rivers originating from the Western [illegible]
hydel power and irrigation of agricultural crops and orchards.

(vi) There are numerous hill stations and hill resorts, of which Ooty, Udhagamandalam, Kodaikonal, Mahabaleshwar, Khandala, Metheron, Pachmarhi, and Mount Abu are the most important.

(vii) Apart from teak and fuelwood, the forests of Western and Eastern Ghats are rich in medicinal plants.

(viii) The hilly and mountainous areas of the Peninsula are the abodes of many scheduled tribes. South of the Vindhyans is a predominance of Dravidian culture.

THE HIMALAYAS

The Himalayas consist of four lithotectonic mountain ranges, namely (i) the Trans-Himalaya or the Tethys Himalaya, (ii) the Greater Himalaya, (iii) the Lesser Himalaya, and (iv) the Shiwalik or the Outer Himalaya. The Indian Himalayas extend from the eastern boundary of Pakistan to

the border of Myanmar for about 2500 km with a varying width of about 500 km in the west and about 320 km in the east. They lies to the north of the Ganga–Brahmaputra Plains and are separated from the plains by the Himalayan Front Fault (HFF). They include parts of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Nepal, Sikkim, Bhutan and Arunachal Pradesh. Their offshoots run in a north–south direction along the India–Myanmar boundary through Nagaland, Manipur, and Mizoram.

Origin of the Himalayas

The origin of the Himalayas has been a point of contention among the geologists and geomorphologists. It is a complex mountain system having rocks from the Precambrian and Eocene periods. Mostly formed of sedimentary and metamorphic rocks, it has been subjected to intense folding and faulting. The main theories about the origin of the Himalays are as under:

(i) The Geosynclinal Origin

The main supporters of the geosynclinal origin of the Himalayas are Argand, Kober, and Suess. According to these geologists, the disintegration of Pangaea, about 200 million years back, led to the formation of a long Tethys Sea between the Lauratian Shield (Angaraland) of the north and the Gondwanaland of the south. This sea was occupying the region of Himalayas during the Mesozoic Era (180 million years ago). At the end of the Palaeozoic and beginning of the Mesozoic Eras, the Tethys almost girdled the whole Earth running from Europe in the west to China in the east. Eroded material from the two land masses (Eurasian Shield—Angaraland and Gondwanaland) was deposited in the Tethys Sea and assumed considerable thickness due to the sinking nature of the sea bed **(Fig. 2.4 and Fig. 2.5)**. During the Cretaceous Period, the bed of the sea started rising which led to the folding of three successive ranges of the Himalayas. The first upheaval led to the formation of the Greater Himalayas during the Eocene Period (about 65 million years back). Similarly, the second upheaval took place during the Miocene Period (about 45 million years back) resulting in the formation of the Lesser Himalayas, and the third upheaval started in the Pliocene period (about 1.4 million years back) resulting in the formation of the Shiwaliks or the Outer Himalayas.

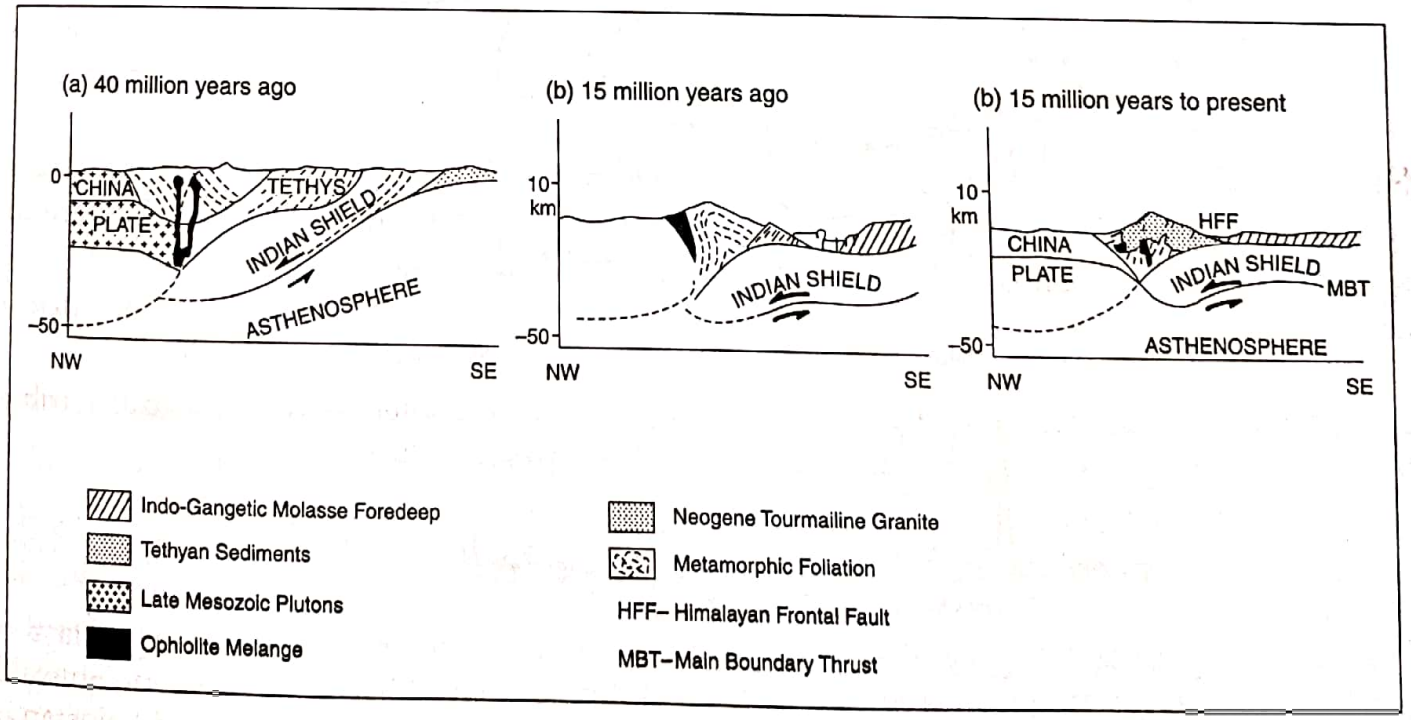

Fig. 2.4 Origin of the Himalayas

(ii) The Plate Tectonic Origin of the Himalayas

The theory of Plate Tectonics was put forward by W.J. Morgan of Princeton University in 1967. This theory is based on the concept of "Sea-Floor Spreading" advocated by H.H. Hess. According to this theory, about 70 or 65 million years ago there was an extensive geosyncline, called the Tethys, in place of the Himalayas. About 65–30 million years ago the Indian plate came very close to the Asian plate and started subducting under the Asian plate (**Fig. 2.6**). This

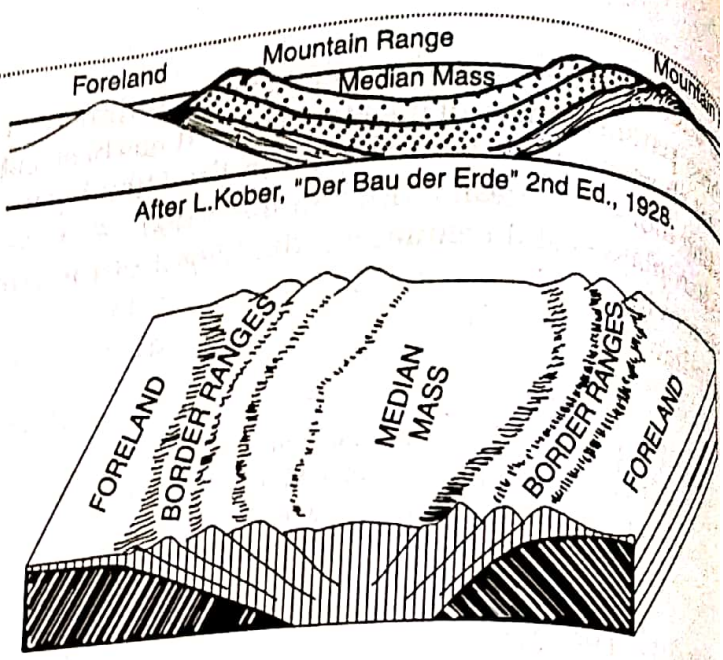

Fig. 2.5 Formation of the Himalayas

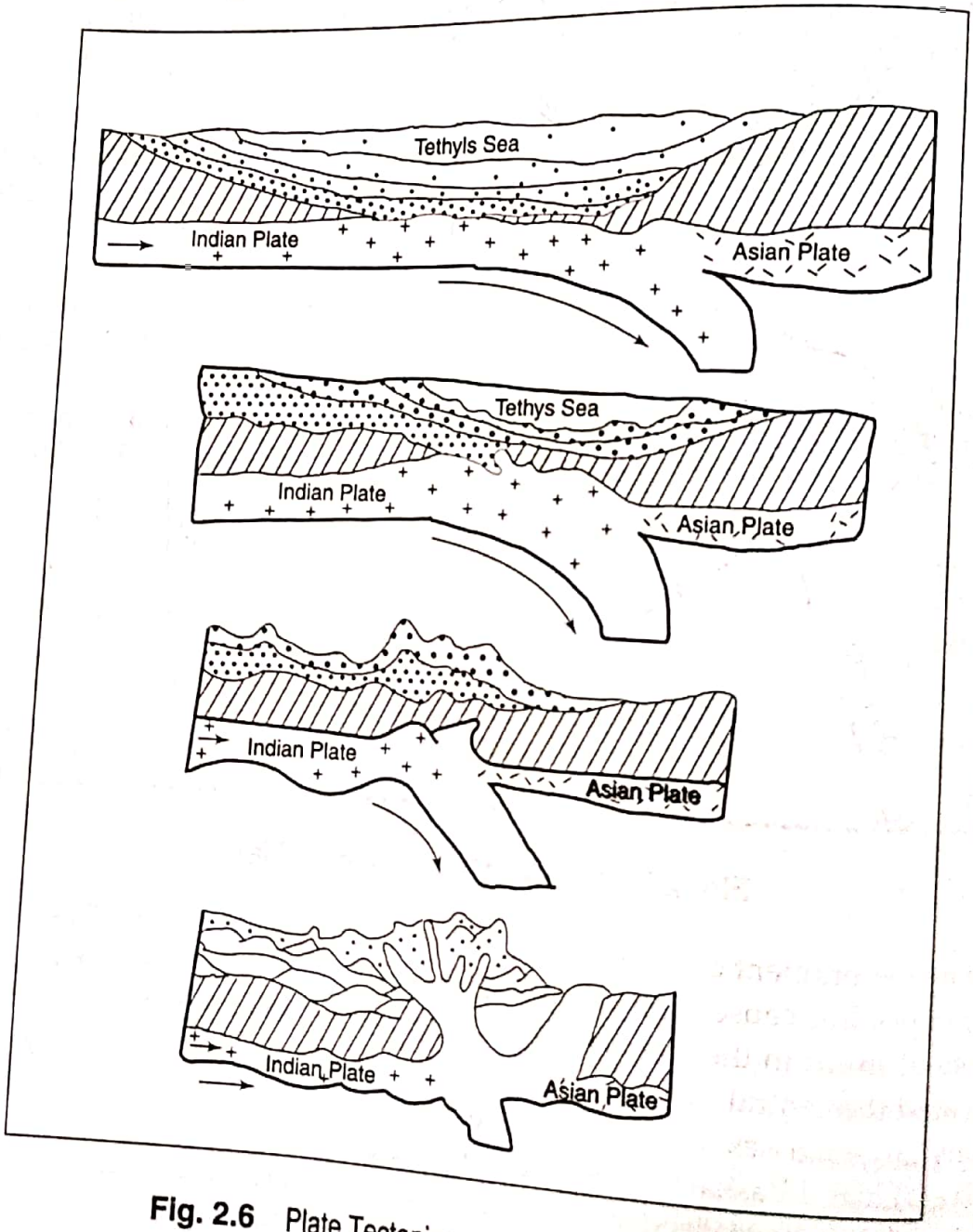

Fig. 2.6 Plate Tectonics and Origin of the Himalayas

caused lateral compression due to which the sediments of the Tethys were squeezed and folded into three parallel ranges of the Himalayas. It has been estimated that this convergence has caused a crustal shortening of about 500 km in the Himalayan region and is compensated by sea floor spreading along the oceanic ridge in the Indian ocean region. Since the northward movement of the Indian plate is still continuing, the height of the Himalayan peaks is increasing. The Indian Plate is moving northward and the center of rotation is constantly changing. The northward drift of the Indian Plate and the subcontinent of India have been shown in **Fig. 2.7 and Fig. 2.8.**

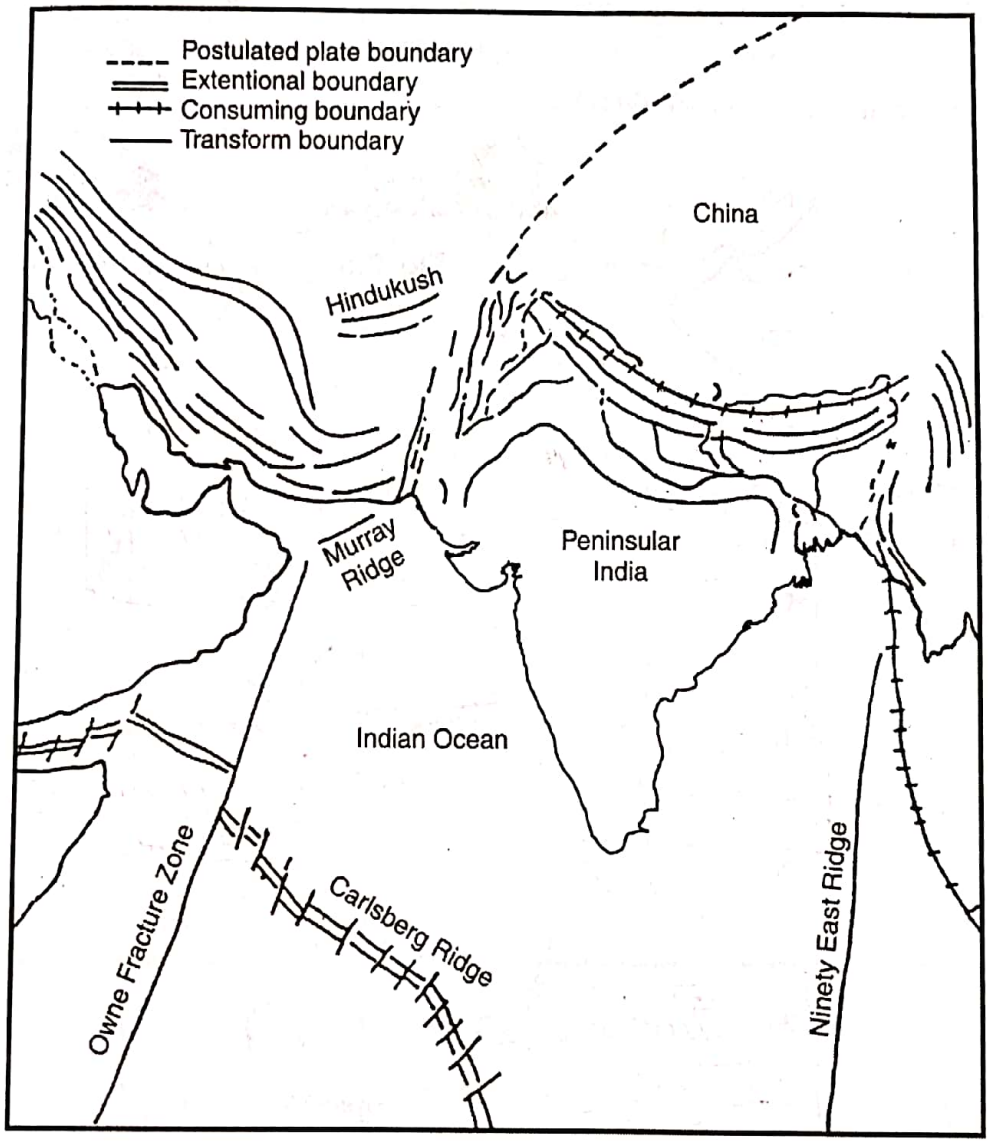

Fig. 2.7 Northward Drift of the Indian Plate

The continent-to-continent collision between the Indian and the Asiatic plates started around 65 million years ago and caused the Himalayas to rise from the Tethys geosyncline. Thus, the first major phase of uplift in the Himalayas occurred around 65 million years ago. This orogenic movement elevated the central axis of ancient crystalline and meta-sedimentary rocks which have been intruded by large masses of granite. It is believed that the first major phase of uplift initially produced the Ladakh and Zaskar ranges of the Trans-Himalayas before the formation of the Great Himalayas. Hence, it is to be realized that except the Kashmir part of the Himalayas, the Himalayan ranges have not developed from a geosyncline and are made up of elements formerly connected

to the marginal parts of the Indian shield. During the main Himalayan orogeny, this continuous geosynclinal sedimentation led to the underthrusting of the Indian shield against the Tibetan Massif which buckled down the geosynclinal deposits, resulting in the outflow of a large amount of ultrabasic rocks known as ophiolites. These ophiolites are seen as exotic blocks on the Ladakh and Zaskar Ranges of the Trans-Himalayas. The end effect of the buckling of the geosyncline was not only the crustaline thrust effect on Ladakh and Zaskar leading to their rise as ranges, but also the creation of the sharp tectonic line of the Indus suture along which large geosynclinal areas disappeared.

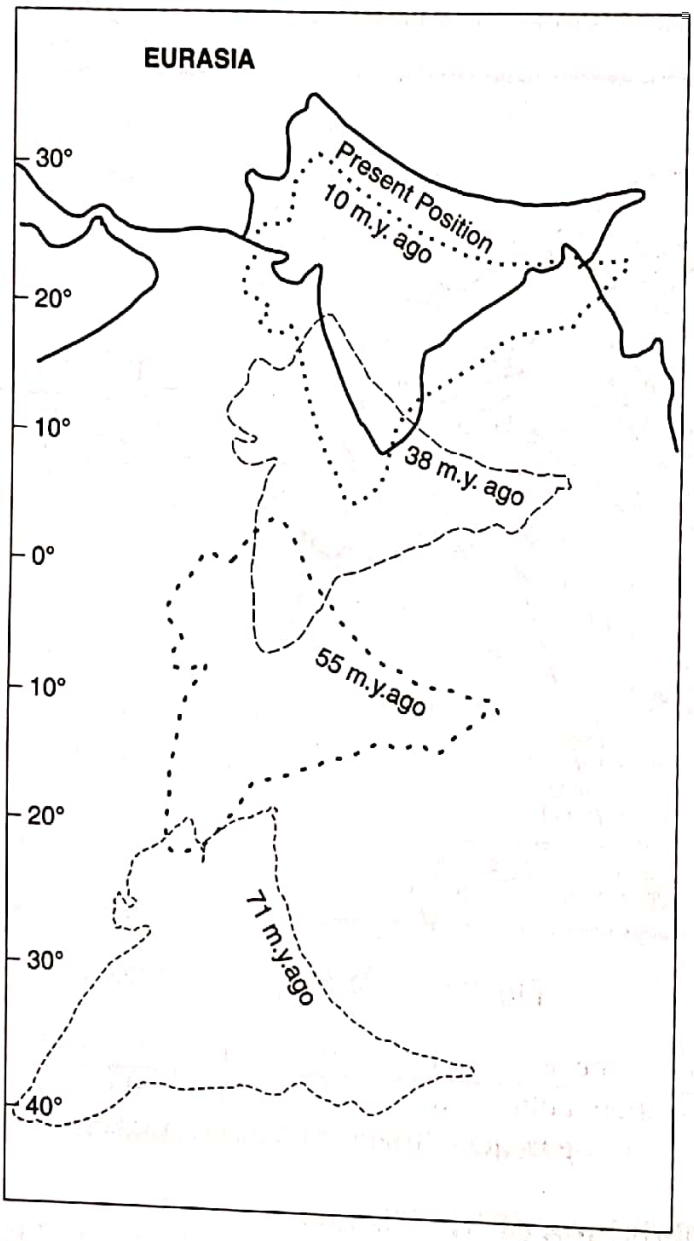

Fig. 2.8 Northward Drift of the Indian Subcontinent

The intermontane basins in the Indus suture zone of Ladakh continued to receive molasses sedimentation in this period. The second major uplift which took place around 45 million years ago, caused the rapid uplift of the southern mountain front of the Lesser Himalayas, giving rise to the extremely rugged and youthful Pir-Panjal, Dhauladhar, Karol, and Mahabharat Ranges abruptly

and steeply. The Greater Himalayas and the Lesser Himalayas are separated by the Main Central Thrust (MCT). These spurs of the Lesser Himalayas again formed, in their turn, the intermontane basins of Kashmir, the Karol-basin, Dun Valley (Uttarakhand), and the Kathmandu Valley of Nepal. The foredeep which was formed further away received the thick sequence of terrestrial sediments called Shiwaliks from the middle-Miocene to the middle-Pleistocene periods, covering a span of about 1.4 million years. The Lesser Himalayas and the Shiwaliks are separated from each other by the Main Boundary Thrust (MBT). The 5000 m thick Shiwaliks dominated by boulder and conglomerate, reflect the progressive uplift of the Himalayas from which they have been derived as a result of the third major phase of uplift. The Shiwaliks are separated from the Northern Plains of India by the Himalayan Front Fault or HFF **(Fig. 2.9 and Fig. 2.10)**.

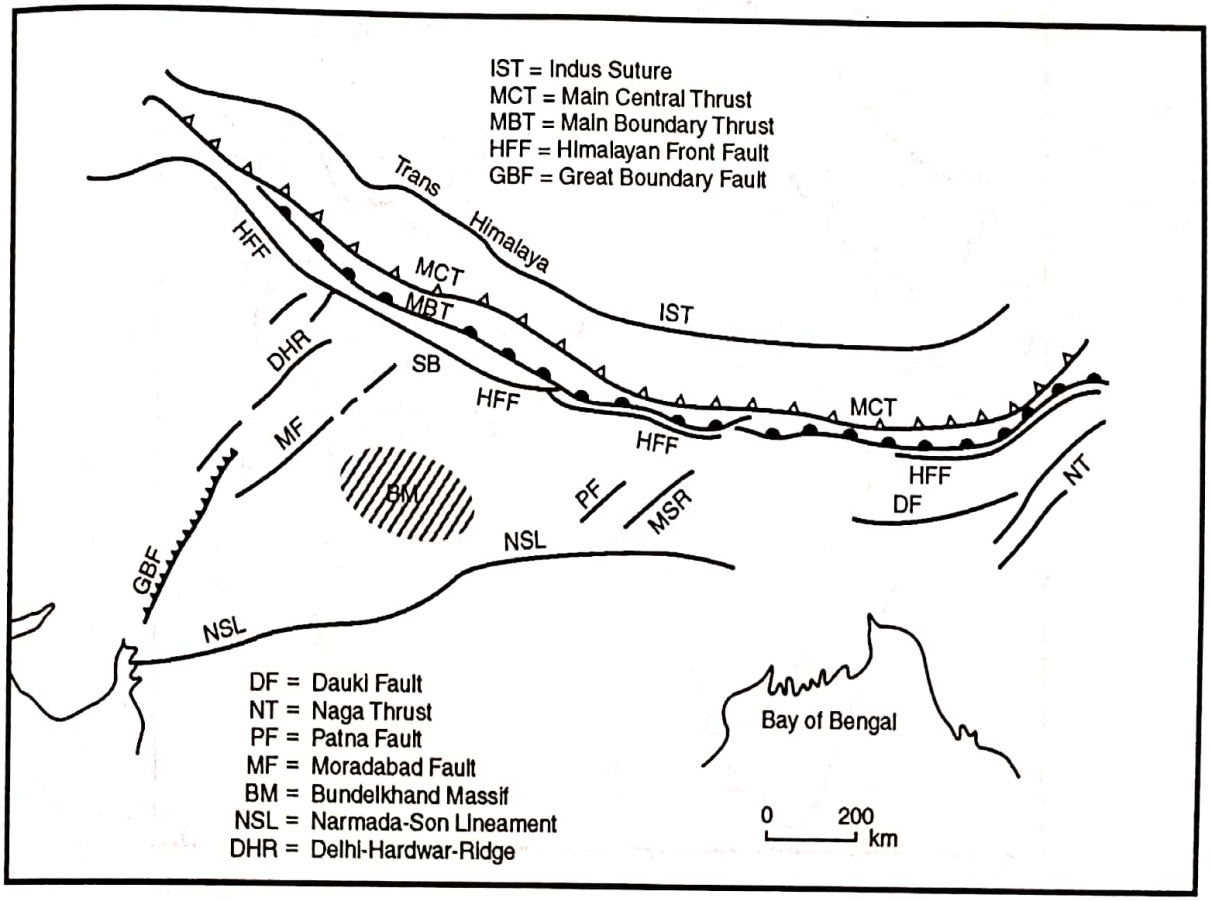

Fig. 2.9 Major Faults of the Himalayas

The Shiwaliks form the normal Jura type of structures with wider basin-like synclines alternating with steep, often faulted, asymmetric anticlines. At present, the Himalayan Front Fault (HFF) is quite active recording frequent tremors and earthquakes.