Data in Support of *Diagenetic controls on location of reservoir sweet spots relative to paleotopographic and structural highs*

Poteet, Jessica E., Robert H. Goldstein, and Evan K. Franseen

Extracted from:

Poteet, J. E. 2007. Porosity and permeability evolution of the Raytown Limestone oolite, central Kansas: M.S. Thesis, University of Kansas, Lawrence, Kansas, 199 p.

POROSITY AND PERMEABILITY DATA

FROM CORE PLUGS

Porosity and Permeability Data measured from Core Plugs
measured by Alan Byrnes, Kansas Geological Survey

Core Name	Depth	Poro. (%)	Perm. (md)
Carter-Colliver	2955	21.1	13.22
	2956	20.0	26.83
	2957	15.7	3.04
	2958	5.6	0.07
	2959	13.1	0.69
	2960	21.0	42.62
	2961	14.2	29.59
	2962	11.5	10.47
	2963	17.2	0.47
	2964	20.3	55.82
	2965	18.2	24.36
	2966	21.5	56.6
	2967	19.8	7.37
	2968	22.1	25.96
	2969	20.8	297.55
	2970	20.9	8.6
	2971	22.8	223.45
	2972	20.9	10.86
	2973	22.3	5.36
	2974	16.6	2.51
	2975	13.6	3.23
	2976	18.4	19.99
Average		**18.1**	**39.48**
Drews A-1	3131.3	10.8	0.02
	3134	11.5	0.04
	3135	14.2	0.08
	3135.1	14.7	0.01
	3147	20.1	0.01
	3147.3	16.9	0.11
	3147.5	21.4	0.96
Average		**15.7**	**0.18**

Core Name	Depth	Poro. (%)	Perm. (md)
H. Rader #1	3172	27.2	4.78
	3173	30.0	0.72
	3176.5	17.9	0.04
	3177	19.3	0.02
Average		**23.6**	**1.39**
Hafferman #1	2955.5	29.9	39.25
	2955.5	30.5	20.28
	2955.6	32.6	16.12
	2958.2	25.8	24.99
	2958.9	28.5	2.25
	2958.9	27.7	4.82
	2961.2	23.8	4.65
Average		**28.4**	**16.05**
Michaelis #1	3165	19.7	0.16
	3165.6	18.0	0.07
	3166	21.6	0.32
	3167	18.2	0.08
	3168	15.6	0.07
Average		**18.6**	**0.14**
Rader #2	3112.3	28.7	2.76
	3112.6	21.4	21.77
	3113	20.8	15.39
Average		**23.7**	**13.31**
(E.E.) Tobias ;	2965	26.3	10.24
	2966	27.8	28.40
Average		**27.1**	**19.32**

POROSITY OCCLUSION DATA – COMBINING CORE PLUG MEASUREMENTS AND THIN SECTION ESTIMATION

Explanation of Data Given:

- Each spreadsheet gives the percent porosity occluded by each cement found at that specific depth, as well as the remaining extant porosity.
- Only data from the oolitic grainstone facies was used in determining averages of porosity occlusion by cement for the porosity evolution model (Figure 5-2).
- Extant porosity was measured from core plugs extracted from oolitic grainstone intervals of the core by Alan Byrnes of the KGS.
- Extant porosity of the oolitic packstone intervals and the oolitic grainstone intervals that do not have core plug data was visually estimated from thin sections, using Terry and Chilingar (1955). These values are italicized in the extant porosity rows of the spreadsheets.
- All data of porosity occlusion percentages for each cement was visually estimated from thin section analyses.
- Total porosity occlusion averages for the early cements (Events 3-8) were calculated for the total porosity occluded for the entire well. Therefore, these averages were calculated separately, since early cements were not found within an entire well.
- Total porosity occlusion averages for late cements (Events 9-29) from the Carter-Colliver CO_2 Injection Core were calculated only from depths where early cements were not present, to make data from other wells comparable.

- Key to Abbreviations:
    - MC – Meniscus Cement (Event ¾)
    - SED – Micritic Cement/Sediment (Event ¾)
    - SL1 – Cement SL1 (Event 5)
    - NL1 – Cement NL1 (Event 6)
    - YC – Yellow Cement (Event 7)
    - BL1 – Cement BL1 (Event 8)
    - SL2 – Cement SL2 (Event 11/12)
    - NL2 – Cement NL2 (Event 14)
    - ICRD – Intracrystalline Rhombic Dolomite (Event 15)
    - ML1 – Cement ML1 (Event 18)
    - E24 – Late Calcite Cements NL3, SL3, NL4, BL2, DB1 (Event 24)
    - Bdolo – Baroque Dolomite (Event 25/26)
    - Qtz – Mega-quartz (Event 25/26)
    - ExP – Extant Porosity

Calculation of % occlusion by early cements for western wells:
* from the Carter-Colliver CO2 Injection Core data

Within 2.0 feet, there is an average of 47% porosity occlusion by early cements.
15.6 (MC) + 12.8 (SED) + 4.2 (SL1) + 6.0 (NL1) + 1.4 (YC) + 6.0 (BL1)
equals 46% (Early Cements total) occlusion
Total footage for the well is 22 feet.
Therefore, early cements occlude only 4.7% of this 22 feet.
(46% occlusion * 2.0 ft.) / 22 ft total = 4.7% occlusion)

Calculation of % occlusion by early cements for eastern wells:
* from the E.E. Tobias #1 core data

Within 0.3 feet, there is an average of 9% porosity occlusion by early cements.
12% @ 2965 ft. + 6% @ 2965.3 ft = 9% within 0.3 ft.
Total footage for the well is 3.2 feet.
Therefore, early cements occlude only 0.84% of this 3.2 feet.
(9% occlusion * 0.3 ft.) / 3.2 ft total = 0.84% occlusion)

Porosity Data for Percent Cement Occlusion:

Well: Carter-Colliver CO2 Injection Core

*this data was used to make Figure 2-11

Oolitic Grainstone Data:

Depth (ft)	2955	2955.25	2955.5	2955.75	2956.8	2957	2958	2959	2960	2961	2962	2963	2964	2965
Cements:														
MC	20	23	20	15	0	0	0	0	0	0	0	0	0	0
SED	15	12	24	13	0	0	0	0	0	0	0	0	0	0
SL1	7	7	4	3	0	0	0	0	0	0	0	0	0	0
NL1	10	10	5	5	0	0	0	0	0	0	0	0	0	0
YC	5	0	2	0	0	0	0	0	0	0	0	0	0	0
BL1	5	7	5	8	5	0	0	0	0	0	0	0	0	0
SL2	0	0	0	5	10	17	15	15	15	20	20	15	10	20
NL2	5	5	10	10	15	5	10	12	17	15	18	25	22	26
ICRD	0	0	0	0	0	2	0	3	1	1	1	1	3	5
ML1	0	3	0	5	5	5	5	5	8	10	7	2	0	9
E24	25	27	15	15	45	50	60	47	35	40	40	30	25	20
Bdolo	0	0	0	0	0	0	0	0	3	0	2	10	10	0
Qtz	5	2	5	0	0	5	4	5	0	0	0	0	10	2
ExP	3	*4*	*10*	*21*	*20*	16	6	13	21	14	12	17	20	18

Well: Carter-Colliver CO2 Injection Core

Oolitic Grainstone Data cont:

Depth (ft)	2966	2967	2968	2969	2970	2971	2972	2973	2974	2975	2976
Cements:											
MC	0	0	0	0	0	0	0	0	0	0	0
SED	0	0	0	0	0	0	0	0	0	0	0
SL1	0	0	0	0	0	0	0	0	0	0	0
NL1	0	0	0	0	0	0	0	0	0	0	0
YC	0	0	0	0	0	0	0	0	0	0	0
BL1	0	0	0	0	0	0	0	0	0	0	0
SL2	18	18	25	25	25	25	25	25	25	30	25
NL2	25	25	25	25	21	20	20	20	26	26	20
ICRD	5	5	5	0	0	0	2	0	3	5	0
ML1	5	2	1	4	0	4	8	5	4	0	2
E24	20	20	20	25	25	15	24	24	25	25	25
Bdolo	0	3	0	0	8	5	0	5	0	0	5
Qtz	5	7	2	0	0	10	0	0	0	0	5
ExP	22	20	22	21	21	21	21	21	17	14	18

Fossiliferous Ooltic Packstone Data

Depth:	2959.8	2963.25
Cements:		
Dep Mud	10	10
SL2	15	15
NL2	15	22
ICRD	1	1
ML1	10	5
E24	35	30
Bdolo	3	10
Qtz	0	0
ExP	*11*	*18*

Well: Drews A-1

Oolitic Grainstone Data:

Depth (ft)	3133	3134	3134.7	3135	3147.3	3147.7
Cements:						
MC	0	0	0	0	0	0
SED	0	0	0	0	0	0
SL1	0	0	0	0	0	0
NL1	0	0	0	0	0	0
YC	0	0	0	0	0	0
BL1	4	0	0	0	0	0
SL2	8	17	17	26	15	12
NL2	35	17	25	18	35	24
ICRD	2	0	1	5	0	0
ML1	5	6	2	0	0	2
E24	23	38	35	32	30	34
Bdolo	2	0	0	0	0	7
Qtz	10	10	5	5	3	0
ExP	11	12	15	14	17	21

Fossiliferous Oolitic Packstone Data

Depth:	3147.1	3156
Cements:		
Dep Mud	5	38
SL2	7	5
NL2	23	10
ICRD	3	0
ML1	2	0
E24	35	34
Bdolo	0	0
Qtz	5	0
ExP	20	13

Well: H. Rader #1

Oolitic Grainstone Data:

Depth (ft)	3172	3172.2	3173	3173	3173.5	3173.9	3175.2	3177
Cements:								
MC	0	0	0	0	0	0	0	0
SED	0	0	0	0	0	0	0	0
SL1	0	0	0	0	0	0	0	0
NL1	0	0	0	0	0	0	0	0
YC	0	0	0	0	0	0	0	0
BL1	0	0	0	0	0	0	0	0
SL2	12	13	10	20	10	12	10	14
NL2	25	33	30	20	30	35	33	30
ICRD	0	0	2	0	0	0	0	0
ML1	2	0	1	0	4	0	2	0
E24	30	18	20	20	30	25	36	18
Bdolo	4	11	9	10	4	3	0	8
Qtz	0	0	0	0	0	0	0	10
ExP	*27*	*25*	*28*	30	*22*	*25*	*20*	20

Fossiliferous Oolitic Packstone Data

Depth:	3173.2	3176.5
Cements:		
Dep Mud	10	15
SL2	10	10
NL2	20	5
ICRD	0	0
ML1	4	2
E24	40	30
Bdolo	10	20
Qtz	0	0
ExP	*6*	*18*

Well: Michaelis #1

Oolitic Grainstone Data:

Depth (ft)	3165	3165.6	3166	3166.3	3167	3168
Cements:						
MC	0	0	0	0	0	0
SED	0	0	0	0	0	0
SL1	0	0	0	0	0	0
NL1	0	0	0	0	0	0
YC	0	0	0	0	0	0
BL1	0	0	0	0	0	0
SL2	21	25	13	20	10	12
NL2	18	35	37	25	37	33
ICRD	0	0	0	0	0	0
ML1	1	2	2	2	0	0
E24	37	20	23	25	28	36
Bdolo	3	0	3	5	7	3
Qtz	0	0	0	0	0	0
ExP	20	18	22	23	18	16

Well: Rader #2

Oolitic Grainstone Data:

Depth (ft)	3112.3	3112.4	3113	3113.5
Cements:				
MC	0	0	0	0
SED	0	0	0	0
SL1	0	0	0	0
NL1	0	0	0	0
YC	0	0	0	0
BL1	0	0	0	0
SL2	15	12	12	15
NL2	30	35	40	30
ICRD	1	0	0	0
ML1	0	0	5	0
E24	25	28	22	35
Bdolo	0	0	0	0
Qtz	0	4	0	3
ExP	29	21	21	17

Fossiliferous Oolitic Packstone Data

Depth:	3112	3115.5
Cements:		
Dep Mud	5	17
SL2	20	20
NL2	15	15
ICRD	3	0
ML1	7	5
E24	40	35
Bdolo	0	0
Qtz	3	0
ExP	7	8

Well: Hafferman #1

Oolitic Grainstone Data:

Depth (ft)	2955	2955.5	2955.5	2955.6	2955.9	2958	2958.2	2958.9	2958.9	2961.2
Cements:										
MC	0	0	0	0	0	0	0	0	0	0
SED	0	0	0	0	0	0	0	0	0	0
SL1	0	0	0	0	0	0	0	0	0	0
NL1	0	0	0	0	0	0	0	0	0	0
YC	0	0	0	0	0	0	0	0	0	0
BL1	0	0	0	0	0	0	0	0	0	0
SL2	22	14	15	16	27	25	25	25	27	24
NL2	17	20	33	28	24	23	25	19	20	33
ICRD	2	1	0	0	1	0	1	0	0	0
ML1	2	4	7	6	4	2	3	5	5	5
E24	20	25	15	17	11	15	20	17	11	10
Bdolo	3	5	0	0	0	6	0	4	9	4
Qtz	0	0	0	0	7	0	0	1	0	0
ExP	*34*	31	30	33	*26*	*29*	26	29	28	24

Well: E. E. Tobias #1

Oolitic Grainstone Data:

Depth (ft)	2965	2965.3	2966	2966.1	2968	2968.2
Cements:						
MC	5	3	0	0	0	0
SED	0	0	0	0	0	0
SL1	0	0	0	0	0	0
NL1	0	0	0	0	0	0
YC	0	0	0	0	0	0
BL1	7	3	0	0	0	0
SL2	19	17	15	20	29	18
NL2	23	22	30	20	23	30
ICRD	0	0	1	0	2	0
ML1	4	2	3	0	1	0
E24	12	21	15	20	15	11
Bdolo	4	3	8	5	0	2
Qtz	0	2	0	5	0	7
ExP	26	27	28	30	30	32

***Averages from each core for each cement used in the back-calculations presented in the porosity evolution section.*

Western Wells	Carter-Colliver	Drews A-1	H. Rader #1	Michaelis #1	Rader #2	**Average %**
Cements:						
Early Cements	4.7	n/a	n/a	n/a	n/a	**4.7**
SL2	20.8	15.8	12.6	16.8	13.5	**15.9**
NL2	20.2	25.7	29.5	30.8	33.6	**28.0**
Event 24 Cements	29.8	32.0	24.6	28.1	27.5	**28.4**
Extant Porosity	18.0	15.0	25.0	19.5	22.0	**19.9**

Eastern Wells	Hafferman #1	E.E. Tobias #1	**Average %**
Cements:			
Early Cements	n/a	0.8	**0.8**
SL2	20.8	19.7	**20.3**
NL2	24.2	24.7	**24.5**
Event 24 Cements	16.1	15.7	**15.9**
Extant Porosity	29.0	28.8	**28.9**

STABLE ISOTOPE DATA

Stable Isotope Data - continued

Cement Sample	Core	Depth	$\delta^{18}O$ (VPDB)	$\delta^{13}C$ (VPDB)	$\delta^{18}O$ Std. Dev.	$\delta^{13}C$ Std. Dev.
Early Cements (Events 2-7)	Carter-Colliver	2955	-4.64	-0.678	0.049	0.036
Early Cements (Events 2-7)	Carter-Colliver	2955	-3.609	-2.388	0.052	0.025
Early Cements (Events 2-7)	Carter-Colliver	2955	-5.706	-1.442	0.055	0.071
Early Cements (Events 2-7)	Carter-Colliver	2955	-4.817	-1.551	0.051	0.015
Early Cements (Events 2-7)	Carter-Colliver	2955	-4.466	-1.057	0.061	0.036
Early Cements (Events 2-7)	Carter-Colliver	2955	-3.824	-1.56	0.04	0.024
Early Cements (Events 2-7)	Carter-Colliver	2955	-4.551	-0.821	0.041	0.025
Early Cements (Events 2-7)	Carter-Colliver	2955.25	-6.048	1.641	0.019	0.032
Early Cements (Events 2-7)	Carter-Colliver	2955.25	-5.858	0.867	0.019	0.021
Early Cements (Events 2-7)	Carter-Colliver	2955.25	-5.051	-0.643	0.077	0.04
Early Cements (Events 2-7)	Carter-Colliver	2955.25	-5.658	1.263	0.044	0.031
Early Cements (Events 2-7)	Carter-Colliver	2955.25	-4.813	-1.95	0.026	0.02
Cement SL2 (Event 11/12)	Hafferman	2961.2	-6.054	5.137	0.039	0.018
Cement SL2 (Event 11/12)	Rader #2	3112.3	-5.413	4.179	0.03	0.018
Cement SL2 (Event 11/12)	Rader #2	3112.4	-6.091	3.715	0.04	0.007
Cement SL2 (Event 11/12)	E.E. Tobias	2965	-5.788	4.572	0.059	0.023
Cement SL2 (Event 11/12)	E.E. Tobias	2965	-6.107	4.536	0.029	0.025
Cement NL2 (Event 14)	Hafferman	2961.2	-5.409	5.196	0.017	0.03
Cement NL2 (Event 14)	Rader #2	3112.3	-4.75	5.431	0.07	0.031
Cement NL2 (Event 14)	Rader #2	3112.3	-4.328	5.74	0.017	0.016
Cement NL2 (Event 14)	Rader #2	3112.3	-4.715	5.649	0.053	0.027
Cement NL2 (Event 14)	Rader #2	3112.3	-3.965	4.601	0.018	0.028
Cement NL2 (Event 14)	Rader #2	3112.4	-4.745	5.138	0.038	0.039
Cement NL2 (Event 14)	Rader #2	3112.4	-4.823	4.836	0.053	0.028
Cement NL2 (Event 14)	Rader #2	3112.4	-5.641	4.233	0.057	0.043
Cement NL2 (Event 14)	Rader #2	3112.4	-4.888	5.362	0.047	0.028
Cement ML1 (Event 18)	Rader #2	3112.3	-5.316	4.747	0.043	0.02

Stable Isotope Data - continued

Cement Sample	Core	Depth	$\delta^{18}O$ (VPDB)	$\delta^{13}C$ (VPDB)	$\delta^{18}O$ Std. Dev.	$\delta^{13}C$ Std. Dev.
Late Calcite Cements (Event 24)	Carter-Colliver	2955	-7.074	0.478	0.02	0.029
Late Calcite Cements (Event 24)	Carter-Colliver	2955	-5.699	-0.559	0.029	0.016
Late Calcite Cements (Event 24)	Carter-Colliver	2955	-7.479	1.136	0.03	0.019
Late Calcite Cements (Event 24)	Carter-Colliver	2955	-7.199	0.369	0.02	0.014
Late Calcite Cements (Event 24)	Carter-Colliver	2955	-7.717	0.735	0.054	0.031
Late Calcite Cements (Event 24)	Carter-Colliver	2955.25	-2.949	6.52	0.083	0.27
Late Calcite Cements (Event 24)	Carter-Colliver	2955.25	-6.789	3.58	0.034	0.009
Late Calcite Cements (Event 24)	Carter-Colliver	2958	-5.538	3.562	0.016	0.024
Late Calcite Cements (Event 24)	Carter-Colliver	2958	-5.779	3.464	0.034	0.018
Late Calcite Cements (Event 24)	Carter-Colliver	2958	-5.665	3.446	0.018	0.014
Late Calcite Cements (Event 24)	Drews A-1	3156	-4.538	3.118	0.015	0.041
Late Calcite Cements (Event 24)	Drews A-1	3156	-8.087	1.306	0.015	0.031
Late Calcite Cements (Event 24)	Drews A-1	3156	-4.56	3.26	0.057	0.045
Late Calcite Cements (Event 24)	Drews A-1	3156	-4.598	2.827	0.016	0.045
Late Calcite Cements (Event 24)	Drews A-1	3156	-5.2	3.873	0.009	0.02
Late Calcite Cements (Event 24)	Drews A-1	3156	-4.06	4.877	0.025	0.05
Late Calcite Cements (Event 24)	Drews A-1	3156	-6.481	3.679	0.038	0.016
Late Calcite Cements (Event 24)	Drews A-1	3156	-6.626	3.445	0.038	0.048
Late Calcite Cements (Event 24)	Drews A-1	3156	-6.556	3.312	0.059	0.03
Late Calcite Cements (Event 24)	Drews A-1	3156	-5.955	3.242	0.037	0.039
Late Calcite Cements (Event 24)	Drews A-1	3156	-7.182	3.958	0.037	0.058
Late Calcite Cements (Event 24)	Drews A-1	3156	-5.935	3.135	0.057	0.036
Late Calcite Cements (Event 24)	Drews A-1	3156	-6.443	3.356	0.039	0.038
Late Calcite Cements (Event 24)	H. Rader #1	3173.2	-7.423	2.371	0.014	0.053
Late Calcite Cements (Event 24)	H. Rader #1	3173.2	-8.435	2.468	0.068	0.038
Late Calcite Cements (Event 24)	H. Rader #1	3173.2	-7.32	2.136	0.032	0.037
Late Calcite Cements (Event 24)	Rader #2	3112.3	-8.047	3.778	0.038	0.044
Late Calcite Cements (Event 24)	Rader #2	3112.3	-4.331	5.276	0.007	0.015
Late Calcite Cements (Event 24)	Rader #2	3112.3	-4.408	5.128	0.026	0.031
Late Calcite Cements (Event 24)	Rader #2	3112.4	-7.937	2.192	0.007	0.052

Stable Isotope Data - continued

Cement Sample	Core	Depth	$\delta^{18}O$ (VPDB)	$\delta^{13}C$ (VPDB)	$\delta^{18}O$ Std. Dev.	$\delta^{13}C$ Std. Dev.
Dolomite (Event 25/26)	Drews A-1	3147	-5.807	3.623	0.05	0.009
Dolomite (Event 25/26)	Drews A-1	3156	-2.619	5.527	0.009	0.019
Dolomite (Event 25/26)	Hafferman	2961.2	-7.224	4.174	0.065	0.056
Dolomite (Event 25/26)	Hafferman	2961.2	-6.927	3.614	0.069	0.04
Dolomite (Event 25/26)	Hafferman	2961.2	-7.071	4.351	0.028	0.018
Dolomite (Event 25/26)	Hafferman	2961.2	-5.571	4.335	0.036	0.026
Dolomite (Event 25/26)	H. Rader #1	3172.2	-6.148	2.796	0.026	0.017
Crinoid	Drews A-1	3156	-6.924	4.969	0.008	0.033
Crinoid	Drews A-1	3156	-7.212	4.898	0.07	0.044
Micrititized Crinoid	Carter-Colliver	2956.4	-4.964	3.981	0.024	0.012
Micrititized Crinoid	Drews A-1	3147.1	-5.157	4.594	0.025	0.026
Micrititized Crinoid	Drews A-1	3147.1	-6.597	3.681	0.045	0.029
Micrititized Crinoid	H. Rader #1	3172.2	-6.675	2.466	0.037	0.017
Micrititized Crinoid	Rader #2	3112.4	-5.771	4.425	0.065	0.042
Micrititized Crinoid	E.E. Tobias	2965	-6.401	4.302	0.029	0.019
Micritized Ooid	H. Rader #1	3173.2	-7.753	1.919	0.05	0.013
Neomorphosed Ooid	Carter-Colliver	2955	-5.445	-0.454	0.067	0.04
Neomorphosed Ooid	Carter-Colliver	2956.4	-4.443	4.547	0.037	0.018
Neomorphosed Ooid	H. Rader #1	3175.2	-6.962	1.185	0.039	0.058
Neomorphosed Ooid	Rader #2	3112.4	-5.401	4.113	0.061	0.037
Depositional Micrite	Carter-Colliver	2955.25	-6.26	0.844	0.042	0.049
Depositional Micrite	Drews A-1	3156	-5.723	4.454	0.079	0.05
Depositional Micrite	Drews A-1	3156	-5.454	4.614	0.045	0.046
Depositional Micrite	H. Rader #1	3173.2	-5.738	1.869	0.018	0.054
Depositional Micrite	H. Rader #1	3173.2	-6.393	1.692	0.067	0.055
Depositional Micrite	H. Rader #1	3173.2	-5.773	2.069	0.035	0.026
Depositional Micrite	H. Rader #1	3175.2	-6.391	1.229	0.068	0.03
Depositional Micrite	H. Rader #1	3175.2	-6.116	1.391	0.039	0.065

FLUID INCLUSION DATA

Key to the abbreviations used in the headings of the following spreadsheets:

- **FIA**: Fluid Inclusion Assemblage (numbered according to well and depth)
  - Example – Rader #2 well at depth 3112.4 feet had three separate FIAs measured (FIA1, FIA2, and FIA3).

- **Th min (˚C)**: The minimum homogenization temperature
- **Th max (˚C)**: The maximum homogenization temperature, if a range of temperatures was measured.
- **Te (-˚C)**: The eutectic temperature
- **Tm final (-˚C)**: The final melting temperature of ice

Fluid Inclusion Data

Cement SL2 (Event 11/12)

Well	Depth (ft.)	FIA	Th min (˚C)	Th max (˚C)	Te (-˚C)	Tm final (-˚C)
Rader #2	3112.4	FIA 1	51.0	52.0	54/40/28	13.5
Rader #2	3112.4	FIA 1	49.0	51.0	-	14.5
Rader #2	3112.4	FIA 1	48.0	49.5	-	14.0
Rader #2	3112.4	FIA 1	43.0	45.0	54/40/28	16.0
Rader #2	3112.4	FIA 1	-	-	-	13.9
Rader #2	3112.4	FIA 1	-	-	-	12.6
Rader #2	3112.4	FIA 1	-	-	-	13.8
Rader #2	3112.4	FIA 2	47.0	49.0	-	-
Rader #2	3112.4	FIA 2	44.0	45.0	-	-
Rader #2	3112.4	FIA 3	50.0	51.0	-	14.0
Rader #2	3112.4	FIA 3	-	-	-	13.8
Rader #2	3112.4	FIA 3	-	-	-	14.2
Rader #2	3112.4	FIA 3	-	-	-	13.3
Rader #2	3112.4	FIA 3	-	-	-	12.9
Rader #2	3113.5	FIA 1	48.0	49.0	-	14.1

Fluid Inclusion Data - continued

Cement NL2 (Event 14)

Well	Depth (ft.)	FIA	Th min (˚C)	Th max (˚C)	Te (-˚C)	Tm final (-˚C)
Drews A-1	3147.7	FIA 1	59.9	61.4	-	17.0
Drews A-1	3147.7	FIA 1	58.0	61.4	-	-
Drews A-1	3147.7	FIA 1	57.0	60.1	-	19.3
Drews A-1	3147.7	FIA 2	55.0	57.0	-	-
Rader #2	3112.4	FIA 1	54.0	55.0	-	14.4
Rader #2	3112.4	FIA 1	56.0	57.0	52/40/26	12.9
Rader #2	3112.4	FIA 1	-	-	-	13.7
Rader #2	3112.4	FIA 1	-	-	-	14.0
Rader #2	3112.4	FIA 1	-	-	-	13.8
Rader #2	3112.4	FIA 1	-	-	-	6.9
Rader #2	3112.4	FIA 1	-	-	-	14.0

Fluid Inclusion Data - continued

Cements NL3, SL3, NL4, BL2, and DB1 (Event 24)

Well	Depth (ft.)	FIA	Th min (˚C)	Th max (˚C)	Te (˚C)	Tm final (-˚C)
Drews A-1	3147.7	FIA 1	75.1	78.9	-	-
Drews A-1	3147.7	FIA 1	98.0	100.0	-	-
Drews A-1	3147.7	FIA 1	100.0	102.0	-	-
Drews A-1	3147.7	FIA 1	-	-	-	17.1
Drews A-1	3147.7	FIA 1	-	-	-	17.2
Drews A-1	3147.7	FIA 1	-	-	-	16.2
Drews A-1	3147.7	FIA 2	85.0	88.0	-	17.4
Drews A-1	3147.7	FIA 2	78.0	79.0	-	11.3
Drews A-1	3147.7	FIA 2	65.0	68.0	-	-
Drews A-1	3147.7	FIA 3	97.5	99.1	-	-
Rader #2	3113.5	FIA 1	68.2	68.9	-	16.8

Fluid Inclusion Data - continued

Baroque Dolomite Cement (Event 25/26)

Well	Depth (ft.)	FIA	Th min (˚C)	Th max (˚C)	Te (˚C)	Tm final (-˚C)
Drews A-1	3147.7	FIA 1	108.0	110.0	-	20.1
Drews A-1	3147.7	FIA 1	129.0	130.0	-	22.9
H. Rader #1	3172.2	FIA 1	93.7	95.7	-	18.1
H. Rader #1	3172.2	FIA 1	100.0	102.0	-	-
H. Rader #1	3172.2	FIA 1	116.0	119.0	-	23.1
E.E. Tobias	2966	FIA 1	90.7	-	-	23.1
E.E. Tobias	2966	FIA 1	103.9	-	-	22.3
E.E. Tobias	2966	FIA 1	97.3	-	-	-
E.E. Tobias	2966	FIA 1	105.1	-	-	20.2
E.E. Tobias	2966	FIA 2	-	-	-	21.4
E.E. Tobias	2966	FIA 2	-	-	-	23.0
E.E. Tobias	2966	FIA 2	-	-	-	22.2
E.E. Tobias	2966	FIA 3	121.0	123.0	-	-
E.E. Tobias	2966	FIA 3	113.0	114.0	-	-
E.E. Tobias	2966	FIA 3	116.9	118.0	-	-
E.E. Tobias	2966	FIA 4	105.0	107.0	-	-
E.E. Tobias	2966	FIA 4	93.0	95.0	-	-
E.E. Tobias	2966	FIA 4	101.0	103.0	-	-

CALCULATIONS OF $\delta^{18}O$ (VSMOW)

This appendix includes all the data used to calculate the oxygen isotopic composition of the pore fluids from which the various calcite and dolomite phases precipitated. The calculations were carried out for calcite using the following equation (Friedman and O'Neal, 1977):

$$10^3 \ln \alpha = 2.78 * 10^6 T^{-2} + 2.89 \quad (\textbf{equation 1})$$

where ($10^3 \ln \alpha$) is approximately equal to ($\delta^{18}O_{calcite} - \delta^{18}O_{water}$) and T equals the temperature in Kelvins. By rearranging equation 1:

$$(\delta^{18}O_{calcite} - \delta^{18}O_{water}) = ((2.78 * 10^6) / T^2) + 2.89$$

$$- \delta^{18}O_{water} = ((2.78 * 10^6) / T^2) + 2.89 - \delta^{18}O_{calcite}$$

$$\delta^{18}O_{water} = ((2.78 * 10^6) / T^2) - 2.89 + \delta^{18}O_{calcite} \quad (\textbf{equation 2})$$

where $\delta^{18}O_{water}$ and $\delta^{18}O_{calcite}$ are in permil (‰) relative to CO_2 evolved from PDB. Lastly, the following equation was used to convert $\delta^{18}O_{water}$ (VPDB) to $\delta^{18}O_{water}$ (VSMOW):

$$\delta^{18}O_{water} (VSMOW) = 1.03092 * \delta^{18}O_{water} (VPDB) + 30.92 \quad (\textbf{equation 3})$$

For dolomite, these equations vary slightly, and the original publication of these equations can be found from Land (1985) and Anderson and Arthur (1983):

$$10^3 \ln \alpha = 2.78 * 10^6 T^{-2} + 0.91 \quad (\textbf{equation 1a})$$

where ($10^3 \ln \alpha$) is approximately equal to ($\delta^{18}O_{dolomite} - \delta^{18}O_{water}$) and T equals the temperature in Kelvins. By rearranging equation 1:

$$(\delta^{18}O_{dolomite} - \delta^{18}O_{water}) = ((2.78 * 10^6) / T^2) + 0.91$$
$$- \delta^{18}O_{water} = ((2.78 * 10^6) / T^2) + 0.91 - \delta^{18}O_{dolomite}$$
$$\delta^{18}O_{water} = ((2.78 * 10^6) / T^2) - 0.91 + \delta^{18}O_{dolomite} \textbf{ (equation 2a)}$$

where $\delta^{18}O_{water}$ and $\delta^{18}O_{dolomite}$ are in permil (‰) relative to CO_2 evolved from PDB. Lastly, the following equation was used to convert $\delta^{18}O_{water}$ (VPDB) to $\delta^{18}O_{water}$ (VSMOW):

$$\delta^{18}O_{water} \text{(VSMOW)} = 1.03086 * \delta^{18}O_{water} \text{(VPDB)} + 30.86 \text{ (}\textbf{equation 3a}\text{)}$$

The following headings are used in the spreadsheet used to calculate the oxygen isotopic composition of the water from which the cement phases precipitated:

- **Cement:** The cement phase (and corresponding event number) that the preceding calculations are being applied to find the oxygen isotopic composition of the pore fluids that precipitated that particular cement.
- **δ^{18}O calc/dolo (VPDB):** The measured oxygen isotopic value (Appendix Six) of the calcite or dolomite samples, expressed in delta value notation in permil (‰).
- **Th (˚C):** The homogenization temperature obtained from fluid inclusions (Appendix Seven). A maximum and minimum T_h was employed for each cement during calculations.
- **Th (K):** T_h converted to the Kelvin temperature scale.
- **δ18O H2O (VPDB):** The value of $\delta^{18}O_{water}$ (VPDB), (see equation 2/2a)
- **δ18O H2O (VSMOW):** The value of $\delta^{18}O_{water}$ (VSMOW), (see equation 3/3a

Calculations δ18O Water (VSMOW)

Cement	*δ18O calc/dolo (VPDB)*	*Th (˚C)*	*Th (K)*	*δ18O H_2O (VPDB)*	*δ18O H2O (VSMOW)*
Early (2-7)	-3.6	20	293	-33.09	-3.2
Early (2-7)	-6.0	20	293	-35.49	-5.7
Early (2-7)	-3.6	25	298	-32.01	-2.1
Early (2-7)	-6.0	25	298	-34.41	-4.6
SL2 (11/12)	-6.1	52	325	-29.53	0.5
SL2 (11/12)	-5.4	52	325	-28.83	1.2
SL2 (11/12)	-6.1	43	316	-31.05	-1.1
SL2 (11/12)	-5.4	43	316	-30.35	-0.4
NL2 (14)	-5.7	61	334	-27.73	1.4
NL2 (14)	-3.9	61	334	-25.93	4.2
NL2 (14)	-5.7	45	318	-30.30	-0.3
NL2 (14)	-3.9	45	318	-28.51	1.5
Late Calcites (24)	-8.4	102	375	-25.28	4.9
Late Calcites (24)	-4.1	102	375	-20.98	9.3
Late Calcites (24)	-8.4	65	338	-29.84	0.2
Late Calcites (24)	-4.1	65	338	-25.54	4.6
Dolomite (25/26)	-7.2	130	403	-25.22	4.9
Dolomite (25/26)	-5.5	130	403	-23.53	6.6
Dolomite (25/26)	-7.2	90	363	-29.21	0.8
Dolomite (25/26)	-5.5	90	363	-27.51	2.5

BACK-CALCULATIONS FOR DETERMINATION OF POROSITY EVOLUTION

This appendix includes a brief overview of the back-calculations used to determine the extant porosity at each step of the porosity evolution presented in Chapter Five (Figure 5-2). There are three types of data used in these calculations: 1) measured (actual), 2) hypothetical (assumed), and 3) calculated. The measured data was split into two categories for comparison purposes, eastern (downdip) well versus western (updip) wells, and the averages of each localities (eastern and western) data set was used for final back-calculations. Averages given are for the total porosity occluded for the entire Raytown Limestone.

1. *Measured Data*
    a. Final Extant Porosity – This is the percent porosity remaining at the end of Step Seven. These data were obtained from core plug analyses.
        i. Average final extant porosity for eastern wells: 28.9%
        ii. Average final extant porosity for western wells: 19.9%
    b. Porosity Occluded by Event 24 Cements – This is the percent porosity occluded by the late calcite cements (Event 24) during Step Seven. Occlusion by these cements yields the final extant porosity. These data were obtained by visual estimates from thin section analyses.
        i. Average porosity occluded by Event 24 cements in eastern wells: 15.9%
        ii. Average porosity occluded by Event 24 cements in western wells: 28.4%
    c. Porosity Occluded by Cement NL2 – This is the percent porosity occluded by cement NL2 (Event 14) during Step Five. Occlusion by this cement yields the extant porosity remaining prior to dissolution occurring in Step Six. These data were obtained by visual estimates from thin section analyses.
        i. Average porosity occluded by NL2 in eastern wells: 24.5%
        ii. Average porosity occluded by NL2 in western wells: 28.0%

d. Porosity Occluded by Cement SL2 – This is the percent porosity occluded by cement SL2 (Event 11/12) during Step Four. Occlusion by this cement yields the extant porosity remaining prior to occlusion of porosity during Step Five. These data were obtained by visual estimates of thin section analyses:
    i. Average porosity occluded by SL2 in eastern wells: 20.3%
    ii. Average porosity occluded by SL2 in western wells: 15.9%
e. Porosity Occluded by Early Cements – This is the percent porosity occluded by early cements (Events 3-7) during Step Two. Occlusion by these cements yields the extant porosity remaining prior to dissolution and compaction during Step Three. These data were obtained by visual estimates of thin section analyses:
    i. Average porosity occluded by early cements (Events 3-7) in eastern wells: 4.7%
    ii. Average porosity occluded by early cements (Events 3-7) in western wells: 0.8%
f. Porosity Created After Final Dissolution – This is the percent porosity remaining after dissolution during Step Six (Events 17 and 22), which occurred after microfracturing (Event 16) and stylolitization (Event 20/21). Remaining porosity after Step Six yields the porosity occluded during Step Seven. This dissolution was equal throughout the Raytown Limestone, due the regional nature of microfractures that acted as fluid conduits. These data were determined by subtracting the porosity occluded by Event 24 cements from the final extant porosity.
    i. Porosity created after final dissolution in both eastern and western wells: 20%

2. *Hypothetical Data*
    a. Initial porosity – This is the percent porosity of the Raytown Limestone directly after deposition (Step One). These data were obtained from theoretical calculations, based on research by Graton and Fraser (1935). An initial value of porosity was assumed based on packing and sorting configurations of the Raytown Limestone, and the same value was used for both eastern and western locations.
        i. Hypothetical initial porosity for both eastern and western wells: 32%.
3. *Calculated Data*
    a. Porosity Created by Initial Dissolution – This is the percent porosity remaining after dissolution and compaction (Events 9 and 10) at the end of Step Three. The porosity created during Step Three yields the porosity to be occluded during Steps Four and Five. These data were determined from subtraction of porosity values determined in Steps One and Two. This step is underlined in the back-calculations.
        i. Porosity created after dissolution in eastern wells: 38.4%
        ii. Porosity created after dissolution in western wells: 44.9%
    b. Extant Porosity Remaining After Initial Dissolution - This is the percent porosity remaining after dissolution and compaction (Events 9 and 10) at the end of Step Three. The porosity created during Step Three yields the porosity to be occluded during Steps Four and Five. These data were determined from subtraction of porosity values determined in Steps Seven, Six, Five, and Four. This step is italicized in the back-calculations.
        i. Porosity created after dissolution in eastern wells: 69.6%
        ii. Porosity created after dissolution in western wells: 72.2%

*Back-calculations to determine the extant porosity after initial dissolution (Event 9):

1. **Step Seven:** Final Extant Porosity
    a. Eastern Wells: 28.9%
    b. Western Wells: 19.9%
2. **Step Six:** Final Extant Porosity minus Occlusion by Event 24 Cements equals Porosity remaining after final dissolution
    a. Eastern Wells: 28.9% - (-15.9%) = 44.8%
    b. Western Wells: 19.9% - (-28.4%) = 48.3%
3. **Step Five:** Porosity remaining after final dissolution minus Final dissolution equals Porosity remaining after occlusion by Cement NL2
    a. Eastern Wells: 44.8% - 20% = 24.8%
    b. Western Wells: 48.3% - 20% = 28.3%
4. **Step Four:** Porosity remaining after occlusion by Cement NL2 minus Occlusion by Cement NL2 equals Porosity remaining after occlusion by Cement SL2
    a. Eastern Wells: 24.8% - (-24.5%) = 49.3%
    b. Western Wells: 28.3% - (-28.0%) = 56.3%
5. **Step Three:** Porosity remaining after occlusion by Cement SL2 minus Occlusion by Cement SL2 equals *Extant porosity remaining after initial dissolution*
    a. Eastern Wells: 49.3% - (-20.3%) = *69.6%*
    b. Western Wells: 56.3% - (-15.9%) = *72.2%*

*Back-calculations to determine the percent of dissolution during Event 9:

6. **Step One:** Initial Porosity after Deposition
    a. Eastern Wells: 32%
    b. Western Wells: 32%

7. **Step Two:** Initial porosity after deposition minus Occlusion by Early Cements equals Porosity remaining after occlusion by Early Cements
    a. Eastern Wells: 32% - 0.8% = 31.2%
    b. Western Wells: 32% - 4.7% = 27.3%
8. **Step Three:** *Porosity remaining after initial dissolution* minus Porosity remaining after occlusion by Early Cements equals <u>Porosity created by initial dissolution</u>
    a. Eastern Wells: *69.6%* - (-31.2%) = <u>38.4%</u>
    b. Western Wells: *72.2%* - (-27.3%) = <u>44.9%</u>