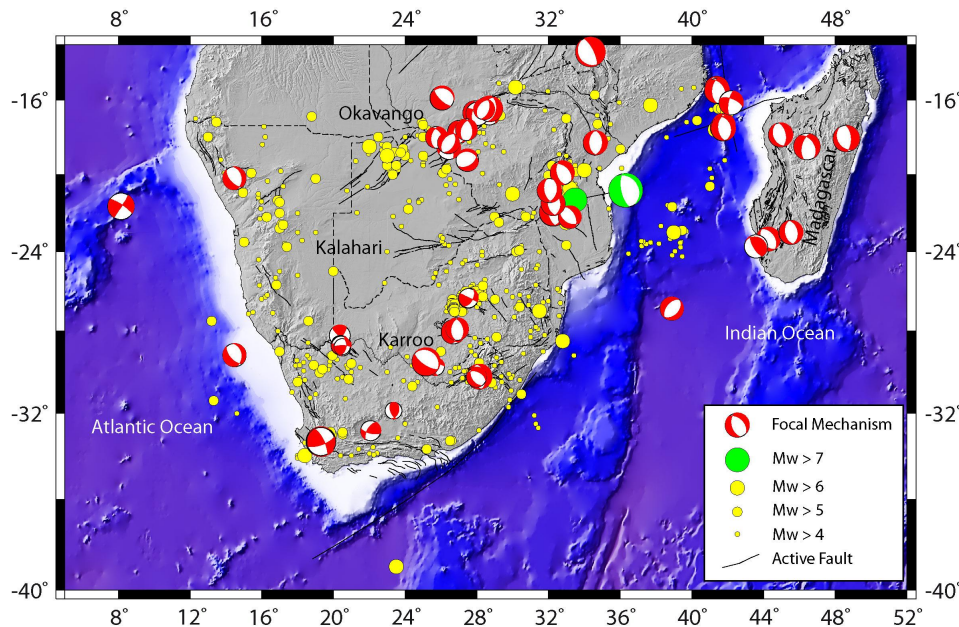




# GEOSCIENCE INFORMATION FOR TEACHERS (GIFT) WORKSHOP at the 35th IGC (27 – 28th Aug. 2016)



## EARTHQUAKE STUDIES IN AFRICA Faulting and seismotectonics



By Mustapha Meghraoui  
Institut de Physique du Globe de Strasbourg, France  
E-mail: [m.meghraoui@unistra.fr](mailto:m.meghraoui@unistra.fr)



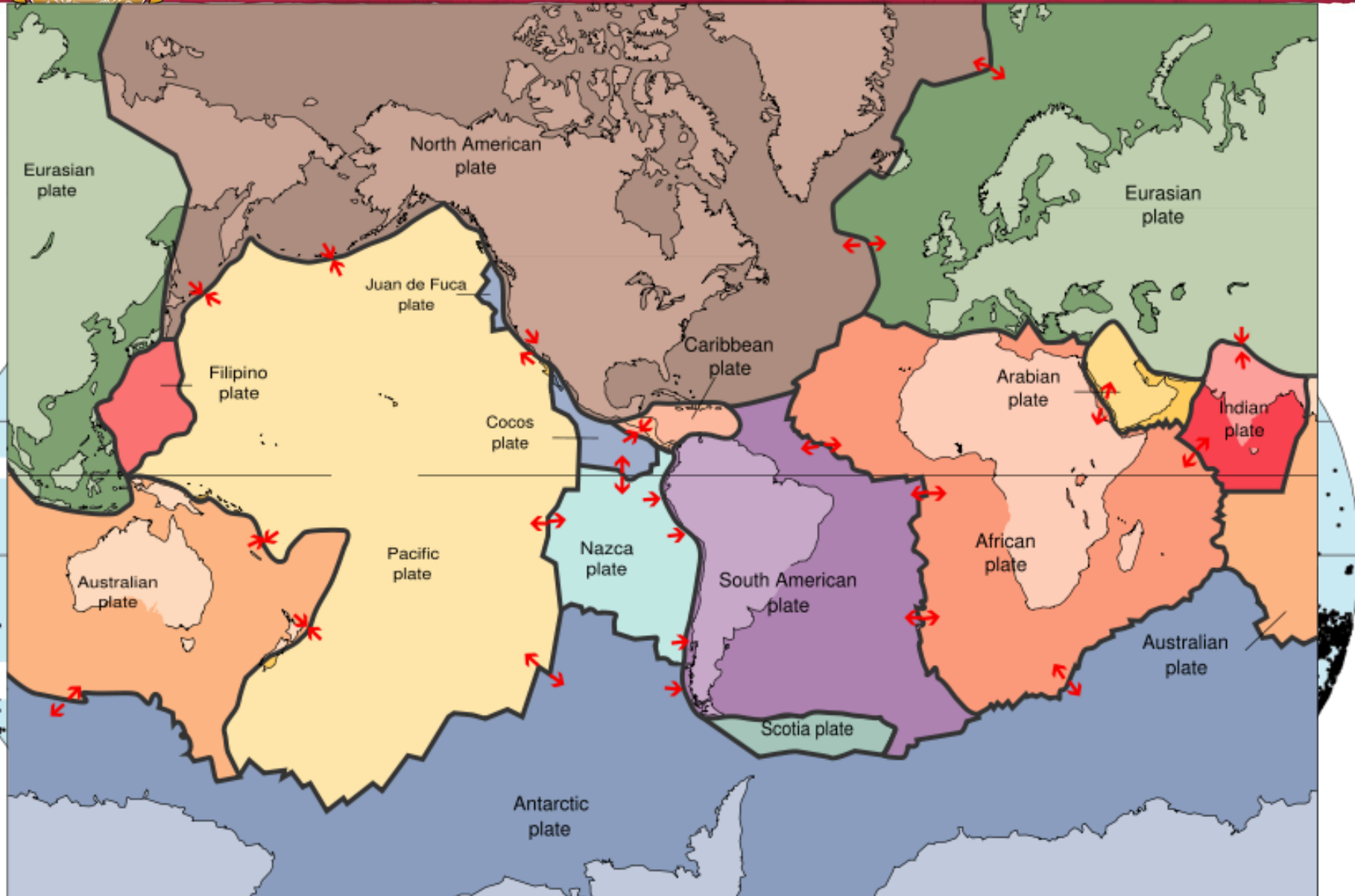
# ***GEOSCIENCE INFORMATION FOR TEACHERS (GIFT) WORKSHOP at the 35th IGC (27 – 28th Aug. 2016)***

## **OUTLINES**

- Earthquakes and plate tectonics
  - How do we understand earthquakes ?
  - Crustal deformation and earthquake ruptures
  - New techniques (Lidar, InSAR)
- Seismotectonics in Africa
  - On the importance of a database!
  - Intraplate versus interplate seismic activity
- Major earthquakes of southern Africa
  - Earthquake Damage
  - Hazard assessment and loss estimate
- References

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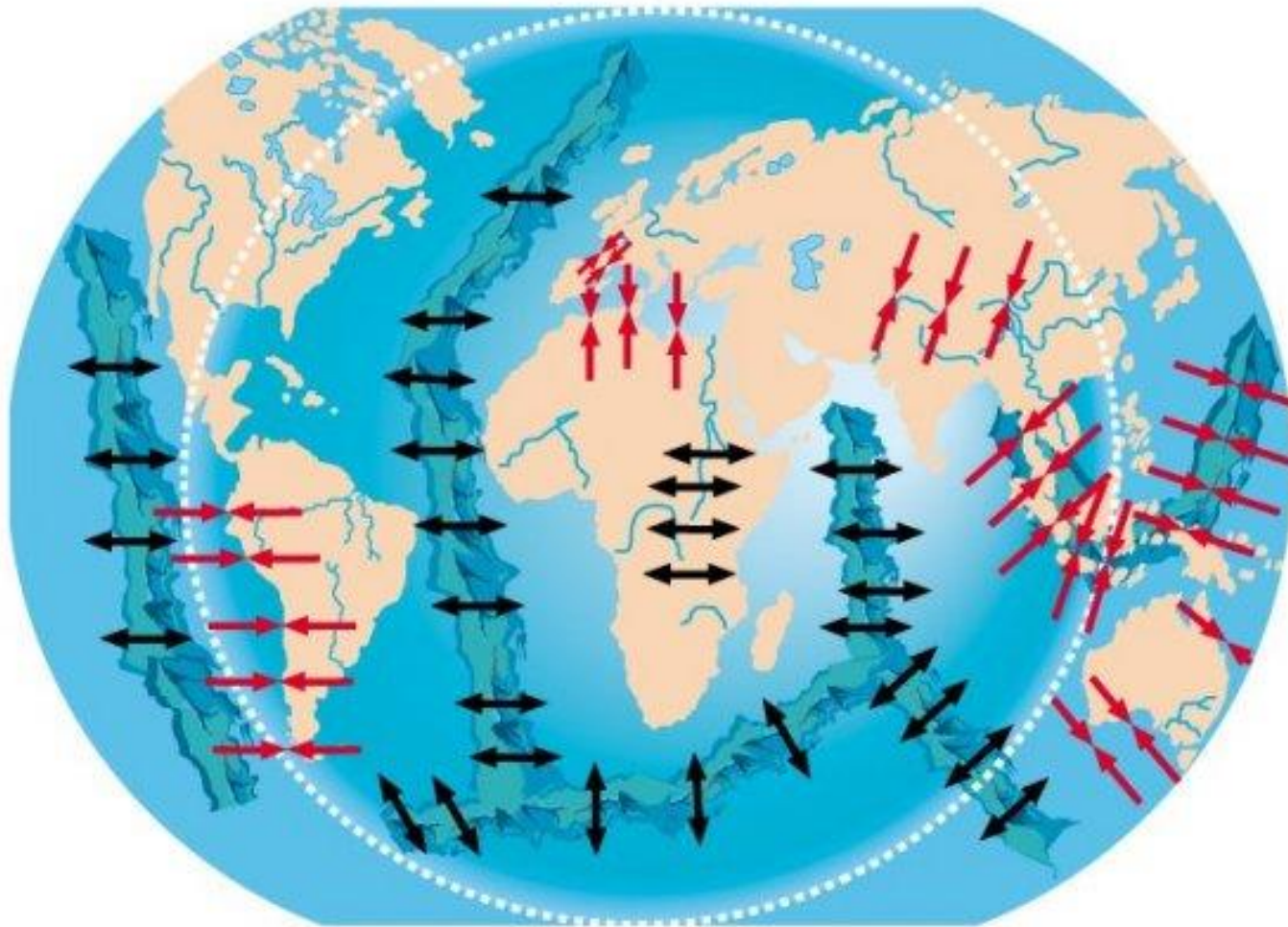
## Earthquakes and Plate Tectonics





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## Earthquakes and Plate Tectonics



Divergence



Convergence



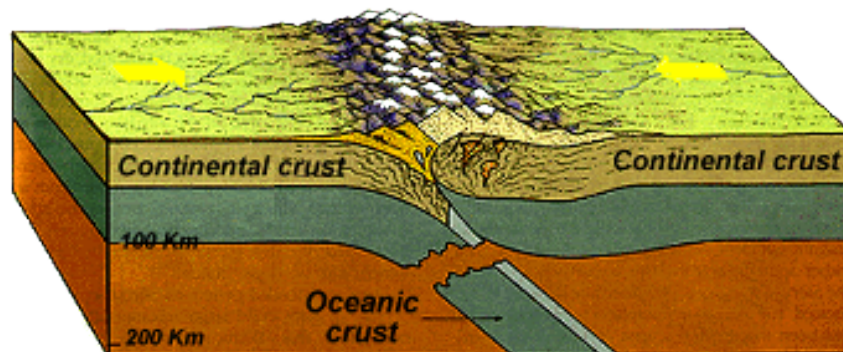


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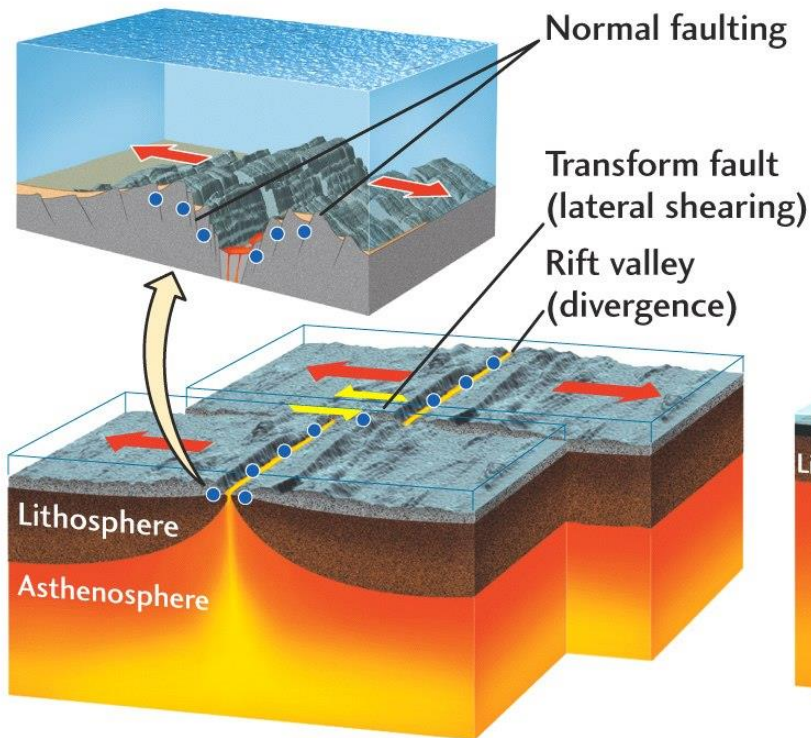
## Earthquakes and Plate Tectonics



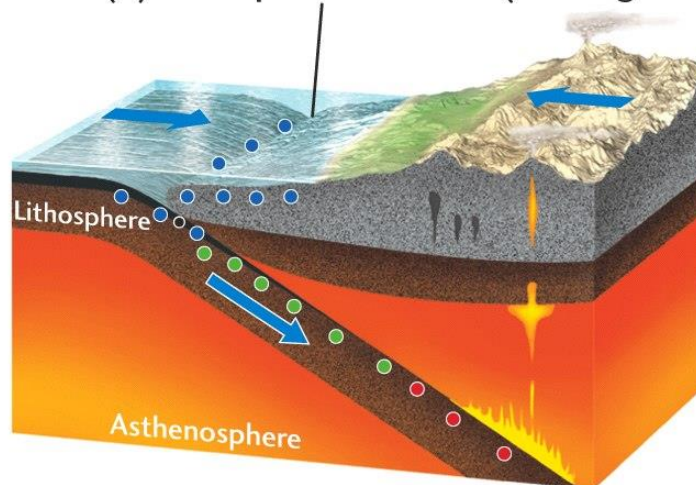
### Collision tectonics



(a) Mid-ocean ridge (divergence)



(b) Deep-ocean trench (convergence)

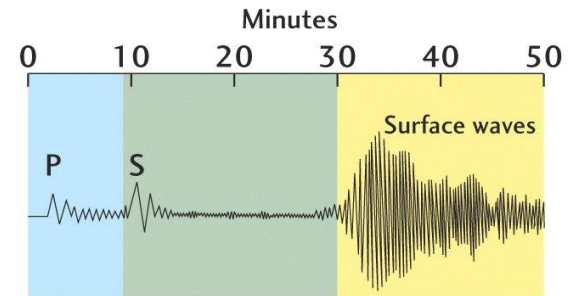
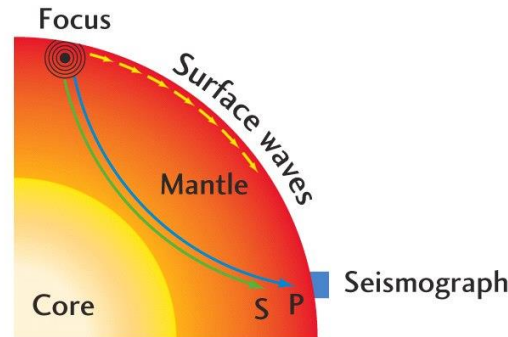
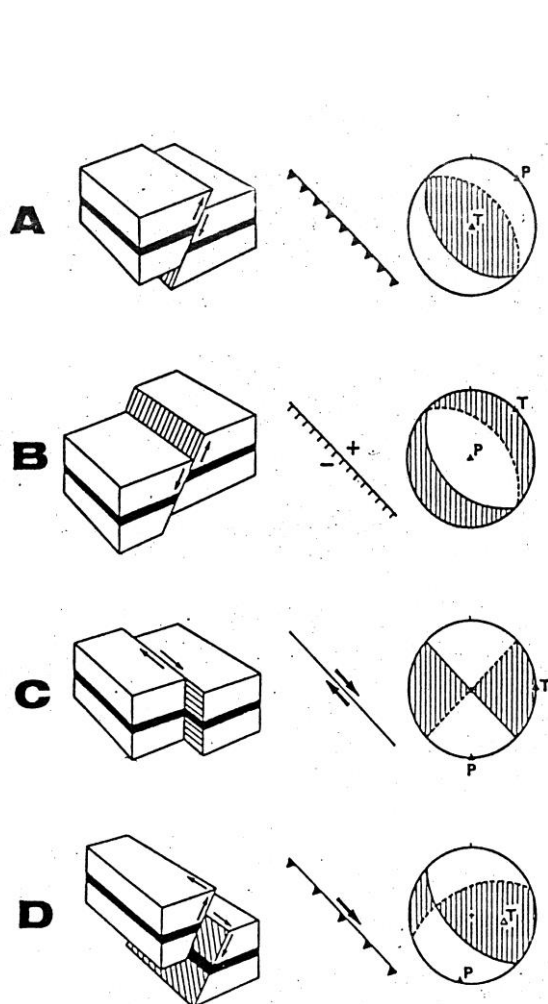




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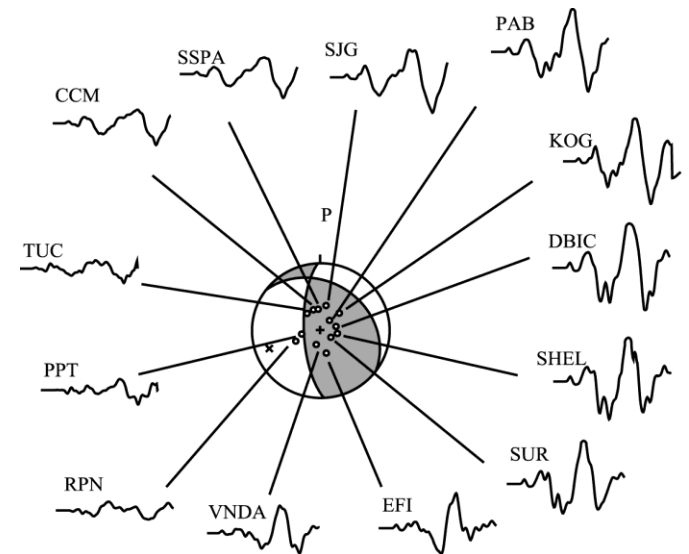
## Earthquakes and Plate Tectonics

THE THREE DIFFERENT TYPES OF SEISMIC WAVES MOVE AT DIFFERENT SPEEDS



$$M = \log A - \log D$$

$$\log E = 11.8 + 1.5 M$$



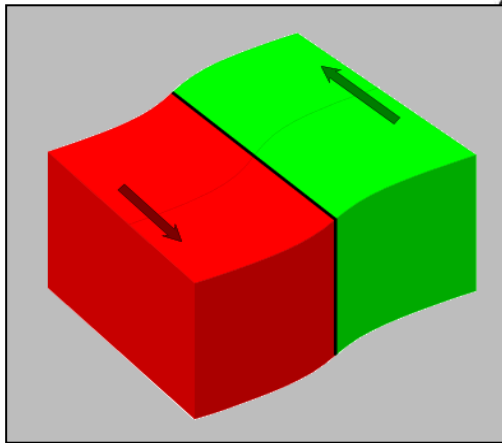
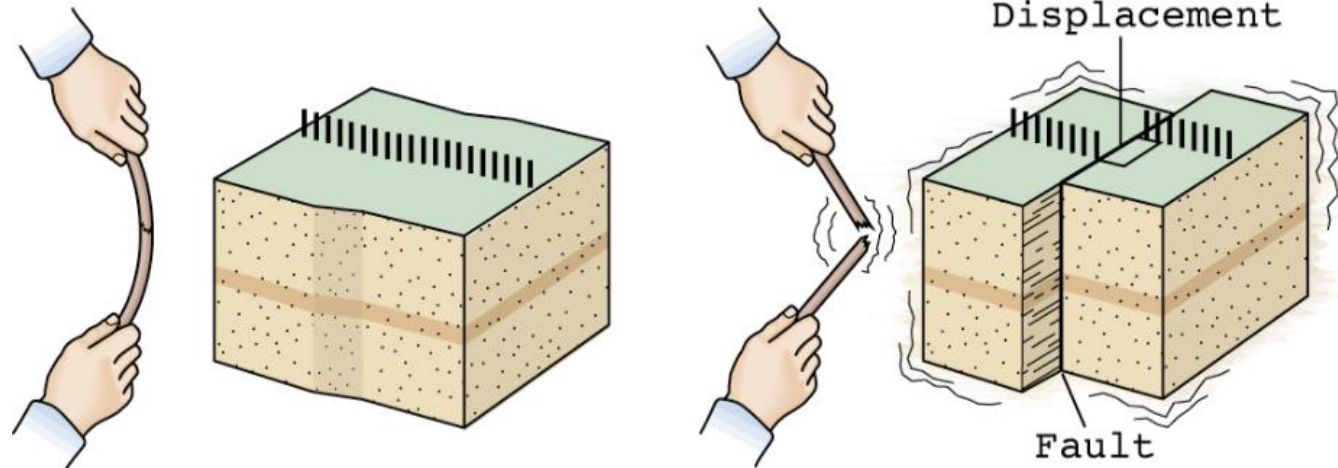




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## Earthquakes and Plate Tectonics

### Faulting and Seismic Rupture



Elastic rebound (Reid, 1910)

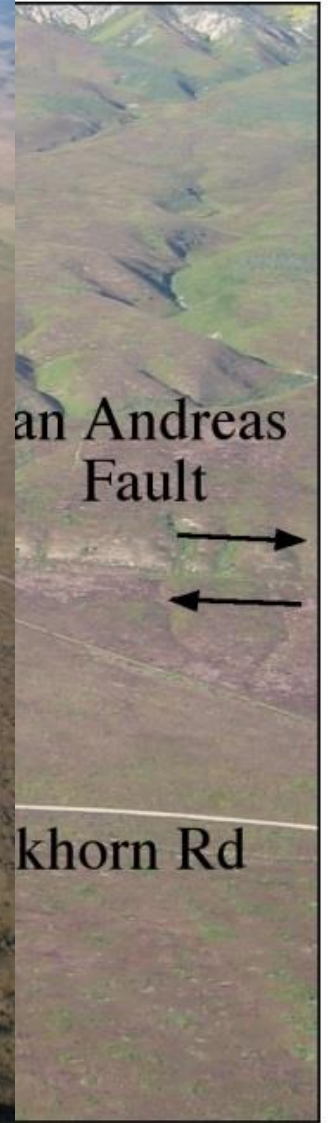
Seismic moment

$$M_0 = \mu L W D$$

Moment magnitude

$$M_w = 2/3 \log M_0 - 10.73$$

Aug. 2016)



San Andreas Fault



Khorn Rd

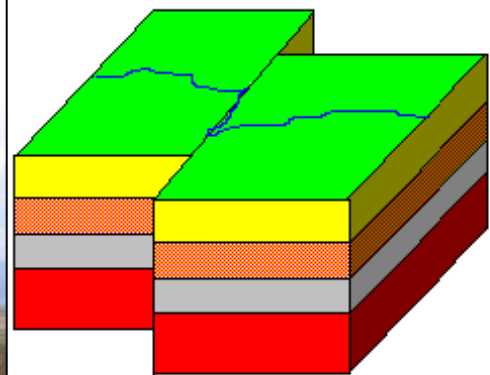
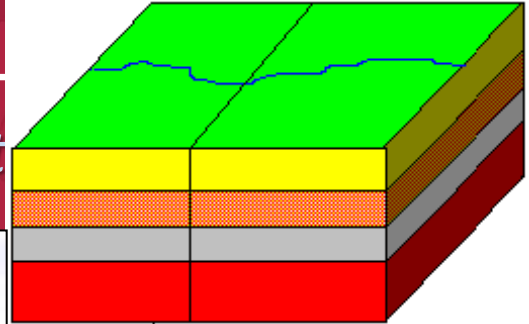


Physique au Globe de Strasbourg





# GIFT WORKSHOP at the 35th IGC (27 – Earthquakes and Plate Tect





# WORKSHOP at the 35th IGC (27 – 28th Aug. 2016)

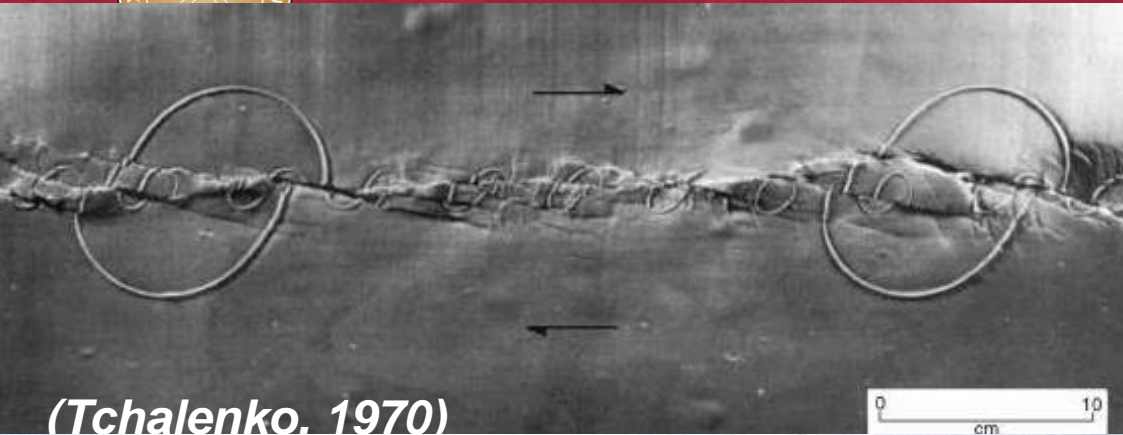
## Earthquakes and Plate Tectonics





# GIFT WORKSHOP at the 35th IGC (27 – 28th Aug. 2016)

## Earthquakes and Plate Tectonics



(Tchalenko, 1970)



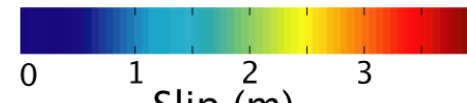
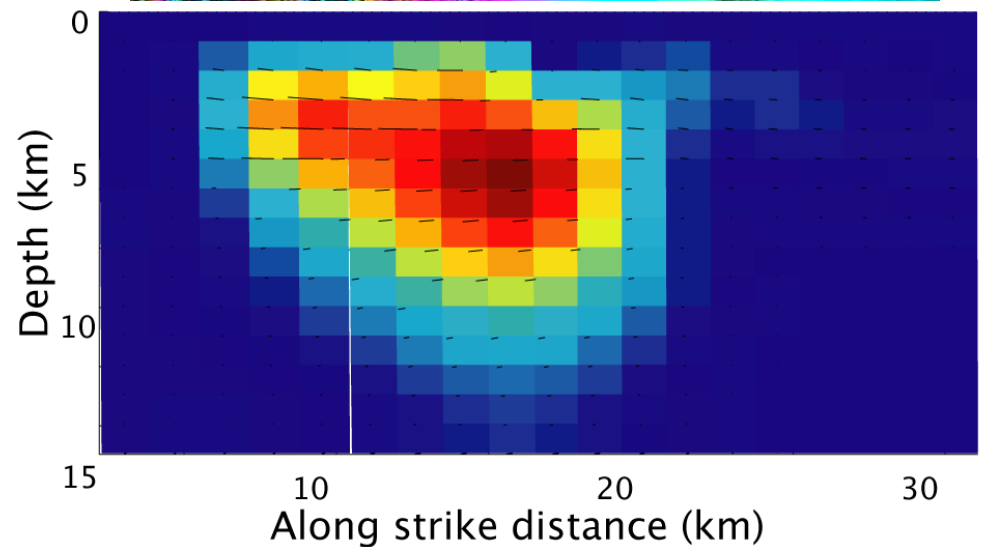
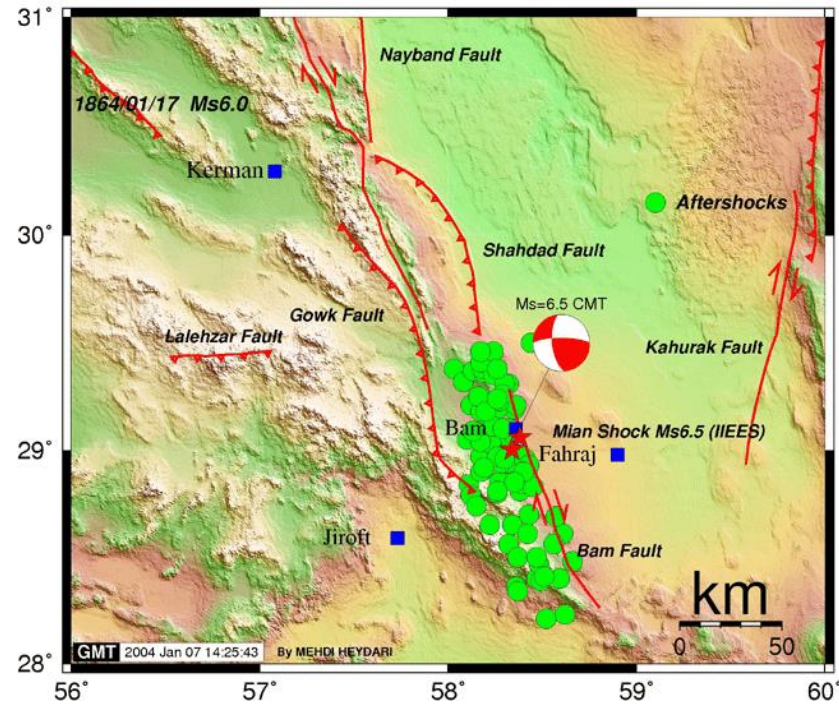
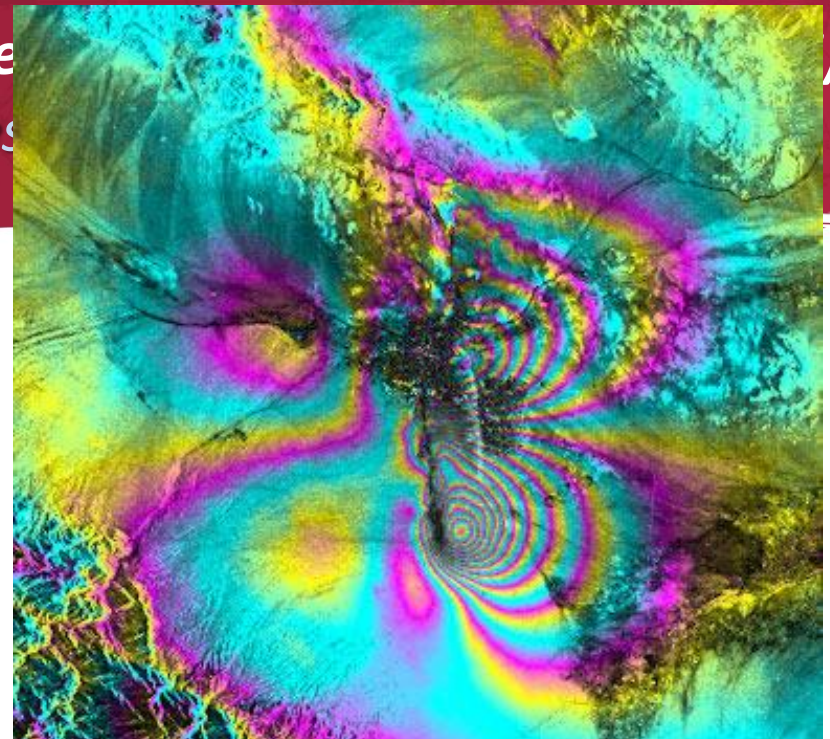
Analogue modelling  
and  
surface faulting





# GIFT WORKSHOP at the Earthquakes

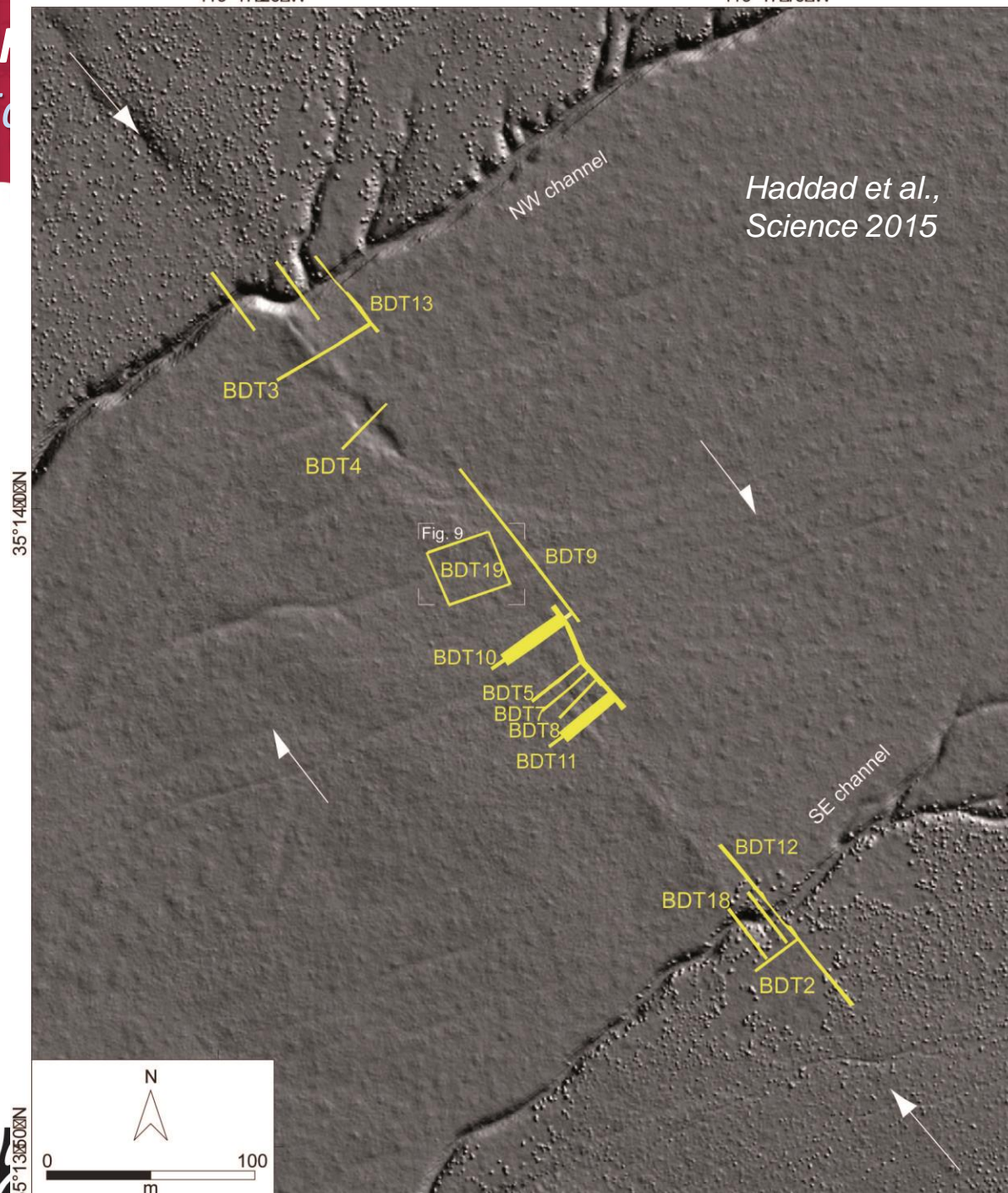
## InSAR Bam earthquake (2004, Mw 6.5)







# LIDAR technique (high-resolution Topography)





# ***GIFT WORKSHOP at the 35th IGC (27 – 28th Aug. 2016)***

## ***Seismotectonics in Africa***

### **THE NEW SEISMOTECTONIC MAP OF AFRICA**

- 4745 instrumental earthquakes  $M > 4$  1900 to 2012
- ~ 100 historical (pre-1900 damaging earthquakes)
- ~ 155 active (seismogenic) faults
- 211 volcanoes (~ 43 presently active)

**12 damaging earthquakes in South Africa (1766 to 1899)**

**1315 seismic events  $M > 4$  in southern Africa (1900 – 1912)**

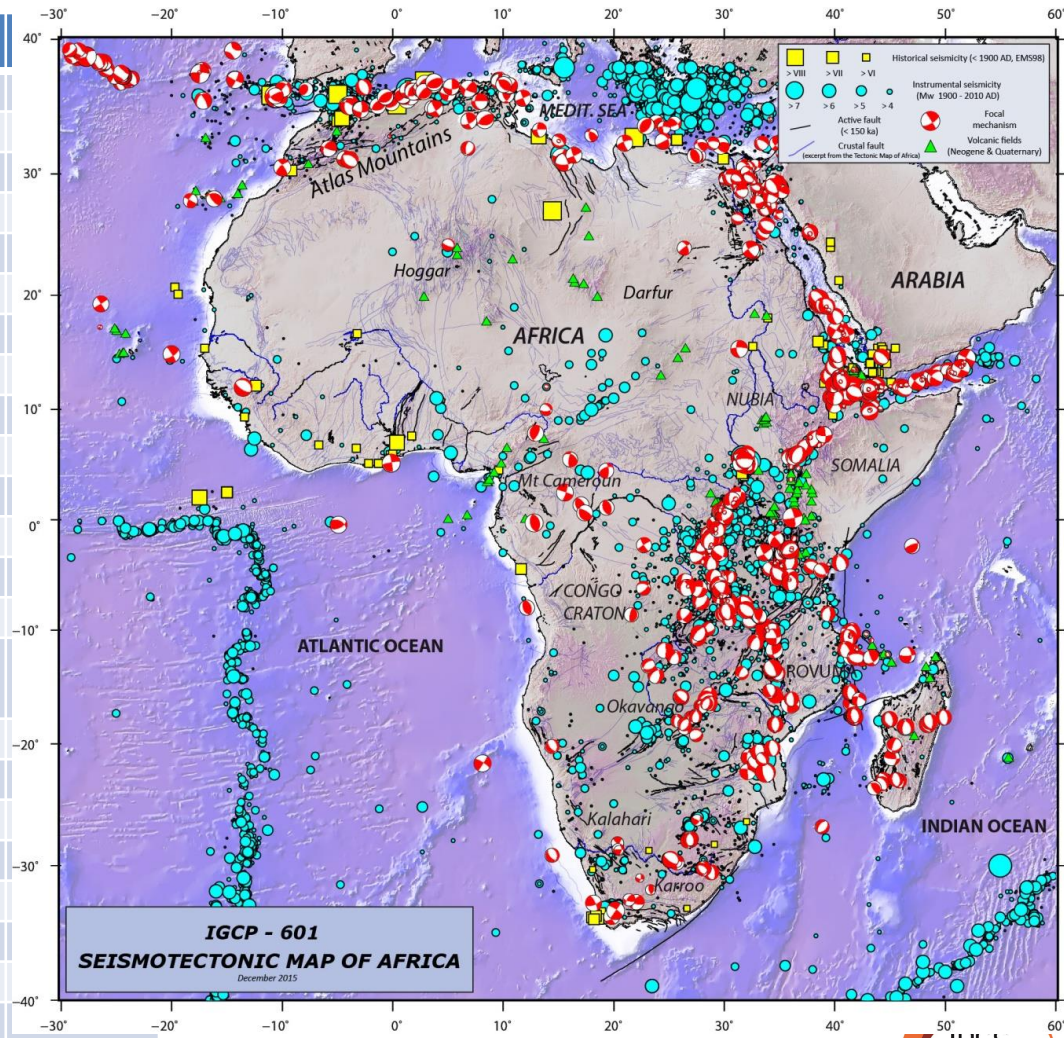




# GIFT WORKSHOP at the 35th IGC (27 – 28th Aug. 2016)

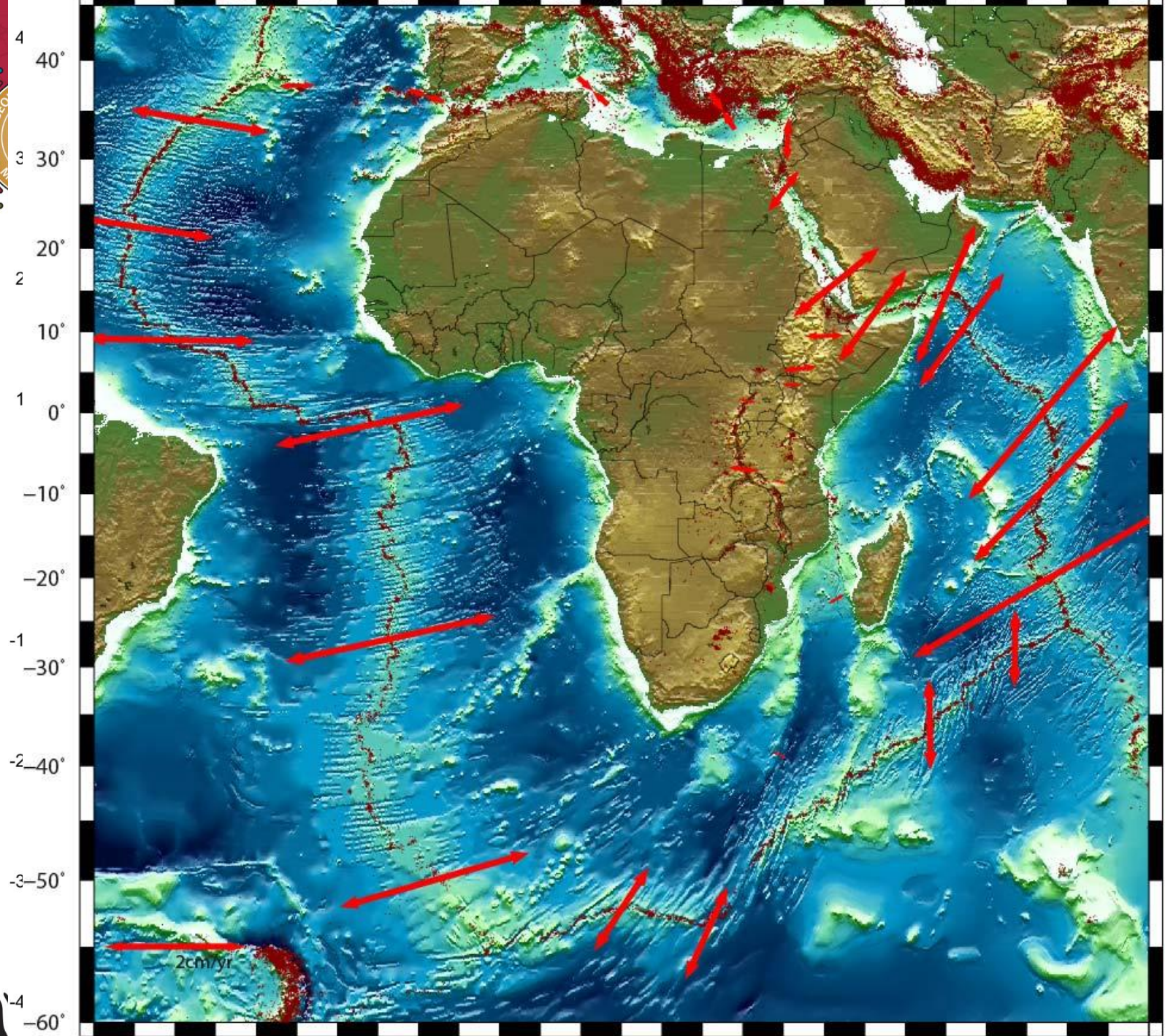
## Seismotectonics in Africa

Earthquakes	Dates	Latitude	Longitude
Lac Tanganyika	1910 Dec. 13	-6.5	29.5
El-Asnam, Algeria	1980 Oct. 10	36.23	1.32
Nuweiba, Egypt	1995 Nov. 22	28.81	34.80
Juba, South Sudan	1990 Mai 20	5.11	32.18
Subukia, Kenya	1928 Jan. 6	0.4	36.11
Al-Qadahia, Libye	1935 Apr. 19	31.38	15.4
Machaze, Mozambique	2006, Feb. 22	-21.32	33.58
Kalemie, Congo-Tanzania	2005 12 5	-6.25	29.79
Zemmouri, Algeria	2003, May 21	36.83	3.65
Orleansville, Algeria	1954 Sep. 9	36.28	1.47
Salima, Malawi	1989 Mar. 10	-13.71	34.49
Accra, Ghana	1939 Jun. 22	5.18	0.13
El-Hoceima, Morocco	2004, Feb. 24	35.14	-4
Dobi, Ethiopia	1989 08 20	11.75	41.96
Ceres, West Cape, S. Africa	1969 Sept. 29	-33.36	19.31
Kivu, DR Congo	2002 Oct. 24	-1.905	29.013
Karonga, Malawi	2009 Dec. 19	10.108	33.81
Gaoual, Guinea	1983 Dec. 22	11.95	-13.6
Mascara, Algeria	1994 Aug. 18	35.45	0.08
Bukavu, DR Congo	2008Fev. 2	28.74	-2.45
Rukwa, Tanzania	1994 Aug. 18	6.5	29.5
Agadir, Morocco	1960 Fev. 28	30.41	-9.6
Cairo, Egypt	1992 Oct. 12	29.78	31.14





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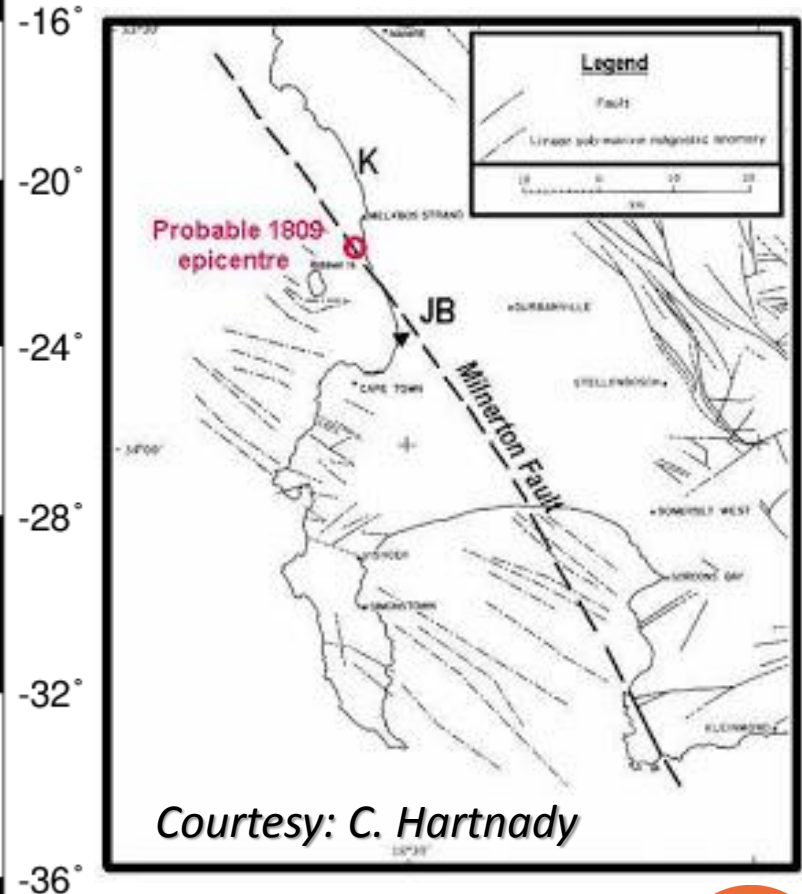
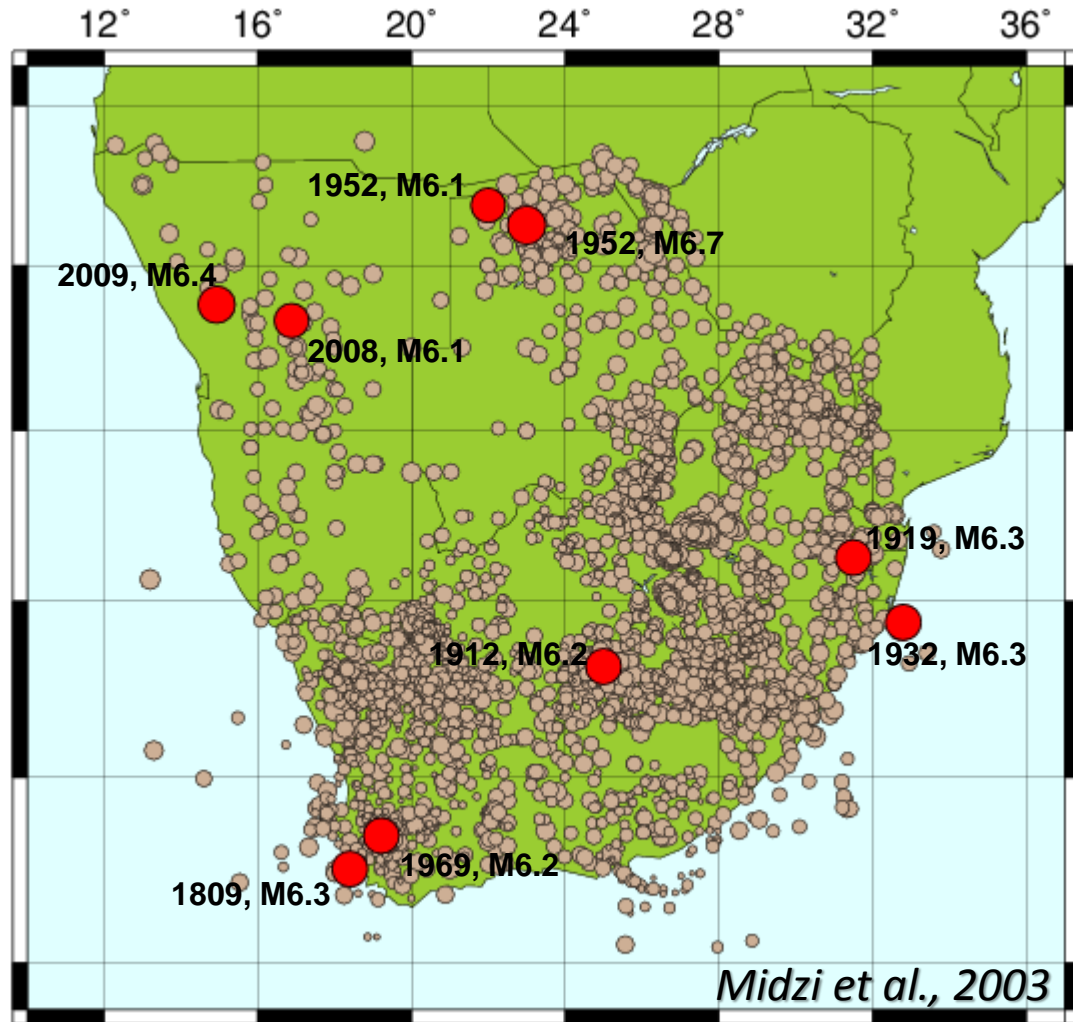
**... to southern Africa  
Seismicity!**





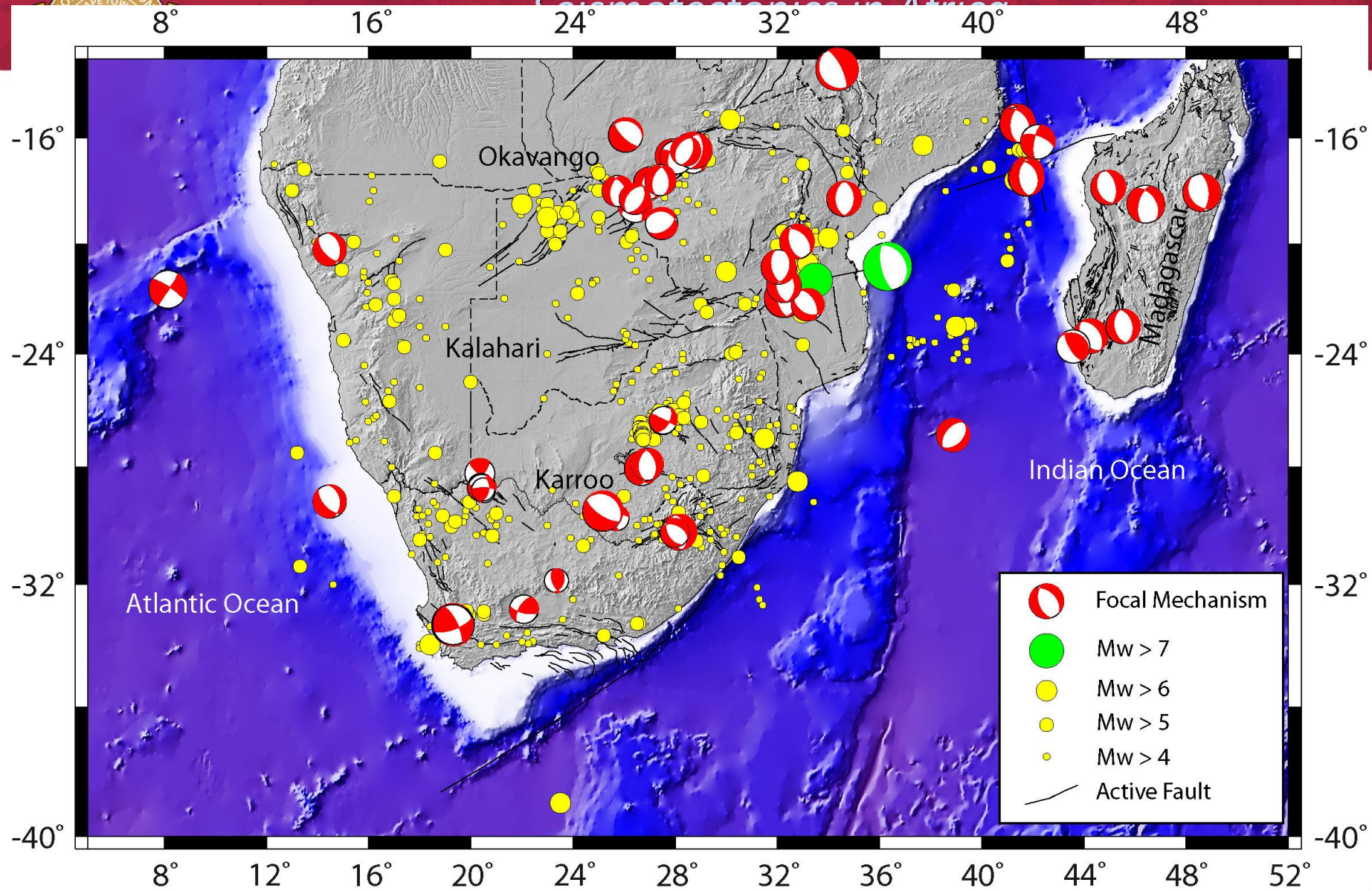
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## Major earthquakes in southern Africa





# GIFT WORKSHOP at the 35th IGC (27 – 28th Aug. 2016)







# GIFT WORKSHOP at the 35th IGC (27 – 28th Aug. 2016)

## Major earthquakes in southern Africa

(a) Machaze earthquake, Mw 7.0 (b)



Toussca et al., GRL 2014



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## Major earthquakes in southern Africa



- 12 people killed     *Ceres (Tulbagh) earthquake of 29/09/1969 Mw 6.3*
- Damage to structures worth \$24 million observed



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[https://www.iris.edu/hq/programs/education\\_and\\_outreach](https://www.iris.edu/hq/programs/education_and_outreach)





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**Beware of Gnami Gnami**

**Thank you**

