Index No.: 166/18/Geol. Sc./26

Title of the thesis: Transpressional kinematics of ductile shear zones and its implications for emplacement of granitic rocks in the western margin of the South Delhi Fold Belt, Rajasthan, India: a field-based study

Abstract:

Granite emplacement within transpressional shear zones is a complex geological process that plays a crucial role in the structural and tectonic evolution of Earth's crust. Transpressional shear zones represent regions where compressional and strike-slip tectonic forces interact, leading to the deformation and displacement of crustal rocks. The emplacement of granite bodies within these zones is a result of an intricate system that interplays between magmatic processes and tectonic stresses. Several tectonic models on the emplacement of granites have been proposed for different tectonic settings. However, to understand the tectonic framework, different approaches have to be done, such as analyses of geometry and kinematics of shear zone structures and detailed analyses of petrological, geochemical and geochronological factors of the affected rocks. In the north western Indian shield, the NE-SW trending South Delhi Fold Belt (SDFB) is a multiply folded and poly-metamorphosed rock of the Proterozoic age. Phulad Shear Zone (PSZ) is described as a terrane boundary shear zone that separates the SDFB to the east and Marwar craton to the west. The PSZ has developed in a ductile transpressive regime with a top-to-the-NNW reverse sense of movement during 810 Ma. The present study deals with the deformation of PSZ and a variably deformed porphyritic granite named Phulad granite that occurs about 200 by 6 km along and across the PSZ. This shear zone is defined by steep southeasterly dipping mylonitic foliation and strong downdip stretching lineation. The PSZ shows regional NE-SW trends with small bends of N-S orientation. The Phulad granite is characterized by a bi-modal grain size population with prominent euhedral grains of feldspar clasts (2-6 cm long) in a fine-grained (<3mm) mosaic of

recrystallized feldspar and quartz aggregates. It consists of phenocrysts of K-feldspar that show characteristic features of magmatic origin. Mesoscopic field relations show evidence of magmatic fabric in the studied granite. The granite also preserves tectonic foliation parallel to this magmatic fabric. Strong foliation developments with a mean attitude of 23°/77°E and prominent stretching lineation (both gentle and steep) have been developed in the granitic rock. A detailed study of structural elements of Phulad granite and PSZ demonstrates a similarity in geometry and style, signifying that the deformation in both units is synchronous. The study of microstructures reveals a series of magmatic, submagmatic, high-temperature and solid-state deformation features in this granite, which further suggests that the granite was emplaced syn-tectonically. A detailed study of structural elements suggests that Phulad granite has formed during the regional deformation in the country rock shear zone prior to its complete crystallization. The present study indicates that the N-S orientation within the PSZ acted as releasing bends and provided the space required for the emplacement of the Phulad granite in a transpressional regime. Geochemical investigation suggests the Phulad granite was emplaced syn-tectonically from a predominant crustal source. Monazite chemical age data and conventional zircon age data suggest a magmatic age of 819.1±4 and 818±18 Ma, respectively. Integrating micro-meso and macro scale structures along with the geochemistry and geochronology of the Phulad granite, it is suggested that the Phulad granite acted as a stitching pluton along the PSZ during the suturing of the Marwar craton with the remaining part of India around 810- 820 Ma.

Ayan Kumar Sarkar 28/08/2023

Ayan Kumar Sarkar

Sadhana M. Chatterjee 28/08/2023

Supervisor: Dr. Sadhana M. Chatterjee

Dr. Sadhana M Chatterjee
Associate Professor
Department of Geological Sciences
Jadavpur University
Kolkata-700 032