



# Seismicity of Egypt

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Research Assistant

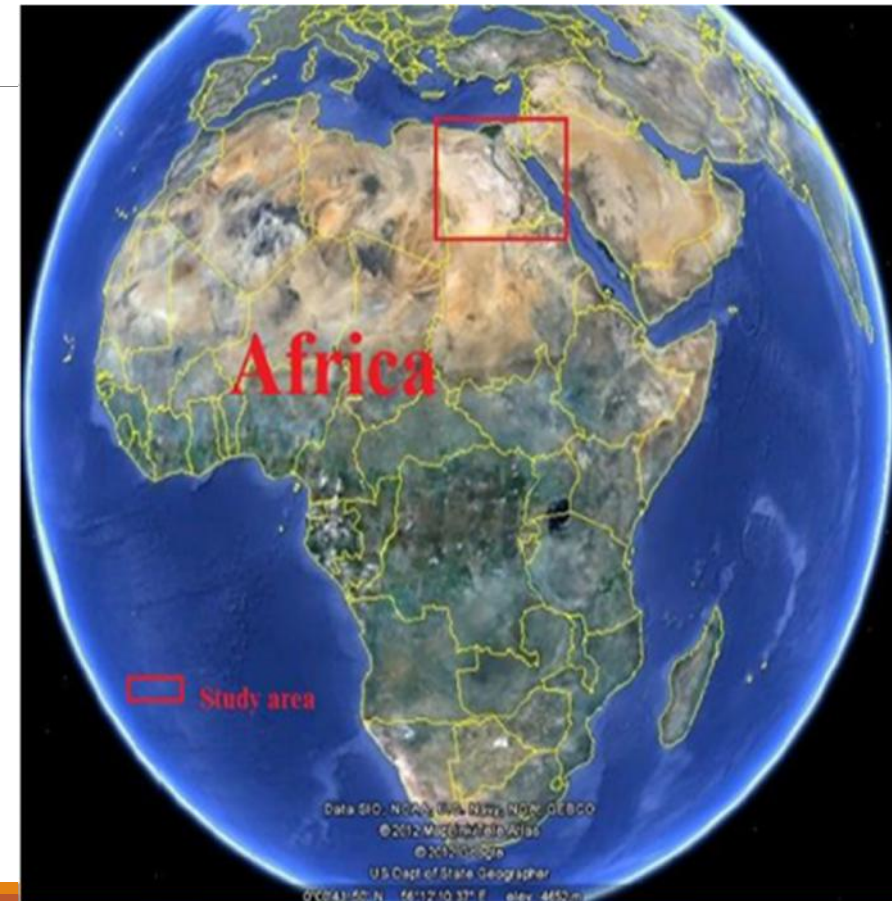
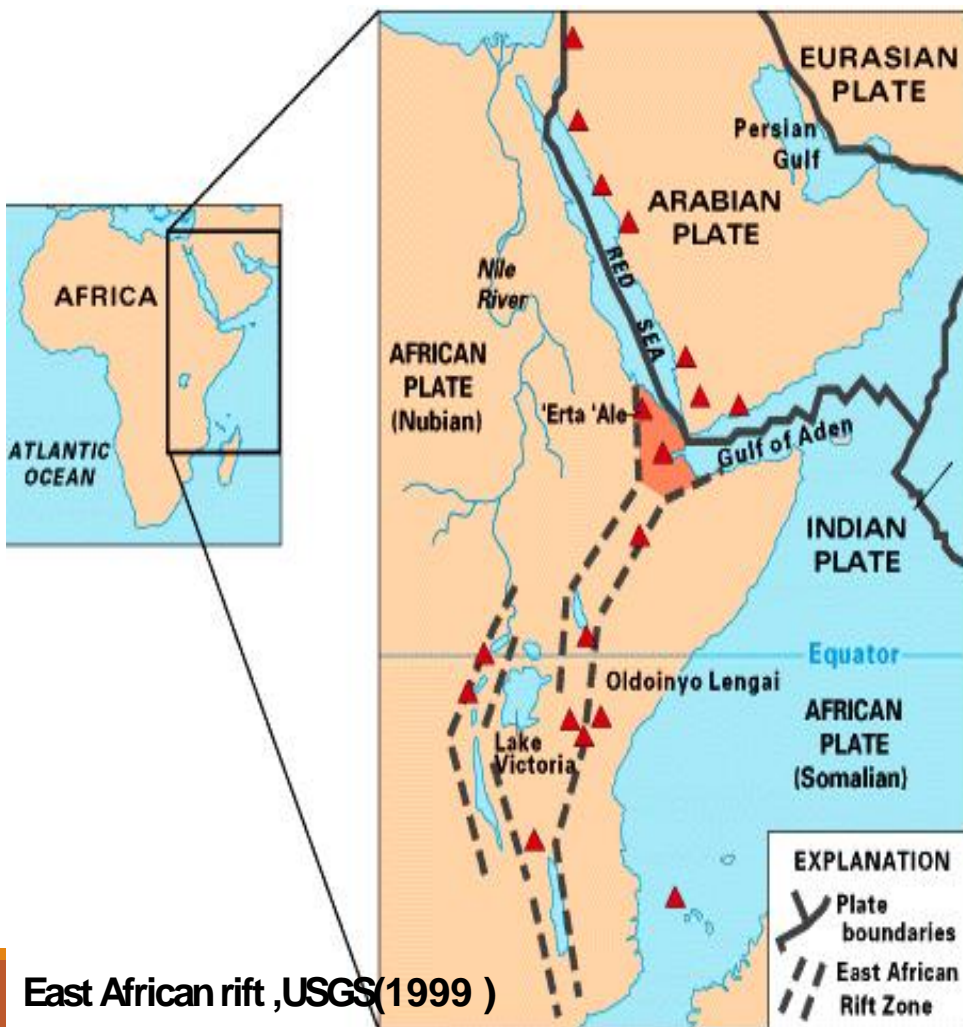
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# Outline

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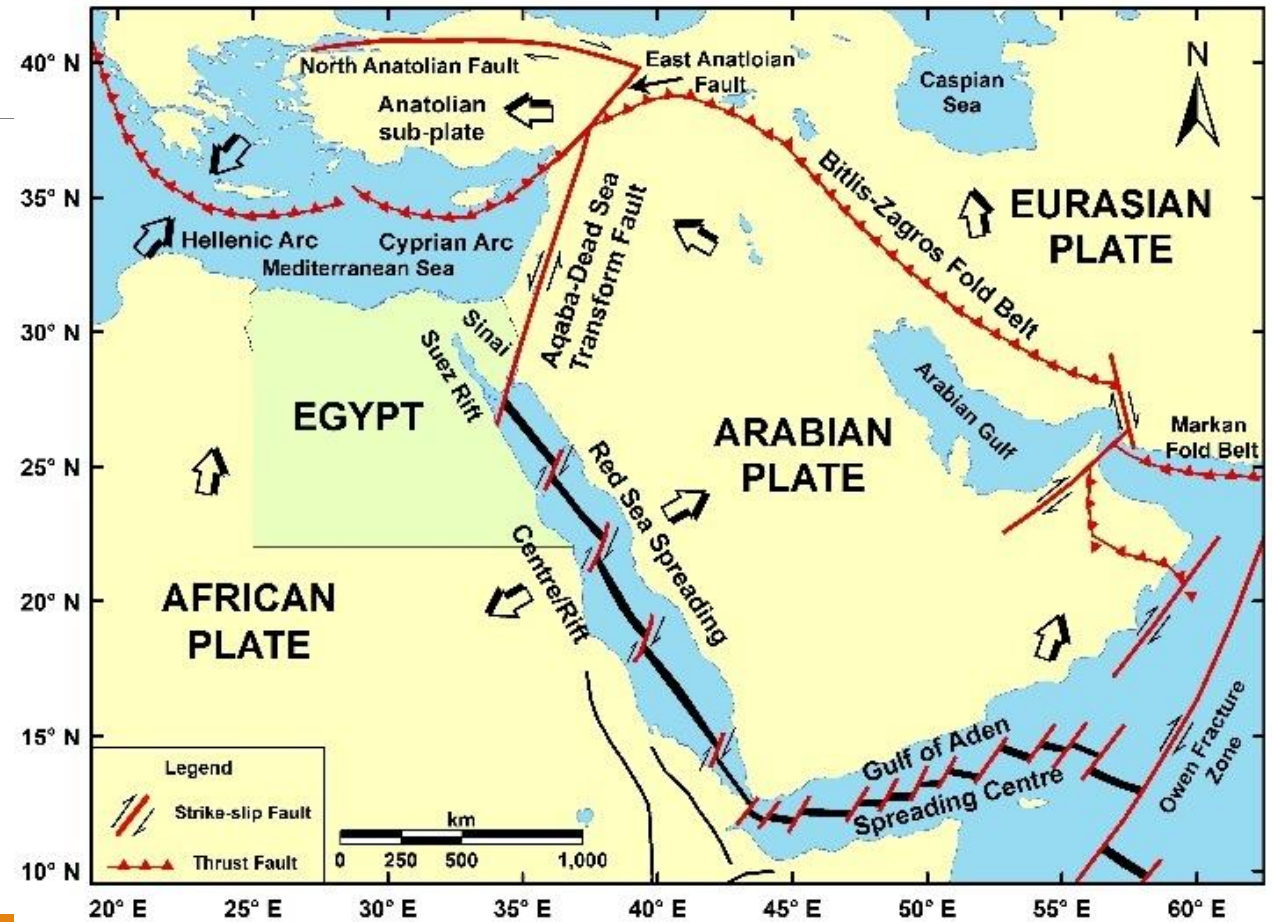
- Introduction
- Seimotectonic setting
- Seismicity of Egypt

# Introduction



## Location map of Egypt with in Africa

# Seismotectonic setting of Egypt



redrawn after Ziegler [2001] and Pollastro [2003]

# Seismicity of Egypt

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**A-Historical Seismicity**

**B-Instrumental Seismicity**

## A-Historical seismicity

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- ❖ Historical earthquakes which occurred before the advent of the seismograph, In the period from 2200 B.C. till A.D. 1899
- ❖ Forecasting seismic risk and mitigation of damage and human losses from future ones , Give valuable information on the recurrence interval of each region , construction of intensity maps and the rate of attenuation with distance.

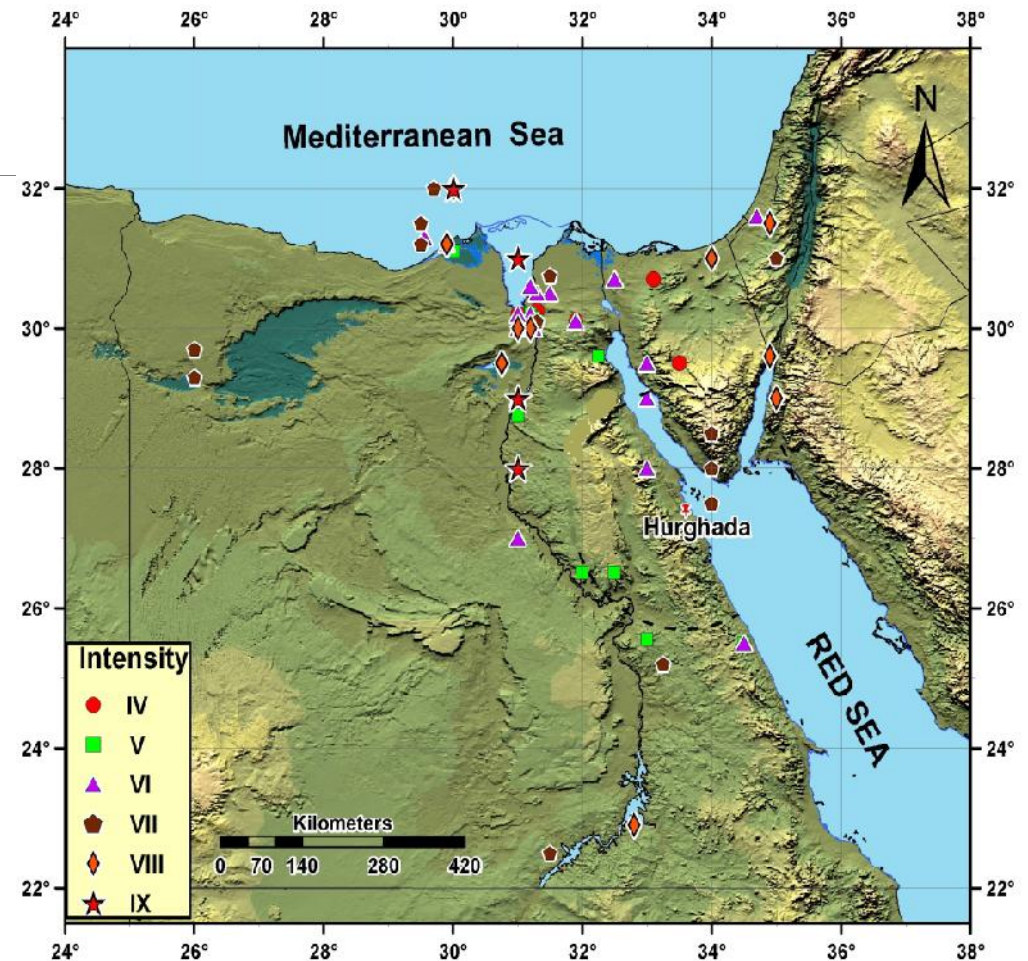
# Sources of historical earthquake data

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- ❖ During the **Pharaonic** period the chief sources is the archaeological evidence provided by the temples and monuments themselves.
- ❖ In the classical period, **Greek** historiographers from about 500BC.
- ❖ and **Latin** ones from 200BC .
- ❖ During the **Byzantine** period (450AD-1453) more information becomes available mainly from ecclesiastical histories (Ambraseys et al. 1995).
- ❖ In the early seventh century, the formation of the **Islamic** Empire.



❖ Unfortunately a lot of remarks about some of historical earthquakes in Egypt were removal or it is became difficult to identify them because the distribution of population in a narrow zone along the Nile Valley and Delta.



Epicentral distribution of historical earthquakes in and around Egypt during the period from 2200 BC to 1899 AD (Toni, 2007 and 2012).



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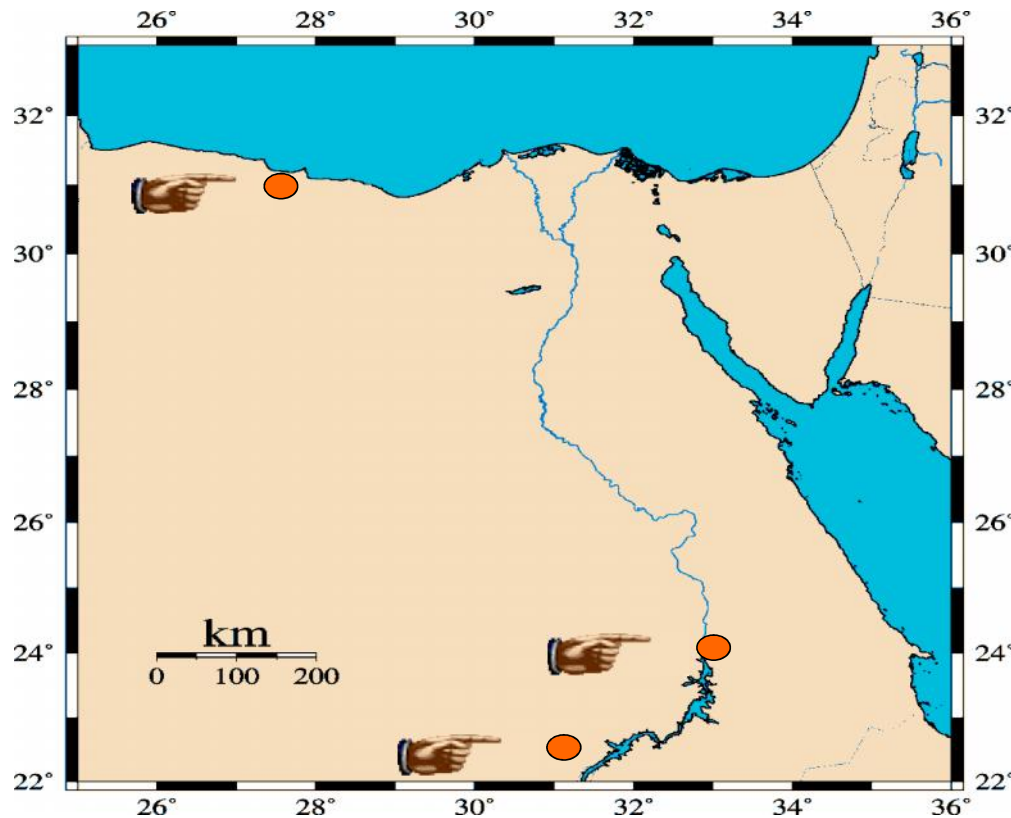
# History of Upgrading the Seismic Stations

## A single station at Helwan since 1898

- ❖ In 1899 is the beginning of the instrumental recording of earthquake
- ❖ the first seismic station at Helwan (about 25 km south of Cairo) .
- ❖ in 1964, Helwan station (HLW) has been selected as one of the American World Wide Standardized Seismograph Network (WWSSN).



The location map of the first seismic station in Egypt



➤ In 1975 short period (three component) Seismograph of Kimos type (Russian type):

- Aswan

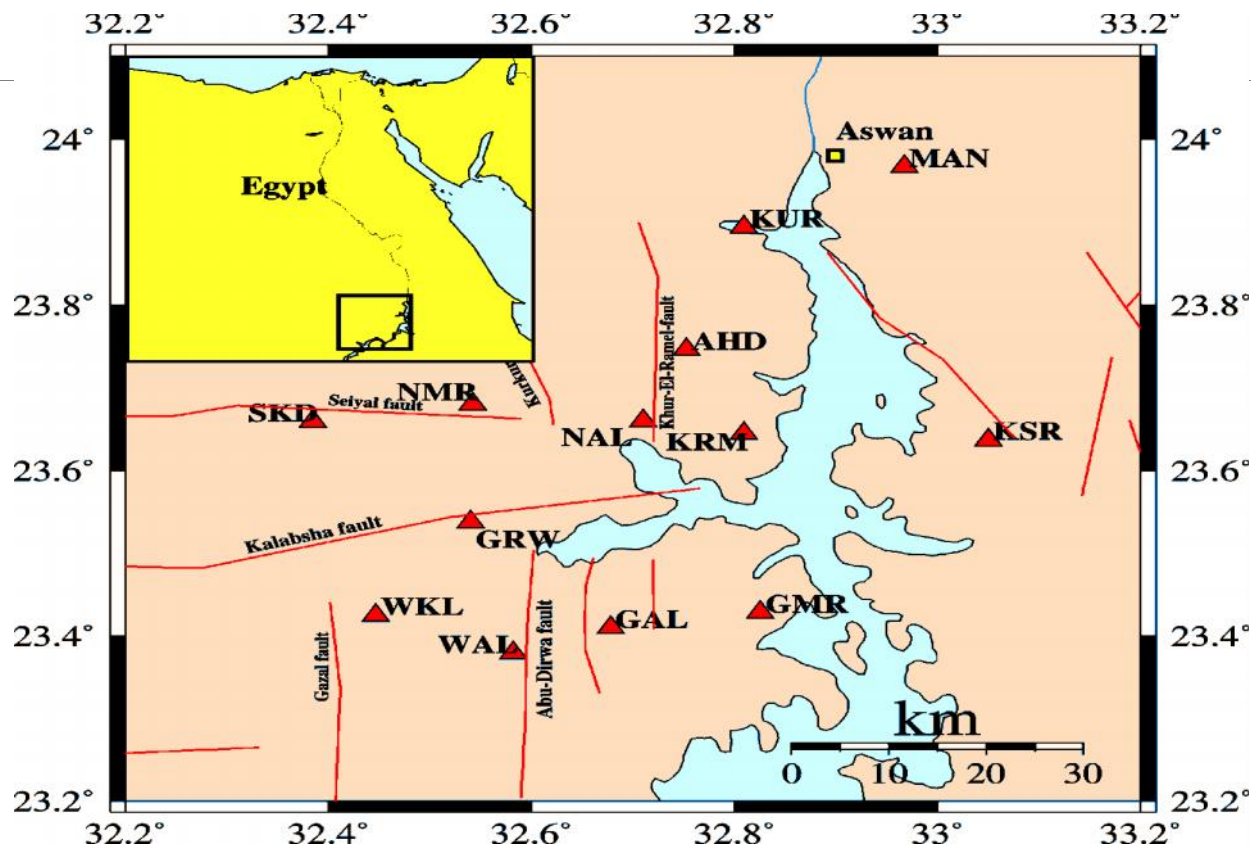
➤ In 1975, UNESCO denoted two stations Kimos type at:

- Matrouh

- Abu-Simble

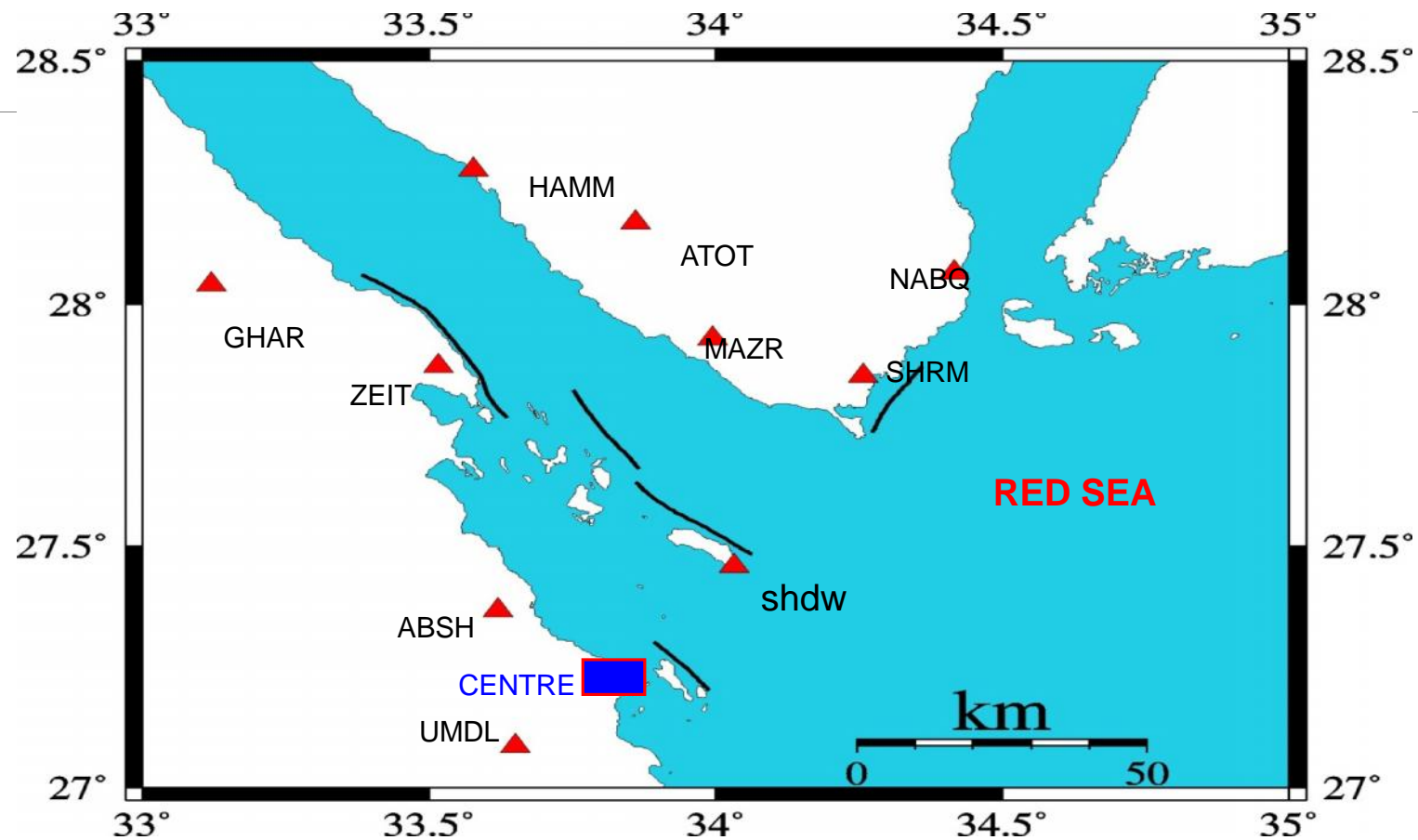
The locations map for the three seismic networks erected in Egypt

**IN 1982 Aswan local Seismic network  
was established after Kalabsha earthquake (1981)**



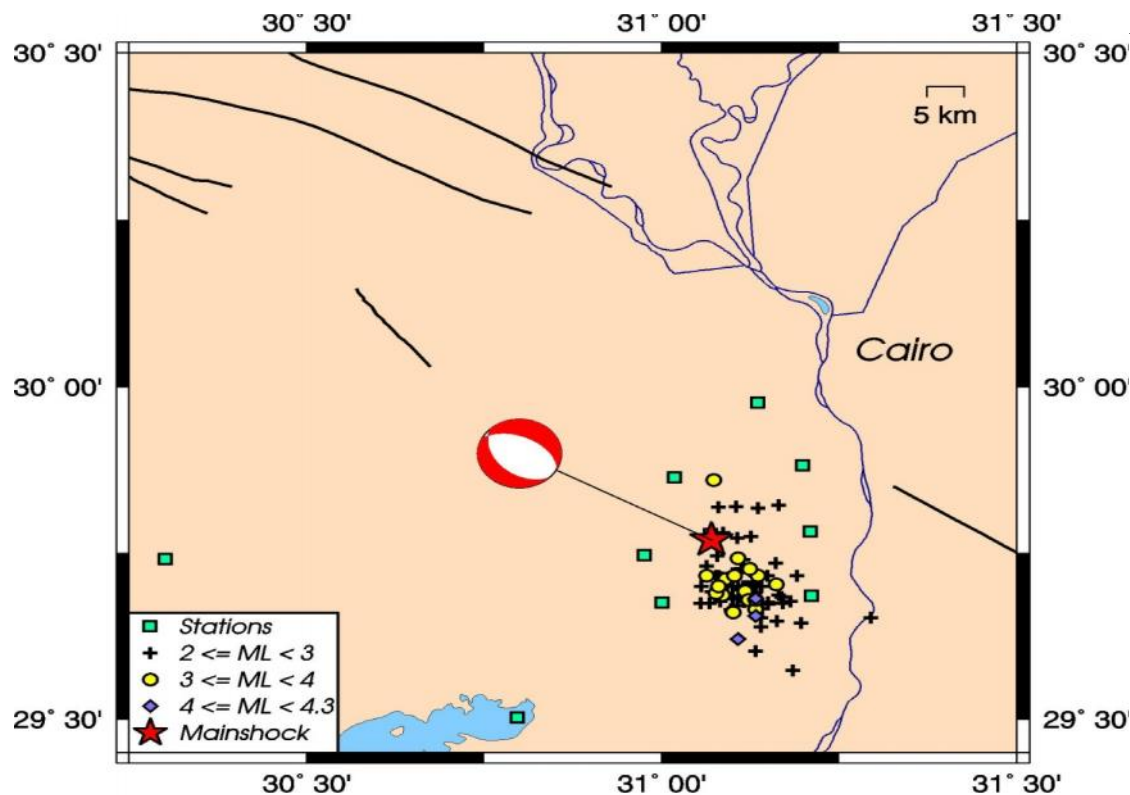
Main faults in Aswan area (after WCC, 1985)

**In August 1994, a telemetry network of 10 stations installed at both sides at the southern part of the Gulf of Suez**



After (NRIAG, 2010)

## The October 12,1992 earthquake



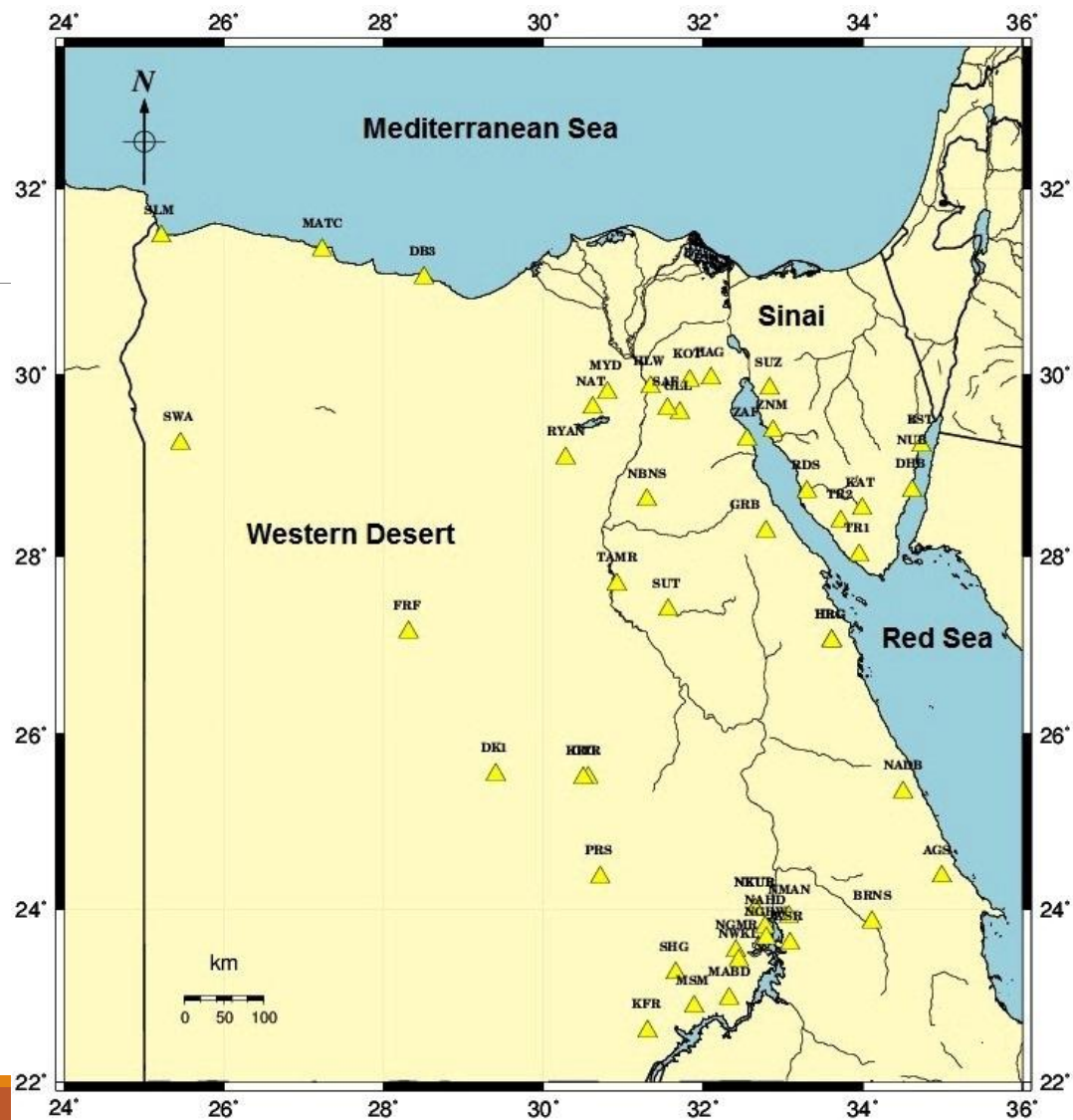
The 12 October 1992 earthquake caused 561 deaths, injured more than 9000 and left a damage of more than 35 million U\$.

As a result, the Egyptian Government gave order to the National Research Institute of Astronomy and Geophysics to install the seismological network and strong motion network.

Modified after (Kamal Abou Elenean. et. al., 2000)

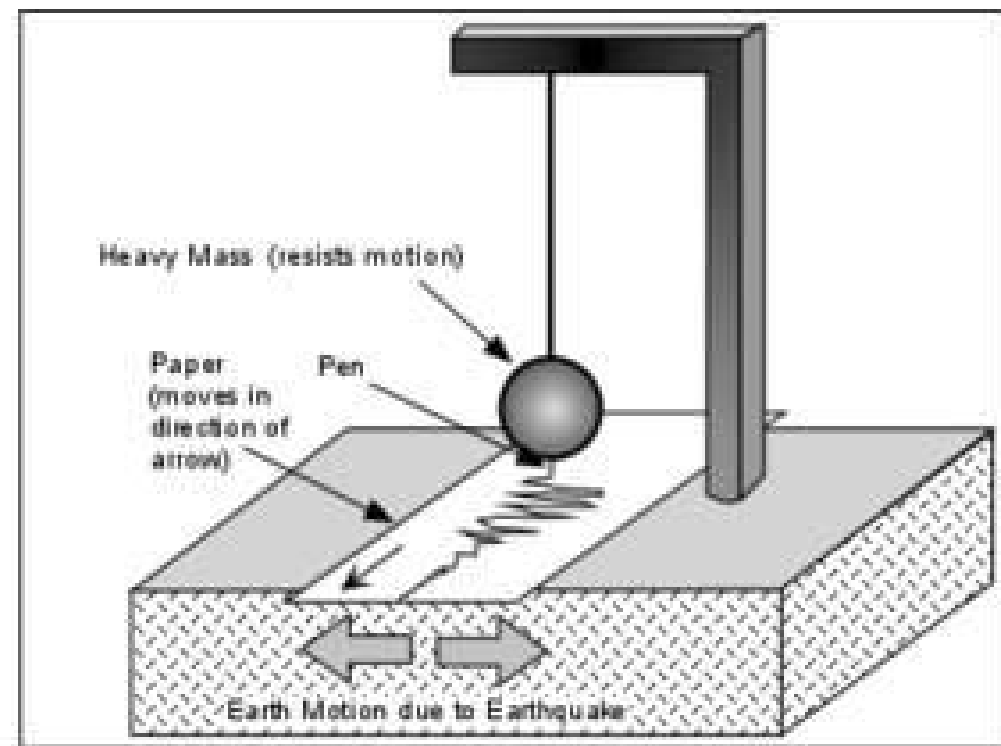


## Distribution of ENSN



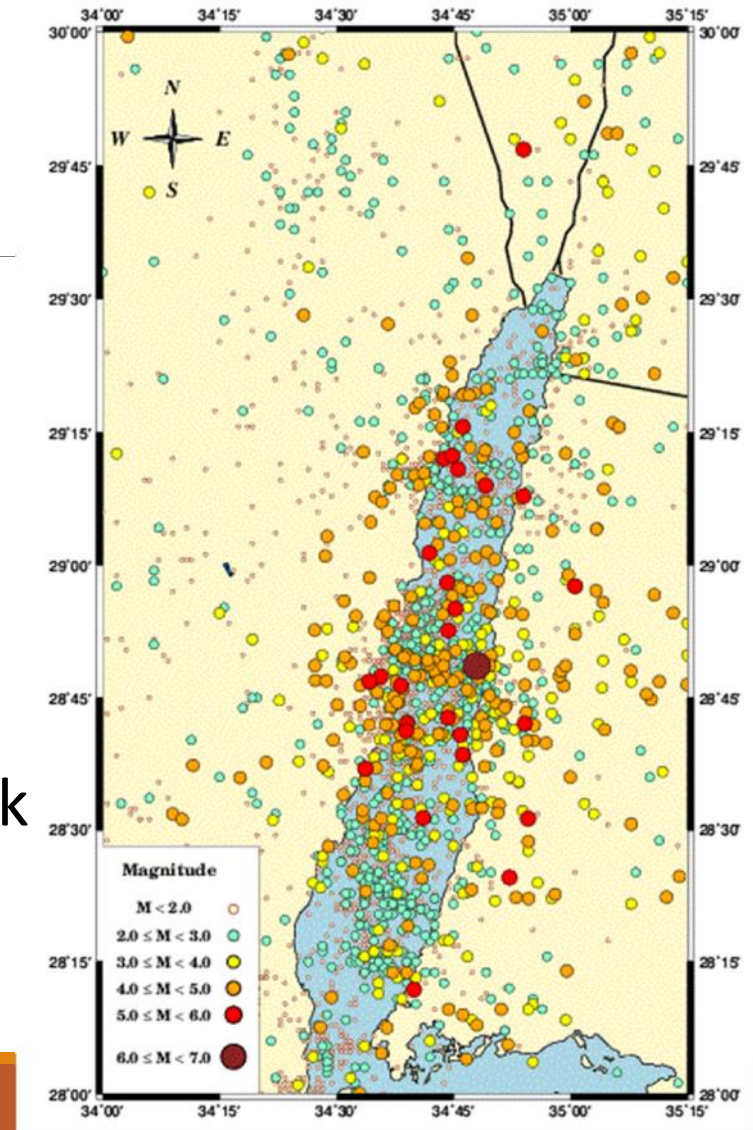
# B-Instrumental Seismicity

Sieberg (1932a); Ismail (1960); Gergawi and El-Khashab (1968); Maamoun and Ibrahim (1978); Maamoun et al. (1980); Maamoun et al. (1984); Albert (1987); Kebeasy (1990); Abu Elenean (1997); Deif (1998); El-Hadidy (2012) ; Sawires et al. (2015); Abelazim et. al 2016 .



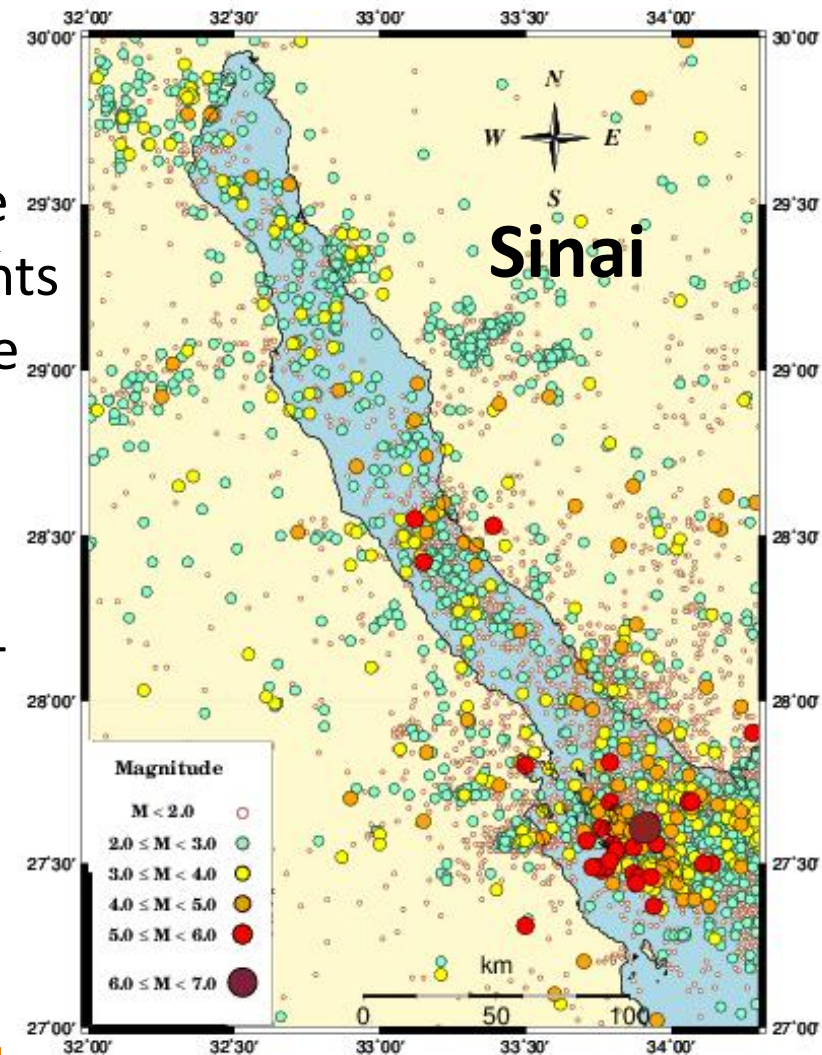
# Gulf of Aqaba

- ❖ The Gulf of Aqaba has been affected by many destructive earthquakes.
- ❖ it is considered one of the most active seismic zones in Egypt
- ❖ The Gulf of Aqaba is characterized by foreshock-mainshock-aftershock, mainshock-aftershock and swarm type activity .



# Gulf of Suez

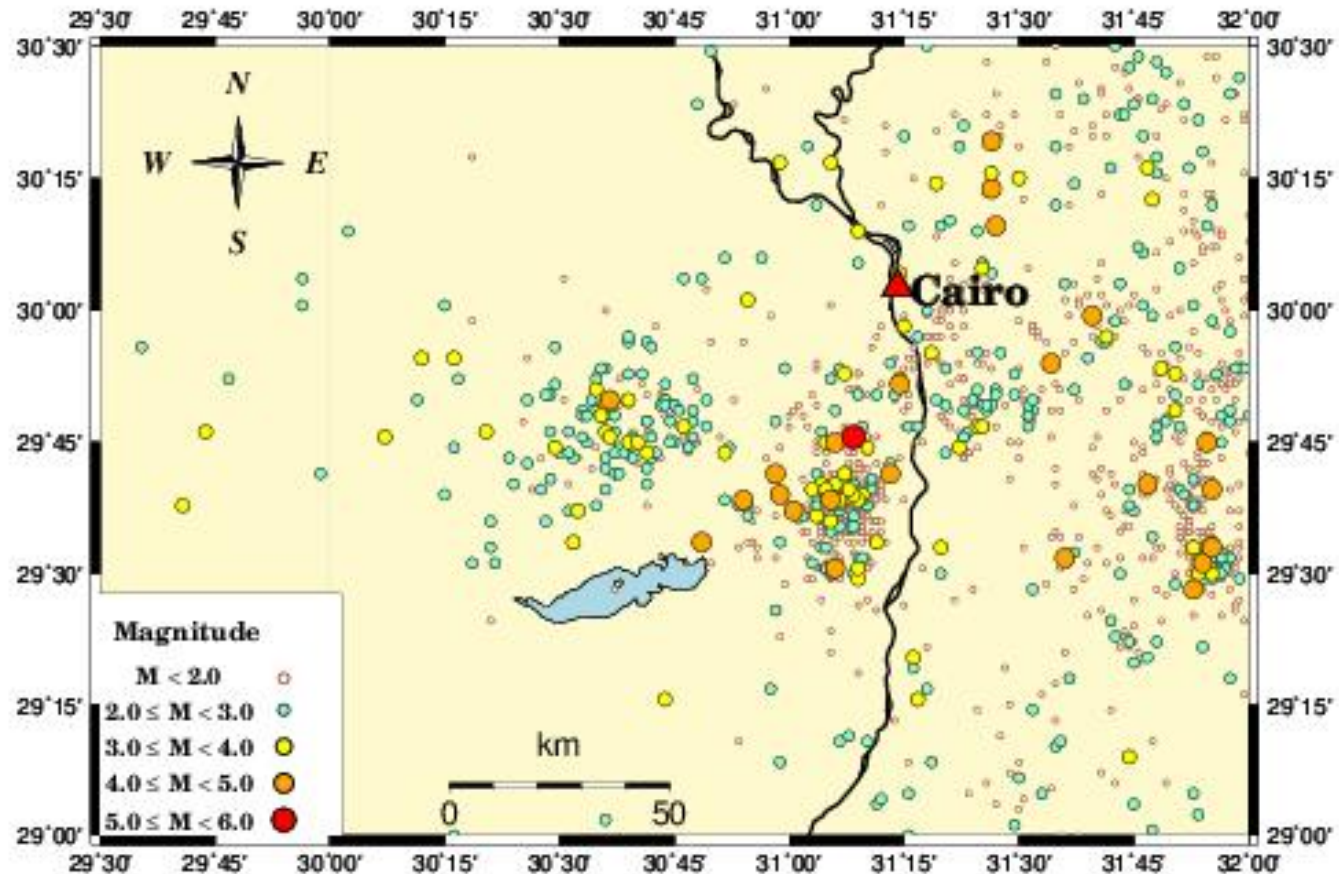
- ❖ The seismic activity of the southern end of the Gulf of Suez is related to the crustal movements among the Arabian plate, African plate and the Sinai sub plate.
- ❖ The Gulf of Suez is characterized by foreshock-mainshock-aftershock, mainshock-aftershock and swarm type activity .





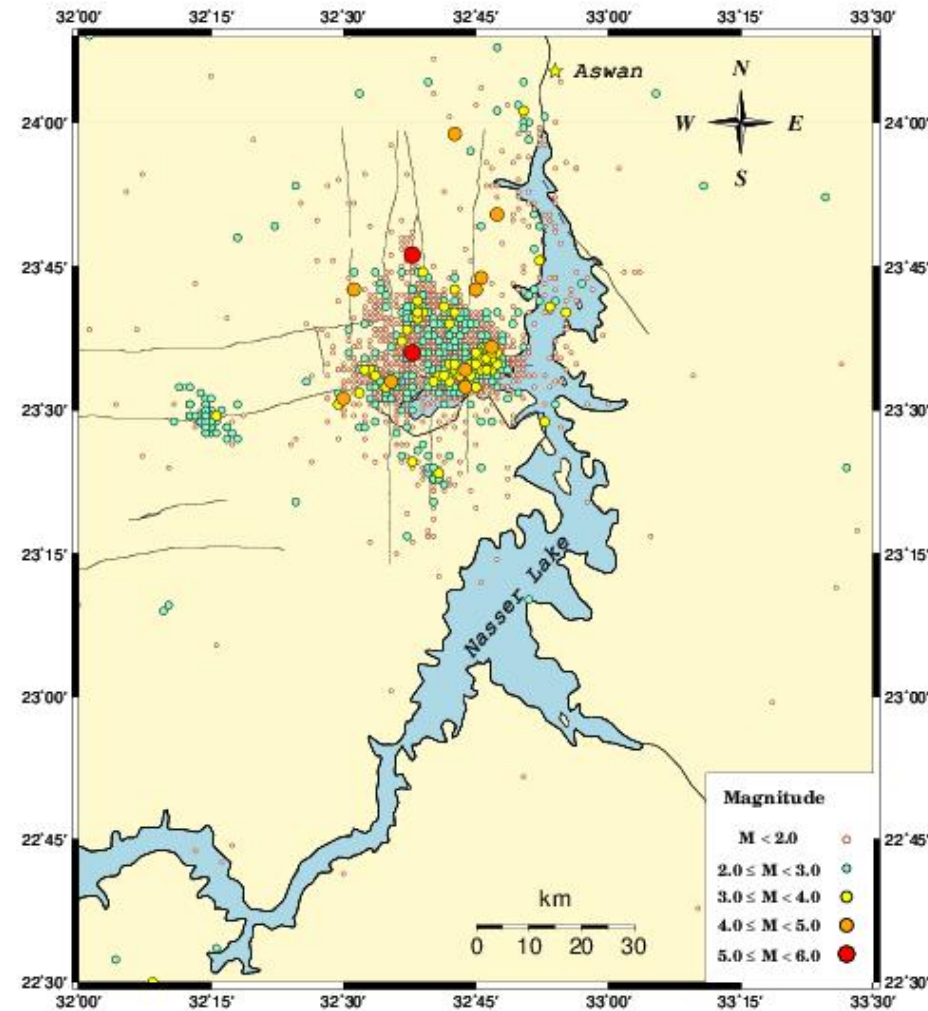
# Dahshour zone

- ❖ This seismic zone is characterized by the occurrence of small to moderate magnitude earthquakes.
- ❖ There is a large number of historical events that has been reported in this Zone.
- ❖ The recent earthquake of 1992, October 12 (mb 5.8);



# Aswan Zone

- ❖ Aswan is one of the most important areas in Egypt
- ❖ This seismic zone is the source of the November 14, 1981 earthquake (ML 5.5) which caused considerable damages to Aswan Area. This earthquake occurred at about 60 km SW of Aswan High Dam.
- ❖ Kalabsha, Kurkur and Khour El Ramla faults are the main reasons of the seismic activity in this zone



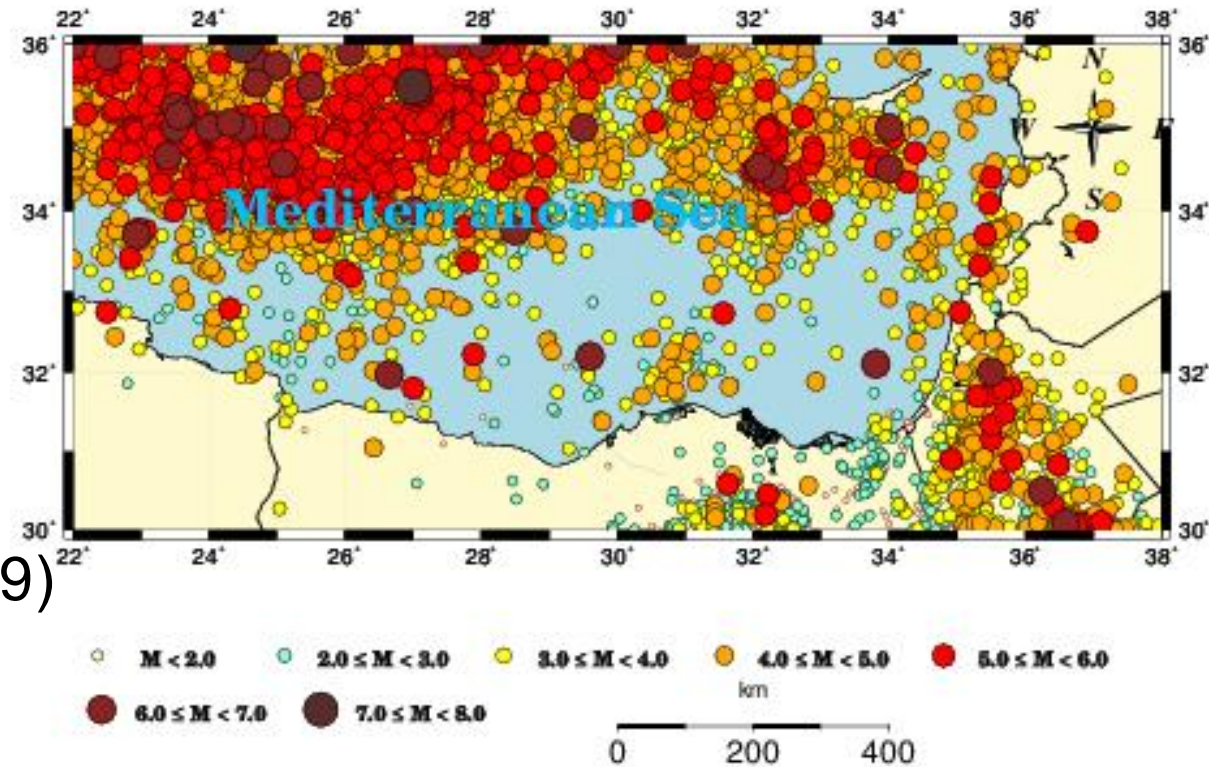


# Passive continental margin

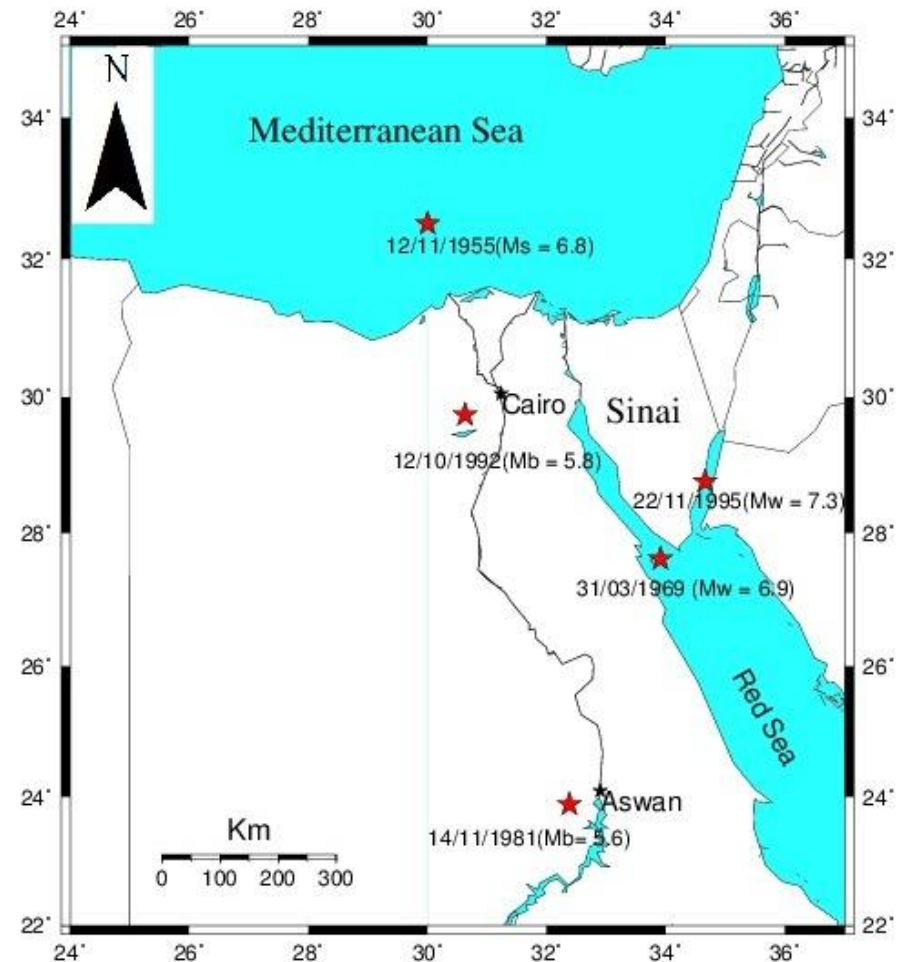
❖ The northern Egypt has been shocked by a number of moderate size earthquakes.

❖ The largest historical events in this area are those of 320 , 956 ,1303 and 1870 A.D.

❖ September, 12, 1955( $M_s = 6.8$ ) and 10 October 2012 ( $m_l = 5.29$ )



- ❖ September 12, 1955 Alexandria earthquake ( $M_s = 6.8$ ) .
- ❖ March 31, 1969 Shadwan Earthquake ( $M_w = 6.9$ )
- ❖ Nov. 14, 1981 Aswan (Kalabsha) earthquake ( $M_b = 5.6$ )
- ❖ October 12, 1992 Cairo (Dahshour) earthquake ( $M_b = 5.8$ )
- ❖ November 22, 1995 Gulf of Aqaba earthquake ( $M_w = 7.3$ )



**The most recent severe damages earthquakes in Egypt.**

**THANKS FOR YOUR ATTENTION**





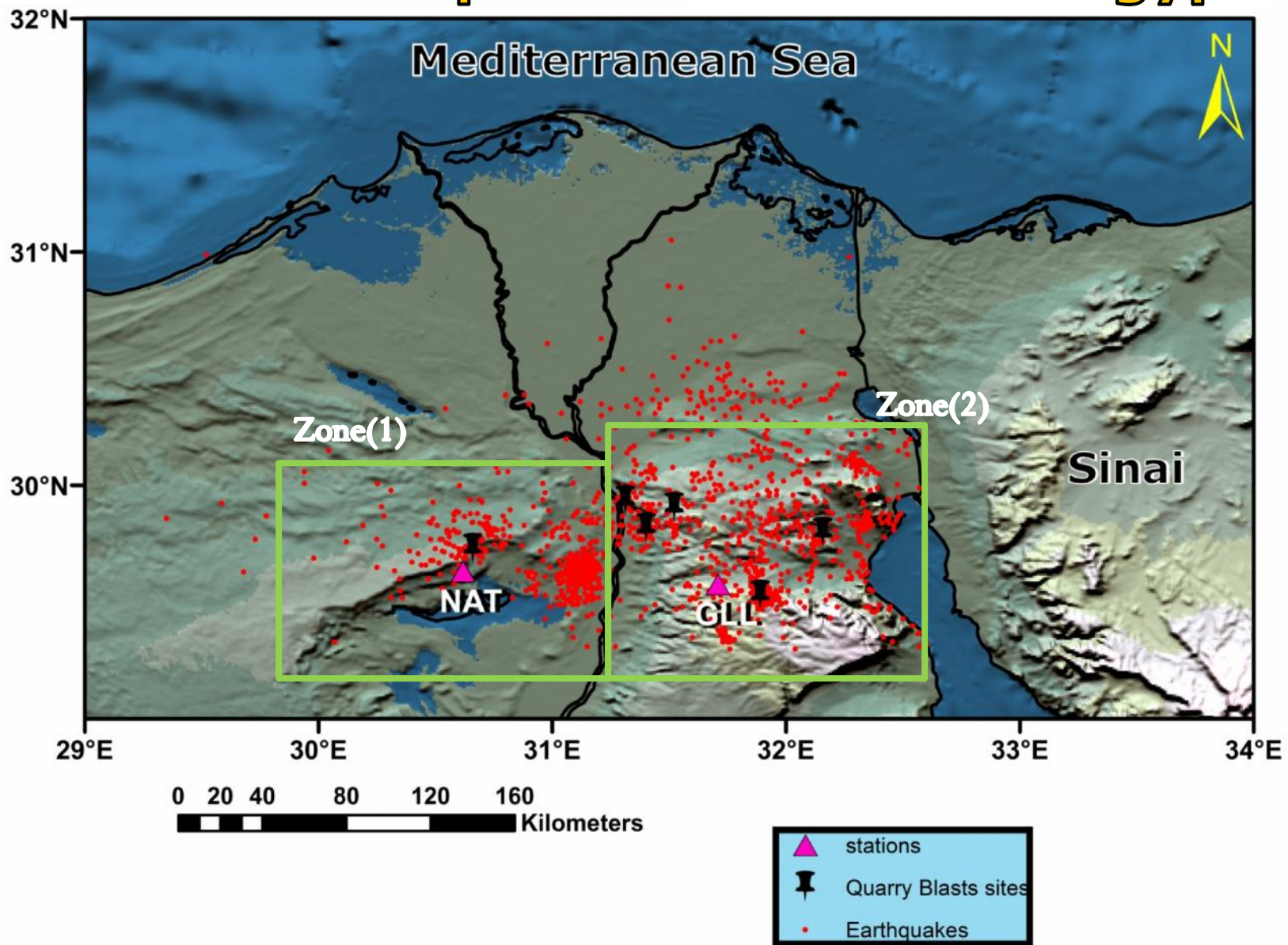
# Decontamination of Microearthquake catalogue from quarry blasts in Northern Egypt

**By**  
**Walid Farid Ahmed**

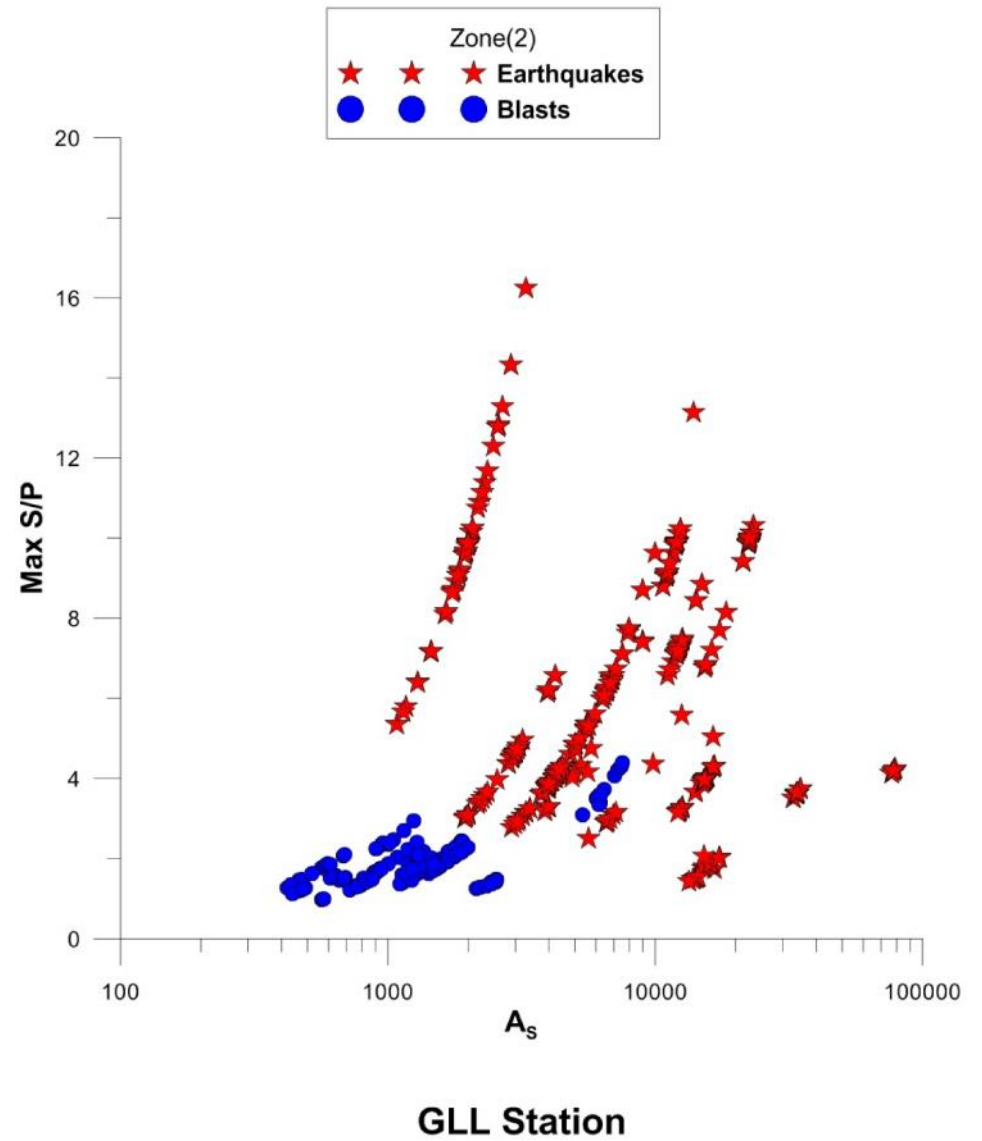
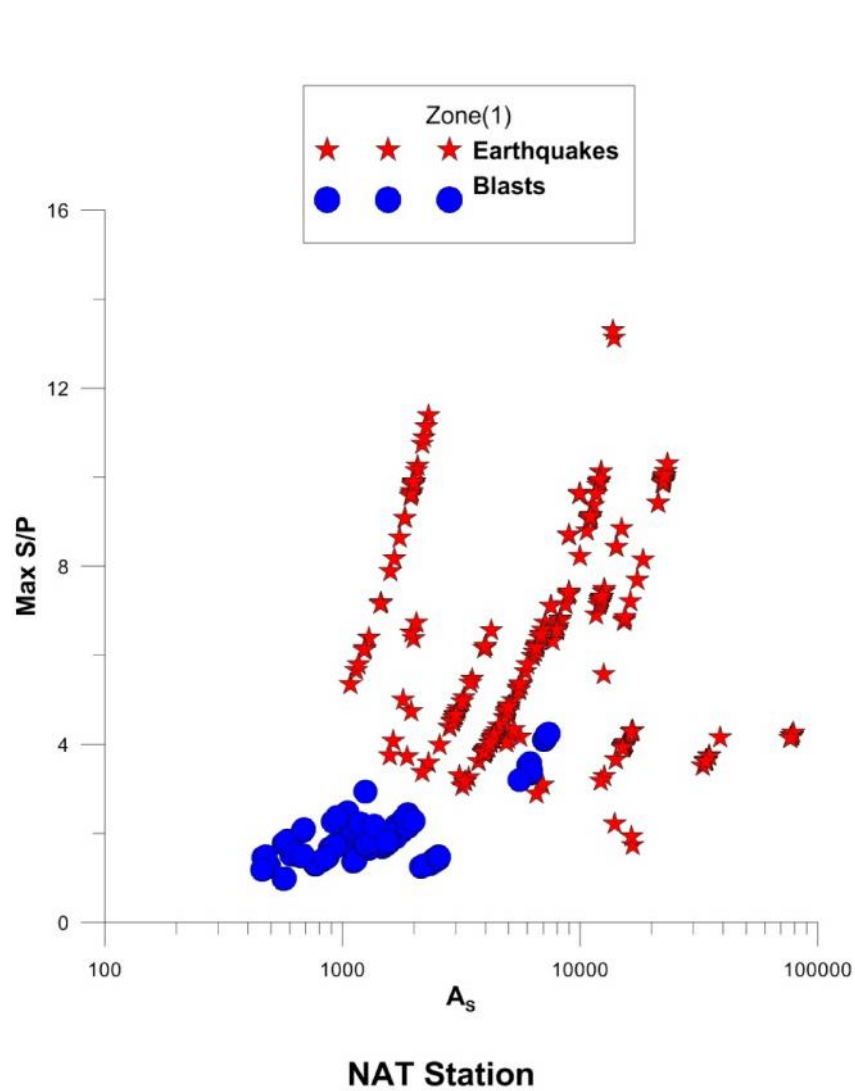
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# Microearthquakes of Northern Egypt



# S/P wave amplitude peak ratio

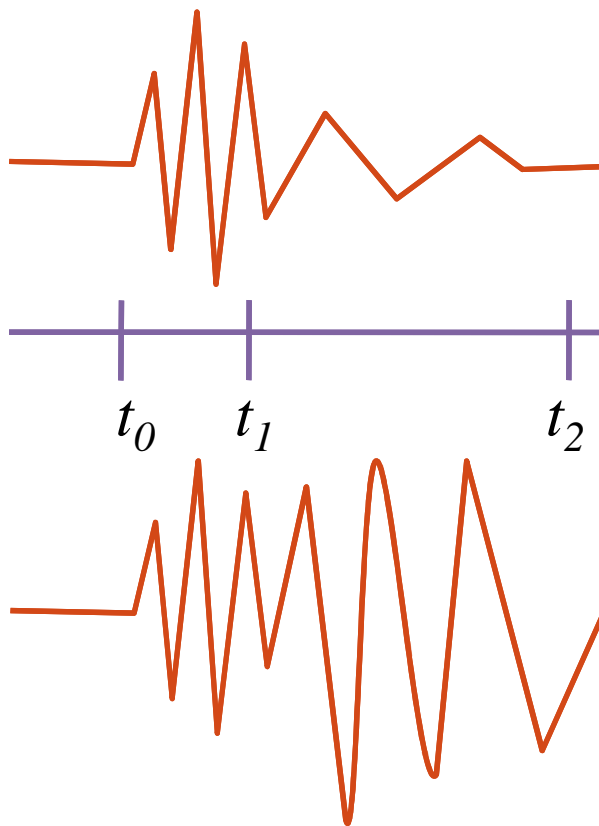




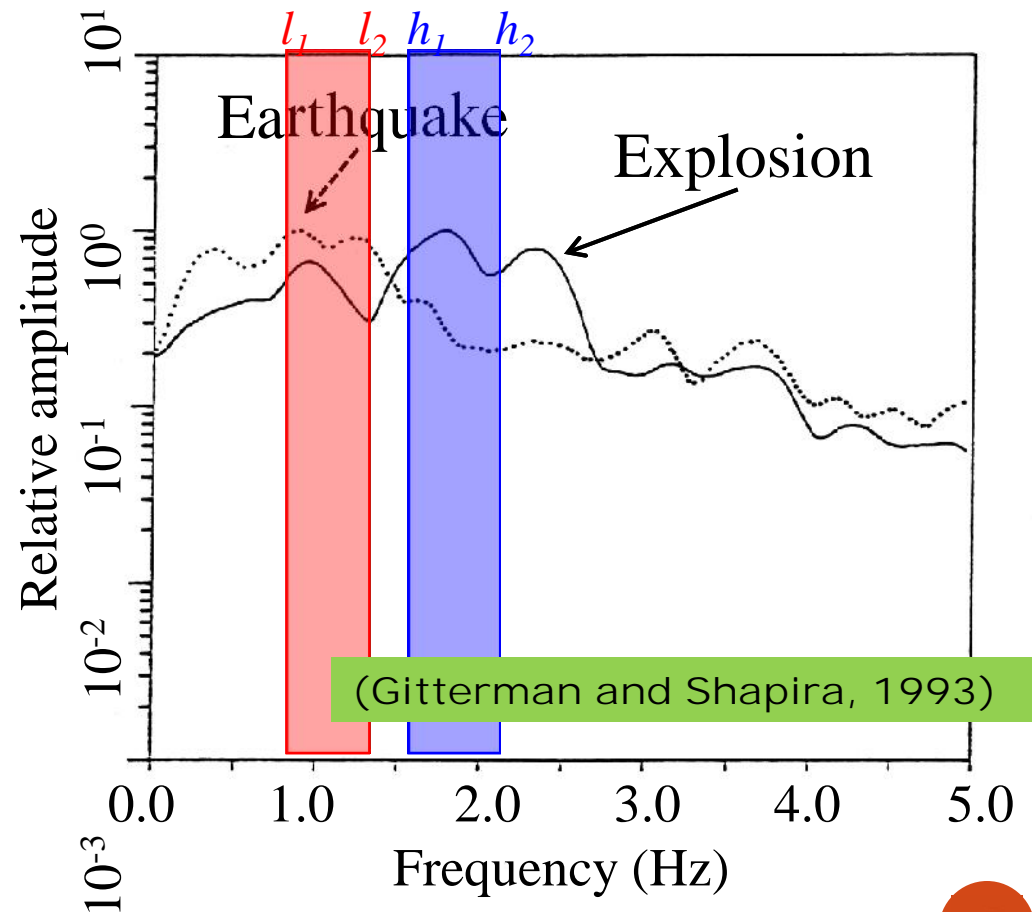
# Complexity and Spectral amplitude ratio analysis

$$C = \frac{\int_{t_1}^{t_2} s^2(t) dt}{\int_{t_0}^{t_1} s^2(t) dt}$$

(Arai and Yosida, 2004)

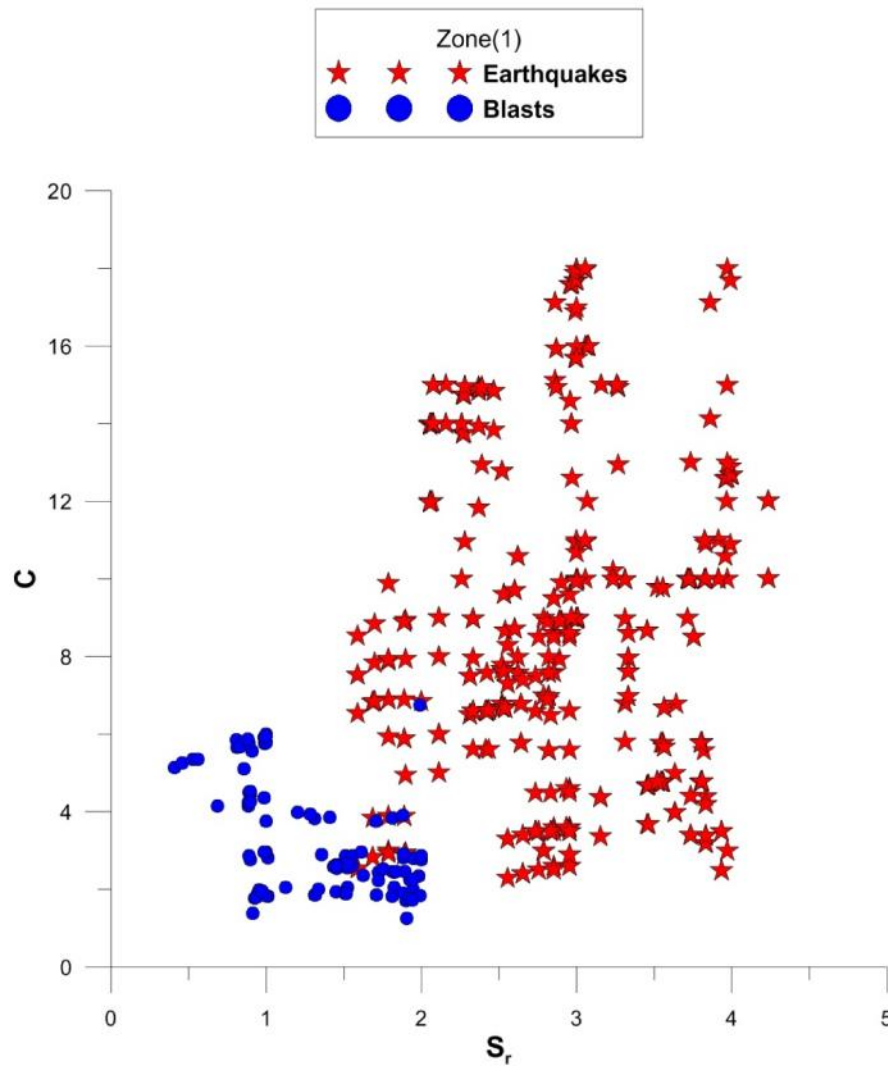


$$SR = \frac{\int_{h_1}^{h_2} A(f) df}{\int_{l_1}^{l_2} A(f) df}$$

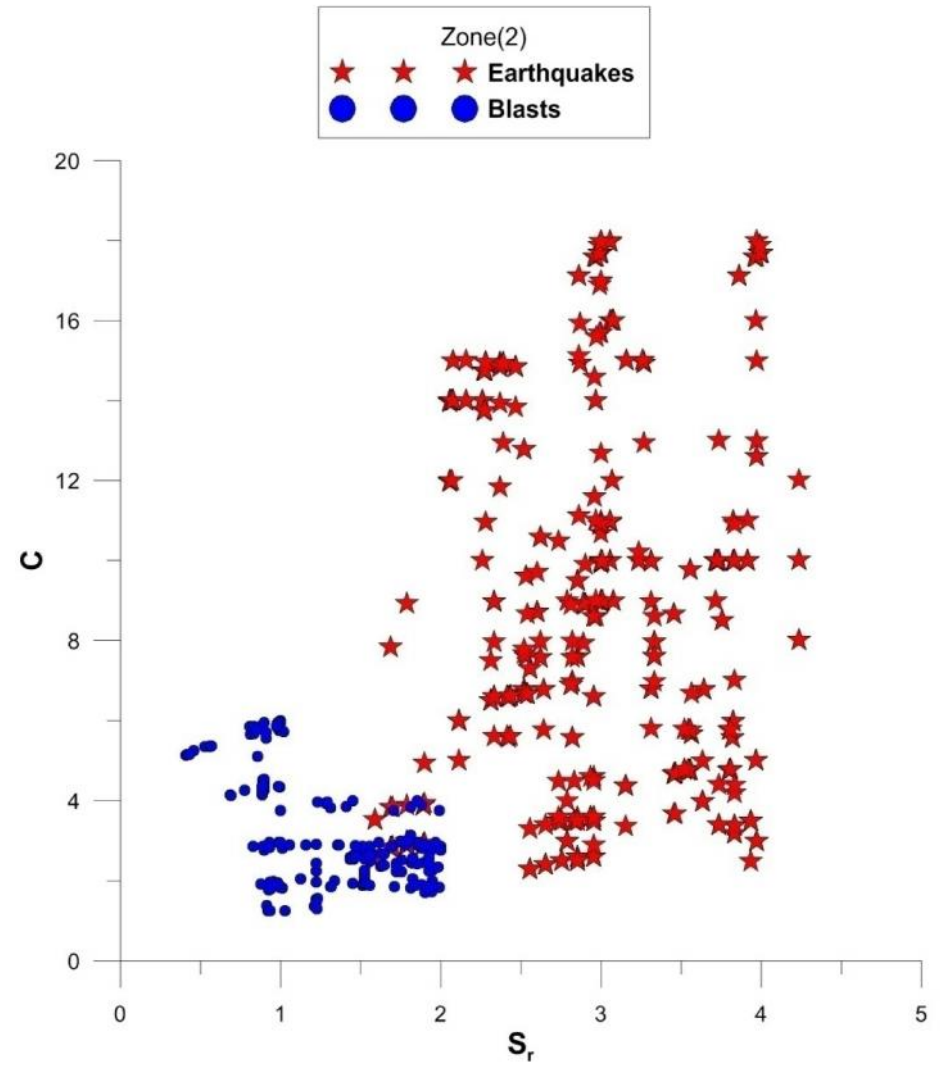


(Gitterman and Shapira, 1993)

# Complexity and Spectral amplitude ratio analysis



NAT Station

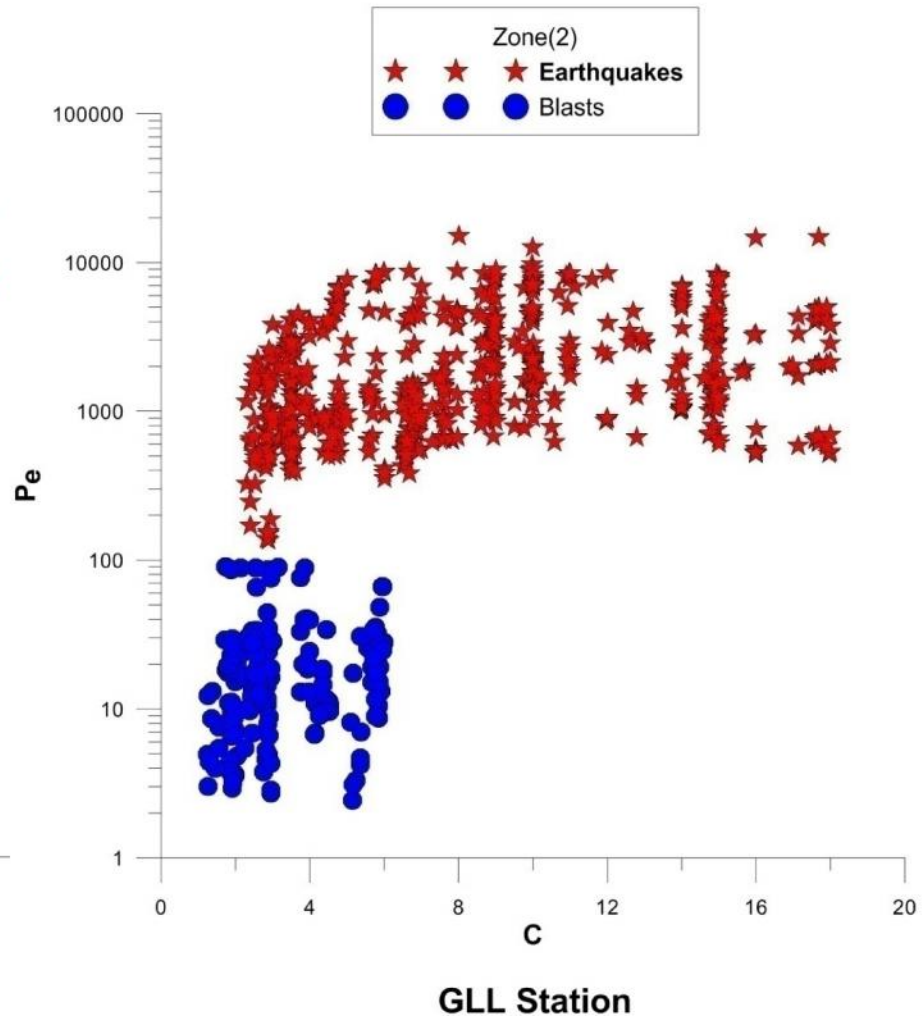
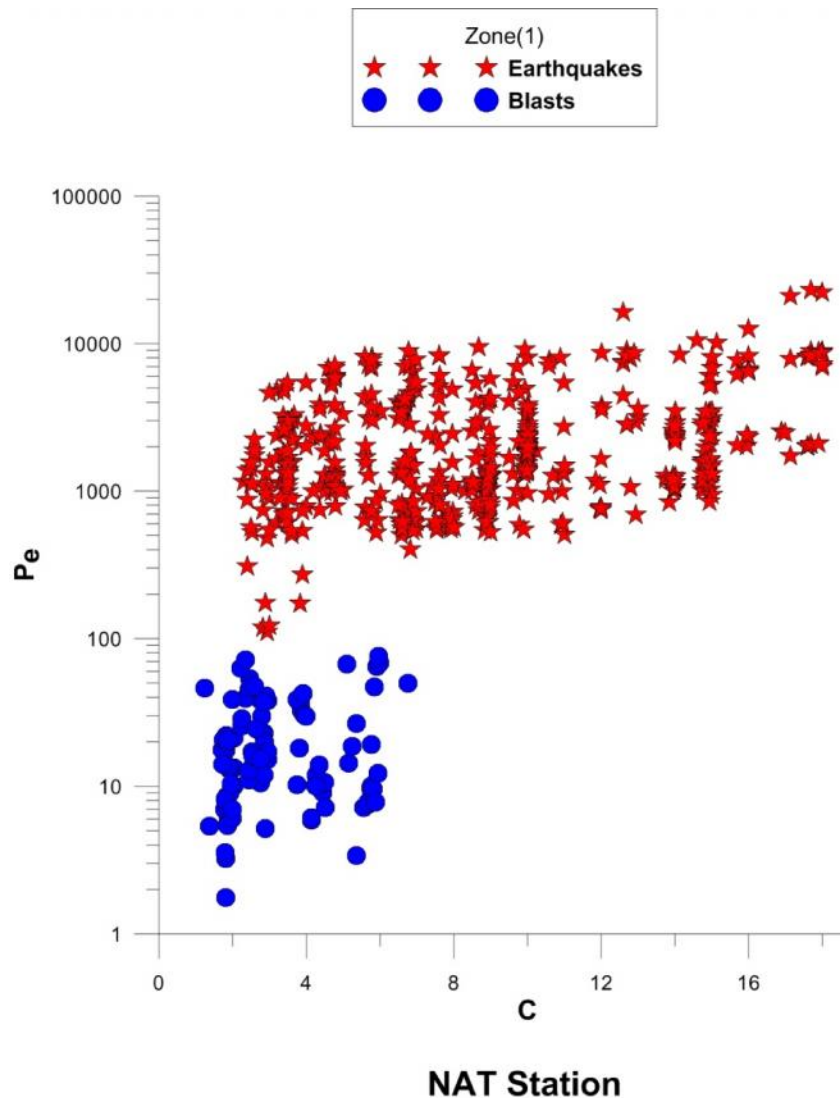


GLL Station

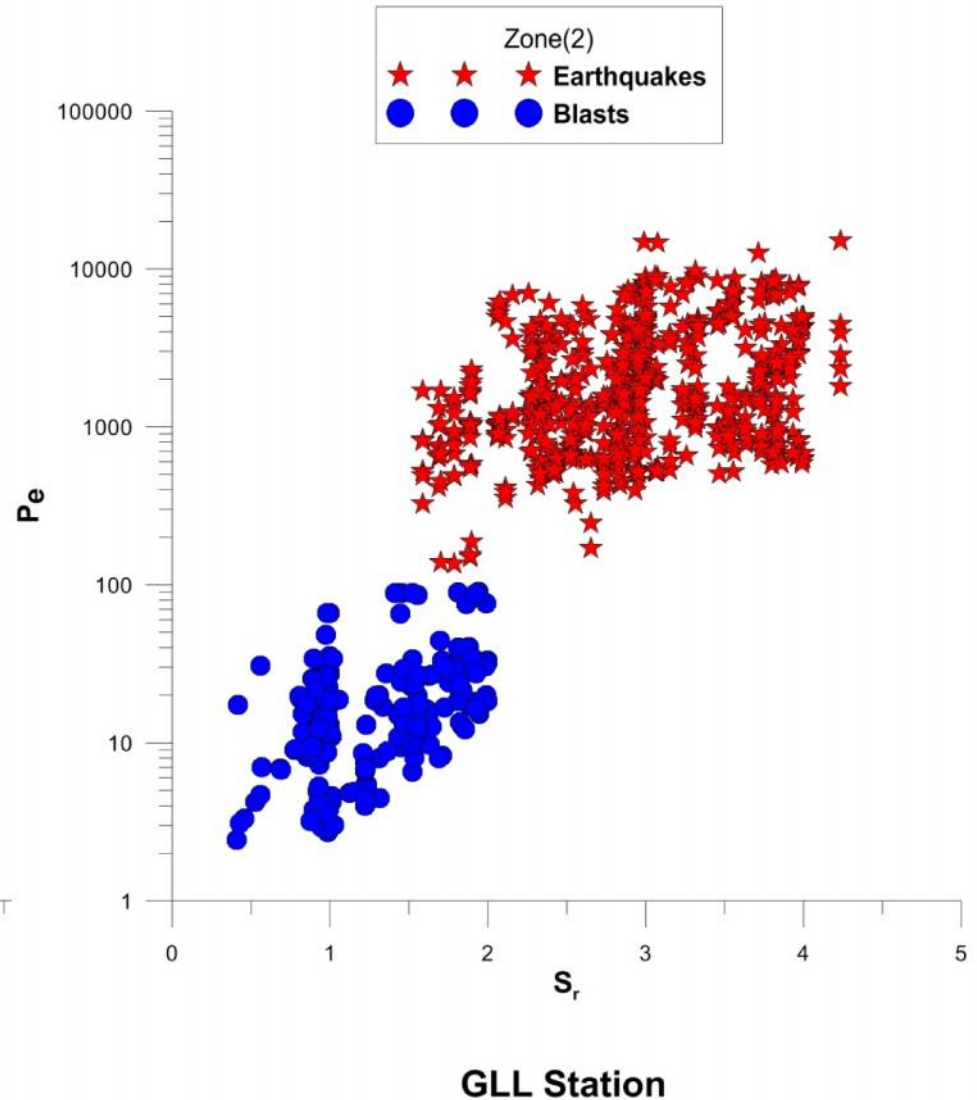
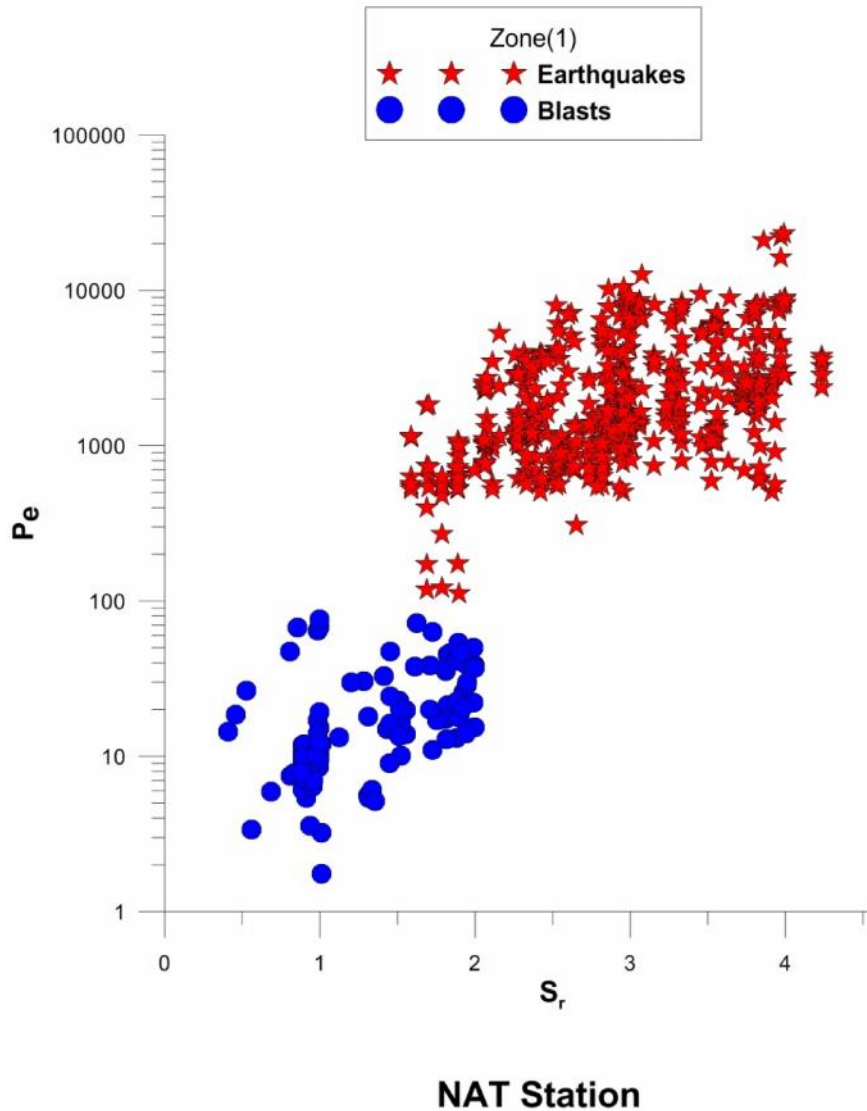
# Multi- parameter discrimination; Pe (Power of event) analysis

$$Pe = (R_{S/P})^2 \times C \times (Sr)^2$$

(Kekovalu et al., 2012)

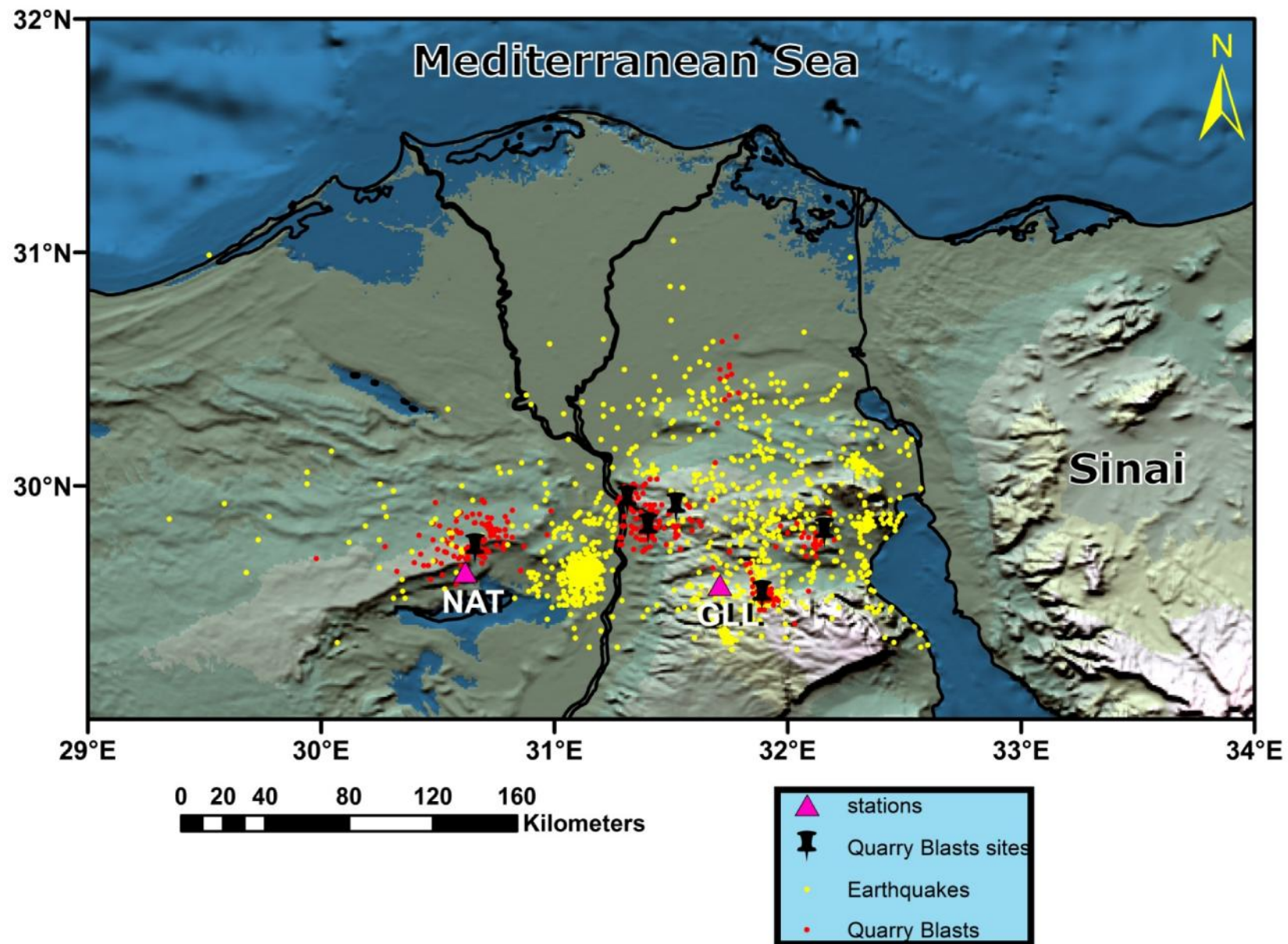


# Multi- parameter discrimination; Pe (Power of event) analysis





# After Decontamination



# Conclusion

No.	Zone (1)	Zone (2)
Initial events	605	876
Earthquakes	503	679
Blasts	102	197



*Thanks For Your Attention*



# Focal mechanism solutions in Egypt

- The focal mechanisms of earthquakes in and around Egypt are calculated for the period 2012 -2016 with local magnitude  $\geq 3.5$ .
- Data source:

The digital waveform data were extracted from the database of :

- Egyptian National Seismological Network (ENSN)
- International Data Center (IDC)
- International seismological center (ISC)



- Methods:

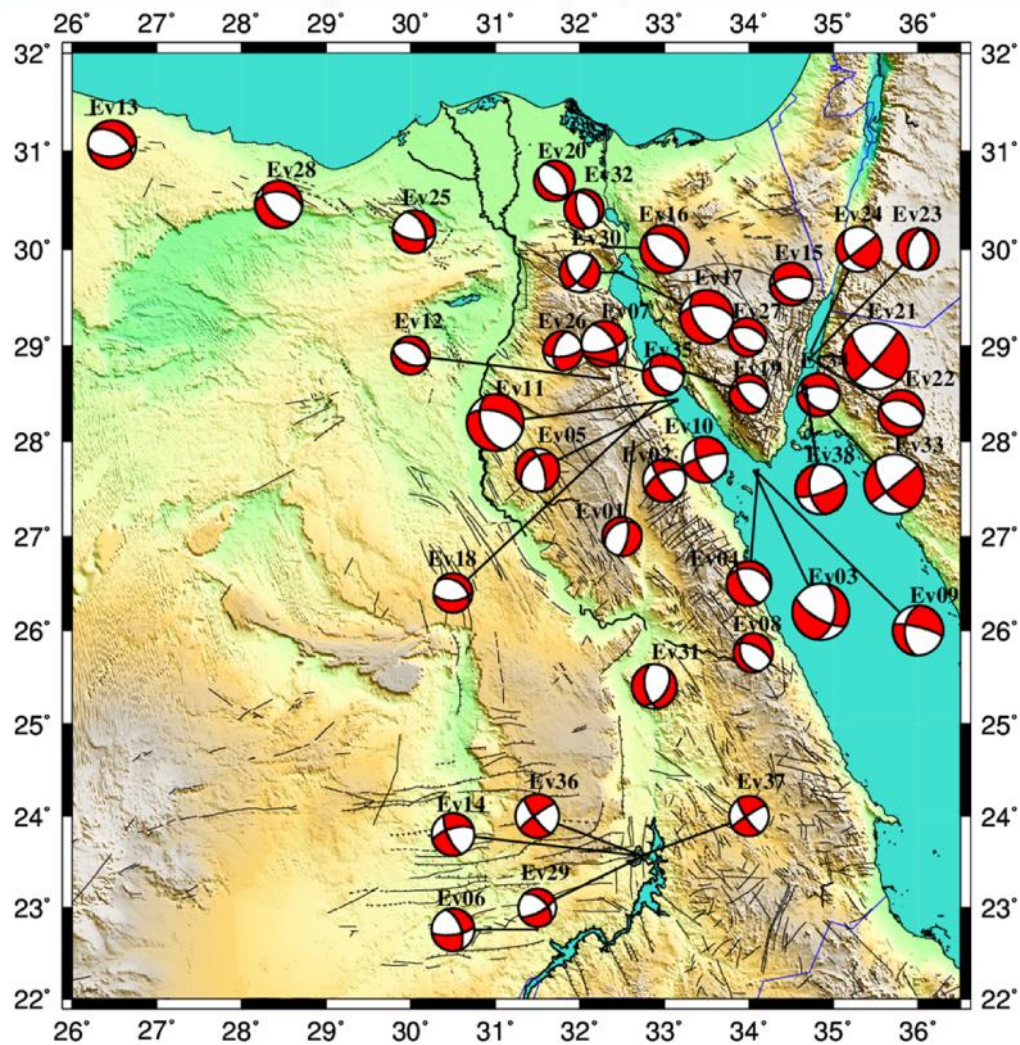
In this study we depend on two software:

- PMAN software
- FOCMEC software

PMAN software is used to obtain an initial focal mechanism solution. FOCMEC software is used to add more information to make the obtained solutions more reliable solutions such polarities of  $\mathbf{S_V}$ ,  $\mathbf{S_H}$ , and spectral amplitude ratios of  $\mathbf{S_V/P}$ ,  $\mathbf{S_H/P}$  and  $\mathbf{S_V/S_H}$ .



- Quality control :
- An accepted solution was required to have:
- At least ten polarity readings.
- Azimuthal coverage of station readings on the focal sphere greater than 90 .
- A total sum of the values (points) of the reliability estimators of at least fair (9–11points), where good solutions (5–8 points) were given less weight and poor solutions (12–15 points).



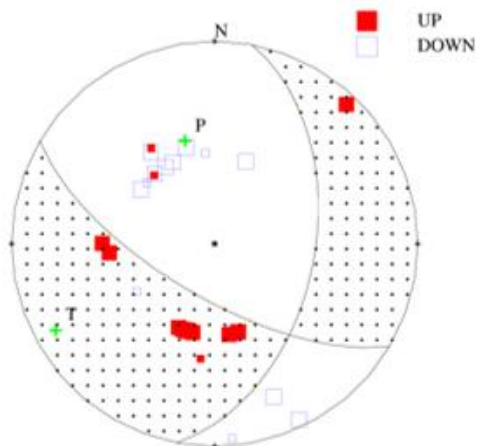
Focal mechanism solutions for earthquakes in Egypt during the period from 2012 to 2016



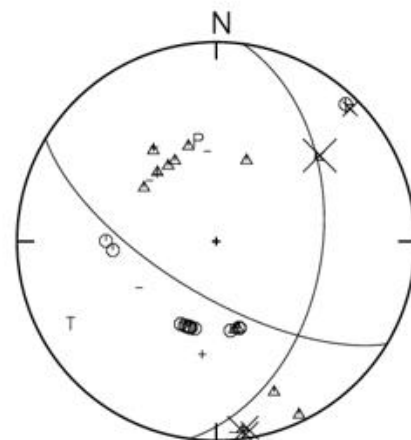


# Focal mechanism in Gulf of Suez region

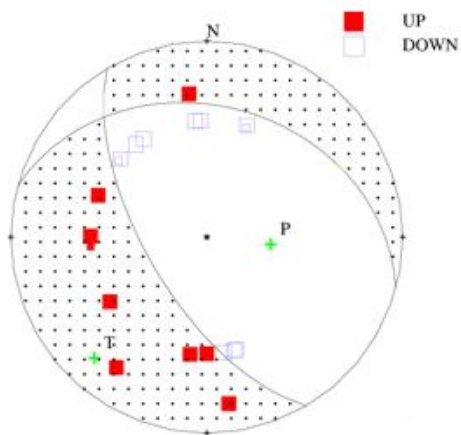
Ev.no	Date			Time			Location		H(Km)	ML	Mechanism						P-axis		T-axis	
	Year	Month	Day	Hour	Minutes	Seconds	Lat	Long			Strike1	Dip1	Rake1	Strike2	Dip2	Rake2	az	pl	az	pl
Ev01	2012	1	30	17	4	26.35	27.69	34.06	9.59	5.18	120	69	-135	11	49	-29	343.9	46.1	241	12.3
Ev02	2012	6	2	8	13	56.68	27.70	34.11	9.08	4.14	169	65	-67	285	33	-129	96.1	62.7	222	16.9
Ev03	2013	1	22	0	35	52.42	28.44	33.14	15.95	3.99	225	44	-36	343	66	-127	206.4	52.9	99.1	12.7
Ev04	2013	4	7	15	58	1.86	27.69	34.08	17.35	4.57	183	46	-16	284	79	-135	154.2	39.2	46.5	20.6
Ev05	2013	4	11	3	56	9	27.81	33.48	19.53	4.22	158	64	-13	253	78	-153	118.6	26.9	23.7	9.61
Ev06	2013	6	1	11	49	28.87	28.42	33.15	13.31	5.45	160	50	-43	282	58	-131	136.0	56	39	5
Ev07	2014	7	22	3	3	44.99	29.77	32.43	22.13	4.99	149	51	-49	274	54	-130	124	59	31	1
Ev08	2015	6	10	6	48	23.71	28.79	33.13	16	3.6	141	63	-62	272	39	-132	96	61	149	13
Ev09	2015	8	6	6	16	52	28.69	32.99	15.2	3.57	83	65	-41	193	53	-148	43	46	140	7
Ev10	2015	12	1	0	59	53.85	29.76	32.51	19	3.65	142	54	-158	39	72	-38	355	39	11	94
Ev11	2016	9	8	0	26	50.78	28.69	32.99	18	3.78	148	47	-49	277	56	-125	131	61	31	5



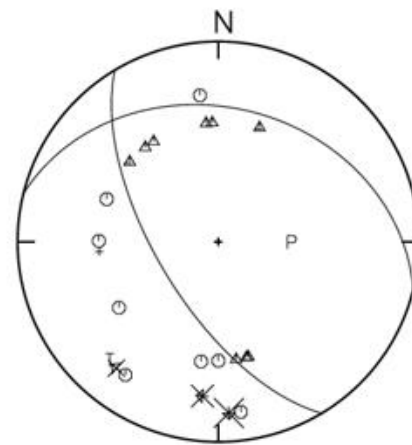
Focal mechanism of Ev01



Focal mechanism of Ev01

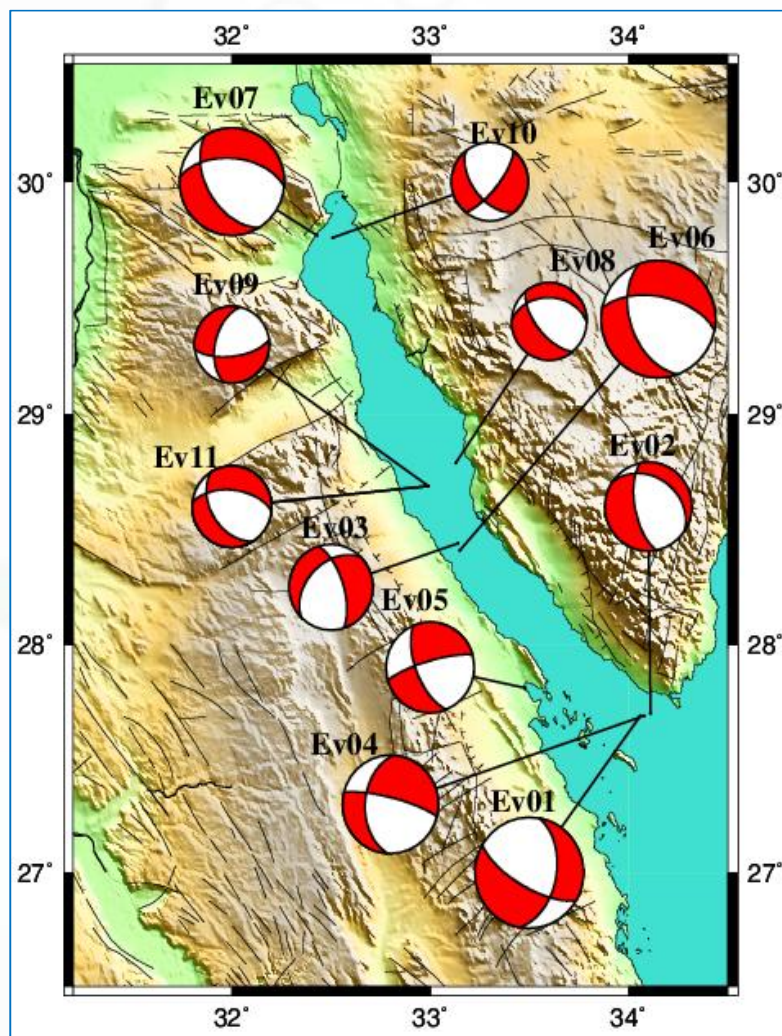


Focal mechanism of Ev02



Focal mechanism of Ev02

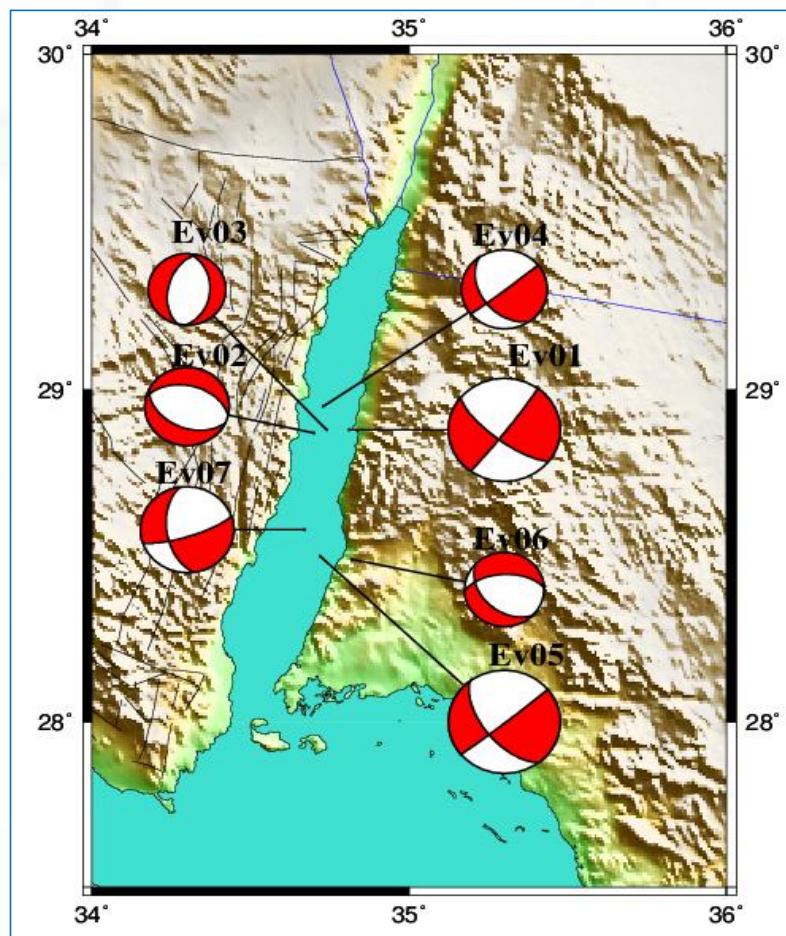
Fault plane solutions for  
earthquakes in the Gulf of Suez  
region



Fault plane solutions for earthquakes in the Gulf of Suez region.



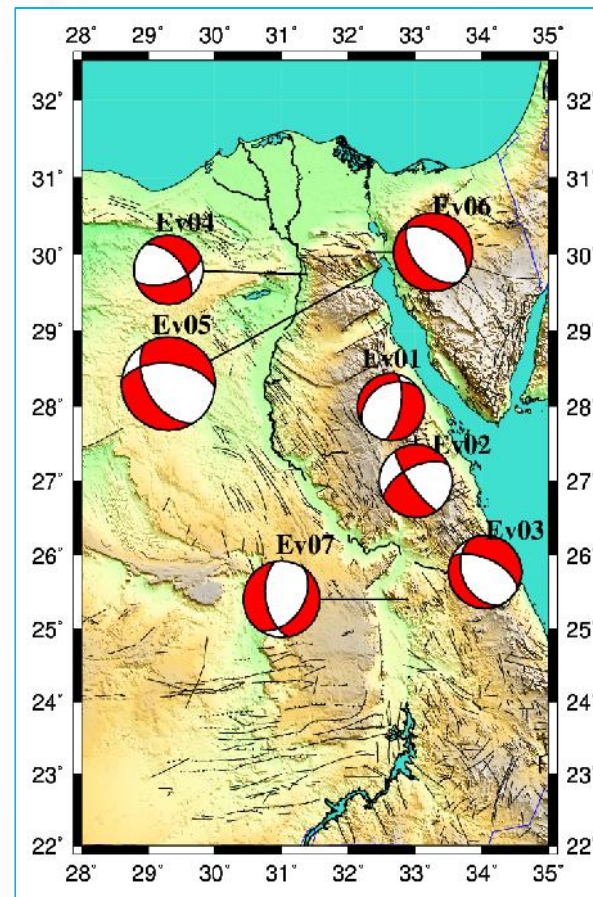
# Focal mechanism in Gulf of Aqaba region







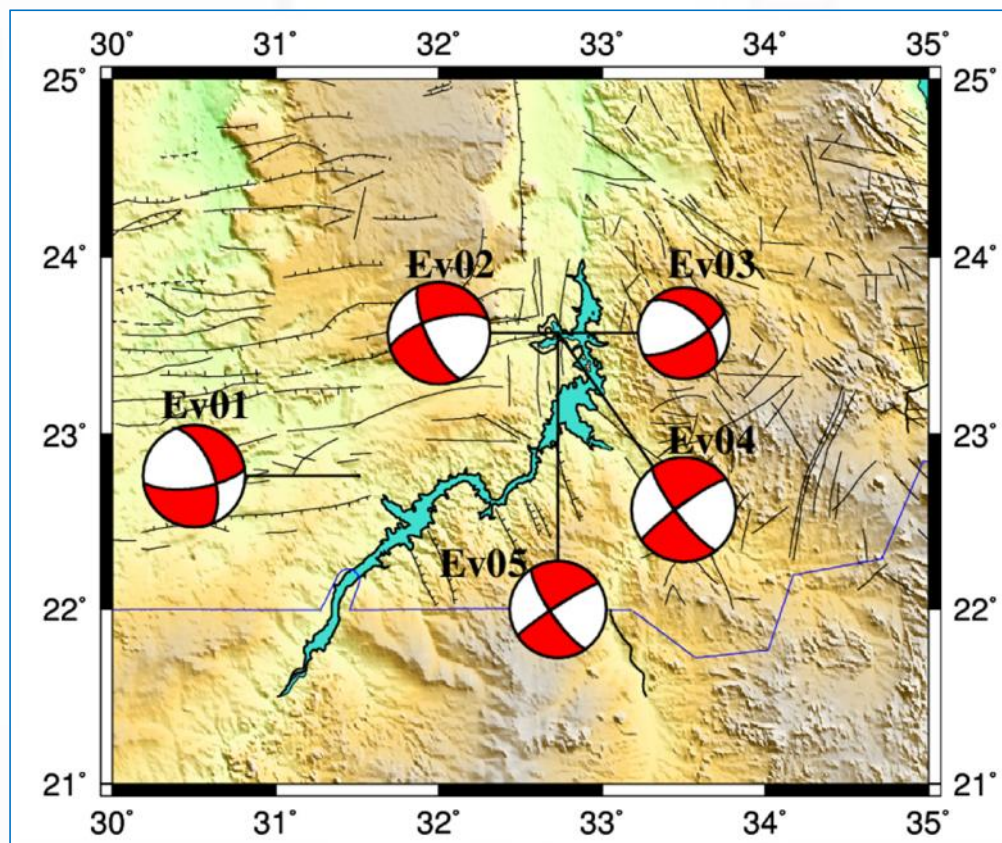
# Focal mechanism in Eastern desert





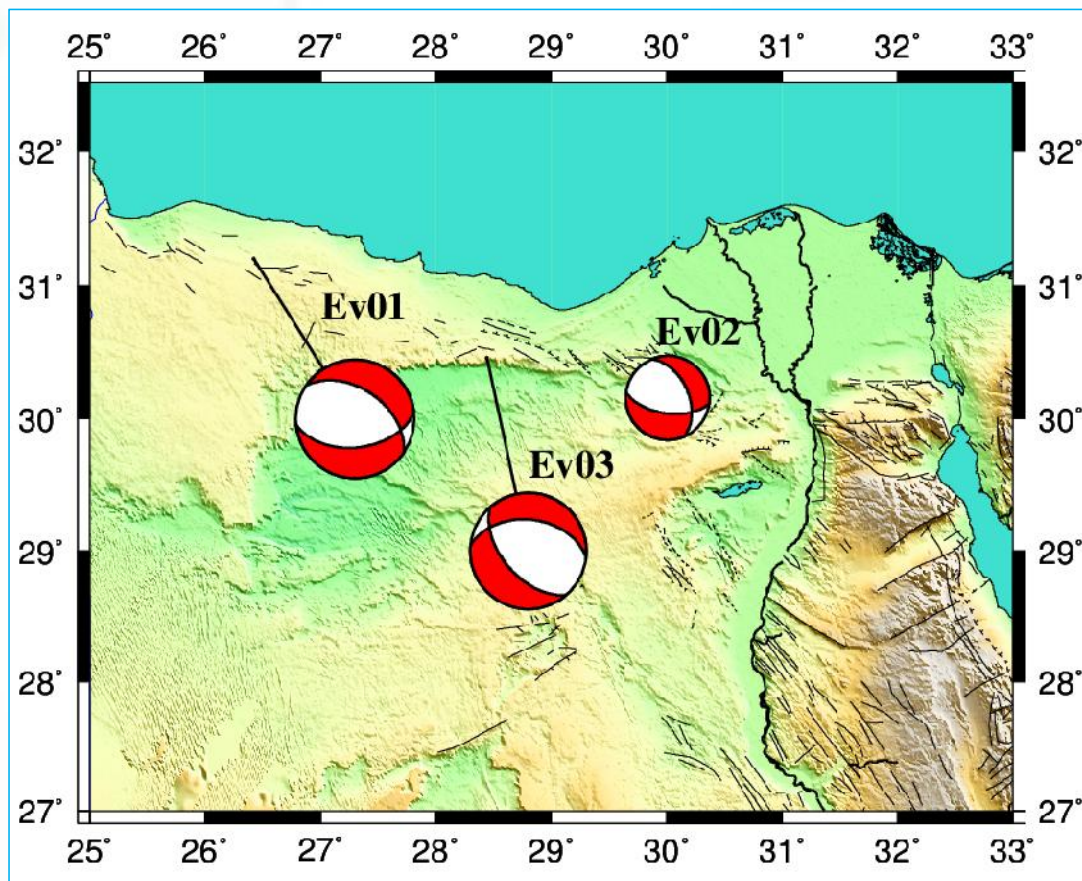


## Focal mechanism solutions at Aswan region





## Focal mechanism in Western desert





## Focal mechanism in Sinai region

