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The Inkai ISL Uranium Project in Kazakstan

Glenn Catchpole

The Inkai ISL Uranium Project, located in the Republic of Kazakstan, is a joint venture between Uranerz, Cameco and the local partner KATEP, each party having one-third ownership. The sandstone orebodies to be developed are named the Inkai and Mynkuduk ore fields; thus the name Inkai project. Uranerz has been designated the operator for the Inkai joint venture.

Substantial exploration was completed in the project area while it was part of the former Soviet Union, putting some 270 million pounds U_3O_8 (104 000 tU) in the proven and probable (C1 or better) categories. Results of a preliminary feasibility study by a technical team from Uranerz and Cameco, with assistance from KATEP, indicated favourable economics for the project.

Assuming positive results from a comprehensive feasibility study and environmental assessment currently under way, Uranerz will construct and operate a commercial in-situ leach (ISL) uranium mine at the Inkai project site with an initial annual production rate of 1 million pounds U_3O_8 (385 tU), increasing to about 2.6 million pounds U_3O_8 (1000 tU). The project has the capability of expanding production significantly above 2.6 million pounds per year, subject to market conditions.

The Republic of Kazakstan, the ninth largest country by area in the world, with a population of 17 million people, is about four times larger than the state of Texas. Kazak is the official language but the commercial language, and the language on the street, is Russian. The country is a stable democracy with an elected president and parliament.

The government is presently in the process of moving the capital from Almaty in the southeast corner of the country (population 1.2 million) to Akmola in the north central portion of the country (population 300 000). The actual move is scheduled to take place by the end of 1997. It is generally felt that despite the moving of the capital, Almaty will remain the commercial centre for the country. Uranerz has maintained a project office in Almaty since 1995.

Project Location and Infrastructure

The Inkai project, encompassing some 1310 km^2 of land surface, is located on the Central Asian Steppe in the Chu-Saryssu basin of south central Kazakstan, as depicted in Figures 1 and 2. The project site, at latitude 45 degrees north and 200 m above sea level, is very remote, being some 120 km by unimproved dirt road from the nearest village and 370 km by road from the regional capital, Chimkent.

The topography is relatively flat, being similar in appearance to the Red Desert area of southwest Wyoming, USA. In this semi-arid region the vegetation is sparse and there are almost no trees. The land is used for the grazing of sheep, goats, camels, cattle and horses. The continental climate in the region provides for hot summers with temperatures up to 40^{o}C, and cold winters with temperatures down to -30^{o}C.

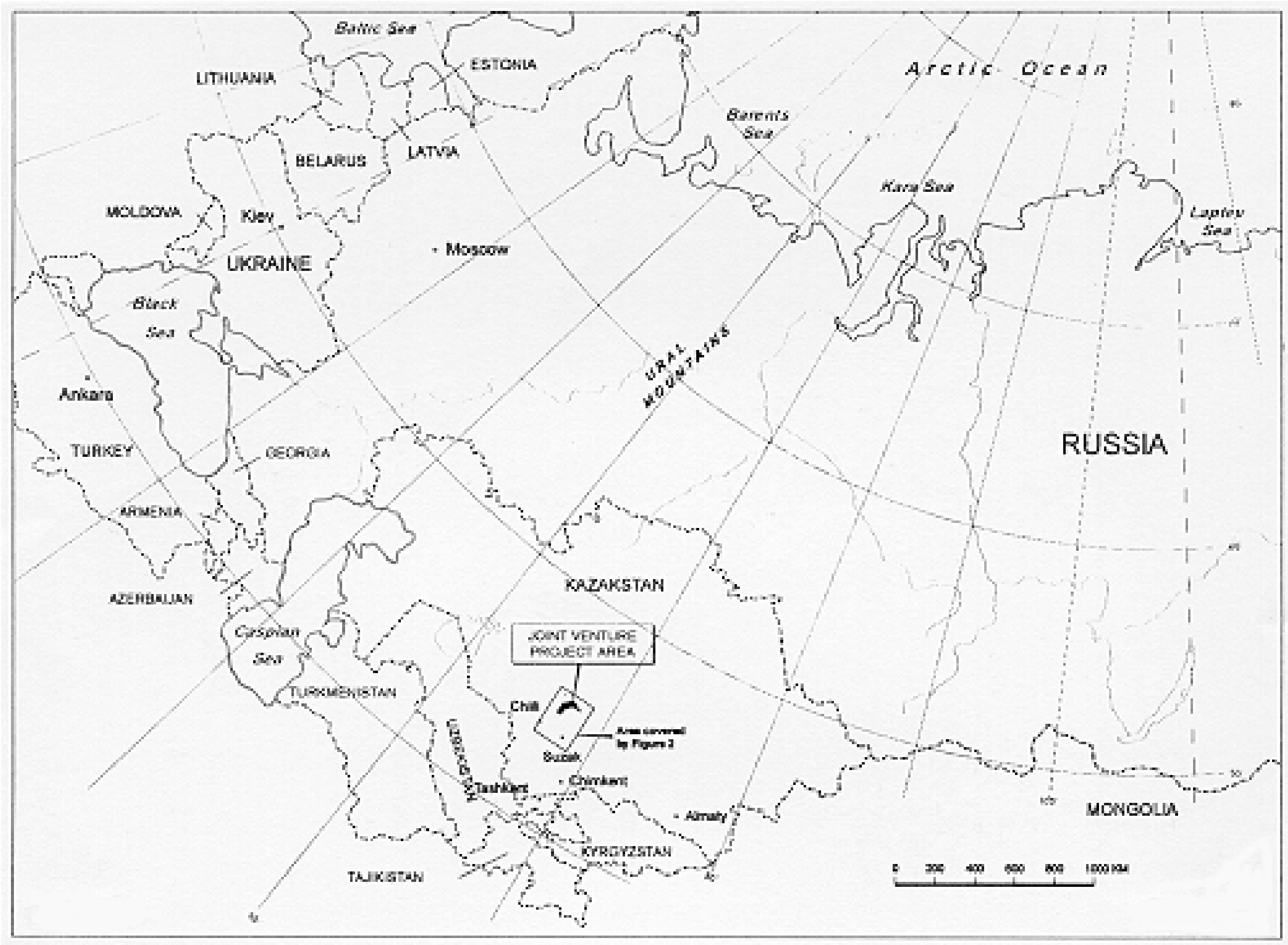

Figure 1. Location map of Kazakstan and Central Asia.

At the project site there is a small exploration camp named Taikonur, which served as the living community and offices for the substantial uranium exploration that took place in this area in the 1970s and 1980s. KATEP still maintains a work force at Taikonur to continue with certain exploration and test mining activities. Approximately 100 workers plus their families currently live at Taikonur.

Communication with the outside world is by two-way radio. Electricity is provided by a power line that comes from one of the operating uranium ISL mines in the region, of which there are three: Stepnoye, Centralia and Chiili. These three mines are owned and operated by the government through an agency called Kazatomprom, of which KATEP is a part.

It is planned that most of the local workers and families for the Inkai project will live at Taikonur. Major infrastructure improvements will include upgrading the roads and modernising the communication system. The joint venture will also assist with improving community services such as schools, streets, heating and health care.

Joint Venture History and Structure

In the middle of 1992 Uranerz and Cameco sent a technical team to Central Asia to determine if there might be opportunities to develop mining projects in the newly independent republics in the region. Potential projects were identified in the countries of Kazakstan, Kyrgyzstan and Uzbekistan. Cameco's Kumtor gold mine in Kyrgyzstan is an example of one of the developments that resulted from this initial trip.

Sandstone uranium deposits in south central Kazakstan amenable to ISL mining also caught the attention of the technical team. Follow-up trips to Kazakstan by Uranerz and Cameco technical staffs in 1994 and 1995 resulted in the identification and selection of the Inkai and Mynkuduk ore fields for possible development. The internal pre-feasibility study conducted on these ore fields in 1995 convinced Uranerz and Cameco to pursue plans for possible commercial development.

The next step towards commercial development of the project was to form a legal joint venture between Uranerz, Cameco and the local partner, KATEP. In 1996 the joint venture was officially

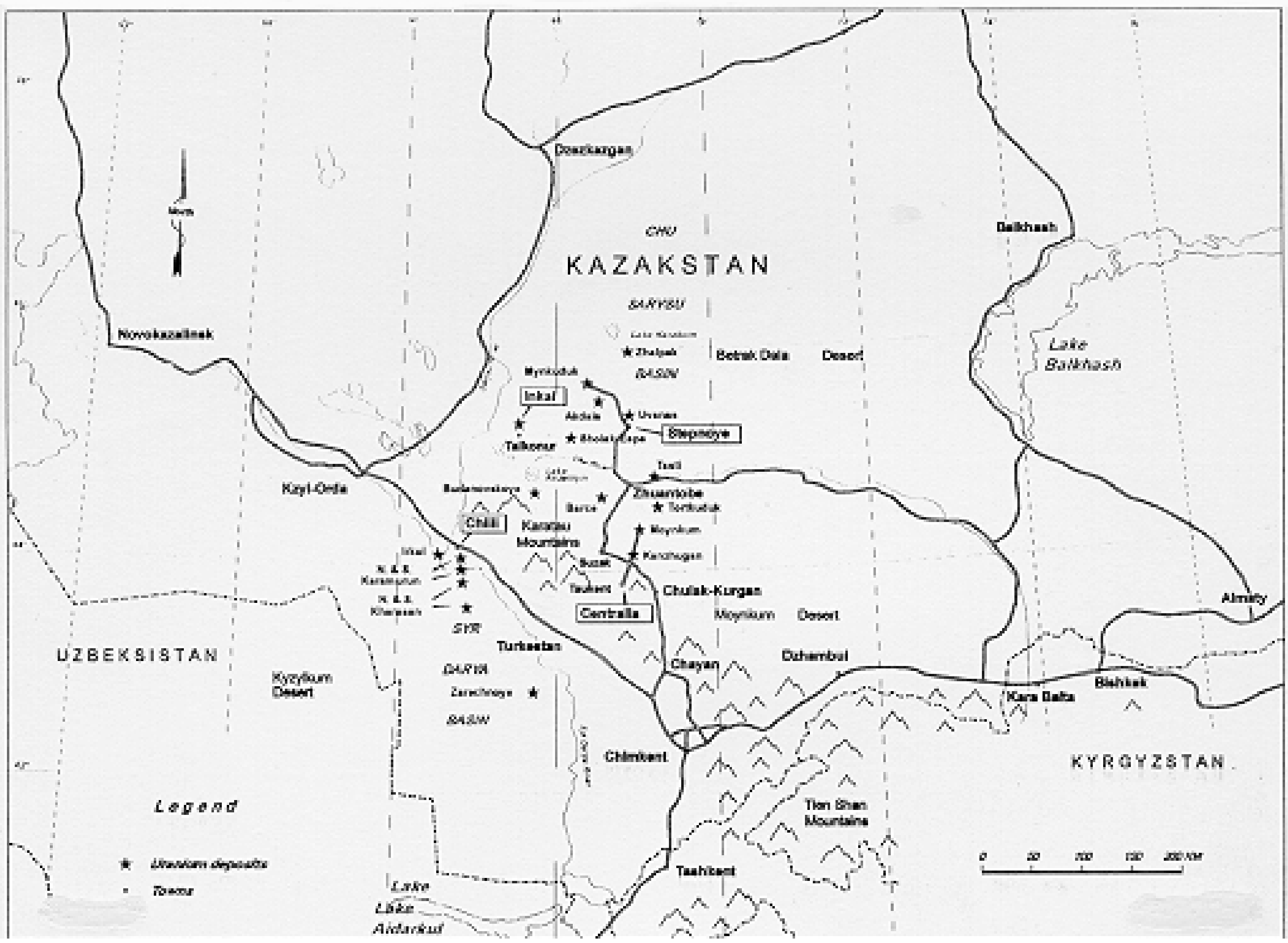

Figure 2. Sandstone hosted uranium deposits in south Kazakstan.

registered with the government of Kazakstan. Briefly, the joint venture agreement specifies that the three participants will each have a one-third interest in the project and that the joint venture will be formed to explore for and mine uranium in Kazakstan, and to export it. Financing of the project will be in the form of a loan to the joint venture from the Western participants which will be repaid from the profits of the operation. Uranerz, as the operator, is responsible for getting the necessary government approvals for the project, and for establishing and implementing the development plan.

Geology and Hydrogeology

The Cretaceous–Cenozoic Chu-Saryssu artesian basin is up to 250 km wide and extends for more than 1000 km from the foothills of the Tien Shan Mountains to the south and southeast, merging into the flats of the Aral Sea depression to the northwest. The basin is underlain by various Palaeozoic and older rocks. These older rocks also flank the basin, outcropping most prominently at its southwest margin where the quaternary uplift of the Karatau Mountains separates the Chu-Saryssu Basin from the parallel Syr Darya Basin (see Figure 2).

The general structure of the Chu-Saryssu Basin is that of an asymmetric syncline with a broad, gently sloping, northeastern limb which plunges to over 700 m in depth, and a short upfaulted limb marking the rise of the Karatau Mountains (an active NW–SE horst structure). The axis of the basin closely parallels its southwestern margin.

The source of the sediments, and also the uranium, is the Tien Shan Mountains which abut the basins to the south and southeast. This segment of the Tien Shan includes a large number of Ordovician and Silurian granites and granodiorites, as well as crystalline schists and slates. Additional minor sources of sedimentation are the Karatau Mountains and the Palaeozoic uplands to the north.

The groundwater movement in the Chu-Saryssu Basin is directed towards the northwesterly discharge areas. The annual natural flow rate averages 1 to 4 m depending on the various permeabilities of the different sand horizons. The unconsolidated Upper Cretaceous sediments provide an excellent groundwater storage reservoir,

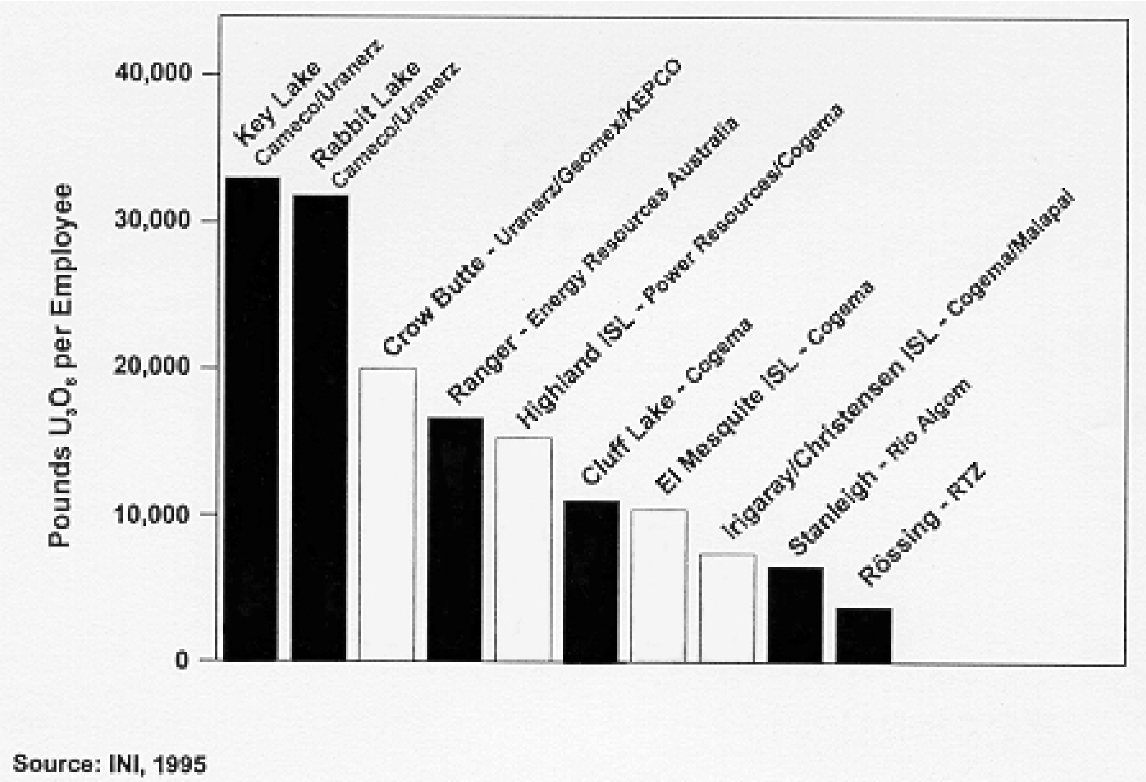

Figure 3. Uranium mine productivity levels, top ten mines for 1995.

some 250 to 300 m thick. This reservoir is regionally confined by the underlying Palaeozoic rocks and the overlying thick Paleogene marine clays. To varying degrees there is local confinement created by the sedimentation cycles, with each cycle including fine sands to silts and occasional clay seams at the top.

The various sands have high horizontal permeabilities, with the coarse sands having filtration coefficients often in the range of 20 to 30 m / day (equivalent to 23 to 35 Darcies) at Inkai, and of the order of 10 m / day (equivalent to about 12 Darcies) at Mynkuduk. The confined Upper Cretaceous aquifers produce artesian conditions where the topography is depressed below the piezometric surface of about 135 to 140 m above sea level. The general water table is at a depth of 8 to 10 m at Inkai and 80 m at Mynkuduk.

The uranium mineralisation at Inkai and Mynkuduk ore fields is found in a sandstone roll front setting in the Upper Cretaceous sediments mentioned above. The sands are generally feldspathic, typically containing 50% to 60% quartz and 10% to 15% feldspar. Clay content is in the range of 5% to 10% at Inkai and 10% to 20% at Mynkuduk. The two ore fields have developed along a regional system of superimposed mineralised fronts.

The strike length of the Inkai ore field is 60 km and the Mynkuduk ore field has a 90 km strike length. The main uranium minerals are sooty pitchblende and coffinite. Sooty pitchblende occurs as micron-sized globules and spherical aggregates, while coffinite forms tiny crystals. No other elevated trace elements, as potential deleterious material, have been detected. The uranium mineralisation is reported to be essentially clean and mono-metallic.

Reserves

Geologic (global) reserves in the Inkai ore field total 330 000 tU (860 million pounds U_3O_8). Proven and probable reserves (category C1 and better) total 55 016 tU (143 million pounds U_3O_8) at an average grade of 0.06% U, an average grade thickness (GT) of 0.41 metre percent U and an average thickness of 6.76 m. Depth to mineralisation is in the range of 290 to 520 m.

Geologic (global) reserves in the Mynkuduk ore field total 67 000 tU (174 million pounds U_3O_8). Proven and probable reserves (category C1 and better) total 49 000 tU (127 million pounds U_3O_8) at an average grade of 0.035% U, an average GT of 0.25 metre percent U and an average thickness of 7 m. Depth to mineralisation is in the range of 200 to 390 m. In total for the two ore fields, the C1 and better reserves total some 104 000 tU (270 million pounds U_3O_8).

Development Plan

The Inkai joint venture is in the final stages of obtaining its two major government approvals, these being the Subsoil Use Permit (or mining licence) and the Contract with the Government. Once these two documents are finalised Uranerz will commission a full feasibility study and environmental assessment of the planned commercial development.

The joint venture will also fund the construction and operation of a small test mine designed to produce about 118 000 pounds of U_3O_8 (45 tU) per year. It is planned that the initial results from this test mine will be incorporated into the feasibility study. Construction of the test mine is underway and start-up is scheduled for late 1997. The 60 m^3 per hour feed to the test plant will come from six production wells. Downflow ion exchange columns, manufactured in Kazakstan, will be used to extract the uranium from the feed solution. The pregnant solution from the ion exchange circuit will be trucked off-site to one of the nearby ISL uranium mines for further processing. The leach solution will consist of native groundwater fortified with sulphuric acid.

In 1989 KATEP performed a small pilot test on the Inkai ore field. The results of that 30 m^3 per hour operation were very positive and the data from that test will also be used in the feasibility study.

Subject to favourable results from the feasibility study and environmental assessment, the Inkai joint venture will commence commercial development activities. The general plan is to construct an ISL mining facility consisting of a main processing plant supported by enough satellite plants to maintain the desired level of yellowcake production.

The initial design production rate of the main processing plant will be 1 million pounds U_3O_8 (385 tU) per year. Approximately three years later the production rate will be increased to 2.6 million pounds U_3O_8 (1000 tU) per year through the addition of a satellite plant. Further expansion of the production rate will take place depending on market conditions. Commercial production is expected to start in 1999 or 2000.

It is planned that the Inkai joint venture will use a sulphuric acid based leach solution for the commercial operation, which is the same type of leach solution used at the other three operating ISL mines in Kazakstan. This technology has been in use in Central Asia for over 25 years. The uranium will be extracted from the well field solution using an ion exchange circuit. The pregnant eluant from the ion exchange circuit will go through precipitation, washing and drying, with the final product being dried yellowcake ready for shipment to a Western converter.

While the basic ISL technology has already been developed in Kazakstan, as the project operator Uranerz will strive to make the operation as efficient as possible. Use will be made of experience gained at Uranerz' Crow Butte ISL uranium mine in Nebraska, USA, which is the third most efficient uranium mine in the world (see Figure 3), exceeded only by Uranerz' and Cameco's two high grade uranium mines in northern Canada.

Instrumentation and process controls imported from the West will be used in the Inkai project, and the organisational structure and workforce level will be patterned after ISL mines in the USA. By design, Uranerz and Cameco have acquired a uranium project in Central Asia that is not burdened by an existing combinat (company town) with an associated large infrastructure and population to support. The operation will conform to all Kazakstani health, safety, radiation protection and environmental regulations.

Conclusion

Uranerz and Cameco, in cooperation with their local partner KATEP, have formed a joint venture to explore, extract and export uranium from an ISL mining project located in south-central Kazakstan. The project, called the Inkai project, contains large uranium reserves amenable to the low-cost ISL mining method. The reserve base in the proven and probable category (C1 or better) is reported at some 270 million pounds U_3O_8 (104 000 tU).

Following the completion of a full feasibility study and environmental assessment scheduled for 1997 or 1998, the joint venture plans to construct a commercial mining facility capable of an initial annual uranium production rate of 1 million pounds U_3O_8 (385 tU) starting in 1999 or 2000, followed within three years by an increase in annual production rate to 2.6 million pounds U_3O_8 (1000 tU).

The ISL mining technology developed by KATEP over the past 25 years will be heavily utilised at the commercial facility, augmented by Western technology in the form of instrumentation, process controls and organisational structure. Further expansion beyond 2.6 million pounds U_3O_8 per year will be readily obtainable if market conditions warrant.