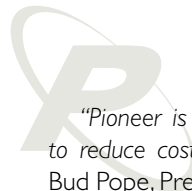




NEW GEOSPATIAL products



A large independent exploration and production company based in Dallas, Pioneer has extensive operations throughout North America and in both northern and southern Africa. In Tunisia's Ghadames Basin, the company holds interests in six blocks covering more than three million acres. Oil and natural gas are already flowing from two of the active blocks with exploration and development continuously bringing new wells on line throughout the basin.



"Pioneer is always looking for new tools and techniques to reduce costs and make operations more efficient," says Bud Pope, President of Spatial Energy Inc., a Boulder, Colo., provider of imagery solutions to the worldwide energy industry.

The company supports its activities from a Geoscience Technology Group (GTG) in Texas. Pioneer often relies on Spatial Energy to obtain and pre-process satellite or aerial imagery. The operator uses web mapping services to disseminate geospatial data to its teams in the field.

SPOTMaps subscene showing petroleum facilities.



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DR

EVERY HYDROCARBON DEVELOPMENT PROJECT FACES CHALLENGES

UNIQUE TO THE LOCAL GEOGRAPHY AND TERRAIN, AND THE OPERATIONS OF PIONEER NATURAL RESOURCES IN SOUTHERN TUNISIA ARE NO DIFFERENT. THE REMOTE LANDSCAPE DOMINATED BY MASSIVE SAND DUNES COMPELLED IT TO DEPLOY A NEW SET OF GEOSPATIAL PRODUCTS.

for oil and gas

“The GTG is mainly focused on high-end geophysics and petrophysics, which include seismic data acquisition, processing, modelling and attribute analysis,” says Mark George, Pioneer’s Geoscience Systems Coordinator. *“But we also perform image processing, including discrimination analysis, image classification and modelling with DEMs.”*

During discussions on progress in the Ghadames Basin, Spatial Energy saw the topography of seemingly endless sand dunes was creating difficulties and slowing logistical aspects of exploration and development, including seismic surveys. The firm recommended two satellite-based products: SPOTMaps and SPOT DEMs. These products appealed to Pioneer for several reasons, most notably because both were available off-the-shelf for quick delivery at an extremely competitive price.

Finding the right data sets

Oil and gas companies operating inside the United States can obtain aerial imagery quickly and easily at almost any scale. But high-quality, up-to-date map data is usually much more difficult to acquire in other nations. Imaging satellites offer a better alternative because they are not limited by political boundaries or logistical issues. However, in unpopulated regions like southern Tunisia, high-resolution satellite imagery typically is not available off-the-shelf. Spatial

Energy and Pioneer considered ordering a large block of one-metre scenes and stitching them into a mosaic, but the potential cost prompted them to look at other options.

The most daunting hazards in the Ghadames Basin are the towering sand dunes, creating an undulating landscape that slowly shifts with the winds. Recent satellite imagery was needed to find flat sites to position drilling pads, build hydrocarbon processing facilities and carve access roads into the sand.

Spatial Energy saw SPOTMaps as the ideal solution for the oil field applications. SPOTMaps are regional mosaics of 2.5-metre images acquired by the SPOT 5 satellite. Their off-the-shelf availability, cost per sq.km and spatial resolution incited Pioneer to give them a try, explains Pope. Spatial Energy ordered the necessary SPOTMaps data from SPOT Image Corp. and delivered them in August 2008.

“Since our area was so large, we knew that SPOTMaps would give us the resolution we needed,” agreed George. *“We could see our facilities already in place, as well as some of the road and pipeline networks.”* ▶

SPOT DEMs are digital elevation models produced by automatic correlation of stereopairs acquired by the HRS instrument aboard the SPOT 5 satellite. Spot Image has already captured and archived HRS data for two-thirds of the Earth's surface, including Tunisia, which means DEM products can be delivered quickly for many parts of the world. Each DEM has a 20-metre post spacing, 10-metre vertical accuracy and 15-metre horizontal accuracy, and does not require end-users to supply ground control points.

► **Putting SPOTMaps to work**

Pioneer loaded the SPOTMaps data file onto its web mapping service for access by personnel in London, Tunisia and United States. First, it used the imagery to create an accurate map of existing infrastructure in the basin. Previously, Pioneer relied only on engineering sketches and GPS locations of well pads and processing facilities. Technicians in Dallas overlaid the sketches on the images to construct the infrastructure feature layer, ensuring that each building and drill site had been precisely located and accurately depicted. A pipeline layer was generated in the same fashion.

The imagery was then used to select routes for laying pipelines between newly drilled wells and hydrocarbon processing plants. Technicians examined the images for paths of least resistance, which usually means limited elevation change and absence of natural hazards that could result in future pipeline damage. Because every linear foot of pipe laid adds to development costs, they rely on

the imagery to find the shortest route around tall dunes, seasonal stream beds and drainage washouts.

Pioneer also expects to use SPOTMaps extensively in planning seismic surveys in Tunisia. As the locations for seismic lines are selected, technicians can review the imagery to determine the best route for heavy seismic trucks. "Clearing these paths is expensive," says George. "The imagery gives us an idea of estimates on additional costs and time."

This planning allows Pioneer to more accurately budget each seismic survey. In addition, such actions can avoid time-consuming delays caused by vehicles getting stranded in the sand.

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DEMs for seismic surveys

The sand dunes in Tunisia have hindered exploration activities as well. Specifically, seismic surveys in areas covered by thick layers of unconsolidated overburden such as sand dunes often yield inaccurate results. This problem is caused by seismic velocities

varying in non-uniform manners as they pass through the sand layer. In addition, most seismic processing algorithms assume a linear relationship between the vibration source and receivers, but in Tunisia there are sometimes huge elevation gaps between those points due to the extreme undulations in the sandy terrain.

"Recent seismic publications [The Leading Edge, February 2009, Lake and Zaghoul] suggest that using DEMs along with remote-sensing data may help build an accurate 3D geologic model to achieve better static corrections of seismic data," says George.

Pioneer field crews typically collect regional up-hole data and x, y and z coordinates at each source and receiver point in the seismic survey using GPS devices, but acquiring a more detailed elevation grid with ground-based GPS

over such an expansive area would take years. So in 2009, Spatial Energy recommended SPOT DEMs, an inexpensive yet accurate alternative to aircraft or field surveys.

At the time of writing this article in March,, Pioneer had just received the first SPOT DEM products for Tunisia. If the project proceeds as planned, Pioneer expects the DEMs to enhance processing accuracy in two ways:

- First, the DEMs will fill in differences in elevation values between the vibration source and receiver points, which traditionally have been interpolated.
- Second, they will help to build a more precise geologic model from the surface of a dune down to the bed rock, so that velocity variations through the sand layer can be modelled and accounted for more accurately.

"These DEMs could significantly improve the quality of our seismic processing in Tunisia," says George. "Depending on the results we achieve, high-accuracy satellite-derived DEMs may become standard data inputs in our seismic processing workflow." ■

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- www.pioneer.com
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