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Lost Circulation Wells

WABAMUN AREA CO_2 SEQUESTRATION PROJECT (WASP)

Author

Rob Lavoie

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INTRODUCTION

BACKGROUND

As part of the reservoir characterization effort undertaken for the WASP study, any data that could lead to a determination, qualitative or quantitative, of the permeability associated with the Nisku aquifer are important. A number of wells on the eastern edge of the WASP study area had experienced lost circulation conditions while drilling through the Nisku aquifer. This lead to the speculation that potentially there was a link between these wells and a possible higher permeability trend along the inboard margin of the Nisku aquifer. To confirm or dispute this inference, a closer study of the lost circulation conditions associated with these wells was conducted.

Lost circulation is the loss of returned mud from the annulus of a conventionally circulated well. From a hydraulic standpoint, it means that the mud column hydrostatic pressure exceeds the ability of the formation to resist injection. There are many reasons for this. Some of these are, naturally fractured formations or vugular porosity in which the formation pore pressure is the only resistance to mud loss, high-porosity/high-permeability formations, leaks to upper intervals of various kinds, induced fractures and other types of induced inter-well communications (Reference 1).

DISCUSSION

1. METHODOLOGY

A database search of the wells in the WASP study area was conducted to determine which wells in the area had experienced lost circulation or other problems during drilling. Wells that experienced problems during drilling through the Nisku formation are listed in Table 1 and located on Figure 1.

Table 1: List of wells overlaying the Nisku formation in the WASP study area.

No.	Well I.D.	Event Recorded in the Tour Report	Date of Event
1.	100/02-21-048-01W5/00	Lost circulation	February 5, 1962
2.	100/10-22-047-01W5/00	Lost circulation	September 10, 1964
3.	100/10-25-046-02W5/00	Lost circulation	July 17, 1966
4.	100/10-14-053-03W5/00	Lost circulation	January 13, 1976
5.	100/04-14-051-03W5/00	Lost circulation	July 21, 1963
6.	100/06-10-045-04W5/00	Kick	January 7, 1986
7.	100/02-29-051-05W5/00	Lost circulation	March 22, 1994
8.	100/14-21-045-02W5/00	Lost circulation	August 20, 1960
9.	100/15-35-044-02W5/00	Lost circulation	January 19, 1988

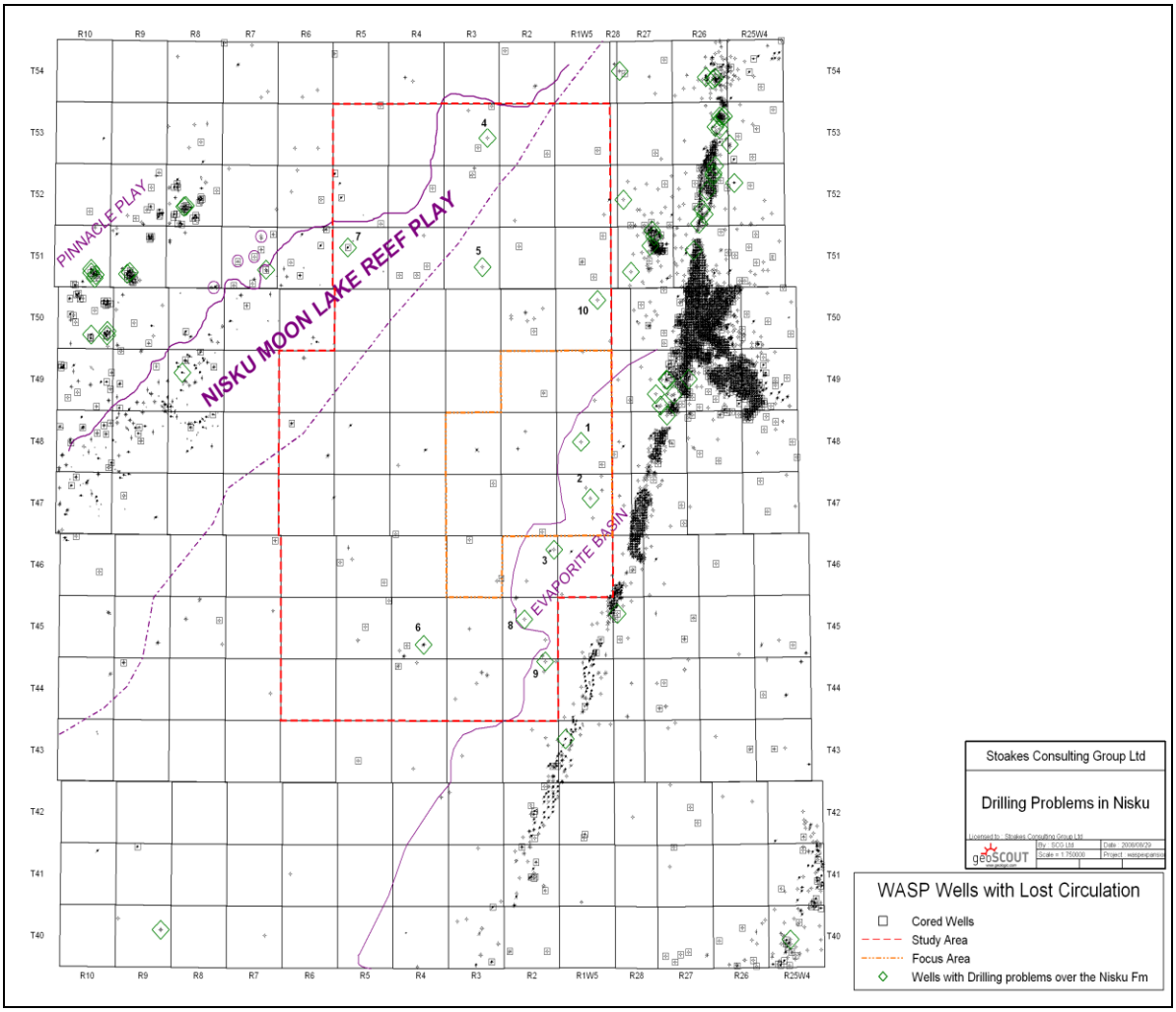

Figure 1: Numbered wells (corresponding to Table 1) with events recorded in tour reports.

Well tickets for each of these wells were printed and the tour occurrence dates noted. Additionally, the drilling rig tower sheets were obtained for each of these wells and the dates of the tour occurrences obtained from the well tickets were checked on the tower sheets. In this way drilling depths and mud densities could be used to estimate the hydrostatic pressure of the drilling fluid at the lost circulation depth. Table 2 lists the mud densities, formation depths, and column pressures for each well that had a tour occurrence while drilling in the Nisku formation.

Table 2: Drilling fluid and pressure data for wells with tour occurrences in WASP study area.

No.	Well I.D.	Mud Weight		Depth of Event Recorded in the Tour Report		Nisku Top		Pressure	
		gm/cc	ppg	m	ft.	m	ft.	kPa	psi
1.	100/02-21-048-01W5/00	1.078	9.0	1896	6221	1876	6155	20074	2911
2.	100/10-22-047-01W5/00	1.174	9.8	1995	6546	1676	5500	23000	3336
3.	100/10-25-046-02W5/00	1.102	9.2	2128	6981	2118	6950	23027	3340
4.	100/10-14-053-03W5/00	1.066	8.9	1786	5858	1781	5844	18692	2711
5.	100/04-14-051-03W5/00	1.174	9.8	1838	6030	1789	5870	21187	3073
6.	100/06-10-045-04W5/00	1.054	8.8	2510	8235	2488	8161	25863	3751
7.	100/02-29-051-05W5/00	1.018	8.5	2048	6719	2043	6703	20505	2974
8.	100/14-21-045-02W5/00	1.174	9.8	2248	7376	2204	7230	25916	3759
9.	100/15-35-044-02W5/00	1.090	9.1	2222	7290	2192	7190	23774	3448

Figure 2 shows the area wide distribution of the pressures at which tour occurrences occurred. For each well the hydrostatic pressure was calculated using the following equation:

$$\text{Pressure} = \text{MW} \times \text{Depth} \times 0.052$$

Where MW is the drilling fluid density in pounds per gallon, Depth is the true vertical depth in feet, and 0.052 is the unit conversion factor such that pressure results in units of pounds per square inch.

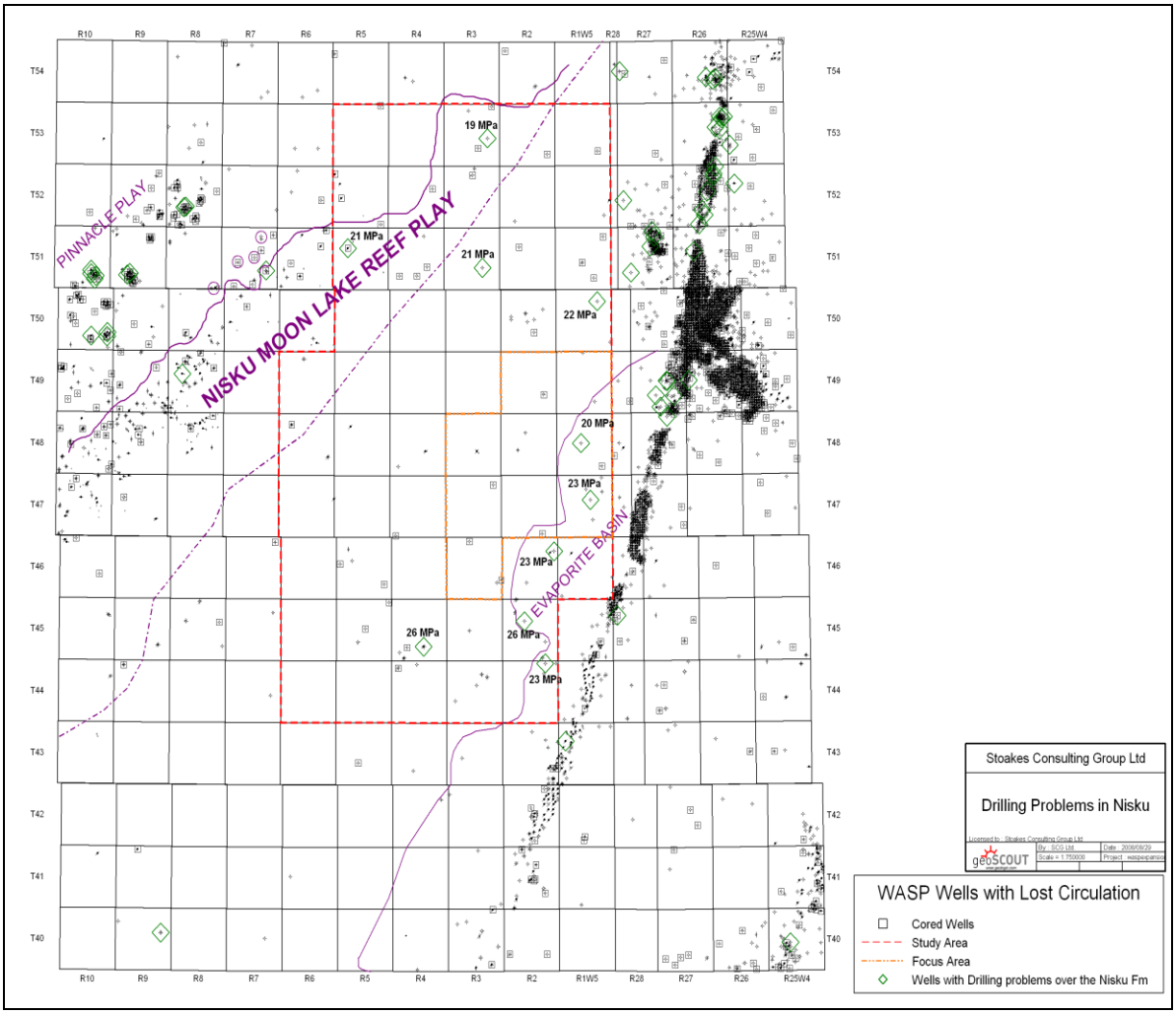

Figure 2: Hydrostatic pressure for wells with tour occurrences.

2. CONCLUSION

The Nisku reservoir's original reservoir pressure is in the order of 16 to 18 MPa. Table 2 indicates that only two of the nine (9) wells had hydrostatic mud weights greather than 24 MPa at the time they were being drilled through the Nisku aquifer. These mud weight may have been high enough to have resulted in a lost circulation condition. Five (5) of the nine (9) wells had mud weights greater than or equal to 23 MPa. These wells may also have been overpressured to the point of losing circulation.

Based on these results it is difficult to draw conclusions about a possible trend towards higher permeabilities on the eastern edge of the Nisku aquifer in the WASP study area even though it is compelling to do so for other reasons. Other wells, such as the water source well discussed elsewhere in this set of WASP reports, suggest that there might be a high permeability trend along the inboard margin of the Nisku aquifer. Our investigation of lost circulation wells neither supports nor refutes this hypothesis.

REFERENCES

1. Les Skinner, Lost Circulation, World Oil, August 2006.