Santos Basin: 40 Years from Shallow to Deep to Ultra-Deep Water*

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Developments

Santos Basin—350,000 km²

- 1970-1987: 59 dry holes; one discovery—Merluza Gas Field (0.07 tcf)
- 1988-1998: 45 wells, some small discoveries (e.g., Tubarao Field (30 mmbbl)
- 1999-2005: 81 wells, some medium-sized discoveries (e.g., Mexilhao, Tambuata fields)
- 2006-2012: 166 wells, huge discoveries (e.g., Lula Field, 8 Bbbl)
- 2013: Sagitarius Field—31° API oil, sub-salt carbonate, 6150 m depth, 1871 m water depth

Hydrocarbon Type and Age and Type of Reservoir

- Gas in Santonian turbidites--1984 (4900 m)
- Oil in Albian grainstones--1988-2001 (4500 m)
- Oil and gas in Santonian-Campanian turbidites--1999-2005 (4200 m)
- Oil and gas in Aptian carbonates--2006-2012 (6000 m)

Selected References


Selected Website

SANTOS BASIN

40 years from shallow to ultra-deep water
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Petrobras
Basement from +1 km to -10 km
SANTOS BASIN

350,000 km²
THE OLD SEVENTIES

EXPLORATORY ACTIVITY LIMITED TO SHALLOW WATERS

ONE DISCOVERY: MERLUZA GAS FIELD (PECTEN, 1984) 0.07 tcf
Merluza Field: Pecten 1984

SANTONIAN TURBIDITES
THE RICH NEIGHBOR, 1974 - 1985

http://pg.geoscienceworld.org/content/16/3/217/F11.expansion.html
1988-1998: 45 WELLS, SOME SMALL DISCOVERIES

TUBARÃO FIELD, 1988
30 mbbl

200 km
TUBARÃO OIL FIELD, 1988

ALBIAN GRAINSTONES

AGÊNCIA NACIONAL DE PETRÓLEO 2004
ALBIAN GRAINSTONE

PRIMARY INTERPARTICLE POROSITY AT 4732 M
1999-2005: 81 WELLS, SOME MEDIUM-SIZED DISCOVERIES

MEXILHÃO FIELD, 2003
TAMBUTÁ FIELD, 1999

200 km
MEXILHÃO GAS FIELD, 2003
Santos basin, a gas-prone basin?
BIG MODEL CHANGE: FROM LONG-DISTANCE TO SHORT-DISTANCE SECONDARY MIGRATION FROM ABOVE SALT TO SUB-SALT RESERVOIRS

DRILLING AND PRODUCTION CHALLENGES: 2000 m WATER + 2000 m UK-T + 2000 m SALT
TUPI LEAD, A BOLD MOVE

Formigli 2007
TUPI LEAD = LULA (SQUID) FIELD
MICROBIAL RESERVOIRS

BIG CHALLENGE: HOW TO PREDICT POROSITY BEHAVIOR FROM INTEGRATION OF SEISMIC, WELL LOGS AND ROCK DATA
SECONDARY POROSITY AT 5500 M

Terra et al., 2010
2006-2012: 166 WELLS, HUGE DISCOVERIES

LULA FIELD, 2006
8 Bbbl
200 km
SANTOS BASIN 2008

Chang et al., 2008, Revista Brasileira de Geociências
My first chopper flight

Hard to take off
Too much weight
My first drillship

Two long weeks
Only cuttings
Dry hole
Pitch, Roll, Heave
OIL & GAS IN SANTONIAN-CAMPANIAN TURBIDITES 1999-2005 (4200 m)

GAS IN SANTONIAN-CAMPANIAN TURBIDITES 2003 (5600 m)

GAS IN SANTONIAN TURBIDITES 1984 (4900 m)

OIL IN ALBIAN GRAINSTONES 1988-2001 (4500 m)

OIL & GAS IN APTIAN CARBONATES 2006-2012 (6000 m)
SOUTH ATLANTIC EVOLUTION

120 ma

http://www2.nau.edu/rcb7/120moll.jpg
SOUTH ATLANTIC EVOLUTION

J.L. DIAS, 2005
THICK SALT AS A SEAL

Salt wall

Thrusts at top evaporites

Diapiric Salt

Layered evaporites

Sag

Carbonate build-up

Syn-rift

Prograding carbonate reef

2.5 km

10 km

CGG VERITAS
State-owned areas to be bidded (Petrobras 30%) Law 12351/2010
LIBRA PROSPECT

BASE SALT STRUCTURAL DEPTH MAP
NP = 326 M  RESERVES = 8-12 Bbbl 27° API OIL  ANP 2013
31° API OIL
SUB-SALT CARBONATE
6150 m deep
1871 m WD
PETROBRAS 60%
BG 20%
REPSOL SINOPEC 20%
SUB-SALT DISCOVERIES UNDER DEVELOPMENT

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VOLUMES ADDED IN THE NEXT TEN YEARS AS LARGE AS IN THE PREVIOUS FIFTY YEARS
MARCH 2013 = 300,000 b/d
DO NOT GIVE UP EVEN AFTER 59 DRY HOLES IN 18 YEARS

Thank you!

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