OIL AND GAS OCCURRENCE AND POTENTIAL IN ARIZONA

by
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Chairman, Arizona Oil and Gas Conservation Commission
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Current web page:  www.azogcc.az.gov/

see also:  http://azgs.arizona.edu/energy-resources-arizona
Basic requirements for drilling, completing, and producing oil and gas wells are explained in the oil, gas, and geothermal resources rules, which are part of the Arizona Administrative Code (A.A.C.) in Title 12 (Natural Resources), Chapter 7 (Oil and Gas Conservation Commission). Paper copies may be purchased from the Secretary of State. The OGCC has authority to approve requests for variance or exception to many of the general statewide rules after notice and hearing.

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Arizona Has Helium

Helium interest has increased since enactment of the Helium Stewardship Act of 2013. Some of the richest helium-bearing gas in the world was produced in Arizona. Helium concentrations range from trace amounts up to ten percent in the Holbrook Basin and Four Corners. Both areas have good potential for additional discovery and production of helium. This potential was the focus of the Winter 2003 edition of Arizona Geology.

Additional reports about helium in Arizona are available online at the AZGS document repository.

Learn more about the Federal Helium Program.

Read the 2015 report by the Government Accountability Office about FLM’s difficulties implementing the Helium

Drill rig at the Phillips 1-A Arizona State, near Florence; deepest well in AZ 18,013 ft
1,127 oil/gas exploratory wells have been drilled in Arizona.
Generalized Geologic Map Of Arizona

SW-NE cross-section of Arizona
PRODUCTION HISTORY

21 million barrels oil
31 billion cubic feet natural gas
10 billion cf gas with 8% helium
378 thousand cubic feet of CO₂
Production of oil, gas in the Paradox Basin (in barrels oil, mcf gas) and CO2/helium in the Holbrook Basin.
Paradox Basin stratigraphy and producing intervals

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Pennsylvanian Hermosa Group
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**EXPLANATION**

- **Geologic age of surface rock**
  - Note: No vertical scale indicated
- **Deepest stratigraphic penetration and depth (ft)**: 4821

**POOL STATUS**

- Producing or Shut-in
  - Oil
  - Gas, Natural
  - Oil & Gas
  - Helium

**MISSING SECTION**

- Regional
- Local (Schematic)
- Unconformity
- SI Shut-In

- Mississippian Redwall (Leadville) Limestone

- Paradox Basin producing intervals by field
Aerial photograph of Dineh-bi-Keyah Field

Location of Dineh-bi-Keyah Field
NE-SW cross section of Dineh-bi-Keyah Field. Producing interval is an igneous sill in Pennsylvanian limestone.
AREAS OF POTENTIAL OIL AND GAS PRODUCTION

- Marine sedimentary rocks
- Oil & gas shows
- Structural and stratigraphic traps
- cf. adjacent areas of production
AREAS OF POTENTIAL OIL AND GAS PRODUCTION

- Paradox Basin
- Chuar Basin
- Cordilleran Shelf
- Black Mesa Basin
- Holbrook Basin
- Pedregosa Basin
- Bisbee Basin
- Salton Trough
Potential Areas

Total thickness of Paleozoic rocks

Contour Interval = 500 feet
Upper Paleozoic section at Grand Canyon

Thickness of upper Paleozoic rocks
Devonian Martin Formation, central Arizona

Thickness of lower Paleozoic rocks
BLACK MESA BASIN

- Paleozoic marine rocks
- Lower Paleozoic pinchouts
- Mesozoic basin/shelf/shore deposits
- Laramide folds
- Coalbed methane potential
- Untested by drilling

  cf. Paradox, San Juan, Uinta basins
  Navajo Ss. production in S. Utah
Potential Areas:
Black Mesa Basin

Geologic Map of Arizona:
Cretaceous outcrop area
Aerial of Black Mesa - Jurassic to Cretaceous

Cross Section of Black Mesa
Cross Section: Cretaceous of Western Interior
Coal in Wepo Formation: methane potential

Cretaceous strata: Black Mesa Basin
Cretaceous total coal isopach, Black Mesa

Cretaceous stratigraphic section of Black Mesa

Dakota Formation

Mancos Shale

Toreva Formation
Jurassic Navajo Sandstone

Generalized cross section:
Grand Canyon to Black Mesa
CORDILLERAN SHELF AND CHUAR BASIN

• Pz marine rocks thicken to west
• Oil shows north of Grand Canyon
• Production in Utah and Nevada
• 12,000 ft.- well planned near Kingman
• Oil rich Chuar Group rocks in Grand Canyon
Paleozoic Cordilleran marine shelf

Paleozoic Cordilleran Shelf & Proterozoic Chuar Basin
Permian Kaibab Formation

Pennsylvanian-Permian Supai Group
Permian Isopach
CI = 250 ft.
Mississippian Isopach
CI= 250 ft.

Pennsylvanian Isopach
CI=250 ft

Mississippian Redwall Ls., Cambrian Muav Ls. & Bright Angel Sh.
Devonian Temple Butte Fm.
Cambrian Muav Limestone
Bright Angel Shale

Cambrian Isopach
CI=250 ft

Devonian Isopach
CI=250 ft

Cambrian Tapeats Ss.
Proterozoic Chuar Group in Grand Canyon (note scale change)
HOLBROOK BASIN

- Thick Pennsylvanian-Permian marine strata
- Thick evaporite sequence (cf. Permian Basin)
- Oil shows in numerous test wells
- Helium/CO$_2$ production
- Pinchouts of lower Pz strata at Defiance Uplift
CURRENT ACTIVITY IN HOLBROOK BASIN

- CO$_2$/helium drilling by Ridgeway-Arizona Petroleum Corporation
- CO$_2$ (80-90%) and He (0.1-0.8%)
- 28 wells in AZ, 8 in NM
- 17 temporarily abandoned, 1 produced CO$_2$
- CO$_2$ development plan in progress
- Salt cavern storage of LPG
PEDREGOSA BASIN

- Thick Paleozoic marine (cf. Permian Basin)
- Oil/gas recovered in drillstem tests
- Effect of Basin & Range faulting (?)

  cf. Grant Canyon, Eagle Springs fields in Nevada
Potential Areas:
- Pedregosa Basin (Paleozoic)
- Bisbee Basin (Mesozoic)

Thickness of Pennsylvanian rocks:
- 2,000 feet
- 1,500 feet
Oil & gas shows in wells:

- **Horquilla Ls.**
- **Martin Fm.**
Stratigraphic column: SE AZ and Permian Basin

Paleozoic section near Naco
BISBEE BASIN

• Thick Cretaceous marine section
• Reefs and organic basin sediments
cf. Golden Trend of Mexico
• Effect of Basin & Range faulting?
Cross section of Cretaceous rocks, SE AZ
Reef matrix of rudistids and corals

Mural Limestone reef
Geologic Map of AZ

Basin & Range structure with normal & thrust faults
SALTON TROUGH

• Cenozoic marine sediments
• Gas in Gulf of Mexico
• Updip pinchout of marine sands
• San Andreas fault effect?

  cf. basins of southern California
Potential Areas: Salton Trough

Structure map:
San Luis Basin
Stratigraphic Column:
Cenozoic of San Luis/Altar Basin

Map: Tectonic relationships with southern California
GAS STORAGE DEVELOPMENT

LPG/ GAS STORAGE IN SALT SOLUTION CAVERNS:
- 86 mm gallons in Holbrook Basin
- 156 mm gallons in Luke Basin

POTENTIAL FOR MORE LPG/GAS
Holbrook, Picacho, etc.

STRATEGIC PETROLEUM RESERVE

POTENTIAL FOR COMPRESSED AIR ENERGY STORAGE (CAES)
- Germany, Alabama, Ohio
- UA proposed development in AZ

Green pattern = known salt deposits
Red pattern = potential salt deposits
GEOTHERMAL POTENTIAL

Yellow areas = known geothermal areas of low to moderate temperatures
HOT SPOTS FOR OIL/GAS DRILLING, 1980s
OVERTHrust BELT ACROSS ARIZONA?

- SEISMIC SECTION
- POTENTIAL AREAS MAP
9 wells drilled on overthrust play, incl. 18,013 ft test near Florence
January 2002

$100/barrel

January 2008

$20/barrel