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High-resolution displays effective for regional interpretation

'Detail in context' offers the interpreter a different perspective.

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Exploration teams prospecting for new reserves in frontier areas, underexplored basins, and even developed basins, are leveraging regional-scale datasets to gain new insights that may help predict potential for hydrocarbon accumulation. Geoscientists historically have relied on a large-scale perspective to more thoroughly understand stratigraphic and structural history as the foundation for estimating hydrocarbon source, migration pathway, maturation history, trap, and seal. However, it has always been a challenge to visualize large datasets and disparate data types in a common system at the data's full resolution.

New tools

To explore more effectively today, geoscientists are revisiting exploration fundamentals with new tools. Continued improvement in seismic acquisition is delivering more data, higher data resolution and quality, and ultimately more subsurface information than ever before. Thanks to new ultra-high resolution display systems coupled with modern computer power and innovative software, the interpreter is no longer forced to choose between quality and quantity; all data can be displayed. Subtle yet critical geologic features and seismic character now can be preserved and visualized in context of the basin scale. By visualizing the details in the larger context, geoscientists are able to better understand the petroleum system. Armed with this knowledge, they are able to more efficiently develop new play or prospect concepts and resolve ambiguities at the reservoir level.

Successful exploration on such a scale also typically requires integration of many disparate data types, including 2-D and 3-D seismic surveys, well data, production data, potential field data, lease boundaries, and ownership information. Image data from satellites and maps or cross-sections from previous studies are often used. The ability to integrate these data types, each with its own scale and format, in a common visual environment can enable construction of a cohesive basin-scale interpretation.

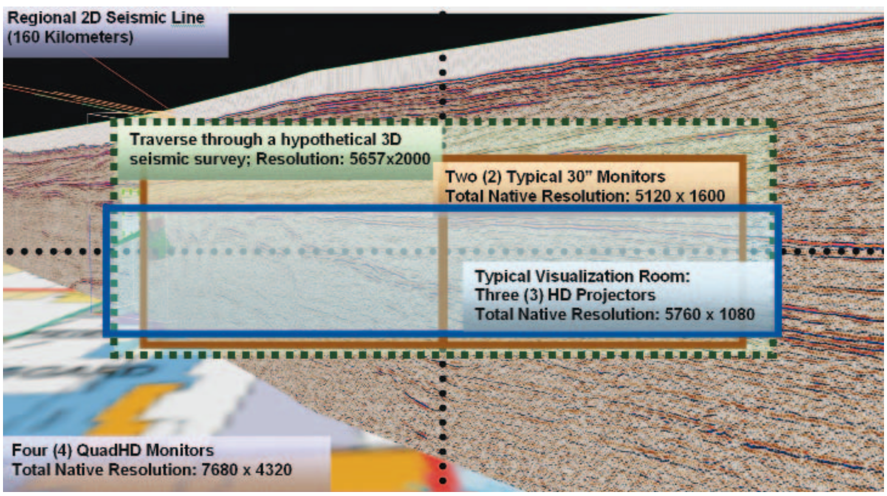
Additionally, by displaying all of the data in a single visualization environment, it is possible to quickly discover and correct potential positioning errors in the data.

High-res display fundamentals

Large, ultra-high resolution display systems are becoming increasingly available and less expensive. It is no longer necessary to purchase exotic computer hardware to drive these displays. At the Society of Exploration Geophysicists 2009 Annual Meeting, Halliburton showcased Geoprobe software displaying regional data on a 32-megapixel display. The display used four BARCO LC-5621 QuadHD monitors driven by an HP Z800 workstation with two NVIDIA Quadro Plex 2200 D2 visual computing system modules. The native resolution of 7,680 by 4,320 pixels for each monitor delivered a regional-scale image with 16 times the resolution of a 1080p HDTV.

While the display system could be improved by removing the monitor housings for a more seamless display, this demonstration showed the feasibility of constructing an ultra-high resolution display system from off-the-shelf components. Several vendors are now developing near-seamless display components.

The pixel resolution of a display system is commonly defined as the number of picture elements (pixels) presented by the display. The pixel resolution is typically given as two numbers, where the first is the number of pixel



The data shown in a quad screen display is about three times that shown in a typical 3-D traverse (green box, four times the amount shown in a typical dual monitor display (orange box), and 5.5 more than data displayed in a typical visualization room (blue box). (Images courtesy of StatoilHydro and the Norwegian Petroleum Directorate) columns (width) and the second is the number of pixel rows (height). For reference, high-definition display formats such as 1080p have a resolution of 1,920 by 1,080.

Related dimensions are the physical size of the display and its pixel density. Together, they define total resolution. The price of high-resolution desktop monitors has fallen, and as a result interpreters can now have more pixels available on their desktop than in the visualization center down the hall.

Digital projectors, plasma panels, and LCD monitors consist of a fixed array of pixels. The dimensions of this array are referred to as the device's native resolution. While these display devices can typically accept signals at several different resolutions, if the incoming signal does not match the native resolution of the device, the image is scaled (interpolated) to fit the native resolution. This causes a loss in quality. When there is not a one-to-one pixel mapping, there can be distortion and imaging errors.

Similarly, if the data being displayed has a higher resolution than the native resolution of the display device, the data image will be scaled to fit the screen. This too causes degradation and may obscure subtle detail in the data — for example, subtle faults, depositional features, or amplitude variation.

See the forest and the trees

To better understand what workflow benefits ultra-high resolution displays can deliver to seismic interpretation, consider a hypothetical 3-D seismic survey with the following parameters:

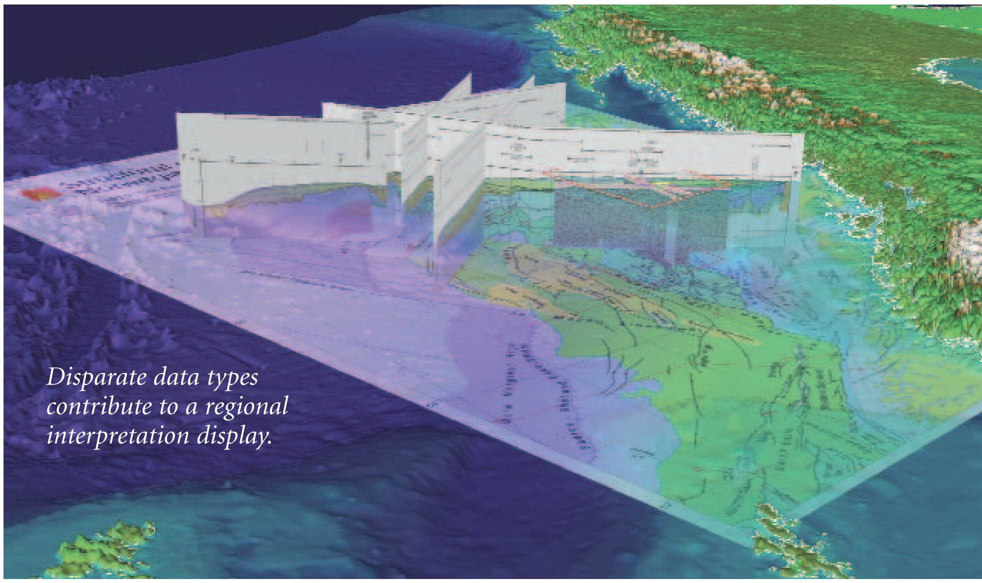
- Areal extent: 100 km by 100 km
- Seismic bin size: 25 m by 25 m
- Time range: 0-8,000 ms
- Sample rate: 4 ms

This dataset covers approximately 427 OCS blocks, which translates to a seismic cube with the dimensions 4,000 by 4,000 by 2,000 voxels. A diagonal traverse through the cube would have a lateral dimension of 5,657 voxels. If the typical desktop interpretation display environment is two adjacent 30-in. monitors having native resolution of 2,560 by 1,600 each, they would not quite be able to display a single line or cross-line at its full horizontal resolution.

The data dimensions of a regional 3-D seismic survey or regional 2-D lines can be much larger than the example. The limitations of this typical display environment would not allow the interpreter to see the entire dataset at its full resolution. To appreciate subtle faulting or depositional features at full resolution, the interpreter will have to zoom in.

In this scenario, the interpreter is forced to zoom out to appreciate the regional perspective and zoom in to interpret detailed features. In complex areas, it is easy to lose one's place in the data, which forces yet another round of zooming in and out. This interpretation technique is inefficient and time-consuming.

A large, ultra-high resolution display is a tool that can help make an interpreter more efficient by not only enabling the display of full-resolution data, but also by reducing the time spent panning and zooming while interpreting. For example, the interpreter can better appreciate reservoir-scale features in the context of regional trends. We call this "detail in context." By viewing all of the data at full resolution, the interpreter can see the forest and the trees.



Disparate data types contribute to a regional interpretation display.

An integrated system

Display hardware is just one component of a functional high-resolution interpretation system. Effective interpretation of ultra-high resolution displays at this scale requires software applications designed to drive real-time performance. To achieve this level of performance on very large datasets, Landmark GeoProbe software uses multithreaded operations and leverages the graphics processor. In the past, interpreting very large data sets at full resolution without decimating or trimming required systems to have very large physical memory. Alternatively, GeoProbe software streams data directly from disk, allowing interpreters to navigate massive datasets in real time without the need for large expensive system memory.

Effective exploration for new reserves requires interpreters to integrate disparate data types and interpret large high-resolution datasets. Visualizing high-resolution details in the context of a regional or basin-scale perspective is valuable to prospect generation and reservoir understanding. Ultra-high resolution display environments and interpretation software available today can aid in accelerating more efficient prospect generation workflows. E&P