Phosphorites:
Visible target for optimistic prosperity

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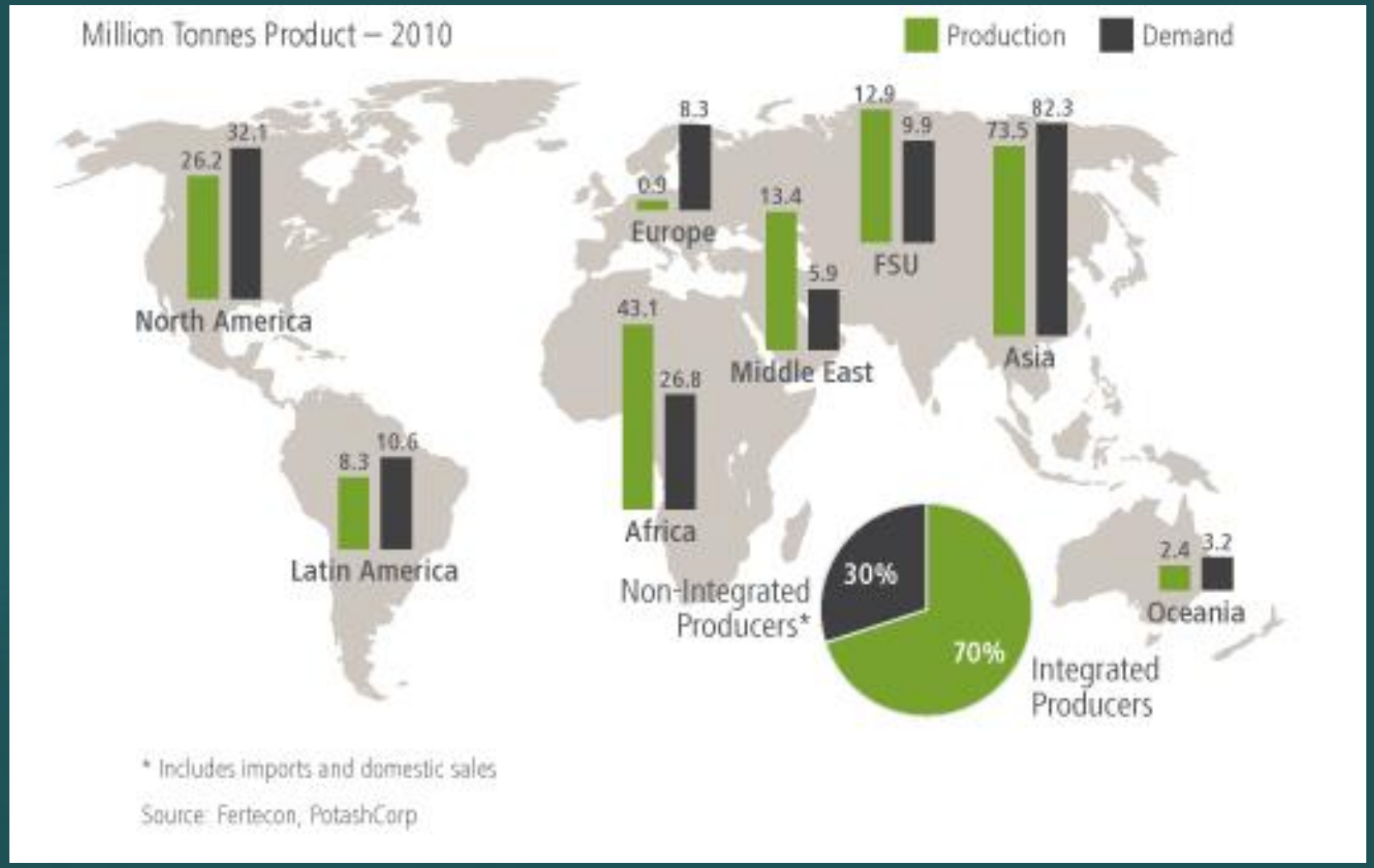
Africa and the Middle East are the only in the world where production exceeds demand!

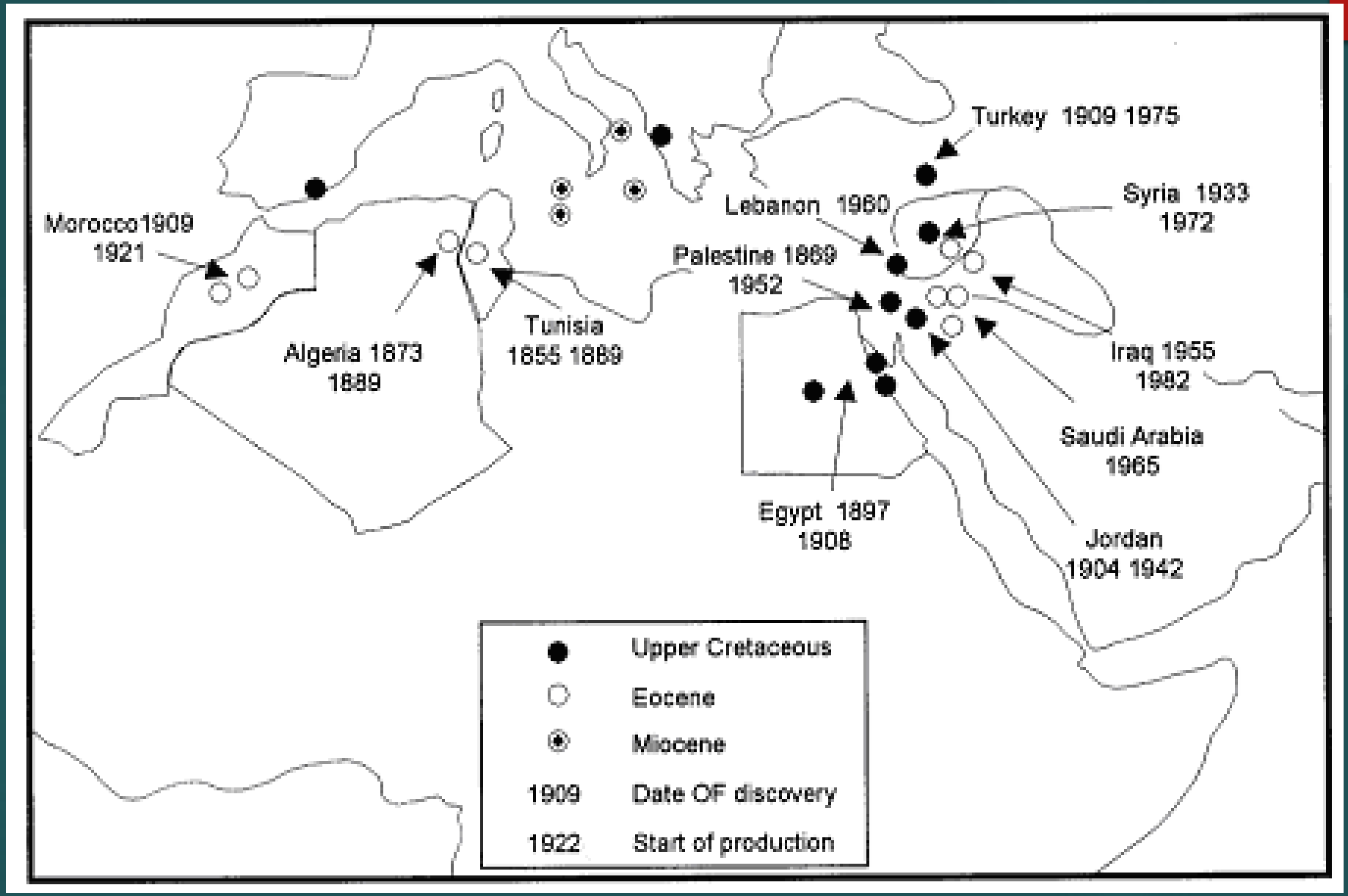


To avoid food crises and to have sustainable agriculture development in Africa, the demand must be doubled up during the coming decade.

Manufacturing of phosphorite in Africa seems to be crucial commitment.

It is prosperous business to satisfying the increasing demand for phosphoric acid in the Middle East

Distribution of phosphate resources in the Mediterranean (Tethyan) phosphate provinces



The era of cheap high grade phosphorites is over.

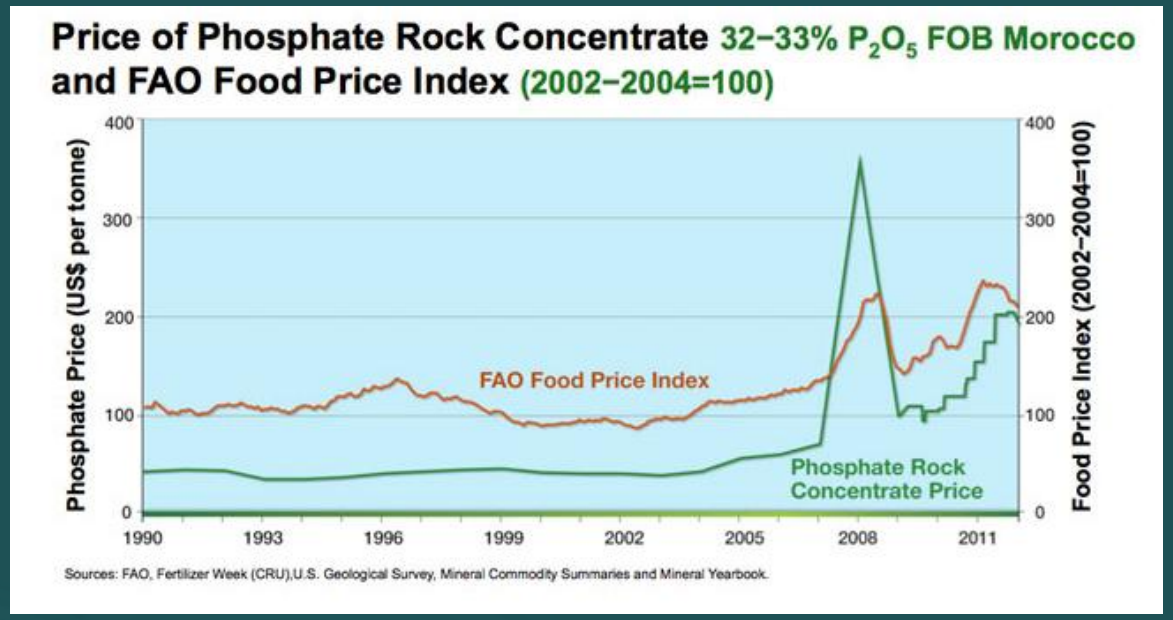
1. Reserves of high grade phosphorites are really enough in Egypt, but at higher coast of production.
2. High grades phosphorites are decreasing worldwide, as the richer deposits were mined out. Whilst there is plenty of low or medium grade phosphate rock in the world which can be recovered it is becoming more expensive to produce good grade phosphate rock for easy processing into phosphoric acid and other fertilizer products.

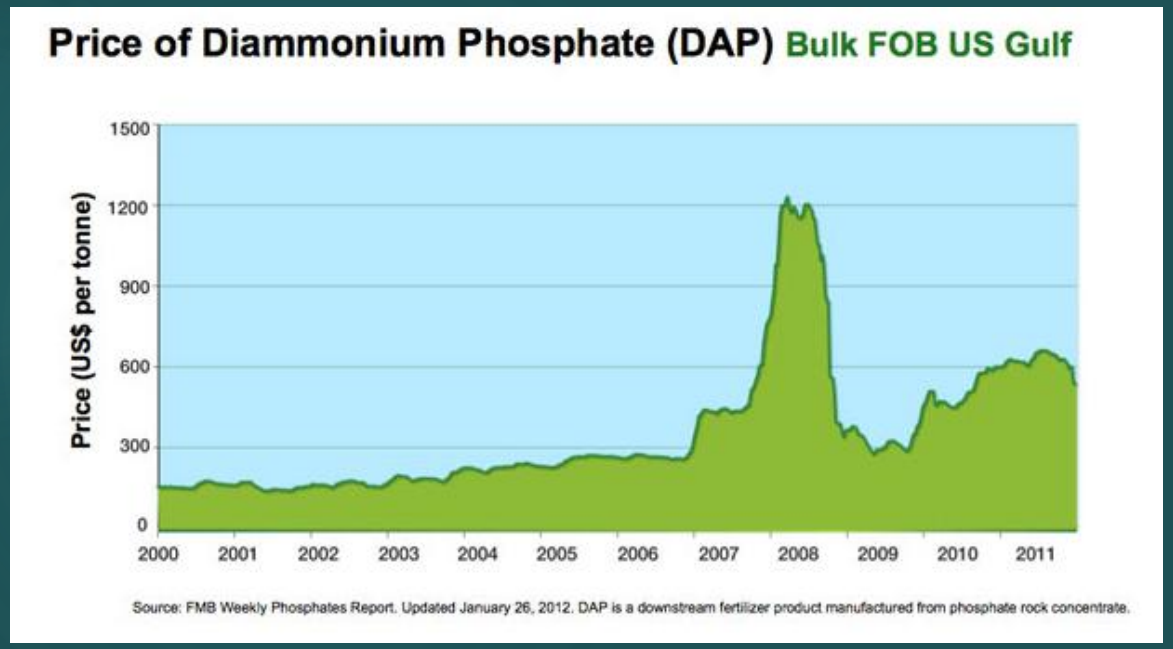
Many Phosphate Rocks have not needed flotation to produce an easily marketable grade of Phosphate Rock. This is now changing, and flotation is necessary for most phosphate rocks to either produce an acceptable and marketable product or to reduce the level of contaminants which prevent easy processing of Phosphate Rock into phosphoric acid and other fertilizer products. Scarcity of water in most places in Egypt put forward flotation by air.

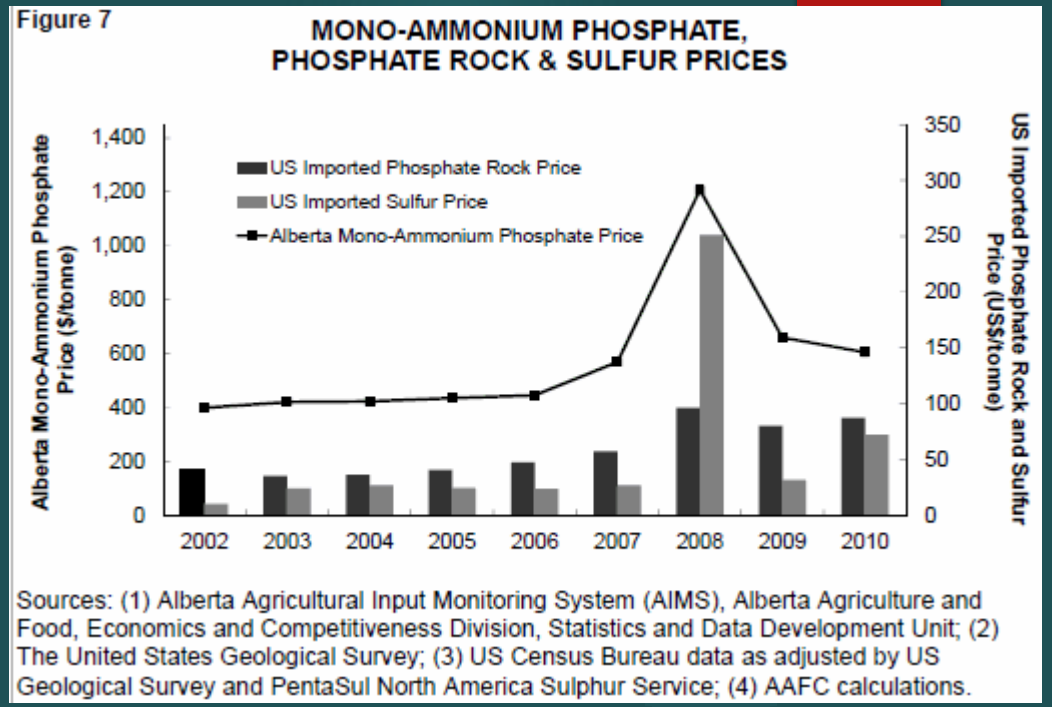
The average uranium contents in ppm of various phosphorites from Egypt and North Africa.

Area		Locality	U ppm	Reference
EGYPT	RED SEA	Quseir	85	Davidson &Atkin (1953)
		Safaga	102	Davidson &Atkin (1953)
		Hamrawin	94	Hassan & El Kammar (1975)
		Abu Shegiala	35	Ahmed (1986)
	NILE VALLEY	Oweinia mine	143	Hassan & El Kammar (1975)
		Mahamid East	98	Germann *et al.* (1987)
		Mahamid West	67	Hassan & El Kammar (1975)
		Sibaiya East	94	Hussein (1954)
		East Luxor	114	Solman (1974)
		Wadi Higaza	69	El Aassy (1977)
	WESTERN DESERT	Kharga Oasis	20	Zaghloul & Abdel Aziz (1961) Zaghloul, & Mabrouk (1964)
		Abu Tartur	20 33	El Mahrooky (1975), El Kammar & El Reedy (1988)
	SINAI	East El Qaa Plain	88	El Aassy (1992)
MOROCCO			100 & 500	Saadi (1986)
TUNISIA			60	Sassi (1974)
LIBYA			50.5	Lagha *et al.* (1999)

Uranium content in phosphoric acid is proportional to its content in the phosphate ore. However, Concentrations above 80 ppm U, is viable as commercial byproduct.
It is important to note that removal of uranium from phosphoric acid is an environmental commitment.







1. The price of phosphorite mirrors the food price index
2. The price of the fertilizer (mono- or di-ammonium phosphate is 12 fold the price of the phosphate rock
3. Sulfur or sulfuric acid industry are necessary for the phosphoric acid industry

impurity of Cd and As are considered to be especially damaging to the environment, whereas U is removed as a by product.

Annual phosphorite production of North Africa and Egypt between 1976 and 1988 (in thousand ton)

Year	Egypt	Tunisia	Algeria	Morocco	Total African production
1977	581	3613	1055	17259	29147
1978	642	3766	997	19719	32353
1979	645	4040	1083	20175	33838
1980	658	4582	1025	18824	32893
1981	720	4596	858	19696	33199
1982	708	4196	946	17754	29907
1983	647	5924	893	20106	33795
1984	1043	5346	1000	21245	35696
1985	1074	4530	1208	20737	34418
1986	1271	5951	1203	21178	36033
1987	1103	6389	1073	20954	36649

In Egypt, the annual phosphate production in 2011 was 2.4 m.t. increased to 4.7 m.t. in 2012.

Important remarks on the management of the phosphorite in Egypt

1. The phosphoric acid industry in Egypt consumes less than 200 thousand tons per year (i.e., 5 to 10 % of the annual production). The production rate of 2012 can grant phosphoric acid industry of more than 1.5 million ton diammonium phosphate. In such a case, at least 50 tons of yellow cake can be obtained as byproduct!
2. There is no "unified" Egyptian **standard export code** for phosphorites. Mixing of phosphorites from different localities may solve prolonged problems such as pyrite in Abu Tartur phosphorites.
3. At present, quarrying, and not mining, is the routine approach for production in Egypt.
4. Considering the ongoing policy and annual rate, the reserves may satisfy 20 to 30 year, at most. However, the in-place geological reserves are enormous.

ROAD-MAP FOR PHOSPHORITES IN EGYPT

There are **FOUR** main roads that can optimize the production of the local phosphate resources, and to implement real sustainable development.

The **FIRST ROAD** is to explore the plateau at the western side of the Nile Valley (west the area from Idfu to Qena.

The **SECOND ROAD ROAD** is to consider the medium grades (and even the low grade) phosphate in the New Valley in general and Dakhla province in particular.

The **THIRD** is to consider the different available resources in Abu Tartur area (not only the phosphate).

The **FOURTH ROAD** is to re-operate the underground mining in Quseir area, using a new strategy of operation.

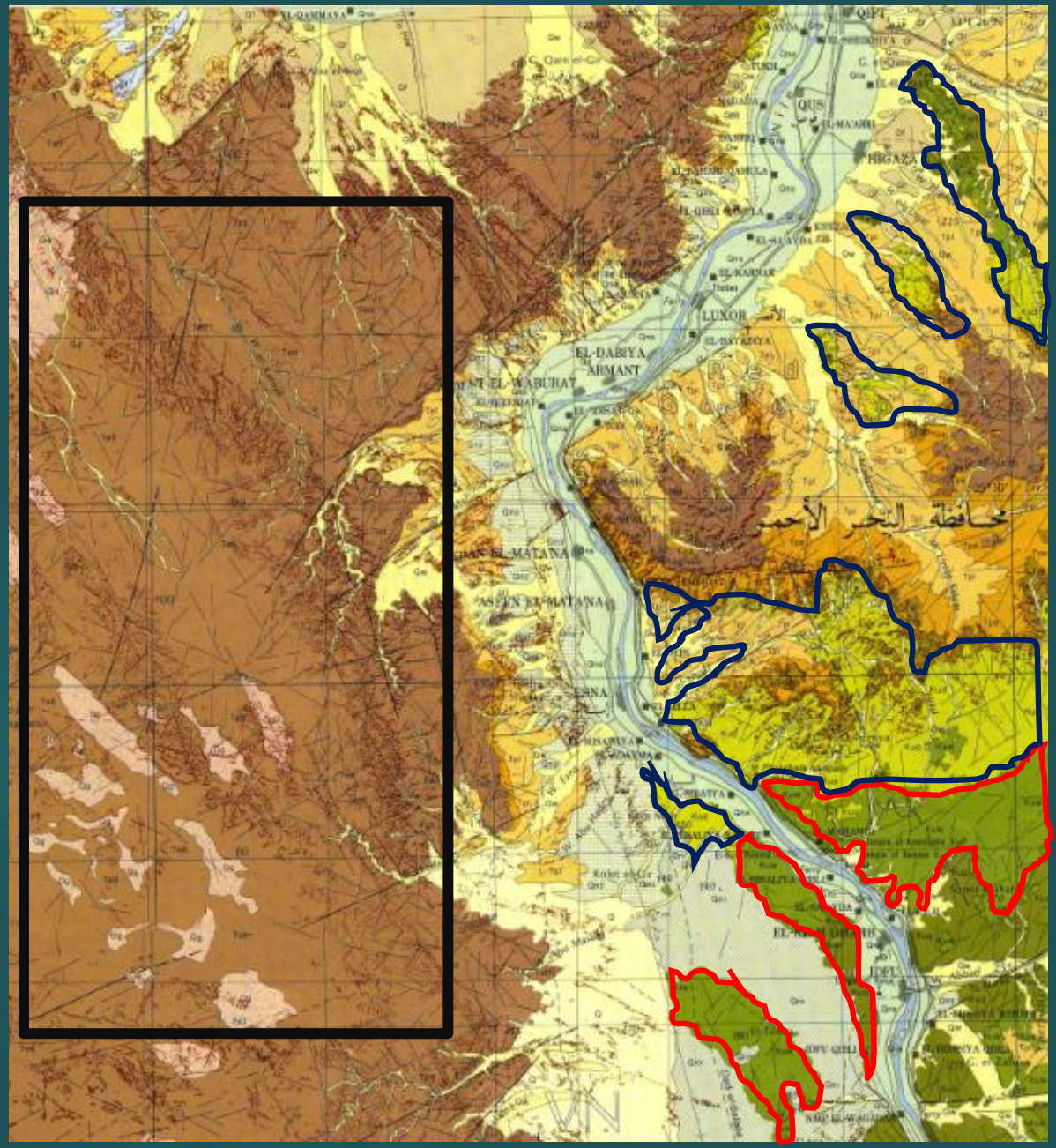
THE FIRST ROAD:

The phosphate belt extends from Qusier –Safaga to Abu Tartur, passing through the Nile Valley between Idfu-Qena. There is no available data on the western plateau of the Nile Valley. Short exploration program may contribute significantly to the known reserves.

Drilling of few shallow boreholes are required.

Still there is unexplored vast area between the now-a-days known occurrences

1. We have clear idea about the shore line of the depositional sea
2. We have clear idea about the location of the high grade ores
3. But we have absolutely no idea about the possible resources between Nile valley and New Valley

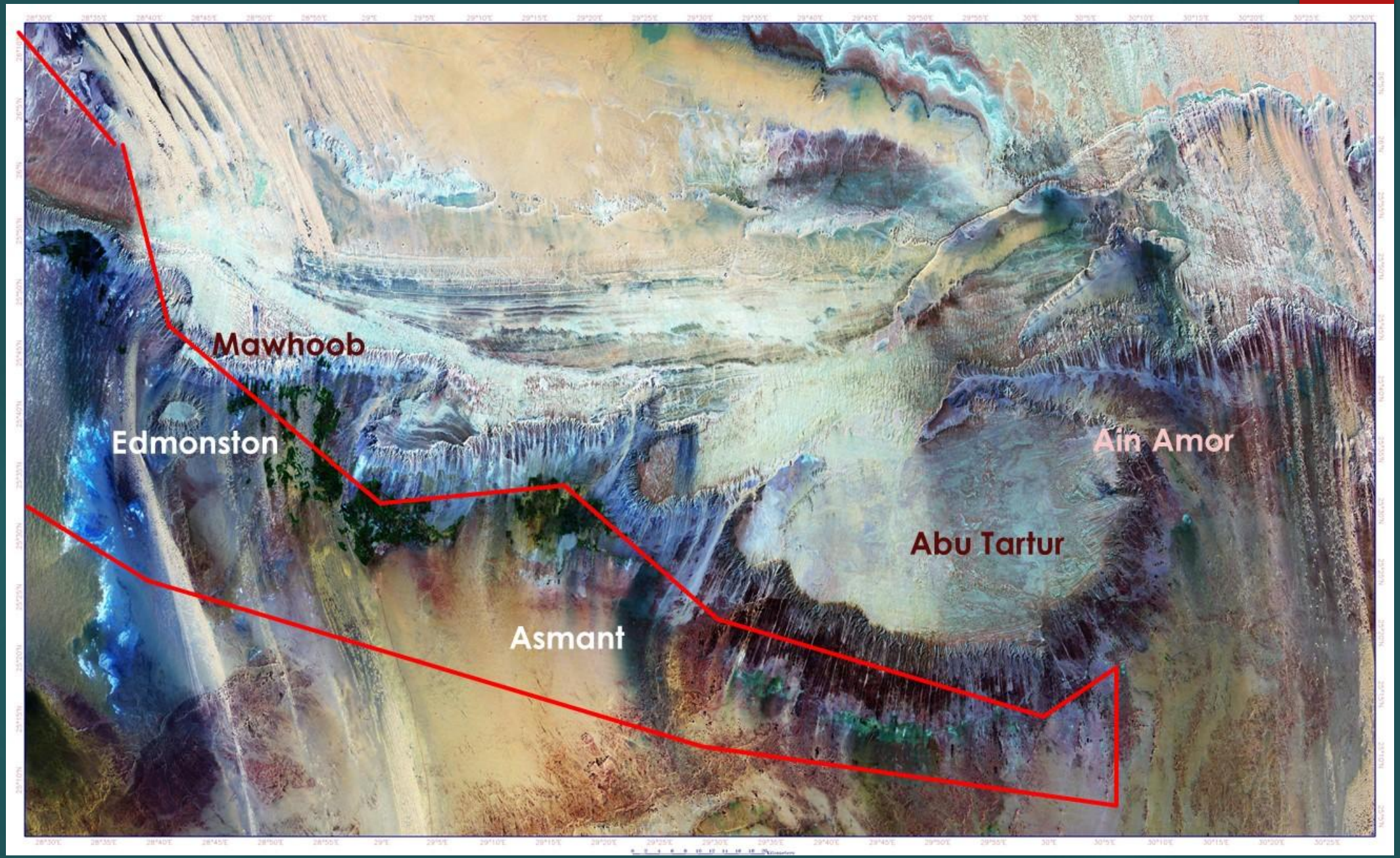


The lineated rectangle represents very optimistic concession target for phosphate underground mining. High grade ore, suitable thickness,, vast extension availability of good cap-rock, and possible added vale

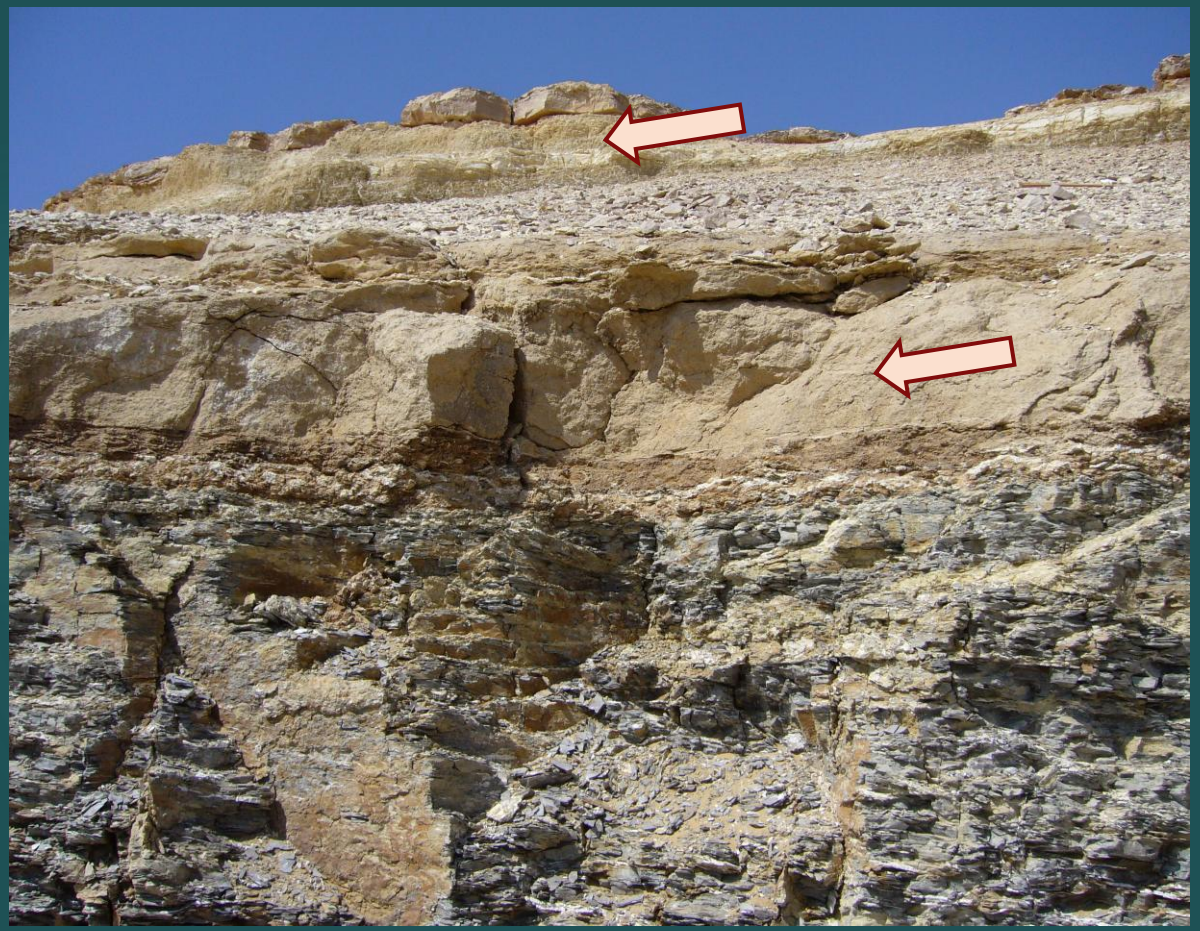
THE SECOND ROAD:

The Medium grade phosphate rocks

- Where they are?
- How much they are?
- Are they mineable?
- Are they really potential?
- What is the best utilization?


Mawhoob
Edmonston
Ain Amor
Abu Tartur
Asmant

Shekh Abdalla resting on phosphate bed, near Qase El-Dakhal



Phosphate bed other than the famous lower bed. Other thinner one can be seen above

The exploration program by the Egyptian Mineral Resources Authority (EMRA) proved that the vast low land area of the Dakhla environs is target of:

1. About 500 million tons of medium grade phosphorites
2. The average thickness varies between 1.5 and 3 meters. However, the thickness of the individual beds ranges, in most cases, between 30 cm and 90 cm.
3. The grade of the ore ranges between 18 and 29% P_2O_5, averaging about 22%. The available data after EMRA indicate that U is 174 ppm
4. The ore is shallow and can be operated through open cat quarrying. The stripping ratio is generally at the limit than 1 to 4-18.
5. The main gangue minerals are dolomite (ferroan type), gypsum-anhydrite and ferruginous material.
6. Beneficiation seems to be viable.

The main challenges are:

1. Scarcity of water
2. Long distance of transportation
3. Hyper-arid climate

Utilization of low grade phosphate resources by developing **phospho-composts** or other suitable compositions for enhancing the efficiency of available P_2O_5 in these low grade rock phosphates. This could be achieved by **microbes** or **partial acidulation** or **alkalization** or **else** exploiting these resources by *in-situ* leaching and developing management strategies to increase phosphorus efficiency by using these low grade phosphate resources for phosphorus efficient plant species etc. are considered to be most suitable techniques and methods for optimal utilization of the available indigenous phosphate resources.

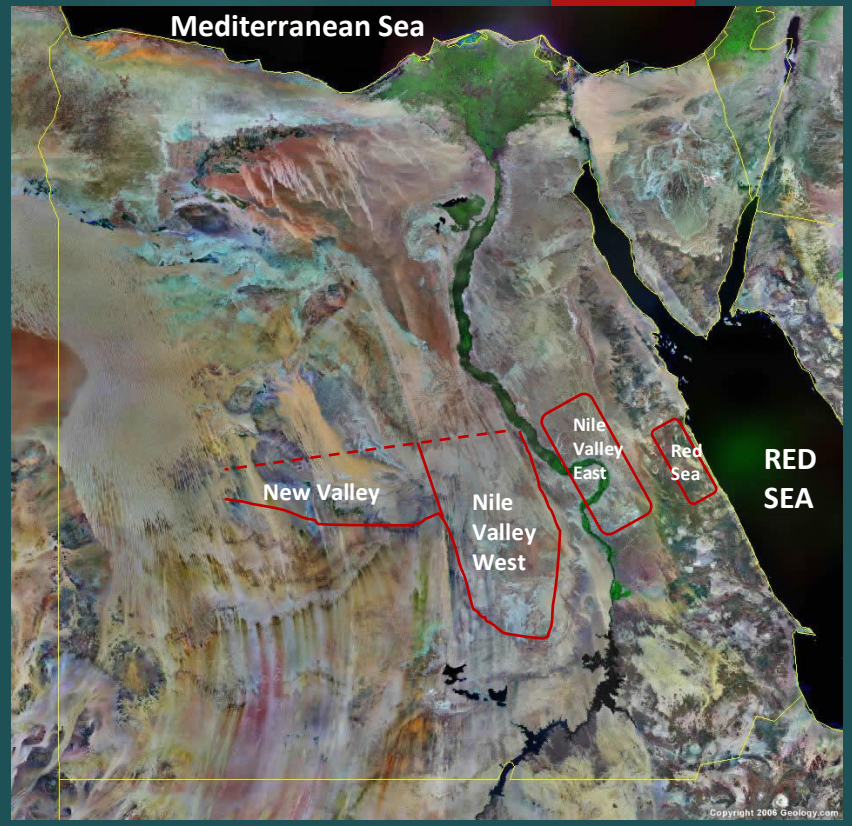
The low grade deposits should be mined and processed by **Vat leaching or heap leaching method** using commercial grade HCl or HNO_3 acid. Leaching the rock *in-situ*, or mining the deposit, crushing and leaching it in heaps or in Vats, is a cheaper technology than leaching in agitated tanks followed by counter-current washing in a series of thickeners as is practiced today.

THE THIRD ROAD:

Re-evaluate “definite part(s)” of Abu Tartur plateau

- What part?
- Is it visible?
- How much the proved reserves?
- What is the best method of operation?

Mining of phosphorites, everywhere in Egypt, is challenged by geological and quality problems, but their is no desire or wish to overcome the obstacles



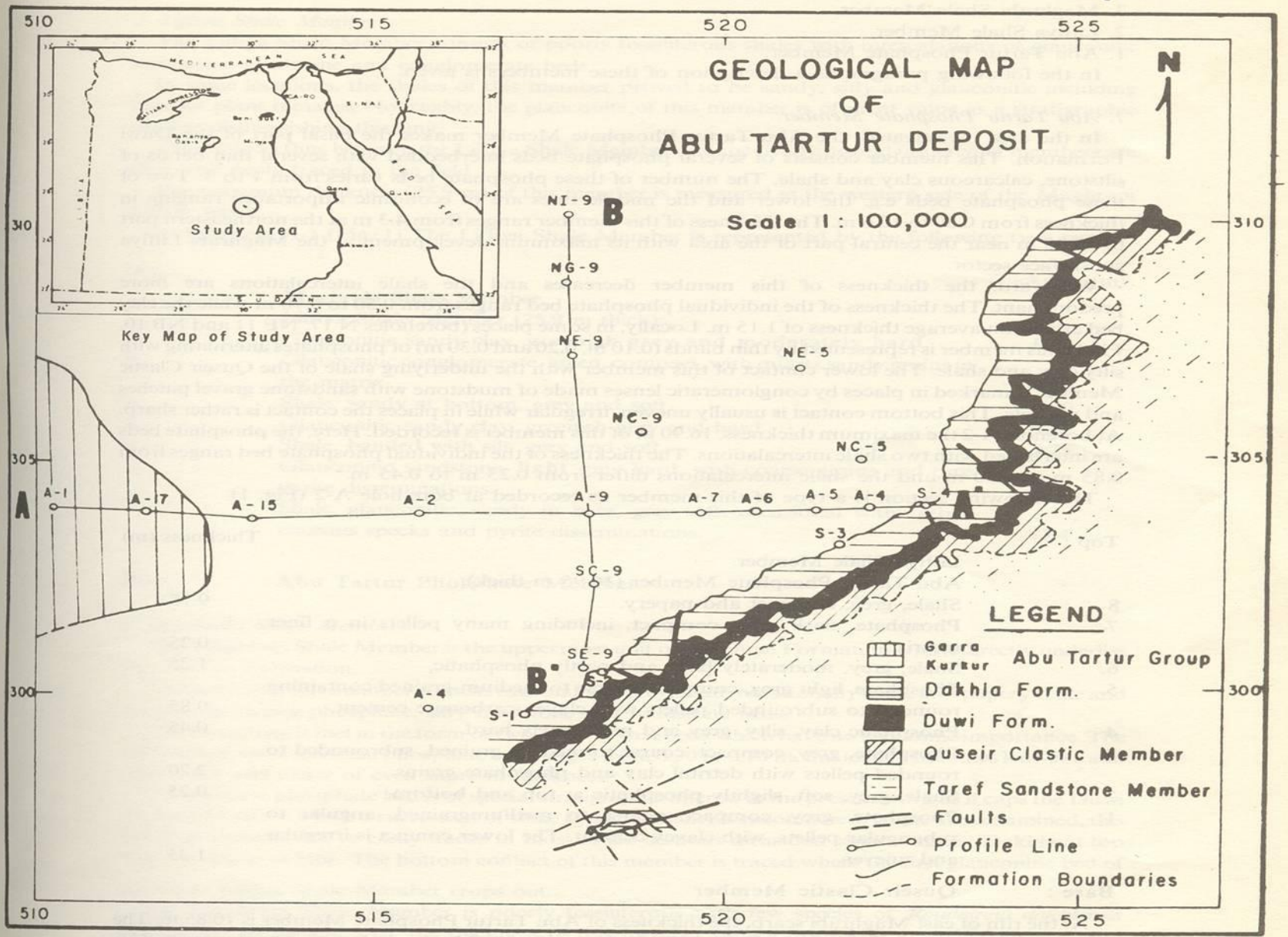
The reserves in the Maghrabi-Liffiya sector (red square) are estimated by the Geological Survey of Egypt to be billion tons.

Only 3-5% of these reserves can be recovered by the present-day policy

For example, in Abu Tartur, the plan was to produce 12 m.t. annually. There is advanced infra-structure and huge investment, but mining is not possible at present and even in future. In spite of the 11 billion E£ disbursed on the project, the actual production is insignificant.

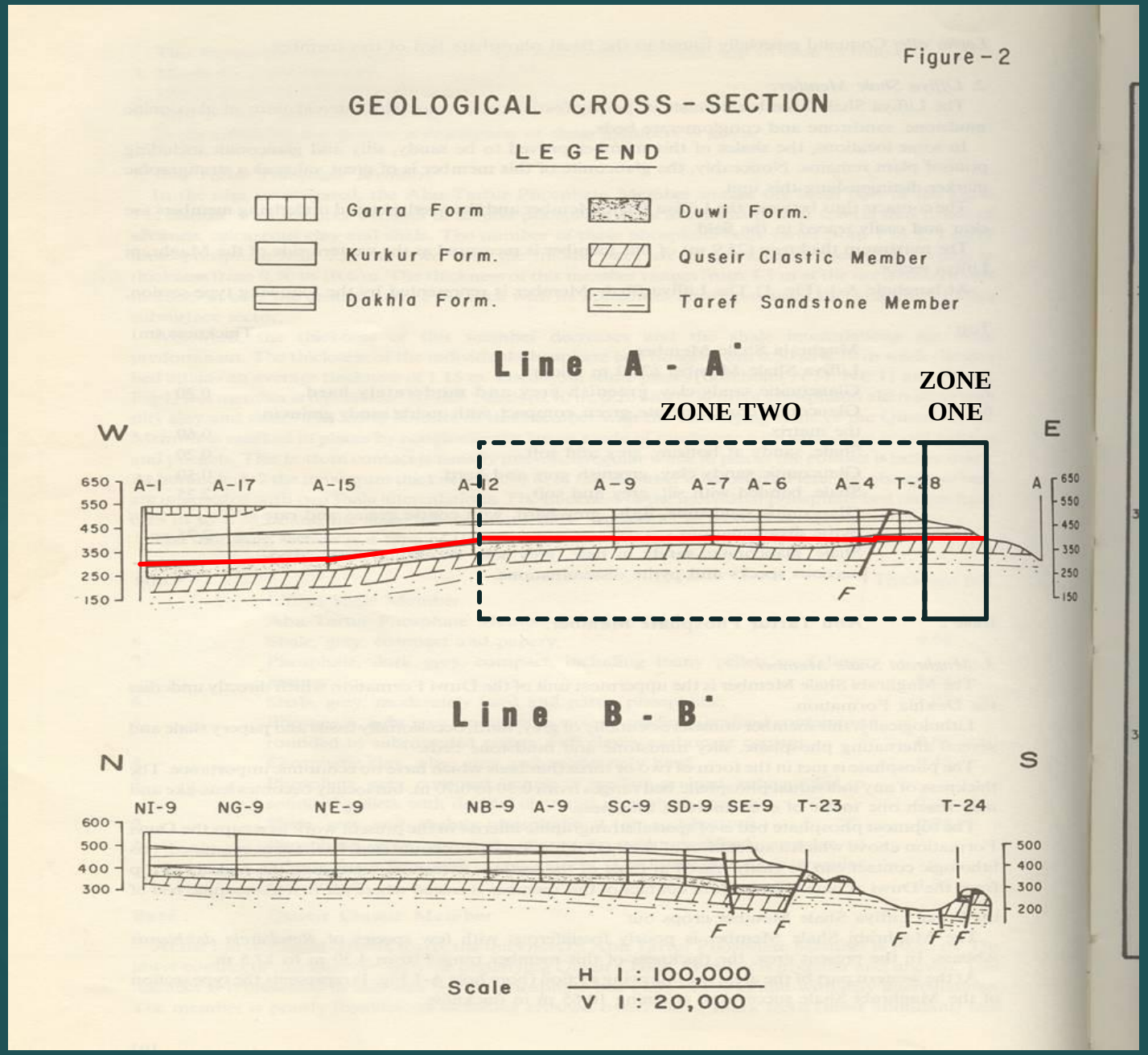
It is a failure of administration.

Figure – I



The quarrying of phosphate ore is going on now-a-days along the surface exposure, precisely at the lower limits of the black zone in the figure.

There are two geological profiles drawn along A-A" (East- West) and B-B" (North – South)



The two profiles suggest the following observations:

1. The thickness of the Duwi Fm is almost consistent.

2. The total thickness of the sedimentary succession increases due West and also due North.

3. The above increase in total thickness is basically related to thickening of the Eocene limestone (Kurkur and Garra Formations)

The ongoing mining (?) operation in Abu Tartur Plateau.
It is just excavation of the surface exposed resources of the low plateau (zone one).

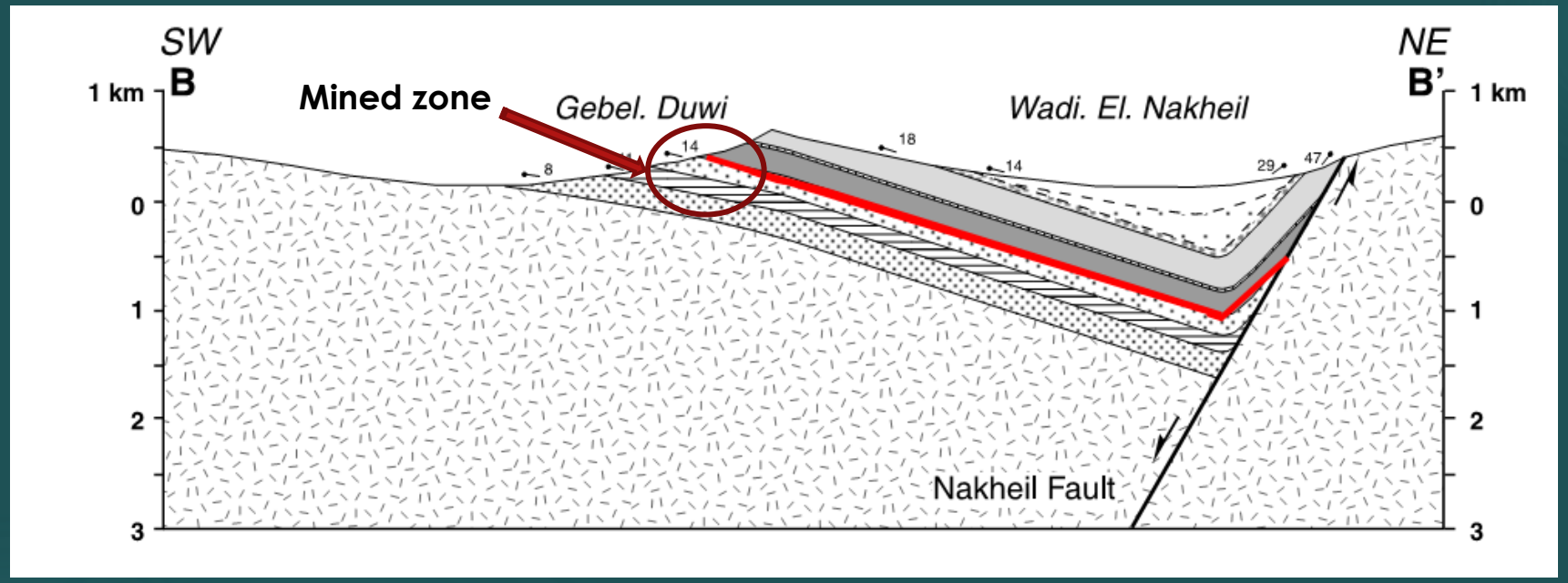
The annual production may exceed 2 million tons, but for how long?

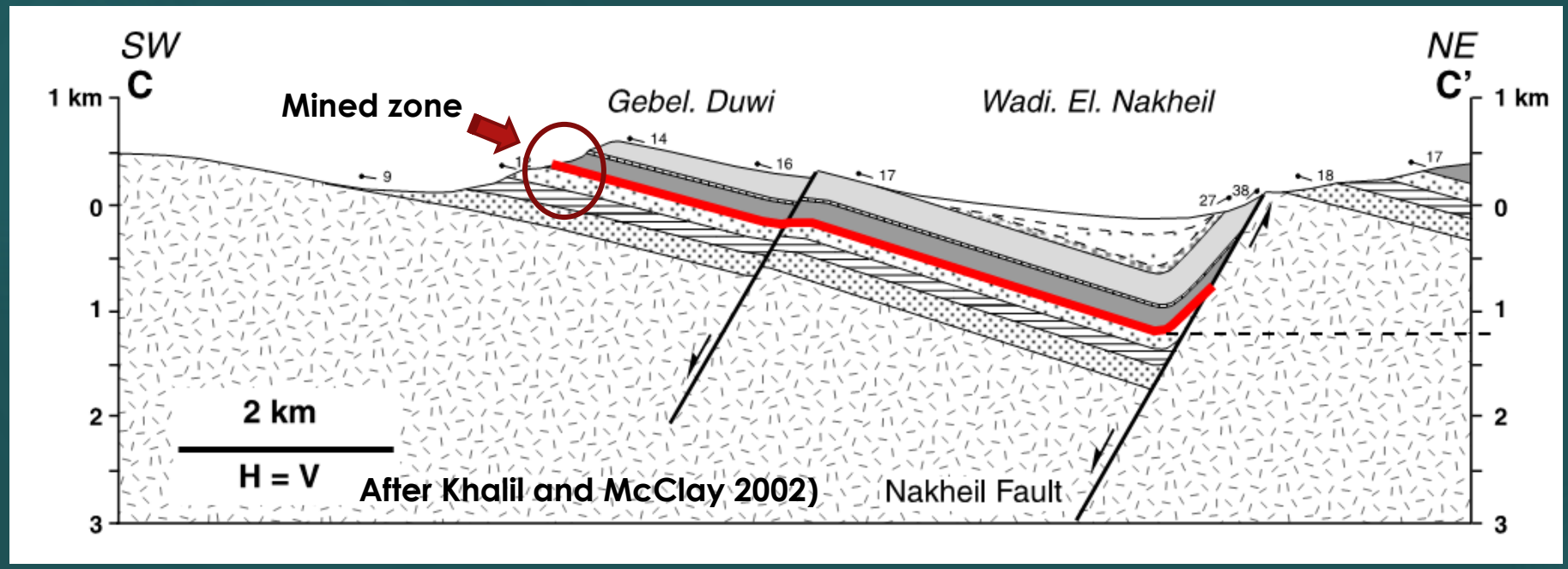
Do we have better alternatives

THE FOURTH ROAD:

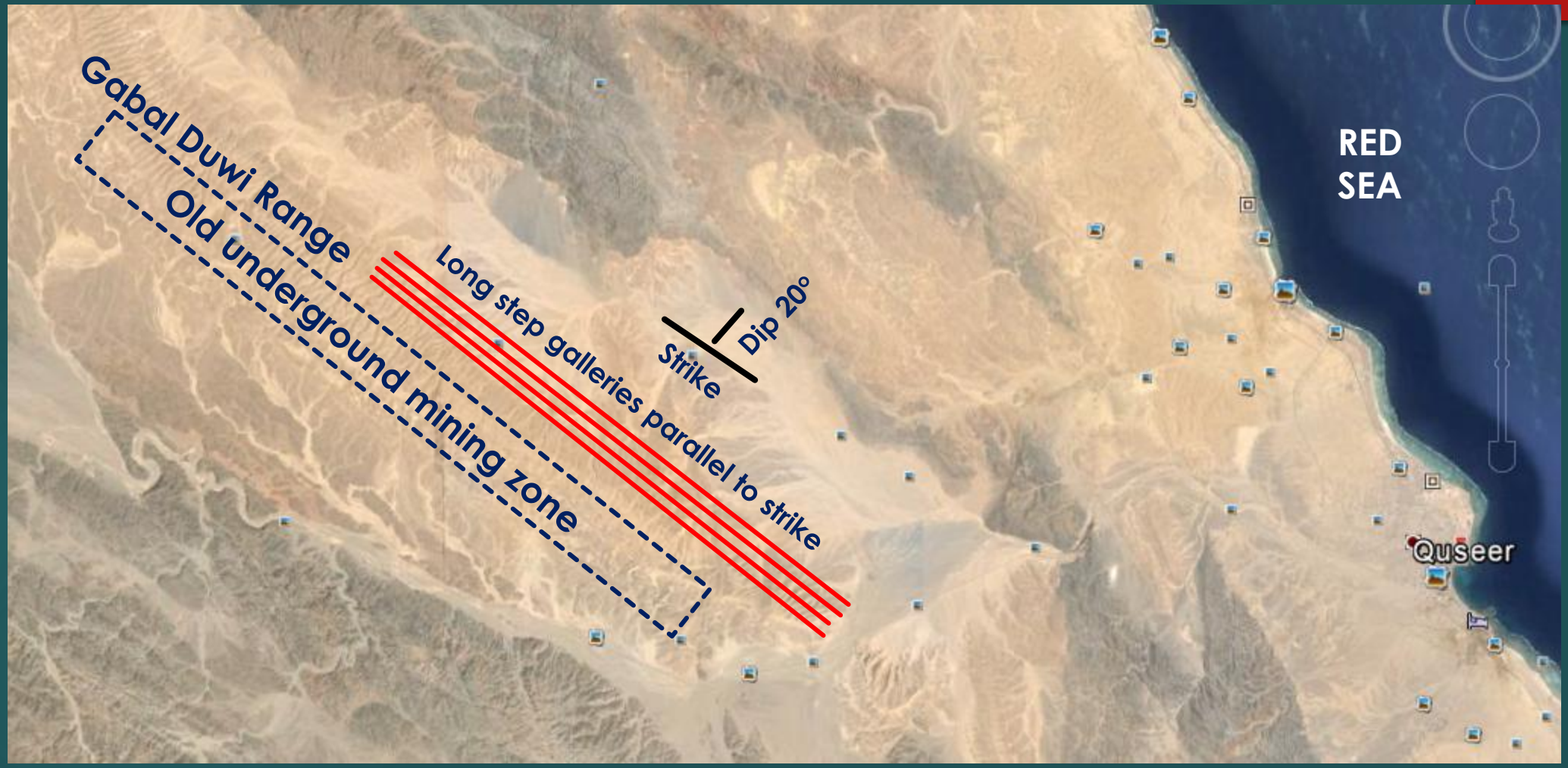
Underground mining in G. Duwi and other phosphate occurrences in Quseir-Safaga region was the routine strategy from 1930s to 1980s. The mining was always along the dip, and problem starts when the mine reach the level of the water table.

Applying new strategy of underground mining through long step galleries running at right angle direction of the dip (parallel to the strike direction) may be successful.





In Quseir-Safaga region, mass production stopped since about three decades. The easy mineable ore was exploited from 1930 to 1980. The tilted and deep seated ores count for billion tons of commercial grade. It is real challenge and needs operation by unconventional modern mining techniques.


Gabal Duwi Range
Old underground mining zone
Long step galleries parallel to strike
Dip 20°
Strike
RED
SEA
Quseer

CONCLUSIONS

1. The domestic production of phosphate ore is 4.8 million tons in 2012, which can produce more than 1.5 million ton of phosphoric acid. This can ensure the start of potential phosphoric acid enterprise. If this strategy of phosphoric acid will be implemented, we can ensure annual production of about 50 tons of yellow cake.
2. It is time to invest in **NEW OCCURRENCES** and in the modern mining technologies for phosphorites and other associating ore deposits.
3. Establishment of National code for phosphate ore and phosphate concentrate is an obligation
4. Attention should be given to the "Phospho-composite" or "fertilizers of the poor" which utilizes the medium and even the low grade ore (the most available in Egypt).

Thanks for attention

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