Economic importance of the northern Trans-Indus Mountain ranges of Khyber Pakhtunkhwa, Pakistan

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The Trans-Indus Ranges of Khyber Pakhtunkhawa Pakistan are about 80km south of Kohat are group of arcuate mountains lying west of the Salt Range on both side of the Indus River. Individual ranges include the Surghar, Shinghar, Marwat and Khisor Ranges (Table-1). The Makarwal coal field is in the Surghar Range, which is well defined series of ridges bounded by a prominent escarpment facing the Indus River. Another belt of parallel ridges west and north of the Surghar Range is called the Shinghar Range. These two ranges comprise the northern part of the Trans-Indus Mountains.

Sedimentary rocks of marine and non-marine origin ranging in age from Permian to Pleistocene constitute most of the strategraphic sequence in the Trans-Indus Mountain in Khyber-Pakhtunkhawa in Pakistan. Their total thickness in the Surghar, Shinghar, Marwat and Khisor ranges exceeds 20,000 feet. The sequence consists of more than 20 formation and members. They are all typically developed, well exposed and readily accessible.

Makarwal coalfield is located in Surghar Range. The coalfield serves as a source of energy for cement industry and bricks kiln.

The coal bearing strata are of Paleocene age and overlain by later Tertiary rocks that exceed 15,000 feet in total thickness. The coal was involved in at least two episodes of mountain building activity that produced the Trans-Indus Mountains.

The coal is produced from a single bed that ranges in thickness from 2feet to more than 10feet and averages 4feet. Most of the coal is in the west limb of the Makarwal anticline and dips 30^{oW}. The coal is ranked as high volatile, C bituminous, containing ash in the range of 7 to 22 percent, fixed carbon 36.3 to 43.4 percent, sulfur 4.1 to 5.6 percent and calorific value, 9550 to 11850 B.t.u. The total reserves to a depth of 200 feet below sea level are 18,400 tons (Danilclich & Shah, 1975).

Other mineral resources in the Makarwal coalfield include large reserves of limestone, greensand glass sand an iron formation for possible source of iron. Substantial amount of limestone may be source of cement industry in this region in future.

From October to April when the humidity is low and mid-day temperature range between 85^{o} and 95^{o} F. By mid April, the daytime temperature is nearly 100^{o}F, and during the summer month exceeds 110^{o}F for many days without relief.

The rainy season is during the summer months; the heavy downpours provide temporary relief from the heat but are followed by humidity. The rain produces torrents that rush down the gorges

carrying vast amount of detritus. Travel and activity in these mountains during the rainy season may be dangerous because of floods and falling rocks.

The earliest published comprehensive description of the geology of the Tran-Indus Mountains is by Wynne (1880); however he made only passing reference to the coal resources. Simpson's (1904) study of the coal in the Makarwal area, which he referred to as the "Maidan Range coal field" includes descriptions of the coal at all known coal localities between Kalabagh and Makarwal. Apparently the coal had not been exploited at that time and Simpson recommended sites for development of the coal, which have been or are now being worked.

Gee (1938) gave a detailed description of the geology in areas that had been developed by 1938. His report contains production figures that indicate that coal was being mined as early as 1914. Gee's description of mines and mining problems is complemented by a report by Coulson (1938) on ground water availability in the Isa Khel area. He described the water problem in the Makarwal area and recommended ways of solving it.

To provide more accurate information on the structure resources and mining conditions of the Makarwal coalfield, the geology of the Makarwal field was made jointly by the GSP and USGS during the period March 1958 to February, 1960, with the cooperation of the Pakistan Industrial Development Corporation. The Makarwal coalfield and the Makarwal quad-range were mapped geographically in detail; the stratigraphic study involved a large area. Geological mapping of the Makarwal coalfield was done on large scale (1:2000) topographic maps; the topographic map of the southern half of the coalfield had been prepared by the survey of Pakistan. The northern half had been topographically mapped by GSP on 1:2000.

Geological mapping covering the Makarwal topographic quadrangle 38 P/1 (1:50,000) was done by using aerial photographs produced by the Geological Survey of Pakistan.

Chaudhry and Ashraf (1981) have presented an account of the petrology of Middle Siwalik rocks of Kotli area Azad Kashmir. They concluded that these rocks were derived from the Pir Panjal Range of Kashmir, Wells (1983-84) discussed the depositional environments of the Early Eocence rocks particularly the Kuldana Formation. Abid et al., (1983) gave a preliminary account of the petrography and provenance of the Dhok Pathan Formation from a small part of the Surghar Range along the southern fringes of the Kohat Plateau. Khan (1983) has studied magneto stratigraphy of the Kohat Plateau. Mc Doughal (1985, 1987, 1989) described associated structures with the Kalabagh lateral ramp in relation to the changes in course of the Paleo Indus River during the last one million year. Khan et al., (1987) have studied the magnetic polarity stratigraphy and tectonics of the Siwalik Group. They have suggested that the Siwalik Group is time transgressive and that the Siwaliks of Trans-Indus are younger than the Siwalik of Potwar Plateau. Kassi (1987) has presented preliminary sedimentology of the Siwaliks Group of Baluchistan area and suggested a source area which lies to the west of Kach and Zarghun region. Ahmad (1989) has recorded sedimentology and structure of the Southern Kohat Trans-Indus Ranges. Wang et al., (1989, 1995), Baig (1990) and Moghal (1992) have studied the sandstone type uranium deposits in the Siwaliks of Pakistan.

Along the western flank of Surghar Range, Ph. D. studies were undertaken by the author in 1998 in order to find uranium. These studies have shown the following results:

1. The collision of Kohistan Island Arc with Eurasia occurred at about 90-100m.a. resulting in an Andean type of margin. At 40 to 65 m.a. the Indian Plate collided with the Eurasian Plate sandwiching the Island Arc.
2. The Himalaya represents the most extensive active collision zone in the World, extending westwards from Burma through India, Nepal and southern Tibet into northern Pakistan. Active foreland thrusting is occurring on continental scale as the Indian Shield is being overridden by its own northern margin in a series of south-verging thrusts. Southward migrating thrust sheets from the Himalaya shed their erosion products into the active foredeep (Ganga Basin in India: Jhelum Plain in Pakistan) which is itself migrating southward. The study area is part of Himalayan foreland fold and thrust belt.
3. The molasse of the study area contains a fair amount of red and green cherts, which are uncommon in sutures and volcanic arc of Pakistan but are more common in southeastern Afghanistan. Agglomerates appear to have been derived from both Pakistan adjoining Afghanistan. Schist slate and phyllite fragments could not have been derived from far of sources of Himalayas and Karakoram, so they have mainly been derived from the nearby source rocks of Afghanistan. In addition to material derived from Kohistan Island Arc and Western Karakoram, Substantial amounts of material have been derived from the adjoining Afghanistan and Parachinar. Blue green hornblende derived from Kohistan is minor. Green hornblende derived from Afghanistan is more abundant. Ampibolite and diorite are minor, therefore contribution from Kohistan proper is subordinate. Diamectite bed contains substantial amount of red cherts and slates. In fact the diamectite granule and pebble clasts are fairly similar to clasts in the Dhok Formation. This diamectite is known to have come from Afghanistan as a Lahar, therefore a large part of the Siwalik molasse is likely to have been derived from Afghanistan too. Local derivation of Lumshiwal sandstone, Murrees, Datta and Eocene limestone is minor. Mostly shale horizons of the Dhok Pathan Formation contain saponite clay (smectite group) as high as 15%. This variety of clay is derived from the volcanic ashes, which contain uranium. Leaching of this clay has also provided the uranium to the system. So the whole Trans-Indus molassic sediments have now assumed greater importance from uranium exploration points of view.
4. The study area possesses a potential for a sandstone type uranium deposit. This may be similar to those of Baghalchur, Nangar Nai and Qubul Khel in characters. As a large number of surface samples, have more than 0.05% chemical U_3O_8. Further integration of data and exploration work particularly core-drilling may add to uranium tonnage of the country.

In the light of above studies, exploration strategy was designed to find out uranium deposit. As a result of this exploration a uranium deposit was discovered at Shanawa area. Exploration studies are in progress now-a-days will enhance uranium tonnage of the country in future.