

SR2020's CO₂ Monitoring Capability Makes a Giant Step Forward for Oil Industry

CO₂ injection into oil reservoirs has been used extensively in the oil field and is recognized as a leading [Enhanced Oil Recovery](#) (EOR) technique. At the forefront of this effort is SR2020's PRO [3D VSP](#) advanced seismic monitoring capability. SR2020 provides high definition seismic images and data that enable oil producers to better predict and detect the migration pathways of CO₂ through rock that rests thousands of feet below the earth's surface. Interestingly, this capability has recently given the oil industry and EOR efforts a giant step forward as a promising means of CO₂ sequestration.

EOR projects inject expensive fluids and gases into the subsurface to move hydrocarbons to producing wells. These fluids move based on the pattern of injectors, producers and variations in the geology. Common problems for EOR are breaches in sealing shale beds, undetected faults that are barriers or vertical conduits to fluid movement, stratigraphic channeling and pinch outs that can redirect fluids, anisotropic permeability, and discontinuities in the [reservoir](#) that reduce the effectiveness of the project. Over time, the injection program will redistribute hydrocarbons and formation pressures, changing the fluid dynamics and altering fluid flow. Areas may be left unaffected by the injected fluids while other areas may be completely processed by the injected fluids earlier than predicted.

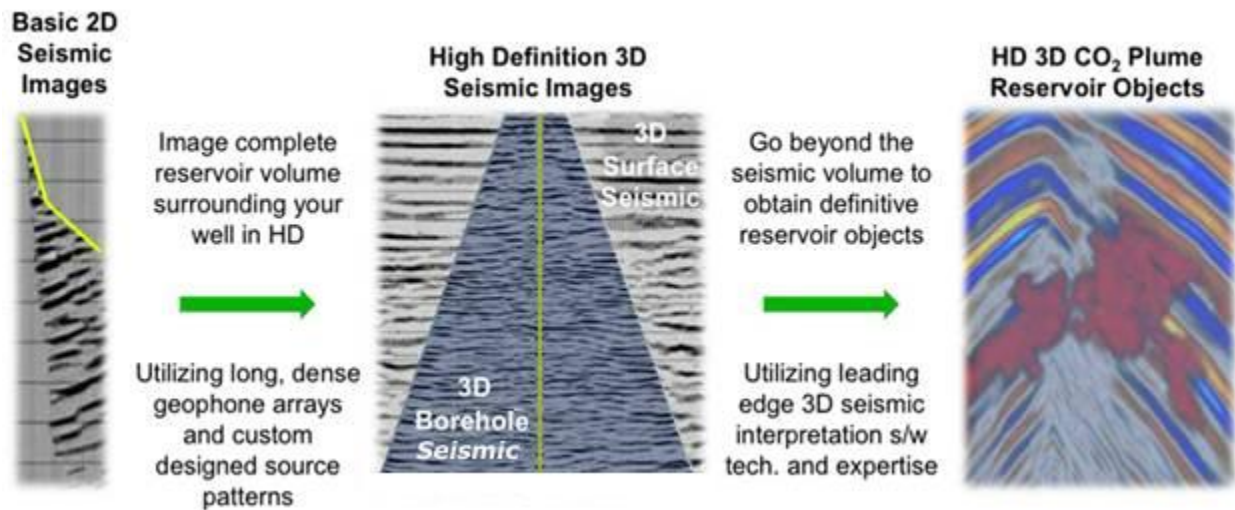
In the case of CO₂ sequestration, gas is injected into the subsurface, but in this case into deep saline reservoirs for permanent disposal. Facilities can be expensive and collection and distribution systems extensive. The gas may channel into and through high permeability portions of the reservoir. If this highly mobile gas finds faults or other boundaries which are either barriers or conduits to flow undesirable movement may result.

Direct and periodic monitoring of the subsurface will document the movement of fluids and gases and provide valuable insight into the efficiency and effectiveness of CO₂ injections, but traditional efforts are often less than satisfactory.

Oil and gas reservoirs consist of porous rocks covered by a non-porous cap rock, in a location that traps, concentrates, and prevents further loss of hydrocarbons. Several thousand oil and gas fields are many decades old, and seemingly near the end of their economically productive lives. Using standard petroleum extraction methods, most oil fields recover only approximately 20-40% of the original oil in the reservoir. The EOR technique of CO₂ flood into a reservoir is a process which has the potential to increase an oil field's recovery rate up to 60% and almost doubling the oil field's life, extending it by decades.

When CO₂ is injected for EOR it reaches and interacts with oil that cannot be produced using standard petroleum extraction methods. The CO₂ causes the oil to "inflate" or swell and become less viscous, making it more fluid - both in property and flow. The swelling of the oil by the CO₂ enables it to push the oil to the production wells, increasing production.

SR2020's PRO 3D VSP offers a direct and specific method to establish an effective and well-placed CO₂-EO. The PRO 3D VSP captures a high definition "picture" of both the pre-CO₂ flood formation dynamics, while monitoring the impact, saturation, flow, and interaction of reservoir fluids during and after a CO₂ flood. This enables any necessary modification of the CO₂ injection placement or setup.



It is important to have a strong, HD analysis and picture of the pre-injection reservoir- a baseline from which to compare post-injection changes in fluid properties, potential leaks, and seismic activity. Historical knowledge of the production, well bores, and geological data of a reservoir are all important pieces of information to determine a plan for EOR via a CO₂ flood and establish the baseline. Production data sampling, surface seismic monitoring, are viable standard tools. However, PRO 3D VSP and related borehole imaging technologies (e.g. cross-well tomography, 2DWAUVSP, CVSP) are well established and relatively inexpensive methods of directly monitoring injected fluids into the subsurface. These high resolution methods can help accelerate and increase recovery, provide insight into well and injectant placement, and reduce the cost of infrastructure.

Overall Benefits of SR2020's PRO 3D VSP Monitoring:

- Direct, High Definition monitoring of injected fluids over time
- Maximizing the value of injected fluids by targeting unprocessed zones
- Recognizing breaches in sealing shales and presence of permeable faults
- Accelerate and maximize oil recovery
- Reduce the cost of infrastructure and improve overall financial performance

SR2020, Inc., established in 1998 and headquartered in Brea, California, is an independent services and technology company dedicated to answering difficult reservoir management questions through the application of advanced borehole seismic methods. They have offices in Houston, and Dubai.

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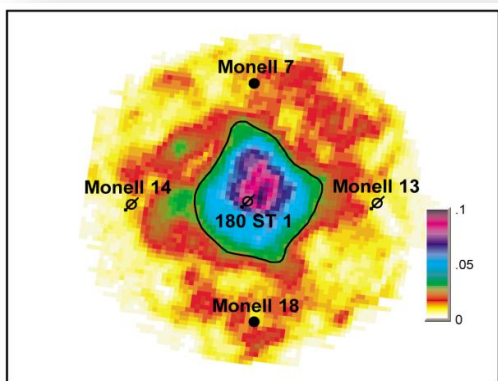
Article Summary:

SR2020 3DProVSP reservoir monitoring images the physical and chemical effects of EOR-CO₂ injection on the reservoir--tracking the spread of CO₂ inside and potentially outside the reservoir, as well as the redistribution of oil and gas over time. SR2020's high resolution methods and data accuracy can help accelerate and increase recovery, provide insight into well and injectant placement, and reduce the cost of infrastructure and improve financial performance.

Quote:

"In a CO₂-EOR project, utilizing SR2020's PRO 3D VSP's high definition imaging adds pinpoint precision with clear definition and accuracy, enabling much better management of the injection, and documentation of CO₂ capture. This capability is a significant technical and financial step for the multitude of oil producers in our country." Dr. Martin Karrenbach, Sr. Vice President, Research and Development, SR2020, Inc.

Addl Pictures:



From [John O'Brien](#), [Fiona Kilbride](#), and [Frank Lim](#), 2004, Time-Lapse VSP Reservoir Monitoring, The Leading Edge **23**, 1178-1184.

Image volume from a full 3D borehole seismic survey

