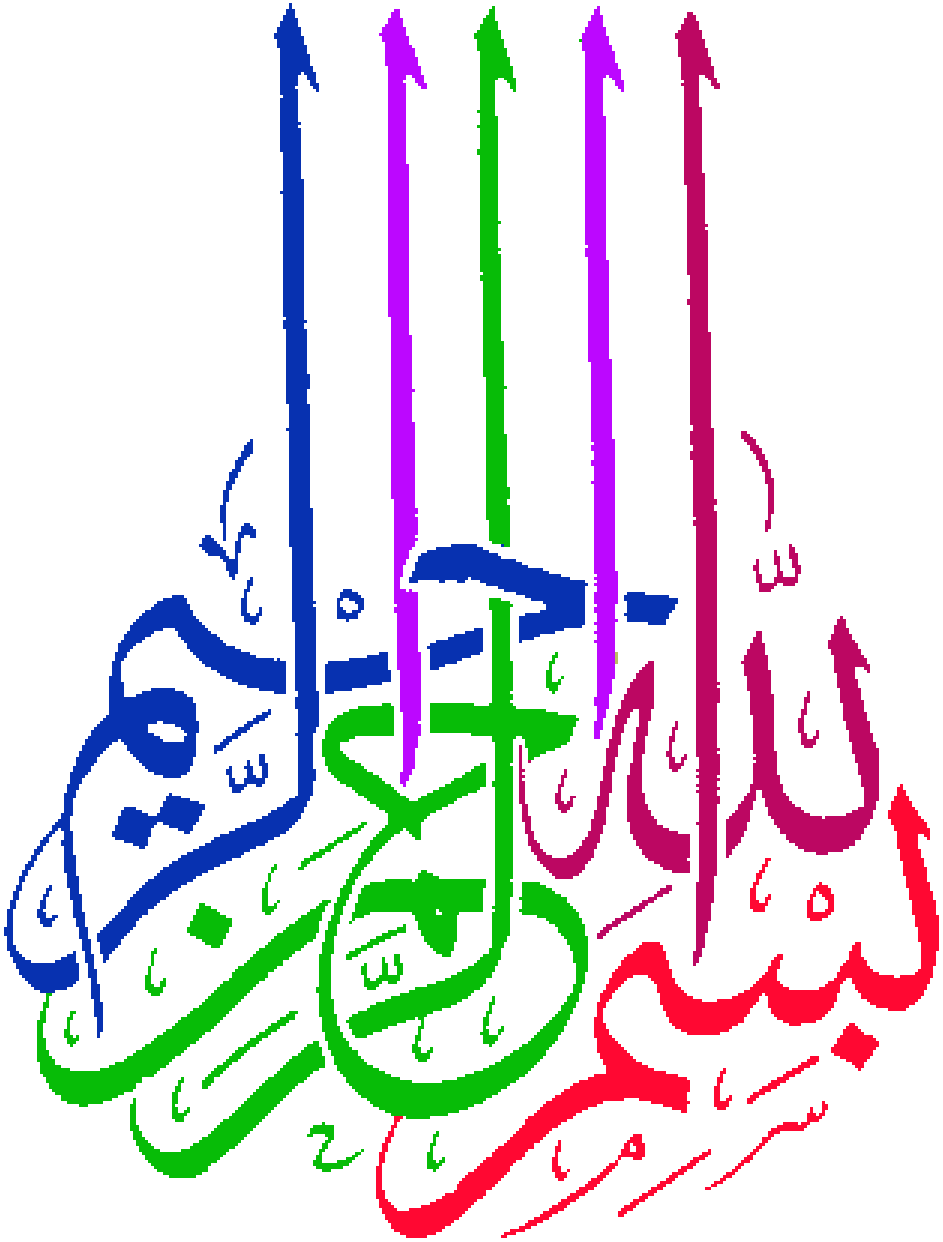

بسم الله الرحمن الرحيم

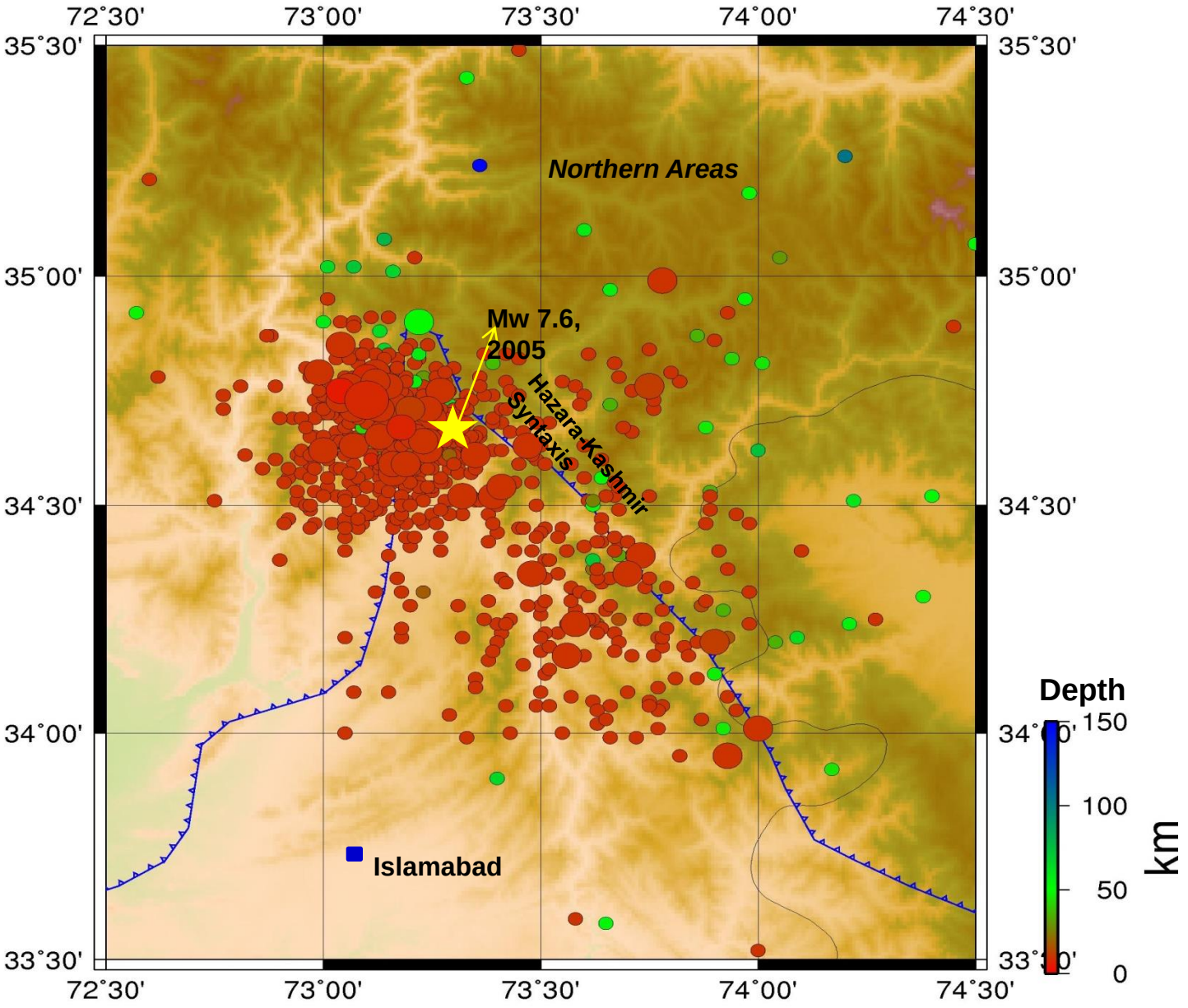
Seismicity Pattern of Pakistan and Surrounding Areas

Pakistan Meteorological Department

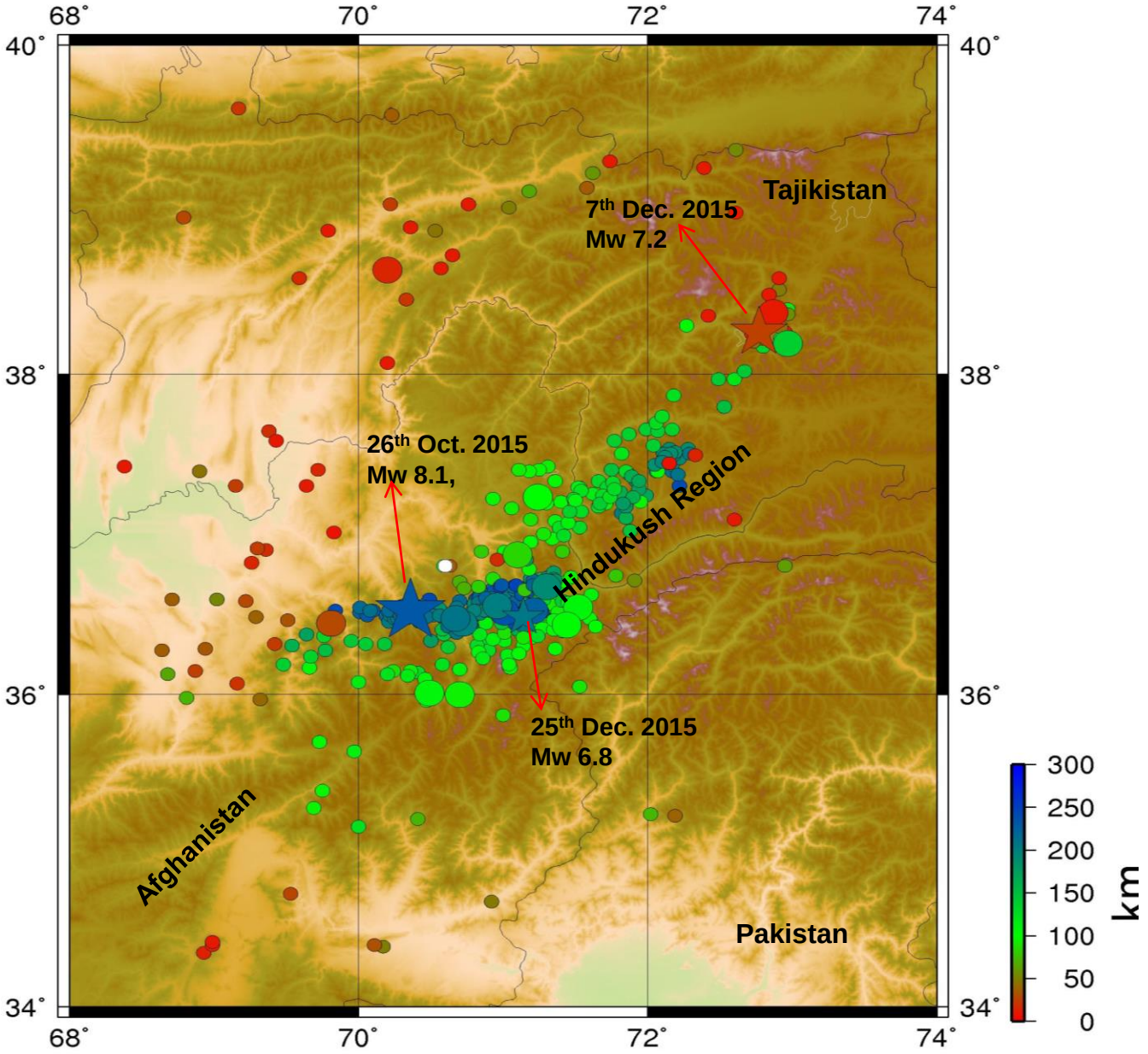
National Seismic Monitoring Network, Islamabad

Dated: 5th January2016

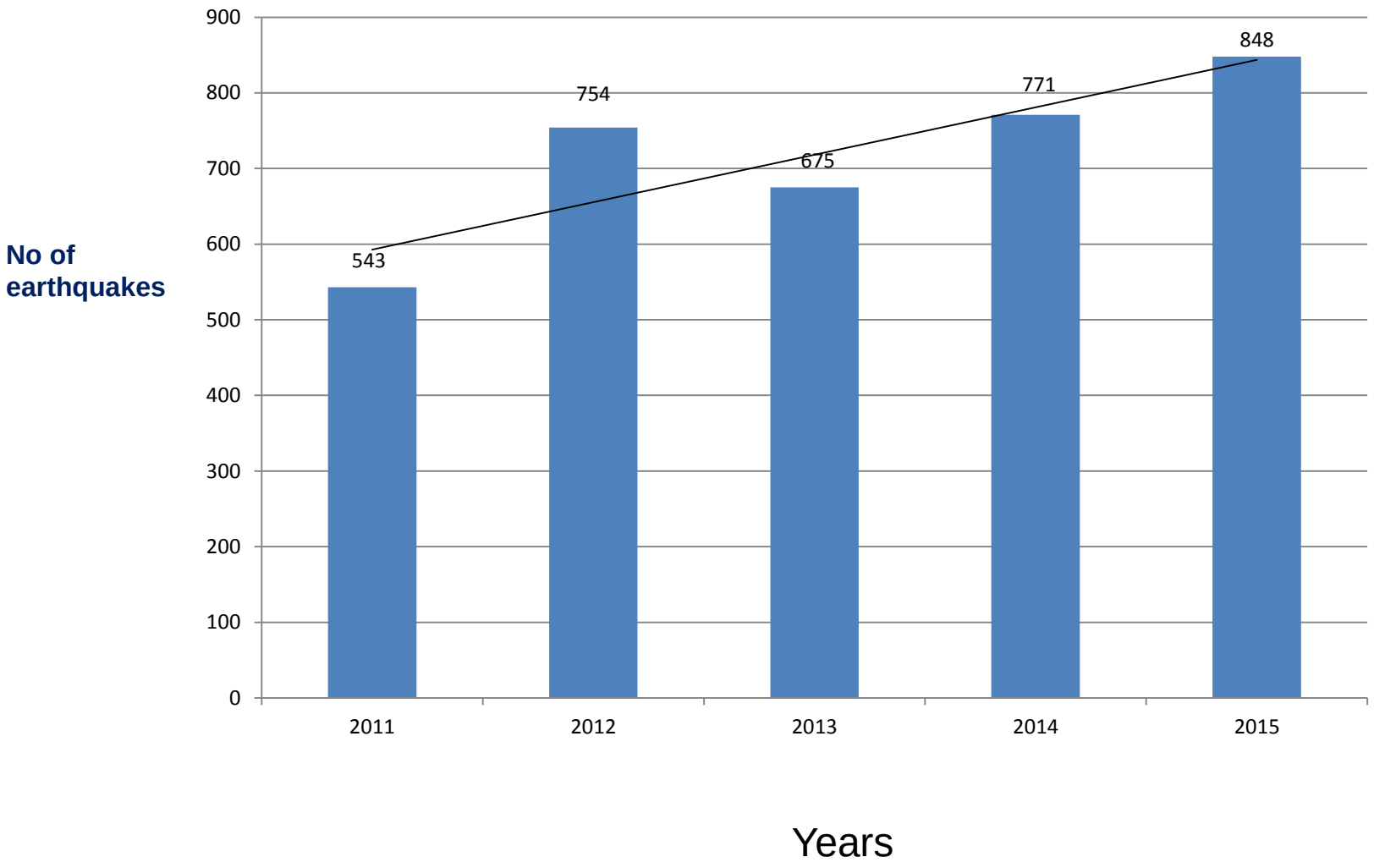
8th October, 2005 Kashmir Earthquake Mw 7.6 and Aftershocks Distribution



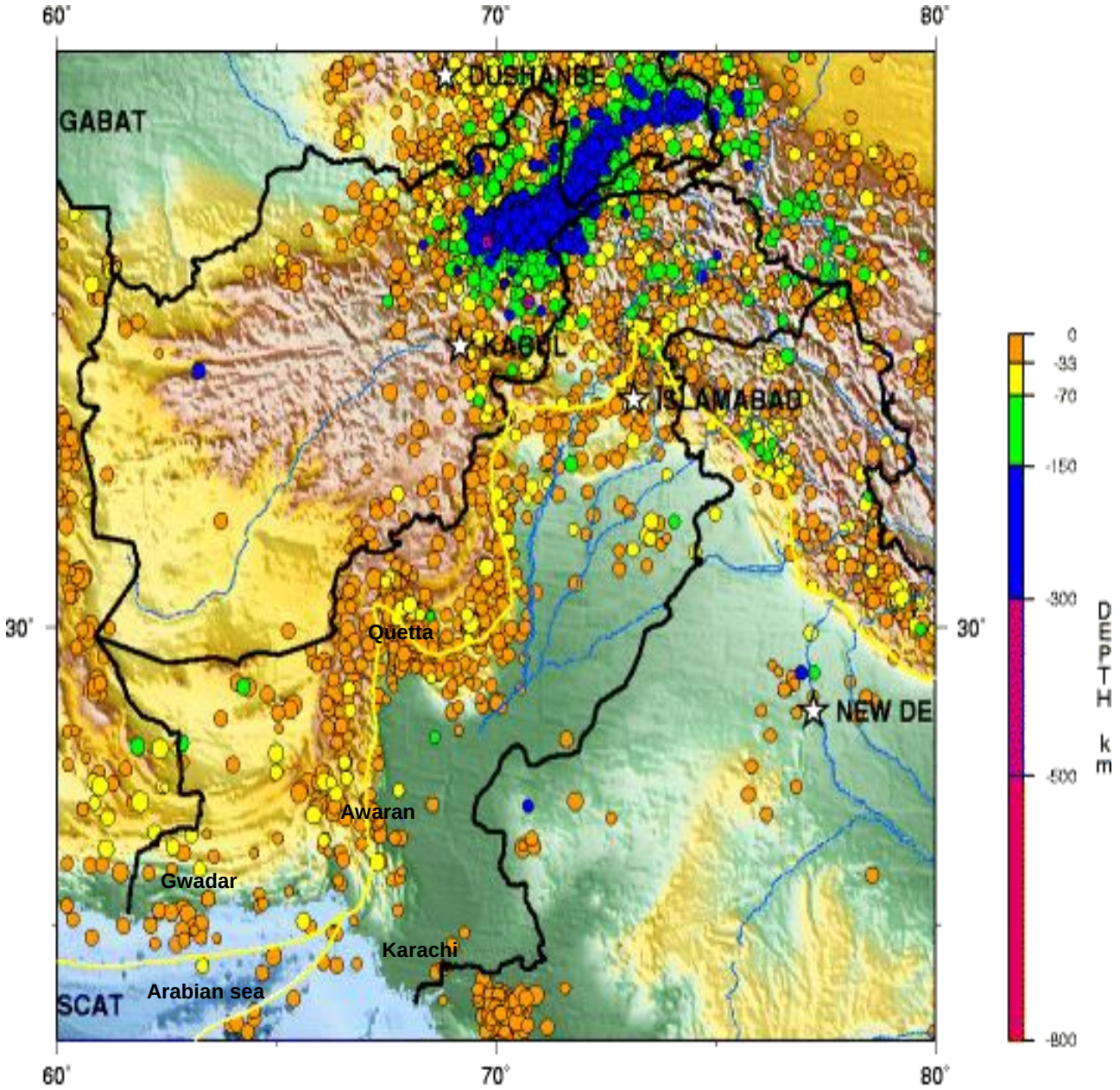
26th October, 2015 Hindukush Region Earthquake Mw 8.1 and Aftershocks Distribution



Last Five Years Frequency of Earthquake in and around Pakistan

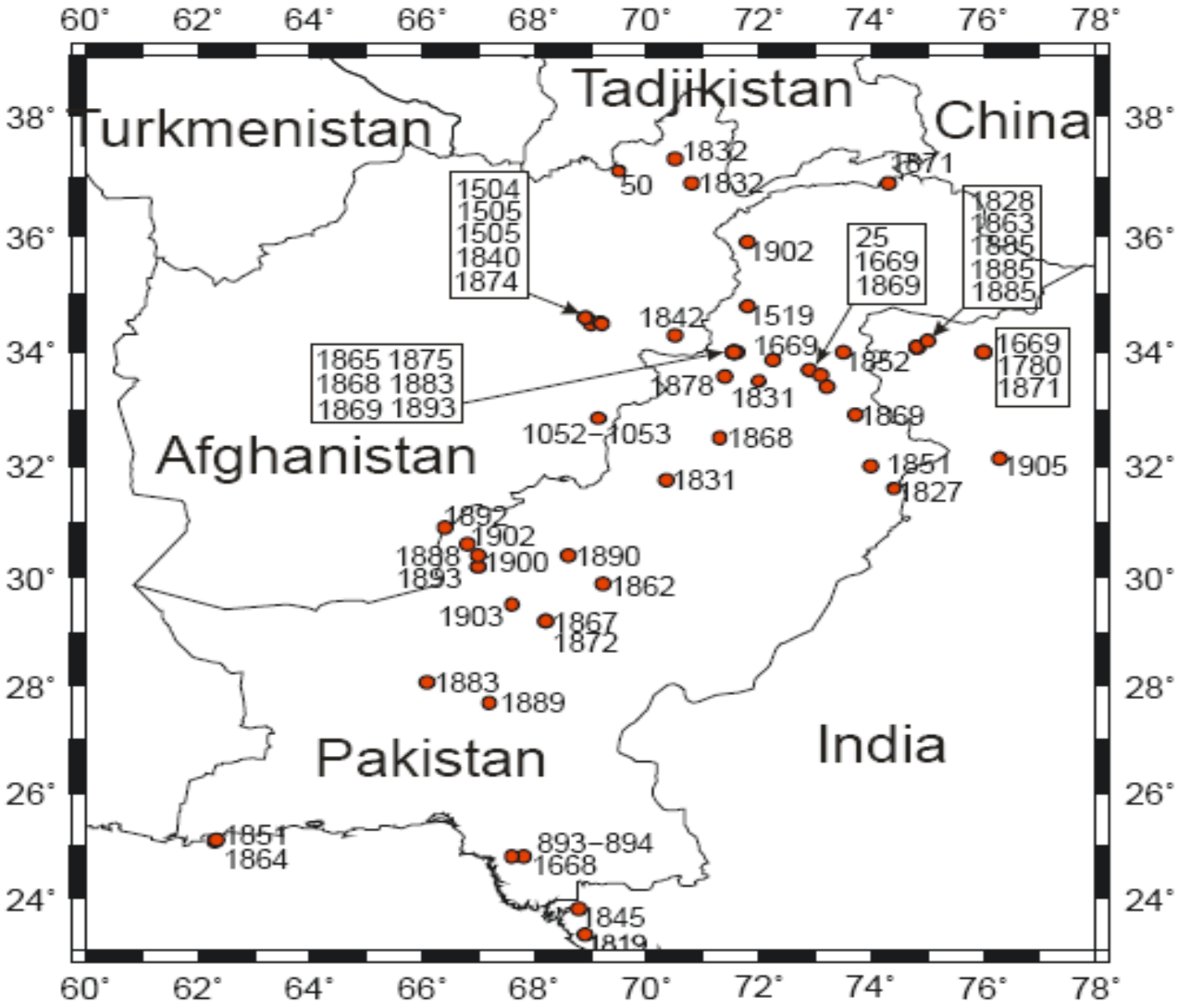


General Seismicity Pattern of Pakistan & Surrounding Areas

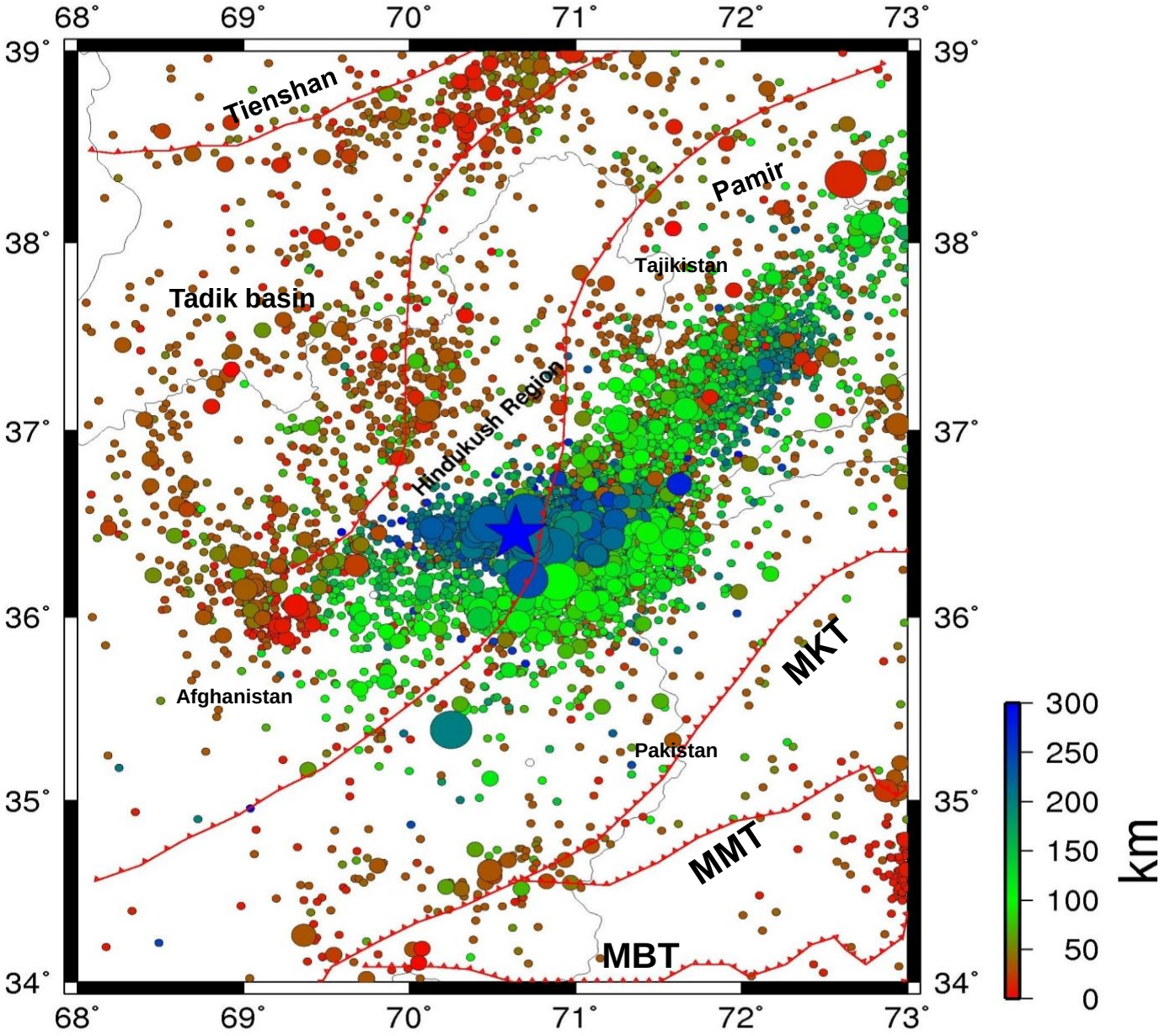


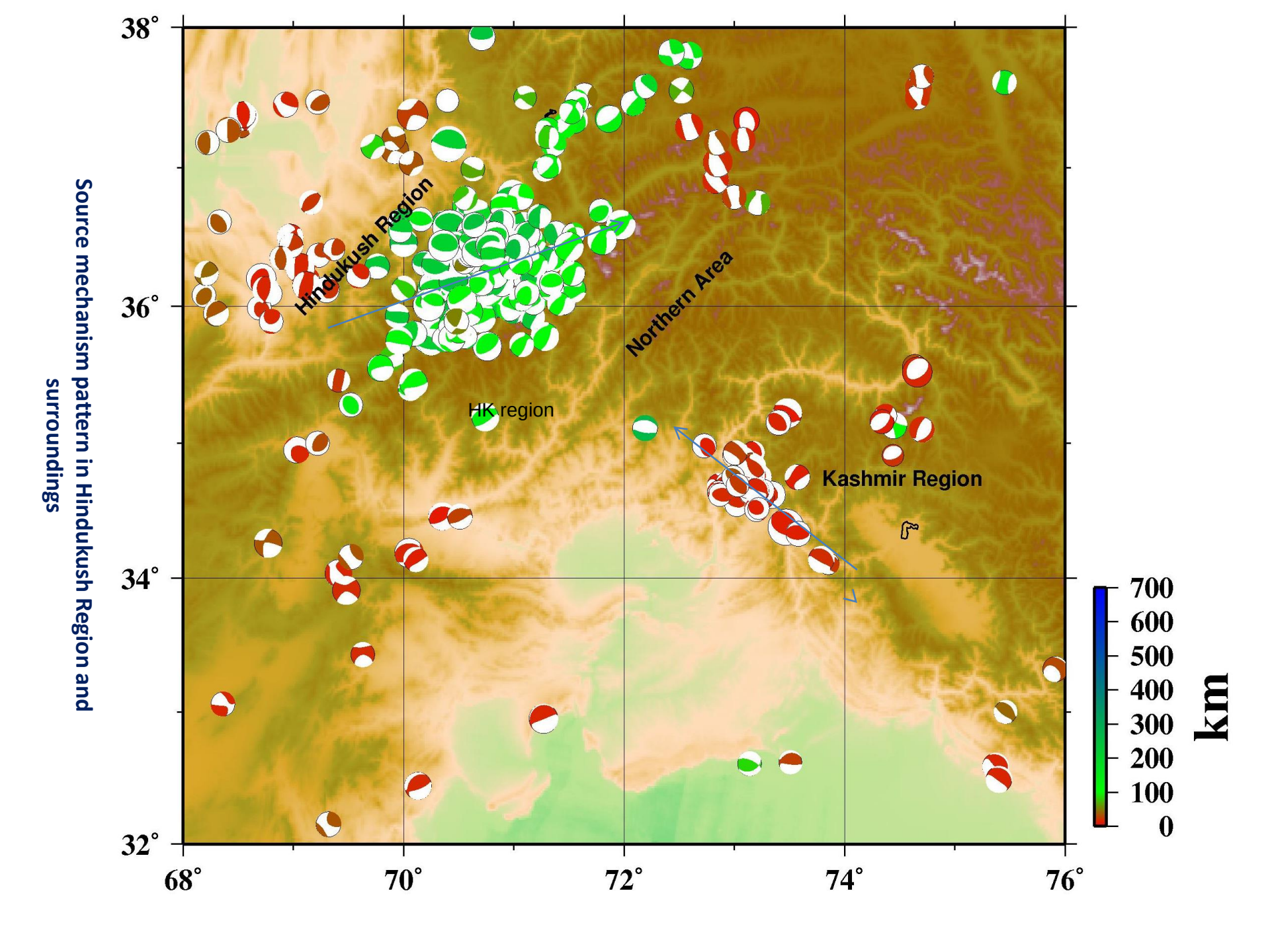
- A Brief Seismicity Analysis of Pakistan & surroundings:
  - 1900-2015
  - 4.0 to 4.9 64% of the total events,
  - 25% from 3.0 to 3.9 and
  - 9% from 6.0 to 6.9
  - Only 150 events with magnitude ≥ 6.0
  - 28 events with magnitude range 7.0 to 7.9
  - Only 3 events have magnitude ≥ 8.0

Historical Earthquakes of Pakistan

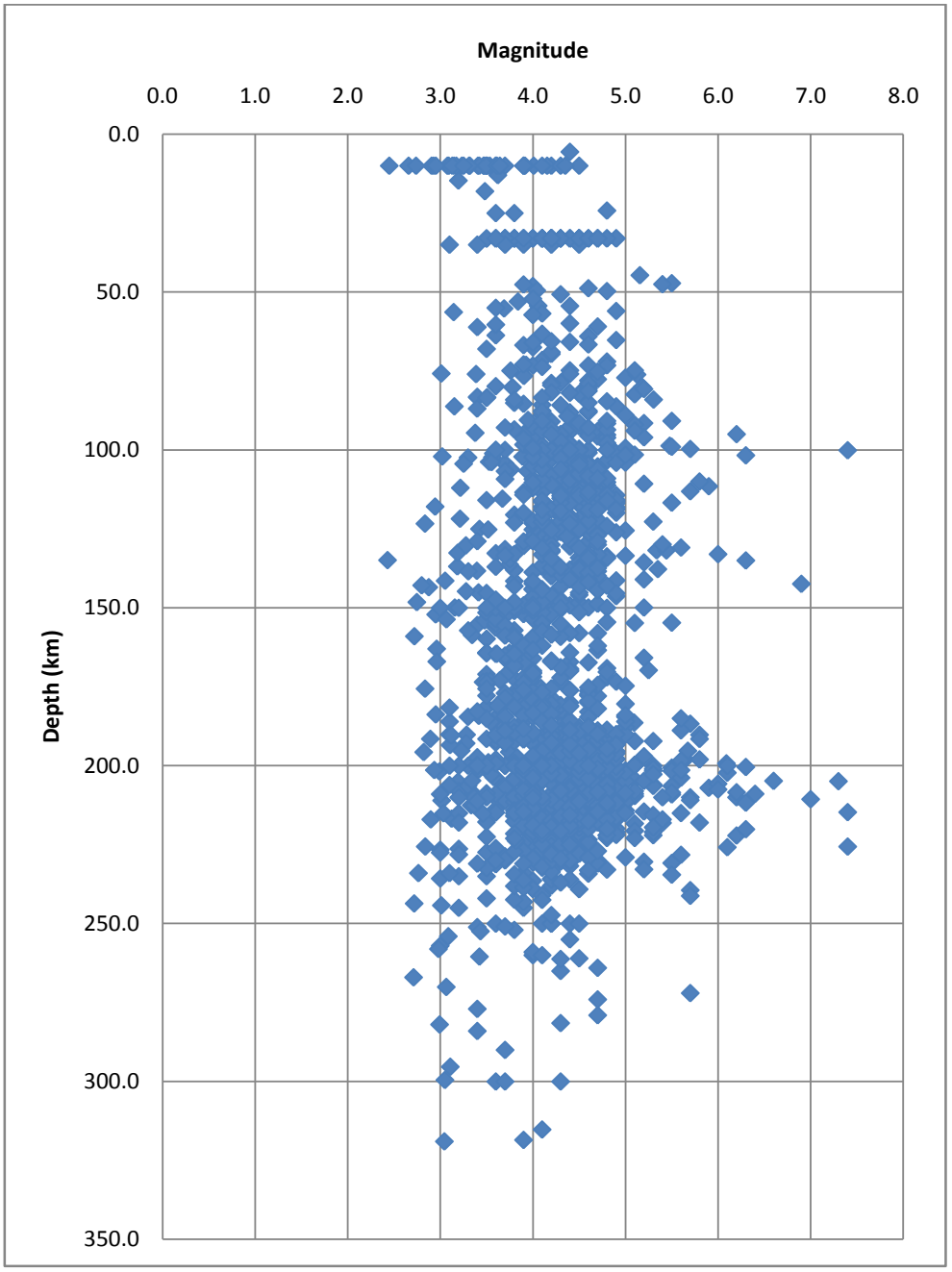


Seismicity Pattern in Hindukush Region




Source mechanism pattern in Hindukush Region and surroundings
Hindukush Region
Northern Area
HK region
Kashmir Region
38°
36°
34°
32°
68°
70°
72°
74°
76°
700
600
500
400
300
200
100
0
km

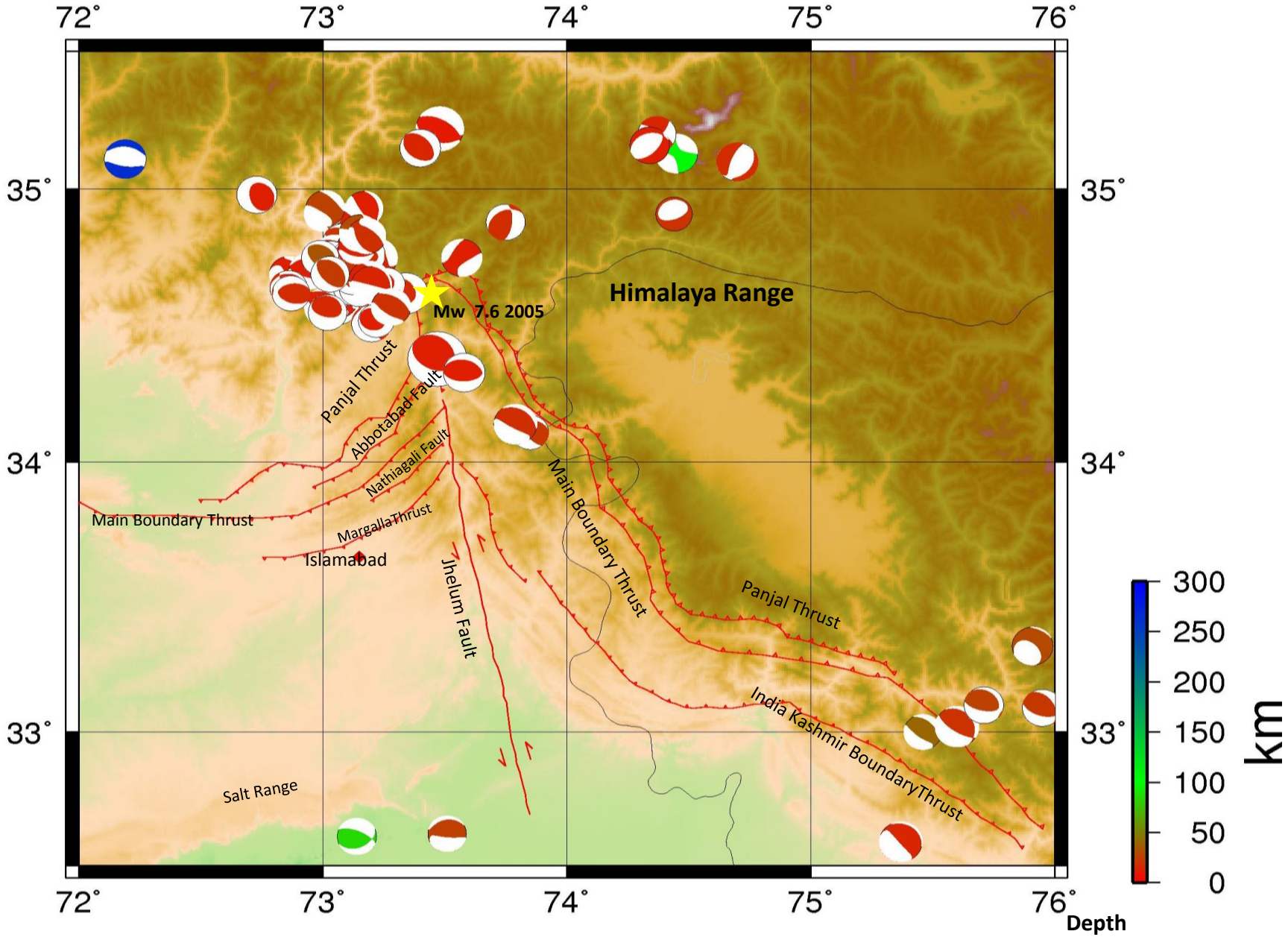
Depth Profile of Hindukush Region



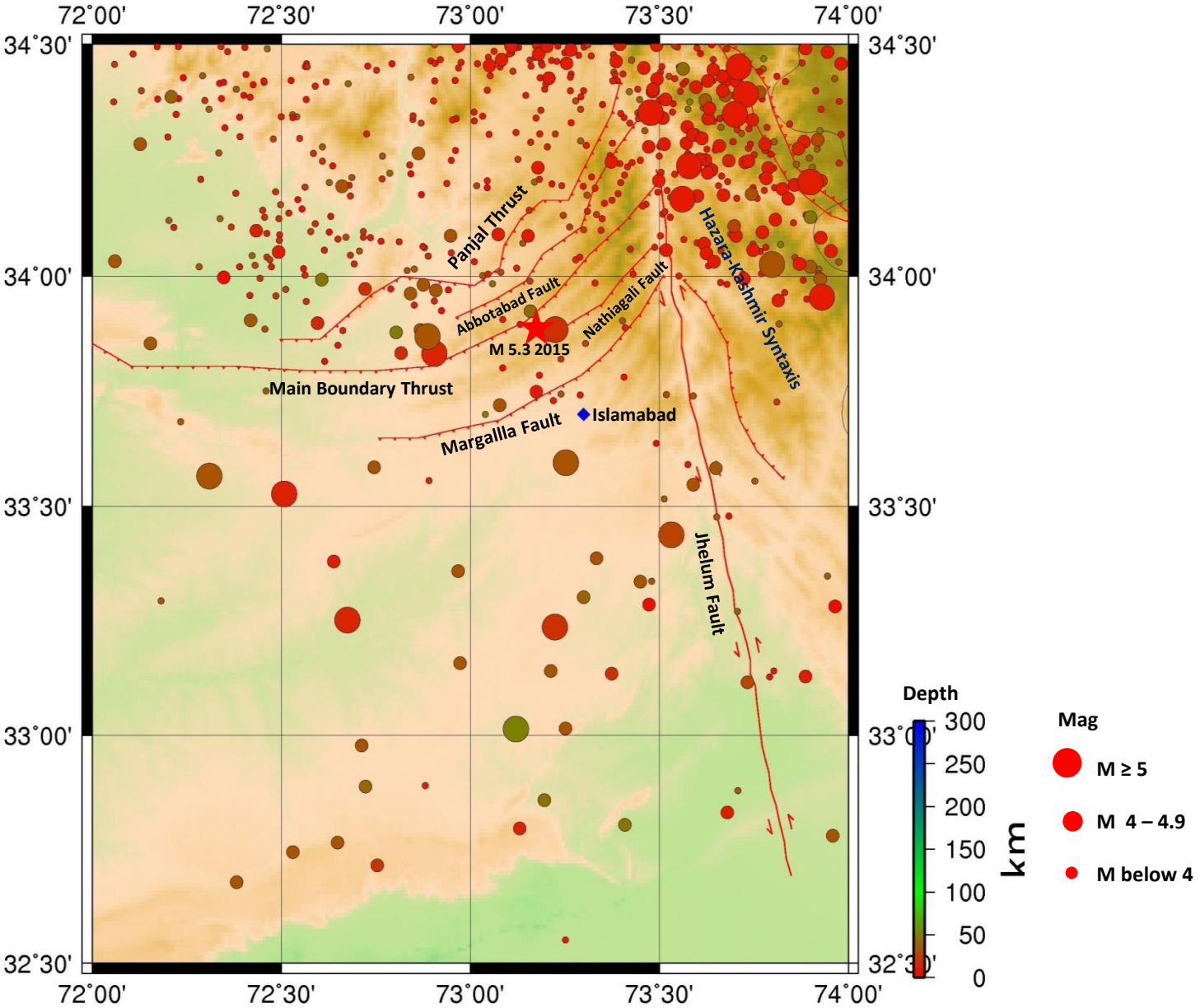
Part – 2
General Seismicity Pattern of Pakistan

Seismicity Trend Analysis over Active Faults in Hazara-Kashmir Syntaxis

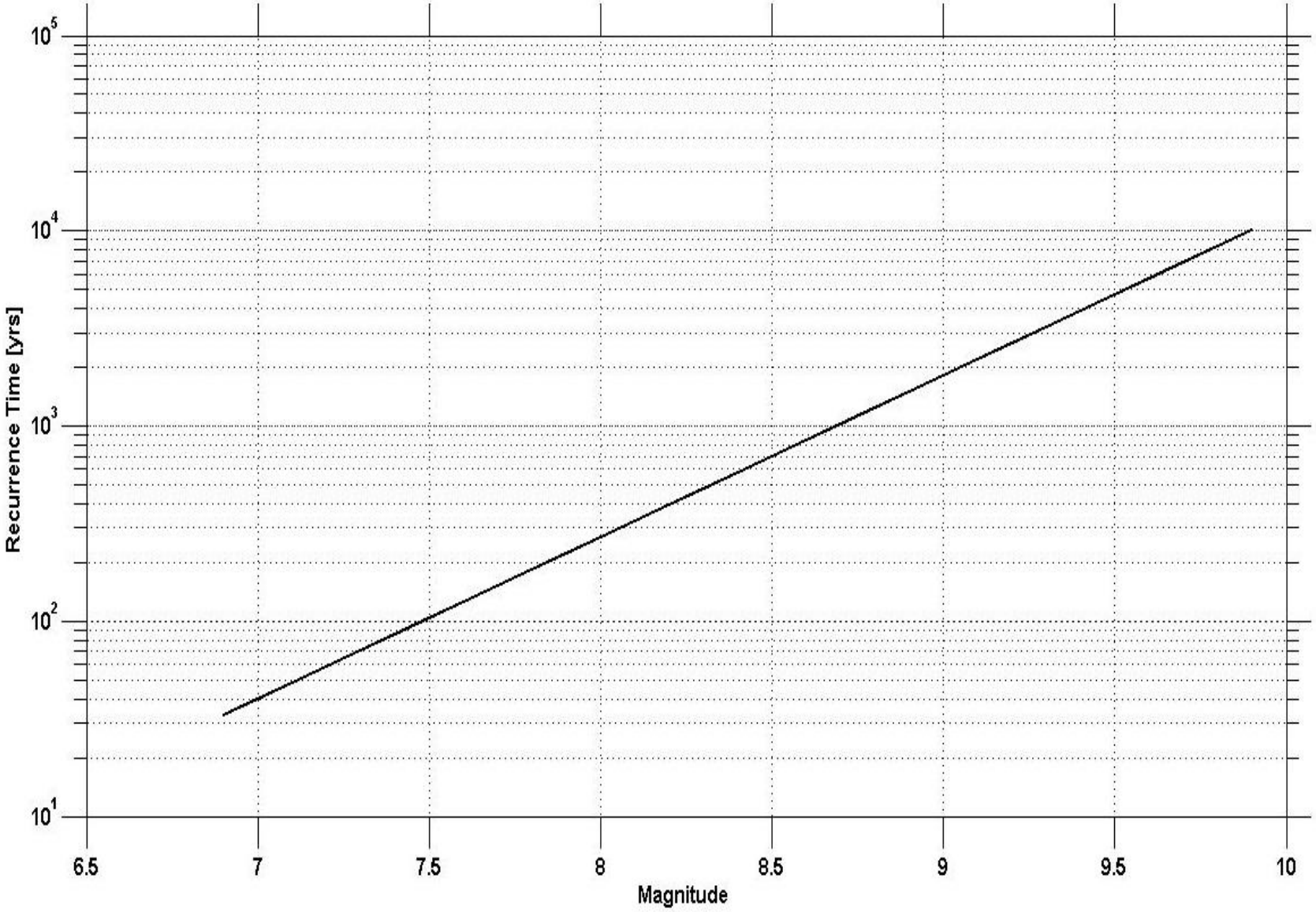
Active Faults and Source Mechanism of Earthquakes
(1970 – 2015 , M > 5.5)

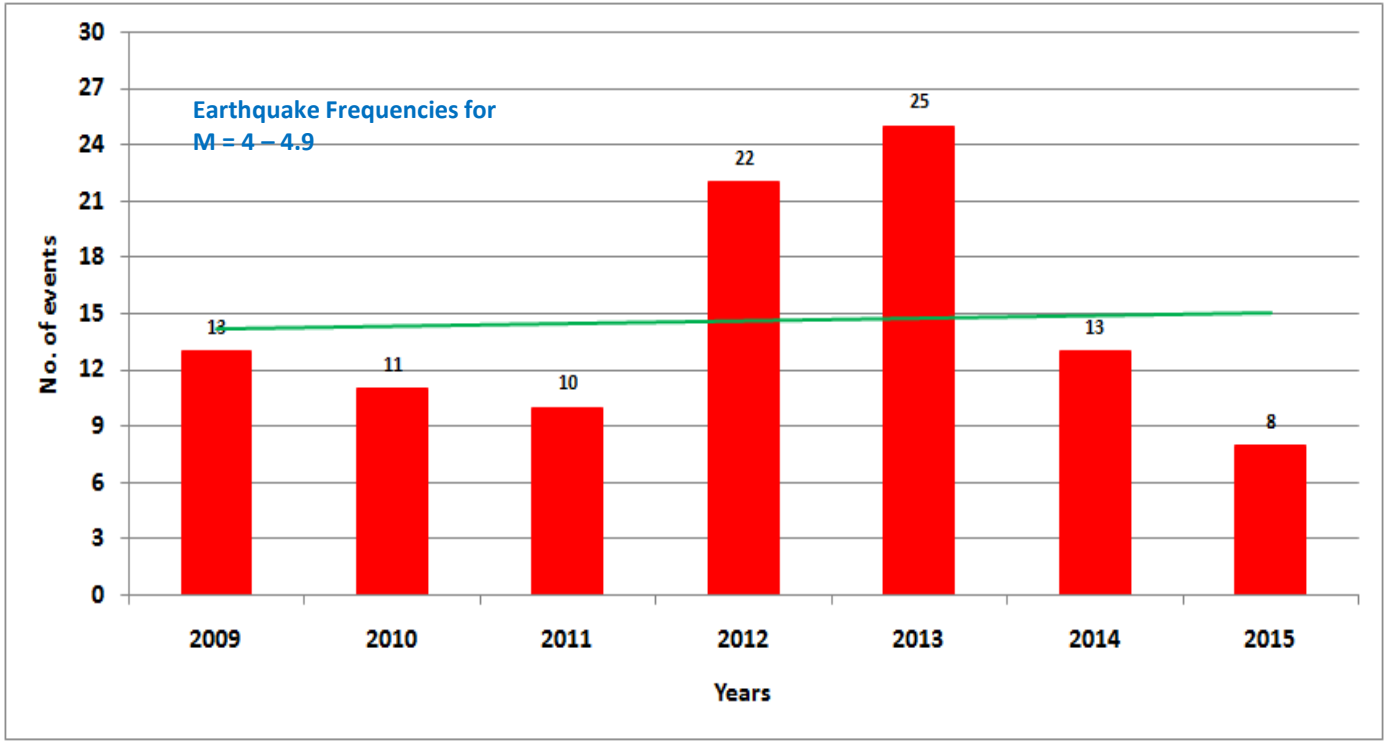


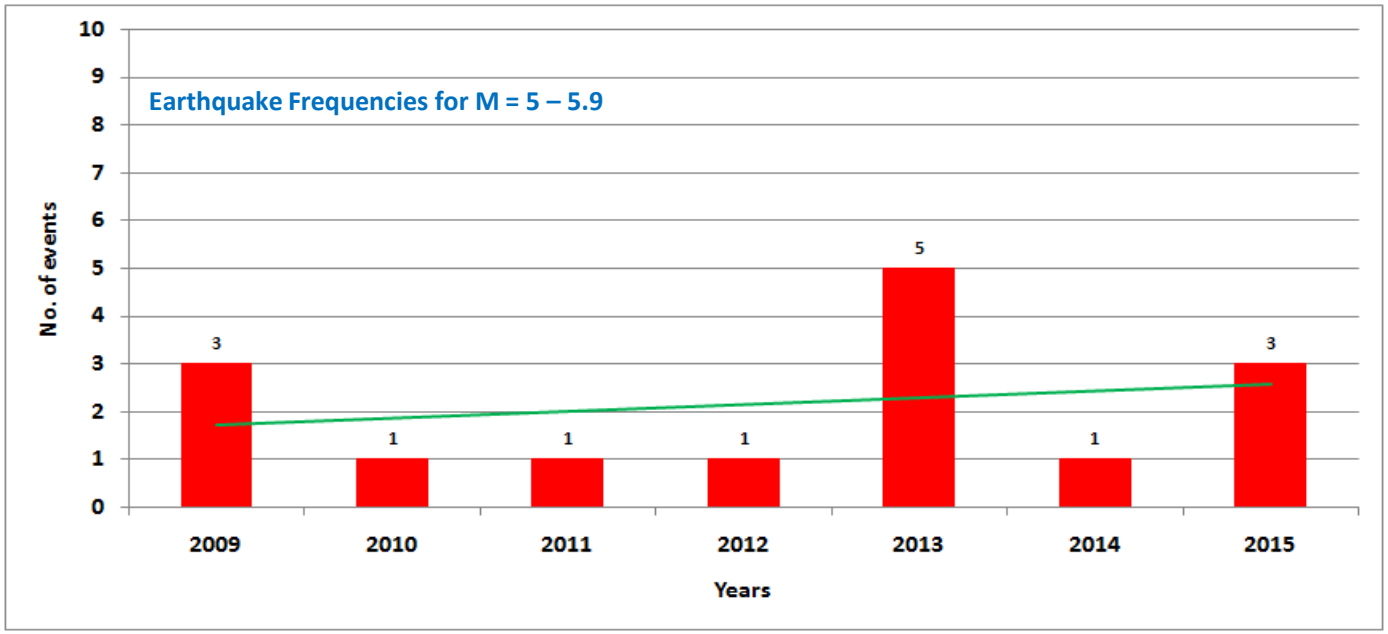
Seismicity and Active Faults Near Islamabad



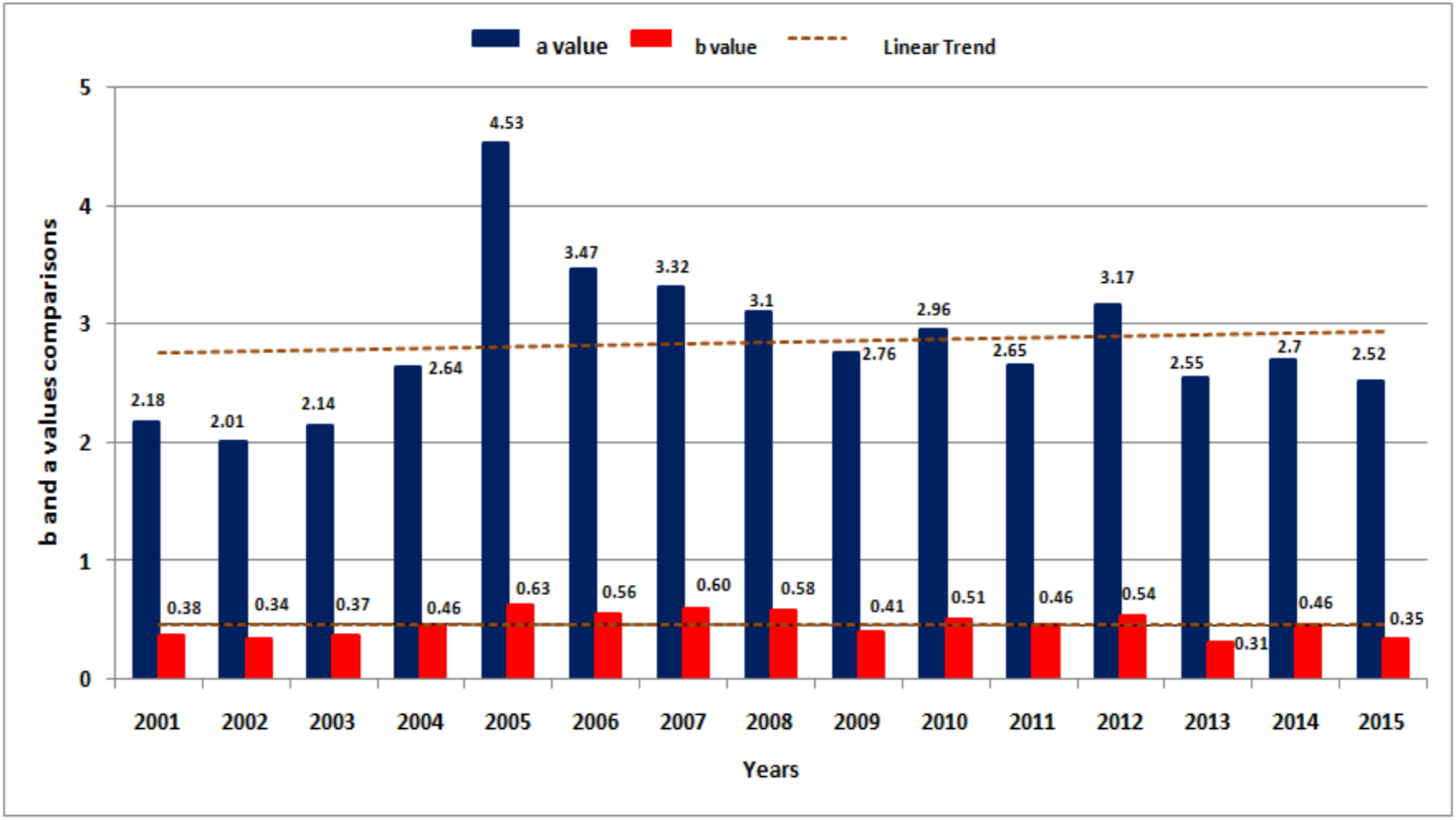
Future Large Earthquake Probability




Earthquake Frequencies for
M = 4 – 4.9
No. of events
Years
30
27
24
21
18
15
12
9
6
3
0
2009
2010
2011
2012
2013
2014
2015
13
11
10
22
25
13
8


Earthquake Frequencies for M = 5 – 5.9
No. of events
Years
10
9
8
7
6
5
4
3
2
1
0
2009
2010
2011
2012
2013
2014
2015
3
1
1
1
5
1
3

‘a’ and ‘b’ value comparison on yearly basis between 2001 – 2015



Conclusion – 1

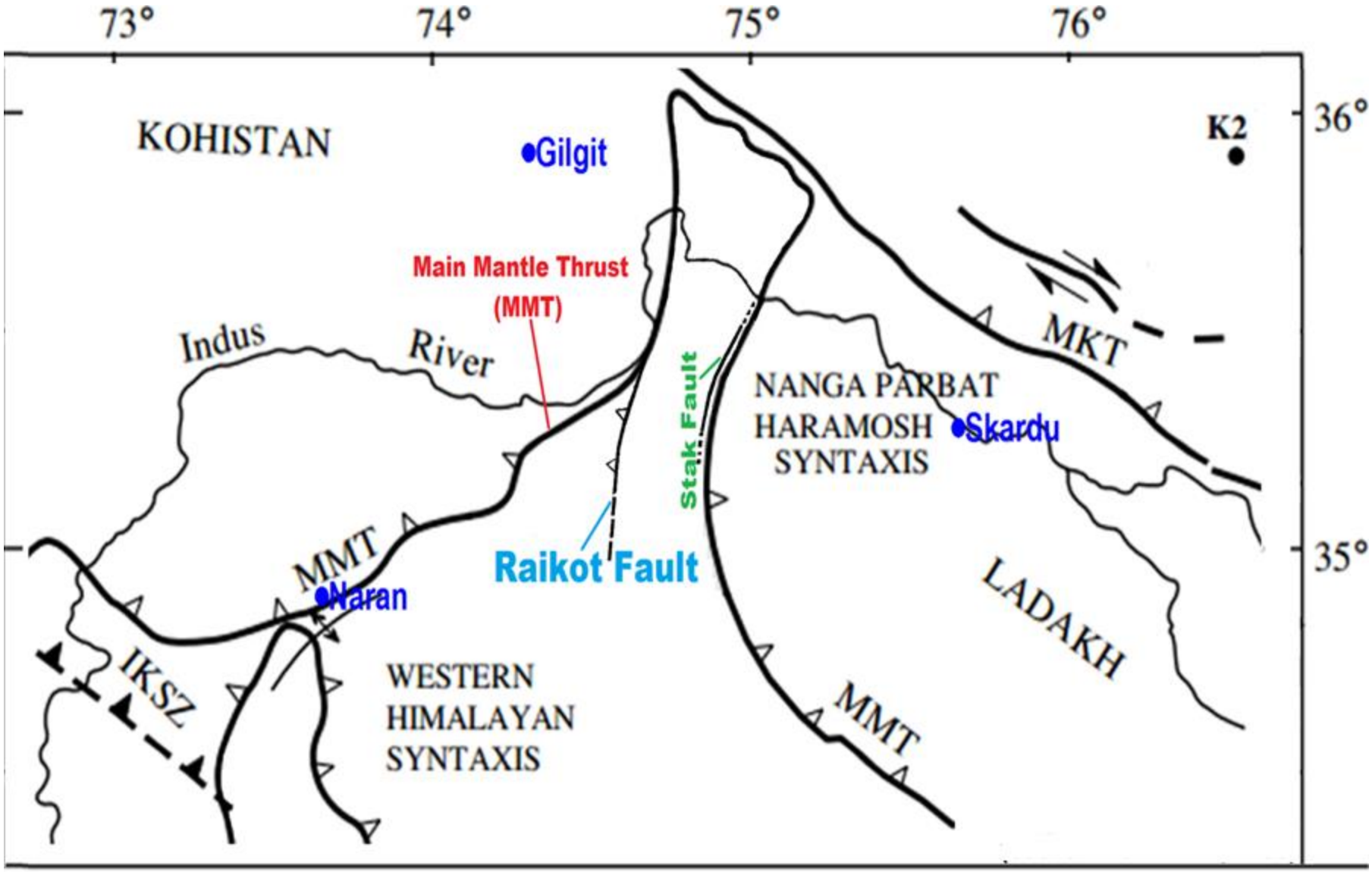
The Hazara/Kashmir Syntaxis

- Over all there is an increasing trend in Hazara-Kashmir Syntaxis area since last five years.

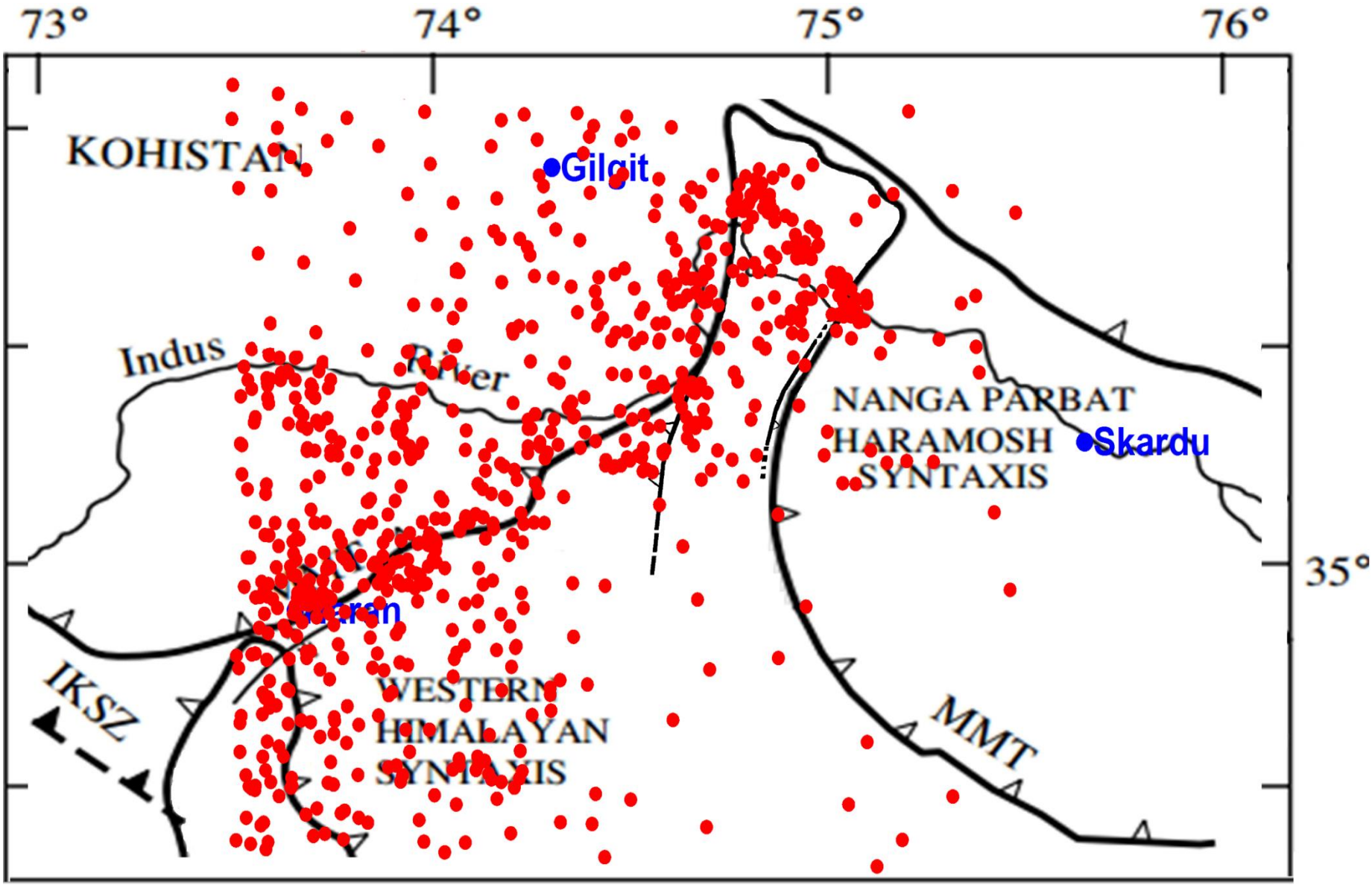
- Frequency of intermediate rang events increased,

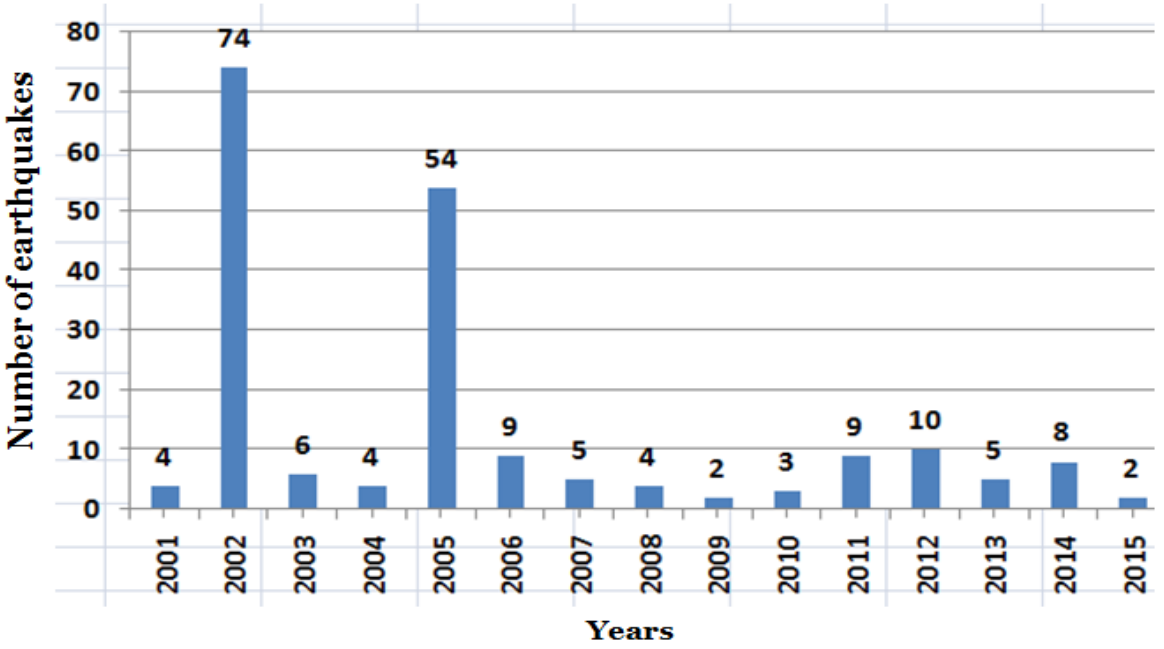
Seismicity in Main Mantle Thrust and Nanga Parbat, Haramosh area

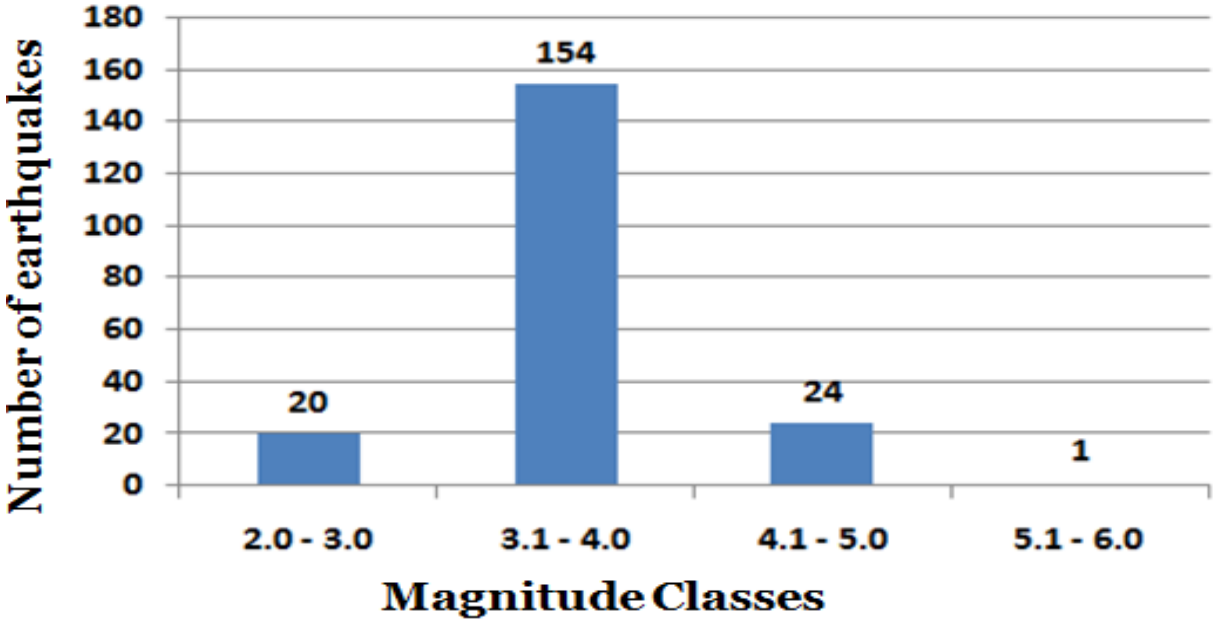
The Tectonic Map of the Area

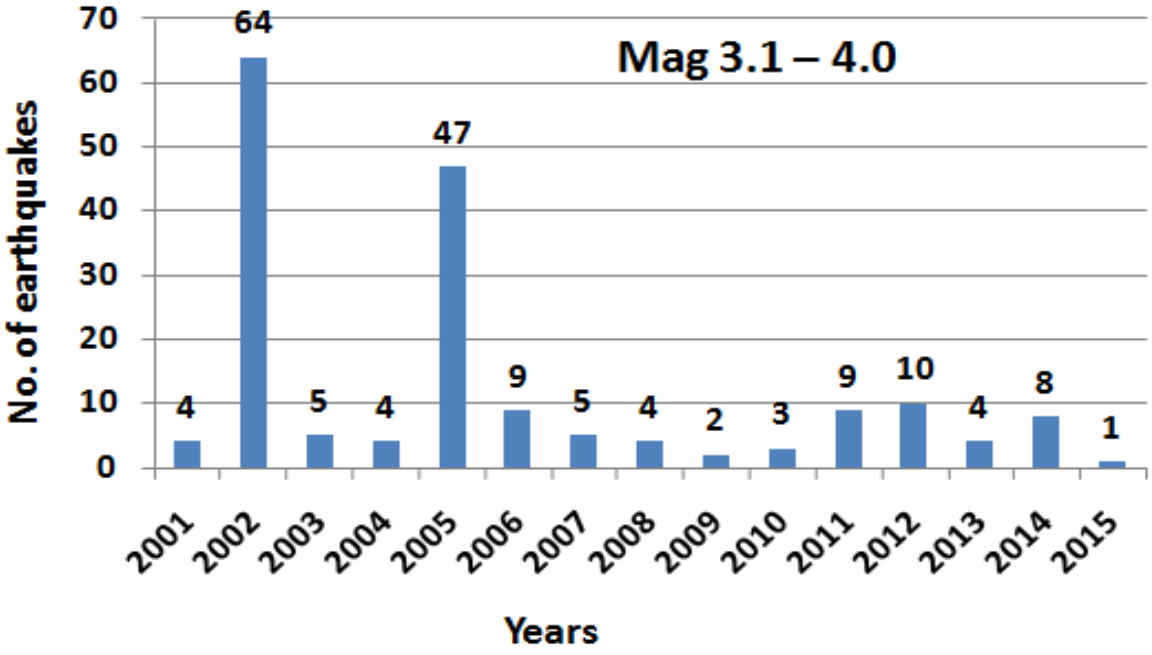


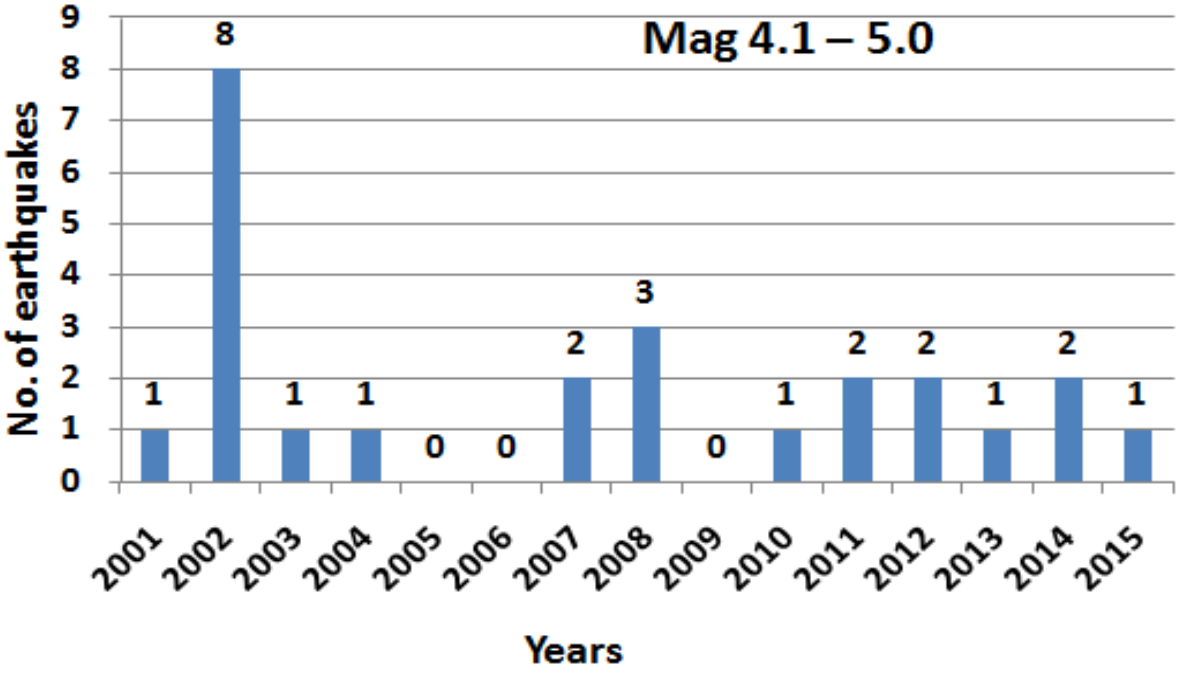
Seismicity of the Region




Number of earthquakes
80
70
60
50
40
30
20
10
0
74
54
4
6
4
9
5
4
2
3
9
10
5
8
2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Years


Number of earthquakes
180
160
140
120
100
80
60
40
20
0
154
20
24
1
2.0 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
Magnitude Classes





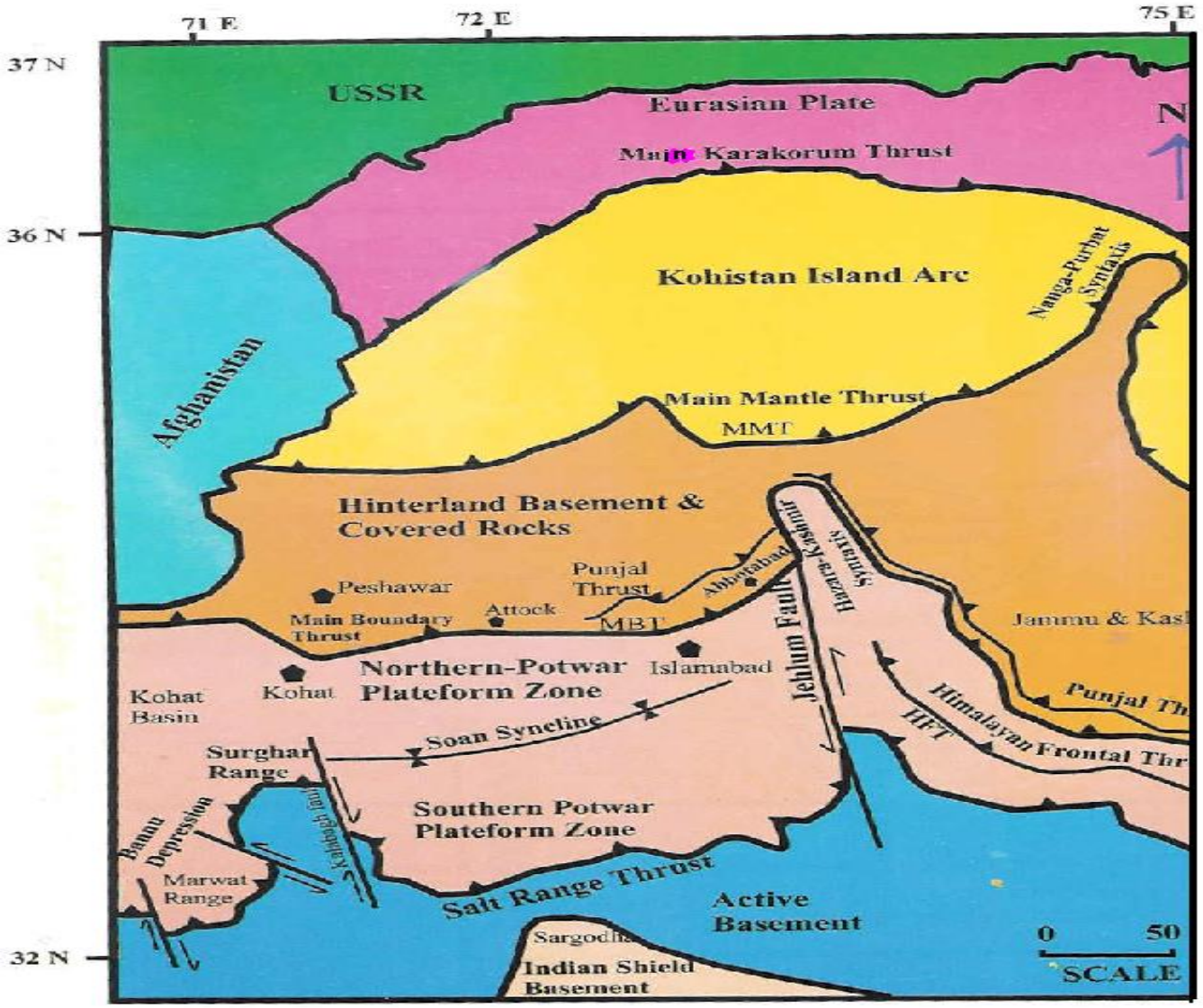
Only one earthquake occurred on 2002 with Magnitude range 5.1-6.0

Conclusion – 2

The Main Mantle Thrust and Nanga Parbat Haramosh Syntaxes

This area has potential of intermediate range seismic activities (3.1-4.0).

Seismicity Trend in the Region of Salt Range



MAIN FAULTS IN THE REGION

- **Kalabagh Fault**

  (North South)

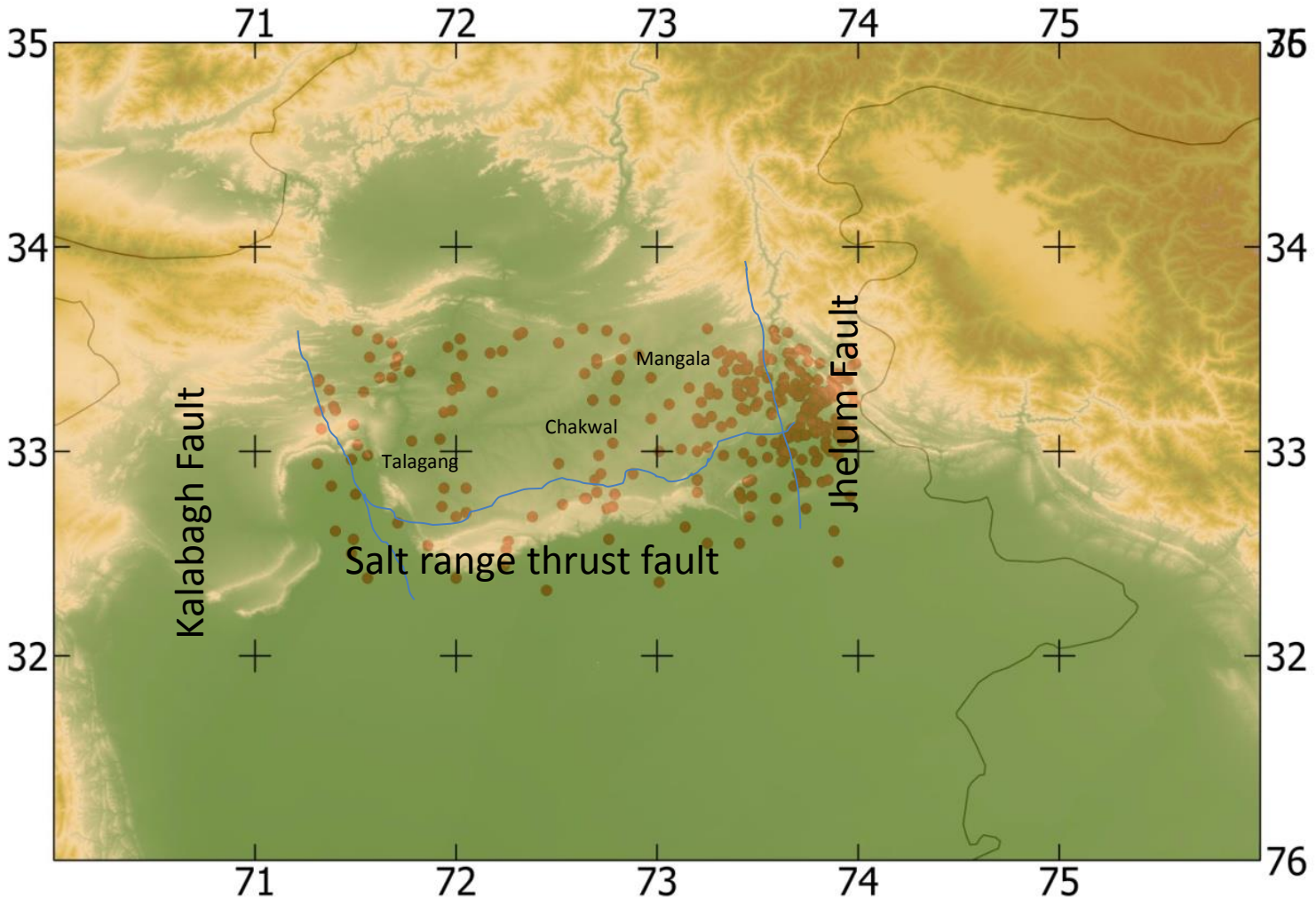
- **Jhelum Fault**

  (North South)

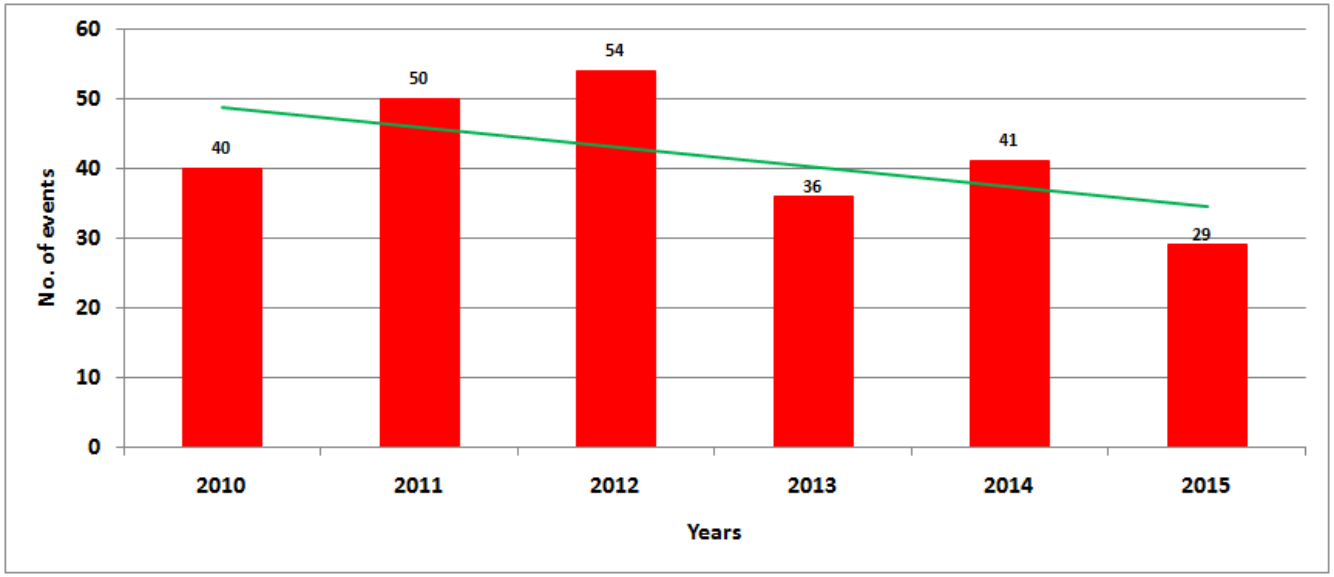
- **Salt range thrust fault**

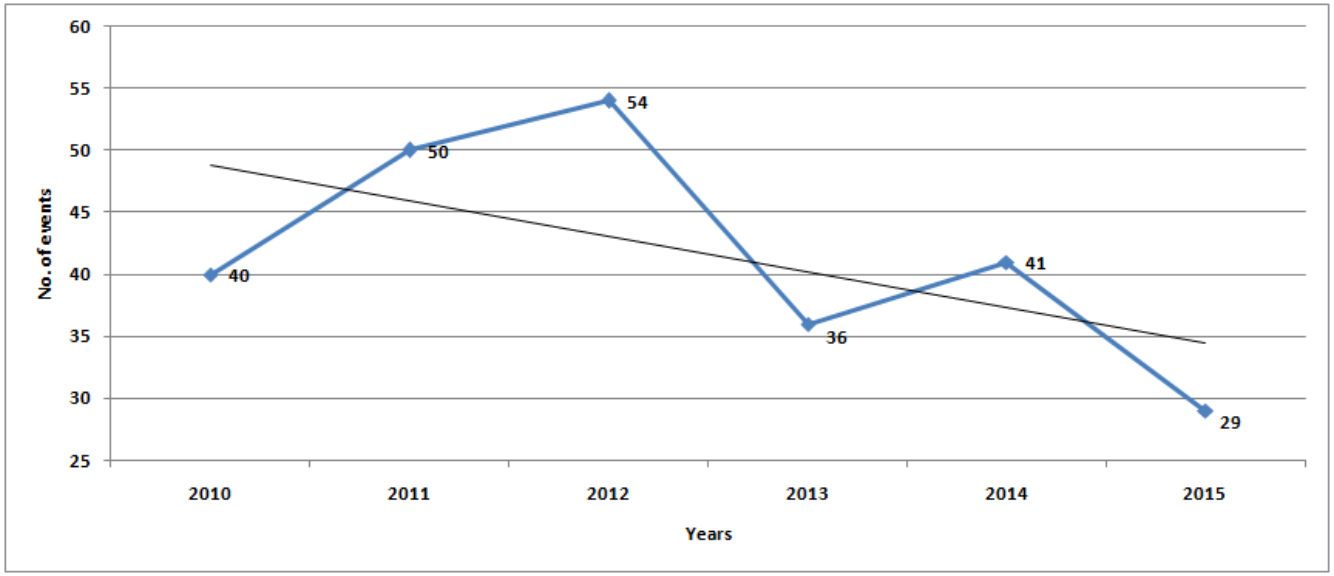
  (East-West)

Seismicity of Salt Range

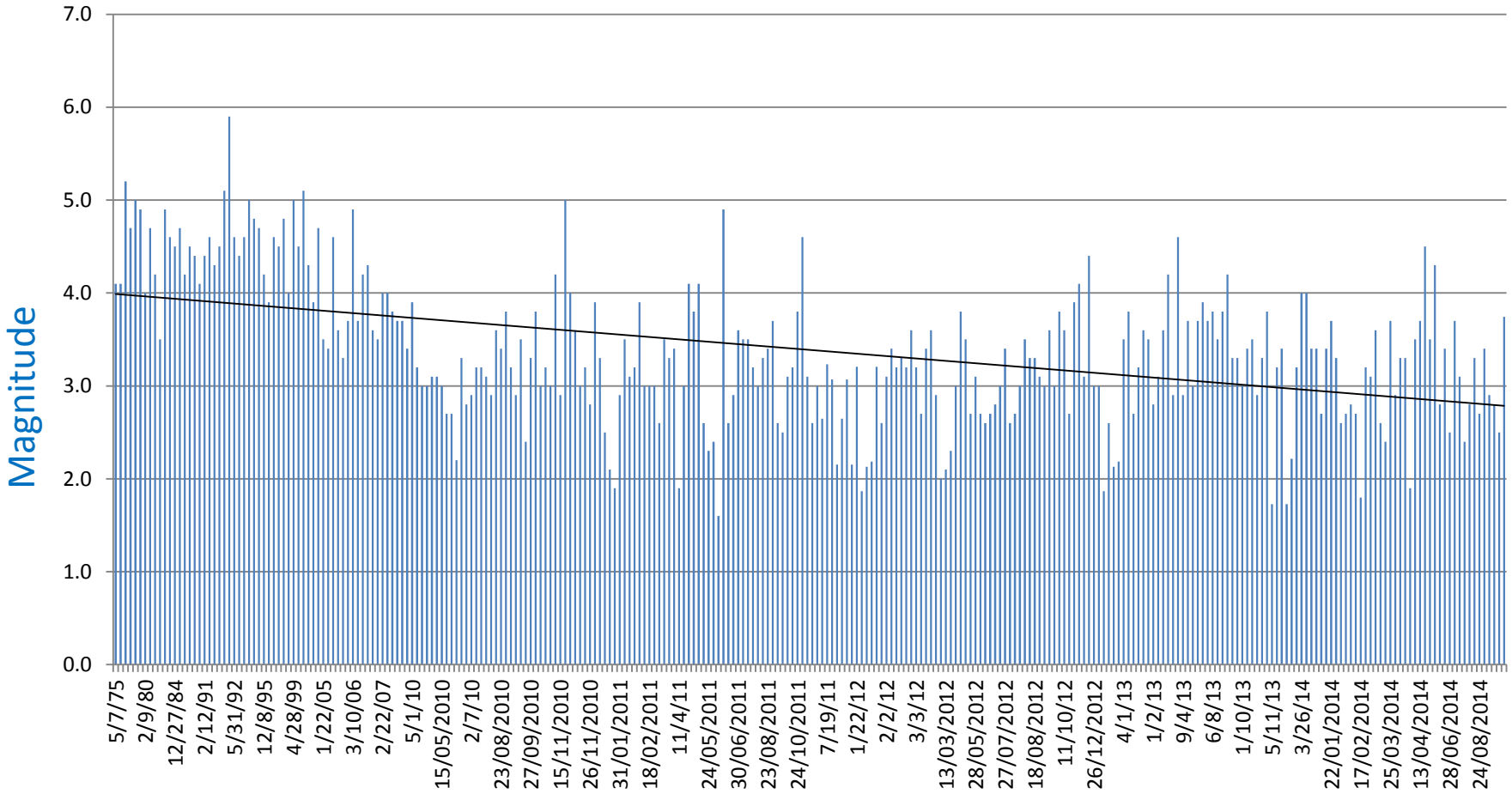


Salt Range Events Frequency





EARTHQUAKE FREQUENCY TREND WITH RESPECT TO MAGNITUDE FOR THE PERIOD 1975-2015



Conclusion – 3

The Region of Salt Range

1. Over all Earthquake occurrence frequency trend is same.
2. Area representing the moderate seismicity

Way forward

I. The risk of earthquakes has significantly increased due to the urbanization. A big earthquake hitting a densely populated city could have devastating impacts. Besides existing earthquake monitoring network, a dense network will be required particularly for **Northwest, northeast and southwest areas** of Pakistan.

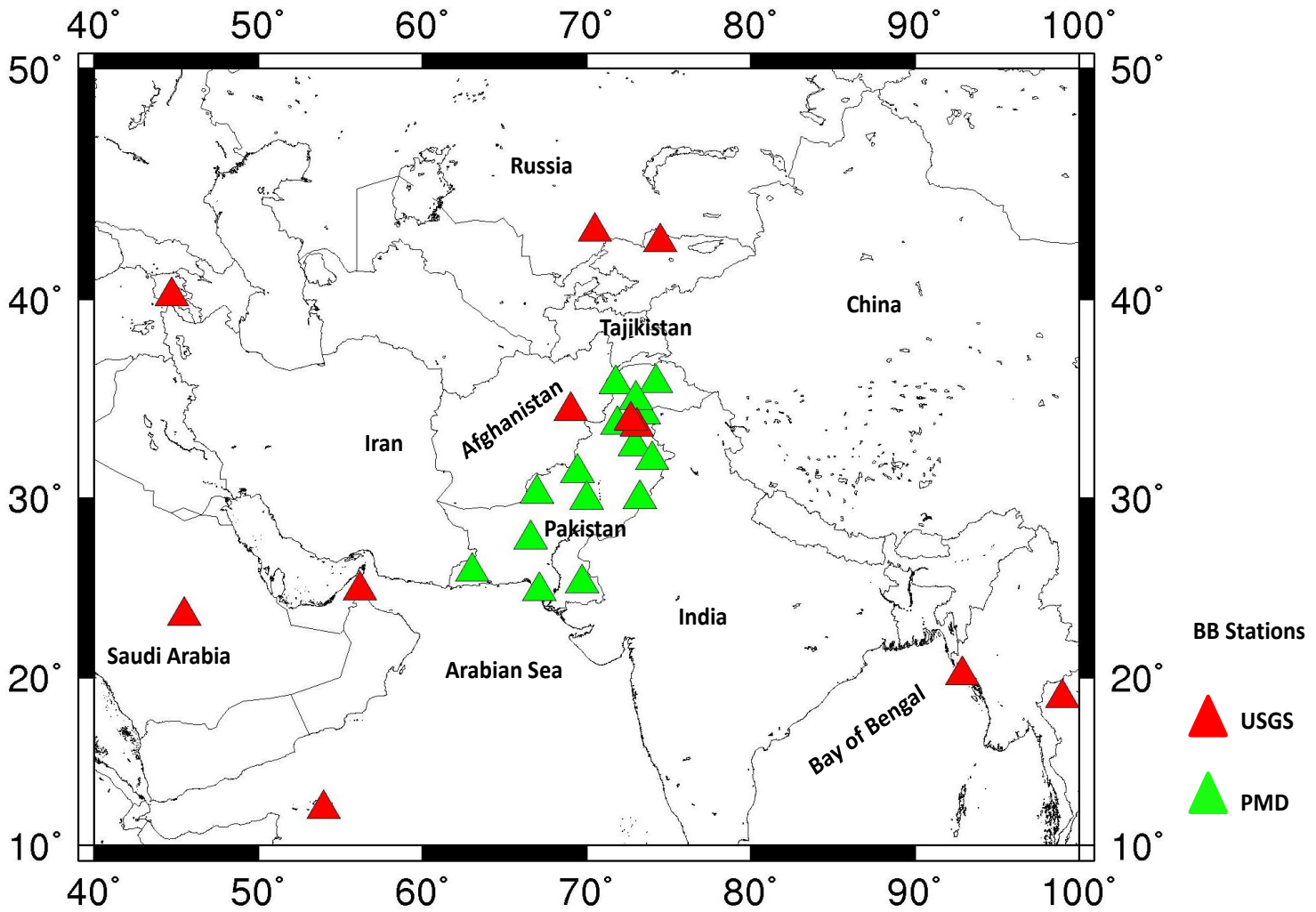
II. Earthquake Early warning system is recommended for **Northwest, northeast and southwest areas.**

III. Increase the local capacity of earthquake prone areas for disaster resilience with series of training workshops for regarding **MEASURES TO MINIMIZE THE EFFECTS OF AN EARTHQUAKE**.

IV. For disaster Reduction planning is the best way for a more community to move toward Disaster Resilience.

Thanks

Local and International Broadband Stations Network



Magnitude and Intensity

- MAGNITUDE
  - Measure of earthquake size (energy)
  - Quantitative measure
  - Source Parameter
  - Remains same everywhere

- INTENSITY
  - Measure of the destruction caused by an earthquake
  - Qualitative measure
  - Site parameter
  - Different at different places (Attenuation and amplification phenomena)
  - Most commonly used intensity scale is “MMI or Modified Mercalli Intensity Scale.

Magnitude and Intensity

- DIFFERENCE BETWEEN MAGNITUDE & INTENSITY
  - **Magnitude** remains unchanged with distance from the earthquake. **Intensity** decreases with distance from the earthquake epicenter.
  - **Magnitude** measurement requires instrumental monitoring for its calculation, however, assigning an **intensity** requires a sample of the felt responses of the population.

Different Magnitude Scales

Earthquake Magnitude

Richter Local Magnitude

- Surface Wave Magnitude

  $M_s = \log A + 1.66 \log \Delta + 2.0$

- Body Wave Magnitude

  $m_b = \log A - \log T + 0.01 \Delta + 5.9$

- Other Instrumental Magnitude Scales

  M_C , M_D , M_{JMA}

- Moment Magnitude (preferred)

  $M_w = (\log M_o)/1.5 - 10.7$