Structural investigation and geological mapping of a part of eastern Salt Range around Basharat Village, Punjab, Pakistan, using GIS/RS

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The present study is meant to address the structural geology of the Basharat area (32° 52′ 0.37″ N to 32° 37′ 32.68″ N; 73° 01′ 53.71″ E to 73° 97′ 51.56″ E) Jhelum district, Punjab, Pakistan. The study area lies in the easternmost extension of the Salt Range-Potwar Plateau. The primary mapping technique adopted for the structural investigation is GIS/RS. A GPS device was utilized in order to mark different lithostratigraphic units as well as the structural points of interest. Two GIS softwares, i.e., Google Earth and Global Mapper were integrated together for the preparation of the geological map of the area at a scale of 1:25,000. POIs were transferred from the GPS device to the Google Earth and via picking up the colour tone of different formations, the stratigraphic assemblages were mapped. Finally, Corel draw was used for the map digitization.

The study area is contained in the Sub Himalayas after Gansser (1964) or in the External Zone of Coward et al. (1988). The Himalayas is a spectacular fold and thrust belt formed as a result of the collision between Indian and Eurasian plates. The Indian plate separated from the African plate and started its northward drift towards Eurasia in Cretaceous time. This drift resulted in the intra-oceanic subduction within the Neo-Tethys and resulted in the formation of a series of magmatic arcs (Kohistan, Laddakh, Nuristan and Kandhar). The collision between India and Eurasia started in Eocene time as the Indian Plate collided and under-thrusted the Kohistan Island Arc. The Himalayan Thrust System from north to south is divided into five tectono-stratigraphic units including Karakoram Block, K.I.A., Northern Deformed Fold, and Thrust Belt, Southern Deformed Fold, and Thrust Belt, Salt Range, and Punjab Plain delineated by regional faults represented by Main Karakoram Thrust (MKT), Main Mantle Thrust (MMT), Main Boundary Thrust (MBT) and Salt Range Thrust (SRT). This indicates that major tectonic transport is from north to south and thus the study area lies in the foreland portion of the Himalayan Thrust System.

The study area comprises predominantly of molasses ranging in age from Miocene to Pliocene represented by Rawalpindi and Siwalik Groups in the north-western portion. The Eocene Cherat Group has large, prominent and continuous exposures in the middle part while the older successions are exposed in the southern half of the mapped area. The latter include Palaeocene Makarwal Group, Permian Nilawahan Group and Cambrian Jhelum Group along with Pre-Cambrian Salt Formation. The Siwalik Group is represented by the Chinji and Nagri Formations underlain by Rawalpindi Group. Nammal and Sakesar Formations of the Cherat Group lie above the Patala Formation which is the sole representative of the Makarwal Group in the study area. The Permian Nilawahan Group consists of Tobra, Dandot and Warchha Formations. The group is separated by an unconformity from underlying Cambrian successions which are represented by Khewra, Kussak, Jutana and Baghanwala Formations

of Jhelum Group. Salt Range Formation of Pre-Cambrian age is the oldest while Pliocene Nagri Formation is the youngest formation encountered in the mapped area.

According to Baker et al. (1988), the eastern Salt Range exhibits the geometry of a fault bend fold. The study area is thoroughly influenced by activity along the Salt Range Thrust. The major trend of the hinges of the ridges is northeast-southwest which indicates that it experienced strong northwest-southeast compressive stresses. The area comprises of five anticlines, six synclines, two fore-thrusts, one backthrust and the major decollement Salt Range Thrust (Fig. 1).

Traversing from the south-eastern boundary to the north-western one the first major structure is Salt Range Thrust which has juxtaposed the oldest Salt Range Formation over Jhelum Plain. To the north, there are two forethrusts, i.e., Lower and Upper Chhammal Thrusts enclosing Chhammal Syncline (Fig. 2). There is a series of anticlines and synclines up to the Siwaliks which disappear under the cover of alluvium in the north. All these anticlines and synclines are oriented northeast-southwest, sharing their limbs between them and occur one after the other in following order northwards, i.e. Lower Takwen Syncline, Lower Takwen Anticline, Takwen Syncline, Upper Takwen Anticline, Upper Takwen Syncline, Saloi Takwen Anticline, Saloi Syncline, Saloi Anticline, Lahr Syncline and Wahali Anticline. The only backthrust of the area is located in the north-eastern part termed as Diljabba Thrust having northwest vergence. The research work has been summed up in form of a map and two cross sections, i.e. AB and CD which depict the structural geology of the area (Fig. 2, 3). The discussion concludes that the mapped area has undergone severe deformation in the northwest-southeast direction. The intensity of folding and faulting is much higher in the southern portion indicated by the dip angles of the folds and faults as compared to the northern half. The vergence of the forethrusts indicates that the tectonic transport direction is towards southeast.

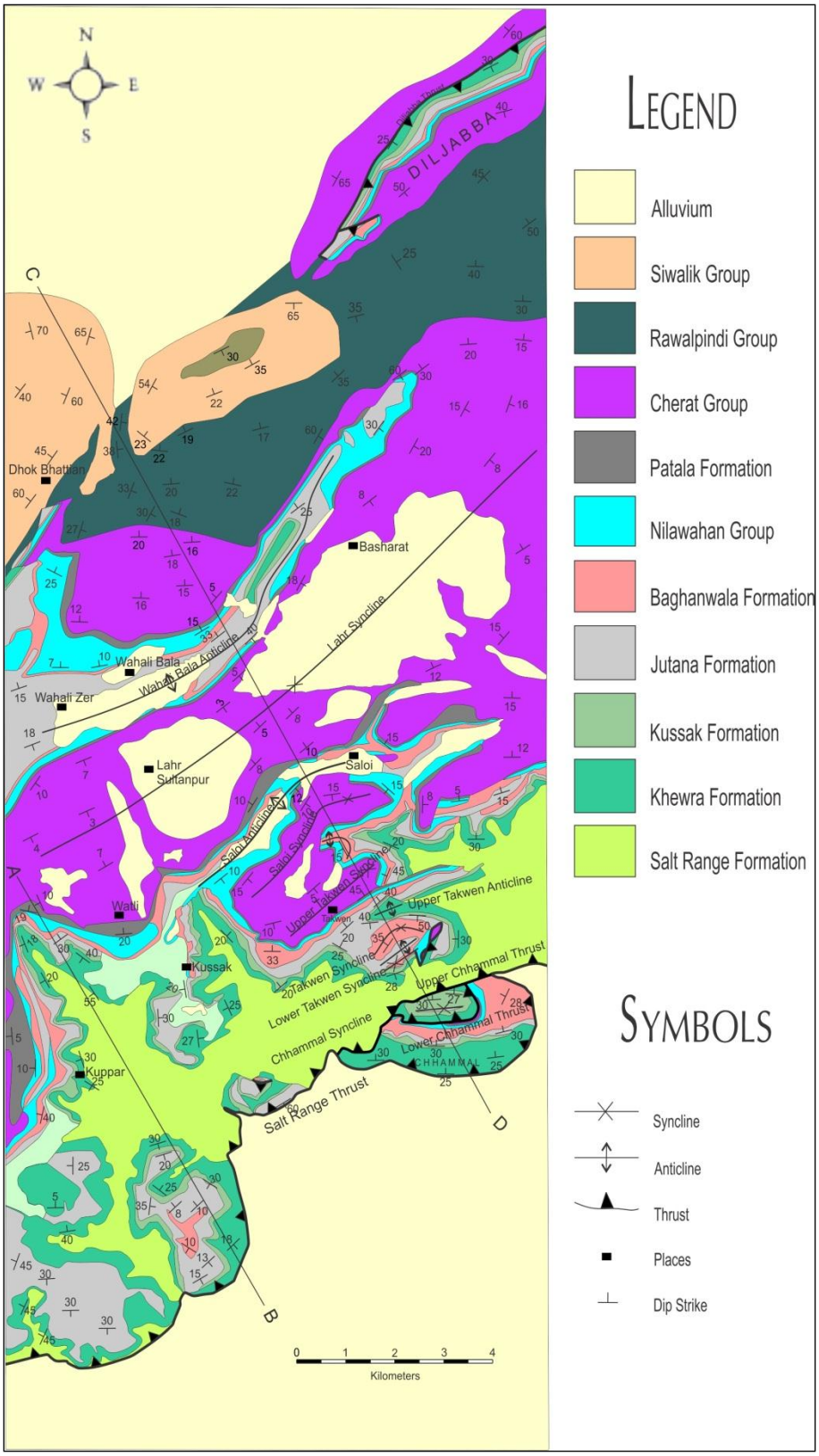

Fig. 1. Geological map of the study area.

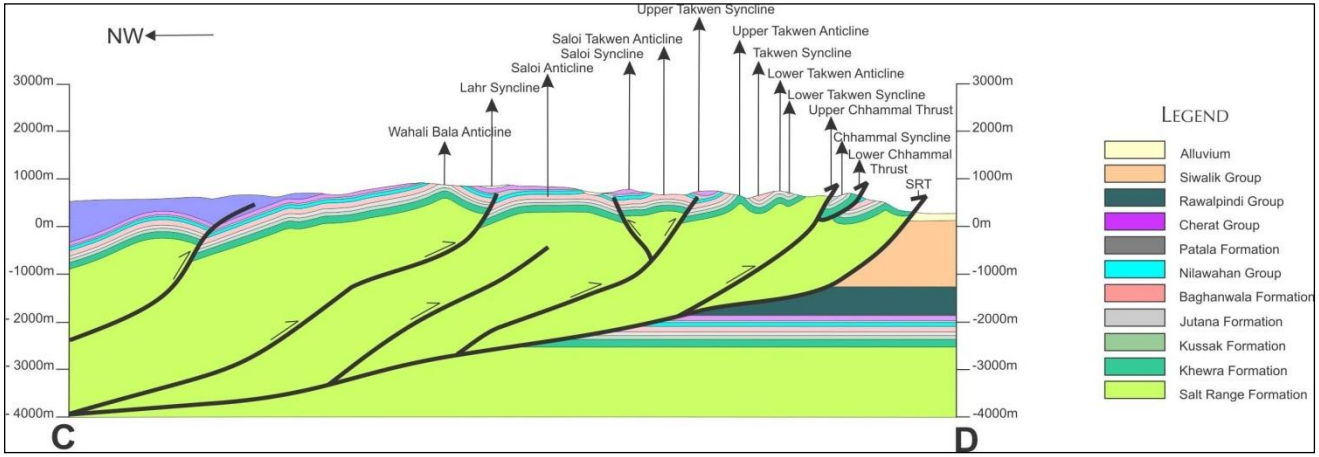

Fig. 2. Cross Section along traverse line

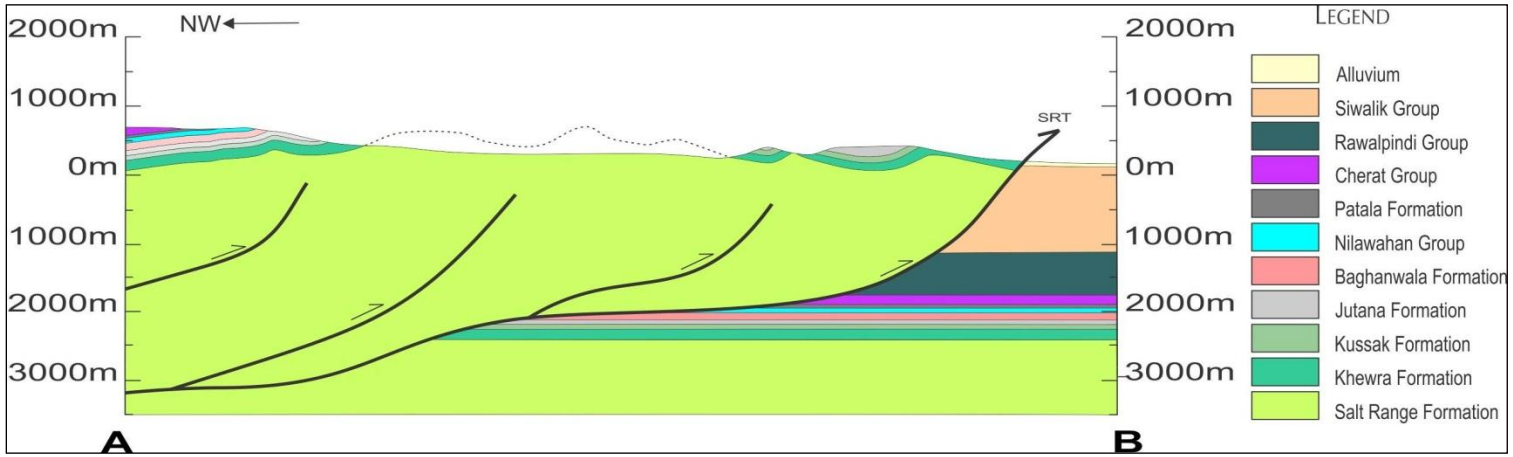

Fig. 3. Cross Section along traverse line AB.CD.