

# **<sup>AV</sup>Tectonic Setting of 79 Giant Oil and Gas Fields Discovered from 2000-2007: Implications for Future Discovery Trends\***

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\*Abstract prepared prior to presentation at session, "Searching for Success," AAPG 2007 Annual Convention, Long Beach, California, April 1-4, 2007. The title and some numbers given herein vary from those shown and described in presentation, reflecting the acquisition of data after submittal of abstract and before presentation.

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## **Abstract**

### **"Emerging Trends from 69 Giant Oil and Gas Fields Discovered from 2000-2006"**

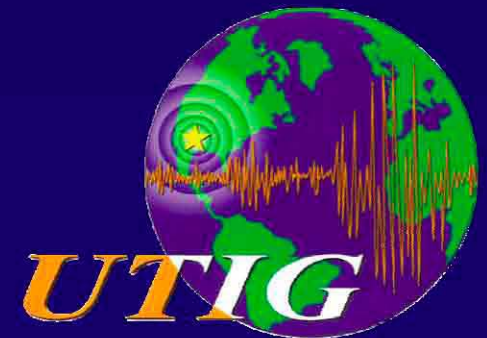
932 giant oil and gas fields account for about 50±10% of the world's petroleum reserves. In the period of 2000-2006, 33 new oil giants and 36 new gas giants were added to the existing 863 oil and gas giants discovered in the interval of 1868-1999. We have identified several dominant clusters of giants occupying specific tectonic settings. Most clusters of 2000-06 discoveries occupy established provinces like the rift/collisional setting of the Persian Gulf (6 oil/5 gas giants, or 15% of the new discoveries), the passive margin setting of northwest Australia (8 gas), the passive margin of west Africa (5 oil/2 gas), the passive margin of the deepwater GOM (6 oil), and the passive margin of Brazil (7 oil/3 gas). However, new emerging clusters include the passive margin setting of India and Myanmar (3 gas) and the collisional basins of western China (1 oil/3 gas). Other giant clusters include: rift setting of the Western Siberian basin (1 gas), rift and collisional setting of the Caspian Sea (3 oil/2 gas), collisional and strike-slip setting of northern South America (1 oil/1 gas), subduction setting of Indonesia (2 gas), rift setting of the North Sea (1 oil) and northern Africa (1 oil), and passive margin setting of Norway (1 gas). Despite the steady decline in the discovery of new giants since 1970, we predict 33 future oil and gas giant discoveries will be made during the remainder of this decade. This tally would make 2000-2009 the third highest discovery decade in history.

# Tectonic setting of 79 giant oil and gas fields discovered from 2000-2007: Implications for future discovery trends

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Houston, Texas



# Acknowledgements



**Lisa Bingham,  
UTIG CBTH industry consortium**

**Larry Lawver and Lisa Gahagan  
UTIG PLATES industry consortium**

# Talk outline:

1. **Introduction: Definition and importance of giant oil and gas fields.**
2. **Tectonic Setting of 945 giant oil and gas fields: where are the major clusters, why are some basin types better settings for giants?**
3. **Map-based summary of tectonic settings of 79 giants from 2000-2007 including discovery “trendology”.**
  - Least interesting: infill
  - More interesting: deeper water, along-strike
  - Most interesting: frontier, emerging cluster
4. **How can we use this information to predict the settings and numbers of future giants?**



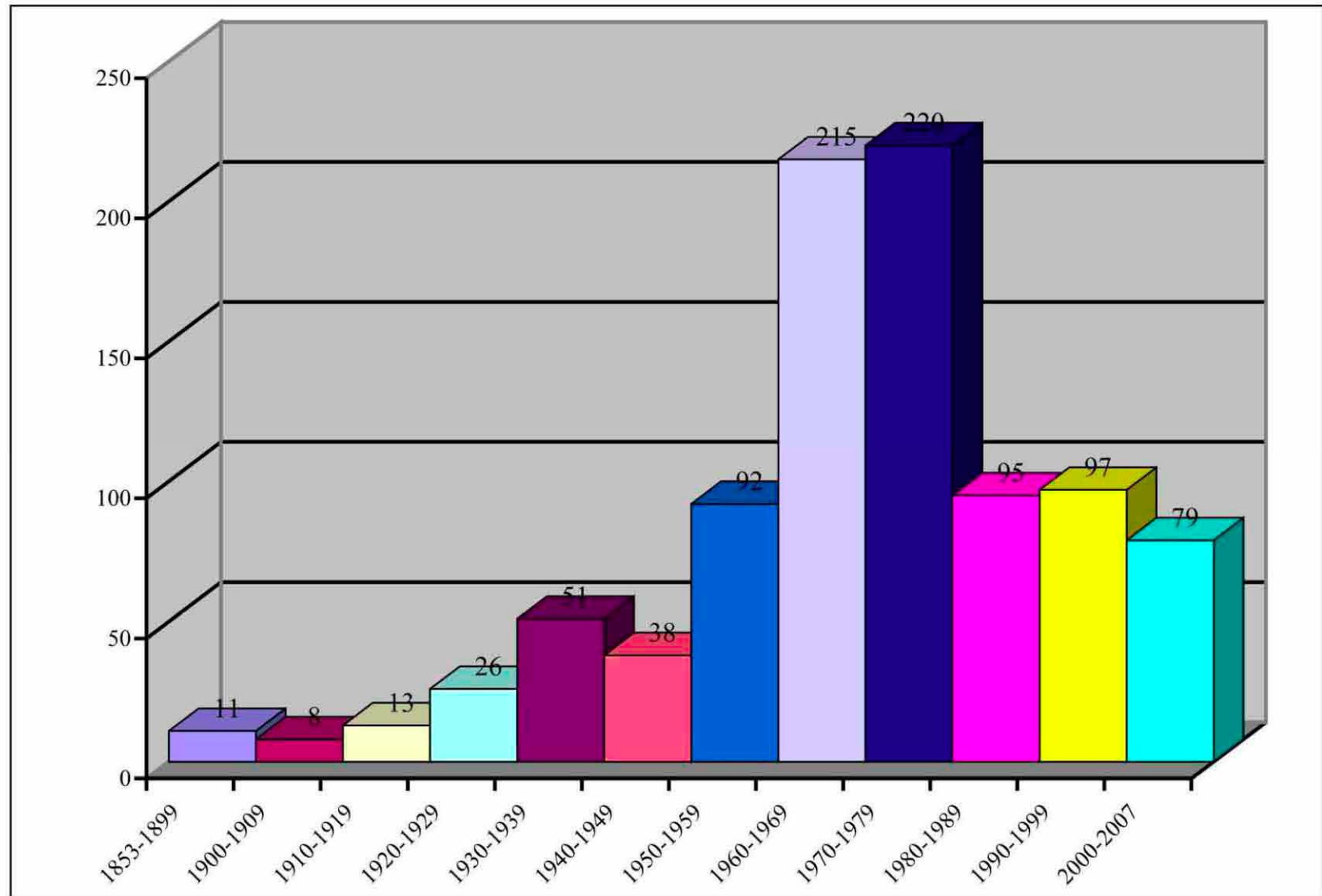
# What is a giant oil/gas field?

1. Field with an estimate of ultimately recoverable hydrocarbons greater than 500 million barrels of oil or 3 trillion recoverable cubic feet of gas.
2. Some giants are hybrids, based on their combined amounts of oil and gas.
4. 79 giants were added in 2000-2007 to make a total of 945.
4. We also track and classify the “little giant” discoveries with <200 MBOE. They help highlight some of the emerging clusters and support trends for the true giants.

# Why are giant fields important?

1. **Giants presently account for about half of the world's proven reserves.**
2. **Despite technological advances like deepwater exploration, the discovery rate for giants has fallen since the 1970's.**
3. **Giants cluster in 17 main regions of the world with the densest concentrations in the Persian Gulf and Western Siberian basin.**
4. **79 giants were added in 2000-2007 to make a total of 945.**

# 945 giants sorted by discovery decade





945 giants sorted by tectonic setting

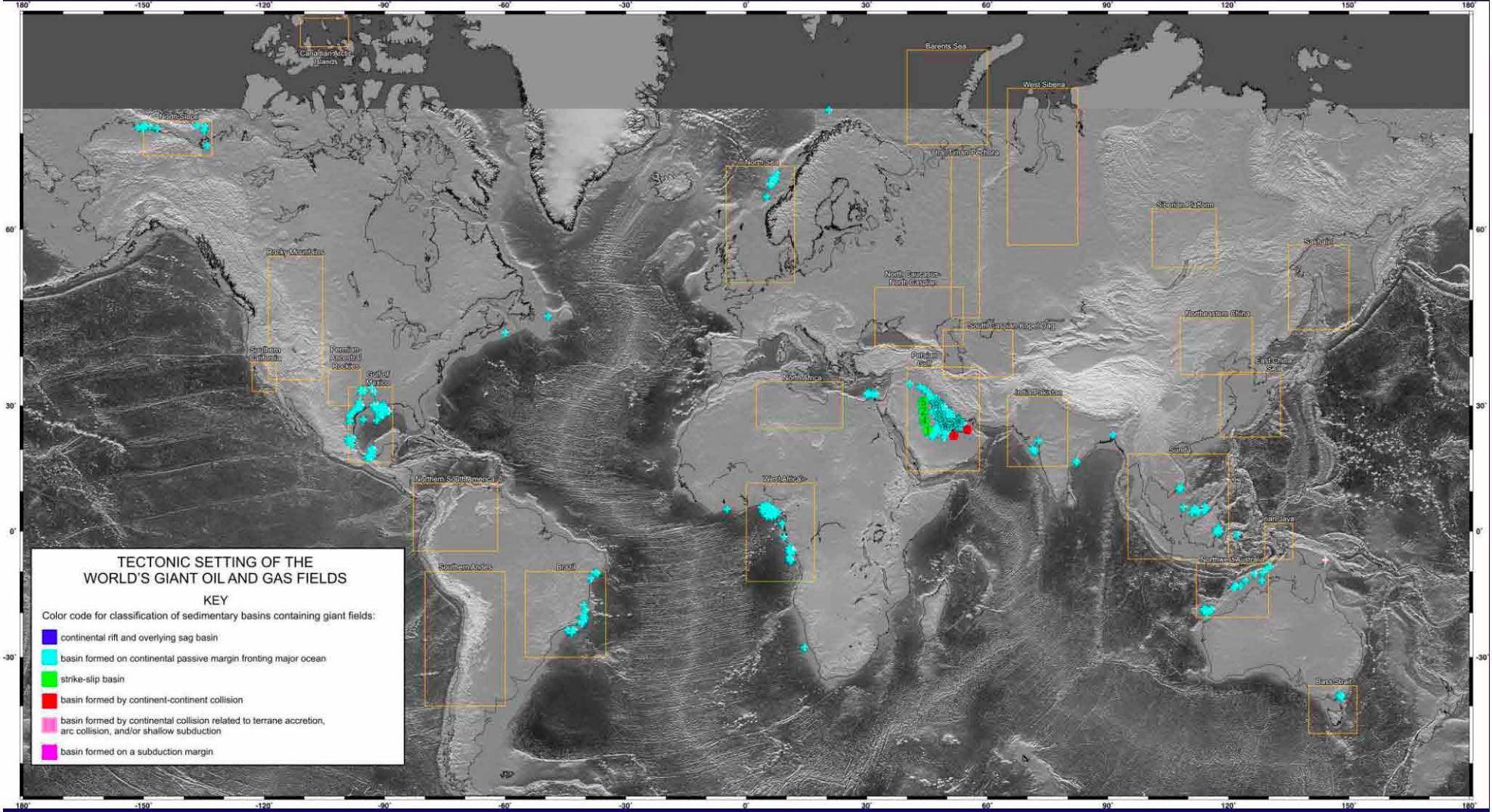


945 giants sorted by tectonic setting



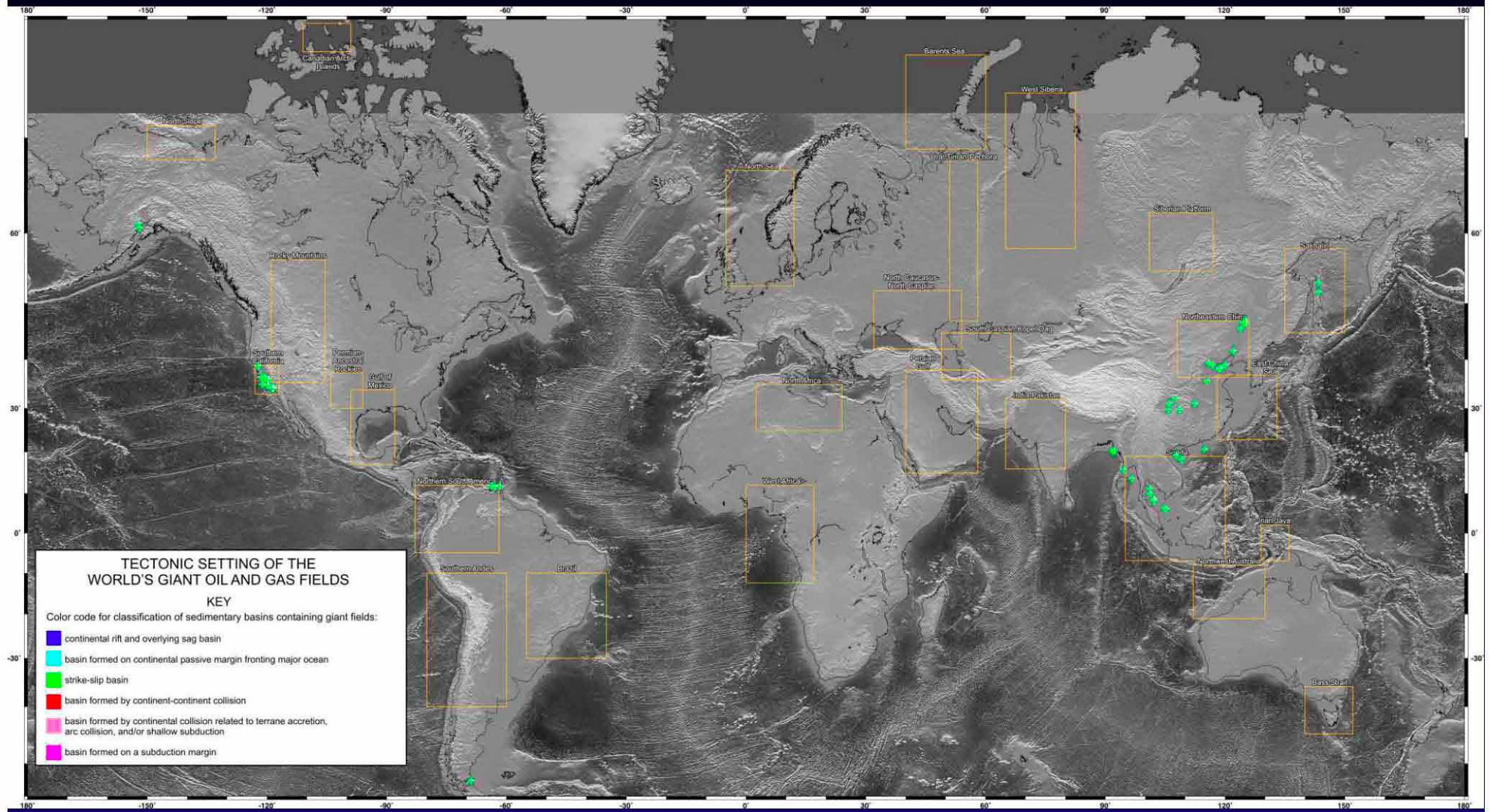


945 giants sorted by tectonic setting



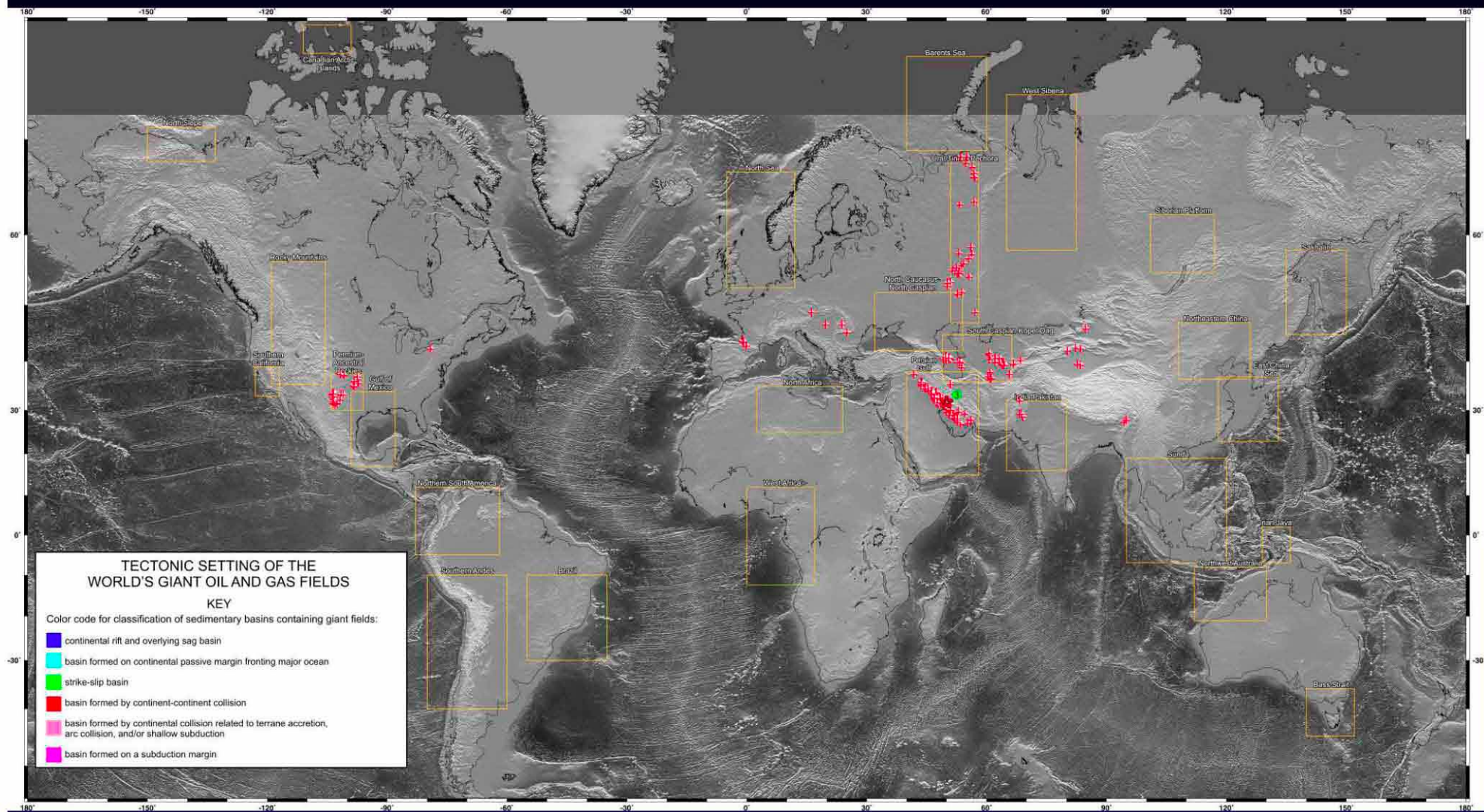


# 945 giants sorted by tectonic setting



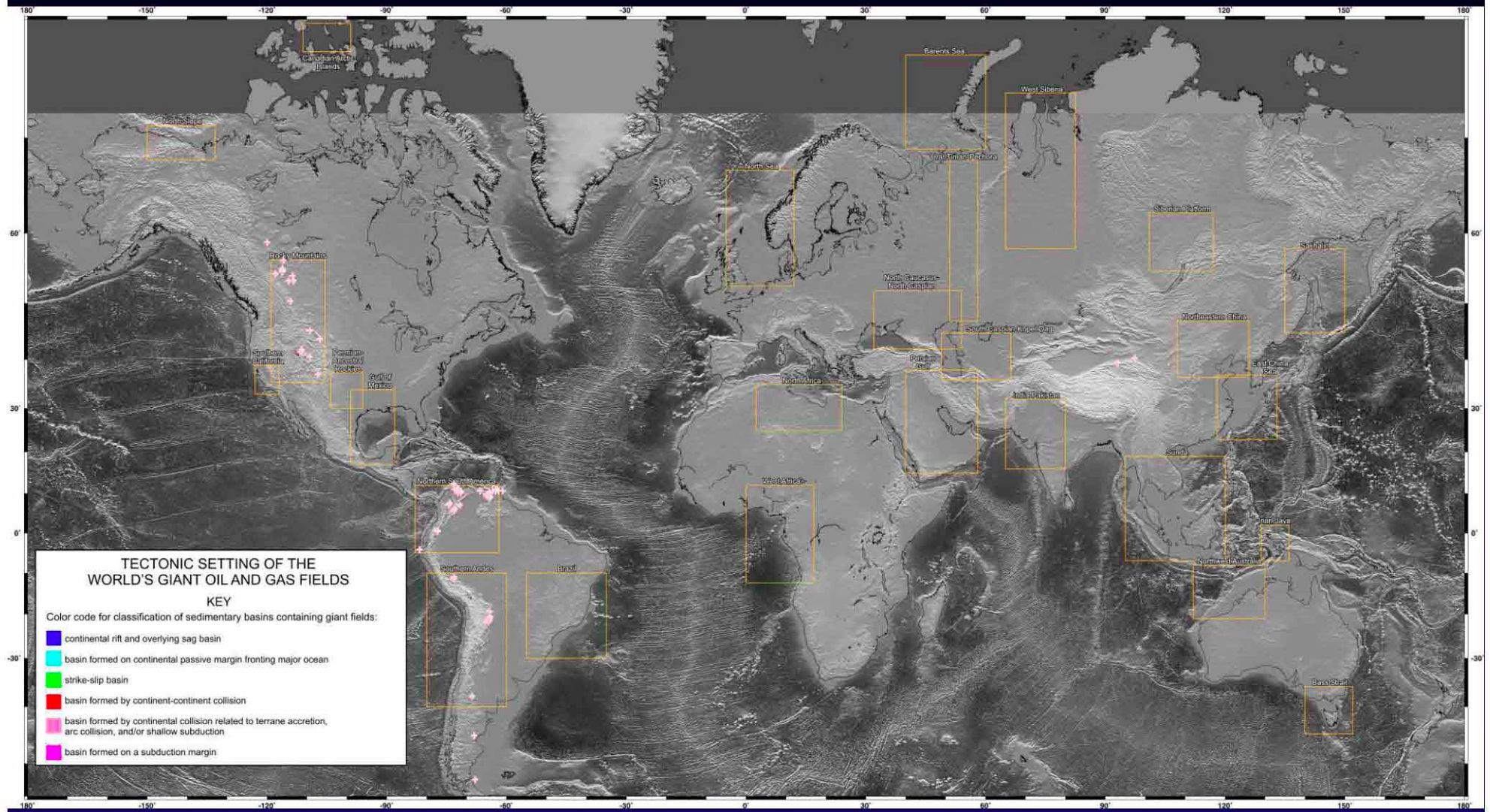


# 945 giants sorted by tectonic setting



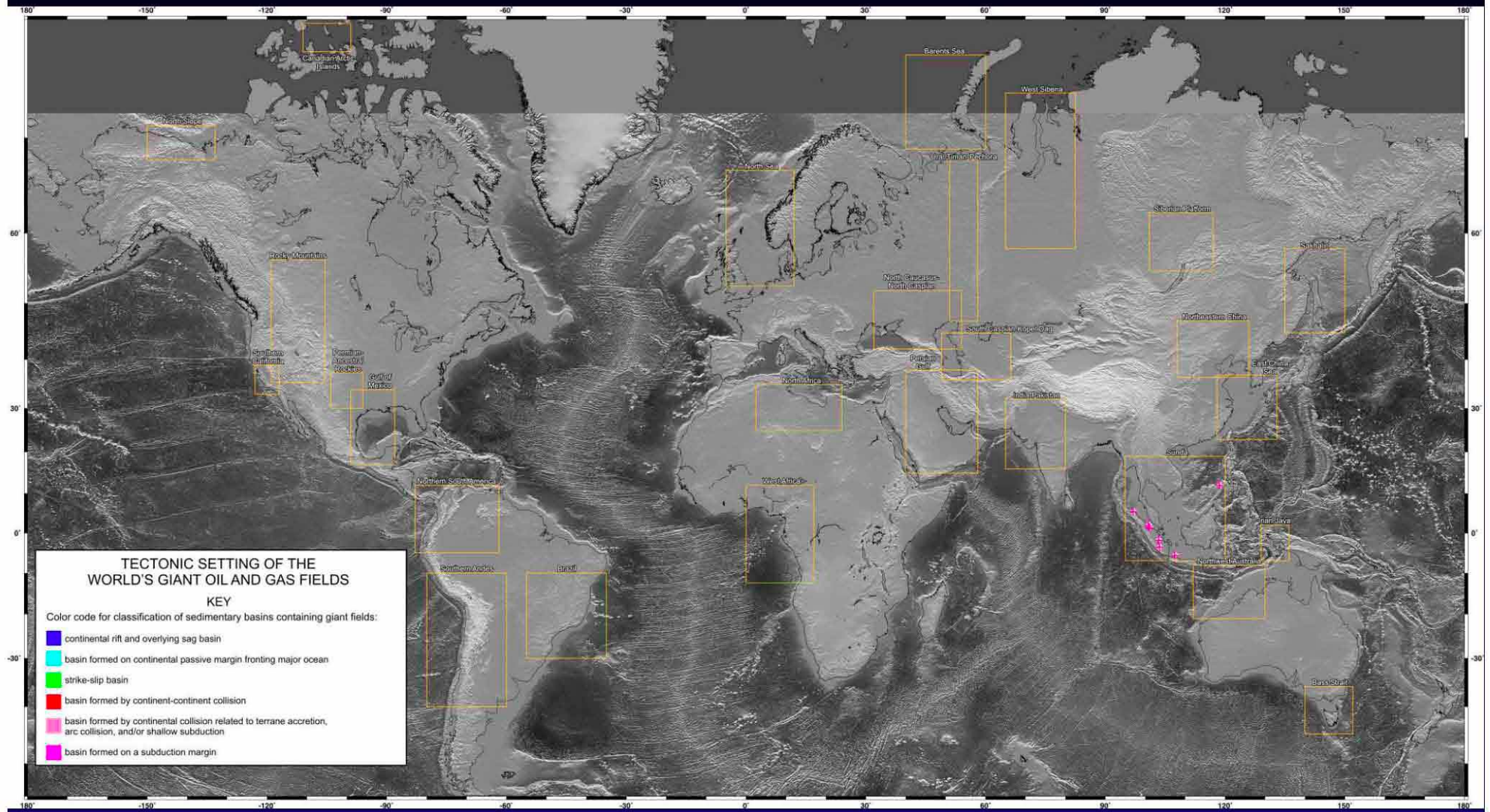


# 945 giants sorted by tectonic setting



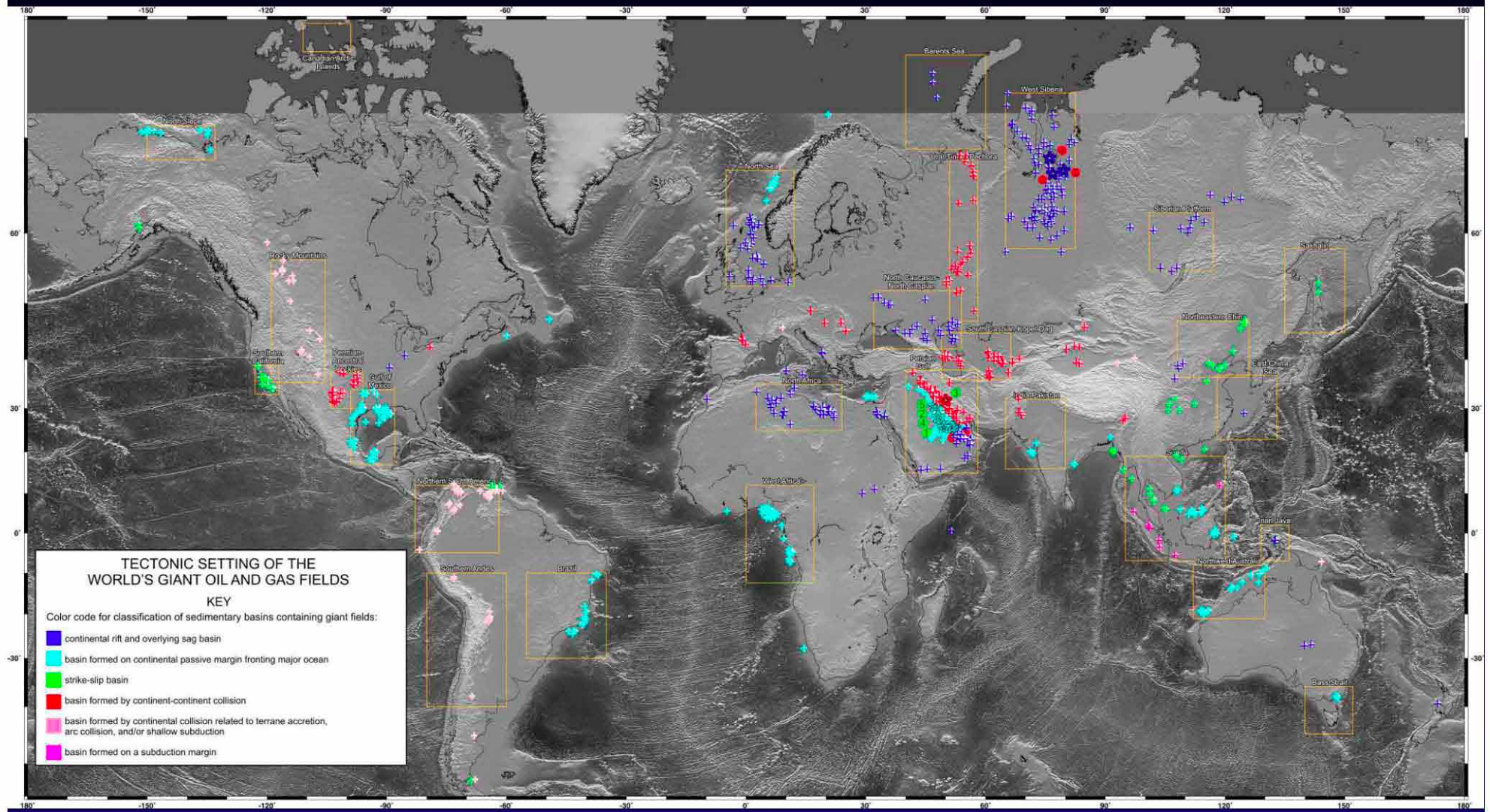


# 945 giants sorted by tectonic setting

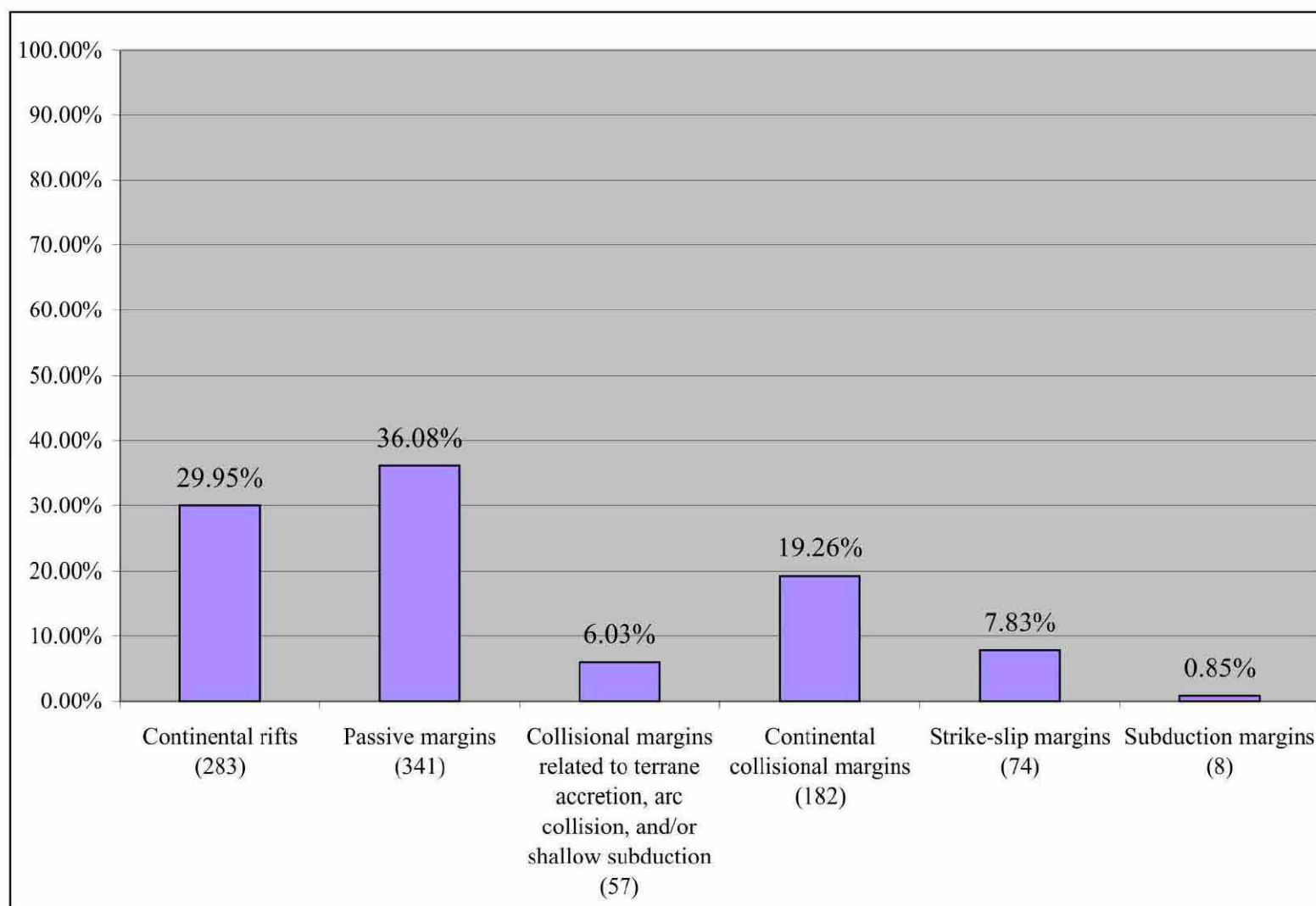




# 945 giants sorted by tectonic setting



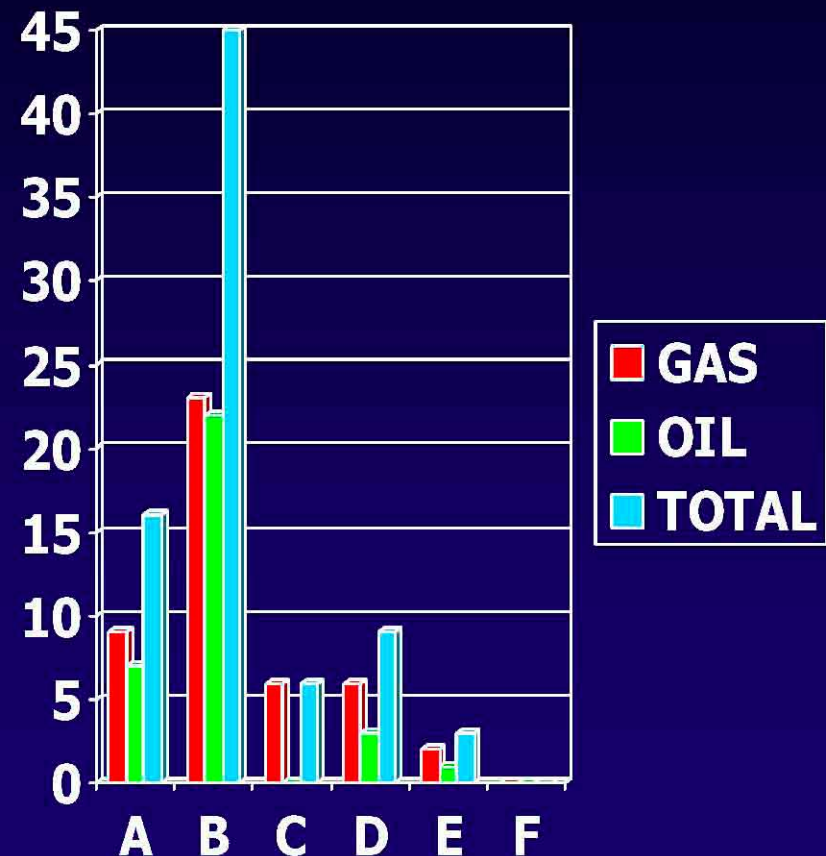
# Tectonic settings of 945 giants using tectonic classification proposed in AAPG memoir 78 (2003)

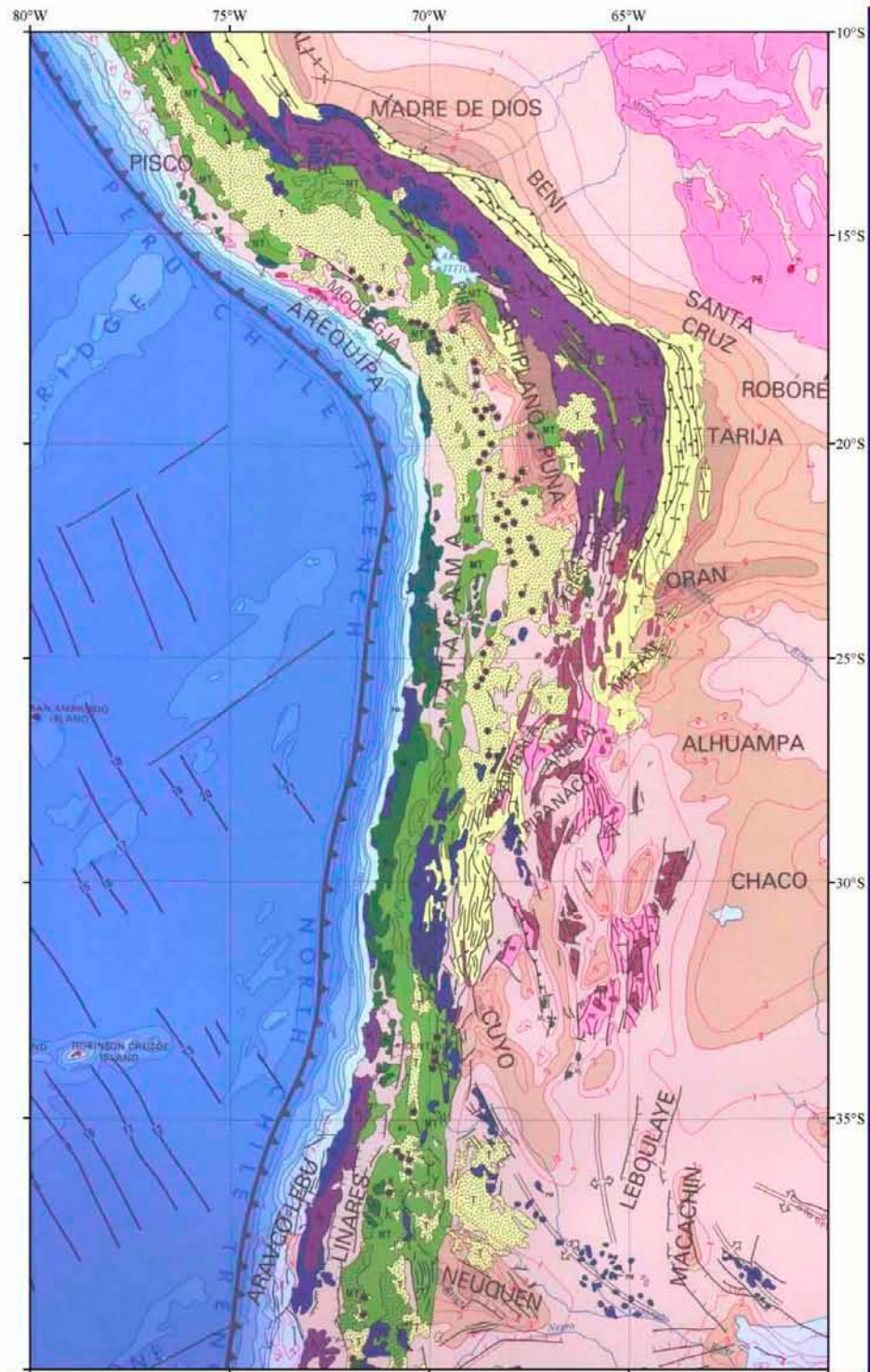




# Tectonic setting of the 79 newest giants (2000-2007)

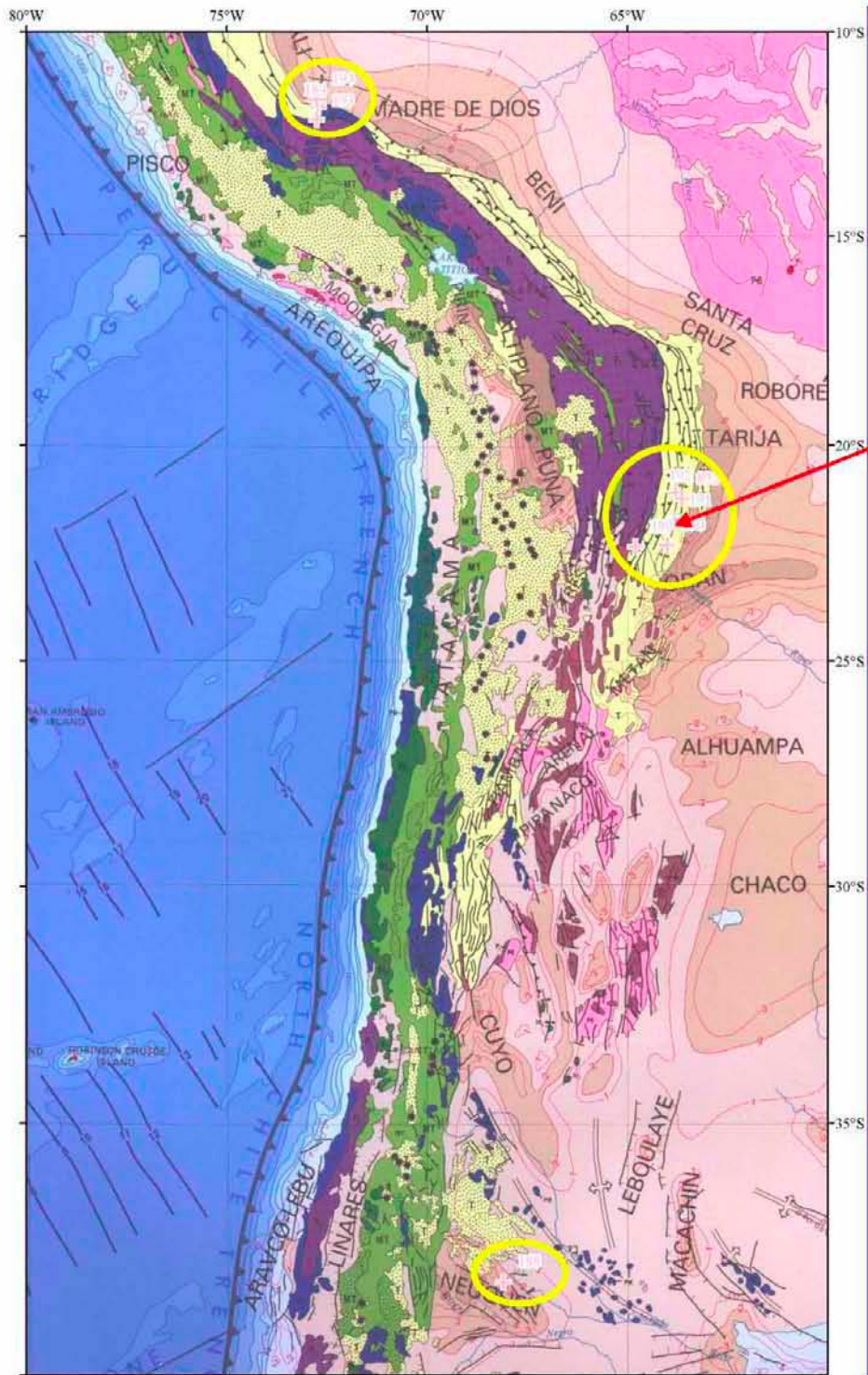
- A. Continental rifts and overlying "steers head" sag basins.
- B. Continental passive margins fronting major ocean basins.
- C. Strike-slip margins.
- D. Continent-continent collisional margins.
- E. Continental collisions related to terrane accretion, arc collision, and/or shallow subduction
- F. Subduction margins





## Southern Andes

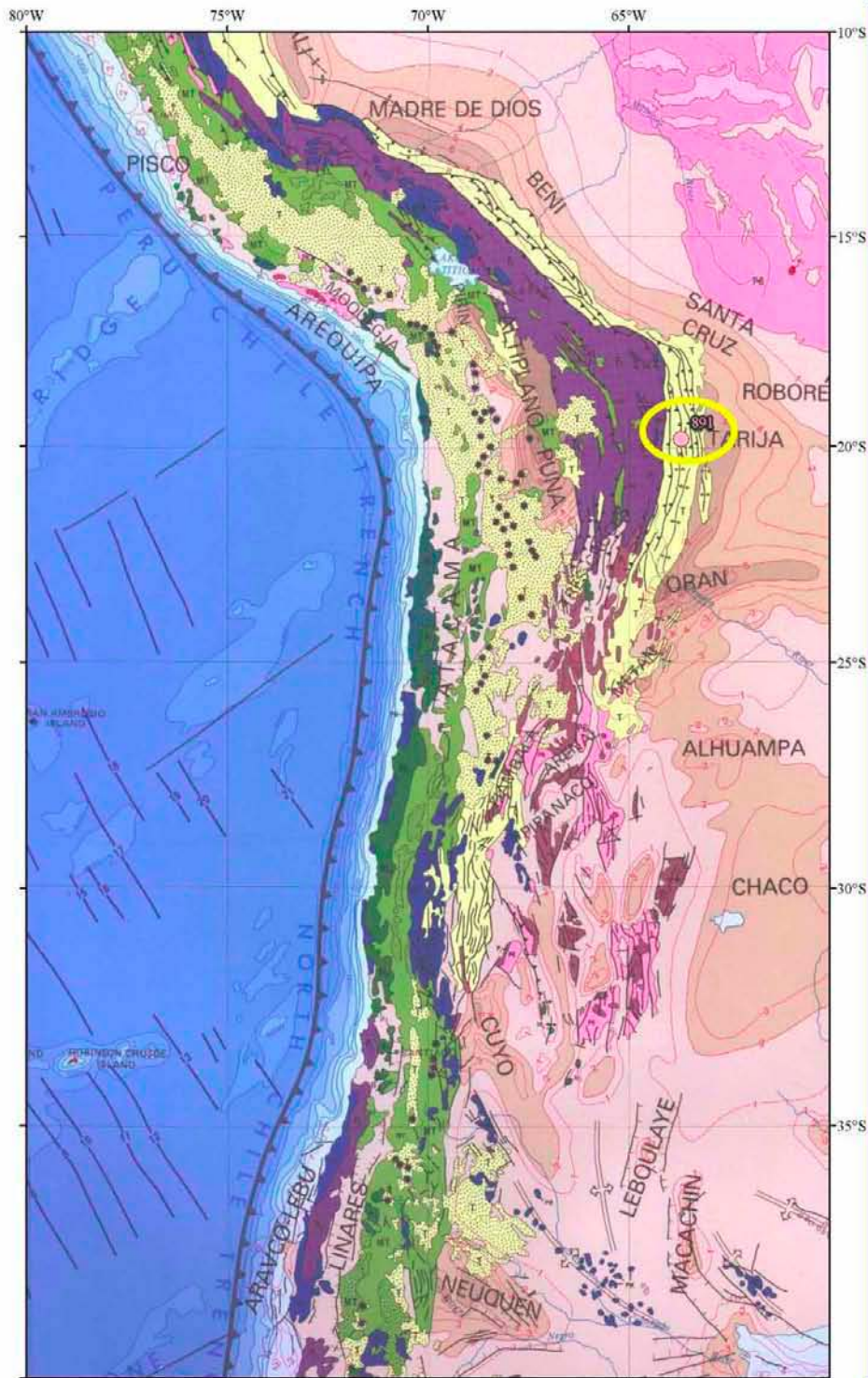




## Southern Andes

9 Gas Giants 1928-1999

189. Ramos

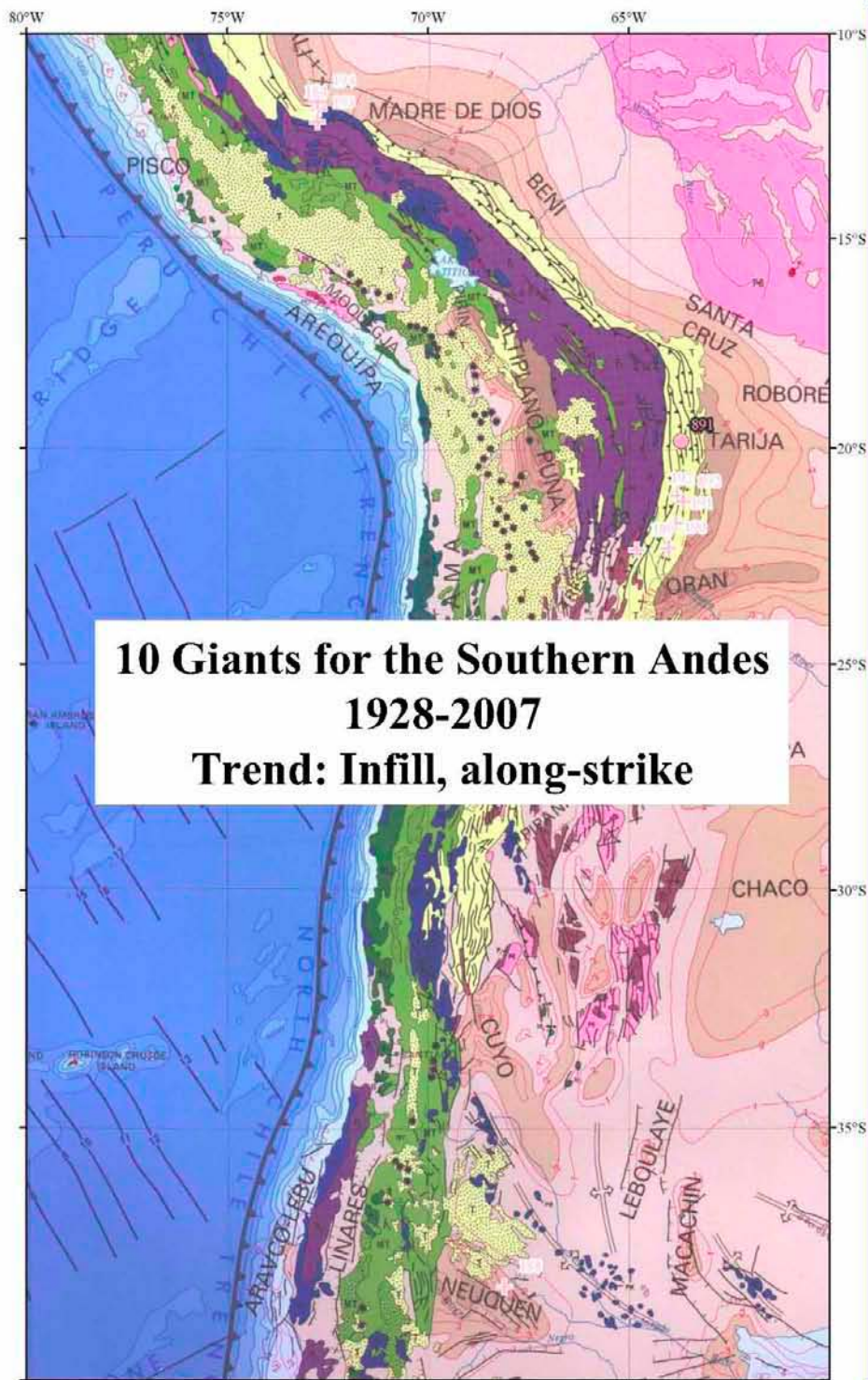


## Southern Andes

1 Gas Giant from 2000-2007

891. Incahuasi x-1 ST





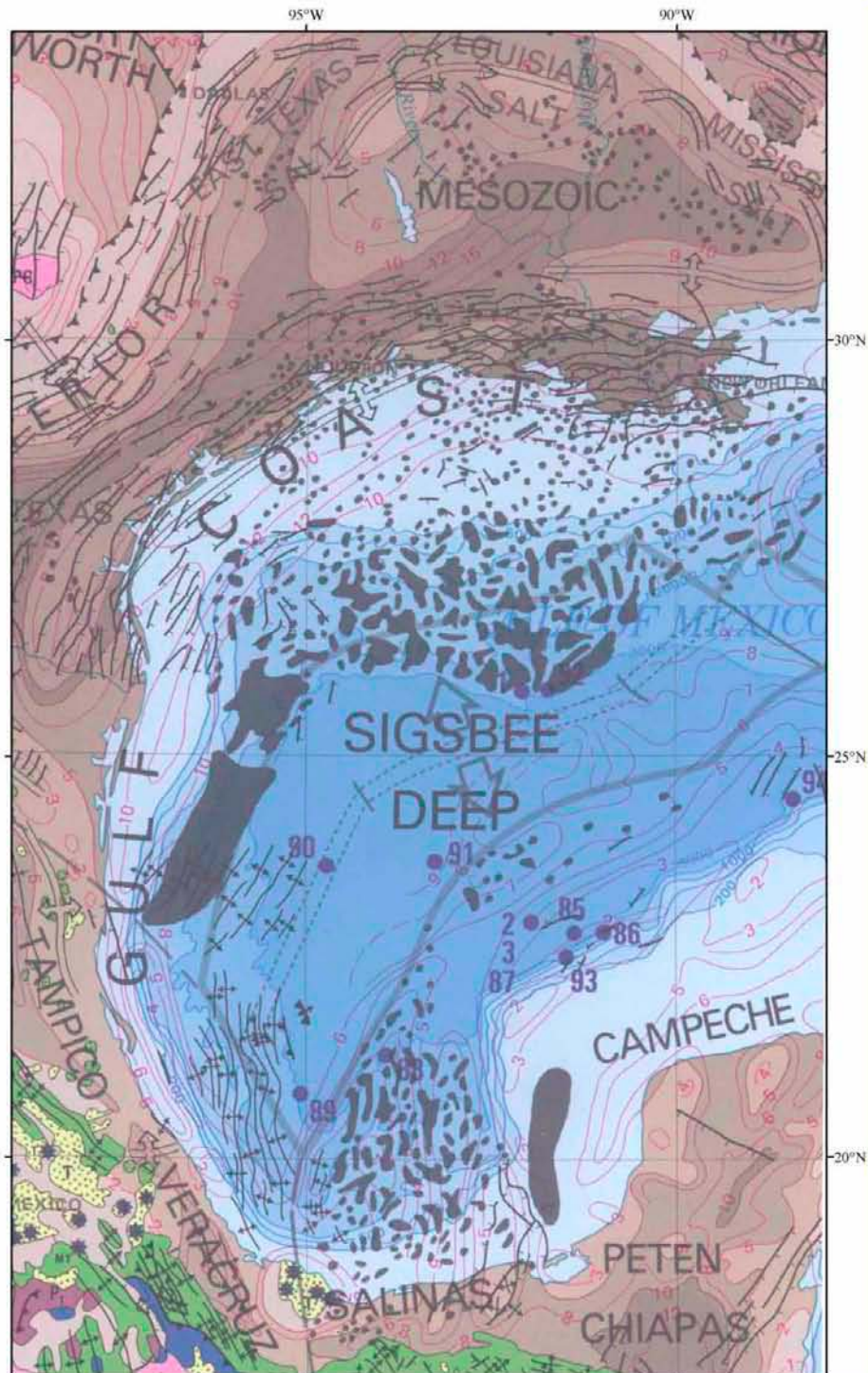
## Southern Andes

9 Gas Giants 1928-1999

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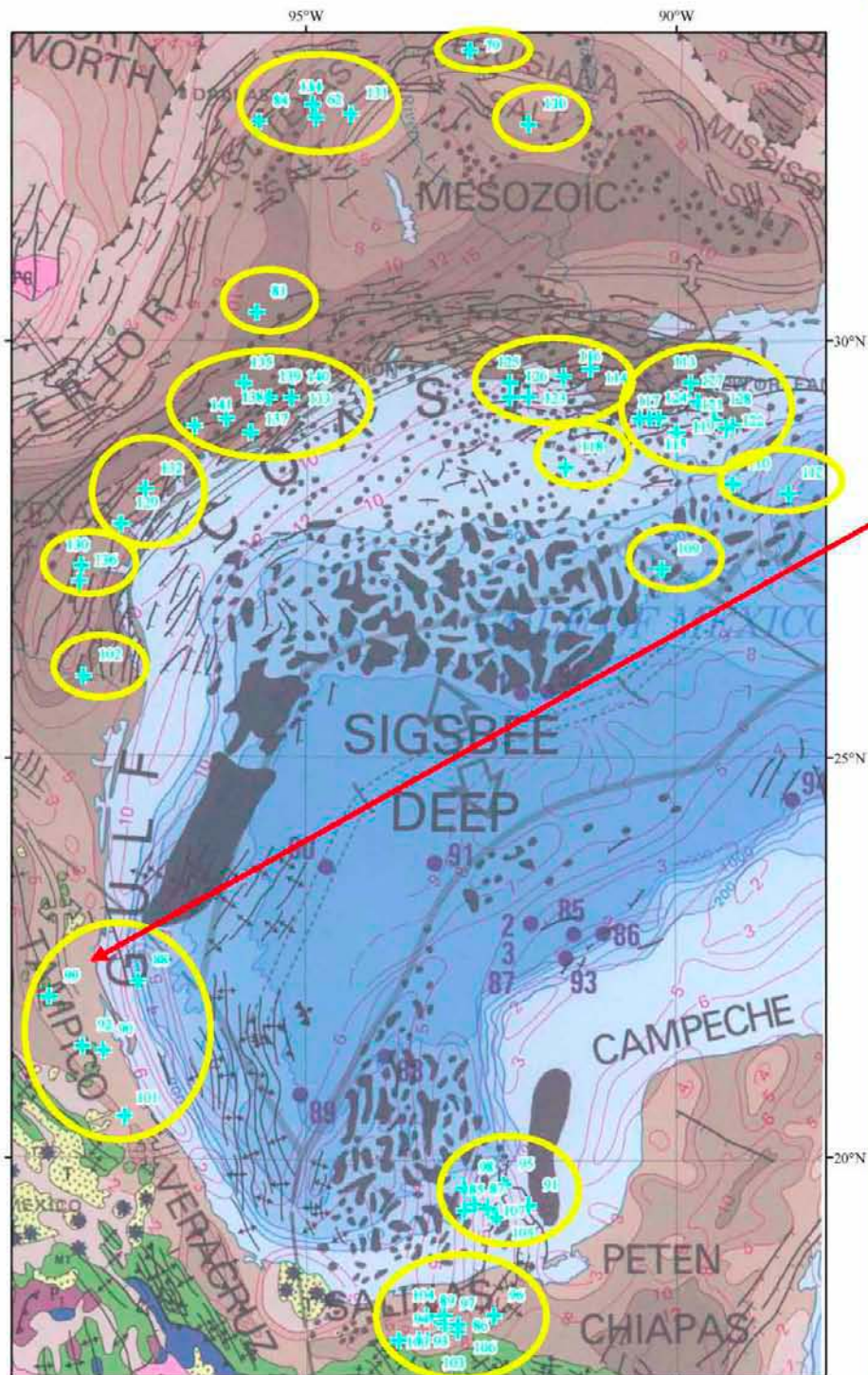
1 Gas Giant from 2000-2007

**891. Incahuasi x-1 ST**



## Gulf of Mexico



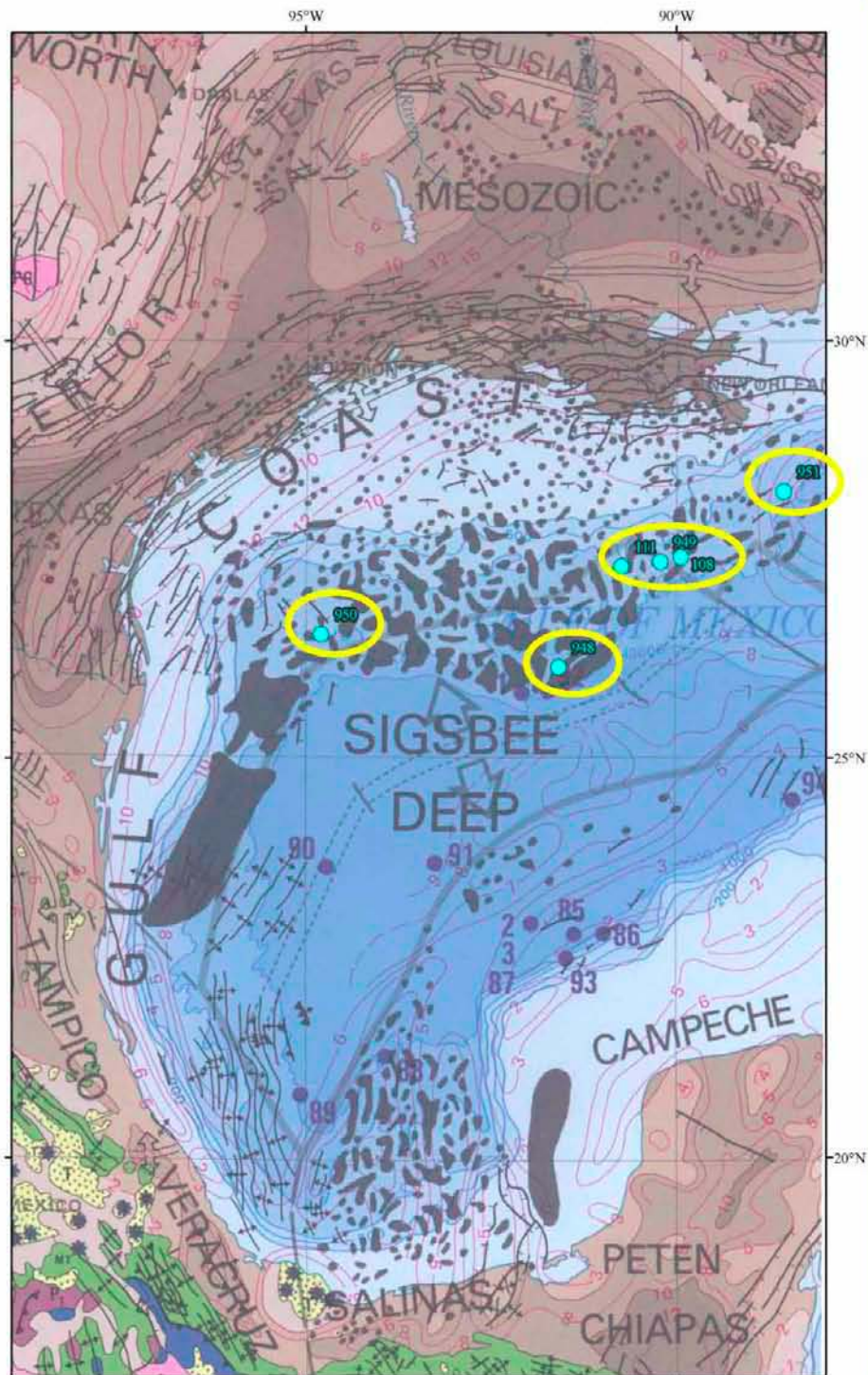


# Gulf of Mexico

16 Gas and 43 Oil Giants 1901-1999

99. Panuco





# Gulf of Mexico

6 Oil Giants from 2000-2007

108. Atlantis

111. Tahiti

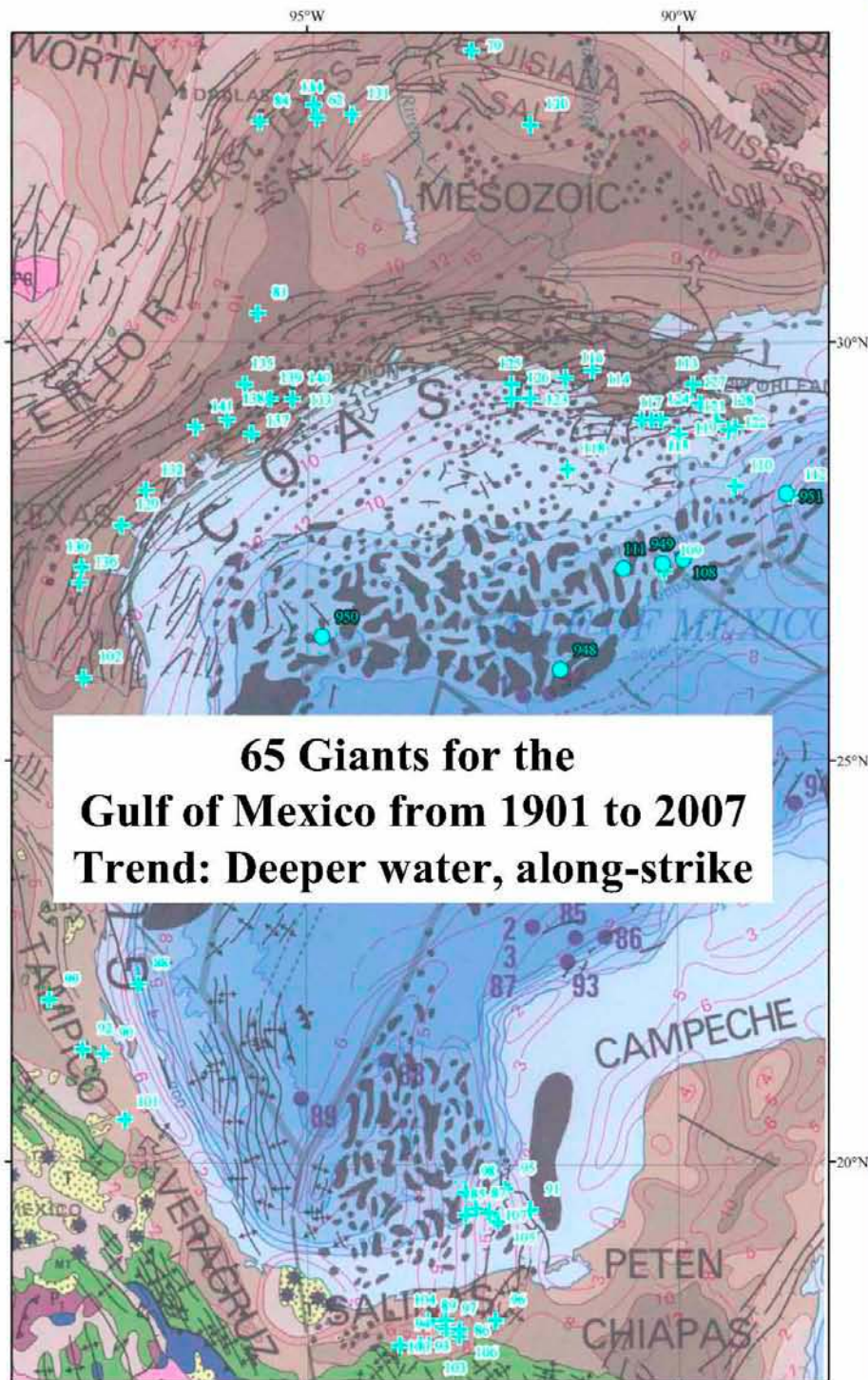
948. Jack

949. Knotty Head

950. Silvertip

951. Thunder Horse North





## Gulf of Mexico

16 Gas and 43 Oil Giants 1901-1999

99. Panuco

6 Oil Giants from 2000-2007

108. Atlantis

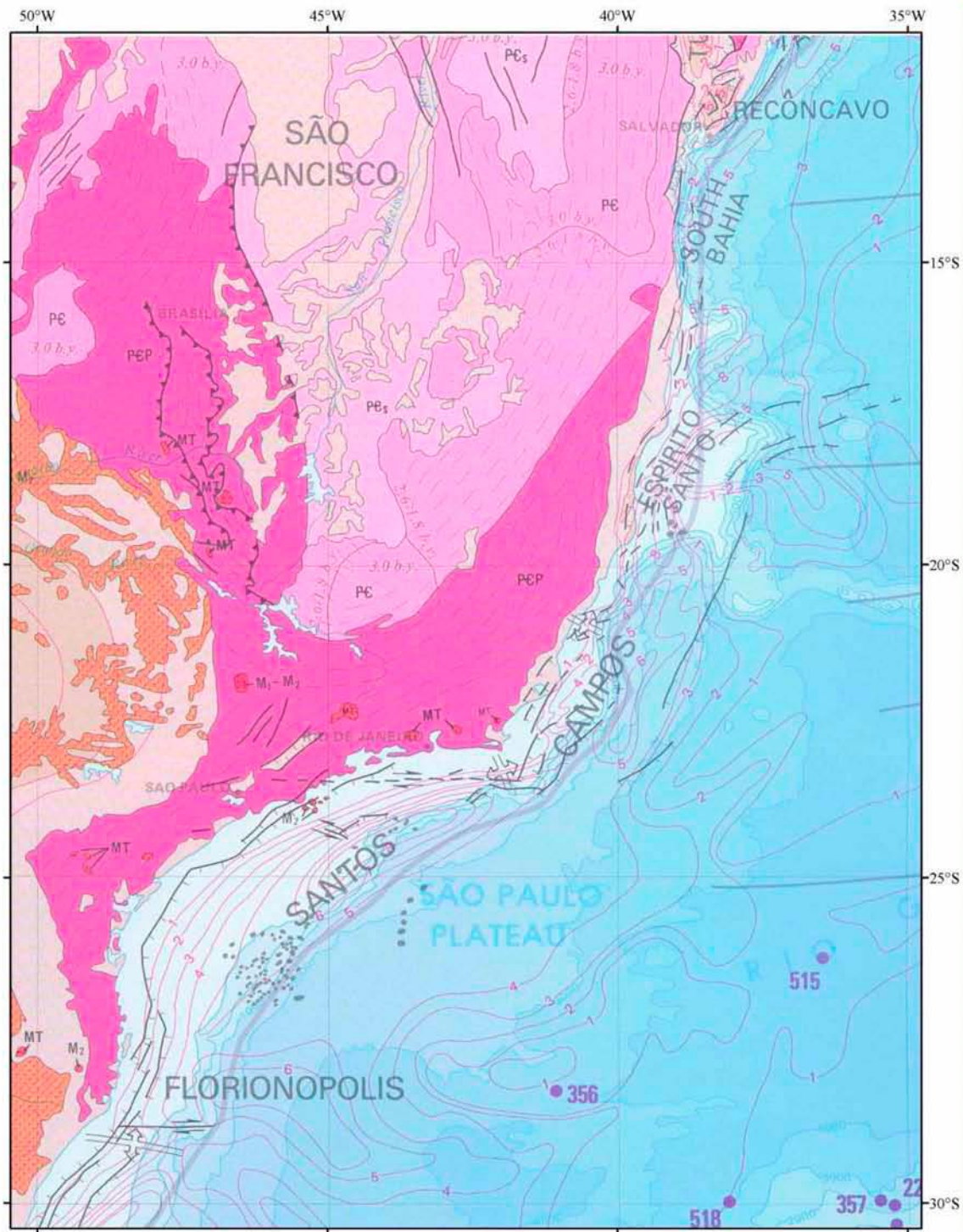
111. Tahiti

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949. Knotty Head

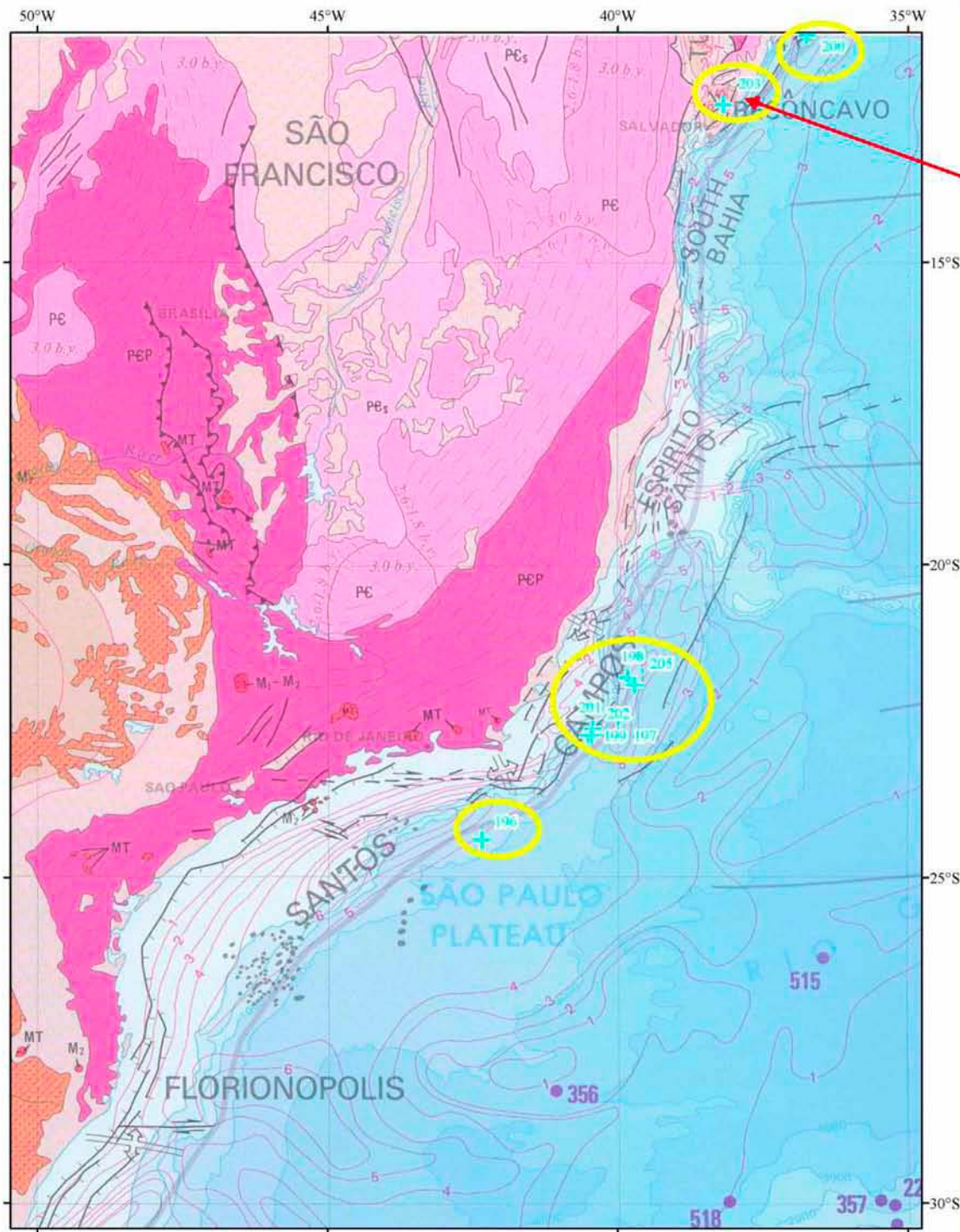
950. Silvertip

951. Thunder Horse North



Brazil



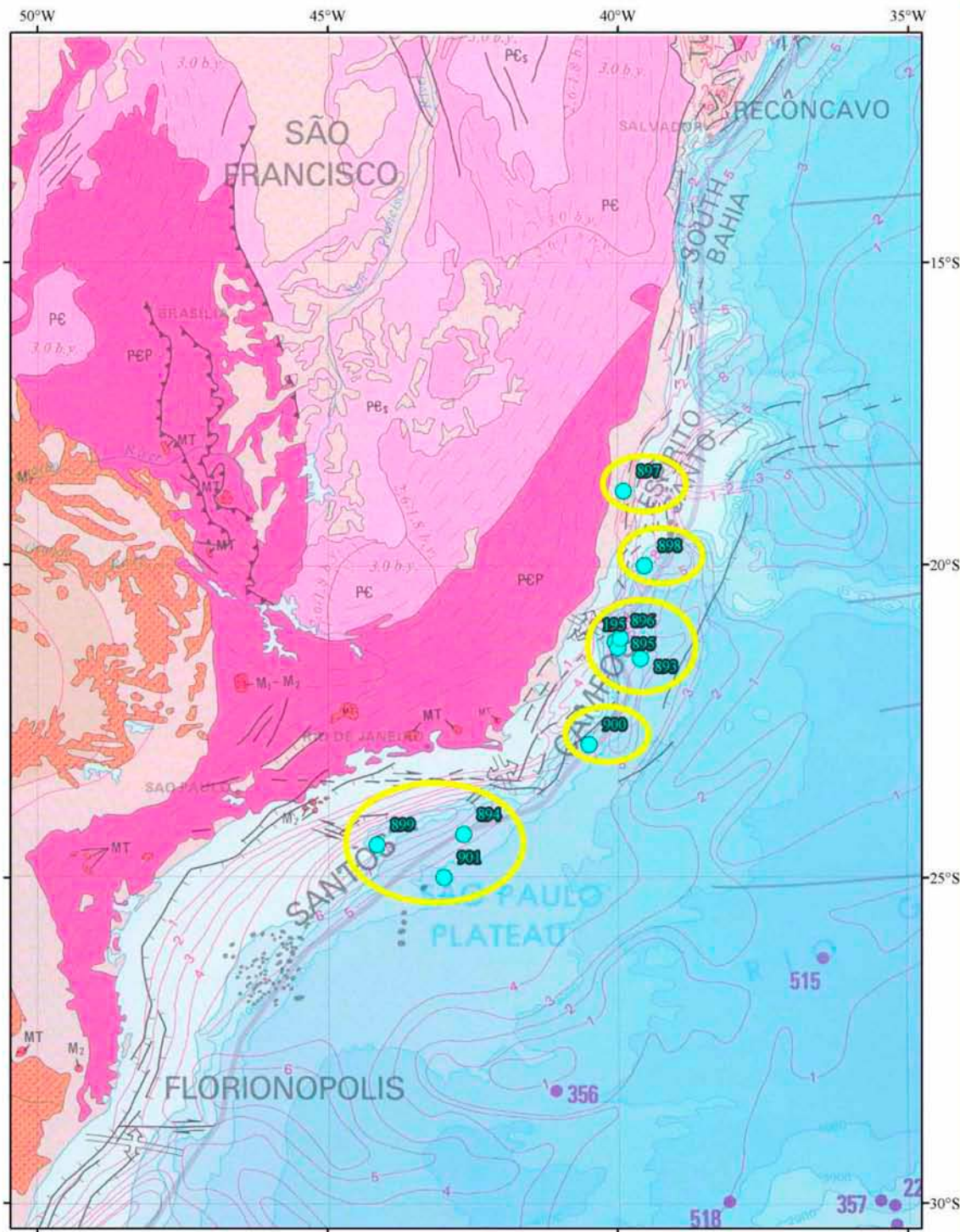


## Brazil

1 Gas and 8 Oil Giants 1965-1999

203. Miranga





# Brazil

3 Gas and 7 Oil Giants from 2000-2007

195. Jubarte

886. Mexihalo

884. Cachalote

882. 1-ESS-130

927. 1-RJS-587

883. Baleia Franca

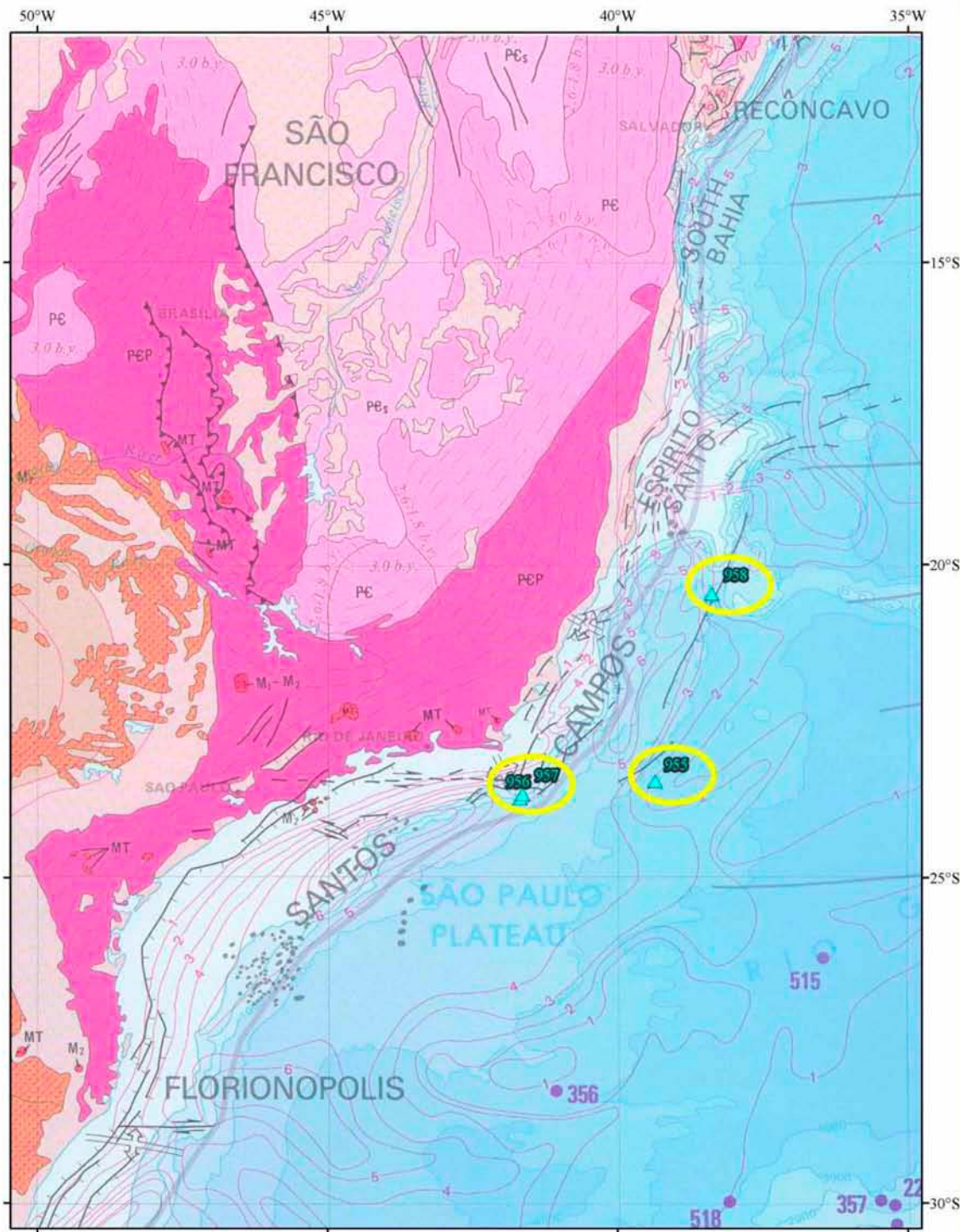
926. Fazenda Cedro

885. Golfinho

900. Papa-Terra

901. RJS-628A





# Brazil

4 >200 MMBOE from 2000-2007

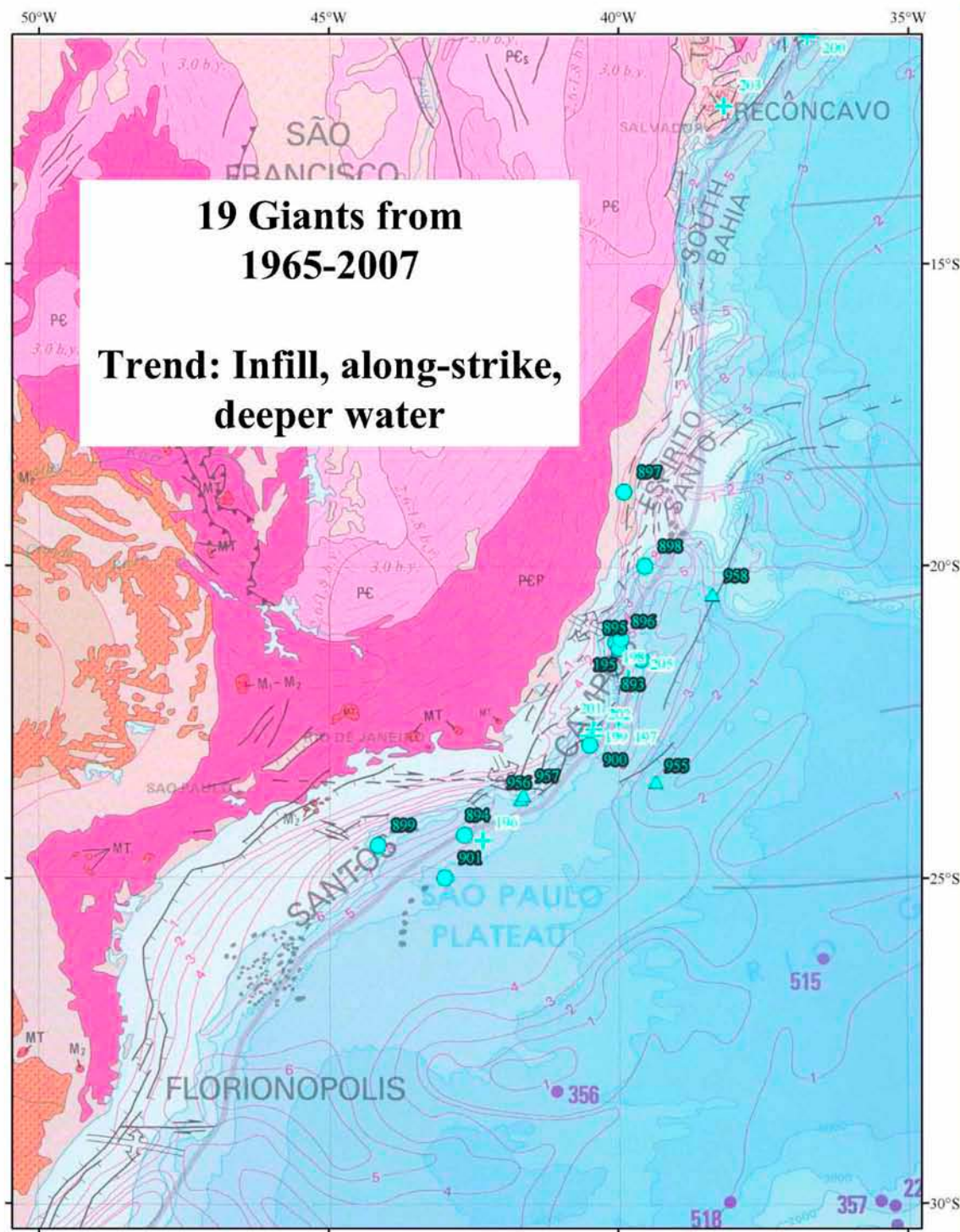
955. 1-EPB-001

956. 1-RJS-559B

957. 1-RJS-581

958. Catua





## Brazil

1 Gas and 8 Oil Giants 1965-1999

203. Miranga

3 Gas and 7 Oil Giants from 2000-2007

195. Jubarte

886. Mexihalo

884. Cachalote

882. 1-ESS-130

927. 1-RJS-587

883. Baleia Franca

926. Fazenda Cedro

885. Golfinho

900. Papa-Terra

901. RJS-628A

4 >200 MMBOE from 2000-2007

955. 1-EPB-001

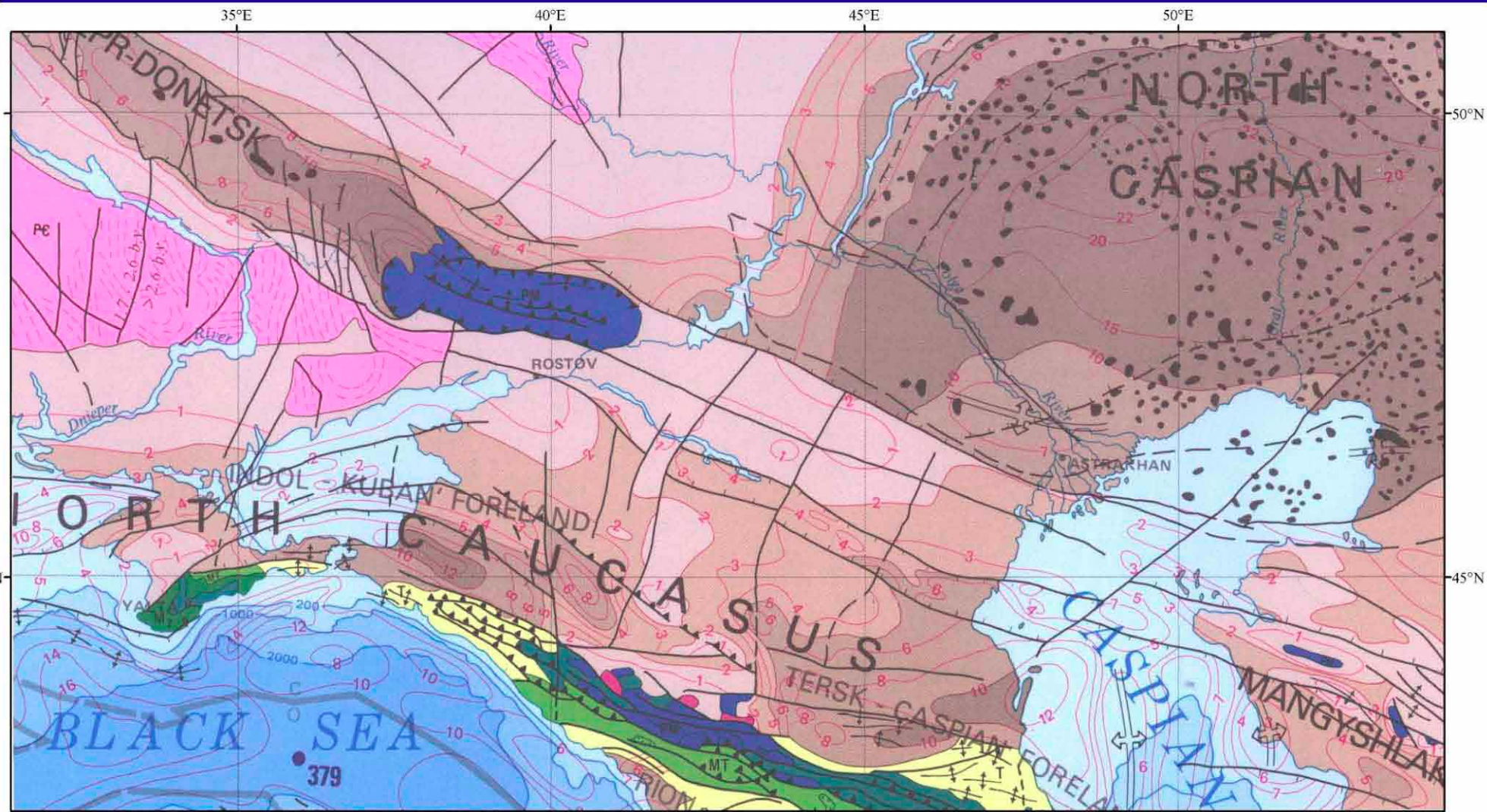
956. 1-RJS-559B

957. 1-RJS-581

958. Catua



# North Caucasus – North Caspian

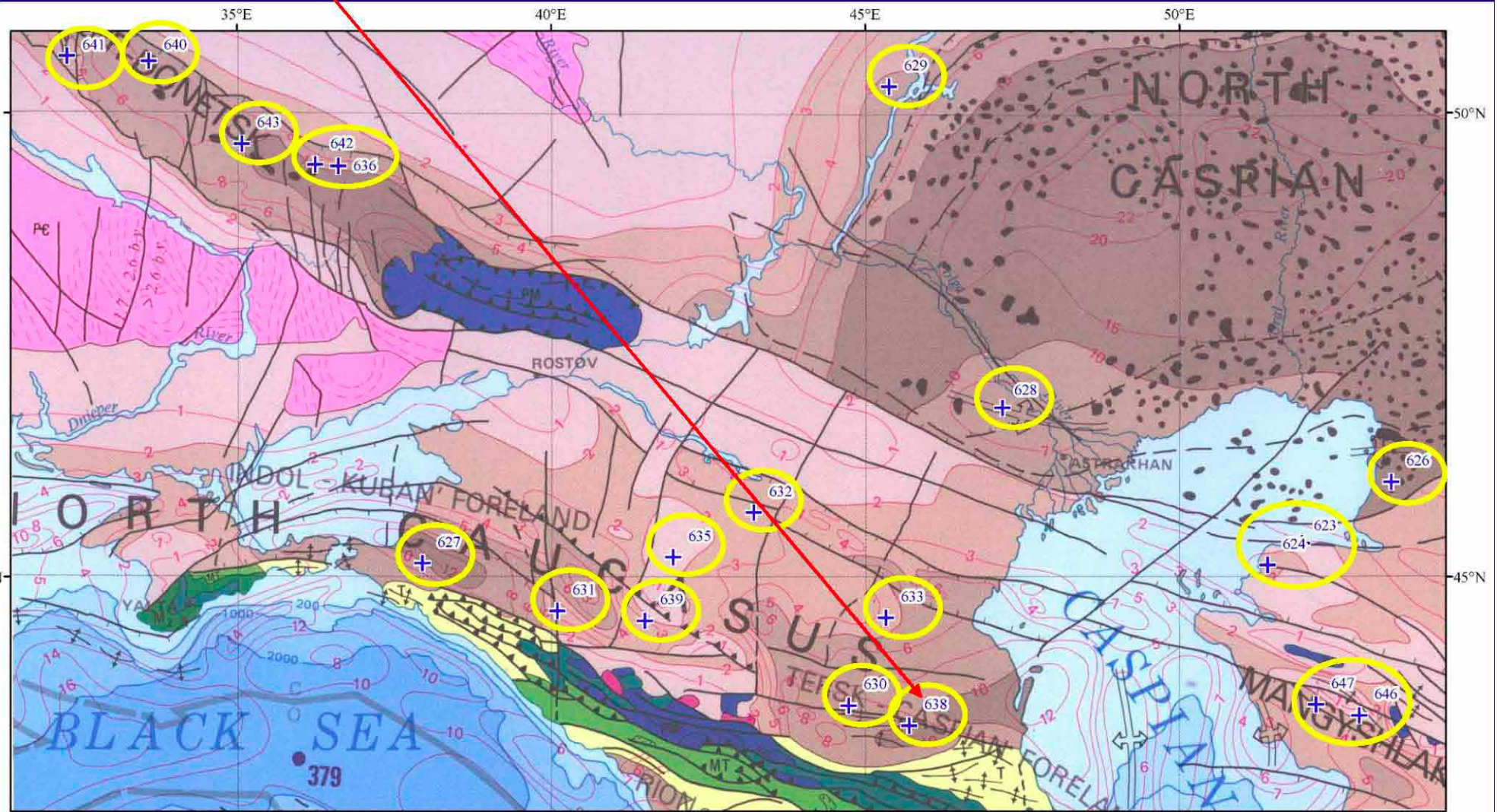




# North Caucasus – North Caspian

9 Gas and 11 Oil  
Giants 1893-1999

638. Starogrznyy

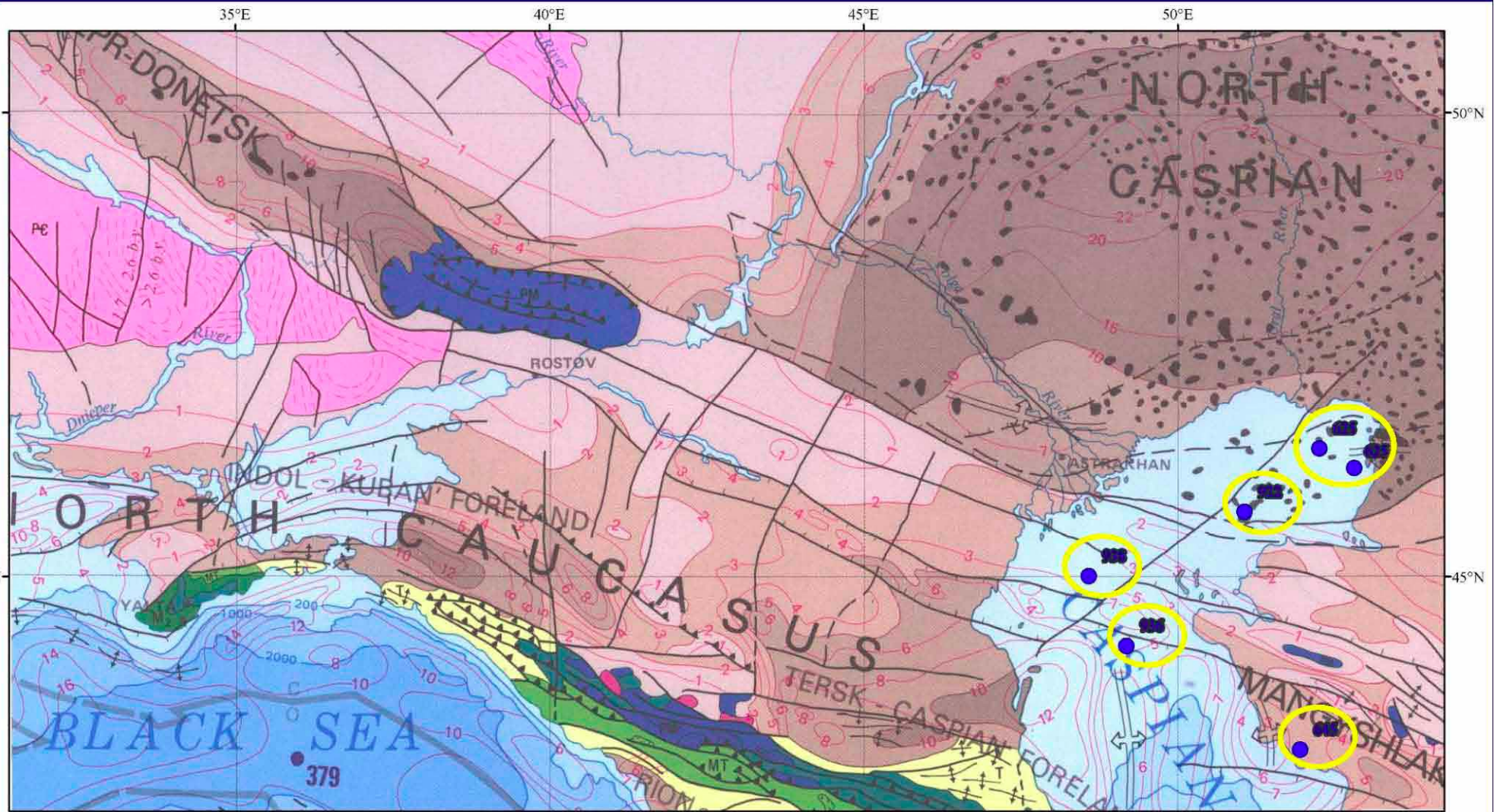




# North Caucasus – North Caspian

4 Oil and 2 Gas  
Giants 2000-2007  
625. Kashagan

936. Khvalynskoye 938. Vladimir Filanovsky  
645. Rakushechnoye 922. Kalamkas-More  
625. Aktote





# North Caucasus – North Caspian

9 Gas and 11 Oil  
Giants 1893-1999

638. Starogrznyy

4 Oil and 2 Gas  
Giants 2000-2007

625. Kashagan

936. Khvalynskoye

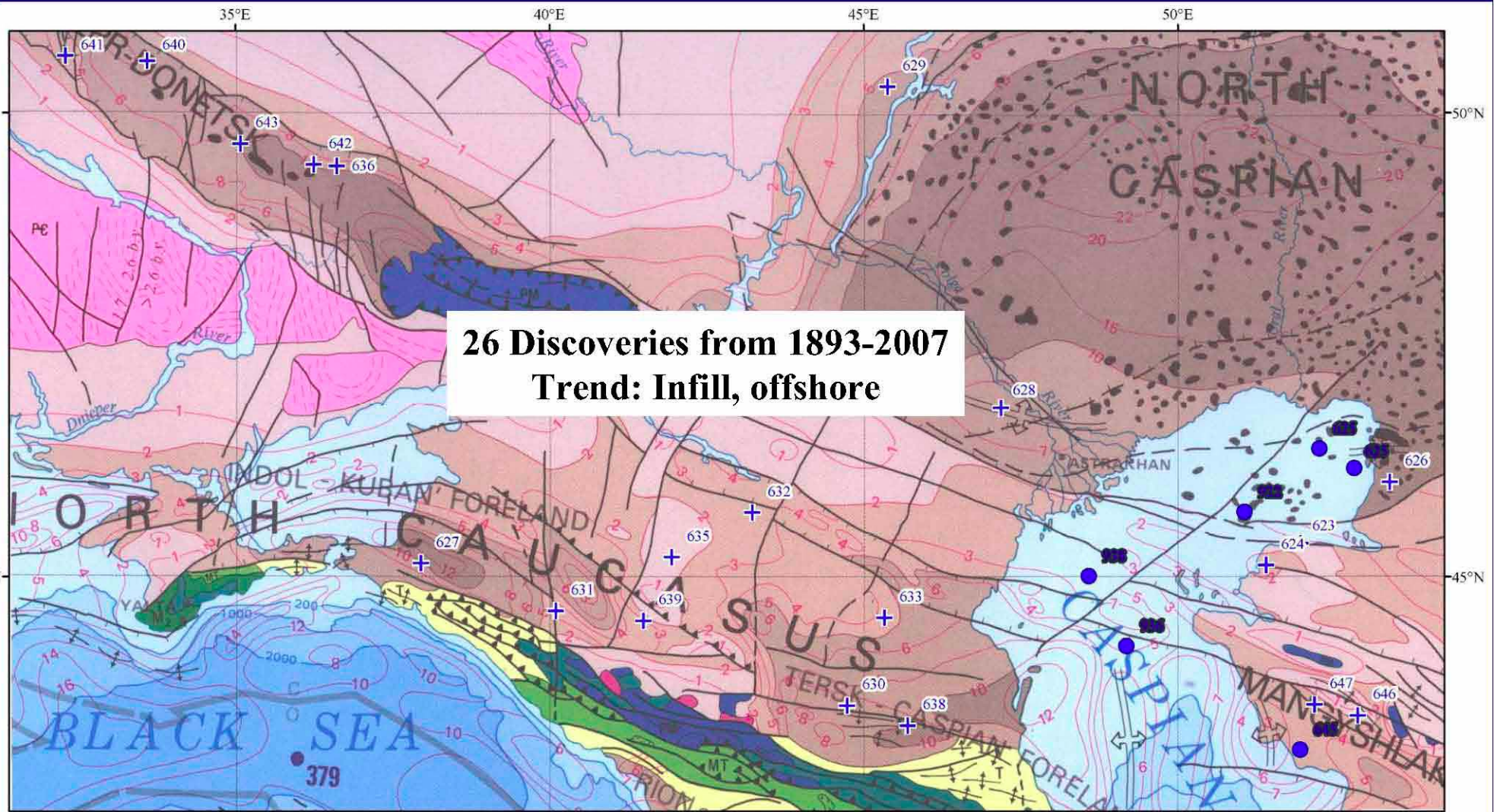
645. Rakushechnoye

625. Aktote

938. Vladimir Filanovsky

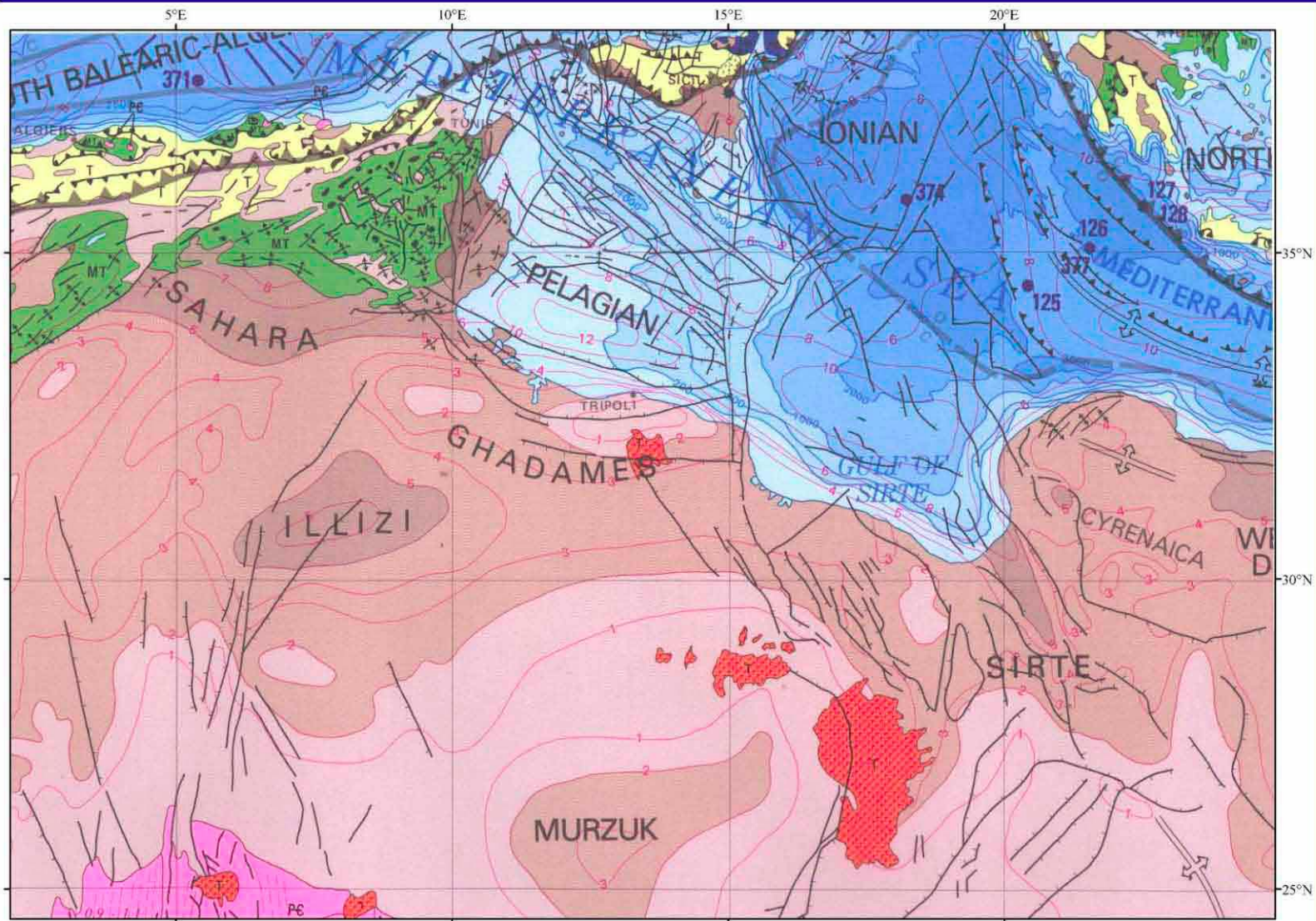
922. Kalamkas-More

**26 Discoveries from 1893-2007**  
**Trend: Infill, offshore**





# North Africa



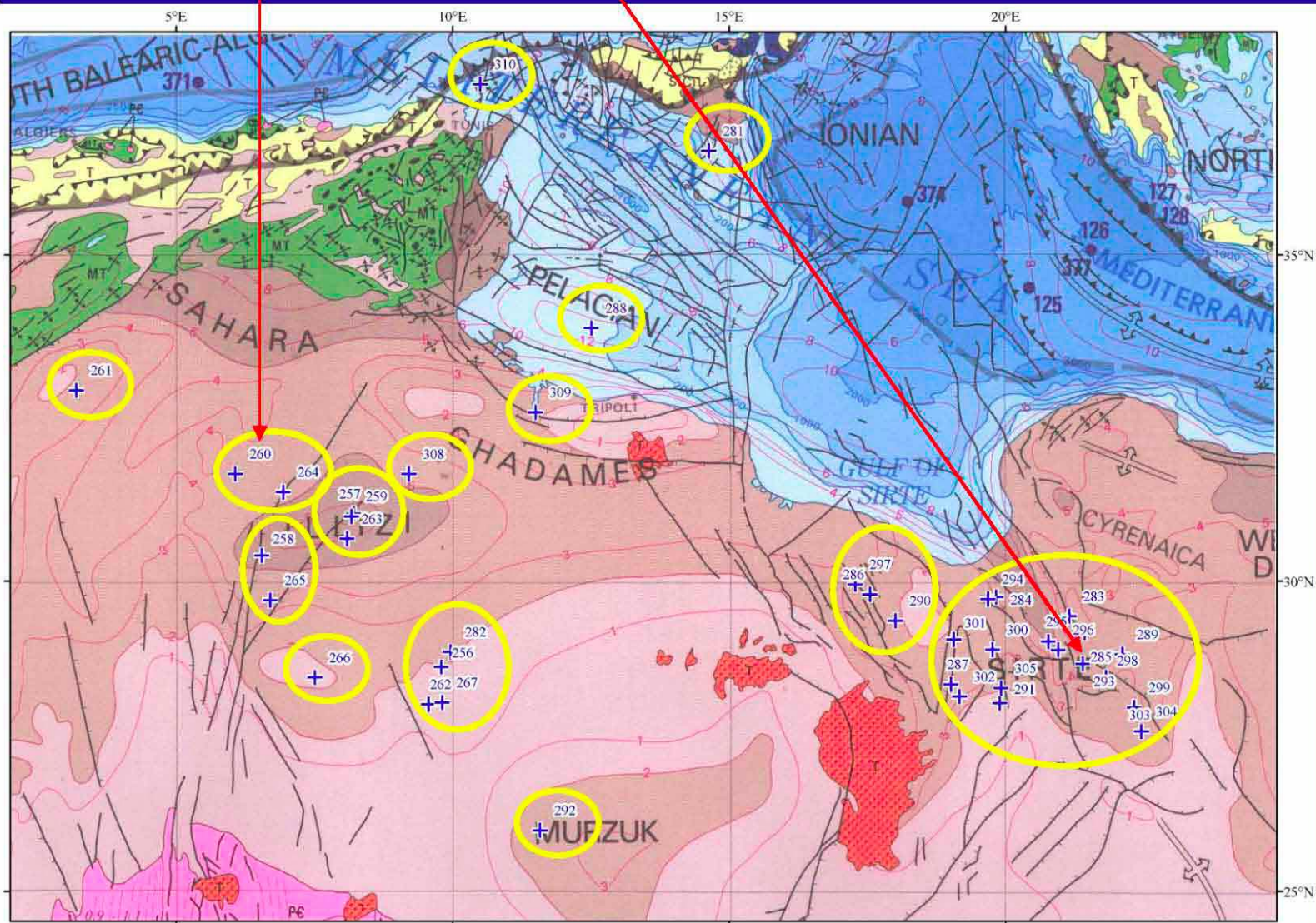


# North Africa

11 Gas and 29 Oil Giants from 1956 to 1999

260. Hassi Messaoud

285. Augila-Nafoora

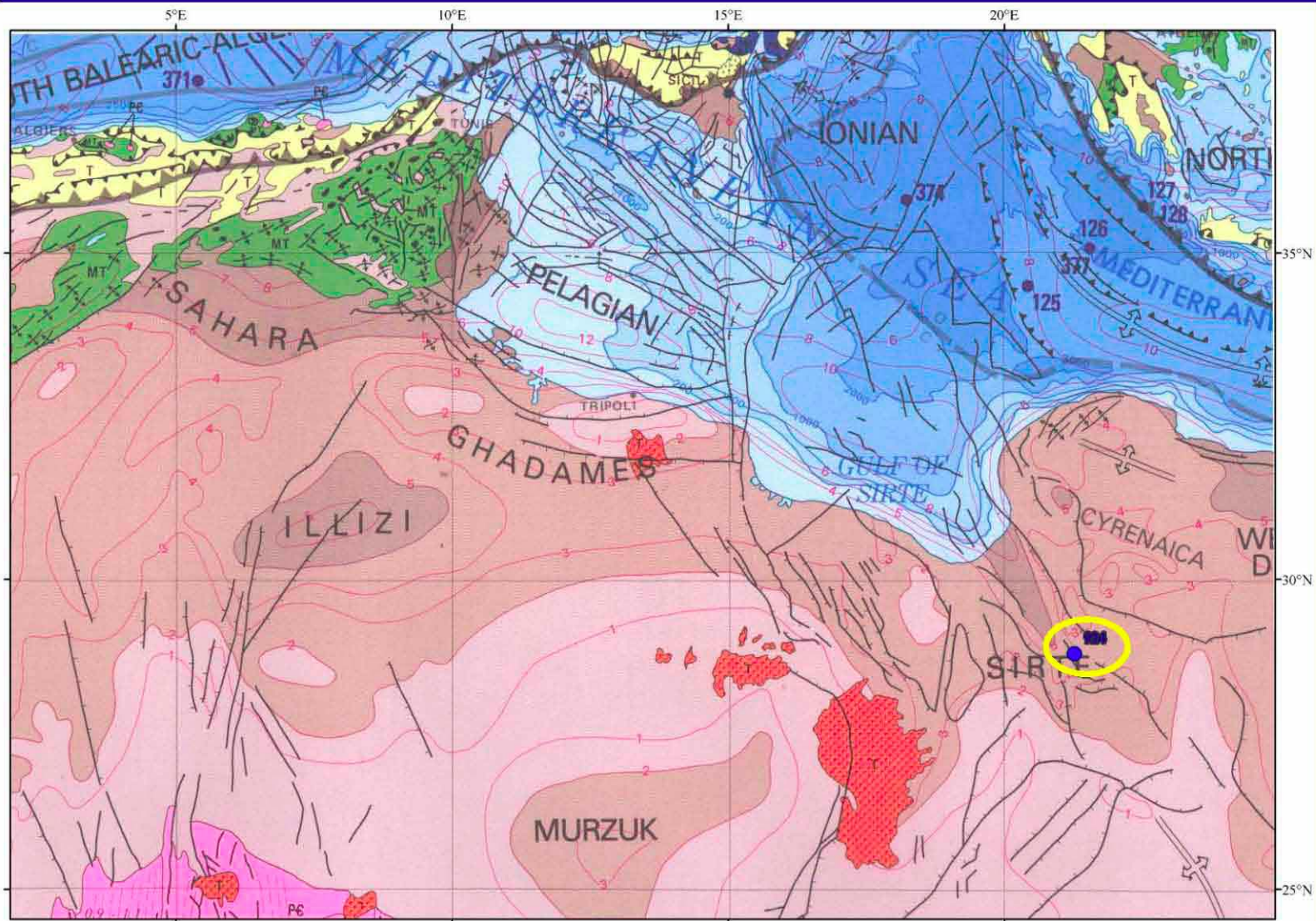




# North Africa

1 Oil Giant 2000-2007

924.059-6J-001





# North Africa

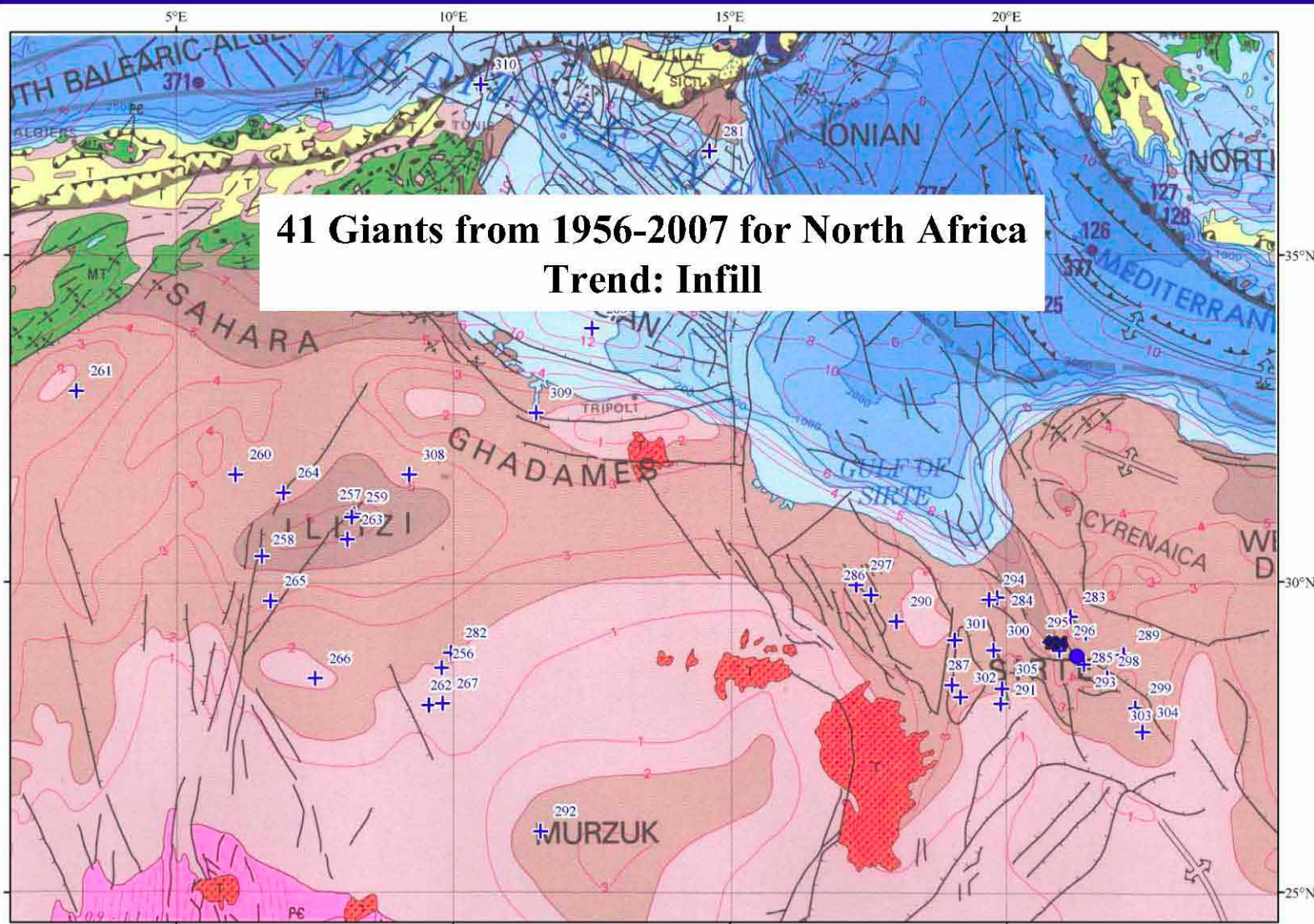
11 Gas and 29 Oil Giants from 1956 to 1999

260. Hassi Messaoud

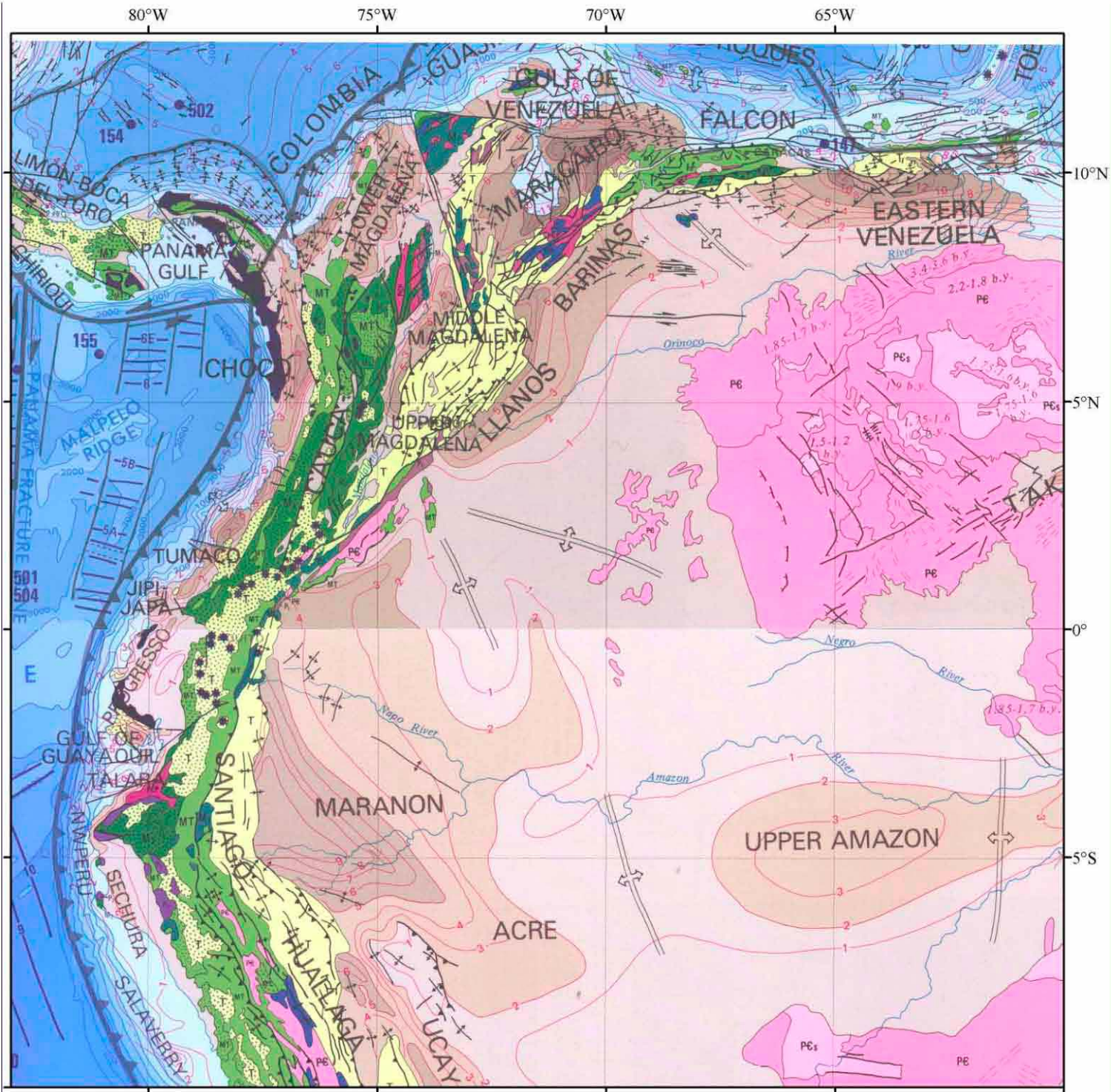
285. Augila-Nafoora

1 Oil Giant 2000-2007

924. 059-6J-001

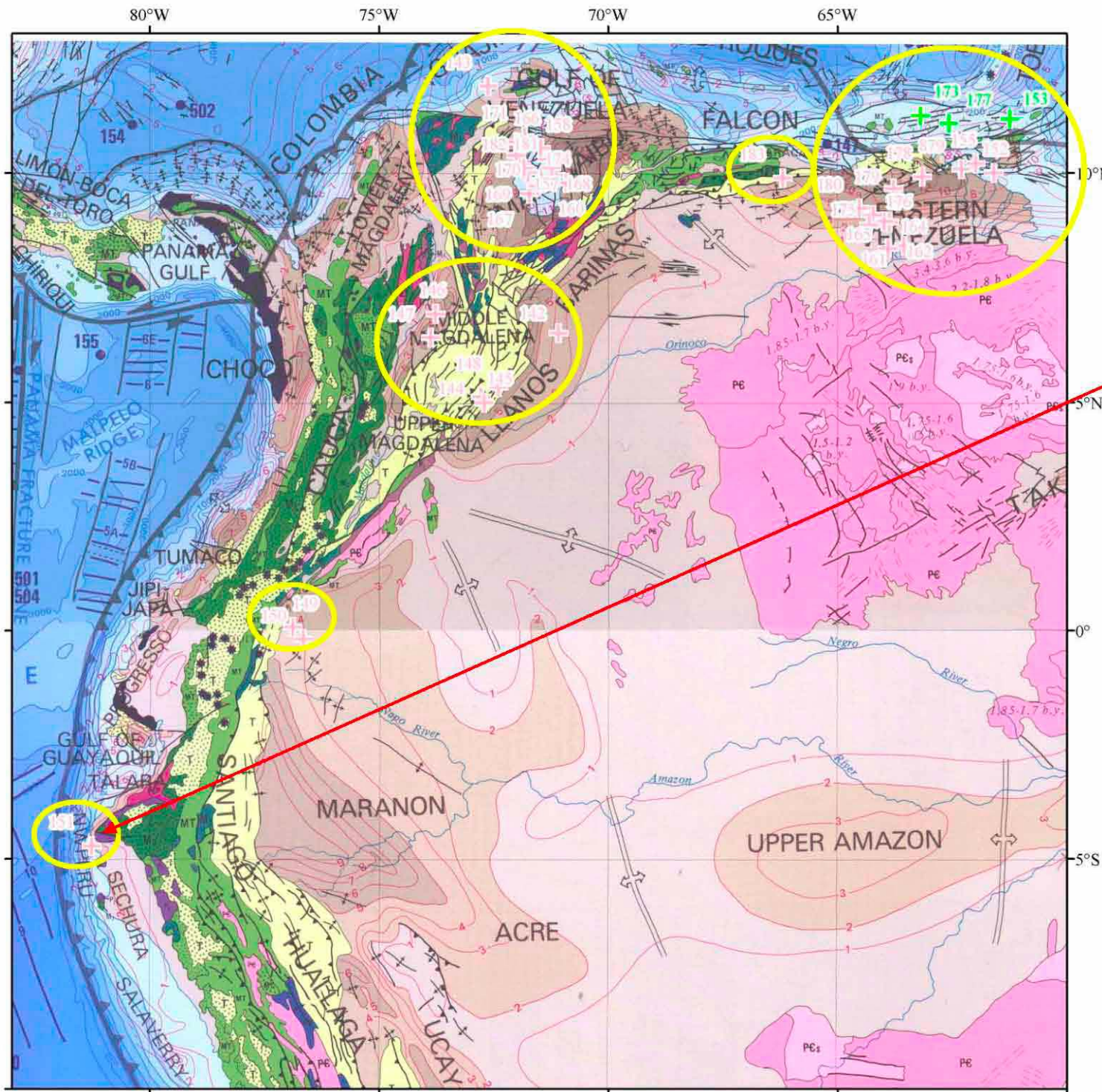






## Northern South America

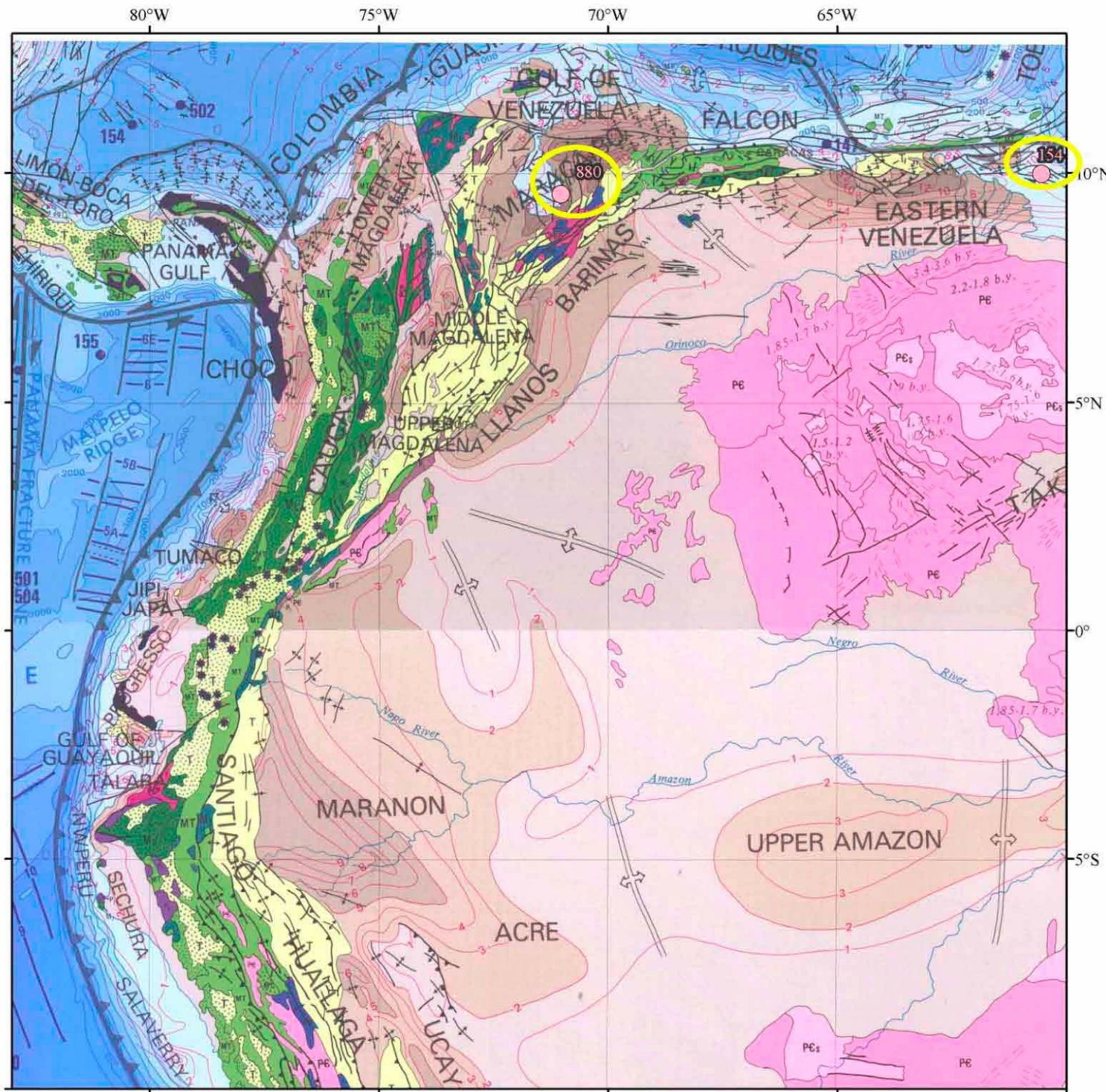




# Northern South America

11 Gas and 31 Oil  
Giants  
1868-1999  
151. La Brea



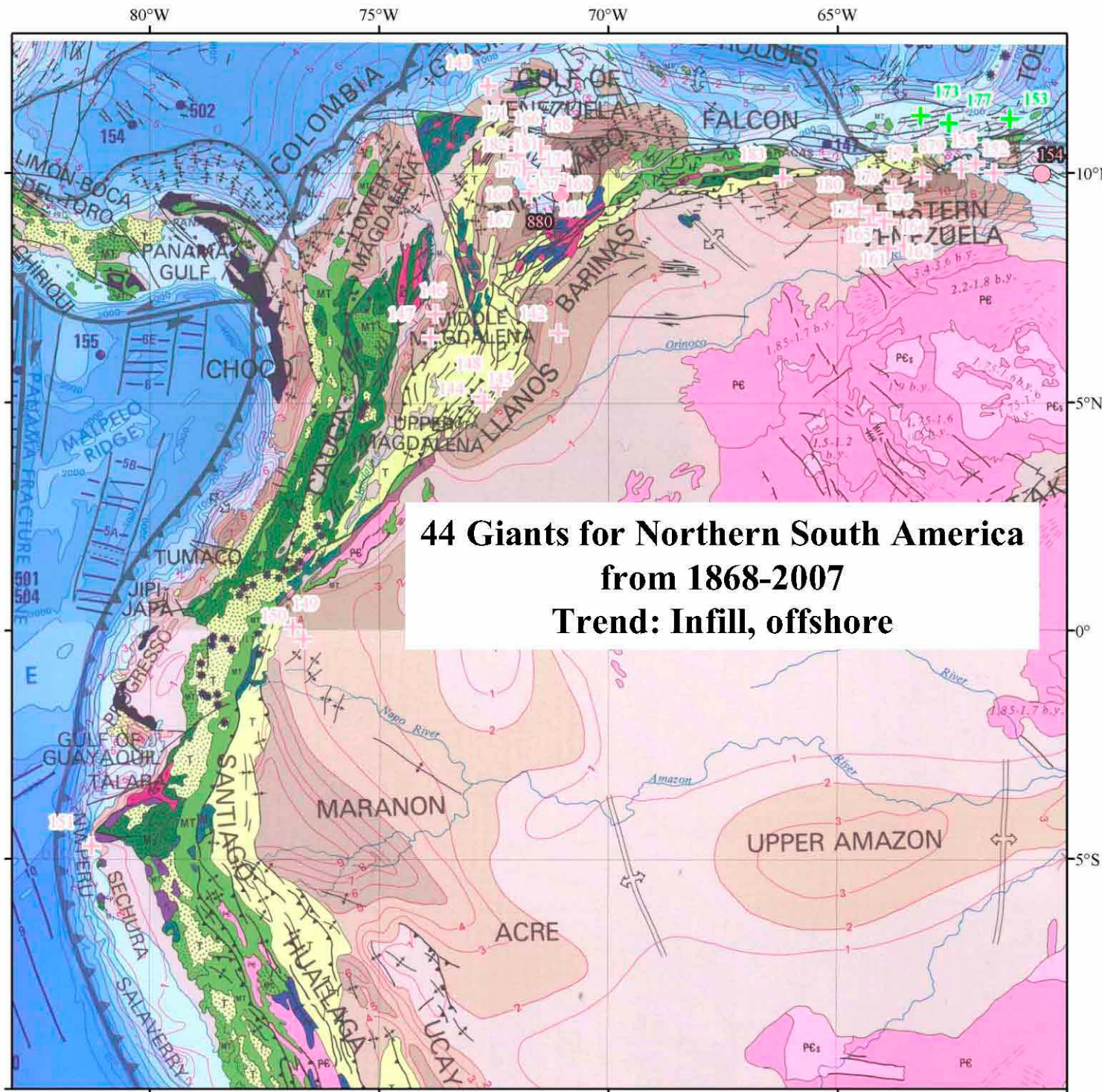


## Northern South America

1 Gas and 1 Oil Giant  
2000-2007

880. Cueta-Tomoporo  
154. Red Mango





## Northern South America

11 Gas and 31 Oil  
Giants

1868-1999

151. La Brea

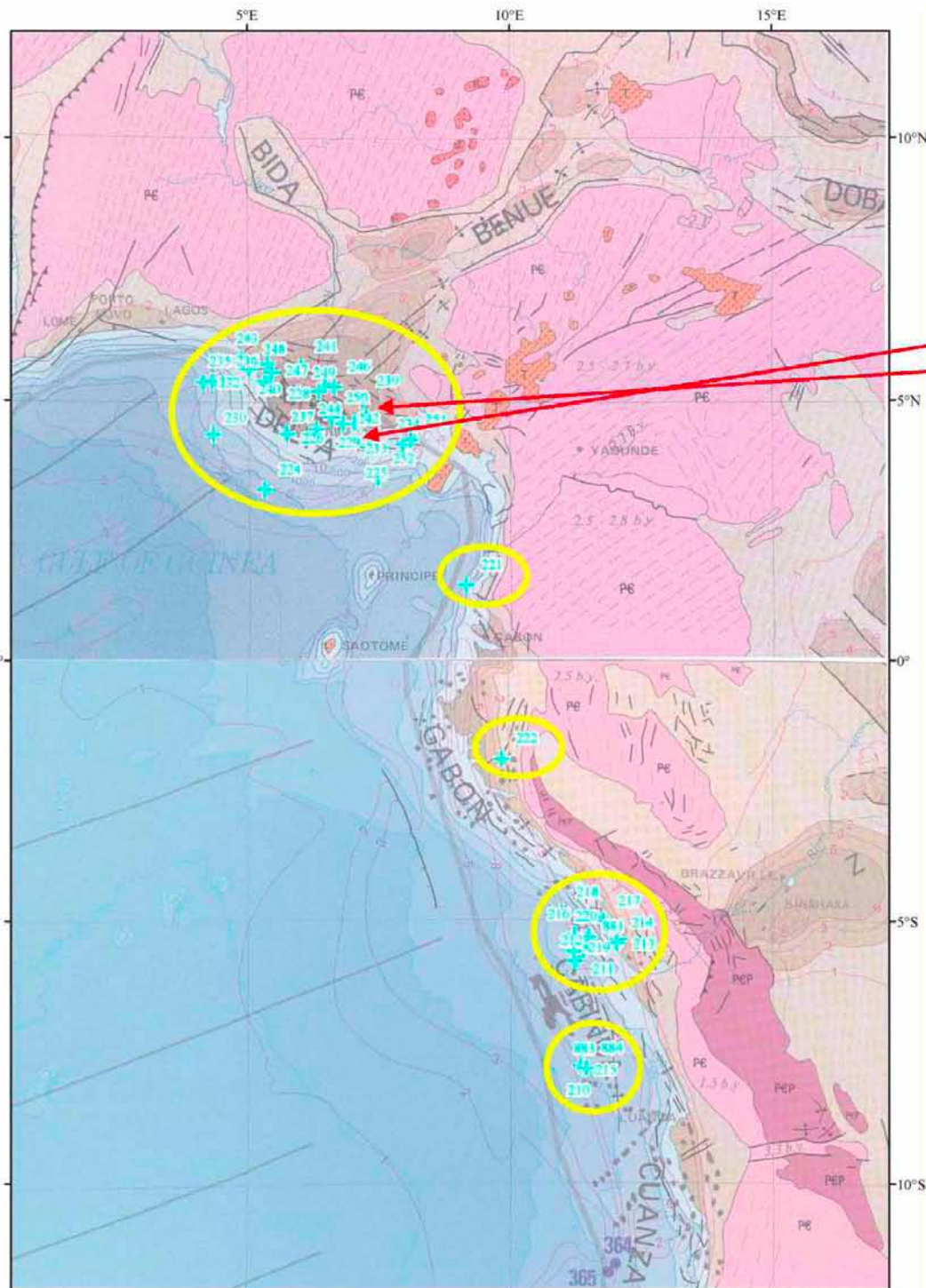
1 Gas and 1 Oil Giant  
2000-2007

880. Cueta-Tomoporo

154. Red Mango







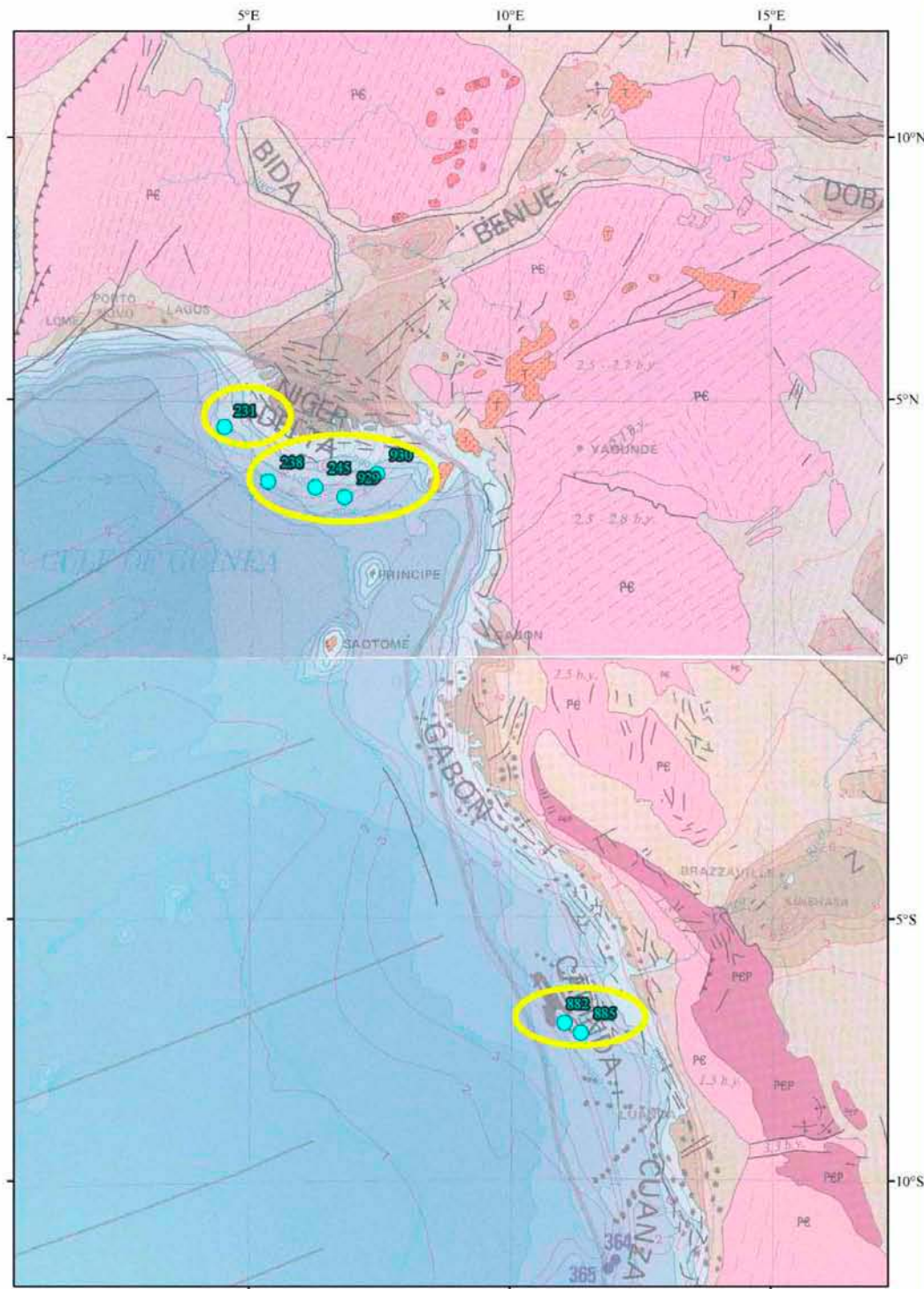
## West Africa

7 Gas and 35 Oil Giants 1958-1999

229. Bomu

250. Soku





## West Africa

5 Oil and 2 Gas Giants 2000-2007

231. Bonga, Southwest

238. Ikija 1 (offshore)

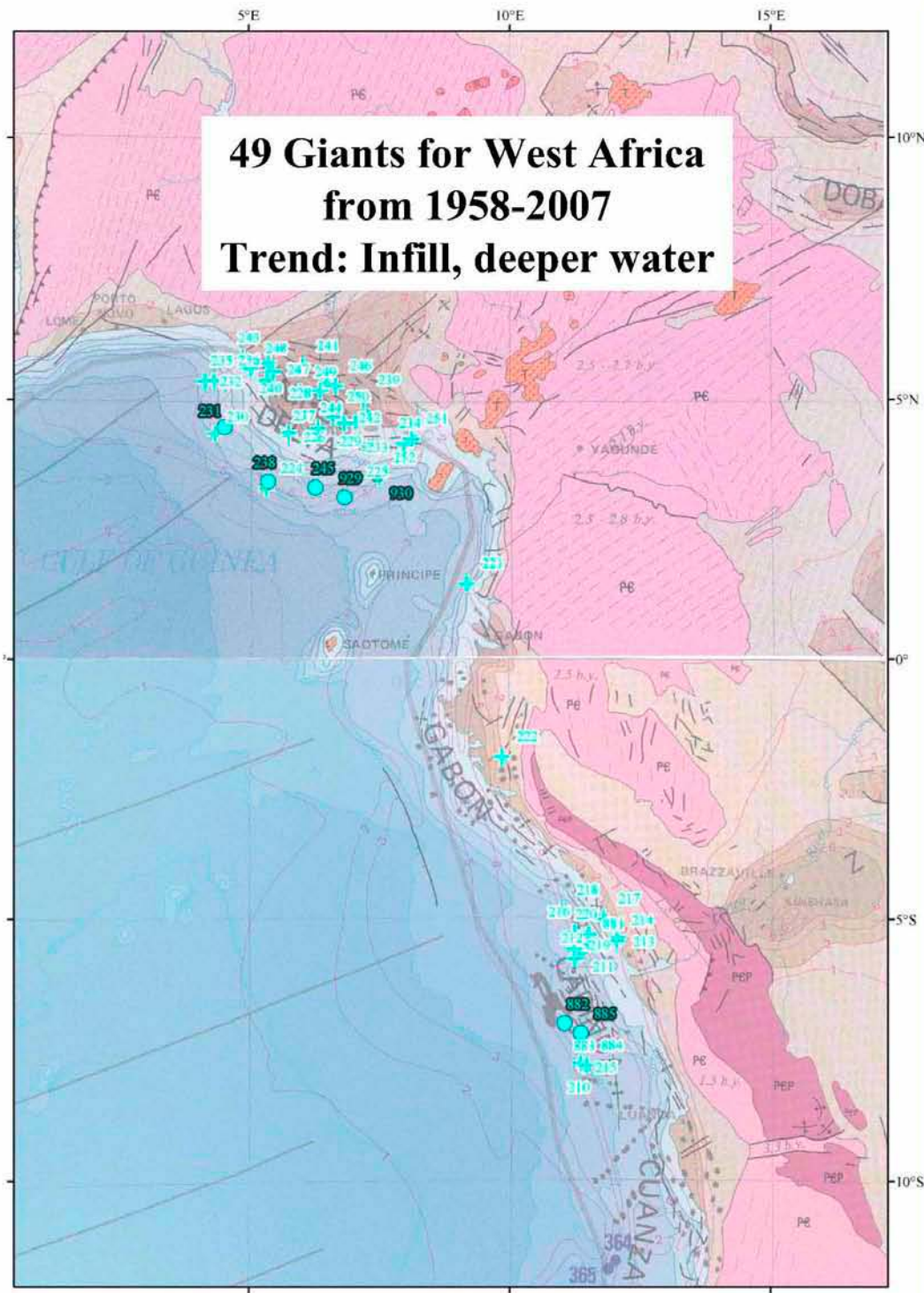
929. Akpo

930. Usan

245. Nnwa Doro

882. Block 15 Complex

885. Gindungo 1



## West Africa

7 Gas and 35 Oil Giants 1958-1999

229. Bomu

250. Soku

5 Oil and 2 Gas Giants 2000-2007

231. Bonga, Southwest

238. Ikija 1 (offshore)

929. Akpo

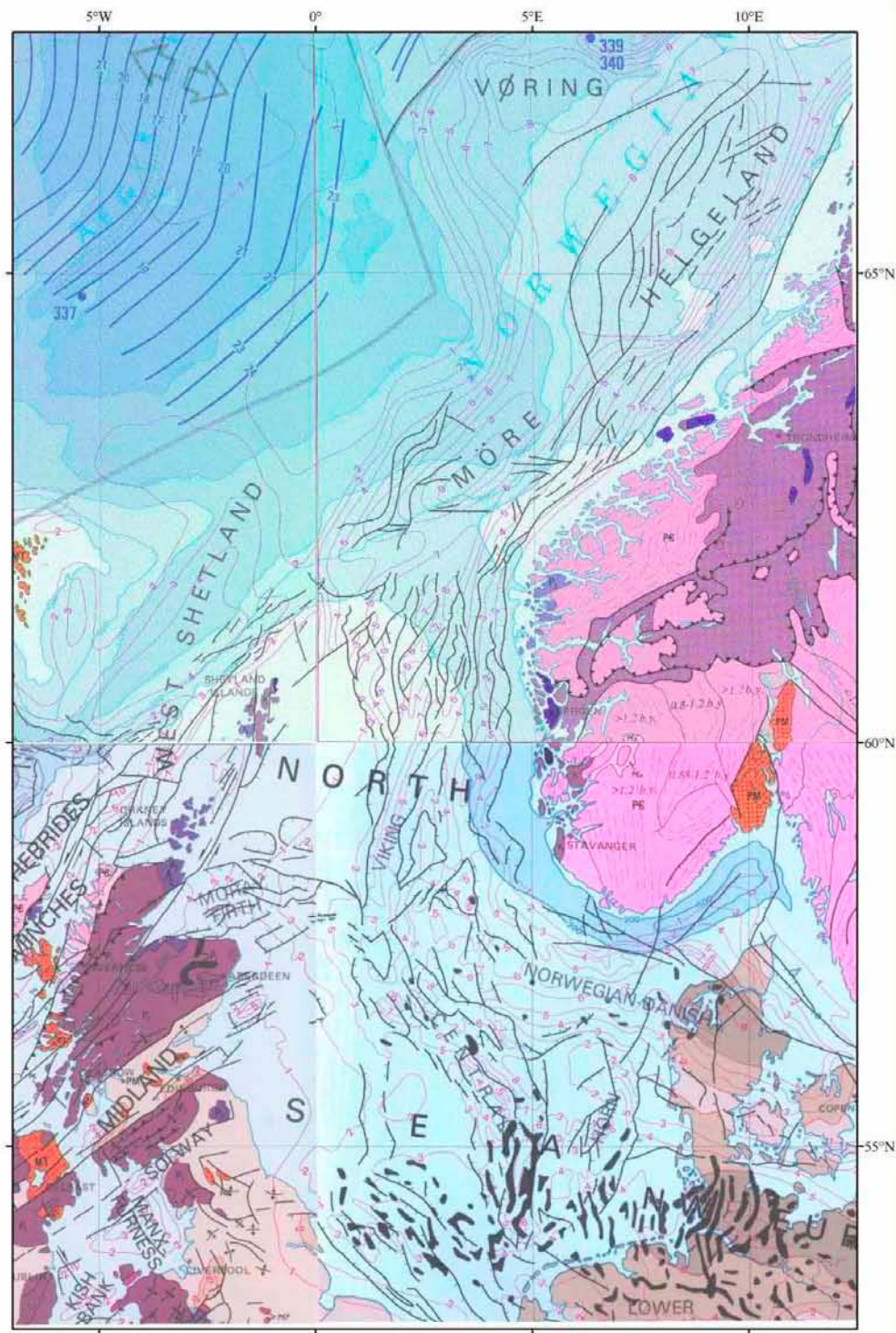
930. Usan

245. Nnwa Doro

882. Block 15 Complex

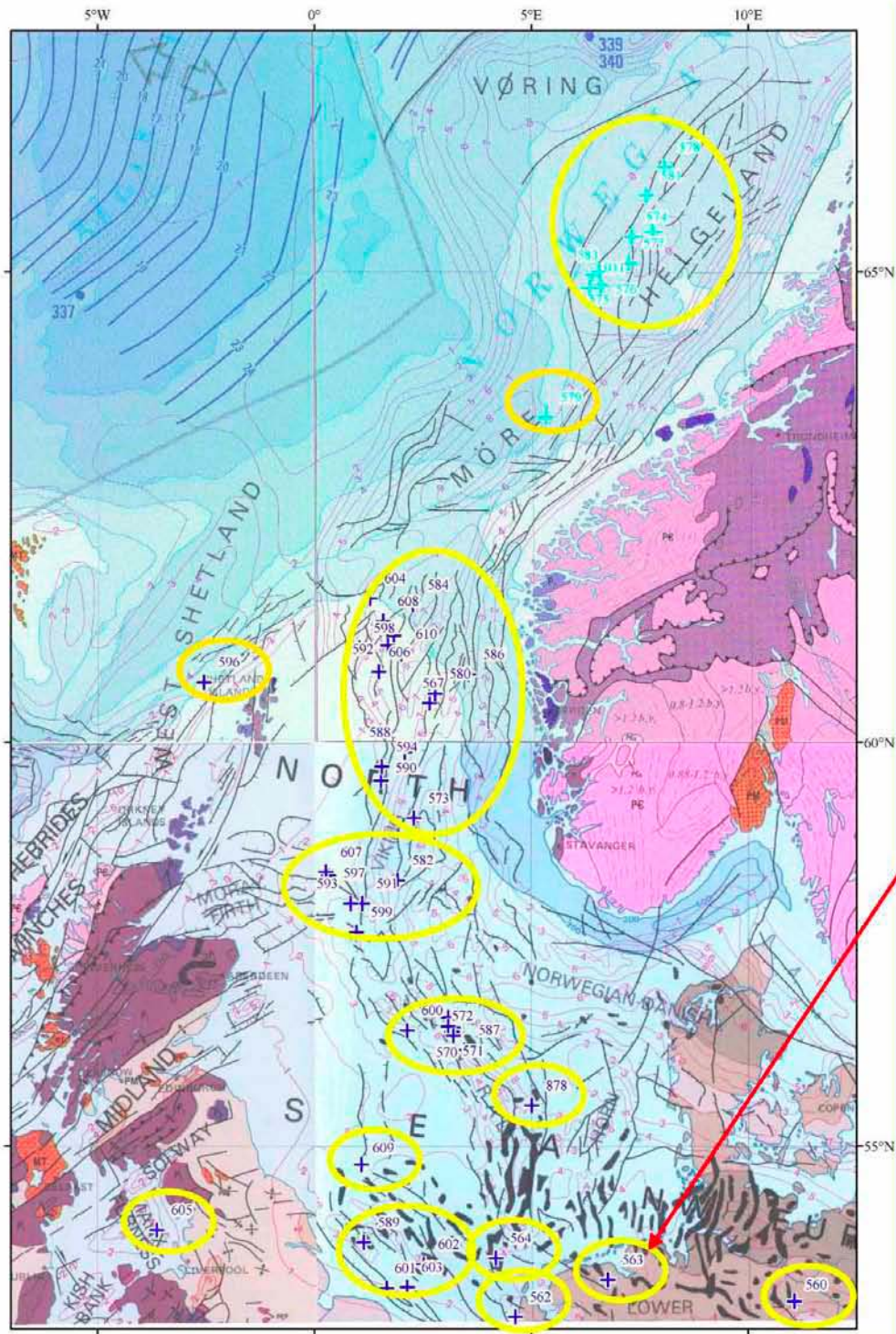
885. Gindungo 1





## North Sea



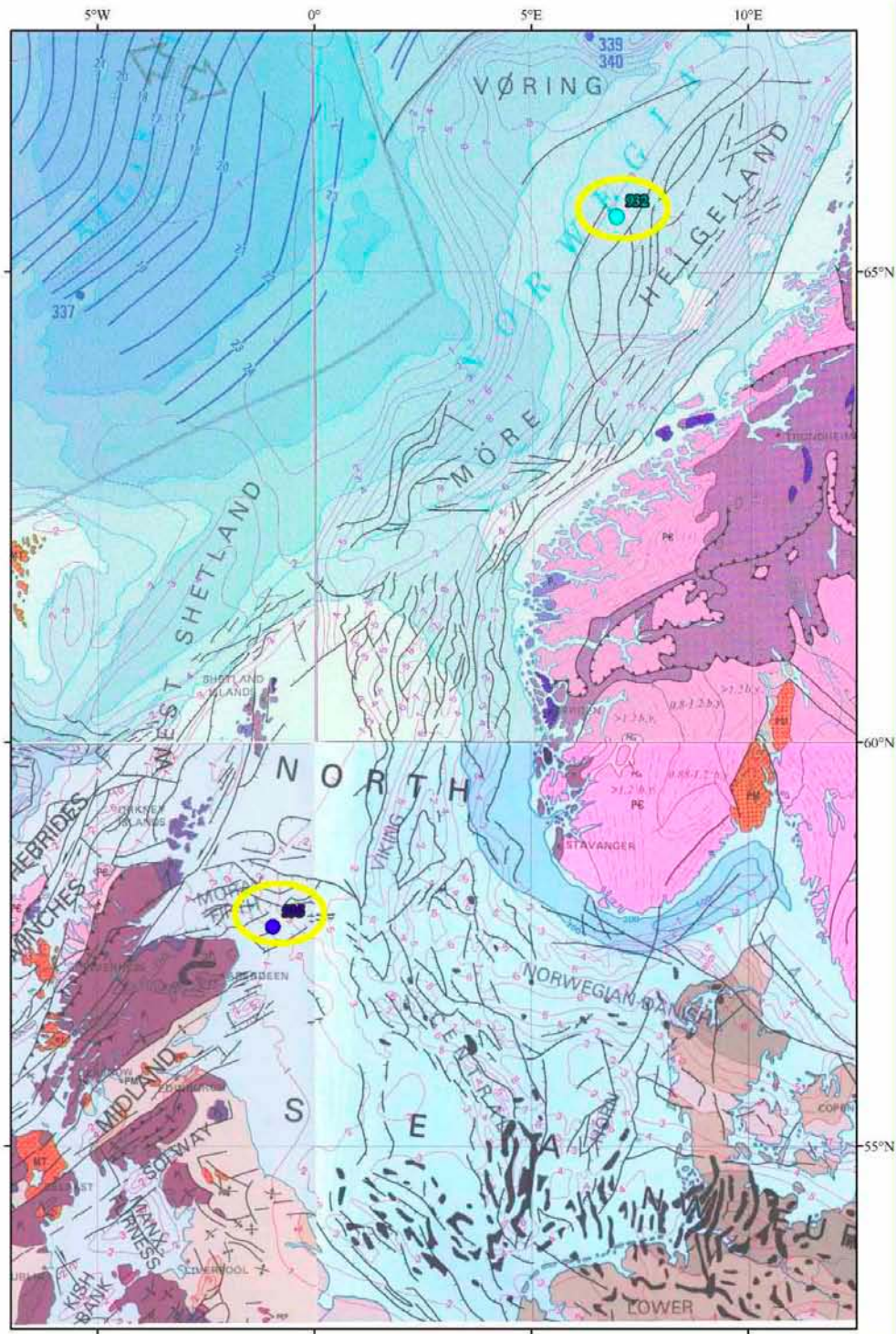


## North Sea

23 Gas and 27 Oil Giants 1959-1999

563. Groningen





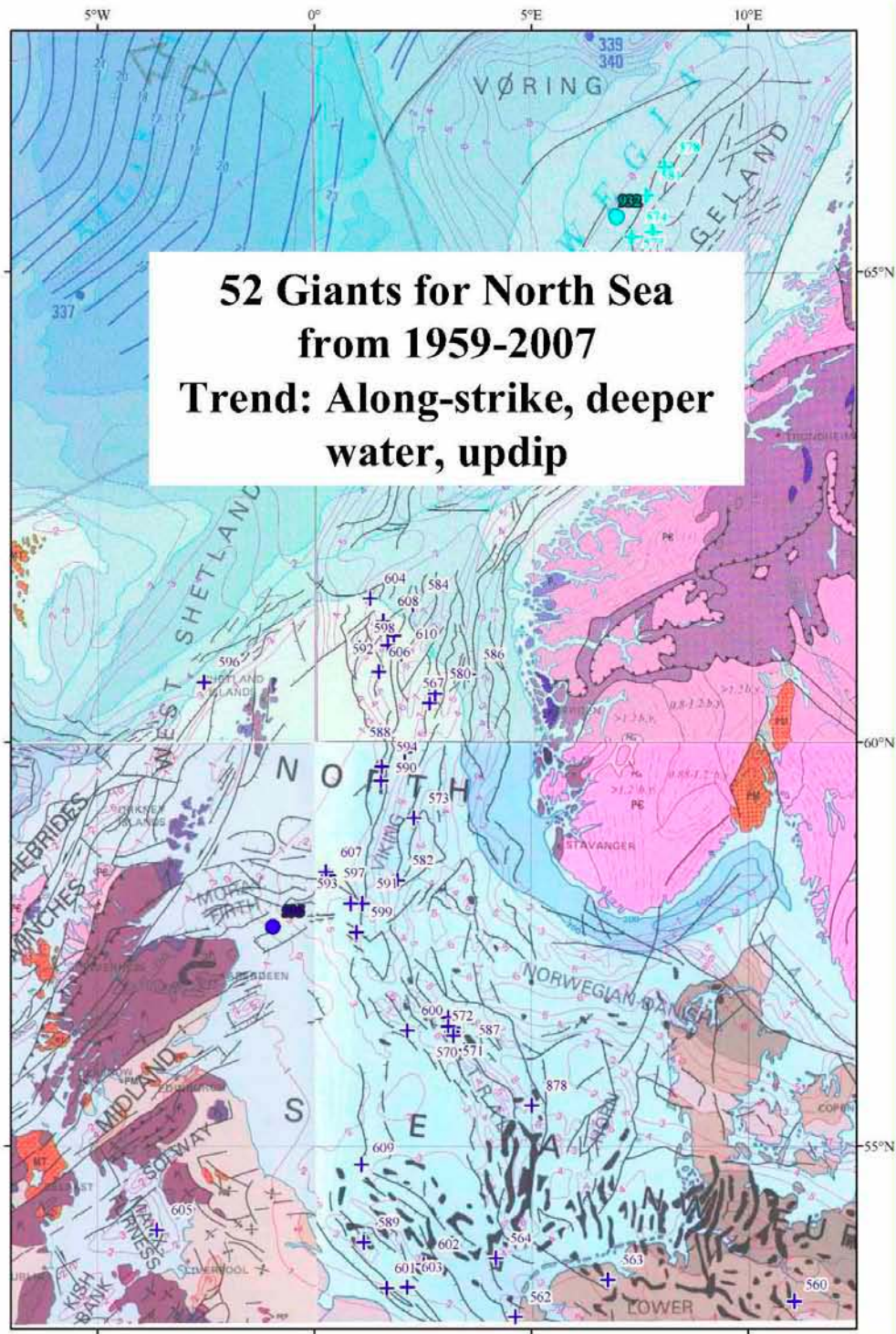
# North Sea

## 1 Gas and 1 Oil Giant 2000-2007

899. Block 6506/06-01

595. Buzzard





## North Sea

23 Gas and 27 Oil Giants 1959-1999

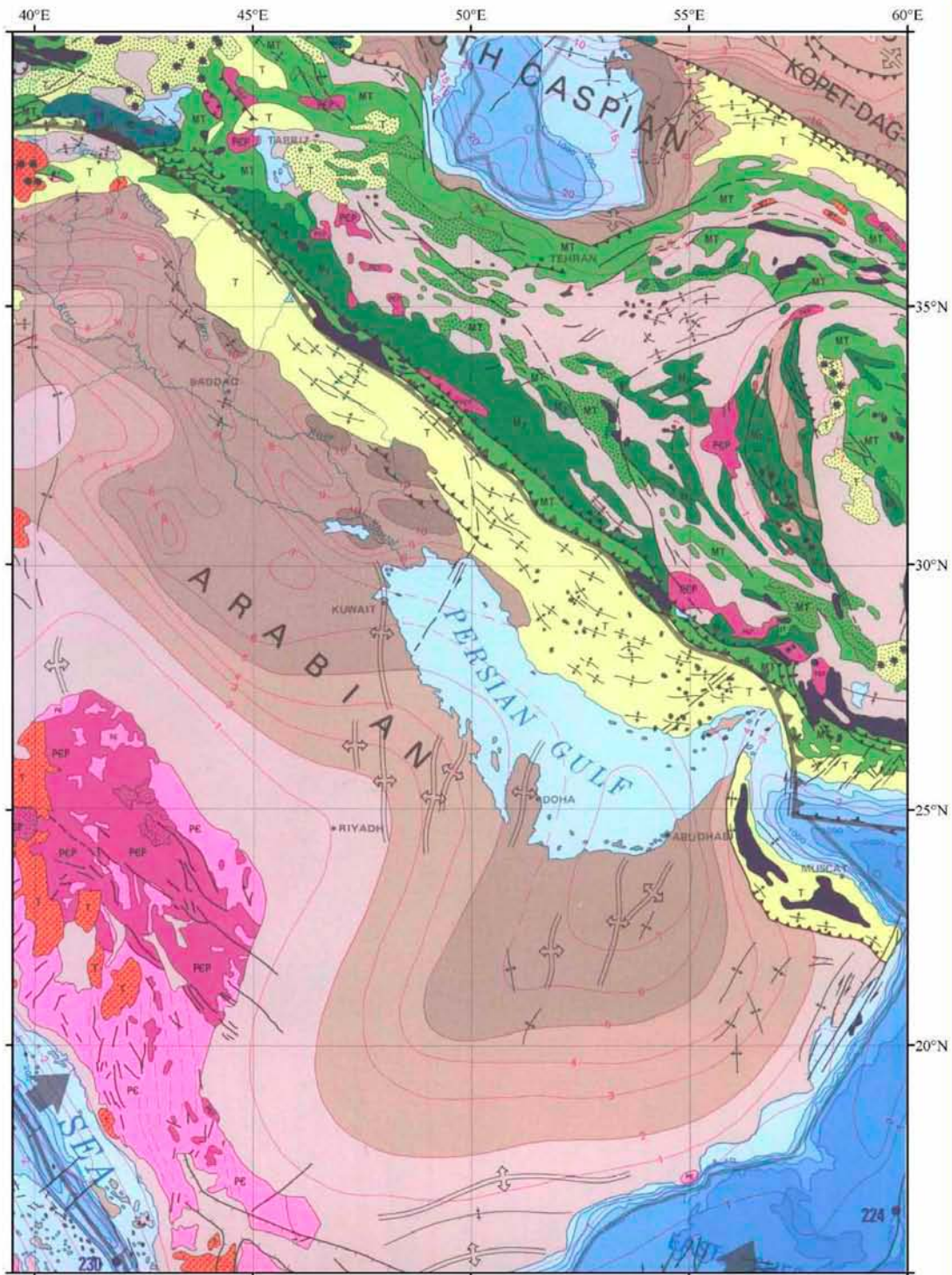
**563. Groningen**

1 Gas and 1 Oil Giant 2000-2007

**899. Block 6506/06-01**

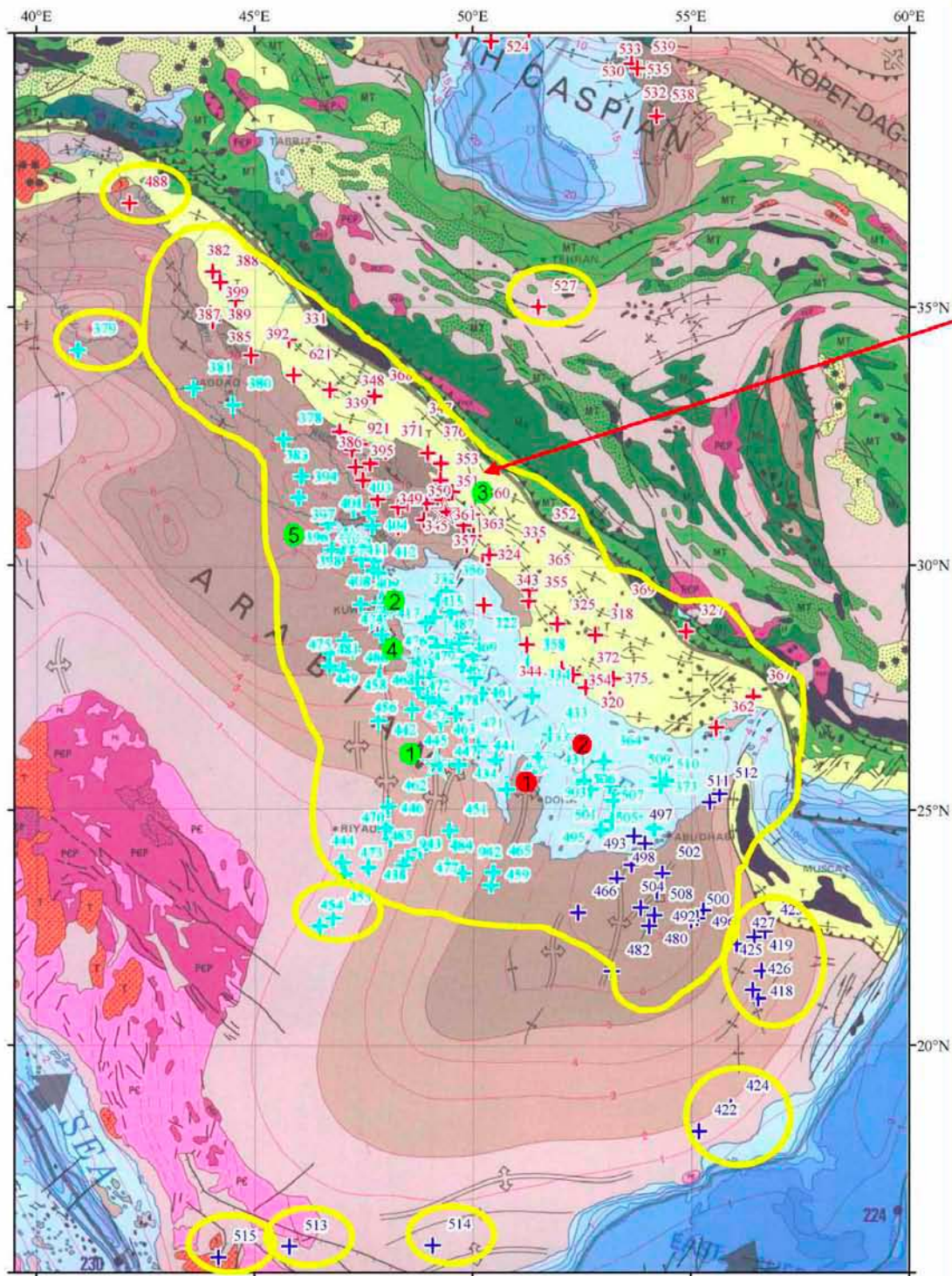
**595. Buzzard**





# Persian Gulf



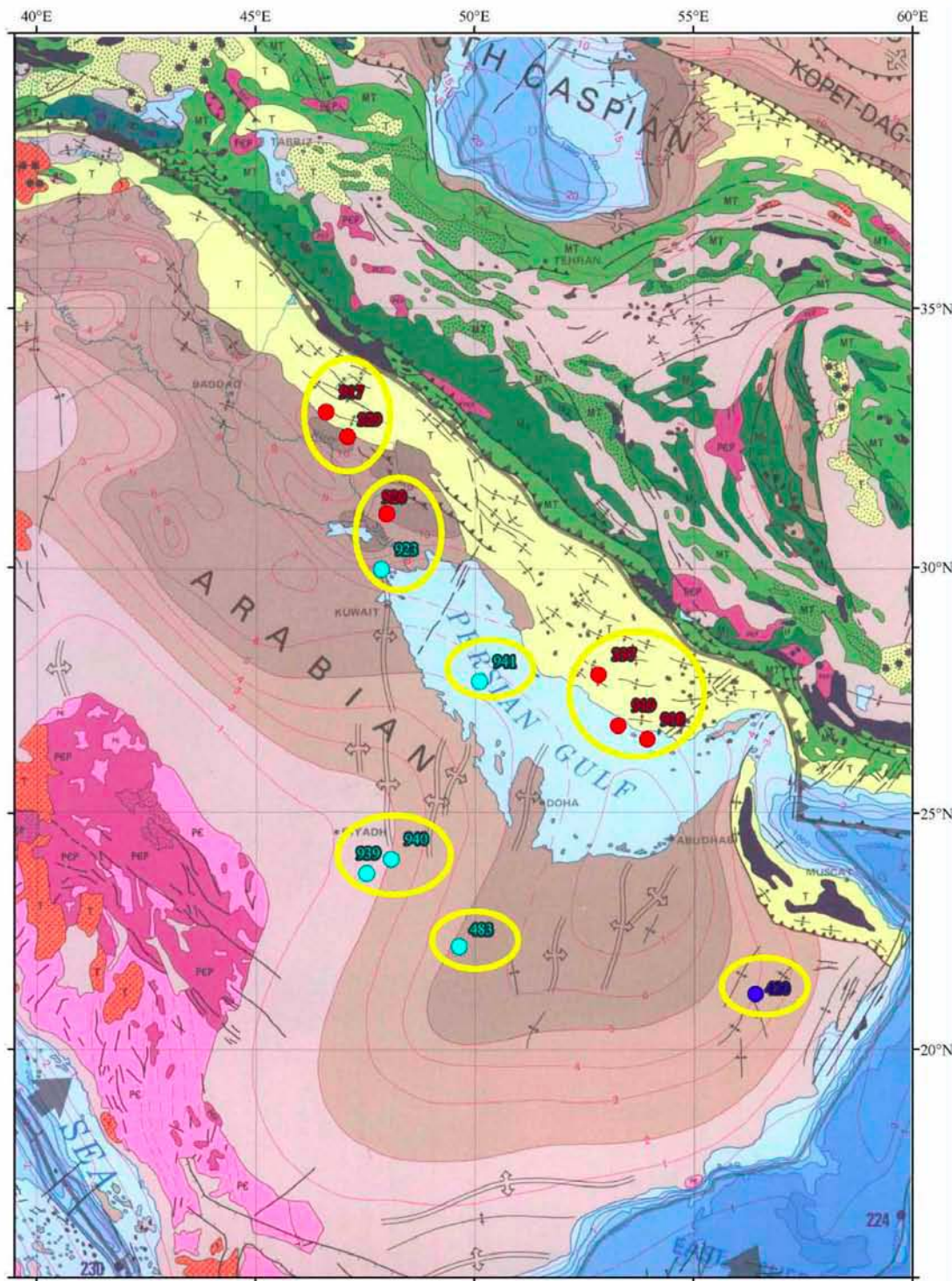


# Persian Gulf

49 Gas and 150 Oil Giants 1908-1999

351. Masjid-i-Sulemain





# Persian Gulf

7 Gas and 5 Oil Giants 2000-2007

329. Day

337. Homa

420. Khazzan

483. Takhman

917. Azar

918. Kish 2

919. Lavan 1ST

920. Yadavaran

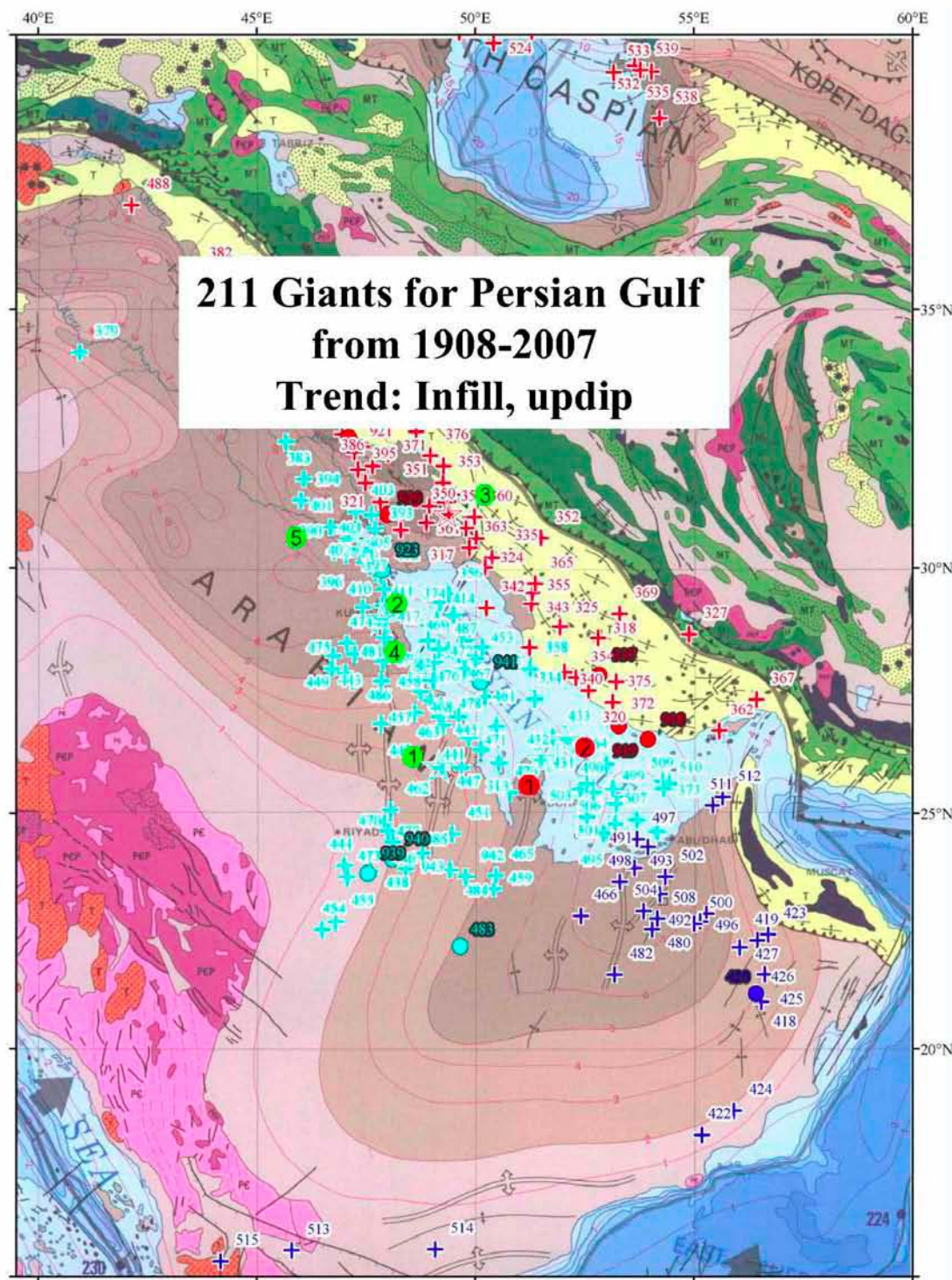
923. Umm Niqa

939. Du-ayban

940. Ghazal

941. Karan 6





## Persian Gulf

49 Gas and 150 Oil Giants 1908-1999

351. Masjid-i-Sulemain

7 Gas and 5 Oil Giants 2000-2007

329. Day

337. Homa

420. Khazzan

483. Takhman

917. Azar

918. Kish 2

919. Lavan 1ST

920. Yadavaran

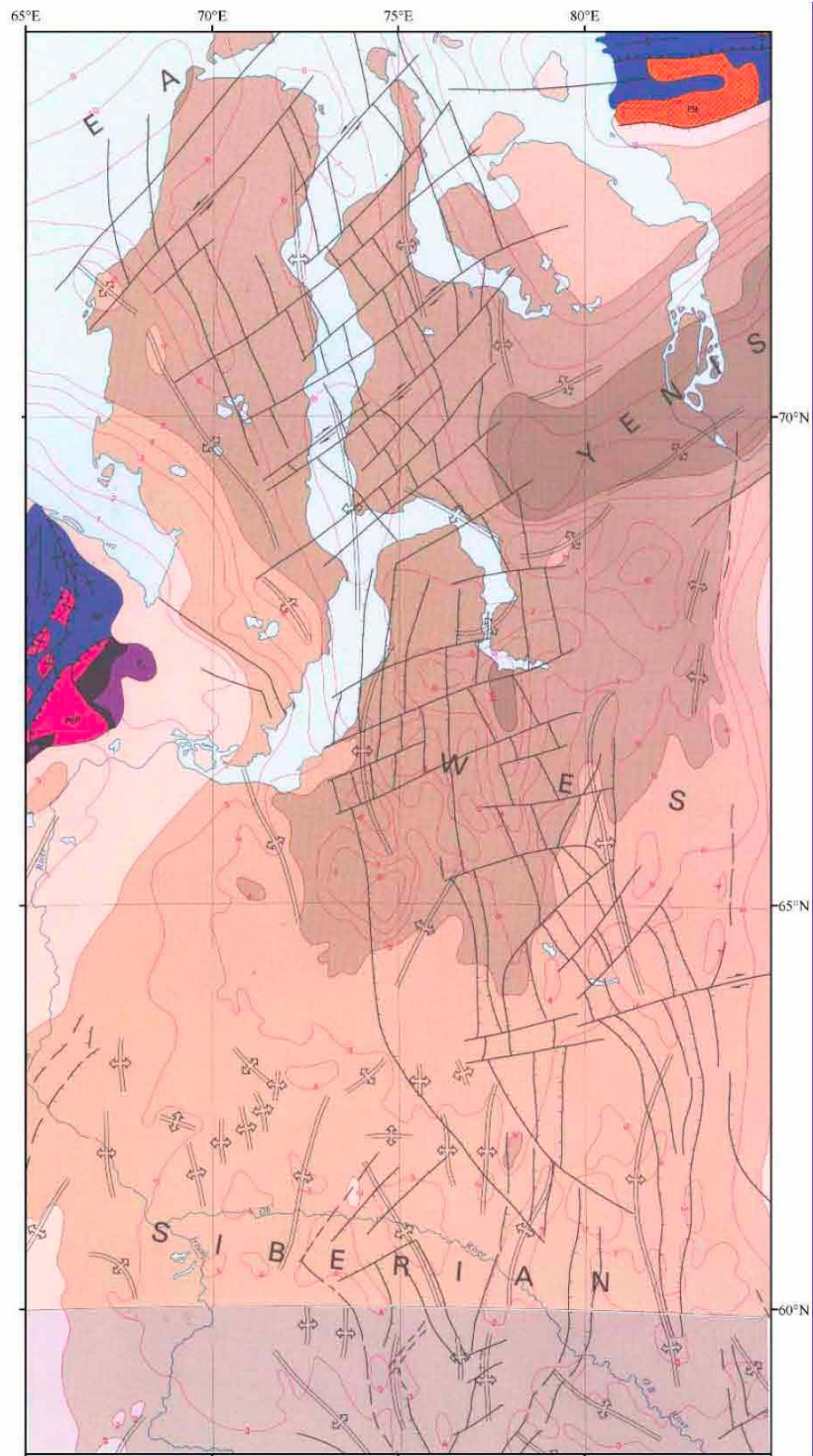
923. Umm Niqa

939. Du-ayban

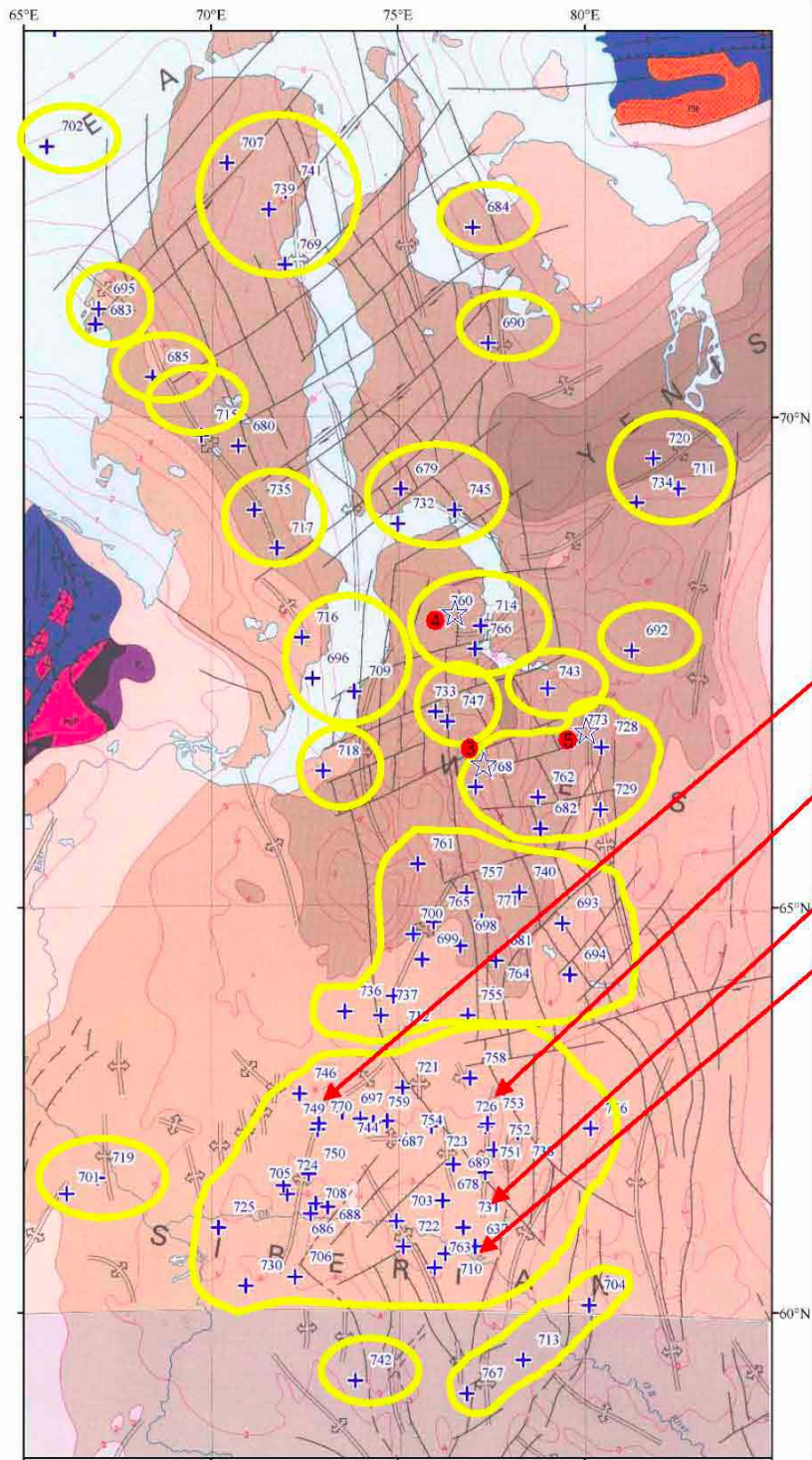
940. Ghazal

941. Karan 6





## West Siberia



## West Siberia

52 Gas and 41 Oil Giants 1961-1999

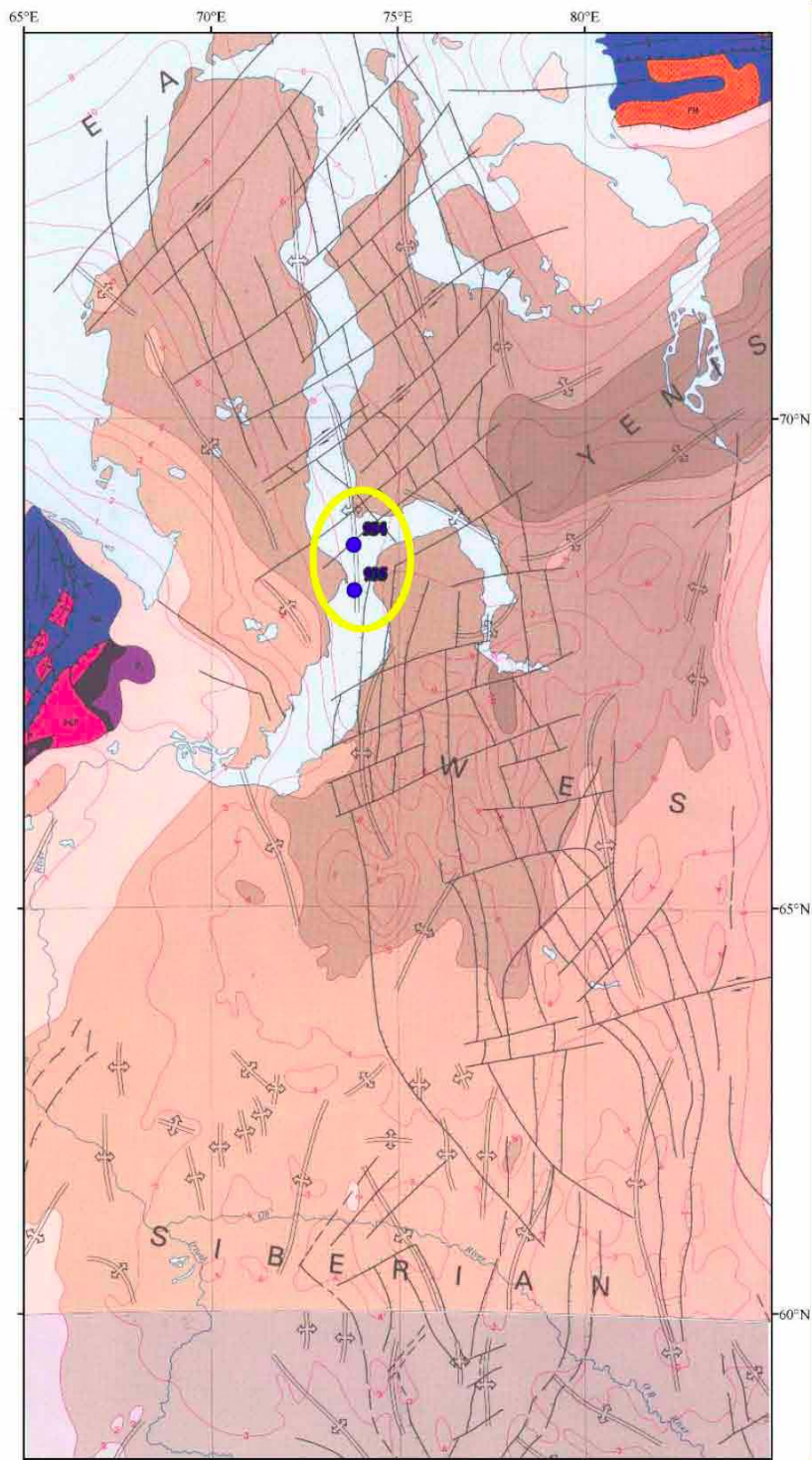
749. Ust'-Bakyskoye

726. Punga (Punginskoye)

731. Samotlor

710. Megion



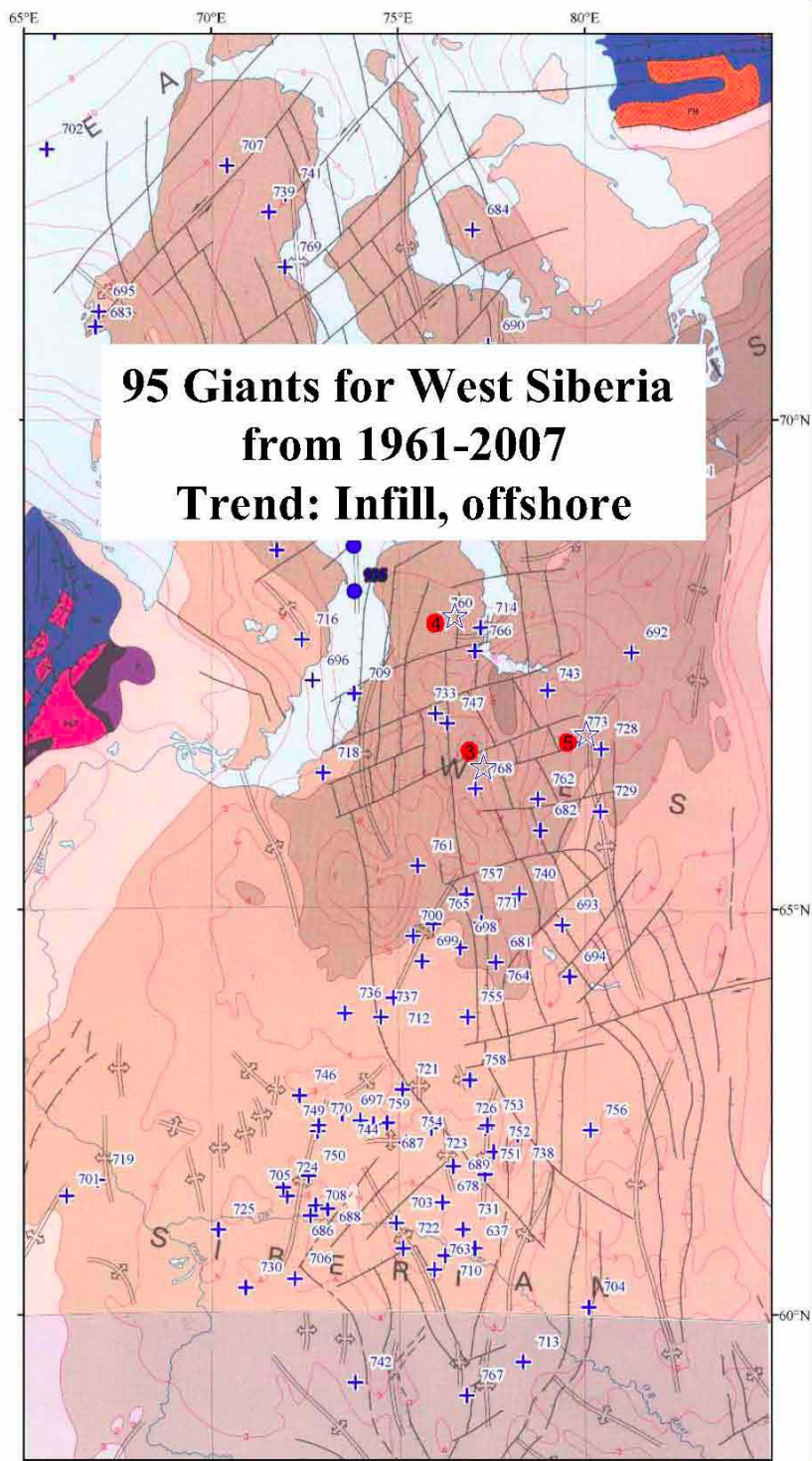


## West Siberia

2 Gas Giants 2000-2007

934. Kamennomysskoye Severnoye

935. Kamennomysskoye-More



## West Siberia

52 Gas and 41 Oil Giants 1961-1999

749. Ust'-Bakyskoye

726. Punga (Punginskoye)

731. Samotlor

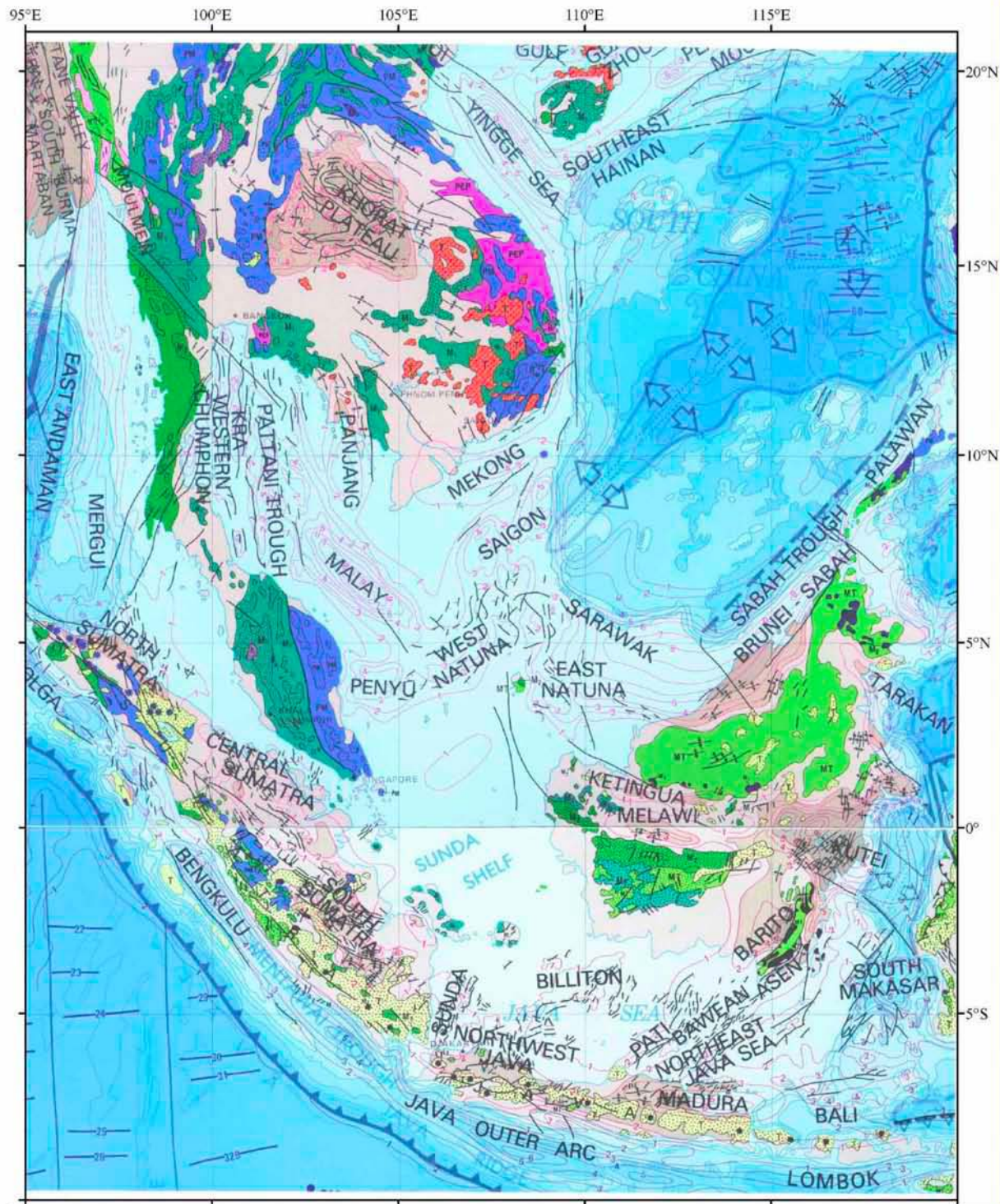
710. Megion

2 Gas Giants 2000-2007

934. Kamennomysskoye Severnoye

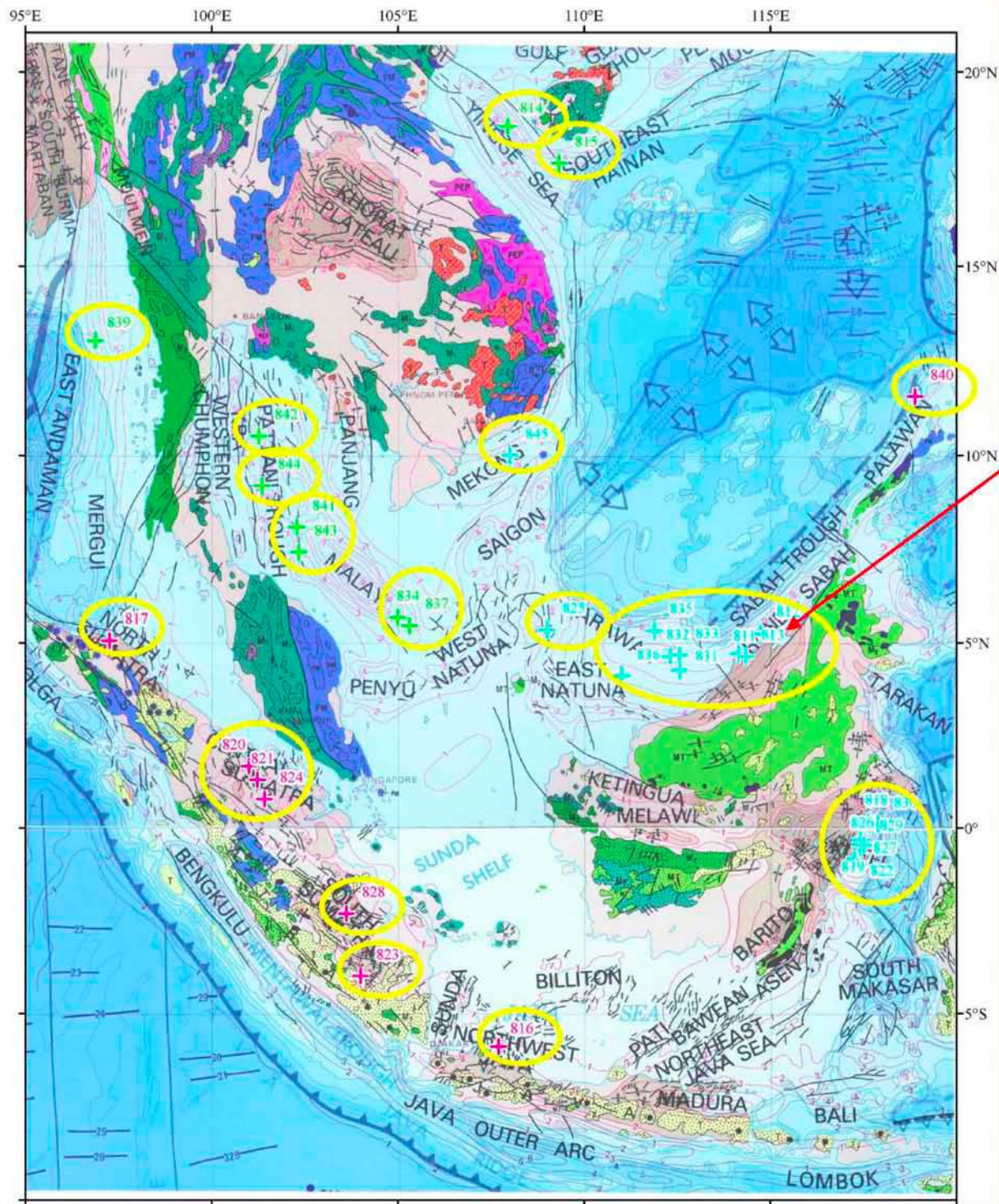
935. Kamennomysskoye-More





Sunda



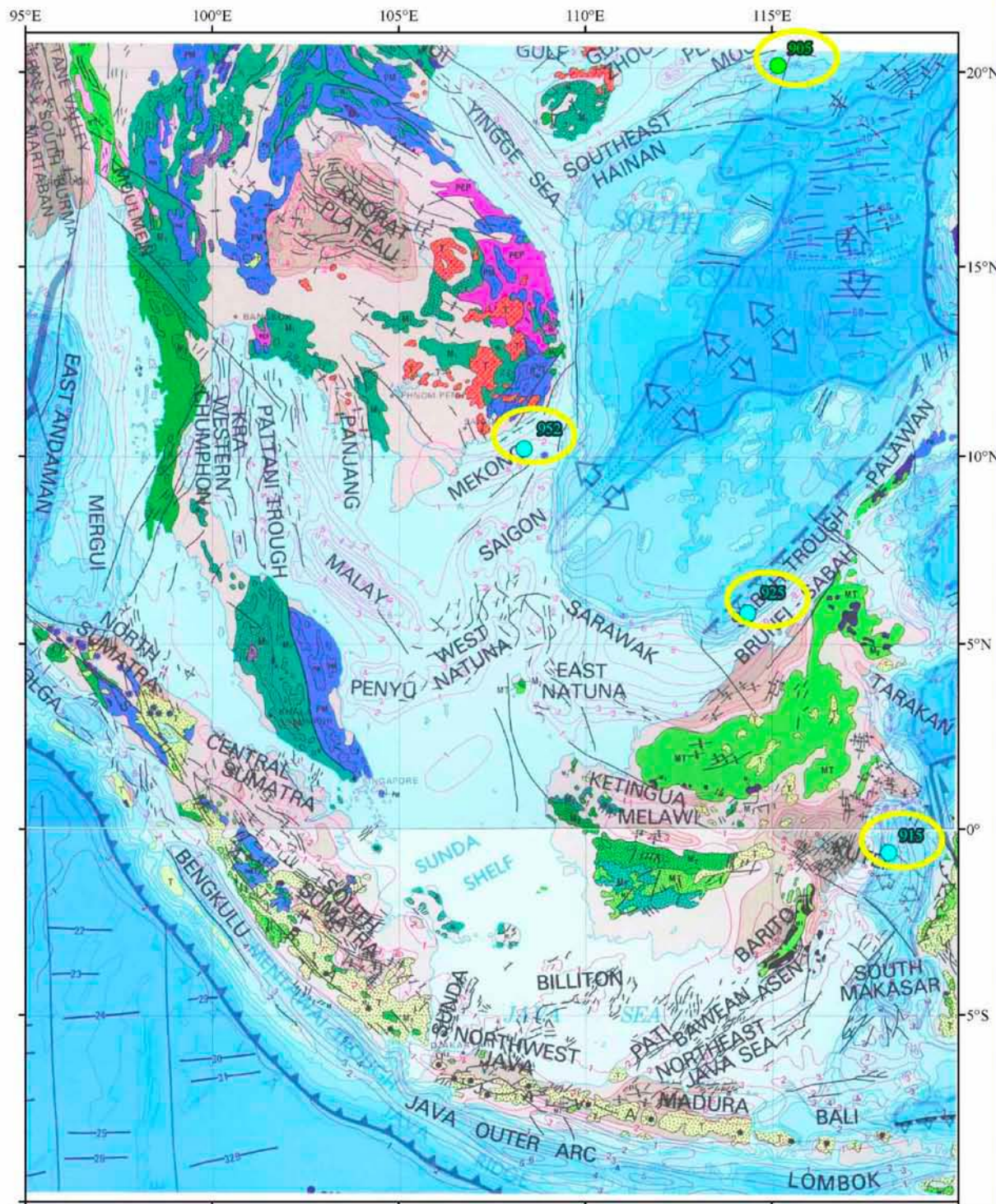


## Sunda

23 Gas and 11 Oil Giants 1929-1999

813. Seria





# Sunda

1 Oil and 3 Gas Giants 2000-2007

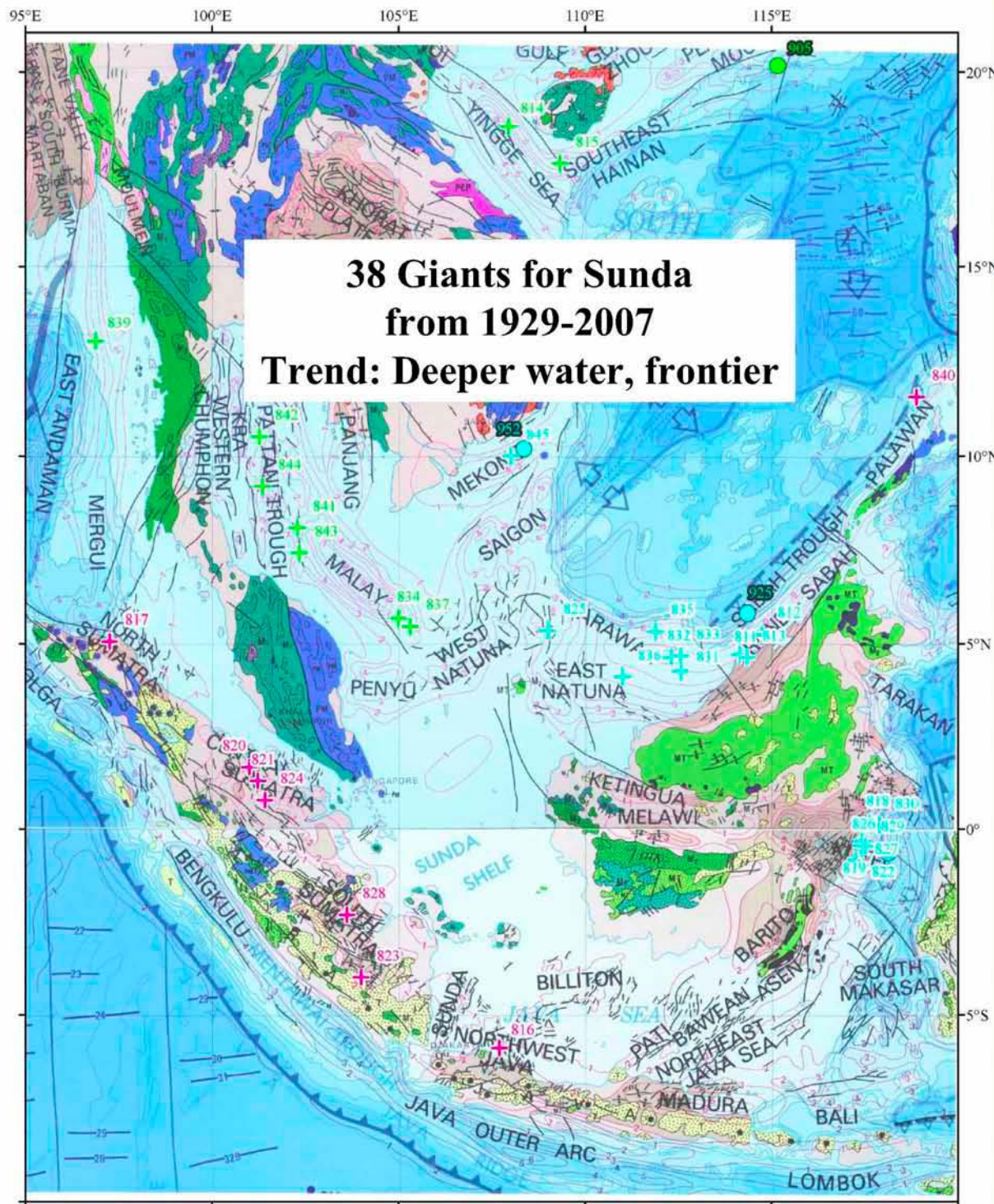
905. Liwan 3-1-1

952. Su Tu Trang

925. Gumusut

915. Gula





# Sunda

## 23 Gas and 11 Oil Giants 1929-1999

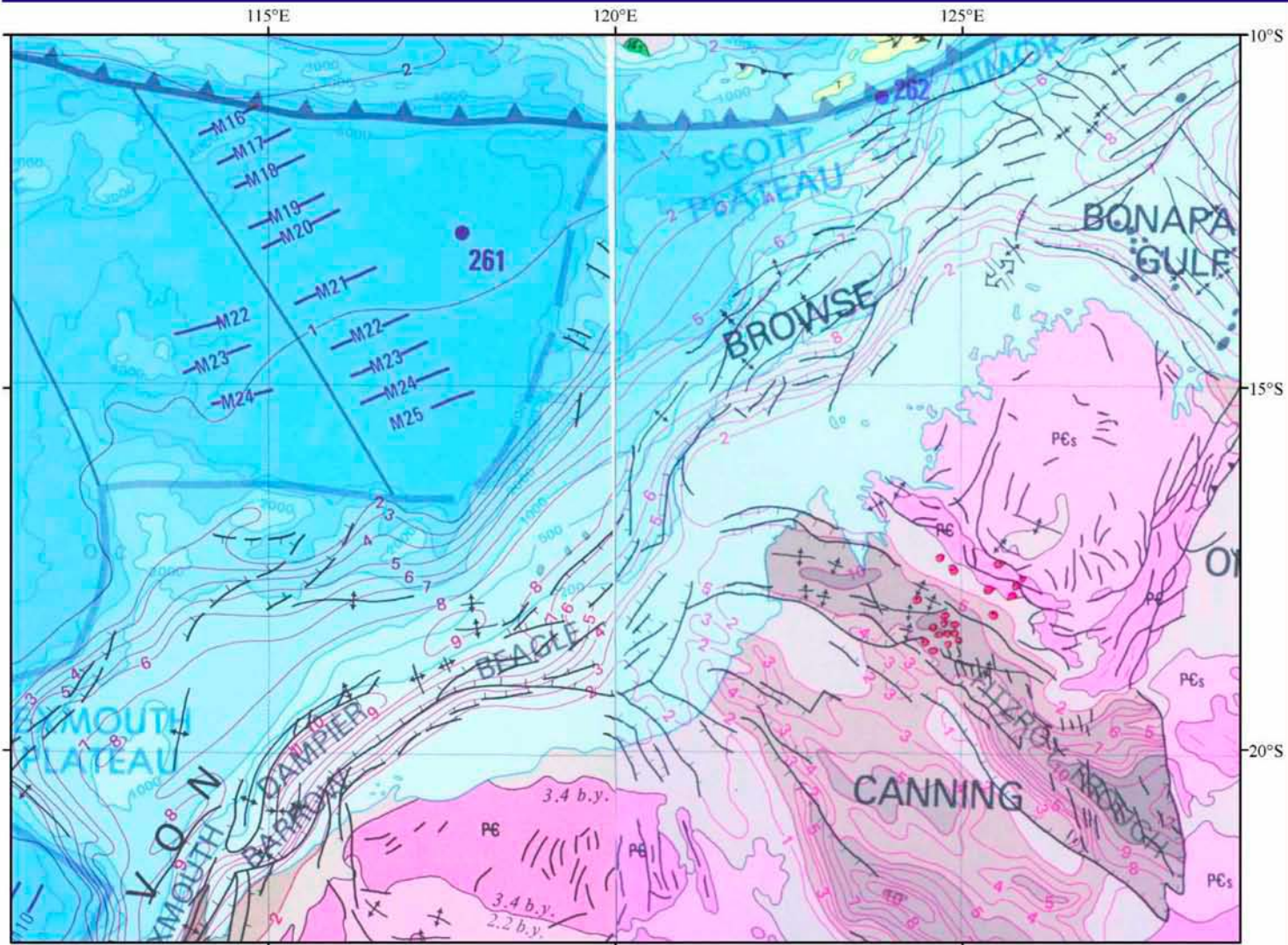
813. Seria

## 1 Oil and 3 Gas Giants 2000-2007

925. Gumusut

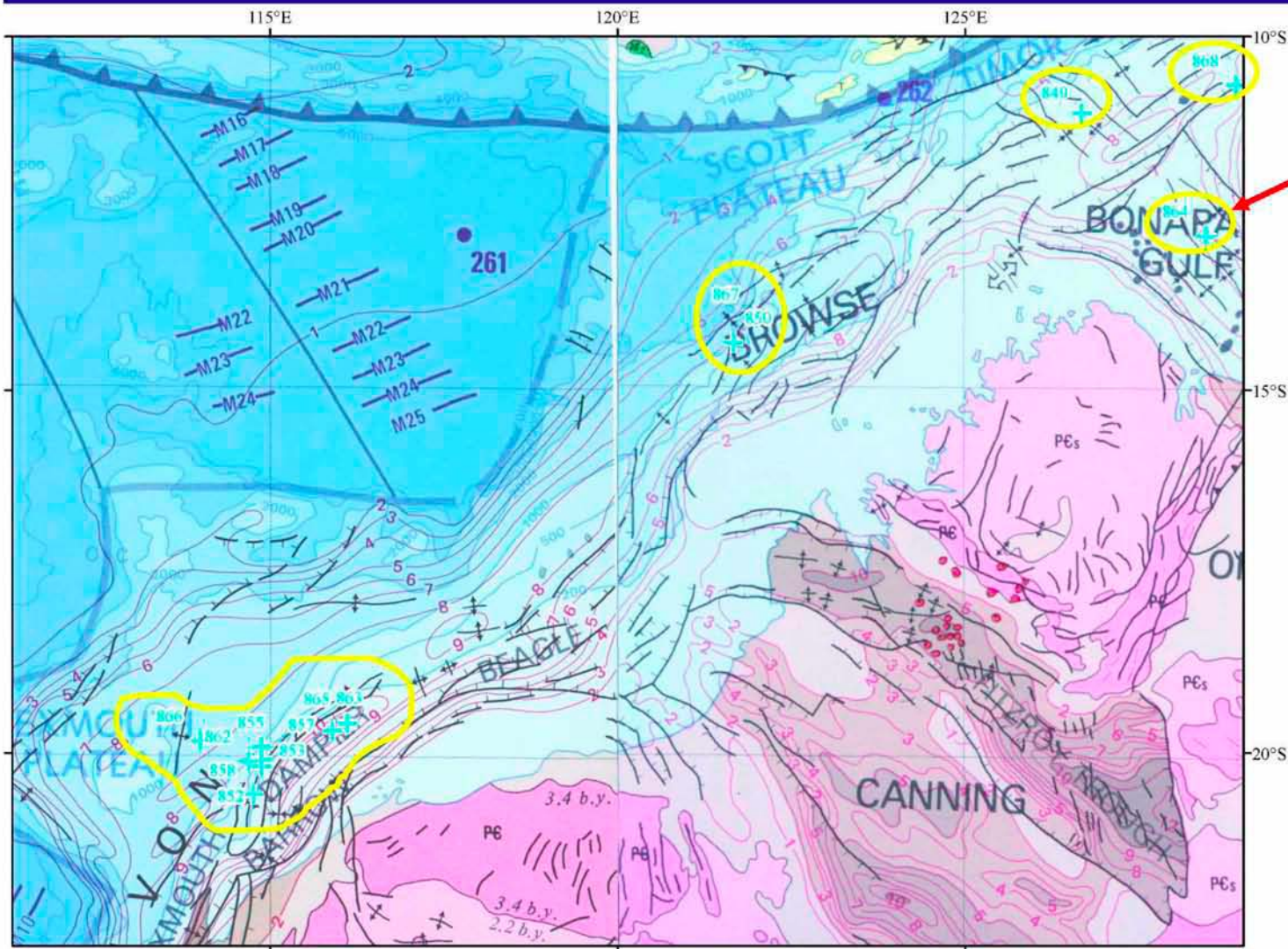


# Northwest Australia





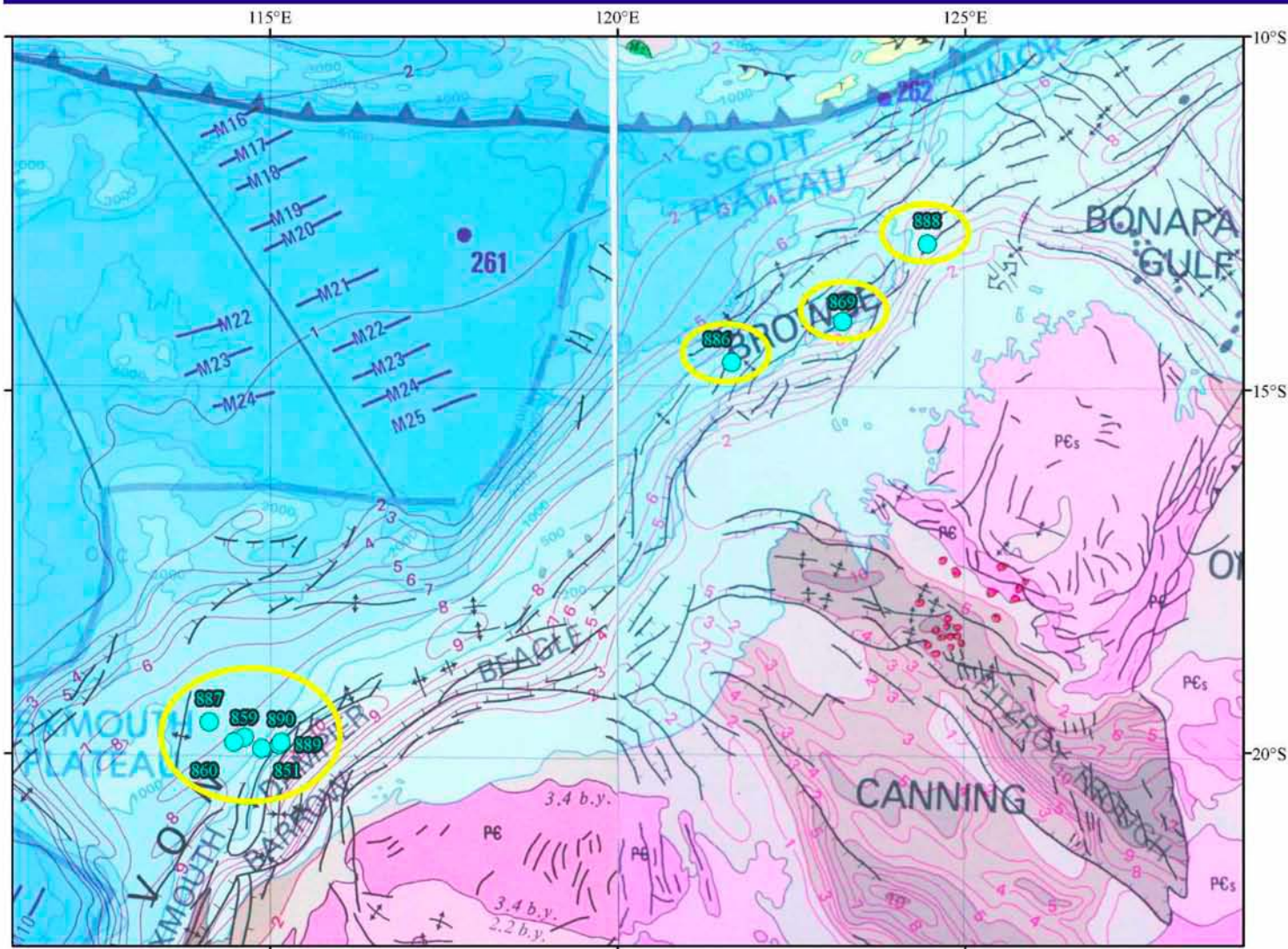
# Northwest Australia



14 Gas Giants  
1969-1999  
864. Petrel



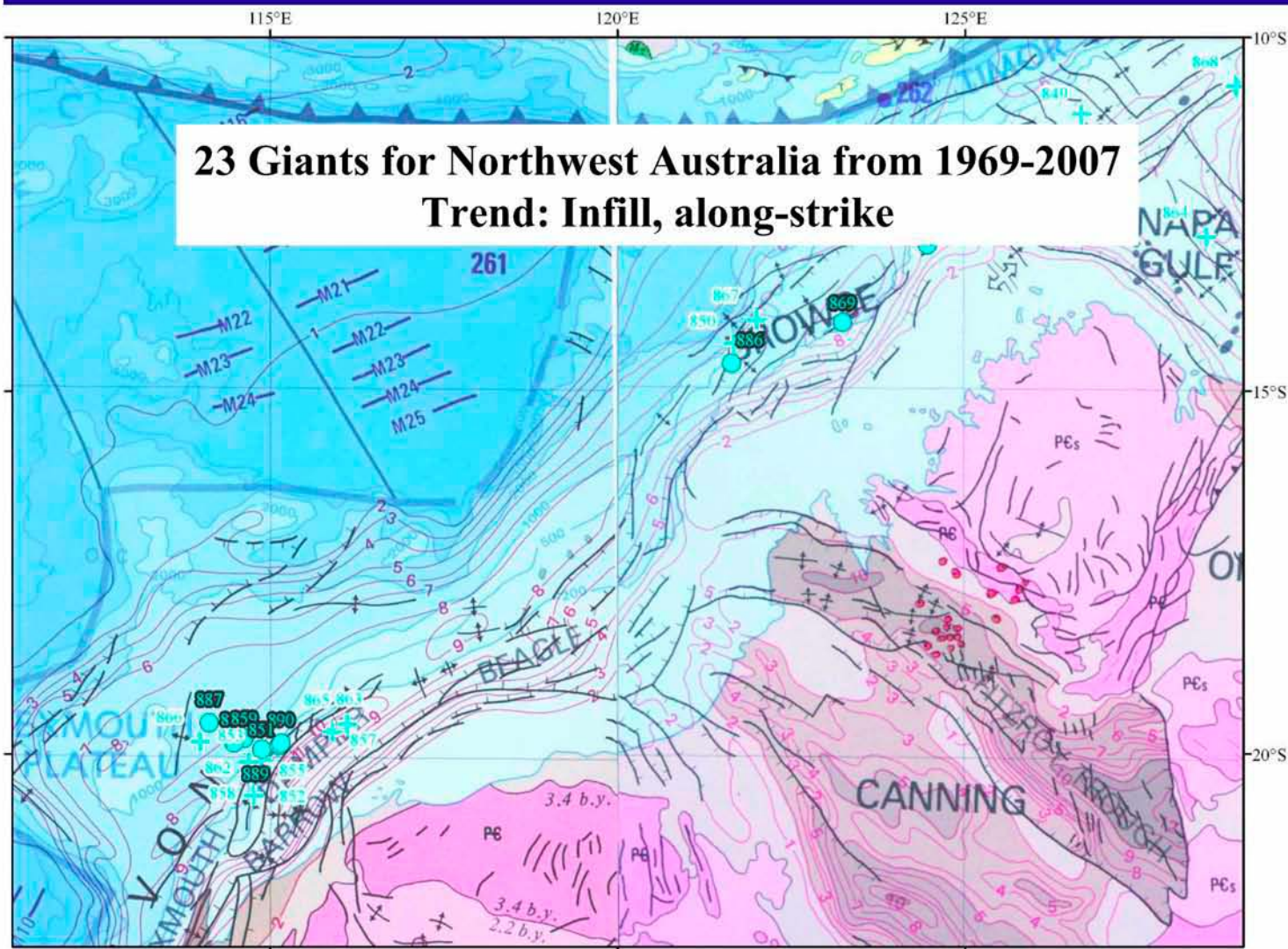
# Northwest Australia



9 Gas Giants  
2000-2007  
888. Crux 1  
869. Titanichthys  
886. Calliance  
859. Io  
860. Jansz  
889. Pluto 1  
851. Callirhoe  
887. Chandon  
890. Wheatstone



# Northwest Australia



14 Gas Giants  
1969-1999

864. Petrel

9 Gas Giants  
2000-2007

888. Crux 1

869. Titanichthys

886. Calliance

859. Io

860. Jansz

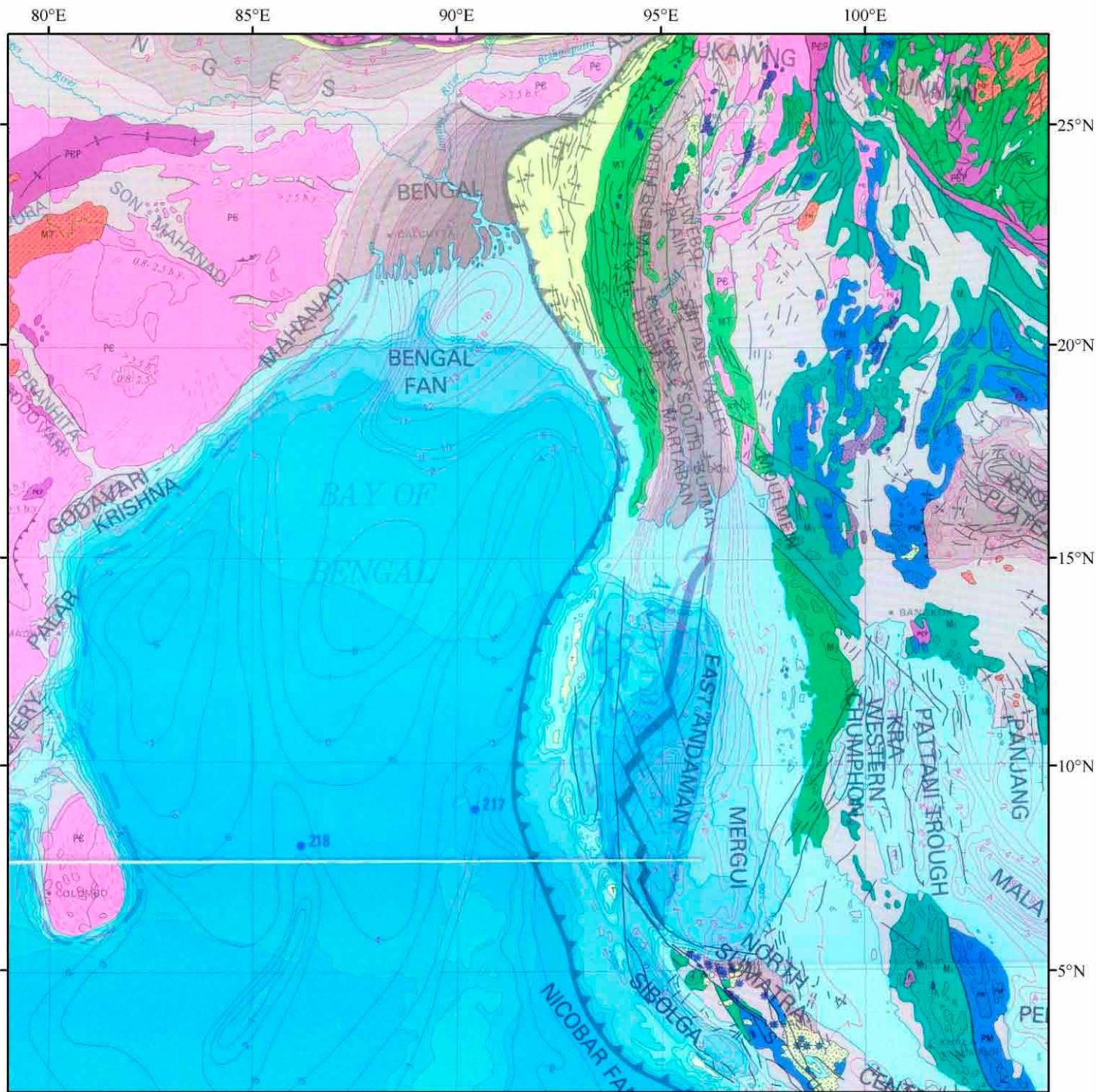
889. Pluto 1

851. Callirhoe

887. Chandon

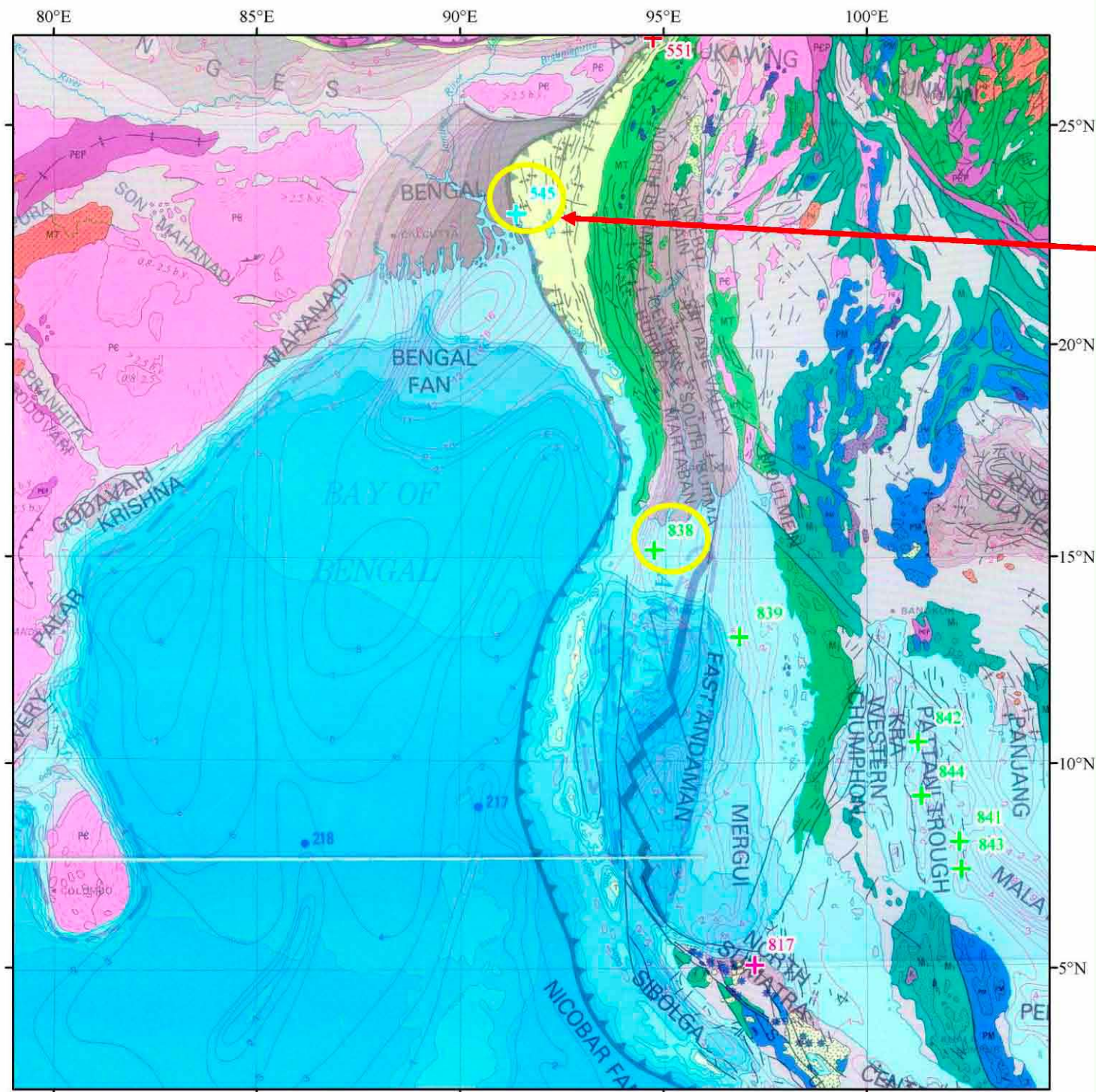
890. Wheatstone





# Bay of Bengal



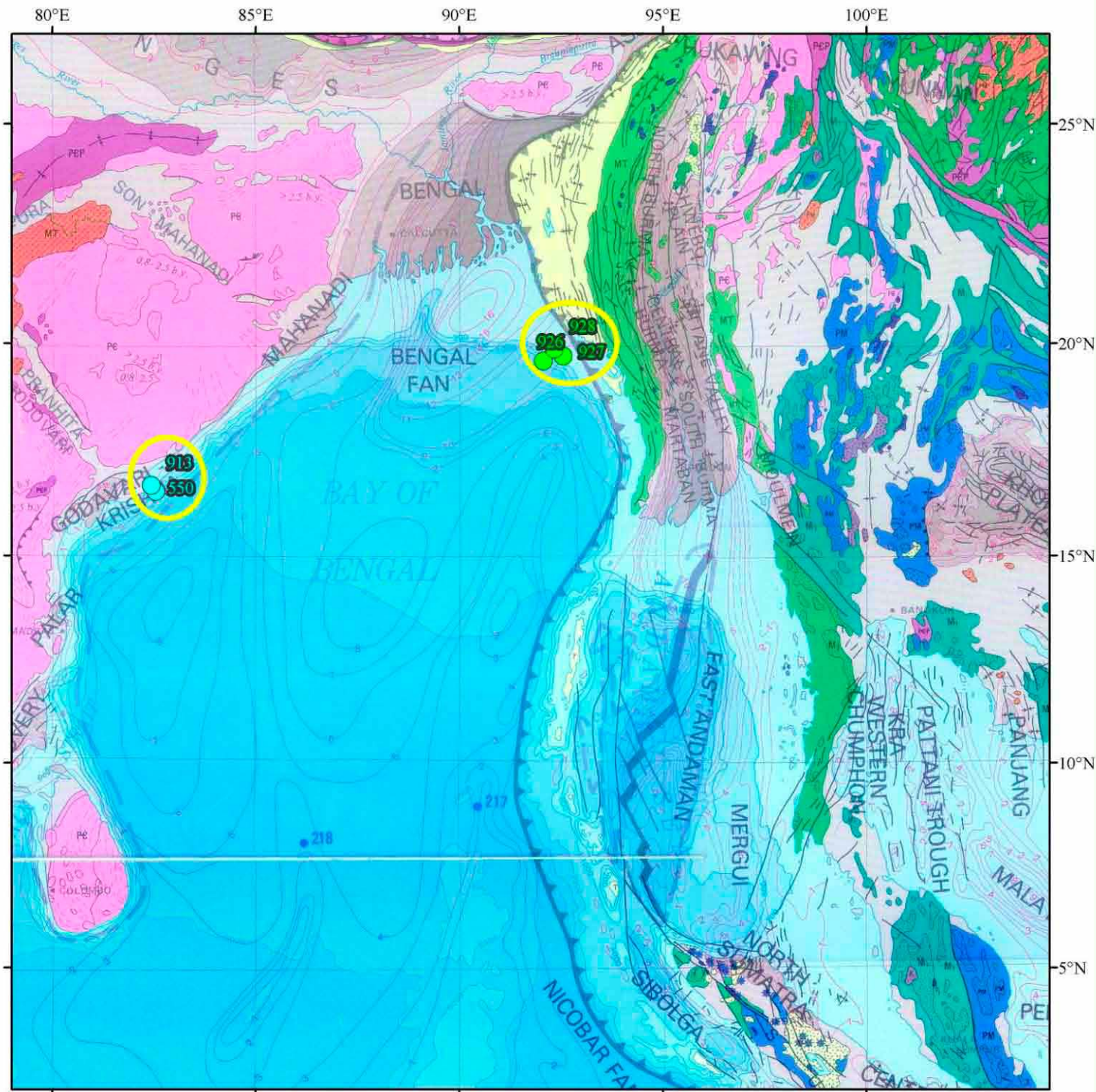


# Bay of Bengal

2 Gas Giants  
1980-1999

545. Feni



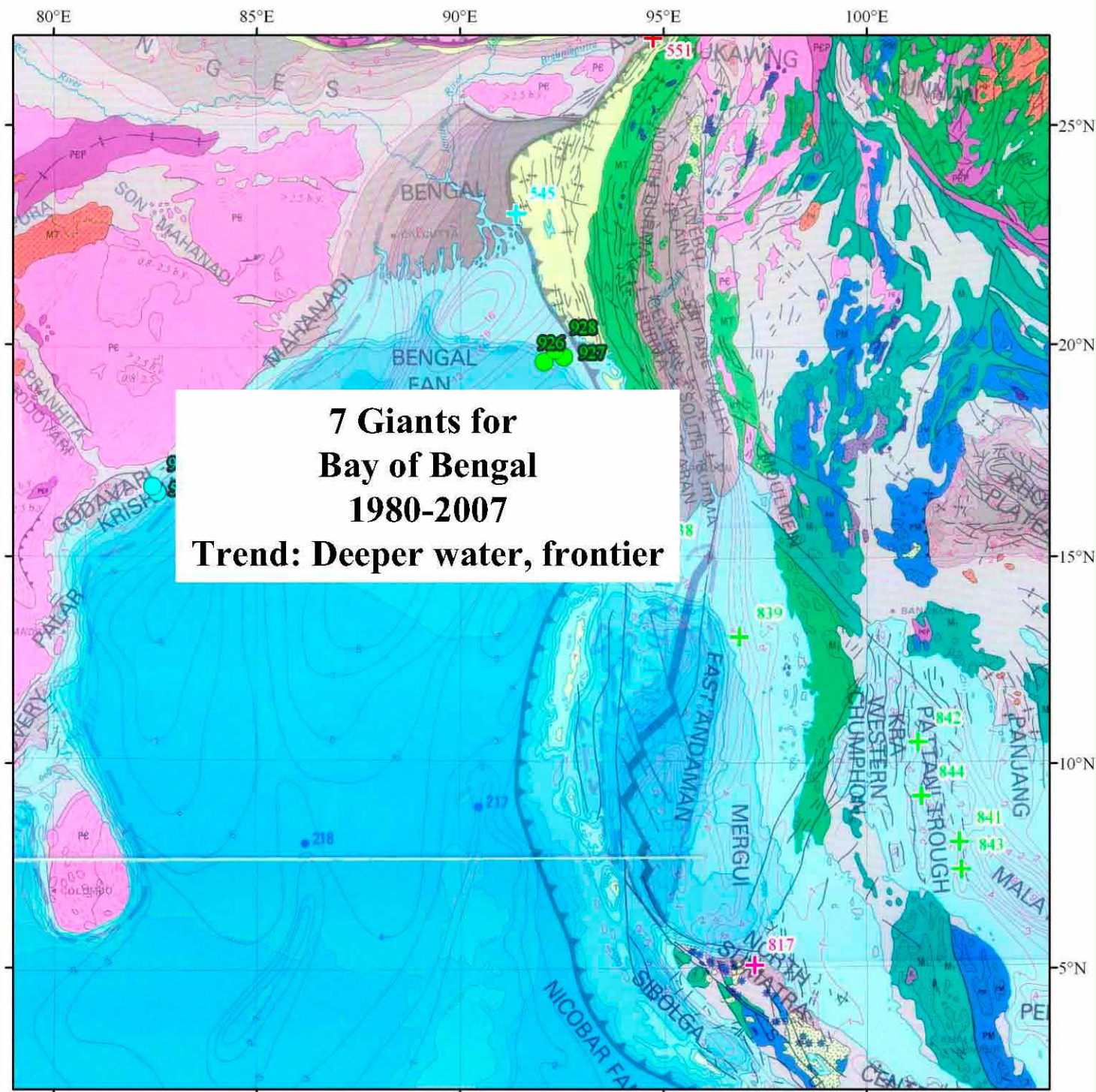


# Bay of Bengal

5 Gas Giants  
From 2000-2007

- 926. Mya
- 928. Shwe Phyu 2
- 927. Shwe 1 ST1
- 913. Deen Dayal
- 550. Dhirubhai





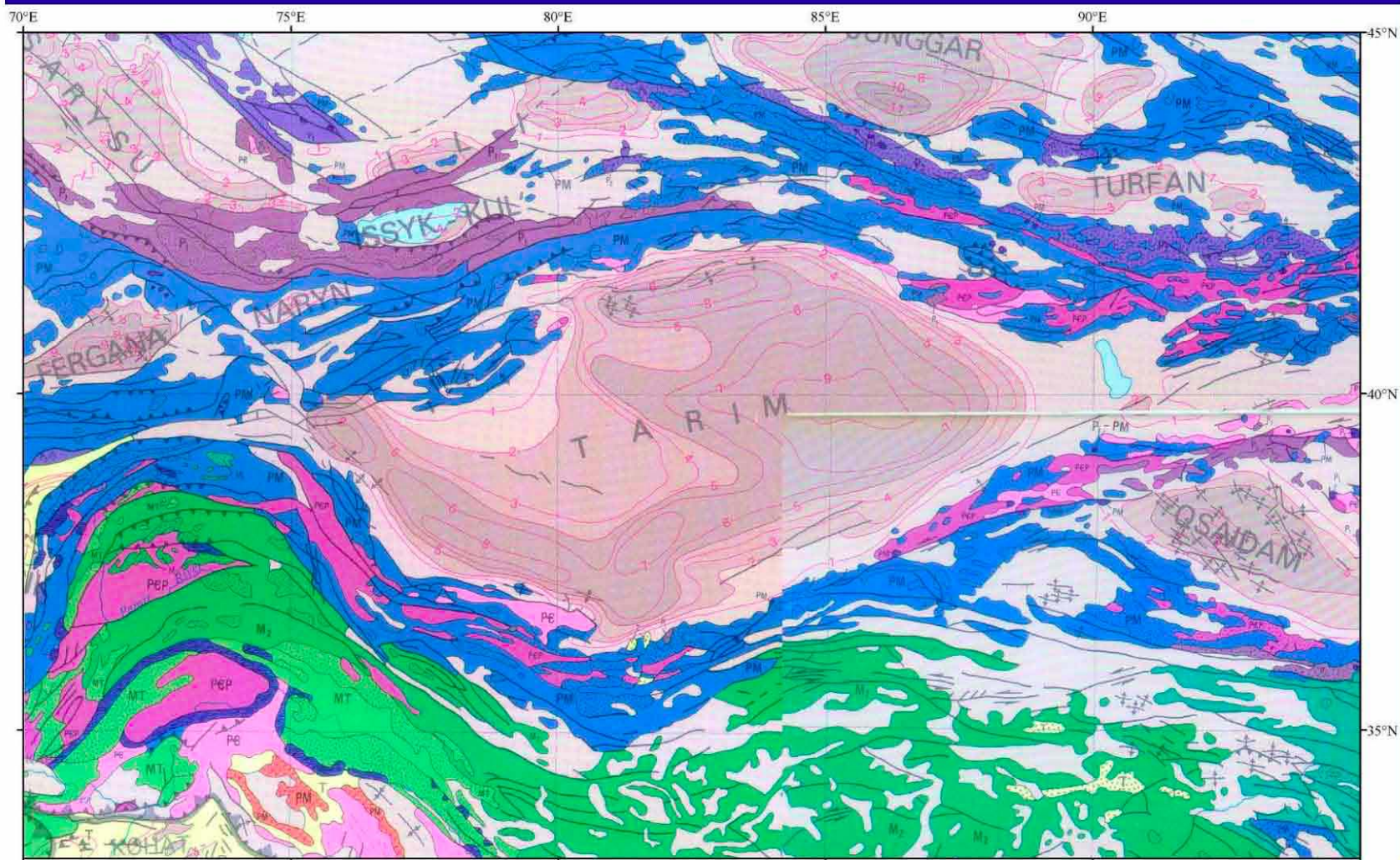
## Bay of Bengal

2 Gas Giants  
1980-1999  
**545. Feni**

5 Gas Giants  
From 2000-2007  
**926. Mya**  
**928. Shwe Phyu 2**  
**927. Shwe 1 ST1**  
**913. Deen Dayal**  
**550. Dhirubhai**



# Tarim Basin

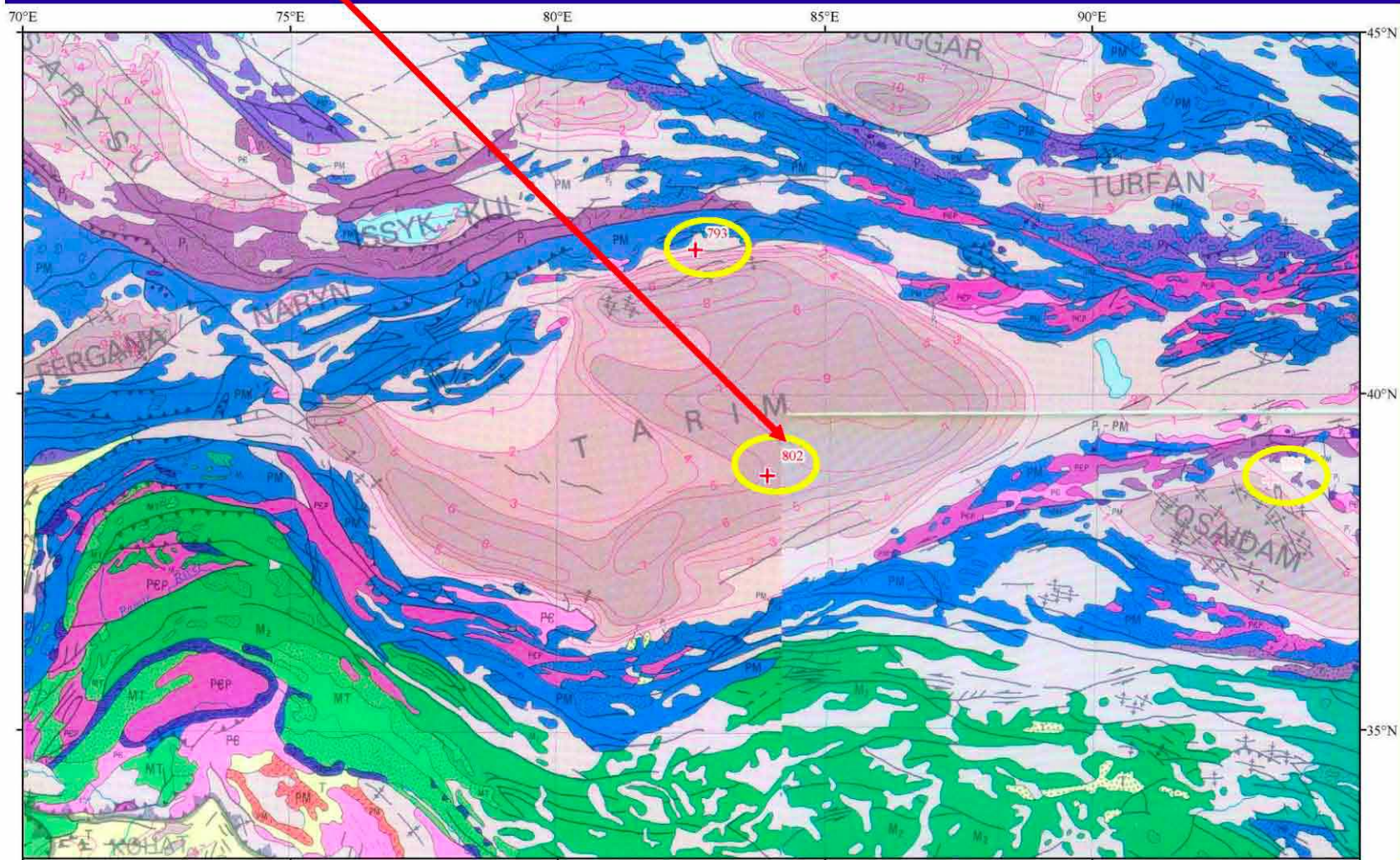




# Tarim Basin

1 Oil and 2 Gas Giants 1989-1999

802. Tazhong





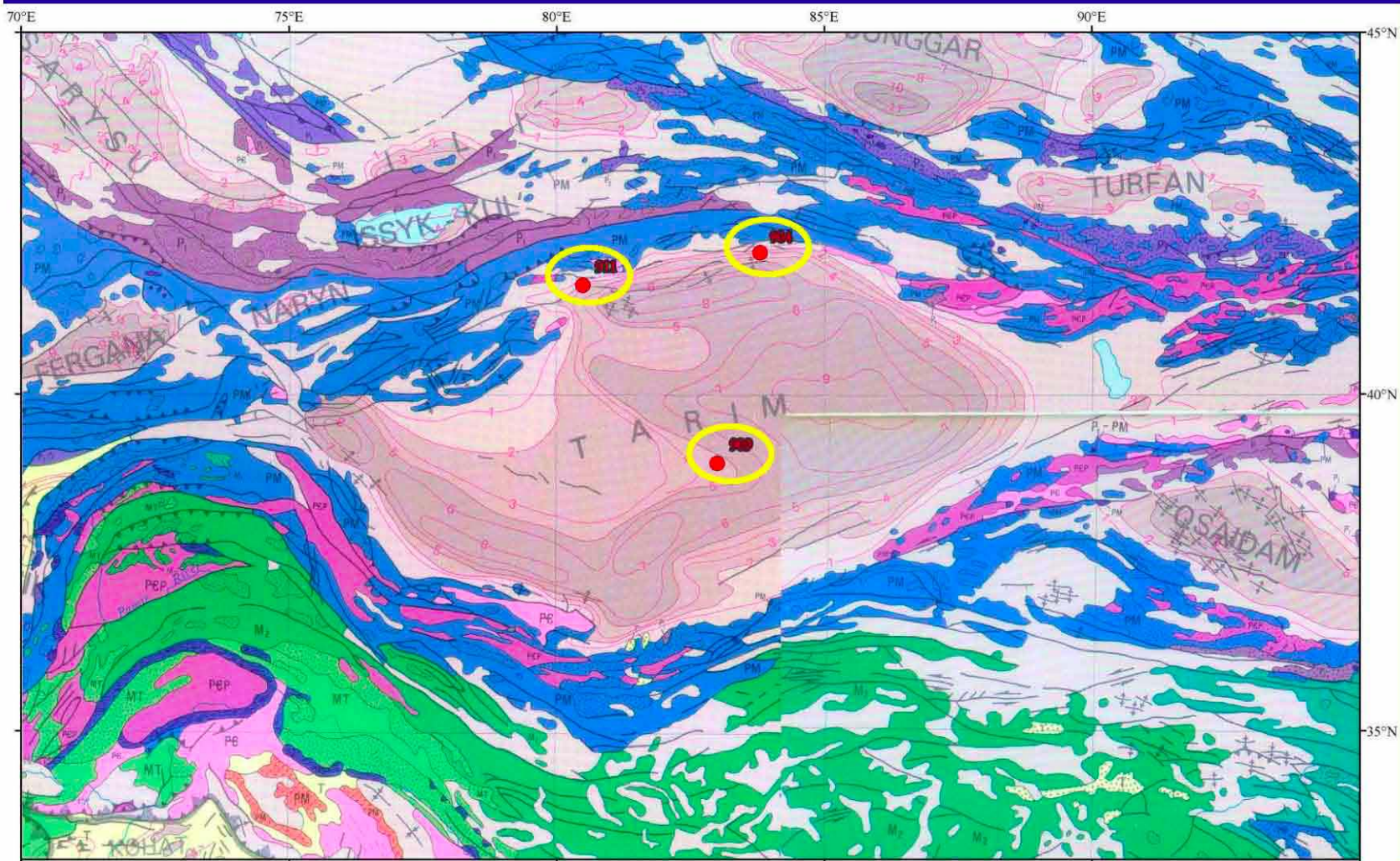
# Tarim Basin

3 Giants 2000-2007

911. Yilake

904. Dina

909. Tazhong-82





# Tarim Basin

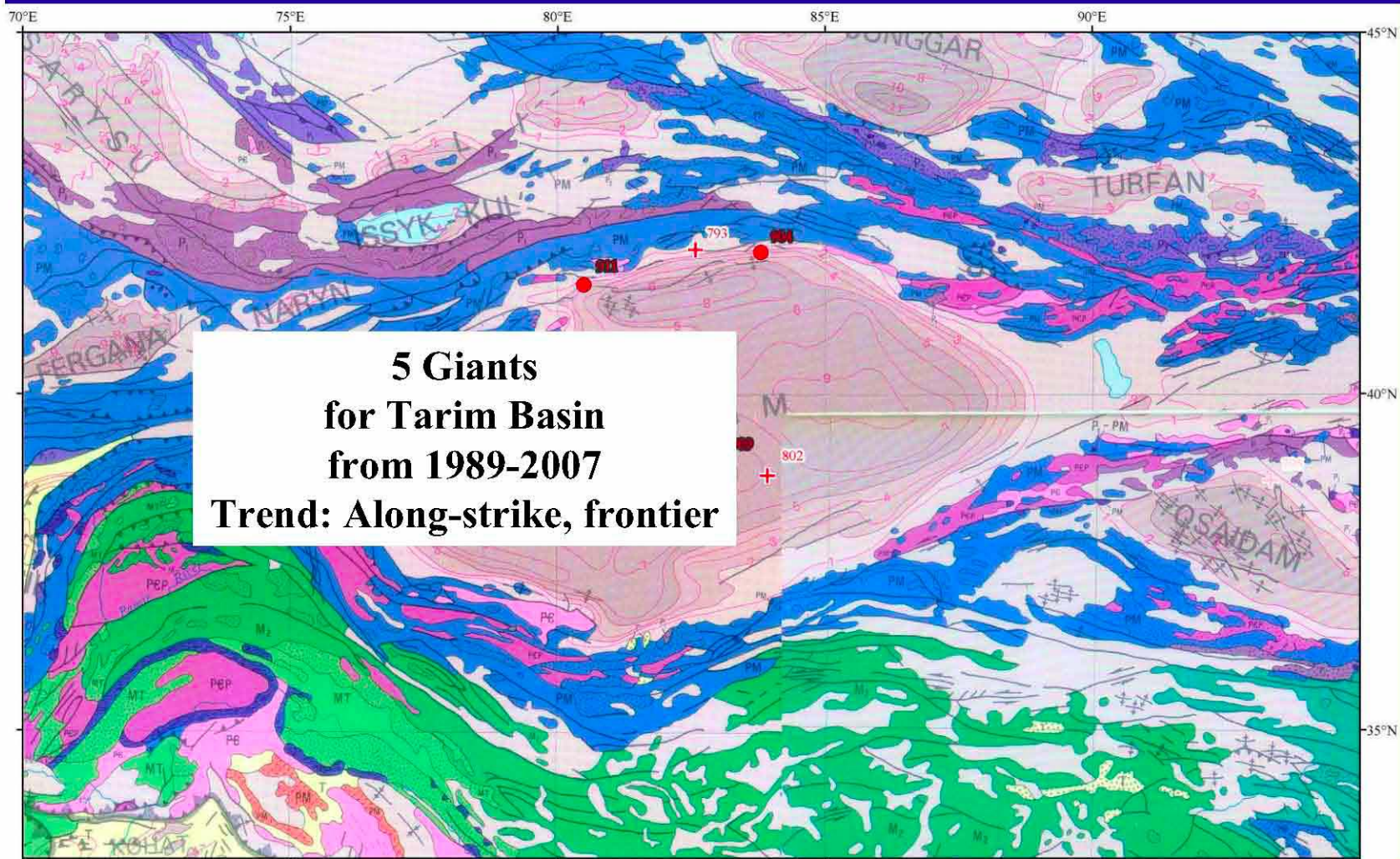
1 Oil and 2 Gas Giants 1989-1999    3 Giants 2000-2007

802. Tazhong

911. Yilake

904. Dina

909. Tazhong-82







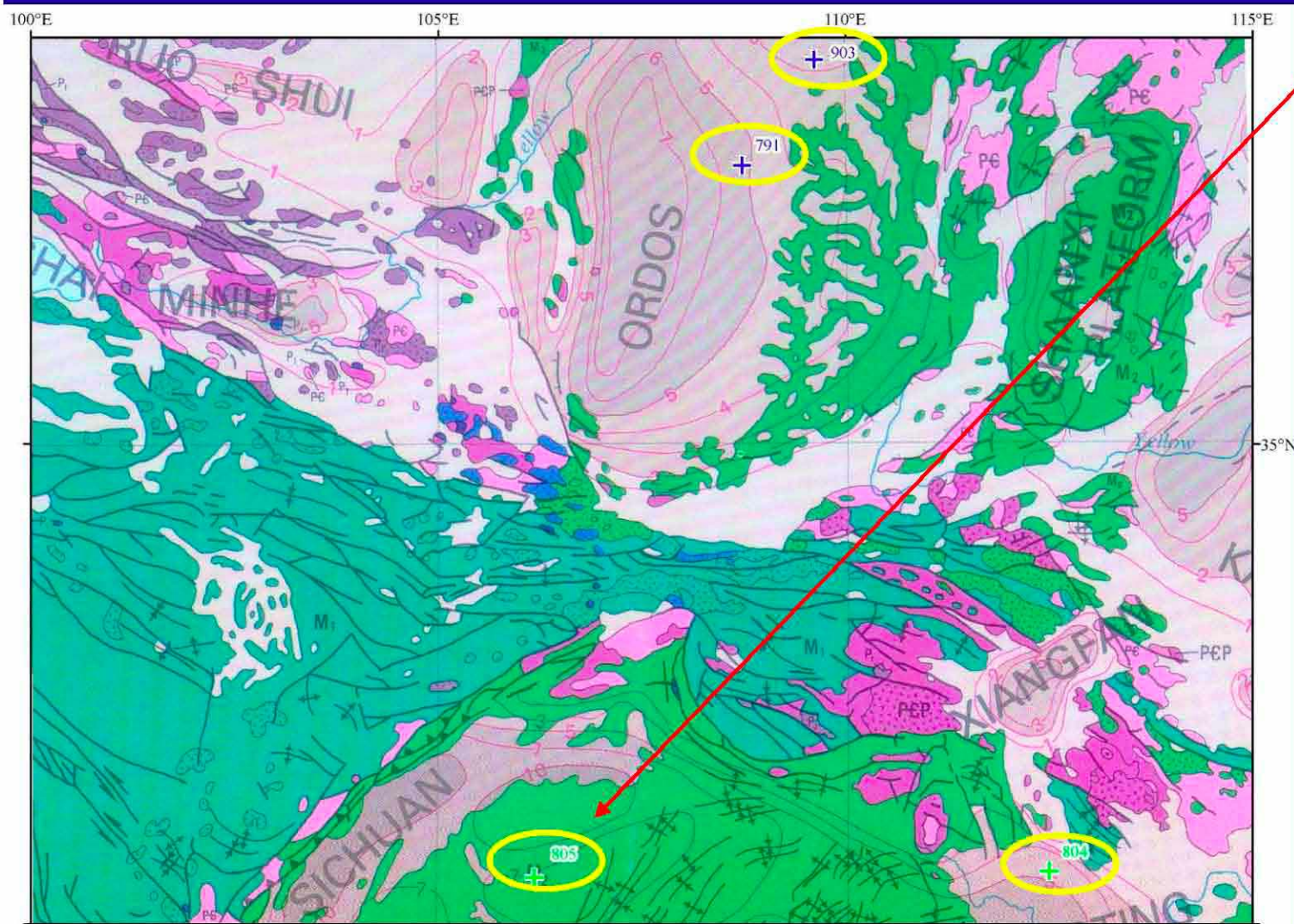


# Ordos Basin

2 Gas and 2 Oil  
Giants

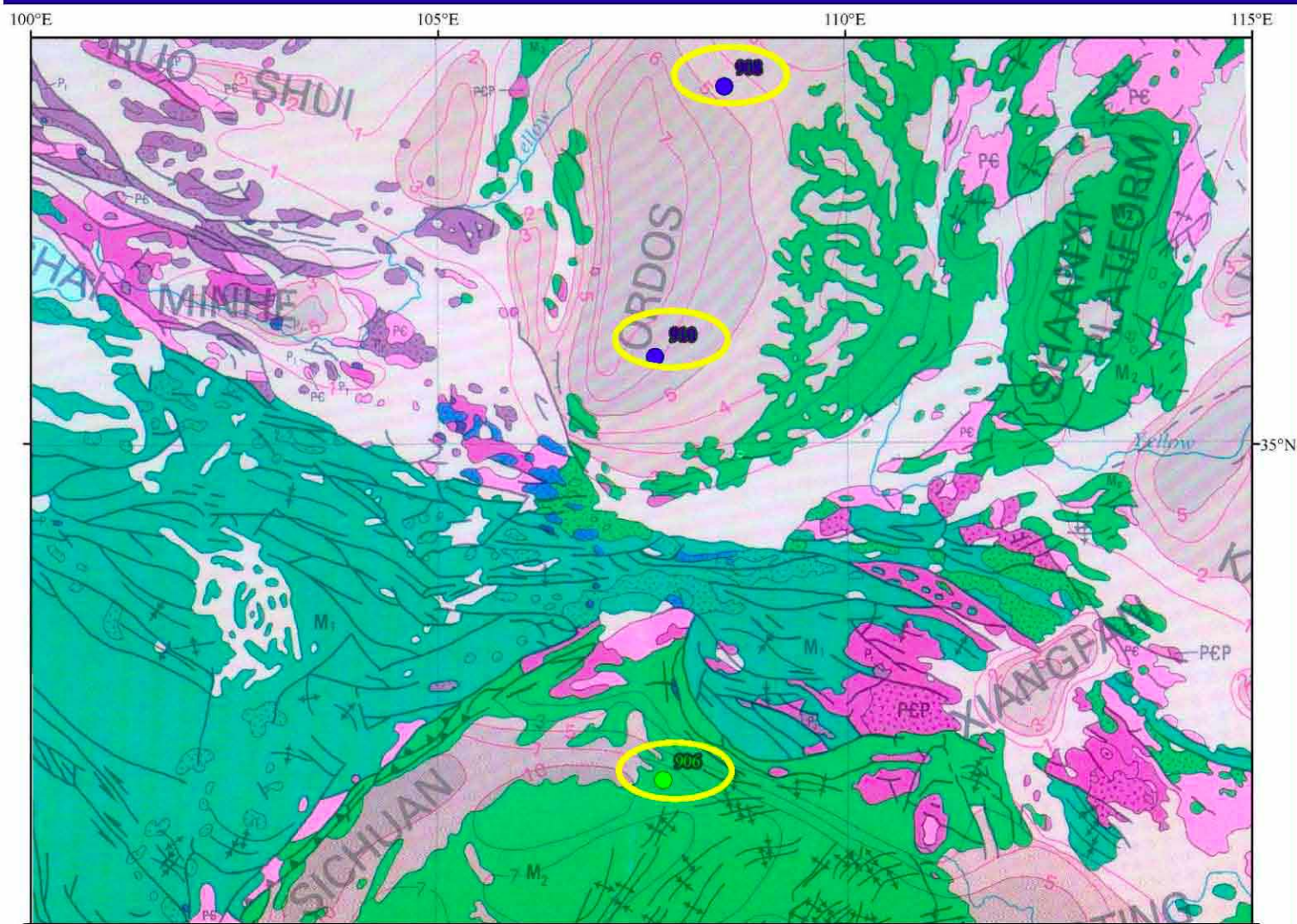
1956-1999

805. Lung-nu-ssu





# Ordos Basin



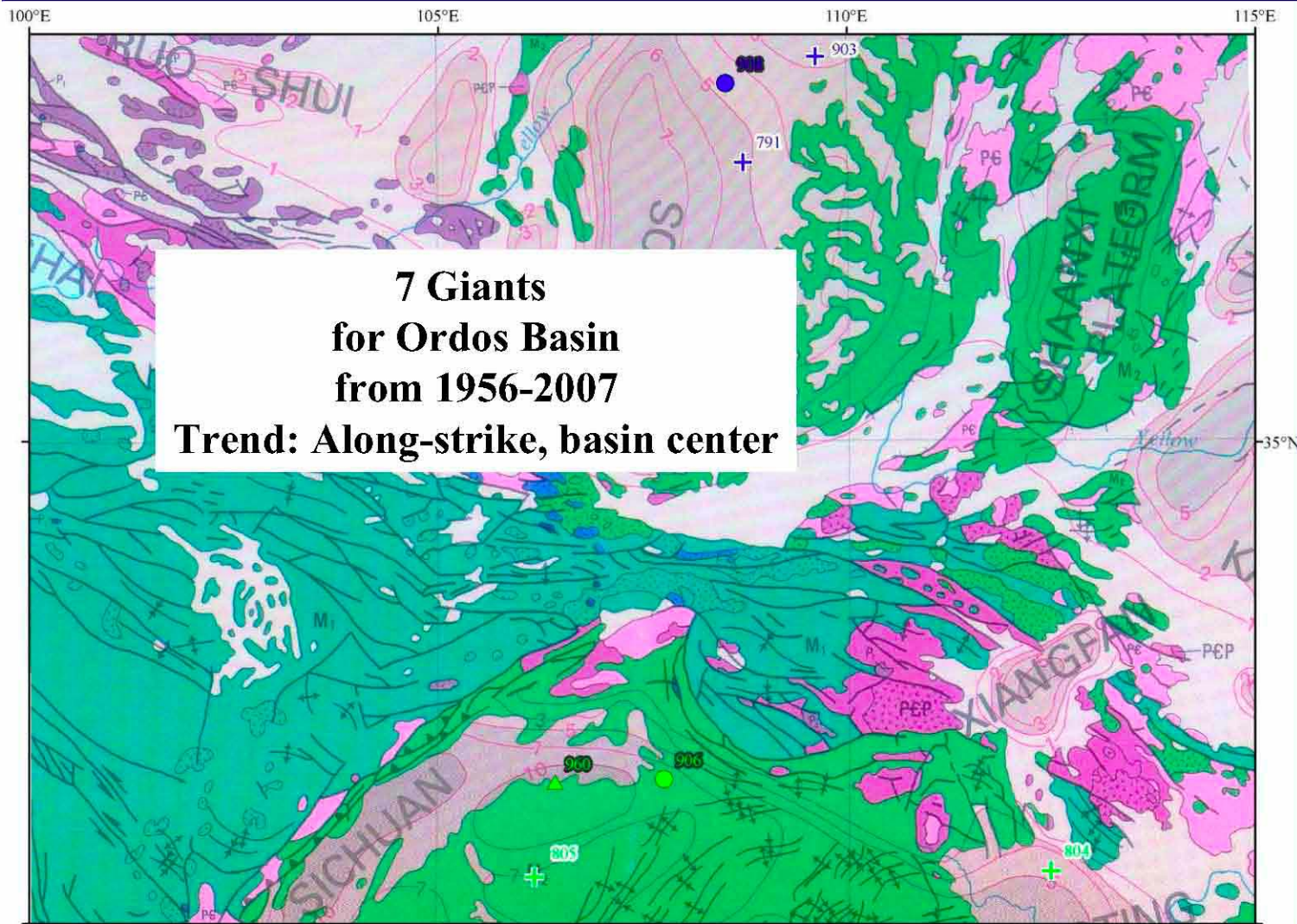
3 Gas Giants  
2000-2007  
908. Sulige  
910. Xifeng  
906. Puguangsi







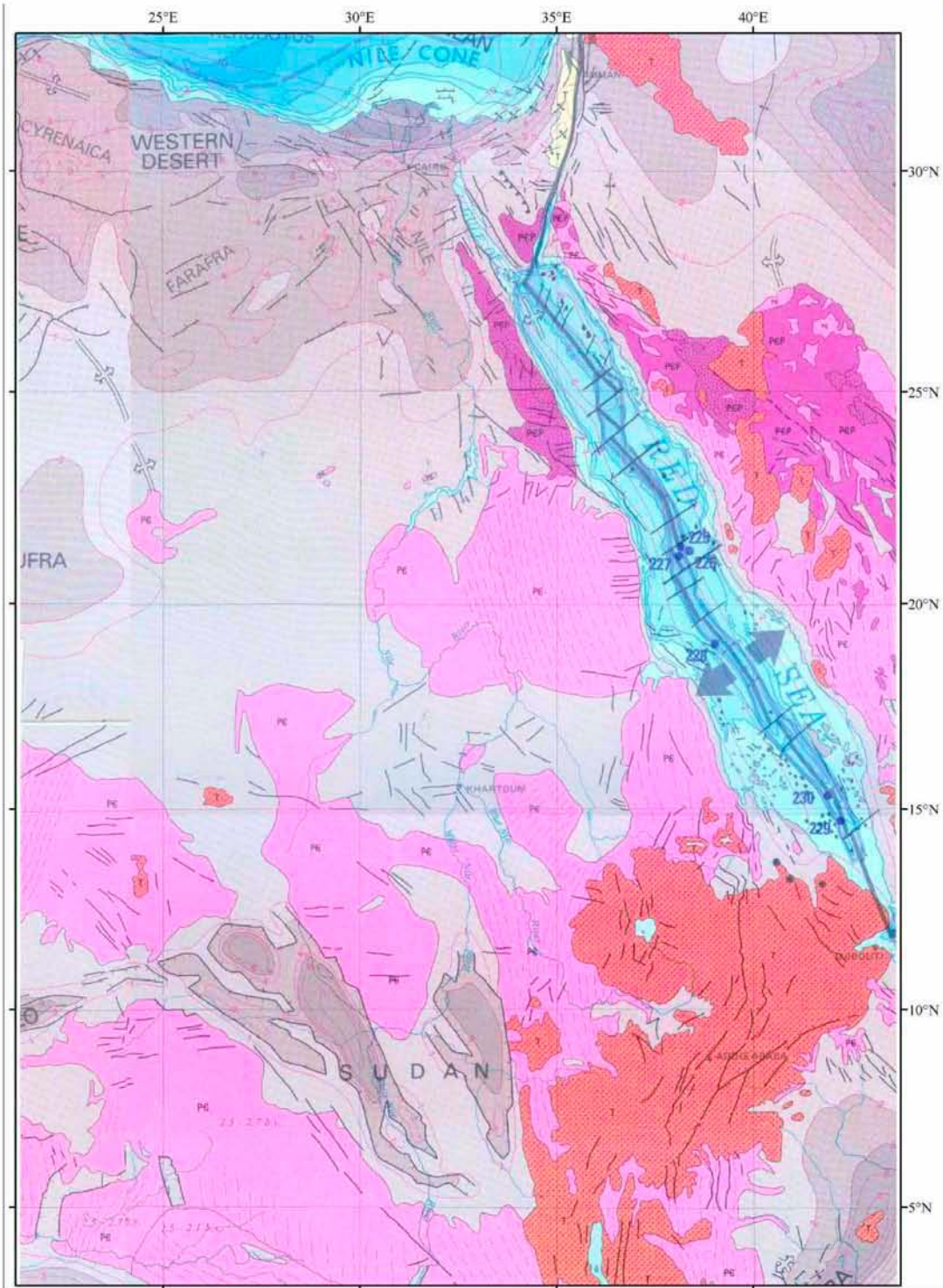
# Ordos Basin



2 Gas and 2 Oil  
Giants  
1956-1999  
805. Lung-nu-ssu

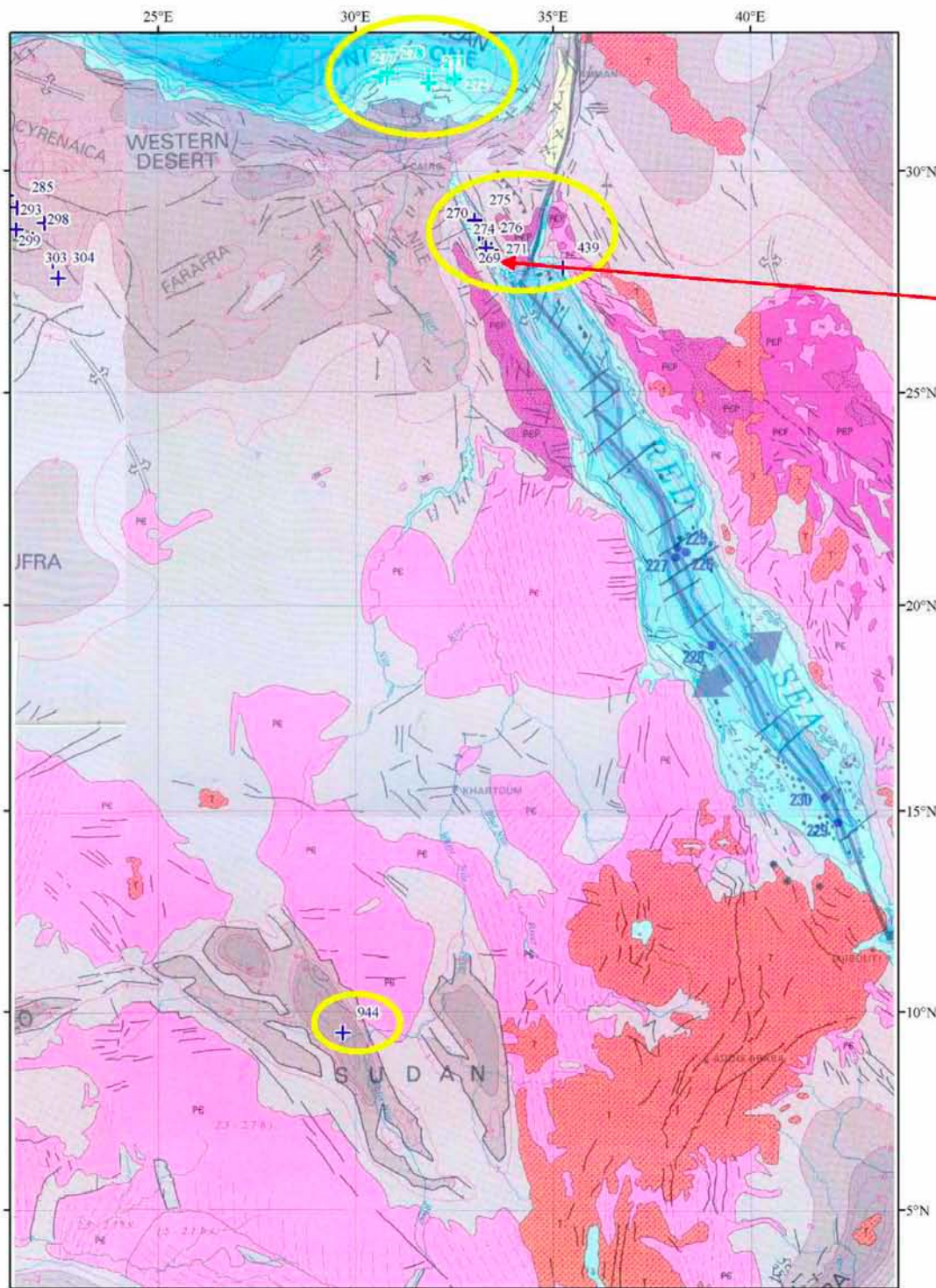
3 Gas Giants  
2000-2007  
908. Sulige  
910. Xifeng  
906. Puguangsi  
1 > 200 MMBOE  
2000-2007  
960. Longgang





## Northeast Africa



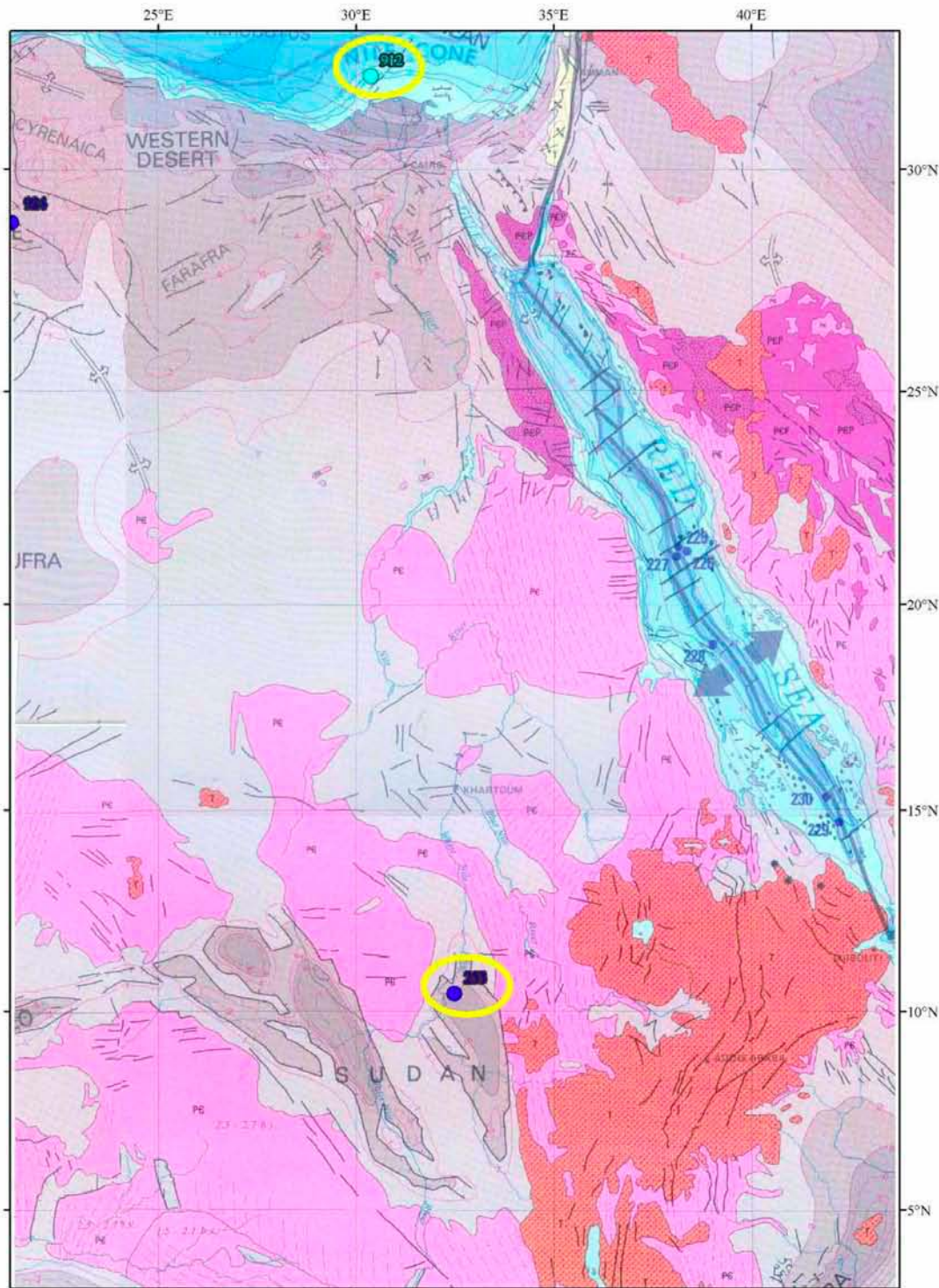


## Northeast Africa

8 Oil and 5 Gas Giants from 1955-1999

269. Belayim Land





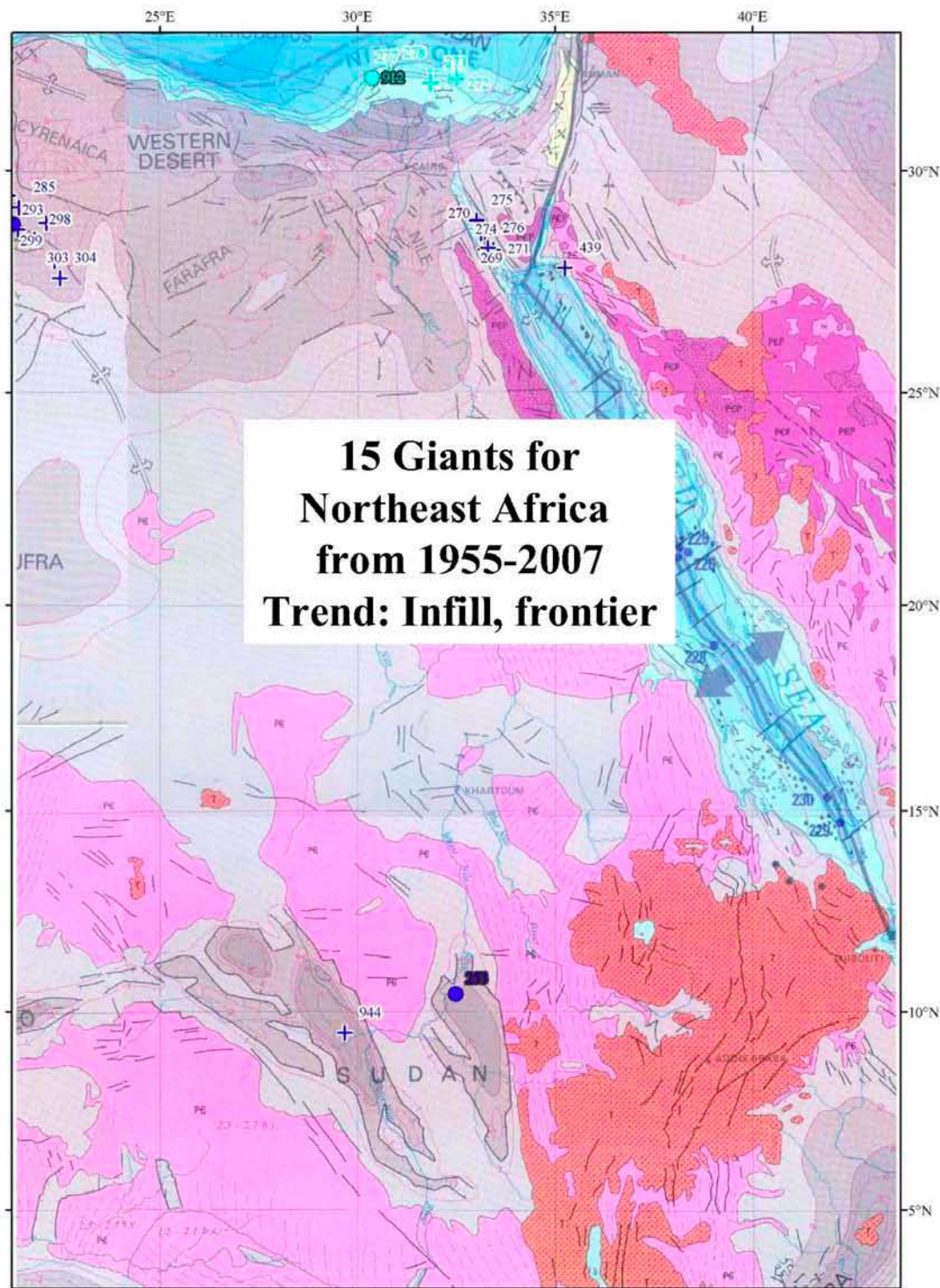
## Northeast Africa

1 Oil and 1 Gas Giant 2000-2007

253. Palogue

912. Sapphire





## Northeast Africa

8 Oil and 5 Gas Giants from 1955-1999

269. Belayim Land

1 Oil and 1 Gas Giant 2000-2007

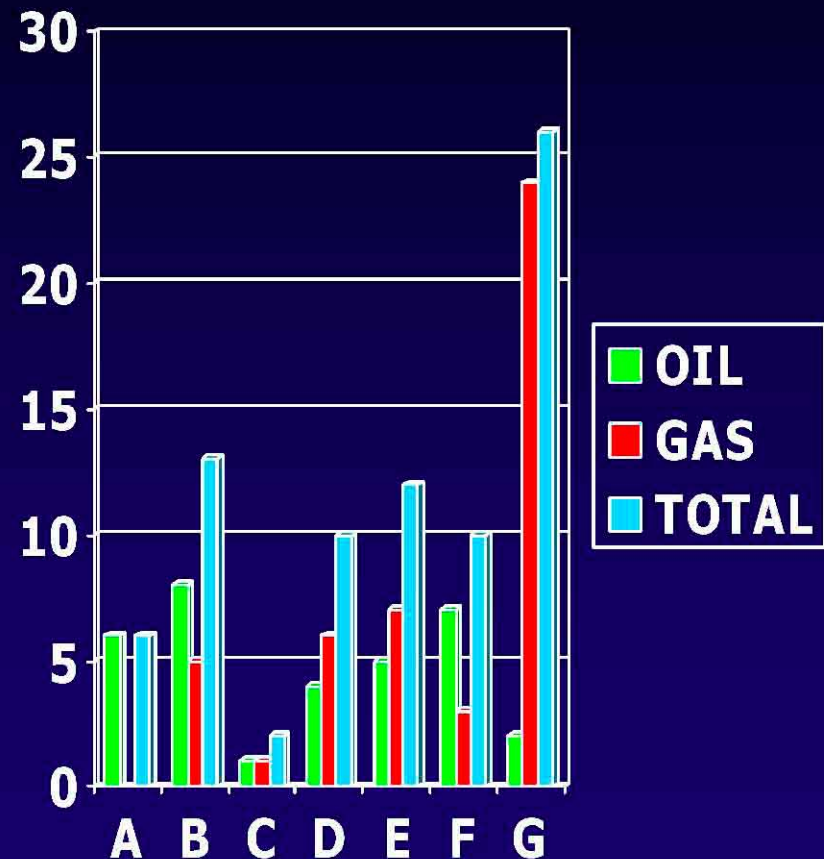
253. Palogue

912. Sapphire



## Location 79 giants (2000-2007)

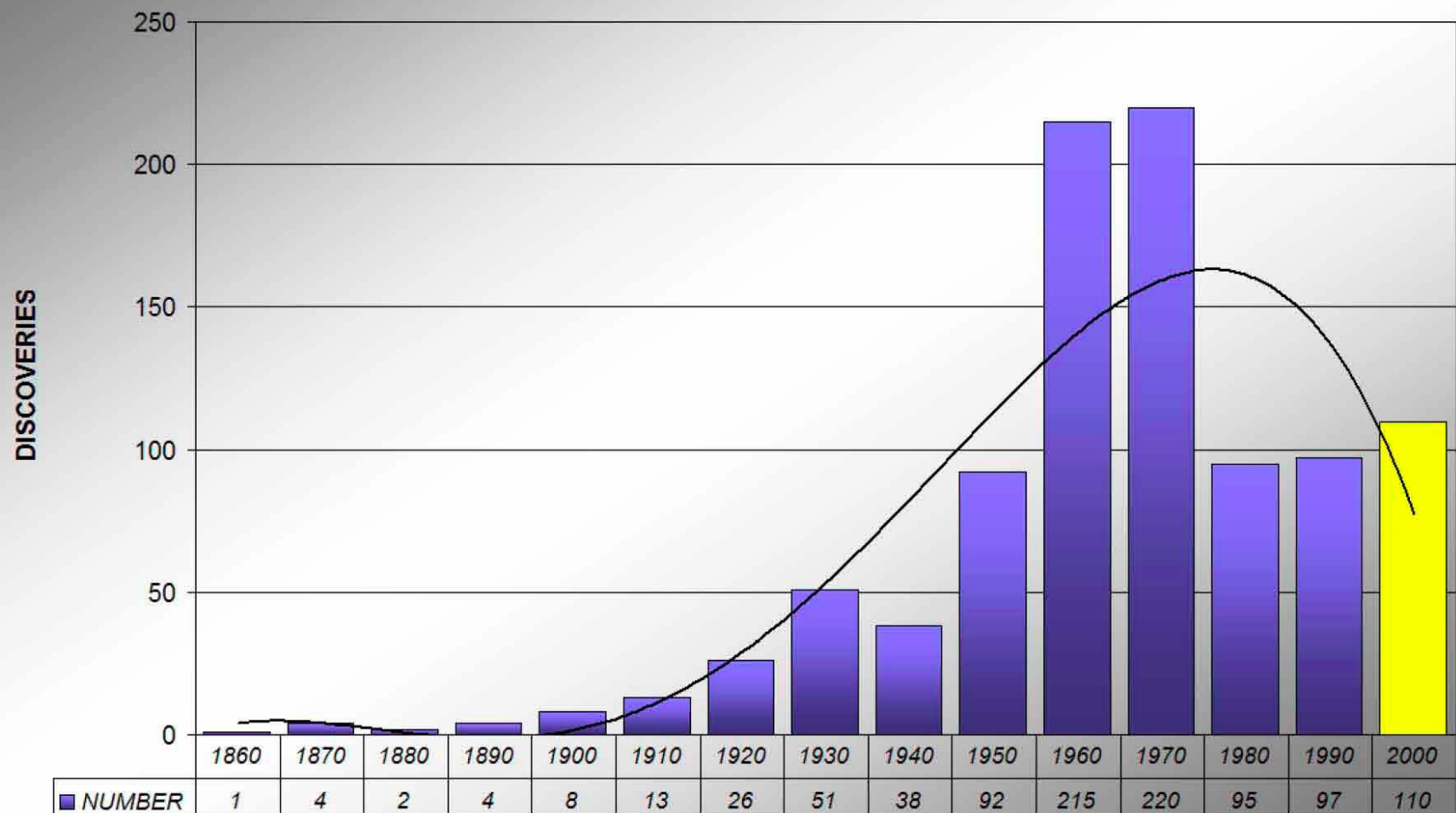
- A. North America
- B. South America
- C. Western Europe
- D. Eastern Europe and former USSR
- E. Middle East
- F. Africa
- G. Asia and Oceania





# Prediction for total giants discovered from 2000-2009

GIANTS BY DISCOVERY, DECADE 2000 EXTRAPOLATED





## Conclusions:

1. Most common tectonic settings for 2000-2007 giant discoveries follows the same pattern as 1867-2000 discoveries: 1) passive margins (~36%), 2) continental rifts and overlying sags (~30%); and 3) continental collisional zones (20%).
2. Trends in 2000-2007 discoveries: 1) infill discoveries in cluster areas (least interesting); 2) deeper water and along-strike discoveries in cluster areas (more interesting); and 3) frontier discoveries in areas of no previous giants (most interesting).
3. Frontier discovery areas in 2000-2007 include: Bay of Bengal (both India and Myanmar), central Tarim basin, central Ordos basin, Mekong Delta, Sudan rift, deepwater northern Australia.
4. Future trends from > 200 MBOE 2007 data: passive margins still dominant, then rifts and collision belts.