

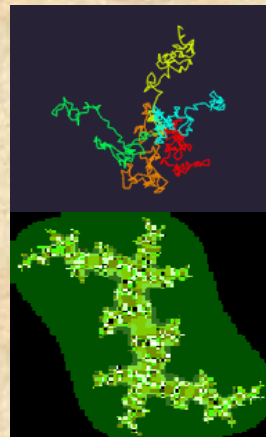
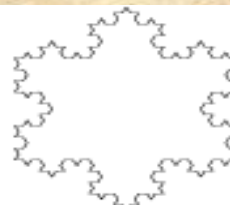
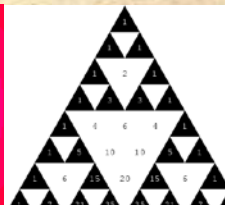
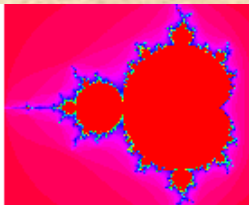


A Fractal Approach to Understand the Tectonic Behaviour of Doon Valley, Himalaya



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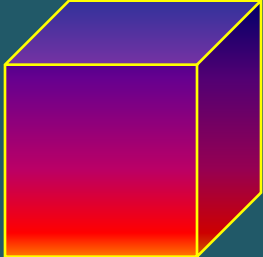




FRACTAL GEOMETRY

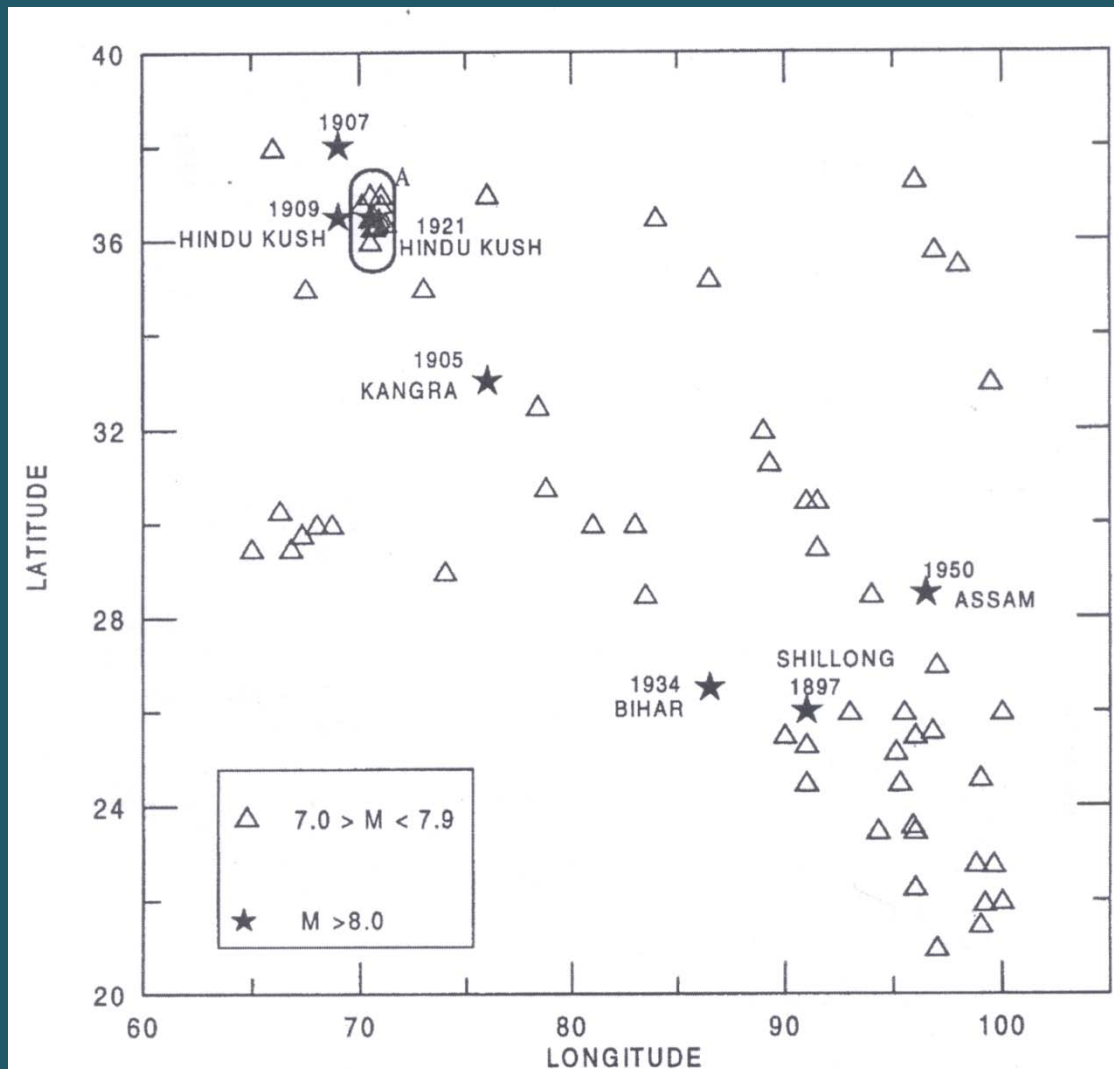


In Euclidian geometry we have regular objects with well-known dimensions, as our sense of perception is limited...

Dimension	Object
0	
1	
2	
3	

“But Mother Nature is much more complex than what we think...”

Himalayan Seismicity



**Spatial distribution of $M \geq 7$
(period 1895-1995)**

Different Fractal Dimensions

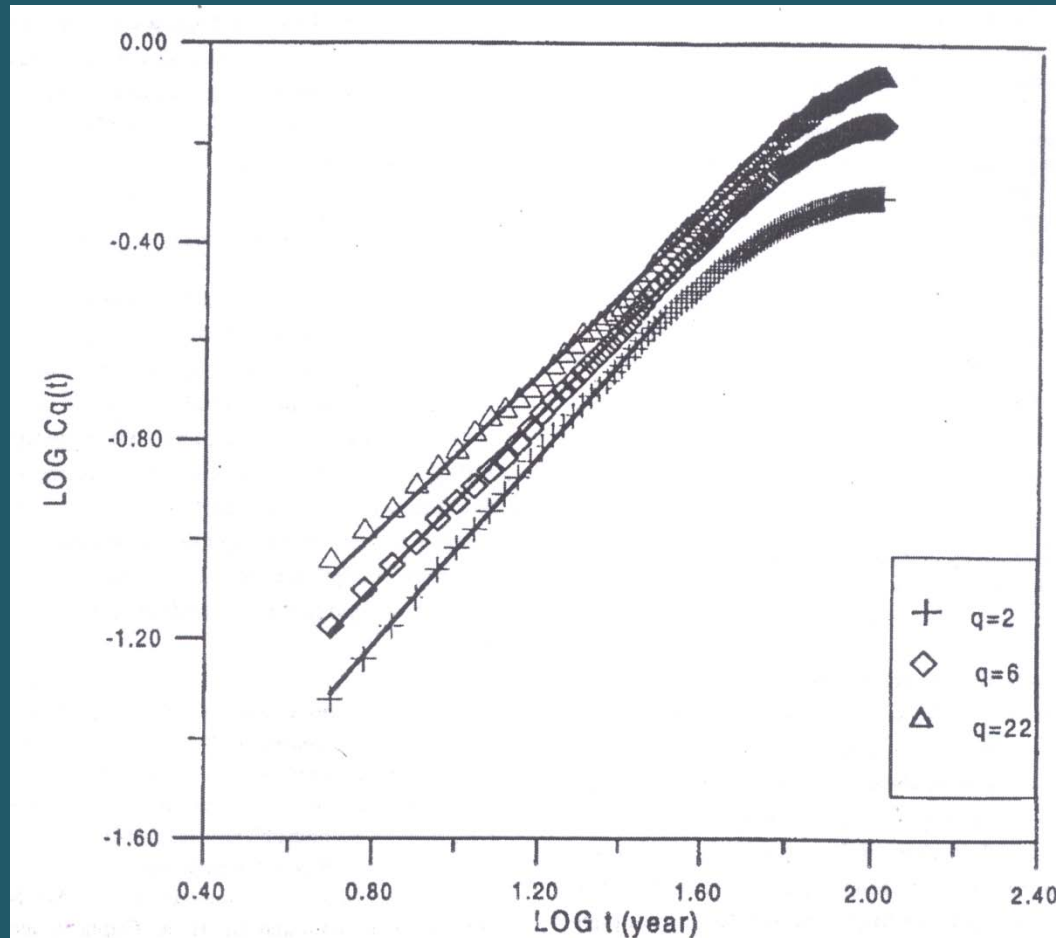
- Similarity Dimension
- Capacity Dimension
- Information Dimension
- Correlation Dimension
- Generalized Dimension

Estimation of generalised fractal dimension D_q from generalized correlation integral

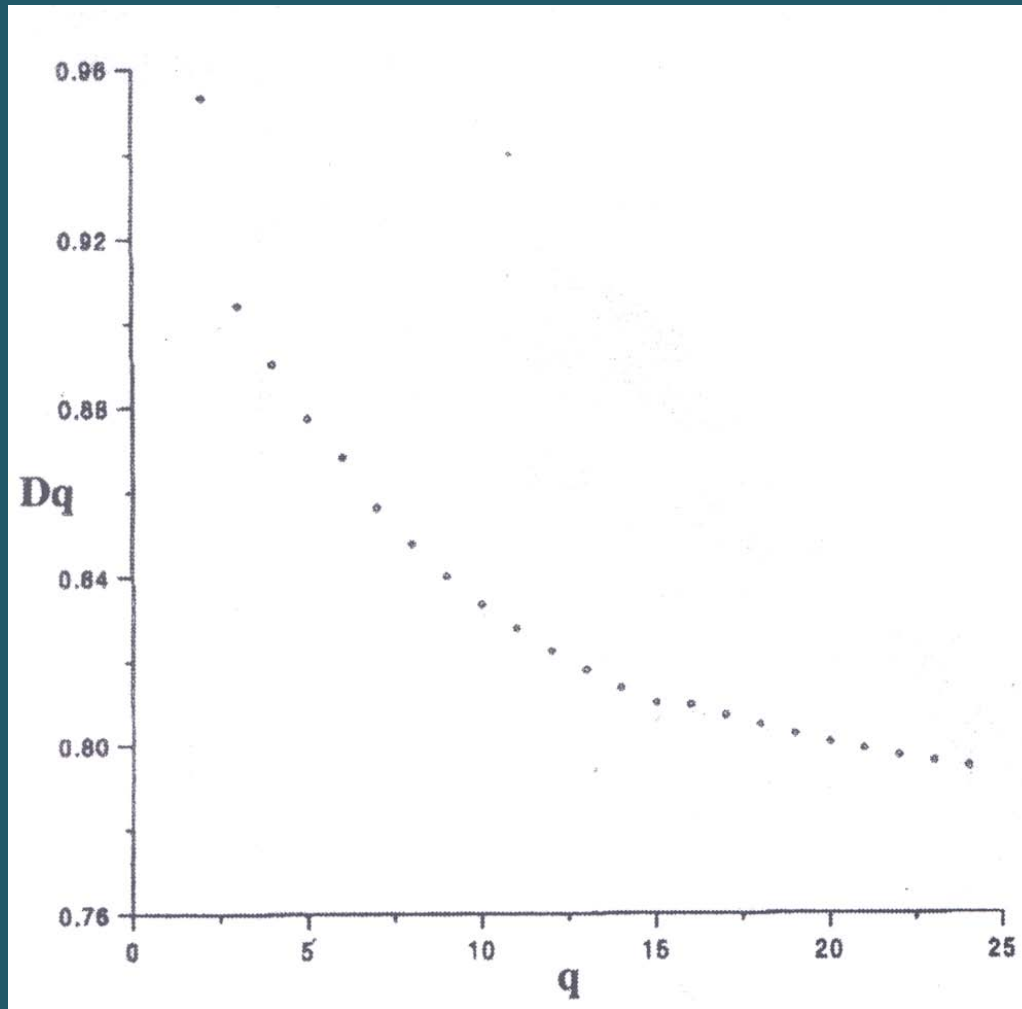
$$n_i(r) = (1/N - 1) \left\{ \lim \sum \left(r - |x_i - x_j| \right) \right\}$$

$$C_q(t) = \left\{ \left[\sum (n_i(t))^{q-1} \right] / N \right\}^{1/(q-1)}$$

$$C_q(t) \sim t^{D_q}$$



Log $C_q(t)$ vs log t for some values of q

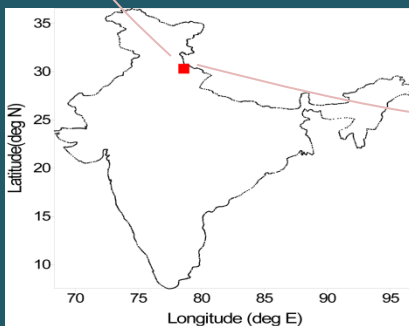
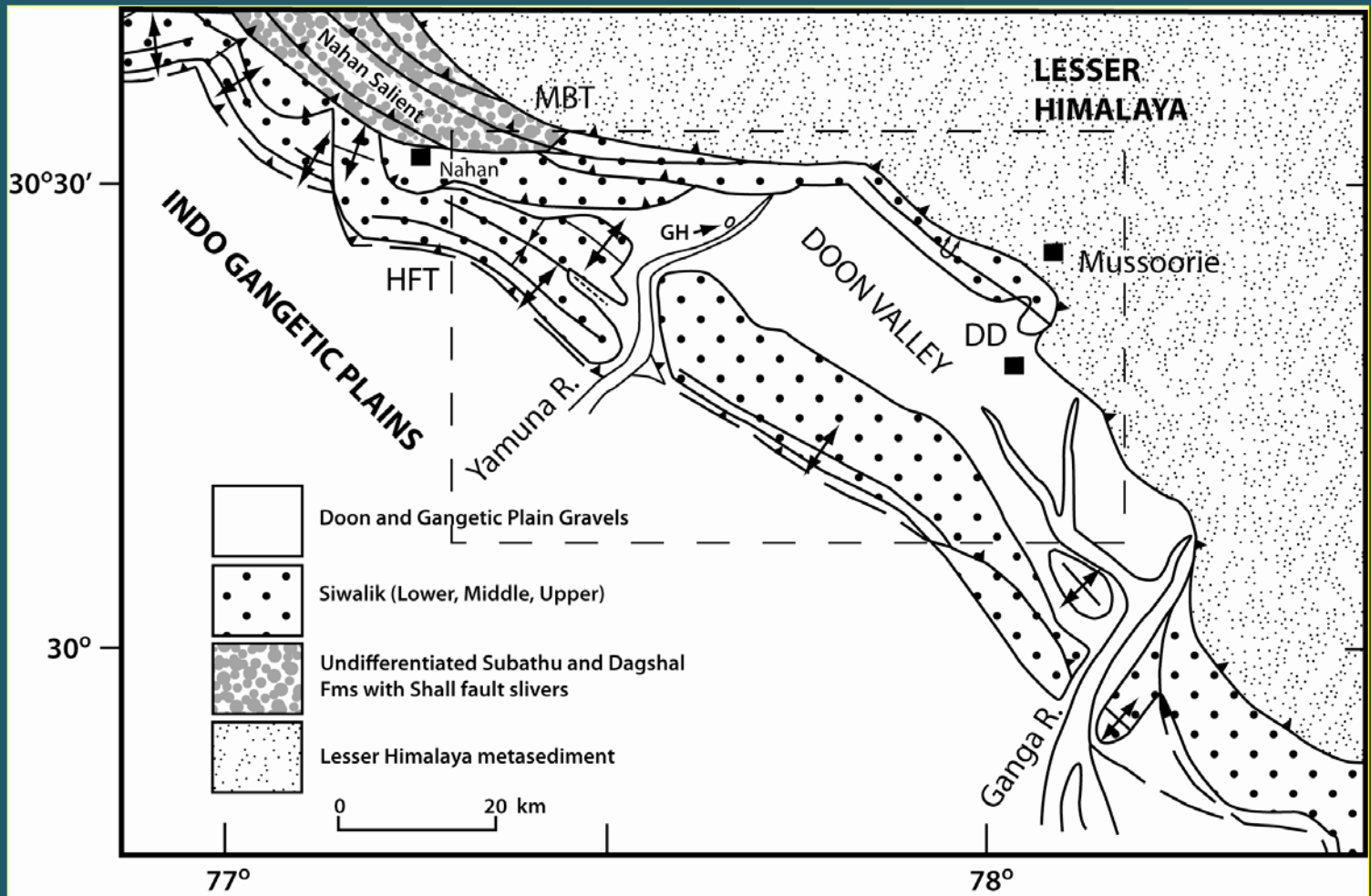


Generalized fractal dimension D_q vs q

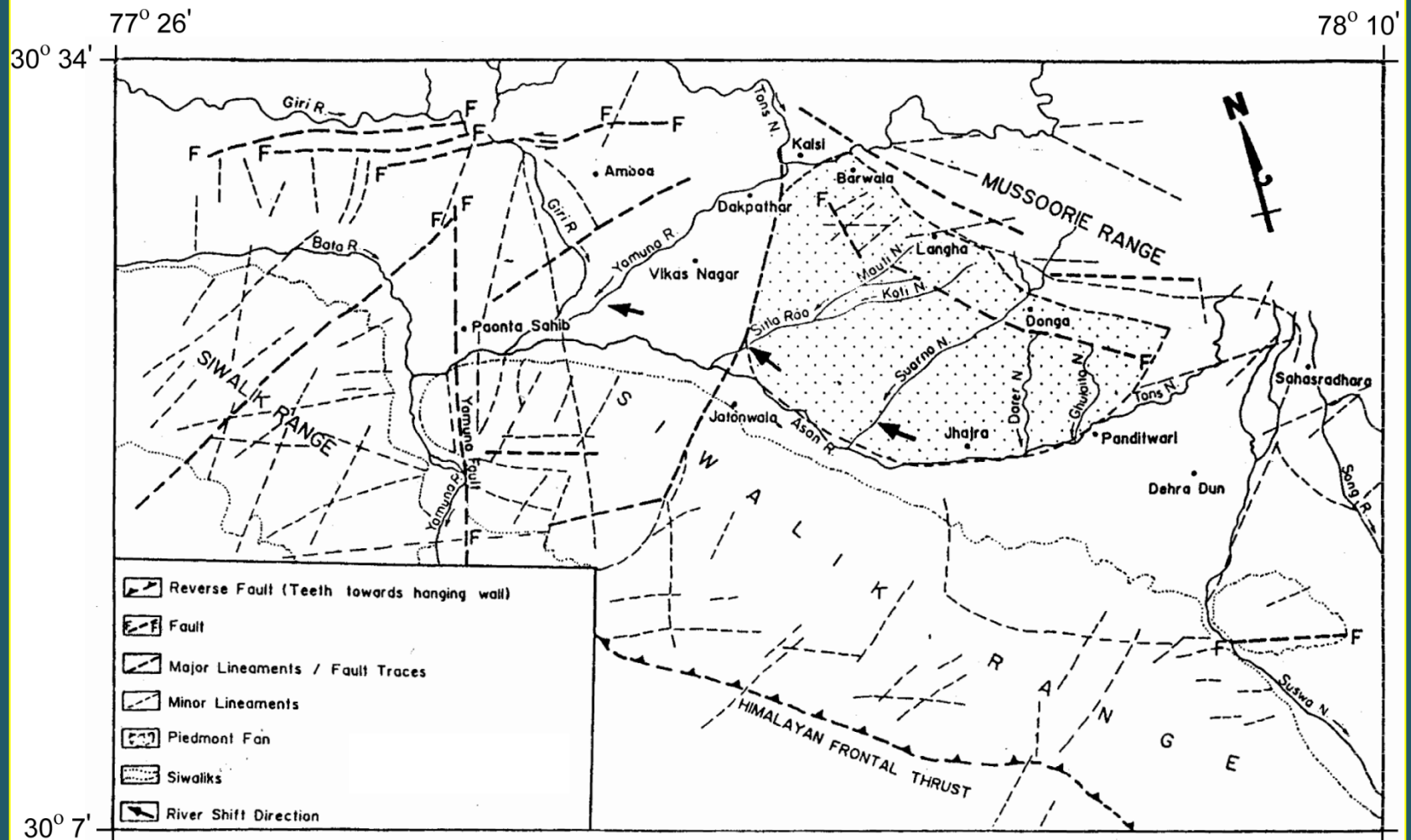
Findings

- The earthquake data responds to properties of multifractal.
- The D_q has non-integer value indicating an increase in clustering and void along time axis.
- The D_q vs q curve indicates a heterogeneous fractal structure due to the presence of larger zones of quiescence.

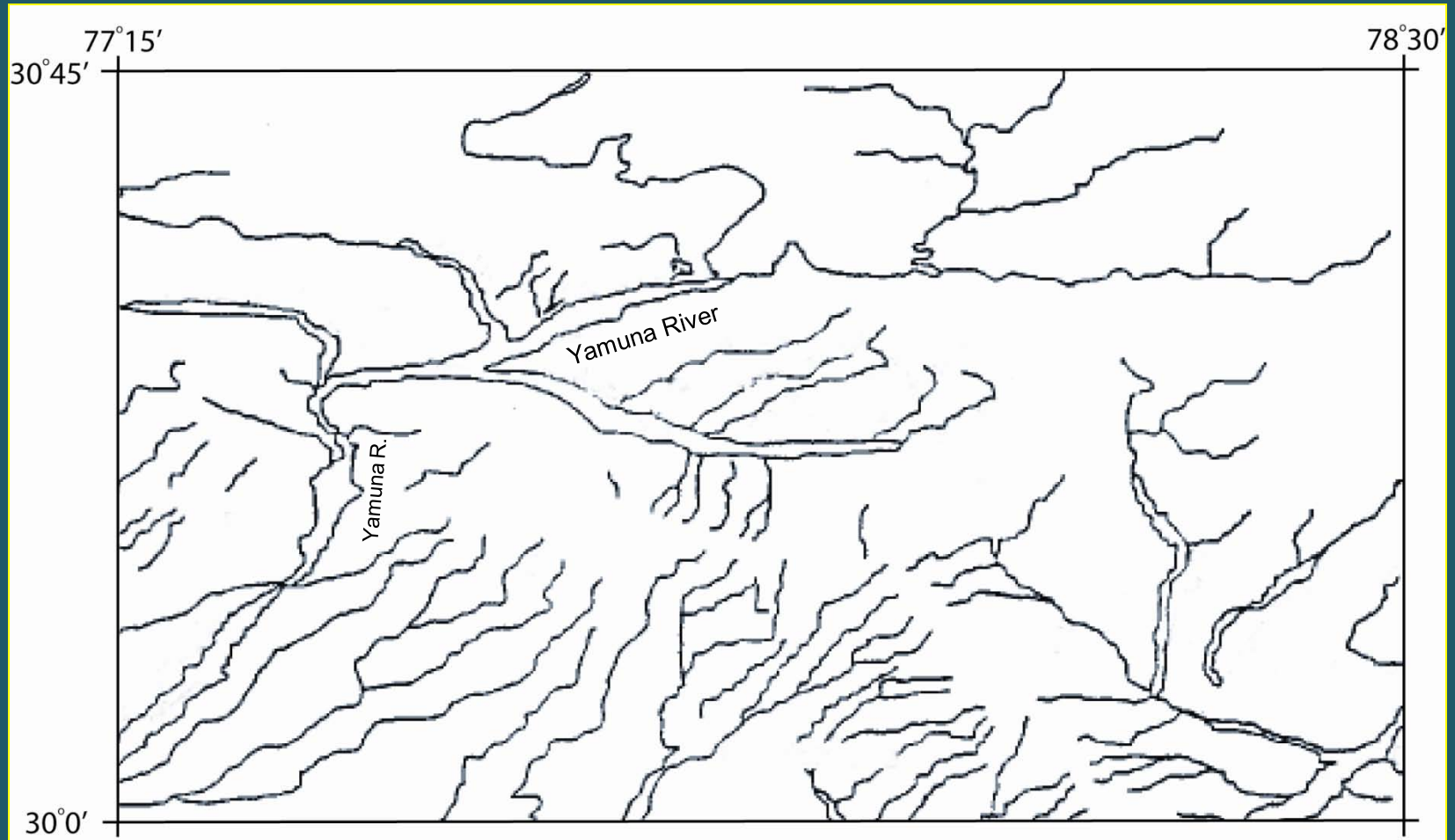
A Case Study from Doon Valley



Study Region



Lineament Map

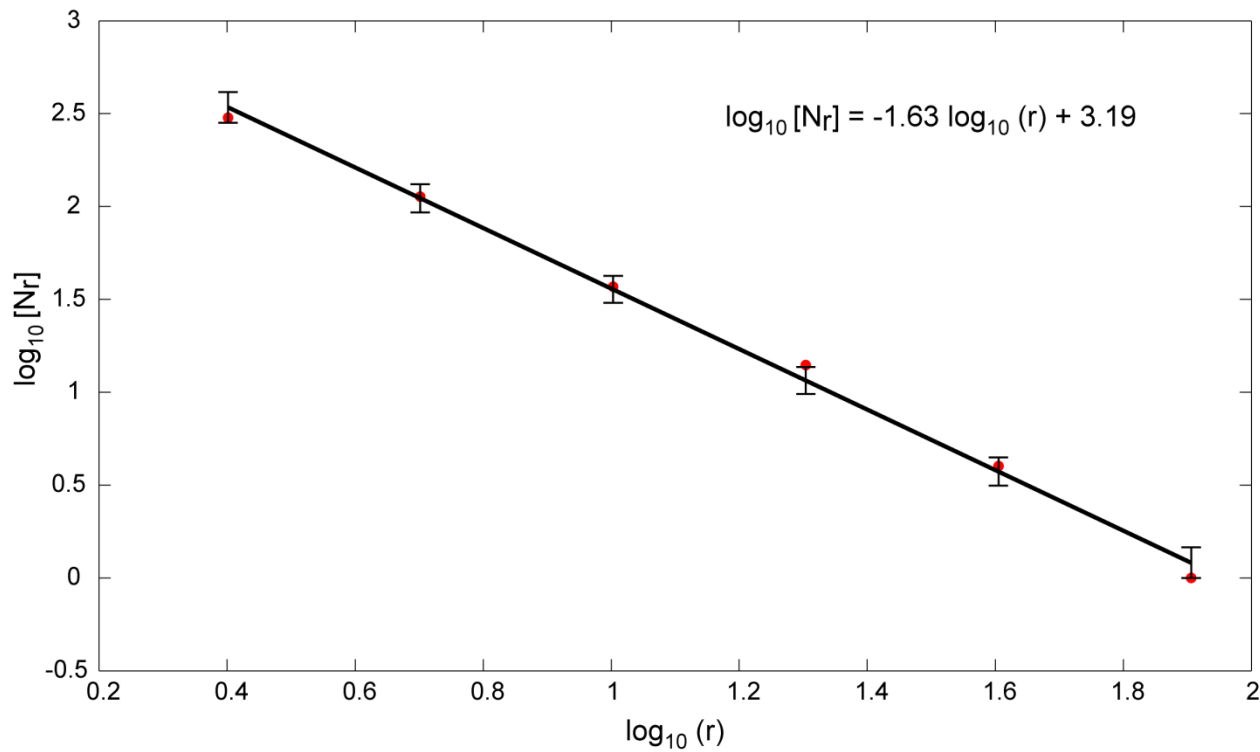


Drainage Map

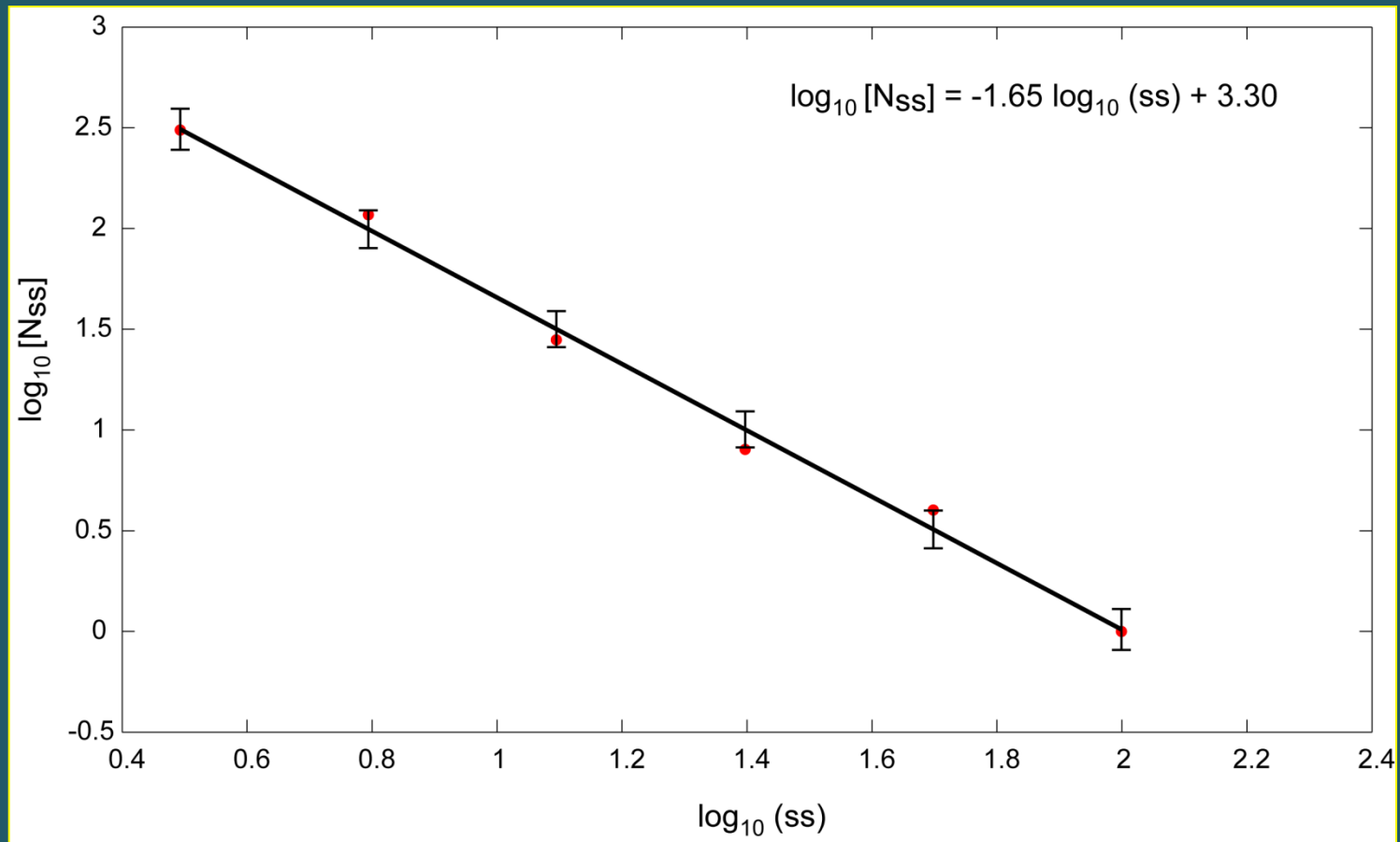
Scaling law in Box Counting Method

$$N(r) \sim r^{-D}$$

Results



Fractal Analysis Lineament Map



Fractal Analysis Drainage Map

Conclusion

- Fractal analysis of earthquakes in Himalaya shows multifractal behaviour and clustering of earthquakes.
- The high values of fractal dimension for lineament (1.63) and drainage pattern (1.65) correlates well with each other.

- This shows that the lineaments are tectonically active in the region. The high values of the fractal dimension for the lineament and drainage system confirm the neo tectonic activity of the region.
- The presence of high seismicity in the near MCT zone can seismically propagate to the study region and result into a seismic hazard.

Thank You