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Geology of the California Creek Uranium Prospect
Elko County, Nevada

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California Creek Uranium Prospect
Executive Summary

The California Creek Uranium Prospect is located in northern Elko County, Nevada. It is an unconformity-type uranium occurrence that occurs in basal, Tertiary Age sediments lying immediately above a granitic erosional surface. The lateral extent of this sedimentary basin is significant. The shallow parts of the unconformity (less than 500 foot depth) may cover as much as several square miles. Uranium deposits near Mountain City, Nevada were discovered about 1954. They have produced about 4,700 tons of uranium ore.

Two phases of previous work are documented. The first phase, done around 1960, resulted in the excavation of at least two open pits and production of perhaps 2500 tons of uranium ore. The grade of this ore is uncertain. This mineralization, hosted by coarse fluvial sediments, was up to 80 feet in thickness. Grades of up to 2.0% U3O8 were reported in some thin zones. The second phase of exploration consists of an unknown amount of work in the early 1980's.

Two types of rock may host economic uranium mineralization. The first target consists of lenticular stream channels or braided stream channels which contain coarse arkosic sediments and carbonized wood fragments. The second target consists of tabular, gently-dipping, tuffaceous volcanics and sediments that are reported to be clay-rich. Uranium in solution may be deposited where it encounters a reducing environment, clay minerals, or organic trash in the sediments.

The next phase of work should include expanding the claim block, acquisition and compilation of existing data, appropriate geophysics, and a rational exploration drilling program.

Currently, worldwide uranium consumption is about 200 million pounds annually. Production is about 100 million pounds annually. This supply deficit, coupled with planned construction of 30+ nuclear power plants worldwide over the next 15 years, bodes well for spot uranium prices over at least the next 5-10 years. Mining at California Creek may have ceased simply because of a downturn in uranium prices. Pathfinder Resources began work on the property in 1981, coincident with the last decline in uranium prices.

Introduction

The California Creek Uranium Prospect lies in sections 34 and 35, T46N, R54E, Elko County, Nevada. Eighteen unpatented lode claims were located over the most favorable geologic areas and two open pits on December 20th and 21st, 2004. The prospect lies about 6 miles east of Mountain City, Nevada (Figure 1) at elevations between 6,000 and 6,500 feet above sea level. Access is good via gravel and dirt roads. A network of unimproved roads provides adequate access to most of the claim group.

Uranium mineralization lies within Tertiary Age arkosic sediments and bentonitic tuffs that overlie quartz monzonite at an unconformity. Mineralized rocks are reportedly localized in fluvial channels and depressions at the unconformity. Uranium mineralization is reported to be up to 80 feet in thickness, locally containing grades of over 2% U3O8.

The prospect lies within a broad valley where the unconformity and overlying host rocks may exist at a relatively shallow depth over perhaps as much as two square miles. This topography may be favorable for open pit mining should sufficient mineralization be delineated. The open pit potential is important since very low grades of uranium then become economic even if in-situ leach (ISL) technology is not feasible.

2003-2004 were pivotal years for the uranium industry as prices nearly doubled. At the current price of $21.00/lb., U3O8 grades averaging as little as 0.10% may become attractive. An uranium grade of 0.25% would presently be roughly equivalent in value to 0.25 opt gold. The impending shortage of uranium bodes well for uranium prices (Figure 4) and provides incentive to further explore this prospect.

Land Status

Most of the area of interest is federal land controlled by the Bureau of Land Management (Figure 2). Therefore, the acquisition cost for mineral rights in most of the favorable area is about $10.00 U.S./acre. Annual holding costs to maintain said mineral rights is $5.00 U.S./acre with no underlying royalty due the federal government. It doesn't get much easier or cheaper than this to acquire a valuable uranium prospect during a period of rapidly escalating prices. The initial 18 claims are not sufficient to cover the entire prospective area. More claims should be staked as soon as it becomes practical.

Previous Work

The California Creek occurrence is a relatively recent find. In fact, Lovering (1954) reported no uranium mineralization in Elko County, Nevada. However, he did emphasize that only a relatively small part of Nevada had been adequately explored for uranium at that time. Although recent previous work on the California Creek property is poorly documented, it seems that there were two rounds of exploratory work on the property. Total production from the Mountain City area is recorded to be about 4,700 tons of uranium ore (Birkholz, 1978).

The first phase of work began in the late 1950's, culminating in several thousand feet of rotary drilling and development of at least two small open pits. Less than 2,000 tons of uranium ore were reportedly extracted from the Pixley Pit by Valley Engineering (Garside, 1973). A second nearby pit had a recorded production of less than 500 tons of uranium ore by Bogdanich Development Company (Garside, 1973). The average grade of this "ore" is uncertain.

The second phase of work appears to have been completed during the early 1980's when Pathfinder Resources located over 100 claims in the area. The amount of drilling done by Pathfinder Resources is uncertain, but few drill sites were noted during the December 2004 claim staking except very near the Pixley open pit. Therefore, at least initially, it appears that the property may have had only a cursory amount of drilling thus far. Reports from the Pathfinder Resources program, if available, may be helpful in planning further work at California Creek.

Geology and Mineralization

These uranium prospects occur in a laterally extensive, Tertiary Age basin. The host rock consists of both carbonaceous, bentonitic tuffs and coarse, fluvial sediments at an unconformity (Garside, 1973). Some of the tuff breccias have a montmorillonite matrix (Birkholz, 1978). Significant amounts of pyrite may also exist since the rocks in the pit are moderately iron-stained. A chemically reduced environment is favorable for deposition of epigenetic uranium mineralization.

The sediments that lie immediately above the unconformity are the most prospective for economic uranium mineralization. Geological mapping by Coats et al (1984) indicates that much of this prospective sediment package lies at depths of 500 feet or less (Figure 3). This favorable horizon is shaded and labeled Tbs in the cross-section shown on figure 3.

Previous work by Garside (1979) is probably the best description of this mineralization available from the public domain. The Pixley Pit is reported to contain autunite with minor uraninite, carnotite, zorbernite, and renardite. It occurs in fractures and pyritiferous, carbonized wood at the base of a sequence of andesitic-dacitic tuffs. The deposit is localized in channels and depressions cut in the Cretaceous Age quartz monzonite.

The fluvial rocks which fill these depressions are arkosic, conglomeratic granite wash and clay-rich tuffs. Mineralized rock is bleached and hematite-stained, reaching a maximum thickness of 80 feet (Garside, 1979). Grades of U3O8 exceed 2% locally. Vanadium, zinc, copper, molybdenum, nickel, and cobalt are highly anomalous. Epigenetic uranium deposits occurring in sandstones commonly contain elevated levels of the aforementioned elements because of their geochemical similarity to uranium (Finch, 1967).

Possible source rocks include the Cretaceous Age quartz monzonite and Tertiary Age volcanic rocks. Uranium-bearing solutions may have migrated along the porous unconformity and deposited uranium on clay minerals, organic debris, or reduced fluvial sediments.

Discussion

The uranium mineralization found at California Creek is similar to that of many other sediment-hosted uranium deposits. The sediments are commonly of continental origin and were deposited into poorly-drained basins. The basins may be shallow depressions in foreland belts, intermontane basins, or coastal planes. Drainage is poor in many of these environments. As a result, the connate waters remain in place for a long period of time during which they are capable of becoming saturated with respect to uranium content.

Most uranium in igneous rocks oxidizes readily, releasing water-soluble uranium in the high-valent (+6) state, easily soluble in common ground water (Finch, 1967). When these connate waters are disturbed and mobilized, the uranium may then be deposited on any clay minerals, organic matter, or chemically reduced sediments that they encounter.

In composition, the sedimentary host rocks of most epigenetic uranium deposits are usually immature, quartzose to arkosic sediments, and are often interbedded with tuffaceous, clay-rich material. Fossil plant remains are common (Finch, 1967).

Uranium deposits at California Creek may exist in two different configurations. The first of these would be lenticular and cigar-shaped, mimicking the stream channels that contain the coarse fluvial sediments. The second of these may be tabular shaped, gently-dipping tuffaceous beds. Given the shallow depth of the unconformity and 80 foot thickness of documented mineralization, there is a good chance that a pittable resource may exist at California Creek.

The recently discovered Honeymoon Project in southern Australia may be a close analogy to the California Creek Prospect. The Honeymoon Project mineralization is hosted by Tertiary Age, coarse fluvial sands of a braided river system that exists at depths of 300-400 feet below surface. As of January 2005, the Honeymoon project boasts a resource of 2.8 million tons averaging 0.12% U_3O_8, containing roughly 6.6 million pounds of uranium (Skidmore, 2005). An ISL process is proposed for the project, providing cost-effective uranium recovery.

Drilling for uranium is unlike most mineral exploration drilling. It is more akin to oil and gas exploration. Holes are rapidly and cost-effectively drilled with conventional rotary rigs. Lithologic samples are taken at appropriate intervals. The samples are not assayed. When the hole is completed, a geophysical probe is inserted into the hole to produce a geophysical log which is used to indirectly determine uranium content. The cost for drilling and the geophysical logging may be less than U.S. $10/foot. Therefore, a 500 foot hole, which can be completed in one day, may cost a total of less than $5,000. It is desirable to proceed in stages. First geophysics, then rapid drilling of a sequence of many holes while all crews are on-site, followed by re-evaluation in the office and, planning of the next phase.

Although the drilling method is relatively unsophisticated, the geophysical log produced with the downhole probe is of the utmost importance. It is essentially the same as an assay, and therefore it must be accurate. These probes must be calibrated often and properly handled. Therefore, it is desirable to contract a geophysical crew to be on-site during the drilling. This is especially important since holes are often completed on a daily basis and they must be probed before the hole collapses, which may be only a matter of hours in poorly consolidated sediments.

Geophysics

Traditionally, scintillometer surveys and track-etch surveys were the mainstay of the uranium explorers. Since the last uranium boom, around 1980, other geophysical methods have been refined to the point where they have become useful. Both scintillometer and track etch surveys are limited by the fact that they identify near-surface radioactivity. Therefore, instead of identifying anomalies at depth, they may define either anomalous surface mineralization or structures along which radiation escapes from mineralization at depth. Several meters of cover can block significant radiation existing even at shallow depths.

At the recently discovered Honeymoon Prospect in Australia, the mineralization was defined at depths of 300-400 feet by a Tempest AEM survey using a 25Hz broad bandwidth system operated by Fugro Airborne Surveys (Skidmore, 2005). However, the groundwater residing in the paleochannels at depth had very high salinities that provided a conductivity anomaly with respect to the surrounding rocks. The Tempest AEM survey may not be as effective when the groundwater in the paleochannels is less saline.

Alternative geophysical methods may also be effective. Gravity may be useful in mapping the location of paleochannels if there is a density contrast between alluvial material and the underlying granite. However, it must also be kept in mind that two targets need to be investigated. Although the primary target is the paleochannel, the gently-dipping tuffaceous volcanics also need to be tested. A competent geophysicist needs to be consulted regarding appropriate geophysical methods specific to the California Creek property.

During the last uranium boom, drill holes were commonly evaluated using a truck-mounted radioactive probe that simultaneously measured Gamma Ray/SP/Resistivity throughout the entire hole length. However, gamma ray measurements are not always accurate representatives of uranium grades in young deposits because uranium may not yet be in equilibrium with it's "daughter" products. This was a problem for many years.

During the late 1970's, Sandia Laboratories and Mobil Oil developed Prompt Fission Neutron (PFN) Technology to solve this problem. Unfortunately, this technological advancement became available near the beginning of the last uranium price crash (Figure 4). PFN is a direct and accurate measure of downhole uranium contents. PFN is crucial for evaluation of Tertiary Age uranium deposits since they are young enough to suffer radioactive disequilibrium (Skidmore, 2005).

PFN Technology is far superior to the early radioactive probe methods. The PFN probe is safer, being a neutron generator rather than a radioactive source. It is also more representative because it measures a half-meter diameter sphere sample volume. Perhaps best of all, results are accurate and instantaneous. No time will be spent awaiting assay results.

The Bright Future of Uranium

The future for uranium mining appears to be bright. Despite the last three decades of misinformation and the resultant irrational fear regarding nuclear power and radiation, there is a growing realization, and grudging acknowledgement, that uranium is indeed the fuel of the future. Only the most dull-witted members of the aging baby boomers may be unaware of this fact. Barring hydroelectric power, nuclear is the cleanest, and presently, the most cost-effective source of energy available to mankind.

For example, coal-fired power plants emit much more radiation than do nuclear plants due to minute amounts of radioactive minerals within the coal. They also produce a great amount of "greenhouse" gasses. Other fossil fuels are becoming almost expensive enough to be cost prohibitive for power generation. Wind and solar energy are often impractical since the initial capital costs are relatively high. They are referred to as low-density fuels because they produce a limited amount of power from a large surface area. Biomass, although locally useful, is mainly a sham touted by pandering politicians and crackpots.

Until cold fusion becomes a reality (if ever), nuclear power is the only sensible alternative. It currently supplies roughly 20% of the energy produced in the United States. A mere handful of nuclear fuel pellets provides enough power to supply the needs of one person for their lifetime. And, although nuclear waste disposal is still controversial, the total amount of high-level nuclear waste that exists could be buried on the bottom few meters of a large open pit-mine. Therefore, given a favorable geologic and physiographic setting, the waste could be buried safely in a relatively small area.

Currently, the world is producing roughly 100 million pounds of uranium on an annual basis, but consuming nearly double that amount! In the spring of 2004, Chinese Vice-President Zeng Qinghong told the visiting U.S. Vice-President Dick Cheney that China plans to build 20-30 more nuclear plants within the next fifteen years (Dines, 2004).

Similarly, the Japanese government plans to build 11 more reactors by 2010 since they have virtually no fossil fuels of their own. In early September, 2004, India actually reduced the amount of power generated from their nuclear facilities because of a shortage of uranium (Dines, 2004).

It is a known fact in the mineral resource business that higher prices tend to stimulate exploration. However, the truth is that it takes a minimum of five to ten years to bring new uranium to market since it takes at least that long to discover and develop new mines. Given this fact, combined with the current supply deficit, and the planned building of 30+ more nuclear power plants in the near future, it seems unlikely that there will be an uranium price slump anytime soon. As the inevitable shortages rear their ugly heads, it would be folly to even speculate upon the magnitude of price spikes in uranium. The only alternative will be to turn out the lights!

Recommendations

The claim group needs to be expanded to cover at least the area recommended for acquisition shown in figure 2. This will cost less than $15,000 U.S. This should be done as soon as possible to preclude competitor activity. Any previous data generated by Pathfinder Resources should be acquired if possible.

Once the data is compiled, an appropriate geophysical survey over the area of interest should be completed in an attempt to identify the location of the braided paleochannels at depth. The Tempest AEM survey used on the Honeymoon Project may be useful at California Creek if the conductivity of the groundwater in the paleochannels contrasts with that of the adjacent rocks. Alternatively, a gravity survey may be useful if the density contrast between the fluvial sediments and the weathered granite is significant.

Following this, a series of drill holes should be completed based upon the results of the geophysical survey. The intent of this is to test not only the paleochannels, which may contain the most favorable host rock, but also the tabular, gently-dipping tuff units. These holes should be logged using the new PFN Technology.

Two factors suggest that the paleochannels may trend in an easterly direction. First, the two productive pits are east and west of one another. Secondly, there are a number of east-west trending faults that parallel the axis of the California Creek valley. The orientation of the present day drainage may be the same as that of the paleochannels. Once the geophysics and drilling are completed, we will know significantly more.

The geological mapping completed by Coats et al (1984) is probably sufficient for the initial phase of work, but geological mapping at a more appropriate scale (perhaps 1:4800) may eventually be desirable.

Conclusion

Previous production in California Creek is limited by contemporary standards, but it may be due to the fact that the two producers of record were small companies, essentially "tiff" miners. The scope of work by Pathfinder Resources is unknown, but few drill sites a significant distant from the Pixley Pit were noted during staking. Work completed during the two exploration phases at California Creek may have ceased due only to the inevitable commodity price cycle. Pathfinder Resources acquired the property in 1981 at the beginning of the last uranium market decline. There may be considerable untested uranium potential at California Creek.

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