References:

Avcioğlu E (2010) Hydrocarbon Microseepage Mapping Via Remote Sensing For Gemrik Anticline, Bozova Ol Field, Adiyaman, Turkeymiddle East Technical University.

API American Petroleum Institute. (1982). Basic Petroleum Data Book, Petroleum Industry Statistics. Washington 2:1.

ARIH (Advanced Resources International Houston), (2009), Identifying Oil Exploration Leads Using Integrated Remote Sensing And Seismic Data Analysis, Lake Sakakawea, Fort Berthold Indian Reservation,Williston Basin.

BENISSA M .A (2006), Application Of Remote Sensing And GIS For Petroleum Exploration In GHADAMIS Basin, NW Libya, Libyan Petroleum Institute.

Biegert Ed. K , (2007) , From Black Magic To Swarms: Hydrocarbon Exploration Using Non-Seismic Technologies, Shell International Exploration And Production.

Bungum, H., Harbitz, C.B., Glimsal, S., Lindholm, Dc., And Pedersen, G (2006).. "Earthquake Related Tsunami Hazard Along The Western Coast Of Thailand." Natural Hazards And Earth System Sciences. Vol. 6, No. 6, 979-997. November 30.

Byfield, V., (1998).“Optical Remote Sensing Of Oil In The Marine Environment”, Ph.D. Thesis, University Of Southampton.

Cloutis, E. A., (1989), Spectral Reflectance Properties Of Hydrocarbons: Remote Sensing Implications, American Association For The Advancement Of Science ,245 , Pp.165- 168.

Collins R.J., Petzel G.J., Everett And J.R. (1975). An Evaluation Of The Suitability Of Skylab Data For The Purpose Of Petroleum Exploration: United States NASA, NAS9-13297, 117 .

ESC (Earth Satellite Corporation) , (1997), Remote Sensing And Fracture Analysis For Petroleum Exploration Of Ordovician To Devonian Fractured Reservoirs In New York State , New York State Energy Research And Development Authority.

Filho R , Miranda, F.P.,Lorenzzetti J.A. ,Pedroso E.C, Beisl C.H.(2005) , RADARSAT-1 Images In Support Of Petroleum Exploration: The Offshore Amazon River Mouth Example, Encana Corporation, Calgary, Canada.

Freeman H, (2003), Evaluation Of The Use Of Hyperspectral Imagery For Identification Of Microseeps Near Santa Barbara, California, West Virginia University.

Froman, N,L,, (1976), Petroleum Exploration Using Landsat Imagery:Unpublishedmasters Thesis. University Of Wyoming, Department Of Geology, P 96.

Fu, B., Zheng, G., Ninomiya, Y., Wang, C., Sun, G., (2007), Mapping Hydrocarbon-Induced Mineralogical Alteration In The Northern Tian Shan Using ASTER Multispectral Data,Terra Nova 19, Pp.228, 229.

GOSD (Global Offshore Seeps Database), (2013), Indonesia 2013 Seepage Study.

Haderer M . (2013) An Introduction To The Oil Industry , Public Relations & Information Department , OPEC.

Harris R, Cooper M, And Shook I (2002), Focusing Oil And Gas Exploration In Eastern Yemen By Using Satellite Images And Elevation Data Alongside Conventional 2D Seismic , Encana Corporation, Calgary, Canada.

Hörig, B., Kühn, F., Oschütz, F., And Lehmann, F.,(2001), Hyperspectral Remote Sensing To Detect Hydrocarbons,International Journal Of Remote Sensing , 22 , Pp. 1413-1422.

Ivanov A. Yu. ,Golubov B. N. , Zatyagalova B. B. (2006), Oil And Gas Seeps And Underground Fluid Discharge In The Southern Caspian Based On Space Radar Data, Shirshov Institute Of Oceanology, Russian Academy Of Science, Moscow Institute Of Geospheres Dynamics, Russian Academy Of Science, Moscow Almaz Center, Federal State Unitary Enterprise "NPO Mashinostroyenia", Reutov, Moscow Region
Jong De , S.M. And Van Der Meer, F.D.,(2004), Remote Sensing Image Analysis:Including The Spatial Domain, Pp.201-210.

Kahn, S.D. And Jacobson, S., (2008), Remote Sensing And Geochemistry For Detecting Hydrocarbon Microseepages, GSA Bulletin , 120 , Pp. 96, 99-104.

Kahn, S.D., (2006), Mapping Alteration Caused By Hydrocarbon Microseepages In Patrick

Draw Area Southwest Wyoming Using Image Spectroscopy And Hyperspectral Remote Sensing, Gran T/Cooperative Agreement No. DE-FG26-05NT42494, 15p.

Kuhn, F., Opperman, K., And Höring, B., (2002),Hydrocarbon Index-An Algorithm For Hyperspectral Detection Of Hydrocarbons, International Journal Of Remote Sensing , 25 , No.12, Pp. 2467-2473.

KUMPULA T , FORBES B.C. And STAMMLER F, (2009) , Remote Sensing And Local Knowledge Of Hydrocarbon Exploitation: The Case Of Bovanenkovo, Yamal Peninsula, West Siberia, Russia, The Arctic Institute Of North America.

KUMPULA, FORBES2T. B.C. And STAMMLERF (2009.) -(Remote Sensing And Local Knowledge Of Hydrocarbon Exploitation:The Case Of Bovanenkovo, Yamal Peninsula, West Siberia, Russia.

Lammoglia, T., Souza Filhoa, C.R., And Filho, R.A.,(2008), Characterization Of Hydrocarbon Microseepages In The Tuca No Basin, (Brazil) Through Hyperspectral Classification And Neural Network Analysis Of Advanced Spaceborne Thermal Emission And Reflection Radiometer (Aster) Data, The International Archives Of The Photogrammetry, Remote Sensing And Spatial Information Sciences 37 , Part B8., Pp.1196, 1198.

Marrs, R,W,, And Karainsky, B,, (1977), A Study Of Landsat Imagery For Detection Of Surface Anoraalies Related To Petroleuraaccuraulations:University Of Wyoraing, Departraent Of Geology, P 207.

Mazumder S And Saha K.K , (2006) , 6th International Conference & Exposition On Petroleum Geophysics , Remote Sensing &Geomaticsdiv, KDMIPE Oil And Natural Gas Corporation Limited.

Mishra. P And Sagar N. Mehta (2003) Using Remote Sensing And GIS Technologies As An Aid For Hydrocarbon Exploration In The Assam-Arakan Fold-Thrust Belt Hindustan Oil Exploration Company Limited, Tandalja Road, Vadodara, Gujarat.

Mitchell G , (2011), The Application Of Highly Accurate Stereo Satellite Elevation Mapping To Oil And Gas Exploration And Development. Photosat.

Mobley, C. D., (1999) "Estimation Of The Remote-Sensing Reflectance From Above-

Surface Measurements", Appl. Opt.38(36), 7442-7455.

Nicholas M. Short, Sr-(February, 2007) Society Of Exploration Geophysicists – RST – Section 5 – Geologic Applications II – Mineral And Petroleum Exploration.

NPA Group, 2004, Key Features Of OBS Technology, Crockham Park, Edenbridge, Kent, TN8 6SR, England.

Petrovic, A., Khan, S.D., Chafetz, H.S ., (2008), Remote Detection And Geochemical Studies For Finding Hydrocarbon-Induced Alterations In Lisbon Valley, Utah, Marine And Petroleum Geology, 25 , 696 P.

Ricky G. (1982), Use Of Remote Sensing Techniques And Statistics In Petroleum Exploration: Permian Basin, Texas ,Texas Tech University.

Ruisong Xu , (2001) , Petroleum And Gas Research By Remote Sensing In South China Sea , Guangzhou Institute Of Geochemistry, Chinese Academy Of Science.

Sandra L. Perry And Fred A. Kruse, (2011), Evidence Of Hydrocarbon Seepage Using Multispectral Satellite Imagery, Kurdistan, Iraq, Horizon Geoimaging LLC, Frisco, CO.

Saunders D.F. Thoraas,, G.E Kinsiman,. F.C. And Beatty D.F.. (1973) ERTS-1 Imagery Use In Reconnaissance Prospecting: Evaluation Of Commercial Utility Of ERTS-1 Imagery In Structural Reconnaissance For Minerals And Petroleura, Final Report: Texas Instruraents, Dallas, P 129.

Shi P, Fu B, And Yoshiki Ninomiyab, (2010), Mapping Hydrocarbon Seepage Induced Anomalies In The Arid Region, West China Using Multispectral Remote Sensing, Institute Of Geology And Geophysics, Chinese Academy Of Sciences,Geological Survey Of Japan, National Institute Of Advanced Industrial Science And Technology.

Sikabonyi L.A., And Rodgers.W.J. (1959).Paleozoic Tectonics And Sedimentation In The Northern Half Of The West Canadian Basin: Journal Of The Alberta Society Of Petroleum Geologists, V7, P 193–216.

Srivastava. K. S And Arulmani. M, 2005, Radars Click Slicks To Evaluate Hydrocarbons, Geospatial Today, Vol 3, Issue 5, Pp 55-57.

Staskowski, R.J., (2004), Utility Of Aster For Detecting Hydrocarbon, AAPG Annual Convention, Pp.1-2.

Sundberg KR (1994) Surface Geochemistry Applications In Oil And Gas Exploration. Oil Gas J 92(23):47–56.

Sunstar. M. (2008) .Oil History Volume VI Dr, D.D) Http://Www.Enotes.Com/Ear th-Science /Petroleum-History-Exploration.

Tian Q, (2012), Study On Oil-Gas Reservoir Detecting Methods Using Hyperspectral Remote Sensing, International Institute For Earth System Science, Nanjing University.

Van Der Werff, H.M.A, Noomen, M.F.,Van Der Meijde, M, .And Van Der Meer, F.D., (2007), Remote Sensing Of Onshore Hydrocarbon Seepage: Problems And Solutions, Geological Society, London, Special Publications ; 283 ; Pp. 131-132.

Victoria V. Zatyagalova, Andrei Yu. Ivanov, Boris N. Golubov, (2007), Application Of ENVISAT SAR Imagery For Mapping And Estimation Of Natural Oil Seepage In The South Caspian Sea, Envisat Symposium 2007', Montreux, Switzerland.

Wang, X. And Mullins, O. C., (1994) "Fluorescence Life Time Studies Of Crude Oils", Appl. Spectrosc. 48, 977-984.

Williams, A., And G. Lawrence, 2002, The Role Of Satellite Seep Detection In Exploring The South Atlantic's Ultra Deep Water, AAPG Studies In Geology No. 48 And SEG Geophysical References Series No. 11, P. 327–344.

Wuyi Yu , Xiaoping Qi , And Zouliqun (2001), Evaluation Of Multi Sensor Remote Sensing Dataapplied Oil And Gas Explorationin The Loess Highlands , China , Research Institute Of Petroleum Exploration And Development Of Petrochina Co Ltd , Beijing.

Yang, H., Van Der Meer, F., Zhang, J., Kroonenberg, S.B., (2000), Direct Detection Of Onshore Hydrocarbon Microseepages By Remote Sensing Techniques, Remote Sensing Reviews, 18 ,Pp. 5-7, 13.

ONLINE RESOURCES

http://asterweb.jpl.nasa.gov.

http://blog.urthecast.com/education-tag/the-use-of-satellite-imagery-in-oil-reserve-exploration.

http://en.wikipedia.org/wiki/Petroleum_geology.

http://fas.org/irp/imint/ docs/rst/Sect5/Sect5_5.html.

http://hotcopper.com.au/threads/geology-lesson-1481441 /#.VA5TQckT81E.

http://iit.edu/arc/workshops/pdfs/SENSORS.pdf

http://irina.eas.gatech.edu/EAS6145_Spring2013/Lecture1.pdf

http://modis.gsfc.nasa.gov/about.

http://nature.berkeley.edu/~penggong/textbook/chapter7/html/sect71.htm

http://pubs.usgs.gov/fs/2010/3026/pdf/FS2010-3026.pdf, 2014

http://staff.aub.edu.lb/~webeco/rs%20lectures.htm

http://tle.geoscienceworld.org/content/19/3/258.extract

http://uregina.ca/piwowarj /Satellites/TerraAqua.html

http://uregina.ca/piwowarj/Satellites/ Landsat. Html

http://uregina.ca/piwowarj/Satellites/ NOAA.html

http://uregina.ca/piwowarj/Satellites/IRS.html

http://www.aaas.org/page/satellite-imagery-analysis-environmental-monitoring-turkmenbashi-turkmenistan.

http://www.cem.msu. edu/~cem 924sg/Topic11.pdf

http://www.crisp.nus.edu.sg/~research/tutorial/opt_int.htm

http://www.crisp.nus.edu.sg/~research/tutorial/process.htm http://www.esa.int/SPECIALS/Eduspace _EN/SEMDQY3Z2OF_0.html

http://www.hk-phy.org/energy/power/print/source_is_print_e.html

http://www.landforms.eu/orkney/Geology/Oil/OIL%20 petroleum%20system.htm

http://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/educational-resources/9347

http://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/educational-resources/9303

http://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/educationa l-resources/9291

http://www.physics.uc.edu/~sitko/ReflectanceSpectroscopy.pdf

https://apollomapping.com/wp-content/user_uploads/2011/11/NASA_Remote _Sensing _Tutorial_Oil_and_Gas

https://www.academia. edu/6242977 /Platform_and_Sensors

Appendix A: Questionnaire

Faculty of Engineering
Alexandria University

Remote sensing for oil exploration has become incorporated into every practice. Its now standard procedure to examine satellite imagery at the area selection stage and to carry out an interpretation at the inception of field studies for integration with the results of geophysical survey

Purpose of research

Assessment of the role of remote sensing in oil exploration

Study Factors affecting exploration using remotely sensed data

Evaluate the value for each factor versus other factors

Create options for each factor and introduce a complete evaluation for each case before starting

This short survey will add a great value to our work, where we consider industrial aspects within this project, consequently include your comments to reflect the industrial flaxen at the end

Thank you for your patience. Please help us improve our research and our service to you by completing this survey .

The entire survey will take approximately 5-10 minutes of your time to complete.

Some basic demographic information

In this section, we are hoping to learn a bit about you on an anonymous basis (i.e. this information will help us identify what aspects of the Method are useful to different demographic groups)

Name	Company	Title

Based on our description on the previous page, how well do you understand our method idea?

☐ Don't Understand

☐ Somewhat Understand

☐ Understand

☐ Understand Very Well

What is your overall interest in the method described?

☐ Not Interested

☐ Somewhat Interested

☐ Interested

☐ Very Interested

Have you ever used a method such as the one proposed?

☐ Yes

☐ No

Please tell us a bit about your experience in trying the method that was similar to what we are proposing:

What did you like the most?

What did you like the least?

What was the main reason for using this method?

Assuming that we offered the proposed Method at a price level similar to the subject/method that you tried, how would you rate the value of our offering?

- ☐ Very Poor
- ☐ Poor

- ☐ Average
- ☐ Good
- ☐ Great

How probable is it that you would Use a Method like ours in the future?

- ☐ Definitely
- ☐ Probably
- ☐ Not Sure
- ☐ Probably Not
- ☐ Definitely Not

Please explain difficulties and disadvantages of your system of exploration

Please answer the questions below assuming that you would use this Method:

How often do you believe you would use this Method?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes

☐ Often

☐ Always

How long do you believe such a Method could be useful to you?

☐ Less than a month

☐ 1-6 month

☐ 1-3 years

☐ Over 3 years

☐ Wouldn't be useful

Assuming this Method encompassed everything that was important to you, what would you pay for it?

Please indicate your answers in USD:

What is the most you would pay? [ ]

What is the least you would expect to pay? [ ]

What do you believe would be the ideal price? [ ]

Where would you expect to find out about a Method like ours?

Please select all that apply

☐ On a website

☐ On a blog

- ☐ In a magazine
- ☐ In a trade-show
- ☐ On TV
- ☐ On the Radio
- ☐ On a billboard
- ☐ In a store
- ☐ Via a colleague/friend
- ☐ Via email
- ☐ Via flyer
- ☐ Industry Publication
- ☐ Other, please specify: [ ]

Any final comments

[ ]

Appendix B: Data collection Tables

Paper No	Satellite characterization				Weather conditions					processing		Interpretation Elements								Existing Data	Notes
	type	resolution	bands	Time D/N	wind speed	temperature				classification	PCT	pattern	Shadow	Size	Shape	Texture	Tone color	Time	Association		
1	IRS-1D LISS-III and IRS-ID PAN		combining Bands 4, 3 and 2 of the LISS-III image							*serial balanced cross sections* pseudo 3-dimensional models of stratigraphichorizons							o			geological maps, structure contour maps, and topographical maps (1:50,000 scale). Field survey data of existing well and seismic line locations, as well as GPS survey points	both the images were “resolution merged” together to obtain a multi-spectral image having higher spatial resolution
2	TM124'34(1992) TM124'35(1992) TM128'34(1998) TM128'35(1987) MSSKR137'34(1976) ETM127'34,35(2000) ETM128'34,35(2000) SPOT268-274(1988)		B1,B3,B5 from TM128'35(1987) B2,B7 from TM128'34(1998) B4 from ETM127'34,35(2000) ETM128'34,35(2000)			9				Statistical analysis Bands from different images combined to create multi-temporal image using map to map matching Combining contrast enhancement, band ratio , principal component analysis and color spatial transform								o			Multi source information fusion processing of multi-temporal and multi platform remote sensing are used High correlation factor among images of TM 1998 Data , TM 2000 Data and MSS 1976 Data Tonal anomalies and subtle changes in information content are used as indicator of oil existence

	RADARSAT S1 (1998)																				
3	NOAA-11 (1990) NOAA-11 (1993) NOAA-11(1994)		CH 1,2,4,5							SST processing for CH 4,5 False color image processing for CH 5,2,1 Factor correlation analysis for the study of temperature change									O		the hydrocarbonphilous microorganism algae and plankton have been displayed special cherry red color on CH 5,2,1 different from background color study the relation between surface temperature and oil basin existence
4	Landsat-2 1980		Band 4, the green band, 0.5 - 0.6 µm Band 5,the red band, 0.6 - 0.7µm Band 6, the near-infrared band, 0.7 - 0,8 µm Band 7, the second near-infrared band, 0.8 - 1.1 µm							compensation for geometric and radiometric distortions and elimination of systematic noise cosmetic processing to remove random noiseand imperfections in data analysis, including image comparison and extraction of measurement data false color composite for Bands 4, 5,7		C								Old geological maps from atlas	The three types of anomalies (tonal, arcuate, and circular) are identified Rocktype and ages were assigned to the overlay from published maps. The oil and gas fields were mapped on the basis of pattern recognition

5	TM5 R,G,B color composite image		Bands 7,4,2									C							O	1:250,000 scale topographic maps The distribution and depth of source/reservoir rocks as derived from well logs Oil and gas field production statistics Well location maps Contour map for the study area	This study focused on the organic-rich , Black and Brown shales of Ordovician to Devonian age and the closely associated sandstones and siltstones
6	Landsat 1											C								Available seismic reflection profiles	focus on the study of a number of geological morphology of certain features (Depressions-Sinkholes)

7	Landsat 7		Combining bands 7 (reflected infrared (IR)), 4 (reflected IR) and 1 (blue-green) as a RGB raster in ERMAPPER							Combining bands 7,4,1 to create a false color composite image that exhibits the best distinction between the various outcropping lithologies		c								digital elevation model Data Ground Control points Contour maps Structure maps Seismic Data	A potential source basin was identified by surface expression adjacent to the mapped structures combines Landsat images with adigital elevation model (DEM) to map surface structure and geology
8	TM		Bands 4,5,6							Detection of oil in ocean in various spectrums											80% of offshore oil exploration starts by searching for seeps. Most seeps represent tiny but detectable volumes of oil and gas which are not significantly depleting the reservoir seeping oil and gas are often easier to detect due to the fact that oil is normally transported from the sea-bed vent to the surface as oil-coated gas bubbles. At the surface Slicks are interpreted on the

																					SAR imagery as dark patches. The pollution slicks are thicker than the seepage slicks. The seepage slicks are ultra thin films.
9	RADARSAT-1 (AVHRR) sensor data (SSM/I) sensor data		Descending ScanSARnarrow 1 (SCN1) and wide 1 (W1) beam modes were chosenbecause of their steep incidence angles (20°–31° for W1 and20°–40° for SCN1 modes)							An unsupervised semivariogram textural classifier algorithm was used to enhance areas of smooth texture and lowradar backscatter, indicative of the seepage slick targets										radar frequency, incidence angle,spatial resolution, environmental conditions, and size of the oilslicks. sea surface temperature, cloud top temperature, wind velocity, and tidal regime Wind speed and direction Geological data for study area	All the images were submitted to visual analysis with the objective of identifying possible seepage slick candidates Sea surface and cloud top temperatures were obtained from data collected by the thermal infrared bands of the advanced very high resolution radiometer (AVHRR)sensor onboard the TIROS-N series satellite of the National Oceanographic and Atmospheric Administration (NOAA)

10	ASTER sensor																				A general seepage model has been developed through multiple case studies Oil assemblages commonly ssociated with hydrocarbon microseepage.
11	Landsat Thematic Mapper images		three visible bands (1, 2, 3) and three reflected IR bands (4, 5, 7). Band 6 records thermal IR energy							Color composite image of TM bands 2, 4, and 7 combined inblue, green, and red.										Contour maps Structure maps Seismic Data	TM bands 4, 5, and 7 areespecially useful for mapping differentrock types. The reflectance spectra of common sedimentary rocks and vegetation are strong oil indicator

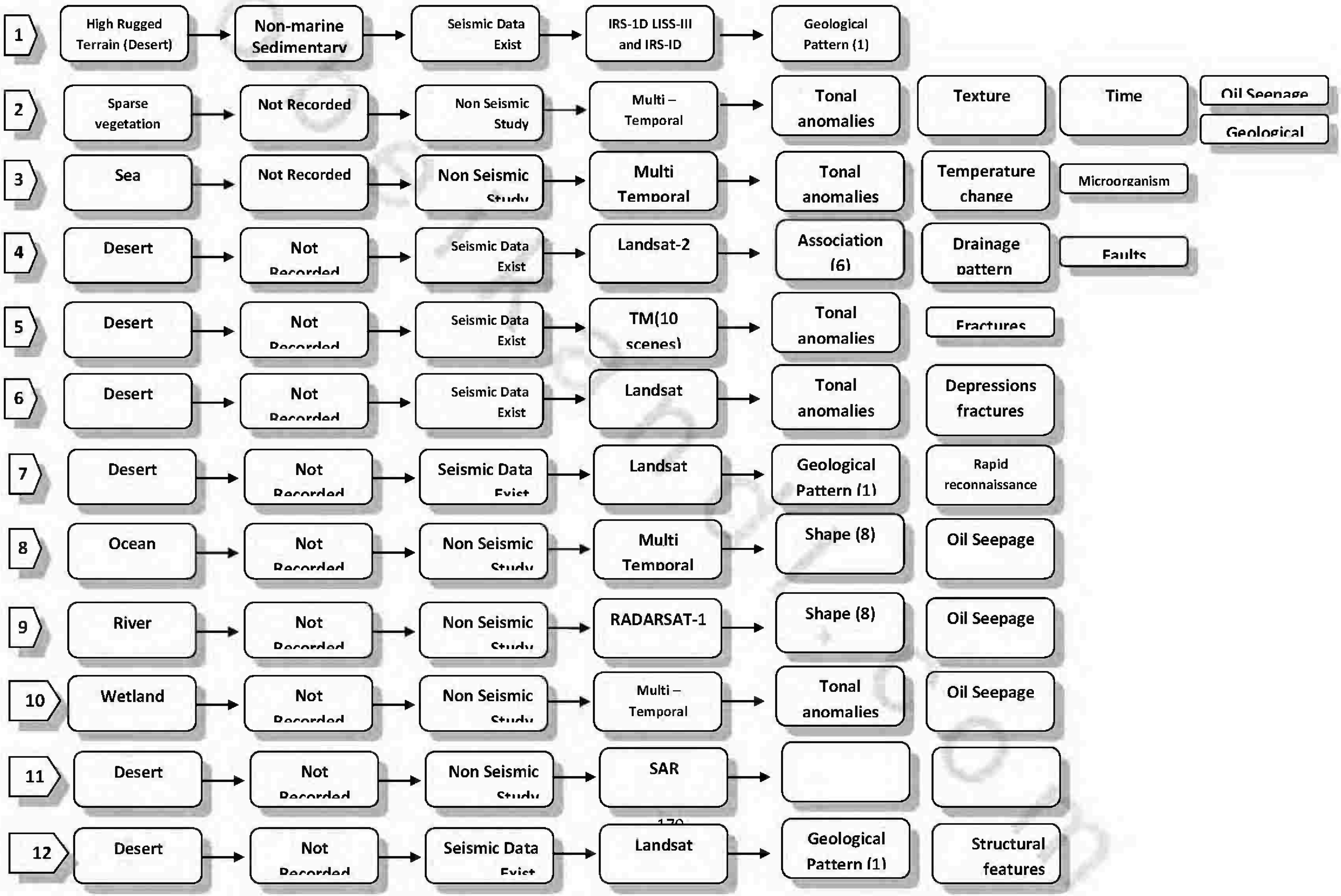
12	Landsat 7		Bands 3, 4, 5 interpreted with and without elevation data							Overlaying Band 4 Image on Digital Elevation Model (DEM) improves Interpretation in low relief areas.										Reservation Area Base Map Regional Cross-Section Structure Map Siesmic 2-D National Elevation Dataset (NED) windowed and combined with Landsat ETM7+ imagery to provide elevation control	592 oil and gas tests, resulting in -392 producing wells, for a -Success rate of 69%. Interpretation directed towards fault influence ofsurface geomorphology
13	TerraSAR-X, Radarsat-2 and Cosmo Skymed																			geological, geophysical and geochemical data	Enhanced and interpreted SAR satellite imagery is capable of identifying key regions of seepage, thus focusing exploration efforts and reducing costs

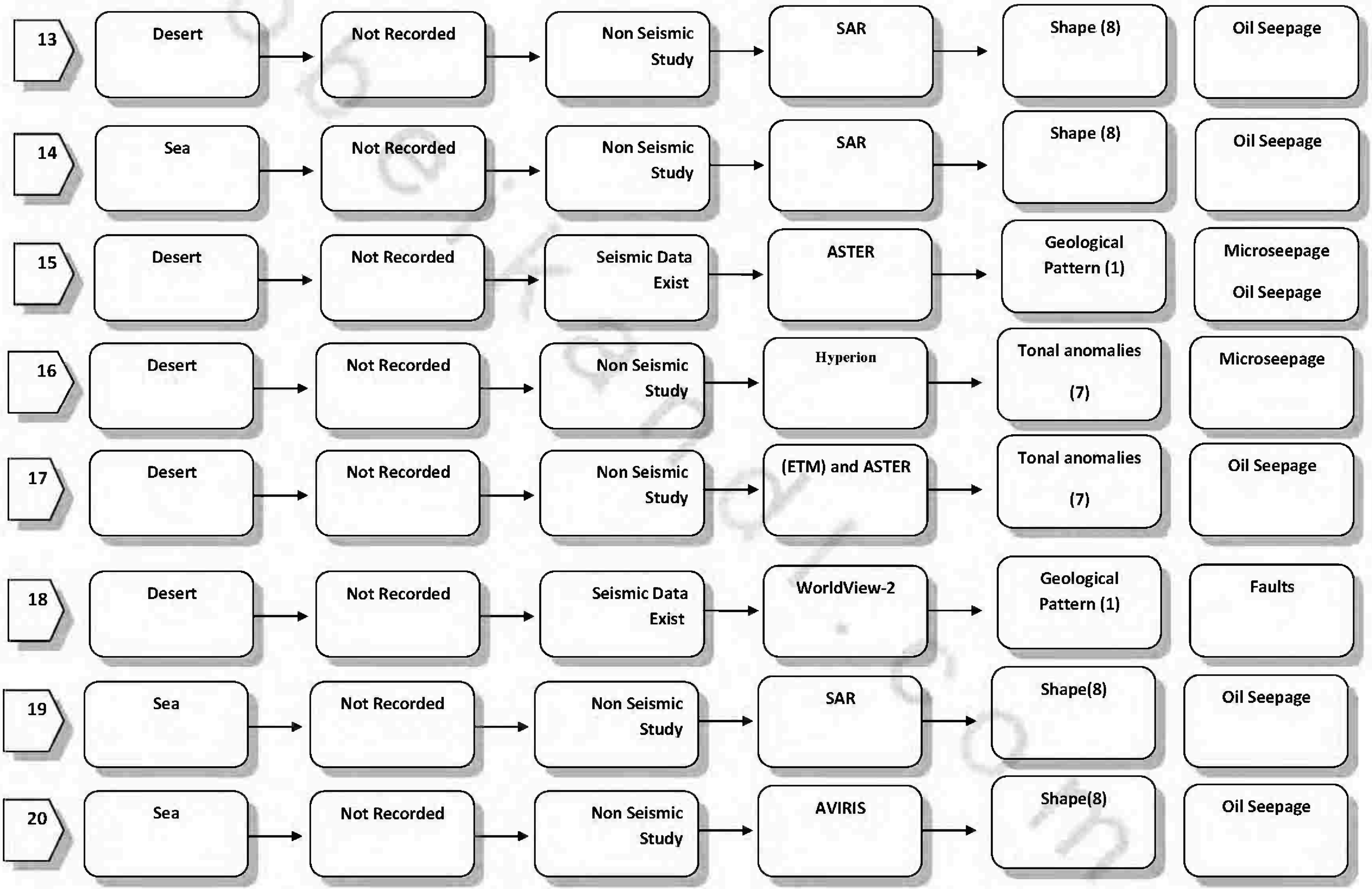
14	synthetic aperture radar (SAR) images ERS-1/2, Almaz-1 and Radarsat-1	25 m								(1) antenna pattern correction, SAR image resampling and speckle noise reduction, (2) detection of dark features, (3) interactive classification on the basis of geometrical/textural properties and contextual information, and (4) discrimination among other look-alikes.										bathymetry, geophysical and seismic data GIS information about coastline, coastal settlements, hydrography features (river mouths and coastal lakes), bathymetry, location of oil and gas formations and positions of known underwater mud volcanoes	Oil slicks are basically concentrated over the local geological formations of the sedimentary cover having oil and gas resources Five ASAR images showing multiple seepage slicks are depicted
15	synthetic aperture radar (SAR) sensors	500 m								image flattening, features extraction and oil spill classification											

16	Hyperspectral image									Three-Band-Ratio algorithm amplifies the absorptive signature,										geological, geophysical and geochemical data	about 85% of oil and gas fields have the phenomenon of microleakage. The hydrocarbon microseepage information of oil/gas depositseither onshore or offshore can be directly detected usinghyperspectral remote sensing data, of which identifying thedistinct absorption features related to micoseepage is the keyelement.
17	Landsat Enhanced Thematic Mapper (ETM) and ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer)	30 m	Landsat visible and near-IR (VNIR) bands 1, 2, and 3 were combined with ASTER short-wave IR (SWIR) bands 5, 6, 7, 8, and 9 to create a hybrid and optimum data set for image analysis							once spectral bands are adequately masked, VNIR and SWIR bands are transformed using ratioing and principle-component techniques, thereby accentuating spectral characteristics that aid in predicting composition as well as altered rock and soil exposures										geological, geophysical and geochemical data	

18	WorldView-2 stereo satellite	50 cm																			Mapping surface traces of geologic faults on stereo satellite elevation images
19	Envisat	25 m								1) Radiometric correction (radiometric adjustment of radar image brightness towardsslant range); 2) Speckle-noise smoothing with the use of filtration; 3) Geometric correction per orbital data; 4) Georeferencing of images (transformation into map projection without ground controlpoints); 5) Interactive delineation of dark spots (slicks) on radar images.										geological and geophysical surveys (maps for mud volcanoes distributionand local structures	Delineation of oil slicks on radar images took into account the following features: - recurrence of slicks at the same locations on images taken at different times which was considered as evidence to regularity of formation fluid discharge or mud volcanism; - extent of slick spatial clustering; - association of slicks with local structures of the sedimentary cover or mud volcanoes at the sea bottom (these geological bodies are most efficiently detected

																					using sea seismic survey data).
20	(AVIRIS) hyperspectral imagery									convert the image radiance data to apparentreflectance to facilitate comparison with the library reflectance spectra										Geological data	Oil assemblages commonly ssociated with hydrocarbon microseepage.


1
High Rugged Terrain (Desert)
Non-marine Sedimentary
Seismic Data Exist
IRS-1D LISS-III and IRS-ID
Geological Pattern (1)
2
Sparse vegetation
Not Recorded
Non Seismic Study
Multi – Temporal
Tonal anomalies
Texture
Time
Oil Seepage
Geological
3
Sea
Not Recorded
Non Seismic Study
Multi Temporal
Tonal anomalies
Temperature change
Microorganism
4
Desert
Not Recorded
Seismic Data Exist
Landsat-2
Association (6)
Drainage pattern
Faults
5
Desert
Not Recorded
Seismic Data Exist
TM(10 scenes)
Tonal anomalies
Fractures
6
Desert
Not Recorded
Seismic Data Exist
Landsat
Tonal anomalies
Depressions fractures
7
Desert
Not Recorded
Seismic Data Exist
Landsat
Geological Pattern (1)
Rapid reconnaissance
8
Ocean
Not Recorded
Non Seismic Study
Multi Temporal
Shape (8)
Oil Seepage
9
River
Not Recorded
Non Seismic Study
RADARSAT-1
Shape (8)
Oil Seepage
10
Wetland
Not Recorded
Non Seismic Study
Multi – Temporal
Tonal anomalies
Oil Seepage
11
Desert
Not Recorded
Non Seismic Study
SAR
12
Desert
Not Recorded
Seismic Data Exist
Landsat
Geological Pattern (1)
Structural features


13
Desert
Not Recorded
Non Seismic Study
SAR
Shape (8)
Oil Seepage
14
Sea
Not Recorded
Non Seismic Study
SAR
Shape (8)
Oil Seepage
15
Desert
Not Recorded
Seismic Data Exist
ASTER
Geological Pattern (1)
Microseepage Oil Seepage
16
Desert
Not Recorded
Non Seismic Study
Hyperion
Tonal anomalies (7)
Microseepage
17
Desert
Not Recorded
Non Seismic Study
(ETM) and ASTER
Tonal anomalies (7)
Oil Seepage
18
Desert
Not Recorded
Seismic Data Exist
WorldView-2
Geological Pattern (1)
Faults
19
Sea
Not Recorded
Non Seismic Study
SAR
Shape(8)
Oil Seepage
20
Sea
Not Recorded
Non Seismic Study
AVIRIS
Shape(8)
Oil Seepage

جامعة الاسكندريه

كلية الهندسة

قسم هندسة المواصلات

إستخدام صور الإستشعار عن بُعد فى الاستكشافات البترولية

رساله علميه مُقدمه من

إيمـــــــــــــان طه محمد محمود

بكالوريوس هندسة المساحة – كلية الهندسة – جامعة بنها

لنيــل درجة الماجستير فى هندسة المواصلات

تحت إشراف

أ.د / حسن جـــــابر الغزولي

استاذ المساحة و الجيوديسيا

كلية الهندسة

جامعة الاسكندريه

أ.د / محمـــد محمود حسني

استاذ مساعد المساحة و الجيوديسيا

كلية الهندسة

جامعة الاسكندريه

أ.د / حســـام فريد الحبروك

استاذ مساعد المساحة و الجيوديسيا

كلية الهندسة

جامعة الاسكندريه

2014

مُلخص الرساله

يُعتبر البترول من أهم الموارد الطبيعيه و من أهم العناصر التى تمثل قيمه اقتصاديه لاي دولة . و قد أصبح وجود البترول فى كل مكان شيئ لا غنى عنه لما لـه من استخداما ت متعدده فى كل مجالات الحياه. لذا أصبح الكشف و التنبأ بوجود البترول أمر مُكلف جداً مما يدفع معظم شركات البترول لإنفاق ملايين الدولارات سنوياً للتنقيب عن وجود البترول فى مناطق معينه.

و كان مِنَ الضَّرورى إيجاد وسيله أقل فى التكلفة و أعلى فى الدقة فى الكشف عن البترول و تُعتبر صور الأقمار الصّناعية لها أهمية كبيرة في التنمية الاقتصادية وإدارة الموارد الطبيعية في أي بلد .لذلك، فمن المهم زيادة إستخدام صور الأقمار الصناعية لعملية التنقيب عن النفط في الوقت الحاضر.

وحيث أن المسح السيزمي أو الموجات الكهرومغناطيسيه هى أكثر الطرق انتشارا فى الكشف عن وجود البترول لكن نظرا للتكلفة المرتفعة و الدقة المنخفضة لهذه الطرق اصبح البحث عن بدائل أمر غايه في الأهميه.

و من مميزات استخدام المسح الجوى و الإستشعار عن بُعد فى الكشف عن البترول أنه يُغطى مساحه اكبر بالاضافه إلى إمكانيه الوصول الى المناطق صعبة التضاريس و المكتظه بالاشجار او المستنقعات كالغابات و غيرها و التى كان من المستحيل الوصول اليها بالطرق التقليديه.

عِلاوة على ذلك، قدم الجيل الجديد من صور الاستشعار عن بعد عالية الدقة والتقنيات الحديثة في معالجة الصور اتجاهاً جديداً في العثور على مؤشرات النفط على مستويات مختلفة وإنتاج الخرائط وتحديد مواقع الأجسام التي تنبئ بوجود البترول فى منطقه معينه.

الغرض من هذا البحث هو إدخال أساليب فعالة من حيث التكلفة لإيجاد مؤشرات النفط الحقيقيه في مرحلة الاستطلاع، ووضع أداة للمستخدم لاختيار صور الأقمار الصناعية المناسبة وفقا لشروط محددة. ويمتد هذا الغرض لدراسة تأثير العوامل المختلفة التي قد تؤثر على إحتمال وجود النفط خلال عملية البحث على النفط من الفضاء باستخدام صور الاقمار الصناعيه.

ويشمل هذا دراسة وتحليل المشاريع المختلفة التي تستخدم صور الأقمار الصناعية لإيجاد مؤشرات النفط في الظروف البيئية والطبوغرافية المختلفة لتغطية معظم الحالات الشائعة التي قد تحدث ولحل المشاكل الناجمة عن استخدام الطرق التقليدية الأخرى. أيضا قد اقْتُرحَ عمل استبيان لشركات النفط في القطاعات المختلفة للتعاون والربط بين البحث العلمي وصناعة النفط، ، وقد تم جمع النتائج وتحليلها لغرض تقييم قيمة استخدام صور الأقمار الصناعية للتنقيب عن النفط والحصول على خلفية عن مشاكل في التنقيب مصر.

لقد كانت النتائج واعدة، وقد تم أستحداث برنامج لإدارة البيانات المستخرجة من المشروعات المختلفه التى استخدمت الاستشعار عن بعد و جعلها دليل للمستخدم لتحديد صورة القمر الصناعي المناسبه.

و تشتمل الرسالة على خمسة فصول:

الفصل الاول : يشتمل على الجزء التمهيدي للرساله , فهو يقدم المشاكل المرتبطه باستخدام الطرق التقليدية فى الكشف عن وجود البترول و يقدم الخطوط العريضة التى سوف يُبنى عليها هذا البحث.

الفصل الثاني : يقدم الأبحاث السابقة حول استخدام بيانات الاستشعار عن بعد للتنقيب عن النفط ، ثم يصف مكونات نظم الاستشعار عن بعد مع التركيز على أساسيات عملية التفسير والعناصر المستخدمة فى تحليل صور الاقمار الصناعيه.

الفصل الثالث : يشتمل على تفاصيل الابحاث المختاره و التى تم التركيز عليها لشرح العناصر المستخدمه فى الكشف عن وجود البترول باستخدام صور الاقمار الصناعيه.

الفصل الرابع : يشتمل على الاستبيان الذى تم ارساله الى شركات الكشف عن البترول لمعرفة مدي معرفة حاجة سوق العمل لاستخدام صور الاستشعار عن بعد.

الفصل الخامس : الاستنتاجات والتوصيات، استنادا إلى النتائج التي تم الحصول عليها من تحليل الابحاث، و نتائج الاستبيان التى تم استقبالها من اكثر من مصدر.