CHALLENGE
Increase production by converting an existing slanted well into a horizontal well by geosteering in a structurally uncertain zone.

SOLUTION
Perform sidetrack operation and optimize geosteering by deploying a BHA consisting of
- GeoSphere* 475 reservoir mapping-while-drilling service to identify structural changes
- PowerDrive Orbit* rotary steerable system to accurately control trajectory
- SonicScope* multipole sonic-while-drilling service to assess permeability and identify open and closed fractures
- MicroScope* resistivity- and imaging-while-drilling service to provide resistivity data and identify structural dip, fractures, and faults
- Petrel* E&P software platform to evaluate structural complexity using 3D visualizations.

RESULTS
Achieved geosteering objectives by accurately drilling the well using GeoSphere 475 service for the first time, which provided real-time reservoir data from a 22-m [72-ft] depth of investigation around the wellbore.

Making proactive decisions to manage structural uncertainty and well trajectory
An onshore field operated in Sicily, Italy, produces from heavy oil–bearing formations. The upper reservoir formation consists of interbedded shales and carbonates, and the lower reservoir formation is mostly fractured dolomite. The operator wanted to produce oil from a structural high—as identified from seismic data—with the lower reservoir as the main target formation.

Because of possible subseismic faults, a highly fractured composition, and a water zone at the bottom of the formation, drilling into the lower reservoir would be difficult. The operator planned to drill within the upper reservoir and approach the top of the lower reservoir sufficiently high on the structure with an inclination that would quickly level off the trajectory at 90°. Drilling at 90° in the lower reservoir would allow the operator to optimize production by maximizing the distance from the water contact below.

The trajectory would need to be modified based on well correlation, LWD images, and reservoir mapping information. The operator planned to discriminate between open and closed fractures, as well as identify producible zones via primary permeability. Because of its high depth of investigation, reservoir mapping with GeoSphere 475 service would play a key role in helping the operator make proactive decisions in managing the structural uncertainty and well trajectory.

Integrating the BHA to make real-time, informed trajectory changes
The operator planned a sidetrack operation by setting a whipstock to mill a 95/8-in casing window, followed by 8½-in and 6-in sections of directional drilling. After the 8½-in section was drilled 3,267-m [10,719-ft] MD, the 6-in section — the more challenging of the two sections — was used to drill through the two target reservoir formations.

The GeoSphere 475 service enabled proactive steering through the upper reservoir for target entry into the lower reservoir by mapping structural uncertainty to make informed decisions to change well trajectory. Courtesy of Eni Mediterranea Idrocarburi SpA.
CASE STUDY: The operator uses GeoSphere 475 service to geosteer difficult trajectories, Sicily

As part of the formation evaluation plan, the geoVISION* imaging-while-drilling service was used to assess the structural setting in the 8½-in section, and the real-time information enabled updating the structural setting; this helped to plan a change both in the azimuth and inclination of the trajectory for the 6-in section.

Because the 6-in section required a turn and build, the operator used the PowerDrive Orbit system to deliver up to 5°/100 ft [5°/30 m] of dogleg severity (DLS), maintaining operational efficiency and withstanding several days of drilling under severe shock and vibration conditions.

To discriminate between open and closed fractures, the operator used the SonicScope service and MicroScope service on the BHA while the GeoSphere 475 service geosteered the section to confirm directional drilling did not cross relevant faults and the trajectory would not exit the lower reservoir as the main target. With the integration of these services, the Schlumberger well placement team collaborated with the operator to optimize the trajectory to compensate for the structural change, enabling steering the well into the lower reservoir at 90° by performing an azimuthal trajectory change while maintaining inclination.

The SonicScope sonic service and MicroScope resistivity service were used to identify the most productive reservoir intervals, as validated by the mud logging data.

Completing geosteering ahead of schedule and providing large depth of investigation footprint

The GeoSphere 475 service used real-time data to map the top of the lower reservoir with a depth of investigation of 22 m [72 ft] around the wellbore to successfully geosteer the well for 178 m [584 ft] along the lateral. The Petrel software platform used inversion results from the GeoSphere 475 service to provide 3D visualizations that enhanced formation evaluation. Because of the comprehensive formation evaluation—an integrated solution using the GeoSphere 475 service with a fit-for-purpose BHA—the drilling operation was completed two days ahead of schedule.