

Petroleum Club • 800 Bell (downtown)
Social 11:15 a.m., Lunch 11:45 a.m.

Cost: \$30 with advance reservations, \$35 for walk-ins, space available (\$15 for Emeritus and Honorary).

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by Aafke E. Bouma, Bret D. Hampton
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Shell Exploration and Production Company

The Princess Discovery, Sub-Salt Gulf of Mexico: Challenges of Sub-Salt Imaging in a Fast-Paced Sub-Sea Development

This paper (1) gives a brief overview of the Princess Field and its setting in the Mars Basin in the Gulf of Mexico, (2) discusses the strategy and maturation of the sub-salt seismic imaging and (3) analyzes the impact on the field development.

The Princess discovery is located in 3700 ft of water on the northern flank of the Mars Basin on Mississippi Canyon blocks 765 and 766, adjacent to the Ursa field (Fig.1). Shell is the operator for BP, ExxonMobil and ConocoPhillips. The discovery well, drilled in the year 2000 on a poorly-imaged sub-salt truncation trap, penetrated stacked Upper Miocene turbidite reservoirs.

Given the large uncertainty associated with the sub-salt setting, the development system was chosen to anticipate many different outcomes. This resulted in a four-well, 15,000 psi-capable, dual flowline sub-sea tieback to Ursa, which can be expanded in the future. First production was achieved late 2002 initially through a well drilled to Princess from the Ursa Tension Leg Platform (TLP), followed in late 2003 by the first production through the sub-sea system, some 3½ years after discovery. Challenges that were met during the development not only pertained to the large subsurface uncertainty, but also to the complexity of drilling high-angle extended reach wells through shallow hazard zones and depleted reservoirs. Princess Field is currently (April 2005) producing approximately 45 MBOPD and approximately 95 MMSCFPD through four wells from two different reservoirs.

Princess Field is hidden completely underneath the East Antares salt body. At the time of discovery, the existing 3D data yielded no sedimentary details of the field or even the position of the large Antares salt overhang (Fig. 2). The discovery well was drilled using a limited depth-migrated long-cable 2D image. A large range in the estimated discovery volumes reflected the uncertainty

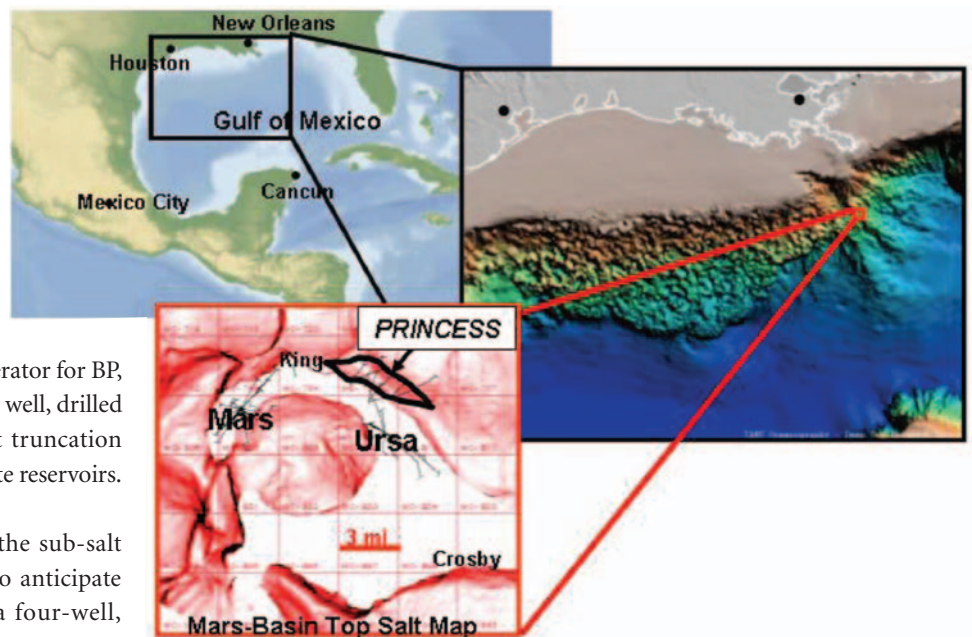
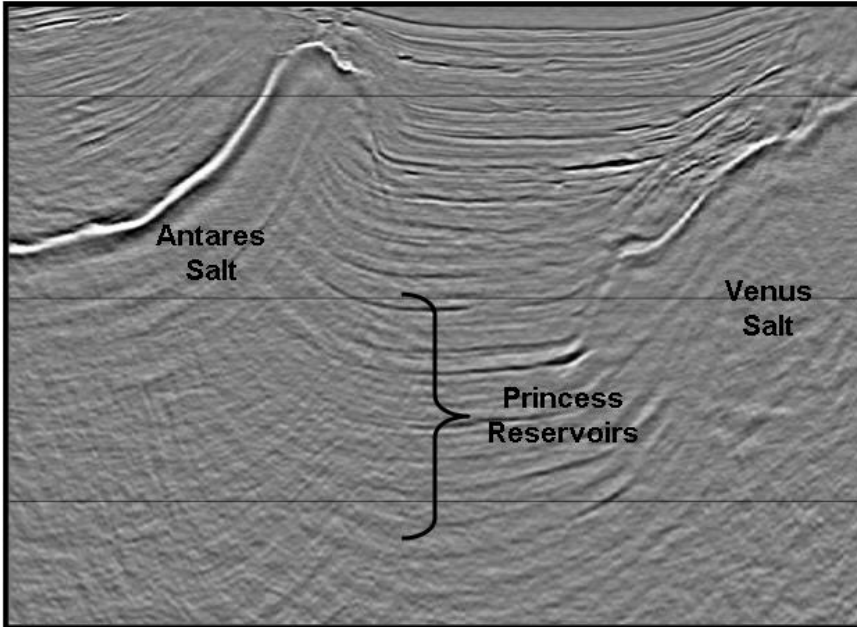


Figure 1. Princess Field location map

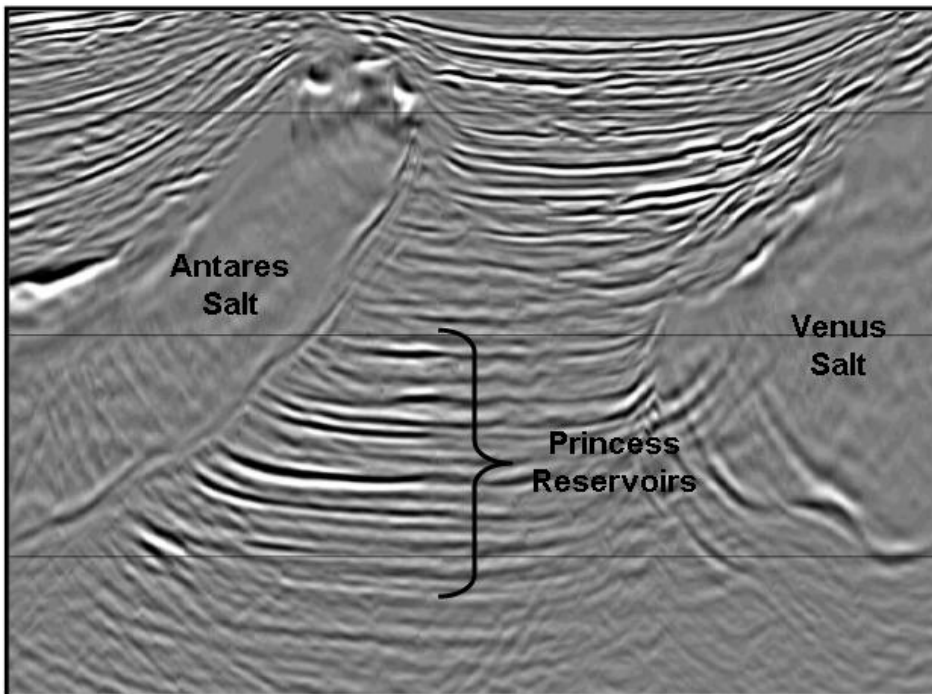
associated with the limitations of seismic imaging below salt and the upside potential in untested stratigraphy and a possible waterflood. To support initial appraisal and development activities the first 3D image was obtained through executing a pre-stack depth migration (PSDM) on existing 1988 seismic data. This survey proved to be in a reasonable orientation to illuminate sub-salt, but lacked the offset range to provide more than a localized image of the field. Consequently a 3D seismic survey tailored to the specific sub-salt setting was acquired. This dataset has undergone various rounds of reprocessing using a number of pre-stack depth migration algorithms and velocity models (Fig. 3). Evaluation of this survey, integrated with well results and borehole seismic data, has provided a step change in the further characterization of the field. The seismic image at Princess is still evolving with technology in pursuit of further development opportunities in the field. ■

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Biographical Sketch

Aafke Bouma has been working for Shell Exploration and Production Company in New Orleans for the past five years as a staff geophysicist in the Mars Basin, deepwater Gulf of Mexico. One of her prime focuses has been the Princess sub-salt development with all its imaging and interpretation challenges. Prior to this assignment she served for four years in Brunei as a production seismologist and field development team leader,



working on stacked shallow deltaic heavily faulted reservoirs, which posed a whole different set of challenges. The first five years of her career after joining Shell in 1992 were spent in London, United Kingdom. There she primarily worked in the deepwater Atlantic Margin Venture as exploration geophysicist. Aafke holds an MSc in structural geology with a minor in geophysics from the University of Utrecht in the Netherlands and is an active member of SEG and AAPG.

Figure 2. (top) 3D time-migrated image at the time of Princess discovery (N40W acquisition)

Figure 3. (bottom) Current 3D pre-stack depth migrated image from dedicated N30E acquisition

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