Production Log Validates LateralScience℠ Results

LateralScience Engineered-Completion Evaluation Matches Production Log Results on 21 of 24 Stages

Production Logs and Engineered Completions

Horizontal well fracture stimulation treatments are designed and pumped one stage at a time. To effectively evaluate the benefits of LateralScience℠ engineered completions, it is ideal to investigate production results perforation cluster by perforation cluster, rather than stage by stage.

Comparing the results of the LateralScience method to a production log is the most accurate and effective way to evaluate this engineered completion technology and gives direct, measured insight into the validity of this technology. The subject well was drilled in the summer of 2015, and upon completion in 2016, each cluster's contribution was evaluated using a production log.

Evaluation Approach

The well completion was executed in Q2 2016 using three clusters per stage with 99 ft of spacing between perforation clusters. Overall, the 8,500-ft lateral was completed in 29 stages. As shown in the adjacent table, each perforation cluster in the LateralScience cluster analysis is color-coded per the calculated hardness index, while the value in the far-right column shows the percent of total well production, indicated by the production log. The numerical value shown for each cluster represents the percent of total well flow for that particular perf cluster. The sum of each row matches the value in the far right column.

The LateralScience cluster analysis predicts that the perf clusters in only nine of the 29 stages are placed in similar rock, thus all three perf clusters would be expected to contribute significant flow. Of the remaining 20 stages, the analysis predicts five would have two clusters flowing, 10 would have one cluster flowing, and five would have drilling data issues that compromise the ability to make an accurate prediction.

Because each stage is stimulated independently, the evaluation is done one stage at a time. This is equivalent to performing 29 independent tests of the LateralScience method, leading to a much more statistically significant evaluation.

For each three-cluster stage, there are eight possible flow-profile scenarios, as detailed in the table to the right. This means that, in this case of a geometric/random completion design, the odds of a flow profile prediction matching the production log exactly within each stage is one in eight. The LateralScience prediction is significantly better than this one-in-eight probability.
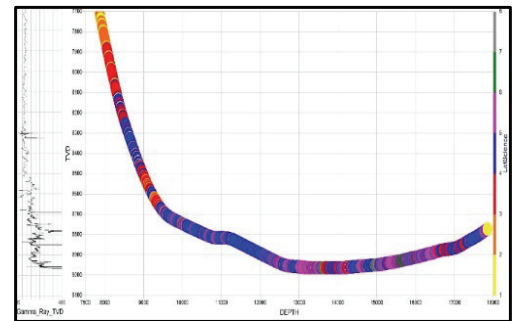
LateralScience trajectory plot on subject well

MSE Color/Prod %				
Stage	Cluster 1	Cluster 2	Cluster 3	Prod %
1	0.56	1.84	0.52	2.92
2	0.01	0.01	0.68	0.7
3	0.71	0.79	0.83	2.33
4	0.01	0.01	0.42	0.44
5	3.17	0.01	0.01	3.19
6	0.19	0.18	0.14	0.51
7	1.12	0.16	0.19	1.47
8	0.14	0.2	0.17	0.51
9	0.17	1.15	0.87	2.19
10	0.83	0.01	1.03	1.87
11	0.04	0.01	2.61	2.66
12	0	0.43	1.78	2.21
13	0.03	0.03	2.07	2.13
14	2.32	2.41	2.58	7.31
15	2.66	2.75	3.27	8.68
16	3.27	3.39	3.66	10.32
17	3.82	4	4.08	11.9
18	4.49	0.03	0.02	4.54
19	0.71	1.96	1.46	4.13
20	1.47	1.94	1.95	5.36
21	2.10	2.16	2.29	6.55
22	2.54	2.77	0.03	5.34
23	1.67	0.05	0.01	1.73
24	0.01	0.01	1.03	1.05
25	0.6	0.32	0.41	1.33
26	0.01	0.01	0.01	0.03
27	0.03	1.08	0.61	1.72
28	0.84	0.66	1.88	3.38
29	1.5	2.05	✕	3.55

LateralScience cluster analysis on subject well

	CLUSTER 1	CLUSTER 2	CLUSTER 3
TYPE 1	NO FLOW	NO FLOW	NO FLOW
TYPE 2	NO FLOW	FLOW	NO FLOW
TYPE 3	NO FLOW	FLOW	FLOW
TYPE 4	NO FLOW	NO FLOW	FLOW
TYPE 5	FLOW	NO FLOW	NO FLOW
TYPE 6	FLOW	FLOW	NO FLOW
TYPE 7	FLOW	NO FLOW	FLOW
TYPE 8	FLOW	FLOW	FLOW

Eight possible stage-level flow profiles (3-cluster stage design)

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Stage 1-10

Stage 11-20

Stage 21-29

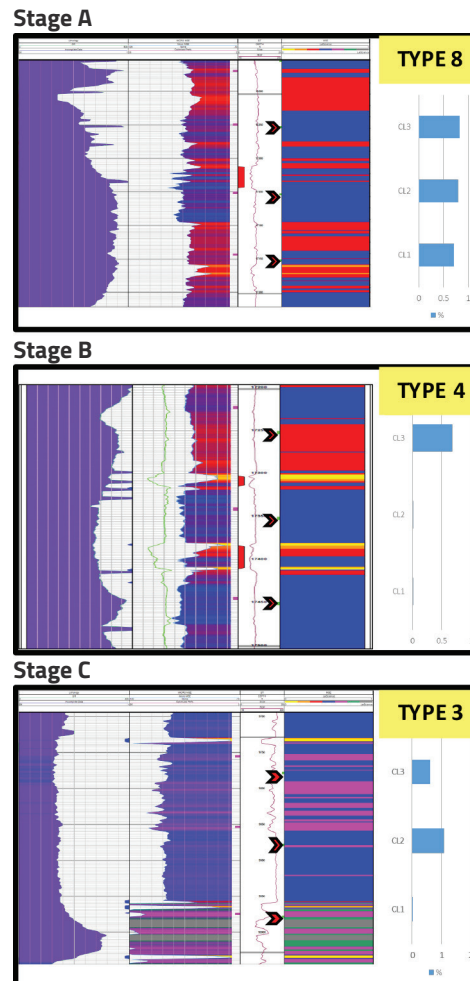> **Contributing Clusters:**
> **59/86**

Results

The results from the production log are displayed above as a percentage of the total flow of the well. The relative contribution from each of the 86 perf clusters is shown as a blue bar, with a vertical scale of 0−5%. The clusters are grouped as stages in sets of three (with the exception of stage 29, which was a stage with only two clusters). Stages are color-coded green, yellow and red. Green indicates a perfect match between LateralScience predictions and the production log. Red indicates a mismatch, while yellow indicates data quality issues that compromise the comparison. Of the 24 stages that were green or red, there was a perfect match in 21 of the 24 stages.

Overall, the LateralScience analysis predicts that 58 of 86 clusters should contribute to flow. The production log measures flow in 59 of 86 clusters.

Examples of three different stages that had a perfect match are shown to the right. Stage A had all three clusters in the blue facies, and all three were flowing according to the PL (blue bars). Stage B had Clusters 1 and 2 in the blue facies and Cluster 3 in the weaker red facies, and only Cluster 3 showed flow on the production log. In Stage C, Cluster 1 was placed in the gray facies, while Clusters 2 and 3 were in the weaker blue facies and only Clusters 2 and 3 were flowing, according to the production log results.

Stage A

Stage B

Stage C

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