

A Decade of Exploration in the Kurdistan Region of Iraq*

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Abstract

The Kurdistan Region of Iraq is perhaps the world's largest onshore discontinuity to emerge in the new millennium. The region has witnessed extraordinary levels of exploration activity since the first exploration well to be drilled in three decades was spudded in 2005. Since that time, over 180 wells have been drilled. Whilst the region is proximal to many of the giant and supergiant fields of Iran and Iraq, the reservoirs in which discoveries have been made are largely different. In Iraq, a large percentage of discovered reserves reside in Tertiary and Cretaceous sediments capped by Tertiary evaporite sequences. Over much of Kurdistan, particularly the north and northeastern parts of the region, Tertiary strata are absent.

A decade ago, many were doubtful that significant quantities of hydrocarbons could be trapped in the absence of the Tertiary evaporite sequences. Furthermore, whilst the presence of large surface structures and significant oil seeps were encouraging to some, to others it fuelled concerns about trap leakage. Against this background, a number of entrepreneurial companies negotiated Production Sharing Contracts with the Kurdistan Regional Government and began hydrocarbon exploration. In a region almost devoid of sub surface data, early explorationists went 'back to basics' undertaking field work, structural restorations based on surface measurements and geochemical evaluation of surface oil seeps and potential source rocks. Freely available satellite image data was invaluable as was the work undertaken by a number of early workers including the Iraq Petroleum Company.

Today the majority of the surface anticlinal features in Kurdistan have been drilled, though they remain to be fully evaluated. Almost all of this exploration activity has taken place on 2D seismic data sets with vertical exploration wells. Only a handful of 3D seismic surveys have been acquired and small numbers of horizontal wells have recently been drilled, some with impressive results. Advanced techniques commonly used for exploiting tight fractured carbonates have not as yet been used in the region. Challenges remain in what is a structurally complex and recently deformed region; however, significant new reserves have been discovered in less than a decade of activity. New pipeline infrastructure has recently been completed and it is likely that the Kurdistan Region of Iraq will develop to become an important contributor to world oil and gas production.

A decade of exploration in the Kurdistan Region of Iraq

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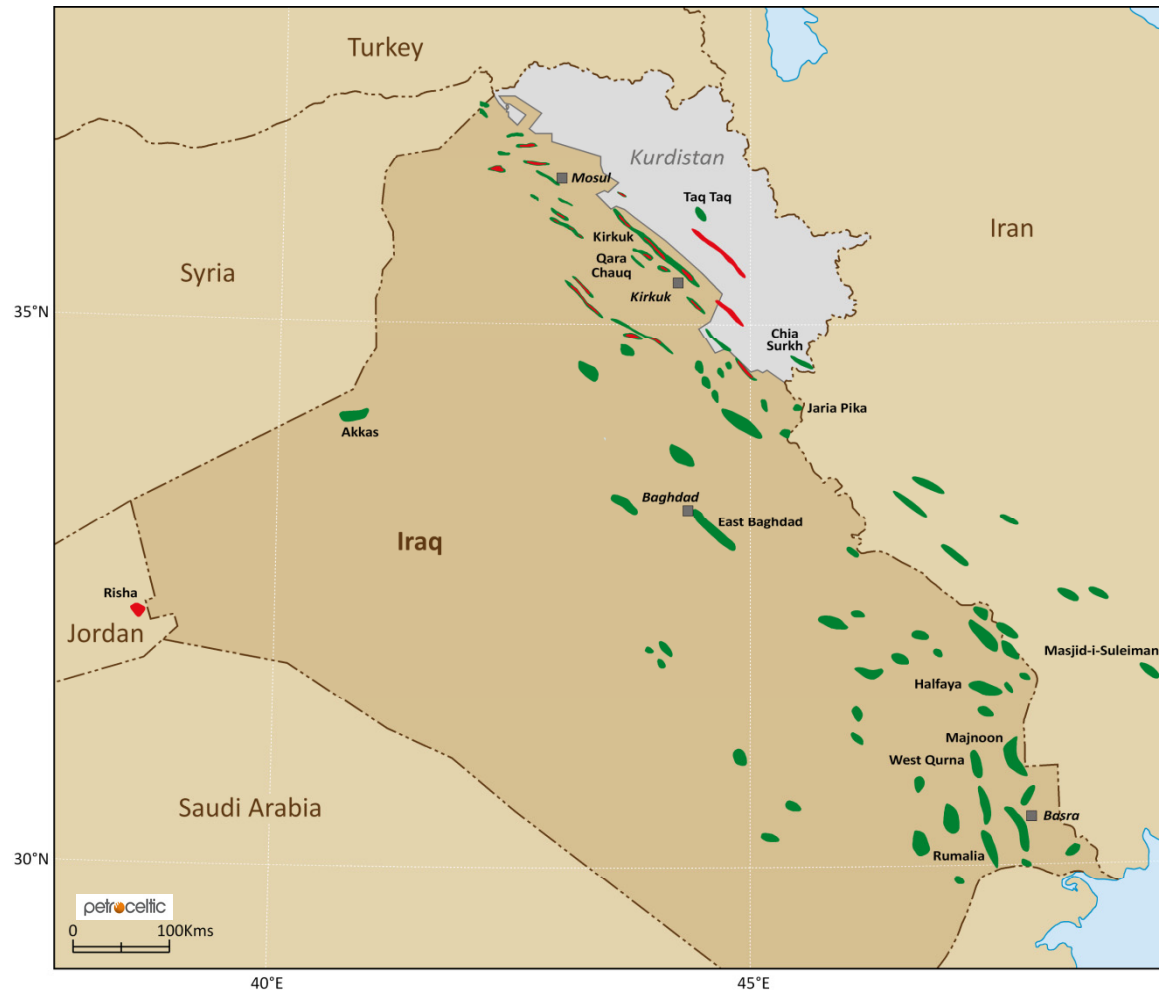


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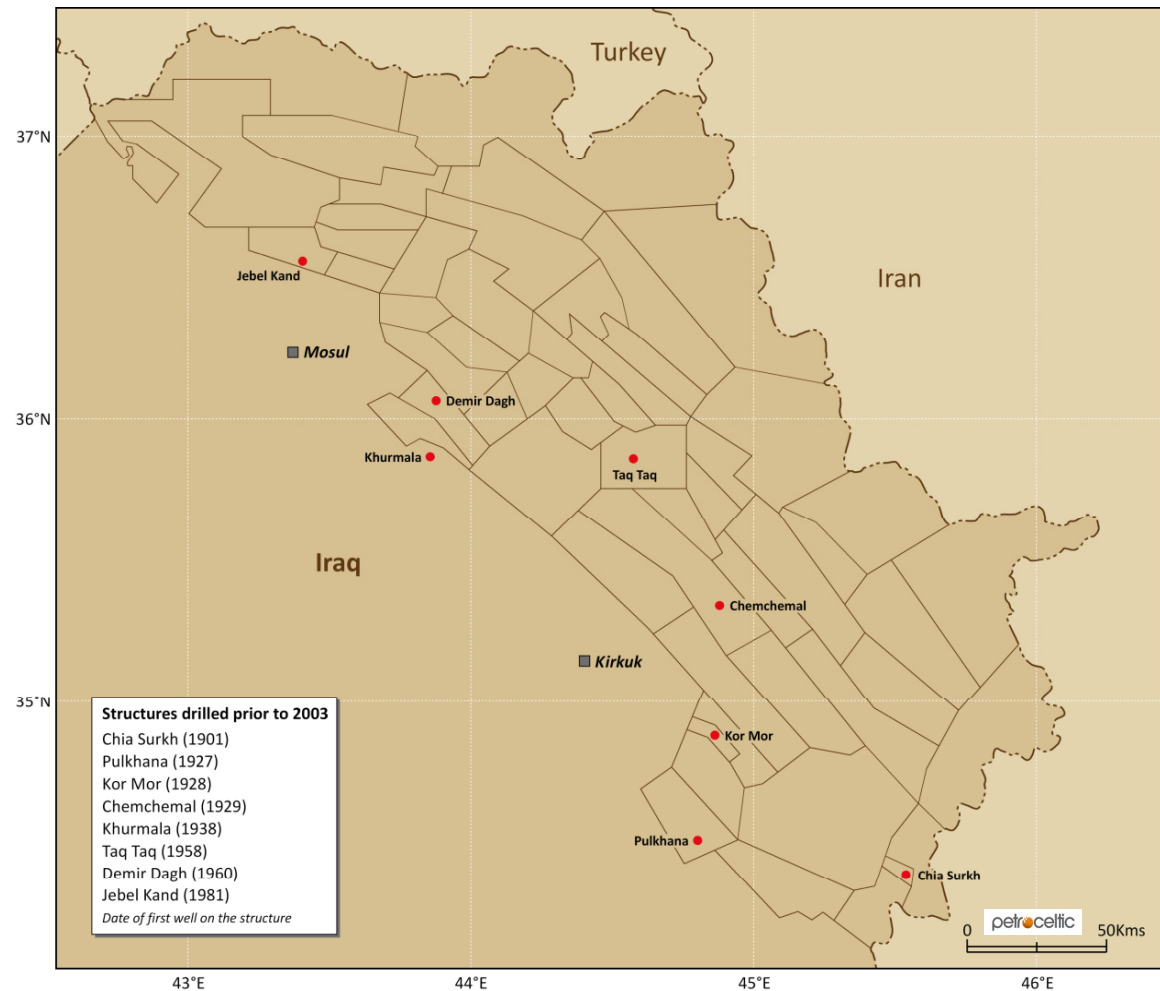
Iraq : Pre 2004

- Chia Surkh : 1901*
- Post 1st world war drilling
 - Kirkuk, Qaiyarah, Pulkhana, Injana, Kor Mor
- Chemchemal : 1929
- Taq Taq : 1958



Kurdistan : Pre 2004

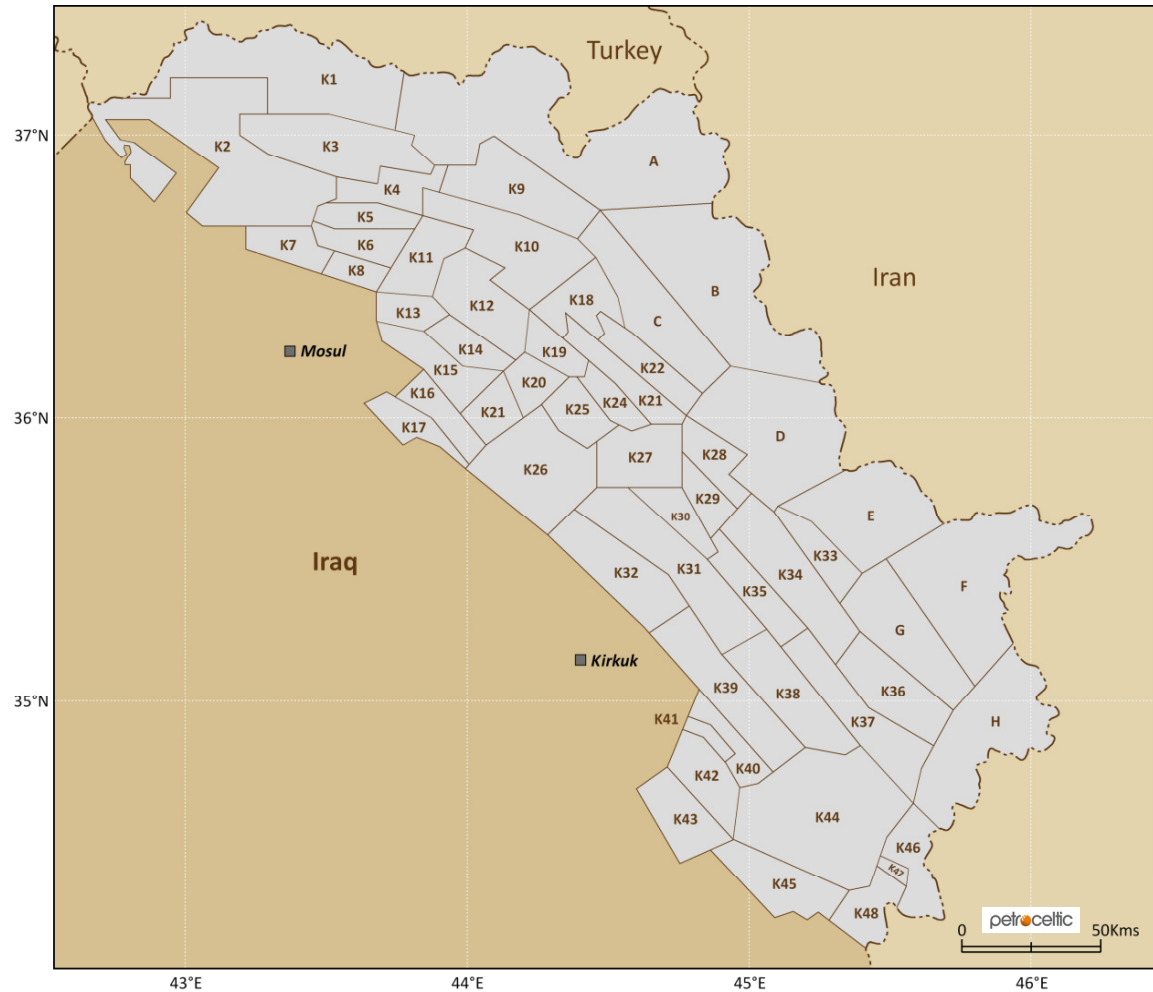
- Drilling limited to 8 structures
- Limited appraisal
- No significant production
- Last well Jebel Kand – 1981 (INOC)
- First PSC's signed 2002 / 2003



Block map based on map published by the KRG in 2007

Initial Block subdivision

- ~1 structure per block
- 48 blocks
- 8 lettered blocks
- Fiscal terms varied according to perceived risk
- No data rooms, no data packages
- 5 year PSC
- Signature bonus, 2D seismic and drilling



Block map based on map published by the KRG in 2007

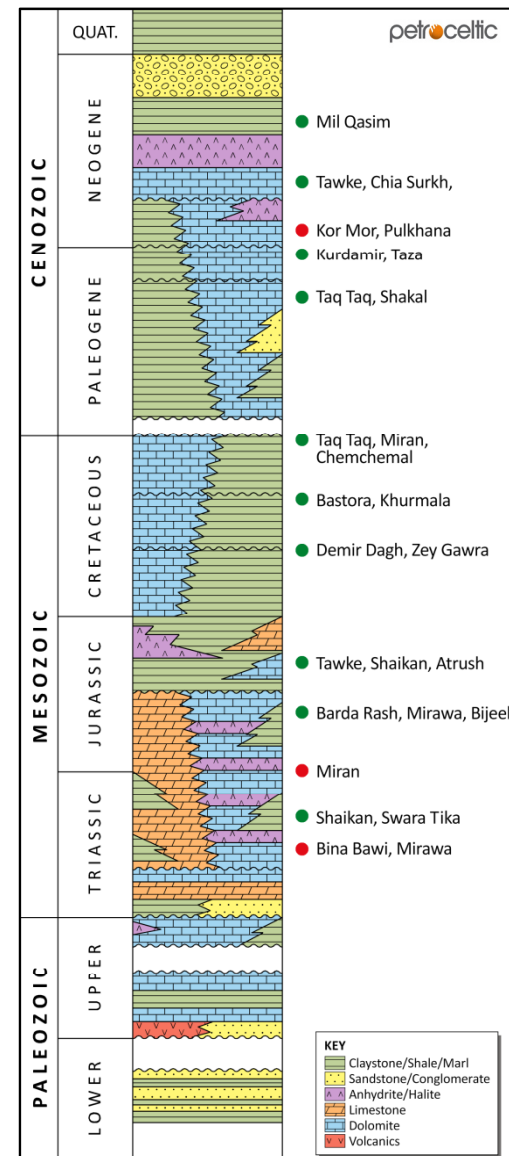
Concerns

- No fields, no drilling, no seismic
- World class seeps
- Trap preservation?
- Lack of Tertiary cover
- Mountains un-prospective?
- Pre-Cretaceous prospectivity?



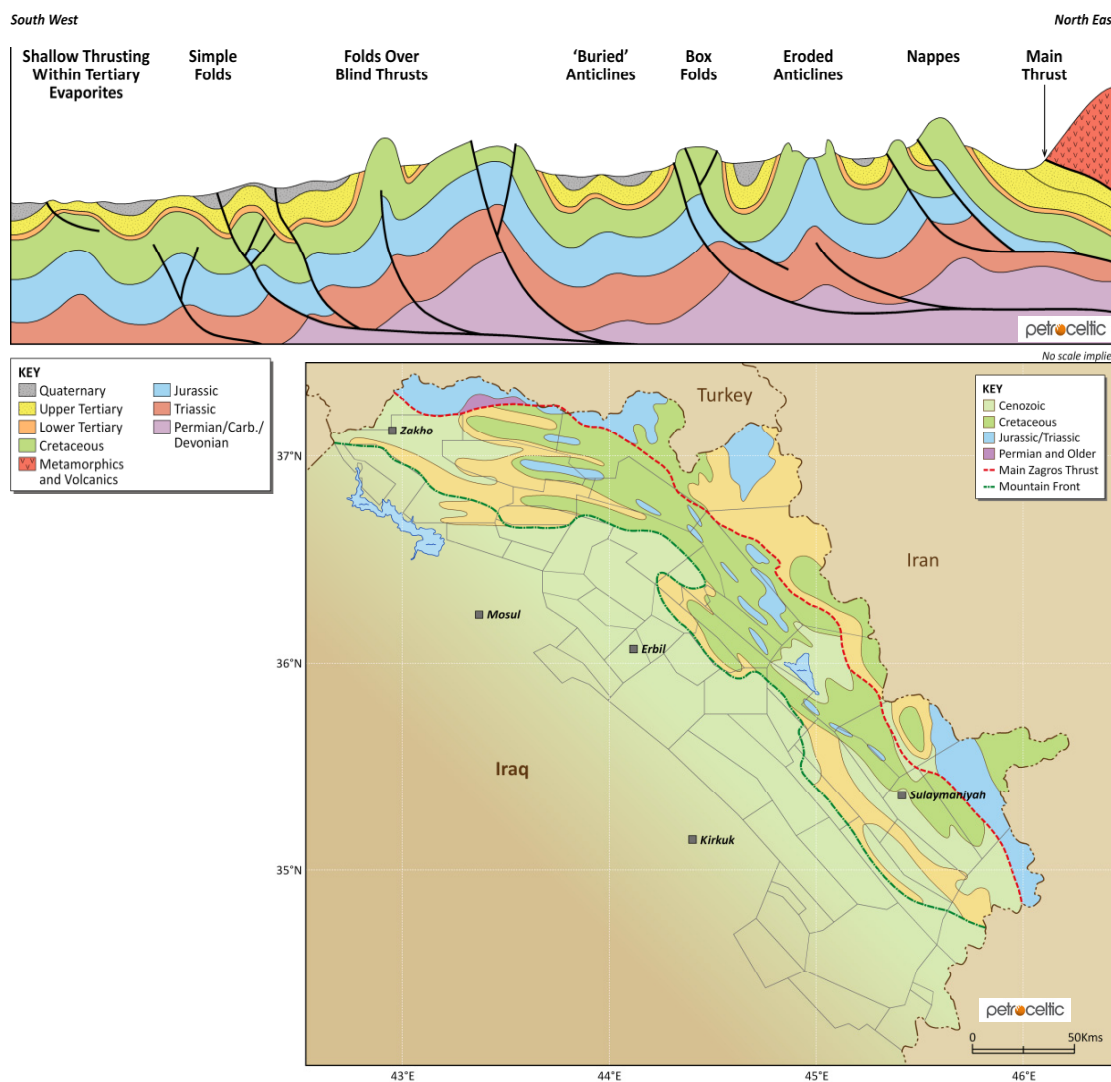
Stratigraphy & reservoirs

- Interbedded carbonates, claystones, anhydrites
- Multiple potential source rocks: shales / organic rich marls / carbonates
- Multiple stacked reservoirs: Late Tertiary to Triassic
- Generally low matrix porosity / low matrix permeability carbonates
- Often highly fractured



Structure

- North east: more complex
- Tighter anticlines, nappes / thrusts
- Older strata exposed
- Limited Tertiary cover beyond mountain front
- Stratigraphically deeper plays towards north east - sub thrust plays?
- Poor seismic imaging – detachment surfaces
- Potentially lower success rates in mountain zone





Harir Mountain – Fractured box fold : Karstified Cretaceous Bekhme Formation at outcrop

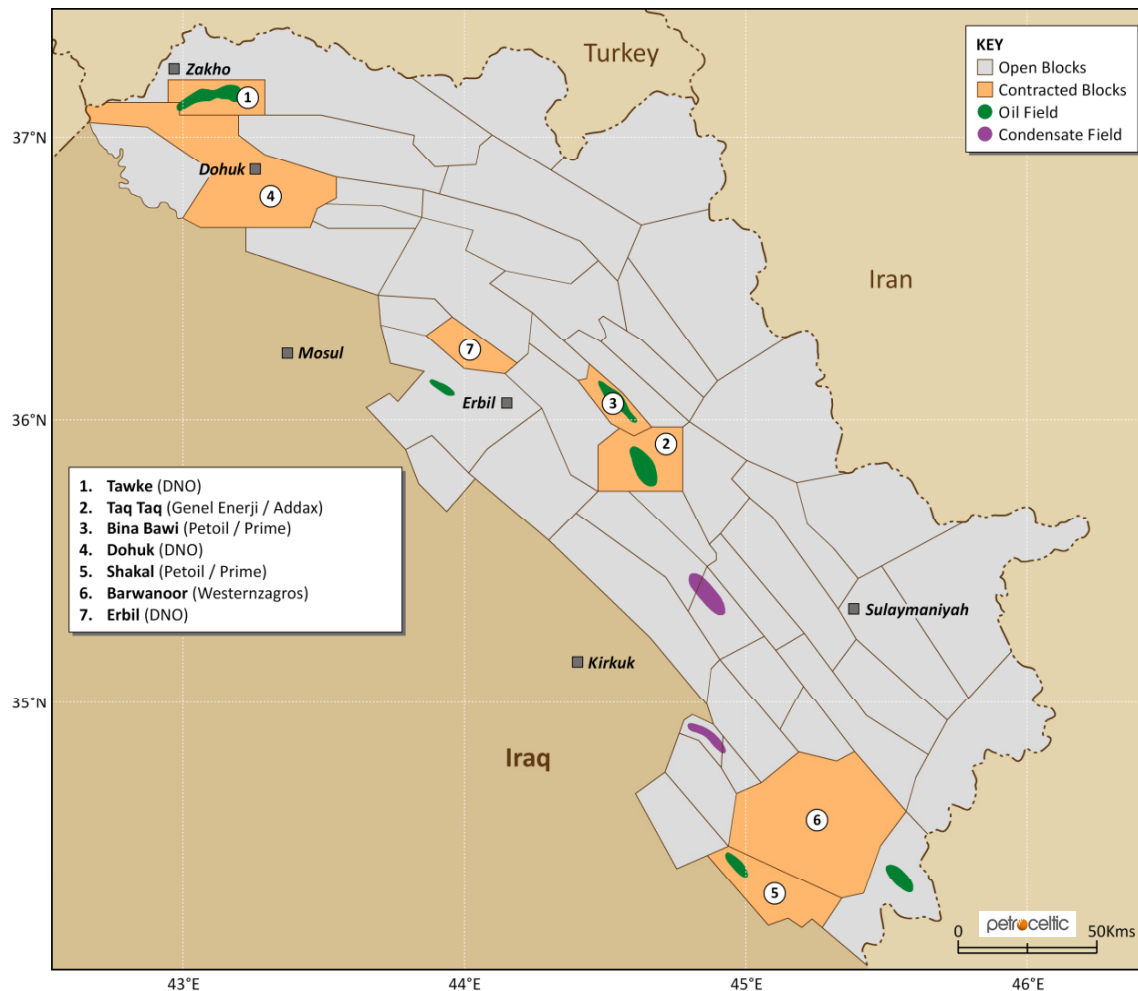
Source

- Excellent source rocks
- Jurassic, Triassic and Cretaceous
- Organic rich shales and carbonates
- High TOC's, HI's, variable H₂S levels
- Range of crude – heavy oil to gas
- Sourced considerable volumes of hydrocarbons in region



Licensing position 2006

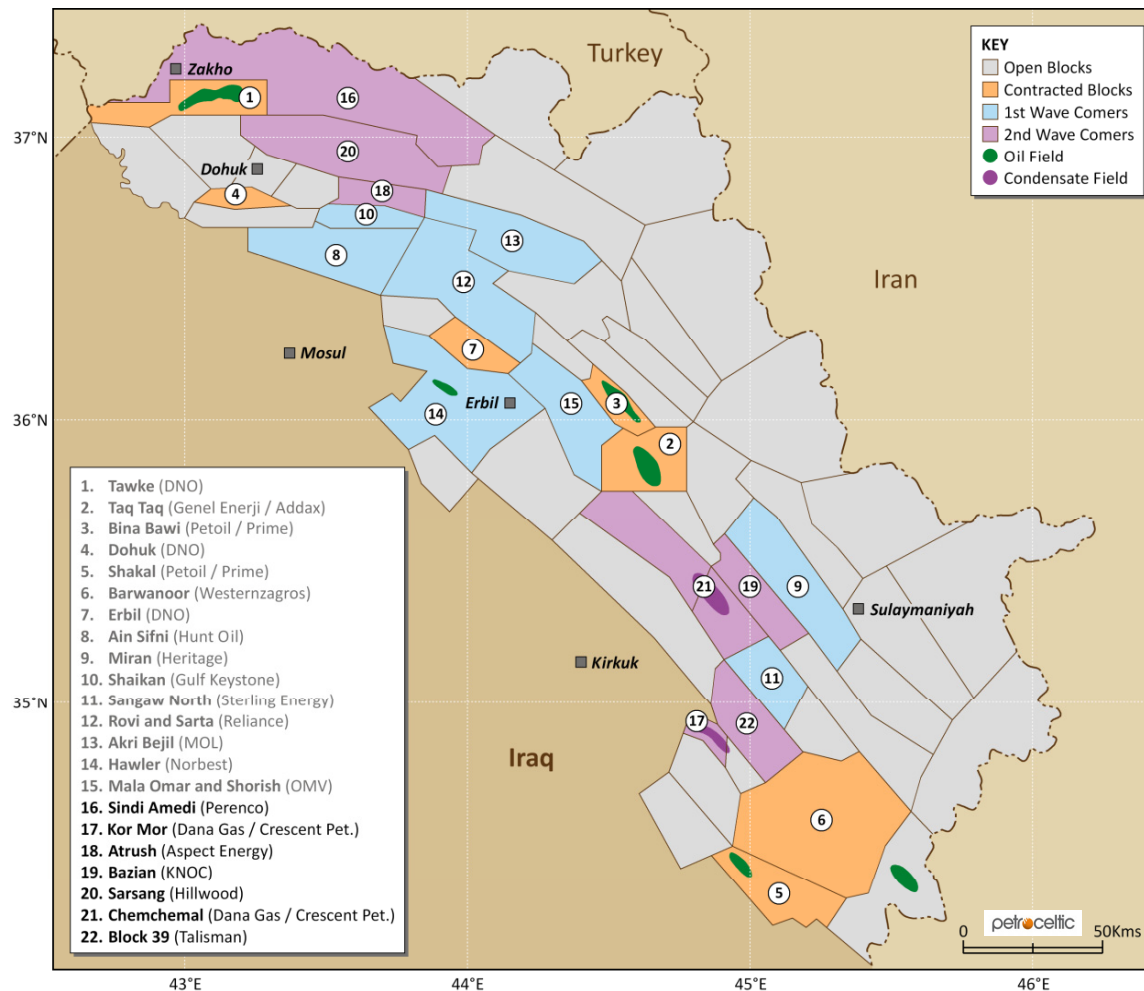
- 7 PSC's signed
- <10 new wells drilled
- Field work, satellite image interpretation, offset fields in Iraq, Iran, NE Syria, geological maps, publications
- Geological mapping, transects, 2D seismic
- 1st well post 2003 Iraq war drilled in 2005 – Tawke Discovery



Block map based on map published by the KRG in 2007

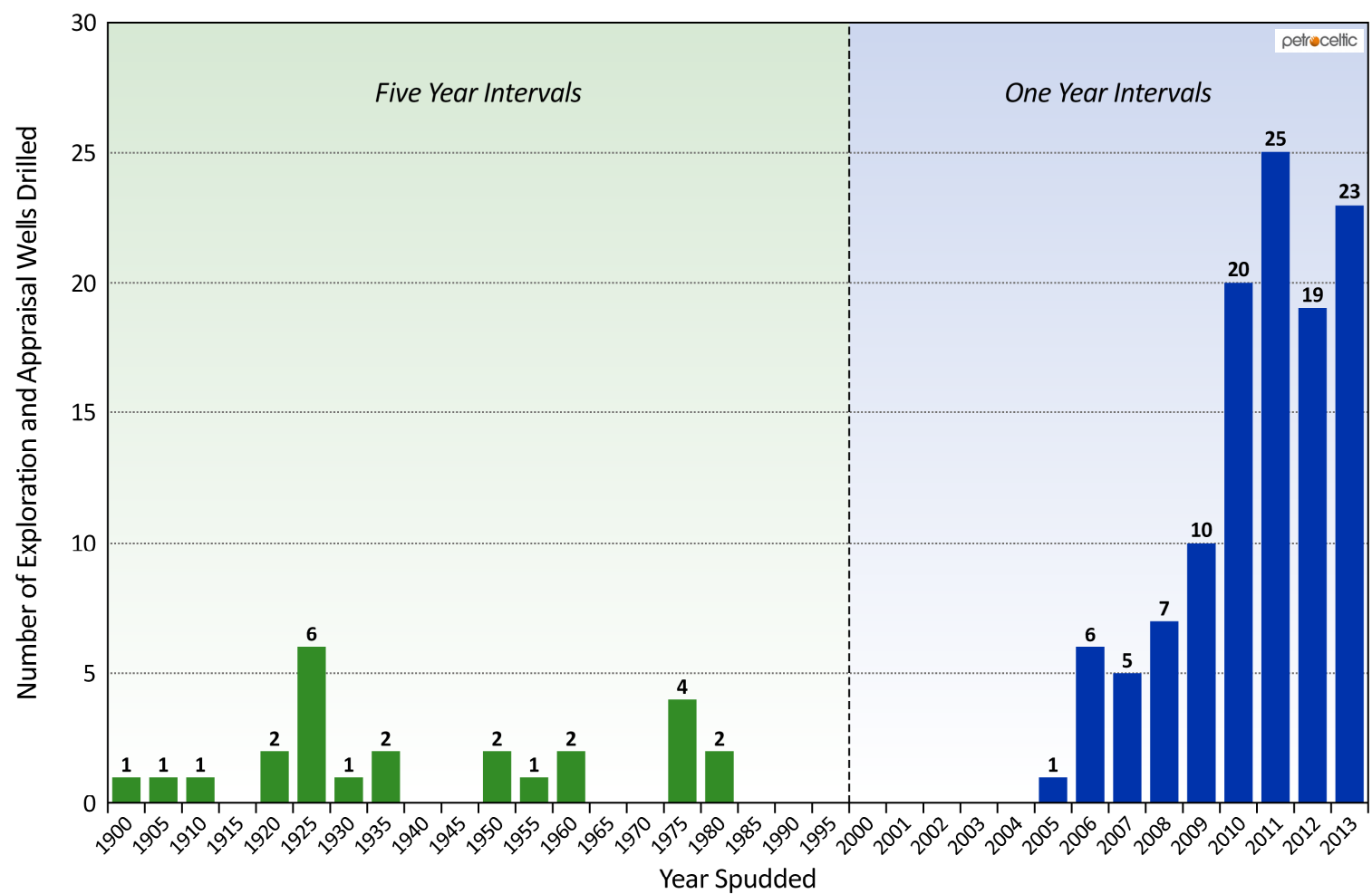
Licensing position 2008

- Half of the blocks assigned
- 22 PSC's – 19 different companies
- Exploration ramping up



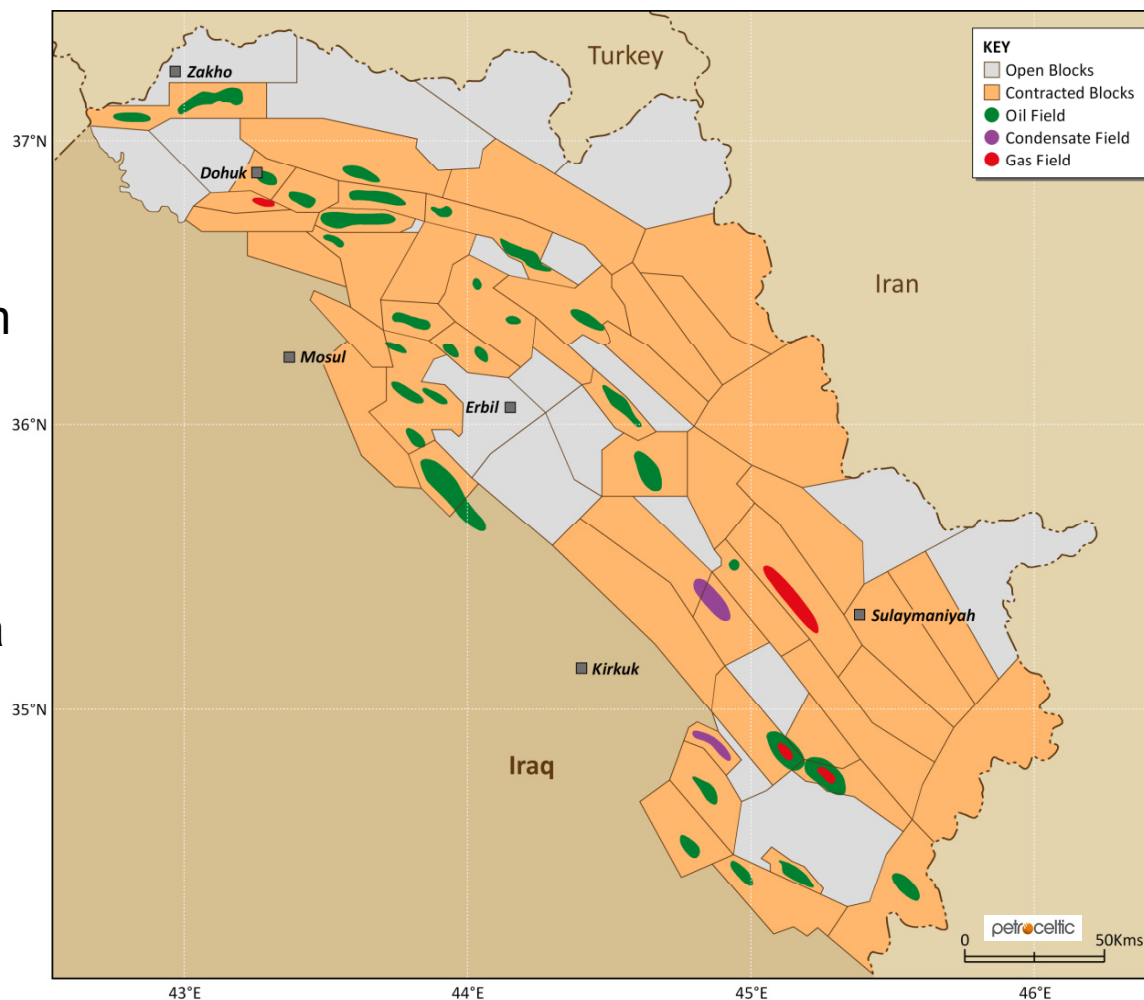
Block map based on map published by the KRG in 2007

Drilling activity



Licensing position 2014

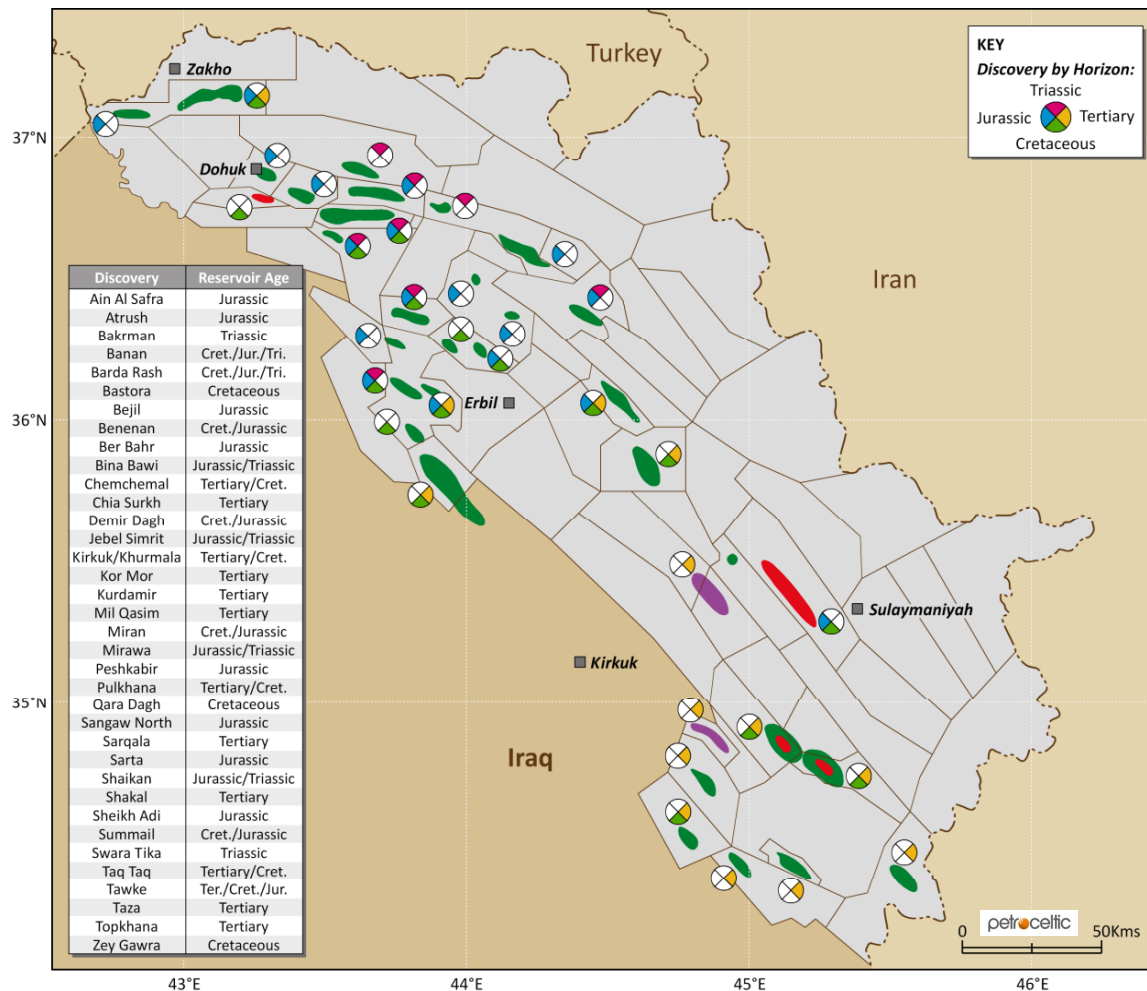
- 36 significant discoveries
- 10 fields declared commercial
- Significant production from 4 main fields
- Tawke and Taq Taq averaging 234 k bopd* of which 78% via pipeline
- Taq Taq, Tawke, Khurmala and Kor Mor have together produced in excess of 250 mmbore



* Genel Energy (September 2014)

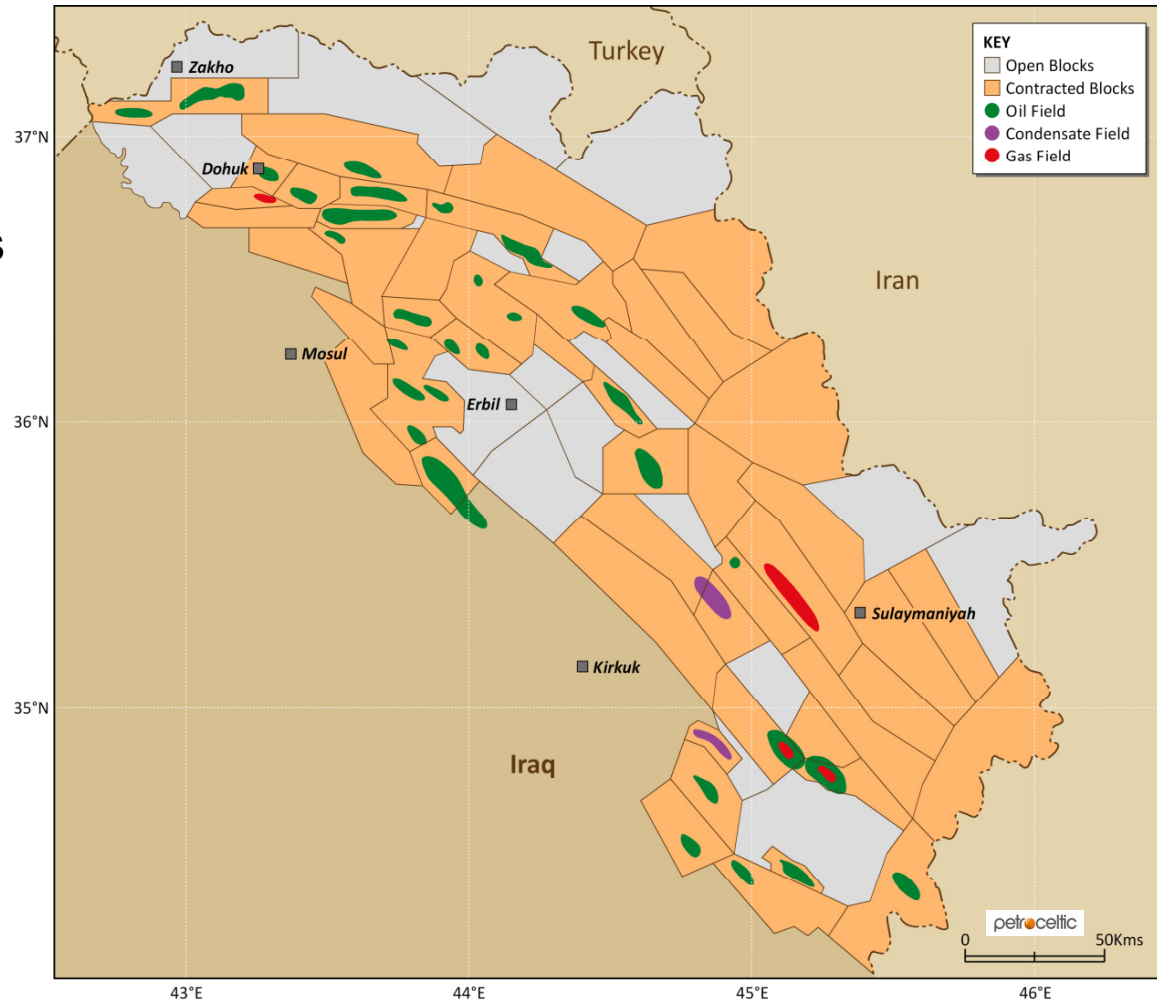
Discoveries

- Principally Triassic, Jurassic and Cretaceous discoveries in the north
- Tertiary and Cretaceous discoveries in the south
- North : more liquids and heavier oils
- South : lighter hydrocarbons and gas



Challenges

- Initial paucity of data
- Service sector / logistics
- Terrain / altitude / seasons
- Mud losses
- Structural configuration, complexity, trap integrity
- Seismic imaging
- Timing of migration
- Petrophysically challenging
- Reservoir damage / testing / interpretation
- Reserve estimation
- Water supply and H₂S



Future

- New province : old problems
- More 3D seismic : better acquisition & processing
- Reservoir facies distribution
- Data sharing, industry / government participation
- Almost all exploration wells to date drilled on 2D and on visible structures – future stratigraphic tests ?
- Deeper targets – depth and age – sub thrust ?
- More advanced drilling
 - horizontal wells / multi-laterals / underbalanced drilling / propping
 - Targeting of large STOIP ‘poorer’ reservoirs
 - Improve recovery factor
- Use of static and dynamic reservoir data
- Hydrocarbon migration and timing
 - Better understanding of local source kitchens proximal to structures / trap destruction and breaching

Summary

- Largest conventional onshore resource to emerge in last decade
- Almost all blocks licensed within 24 months
- 28 wells drilled 1901-2004. >150 E&A wells drilled from 2005-2014
- All exploration wells thus far drilled on 2D seismic, satellite imagery and field work
- These have targeted surface or in a few cases sub surface anticlines
- Stacked reservoirs / seals : Tertiary, Cretaceous, Jurassic, Triassic
- 1st well for 25 years – Tawke-1, 2005 (~1bn bbl discovery)
- High success rates – especially in the less structurally complex areas
- 10 fields declared commercial, >16bn bbls reserves*
- 4 fields with significant production history: >250,000 bopd production present day

* 2P recoverable resources based on published reserves by operators in Kurdistan

