Lake Agassiz, the Emerson and the Nipigon, began around 9900 years BP as the level of Lake Agassiz rose to the Norcross strandline (escarpment in unit 2a). Large gravel and sand spits (unit 6) and littoral sand bodies (unit 5) formed along the western flank of the Bedford Hills interlobate moraine. A series of strandlines, down to the Lower Pas (indicated by beach symbols), represent the final drainage of Lake Agassiz from the area about 8500 years BP.

Post-glacial alluvium (unit 7) of the Assiniboine and Red rivers, organics developed in poorly drained areas (unit 8), and eolian activity (dunes in unit 5) complete the present day landscape.

A. QUATERNARY GEOLOGY



ECONOMIC GEOLOGY

Various industrial mineral commodities, such as peat moss, aggregate, clay, gypsum and limestone, have been and are presently being exploited in NTS 62H.

Sphagnum peat moss is being quarried at the Julius Bog by Fisons Western Co., for use in horticulture as a soil conditioner, and as packing material for the shipment of perishible fruits, vegetables and cut flowers.

Aggregate resources in NTS 62H are derived primarily from glaciofluvial and glaciolacustrine deposits (see Insert A - units 2b and 6). Beach deposits (unit 6) are less significant as regional sources of aggregate due to their typically fine particle size, but they are suitable for local use. Glaciofluvial deposits (unit 2b), although variable in texture, contain substantial quantities of aggregate capable of meeting high quality end uses such as concrete. The major aggregate producers operate from these sources near the towns of Birds Hill, Ross, Vivian, Monominto (northeast of Rosewood) and Grunthal.

The high cost of transporting aggregate divides the southern Manitoba market into two primary markets: deposits within a 60km radius of the City of Winnipeg that supply urban development within the city; beyond 60km, value of aggregate is dependent on highway contracts and local demand, varying significantly from year to year. In 1988, 31% of the total provincial production was consumed by the City of Winnipeg; 71% of the city's requirements, approximately 3.6 million tonnes, was produced from within this map area.

Lake Agassiz clays (Insert A - unit 3) of the Red River Valley are used in the production of light weight aggregate (Kildonan Concrete Products) and Portland cement (Inland Cement), from seasonal pits operating in the northeastern part of Winnipeg (St. Boniface, Transcona) and in the west end of the city (Tuxedo) respectively.

In 1964, the Silver Plains Gypsum Mine started production in the Jurassic Upper Amaranth Formation, along the northern flank of the "Dominion City Channel" (35km south of Winnipeg). In the eleven years the mine was open, 63 000 to 136 700 tonnes of gypsum were mined annually for use in wallboard manufacturing, Portland cement and plaster of Paris. Unfortunately, artesian pressures caused leakage in the mine floor, and before proper remedial measures could be taken, the mine was flooded in 1975 and has remained inactive since.

Upper Amaranth Formation gypsum beds had also been reported in 1920 in the Mesozoic outlier in the Charleswood area. The area attracted periodic interest due to its proximity to wallboard plants in Winnipeg, but the gypsum beds have not been exploited to date.

Little Stony Mountain quarry, in the northwest part of the City of Winnipeg, operated from 1850 to 1905 and produced aggregate and building stone. Both the Gunton and Penitentiary members of the Ordovician Stony Mountain Formation were quarried. The plant and town at the quarry site were dismantled and transported north to Stony Mountain in 1905. The Gunton Member is presently quarried extensively for aggregate material in the Stony Mountain area (NTS 62-I). Some exploration drilling in the Winnipeg area was carried out to determine if limestone from the Fort Garry Member (Ordovician Red River Formation) could provide an economic source of high calcium limestone, but present-day economics and technology have precluded the exploitation of this deposit (Bannatyne, 1975).

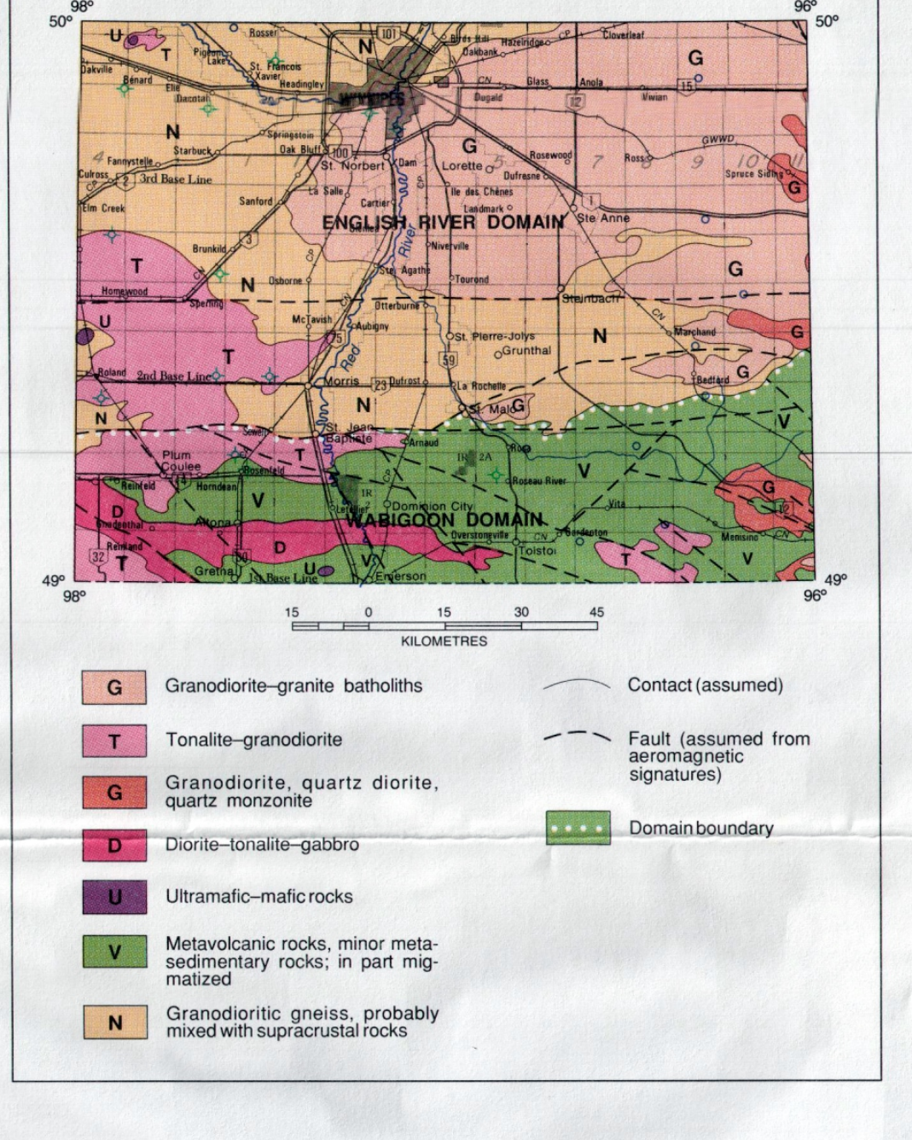
PRECAMBRIAN

The geological map of the subsurface Precambrian basement in NTS 62H is based on petrographic data of chips from 12 oil and water wells, cores from 2 oil wells, 5 logs from Manitoba Water Drillers reports (unpublished) and 2 logs of oil well cores (unpublished). The locations of these wells are plotted on the Precambrian Geology map (Insert B). In addition, interpretations from aeromagnetic maps (Geological Survey of Canada, 1965) and Bouguer gravity maps (Thomas *et al.*, 1987; Geological Survey of Canada, 1987) were used, as well as information from adjacent areas (Klasner and King, 1986; Manitoba Energy and Mines, 1987; Ojakangas *et al.*, 1979).

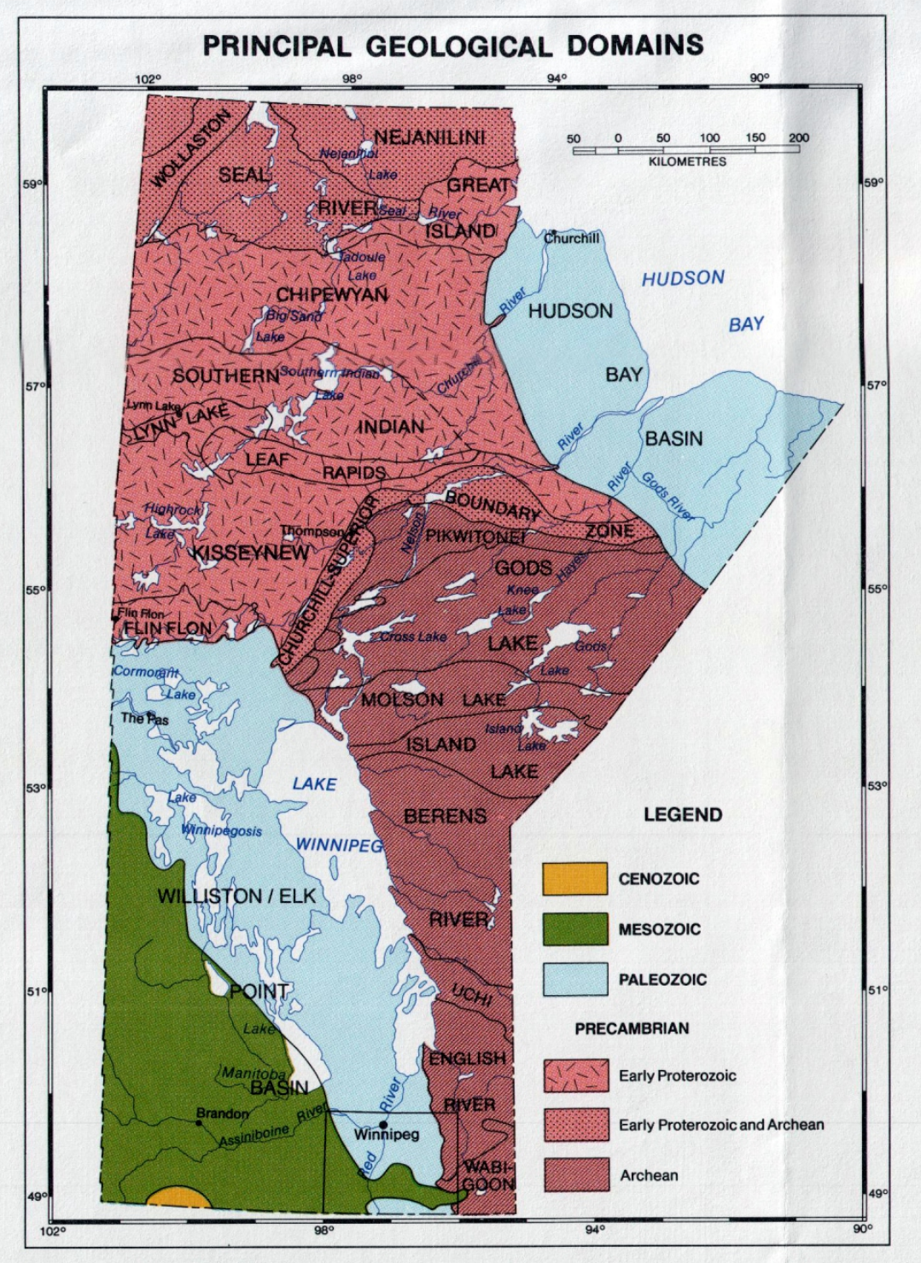
The Magnetic Anomaly Map (Insert C) clearly shows the main characteristics used for the subdivision of the Precambrian basement. The **English River domain** consists predominantly of moderate to high, fairly broad magnetic signatures that are attributed to granodiorite and granite batholiths (**G**) and tonalite to granodiorite (**T**). This has been confirmed by logs of two cores. The magnetic lows in the English River domain also yielded tonalitic to granodioritic core, but the area is interpreted to consist of migmatite gneiss (**N**) derived from supracrustal rocks that were intruded by granodioritic melts.

The **Wabigoon domain** consists largely of low- to very low-magnetic signatures, which are southwest trending. Diamond drill hole data in NTS 52E have indicated that these lows are related to metavolcanic and metasedimentary rocks and the lows in NTS 62H are also interpreted to be the result of partly migmatized metavolcanic and metasedimentary rocks (**V**). A few small areas of magnetic highs in the Wabigoon domain are interpreted to be related to tonalite–granodiorite (**T**), and diorite–tonalite–gabbro (**D**). Unit (**D**) that trends in an east-west direction, coincides with a pronounced gravity high. Small concentric magnetic highs in both domains are interpreted to be related to ultramafic–mafic rocks (**U**).

B. PRECAMBRIAN GEOLOGY

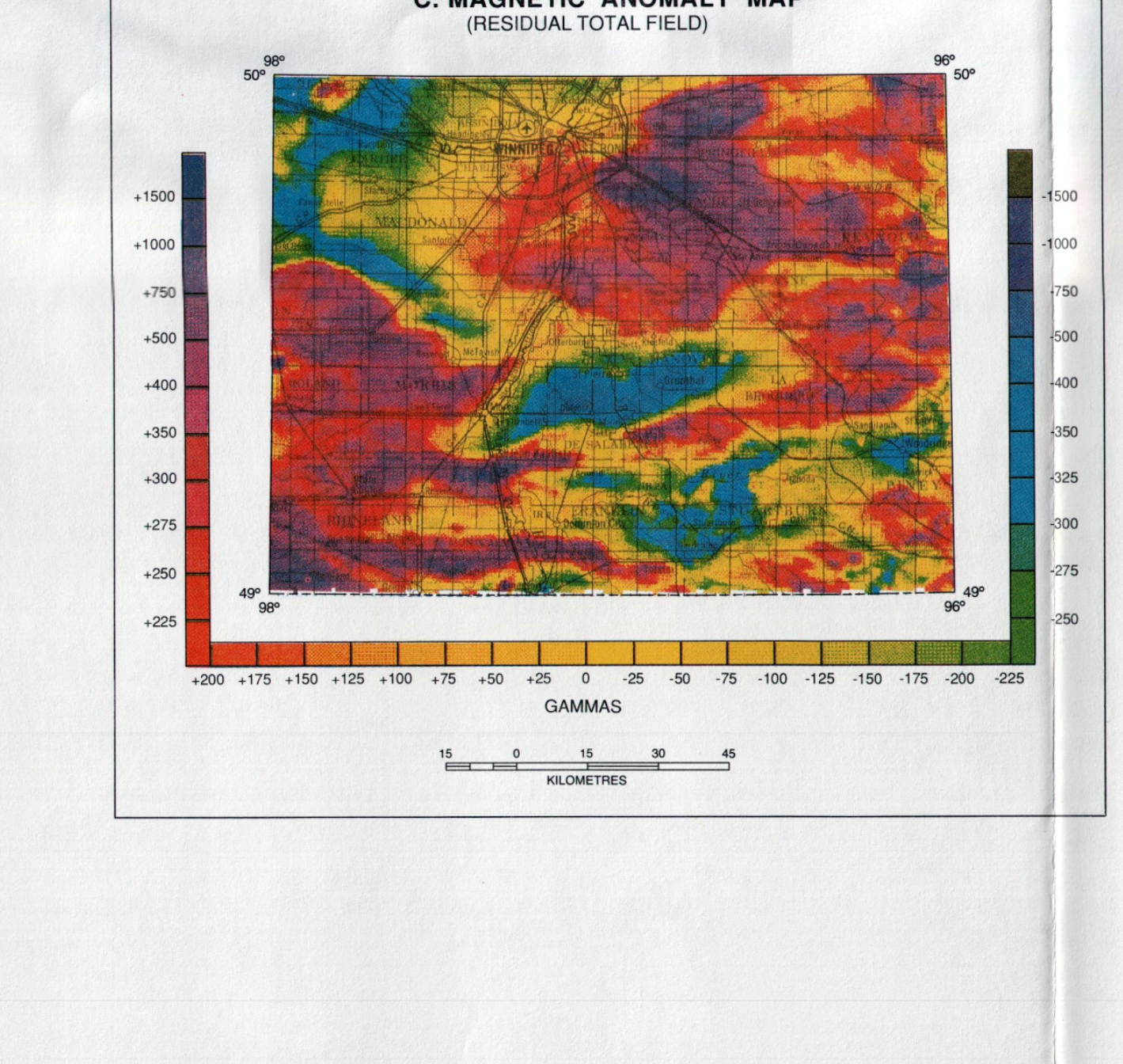


PRINCIPAL GEOLOGICAL DOMAINS



C. MAGNETIC ANOMALY MAP

(RESIDUAL TOTAL FIELD)



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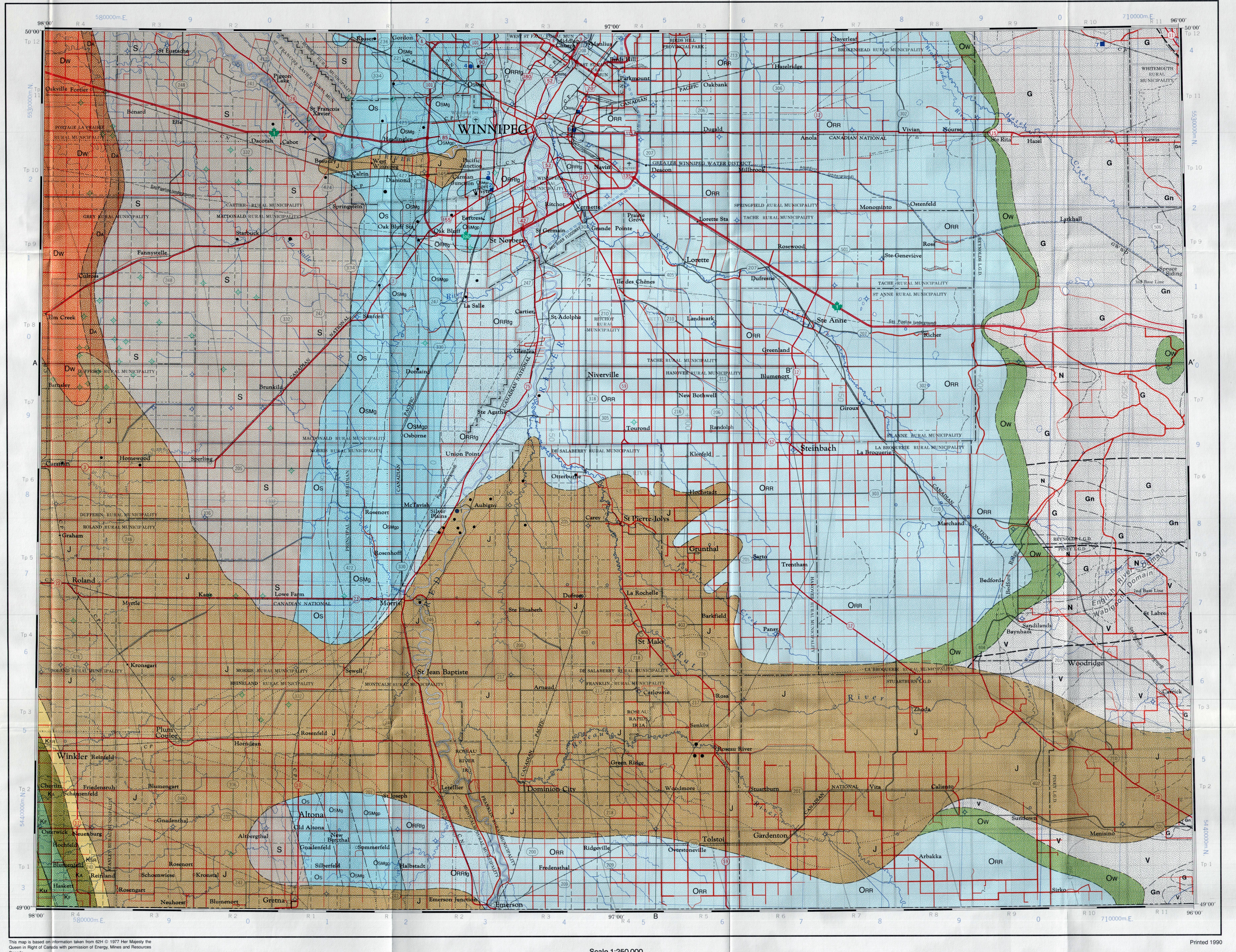

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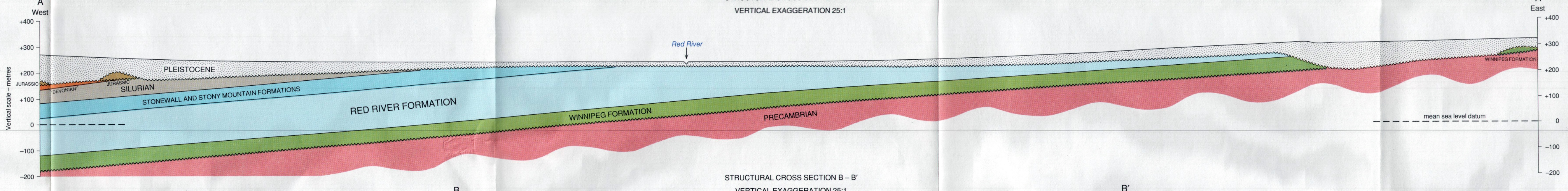
Printed 1990

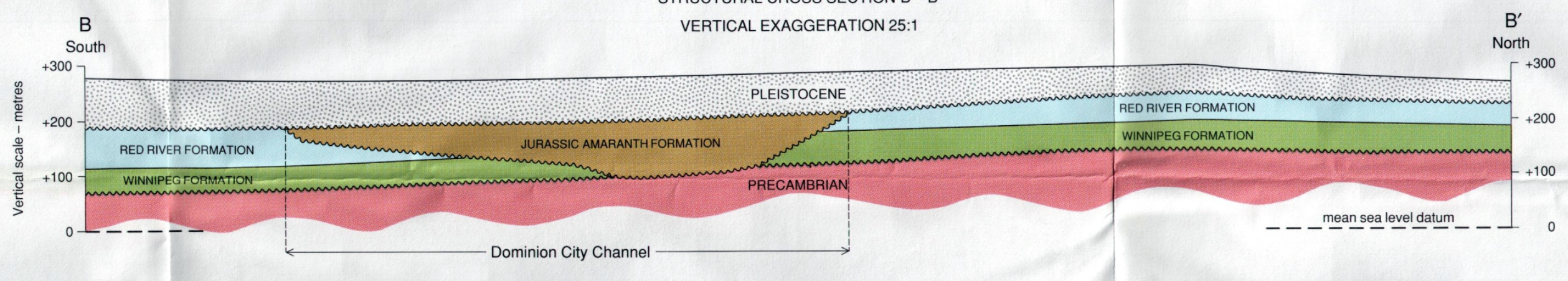
Scale 1:250 000

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

STRUCTURAL CROSS SECTION A – A'
VERTICAL EXAGGERATION 25:1



STRUCTURAL CROSS SECTION B – B'
VERTICAL EXAGGERATION 25:1



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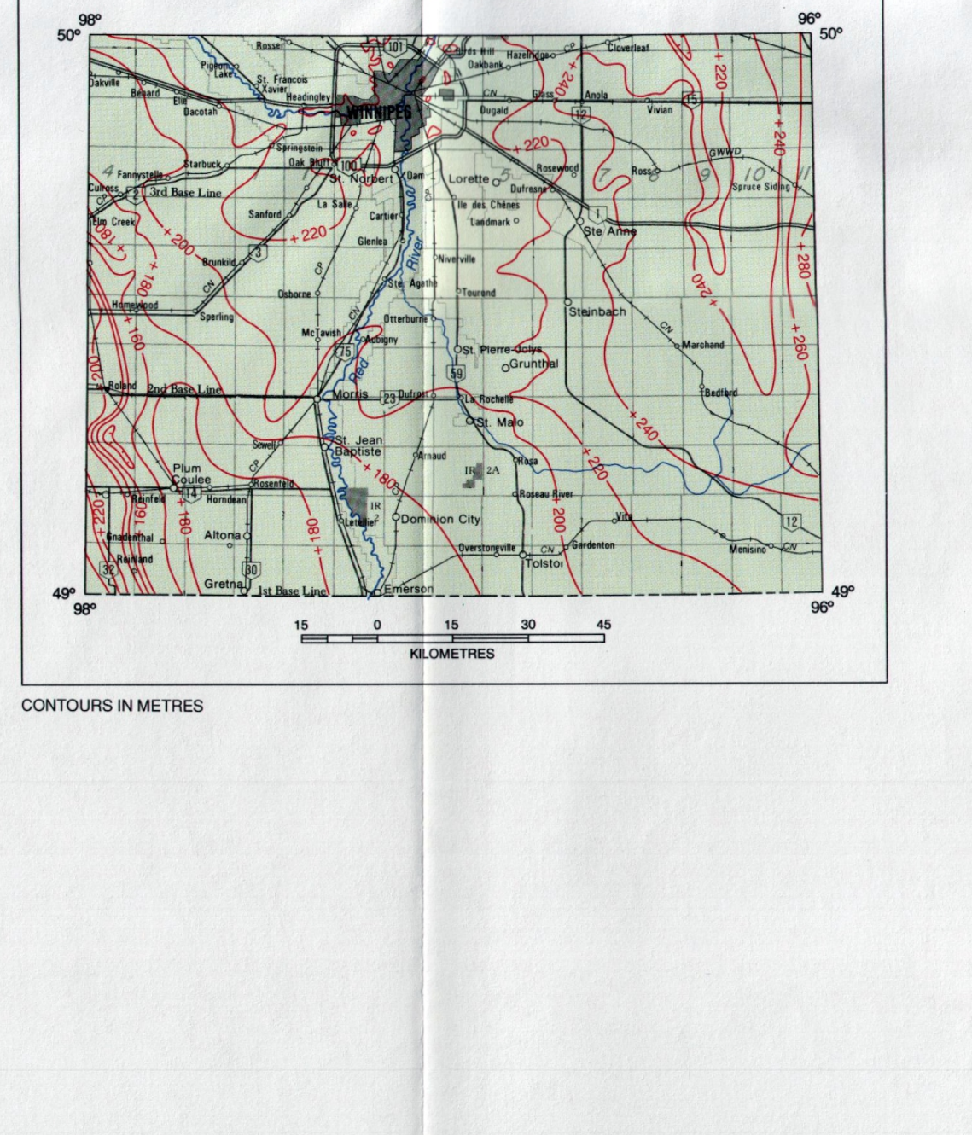
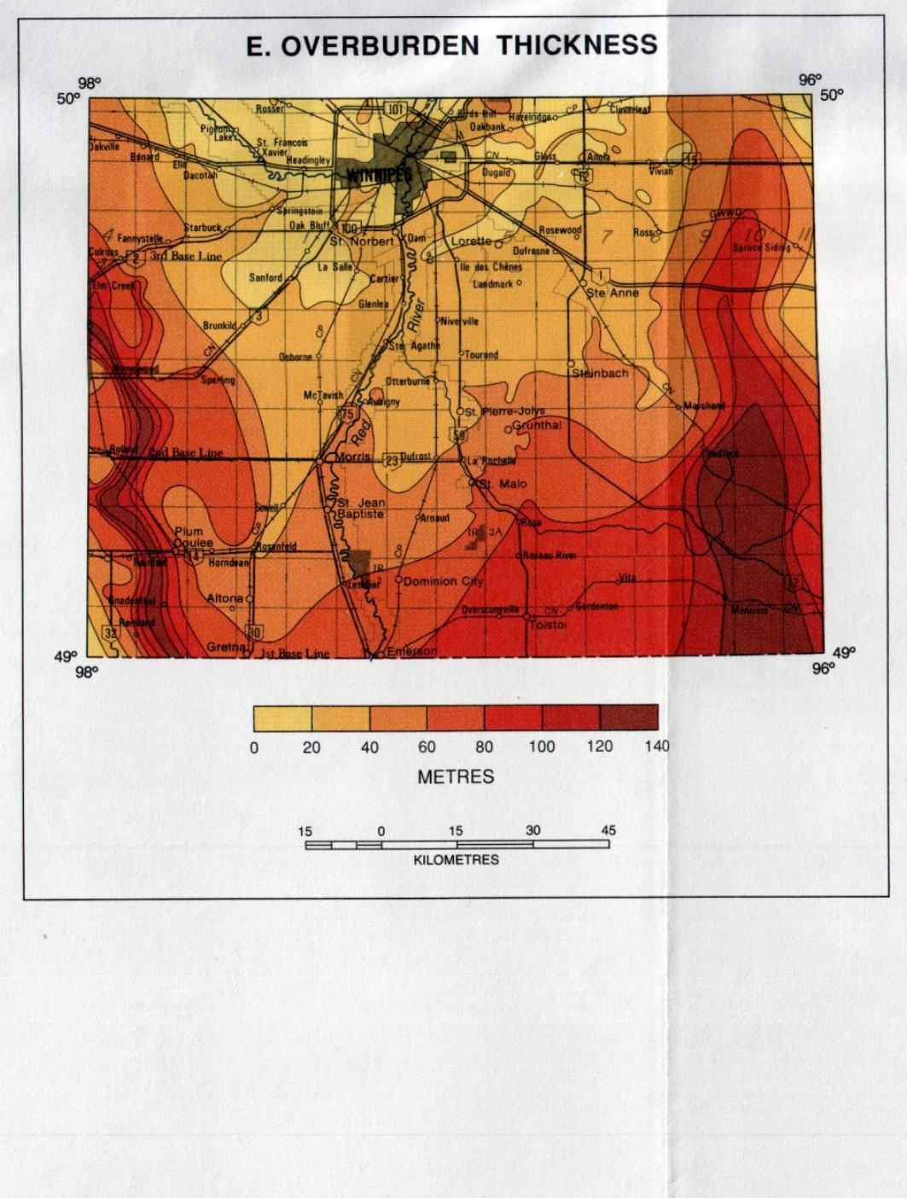
D. BEDROCK TOPOGRAPHY



CONTOURS IN METRES

E. OVERBURDEN THICKNESS



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Geology by H.R.McCabe, with contributions by W. Weber, C.R. McGregor and G. Matile

Compilation by R. Bezys and D. Lindal

Cartography by D.L. McShane

LEGEND

Mesozoic

Cretaceous

Upper Cretaceous

KM	Morden Shale (Formation) (10 - 20m): carbonaceous shale
KF	Favel Formation (± 35m): calcareous speckled shale ("Second Specks"); minor limestone, bentonite and "oil shale"

Upper and Lower Cretaceous

KA	Ashville Formation (± 50m): dark grey carbonaceous shale, in part bituminous; minor sand, silt and bentonite

Lower Cretaceous

KSR	Swan River Formation (0 - 20m): sandstone, in places glauconitic; kaolinitic shale, minor lignite; also includes isolated channel- and/or karst-fill within Paleozoic outcrop belt; locally missing from outcrop sequence due to nondeposition

Jurassic

J	Amaranth Formation * : red argillaceous dolomitic siltstone and sandstone overlain by gypsum and anhydrite; Reston Formation: limestone and dolomite, shale interbeds; Melita Formation: fine grained sandstones, variegated shale, minor limestone; total Jurassic thickness up to 140m

Paleozoic

Devonian

DW / DEP	Elm Point Formation: limestone, biomicritic; Winnipegosis Formation: dolomite; these two formations are facies equivalents, and data are not sufficient to determine which lithology is present in NTS 62H (± 12m)
DA	Ashern Formation (3 - 10m): dolomitic shale and argillaceous dolomite, red to greenish-grey

Silurian

S	Interlake Group (50 - 70m): dolomite, fossiliferous, stromatolitic, finely crystalline and dense to sublithographic; several thin, sandy, argillaceous marker beds

Ordovician (and Lower Silurian)

OS	Stonewall Formation (10 - 15m): dolomite, yellow-brown to grey, finely crystalline, mottled; Williams Member: basal, sandy, argillaceous beds (previously included with Stony Mountain Formation); medial sandy argillaceous marker (T) may define Ordovician/Silurian boundary

Ordovician

OSM	Stony Mountain Formation (35 - 40m): Gunn and Penitentiary members (gp) - calcareous shale, fossiliferous limestone and argillaceous dolomite; Gunton Member (g) - nodular dense dolomite
ORR	Red River Formation (150 - 175m): lower Red River Formation (Dog Head, Cat Head and Selkirk members): mottled dolomitic limestone, fossiliferous; upper Red River Formation: Fort Garry Member (fg): massive to laminated dolomite; minor argillaceous dolomite and high-calcium limestone; in part cherty
OW	Winnipeg Formation (35 - 60m): basal sandstone overlain by complex sequence of quartzose sandstone and shale; local development of thick sandstone body, the "Carman Sand"

* subdivisions described in ascending stratigraphic sequence

PRECAMBRIAN

Archean

Younger Plutonic Rocks

G	Granite and granodiorite batholiths
Gn	Granodioritic gneiss

WABIGOON DOMAIN

Supracrustal Rocks

V	Metavolcanic rocks, minor metasedimentary rocks; in part migmatized
N	Granodioritic gneiss, probably mixed with supracrustal rocks

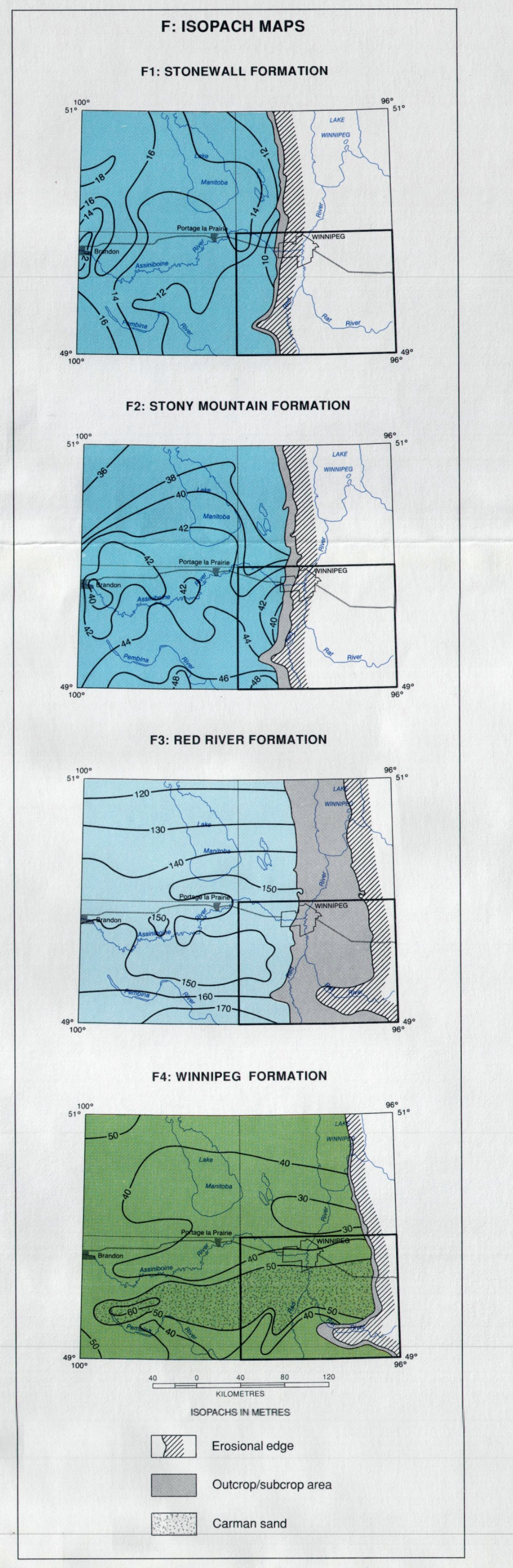
F: ISOPACH MAPS

F1: STONEWALL FORMATION

F2: STONY MOUNTAIN FORMATION

F3: RED RIVER FORMATION

F4: WINNIPEG FORMATION



Approximate mean declination (1990) for centre of map
Decreasing 7.1' annually

SYMBOLS

- Geological boundary, approximate (overburden <10 m)
- Geological boundary, estimated
- Subcrop boundary
- Fault (assumed)
- Area of sparse or no Precambrian outcrop
- Area of sparse or no Paleozoic outcrop
- A ⊢—⊣ A' Structural cross-section
- ● • Stratigraphic / Mineral exploration core hole
- Oil well test hole
- ○ Water well / Water Resources Branch test hole
- –150 Elevation of Precambrian basement (m)

BEDROCK GEOLOGY COMPILATION MAP SERIES

WINNIPEG

NTS 62H

INDUSTRIAL MINERALS

	Name	UTM Northing/ Easting	Commodities	References
1 ●	Silver Plains	5479200/625000	gp	MI 62H/6 GYP1[1]
2 ■	Fort Whyte	5519700/628500	cl	MI 62H/14 CLY3
3 ●	Tuxedo	5521750/628000	cl	MI 62H/14 CLY4
4 ●	Little Stony Mountain	5535500/625500	cs/dl	MI 62H/14 DOL1
5 ■	St. Boniface	5530000/639200	cl	MI 62H/14 CLY2
6 ●	Transcona	5527800/639300	cl	MI 62H/14 CLY1
7 ■	Julius Bog	5540700/705200	pt	MI 62H/16 PEA1

PROPERTY STATUS

Producer	■
Past Producer	●

COMMODITIES

cl	clay
cs	crushed stone
dl	dolomite
gp	gypsum
pt	peat

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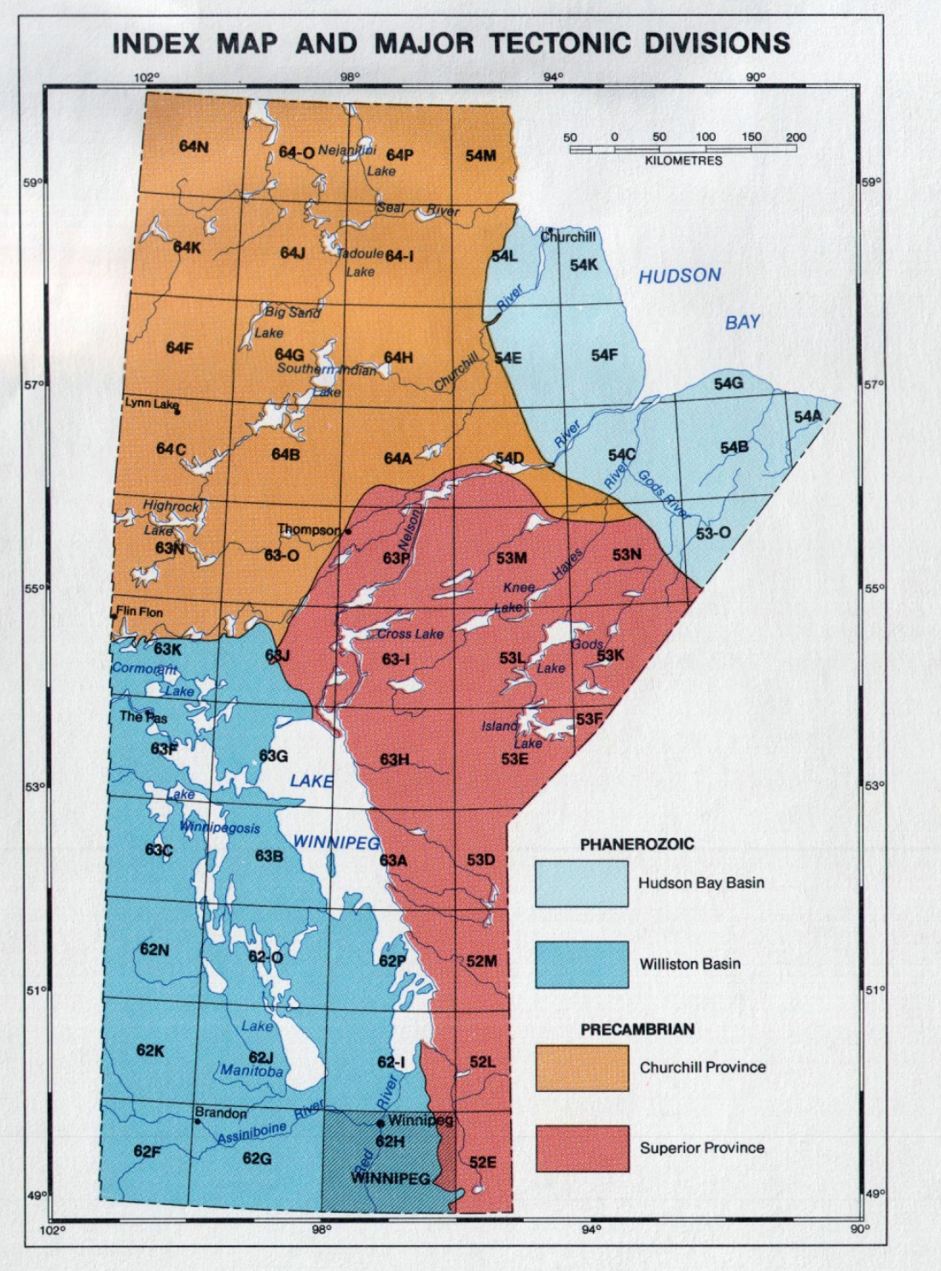
[1] Mineral Inventory card, Minerals Division, Manitoba Energy and Mines; includes additional references.

INDEX MAP AND MAJOR TECTONIC DIVISIONS



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