FRACTURED SANDSTONE RESERVOIRS OF THE SAN JUAN BASIN ARE NOT MODELS FOR “BASIN-CENTERED” GAS

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BASIN-CENTERED GAS HAS BEEN CALLED:

- Low-permeability reservoirs
- Tight-gas reservoirs
- Continuous-gas accumulations
- Deep-basin gas
- Basin-centered gas
REQUIREMENTS FOR BCG:

1. Gas trapped in the basin center
2. Gas-bearing sandstones are continuous from basin center to outcrop
3. Sandstone permeability is continuous across basin
REQUIREMENTS FOR BCG: (Continued)

4. Water in pore space up dip from reservoir
5. Little or no water in gas reservoir
6. Low matrix porosity and permeability
7. An up dip water seal
Berry (1959) -- Mysterious, hydrodynamic, up-dip, water-seal model
UP-DIP HYDRODYNAMIC SEALS

Modified from Law (2002)
“And those guys are not ever going to tell me that the San Juan Basin is not a basin-center accumulation in the basin syncline rimmed all the way around by water. The water holds that gas in. There is no question about that.”

Masters (2004)
OBJECTIVES

- Show stratigraphy of SJB sandstones
- Show the distribution of wells in SJ Basin’s three major Ss reservoirs
- Show the compartmentalization of production in each reservoir
- Show that up-dip reservoir seals are stratigraphic permeability seals
- Discuss major sandstone reservoirs in terms of “basin-centered gas” concepts
STRUCTURE MAP OF SAN JUAN BASIN
(Contoured on Huerfanito Bentonite Bed)

COLORADO
NEW MEXICO

Kf crop

CROSS SECTION LINE

CI = 500’ & 100’
STRUCTURAL PROFILES

X - 24

TERTIARY AND UPPER CRETAEOUS ROCKS

Top P.C.

H.B.B.

A. D. = 4.60°

Average dip = 0.80°

A. D. = 0.23°

A. D. = 0.52°

Structural flex point

Structural hinge point

Structural nose

1 to 1 profile - no vertical exaggeration
CHARACTERISTICS OF THREE SANDSTONE RESERVOIRS:

- Nearly all sandstones have northwest depositional trend
- Sandstones are fine- to medium-grained
- Sandstones are tightly cemented with low matrix porosity and permeability
- A dominant north-trending fracture system creates the reservoirs
- North-trending fractures further compartmentalize northwest-trending reservoirs
From Lorenz and Cooper (2001)
PRINCIPAL SAN JUAN BASIN GAS RESERVOIRS:

- Dakota Sandstone
- Mesaverde Group
- Pictured Cliffs Sandstone

Have produced 22 TCFG (to October 2004)
DAKOTA STRATIGRAPHY

From Deischl (1973)
DAKOTA STRATIGRAPHY

Contour interval = 250 ft
Datum is mean sea level

From Deischl (1973)
PALEOGEOGRAPHIC MAP SHOWING 
DAKOTA SANDSTONE DEPOSITION

From noon (1980) 
based on a sketch 
by Owen (1979)
DAKOTA SANDSTONE RESERVOIR SEALS:

Gas is trapped in Dakota Sandstone reservoirs by stratigraphic pinch-outs of individual Dakota sandstone lenses
- Active Mesaverde gas wells (6,898)
- Non-productive Mesaverde gas wells (994)
Cliff House Ss Shelf Sandstone(s)

Lewis Shale

DATUM - Top of Menefee Formation

Menefee Formation

SW Lobe PL Ss

Water

Mancos Shale

Gas

NE Lobe PL Ss

7.8 miles
Gas is trapped in Mesaverde Group sandstone reservoirs by stratigraphic pinch-outs of individual Mesaverde Group sandstone lenses
4.2 TCFG
6,419 wells
(Oct. 2004)

- Active Pictured Cliffs gas wells
  (4,405)
- Non-productive PC gas wells
  (2,014)
PICTURED CLIFFS
SANDSTONE RESERVOIR
SEALS:

Gas is trapped in Pictured Cliffs Sandstone reservoirs by stratigraphic pinch-outs of individual Pictured Cliffs sandstone lenses
ARE SAN JUAN BASIN SANDSTONE GAS RESERVOIRS “BASIN-CENTERED GAS DEPOSITS?”
BCG CRITERIA

1. Reservoir in basin center
2. Low matrix porosity & perm.
3. Water up dip from reservoir
4. No water in reservoir

SAN JUAN BASIN

1. Yes, but not in structural center
2. Yes, but good fracture perm.
3. Yes, but in separate Ss bodies
4. No, small to moderate water
BCG CRITERIA

5. Continuous sandstones w. interconnected perm.

6. Up-dip hydrodynamic water seals holding gas in place

SAN JUAN BASIN

5. Sandstones not continuous thus no interconnected permeability

6. No up-dip water seals; up-dip seals are stratigraphic pinch-outs
SJB-TYPE SANDSTONE RESERVOIRS ARE NOT:

- LOW PERMEABILITY
  (DUE TO FRACTURING)
- OR TIGHT
  (DUE TO FRACTURING)
- OR CONTINUOUS
  (BECAUSE OF STRATIGRAPHIC SEPARATION OF SS BENCHES)
MOREOVER!
GAS IN THESE SS RESERVOIRS IS NOT TRAPPED BY:
UP-DIP WATER SEALS
WE THEREFORE RECOMMEND THAT:

SAN-JUAN-BASIN STRATIGRAPHIC GAS DEPOSITS BE REFERRED TO AS:

FRACTURED-SANDSTONE GAS DEPOSITS
AND WE SUGGEST THAT

THE CHIMERICAL, UP-DIP, WATER-SEAL CONCEPT SHOULD BE CAREFULLY EVALUATED IN OTHER WESTERN-INTERIOR BASINS TO SEE IF IT STANDS SCRUTINY

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