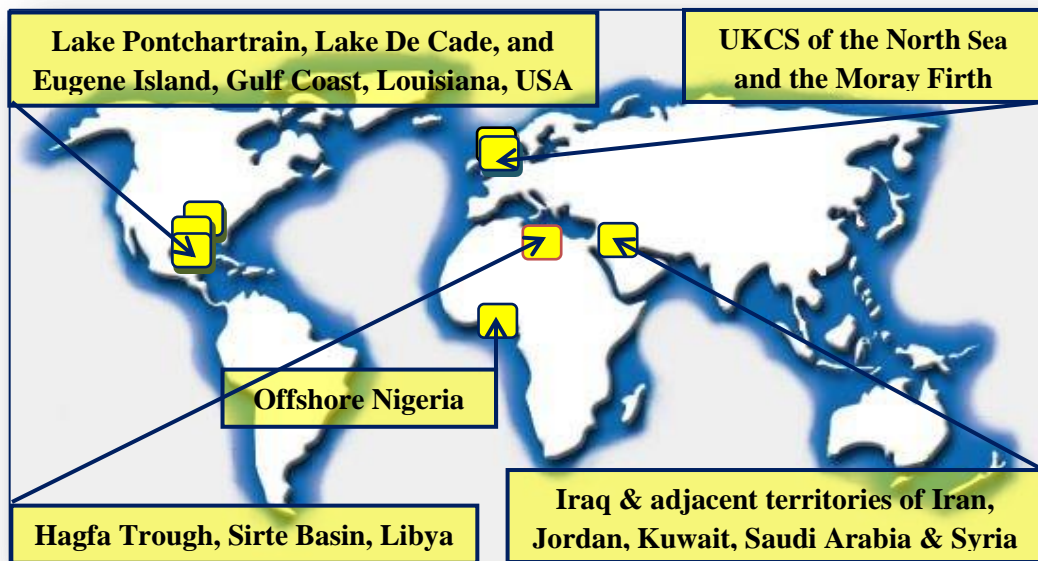


Target Exploration

Energy Geosciences Research & Development



CGG-ESTI[©] Software for:



1. Geothermal Gradients Mapping and Analysis

2. Geothermal Exploration for “Undiscovery Wells”

3. Mature Petroleum Basins Rejuvenation, and

4. Geothermal Energy Prospects Generation

Global Exploration Record of Missed, By-passed & Un-Reached HC Traps by “Undiscovery Wells”

Global hydrocarbon exploration records attest to many early "dry holes" or "dry" anomalies becoming hydrocarbon producers or oil fields with advancement in seismic, gravity, magnetic, geochemical, risk analysis, logistics, exploration, drilling and/or production methods. Wells classified as “dry holes” at completion dates, then proved to be producers at later dates could be described as “un-discovery wells”, ([e.g. DeMis 2007](#)).

Hydrocarbon exploration in the Middle East and North Africa has been until now an exploration for giant oil fields, and many exploration wells have undoubtedly been suspended, plugged and abandoned and declared dry under giant-prone early exploration strategies, obsolete logistics, drilling technology, production methods, economic reserves limits, risk evaluation or political climate, which can be changed to proven, potential, probable or possible “un-discovery wells”. ([IBRAHIM 2008](#))

Geothermal Gradient Anomalies of Hydrocarbon Entrapment

Anomalous geothermal gradients are known in the stratigraphic columns overlying hydrocarbon traps, the anomalies are mainly caused by focused migration of heat-convective subsurface fluids into shallow reservoir closures. At Target Exploration we noticed this phenomenon in discovery wells in academia and while working within several operating oil companies. ([IBRAHIM 1986](#))

Case Studies of Geothermal Gradient Anomalies of Hydrocarbon Entrapment

At Target Exploration, we compile the compensated geothermal gradient–Extrapolated Surface Temperature Intercept computer programme (CGG-ESTI[®]) in order to analyse large number of wells and BHT data, and was proved to be a time saving and cost effective tool for:

1. Collecting Bottom Hole Temperature (BHTs) data, correcting, plotting, analysing and mapping the generated geothermal gradients of large number of old and new exploration and production wells.
2. The CGG-ESTI[®] Software was tested on databases of two exploration time-frames (pre-1970 and 1990) of the Hagfa Trough Area in Sirte Basin, Libya found that high geothermal gradient anomalies to be associated with most of the known oil and gas fields in the two exploration time frames, as well as anomalous "dry holes". [\(IBRAHIM 2000B\)](#)
3. Testing the CGG-ESTI[®] Software on the earlier time frames database, we delineate several geothermally anomalous "dry hole", one of them was deepened and became an "un-discovery well" i.e. became an oil producer in a new field in 1987, [\(IBRAHIM 2018B\)](#)
4. Examples of un-discovery well from Sirte Basin is "dry holes" K1-13 of Mobil Oil Libya (now K1-NC149 a producer in Wadi Field, Block NC149 of Sirt Oil), and J1-85 of Aquitaine (now a new discovery via re-entry in Block NC177 of Red Sea Oil). [IBRAHIM 2018B](#) [\(PPTX\)](#)
5. Another example is the B/44 proven anomaly that was generated by a "dry hole" in the Southern UKCS of the North Sea. The B/44 anomaly that was first generated as potential high CGG-low ESTI closed contours anomaly around Burmah's 1968 dry hole 44/19-02 (2.3 F/100 Ft and 25.2 F), then, it was changed to proven geothermal anomaly when the status of the 1989 Sovereign Carboniferous gas discovery via well 44/19-03 was confirmed by the UK-DOE in 1990. [\(IBRAHIM 1994\)](#)

6. Staff of Target Exploration presented several case studies of using the CGG-ESTI[®] software and method to delineate potential, probable and possible "un-discovery wells" among a large number of genuine dry holes as papers at several international petroleum conferences, and geothermal energy meetings. ([IBRAHIM 2000](#))

Target's Nonexclusive Geothermal Exploration Reports

Target Exploration Consultants published several nonexclusive reports, studies and research on recognising missed and bypassed hydrocarbon traps using associated geothermal gradient anomalies of Hydrocarbon entrapment in Offshore Nigeria, Offshore and Onshore Louisiana, UKCS, Iraq, Libya, Saudi Arabia and Syria. (See location map of studied areas above):

1. Report Tar-06: Geothermal gradient anomalies of hydrocarbon entrapment, Al-Hagfa Trough, Sirt Basin, Libya. Non Exclusive Report, 37 p. 70 Figures, 5 Enclosures and One PDF CD. [TAR06.PDF](#)
2. Report Tar-05: Geothermal Gradient Anomalies of Hydrocarbon Entrapments in Iraq (and adjacent areas in Iran, Jordan; Kuwait, Saudi Arabia and Syria), Non-Exclusive Report, Target Exploration, London, UK, 121 p, 178 figures, 7 enclosures. [TAR05.PDF](#)
3. Report Tar-08: Geothermal Gradient Anomalies of Hydrocarbon Entrapment, UKCS Quadrants 35, 36, 37, 38, 39, 41, 42, 43, 44, 47, 48, 49, 50, 52, 53, and 54. Non-Exclusive Report, Target Exploration, London, UK. 60 Pages, 290 Figures and 5 Enclosures. [TAR08.pdf](#)
4. Geothermal Gradient Anomalies of Hydrocarbon Entrapment, Morecambe Bay, UKCS Quadrant 110, Non-Exclusive Report, Target Exploration, London, UK. 80 Pages, 40 Figures and 5 Enclosures. [\(On hold\)](#).

5. Geothermal Gradient Anomalies of Hydrocarbon Entrapment, Off-Shore Nigeria, Non-Exclusive Report, Target Exploration, London, UK. [\(On hold\)](#).
6. Geothermal Gradient Anomalies of Hydrocarbon Entrapment, On- and Off-Shore Louisiana, USA, Non-Exclusive Report, Target Exploration, London, UK. 220 P. [\(On hold\)](#).

Target's Publications on Geothermal Gradients in Mature Basins

1. Ibrahim MW (1986) Compensated geothermal gradient: New Map of old data. AAPG Bull 70 (5) p 603. Abstract. [IBRAHIM 1986](#)
2. Ibrahim MW (1988) Compensated Geothermal Gradient Anomalies in a mature hydrocarbon basin: Lake Pontchartrain, Lake Decade and Eugene Island, the Gulf Coast, Louisiana, USA. AAPG Bull 72 (2) pp 200. Abstract. [IBRAHIM 1988](#)
3. Ibrahim MW (1993) Geothermal Gradient Anomalies of Hydrocarbon Entrapment, UKCS North Sea. (Abstract). In Proc. of 10th Iraqi Geological Congress, Union of Iraqi Geologist, Baghdad, 28-31 Feb. 1992.
4. Ibrahim MW (1994) Geothermal Gradient Anomalies of Hydrocarbon Entrapment, UKCS Quadrants 35-54, In Proceedings of European Petroleum Computer Conference, 15-17 March 1994, Aberdeen, SP Paper No. 27547, pp 85-96. [IBRAHIM 1994](#)
5. Ibrahim MW (1995) Geothermal Gradient Anomalies of Hydrocarbon Entrapment in the Middle East and North Africa, In Proceedings of GEO 94 the Middle East Geosciences Exhibition and Conference, 25-27 April 1994, Bahrain, Vol.2, pp 543-552. [IBRAHIM 1995](#)
6. Ibrahim MW (1996) Cretaceous Oil Plays in Mesopotamia, (Abstract). In PESGB Farm-in / Farm-out Seminar, 15 March 1996, London, 1p.

7. Ibrahim MW (1997) Geothermal gradient anomalies of hydrocarbon entrapment, Al-Hagfa Trough, Sirt Basin, Libya. In Geology of Sirt Basin, Salem et al, Eds. Elsevier pub. Co., pp 419-433.
8. Ibrahim, MW (1999) Petroleum Geology and Hydrocarbon Provinces of Iraq. In Iraqi Petroleum Conference 1999, 9-10 September 1999, Imperial College, London. 17p. [IPC1999](#)
9. Ibrahim, MW (2000A) Missed, By-passed, and Under-estimated Hydrocarbon Traps: Examination of Basic Exploration Records Reveals Potential "Un-Discovery" Wells in Libya, (Abstract). Geo 2000, 4th. Middle East Geo-sciences Conference, 27-29 March, Manama, Bahrain. GeoArabia, V. 5, No. 1, p113. [IBRAHIM 2000](#)
10. Ibrahim, MW (2000B) Missed, By-passed, and Under-estimated Hydrocarbon Traps: Examination of Basic Exploration Records Reveals Potential "Un-Discovery" Wells in Libya, (Abstract). AAPG Annual Convention, 16-19 April 2000, Louisiana, p. A-72. [IBRAHIM 2000B](#)
11. Ibrahim, MW, (2001) Missed, Bypassed, and Underestimated Hydrocarbon Traps: Analysis of Basic Exploration Records Reveals "Un-Discovery Wells" in Iraq, 17 p. In MENA 2001 Oil and Gas Conference (The 2nd Middle East and North Africa Oil and Gas Conference), Target Exploration, 18 & 19 September 2001, Imperial College, London, 350 p. [MENA2001](#)
12. Ibrahim, MW, (2002) Missed, Bypassed, and Underestimated Hydrocarbon Traps: Analysis of Basic Exploration Records Reveals "Un-Discovery Wells" in North Arabia, (Abstract). In AAPG Annual Convention, Houston, Texas, USA. [IBRAHIM 2002](#)
13. Ibrahim, MW (2007) Missed, Bypassed and Under-estimated Hydrocarbon Traps: Analysis of Exploration Records Reveals "Un-discovery Wells" in North Arabia, In MEOS, 15th Middle East Oil Show and Conference, 11-14 March 2007, SPE, Bahrain, Conference CD.

14. Ibrahim, MW. (2008). Missed, Bypassed and Under-Estimated Hydrocarbon Traps (Analysis of BHT Records Reveals “Undiscovery Wells” in Some OAPEC Countries). In Symposium on “Development in Petroleum Exploration & Production Technologies”, Jointly Organized by OAPEC and the Oil and Gas National Authority in Kingdom of Bahrain, Manama-Kingdom of Bahrain; 10-12 November, 2008. Conf. Abstracts, P. 31-33. [IBRAHIM 2008](#)
15. Ibrahim, M.W. (2011) Mud Gas Logs and Mud Gas Ratios of Fractured Reservoirs of North Iraq. In MENA 11 Oil and Gas Conference (The 9th Middle East and North Africa Oil and Gas Conference: Undeveloped Oil and Gas Discoveries of the Middle East and North Africa). Target Exploration, 19 & 20 September 2011, Imperial College, London, 149p. and one PDF CD. [MENA11](#)
16. Ibrahim, M.W. (2012) Exploration Ramifications of the Regional Geothermal Gradient of Iraq. (Abstract). IPC 2012 (Iraq-In Preparation for the 5th Bid Round (Exploration, Fields Development and Operation Challenges, the 4th Iraqi Petroleum Conference) Target Exploration, 13 & 14 September 2012, Imperial College, London, 80p. and PDF CD. [IPC2012](#)
17. Ibrahim, MW. (2017B) Using geothermal gradient anomalies of hydrocarbon entrapment in rejuvenating mature basins and identifying missed and bypassed traps, 1P Abstract, Geothermal Cross Over Technology Workshop. Organised by AAPG Europe Section, Collingwood College; Durham University, UK. 25th - 27th April 2017. [IBRAHM 2017B](#)
18. Ibrahim, MW. (2017C) Geothermal gradient anomalies of hydrocarbon entrapment of central Sirte Basin, Libya: a mature basin rejuvenation technique. Extended abstract, pp. 152-153, abstract volume, 16th African conference, 31 August-1 September 2017, organised by the PESGB at the Business Design Centre, London, UK. 172p. [IBRAHIM 2017C](#)
19. Ibrahim, MW and B. Al-Kubaisi (2018A) Geothermal gradient anomalies of hydrocarbon entrapment at Southern North Sea basin, UKCS: a mature basin rejuvenation technique. Extended Abstract. Geo 2018 Conference and Exhibition, 5-8 March 2018, organised by AAPG ME Section, Manama, Bahrain. [IBRAHIM 2018A](#)

20. Ibrahim, MW and G. Reeh (2018B) Geothermal gradient anomalies of hydrocarbon entrapment at central Sirte basin, Libya: a mature basin rejuvenation technique. Extended Abstract, Geo 2018 Conference and Exhibition, 5-8 March 2018, organised by AAPG ME Section, Manama, Bahrain. [IBRAHIM 2018B \(PPTX\)](#)

Chia Surkh-1, first “Undiscovery Well” in the Middle East

Another “Un-discovery Well” that missed, bypassed or stopped short of hydrocarbon trap is well Chia Surkh-1. It is the first rotary drilling petroleum exploration well drilled in the Middle East; spudded in 1901 close to oil seep northeast of Khanaqin town, Diyala Governorate of the Arabian Republic of Iraq. The well reached TD in the Lower Miocene Kallhur reservoir (Jeribe Fm. equivalent), and declared plugged and abandoned as dry hole with oil & gas shows in 1902 or 1903.

Around 110 years later, Genel Energy drilled well Chia Surkh-10 in the dormant Chia Surkh Oil Field anticline in 2013, which tested 11,950 BOPD of 41°API oil and 15 MMCFD gas from Oligo-Miocene reservoirs. The editor of Oil & Gas Journal reported it as a major oil and gas discovery in the 10th of April 2013 issue of the OGJ.



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22-02-2022