

Table 1. A generalized correlation of Devonian through Cambrian formations between selected South Dakota, Iowa, and Nebraska test holes

Core hole	SDGS R20-2002-01	Sioux Valley No. 1 Lafleur	Doerr No. 1 Boler ¹	Camp Quest Core ²	
Nearest town	Elk Point, SD	Richland, SD	Dakota County, NE	LeMars, IA	
Legal location	NW¼ NW¼ NW¼ NE¼ sec. 13, T. 90 N., R. 50 W.	SW¼ NE¼ NW¼ SW¼ sec. 18, T. 80 N., R. 48 W.	SE¼ NE¼ sec. 11, T. 28 N., R. 7 E.	SW¼ sec. 2, T. 92 N., R. 45 W.	
Devonian strata	Present, but unknown formation. Mainly gray to tan, vuggy dolostone and limestone, ~ 35.5 feet thick	Possibly present up to 120 feet thick (M. Carlson, unpublished lithologic log)	Present, unknown formation underlying Mississippian strata. Mainly tan to gray dolostone, ~ 170 feet thick	Not present	
Ordovician strata:					
a) Galena Group: Wise Lake Fm Dunleith Fm Decorah Shale	a) Wise Lake Fm (27.5 ft), Dunleith Fm (57.7 ft), and Decorah Shale (112 ft) are all present	a,b,c) Upper dolostone (~155 ft), Decorah Shale, Platteville and Glenwood Formations (together ~100 ft)	a) Upper dolostone (185 ft) and underlying Decorah Shale (probably includes the Platteville and Glenwood Formations (149 ft)	a) Dunleith Formation (29 ft) and Decorah Shale (95 ft)	
b) Platteville Fm	b) ~ 17 feet thick		b) not identified	b) ~ 26 feet thick	
c) Glenwood Fm	c) ~ 12 feet thick		c) not identified	c) ~ 28 feet thick	
d) St. Peter Sandstone	d) ~ 28 feet thick		d) ~ 40 feet thick	d) ~ 36 feet	d) ~ 36 feet thick
e) Other formations	e) none present		e) none present	e) Arbuckle Formation	e) none present
Cambrian strata:					
a) St. Lawrence Fm	a) not present	a) not present?	Not intersected, hole terminated in Arbuckle Formation	a) ~ 43 feet thick	
b) Lone Rock/Davis Fm	b) Davis Formation (53 ft)	b) Davis Formation (95 ft)		b,c) Lone Rock (and Wonewoc?) Formation (145 ft)	
c) Wonewoc Sandstone	c) ~ 47 feet thick	c) ~ 64 feet thick		d) ~ 50 feet thick	
d) Eau Claire Fm	d) ~ 23 feet thick (?)	d, e) ~ 43 feet thick		e) not present	
e) Bonneterrre Fm	e) ~ 58 feet thick			f) ~ 42 feet thick	
f) Mt. Simon Sandstone	f) ~ 9 feet thick	f) ~ 8 feet thick			

¹ Lithologic log provided by the Nebraska Conservation and Survey Division, School of Natural Resources, University of Nebraska-Lincoln.

² Lithologic log provided by the Iowa Geological Survey, Iowa Department of Natural Resources.

Table 2. Results from biostratigraphic analyses of trilobite and brachiopod fragments in Cambrian strata

Sample ¹	Hand sample description	Identification ²	Faunal zone/Stage
R20-2002-01-706	Trilobite fragment in shale	Piece of a pygidium; <i>Dikelocephalus</i> cf. <i>D. minnesotensis</i> Owen	<i>Dikelocephalus</i> Zone of the upper Sunwaptan Stage
R20-2002-01-719	Trilobite fragment in shale	Indeterminate trilobite thoracic segment	
R20-2002-01-725	Trilobite fragment in shale	Piece of a pygidium; Dikelcephalid; genus and species indeterminate, but not <i>Dikelocephalus</i>	Probably still in the upper part of the Sunwaptan Stage
R20-2002-01-741	Trilobite fragment in shale	Cranidium; <i>Wilbernia</i> cf. <i>W. pero</i> (Walcott)	Widespread genus in the middle Sunwaptan Stage
R20-2002-01-742	Trilobite fragment in shale	Cranidium, deformed; <i>Wilbernia?</i> sp.	
R20-2002-01-745	Trilobite fragment in shale	Indeterminate trilobite free cheek	
R20-2002-01-816	Trilobite fragment in shale	Sedimentary artifact?	
R20-2002-01-820	Possible acrotretid brachiopod	Piece containing pedicle valve of an acrotretid brachiopod; not stratigraphically distinctive	
R20-2002-01-821	Possible acrotretid brachiopod	Piece containing pedicle valve of an acrotretid brachiopod; not stratigraphically distinctive	
R20-2002-01-822a, b, c	Trilobites in dolostone/grainstone	Cranidia; <i>Aphelaspis</i> sp.	Early Steptoean. The Sauk II/III boundary occurs uphole

¹ The sample identification consists of two, and in one case, three parts. The first part, R20-2002-01, is a unique identifier for the test hole from which the samples were collected and is the same for all entries in this table. The second part (i.e., 706 or 820) indicates the depth below land surface from which the sample was collected. The third part pertains only to the last entry in the table (a, b, c) and indicates that three samples were collected from the same depth of 822 feet

² The analyses were carried out by A.R. Palmer, Institute for Cambrian Studies, Boulder, Colorado

Table 3. Oxide and element geochemistry of the Precambrian metagabbro intersected in test hole R20-2002-01

Oxide ¹ (wt. %)	R20-2002-01 919 ft	R20-2002-01 940 ft	R20-2002-01 947 ft	Element (continued)	R20-2002-01 919 ft	R20-2002-01 940 ft	R20-2002-01 947 ft
Al₂O₃	12.52	11.5	11.37	In (ppm)	0.21	0.16	0.175
BaO	0.06	0.08	0.08	K (%)	1.01	1.29	1.31
CaO	7.75	8.12	8.45	La (ppm)	37	43.5	38.5
Cr₂O₃	<0.01	<0.01	<0.01	Li (ppm)	19.4	21.8	23.2
Fe₂O₃²	17.01	19.24	19.47	Mg (%)	1.96	2.19	2.39
K₂O	1.33	1.65	1.63	Mn (ppm)	1745	2030	2100
MgO	3.7	4.02	4.35	Mo (ppm)	2.95	1.35	2.35
MnO	0.25	0.28	0.29	Na (%)	1.98	1.65	1.61
Na₂O	2.6	2.08	1.92	Nb (ppm)	7.8	3.2	1.6
P₂O₅	1.24	1.45	1.95	Ni (ppm)	13.2	12	11.4
SiO₂	47.12	45.24	43.62	P (ppm)	4700	4980	5180
SrO	0.03	0.03	0.02	Pb (ppm)	10.5	9	8.5
TiO₂	3.02	3.4	3.61	Rb (ppm)	31.2	45.3	48
LOI	1.08	0.56	0.83	Re (ppm)	0.002	0.002	<0.002
TOTAL	97.71	97.65	97.59	S (%)	0.59	0.25	0.3
Element¹				Sb (ppm)	0.8	0.6	0.4
Ag (ppm ³)	0.08	0.02	0.06	Se (ppm)	1	1	1
Al (%)	6.39	5.85	5.84	Sn (ppm)	1.8	1.8	1.6
As (ppm)	2	1.8	1.2	Sr (ppm)	277	221	212
Ba (ppm)	500.7	734.4	736.4	Ta (ppm)	0.4	0.2	0.1
Be (ppm)	1.7	1.75	1.65	Te (ppm)	<0.05	<0.05	<0.05
Bi (ppm)	0.08	0.08	0.08	Th (ppm)	4	4.2	3.4
Ca (%)	4.7	5.1	5.2	Ti (%)	1.74	1.83	1.8
Cd (ppm)	0.26	0.24	0.28	Tl (ppm)	0.3	0.34	0.36
Ce (ppm)	86.1	98.4	90.1	U (ppm)	1.6	1.3	1.3
Co (ppm)	35.9	39.8	42.4	V (ppm)	136	144	158
Cr (ppm)	37	37	25	W (ppm)	0.6	0.4	0.3
Cs (ppm)	2.9	4.1	4	Y (ppm)	54.4	58.2	56.6
Cu (ppm)	56	29	37	Zn (ppm)	158	200	222
Fe (%)	10.25	11.85	12.05	Zr (ppm)	145	44.5	24
Ga (ppm)	24.7	25.75	25.6	Au (ppb ⁴)	4	<2	<2
Ge (ppm)	0.1	0.15	0.15	Pt (ppb)	25	35	40
Hf (ppm)	3.3	0.7	0.3	Pd (ppb)	<2	<2	<2

¹ Analyses were carried out at ALS Chemex Labs, Vancouver, British Columbia, Canada, using ME-ICP06 analytical package for oxide analyses, ME-MS61 analytical package for trace element analyses, and PGM-MS23 for PtPdAu trace level analyses. Analyses are courtesy of WMC Exploration Inc., Denver, Colorado

² All iron as Fe₂O₃

³ Parts per million

⁴ Parts per billion

Table 4. CIPW normative mineral calculations using a Fe₂O₃/FeO ratio of 0.2

Normative Minerals^{1,2}	CIPW³ norm for sample R20-2002-01, 919-foot depth (wt. %)	CIPW norm for sample R20-2002-01, 940-foot depth (wt. %)	CIPW norm for sample R20-2002-01, 947-foot depth (wt. %)
Quartz	3.01	1.67	0.57
Feldspar:	50.87	46.06	45.71
Orthoclase	8.27	10.26	10.15
Albite	23.11	18.49	17.08
Anorthite	19.49	17.31	18.48
Diopside:	11.23	13.64	11.48
Wollastonite	5.55	6.73	5.68
Enstatite	1.99	2.36	2.09
Ferrosilite	3.69	4.55	3.71
Hypersthene:	22.05	24.05	26.01
Enstatite	7.73	8.21	9.36
Ferrosilite	14.32	15.84	16.65
Olivine	0.00	0.00	0.00
Magnetite	3.95	4.47	4.53
Hematite	0.00	0.00	0.00
Ilmenite	6.03	6.79	7.22
Apatite	2.85	3.33	4.48
Total	100.00	100.00	100.00

¹ Middlemost (1989)

² Calculations made using Minpet software; calculations are courtesy of S. Treves, Department of Geosciences, University of Nebraska–Lincoln

³ Cross-Iddings-Pirsson-Washington method of normative mineral calculation

Table 5. Water quality of two Union County aquifers and two water samples from test hole R20-2002-01

Parameter	Missouri aquifer ¹	Dakota Formation aquifer ¹	R20-2002-01 dolostone (446 ft)	R20-2002-01 sandstone (760 ft)	South Dakota drinking water standard ²
Common Inorganics³					
Alkalinity	375	240	151	161	
Ammonia	0.58	---	0.46	0.22	
Calcium	126	105	207	244	
Chloride	7	21	46	60	
Fluoride	0.31	1.58	2.26	2.71	4.0
Iron	4.3	3.43	0.27	0.79	
Magnesium	34.8	35	38.3	42.4	
Manganese	2.87	0.1	0.14	0.10	
Nitrate + Nitrite	< 0.1	< 0.05	< 0.1	< 0.1	10
Conductivity (µmho/cm) ⁵	933	1220	1690	1740	
pH (pH units)	7.21	---	7.62	7.41	
Potassium	5.9	19	22.5	23.2	
Sodium	16.3	109	87.9	94.5	
Dissolved Solids	616	838	1260	1353	
Sulfate	141	373	685	709	
Bicarbonate	458	292	184	196	
Carbonate	0	---	0	0	
Hardness	458	405	674.5	783	
Hardness (grains/gal)	26.6	23.5	39.1	45.4	
Trace Metals⁶					
Antimony	< 0.2	---	---	< 0.4	6
Arsenic (mg/L)	12.8	---	---	< 0.001	50
Barium	166	---	---	12.0	2000
Beryllium	< 0.2	---	---	< 0.4	4
Cadmium	< 0.2	---	---	< 0.2	5
Chromium	15.7	---	---	< 0.2	100
Copper	< 0.3	---	---	0.7	160
Lead	< 0.1	---	---	< 0.1	1
Mercury	< 0.2	---	---	< 0.1	2
Nickel	4.5	---	---	4.9	
Selenium	< 0.5	---	---	1.8	50
Thallium	< 0.1	---	---	< 0.1	2
Cyanide (mg/L)	< 0.010	---	---	< 0.010	0.2
Radionuclides⁷					
Gross-alpha (pCi/L)	< 0.3	---	---	16 ± 4.8	15
Radium 226 (pCi/L)	---	---	---	4.1 ± 0.7	
Radium 228 (pCi/L)	---	---	---	4.8 ± 0.5	
Uranium (ug/L)	---	---	---	0.6	

¹ Selected representative analyses

² Found at <http://legis.state.sd.us/rules/rules/7404.htm#74:04:05>

³ All common inorganics reported in mg/L (milligrams per liter) unless otherwise indicated

⁴ Not analyzed

⁵ µmho/cm = micromhos per centimeter

⁶ All trace metals reported in ug/L (micrograms per liter) unless otherwise noted

⁷ Values are reported as indicated in either pCi/L (picocuries per liter) or ug/L