Chapter 8

DISCUSSION AND CONCLUSION

8.1 DISCUSSION

The Himalaya is considered as the youngest example of continent – continent collisional tectonism between Indian and Eurasian Plate. The Indian plate is moving further northward since the initial collision resulting in crustal shortening which leads to the development of various thrusts and folds within the rocks south of the Indo-Tsangpo Suture Zone.

The Bhalukpong – Zimithang geotransect of Western Arunachal Himalaya comprises of a number of thrust bound lithological units namely Siwalik, Gondwana, Lesser Himalayan Sequences, Higher Himalayan Sequences and Zimithang Granite from lower to higher structural level. As already stated in Chapter 2, Siwalik and Gondwana are excluded from this study. The rocks of Lesser Himalayan Sequence can be divided into Lesser Himalayan Sedimentary Sequence (LHSS) and Lesser Himalayan Crystalline (LHC). The low to medium grade metasedimentary rocks of Tenga and Dirang Formation of LHSS maintain an intrusive contact with a huge granitic body, Bomdila Gneiss which is considered as LHC. The Lumla Formation of LHSS can be equated with Dirang Formation based on their similar lithological characters. The tectonostratigraphic status of Lumla Formation is very complicated. Some workers consider them as younger or have a different age to that of enveloping SeLa Group of rocks and another school of thought opined that Lumla Formation is a part of the SeLa Group. According to the present study the first opinion is more acceptable as the grade of metamorphism and lithological assemblage of Lumla Formation is different from that of SeLa Group.
The high grade migmatites of SeLa Group are thrusted over low to medium grade metasedimentary rocks of Dirang Formation along the Main Central Thrust (MCT1). The MCT1 acts as a zone of shear planes rather than a single thrust plane (5 – 8 km width) where strain effect is more conspicuous.

The granitoids of Western Arunachal Himalaya includes Bomdila Gneiss, Zimithang Granite and Higher Himalayan Leucogranites. They are S-type (Chappell and White, 1974) muscovite bearing peraluminous granites (Barbarin, 1999) formed in syn-collisional tectonic setting. These granitoids are formed during various magmatic activities at different stratigraphic intervals. Yin (2010) has suggested a series of magmatic events as 1750 Ma, 825-879 Ma, 500 Ma and 28-20 Ma. The first three magmatic events are correlateable with Indian craton whereas the fourth event is correlateable with Indo-Asian collision during Cenozoic period. The earliest magmatic event in Western Arunachal Himalaya is probably marked by the intrusion of Bomdila Gneiss into the LHSS (Tenga and Dirang Formation) during Palaeoproterozoic time. Zimithang Granite intruded during late Palaeozoic time as indicated by monazite and xenotime dating. Both Bomdila and Zimithang Granites are deformed and the latest mylonitic foliation overprints the earlier deformational fabrics. The migmatites of SeLa Group are intruded by tourmaline bearing leucogranites. The lensoids of leucogranites may have formed in vapour free condition (Harris et al., 1993) and do not seem to have migrated much from their source. Leucogranites are formed due to partial melting of the rocks of SeLa Group. Bhalla and Bishui (1982) gave an age of 27±5 Ma for the leucogranites of SeLa Group.

Magnetic susceptibility study of Bomdila Gneiss has been carried out with precise geographic coordinates. Susceptibility measurements are taken with the help of hand held kappameter KT6 on insitu rock surfaces of Bomdila Gneiss. Data are corrected due to surface
unevenness based on recommended correction factors (1mm = 1.07, 2mm=1.15, 3mm=1.23, 4mm=1.32, 5mm=1.41). Granitic classification of Bomdila Gneiss for magnetite series (MS value > 3 x 10^{-3} SI Unit) and ilmenite series (MS value ≤ 3 x 10^{-3} SI Unit) has been done. Almost all the samples of Bomdila Gneiss exclusively fall into the field of ilmenite series granitoid. It may be the results of interaction or contamination with the country rocks (LHSS) as most of the data were collected near the border zone of the pluton. Reduced nature observed from the data plots is probably indicative of the reduced nature of the upper mantle source during early Precambrian time.

A late Palaeozoic crystallization age for granites is reported for the first time from Arunachal Himalaya. EPMA xenotime dating indicates an average of 286 ± 41 Ma for Zimithang Granite which does not match with that of Yin et al. (2010). Yin et al. (2010) reported two U-Pb zircon ages of 878 and 627 Ma from the Zimithang Granite and related the 878 Ma with the time of crystallisation for the pluton and younger age of 627 Ma to represent a later metamorphic event. Since the grey and leuco phases of Zimithang Granite gave almost same ages these two components seem to be coeval. These granites are equivalent to 262 Ma Pikang Granite of Lhasa block (Zhu et al., 2009) and 284 Ma Zanskar Granite (Horton and Leech, 2013). From geochemical study, it can be observed that Permian granites in the north-eastern, eastern and western Himalayas are compositionally and chronologically similar and may be related to rifting processes associated with the breakup of Gondwana. In this context Zimithang Granite as well as other Permian granites in Himalayas may provide a clue into the breakup of Gondowana land and the paleo-juxtaposition of major Himalayan lithotectonic unit.
8.2 CONCLUSION

The following conclusions are drawn from the observations carried out systematically and are integrated together in the context of the Great Himalayan tectonics. The stack of thrust sheets along Bhalukpong – Zimithang geotransect attracts the attention of many people both from Indian subcontinent and abroad, but still some of the basic issues are unattended either because of high hilly terrain, inaccessibilities from road / transport communication system, International border restriction zone or rainfall and heavy snow cover alternately throughout the year. Yet an attempt has been made to draw a more logical, transparent data and fact based conclusion.

1. The LHS are metamorphosed to biotite – garnet – staurolite – kyanite zone representing greenschist to lower part of amphibolite facies while the Higher Himalayan Sequences are metamorphosed upto sillimanite zone (middle part of upper amphibolite facies). Barrovian zonal concept is applicable in an inverted way although Goswami et al. (2009) advocated that this geotransect invites a deviation from classical Barrovian type of metamorphism of inverted nature.

2. Lumla Formation occurs as a tectonic window within SeLa Group and is equivalent to Dirang Formation. Lumla thrust is designated as MCT₂.

3. Very narrow exposures of Dirang / Lumla Formation at higher structural level towards north indicates an increasing nature of Barrovian zonation with index minerals from biotite, garnet, staurolite structurally lie over Tenga/ Dedza Formation at lower structural level.

4. In the MCT₁ zone, metasediments of both Dirang and Lumla Formation register the presence of zincian staurolite (gahnite) with garnet. Staurolite containing 5 – 6% ZnO
while gahnitic staurolite contains 30 – 32% ZnO. Presence of Zn in MCT₁ zone is reported for the first time and the work is in progress.

5. Metamorphic event is worked out by Yin et al. (2006) based on Monazite dating in case of Dirang and Lumla metasediments as 60-120 Ma whereas, Xenotime dating of Zimithang granite is worked out to 286 ± 41 Ma (Bhattacherjee et al., 2013).

6. Four phases of deformations are witnessed in this geotransect, out of which first phase is treated as Prehimalayan, second and third phases are related to Synhimalayan phase and fourth belongs to Posthimalayan. These deformational history are set systematically in accordance with the observation made by Jain et al. (2002).

7. Based on vergence pattern of small scale folds of different generations and scales, the sense of asymmetry is worked out and it is observed that Pre Himalayan and Syn Himalayan structural fabrics are showing top to the SE to SW through S sense of shear. On the regional scale, slip vector may be considered as top to the south sense of tectonic transport. This kinematic direction coincides with the regional kinematic directions of MFT, MBT and MCT (Yin et al., 2010).

8. Magnetic susceptibility of the Bomdila Gneiss is worked out and data sets generated are exclusively fall in the ilmenite series of granitoid. As 80% data are collected from the border zone of granitoid, therefore, it may be suggested that they are the result of interaction or contamination with the country rocks. Reduced nature documented by observed data plots is probably indicative of the reduced nature of the upper mantle source during early Precambrian time. Shape of the Bomdila Gneissic pluton is worked out as roughly elliptical or elongated with long (ENE–WSW) direction and short direction (NNW–SSE) which is the cause and effect of interference between pluton ballooning and regional simple shear.
9. From AMS study, it is inferred that the constriction type of strain is an indicative of emplacement mechanism under convergent tectonic setting in the Himalayan orogenic belt.