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Mitigating Risk on Well Placements by Volumetric Simulation of Well Drainage and Frac Shadows

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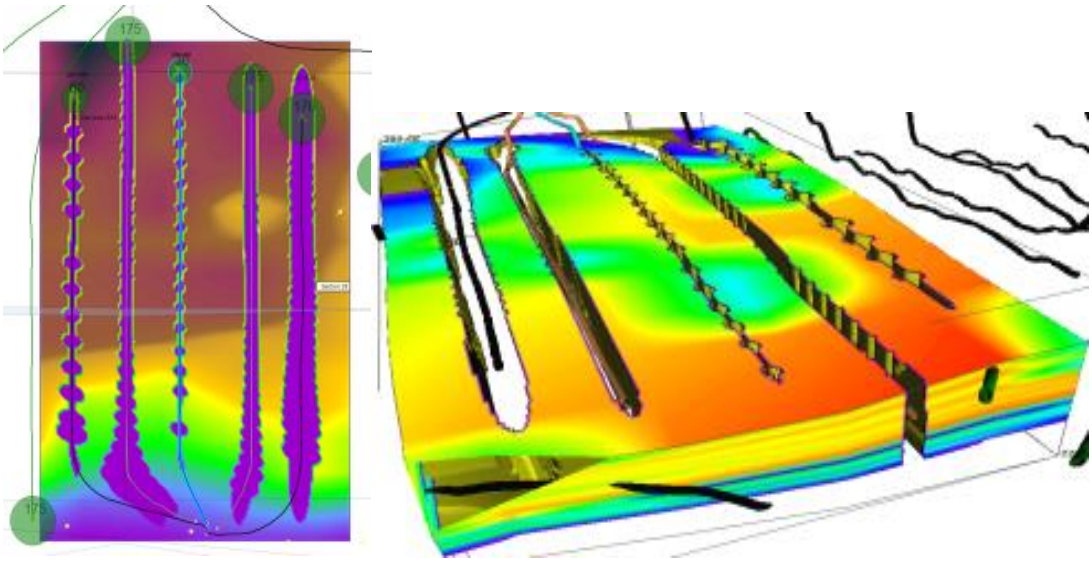
Summary

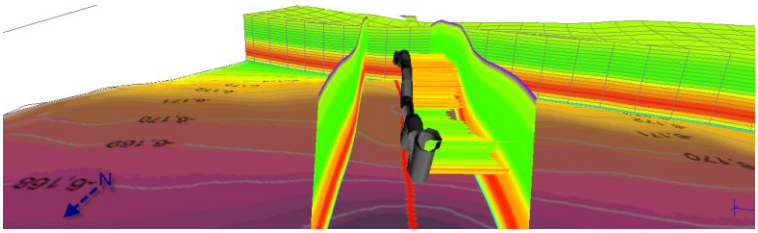
Market forces are pushing Producers and Service Providers towards placement optimization, added efficiency and technology.

Creating value and planning for success in field development operations is a multi-disciplinary process that needs both a continuous learning and integrative approach to optimize capital. Technological advantage for producers comes from implementing just-in-time processes continuously to provide Dynamic Intelligence® for operations teams and their drilling programs. Combining geosteering with risk reduction from modelling well drainage and frac shadows from a Reservoir Engineering perspective using Volumetric Sweep Mapping (VSM) simulation process will help in planning new infills that are in new HCPV avoiding potential low pressure areas of the resources exploited to increase economic success.



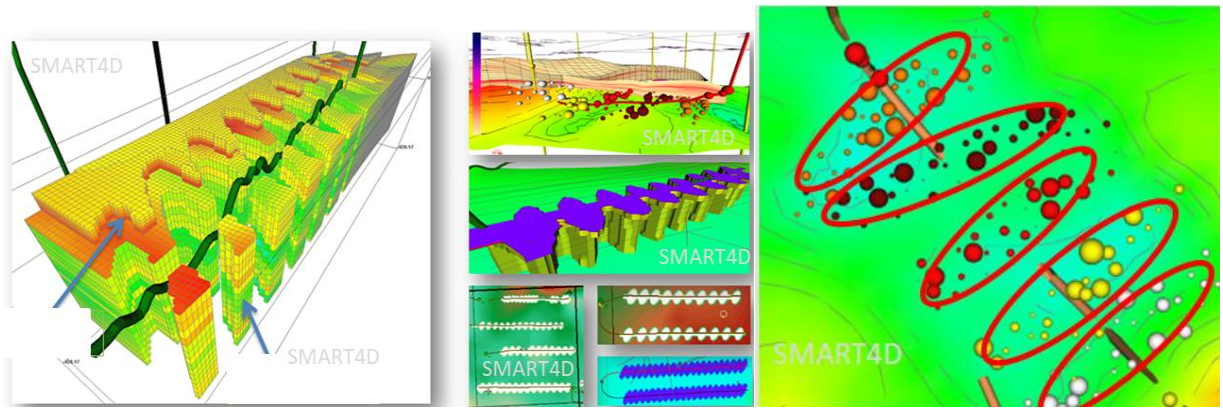
VSM Reservoir Drainage Modelling Study in Montney Play, Alberta. Using a base case Displacement Efficiency.

While drilling robust geomodels solve for structure, dip, thickness and rock property changes ahead of the bit to catch deviations early while geosteering.



View to a drill: Live updates to 3D rock properties for Geosteering.

The volumetric simulator helps visualize well and frac drainage patterns in both Conventional and Unconventional Plays to avoid areas with high risk to drill or complete. Operations teams that includes G&G, and engineers (drilling, completions, reservoir and other stakeholders) avoid potential low pressure areas and mitigate frac hits by better pre-planning. In preparation of a drilling program, integrated studies and while drilling processes improve well placement and NPVs with multidisciplinary approach. The robust geo-models act as a hub for projects that include geomechanics, completions, G&G lithology/property modelling, drilling optimization as a continuous improvement process for field operations.



VSM drainage from HCPV models in Tight Oil/Unconventionals showing Stimulated Reservoir Volumes (SRVs); 3D and map view of microseismic events visualized

Theory / Method / Workflow

The need for the technology arose based on request from Operators to reduce cost and time of flow simulators particularly when a number of horizontal wells were involved. These projects had a few to several hundred wells in a field.

The described volumetric simulation technology works at very high resolutions. The upscaling facilities that allowed us to bring the property model to a flow simulator is now

used to downscale to a 5-10 million geo-cellular model. The 3D voxel sizes are about 8mx8mx0.5m.

3D geo-model framework from geo-steering processes and reservoir characterization of Porosity, gamma, & saturation in various Conventional (Heavy Oil and waterflood modelling) and Tight Oil/ Unconventionals are the starting place for these integrated reservoir studies. Production data, EURs, perfs, fracs, etc. provide the reservoir engineering input. Automation processes have been developed to iteratively match the EURs or production to dates to the 3D well drainage and SRV's/frac shadows.

Both vertical and horizontal wells are then designed in the available HCPV volume. Typical model runs take about an hour for a large field with a couple of hundred wells. Once matches of EUR and the SRV are completed, the volumes are stacked for presentation and analysis. The matching factor is the displacement efficiency that will be different for every field.

Results / Observation / Conclusions

To date hundreds of wells have been successfully drilled using the VSM process described. 2 case studies will be presented. One in a mature Heavy Oil in a Dina Sand in Alberta Operated by Rife Resources and a Montney Tight Oil Play Operated by CanaMax Resource will be reviewed.

Typical studies take about 1-2 month as opposed to several months from the beginning of model building process to end of proposed new locations. VSM results are integrated with the next step in development ie. well placement/geosteering to close the loop. Incremental updates with new wells are done periodically or on a daily basis while drilling and in preparation for completion programs.

In conclusion, the integrated approach of Geomodelling for geosteering and volumetric simulation can reduce risk on capital.