

Study sizes up Iraq's reserves, exploration status, production potential

Muhammad W. Ibrahim
*Target Exploration
 Consultants
 London*

Iraq has a volatile exploration and production history, but unlike more stable OAPEC countries it was National Oil Co. (INOC) rather than foreign oil companies that discovered most of the country's proved oil reserves.

Proved reserves are in Paleozoic, Triassic, Jurassic, Cretaceous, and Tertiary reservoirs charged by Silurian and Jurassic and/or Cretaceous source rocks.

The pre-gulf war production capacity was 3.5 million b/d, but the country's current damaged production capacity is about 2.5 million b/d.

Introduction

Dr. Safa'a Hadi Jawad, who preceded the present Gen. Amer Rasheed as oil minister of Iraq, said in an interview published in the February 1995 issue of the Arabic periodical *Earth and Environments* that new discoveries have elevated Iraq's proved reserves to 120 billion bbl of oil.

This is an accomplishment

of Iraq's human resources. Iraqi petroleum technologists have been behind the discovery of most of the country's hydrocarbon reserves and the rapid growth of its oil industry.

Exploration history

Being an oil producer from surface oil seeps since antiquity, Iraq acquired rather than discovered its first subsurface oil field (Naft Khanah-Naft Shah) via a border deal with Iran in 1923.

Formal exploration of Iraq began after a 1925 agreement with British Iraq Petroleum Co. (IPC), which led to discovery of supergiant Kirkuk oil field (more than 16 billion bbl recoverable) of northeastern Iraq in 1927. The Kirkuk discovery well was located on a surface anticline near a gas seep known as the "Eternal Fire" of Baba Gurgur, which ancients worshipped for centuries (Fig. 1).

Iraq Petroleum Co. and subsidiaries Mosul Petro-

leum (MPC) and Basrah Petroleum (BPC) managed to delineate about 100 drillable prospects, discovered 39 billion bbl of recoverable reserves, and produced a total of 3 billion bbl before 1961. Growing dissatisfaction of the Iraqi government with the speed of field development and rate of production were among factors that led to relinquishment of undeveloped parts of the IPC, MPC, and BPC concessions in 1961, followed by partial takeover in 1972 and full takeover by INOC in 1973.¹

Iraq formed Iraq National Oil Co. in 1964, but it remained inactive until 1968, when the present Iraqi government signed a contract with Elf-ERAP to explore the area east of Amara. This later became known as the Buzurgan area after discovery of Buzurgan oil field in 1970.

Many of the early anomalies INOC drilled were originally found by the IPC Group, but INOC managed

Fig. 1

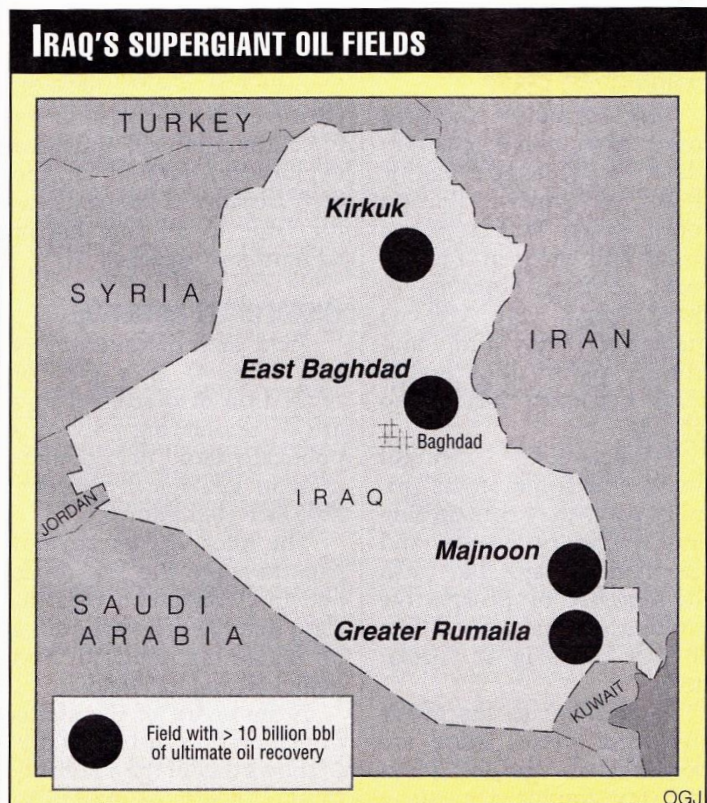


Fig. 2

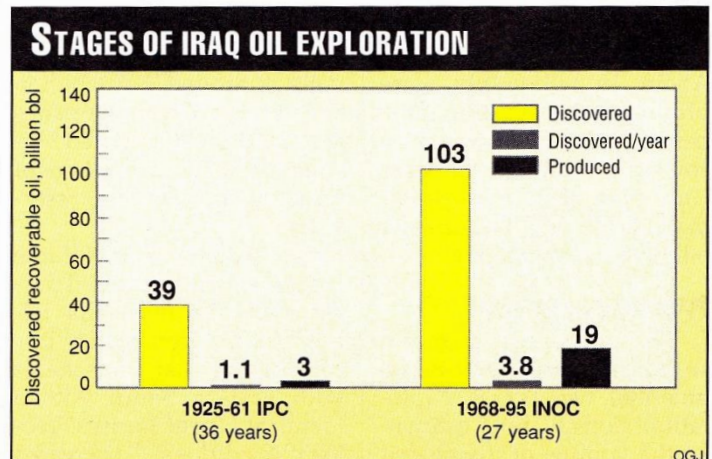
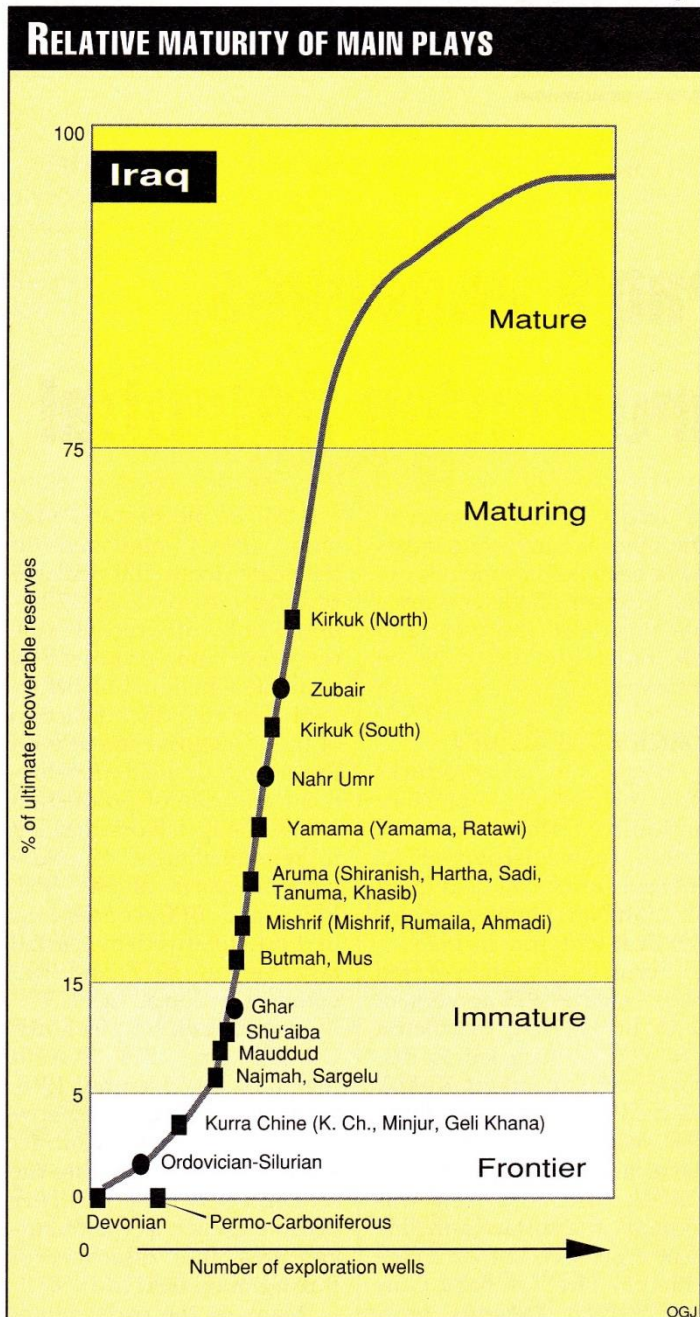


Fig. 3



to increase the 100 inherited prospects to 400 prospects by 1989. INOC and its subcontractors discovered more than 103 billion bbl of recoverable oil during 1968-1995. About 19 billion bbl were produced during the same period.^{2,3} INOC's rate of discovery, 3.8 billion bbl/year, was more than three times that of the IPC Group—1.1 billion bbl/year (Fig. 2).

Proved reserves

The author, in a recent study of Iraq's petroleum potential for Target Exploration Consultants,⁴ estimated the volume of discovered

(produced and remaining) oil reserves in the country's Tertiary reservoirs to be about 33.8 billion bbl and the volume of discovered oil reserves in Cretaceous reservoirs at around 107.1 billion bbl (Table 1). The estimates are based on an updated version of INOC's percentage of reserves in various reservoirs.⁵

According to the same percentage the Jurassic-Triassic reservoirs hold 0.14 billion bbl, disappointingly low considering that Iraq shares with eastern Saudi Arabia identical Upper Jurassic geologic conditions that created

Fig. 4

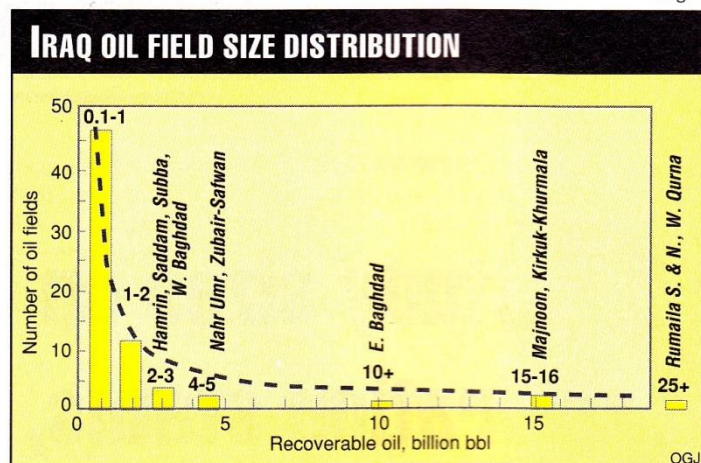


Table 1

GEOLOGIC AGE OF IRAQ OIL RESERVOIRS	
Age	Proved reserves, billion bbl
Tertiary	33.8
Cretaceous	107.1
Jurassic-Triassic	0.14
Paleozoic	1.0

Upper Jurassic supergiant Ghawar oil field.⁶ One reason for this difference is INOC's lack of high pressure-high temperature deep drilling technology to overcome the high pressure regime below the Tithonian Gotnia (Hith) evaporite seal of Iraq's Upper Jurassic reservoirs.

Exploration plays

Target's study⁴ outlined more than three primary plays in Paleozoic rocks, three in Jurassic-Triassic rocks, seven in Cretaceous rocks, and three in Tertiary rocks of Iraq. Fourteen of these plays are proven maturing, immature, and frontier plays; none of the plays is mature inside Iraq (Fig. 3).

Furthermore, Target found that some of the primary plays may contain several secondary proven and speculative plays that push the number of prospective geological units to more than 30 pay zones in 25 formations.

In addition to the above structural plays, there are potential stratigraphic plays and stratigraphic elements in

Table 2

IRAQ EXPLORATION STATUS END 1995	
Exploration efforts 1925-61, 1968-95	
• 400 total structural prospects	
• 150 drilled structural prospects	
• 17 oil discoveries	
• 8 gas discoveries	
• 19 holes status unknown	
• 40 dry holes	
• 250+ undrilled prospects	
Exploratory drilling record	
• 1 exploration well per 2,900 sq km	
• 70% oil and gas discoveries	
• 50% commercial discoveries	

many structural plays. The author identified one INOC well drilled deliberately to delineate a probable stratigraphic discovery in an Upper Cretaceous rudist reef. However, Iraq is most likely to continue to drill anticlinal exploration targets in the early decades of the next century due to its long list of structural prospects.

Exploration potential

Field size distribution of Iraq (Fig. 4) is a plot of revised oil field sizes of Iraq after translating INOC's politically laced field boundaries to geologically acceptable field definitions.

The plot shows several gaps between the 3-4, 10-15, and 15-25 billion bbl oil field sizes that give away the sizes of remaining undiscovered giants oil and gas fields.

A summary of the status of exploration in Iraq (Table 2) shows that of the 400 structural prospects delineated so

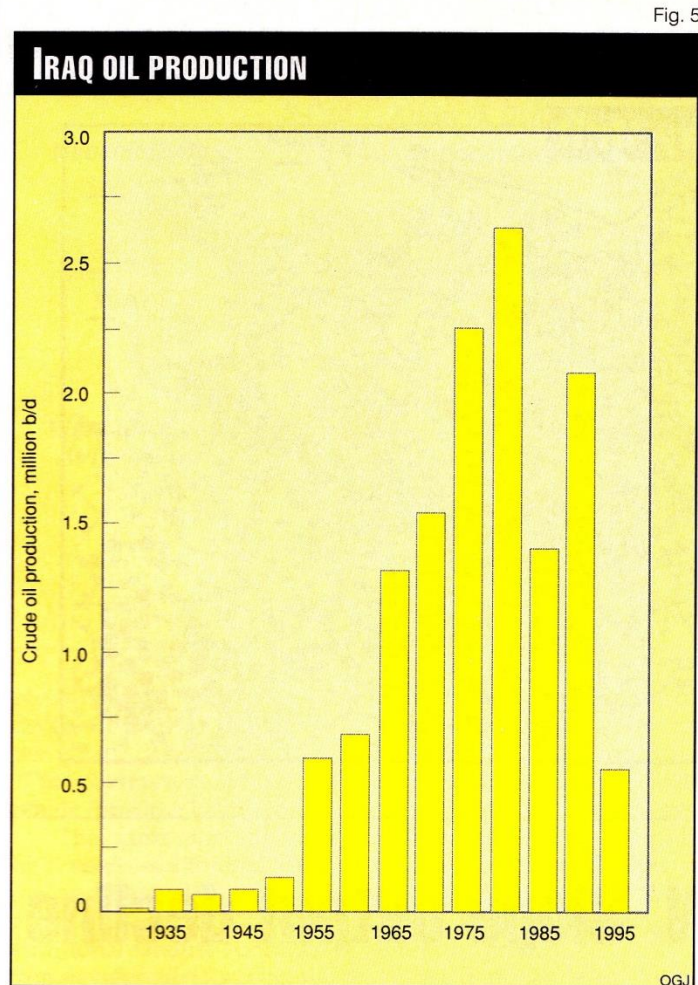
far, 150 have been drilled, leading to the discovery of more than 66 commercial oil fields, eight commercial (mainly) gas discoveries, 17 oil discoveries, 19 holes of unknown status, and 40 "dry holes."

Iraq exploratory drilling indicates a 70% overall success record and 50% rate of commercial oil and gas discovery. As Iraq's 440,000 sq km is almost entirely underlain by Silurian and/or Jurassic and Cretaceous source rocks and sparsely drilled by one exploratory well per 2,900 sq km, the remaining 250 undrilled structural prospects probably will yield at least as much oil as has been discovered.

Target⁷ reviewed the geothermal gradients of drilled holes in Iraq and adjacent countries and found anomalous high geothermal gradients above oil and gas fields. However, some "dry holes" were found to express similar anomalously high geothermal gradients. Upon reviewing the available records of these wells Target found that some were actually plugged and abandoned oil and/or gas producers.

The review also found that numerous oil and gas shows were not tested or properly tested before being sealed behind casing. This was probably done because they were not associated with the highly productive primary targets. All this led the author to conclude that some of the old IPC, MPC, BPC, and INOC "dry holes" may become producing oil and/or gas wells in the future.

In addition to the remaining undrilled prospects, untested shows, geothermally anomalous "dry holes," and potential stratigraphic plays, many of the discovered fields are yet to be tested for their deeper Neocomian Yamama and Upper Jurassic Najmah potential. Such tests will probably increase Iraq's Jurassic as well as Cretaceous oil reserves to resemble the pattern of reserves per reservoir



age of the Middle East. Therefore Iraq leads most OPEC countries in probable undiscovered oil reserves.⁸

Production potential

Iraq is producing about 600,000 b/d of oil at present,⁹ far below its production capability of 2.5 million b/d. Both are below Iraq's current export capacity of 3.0-3.6 million b/d through three of its six oil exports outlets.

Iraq's oil production (Fig. 5) has been hampered by the IPC Group in the 1950s-60s, the Iraq-Iran war in the 1980s, and the gulf war and United Nations Security Council embargo in the 1990s.

The latent production potential of Iraq is still and will remain sizable. Iraq produced more than 3.5 million b/d in 1979 before the Iraq-Iran war. In the above mentioned interview Dr. Jawad said Iraq was producing 3.2 million b/d in 1990 just

before the gulf war.

The gulf war damaged some production facilities and reduced Iraq's exploration and development activities. Iraq hosted 72 seismic crews/month during 1990 vs. one crew/month during 1992. It ran 19 drilling rigs during 1990 vs. three during 1994. It completed 113 exploration and development wells in 1990 vs. 30 in 1994.³

Iraq in March 1995 offered 33 oil fields for joint development with foreign partners in an ambitious plan which if implemented successfully may increase Iraq's production by 4,650,000 b/d above pre-gulf war capacity, i.e., to 7.85-8.15 million b/d by 2010.¹⁰

Whether Iraq needs to produce this much oil is debatable, but the offer presents an irresistible opportunity to the international oil industry at a time when replenishment of exhausted oil reserves is becoming

THE AUTHOR

Muhammad W. Ibrahim is an EAME geologist with Target Exploration Consultants in London. He was a field geologist for Geological Survey of Iraq in 1970-71. After earning a PhD in 1978 he headed the Department of Petroleum Geology in the faculty of earth science of King Abdul-Aziz University, Jeddah, Saudi Arabia and later a consulting geologist for the Kuwait Institute for Scientific Research. In 1982-91 he worked as staff geologist for Mobil Oil Libya, Veba Oil, and Lasmo plc. He has a BSc in geology from the University of Baghdad and a MSc, DIC, and PhD in petroleum geology from the Royal School of Mines, Imperial College, University of London.

increasingly harder and the size of explored anomalies is becoming smaller.

Acknowledgment

This article reflects the author's personal opinions, which are not necessarily those of Target Exploration Consultants.

References

1. Zaini, M., The Iraqi Economy, Rafid Publishing Co., London, 1995, 510 p. (in Arabic).
2. Alnasrawi, A., The Iraqi economy: oil, development, wars, destruction and prospects 1950-2010, Dar Al Knoz Al Adabiah, Beirut, 1995, 228 p. (in Arabic).
3. Organization of Arab Petroleum Exporting Countries Secretary General's 21st annual report, OAPEC, Kuwait, 1995, 183 p.
4. Mesopotamia Petroleum Potential, nonexclusive report, Target Exploration Consultants, 1995.
5. Al Khersan, H., and Al Siddiki, A., Hydrocarbon exploration development in Iraq (abs.), Abstracts 28th International Geological Congress, Vol. 1, 1989, pp. 1-28.
6. Ibrahim, M.W., Tectonic history, basin evaluation, and petroleum geology of Upper Jurassic facies of South Iraq (abs.), AAPG Bull., Vol. 71, No. 5, 1987, p. 569.
7. Geothermal gradient anomalies of hydrocarbon entrapments in northern Arabia, nonexclusive report, Target Exploration Consultants, 1995.
8. Riva, J., Dominant Middle East oil reserves critically important to world supply, OGJ, Sept. 23, 1991, pp. 62-68.
9. Worldwide crude oil and gas production table, OGJ, Mar. 11, 1996, p. 109.
10. Stauffer, T., Iraq challenges sanctions, offers 4.5 million b/d developable capacity, OGJ, Apr. 10, 1995, pp. 112-113.