THE OIL SHALE RESOURCES OF EGYPT:
PRESENT STATUS AND FUTURE VISION

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Exploration project for oil shale in Egypt started on October 2006 and concluded on April 2010. A total budget of 1.25 million US$ was sponsored by DanaGas© Egypt, under the supervision of the Ministry of Petroleum and Mineral Resources. The exploration involves continuous coring of 10 shallow boreholes (200 to 500m deep) in Abu Tartur and Qusier-Safaga landstretch. More than 1700 metric core samples were analyzed for complete organic and inorganic composition, besides the calorific value, pyrolysis of kerogen and chromatography. Prominent oil shale "source rock" belt of Campanian-Maastrichtian age (Upper Cretaceous) extends across Egypt and outcrops in several areas in Sinai, Red Sea, Nile Valley and New Valley.

The drilling in the Maghrabi-Liffiya sector of Abu Tartur suggests that the organic rich horizon (11m thick) occurs between the uppermost Duwi Fm and the lower part of the Dakhla Fm with 2.1% as an average TOC, while the maximum is 3.6%. This horizon has relatively low hydrogen index (260 mgHC/g TOC, in average) and its kerogen belongs to type II or II+III, proposing main terrestrial organic matter mixed with different quotients of marine organic matter. The organic matter belongs mostly to the gas-prone, exinite-vitrinite type. The highest calorific value is estimated to be 620 kcal/kg. Such low energy content does not satisfy the prerequisites of retorting or direct combustion. In spite of the fact that the obtained data on the organic content is really pessimistic, other resources are examined to be of high potential in Abu Tartur plateau. Phosphorites are not the only economic resources but huge reserves of glauconite and pyrite have to be considered. The pyrite-rich sediments (about 10 m thick) can be used for sulfuric acid industry. The thick limestone capping the plateau (i.e., Kurkur Limestone) may fulfill the requirements of several industries including; Portland cement, ornamental stones and ultra-pure nano-carbonate industries for centuries.

The detailed exploration guided to delineation of potential resources in the Red Sea Region in an area of about 270 km^2. This exploration provided genuine data on the available resources, mining, utilization and added values. The stratigraphic and gamma logging correlations besides the electric profiles confirmed the wide extension of high grade immature source rock at shallow depths. The average grade contains 5 % TOC and 40 mg/g S2. The kerogen is mostly of type I (liptinite) or mixed type I+II (exinite), i.e., oil-prone derived essentially from marine sources.

The Fisher assay on dry basis experiments suggest that the oil shale in Qusier Safaga produce oil yield ranging between 35 and 110 liter per ton (for metric samples). Experiments on large technical sample at the bench scale concluded that the oil yield is 8.6 besides 2.3% gas. In Qusier area, the *in-situe* geological reserves of oil shale of the 800 kcal/kg quality is estimated to be more than 9 billion tons that can produce 5.48 BBLS equivalent upon retorting.

The geochemical investigation provides important clues on the exceptionally very content of some trace metals, particularly; U, V, Zn, Mo, Cd and Ag. The content becomes significantly higher in ash remaining after combustion or retorting. This metals content can be utilized on a commercial scale. The ash is regularly used as road mortar and can be used as an excellent counterpart of Portland cement industry. The optimum utilization of the explored oil shale suggests optimistic potentialities suitable for surface retorting, direct combustion and production of electricity at competitive price. The available reserves can be mined by surface and underground mining operations. In most cases, phosphorites can also be mined along with the oil shale. However, the structural control in the whole region shall remain a serious challenge.

The field reconnaissance, detailed chemostratigraphic correlations and the obtained results of the project point to the fact that the largest extension and highest quality of the kerogen-rich sediments are not yet explored. Optimistic resources of oil shale are expected to be below the Thebes plateau bounding the Nile Valley between Luxor and N. Qena. These resources are not structurally disturbed where oil shales beds are almost horizontal. In many occurrences, the thickness of the oil shale and stripping ratio meet the commercial limits for surface exploitation. Detailed information on the oil shale quality and the spatial distribution of the resources require drilling of few shallow wells in both the eastern and western sides of the Nile Valley. The precise delineation of the oil shale resources in the southern Nile Valley will support the sustainable development to a great extent.