CHAPTER II

REGIONAL GEOLOGICAL SETTING

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II. 1 INTRODUCTION

The Himalaya stretching from Nanga Parbat (8126 m) in the west to Namche Barwa (7756 m) in the east forms an arcuate mountain belt and a rampart for the Indian sub continent along its northern margin and comprises the earth's largest mountain range with varied geotectonic zones.

The Himalaya is 2400 km long along the strike. It is a premier orogenic belt on the globe. Its southern margin is demarcated by the Sindhu (Indus) - Ganga Alluvial belt and the northern margin by the Indus Suture Zone. This organic edifice is young in age although the rocks composing it have a long history ranging from the Paleoproterozoic to the Quaternary. Geographically the Himalaya covers the states of Jammu-Kashmir, Himachal Pradesh, Garhwal-Kumaun of Uttar Pradesh, Sikkim-Darjeeling and Arunachal Pradesh in India, the Hazara and Northwest Frontier Province (NWFP) in Pakistan, Nepal, Bhutan and South Tibet.

Himachal Pradesh lies in the Western Himalaya and embraces a vast mountainous terrain between the rivers ravi in northwest and the Tons – Yamuna in the southeast. It occupies an area of 55,673 km^2 between latitudes 30°22' and long 70°46' and 79°00' E. It is bounded in the northwest and north by the state of Jammu and Kashmir, in the east by Tibet (China), in the southeast by the state of Uttar Pradesh, in the South by Haryana and in southwest by Punjab.

The Himalaya, unlike other terrains in Indian Peninsula, has disntinctive stratigraphic edifice, structural framework and tectonic divisions and has assumed the present orogenic configuration during a span of 60 million years. Thus, it represents a young terrain and morphologically an active one. Besides, the Himalaya represents the greatest example of continent collision due to the meeting of two convergent plates of India and Eurasia and as a consequence, there was a widespread Tertiary transgressions and development of major thrusts and nappes, directed towards the converging plate i.e. the Indian subcontinent. The Himalaya is not only geologically complicated but morphologically very complex with a strong relief variously modified due to action of wind, ice and water (Srikantia and Bhargava, 1998).

II. 1. A. Previous Work

The first authoritative geological work in the Himachal Himalaya, and for that matter in the Himalaya itself was that by Medlicott in 1864 who described the geology of nearly 18,000 km^2 area between the Ravi and the Ganga. His description of the Tertiary and Pre-Tertiary rocks provides the basis for all future work in this part of the Himalaya and to this day remains classic. Medlicott was later followed by McMahon (1882, 1885, 1895) who mapped Dalhousie and other northwestern Himalayan areas. Almost simultaneously Oldham (1883, 1887) surveyed parts of Shimla Hills. In the Tethys Himalaya, Stoliczka (1865) and Hayden (1904, 1908) also von Kraft, mapped the Lahaul-Spiti area and classified the sedimentary sequence.

With the establishment of a Circle Office of the Geological Survey of India for Himachal Pradesh, mapping programme of Himalaya received a great impetus. The initiation of belt-wise mapping covering the major tectono-sratigraphic belts of Himachal Himalaya in the sixties marked an important phase of the programme. This enabled extensive coverage of shali-simla,Largi-Rampur, Deoban-Jaunsar-Krol-Tal belts (Srikantia and Sharma, 1976; Bhargava, 1976; Sharma,1977). The Oil and Natural Gas commission of India carried out mapping of Foothill Tertiary belts (Mathur and Evans, 1964; Sahni and Mathur, 1964; Karunakaran and Ranga Rao, 1979). During the seventies mapping programme was extended to Shimla, Chamba, Lahaul-Spiti, Kinnaur and selcted areas of lower Himalaya. This resulted in major revisions in the geology of Jutogh, Chamba Lahaul-Spiti, Kinnaur areas (Srikantia et al. 1975; Srikantia, 1981; Prashra and Rapa, 1982; Bhargava and Bhattacharya, 1975; Bhargava, 1980). At the same time other organizations contributed to the geological knowledge of the area (Rupke, 1974; Naha and Ray,1972; Ranga Rao,1968; Raiverman,1979; Thakur,1981; Frank et al.1977).Certain essential paleontological and sedimentological aspects which had a bearing on the stratigraphy of rock formations in the lesser Himalayan zone received atttention from workers in universities (Valdiya, 1969; Bhatia,1982). The entire Himachal Pradesh is now covered by geological map on 1:50,000(or 1:63,360) scale. Himachal Pradesh constitutes geologically the most intensely investigated sector of Himalaya and displays best geological sections of the Tethys and Lesser Himalayan Belts.

The Lesser Himalayan tectogen in the south and Tehthys Himalayan tectogen in the north are considered to be two major geo-tectonic zones of Himachal Pradesh

(Srikantia, 1987). They are characterized by diverse stratigraphical sedimentological,faunal, igneous and tectonic elements so as to imply two alien blocks which are now juxtaposed (Srikantia and Bhargava, 1998).

II. 1. B. Lesser Himalayan Tectogen

Lesser Himalayan Tectogen is mainly exposed in the southern part of H.P. between the Main Central Thrust (MCT) and Main Boundary Thrust (MBT). The proterozoic inliers like Riasi Limestone of Jammu and Shali subsidiary belt of Bandla range, Bilaspur in H.P are distinctly part of main proterozoic in Lesser Himalayan zone. Structurally, the northern segment of Lesser Himalayan tectogen lies below the sole of the crystalline nappes translated along the MCT (Srikantia and Bhargava, 1998).

II. 1. C. Tethys Himalayan Tectogen

Exposed mainly in the northern part of Himachal Pradesh between the Main Central thrust (MCT) and the Indus Suture Zone and also as allochthonous units over the Lesser Himalayan Tectogen. The term Tethys Himalayan Tectogen includes the proterozoic crystalline nappes and central crystalline zone and crystalline basement rocks with intrusive granitoids and the sequence of the phanerozoic sedimentary cover occurring in the main Lahaul-Spiti-Kinnaur basin and other sub-basins of Chamba and Tandi. Structurally the area represents basinal belts of Lahaul-Spiti-Kinnaur in the northern part bounded in the southwest by the Central Crystalline Zone followed further south by a sprawling Salkhala metasedimentary nappe with outliers of Permo-Trias in Chamba and Tandi followed by crystalline thrust sheets of Jutogh and Kullu tectonically moved over the Lesser Himalayan Tectogen as nappes and Klippen with direction of movement from NE to SW. The spectacular Jura folds in Mesozoic rocks and contact detachment leading to decollement thrusts are some of the distinctive features of this tectogen (Srikantia and Bhargava, 1998).

II. 2. REGIONAL GEOLOGICAL SETTING OF THE STUDY AREA

The regional geological setting of the area is given in (Fig 2. 1). The stratigraphy is given in (Table 2. 1). The southern side of lower Baspa valley is situated on metamorphic rocks of central crystalline group in Higher Himalaya (Fig 2.1).

(Table 2. 1) Stratigraphic succession of Baspa valley (After Srikantia and Bhargava, 1998 and Geological survey of India 1996)

Group	Formations	Rock type	Age
--	--	Glacial and fluvio-glacial sediments	Quaternary
Sanugba	Kunzamla, Thango, and Takche Formation	Greenish grey siltstone, shale, slate, quartzite, sandstone, dolomite and local pebble beds	Lower- middle Cambrian to Silurian
--	Dalhousie, Mandi, Karsog and Rohtang	Granitoids	Lower Cambrian-Silurian
Haimanta	Batal	Grey-green phyllite, grey-quartzite, carbonaceous phyllite	Terminal Proterozoic
Jutogh	--	Quartzites, schists and phyllites	Neo-Proterozoic
Vaikrita	--	Gneisses (streaky, banded, porphyroblastic, sillimanite and kyanite bearing gneiss)	Meso-Neo Proterozoic

The Vaikrita Group includes variety of gniesses (streaky and banded-gneiss, porphyroblastic gneiss, sillimanite and kyanite bearing gneiss). This is overlained by Jutogh group, which is principal metamorphic belt of Himachal Pradesh comprising of quartzites, schists and phyllites. The Jutogh Group is further overlained by Batal Formation whose basal part exhibits gray-green phyllite, middle part grey-quartzite and topmost part is made up of carbonaceous phyllite. Batal Formation is then overlained by Dalhousie-Mandi-Karsog and Rohtang Granitoids. The uppermost lithology belongs to Kunzamla-Thango and Takche Formations (Table 2. 1), which comprise of greenish grey siltstone, shale, slate, quartzite, sandstone, dolomite and local pebble beds.

The study area exhibits glacially carved, U-shaped profile upstream of Kupa village while the river is presently flowing through a narrow gorged valley carved below the base of

U-shaped profile. Along the coarse of river in upstream direction quartzites and phyllites were exposed in initial reaches while Granitoids and gneisses were exposed near Rakchham village onwards i.e, from middle reaches of the valley. The Granitoids were showing very steep to cliff like faces in sharp crested and projected angular peaked hills as compared to gneisses and phyllites. The skyline of granitoid terrain is rugged and attains great heights as compared to other rock types in the terrain. Huge angular and sharp edged boulders of granitoids are found at many places along the course of river and in deglaciated valleys. Other rock types of slates, phyllites, and schists are found in very small sizes, with disc shaped in the glacio-fluvial regimes of deglaciated valley. The rockfalls (mainly of Granitoids and gneisses) and debris fans are one of the most common feature common feature observed in the valley. The common rock types found in Baspa valley are granitoid, gneiss, phyllite and quartzites along glacio-fluvial regimes. The following rock types were identified during the *petrographic studies.*

Granitoids are medium to coarse grained in nature whereby the dominant constituents include quartz, felspars (microcline, plagioclase), and biotite. Whereas garnet, zircon, muscovite and chlorite occur as accessories.

Slate obtained is fine grained in nature. The dominant mineral constituents include quartz and micaceous minerals. Opaques and plagioclase felspar minerals occur as accessories.

Biotite granitoid occurs as medium to fine grained with quartz, biotite and felspar as dominant mineral constituents.

Sillimanite gneiss occurs as fine grained with quartz and sillimanite as dominant mineral constituents and plagioclase felspar and biotite occurs as accessories.

Lithology plays an important role in protecting glacier from wasting. The part of ablation zone which is covered by morainic debris shows slow melting while those devoid of morainic debris leads to fast melting. This phenomenon is also found in many glaciers of Baspa basin and it has been observed for Shaune Garang and Jorya garang glacier in the field. As granitoids of Dalhousie-Mandi-Karsog-Rohtang Formation, gneisses of Vaikrita Group, and Quartzites of Jutogh group are hard and compact, they resist weathering. Soft rocks such as slates of Kunzamla-Thango-Takche Formations and phyllites, carbonaceous phyllites of Jutogh Group and Batal Formations easily shatters into pieces.

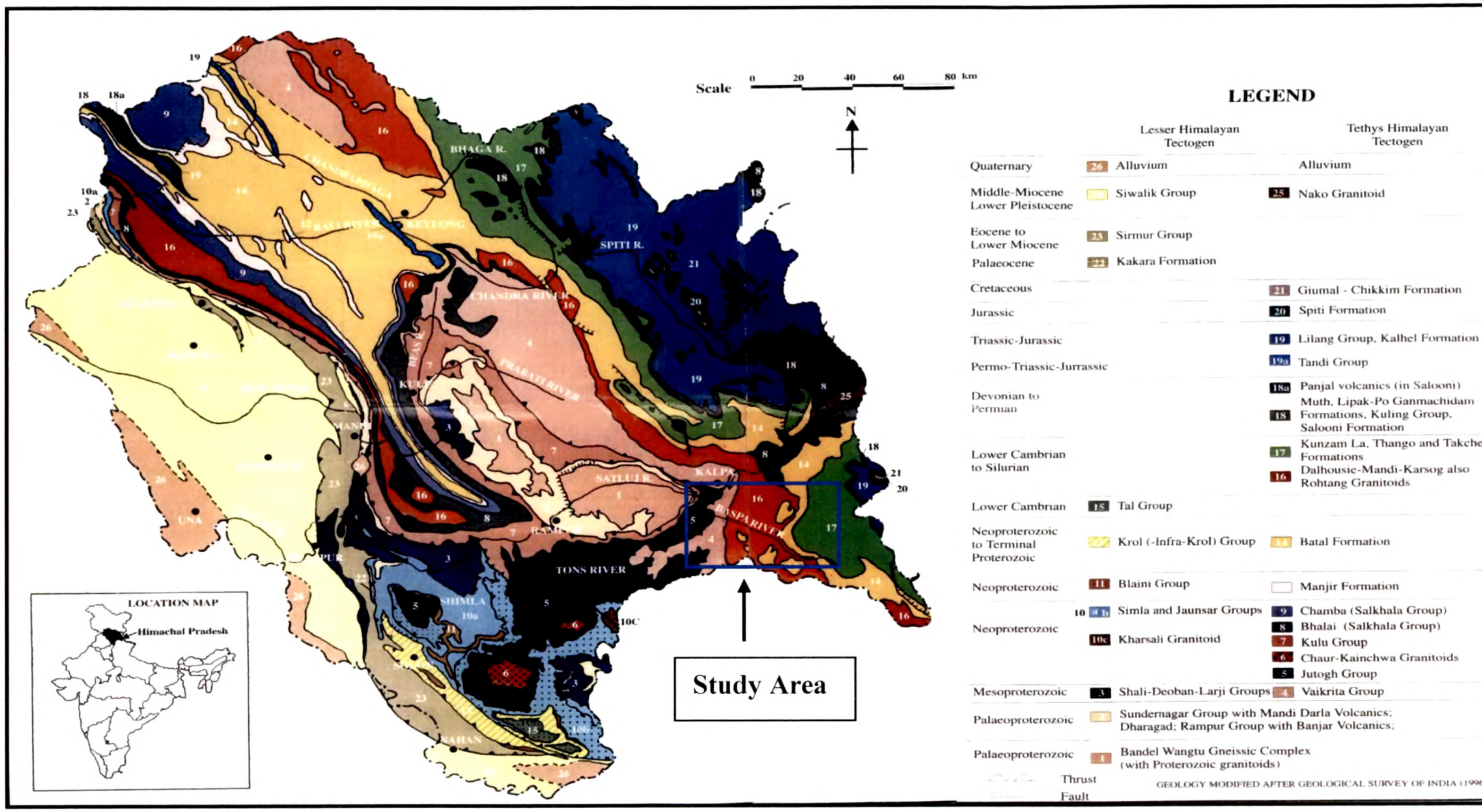

Fig 2.1. Geological map (Srikantia and Bhargava, 1998)