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Evaluation of Magnesium Resources in Phanerozoic Dolomites of the Interlake Area, Manitoba: Part 2 - Sandridge Area

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Energy and Mines

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Deputy Minister

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INTRODUCTION

Abundant resources of dolomite have been reported in the Interlake area of Manitoba (Bannatyne, 1988). A reconnaissance drill program was undertaken in 1990 to determine the MgO contents and purity of some of the known dolomitic formations that outcrop near Winnipeg. Geochemical analyses of the drill cores revealed that the lower beds of the Silurian Interlake Group probably have the highest MgO contents and the least amount of argillaceous and other silicate material (Gale, 1991). Consequently, a follow-up drill program was initiated in 1991 to outline a block of high-MgO dolomite and determine its composition (Fig. 1). This report provides a record of the results obtained.

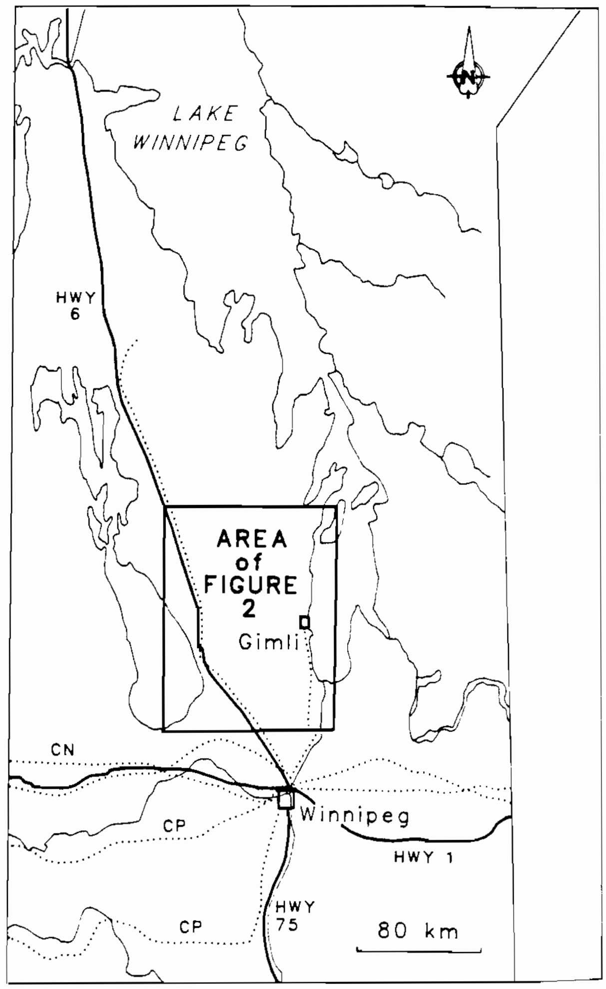

Figure 1: Location of the study area in southeastern Manitoba (dotted lines indicate principal rail lines).

GEOLOGICAL SETTING

The Silurian Interlake Group comprises the Fisher Branch, Moose Lake, Atikameg, East Arm and Cedar Lake formations in ascending stratigraphic sequence (Table 1). The Fisher Branch and Moose Lake formations, separated by the thin argillaceous U1 marker bed (Table 2), are exposed in the general vicinity of Sandridge (Fig. 2).

In the subsurface, the Fisher Branch Formation averages 12 to 15 m thick and is a grey to buff, fossiliferous, fine to medium crystalline, vuggy and porous dolomite with interbeds of white to pale buff porcelaneous micritic dolomite. In contrast, the U1 Marker ranges from 20 to 50 cm thick, is purplish, and has sharp upper and lower contacts.

In the Sandridge area, most of the U1 Marker and the overlying Moose Lake Formation have been eroded and therefore the underlying Fisher Branch Formation is exposed in outcrop. The position of the basal Silurian contact was incorrectly shown on Map ER85-1-1 (Bannatyne, 1988); it occurs further to the west than shown in OF91-3 (Gale, 1991). The correct position was defined by Stearn (1956) and McCabe (1984) and confirmed by the current drill program (Fig. 2). The Moose Lake Formation is 14 to 19 m thick in the subsurface. It consists of a greyish dense micritic dolomite interbedded with finely crystalline dolomite.

The upper beds of the Interlake Group are not present in the Sandridge area, but have been identified in the subsurface and in outcrop near Lundar and Ashern.

Table 1: Stratigraphic Units in the Southern Interlake Area

Age	Group	Formation	Maximum Thickness (m)	Lithology
Devonian	Manitoba	Dawson Bay	20.6	Limestone, argillaceous dolomite
	Elk Point	Winnipegosis	10.9	Dolomite, fossiliferous
		Elm Point	26.4	Limestone, mottled
		Ashern	13.4	Argillaceous dolomite, shale
Silurian	Interlake	Cedar Lake	72.7	Dolomite
		East Arm	18.2	Dolomite
		Atikameg	11.9	Dolomite
		Moose Lake	18.5	Dolomite, micritic
		Fisher Branch	15.3	Dolomite, fossiliferous
		Upper Stonewall	5.8	Dolomite
Ordovician	-	Lower Stonewall	7.3	Dolomite
		Stony Mountain	41.2	Dolomite, argillaceous
		Red River	135.7	Dolomite, dolomitic limestone
		Winnipeg	40.2	Sandstone, shale

Table 2: Depth to Upper Contact of Formations and Marker Beds in the Southern Interlake Area and the Sandridge Area

(Measured in metres)

Drill Hole	Drill Locality	Surface Elev.	Depth M.L.	Depth U1	Depth F.B.	Depth S.M.	Depth U.S.	Depth T	Depth L.S.	Depth L.T	Total Depth
M-4-69	Inwood	271.3	0.0	10.5	10.6	26.0	27.5	30.8	32.3	35.4	39.4
M-5-70	N. Shoal L.	266.7	0.0	11.6	11.9	-	-	-	-	-	18.2
M-2-80	Oak Point	251.5	74.1	87.8	88.1	100.5	102.5	105.5	106.2	111.8	287.6
M-1-84	Sandridge	274.6	-	-	0.0	11.8	13.1	17.8	18.4	23.0	68.7
M-1-88	N. Shoal L.	262.0	29.0	43.5	43.5	54.0	-	59.6	-	-	93.4
M-2-88	Inwood	273.4	0.0	14.4	14.6	29.7	34.2	35.5	36.7	39.0	81.2
M-20-90	Inwood W.	275.8	?	16.6	17.0	-	-	-	-	-	29.7
M-21-90	Broad Valley	263.6	-	-	0.4	9.7	10.7	14.4	15.1	19.8	29.5
M-12-91	Deerhorn	263.7	61.5	80.0	80.2	91.7	-	-	-	-	96.6
M-13-91	Sandridge	276.6	-	-	0.7	12.8	14.5	-	-	-	16.0
M-14-91	Sandridge	275.4	-	-	0.5	12.3	13.9	-	-	-	15.9
M-15-91	Sandridge	276.8	-	-	3.1	15.4	-	-	-	-	15.9
M-16-91	Sandridge	276.2	-	-	1.2	13.3	-	-	-	-	14.4
M-17-91	Sandridge	275.5	-	-	0.0	13.2	-	-	-	-	14.6
M-18-91	Sandridge	276.8	-	-	2.5	13.8	15.3	-	-	-	15.9
M-19-91	Sandridge	276.8	-	-	0.0	12.8	14.3	-	-	-	16.0
M-20-91	Sandridge	276.2	-	-	3.0	7.8	8.5	14.3	14.6	-	15.8
M-21-91	Sandridge	274.9	-	-	2.8	6.0	7.5	11.9	13.0	-	15.9
M-22-91	Sandridge	274.3	-	-	0.0	6.7	8.5	12.6	13.6	13.9	16.3
M-23-91	Sandridge	269.4	-	-	2.8	3.5	4.9	8.8	9.9	-	15.8
M-24-91	Sandridge	272.8	-	-	2.0	7.0	14.1	13.0	19.6	-	20.8
M-25-91	Sandridge	274.9	-	-	0.3	10.9	12.8	-	-	-	15.8
M-26-91	Sandridge	275.2	-	-	3.4	8.8	-	-	-	-	9.9
M-27-91	Sandridge	275.8	-	-	0.0	11.8	13.3	18.0	19.0	23.0	46.4
M-28-91	Sandridge	277.5	?	-	0.0	18.2	-	-	-	-	19.5
M-29-91	Sandridge	279.3	0.1	5.5	5.9	21.2	-	-	-	-	22.0
M-30-91	Sandridge	276.1	0.1	7.2	7.5	-	-	-	-	-	12.8
M-31-91	Sandridge	277.9	0.3	4.2	4.7	19.4	-	-	-	-	20.1
M-32-91	Sandridge	278.5	?	?	0.2	17.3	18.5	-	-	-	21.2
M-33-91	Sandridge N.	273.7	?	?	?	?	-	-	-	-	4.5

M.L. = Moose Lake Formation
U1 = U1 Marker
F.B. = Fisher Branch Formation
S.M. = Stonewall Marker
U.S. = Upper Stonewall Formation
T = T Marker
L.S. = Lower Stonewall Formation
L.T = Lower T Marker

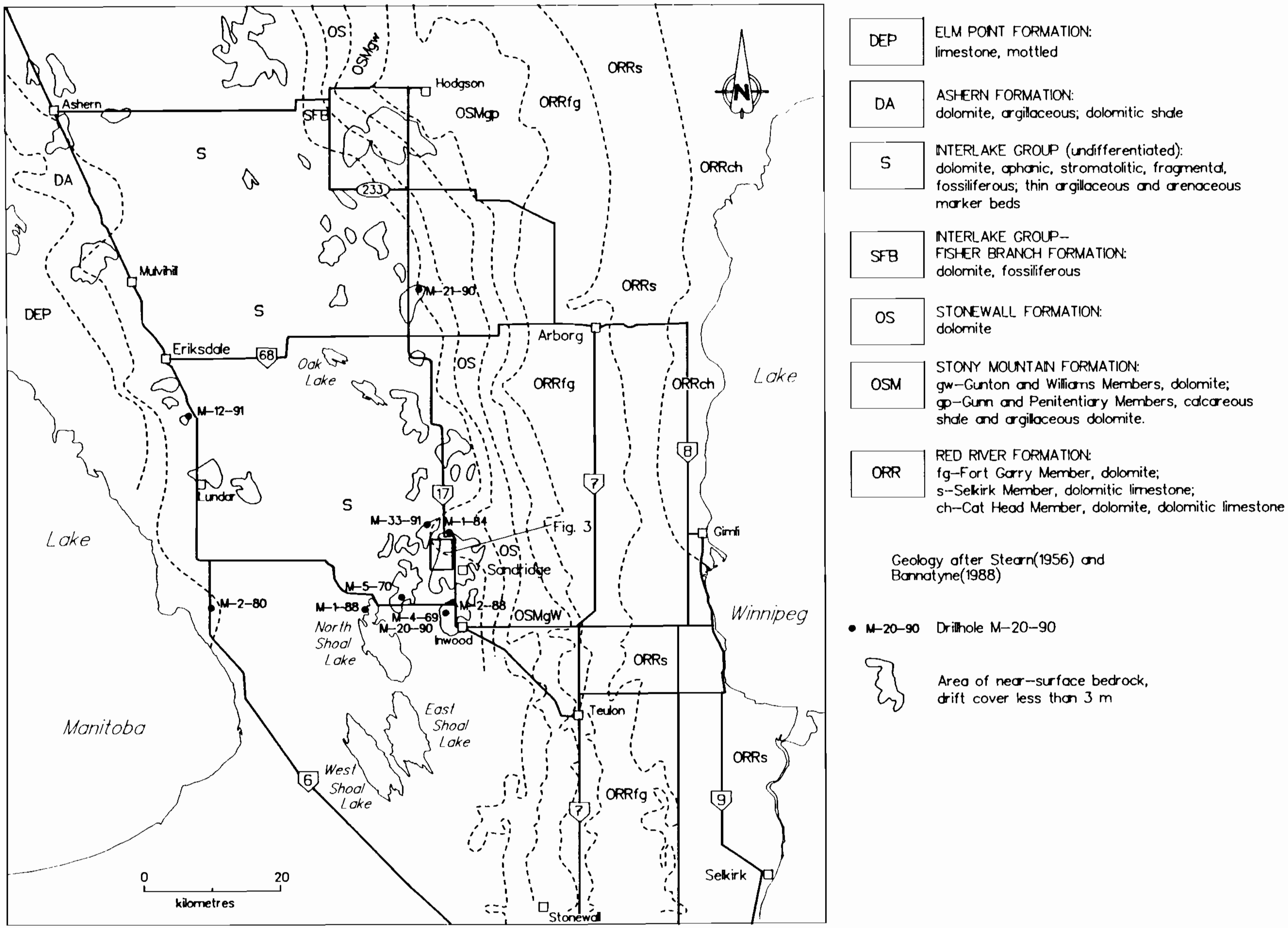

Figure 2: General geology and location of holes drilled for stratigraphic control in the southern Interlake area (outlines of Sandridge area is labelled as Fig. 3).

DRILL PROGRAM

On the basis of analytical results obtained in 1991 (Gale 1991), a drill program consisting of 20 holes was undertaken in 1991 in the Sandridge area on a site of near-surface bedrock composed mainly of the Fisher Branch Formation. Most holes were drilled either at 0.4 or 0.8 km spacing to establish the quantity and quality of the dolomite. The locations of these holes are shown in Figure 3, and formation and marker bed tops are listed in Table 2. Eight additional holes, drilled outside the Sandridge area (Figure 2), are also included in Table 2.

Four cross sections (Fig. 4 to Fig. 7) were prepared from data listed in Table 2. The Fisher Branch Formation thins from 15 m to 0.7 m from south to north due to erosion because the Sandridge area is on the south limb of an east-trending anticlinal arch that was identified by Stearn (1956). The contoured thickness of the Fisher Branch Formation is shown in Figure 3 along with the approximate position of the erosion edge of the U1 Marker and the overlying Moose Lake Formation.

Drillhole M-12-91 was drilled near Deerhorn to permit correlation of the Interlake Group across the Interlake area. This hole can be lithologically and paleontologically correlated with holes drilled in the Sandridge area, even though the two areas are a distance of 57 km apart.

Drillhole M-33-91 was drilled 2 km northwest of the Sandridge area in an attempt to provide another area for future exploration. However, this hole had to be abandoned due to mechanical difficulties with the drill.

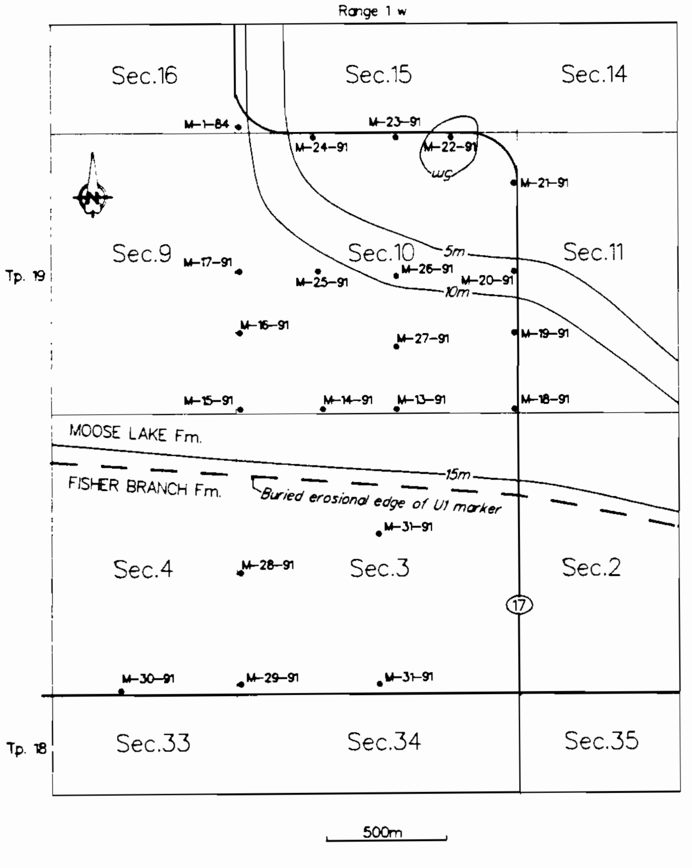

Figure 3: *Location of drillholes in the Sandridge area and isopachs of Fisher Branch Formation (outlined areas in W 1/2 of Sec. 3 and SW 1/4 of Sec. 10, Tp. 19, Rge. 1W contain estimated reserves).*

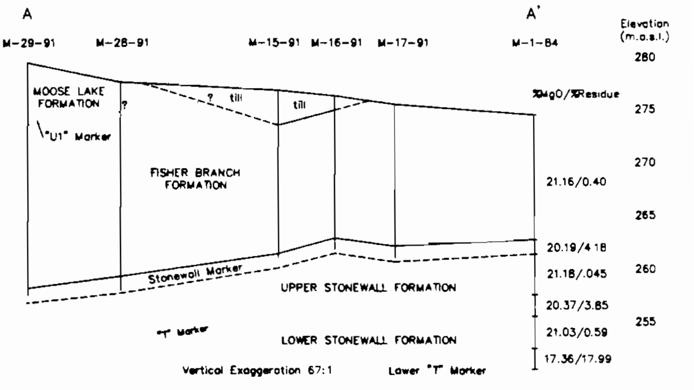

Figure 4: *Structural cross section between drillholes M-29-91 and M-1-84 (along west margin of Sec. 3 and 10, Tp. 19, Rge. 1W, see Fig. 3); and MgO and Residue values from chemical analyses of drillhole M-1-84 (Gale, 1991).*

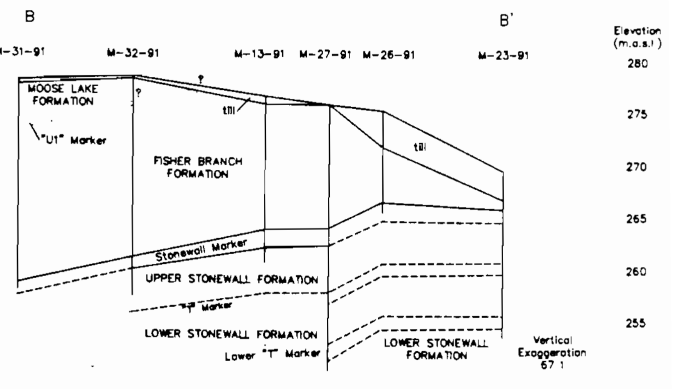

Figure 5: *Structural cross section between drillholes M-31-91 and M-23-91 (through centres of Sec. 3 and 10, Tp. 19, Rge. 1W, see Fig. 3).*

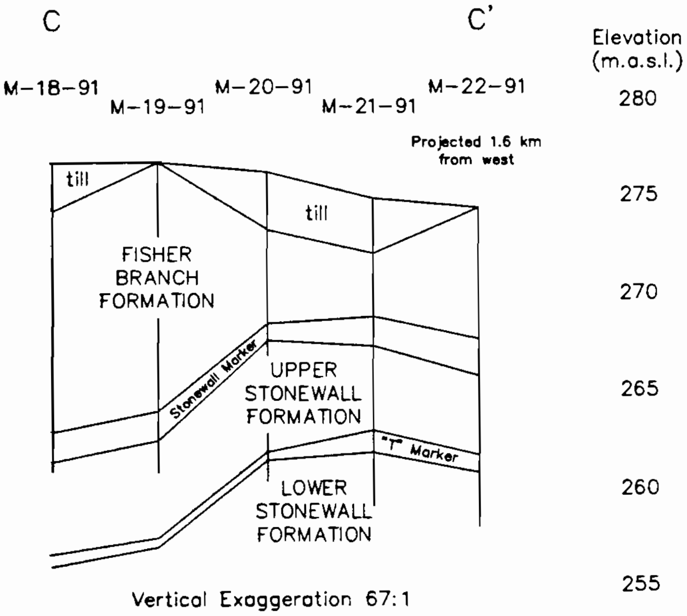

Figure 6: ***Structural cross section between drillholes M-18-91 and M-22-91 (along east margin of Sec. 10, Tp. 19, Rge. 1W, see Fig. 3).***

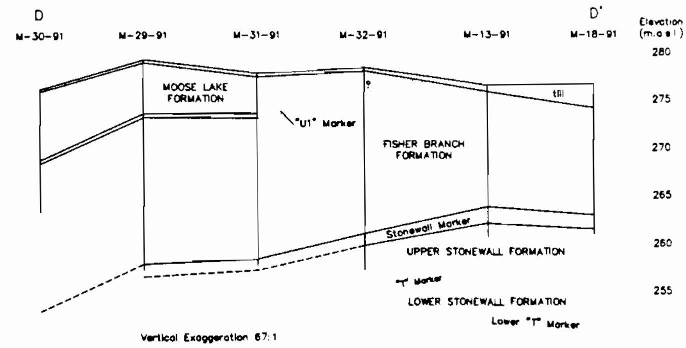

Figure 7: ***Structural cross section between drillholes M-30-91 and M-18-91 (along south margin of W 1/2 of Sec. 3, E 1/2 of Sec. 4 and E 1/2 of Sec. 10, Tp. 10, Rge. 1W, see Fig. 3).***

SAMPLE SELECTIONS

In order to develop a tonnage and grade estimate of a block of high-MgO dolomite, the holes bordering the W 1/2 of Sec. 3 and the SW 1/4 of Sec. 10, Tp. 19, Rge. 1W were selected for analysis. The holes penetrated the maximum thickness of uncontaminated dolomite drilled in the Sandridge area; with only the thin U1 argillaceous marker being present in holes drilled within the SW 1/4 of Sec. 3, Tp. 19, Rge. 1W.

Samples were collected from each of 12 cores by sawing a one-half continuous section. The cut core was air dried and samples were taken at either one metre intervals or at the changes in lithologies as determined by colour variations. The individual samples were broken with a hammer and reduced to a powder in a Braun pulverizer using ceramic grinding plates.

ANALYTICAL METHOD

Ninety-three samples of Fisher Branch Formation were analyzed in the Manitoba Energy and Mines Analytical Laboratory for Si, Al, Fe, Ca, Mg, Na, K, and Mn; and 57 samples were also analyzed for Ti and P. In addition, Loss On Ignition (LOI) was determined for a number of samples and compared with the theoretical CO_2 contents calculated from the Ca and Mg analyses. The chemical data are presented in Table 3. The column identified as Residue in Table 3 is the sum of SiO_2+Al_2O+Fe_2O_3+Na_2O+K_2O+MnO (+TiO_2 +P_2O_5); this item provides a quick reference to the amount of noncarbonate contamination in each sample and within the Fisher Branch and Moose Lake formations and the U1 Marker. Reference analyses for the analytical method used are presented in Appendix I.

Nine samples of Moose Lake Formation were also analyzed in the Manitoba Energy and Mines Analytical Laboratory for the same constituents as the Fisher Branch Formation. In addition, 40 samples of both formations were analyzed for nickel and chrome by the Analytical Laboratory and for sulphur by Chemex Labs.

Twenty-three samples of Fisher Branch Formation from drill core M-18-91 were also subjected to a decrepitation test. Slices of core 2 cm thick, spaced at 0.5 m intervals, were placed in a muffle furnace (that had previously been heated to 1175°C) and heated at that temperature for two hours. During the heating process the samples remained intact without any explosive breakup.

Table 3: Analyses of Dolomite Drill Core from the Fisher Branch Formation in the Sandridge Area

Sample	SiO_2	Al_2O_3	$Fe_2O_3^T$	CaO	MgO	Na_2O	K_2O	MnO	LOI	$ThCO_2$	Residue	Total	TiO_2	P_2O_5
M-13-91- 4.00	0.04	0.03	0.08	29.65	21.14	0.02	0.01	0.008	47.93	46.35	0.188	98.91		
M-13-91- 5.00	0.03	0.03	0.09	29.80	21.38	0.02	0.01	0.008	48.37	46.73	0.188	99.74		
M-13-91- 6.00	0.01	0.03	0.09	29.81	21.46	0.02	0.01	0.009	47.63	46.82	0.169	99.07		
M-13-91- 7.00	0.03	0.04	0.09	30.19	21.47	0.01	0.01	0.008	47.76	47.13	0.188	99.61		
M-13-91- 8.00	0.03	0.03	0.08	30.19	21.43	0.01	0.01	0.009	47.63	47.09	0.169	99.42		
M-13-91- 9.00	0.01	0.03	0.09	30.32	21.59	0.01	0.01	0.009	47.75	47.37	0.159	99.82		
M-13-91-10.00	0.03	0.03	0.11	30.23	21.31	0.01	0.01	0.010	47.65	46.99	0.200	99.39		
M-13-91-11.00	0.04	0.04	0.11	30.58	21.70	0.01	0.01	0.011	47.46	47.69	0.221	99.96		
M-13-91-12.00	0.05	0.04	0.12	30.55	21.55	0.03	0.01	0.011	47.54	47.50	0.261	99.90		
M-13-91-13.00	0.11	0.06	0.10	30.34	21.64	0.02	0.01	0.010	47.51	47.44	0.310	99.80		
M-14-91- 2.00	0.03	0.02	0.08	30.16	21.54	0.02	0.01	0.008	47.67	47.19	0.168	99.54		
M-14-91- 3.00	0.01	0.01	0.09	30.38	21.70	0.02	0.01	0.008	47.69	47.53	0.148	99.92		
M-14-91- 4.00	0.01	0.02	0.09	30.16	21.43	0.02	0.01	0.008	47.71	47.07	0.158	99.46		
M-14-91- 5.00	0.03	0.02	0.09	29.99	21.43	0.02	0.01	0.008	47.76	46.93	0.178	99.36		
M-14-91- 6.00	0.01	0.03	0.08	30.05	21.40	0.02	0.02	0.008	48.24	46.95	0.168	99.86		
M-14-91- 7.00	0.03	0.03	0.09	30.38	21.52	0.02	0.02	0.008	48.01	47.34	0.198	100.11		
M-14-91- 8.00	0.03	0.03	0.09	30.04	21.33	0.02	0.01	0.008	47.72	46.86	0.188	99.28		
M-14-91- 9.00	0.05	0.03	0.17	30.23	21.29	0.03	0.02	0.009	47.68	46.97	0.309	99.51		
M-14-91-10.00	0.05	0.03	0.18	30.22	21.32	0.03	0.02	0.010	47.62	46.99	0.320	99.48		
M-14-91-11.00	0.05	0.02	0.28	30.54	21.26	0.02	0.02	0.011	47.42	47.18	0.401	99.62		
M-14-91-12.00	0.09	0.04	0.31	30.34	21.30	0.02	0.02	0.011	47.47	47.06	0.491	99.60		
M-15-91- 3.00	0.47	0.11	0.14	30.17	21.53	0.02	0.05	0.010	47.21	47.18	0.800	99.71		
M-15-91- 4.00	0.04	0.02	0.08	30.30	21.61	0.02	0.01	0.007	47.57	47.37	0.177	99.66		
M-15-91- 5.00	0.02	0.01	0.07	30.43	21.82	0.02	0.01	0.006	47.63	47.70	0.136	100.02		
M-15-91- 6.00	0.03	0.02	0.08	30.28	21.47	0.02	0.01	0.007	47.63	47.20	0.167	99.55		
M-15-91- 7.00	0.02	0.01	0.08	30.35	21.64	0.02	0.01	0.008	47.65	47.44	0.148	99.79		
M-15-91- 8.00	0.01	0.01	0.09	30.51	21.50	0.03	0.01	0.008	47.55	47.42	0.158	99.72		
M-15-91- 9.00	0.02	0.02	0.08	30.47	21.63	0.03	0.01	0.008	47.70	47.53	0.168	99.97		
M-15-91-10.00	0.02	0.03	0.08	30.08	21.63	0.03	0.01	0.007	47.57	47.22	0.180	99.46		
M-15-91-11.00	0.02	0.03	0.08	30.39	21.47	0.03	0.01	0.007	47.51	48.18	0.180	100.47		

Sample	SiO_2	Al_2O_3	$Fe_2O_3^{T}$	CaO	MgO	Na_2O	K_2O	MnO	LOI	$ThCO_2$	Residue	Total	TiO_2	P_2O_5
M-15-91-12.00	0.07	0.04	0.11	30.67	21.83	0.02	0.02	0.009	47.45	47.90	0.270	100.22		
M-15-91-13.00	0.02	0.03	0.11	30.58	21.82	0.02	0.01	0.009	47.45	47.82	0.200	100.05		
M-15-91-14.00	0.07	0.05	0.11	30.72	21.89	0.02	0.02	0.009	47.47	48.01	0.280	100.36		
M-15-91-15.00	0.05	0.04	0.12	30.50	21.64	0.02	0.01	0.009	47.51	47.56	0.250	99.90		
M-16-91- 2.00	0.04	0.02	0.07	30.47	21.39	0.03	0.01	0.006	47.04	47.26	0.196	99.10		
M-16-91- 3.00	0.01	0.03	0.08	30.25	21.50	0.03	0.01	0.006	47.23	47.21	0.186	99.17		
M-16-91- 4.00	0.00	0.02	0.08	30.37	21.56	0.03	0.01	0.007	47.23	47.37	0.167	99.33		
M-16-91- 5.00	0.01	0.03	0.09	30.58	21.68	0.03	0.01	0.008	47.07	47.67	0.198	99.53		
M-16-91- 6.00	0.01	0.03	0.11	30.41	21.64	0.03	0.01	0.008	47.14	47.49	0.218	99.41		
M-16-91- 7.00	0.03	0.03	0.09	30.53	21.66	0.03	0.01	0.006	47.29	47.61	0.216	99.70		
M-16-91- 8.00	0.03	0.02	0.11	30.31	21.66	0.03	0.01	0.007	47.20	47.43	0.217	99.39		
M-16-91- 9.00	0.01	0.02	0.12	30.36	21.76	0.02	0.01	0.007	47.22	47.58	0.207	99.55		
M-16-91-10.00	0.03	0.05	0.17	30.40	21.55	0.02	0.01	0.009	47.15	47.38	0.299	99.40		
M-16-91-11.00	0.07	0.06	0.18	30.43	21.61	0.03	0.01	0.008	47.25	47.47	0.378	99.67		
M-16-91-12.00	0.15	0.08	0.25	30.43	21.63	0.03	0.01	0.008	47.15	47.50	0.538	99.75		
M-16-91-13.00	0.27	0.14	0.13	30.14	21.36	0.02	0.03	0.007	47.06	46.97	0.617	99.18		
M-17-91- 1.00	0.01	0.02	0.07	30.12	21.76	0.02	0.01	0.006	47.35	47.39	0.156	99.39		
M-17-91- 3.00	0.00	0.01	0.08	30.19	21.90	0.02	0.00	0.006	47.28	47.60	0.126	99.50		
M-17-91- 4.00	0.00	0.02	0.06	30.53	21.58	0.03	0.01	0.006	47.44	47.52	0.136	99.69		
M-17-91- 5.00	0.01	0.03	0.06	30.47	21.79	0.03	0.01	0.006	47.44	47.70	0.166	99.87		
M-17-91- 6.00	0.00	0.03	0.07	30.28	21.79	0.03	0.01	0.007	47.31	47.55	0.157	99.54		
M-17-91- 7.00	0.01	0.02	0.08	30.65	21.80	0.03	0.01	0.007	47.13	47.85	0.177	99.76		
M-17-91- 8.00	0.03	0.02	0.10	30.54	21.80	0.03	0.01	0.007	47.09	47.77	0.217	99.65		
M-17-91- 9.00	0.04	0.03	0.09	30.64	21.68	0.03	0.01	0.008	47.04	47.71	0.228	99.59		
M-17-91-10.00	0.07	0.05	0.11	30.65	21.62	0.03	0.01	0.009	47.16	47.66	0.299	99.73		
M-17-91-11.00	0.06	0.06	0.12	30.18	21.53	0.03	0.01	0.007	47.20	47.19	0.297	99.21		
M-17-91-12.00	0.04	0.04	0.12	30.50	21.58	0.03	0.01	0.008	47.24	47.50	0.268	99.59		
M-17-91-13.00	0.13	0.10	0.11	30.23	21.49	0.02	0.01	0.007	47.17	47.19	0.397	99.29		
M-25-91- 2.00	0.13	0.06	0.08	30.25	21.56	0.03	0.03	0.008	47.29	47.28	0.358	99.46		
M-25-91- 3.00	0.00	0.01	0.07	29.93	21.68	0.02	0.01	0.006	47.37	47.16	0.126	99.11		
M-25-91- 4.00	0.01	0.02	0.07	30.30	21.73	0.03	0.01	0.006	47.39	47.50	0.156	99.58		

Sample	SiO_2	Al_2O_3	$Fe_2O_3^{\dagger}$	CaO	MgO	Na_2O	K_2O	MnO	LOI	$ThCO_2$	Residue	Total	TiO_2	P_2O_5
M-25-91- 5.00	0.01	0.03	0.07	29.70	21.40	0.02	0.01	0.007	47.50	46.67	0.167	98.77	0.01	0.01
M-25-91- 6.00	0.03	0.03	0.09	30.17	21.52	0.04	0.01	0.008	47.38	47.17	0.228	99.30	0.01	0.01
M-25-91- 7.00	0.13	0.11	0.10	30.34	21.42	0.03	0.01	0.009	47.14	47.20	0.459	99.36	0.01	0.06
M-25-91- 8.00	0.05	0.04	0.11	30.37	21.53	0.03	0.01	0.010	47.31	47.34	0.290	99.50	0.02	0.02
M-25-91- 9.00	0.07	0.05	0.10	30.21	21.48	0.03	0.01	0.010	47.16	47.16	0.300	99.15	0.01	0.02
M-25-91-10.00	0.05	0.06	0.11	30.44	21.48	0.04	0.01	0.009	47.30	47.34	0.329	99.55	0.01	0.04
M-25-91-11.00	0.15	0.12	0.10	30.12	21.37	0.04	0.02	0.008	47.23	46.97	0.468	99.19	0.02	0.01
M-26-91- 4.00	0.03	0.04	0.07	30.08	21.56	0.04	0.01	0.007	47.15	47.14	0.207	99.00	0.01	0.00
M-26-91- 5.00	0.01	0.03	0.07	30.04	21.72	0.04	0.01	0.007	47.25	47.29	0.177	99.19	0.01	0.00
M-26-91- 6.00	0.01	0.03	0.08	30.34	21.67	0.02	0.00	0.007	47.09	47.47	0.167	99.27	0.02	0.00
M-26-91- 7.00	0.04	0.04	0.08	30.31	21.66	0.02	0.00	0.007	47.17	47.43	0.207	99.35	0.02	0.00
M-26-91- 8.00	0.04	0.05	0.09	30.27	21.57	0.03	0.00	0.007	47.04	47.30	0.227	99.11	0.01	0.00
M-26-91- 9.00	0.09	0.09	0.09	30.18	21.34	0.02	0.01	0.007	47.02	46.98	0.337	98.88	0.02	0.01
M-27-91- 1.00	0.05	0.03	0.09	30.24	21.28	0.03	0.01	0.006	47.16	46.96	0.236	98.92	0.02	0.00
M-27-91- 2.00	0.00	0.02	0.07	30.34	21.36	0.03	0.00	0.006	47.14	47.13	0.146	98.99	0.02	0.00
M-27-91- 3.00	0.00	0.02	0.07	30.22	21.46	0.02	0.00	0.007	47.34	47.14	0.137	99.16	0.02	0.00
M-27-91- 4.00	0.01	0.01	0.09	30.08	21.65	0.03	0.01	0.008	47.23	47.24	0.178	99.14	0.02	0.00
M-27-91- 5.00	0.00	0.01	0.12	30.05	21.54	0.02	0.01	0.007	47.33	47.10	0.187	99.11	0.02	0.00
M-27-91- 6.00	0.00	0.03	0.10	30.01	21.42	0.03	0.01	0.008	47.43	46.94	0.208	99.07	0.02	0.01
M-27-91- 7.00	0.01	0.03	0.08	30.41	21.57	0.03	0.01	0.008	47.29	47.41	0.198	99.47	0.02	0.01
M-27-91- 8.00	0.01	0.04	0.05	30.12	21.37	0.04	0.01	0.006	47.56	46.97	0.186	99.24	0.02	0.01
M-27-91- 9.00	0.05	0.06	0.07	30.33	21.42	0.04	0.01	0.007	47.44	47.19	0.257	99.45	0.02	0.00
M-27-91-10.00	0.01	0.02	0.09	30.28	21.60	0.03	0.01	0.009	47.24	47.34	0.189	99.31	0.02	0.00
M-27-91-11.00	0.07	0.05	0.12	30.40	21.54	0.03	0.01	0.010	47.11	47.37	0.320	99.37	0.02	0.01
M-27-91-12.00	0.07	0.05	0.12	30.30	21.42	0.03	0.01	0.010	47.04	47.16	0.310	99.07	0.01	0.01
M-28-91- 3.00	0.08	0.05	0.11	30.39	21.59	0.02	0.01	0.007	47.42	47.42	0.280	99.68		
M-28-91- 4.00	0.02	0.03	0.08	30.36	21.58	0.02	0.01	0.006	47.43	47.39	0.170	99.54		
M-28-91- 5.00	0.01	0.02	0.10	30.21	21.66	0.02	0.01	0.007	47.45	47.36	0.170	99.49		
M-28-91- 6.00	0.01	0.01	0.09	30.62	21.74	0.02	0.01	0.006	47.44	47.76	0.150	99.95		
M-28-91- 7.00	0.01	0.02	0.08	30.39	21.75	0.01	0.01	0.006	47.42	47.59	0.140	99.70		
M-28-91- 8.00	0.02	0.03	0.07	30.36	21.71	0.02	0.01	0.005	47.66	47.53	0.160	99.89		

Sample	SiO_2	Al_2O_3	$Fe_2O_3^{\dagger}$	CaO	MgO	Na_2O	K_2O	MnO	LOI	$ThCO_2$	Residue	Total	TiO_2	P_2O_5
M-28-91- 9.00	0.01	0.02	0.07	30.46	21.78	0.02	0.01	0.006	47.69	47.68	0.140	100.07		
M-28-91-10.00	0.01	0.02	0.08	30.46	21.77	0.02	0.01	0.007	47.59	47.67	0.150	99.97		
M-28-91-11.00	0.01	0.02	0.10	30.29	21.69	0.02	0.01	0.008	47.62	47.77	0.170	100.09		
M-28-91-12.00	0.02	0.03	0.09	30.14	21.65	0.03	0.01	0.008	47.63	47.29	0.190	99.61		
M-28-91-13.00	0.03	0.02	0.12	30.23	21.87	0.03	0.01	0.008	47.57	47.60	0.220	99.89		
M-28-91-14.00	0.02	0.02	0.12	30.24	21.67	0.03	0.01	0.008	47.54	47.39	0.210	99.66		
M-28-91-15.00	0.03	0.04	0.12	30.18	21.62	0.03	0.02	0.008	47.67	47.29	0.250	99.72		
M-28-91-16.00	0.04	0.03	0.12	30.39	21.68	0.03	0.02	0.008	47.56	47.52	0.250	99.88		
M-28-91-17.00	0.07	0.04	0.13	30.58	21.64	0.03	0.02	0.009	47.46	47.62	0.300	99.98		
M-28-91-18.00	0.04	0.03	0.10	30.57	21.58	0.03	0.02	0.008	47.55	47.55	0.230	99.93		
M-29-91- 7.00	0.31	0.18	0.11	30.28	21.38	0.02	0.02	0.006	47.20	47.10	0.650	99.51		
M-29-91- 8.00	0.03	0.03	0.10	30.22	21.48	0.02	0.01	0.007	47.14	47.17	0.200	99.04		
M-29-91- 9.00	0.01	0.02	0.09	30.23	21.65	0.02	0.01	0.007	47.16	47.36	0.160	99.20		
M-29-91-10.00	0.01	0.03	0.07	30.17	21.58	0.02	0.01	0.007	47.08	47.24	0.150	98.98		
M-29-91-11.00	0.01	0.02	0.06	30.21	21.63	0.02	0.01	0.006	47.27	47.32	0.130	99.24		
M-29-91-12.00	0.02	0.04	0.05	30.08	21.63	0.01	0.01	0.005	47.42	47.22	0.140	99.27		
M-29-91-13.00	0.01	0.03	0.06	30.33	21.63	0.01	0.01	0.006	47.52	47.42	0.130	99.61		
M-29-91-14.00	0.02	0.03	0.09	30.43	21.71	0.01	0.01	0.008	47.24	47.58	0.170	99.55		
M-29-91-15.00	0.02	0.03	0.11	30.44	21.82	0.02	0.01	0.008	47.23	47.71	0.200	99.69		
M-29-91-16.00	0.03	0.05	0.08	30.51	21.83	0.02	0.01	0.008	47.23	47.78	0.200	99.77		
M-29-91-17.00	0.02	0.03	0.10	30.17	21.55	0.02	0.01	0.008	47.28	47.88	0.190	99.91		
M-29-91-18.00	0.04	0.04	0.08	29.89	21.61	0.04	0.01	0.007	47.40	47.05	0.220	99.12		
M-29-91-19.00	0.04	0.05	0.09	30.13	21.69	0.04	0.01	0.008	47.30	47.33	0.240	99.36		
M-29-91-20.00	0.05	0.04	0.08	30.35	21.70	0.04	0.02	0.008	47.47	47.51	0.240	99.76		
M-29-91-21.00	0.07	0.05	0.11	30.21	21.65	0.04	0.01	0.010	47.36	47.34	0.290	99.51		
M-30-91- 9.00	0.01	0.03	0.08	29.94	21.26	0.03	0.01	0.006	47.29	46.71	0.186	98.68	0.01	0.01
M-30-91-10.00	0.01	0.03	0.10	30.12	21.40	0.02	0.01	0.007	47.24	47.00	0.197	98.96	0.01	0.01
M-30-91-11.00	0.00	0.02	0.08	30.06	21.41	0.02	0.01	0.006	47.31	46.96	0.156	98.94	0.01	0.01
M-30-91-12.00	0.04	0.03	0.06	29.39	21.51	0.02	0.01	0.006	47.37	46.55	0.180	98.45	0.00	0.01
M-30-91-12.75	0.03	0.03	0.07	29.63	21.37	0.02	0.01	0.007	47.23	46.58	0.190	98.42	0.01	0.01
M-31-91- 6.00	0.04	0.04	0.10	30.19	21.55	0.03	0.01	0.008	47.26	47.22	0.230	99.23		

Sample	SiO_2	Al_2O_3	$Fe_2O_3^T$	CaO	MgO	Na_2O	K_2O	MnO	LOI	$ThCO_2$	Residue	Total	TiO_2	P_2O_5
M-31-91- 7.00	0.03	0.03	0.10	29.96	21.52	0.03	0.01	0.009	47.10	47.01	0.210	98.79		
M-31-91- 8.00	0.05	0.05	0.10	30.29	21.63	0.03	0.01	0.008	47.10	47.39	0.250	99.27		
M-31-91- 9.00	0.02	0.03	0.08	30.22	21.81	0.04	0.01	0.007	47.06	47.53	0.190	99.28		
M-31-91-10.00	0.03	0.03	0.07	30.23	21.87	0.04	0.01	0.006	47.29	47.60	0.190	99.58		
M-31-91-11.00	0.02	0.02	0.07	30.72	21.49	0.04	0.01	0.007	47.36	47.57	0.170	99.74		
M-31-91-12.00	0.03	0.03	0.09	30.41	21.85	0.03	0.01	0.009	47.08	47.72	0.200	99.54		
M-31-91-13.00	0.02	0.02	0.10	30.27	21.66	0.04	0.01	0.010	47.20	47.73	0.200	99.65		
M-31-91-14.00	0.02	0.02	0.09	30.22	21.50	0.04	0.01	0.009	47.32	47.19	0.190	99.23		
M-31-91-15.00	0.03	0.03	0.09	30.14	21.75	0.04	0.01	0.010	47.31	47.40	0.210	99.41		
M-31-91-16.00	0.03	0.03	0.08	30.25	21.77	0.05	0.01	0.010	47.30	47.51	0.210	99.53		
M-31-91-17.00	0.04	0.03	0.09	30.24	21.68	0.05	0.01	0.010	47.50	47.40	0.230	99.65		
M-31-91-18.00	0.05	0.05	0.10	30.47	21.74	0.04	0.01	0.010	47.40	47.65	0.260	99.87		
M-31-91-19.20	0.07	0.06	0.12	30.27	21.68	0.04	0.01	0.011	47.23	47.42	0.310	99.49		
M-32-91- 4.00	0.03	0.04	0.10	30.06	21.45	0.03	0.01	0.009	47.16	47.01	0.220	98.89		
M-32-91- 5.00	0.00	0.02	0.09	30.32	21.73	0.03	0.01	0.008	47.29	47.52	0.160	99.50		
M-32-91- 6.00	0.02	0.03	0.08	30.19	21.69	0.03	0.01	0.007	47.35	47.37	0.180	99.41		
M-32-91- 7.00	0.00	0.02	0.08	30.08	21.46	0.04	0.01	0.007	47.51	48.15	0.160	100.41		
M-32-91- 8.00	0.01	0.02	0.08	30.07	21.68	0.04	0.01	0.007	47.41	47.27	0.170	99.33		
M-32-91- 9.00	0.01	0.02	0.09	30.23	21.73	0.04	0.01	0.008	47.40	47.45	0.180	99.54		
M-32-91-10.00	0.01	0.03	0.10	30.39	21.82	0.04	0.01	0.008	47.21	47.67	0.200	99.62		
M-32-91-11.00	0.02	0.03	0.10	30.41	21.82	0.03	0.01	0.008	47.28	47.69	0.200	99.71		
M-32-91-12.00	0.02	0.03	0.12	30.41	21.85	0.03	0.01	0.009	47.30	47.72	0.220	99.78		
M-32-91-13.00	0.02	0.02	0.10	30.34	21.81	0.03	0.01	0.008	47.31	47.62	0.190	99.65		
M-32-91-14.00	0.04	0.04	0.09	30.57	21.79	0.04	0.01	0.008	47.39	47.78	0.230	99.98		
M-32-91-15.00	0.04	0.04	0.09	30.54	21.86	0.04	0.01	0.008	47.46	47.83	0.230	100.09		
M-32-91-16.00	0.07	0.06	0.12	30.48	21.87	0.03	0.01	0.010	47.26	47.80	0.300	99.91		
M-32-91-17.00	0.12	0.10	0.13	30.27	21.76	0.03	0.01	0.010	47.21	47.51	0.400	99.64		

$Fe_2O_3^T$ - total iron as Fe_2O_3
LOI - loss on ignition

Residue - $SiO_2+Fe_2O_3+Al_2O_3+Na_2O+K_2O+TiO_2+P_2O_5+MnO$
Th.CO_2 - theoretical CO_2 based on Ca and Mg analyses

GEOCHEMICAL DATA

FISHER BRANCH FORMATION

The chemical data for the Fisher Branch Formation (Table 3) were subjected to the SPSS/PC+ EXAMINE procedure by G. Conley. The results of this examination (of 150 analyses, from 1 m length vertical samples, of the Fisher Branch Formation in the W 1/2 of Sec. 3 and SW 1/4 of Sec. 10; Tp. 19, Rge. 1W in the Sandridge area) are presented in Table 4, and the mean values are summarized in Table 5.

Relatively high values for SiO_2, Al_2O_3, Fe_2O_3, Na_2O, K_2O, MnO, TiO_2, P_2O_5 and Residue shown in Table 3 (above the mean values listed in Table 4), are directly attributable to contamination from the immediately overlying U1 Marker above, or the underlying Stonewall Marker (Table 2).

As a check on the consistency of analytical procedures used in Gale (1991), 10 samples from drillhole M-1-84 were included in the current analyses. Maximum, mean and minimum values obtained in the previous and current analyses are presented in Table 5.

Samples from the 4.0 to 13.0 m interval of drill core M-13-91 were combined to produce an aggregate sample, which was then analyzed (Table 5). The chemical data for the ten samples from the same interval of M-13-91 were subjected to the SPSS/PC+ EXAMINE procedure. The mean values are listed in Table 5. The close correspondence in values obtained by these chemical and statistical methods show that within the Fisher Branch Formation, sample lengths could be increased to 2 or 3 m without significantly affecting the chemical data. In addition, the values obtained from a single drill core almost duplicate those from the entire block of dolomite in the W 1/2 of Sec. 3 and SW 1/4 of Sec. 10, Tp. 19, Rge. 1W.

MOOSE LAKE FORMATION

The mean values of nine analyses of Moose Lake Formation samples are listed in Table 5. These samples were taken from approximately one metre above the U1 Marker bed and the mean residue value is slightly higher, as expected. An examination of the chemical analyses from drillhole M-20-90 (Gale, 1991) shows that these values decrease upward toward the centre of the Moose Lake Formation.

The forty samples from the Fisher Branch and Moose Lake formations returned values less than 7 ppm for Ni and Cr and contained less than 0.001% S.

NON-MANITOBA SOURCES

Precambrian dolomite is presently quarried for the production of magnesium metal at Haley Station, Ontario and at Addy, Washington. Analyses of samples collected at these sites are shown in Table 6.

Table 4: Statistical Analyses of Chemical Data from the Fisher Branch Formation in the Sandridge Area

	Mean	0.0395	Std Err	0.0045	Min	0.0000	Skewness	4.7487
SiO_2	Median	0.0300	Variance	0.0030	Max	0.4700	S E Skew	0.1980
	5% Trim	0.0314	Std Dev	0.0551	Range	0.4700	Kurtosis	29.7968
					IQR	0.0325	S E Kurt	0.3936
	Mean	0.0361	Std Err	0.0020	Min	0.0100	Skewness	2.9067
Al_2O_3	Median	0.0300	Variance	0.0006	Max	0.1800	S E Skew	0.1980
	5% Trim	0.0328	Std Dev	0.0242	Range	0.1700	Kurtosis	11.3115
					IQR	0.0200	S E Kurt	0.3936
	Mean	0.0976	Std Err	0.0028	Min	0.0500	Skewness	3.3797
FE_2O_3T	Median	0.0900	Variance	0.0012	Max	0.3100	S E Skew	0.1980
	5% Trim	0.0933	Std Dev	0.0345	Range	0.2600	Kurtosis	16.0437
					IQR	0.0300	S E Kurt	0.3936
	Mean	30.2799	Std Err	0.0175	Min	29.3900	Skewness	-.8304
CaO	Median	30.2800	Variance	0.0460	Max	30.7200	S E Skew	0.1980
	5% Trim	30.2903	Std Dev	0.2145	Range	1.3300	Kurtosis	2.0532
					IQR	0.2400	S E Kurt	0.3936
	Mean	21.5973	Std Err	0.0131	Min	21.1400	Skewness	-.2668
MgO	Median	21.6200	Variance	0.0257	Max	21.9000	S E Skew	0.1980
	5% Trim	21.6005	Std Dev	0.1602	Range	0.7600	Kurtosis	-.5191
					IQR	0.2300	S E Kurt	0.3936
	Mean	0.0271	Std Err	0.0007	Min	0.0100	Skewness	0.1643
Na_2O	Median	0.0300	Variance	0.0001	Max	0.0500	S E Skew	0.1980
	5% Trim	0.0271	Std Dev	0.0086	Range	0.0400	Kurtosis	-.3492
					IQR	0.0100	S E Kurt	0.3936
	Mean	0.0111	Std Err	0.0004	Min	0.0000	Skewness	3.2445
K_2O	Median	0.0100	Variance	0.0000	Max	0.0500	S E Skew	0.1980
	5% Trim	0.0108	Std Dev	0.0054	Range	0.0500	Kurtosis	19.6845
					IQR	0.0000	S E Kurt	0.3936
	Mean	0.0078	Std Err	0.0001	Min	0.0050	Skewness	0.3723
MnO	Median	0.0080	Variance	0.0000	Max	0.0110	S E Skew	0.1980
	5% Trim	0.0078	Std Dev	0.0014	Range	0.0060	Kurtosis	-.3741
					IQR	0.0020	S E Kurt	0.3936
	Mean	47.3773	Std Err	0.0186	Min	47.0200	Skewness	1.1384
LOI	Median	47.3350	Variance	0.0521	Max	48.3700	S E Skew	0.1980
	5% Trim	47.3635	Std Dev	0.2283	Range	1.3500	Kurtosis	2.5320
					IQR	0.2925	S E Kurt	0.3936
	Mean	47.3640	Std Err	0.0254	Min	46.3500	Skewness	-.3073
$Th.CO_2$	Median	47.3850	Variance	0.0968	Max	48.1800	S E Skew	0.1980
	5% Trim	47.3707	Std Dev	0.3111	Range	1.8300	Kurtosis	0.4613
					IQR	0.4100	S E Kurt	0.3936
	Mean	0.2280	Std Err	0.0081	Min	0.1260	Skewness	2.7783
Residue	Median	0.2000	Variance	0.0099	Max	0.8000	S E Skew	0.1980
	5% Trim	0.2147	Std Dev	0.0996	Range	0.6740	Kurtosis	10.2328
					IQR	0.0802	S E Kurt	0.3936

Valid cases: 150.0 Missing cases: 0.0 Percent missing: 0.0

TiO_2	Mean	0.0111	Std Err	0.0009	Min	0.0000	Skewness	-.1261
	Median	0.0100	Variance	0.0000	Max	0.0200	S E Skew	0.3163
	5% Trim	0.0112	Std Dev	0.0067	Range	0.0200	Kurtosis	-.7286
					IQR	0.0100	S E Kurt	0.6231
P_2O_5	Mean	0.0096	Std Err	0.0012	Min	0.0000	Skewness	3.4368
	Median	0.0100	Variance	0.0001	Max	0.0600	S E Skew	0.3163
	5% Trim	0.0084	Std Dev	0.0093	Range	0.0600	Kurtosis	16.9196
					IQR	0.0000	S E Kurt	0.6231

Valid cases: 57.0 Missing cases: 93.0 Percent missing: 62.0

Table 5: Mean Values and Chemical Analyses of Dolomite Samples from the Fisher Branch and Moose Lake Formations in the Sandridge Area

	SiO_2 %	Al_2O_3 %	Fe_2O_3T %	CaO %	MgO %	Na_2O %	K_2O %	MnO %	LOI %	$Th.CO_2$ %	Residue %
Fisher Branch Fm.											
W 1/2-3-19-1W SW 1/4-10-19-1W Block 93 analyses	0.04	0.04	0.10	30.3	21.6	0.03	0.01	0.008	47.4	47.4	0.23
Drill core M-13-91 aggregate sample, single analysis 4.0 to 13.0 m	0.04	0.04	0.09	30.7	21.9	0.02	0.01	0.008	47.5	47.9	0.21
Drill core M-13-91 mean value, ten analyses 4.0 to 13.0 m	0.04	0.04	0.10	30.2	21.5	0.02	0.01	0.009	47.7	47.1	0.21
Drill core M-1-84 max., mean	0.09 0.06	0.05 0.02	0.46 0.22	31.08 30.56	21.46 21.20	0.04 0.03	0.02 0.01	0.020 0.012	47.32 47.13	47.32 47.13	0.66 0.36
and min. values ten analyses 1991 1.0 to 10.0 m	0.03	0.01	0.12	30.13	20.58	0.02	0.01	0.009	46.58	46.58	0.21
Drill core M-1-84 max., mean	0.06 0.03	0.04 0.02	0.47 0.22	30.99 30.36	21.73 21.48	0.02 0.02	0.01 0.01	0.019 0.011	47.52 47.36	47.57 47.28	0.62 0.30
and min. values ten analyses 1992 1.0 to 10.0 m	0.01	0.01	0.12	30.01	21.01	0.01	0.01	0.008	47.13	46.95	0.18
Moose Lake Fm.											
mean value, nine analyses	0.07	0.05	0.09	30.3	21.3	0.03	0.01	0.007	47.3	47.0	0.27

	TiO_2 %	P_2O_5 %
Fisher Branch Fm.		
Block 57 analyses	0.01	0.01
Moose Lake Fm.		
mean value, six analyses	0.02	0.01

Table 6: Chemical Analyses of Dolomite Samples from Haley Station, Ontario and Addy, Washington

Location	Sample #	SiO_2 %	Al_2O_3 %	R_2O_3 %	Fe_2O_3 %	CaO %	MgO %	Na_2O %	K_2O %	MnO %	LOI %	Residue* %	Acid Insoluble
Haley	126	0.36	0.27		0.29	31.04	20.99	-	-	-	-	0.92	-
Haley	127	0.20	tr.		0.10	31.28	21.28	-		-	-	0.30	-
Haley	T-1	0.62	0.05		0.12	30.7	21.1	<0.1	0.03	0.02	47.0	0.94	0.6
Haley	T-2	0.31	<0.01		0.05	30.8	21.2	<0.1	0.02	0.02	47.1	0.51	0.4
Haley	T-4	0.59	0.09		0.11	30.7	21.3	0.1	0.02	0.03	46.8	0.94	0.8
Haley	A	-		0.25		31.55	20.8	-	-	-	47.1	0.25	0.3
Haley	B	-		0.30		31.95	20.48	-	-	-	47.1	0.30	0.25
Haley	C	-		0.30		31.75	20.6	-	-	-	46.9	0.30	0.45
Haley	D	-		0.60		31.10	21.15	-	-	-	46.8	0.60	0.35
Haley	E		-	0.30		31.15	21.3	-	-	-	46.9	0.30	0.35
Haley	F	-		0.30		31.2	21.2	-	-	-	47.0	0.30	0.30
Haley	G	-		0.30		31.2	21.35	-	-	-	46.8	0.30	0.35
Haley	H	-		0.25		31.2	21.45	-	-	-	46.8	0.25	0.30
Haley	I	-		0.30		31.2	21.45	-	-	-	46.8	0.30	0.25
Haley	J	-		0.40		30.85	21.55	-	-	-	46.6	0.40	0.65
Haley	K	-		0.20		31.2	21.35	-	-	-	46.9	0.20	0.30
Haley	L	-		0.30		31.2	21.2	-	-	-	46.9	0.30	0.40
Haley	M	-		0.25		31.25	21.4	-	-	-	46.8	0.25	0.30
Addy	544	-		0.56		30.03	21.21	-	-	-	46.68	0.56	1.52
Addy	545	-		0.52		29.68	20.91	-	-	-	46.09	0.52	2.80
Addy	546	-		0.44		30.50	21.44	-	-	-	47.26	0.44	0.36
Addy	547	-		0.56		30.41	21.27	-	-	-	47.00	0.56	0.76
Addy	548	-		0.76		30.32	21.29	-	-	-	46.95	0.76	0.68
Addy	549	-		0.64		30.33	21.31	-	-	-	47.00	0.64	0.72
Addy	550	-		0.60		30.21	21.53	-	-	-	47.16	0.60	0.50
Addy	551	-		0.56		30.52	21.42	-	-	-	47.10	0.56	0.40

Samples:

126 to 127 Goudge (1938, p. 168-169 and 178-179)

A to M Pigeon (1944, p. 29)

T-1 to T-4 Personal Communication from P. LeBaron, Mar. 20/92

544 to 551 Bennett (1944, p. 34)

*Note: Residue = ($SiO_2 + Al_2O_3 + Fe_2O_3 + Na_2O + K_2O + MnO$) or R_2O_3

TONNAGE ESTIMATES

Geological reserves of dolomite within the Fisher Branch Formation in a 2.4 by 0.8 km area were calculated by averaging drilled thickness (Table 2) on a quarter-section basis using the following formula:

$$\text{tonnes of dolomite} = \frac{\underset{\text{Fisher Branch Fm.(m)}}{\text{average thickness}} \times \underset{\text{1/4 section}(m^2)}{\text{area of}} \times \underset{(kg/m^3)}{\text{av. weight}}}{1000}$$

$$= \frac{\text{av. thickness} \times 647220.25 \times 2899.62}{1000}$$

$$= \text{av. thickness} \times 1876692.78$$

1/4 Section	No. of Holes+	Av. Thickness (m)	Tonnage (tonnes)
SW3-19-1W	4	15.0	28 150 392
NW3-19-1W	5	13.6	25 523 023
SW10-19-1W	8	11.0	20 643 621
		Total	74 317 036
	Assuming 10% porosity, proven geological reserves		67 000 000

+ Some holes were drilled along the quarter section boundaries (See Fig. 3).

Another 33 million tonnes of similar material are inferred from the remainder of Sec. 10, Tp. 19, Rge. 1W, outlined by 8 additional drillholes.

CONCLUSIONS

Geological reserves of 67 million tonnes of dolomite averaging 21.6% MgO and 0.23% Residue have been drill proven in the Sandridge area within the W 1/2 of Sec. 3 and SW 1/4 of Sec. 10, Tp. 19, Rge. 1W. An additional 33 million tonnes of similar grade material is inferred in the remainder of Sec. 10, Tp. 19, Rge. 1W. These reserves are contained within the Fisher Branch Formation, which is 4 to 15 m thick from north to south across the area drilled. The highest MgO values and lowest Residue values occur near the centre of the formation.

In the southern portion of the Sandridge area the Moose Lake Formation appears to have a similar MgO and Residue grade, and therefore is a potential source of additional high purity material. Removal of the distinctive U1 Marker bed would be necessary to maintain the purity of the material if both formations were quarried at the same site.

The dolomite of the Sandridge area is comparable in grade with that being produced at the Timminco Ltd. quarry at Haley Station in Ontario and at the Northwest Alloys, Inc. quarry at Addy, Washington. Both of these quarries supply dolomite that is used in the production of magnesium metal.

PLANNED INVESTIGATIONS

Drill core from the Deerhorn hole (M-12-91) was analyzed to determine the MgO content of the Silurian Interlake Group. The results will be published in a future report and will also be used to determine the location of follow-up drill programs. The purpose of these additional programs will be to add to the known tonnage of high-MgO dolomite and to provide alternative areas that could be considered for potential development. The selected site(s) will be tested by a drill program over an area 1.6 by 1.6 km to a depth of 15 to 20 m with at least one hole drilled to a greater depth to provide stratigraphic control.

Mapping of NTS 62I was initiated as part of the Branch's Industrial Minerals investigations during the summer of 1992. All dolomite outcrops will be documented and this information added to the industrial minerals database; a commodity map will be prepared to show zones that have a high potential for industrial mineral production, including high-MgO dolomite.

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APPENDIX I

Reference Analyses for Analytical Method used in Dolomite Evaluation Project

(prepared by Jane Weitzel, Manitoba Energy and Mines, Analytical Laboratory)

DOLOMITE Mg EVALUATION PROJECT

Description of the values identified as Th. CO_2, Residue, CaOMgO, and TOTAL in which are abbreviations and which contain formulas.

Th. CO_2

Th. CO_2 is an abbreviation of theoretical CO_2. A theoretical $\%CO_2$ is calculated based on the assumption that all Ca and Mg is in carbonate form. A $\%CO_2$ equivalent to the % of CaO is calculated using the factor 0.78477. Similarly, a $\%CO_2$ equivalent to the % of MgO is calculated using the factor 1.09176.

$\%CO_2$ = 0.78477 * %CaOCaO + CO_2 = $CaCo_3$

$\%CO_2$ = 1.09176 * %MgOMgO + CO_2 = $MgCO_3$

Formula: @ROUND(0.78477 · H3 = 1.09176 · I3,2)

Residue

The request for analysis specified that the total of SiO_2, Al_2O_3, Fe_2O_3T, Na_2O, K_2O, MnO will be less than 1% in the samples which have the desired purity of dolomite. The term Residue was chosen to mean the total of SiO_2, Al_2O_3, Fe_2O_3T, Na_2O, K_2O, TiO_2, P_2O_5 and MnO. This cell totals the approximate analytes so the residue value can be easily compared with the analysis request specification.

Formula: @SUM(E3..G3) + @SUM(J3..N3)

CaOMgO

CaOMgO is an abbreviation for %CaO + %MgO. This cell contains the sum of %CaO and %MgO.

Formula: +H3+H3

PRECISION & ACCURACY OF DOLOMITE ANALYSIS

Values obtained from the replicate analysis of Certified Reference Materials (CRM) were used to calculate the precision and accuracy of Dolomite analyses in the Geological Services Analytical Lab.

Precision

The precision is defined as one standard deviation.

The pooled estimate of standard deviation for CaO is 0.09%.

The pooled estimate of standard deviation for MgO is 0.11%.

Accuracy

The difference between the Certified Reference Value (CRV) and the Experimental Value (E.V.) is and indication of accuracy. These values are listed in Table 1 for CaO and Table 2 for MgO.

Table 1 CaO - Accuracy

CRM	MRC2	GFS 400	BCS 368	NBS 88a	NBS 88b	JDo-1
E.V.	30.09	30.04	30.31	29.82	29.4	33.43
CRV	30.28	30.51	30.8	30.1	29.95	34.12
E.V.-CRV	-0.19	-0.47	-0.49	-0.28	-0.55	-0.69

Table 2 MgO - Accuracy

CRM	MRC2	GFS 400	BCS 368		NBS 88b	JDo-1
E.V.	21.66	21.55	21.00		21.26	18.85
CRV	21.40	21.50	20.9		21.03	18.40
E.V.-CRV	0.26	0.05	0.10		0.23	0.45

APPENDIX II
Drill Core Descriptions
(logged by Ruth Bezys, Manitoba Energy and Mines Stratigrapher)

M-1-84
NARCISSE
4-15-19-1WPM
Ground Elevation: 274.6 m
(logged by H. McCabe)
(relogged by Bezys, Sept. 1991)

Metres	Description
0.0-11.75	**SILURIAN-INTERLAKE GROUP** **Fisher Branch Fm:** Dolomite: medium to very fine crystalline (relatively coarse-grained); mottled yellowish buff; fair to good vuggy porosity; good calcarenite texture; moderately fossiliferous to quite abundantly fossiliferous especially corals (*Paleofavositids*). Stearn (1956) reports *Virgiana* at this location - fossiliferous core at surface but no diagnostic *Virgiana* present (this is 11.78 m above highest argillaceous zone so it is anomalously high for *Virgiana* since Fisher Branch Fm is approximately 5 m thick. Therefore *Virgiana* has greater stratigraphic range than previously thought - at least in southern Manitoba. ***(R.B.: at 5.65-5.85 m excellent Virgiana and at 11.55-11.75 (but not as well developed).***
11.75-17.75	**Upper Stonewall Fm** **Stonewall Marker:** 11.75-13.1: slightly argillaceous, olive grey dolomite; dense; sublithographic; mostly pale greyish red with fine rounded blebs similar to "raindrop" impressions in Silurian of Inwood Quarry. 13.1-14.82: Dolomite: light grey buff; sublithographic; some vuggy porosity towards base. Grades to... 14.82-17.75: Dolomite: pale yellow grey; faintly mottled with yellowish granular vuggy patches - at least in part due to fossil solutioning. Texture is medium crystalline; dense - almost sublithographic; in part faint pelletal/intraclastic relict texture - possibly slight mud cracking?. Grades to...
17.75-31.77	**Lower Stonewall Fm** **T-Marker:** 17.75-18.41: Mottled reddish argillaceous dolomite: light pinkish buff to dark greyish red; massive; trace medium rounded frosted sand grains. Passes sharply to argillaceous dolomite; olive grey; very irregularly mottled due to diagenetic effects. 18.41-23.00: Dolomite: medium light yellow brown; extreme coarse vuggy porosity (15-50%); basic texture is fine to very fine crystalline; dense; vugs in part fossil solutioning but primary texture has been destroyed (corals?); quite granular in patches; few floating rounded, frosted sand grains towards the base. Passes sharply to... 23.0-24.17: **Lower T-Marker**: dolomitic shale; medium greyish red; distinctly mottled and streaked to purplish in part. Grades to... 24.17-24.90: Dolomite: light grey; massive; fine to medium crystalline; sublithographic; medium vuggy porosity; slightly argillaceous. Grades to... 24.90-27.60: Dolomite: mottled; vuggy; pale grey to pale yellow brown; medium to coarse vugs - in part fossil solutioning; some fossil fragment as relict texture - mostly very fine to medium crystalline; dense to medium granular in yellow earthy patches; trace of rounded, frosted sand grains towards the base. Grades to... 27.60-31.77: **Williams Member**: dolomite; light buff; medium to coarse crystalline; floating sand grains at top; minor intraformational breccia interbeds; downward becomes increasingly reddish and argillaceous with irregular colour mottling to fine lamination; at 29.1 m no red colouration, olive green, just argillaceous dolomite. Grades to...
31.77-42.64	**Stony Mountain Fm** **Gunton Member** - dolomite: light yellow buff to light grey; massive to faint fine lamination; medium crystalline; dense; sublithographic; several fragmental and intraclastic intervals; slightly argillaceous; patchy medium to coarse vuggy porosity. Dolomite: light grey/yellow buff; vuggy; very fine crystalline; dense; hard; massive; yellow patches are slightly granular; few nodular argillaceous partings and stylolites. Grades to...
42.64-64.82	**Penitentiary Member**: Dolomite: argillaceous; burrow mottled; medium light purplish/reddish grey; massive; pronounced oxide reduction; dark dusky, red/light greenish grey; some interbeds of dolomitic shale; some scattered corals and gastropods at 49 m; becomes mostly greenish grey in bottom 2-3 m; sharp contact with underlying unit - unconformable with infill of Penitentiary Mbr argillaceous beds.

64.82-68.65 TD **Red River Fm (Fort Garry Member)??**
Dolomite: pale yellow buff; massive to minor fine banding; grey to brownish, dense chert nodules to 10 cm; mostly fine to very fine crystalline; dense to slightly granular (no sign of limestone zone); minor grey argillaceous bands; minor intraformational breccia zones; several clay infilled fractures.

NOTE:
- Shaly interbeds within the Stonewall Fm are unusually well-developed, especially in second zone.
- Warren hole does not show any shaly zones although bleaching will give appearance of normal sublithographic dolomite.
- Shale content only apparent if reddish colour is developed.
- Teulon hole does have one shaly interbed.
- The mottled, argillaceous dolomite at top of Stonewall Fm seems distinctive (is definitely a Silurian-type lithology - similar to Inwood Quarry beds - seems to correlate well between holes).
- Gross lithologies in Stonewall Fm are compatible, but shaly "markers" come and go.

M-12-91
DEERHORN QUARRY
9-3-21-5WPM
Elevation: 263.7 m

Metres | Description

0.0-43.9 **SILURIAN INTERLAKE GROUP**
Cedar Lake Fm:
0.0-9.8 m: Reefal dolomite: buff yellow; fossiliferous; 5-10% porosity; packstone to wackestone; possible stromatoporoid fragments? scattered throughout.

9.8-11.5 m: very rubbly, broken core with distinct red stain.

11.5-13.5 m: fossiliferous, slightly orange stained dolomite with *Paleofavositid* fragments.

@ 13.5 m: some green clay infill.

@ 18.25-18.75 m: red to green clay infill - stained throughout.

18.75-43.9 m: Slightly fossiliferous dolomite - becoming more fossiliferous and porous to top; fine crystalline to very finely laminated; light tan brown; some intervals are very porous; minor grainstone intervals; slightly nodular.

43.9-61.45 **East Arm Fm:**
Massive to slightly stromatolitic dolomite; some possible stromatoporoid fragments; brown to tan; scattered red colouration; fine crystalline; clean looking dolomite; gradational upper contact to fossiliferous dolomite.

60.4-61.45 m **V-Marker**: Argillaceous to slightly silty dolomite; red to green-grey; spheroidal imprints present - 3-8 mm in diameter.

61.45-79.95 **Moose Lake Fm:**
61.45-65.9 m: light tan to white, clean looking dolomite; very fine to fine crystalline; becoming porous to brecciated towards the top; sharp upper contact.

65.9-66.05 m: **U_2 Marker?** argillaceous, purple red dolomite with distinct spheroids imprints.

66.05-79.95 m: fine crystalline dolomite; -10% porosity; slightly nodular; possibly slightly stromatolitic; minor indiscernible fossiliferous material.

(Lost 1 m of core between 64.09-68.12 m)

79.95-80.15 **U_1 Marker:** light purple red, argillaceous dolomite; slightly sandy with spheroid imprints.

79.95-91.66 **Fisher Branch Fm:**
Dolomite: fine crystalline; fossiliferous; light brown; very clean, porcellaneous looking dolomite; massive with no real structures; 3% porosity; zone of *Virgiana* fossils at base; gradational lower contact.

91.66-96.55 **Upper Stonewall Fm:**
Stonewall Marker
91.66-92.0 m: Dolomite: grey; fine crystalline; containing spheroid imprints.

92.00-93.1 m: Red to green-grey argillaceous dolomite; small spheroidal blebs throughout; some intervals are very sandy - red colour; fine wispy laminations.

93.1-96.55 m: Dolomite: slightly fossiliferous; porcelaneous; light tan to white; very fine crystalline to sublithographic.

End of Hole

Static water level of hole on August 22nd, 1991: 3.84 m

Quarry contained approximately 3.0 m of exposure due to water infill. Unit is very reefal-like, thin to medium bedded dolomite. Buff yellow, porosity 8-10%. Unit is similar to top of M-12-91.

INDUSTRIAL MINERALS DRILLING
SANDRIDGE, MANITOBA
M-13-91
2-10-19-1W
Ground Elevation: 276.6 m

Metres	Description
0.0-3.0	**Fisher Branch Fm** lost 2.3 m of core; very rubbly dolomite; buff yellow; *Virgiana* at 2.8 m. 3.0-12.2: Dolomite: buff yellow; fine to medium crystalline; wackestone; coral-reefal-like fossiliferous debris (*Paleofavositids*); some large vugs (3-5 cm in diameter). 12.2-12.8: Dolomite: very broken and rubbly core; irregular textures; fossiliferous; possible *Virgiana* at base.
12.8-16.0	**Upper Stonewall Fm** **Stonewall Marker:** 12.8-13.4: dolomite: olive brown; fine crystalline; slightly conglomeratic; containing distinct spheroidal imprints. 13.4-14.5: red argillaceous dolomite; slightly arenaceous. 14.5-16.0: dolomite: buff brown; sublithographic; very fine crystalline.

M-14-91
3-10-19-1W
Ground Elevation: 275.4 m
Lost 1.3 m of core between 0.5-2.6 m

Metres	Description
0.5-12.3	**Fisher Branch Fm** Dolomite: at top very reef-like and oolitic; vuggy; rubbly; slightly fossiliferous (coral debris); light brown. @ 2.6 m: core is more competent; fine to medium crystalline; massive and dense; porosity 3-5% - pinpoint; minor breccia and conglomerate beds. @ 10.4 m: *Virgiana* fossils present. 10.7-12.3: transition zone between Fisher Branch and Stonewall?; very rubbly, broken core; faintly laminated; 10% porosity.
12.3-15.9	**Upper Stonewall Fm** **Stonewall Marker:** 12.3-12.8: Dolomite: grey to buff yellow; slightly argillaceous dolomite; conglomeratic; dense; % porosity. 12.8-13.9: Argillaceous Dolomite: red; slightly arenaceous with spheroidal imprints. 13.9-15.9: Dolomite: porcelaneous; massive; dense; sublithographic; microcrystalline to very fine crystalline.

M-15-91
4-10-19-1W
Ground Elevation: 275.8 m

Metres	Description
0.3-3.7	Overburden
3.7-4.5	**Fisher Branch Fm** Dolomite: light brown; wackestone; fossiliferous - possibly some *Virgiana* and *Paleofavositids*; 5-10% porosity; some lithographic beds at top; slightly conglomeratic in places; sharp lower contact. 4.5-13.2: Dolomite: buff; fossiliferous; good *Virgiana* bed at 6.0 m (10 cm thick).
13.2-15.9	**Upper Stonewall Fm** **Stonewall Marker**: Dolomite: buff tan; slightly sublithographic.

M-16-91
5-10-19-1W
Ground Elevation: 276.2 m

Metres	Description
0.0-1.2	Overburden
1.2-10.4	**Fisher Branch Fm** Dolomite: slightly fossiliferous to conglomeratic; light brown to buff; *Virgiana* at 8.0 m.
10.4-11.9	Very broken and rubbly core - may be transitional zone between Fisher Branch and Stonewall formations?.
11.9-14.4	**Upper Stonewall Fm** **Stonewall Marker:** 11.9-13.6: Dolomite: buff yellow to tan; finely laminated; sublithographic. 13.6-14.4: argillaceous dolomite: red with spheroidal imprints.

M-17-91
12-10-19-1W
Ground Elevation: 275.4 m

Metres	Description
0.0-1.24	**Fisher Branch Fm** Dolomite: tan brown; fossiliferous; vuggy; 5-10% porosity. 1.24-10.6: Dolomite: buff; slightly fossiliferous.
10.6-13.1	Dolomite (transitional zone between Fisher Branch and Stonewall: slightly laminated to fossiliferous; poor core.
13.1-14.56	**Upper Stonewall Fm** **Stonewall Marker:** Argillaceous Dolomite: red with spheroidal imprints throughout.

M-18-91
1-10-19-1WPM
GROUND ELEVATION: 276.8 m

Metres	Description
0.0-2.5	Overburden
2.5-13.8	**Fisher Branch Fm:** Dolomite: Buff yellow; vuggy; fossiliferous; good moldic porosity; abundant coral debris throughout; possible oncolith at top with solitary coral fragment in middle; some beds with coated grains at top; *Virgiana* present at 6 and 12.7 m; sharp lower contact to conglomeratic bed.
13.8-15.9	**Upper Stonewall Fm** 13.8-15.3: **Stonewall Marker**: 20 cm dark brown to olive green conglomerate bed overlying red argillaceous dolomite with spheroidal imprints; overlying dolomite is dense, sublithographic; gradational base to: 15.3-15.9: dolomite; dense; buff yellow; sublithographic; massive.

M-19-91
8-10-19-1WPM
GROUND ELEVATION: 276.8 m

Metres	Description
0.0-12.8	**Fisher Branch Fm**: dolomite; buff yellow; at 0.0-1.0 m - grainstone beds - slightly conglomeratic; more massive and dense in upper 6 m; becoming more vuggy and fossiliferous below 6 m; at 6.2 m good specimen of *Paleofavositids* with abundant shelly material; at 7 m slightly conglomeratic; irregularly mottled and nodular; at 11.6 m very vuggy dolomite with moldic porosity; abundant *Virgiana* fragments; minor coral debris; sharp lower contact; sample of *Virgiana* from 11.5 m (#88-80-91).
12.8-16.0	**Upper Stonewall Fm** 12.8-14.3: **Stonewall Marker**: red to green-grey, argillaceous dolomite; with spheroidal imprints throughout; faintly laminated. 14.3-16.0: dolomite; buff; dense; very fine crystalline; sublithographic; massive.

M-20-91
8-10-19-1WPM
GROUND ELEVATION: 276.2 m

Metres	Description
0.0-3.0	Overburden
3.0-~7.3	**Fisher Branch Fm** (Box 1 was dropped): dolomite; buff; distinct moldic porosity; good *Virgiana* at base.
7.3-14.3	**Upper Stonewall Fm** **7.3-8.5: Stonewall Marker**: red to olive green argillaceous dolomite. ~8.5-14.3: buff, dense dolomite; minor porosity; featureless.
14.3-15.8	**Lower Stonewall Fm** 14.3-14.6: **T-Marker?**: olive green/red to slightly argillaceous dolomite. 14.6-15.8: buff, fossiliferous dolomite.

M-21-91
9-10-19-1WPM
GROUND ELEVATION: 274.9 m

Metres	Description
0.0-2.8	Overburden
2.8-6.0	**Fisher Branch Fm**: buff yellow dolomite; slightly fossiliferous; good *Virgiana* at 5.6 m on core break; some moldic porosity; sharp lower contact.
6.0-11.9	**Upper Stonewall Fm** 6.0-7.5: **Stonewall Marker**: olive green to red mottled argillaceous dolomite; containing spheroidal imprints; slightly conglomeratic; faintly laminated; some core is very rubbly; sharp lower contact. 7.5-11.9: buff yellow; fine crystalline dolomite; massive to dense; ~ 5% porosity; minor fossiliferous material; sharp lower contact.
11.9-15.9	**Lower Stonewall Fm** 11.9-13.0: **T-Marker**: olive green to red green, slightly argillaceous dolomite. 13.0-15.9: fossiliferous, vuggy dolomite.

M-22-91
15-10-19-1WPM
GROUND ELEVATION: 274.3 M

Metres	Description
0.0-6.7	**Fisher Branch Fm**: dolomite; vuggy; buff; inclined bedding (30) at the top; very fossiliferous at 4.5 m with large fragments of *Paleofavositids*; grades into sublithographic, dense, less porous dolomite; possible *Virgiana* at 0.6 and 4.1 m.
6.7-12.6	**Upper Stonewall Fm** 6.7-8.5: **Stonewall Marker**: red to green-grey, argillaceous dolomite with spheroidal imprints throughout; very broken core and rubbly core; conglomeratic at 7.2 m. 8.5-12.6: dolomite; buff; dense; sublithographic; minor porosity (%); no discernable fossils; faint laminations in places; sharp lower contact.
12.6-16.3	**Lower Stonewall Fm** 12.6-13.6: **T-Marker**: green-grey to red mottled, argillaceous dolomite; faintly laminated (maybe diagenetic); minor arenaceous beds; gradational lower contact. 13.6-16.3: dolomite; buff; vuggy; mottled to nodular; fossiliferous at base with *Paleofavositids.*

M-23-91
14-10-19-1WPM
GROUND ELEVATION: 269.4 m

Metres	Description
0.0-2.8	Overburden
2.8-3.5	**Fisher Branch Fm**: dolomite; buff; vuggy; fossiliferous (mainly corals); no identifiable *Virgiana*; sharp base.
3.5-8.8	**Upper Stonewall Fm** **3.5-4.9: Stonewall Marker**: upper 10 cm is an olive green argillaceous dolomite which grades to a red argillaceous dolomite; finely laminated with spheroidal imprints; base is not preserved. 4.9-8.8: Dolomite; buff yellow; massive; sublithographic; gradational base.
8.8-15.8	**Lower Stonewall Fm** 8.8-9.9: **T-Marker**: olive green with minor red mottling; faintly laminated; sharp base. 9.9-13.9: dolomite; buff; vuggy; good moldic porosity; indiscernible fossils; base not preserved. 13.9-15.0: **Lower T-Marker**: distinctly red argillaceous dolomite; very mottled; sharp base. 15.0-15.8: Dolomite: olive brown; sublithographic; fine crystalline; massive.

M-24-91
13-10-19-1WPM
GROUND ELEVATION: 272.8 m

Metres	Description
0.0-2.0	Overburden
2.0-7.0	**Fisher Branch Fm**: dolomite: buff yellow; fossiliferous; abundant moldic porosity; some *Virgiana* present in lower 1 m.
7.0-13.0	**Upper Stonewall Fm** 7.0-8.4: **Stonewall Marker**: upper 10 cm is olive brown, slightly argillaceous dolomite; becomes a red mottled argillaceous dolomite with spheroidal imprints throughout; gradational base. 8.4-13.0: dolomite: very fine crystalline; buff; massive and dense; sublithographic; more porous towards the base; minor fossiliferous material; gradational base.
13.0-20.8	**Lower Stonewall Fm** 13.0-14.1: **T-marker**: olive green argillaceous dolomite; becoming red at the base; slightly arenaceous; minor mottling; minor spheroidal imprints; gradational base. 14.1-18.0: dolomite; buff yellow; very vuggy and porous; scattered fossil (*Paleofavositids*); looks reefal (good marine sequence); sharp base. 18.0-19.6: **Lower T-marker**: upper 10 cm is an olive green dolomite; becoming a distinctly red, argillaceous dolomite; mottled. 19.6-19.9: dolomite: live green; fine crystalline; sublithographic; sharp base. 19.9-20.8: dolomite: vuggy; mottled; buff; no discernable fossils.

M-25-91
5-10-19-1WPM
GROUND ELEVATION: 274.9 m

Metres	Description
0.0-10.9	**Fisher Branch Fm**: dolomite; buff yellow; fossiliferous; abundant coral debris (solitary corals and *Paleofavositids*); *Virgiana* present at 3.2 and 10.4 m; abundant moldic porosity below 5.0 m; some irregular mottling; lower 25 cm is very brecciated and conglomeratic; gradational lower contact.
10.9-15.8	**Upper Stonewall Fm** 10.9-12.8: **Stonewall Marker**: dolomite; olive yellow to mottled red; argillaceous; containing spheroidal imprints; irregular mottling; fine-grained; gradational lower contact. 12.8-15.8: dolomite; buff yellow; sublithographic; fine crystalline; massive and dense; scattered porosity.

M-26-91
7-10-19-1WPM
GROUND ELEVATION: 275.2 m

Metres	Description
0.0-3.4	Overburden
3.4-8.8	**Fisher Branch Fm**: dolomite; fossiliferous; buff yellow; good *Virgiana* at 8.5-8.8 m; good moldic porosity; sharp lower contact.
8.8-9.9	**Upper Stonewall Fm** **Stonewall Marker**: dolomite; buff brown; sublithographic; slightly mottled; argillaceous; very red at 9.7-9.9.

M-27-91
7-10-19-1WPM
GROUND ELEVATION: 275.8

Metres	Description
0.0-11.8	**Fisher Branch Fm**: dolomite; buff yellow; fossiliferous; *Virgiana* in basal 25-40 cm.
11.8-18.0	**Upper Stonewall Fm** 11.8-13.3: **Stonewall Marker**: red to olive green, argillaceous dolomite; with spheroidal imprints. 13.3-18.0: dolomite; buff; fine crystalline; sublithographic; porous at base; gradational upper contact.
18.0-32.7	**Lower Stonewall Fm** 18.0-19.0: **T-marker**: red to olive green-yellow, argillaceous dolomite; mottled; gradational upper contact. 19.0-23.0: dolomite: buff yellow; fossiliferous; vuggy and porous; sharp upper contact. 23.0-24.6: **Lower T-Marker**: very red argillaceous dolomite; mottled; sharp upper contact. 24.6-28.3: dolomite: buff yellow; fossiliferous; vuggy. 28.3-32.7: **Williams Member**: slightly argillaceous dolomite; light brown to red (in places); dense to sub-lithographic; very fine-grained; arenaceous in places; very distinct breccia bed at 29.9-30.1 m ... mottled red, olive green breccia with large fragments of dolomite - may be an evaporite solution collapse structure? - Sample 88-81-91 of breccia bed; sand clot present (4 x 4 cm in diameter) with coarse-grained quartz sand (consolidated - does not look like infill) located at 29.4 m; gradational upper contact.
32.7-46.4	**Stony Mountain Fm** 32.7-42.0: **Gunton Member**: buff yellow to brown; mottled to nodular dolomite; slightly fossiliferous; fine to medium crystalline; some moldic porosity; argillaceous marker beds present at 34.9 and 36.4 m (unusual to see these beds in the Gunton?); sharp upper contact. 42.0-46.4: **Penitentiary Member**: distinctly red mottled to olive green argillaceous dolomite; upper 2 m of unit is olive green in colour; fine crystalline; some burrow mottling?; gradational upper contact.

M-28-91
5-3-19-1WPM
GROUND ELEVATION: 277.5 m

Metres	Description
0.0-2.0	Overburden
2.0-18.2	**Fisher Branch Fm**: dolomite: buff yellow; vuggy and fossiliferous; abundant coral debris (*Paleofavositids*); at 11.5 m abundant moldic porosity; some vugs contain dolomite crystals; some coated grains in beds at top; possible *Virgiana* at the base - not well developed; sharp lower contact.
18.2-19.5	**Upper Stonewall Fm** 18.2-18.9: **Stonewall Marker**: brown grey, sublithographic dolomite; fine crystalline; slightly conglomeratic at base; sharp lower contact. 18.9-19.5: red argillaceous dolomite with spheroidal imprints throughout.

M-29-91
1-4-19-1WPM
GROUND ELEVATION: 279.3 m

Metres	Description
0.0-2.3	Overburden
2.3-5.5	**Moose Lake Fm**: dolomite; buff yellow; 5-10% porosity; distinct moldic porosity zone at ~4.0 m; gradational lower contact.
5.5-5.9	**U_1 Marker:** purple; slightly argillaceous dolomite (mudstone); with spheroidal imprints.
5.9-21.2	**Fisher Branch Fm**: dolomite; buff; moldic porosity starting at 17.4 m; good *Virgiana* at 10.6 m; no discernable *Virgiana* at base of unit.
21.2-22.0	**Upper Stonewall Fm** 21.2-21.6: **Stonewall Marker**; buff brown; sublithographic dolomite. 21.6-22.0: red argillaceous dolomite; with spheroidal imprints.

M-30-91
2-4-19-1WPM
GROUND ELEVATION: 276.1 m

Metres	Description
0.0-1.3	Overburden
1.3-7.2	**Moose Lake Fm**: dolomite; buff yellow; distinct grainstone bed at 1.3-2.0 m; porosity ~5-8%; distinct coralgal debris at 5.7-6.7 m.
7.2-7.5	**U1 Marker:** purple argillaceous dolomite (mudstone) with spheroidal imprints.
7.5-12.8	**Fisher Branch Fm**: dolomite; buff; fossiliferous; vuggy; possible *Virgiana* at 12.6 m in fossiliferous interval; also abundant corals.

M-31-91
3-3-19-1WPM
GROUND ELEVATION: 277.9 m

Metres	Description
0.0-3.0	Overburden
3.0-4.2	**Moose Lake Fm**: dolomite; buff; dense; porosity <3%; very broken and rubbly core.
4.2-4.7	**U1 Marker**: dark brown, slightly argillaceous dolomite (mudstone); with spheroidal imprints.
4.7-19.4	**Fisher Branch Fm**: buff yellow dolomite; fossiliferous; abundant coral debris (*Paleofavositids*); fine to medium crystalline; very fossiliferous coquina bed at 15.8 m to base; no well developed *Virgiana*; gradational lower contact.
19.4-20.5	**Upper Stonewall Fm** 19.4-20.2: **Stonewall Marker**; olive brown, sublithographic, slight argillaceous dolomite; massive and dense; faintly mottled; grades to... 20.2-20.5: red argillaceous dolomite (mudstone) with spheroidal imprints.

M-32-91
7-3-19-1WPM
GROUND ELEVATION: 278.5 m

Metres	Description
0.0-17.3	**Fisher Branch Fm**: dolomite; buff; fossiliferous; good moldic porosity at 12.7 m to base; *Virgiana* at 15.7 m.
17.3-21.2	**Upper Stonewall Fm** 17.3-18.5: **Stonewall Marker**: olive green argillaceous dolomite (mudstone) with well developed red colouration; containing spheroidal imprints. 18.5-21.2: olive grey to buff dolomite; dense and massive.

M-33-91
4-21-19-1WPM
GROUND ELEVATION: 273.7 m

This hole was abandoned due to drilling problems and does not contain enough core and marker beds to place it in its stratigraphic sequence.