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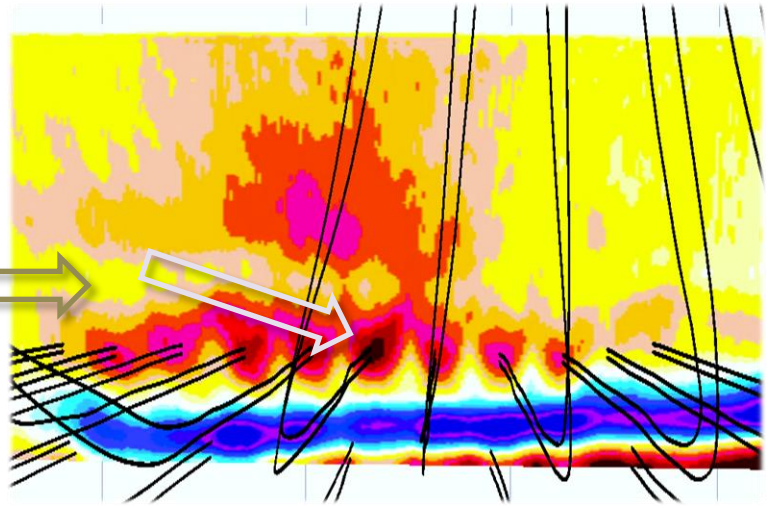
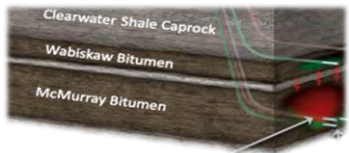
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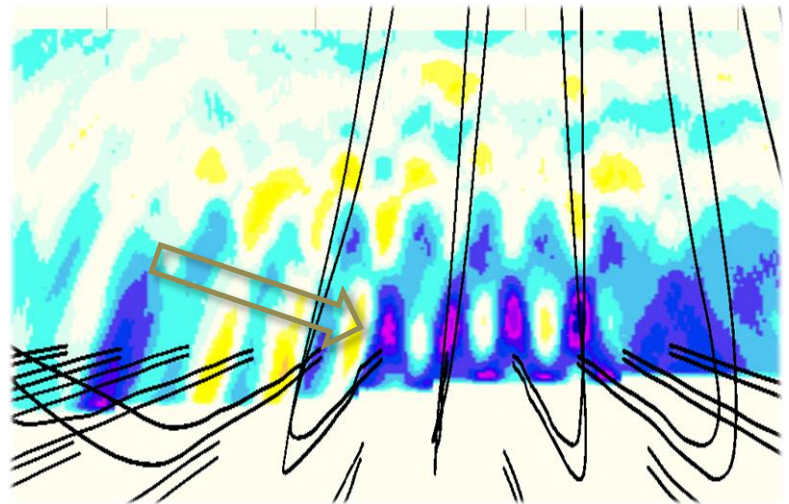
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- Enable detailed mapping of near vertical boundaries within SAGD steam chamber zones to assist reservoir engineers to direct steaming efforts such that overall SOR levels are decreased



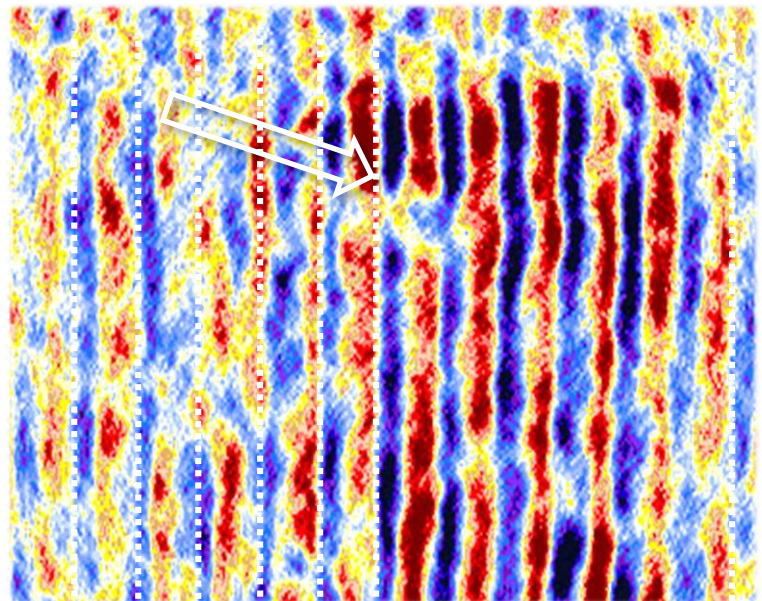
Duplex Wave Migration (DWM)* technique is patented (USA 2005 and other jurisdictions) *Contributors to SAGD Duplex Wave Migration: Statoil Canada Ltd, Eco-Energy Innovations Initiatives, and Computer Modelling Group (CMG)

- Our solution integrates reservoir engineering, geology, geophysics, full wave forward modeling, reservoir simulation, and DWM technologies to delineate SAGD process Steam Chambers and Reduce CO2 emissions



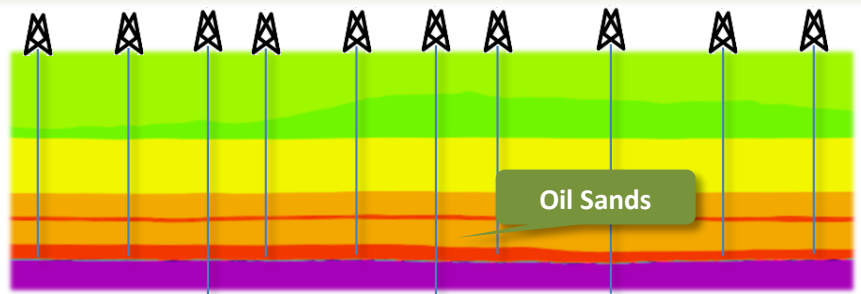
Advantages of DWM over conventional seismic imaging methods:

- ✓ PSTM images the top of the SAGD zone which is much wider than the actual producing core melt zone
- ✓ DWM images energy that has reflected directly off of near vertical boundaries related to the steam chamber zone including the boundary between liquid viscous oil and solid bitumen
- ✓ DWM may also be capable of imaging the central steam core in which bitumen saturation has dropped to zero
- ✓ DWM can be used to identify steam thief zones
- ✓ DWM can be used to identify communication between horizontal well sets



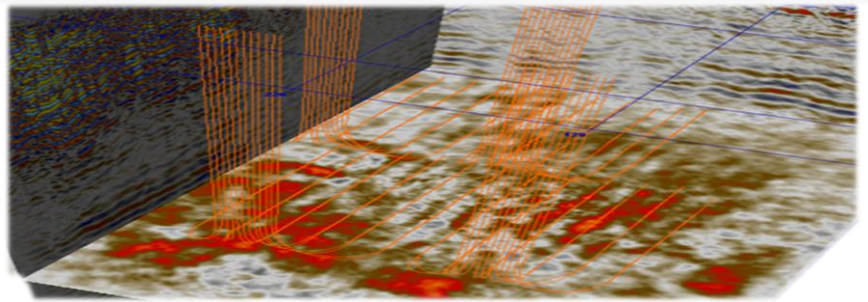
Geology:

- vertical wells are used to provide the geologic background model Vp, Vs and Density



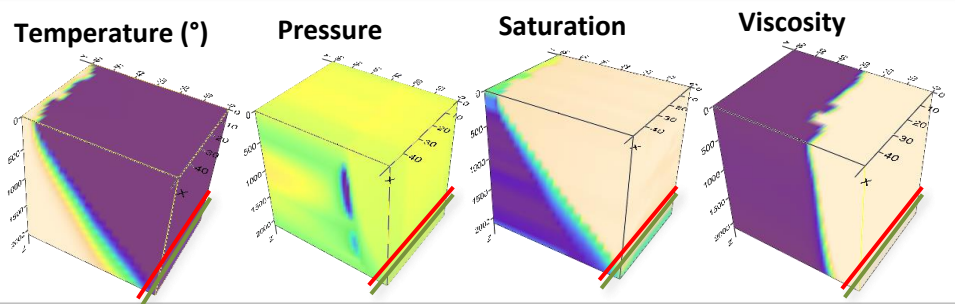
Geophysics:

- high fold 4D survey producing 5m X 5m bins and 12 to 180 Hz bandwidth data



Reservoir Engineering:

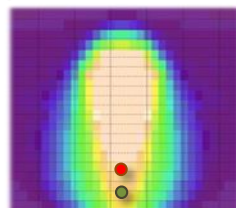
- monitor wells provide temperature, pressure, bitumen saturation etc



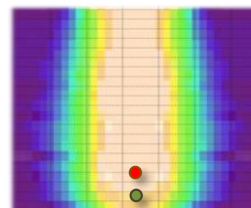
Reservoir simulation:

- predict future changes in reservoir engineering properties

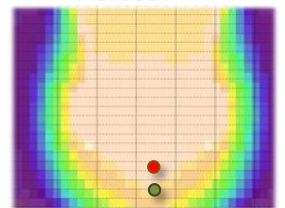
Time lapse: 1 Year



2 Year

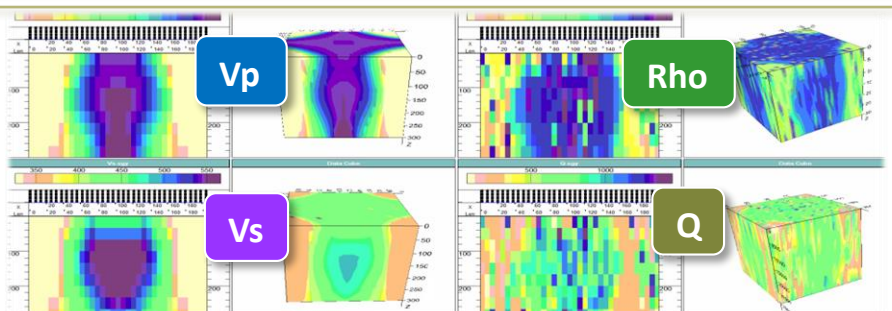


5 Year



Seismic modeling:

- transform reservoir properties into elastic properties Vp, Vs, density, absorption (Q)
- provide link between reservoir engineering and seismic data



Time lapse 3D DWM on both real and synthetic data:

- tie interpretations based on seismic imaging and reservoir simulation
- enable estimation of volumetrics

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