

Coal and petroleum resources of Khyber Pakhtunkhwa and FATA (Pakistan): An overview

M. Sadiq Malkani

Geological Survey of Pakistan, Saria Road, Quetta, Pakistan

E- mail: malkanims@yahoo.com

Due to the present energy crises in the world and particularly in Pakistan, the government and power generation sectors have shown keen interest in the coal and petroleum resources. Production of domestic coal and petroleum will reduce the demand for imported fuels and ultimately save foreign exchange resources. **Coal deposits** are extensively developed in Pakistan and are found in all the provinces of Pakistan, Gilgit-Baltistan and Azad Kashmir. Coal from different areas of Pakistan generally ranges from lignite to high volatile bituminous. Stratigraphically the coals of Pakistan are developed in the Latest Cretaceous and Tertiary horizons. In Khyber Pakhtunkhwa coal is confined to the Hangu Formation (Cretaceous-Tertiary/K-T boundary to Early Paleocene) except the Toi coal of Shirani area which is Early Eocene. Pakistan has huge coal resources about 186.28241 billion tons (Malkani 2012). Out of which 122.99 million tons (mt) are found in Hangu-Orakzai, Dara Adamkhel and Cherat, Gulakhel/Kurd-Sho, and Shirani areas of Khyber Pakhtunkhwa and FATA.

Hangu Coalfields are found in the Kohat and Hangu districts and tribal Orakzai Agency. It shows high ash and high sulphur representing paralic environments. The coal rank in southern part is low (subbituminous B) as compared to northern part (low volatile bituminous). All the sedimentary structure supports a back barrier, shore line (paralic) environment. The coal seam thickness varies from 30cm to 3m but 0.6-1m is common. The estimated reserves reported are 81mt with 1mt measured, 4mt indicated and 76 inferred.

Cherat Coalfield was found in Shekhai, Jabba Khattak, Bakhtai and Shah Kot areas of Cherat Range, Nowshera district. Bakhtai area producing lower and upper coal seams while Shah Kot Bala and Jabba Khattak are producing only lower main coal seam. Shekhai area is abandoned now. Here the sulphur is mostly pyretic with some organic sulphur. Coal is associated with calcareous argillites indicating lagoonal environment. Hussain et al. (1990) estimated reserves like 6mt of Bakhtai-Shahkot, 0.7mt of Shekhai and 1.04mt of Jabba Khattak with total 7.74mt of Cherat Range coal field. The mining water and roof collapse due to argillatites are the main problems.

Shirani coal (F.R.D.I.Khan) is described by Malkani (2010; 2012). It is located in the northeastern extremity of Toi coal basin. The northern part of Shirani area like the Khowara Khel and its close vicinity, show best exposures of 3 carbonaceous shale horizons in Toi Formation. The southern part of Shirani area like Mughalkot, Nispura and Ragma Sar areas, show no best exposures of coal.

Gula Khel coalfields (Karak District) which is the subsurface extension of Makerwal and Surghar range coal. The quality of coal, environment and other details are mentioned in Makerwal coalfields. According to present investigation, the total reserves of Gulakhel coalfields

are 30mt with detail as 25mt inferred and 5mt hypothetical whilst the measured and indicated reserves are mentioned in Makerwal coalfields of Mianwali district.

Dara Adam Khel coalfield is being reported first time by a reconnaissance visit of present author and it needs follow up for further detailed information (Malkani 2012). It is a newly developed coalfield. Dara Adamkhel Coalfield is located on the vicinity of Kohat-Peshawar road, close to north of Kohat Tunnel, south of Peshawar. The Dara Adamkhel Coalfield is hosted by K-T boundary and Early Paleocene Hangu Formation. The Hangu Formation generally consists of continental reddish brown, cross bedded and bioturbated sandstone interbedded with bluish grey shale, coal, carbonaceous clay and limestone. The tentative reserves estimated are 3.75mt because no detail work is done so far. The break up of estimated coal reserves show 0.25mt measured, 0.5mt indicated and 3mt inferred.

Petroleum is known in Pakistan since 1833. Sedimentary basins are the primary host of oil and gas. Pakistan has two large sedimentary basins like Indus and Balochistan which can yield significant oil and gas (Kazmi and Abbas 2001). So far no economic oil and gas reservoirs are known from Balochistan basin (300,000 km²) comprises about 10,000m thick flysch, deltaic and continental sediments. Super Indus Basin (533,500 km²) subdivided in to northernmost (uppermost) Indus, northern (upper) Indus, central/middle Indus and southern/lower Indus basins. Oil resources are frequently being developed from upper Indus basin, while gas resources are being developed from middle and lower Indus basins. Attractive structures, extensive source and cap rocks are found in Kohat sub-basin and northern Sulaiman fold and thrust belt. The share of northern areas of Khyber Pakhtunkhwa and FATA (part of Hindukush-Karakoram block, Kohistan magmatic arc, northern Indus suture and NW Himalaya/Khyber-Hazara basin) are nothing so far due to mostly igneous and metamorphic rocks (which are devoid of petroleum) with minor sedimentary rocks may act as negligible petroleum hosts because of discontinuous nature and metamorphism. The share of southern areas of FATA regions (western Indus Suture) seems to be nothing due to mostly igneous with some sedimentary and metamorphic rocks which may host negligible petroleum. The share of southern areas of Khyber Pakhtunkhwa including the Kohat sub-basin is encouraging and significant, while the northern Sulaiman basin may share successfully in future due to 15-20km thick sedimentary cover with attractive structures, extensive source and cap rocks. Kohat sub-basin and northern Sulaiman foldbelt mostly includes the sedimentary rocks and show promising petroleum exploration targets. According to Hanif et al. (2012) the Khyber Pakhtunkhwa is now contributing significant amount of hydrocarbons (18.32% oil and 2.14% gas) in the primary energy supply of Pakistan after the first discovery well in 1999 which is recent and new relative to adjoining Potwar basin. The best contribution of oil in Potwar show best encouraging exploration targets in Kohat sub-basin.

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