Largest ever full wave seismic survey – 529 km² of China

Intelligent Energy - where we go from here

High performance computing - persuading your boss to buy it

Doing more with fibre in wells

How StatoilHydro hopes to reduce operating costs by 30%
A new way to detect oil: 5hz passive seismic
Building better structural models
Paradigm has developed a new software tool, called SKUA (“Subsurface Knowledge Unified Approach”), which, it believes, enables geoscientists to put together much better earth models more quickly, which, in turn, can be used to perform much better reservoir calculations.

SKUA addresses a problem with the conventional way structural models are currently put together using a series of 2D and 1D operations. In SKUA, operations are performed synchronously in 3D space to ensure integrity of data and consistency of output results.

To explain:

The conventional way of constructing structural models involves connecting the top and base of horizontal layers with pillars, resulting in 3D grids of data that ultimately will be populated with a variety of rock and reservoir properties.

Where faults are present in these rock layers, the pillars need to be aligned with them.

Pillars are placed at regular distances connecting together the tops and bottoms of 2D horizontal layers, creating a model which is built up of cells (blocks).

This is a long and tedious process, which is normally done manually; it also involves a lot of fudging, or effort to force the data to fit the pillar model, when things do not quite fit. This is particularly the case when attempting to model layers with complex fault intersections.

When the model is run through a computer program (for example, to extrapolate well log information outwards away from the well), the assumption is made that all of the cells are the same size, and the walls are all either vertical or horizontal, and parallel with each other.

This is a reasonable assumption if there are no faults in the model, or if the pillars can follow the path of the faults, and the faults are close to vertical.

However, this is not a reasonable assumption if the fault paths are complex, such as with Y faults (two faults joining together, for example see Figure 2) and with other complex fault styles found in many deformed rocks.

In such cases, the modeled cells can end up a long way away from being equally sized (see image figure 3), and if you assume that they are, subsequent calculations (e.g. volumetrics) that make use of the cell, interpolated values can be quite misleading and incorrect.

For example, when you are making calculations on the size of reservoir sand bodies, these calculations are made based on assumptions of true distance separation (e.g. 100m) at the time of deposition.

When the cells have been abnormally stretched or squeezed from the original depositional state (e.g. 10 meters) to the present day geometry (e.g. 2 meters), the sand body in the present time is then sized at 20 meters instead of 100 meters.

Also, when faults are not vertical and grid cells are aligned along the fault planes, calculations involving gravity flow will be in error if the calculation is performed on the basis that liquid will flow vertically from point A to point B, when in fact the liquid will flow from point A to somewhere else entirely.

Paradigm’s solution is to construct a subsurface model of the earth in three dimensions from the outset.

Part of this three dimensional solution is to provide the modeling program information about how the rock layers were deposited.

For every rock layer, as well as providing XYZ information about the location of the different features, the system assigns a dimension T (geochronological time) for when the rock layer was deposited, and a geographic coordinate UV at the time (T) of deposition.

With all of this spatial information (XYZ) where UVT are known, it is much easier to make computer calculations about what is happening in the reservoir and how
Exploration and drilling

the properties are likely to vary in the reservoir (geostatistics).

Benefits
The software provides the biggest benefits when modelling highly complex structures that could not be modeled well using the previous technology.

The software was launched in 2008, and “everybody is amazed with the results,” says Jean-Claude Dulac, executive vice president and chief architect with Paradigm.

Long time “geomodelers” are claiming that they “are able to perform modeling operations that they were unable to do before.”

“You get a better representation of the subsurface, and you don’t have to deform the model to make use of it for subsequent reservoir calculations,” he said.

“We used to fit the earth to the tool. With SKUA, we can model the subsurface honoring the integrity of the available data.”

Paradigm estimates that with the new system, it can reduce the amount of time to model a complex environment (e.g. 51 faults, three thin beds and 12 horizons), from months to days, or reduce the amount of time to model a thrust with 30 different faults from days to hours.

If you can make models more quickly, then many more things become possible. For example, you can create different models of the subsurface for different scenarios, and then see which one is the best.

You can also run more history matches (compare the actual historical reservoir data to what the model thinks would have happened).

Ultimately, you can get a better and faster idea of the subsurface, which should lead to more productive wells and fewer dry ones.

Better Flow simulation
Having a better geological grid means that the accuracy of reservoir flow predictions through simulation will be improved. The geological grid is available to compute volumetrics – i.e. how much oil is thought to exist in a certain location. The reservoir simulation grid is passed through a flow simulator to provide insight into how fluids will flow in the subsurface once production starts.

Reservoir simulation grids typically have a much lower resolution than geological grids, with cells of 50-100 metres, and about 1 million cells in total, compared to the geologic grid with cell sizes of ten feet (3m) and about 100 millions cells in total. In SKUA, reservoir simulation grids can be automatically computed (upscaled) from the geologic grid through this unified volumetric approach, ensuring accuracy and consistency in modeling when moving between the two domains.

Listening for oil
Spectraseis of Switzerland is developing a remarkable new technology, which can spot oil and gas reserves just by listening to them.

Imagine, a way of finding oil and gas reserves by from the noise they make. It sounds too good to be true, and Ok, it is.

But the truth is that Swiss company Spectraseis has developed technology based around 2003 University of Zurich research, showing with a fair degree of certainty that many reservoirs give off very weak seismic waves of 0.05 to 5 hertz (waves per second).

The research also showed that thicker oil columns can create stronger waves (with bigger amplitudes).

No-one knows for certain the physical mechanism behind this phenomenon.

The leading theory is that there is a resonance of the 0.12 to 0.13 Hz waves which echo around the whole planet, caused by the interaction between the ocean and the earth, also called Ocean Wave Pak (OWP) which have been known about for some time.

“One of the theory is that these OWP shake the reservoir very slowly. It gets the hydrocarbons blobs inside the reservoir to resonate, and then remit a signal that can be heard at the surface in the 2-4 Hz range,” suggests Brice Bouffard, vice president, sales and marketing with Spectraseis.

But it does not really matter what the source of the wave is. The important thing is that the low frequency signals have been observed coming out of underground hydrocarbon deposits, and can be used to help find hydrocarbon deposits, or work together with other sources of information to collectively improve the understanding of the likelihood that oil is there, before drilling.

Spectraseis does not promise to offer technology which can suddenly make it obvious where all the oilfields are, but it does provide information which companies can add to the mix.

So, for example, if oil and gas companies use seismic surveys to identify where structural traps might exist, they can also use a passive seismic survey from Spectraseis to get a better idea about whether or not the trap still holds oil.

Not all oilfields emit seismic waves, and sometimes there are seismic waves of this frequency which have not been emitted by an oilfield.

“We’re not making the claim to be able to find all the oil in the world. What we’re addressing is some of the challenges you have with existing seismic survey,” says Ross Newman, CEO.

“There’s a lot of information in this domain that has the potential to dramatically improve the chances of finding oil,” he says.

You could say, that if seismic technology was perfect, you could use it to create a