EXECUTIVE SUMMARY

The ophiolites preserve signatures of variety of geologic processes which provide researchers important insights into the development of our planet. But the main problem with these ophiolites are that, their origin is still a matter of debate over a hundred years because of their mysterious occurrences along tectonic suture zones. The Nidar valley in Indus Suture Zone (ISZ, NW Himalaya, India) displays classical exposures of ophiolite which represents a palaeo spreading center. In the basal section, crosscutting discordant dunite channels carry Iherzolite xenoliths which include very high pressure minerals – C2/c clinoenstatite, disordered coesite, α - Fe₂O₃ glass and probably β - Mg₃SiO₄. These phase discoveries are confirmed by combining petrography, electron probe micro analyses and Raman spectroscopy. Phase stabilities of the minerals require derivation from at least mantle transition zone (410 - 660 km depth). Unlike previous studies that reported minerals of high - pressure origin in similar rocks, here a set of minerals and supportive micro textures are reported. The systematic phase transitions along with micro textural evidences infer continuous pathway from the mantle transition zone to the uppermost mantle region. The phase transitions show systematic evolution of MgO – FeO - SiO₂ terminating beneath the mid-ocean-ridge basalt eruption temperatures of ~1300°C.

Several micro structures and exsolution micro textures supports the deep mantle origin of at least some part of Nidar ophiolite ultramafics. Exsolution needles
of Cr - spinel in olivine, lamellar inclusions of C2/c clinoenstatite in orthoenstatite and many other micro textures infer systematic fall of P – T condition from deep mantle to the ocean ridges.

The thesis also reports rare natural evidences of highly reducing environment in and around mantle transition zone. The very high pressure lherzolites bear dense primary hydrocarbon fluid inclusions along with unusual inclusions of carbons and α – FeO3 in olivine.

The signatures of serpentine dehydration and formation of garnet bearing serpentinite infer deep and steep subduction of primary oceanic lithosphere which releases free high volume of water in sub arc depth. This phenomena facilitate melting at the overlying mantle wedge and potential of volcanism in intra oceanic arc. Additionally due to dehydration and ascent of magma a sudden vacuum can be formed in mantle wedge which may trigger upwelling from mantle transition depth (410 – 660 km). Thus subduction induced mantle flow may create the ‘geodynamo’ which initiated the Himalaya building process.

Besides all, present work documents first site of natural CO2 sequestration in Himalaya. The dunites and serpentinites in Nidar valley react with CO2 at low temperature to produces magnesite as patches on skin and as veins. Understanding the carbonation process is important in terms of global carbon cycle, weathering and fluid rock interaction during serpentinization.