URANIUM AND ENVIRONMENT IN KAZAKSTAN

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Abstract

Kazakstan's data on uranium as a state report has been included for the first time in the Red Book. Therefore the report contains two large themes presented in Suggested Topics for Papers: Country report, based on the 1995 NEA/IAEA Red Book Questionnaire and environmental impact regulations. Kazakstan is considered as one of the world leaders on uranium supply. In Kazakstan there are many well known types of deposits but the main one is the sandstone-rollfront type. That type is represented by the group of deposits of the Syr-Darya uranium ore province. Deposits of that type include the main part of uranium ore of the Republic of Kazakstan and supply almost all of its uranium mining. At the large three enterprises the uranium is extracted by underground leaching. The mining method of uranium extraction is stopped. Because of the poor development of nuclear energy, Kazakstan's need for uranium is not very high. Presence of a large amount of cheap and technological uranium ores allow the Republic to export uranium. There are plans to increase uranium mining and perhaps to establish new mining facilities including joint-ventures. More than 50 uranium deposits are known in Kazakstan. During prospecting and exploitation of these deposits a large amount of rad wastes in the form of ore dumps and tailings were generated. They have a sensible influence on the environment. Moreover, near the sandstone-rollfront type uranium deposits the large amount of underground water has been contaminated by radionuclides. Special investigation of the this phenomenon is necessary. In Kazakstan there are the rad waste disposal conception and contaminated earth recultivation regulations. At present "The Rad Wastes Management Low" is submitted for approval.

1. HISTORY OF URANIUM INDUSTRY IN KazakSTAN

Uranium prospections in Kazakstan were started in 1948 and have been proceeding up to now. The history of prospections and exploration work of uranium carried out can be divided in two stages, combine first with the development of prospection methods and second, with features of the geological structure of Kazakstan surface, because of the fact that the significant part of Kazakstan territory is submitted by friable Mesozoic-Cenozoic sediments overlapping Paleozoic complexes of rocks and performing depression structure (Fig. 1).

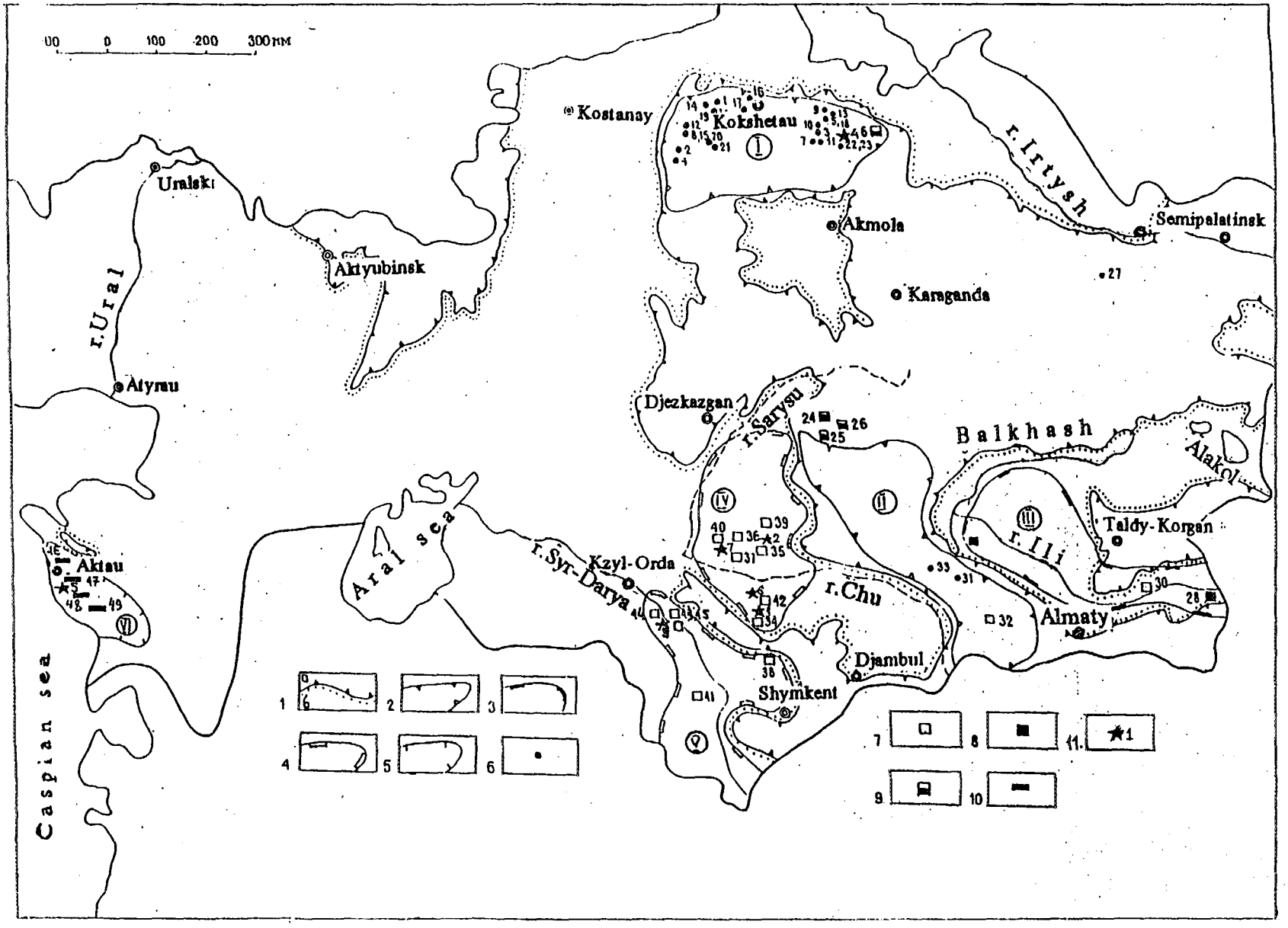
During the first stage (1948–1957) prospections were conducted basically with application of air- and pedestrian gamma surveys in the areas not closed by friable sediments.

During the second stage the prevailing method has become deep geological mapping with application of geophysical methods and drilling works in areas as well opened as basically covered by young friable sediments

Already during the first stage in 1951, the "Kurday" deposit was discovered for exploitation in the south of Kazakstan, and two more deposits were discovered soon at the same place. Kirgizsky Production Centre was then established, which at the present time is owned by the Republic of Kyrgyzstan.

The uranium deposits revealed in the south of Kazakstan form the Pribalkhash uranium province, where the general reasonably assured resources exploited amount to 22 000 t.

In 1953, in northern Kazakstan the deposits Kubasasdyrskoe and Balkashinskoe were opened which marked the beginning of discovering the Kokshetau uranium province and basis for creation of Tselinny Production Centre founded in 1957. Generally reasonably assured resources of the province are about 100 000 t and concentrated basically on large deposits: "Vostok", "Grachovskoe", "Kosachinoe", the ores of which are located in Paleozoic and more ancient rocks.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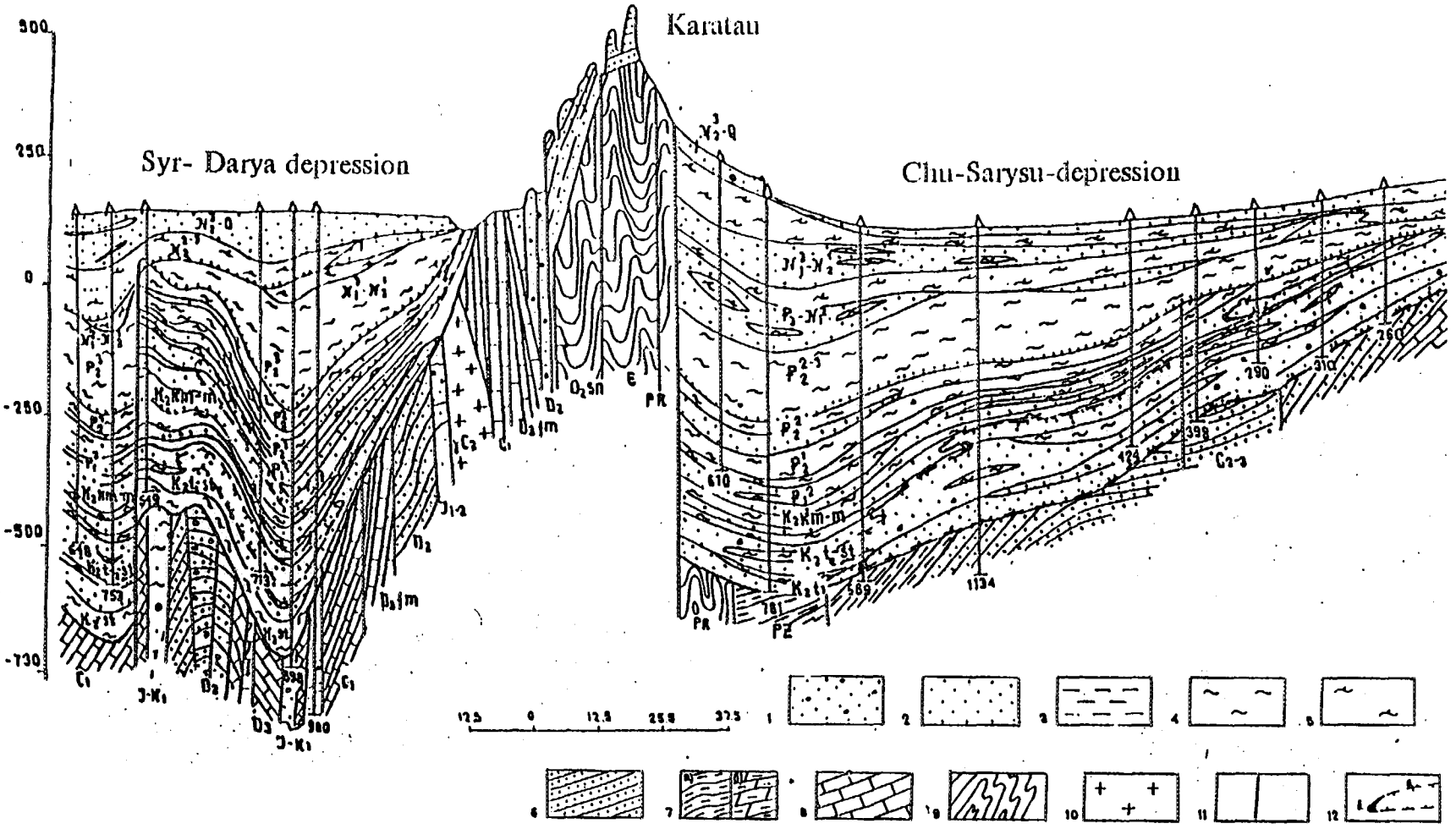
Djezkazgan
r.Sarysu
Balkhash
Alakol
Taldy-Korgan
Aral sea
r.Syr-Darya
Kzyl-Orda
r.Chu
r.Ili
Almaty
Djambul
Shymkent
Aktau
Caspian sea

1. Borders of Premesozoic (a) and Mesozoic-Cenozoic (b) sediments
2. U ore provinces with endogenic deposits in Premesozoic sediments (I- Kokshetauskaya, II- Pribalkhashskaya)
3–5. U ore provinces with exogenic deposits in Mesozoic-Cenozoic sedimentary formations:
   3- with soil oxidation of coal beds (III- Iliyskaya)
   4- with stratal oxidation in penetration sediments (IV- Chu-Sarysuyskaya, V- *Syrdaryinskaya)*
   5- with phosphatic fossil fish bone detritus (VI- Prikaspiyskaya)
6–10. U deposits:
   6- endogenic of different ore formations
   7- infiltrations with stratal oxidation
   8- infiltration with soil oxidation
   9- infiltration with stratal-soil oxidation in sediments of paelovalley
   10- with phosphatic fossil fish bone detritus.
11 Production Centres

Numbers of deposits on scheme:

1- Grachyovskoe
2- Shokhpak
3- Zaozyornoe
4- Kamyshevoe
5- Shatskoe
6- Semizbay
7- Tastykol
8- Akkan-Burluk
9- Glubinnoe
10- Koksorskoe
11- Vostochno-Tastykolskoe
12- Victorovskoe
13- Agashskoe
14- Fevralskoe
15- Burlukskoe
16- Slavyanskoe
17- Chaglinskoe
18- Shatskoe-I
19- Kosachinoe
20- Vostok
21- Zvyozdnoe
22- Manybayskoe
23- Yuzhno-Manybayskoe
24- Shorly
25- Talas
26- Granitnoe
27- Ulken-Akzhal
28- Koldjat
29- Nizhne-Iliyskayay
30- Suluchokinskoe
31- Djusandalinskoe
32- Kopalysayskoe
33- Kyzyltas
34- Kandjugan
35- Uvanas
36- Mynkuduk
37- Sholak-Espe
38- Kyzylkol
39- Zhalpak
40- Inkay
41- Zarechnoe
42- Moyinkum
43- Severny Karamurun
44- Irkol
45- Yuzhny Karamurun
46- Melovoe
47- Tomak
48- Taybogar
49- Tasmurun

FIG. 1. Uranium gradation metallogenic scheme of Kazakhstan.



1-5 penetrated mesozoic-cenozoic sediments; 6-10 unpenetrated premesozoic sediments; 11-fractures; 12-borders of stratum oxidation and concerning uranium ore

FIG. 2. Geological section of Mesozoic-Cenozoic sediments of Syr-Darya and Chu-Sarysu depressions.

In 1954, the large "Melovoe" deposit was discovered in west Kazakstan, on the Magyshlak peninsula. Its uranium mineralization is concentrated in phosphatic fossil fish bone detritus. This unique type ore (so-called organogeneous phosphatic) is industrial despite low contents of uranium in ore since uranium containing bones can be easily enriched during the washing process. In 1959, the Pricaspian Production Centre was created on the basis of the "Melovoe" deposit, which together with three more deposits forms the Pricaspian uranium province. The general reasonably assured resources of the Pricaspian province amount to about 65 000 t.

Prospection works of the second stage, concentrated basically on the study of depressed structures, resulted in the discovery of a series of large and unique deposits in young friable sediments and in the radical reorganization of the structure of resources for the uranium industry of Kazakstan. These works in the south of Kazakstan revealed three uranium provinces, of which two: Chu-Sarysu and Syr-Darya, are the largest in the world for creation of uranium extraction enterprises by methods of underground leaching. A third province — Ili is characterized by ore of soil oxidation (so-called uranium-coal). However, in spite of high enough contents (up to tenths of percent) and significant reasonably assured resources (about 93 000 t), the industry has not been developed yet due to economic reasons.

In 1970–1971, extraction was successfully carried out, using underground leaching method, in the "Uvanas" deposits, Chu-Sarysu province. This marked the beginning of priority development of the deposits in the Chu-Sarysu and Syr-Darya provinces. At present, within the limits of these provinces, more than 10 large and unique deposits are discovered, the ore of which is connected with regional zones stratum oxidation, developing in north-western direction from Tyan-Shan deep into the artesian basins of Syr-Darya and Chu-Sarysu depressions. The zones of stratum oxidation are developed in several good penetrated sand water-bearing horizons, forming system penetration deep into artesian basins of oxygen water tongues (Fig. 2). Front ending of stratum oxidation zones of these tongues forms a regional geochemical barrier on which uranium ore of sand type of rollfront is formed. In this province there are 6–9 productive horizons located which contain ores with unique technological terms that allow to extract uranium very profitably by method of in situ leaching. The general reasonably assured resources of both provinces amount to 320 000 t which has allowed to create on their bases the uranium extraction enterprises by in situ leaching method.

2. THE CURRENT SITUATION

The discovery of highly profitable and technological deposits in the provinces of Chu-Sarysu and Syr-Darya has resulted in decreasing of mining uranium extraction in Kazakstan and increase (to 80%) extraction share by method of in situ leaching.

At present, in addition to three operating in situ leach enterprises, two more are created, and the creation of 2–3 enterprises are planned, so that in the near future all uranium will be extracted in Kazakstan by in situ leaching method. At all inconsistent evaluations of influence of the in situ leaching method on the environment doubtless one, that this method is the most economic and technological one and produces the least amount of radioactive wastes. The problem of restoration of water horizons after in situ leaching quite soluble, including with help of oxygen method of oxidation of working solutions without application of sulfuric acid.

Thus, at present Kazakstan has a well prepared basis for development of uranium extraction by in situ leaching method, which amounts to 320 000 t at total sum of prepared sticks 600 000 t.

It is not planned to carry out further prospection work for discovering new deposits or provinces. The current work is directed to revealing the stocks within the limits of known ore fields and to transfer additional and estimated stocks in the category of reasonably assured resources.

Revealed and prepared stocks suitable for extraction by in situ leaching method create favourable conditions for uranium extraction carried out by in situ leaching method. In this connection there is the task of conversion of two existing production centres.

3. THE SUPPLY AND DEMAND

At the present low level of development of atomic engineering in Kazakstan (presented by on power generating installation BN-350 on the Mangyshlak peninsula), there is practically no uranium demand in the Republic. All uranium concentrate goes to the world market. Unfortunately, the conditions of expert are at present adverse. Upon improvement of these conditions, Kazkahstan can increase, in short time, uranium extraction up to 5-7 thousand tonnes per year.

4. IMPACT OF THE URANIUM INDUSTRY ON THE ENVIRONMENT

With respect to the problem of the impact of the uranium industry on the environment in Kazakstan there are 3 aspects to take into account:

- availability of deposits of uranium ore,
- long functioning of uranium mines and processing operations,
- cessation of works of extraction and processing enterprises of uranium ore.

The impact of deposits of uranium ores on the environment is bets displayed at formation of ore on ending of stratum oxidation zones (sandstone rollfront type) where practically on all front endings on the band of width of 10-15 km marks natural pollution of water horizons by radionuclides. The extent of the front reaches 100-150 km and the polluted area of water horizons is 2000-5000 km^2. The water from such areas cannot be used. On the other hand availability of sand deposits permits to refuse mining of uranium extraction which forms huge quantities of radioactive wastes.

The production of uranium by mining method in Kazakstan carried out for over 40 years has resulted in an accumulation on the surface of more than 200 Mln.t of radioactive processing wastes which represent low radioactive wastes containing alpha beaming nuclides. These wastes are a threat to the environment in the form of soil and water horizon contaminations by radionuclides as well as in the air in connection with dusting of dry beach of tails of processing.

The specific care for Kazkahstan is presented radioactive wastes formed by enterprises which ceased their operation because these wastes have lost the "owner" and their disposal requires large budgetary appropriations.

5. FURTHER RESEARCH

As mentioned already, the discovery of new uranium deposits and provinces is not planned as the Republic has a large reserve of revealed stocks and stocks which can be revealed within the limits of known ore fields. Thus a large part of resources related to the category of highly profitable and technological ores suitable for extraction by in situ leaching method.

It is necessary to note that this way the sulfuric acid process odes not produce much RadWaste (as with the mining method) proceeds the pollution by radionuclides of water horizon from which uranium is extracted, that requires the special costs of restoration of the horizon. Probably the

decrease of the cost is served application of regime of oxygen oxidation without application of sulfuric acid.

The other important direction of research is the reduction of the impact of mining and processing production wastes on the environment.