ConocoPhillips has held Block 48/10b in the UK southern North Sea for some 40 years. The first gas production from the Saturn field in this block was achieved in September 2005. The main geophysical challenge of this block is to understand the sub-salt wall structure of the Rotliegendes reservoir. A variety of geophysical techniques have been applied, some of the earlier methods are briefly reviewed. The main emphasis of this presentation is the interpretation of the pre-stack depth migrated data and its subsequent depth conversion, including a subjective method of removing the artifact created under the salt water overhangs. The result of the recent horizontal wells, together with the pre and post drilling interpretations are used to show the limitations of the seismic reflection data to predict the details of the reservoir structure beneath this salt wall. Finally, a brief review will be made of the two previously stranded gas fields that will be developed using these new Saturn facilities.
First Gas after 40 Years – The Geophysical Challenges of the Saturn Gas Complex

S D Elam
ConocoPhillips
Geographical setting

Block 48/10b
Lower Permian Rotliegend reservoir facies

UK mainland

“ Audrey” salt wall

Block containing core Saturn fields

Blocks containing satellite fields

NO ZECHSTEIN SEAL

TRADITIONAL ROTLIEGENDES LEMAN SANDSTONE

DFEATHEREDGE ZONE

SILVERPIT LAKE (NON-RESERVOIR)

CLEMENSandstone

SALT WALL

SALT WALL

AODREY SALT WALL

BLOCKS CONTAINING SATELLITE FIELDS

AAPG - 2007
Top Rotliegend Depth Closure Map

- Mimas
- Hyperion
- Rhea
- Atlas
- Tethys
- Seismic line A'A

AAPG - 2007
Seismic line shows Sole Pit inversion on left, across Audrey salt wall in centre to a more benign area on the right. Note the poor data quality around and under the salt wall flanks.
Saturn Project Timetable

48/10 Block award to Heritage Phillips 1965

48/10b re-issued to Heritage Conoco 1986

First gas discovery (48/10b-2) Dec 1986

Final appraisal well td (48/10b-13) Jan 2004

ConocoPhillips project sanction May 2004

First Gas (40 years after initial license) Sept 2005

1st & 2nd satellite fields drilled Summer 2006
2D – 3D – PSDM across Hyperion & Atlas

2D Time migrated - 1989

3D Time migrated -1993

3D Depth migrated -2001

“Seismic” depth
Rotliegend Interpretations in depth

2D data - 1989

3D data - 1993

PSDM data - 2006

Atlas field beneath salt wall
Isotropic depth migration depth does not give true depth, so the interpretation was done in the “seismic” depth domain and stretched to time. It was then depth converted “properly”.

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AAPG - 2007

48/10b-N1Z, the last appraisal and 1st producer.

Confidence was built with the results of the 48/10b-13 well, so after Platform installation this well was sidetracked as the 48/10b-N1z producer.

What could go wrong now?

A “sub-seismic” fault with 800 ft throw!!
This time the flow only just exceeded that predicted.
The platform was located to allow the development wells to be drilled through the salt wall.
Another sub-seismic fault, this time with only 550 ft of throw. Even though a surprise was expected, this was not!
Schematic cross section with 48/10b-N3Z
Could we have been that unlucky during appraisal?
The dome part of the planned bi-lateral well, was sidetracked from 48/10b-N3Z, and encountered the dome structure with no further structural surprises.
Rhea well (48/10b-N4) on seismic depth map

This well was planned to line up was the target, to mitigate against depth conversion errors.

Note the deliberate lining up with the target.
Seismic depth data along N4 well path

Well 300 ft high to prognosis
Production rate summary

- **48/10b-N2 (Atlas)**
  - Max production: 96 MMscf/d

- **Hyperion 48/10b-N3Z&Y**
  - Max production: 83 MMscf/d

- **48/10b-N4 (Rhea)**
  - Max production: 140 MMscf/d

- **Annabel**
  - Max production: 145 MMscf/d
Both Mimas & Tethys are some distance from the salt wall, hence are less distorted.

Both well encountered the reservoir at expected depths and tested as expected during 2006.

Tethys started production at 75 MMscf/d in Feb 2007.

Mimas should start production this week.
Was it appropriate to delay the project till now?

On balance probably yes, because:

Seismic imaging was poor, it has improved over the years, first with 3D and later with PreSDM. Hence we gained more confidence in the structural configuration. However remember it is still only an image.

Drilling has progressed so more flexibility can now be built into well design, allowing this project to be completed with less wells than previously envisioned, including ConocoPhillips’ longest North Sea bi-lateral well.

The Mimas and Tethys developments depended on getting the Saturn infrastructure in place to make this stranded gas viable.

Finally, importantly we did catch recent high gas price in the UK.
Comments and conclusions

• In complex structures, plan wells which retain flexibility. Here our driller get A+

• In poor seismic data areas “expect the unexpected”. Here I get a B- . I had started to believe my own maps.

• To conclude with a little luck we have a very profitable investment.
Acknowledgements

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To all my colleagues past & present who have worked this area for the last 40 years.
The End

Thank you and any Questions?