REPORT TO THE GOVERNMENT OF

THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

URANIUM PROSPECTING

DRK/3/003

EVALUATION MISSION

by

Milan MATOLIN
Mohamad TAUCHID
IAEA Experts

1 - 15 May 1987

I. INTRODUCTION

At the request of the Government of the Democratic People's Republic of Korea, a two-man mission was carried out under project DRK/3/003 -- Modernization of Uranium Prospecting and Exploration Method, from 1 to 15 May 1987.

The objective of the mission was to realistically assess the need of the Maebongsan Geoprospecting Expedition in terms of equipment, expert services and training in modern methods of uranium exploration. The two experts were also to provide lectures on matters related to the world's uranium deposits and current exploration techniques.

II. BACKGROUND INFORMATION

II.1 Government Organizations

Uranium exploration activities in the Democratic People's Republic of Korea are carried out by the Maebongsan Geoprospecting Expedition (M.G.E.) in Piongwon County (some 40 km north of Pyongyang) and the Kuwolsan Geoexploration Group (K.G.G.) in Kumchon Country (some 200 km south-southeast of Pyongyang). The first (M.G.E.), the national counterpart for project DRK/3/003, is responsible for the preliminary prospecting stage to the discovery of a deposit. The second (K.G.G.) will take over the newly discovered deposit and develop it further for an eventual exploitation. The two organizations are parts of the Department of Production in the Ministry of Nuclear Energy (the restructured State Committee for Atomic Energy). It is understood that only two years earlier both groups were parts of the Ministry for Development of Natural Resources (M.D.N.R.). It should be mentioned that M.D.N.R. also uses nuclear techniques (ground radiometric and borehole logging) for the exploration of other commodities. Any positive results which may have some bearing on the radioactive mineral potential are transferred to the two organizations mentioned earlier.

Additionally the Radiochemical Institute of the Nuclear Energy Research Centre in Ru Kar Ri, also of the Ministry of Nuclear Energy, has a group which conducts ore processing experiments on the uranium black shale ore. This Institute was the national counterpart for the Agency's technical co-operation project DRK/3/002 "Uranium and Ore Concentrate Analysis".

II.2 Geology and Uranium Resources

Over 50% of the country's territory is underlain by rocks of Archean and Proterozoic Age. Paleozoic rocks covers around 30% of the remaining part with Mesozoic and Tertiary formations covering the rest. Three main geological elements are recognized: stable platform, geosynclines, and younger sediment and volcanic (basalt) covers. Granitic intrusions of Archean to Mesozoic ages are known. Of which, as in many parts of East and Southeast Asia, the Cretaceous granite is considered important in relation to uranium potential.

Uranium mineralization of sedimentary, hydrothermal (vein), metamorphic (stratabound), skarn and pegmatite types are known in the country. However, to date only those associated with the Cambrian black shale are considered important. Sizeable reserve from this type of deposits has been outlined in and around Kumchon County and several prospects are being evaluated throughout the country.

It should be noted that metallogenically, the country is rich in coal and iron resources. Deposits of lead, zinc, magnesite, tungsten, and graphite are also being exploited. A gold mining project at Unsan is being initiated.

III. INFRASTRUCTURE OF MAEBONGSAN GEOPROSPECTING EXPEDITION

III.1 Organization, Manpower and Technical Facilities

Maebongsan Geoprospecting Expedition, the organization carrying out the uranium exploration in all areas of the People's Democratic Republic of Korea, has its headquarters just outside Piongwon, 40 km north of Pyongyang in the South Pyongan Province. The Director is Mr. Paek Tae Kun and the Chief Engineer is Mr. Li Yun Ok. The total number of staff is about 400 out of which around 10% with university degrees. Names of staff members, who took part in common meeting, are noted in Annex-1. The mailing address of the Expedition is:

Maebongsan Geoprospecting Expedition
Pyongwon Country
South Pyongan Province

The Maebongsan Geoprospecting Expedition structure includes field groups, laboratories, workshop and technical section.

There are six approximately 25-men field groups carrying out field geological prospecting radiometric measurements using portable scintillation ratemeters and portable emanometers. One additional field group carries out electrical resistivity measurements. There is a special group guiding the overall field operation, introducing new techniques and charged with research activities. Geological documentation is carried out by professional geologists. Transport facilities seem to be limited.

Laboratories are situated at the headquarters of the Maebongsan Geoprospecing Expedition. They have the capacity of technial preparation of rock samples and their analyses on the level of presently available equipment and respective sensitivities. The electric power supply is 220 V, 60 Hz with standard two point sockets (without the third pole for the ground).

The workshop at the headquarters, with approximately six persons and limited electronic equipment, carries out the equipment repairs and maintenance.

The overall number of geologists is 20 and of geophysicists is 15. All field measurements are carried out by trained prospectors.

For the past two years drilling operations have been suspended. At present there is no drilling equipment in operation.

III.2. Equipment of Maebongsan Geoprospecting Expedition

Equipment	Model	Country and year of origin	Number of pieces
Portable scintillation gamma-ray ratemeter	SRP-2 SRP-68	USSR/1962, 1968 USSR/1982	62* 8*
Portable emanometer	EM-2 EM-6P	USSR/1961 USSR/1971	3 4
Portable ratemeter with small diameter shallow (1.5 m) probe	SRP-6803 SRP-2K	USSR/1980 USSR/1970 DPRK/1982	2 1 1
Portable face radiometer gamma-ray logging (total count)	PRKS	USSR/1972 DPRK/1982	1 1
Electric-resistivity	IKS	USSR/1968	1
Electric-induced polarization	VPP-67	USSR/1968	1
Portable magnetometer	M-2	USSR/1962	1**

* Most of the times only 60 of the 70 ratemeters are operational

** Old type magnetometer of inadequate sensitivity and speed of operation

III.3 Laboratory Equipment

Equipment	Model	Country and year of origin	Number of pieces
Microscope	MIN-8	USSR/1968	1
	MIN-9	USSR/1968	1
Binocular microscope	MBS-2	USSR/1962	2
Emission spectrograph	ISP-30	USSR/1962	1
	ISP-51	USSR/1968	1
Ultraviolet lamp	LUF-57	USSR/1963	1
Equipment for microhardness	PMT-3	USSR/1968	1
Multichannel analyzer + scint. probe	AL-128	USSR/1969	1
Laboratory emanometer	ALPHA-1	USSR/1970	1
Spectrophotocolorimeter	72	China/1973	1
Flamephotometer	PFM	USSR/1969	1
Polarograph		Czechosl./1967	1
Two beam oscillograph	S-1	USSR/1972	1
Oscillograph	DT S1 64	Poland/1984	1
Pulse generator	G5 64	USSR/1967	1
Ultrasonic generator	G2 33		1
Counter	PP-9 1M	USSR	1

The majority of the quoted equipment is of the 1960's model lacking the required sensitivity and precision of measurement. Additionally, it is understood that the spare parts of the mentioned units are difficult to obtain. Consequently some of these equipments may be out of operation from time to time.

IV. URANIUM EXPLORATION

IV.1 Past Activities

Radiometric measurement was carried out as part of the regional geological mapping at the scale of 1:200 000 covering the entire territory of the Democratic People's Republic of Korea. This work was started in the late 1950's and completed around the mid 1960's. The radiometric measurements were primarily done using GM counters, but also scintillation detectors by the early 1960's. These ratemeters were calibrated by means of ^{226}Ra point source and the results of the total gamma ray activity are expressed in μR/h.

As coverage of the radiometric survey, understandibly can be quite irregular, subsequently systematic ground geological and scintillometer survey were carried out at the scale of 1:50 000 and 1:25 000 over areas considered of interest. A more detailed geological mapping and radiometric measurement over anomalous areas may follow at the scale of 1:10 000 or smaller.

Results of these activities are a number of prospects and deposits of which the most important are those associated with the Cambrian black shale. Many anomalies are still without satisfactory explanation or awaiting further follow up study.

IV.2 Present Activities

As noted in III, Maebongsan Geoprospecting Expedition has six active field teams continuing with the follow up work over old and newly discovered anomalies and prospects. The most advanced works, which include trenching and a few exploration drill holes, are generally on the Cambrian black shale type of environment. The work being carried out in Munhwari, Yontan Country, North Hwanghae Province, is a good example.

It was indicated that in the future more effort will be paid to targets other than the black shale type, in particular the Proterozoic geological environment.

Present activities are hampered by old (1960's models) field and laboratory equipments often difficult to maintain and lacking the required sensitivities. Drilling operation has to be suspended completely due to complete brake down (too old) of the drill machines.

V. IMPLEMENTATION OF PROJECT DRK/3/003

The primary objective of project DRK/3/003 is the modernization of the operating capabilities of the Maebongsan Geoprospecting Expedition (M.G.E.). The two weeks' mission by the two experts was to provide lectures on a wide range of topics related to the uranium industry, geology and exploration techniques. The experts were also to make on-the-spot evaluation on the infrastructure and operating practice of the concerned organization. Part III of this report described the human and material resources of the M.G.E.

A three day lectures were given by the two experts as detailed below:

6 May 1987

A.M.
- Uranium Resources, Production and Demand (M. Tauchid)
- Radiometric Methods in Uranium Exploration (M. Matolin)

P.M.
- Uranium Exploration: Facts and Problems (M. Tauchid)
- Gamma ray Spectrometry in Uranium Exploration (M. Matolin)

7 May 1987

A.M.
- Radon Detection Methods in Uranium Exploration (M. Matolin)
- Uranium Deposits of the World (M. Tauchid)

P.M.
- Uranium Exploration in Czechoslovakia: A Case History (M. Matolin)

8 May 1987

A.M.
- Geochemical Exploration for Uranium Deposits (M. Tauchid)
- Assessment of Radiometric Anomalies (M. Matolin)
- Discussions (M. Matolin and M. Tauchid)

Written materials on the above mentioned topics were provided to the audience which consisted of 16 geologists and geophysicists of M.G.E., five staff of the Polytechnical University, and three representatives of the Ministry of Nuclear Energy. The lectures were given in English or Russian which were translated into Korean by either Mr. Hwang Yong Hung (English-Korean) and Mr. Il Kyu Chan (Russian-Korean). There were times when translation from English to Russian and then Korean were necessary.

To appreciate the field operation of the M.G.E. a visit was made to the Munhwari camp in Yontan Country of North Hwanghae Province, some 100 km south southeast of Pyongyang. It is a black shale target which was detected during the 1:200 000 scale regional geological and radiometric (GM counter) survey of the mid 50's and early 60's.

Several formal and informal meetings were held to discuss the most realistic plan to modernize the operating capability of M.G.E.

VI. CONCLUSIONS AND RECOMMENDATIONS

VI.1 Conclusions

Uranium exploration in the Democratic People's Republic of Korea has been going on for more than 25 years. It started with a broad, somewhat irregular, regional radiometric survey as part of 1:200 000 scale geological mapping. Subsequent follow-up work discovered various types of uranium occurrences and deposits. Sizeable reserve has been found in Cambrian black shale.

Field and laboratory work is being carried out by highly experienced and competent professionals and technicians. High work discipline and dedication demonstrated by the technical staff of the M.G.E. are hampered by old equipment lacking, in most of the cases, the required precision and sensitivities. Frequent stoppage of work was due to instrument brake down and delay of repairs for difficulties of obtaining spare parts. It may be noted that in the country's 3rd. Seven Year Plan (1987-1993) considerable stress was put on the mineral industry development and the modernization of geological prospecting in the country. In the same Seven Year Plan, it was also mentioned the country's intention to develop nuclear power stations.

It may be concluded that the Maebongsan Geoprospecting Expedition has sufficient human resources to carry out meaningful uranium exploration work in the country. The points noted below hampered the adequate progress of their activities:

- Lack of information on the general world trend in uranium exploration and industry.
- Lack of familiarities with different types of uranium deposits other than the black shale.
- Lack of adequate field and laboratory equipment with the required precision and sensitivites.
- Lack of knowledge in foreign language.

VI.2 Recommendations

VI.2.1 To the Government

- The modernization of geological prospecting in the Democratic People's Republic of Korea, the Maebongsan Geoprospecting Expedition in particular, is essential for the development of the country's mineral industry. However, this modernization should be accomplished through the Government's own effort supplemented by bilateral (international) technical co-operation. It would be unrealistic to expect the realization of such a task solely through IAEA technical co-operation.

- Although the potential of the Cambrian black shale is ill recognized, the Government should be aware of the difficulties related to uranium production from this type of deposit. Experiences of other countries, Sweden in particular, in trying to solve this problem should be taken into consideration. Since, sizeable reserve of the black shale type deposit is already defined, it is strongly recommended that more efforts be placed for the search of other types of deposits which are more amenable for economic production. Based on geology alone, the possibility of finding Proterozoic unconformity related and stratiform deposits can be speculated. Similarly for hydrothermal vein and/or sedimentary deposits in areas of or adjacent to Cretaceous granitic intrusions.

- Closer co-operation between different government organizations having common interests or facilities. This should include sharing experiences obtained through scientific visits and fellowships abroad (discussion group, seminar).

- It was noted that the majority of technical staff of the M.G.E. have no ability to communicate in foreign language. Technology transfer through expert visits, training abroad and even literature research require this ability. It is recommended that M.G.E. improve this situation taking advantage facility such as found in the Grand People's Study House.

VI.2.2 To the Agency

From this brief mission it can be observed that the Government of the Democratic People's Republic of Korea has followed a long term and systematic approach in the search for uranium deposits. The high discipline and dedicated work habit of the technical staff of the Maebongsan Geoprospecting Expedition deserve praise and support. Considering the good geological potential of the country it is recommended that the Agency provide a multi year assistance to modernize and upgrade the operating capability of M.G.E. as outlined below. It should be noted that where possible most of the recommended equipment should be purchased from countries where the Democratic People's Republic of Korea has trade relations so that future need of spare parts can be easily met.

- EXPERT

1988	1. 2 m/m	in gamma ray spectrometry
1989	1. 3 m/m	in multi-channel analyzer
	2. 2 m/m	in uranium deposits
1990	1. 2 3 m/m	in borehole logging/ore reserve estimation

1989	1	Gamma-ray spectrometer	15,000
(US$ 62,000)	1	Alpha card system (2 readers)	20,000
	1	Multi-channel analyzer	15,000
	1	Spectrophotocolorimeter	10,000
		Reference material for multi-channel analyzer + publications	2,000
1990	5	Scintillometers	15,000
(US$ 50,000)	1	Borehole logger	20,000
	1	Proton magnetometer +	
	1	VLF (electro-magnetic system)	15,000
	1	Po isotope analyser (?)	
	1	Microscope photometer (?)	
		Computer, plotter, digitizer (?)	(25,000)

- TRAINING

1988	- Scientific visits	- Sweden (black shale)
1988-1989:	- Exploration method	- China
	- Uranium deposits	- China, India
	- Laboratory	- Yugoslavia

VII. ACKNOWLEDGMENTS

The experts would like to thank the Ministry of Nuclear Energy and the Maebongsan Geoprospecting Expedition for making the excellent arrangement during the entire period of the mission making the task easy to perform and enjoyable. A special thank is due to the Chief Engineer of the Maebongsan Geoprospecting Expedition, Mr. Li Yun Ok, for his co-operation and hospitality. A sincere gratitude is extended to both Mr. Hvang Yong Hung and Mr. Li Kyu Chan, who accompanied and stayed with the experts during the entire mission, for their assistance in providing translation from English and Russian as well as being friendly guides in all the visits making our stay in the Democratic People's Republic of Korea memorable.

ANNEX- I

LIST OF CONTACTED PERSONS

I 'TRY OF NUCLEAR ENERGY

- Maebongsan Geoprospecting Expedition

Mr. Li Yun Ok	-	Chief Engineer
Mr. Li Kyu Chan	-	Head of Laboratory
Mr. Zu I Sok	-	Geophysicist
Mr. Li Wan Sun	-	Geophysicist
Mr. Yun Hae Do	-	Electronic Engineer

- Institute of Nuclear Physics, Nyonbyon

Mr. Hwang Yong Hung	-	Research Worker

UNITED NATIONS DEVELOPMENT PROGRAMME

Mr. Evan V. Melder	-	Deputy Resident Representative