ABSTRACT

This Ph.D. thesis aims to investigate dynamics of emplacement and tectonic history of selected volcano–plutonic complexes in a continental magmatic arc and back arc setting. The thesis presents new data sets from five field areas, presented in separate chapters, which could be viewed as representing a vertical sections through upper part of an intermediate to felsic magmatic system. From top to bottom in this 'imaginary' vertical system, the examined units are: (1) andesitic lava domes and (2) sub-volcanic magma chambers (<3 km deep) of the Miocene Štiavnica volcano–plutonic complex, Western Carpathians (Slovakia), (3) Shellenbarger pluton (<3 km depth) within the mid-Cretaceous Minarets caldera, Sierra Nevada batholith in California (USA), and ~7–10 km deep granitoids of (4) Lower-Cretaceous Wallowa batholith, Blue Mountains province in Oregon (USA) and (5) Late Devonian Staré Sedlo complex, central Bohemian Massif (Czech Republic). The research incorporates extensive field and structural data, supported by analysis of igneous textures and anisotropy of magnetic susceptibility (AMS). The latter is further accompanied by detailed examination of magnetic mineralogy using thermomagnetic measurements and optical and back scattered diffraction microscopy. In addition, the third chapter contains U–Th–Pb radiometric dating obtained by laser ablation–inductively coupled plasma–mass spectrometry (LA–ICP–MS).

The key results of each of these case studies are as follows. (1) Different fabric patterns of the Štiavnica lava domes and their spatial and temporal association with collapse caldera suggest that the dome growth was controlled by caldera floor subsidence. It is inferred that each dome reflects snapshots of a continuous succession of various modes of caldera collapse from piston through trap-door to piecemeal. (2) Magnetic fabric study of the Štiavnica sub-volcanic plutons revealed contrasting mechanisms of their construction. A diorite pluton represents a steep sided-stock whereas the granodiorite was emplaced in two stages. First, a thin sill intruded along a subhorizontal basement/cover detachment, followed by piecemeal subsidence of the fractured pluton floor due to magma overpressure. (3) The Minarets caldera developed by two Plinian eruptions marked by voluminous deposits of ash-flow tuffs and caldera collapse represented by collapse mega-breccia. The whole sequence was then deformed along a ductile transpressive shear zone and intruded by resurgent Shellenbarger granite pluton within the caldera interior. Magmatic fabrics in the pluton record regional dextral transpression interpreted in terms of oblique convergence of lithospheric plates. (4) Multiple magmatic fabrics in three granodioritic to tonalitic plutons of the Wallowa batholith are interpreted as emplaced syn-tectonically and reflecting progressive deformation during oceanic terrane/continent collision and oroclinal bending in the Blue Mountains Province. (5) Coupled host-rock and magmatic to solid state fabrics of the Staré Sedlo granitoids suggest transtensional deformation which operated prior to, during, and after its emplacement. This syn-convergent transtension is an enigmatic deformation event that occurred during onset of the Variscan Orogeny in the central Bohemian Massif.

In summary, this Ph.D. thesis shows that preexisting environment and active faulting of volcano–plutonic systems may largely control emplacement of volcanic and plutonic rocks as exemplified by the dynamics of growth and construction of lava domes and subvolcanic magma chambers. Furthermore, as opposed to theoretical models, it has been demonstrated that even very shallow-level small-scale intrusions are able to record subtle tectonic strains still in magmatic state. Although the fabrics in plutons preserve only one short snapshot of the inferred instantaneous strain, detailed analysis of syntectonic plutons characterized by hypersolidus fabrics together with precise radiometric dating could unravel complex deformation histories at regional scale over a long period of time. Finally, it has been proposed that pluton fabrics may be used to decipher kinematics of lithospheric plate convergence or divergence and changes in their past relative motions.