GRANULAR RESOURCE INVENTORY
- MACKENZIE -
NORMAN WELLS NTS 96/E
(1:125,000)
Produced for Indian & Northern Affairs
by Dept. of Energy, Mines & Resources

GRANULAR RESOURCE INVENTORY - MACKENZIE

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(1:125,000)

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for - Department of Indian Affairs and Northern Development

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INTRODUCTION

This report attempts to assess the quantity of granular material available for construction. Both unconsolidated and bedrock sources are considered. Glaciofluvial and fluvial materials are considered first rate sources of sand and gravel. Lacustrine and marine deposits are of variable quality whereas eolian material is of limited use because of its fine texture. Generally, moraines have only been considered where they are known to be hummocky and to contain some coarse granular material. Terminal moraines are usually considered to be sources of granular material whereas ground moraines are not.

Bedrock has only been considered if it is coherent and resistant to weathering, i.e., limestones, dolomites, sandstones and most rocks of Precambrian age. Other rock types, such as shales, have not been considered in this report even though they could be used as fill for road and other construction uses.

The information which appears in this report and on the accompanying map has been compiled larely from published and unpublished manuscripts and personal communication with officers of the Geological Survey of Canada. Supplementary data, mainly on depths, thicknesses and, in some cases, on texture of deposits have been obtained from confidential reports of other government departments and industry. (See appendix for details on information sources.)

The basic document used in this compilation is a surficial geology map at a scale of 1:125,000 (Hughes, 1969). It is indexed as GSC Open File Number 26 and may be viewed at Geological Survey of Canada offices in Ottawa, Calgary and Vancouver; ozalid copies may be obtained at nominal cost. All areal data are derived from this source; all major and most minor unconsolidated deposits of granular material are represented at this scale.

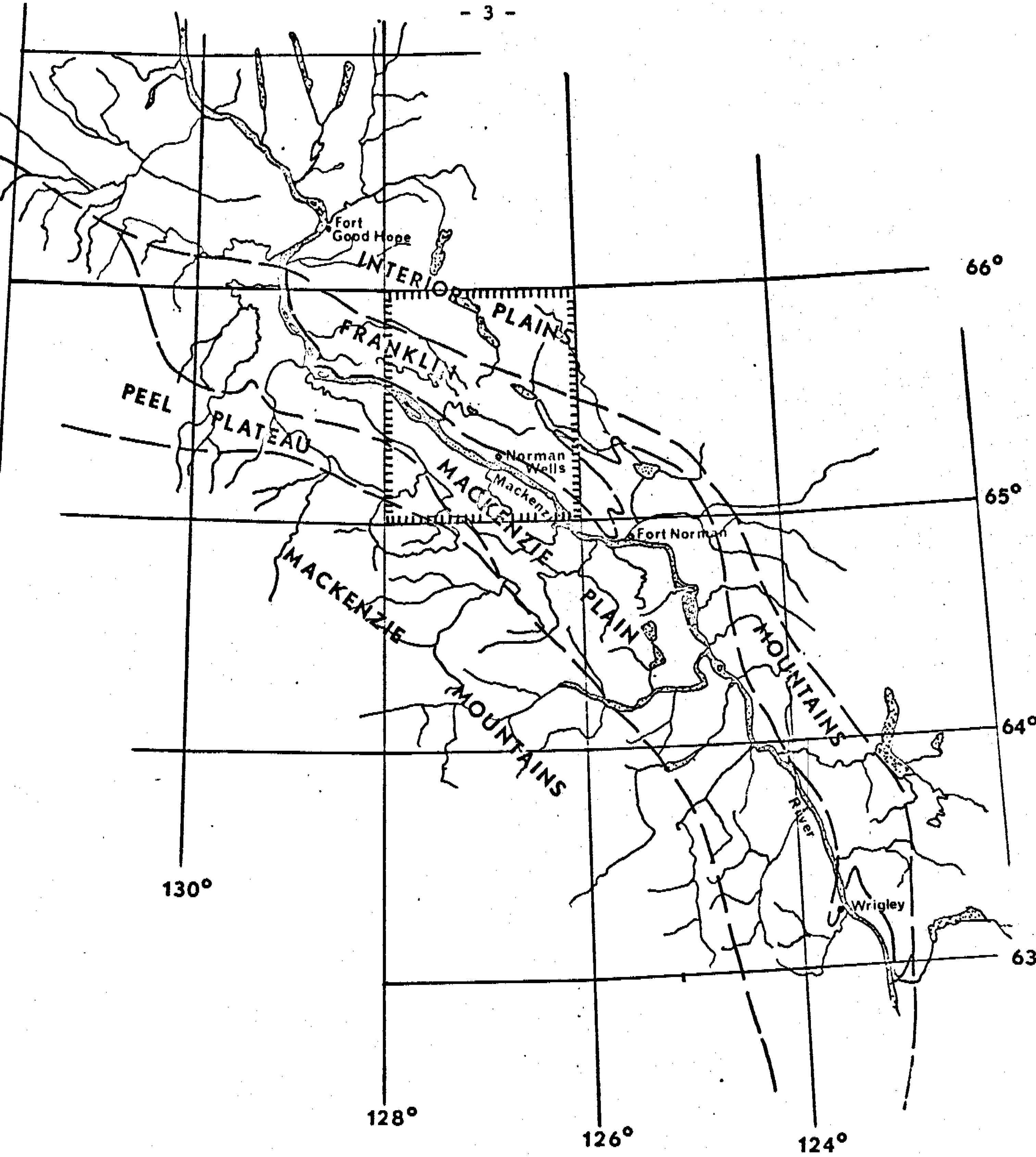
A derived map for granular material has been produced from the basic surficial geology map in close association with the field geologist. His field observations provide additional data on thickness, texture, ice content, drainage, and the variability of the map units.

To supplement thickness and textural data, additional information was gathered from seismic shot hole records and samples, and from other drill hole logs.

Areal extent of deposits were estimated by planimetric means. Average thickness for each deposit was estimated from the data mentioned above and adjusted according to several other variables such as drainage, height above water table, and amount of ground ice. From this, a volume of granular material was estimated. All estimated volumes of material appear in a tabular summary at the end of the paper.

In addition to the estimates of unconsolidated granular material, a derivative bedrock geology map has been prepared as an overlay sheet. This is intended to indicate where bedrock suitable for crushing or fill could be extracted if unconsolidated material is not available.

For purposes of description, areas of granular material are outlined on a transparent overlay and are numbered to correspond to a tabular summary of materials. Areas which appear to have little material with respect to anticipated demand or areas which require more detailed work are discussed in the report.



PHYSIOGRAPHIC REGIONS

NORMAN WELLS

1 : 2,500,000

after Bostock 1948

SUMMARY

Unconsolidated deposits of granular material are in short supply in the Norman Wells map area in general, with the exception of the southwestern section, where abundant fluvial and glaciofluvial material is available. These deposits are, however, approximately 20 miles from the settlement of Norman Wells and on the opposite side of the Mackenzie River from anticipated construction activity. Granular material, in most cases, will be derived from bedrock. Excellent sources of material are available in the Norman Range where resistant limestone and dolomite are abundant. The possibility of dredging material from the Mackenzie River in areas where coarse material is available, i.e. down-stream from major tributaries, should be considered. This material could be moved by barge at relatively low cost.

More detailed work should be carried out on the east side of the Mackenzie River to locate additional unconsolidated material and to assess bedrock resources.

GENERAL GEOLOGY & PHYSIOGRAPHY

Five physiographic subdivisions are represented on the Norman Wells map (Fig. 1). From northeast to southwest they are: Interior Plains, Franklin Mountains, Mackenzie Plain, Peel Plateau and Mackenzie Mountains (Bostock, 1948). The Interior Plains and Franklin Mountains cover the northeast half of the map-area. Surficial geology has not been mapped and the bedrock geology has been mapped only in part (Cook, 1972). In the southwest half of the map-area, bedrock is exposed along the front ranges at the Franklin Mountains, on the Peel Plateau and in the Mackenzie Mountains. Surficial deposits cover most of the Mackenzie Plain and parts of the Peel Plateau (mapped by Hughes 1969).

The bedrock deposits are predominently carbonates, sandstones and shales. Glaciation of the region produced, morainal till deposits, glaciolacustrine sands, silts and clays, glaciofluvial sand and gravel deposits and eskers. Rivers have reworked many deposits to form fluvial fans, terraces and plains. Wind also has reworked some unconsolidated deposits, notably the fine sands. Over these deposits, organic material, peat and muskeg are widespread. Only the glaciofluvial and fluvial deposits produced by fast flowing streams and the eolian sand deposits are of interest as a source of unconsolidated granular material.

Unconsolidated Deposits

Glaciofluvial Deposits G

Three types of glaciofluvial deposits occur in this map-area; glacial outwash deposits (Gf), glaciofluvial channel deposits (Gfc) and eskers.

The outwash plain is generally flat and contains an abundance of both sand and gravel. The channel deposits have a more irregular surface and probably have an abundance of sand. The eskers, characterized by a sinuous, ridged appearance, contain both sand and gravel (Hughes, 1970).

The glaciofluvial deposits vary in depth between 10 and 50 feet and contain approximately 80 per cent available granular material (Hughes, 1972).

Fluvial Deposits F

Only the fluvial deposits produced by fast flowing water are likely to contain suitable granular material. These deposits occur along the foot of the Mackenzie Mountains, in some places along the Mackenzie River, and along the foot of the Peel Plateau. Three geomorphologic fluvial forms are present: fluvial fans, fluvial terrace deposits and fluvial plain deposits. At the base of the Mackenzie Mountains these deposits are fan-shaped and gently sloping. The terrace and plain deposits found generally on, and at the base of, the Peel Plateau are moderately flat with only local relief. The fans have variable composition depending upon the source of the material but the other fluvial deposits are predominantly sand and gravel with some silt.

The fluvial fan deposits range from 15 to 150 feet in thickness and contain approximately 60 per cent available granular material. The terrace and plain deposits range up to 30 feet in thickness and have 80 percent of available granular material (Hughes, 1970).

Eolian Deposits E

Eolian deposits are sand deposits which have been reworked by wind action. These deposits are found primarily on the Mackenzie Plain.

The deposits consist of fine to medium-grained sand. They range between 10 and 50 feet in thickness and have 60 per cent available granular material (Hughes, 1970).

Bedrock Geology

The front ranges of the Franklin Mountains consist of Devonian shales and Ordovician, Silurian and Devonian carbonates. The Peel Plateau consists of Devonian carbonates and shales covered by Cretaceous sandstones and shales. The Mackenzie Mountains are composed of Precambrian rocks, Cambrian shales and Ordovician, Silurian and Devonian carbonates.

The carbonates are the best rock to provide crushed granular material. The Precambrian rocks consist of carbonates, quartzite, some shales and igneous rocks which may also be crushed. Sandstones and, in some cases, shales can be used when inferior materials are acceptable.

MATERIALS

The principal source of readily available granular material on the east side of the Mackenzie River in the area of Norman Wells are glaciofluvial outwash plains, eskers and fluvial fan deposits. These would probably not meet the future needs for granular material. The deposits are not extensive, they are remote from the community of Norman Wells and are composed mainly of fine and medium sand.

Suitable rock material is available within a reasonable distance. Strong coherent carbonate rocks of the Norman Range could be crushed to provide the required material. This already has been done for construction of the air strip at Norman Wells.

On the west side of the Mackenzie River the best sources of granular material are generally the farthest from the river. Within the Mackenzie Plian there are approximately twelve small, widely distributed glaciofluvial deposits. Near the river, opposite Norman Wells, there are approximately 6 square miles of eolian sand distributed parallel to the river. Unfortunately the eolian material is usually fine to medium-grained sands.

About 10 miles to the southwest of the Mackenzie, the Carcajou River crosses the Peel Plateau. Bedrock is exposed on the west bank of the Mackenzie River about 25 miles downstream from Norman Wells at Hoosier Ridge. The ridge is a tightly folded anticline of Devonian limestone which dips steeply into the river. The vast alluvial deposits of the Carcajou and Imperial River flood plains are excellent sources of granular material whereas the fan material at the mountain front is very coarse and would require some crushing. In the same area, between the Carcajou River and the mountain front, thick deposits of glacio-fluvial sand and gravel extend over an area of approximately 18 square miles but in order to recover this material it would be necessary to cross the Carcajou River. On the Peel Plateau, Cretaceous sandstones and shales are well exposed but it is unlikely that this material would be exploited because large quantities of unconsolidated materials are available in the same area.

Immediately to the southwest of the Peel Plateau is the front range of the Mackenzie Mountains. Beyond this point there are few unconsolidated deposits but strong, durable bedrock materials are ubiquitous. Ordovician and Devonian dolomites and limestones from the mountain front and Precambrian rocks of various lithologies form the Carcajou Range. If large quantities of material are required at locations adjacent to the Mackenzie River, either sand and gravel could be dredged from the river or unconsolidated and bedrock material adjacent to the river could be barged at low cost. This possibility should be considered where haulage distances become excessive.

TABULAR SUMMARY

Description and Material	Area (sq. mi.)	Estimated Average thickness (ft.)	Estimated volume of granular material ($yd^3 \times 10^6$) total	available
Area 1 - DISCOVERY RIDGE AREA				
a) Gf	.86	15	13.42	8.72
glaciofluvial outwash; sand and gravel.				
b) 3 eskers	3	20	0.15	0.08
c) fluvial fan;	1.37	20	71.19	42.71
sand and gravel.				
d) carbonate and shale bedrock; Devonian. .				
Area II - NORMAN RANGE WEST				
a) Gf	1.73	15	39.65	31.72
glaciofluvial outwash;	1.18	50	61.02	45.82(Mt. Morrow)
clay over sand or silt.				
b) Gfc	37.89	50	21.35	17.08
glaciofluvial channel; sand.				
c) fine to eolian sand.	0.71	15	43.31	25.97
d) carbonate bedrock is abundant in the northern area.				
Area III - HOOSIER RIDGE				
a) Devonian carbonate rocks.				
Area IV - IMPERIAL RIVER - CARCAJOU RIVER				
a) Fp	43.73	15	677.41	541.92
fluvial flood plain; gravel,sand and silt; cover of organic silt or peat.				

Description and Material	Area (sq. mi.)	Estimated Average thickness (ft.)	Estimated volume of granular material ($yd^3 \times 10^6$) total	available
b) Fa fluvial fans; gravel and sand.	14.57	50	752.67	451.60
c) Gfc glaciofluvial channel complex; sand and gravel.	18.69	50	989.44	988.34
d) Cretaceous sandstone and shale; largely eroded anticline.				
Area V - GUS CREEK				
a) Gfc glaciofluvial channel complex; gravel and sand.	1.37	50	71.19	56.95
Area VI - RAY CREEK				
a) Fg glaciofluvial material; sand and gravel.	0.58	50	30.5	24.4
b) esker	3	20	0.41	0.08
Area VII - MACKENZIE RIVER SOUTH-EAST SHORE				
a) E eolian material; fine to medium grained sand.	5.96	15	92.74	55.63
b) Gf glaciofluvial ridges; sand.	.43	15	6.71	4.02
c) Esker; sand and gravel.	2	20	0.07	0.06
d) Cretaceous sandstone.				

SOURCES OF INFORMATION

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1948: Physiography of the Canada Cordillera, with special reference to the area north of the fifty-fifth parallel; Geol. Surv. Can., Mem. 247.

Canadian Hydrographic Surveys
1968: Great Slave Lake and Mackenzie River pilot including Canadian Hydrographic Service charts; Dept. of Energy, Mines and Resources.

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1972: Surficial Geology of northern Yukon Territory and north-western District of Mackenzie, Northwest Territories; Geol. Surv. Can., Paper 69-36.

Hume, G.S.
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1971: Transportation corridor study; Gas Arctic Systems Study Group report, V. I - III.

Prest, V.K., Grant, D.R., Rampton, V.N.
1967: Glacial map of Canada; Geol. Surv. Can. Map 1253A.

Ripley, Klohn and Leonoff Alberta Ltd.
1969: Mackenzie Valley Pipeline report; V. I and II.

Ripley, Klohn and Leonoff Alberta Ltd.
1970: Presentation of test hole log data; report.

APPENDIX I, Part I

Unconsolidated Granular Materials

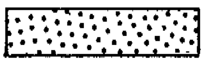
Each map sheet has a surficial geology legend (see appendix I, part IV). The following legend only indicates granular material, classified by genetic characteristics. In some cases, only part of a map unit has been patterned, indicating that only that portion is considered a suitable source for granular material.

Legend

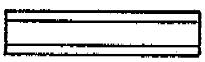
GLACIOFLUVIAL

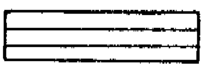
 coarse grained granular material, cobbles, pebbles, gravel; may be mixed with some coarse sand.

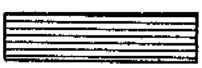
 mixed or interbedded sand and gravel

 predominantly sand or sand with undesireable fines

GLACIOLACUSTRINE

 gravel, lacustrine

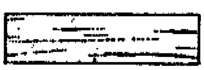
 sand and gravel

 sand

FLUVIAL

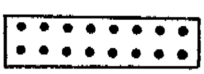
 fluvial (only sand and gravel deposits are patterned)

MORAINAL

 morainal deposit

MARINE

 coarse-grained material, cobbles, pebbles, gravel, may be mixed with coarse sand

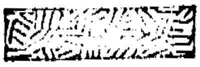
 mixed or interbedded sand and gravel

 predominantly sand or sand with undesireable fines

EOLIAN

 usually fine and medium-grained sandy material

COLLUVIUM

 primarily coarse grained material

Symbols

<<<<<<<	eskers
* * * *	gravel mounds
-o-o-o-	morainal ridge found within moraine

APPENDIX I, Part II

Bedrock Geology

(black line overlay)

The rock units which appear on the accompanying overlay are an engineering geological grouping according to gross lithology and age.

These units were derived from a more detailed geological map (whose units were subdivided largely on the basis of airphoto and stratigraphic interpretation (Cook 1972). The units are identified by a two letter identification code. The first character is an upper case letter designating age which is followed by a mnemonic designating gross lithology e.g. Dls - Devonian limestone.

Legend

I - AGE

T - Tertiary

K - Cretaceous

M - Mississippian

D - Devonian

S - Silurian

O - Ordovician

C - Cambrian

P - Precambrian

OS- Ordovician/Silurian

P - Precambrian/Cambrian

II - LITHOLOGY

car - carbonates
limestone and/or dolomite

ss - sandstone

sh - shale

no lower case mnemonic modifier - rocks are undifferentiated

Symbols

Boundary of bedrock unit (approximate)

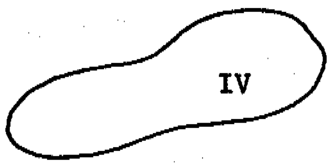
Boundary of bedrock unit inferre[d] in areas of surficial cover

limit of mapping

APPENDIX I, Part III

GRANULAR RESOURCE UNITS

I GRANULAR RESOURCE AREAS (black)



granular resource area

(see text corresponding description)

APPENDIX I, Part (IV)

Surficial Geology and Landforms

TEXTURE

- f fen
- p peat
- c clay
- si silt
- s sand
- g gravel
- b boulder
- t till

GENESIS

- O organic
- M morainic
- G glaciofluvial
- L lacustrine
- A alluvial fluvial
- C colluvial
- E eolian
- U upland, rolling bedrock controlled
- R rock outcrop

MORPHOLOGY

- v veneer
- p plain
- d drumlin
- s fluted striated
- t terrace
- h hummocky
- r ridged
- c croded
- a fan
- m rolling
- c channelled
- k kettled thermokarst
- x complex

SLOPE (superscrip

- 1 moderate ($<5^{\circ}$)
- 2 steep ($5^{\circ} - 15^{\circ}$)
- $>15^{\circ}$ normally in Cx unit

Complex Units:

e.g. in: Mp-fO, fO constitutes 25% to 49% of area
: Mp-fO, fO =5% - 24% of area

Using all four elements of the legend, a smooth ground moraine surface with moderate slope would be tMp^1; hummocky and ridged glaciofluvial gravel would be gGhr. Note that there are inconsistencies in the use of Mp and Mv mainly because of the difficulty in estimating till thickness.