

An Indian-Australian research partnership

Project Title: Crustal evolution of the Archean basement and associated Proterozoic supracrustal rocks in the Aravalli Craton (NW India): Insights from the Bhilwara-Nadhwara transect.

Project Number IMURA0916

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The research problem

The Archean basement rocks in the Aravalli Craton (AC) are invariably termed as crystalline and gneissic complex, and its re-definition and improper usage in the existing literature produces significant ambiguity in understanding the craton and underlying basement (Gupta 1934; Heron 1953; Naha and Halyburton 1974; Mohanty and Guha 1995; Sinha-Roy et al. 1998). The Aravalli Craton generally consists of Archean banded gneissic complex (BGC), which is overlain by the Proterozoic (Aravalli and Delhi Supergroup) and Phanerozoic (Vindhyan Supergroup) metasedimentary sequences (Gupta 1934; Heron 1953; Gupta et al. 1997). The classification and evolution of BGC as basement to the Aravalli Craton and its contact relations with Proterozoic metasedimentary cover sequences (Gupta 1934, Heron 1953, Gupta et al. 1980; Sinha-Roy et al. 1998; Roy and Jakhar 2002) are highly equivocal due to its polychronous nature of deformation and metamorphism. Despite considerable research on the Aravalli Craton over the last half a century, uncertainty still remains which includes (a) characterization of the basement litho units, (b) the nature of contact between the basement rocks and overlying metasedimentary sequences, and (c) the geodynamic processes operated in framing crustal architecture of the Aravalli Craton.

Considering this complex geological history, the current proposal can be aimed at investigating the systematic structural as well as tectono-thermal evolution of the region, including the various grades of metamorphic rocks as well as multiple igneous intrusions along a transect between Bhilwara and Nadhwara (80 km length and 50 km width).

Project aims

The proposed transect between Bhilwara and Nadhwara can provide an overview of the basement (BGC-II; Proterozoic age) characteristics, its principal differences with BGC-I (Archean age), to decipher the timing and metamorphic evolution of pelitic schists and granulites, and to reconstruct the basement-cover relationship between the gneisses and supracrustal units. The following aims can be achieved from this proposal:

- a) Transect between Bhilwara and Nadhwara areas would largely represent the gneisses from BGC-I and -II, which also comprises the Sandmata and Mangalwar complexes according to the classification of GSI (Gupta et al. 1980). Therefore, the lithological and structural differences between BGC-I and II can be delineated, which is enigmatic in the existing literature (Heron 1953; Naha and Majumdar 1971; Gupta et al. 1980; Roy and Jakhar 2002; Roy et al. 2005).
- b) The study area (Bhilwara–Nadhwara) extending across the Mangalwar and Sandmata complexes can provide crucial information about internal geodynamic evolution and mechanism for the mutual juxtaposition of individual terranes during Proterozoic reworking in the BGC-II, which is completely different from the tectonic framework of BGC-I (Roy and Jakhar 2002; Roy et al. 2005; Dharma Rao et al. 2011).
- c) The selected corridor also consists of intensely deformed Proterozoic Pur-Banera belt (Gupta et al. 1980) to the northeastern part, and Delhi Supergroup of rocks to southwestern part of the transect. Further, the Aravalli Supergroup is exposed to the eastern and southeastern parts of the corridor. Although these lithologies are closely associated with the basement gneisses, their contact relationships are dubious. In addition, numerous felsic plutons including Berach Granite and Anjana Granite intrude into the basement lithologies. Therefore, the proposed corridor unequivocally provides an opportunity to understand the crustal evolution of the basement lithologies, supracrustal units and associated intrusive rocks that protracted during the Archean to Proterozoic era (Precambrian) in the Aravalli Craton.

Expected outcomes

1. To decipher the structural and metamorphic evolution of the medium to high-grade metamorphic rocks (e.g., Sandmata and Mangalwar complexes of BGC-II) in the proposed transect between Bhilwara and Nadhwara, and its relevance to the tectonic relationship with BGC-I (Archean age).
2. To reconstruct metamorphic P - T evolutionary history of medium to high-grade lithologies present in the corridor.
3. To outline the deformation microtextures and constrain the timing of deformation and metamorphism using monazite, zircon and rutile geochronology.
4. To describe some of the unresolved issues related to the crustal evolution of BGC-I and II (using major element, trace element, Sm–Nd, Pb–Pb and Lu–Hf isotope data).
5. To propose a comprehensive tectonic model for the crustal growth and petrogenesis of various litho-tectonic units by combining the results outlined using deformation microtextures, mineral paragenesis, geochemistry, isotopic data and monazite-zircon-rutile geochronology.
6. To establish the potential links between Aravalli Craton (NW India) and dismembered neighboring crustal provinces during assembly and fragmentation of major supercontinents (e.g., Columbia, Rodinia and Gondwana).

Kindly note that this kind of study is considered in pure sciences category, therefore, it is most unlikely to get a patent.

Capabilities and Degrees Required

The student should have the following capabilities to work in this project:

- 1) M.Sc. degree in Geology/Applied Geology with minimum 55% of marks.
- 2) GATE and UGC/CSIR JRF qualification is desirable.
- 3) Should have studied core geological courses during M.Sc. (e.g., Petrology, Tectonics and Structural Geology)
- 4) The candidate should have good communication (both oral and written) skills.
- 5) Should have aptitude to work in a group with sophisticated analytical instruments.

Select up to **(4)** keywords from the Academy's approved keyword list (**available at <http://www.iitbmonash.org/becoming-a-research-supervisor/>**) relating to this project to make it easier for the students to apply.

Keyword- 7: Geo science, geotechnical, geomechanics