INTEGRATION OF GEOLOGICAL, GEOPHYSICAL, GEOCHEMICAL AND EXPLORATORY DRILLING TECHNIQUES IN EVALUATION OF COAL RESOURCES: A CASE STUDY OF MUI BASIN, KITUI COUNTY, KENYA.

ABSTRACT

The search for alternative sustainable energy by the Government of Kenya led to discovery of more than 400,000,000 metric tonnes of coal deposits in Mui basin, covering an area of approximately 500Km2, and situated in Kitui County, some 180Km North East of Nairobi. This is fundamental to economic stability and development as interruption of energy supplies can cause major financial losses hence economic havoc. However, there is need to understand the coal development process in order to ensure successful and safe potential coal mining.

This research project assesses the areas overall ground characteristic using geological, geophysical, geochemical and exploratory drilling techniques which are paramount in planning during the preliminary design stage of the mine development and coal usage. This entails understanding the geology, geological structures, coal depths and thickness, character of soils, geochemical and geomorphic characteristics of the area which will be put into account during coal exploitation so as to enable minimized negative impacts of the exercise.

Geological mapping determined the location, extent and attitude of the coal-bearing strata and the relation of the beds to other rock units in the area. It also revealed geological structures e.g. faults and any other features or structures that may affect seam continuity or mining conditions. Electrical resistivity surveys reveal the areas geology in terms of their resistivity, type and trend of the geological structures and sedimentary framework of Mui basin. Coal, soils and water sampling and eventual geochemical analysis indicate the possible pollution activities resulting from coal exploitation. The exploratory drilling gave information on depth, thickness, configuration, and quality of the coal at any point across the area, and the strata with which the coal is associated, hence allowing for detailed physical and chemical testing.

The southern part of the study area is the most vulnerable to pollution delineated based on the low elevation, high iron and sulphur content, dominant clay and silt soils, and geological structures which have a general trend of north-south, northeast-southwest and northwest-southeast, hence allowing water to be directed southwards and as a consequence carry with it the pollutants.

The coal occurrence, rank, dip and thickness reveal that both open cast and underground mining will be used in the area; with the former preferred where the
coal seams are close on the surface while the later where seams are deeper. The possible surface mining methods are area, integrated surface mining system, highwall and strip mining, while the underground mining methods are room-and-pillar and longwall mining.

Geochemical analysis of the coal samples shows variable content of heavy metals (total dissolved solids), ash, sulphur, iron and nitrogen compounds. The most significant reductions in environmental impacts from coal usage will be the adoption of higher efficiency clean coal technologies in coal usage e.g. fluidized-bed combustion, coal gasification, carbon capture and storage (CCS)/carbon sequestration, post-combustion capture, coal washing, oxy-fuel combustion and coal liquefaction. These are expected to be an essential part of an overall technology strategy to achieve the heavy metals, ash, sulphur, and carbon reductions required for stabilizing atmospheric concentration and global warming.

**Keywords:** Coal, Mui basin, geological, geophysical, geochemical, exploratory drilling, mining, pollution, clean coal technologies.