Tectonic Framework of India

Physiographically India is divided in three divisions.

1) The Peninsular India,
2) Indo-Gangetic Alluvium Plain and
3) Extra-Peninsula.

Peninsular India constitutes one of the largest Precambrian shield areas of the world (Fig. 1). The Indo-Gangetic Alluvium Plain (IGAP) separates the Himalaya to the north and the Peninsular Shield to the south . The Shillong Plateau in northeast India constitutes an outpost separated from the main shield by the Bengal Basin and from the Himalaya by the Brahmputra River.

Fig. 1 – Topography of the Indian sub-continent, Tibet, Pakistan and Bangladesh

These broadest physiographic/geomorphic divisions of India also corresponds to the three broadest tectonic divisions.

The Peninsular Shield of India is made up of three main cratonic regions (Fig. 4); the Aravalli, the Dharwar and the Singhbhum which are separated by Proterozoic rifts and mobile belts. The major prominent rifts that separate the southern and northern blocks of the shield are the Narmada Son Lineament (NSL) and the Tapti Lineament (TL), together called the Son-Narmada Tapti lineament (SONATA). The other rift basins are the Kutch, Cambay, Godavari, Cuddapah etc. (Fig. 2).

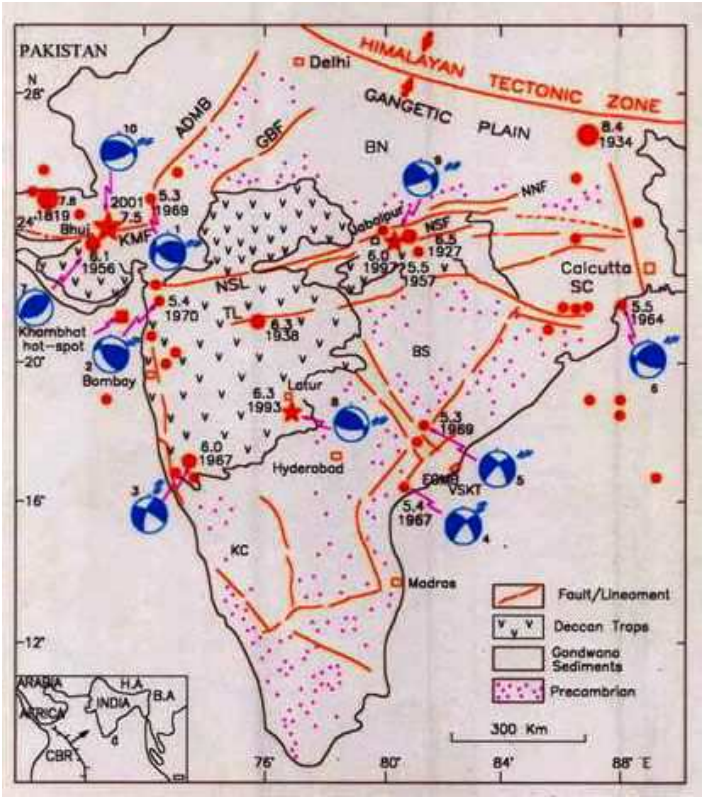
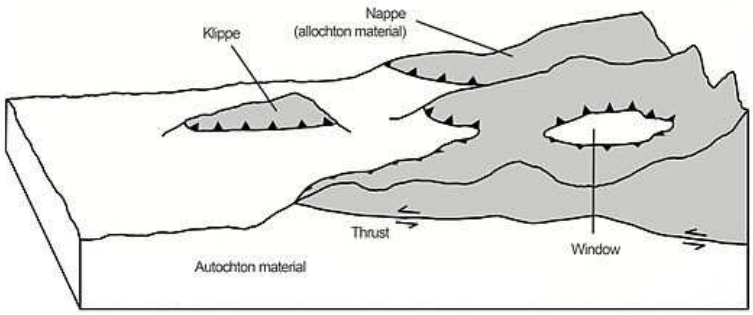


Fig. 4 – Seismo-tectonic map of India

The Himalayan region is very much associated with a high degree of seismicity in comparison to that of Peninsular India (Fig. 5), and making the Himalayan region seismically more vulnerable to earthquake damage (Zone V) than that of Peninsular region (Fig. 6). One of the most striking aspects of the Himalayan orogen is the lateral continuity of its major tectonic elements. The Himalaya is classically divided into four tectonic units that can be followed for more than 2400 km along the belt.

1. The sub-Himalaya (Churia Hills or Siwaliks) **:** The Subhimalaya is thrust along the **Main Frontal Thrust (MFT)** over the Quaternary alluvium deposited by the rivers coming from the Himalaya (Ganges, Indus, Brahmaputra and others), which demonstrates that the Himalaya is still a very active orogen.



2. The Lesser Himalaya (LH) - The sediments of Lesser Himalaya are thrust over the Subhimalaya along the **Main Boundary Thrust (MBT)**. The Lesser Himalaya often appears in tectonic windows (Kishtwar or Larji-Kulu-Rampur windows) within the High Himalaya Crystalline Sequence.
3. The Central Himalayan Domain, (CHD) or High Himalaya **-** It forms the backbone of the Himalayan orogen and encompasses the areas with the highest topographic relief. It is commonly separated into four zones.
    1. The High Himalayan Crystalline Sequence (HHCS) - The HHCS forms a major nappe which is thrust over the Lesser Himalaya along the **Main Central Thrust (MCT)**.
    2. The Tethys Himalaya (TH)
    3. The Nyimaling-Tso Morari Metamorphic Dome, NTMD:
    4. The Lamayuru and Markha Units (LMU)
4. The Indus Suture Zone (ISZ) (or Indus-Yarlung-Tsangpo Suture Zone) defines the zone of collision between the Indian Plate and the Ladakh Batholith to the north. This suture zone is formed by the Ophiolite Mélanges, which are composed of an intercalation of flysch and ophiolites from the Neotethys oceanic crust, volcanics and molasses.

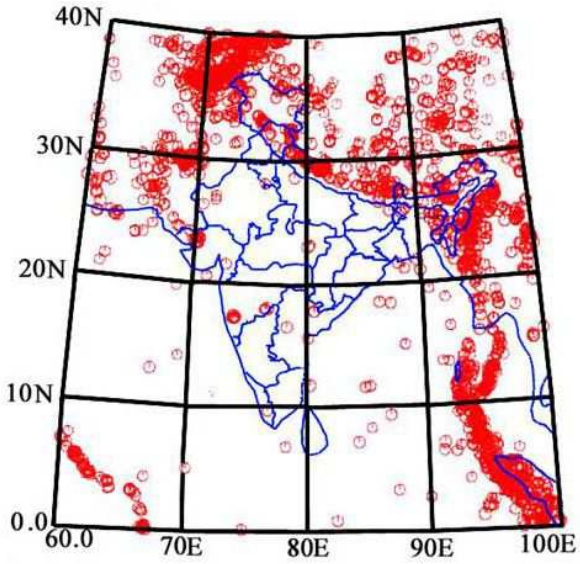


Fig. 5 – Seismicity of the Indian sub-continent, 1964-2002 (Magnitude > 5.0).

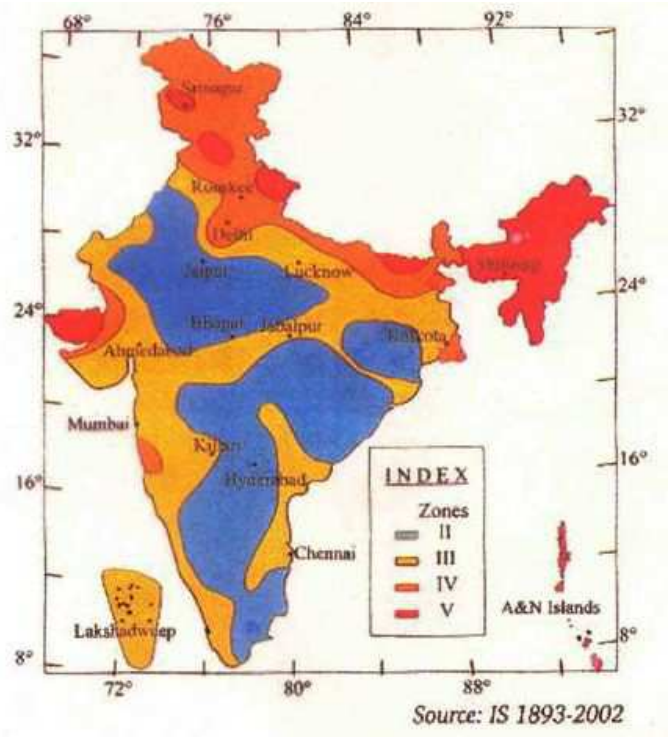


Fig. 6 – Seismic zonation within India.

To gain a better understanding of the crustal architecture of India and the threats posed by earthquakes, the Geological Survey of India (GSI) has, in recent years, determined 3-D seismic velocity structure in different parts of the Himalayan region and in Peninsular India using seismic inversion techniques with the P- and S-wave arrival times recorded by local and regional seismic networks. The aftershock sequences of recent damaging earthquakes (1993 Killari earthquake, Mw 6. 3; 1999 Chamoli earthquake, Mw 6.3; the 2001 Bhuj earthquake, Mw 7.7) have been studied in more detail to provide seismic crustal images of the earthquake source areas.

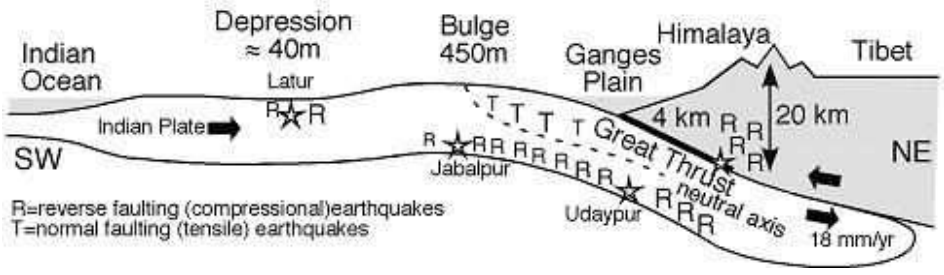


Fig 7 – Buckling of the Indian sub-continent as it collides with the Tibetan Plateau (Bilham, 2004)

*The term "**molasse**" refers to sandstones, shales and conglomerates that form as terrestrial or shallow marine deposits in front of rising mountain chains.