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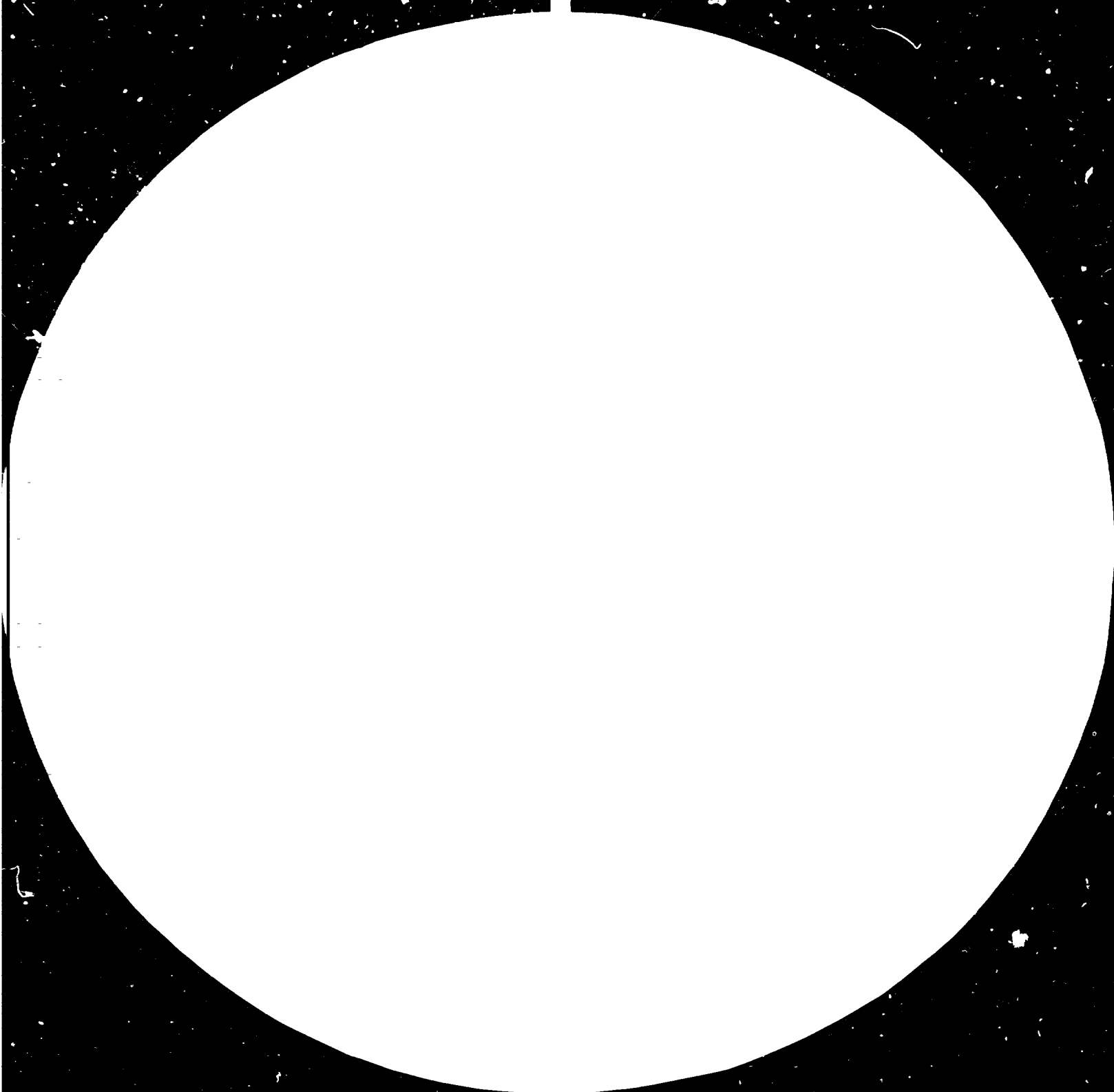

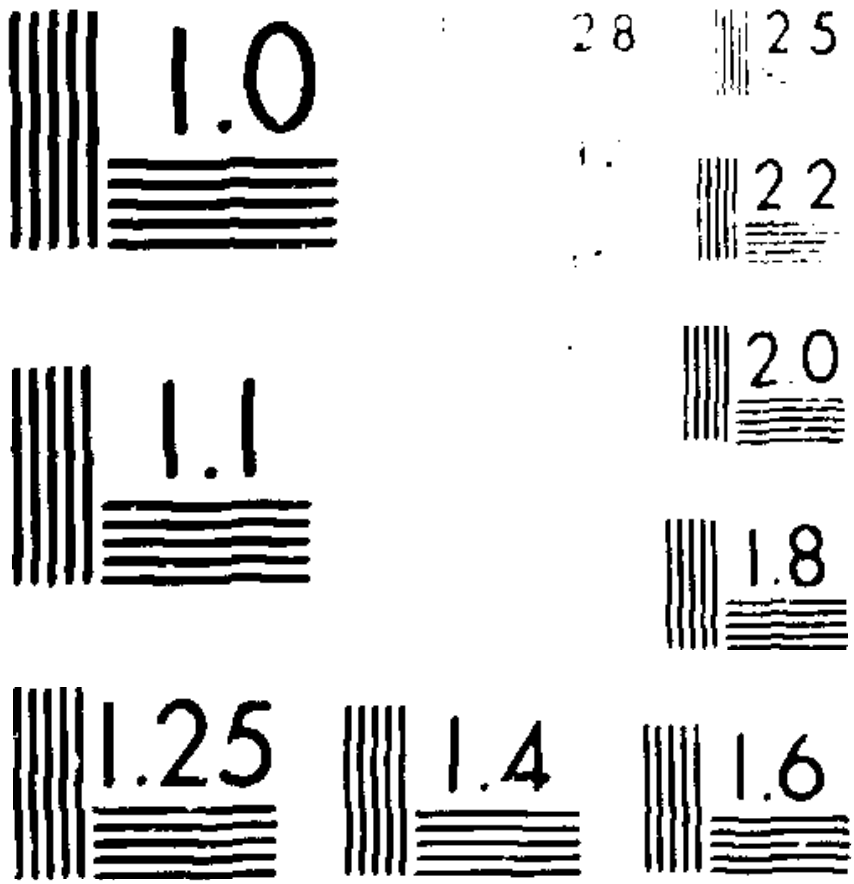
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COUNTRY REPORT

Non-metallic Raw Materials of Jordan

by

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Submitted to UNIDO-Czechoslovakia Joint Programme, Pilsen
"In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals"

April 1980

Pilsen, Czechoslovakia

SUMMARY

This report briefly discuss the general geology of Jordan and non-metallic occurences. The utilization of the non-metallic raw materials in the Jordanian industry is also mentioned.

GENERAL

A geobgical map 1 : 250 000 is now being used in Jordan to show the various formation outcroping in the country. This map was completed in 1966 and many other detailed maps have been prepared particularly where the deposits occur. However, a complete geological map of scale 1 : 50 000 or 1 : 25 000 is of great importance in order to explor any other deposits in the country.

Generally, Precambrian, Paleozoic, Mecozoic and Cenozoic aras occur in Jordan. The cretaceous age covers most of the Jordanian territories, this age is subdivided into seven local units, where the most economical industrial rocks (phosphates) occur. It also contains the limestone deposits which have been used as building materials since ages. The phosphate deposits are considered the biggest export products of the country. The estimated reserves are exceeding 1 000 million tons and the proved reserves are approximately 300 million tons. The output of the phosphate mines ranges between 2 to 2,5 million tons per year. A plant for the production of phosphoric acid and fertilizers is now under construction near the town of Agaba.

However, the details of geology and the occuring formation is beyond of this report.

JORDANIAN NON-METALLIC RAW MATERIALS

The following raw materials occur in Jordan, the reserves were estimated and few of them are being utilized for the Jordanian small-scale industry and export.

1. Clays

Approximately 1.5 million tons of clay deposits were estimated in the area of Mahis (25 km west of Amman). These deposits were classified according to their composition into four categories. Mineralogically the clays contain kaolinite, free quartz and colouring oxides. Chemically ranging as shown in the following table:

	Mahis I	Mahis II	Mahis III	Mahis IV
Al_2O_3, %	23 - 32	18 - 23	12 - 18	10 - 15
SiO_2, %	50 - 65	60 - 70	64 - 82	70 - 85
Fe_2O_3, %	1 - 2.5	1 - 2.5	1 - 1.5	3 - 6

The clays also contain a considerable amount of TiO_2 and small amounts of CaO, MgO and alkalies.

Mahis clays are now exploited for the use of wall tiles, floor tiles, batteries, white cement (categories I, II, III) and brick industry (category IV).

The annual output of the mine is gradually increasing from 3 000 tons in 1975 to 50 000 tons in 1980.

The above mentioned clays occur also in other areas such as Ghor Kabid, Arda, Bagáa and others. Therefore, a comprehensive exploration programme is of great importance in order to increase the amount of the national reserves, this because of the future need of this material for the use in different industries, for example a white cement plant will be consuming more than 90 000 tons per year in the first stage (this plant will be put into operation in 1984), and to cover the needs of other middle eastern countries.

Another clay deposit (Al-Azrak) has been tested very carefully by N. R. A. Geological Survey, the University of Jordan and recently by the Public Mining Company together with UNIDO expert (K. G. Jones). The following results were concluded: Al-Azrak clay deposits are not of the kaolinite group, they are not "bentonite" (commercial term), mineralogically they are smectite illite mixed-layers and the expandability ranges between 30 - 85 %. However, testing of these clays is now being carried out for use of light-weight aggregates.

2. Gypsum

This raw material occurs in various parts of the country and of good quality and quantity. It is exploitable everywhere but the infrastructure of Jordan Did not allow the exploitation from different areas, therefore it is now exploited from an area called "Zerka River" about 50 km north-west of Amman, where the accessibility was made possible by constructing an acceptable road suitable for light weight trucks (10 - 15 tons). The exploited gypsum is now supplied to the cement works and to a plaster plant for the use of building construction as partition walls and decorations.

3. Marble

This industrial rock can be divided into three main types to be used as decorative stones and for the use of building industry:

A - Varicoloured marble - recrystalline limestone of different colours including black, green, brown and pink. The reserves of this material is unlimited, but the jointing systems make the manufacture of external surfaces impossible, therefore, it is now used as mosaic in the floor concrete tiles, and also is used in the so called Agglomarble, where fragments of this material are cemented together by resins in order to make big blocks, then cutting and polishing of the slabs take place for the use of external surfacing.

B - Travertine - Huge deposits of this material occur in the country. Trial exploitation has been started in January 1980 for the use of decoration and external surface slaps.

C - Granites - occur in the area of Agaba, the Public Mining Company have started a detailed study of the possibility to utilize this material as decorative stones.

4. Feldspars

Potassic and sodic feldspars occur only as components in the granitic rocks of Agaba. A feasibility study is being prepared to extract these components out of the mother rock. It was preliminary found that a plant of minimum 20 000 tons would be feasible. Therefore, the feasibility study must be made very carefully particularly marketing and transport.

5. Limestone

This industrial rock occurs all over Jordan and have been utilized as a building stone and lime since ages. It is now considered the greatest exploitable material and used for:

a) Concrete aggregates - more than 10 million cubic meters per year are being crushed for the use of aggregates in the building industry.

b) Grey Portland cement, the output of the cement plant is approximately 1.2 million tons per year using the local raw materials including limestone and marl.

c) White cement industry, an area of limestone deposits containing a very small amount of colouring oxides (~2%) is located for the use of white cement plant (50 km east of Amman). The plant is now under construction.

d) Lime plant - under construction

e) Other small industries.

6. Dolomite

This industrial rock also occur everywhere and found as a marker bed (20 m thick) separating two local stratigraphical units, namely, Kurnub sandstone and Nodular limestone, it also occurs in other units of the cretaceous age. Dolomite is now exploited for the use of ceramic industry and export, it will also be used for the Jordanian glass factory and for potash industry.

7. Silica

It is also one of the widespread minerals in Jordan. Nearly all types of silica including quartz sand, metamorphic quartzite, and amorphous silica (Tripoli) occur in the country.

The Jordanian stratigraphical column includes units of sandstone more than 1500 m in thickness particularly of pre-cretaceous age. The most well known is the so called glass sand. Its silica content and grainsize cistribution show that it is quite suitable for all silica based industries including glass, ceramics and others. These deposits have not been exploited, except few thousands of tons being supplied to the ceramics works in Jordan and Kuwait. The analysis also shows that a washing plant is of great importance to maintain the good qualityfor all industries and export. The washing plant also produces two another by-products probably:
a) China clay for ceramic industry and others
b) Feldspars

Three deposits of unlimited reserves occur near the town of Agaba.

Another silica sand deposits of lower cretaceous age (Kurnub sandstone) is now being exploited near the city of Amman (Mahis and elsewhere) for the use of the following industries:

a) concrete fine aggregates
b) asphalt mixes
c) Johnson pipes (made of sand, fiber glass and resins)
   The sand is prepared by dry screening methods to reach the required grain size. Drying also undetaken to maintain zero moisture content. This screened sand is supplied to a local pipes factory and other four Middle-Eastern countries.
d) sand bricks, the plant will be put into operation by the end of this year.

Another type of silica (Tripoli) was found in Jordan. This is an amorphous silica similar to diatomite, the SiO_2 content ranges from 95 to 99%. This material is now used for small scale paint factories. The industrial application of this material in Jordan have not been studied in detail. However, this material can be used in the light weight concrete (Engelthaler)

8. Other non-metallic raw materials

Many other non-metallic raw materials of good industrial application such as barite, bentonite, tuffs and tuffites must be explored and studied in detail.