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New Reservoir Modelling Software RMS 2011

TACKLING COMPLEX GEOLOGIES

Roxar RMS 2011- Tackling complex geologies within your reservoir model

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Whether it is fractures and fault-prone fields, complex geological formations, such as salt and basalt structures, or just deeper and more remote geological settings, few would argue against the fact that many oil & gas fields are becoming increasingly difficult and complex to model.

All too often, however, the default position of reservoir modelling solutions in meeting this challenge is to oversimplify the model. The result is that users, who commit to one particular modelling package, find out further down the road that their models are simply not robust and accurate enough to meet their reservoirs' complexities.

At this stage, with so much investment having already been expended, there is no turning back, leaving it up to the reservoir engineer to try to quickly 'fix up' the model. The resulting oversimplified reservoir model will have inevitable consequences for reservoir management decision-making with the worst case scenario being reduced field productivity and even misplaced wells.

It is vital for reservoir modellers today to embrace their fields' complexities, avoid the urge to oversimplify their models, and generate accurate data for future reservoir management decisions – from bid valuations to new field development and operational plans, production estimates or divestments

This article looks at how this is being achieved through Emerson's new reservoir modelling software package, Roxar RMS 2011 a software solution that can cope with whatever structural or modelling complexity is thrown at it. A good example of this is in the case of seismic.

Fig.1

A World of Growing Complexity

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The Incorporation of Seismic into Reservoir Models

The ability to integrate seismic data within the reservoir model is central to addressing today's complex reservoir environments and creating an accurate and realistic geological model. The better you incorporate 3D seismic and reservoir heterogeneities into your reservoir model and extend the depth of your static modelling, the more accurate and realistic your models will be.

The last few years have seen an acknowledgement of this and the continued expansion of reservoir modelling into the geophysics domain. The acquisition of 3D seismic is now very much a part of the reservoir model building process, ensuring deeper penetration into the reservoir and high frequency and well constrained reservoir models.

For example, Roxar RMS 2010.1, launched in August 2010, added advanced seismic volume visualization tools to the workflow - tools which facilitate thorough quality control of interpretations, structural and property models, simulation models, and well plans.

To date, however, 4D seismic – a proven technology for monitoring fluid movements and identifying undrained compartments in a reservoir – has rarely been used in reservoir modelling. Instead, it has tended to be deployed as part of IOR (Increased Oil Recovery) techniques to identify new well targets. 4D seismic has been prevalent, for example, in a number of North Sea oil fields, such as Gullfaks, Troll and Oseberg.

The expansion of reservoir modelling's seismic functionality over the last few years, however, has enabled us to take our RMS 2011 software to the next level where 4D seismic can be incorporated into the reservoir model, alongside existing data types, such as geological, geophysical and simulation data.

RMS 2011 comes with enhanced facies modelling tools, enabling the user to rapidly combine the latest 4D seismic surveys into its models to improve the quality of interpretations, structural and property models, simulation models, and well plans.

An important strength of Roxar RMS is the ability to create seismically-driven reservoir models. This can lead to the creation of synthetic seismic from the simulation model and the comparison of these to observed seismic.

RMS 2011 will enable the analysis of observed and synthetic seismic attributes, the extraction of 4D geobodies and the management of 4D vintages to identify production effects and obtain key information on the state of the reservoir.

Combining observed and synthetic 3D and 4D seismic data with elastic parameters - where the synthetic seismic generated from the simulation model is compared to already observed seismic – will lead to improved geological and simulation models and production forecasts.

This forward modelling of seismic is often referred to as petro elastic modelling.

The incorporation of 4D Seismic into the reservoir model brings benefits for both reservoir monitoring and well planning.

A shared reservoir monitoring platform brings together the entire asset team to reduce the number of iterations and decision-making time; 4D Seismic improves the quality of interpretations, structural and property models, simulation models, and well plans; and RMS 2011 can also lead to a more quantitative use of 4D seismic data, especially towards history matching.

Tackling Salt

One the most complex geological structures operators have to model today is salt.

From the salt structures of the Gulf of Mexico to the sub-salt of the Santos Basin, offshore Brazil (a geology mirrored on the far side of the Atlantic on the African margin as well), salt comes with a number of challenges, including poor visibility and the fact that in regions, such as Brazil and West Africa, total depths from the sea surface can be as much as seven kilometres.

RMS 2011 comes with the ability to model beneath and around salt and other complex structures. Features include complex fault modelling, an advanced 3D gridding engine, and the building of intrusion objects into structural modelling to better model salt. This ensures that complex features often seen around salt, such as complicated fault inter-relationships and overturned beds, are not simply passed over in an attempt to simplify the model.

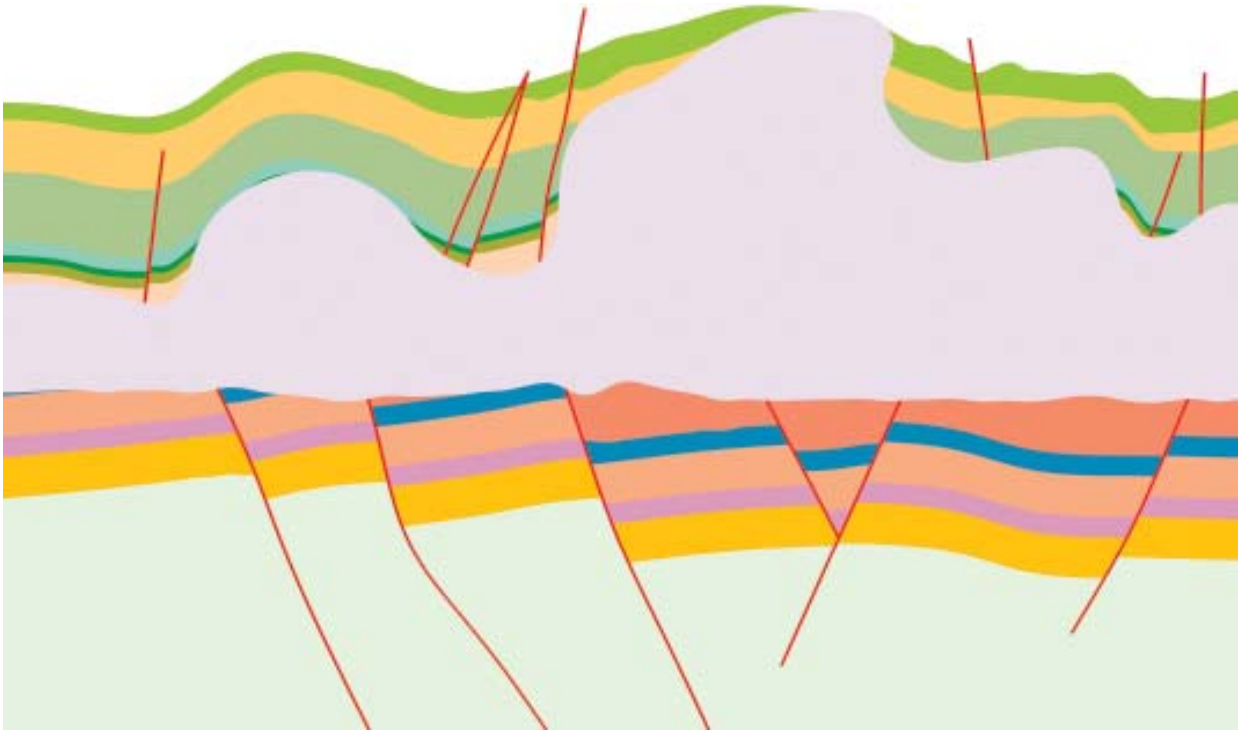

Fig.2

With RMS 2011, modellers can model the entire geological section in one model from target to surface. Figure 2, for example, shows how it is possible to tie together all the elements of the structure– vital to the model when looking at migration, trapping, pressure regimes, compartmentalisation and predicting reservoir presence.

The illustration in figure 2 shows a cross-section of the full model with the deformed post or supra-salt section (in green) and the deformed salt body (grey) sitting on the rifted and eroded pre-salt section (pink and blue). Through reservoir modelling, a complex model can now be handled as a single entity.

Figure 3 shows the top surface of a salt wall and diaper with over-hangs - a geological feature commonplace in sub-salt exploration. The accurate handling through the reservoir model - not just of the shape of the salt but also the shape of the sediments as they intersect the salt structures - is essential in developing an accurate reservoir model and for future reservoir management decision-making, where all fault linkages and complex fault populations need to be captured.

Additional Features

Yet, it is not just 4D seismic and salt

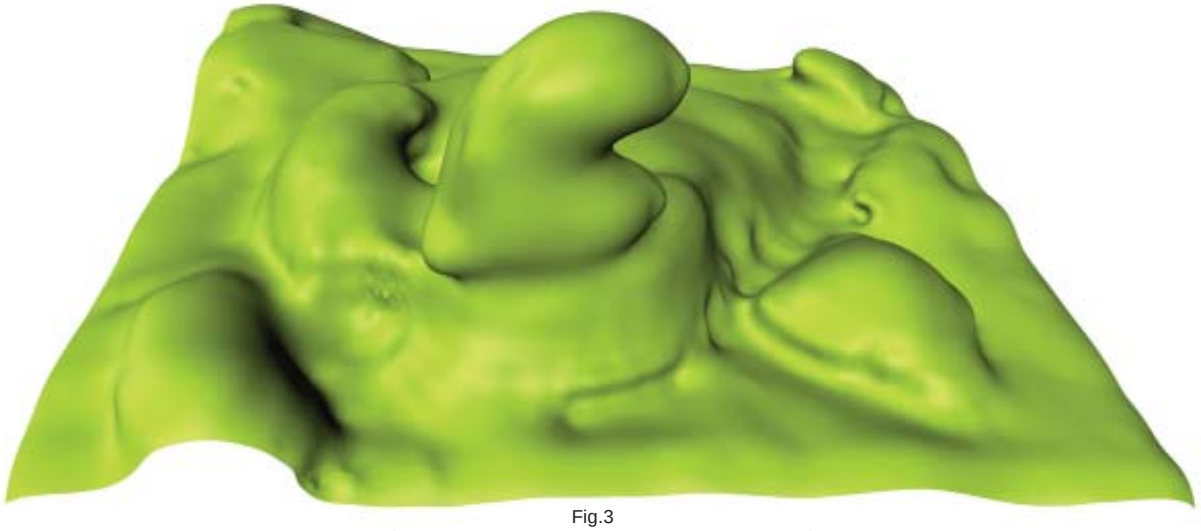

Fig.3

where RMS 2011 is leading the way in supporting modellers and the ever challenging geologies they face.

RMS 2011 comes with a number of new well correlation tools, for example, which provide improved handling for horizontal and vertical well correlations which cross stratigraphic boundaries. Users can split the horizontal well into separate sections so that well data can be inspected in the most practical manner possible.

In addition, advanced ghost curve capabilities can mix and match curves and users can also examine array logs on top of one dimensional well logs, allowing for correlation to take place by taking into account seismic data as well as resistivity logs.

Fractures are also fully integrated into the RMS 2011 workflow through a DFN-based (Discrete Fracture Network) model which enables robust, fractured models to be built faster, providing an important tool in tackling the complex, fracture-prone geologies prevalent throughout the world. This is particularly important when two-thirds of the world's proven reserves lie in areas of the world with acknowledged issues with fracture-affected recovery.

A Single Data Management Platform and the Importance of Usability

Two of the single most important features in any reservoir modelling workflow – especially when tacking complex geologies – are integration and usability. It's simply not feasible for reservoir models to work if they are held back by a lack of interoperability with other tools and data formats and a cumbersome working and visual environment.

With RMS 2011, users are able to easily import large 2D or 3D surveys and enjoy an optimised working environment with updated data analysis charts, multiple and highly interactive visual displays and the best in graphics technology. For quality control purposes, for example, the user can also produce all the necessary charts and maps to check consistency between the property models and the input data.

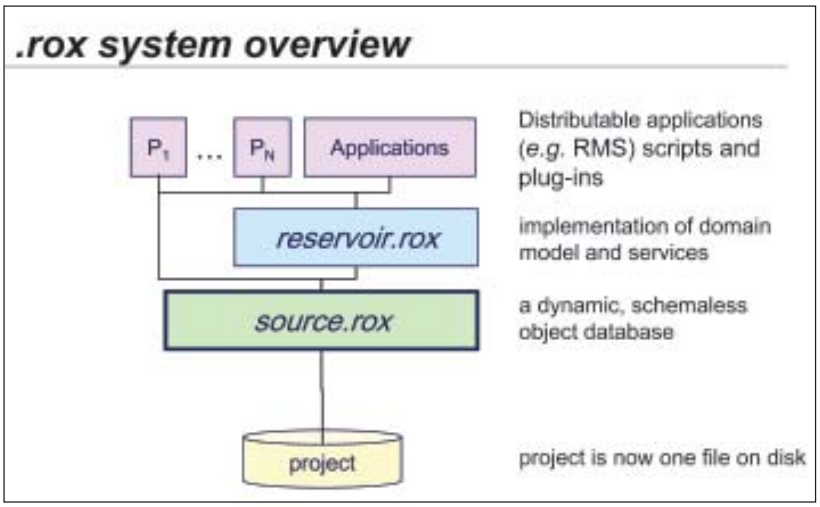

Fig.4

Furthermore, in response to user needs for collaboration and integration, Emerson is taking this a step further the new .rox framework, which will provide an integrated user and common data management platform which applies not just to Roxar RMS but ultimately all of Emerson's reservoir management software.

The framework will be scripted with Python, will be designed for scalability and will have a plug-in capability to RMS. As illustrated in figure 4, it will consist of distributable applications, scripts and plugins which enable users to access all Emerson's reservoir management software; a domain model of the subsurface covering geophysics, geology and reservoir engineering objects (reservoir.rox); and an object database for geological and production data (source.rox).

Building Robust and Complex Models

As operators are faced with deeper and more challenging geological settings, any reservoir model that oversimplifies the obvious geological complexities is not going to deliver the vital information operators require for well planning and reservoir management today

RMS 2011's ability to leverage seismic and accommodate complex geologies will ensure that the challenges of complex geologies are met. The result will be faster, more robust and reliable production models, improved decision-making, more justifiable investments, and enhanced field performance. dewjournal.com

about the author

Tyson is currently Product Manager within Emerson's Roxar Software Services division. Prior to joining Emerson, Tyson spent 20 years at Schlumberger, with the last seven years as part of the Petrel portfolio team where he was responsible for the business side of product development, outlining product strategy, business cases and high level functionality requirements. Tyson was born in the UK but grew up in South Africa. He began his career working as part of a land seismic field crew in South Africa.