Professor R. S. Sharma was a leading metamorphic petrologist of the country, having a holistic approach towards understanding crustal processes and tectonics. This volume brought out in his honour with articles from authors in different countries on diverse topics related to metamorphism and crustal growth is a fitting tribute to an outstanding scientist.

The volume starts with a perceptive treatment of the relation between crustal melting and prograde and retrograde metamorphism by T. E. Johnson and M. Brown. Prograde metamorphism is accompanied by progressive liberation and loss of a volatile phase and causes generation of melts at the upper amphibolite to granulite facies conditions and these may segregate and move out. The authors point out that the extent of post-peak retrogression is influenced by several factors, notably the AP between the prograde and retrograde segments of the P-T path, the rate of cooling, and the availability of fluids. The common preservation of "close-to-thermal-peak mineral assemblages in migmatites and granulites suggest that extensive reaction with melt is uncommon, implying melt loss." At the same time they opine that the limited occurrence of UHT granulites within granulite terrains may suggest that the large terrains of common granulites may have been retrogressed from UHT assemblages, facilitated by retention of some melt within the system. The water dissolved in the melt is transported through the crust to be exsolved on crystallization, and this water causes retrogression at subsolidus conditions. Johnson and Brown review crustal melting of metapelitic rocks within the sillimanite stability field around the amphibolite to granulite facies transition using P-T pseudosections calculated by using THERMOCALC programme and discuss the prograde and retrograde evolution of these rocks. The processes are illustrated with reference to three field examples.

Generation of migmatites and anatectic granitoids receives the attention of M. D. P. Gomez also who shows that within the Avila batholith, central Spain, granodiorites are produced where there is high melt-fraction, and leucogranites represent low melt-fraction. Sillimanite-rich enclaves within leucogranites represent the restitic fraction. The author documents the contrasted geochemical evolution of the two types of granitoids. It is suggested that the granodiorite was produced during the second phase of Hercynian orogeny as a consequence of crustal thickening and the leucogranite was produced later during an extensional episode by decompression melting.

The role of fluids in tectonics and metamorphism is a much discussed topic these days. A leading worker on this line, W. M. Lamb has presented an excellent review of the role that CO₂-rich fluid might have played in the granulite facies metamorphism. Among the various processes suggested to account for low H₂O activity, a characteristic feature of granulite facies metamorphism, one is the infiltration of CO₂-rich fluid. The presence of CO₂-rich fluid inclusions and of carbonate inclusions within other phases in granulite facies rocks is often taken as evidence of pervasive CO₂ infiltration. Lamb presents arguments for doubting that these inclusions record the fluid composition during peak metamorphism. Calculations indicate that the carbonates in granulite facies feldspathic gneisses are not in equilibrium with quartz+orthopyroxene under granulite facies P-T conditions, and therefore, he concludes that "these carbonates should not be used to determine peak metamorphic fluid compositions." The CO₂-rich fluid inclusions might have been trapped or modified after the peak metamorphic event.

S. W. Faryad has discussed the fluid behaviour during metamorphism in high-pressure amphibolite/eclogite facies condition of carbonate-evaporitic rocks in Western Hindukush. He came to the interesting conclusion that during this metamorphism significant amounts of CO₂, halogens, B and S, instead of being driven out, were conserved in mineral structure, mainly in carbonates, F-rich phlogopite, tourmaline, scapolite, apatite, titanite, pyrrhotite and graphite. It is during retrogression that devolatilization took place and F-, S- and Cl-rich phases formed veins and replaced high-grade minerals and the fluids infiltrated into the surrounding rocks and metasomatic reactions produced lapis-lazuli deposits. Water released by crystallization of post-metamorphic granite and infiltrating the carbonate-evaporite also played significant role in the formation of scapolite and sodalite group minerals.

J. G. Liou, T. Tsujimori, I. Katayama and S. Maruyama
have written a review on ultra-high-pressure (UHP) metamorphism which has been recently recognized within major continental plate collision belts. They have been recently discovered in the Himalayan belt also. The index minerals of such metamorphism are diamond and coesite which occur as micron-scale inclusions in chemically and mechanically resistant zircon, garnet, and a few other strong container minerals. UHP metamorphism cannot be explained by homogeneous thickening of the crust, but rather demonstrates that the continental crust subducted to depths as great as 150 km, and also that some of it was subsequently exhumed to the earth’s surface. During exhumation the rocks were subjected to intense hydration and amphibolite facies overprint, which may mask the earlier, high pressure metamorphic history. The finding of such rocks in the collision belts lead new insight into the tectonic models of orogeny.

A. Mohan, I. N. Sharma and P. K. Singh present an overview of ultra-high-pressure (UHT) metamorphism. The P-T range for UHT metamorphism lies between 900°C to 1100°C and 7 kb to 13 kb. The critical mineral associations are sapphire+quartz, spinel+quartz, high aluminous orthopyroxene+ sillimanite+quartz, and osmiumite. They discuss the stability fields of the critical associations on the basis of available experimental data. They review the petrology of the classical UHT terrains from different parts of the world and mention, as is well known, that both isothermal cooling and isobaric decompression are documented in different granulate belts. And they rightly point out the ambiguity about deciding on counter-clockwise versus clockwise P-T-t paths, though this is crucial in erecting a tectonic model of granulate formation.

Four papers in this volume deal with metamorphism-deformation in the Himalayan belt. T. Yoshino and T. Okudaira discuss the deformation and metamorphism in the Cretaceous island arc of Kohistan in the North-Western Himalayas. They describe a three-stage evolution of the belt: crustal thickening, crustal thinning and arc collision. A refreshing approach in this work is the attempt to correlate the structures and accompanying metamorphism with the different tectonic events. The pervasive gneissic foliation (D1) in pods and lenses of relatively undeformed granulite is the earliest structure (D1). D2 is characterized by horizontal pure shear in the lower crust due to magma loading at mid-crustal depth. D2 took place at lower temperature and produced mylonitic shear zone with top-to-SW thrust sense. Cooling path from D1 to D2 was nearly isobaric. D1 and D2 structures facilitated crustal thickening during subduction of Tethys oceanic lithosphere. D3 structures are shear bands and faults with top-to-NE normal fault sense of movement. D3 caused crustal thinning and exhumation of the lowermost crust, and the tectonic set-up is one of frontal convergence and intra-arc extension. D3 is associated with isothermal decompression under lower amphibolite facies condition. D4 stage was triggered by convergence due to the main Himalayan collision and took place under greenschist facies condition. D4 did not contribute to further exhumation of the Kohistan arc.

M. Joshi and A. N. Tiwari, and C.S. Dubey, E. J. Catsos and B. K. Sharma discuss the metamorphic patterns in the Kumaun Himalayas and the Sikkim Himalayas respectively. Joshi and Tiwari document the mineral assemblages, mineral chemistry and the P-T conditions of metamorphism of pelitic schists and gneisses from the higher structural levels of the Almora nappe of the Lesser Himalayas. The metamorphism is of upper amphibolite facies that crossed the first sillimanite isograd. According to them it is most probably of Precambrian age, but this is yet to be confirmed by dating. Dubey, Catsos and Sharma on the contrary think that in the Eastern Himalayas of Sikkim the metamorphism is of Himalayan age. They recognize the presence of two phases of prograde metamorphism each followed by a retrogressive event, though the evidence for separating the two phases is not clearly stated. They talk of Barrovian zones and inverted sequence of metamorphism and describe the P-T conditions of the different zones. Again, there is no rigorous discussion about which metamorphic phase the different zones and the P-T values correspond to. The discussion on the much debated theme of modeling inverted sequence of metamorphism is all too brief. S. Nag, S. Sengupta and P. K. Verma describe the effect of Himalayan metamorphism on 500 Ma old Mandi Granite in the Lesser Himalayas of Himachal Pradesh, though there is no supporting geochronological evidence to prove the age of metamorphism.

A number of papers document the details of metamorphic petrology of specific regions. T. A. Polyakova, K. A. Savko, V. Y. Skryabin discuss the assemblages, phase equilibria and P-T conditions of metamorphism of pelites within a palaeo rift of the basement of the East European platform. The regional metamorphism is of greenschist facies and the staurolite facies developed due to the contact effect of intrusions. An interesting feature of this paper is the use of unusual projection diagrams not common encountered in other publications. H. Thomas describes the polymetamorphic history in the granulite belt within the gneissic terrane east of the Delhi Fold Belt of Rajasthan. According to him this history results from the involvement of granulite complex in late Archaean and late Proterozoic orogenic events, though there is little geochronological

S. M. Mathur’s affordable version of Concise Glossary of Geology is a much needed publication. Apart from routine reference, work of this type would be greatly useful to persons of two categories; a fresh entrant to the subject and the one who would like to revise or browse before appearing for an interview or examination. The author has attempted to incorporate terminology from all branches of geology and the latest International Stratigraphic Chart 2004 of the International Commission on Stratigraphy of the International Union of Geological Sciences. The International Stratigraphic Column is provided as an Annexure.

It is nice to see relatively recent term ‘komatite’; nonetheless, ‘spinifex’ texture is yet to find a place. While describing ‘granite’: S type-, I type-, M type- and A type granites could have been taken into account. As the glossary is written in Indian context, apart from ‘gondite’ and ‘khondalite’ a few other rock types and minerals named after Indian localities such as ‘kodurite’ and ‘bababudanite’ deserved place in the book. Similarly explanation on a few other usages such as Indus Suture Zone, Narmada-Son Lineament, and Himalayan Frontal Thrust are missing. Composition of gondite appears misquoted as ‘quartz and serpentine’ instead of ‘quartz and spessartine’ (a manganese-garnet; gondite is a rock derived from metamorphism of manganese-bearing sediments). There is some erroneous mix up of mineral expressions; ‘lapidolite’ (p. 73) and ‘lepidolite’ (p. 75).

Crystallography and mineralogy are poorly represented. Symmetry in crystals, screw axis, glide planes, lattice and space group deserved place in the glossary. A brief account of internationally accepted Hermann-Mauguin symbols could have been included. Several well established phenomena, such as piezo-/pyroelectric properties and photo-, thermo-, tribo-luminescence, colour/electron centres, solid solution, exsolution, as well as terms related to modern geochemical and spectroscopic analytical techniques such as ED-XRF and EPMA are not encountered in the glossary. Some mineral data needed certain diagnostic optical property and description; e.g. sphene, which is characterised by extreme RI and birefringence; and specific significance as the case may be; e.g. tremolite-actinolite chemistry, and they try to interpret their origin by dehydration melting of biotite in presence of sillimanite and only limited melt extraction. But they acknowledge that further experiments are needed to substantiate this hypothesis.

The paper by T. M. Mahadevan presents a synthetic view of the lower crust of the Indian shield. He proposes an interesting model of exhumation by lowering of density of the lower crust by metamorphic transformation under the influence of episodic and extensive magmatism and fluid activity. Several other factors are also discussed which may have influenced exhumation of the lower crust. These ideas need to be seriously probed.

Overall this is a collection of interesting articles and would provide food for thought to any serious metamorphic petrologist or tectonician. The printing mistakes and omissions in editing, such as linguistic errors, missing references etc., cause some irritation.

S. M. Mathur’s affordable version of Concise Glossary of Geology is a much needed publication. Apart from routine reference, work of this type would be greatly useful to persons of two categories; a fresh entrant to the subject and the one who would like to revise or browse before appearing for an interview or examination. The author has attempted to incorporate terminology from all branches of geology and the latest International Stratigraphic Chart 2004 of the International Commission on Stratigraphy of the International Union of Geological Sciences. The International Stratigraphic Column is provided as an Annexure.