Angular relationship between rocks of the Aravalli and Delhi Supergroups in southeastern Rajasthan – a possible unconformity

The ultimate objective of any geological investigation is to develop an evolutionary model for the terrane, which is based on geological mapping and field relations. In case of complexly deformed and repeatedly metamorphosed Precambrian terrenes, such modelling efforts get severely hampered due to modification/obliteration of primary nature of contact by shearing and other regional-scale tectonic movements. In the NW Indian shield, the contact relationship between Aravalli Supergroup (ASG-Palaeoproterozoic) and Delhi Supergroup (DSG–Meso-Neoproterozoic) has been described variably by earlier workers and has remained an enigma.

The Precambrian geological evolution of the Aravalli mountain region in NW India includes Palaeoproterozoic ASG and Meso-Neoproterozoic DSG deposited over an Archean basement, the latter popularly known as Banded Gneiss Complex (BGC)[1–3] (Figure 1). Both ASG and DSG exhibit unconformable relationship with the BGC. However, their mutual relationship has not been properly understood because of a sheared and tectonized contact. The contact relationship of ASG and DSG along the western margin of the former has been variably described which include angular unconformity[1], structural hiatus zone[4], tectonic zone (R. L. Sahu *et al.* unpublished report, Geol Surv. of India) and a suture[5]. Heron[1] observed overlapping relationship between Aravalli and Delhi lithounits along an unconformable contact. Slivers of older basement rocks separating the ASG and DSG in Udaipur region have been described as the southward extension of the greenstone sequence occurring in central Rajasthan (K. Mukhopadhyay, unpublished report, Geol. Surv. of India; Gupta and Bose[6]). The contact of DSG and pre-Delhi rocks in this terrane has been described to be tectonic in nature[7]. Multiple phases of shearing and small lenticular bodies of pseudo-tachyllite are impressed in the rocks along the western margin of the Aravalli Fold Belt (R. L. Sahu *et al.* unpublished report, Geol. Surv. of India). Deb and Sarkar[8] have lent a tacit support to this far-reaching conclusion of Mukhopadhyay (unpublished) and Gupta and Bose[6], and suggested the existence of an attenuated block of the BGC separating the two. Sharma[9] stated that the Aravalli rocks were deformed by a post-Delhi orogeny only and there was no distinct 'Aravalli Orogeny'. Raja Rao[10] also did not propose any break between Aravalli and Delhi sequences. We have recently carried out detailed geological mapping on 1 : 12,500 scale in the Chhipala area (SE Rajasthan), along a critical segment which marks the boundary between ASG and DSG (Figure 2). This correspondence presents field observations on the angular relationship between these two units and refines our understanding of the Aravalli–Delhi contact relationship, so vital in modelling the Precambrian crustal evolution of this terrain.

The terrain for the present study is located to the south of Chhipala near Modi village (Figure 2) in SE Rajasthan. The main lithounits of the ASG include phyllite/mica schist, chert/quartzite and ultramafics, while the rocks of DSG are

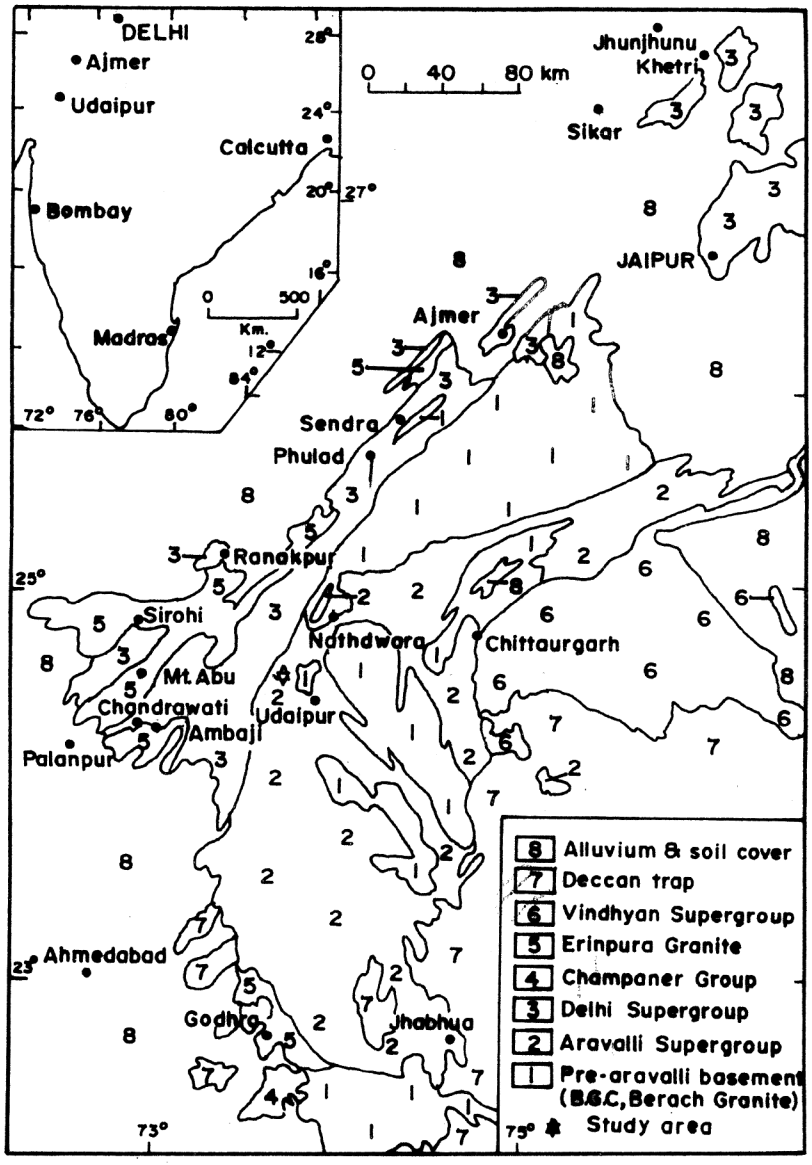

Figure 1. Generalized geological map of southeastern Rajasthan (adapted from published maps[2,3]).

represented by quartzite and quartz-mica schist, subsequently intruded by quartzo-feldspathic veins. The ASG–DSG contact is generally tectonic/sheared, as evident from mylonitization, brecciation, ferrugenation, presence of pseudo-tachylite(?), intense silicification and basic intrusion along the contact. Therefore, nature of original contact remains enigmatic.

The original features of contact relationship seem to have been obliterated and overprinted by strong tectonic fabrics, except for the expression of angular unconformity in the form of truncation of ASG quartzite ridge against DSG quartzite. The most interesting feature is the truncation of Aravalli (Jharol Group) quartzite ridge, against Delhi (Gogunda Group) quartzite ridge, with a definite angularity between them. A small linear ridge of the ASG is truncated by the younger DSG rocks south of Chippala (near Modi village; Figure 2). Truncation of one group of rocks by another can either mark an unconformity (angular) or a fault. In the study area, the presence of red soil zone along the contact, granular size clasts of older rocks in schist (granular conglomerate?), sharp contrast in grade of metamorphism (lower amphibolite facies in ASG rocks and middle green schist facies in DSG rocks), contrasting structural patterns (complex in ASG rocks and relatively simple in DSG rocks), absence of first generation of ASG folds in DSG rocks, and ultramafic magmatism restricted to ASG only, corroborate the presence of angular unconformity. The sharp contrast in the grade of metamorphism is reflected in the ASG rocks reaching up to lower amphibolite facies, which is indicated by the presence of staurolite; while the rocks of DSG show mineral assemblages of middle green schist facies with chlorite as index mineral. The ASG and DSG were metamorphosed in two distinct episodes and main metamorphism of the ASG pre-dated the deposition of DSG. Further, contrasting structural complexity is observed in the area east of Modi, where the ASG rocks show a complexly folded outcrop pattern (Modi ultramafic closure, an antiform and synform at NW of Losing, etc.), while west of Modi, the lithounits of DSG are running parallel. The first-phase structures within the ASG, represented by tight to isoclinal, at places, reclined minor folds with axial plane schistosity and a prominent striping lineation, are absent within the DSG. The DSG does not show any structures comparable to the first-phase structures within the ASG. Chronologically oldest structure observed within the DSG is represented by folds with axial plane schistosity, which compares well with the second phase structures within the ASG; the latter includes folds with axial plane crenulation cleavages.

Our geological map thus underlines the possibility of an angular unconformity between the two units. Simultaneous consideration of all the evidences, discussed above, further substantiate this contention. The tectonic/sheared nature of contact and features like mylonitization, brecciation, ferrugenation, presence of

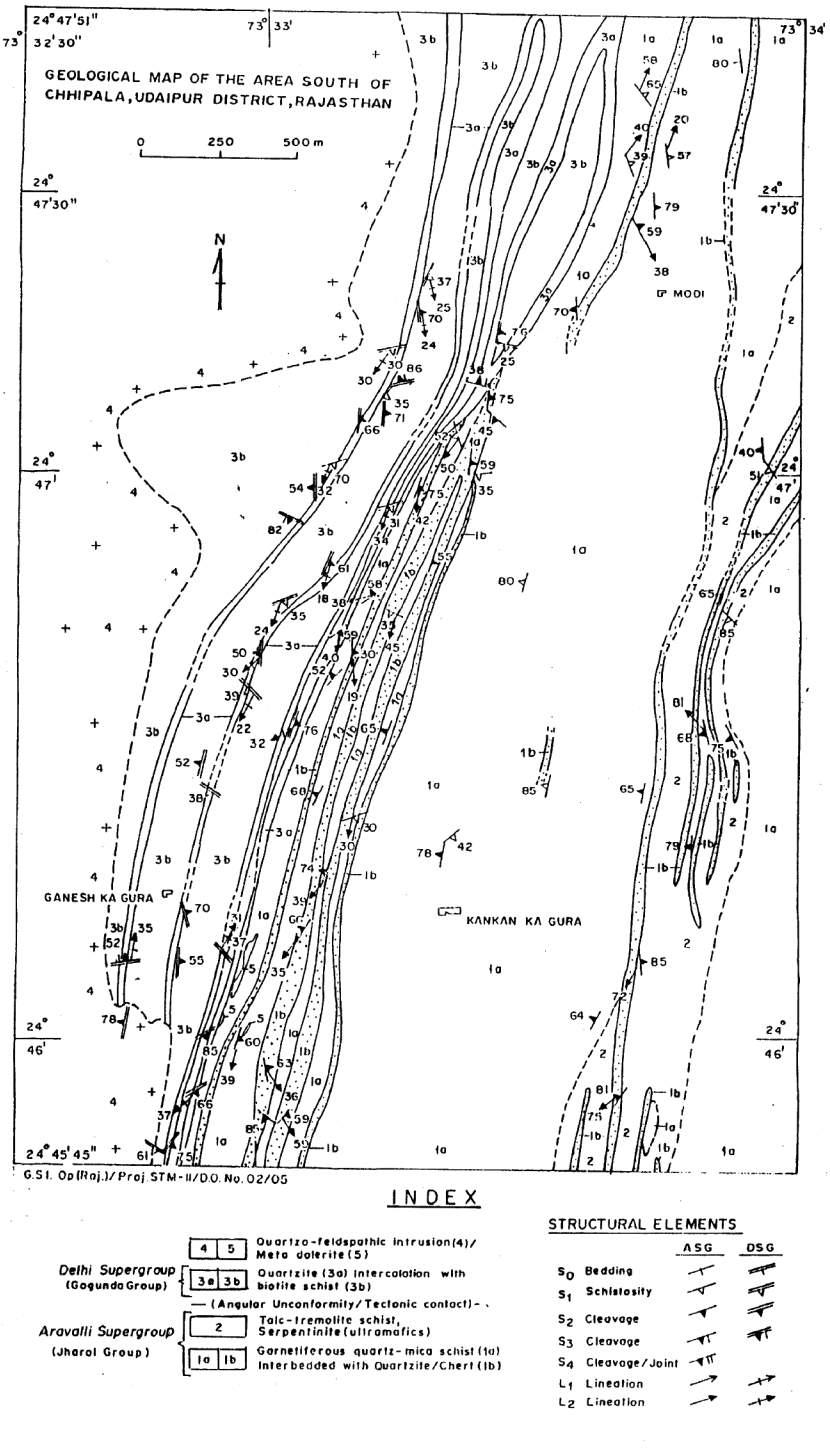

Figure 2. Detailed geological map of area south of Chhipala (mapped by P.S.).

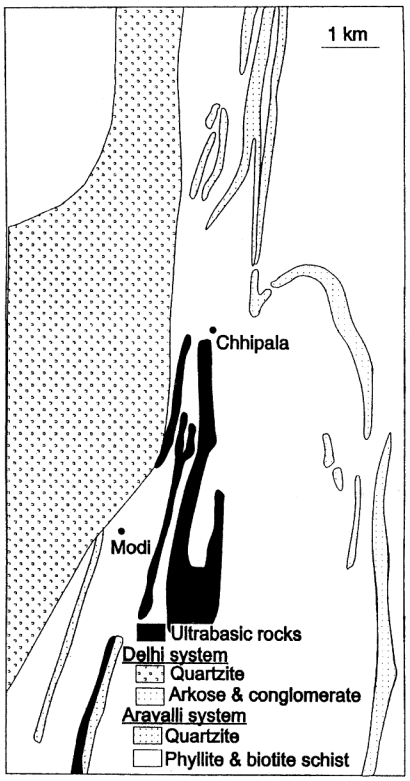

Figure 3. Generalized geological map of southeastern Rajasthan (modified from Heron[1]) showing truncation of rock units of ASG and DSG.

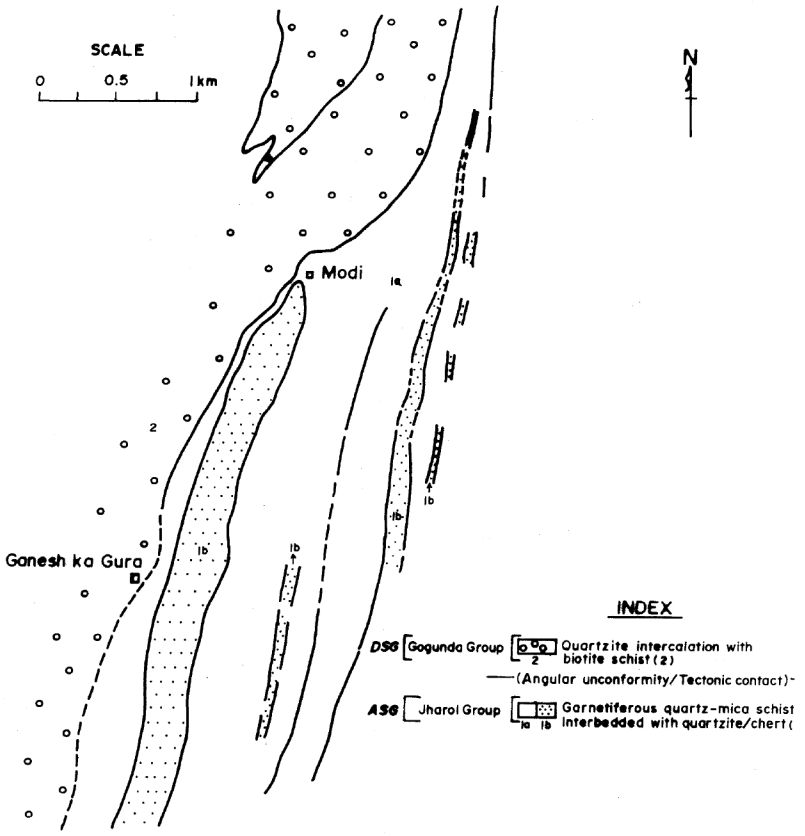

Figure 4. Interpreted geological map based on aerial photograph (with field check); part of Survey of India toposheet No. 45H/9 (1 : 50000).

pseudo-tachyllite(?), intense silicification and metabasic intrusion along the contact can best be described as a post-depositional phenomenon.

Our map pattern has brought out truncation of NNE-trending Aravalli quartzite against NE-trending Delhi quartzite. This angular relationship was also shown in Heron's[1] map, which is reproduced in Figure 3 for comparison. The difference in the earlier phases of structural evolution of ASG and DSG has been attributed to an angular unconformity between the Delhi and the pre-Delhi (Aravalli and Raialo rocks)[4]. Further evidence for angular relationship between these quartzite units is also seen in the aerial photograph of the area (Figure 4). There are no conglomerate horizons (indicative of depositional hiatus) present at the base of the Delhi rocks in southern Rajasthan, especially where they are in contact with Aravalli rocks. In light of the field relations and other supporting evidences, we interpret the angular relationship between ASG and DSG to represent an angular unconformity. This contention, however, needs to be verified through detailed metamorphic and structural studies, which are underway.

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