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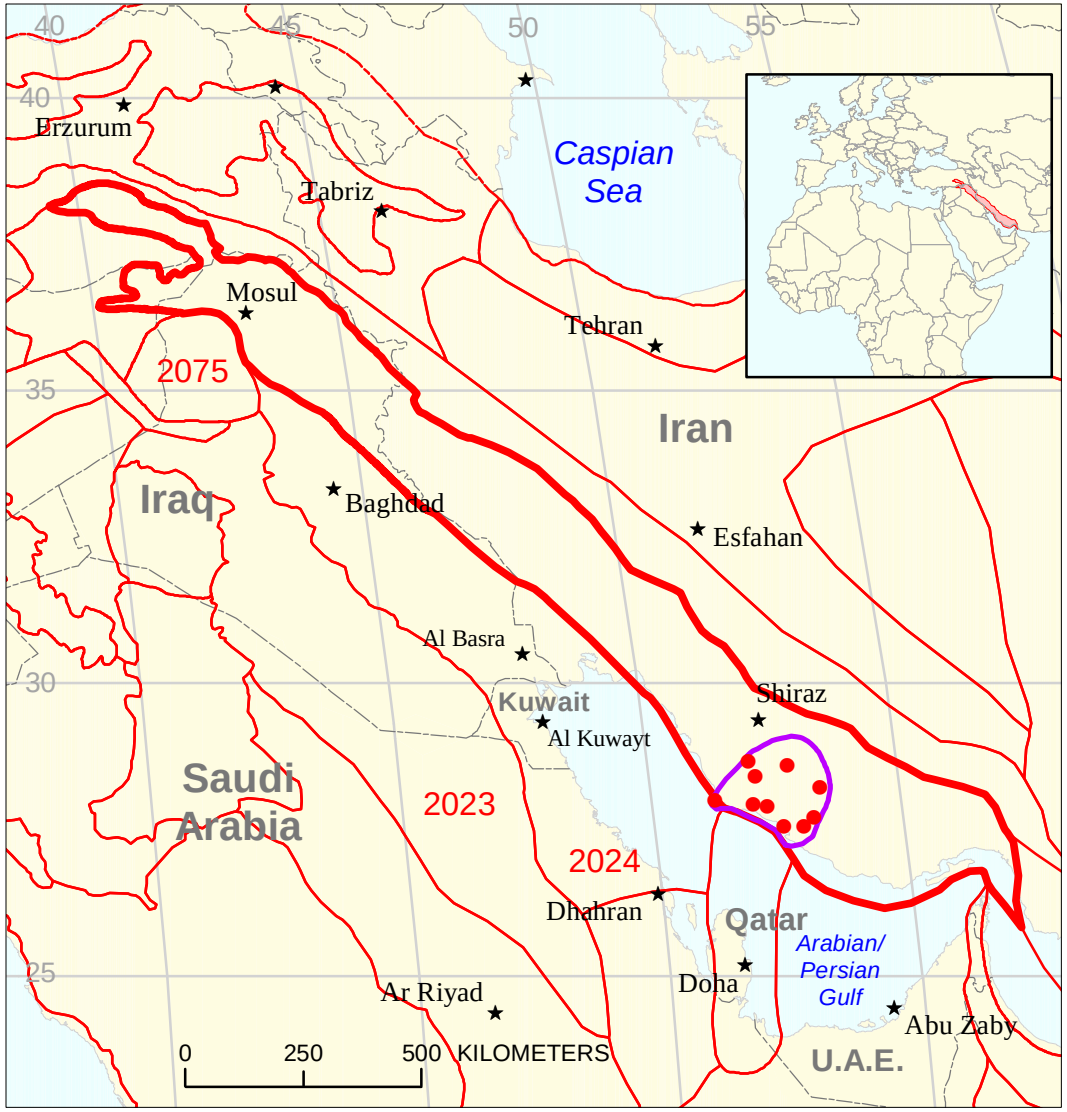
Northern Qatar Arch Extension Assessment Unit 20300201



Northern Qatar Arch Extension Assessment Unit 20300201
Zagros Fold Belt Geologic Province 2030
Other geologic province boundary

Geologic Summary

Detailed map of this assessment unit

Exploration/Discovery-History Data

- Plots of Known Field Sizes
- Plots of Grown Resources
- Tables

Assessment Input Data

Assessment Results

- Assessment Unit Summary
- Detailed Assessment Results
- Undiscovered Field-Size Distributions

USGS PROVINCE: Zagros Fold Belt (2030) **GEOLOGIST:** T.S. Ahlbrandt

TOTAL PETROLEUM SYSTEM: Paleozoic-Permian/Triassic (203002)

ASSESSMENT UNIT: Northern Qatar Arch Extension (20300201)

DESCRIPTION: This assessment unit includes giant and supergiant natural gas fields some with condensate. These large gas fields occur on the northern extension of the Qatar Arch immediately west of the Zagros fold belt. Giant fields such as Pars, Kangan, Nar Aghar, Banubast, Dalan, Asaluyeh, Shanul and Varavi are among the 15 gas fields in this assessment unit. The source of the gas is most likely lateral migration of deep Silurian sourced gas from Zagros foredeeps on the northern and southern side of the Qatar Arch. A more speculative hydrocarbon source is from a potential Permian depocenter (graben) deep beneath the Zagros fold belt.

SOURCE ROCKS: The source rocks are most likely Silurian age shales of the Qusaiba or equivalents in the deep portions of the Zagros foreland although a possible Permian source rock interval has been postulated. The lower part of the Silurian shale are the so called “hot” or radioactive shales that range from 10 to 75 m in thickness and occur in the Gulf salt basins.

MATURATION: In the deeper parts of the Zagros foredeep, the Silurian source rocks are overmature (Ro >2.6) and thought to be the source for the gas in this unit.

MIGRATION: Lateral migration from the Silurian source rock kitchens to the north and south of the Qatar Arch, onto this northern extension of the Arch is the most likely origin for the significant natural gas accumulations here.

RESERVOIR ROCKS: Reservoir rocks are commonly Upper Permian and Triassic dolomitic limestones, dolomites, oolitic limestone or carbonates. In Pars field, there are multiple carbonate reservoirs such as the Dalan Formation (Permian), Kangan Formation (Triassic) and one argillaceous sandstone reservoir in the Faraghan Formation (Permian). All other fields produce from carbonates of the Dalan and Kangan formations or Deh Ram Group (Triassic).

TRAPS AND SEALS: There are several regional significant seals including stratigraphic equivalents of the upper Triassic Baluti Formation, the Jurassic Hith evaporites, the Nahr Umr Shale (Aptian) is a major regional shale seal trapping major accumulations and in much of the Zagros fold belt and foreland Miocene salt and anhydrite seals are known. The Qatar Arch is a prominent structural feature that serves as a regional focus for hydrocarbon charge in the area.

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Bishop, R.S., 1995, Maturation history of the Lower Paleozoic of the Eastern Arabian Platform, in Al-Husseini, M.I., ed., Geo-94, Middle East Petroleum Geosciences Conference, Petrolink, Bahrain: v. 1, p. 180-189.

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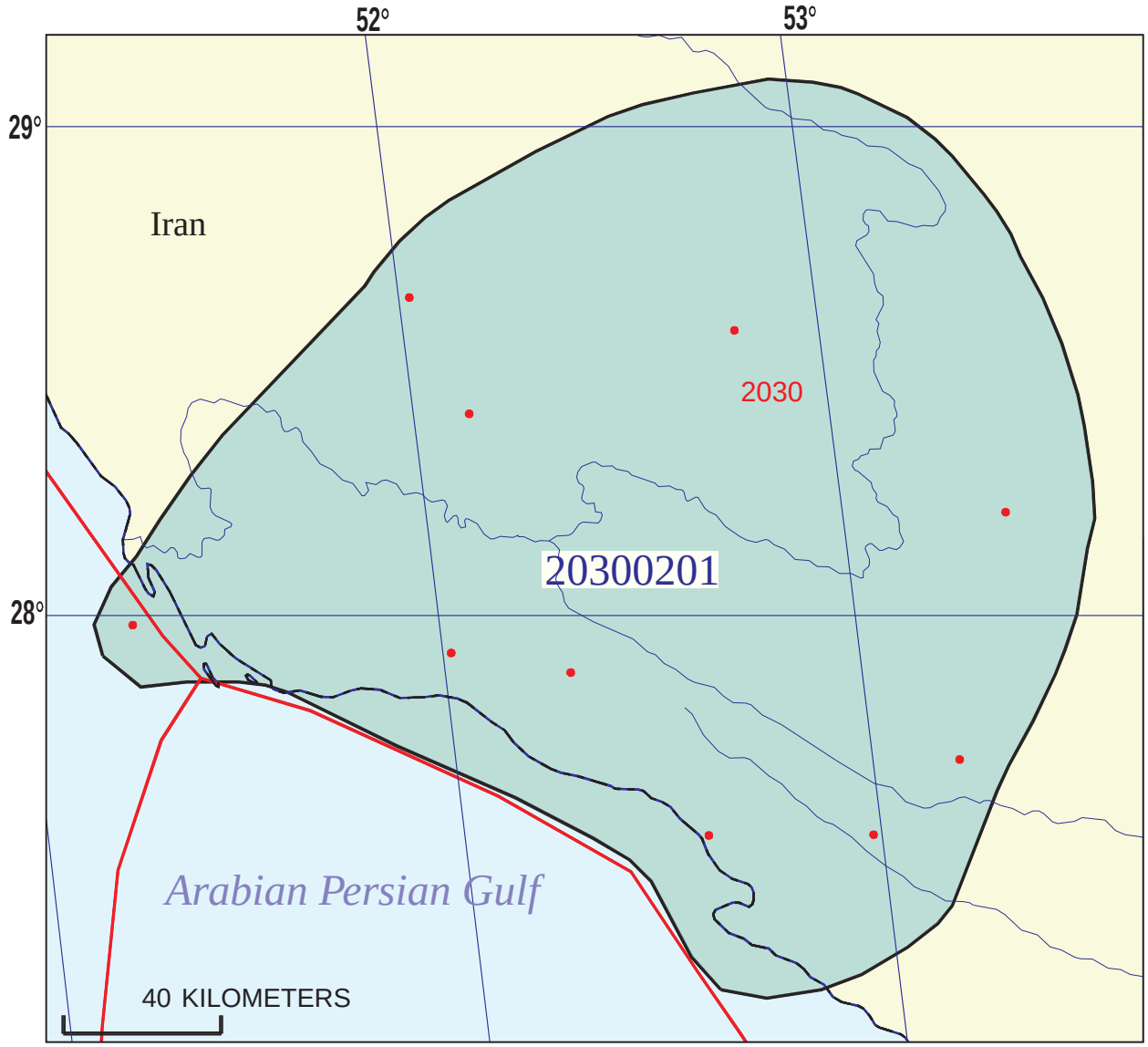

Northern Qatar Arch Extension Assessment Unit - 20300201

EXPLANATION

- Hydrography
- Shoreline
- 2030 — Geologic province code and boundary
- Country boundary
- Gas field centerpoint
- Oil field centerpoint
- 20300201 — Assessment unit code and boundary

Projection: Robinson. Central meridian: 0

SEVENTH APPROXIMATION
NEW MILLENNIUM WORLD PETROLEUM ASSESSMENT
DATA FORM FOR CONVENTIONAL ASSESSMENT UNITS

Date:……..	12/9/99		
Assessment Geologist:……..	T.S. Ahlbrandt		
Region:……..	Middle East and North Africa	Number:	2
Province:……..	Zagros Fold Belt	Number:	2030
Priority or Boutique……	Priority		
Total Petroleum System:……	Paleozoic-Permian/Triassic	Number:	203002
Assessment Unit:……..	Northern Qatar Arch Extension	Number:	20300201
* Notes from Assessor	Lower 48-all growth function. Likely Silurian sourced.		

CHARACTERISTICS OF ASSESSMENT UNIT

Oil (<20,000 cfg/bo overall) **or** Gas (≥20,000 cfg/bo overall):… Gas

What is the minimum field size?……. 20 mmboe grown (≥1mmboe)
(the smallest field that has potential to be added to reserves in the next 30 years)

Number of discovered fields exceeding minimum size:…… Oil: 0 Gas: 10
Established (>13 fields) _____ Frontier (1-13 fields) X Hypothetical (no fields) _____

Median size (grown) of discovered oil fields (mmboe):
1st 3rd _____ 2nd 3rd _____ 3rd 3rd _____
Median size (grown) of discovered gas fields (bcfg):
1st 3rd 18247 2nd 3rd 12054 3rd 3rd _____

Assessment-Unit Probabilities:

Attribute	Probability of occurrence (0-1.0)
1. **CHARGE:** Adequate petroleum charge for an undiscovered field ≥ minimum size……	1.0
2. **ROCKS:** Adequate reservoirs, traps, and seals for an undiscovered field ≥ minimum size……	1.0
3. **TIMING OF GEOLOGIC EVENTS:** Favorable timing for an undiscovered field ≥ minimum size	1.0

Assessment-Unit GEOLOGIC Probability (Product of 1, 2, and 3):…….. 1.0

4. **ACCESSIBILITY:** Adequate location to allow exploration for an undiscovered field ≥ minimum size…… 1.0

UNDISCOVERED FIELDS

Number of Undiscovered Fields: How many undiscovered fields exist that are ≥ minimum size?:
(uncertainty of fixed but unknown values)

Oil fields:……min. no. (>0)	_____	median no.	_____	max no.	_____
Gas fields:……min. no. (>0)	5	median no.	45	max no.	100

Size of Undiscovered Fields: What are the anticipated sizes (**grown**) of the above fields?:
(variations in the sizes of undiscovered fields)

Oil in oil fields (mmbo)……min. size	_____	median size	_____	max. size	_____
Gas in gas fields (bcfg):……min. size	120	median size	650	max. size	40000

Assessment Unit (name, no.)
Northern Qatar Arch Extension, 20300201

AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS

(uncertainty of fixed but unknown values)

Oil Fields:	minimum	median	maximum
Gas/oil ratio (cfg/bo)……			
NGL/gas ratio (bngl/mmcfg)……			

Gas fields:	minimum	median	maximum
Liquids/gas ratio (bngl/mmcfg)……	22	44	66
Oil/gas ratio (bo/mmcfg)……			

SELECTED ANCILLARY DATA FOR UNDISCOVERED FIELDS

(variations in the properties of undiscovered fields)

Oil Fields:	minimum	median	maximum
API gravity (degrees)……			
Sulfur content of oil (%)……			
Drilling Depth (m) ……			
Depth (m) of water (if applicable)……			

Gas Fields:	minimum	median	maximum
Inert gas content (%)……	1	6	12
CO_2 content (%)……	1	2	4
Hydrogen-sulfide content (%)……	1	2	5
Drilling Depth (m)……	500	3000	5000
Depth (m) of water (if applicable)……	0	10	25

Assessment Unit (name, no.)
Northern Qatar Arch Extension, 20300201

ALLOCATION OF UNDISCOVERED RESOURCES IN THE ASSESSMENT UNIT TO COUNTRIES OR OTHER LAND PARCELS (uncertainty of fixed but unknown values)

1. Iran represents 100 areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……			
Volume % in parcel (areal % x richness factor):…			
Portion of volume % that is offshore (0-100%)……			

Gas in Gas Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……			
Volume % in parcel (areal % x richness factor):…		100	
Portion of volume % that is offshore (0-100%)……		7	

2. Province 2030 represents 98 areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……			
Volume % in parcel (areal % x richness factor):…			
Portion of volume % that is offshore (0-100%)……			

Gas in Gas Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……			
Volume % in parcel (areal % x richness factor):…		98	
Portion of volume % that is offshore (0-100%)……		5	

3. Province 2024 represents 2 areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……			
Volume % in parcel (areal % x richness factor):…			
Portion of volume % that is offshore (0-100%)……			

Gas in Gas Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……			
Volume % in parcel (areal % x richness factor):…		2	
Portion of volume % that is offshore (0-100%)……		100	

Northern Qatar Arch Extension, AU 20300201
Undiscovered Field-Size Distribution