

Advanced solutions support enhanced exploration and field development across North Africa and the Middle East

Subsurface modelling in 3D

NEFTEX PETROLEUM CONSULTANTS Ltd (NefTex) is a UK-based international geoscience consultancy specialising in the provision of sequence stratigraphic models for E&P companies. Its vision is to provide a single digital global structural and stratigraphic subsurface model in 3D.

Formed in 2001, NefTex specialises in the interpretation of geoscience datasets (for example, outcrop, subsurface, drilling and engineering) and the delivery of these as integrated subsurface models.

Services

NefTex's services include on-line subscription to non-exclusive sequence stratigraphic interpretations of the Middle East and North Africa, the Black Sea - Greater Caspian and West Eurasia. These models allow - for the first time - the robust linkage of system tracts between exploration and field development activities, with operator data being integrated with NefTex data as necessary.

NefTex's customers include 12 of the world's largest E&P companies, including BP, Chevron, Petrobras, Petronas, Devon, Shell and Statoil amongst others.

One of NefTex's flagship products is NefTex

MENA, an on-line database and interpretation of the complete sequence stratigraphy and petroleum geology of the Middle East and North Africa (MENA) region. Companies can either subscribe to the North Africa or Middle East regions, or, for maximum synergy, both together. The database consists of publicly available information which is then interpreted by NefTex's geoscientists.

For all the benefits of the 2D geodatabase, there was a growing move towards integrated 3D models. Sarah Williams, geologist at NefTex, continues: "While we knew we were filling an important gap in the market with our stratigraphic models, we wanted to give our clients more - an integrated 3D model that provides a fully accurate geometric representation of the structural and stratigraphic compartments within the exploration reservoir."

"Geology is itself three dimensional and 3D models of source rock, reservoir and seal help

reflect this, with the increased visualisation capabilities also helping to quality-control the interpretations from plate to pore."

This 3D model of the MENA region is the NefTex MENA Cube - the only 3D sequence stratigraphic project database on the market today covering the entire MENA region.

Predict subsurface risk

The result for customers is an ability to better predict subsurface risks, such as source rocks, seals and traps (thereby providing them with increased competitive advantage), as well as develop QC field reservoir models within a robust 3D regional framework.

A few years ago, to build an integrated 3D model covering such a vast area and including such large quantities of data would have been unthinkable. Normal 3D models are built over a single reservoir or a few neighbouring reservoirs and even regional mapping tends to cover relatively small areas.

The rise of 64-bit computing and lower cost, high performance desktop workstations, however, has meant that the vision of a single 3D subsurface model is now attainable.

It was within this context that NefTex decided on Roxar's industry leading reservoir modeling software IRAP RMS™ as the vehicle to meet their goals of a 3D integrated subsurface

For all the benefits of the 2D geodatabase, there was a growing move towards integrated 3D models.

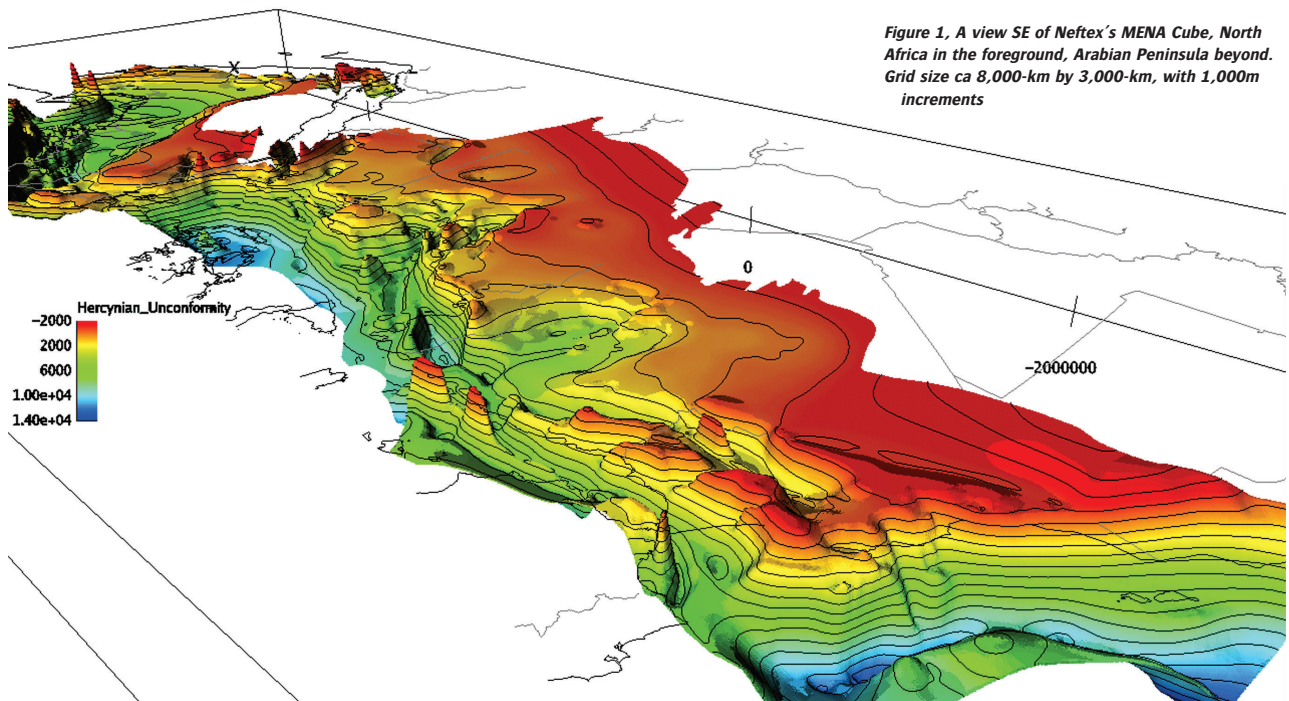


Figure 1, A view SE of NefTex's MENA Cube, North Africa in the foreground, Arabian Peninsula beyond. Grid size ca 8,000-km by 3,000-km, with 1,000m increments

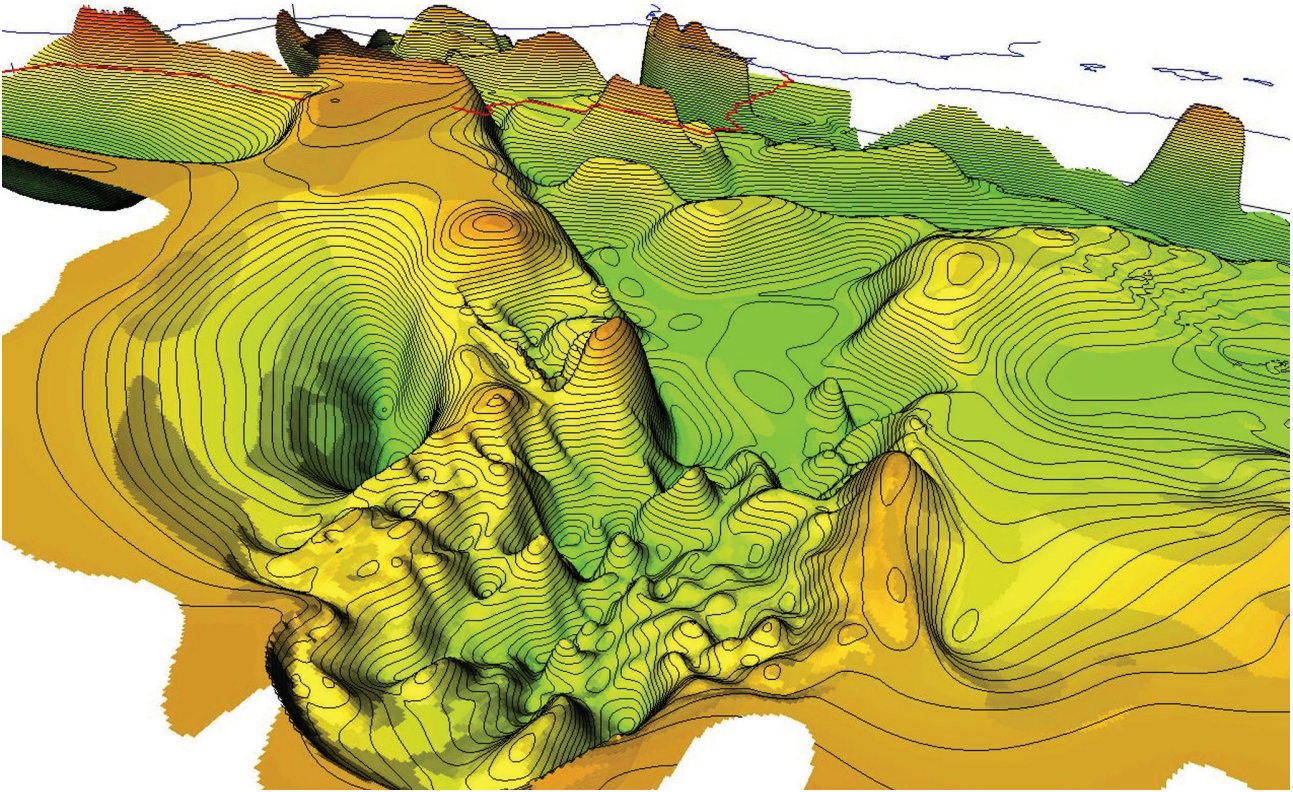


Figure 2, a detailed View of Neftex's North Africa Cube (view NW to Hassi Messaoud, national boundary in red)

model. Sarah Williams continues:

"What was essential to Neftex in developing the Cube was that we did not compromise any of our original data in taking it 3D. We needed a modeling package that had sufficient robustness and scalability to handle large amounts of data on the fly."

"By operating on all 64-bit platforms, IRAP RMS™ allowed us to honour our original data, build our 3D models in considerable detail with high data volumes and provided us with the necessary robustness to calculate complex algorithms."

"And for our clients, there would be no

Roxar's IRAP RMS™ comprises 14 fully integrated software modules including mapping, modeling, planning and workflow management tools.

compromising of performance with the ability to run larger, more detailed models from the desktop at high speeds."

Roxar's IRAP RMS™ comprises 14 fully integrated software modules including mapping, modeling, planning and workflow management tools. All modules operate seamlessly together, leading to a dynamic and closely integrated modeling workflow. In contrast to many other reservoir modeling packages, IRAP RMS™ operates on all common 64-bit platforms.

The sheer amount of data and maps which were to be imported into IRAP RMS™ was immense. It consisted of the mapping of up to six regional horizons over an area ca 8,000 km by 3,000-km, the importing of over 1,500 wells, over 150 regional cross-sections, over 600 digitised field depth contours and over 200 GIS facies maps. Data now being loaded to the Neftex MENA Cube include some 30 additional regional depth maps, 500 new wells and over 5,000 outcrop sections.

The grid scale was chosen at 1,000 metre increments - a level of detail that ties exploration to production thus meeting customers' needs, but also ensures that the time to manipulate and visualise the models was not too excessive.

Neftex found that the best workflow for the Neftex MENA Cube, where large datasets within IRAP RMS™ had to be managed over regional scales, consisted of 1) loading wells, surfaces, GDE maps and cross sections; 2) re-gridding the depth maps and tying them to the cross sections, fields and wells; 3) creating isopach maps, which display the stratigraphic thickness of the rocks; and then 4) checking for consistency (see Figures 1, 2, 3).

MENA Regional Cube in IRAP RMS

Neftex MENA Cube Workflow

Experience shows the following to be the best workflow

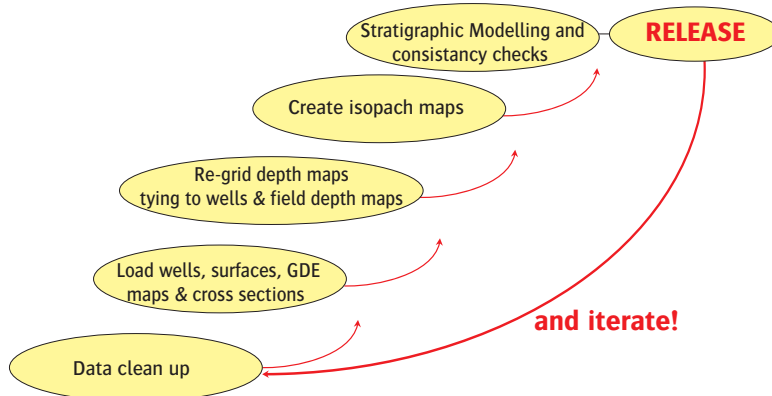


Figure 3, Neftex Cube Workflow

Furthermore, with the mapping having a different scale of operation from regional mapping, different mapping algorithms were selected to tie the regional depth surfaces to the 600+ field depth surfaces. The consistency of interpreted horizons was also checked at each stage.

The Neftex MENA Cube was first released in February 2006 and, as newly interpreted wells have been incorporated into the data, updated versions are released each month.

The result for subscribers is a completely scalable 3D product tying field developments and exploration together into one subsurface model. This allows increased efficiency and better stratal and geometric understanding, leading to reduced risk and increased value. Value increases exceed the cost of the product and software. Specific features of the Neftex MENA Cube within IRAP RMS™ include:

One particular IRAP RMS™ module that is a key tool of the Neftex MENA Regional Cube is RMSwellstrat™, a well correlation tool. RMSwellstrat™ has allowed Neftex to group wells by classification, create well fence diagrams, view well trajectories and log data in 3D alongside other important reservoir data such as seismic, fault information and existing maps. Subscribers to RMSwellstrat™ will also benefit from this feature on the Neftex MENA Regional Cube.

Scalability

With the rise in 64-bit computing and the unrivalled scalability of IRAP RMS™, users can also run the Neftex MENA Cube at high levels of performance. The Cube is also very stable and robust.

The typical hardware a user requires running the Cube is four to 16 gigabytes of RAM, 370 gigabytes of hard drive space and a high specification graphics card. With many geoscientists and reservoir engineers now having access to workstations with these specifications, the Neftex MENA Cube can be utilised across the workflow team.

The improved and faster visualisation capabilities allow users to run stratigraphic models from the desktop in greater detail and to a higher degree of accuracy.

Case study summary

Customer: Neftex Petroleum Consultants Ltd (Neftex)

- ◆ **Challenge:** To produce a commercial 3D stratigraphic model covering the entire MENA (Middle East/North Africa) region - the Neftex MENA Cube™. The challenges involved both the large area to be modeled (ca 8,000km by 3,000-km) and the quantity of data including over 600 field depth maps and 1,500 wells.
- ◆ **Solution:** Neftex imported and presented the data within Roxar's flagship reservoir modeling product, IRAP RMS™. The rise in 64-bit computing (IRAP RMS™ operates on the Linux 64-bit, UNIX 64-bit and Windows 64-bit platforms) and IRAP RMS™'s scalability was central to the project's success.
- ◆ **Results:** A digital 3D database presented within IRAP RMS™ in a single unique 3D environment. The Neftex MENA Cube is fully integrated, provides greater detail of the MENA region subsurface, is easy to use, and has strong visualisation capabilities, enabling Neftex's clients to increase their structural understanding of fields and significantly reduce their subsurface risk.

With the rise in 64-bit computing and the unrivalled scalability of IRAP RMS™, users can also run the Neftex MENA Cube at high levels of performance. The Cube is also very stable and robust.

By accurately representing the reservoir and with the use of geographic co-ordinate systems (taking into account that the earth is not flat), a fully integrated structural and stratigraphic interpretation of the regional reservoir objective can be developed as well as improved volumetric estimates.

Next Steps - Taking Exploration Mapping and Regional Model Building to a New Level

Neftex is looking to incorporate ever greater detail into the Neftex MENA Cube through the addition of all 2nd order depth surfaces (c.40) tied to all wells and well 'sticks', the creation of isopach maps, depth and temperature maps and even object modeling (e.g. highstand carbonate platforms, lowstand clastic wedges etc) during

play fairway evaluation. Currently six depth maps are at the final stage of refinement with Neftex using the latest interpreted well picks to tie to the surface as well as well sticks gathered from field depth maps. Over the next few months, an additional 500 plus wells are also likely to be incorporated into the model. Of particular interest to Neftex is another IRAP RMS™ module, RMSfaultseal™, an easy to use, multi-platform fault seal analysis solution which will analyse fault zone properties within the integrated reservoir model workflow. Through RMSfaultseal™, there will be a greater acknowledgement of faults within the stratigraphic analysis.

Sarah Williams concludes on what she believes has been achieved to date: "We are enormously proud of the Neftex MENA Cube which is an industry first. Whether it be the high levels of visualisation, integration, scalability or structural understanding, the Cube operating within Roxar's IRAP RMS™ is a unique 3D, regional subsurface model. It is helping to unify exploration and development activity and take exploration mapping and regional model building to a new level."

"This could not have been achieved without the integrated workflow tools and scalability of IRAP RMS™." ■