Recent reassessment of the role of uranium in the field of electric generation over the next few decades has shown that the present world uranium reserves are not adequate to keep ahead of the anticipated demand. Projected use will be in balance with supply in 1975 and much of the requirements after that time must come from new discoveries. Hence the search for, and development of, additional uranium deposits is again becoming economic.

General worldwide occurrence of uranium

The types of uranium deposits found throughout the world can be summarized as follows:

1. Sandstone uranium deposits, as found on the Colorado Plateau, Wyoming, and New Mexico. Deposits of this type occur in sediments deposited by rivers adjacent to upland areas. The uranium is thought to have been precipitated at shallow depths from ground waters where they encountered wood, plant fragments, oil, coal, or bodies of reducing ground water. Vanadium, copper, selenium, and other metals may occur with the uranium.

2. Conglomerate deposits of the Blind River type, as found at Blind River, Ontario, and in South Africa. These deposits appear to be fossil placer deposits, and may contain gold and other heavy minerals.

3. Uraniferous coals, phosphorites and shales. Not now economic for uranium because of low-grade, but could become so in the future.

4. Hydrothermal and contact metamorphic deposits as found at the Ross-Adams deposit, Alaska; Great Bear Lake, Canada; the Congo; and Czechoslovakia. These occur as veins or replacements usually near granitic intrusives. They are generally associated with copper, nickel, cobalt, and iron, and may also contain a great variety of other metals.

5. Pegmatites, as at Lac-la Ronge, Canada. Many unusual minerals are found in pegmatites, but the deposits are usually not large.

About 80 percent of the world's uranium reserves are in relatively flat-lying (strata bound) ore deposits in sedimentary rocks (types 1, 2, and 3 above). These deposits typically lie along the margins of large, ancient, eroded highlands. The uranium is thought to have come from the source areas of the sediments, from granite or acid tuffs with normal, or slightly higher, uranium content.

The other 20 percent of the world reserves are in hydrothermal, pegmatitic, and contact metamorphic deposits. The geology of these deposits is similar to that of nonradioactive metal deposits. Pitchblende is commonly found with the primary minerals of iron, copper, cobalt, lead, silver, bismuth. Purple fluorite and hematite are especially good indicators.
Uranium in Alaska

During the uranium rush in the 50's, a considerable amount of exploration was done by the AEC and by private prospectors in Alaska. This work was aimed almost entirely at discovering hydrothermal deposits in the old highland areas. The Ross-Adams deposit, which was discovered near Ketchikan by prospectors, was the only mine found as a result of this effort. The AEC work consisted of testing old prospects for radioactivity and of sampling of concentrates from stream sediments and placer deposits below areas likely to contain ore deposits. The results indicated that Southeastern Alaska and the Seward Peninsula are the most favorable regions for prospecting for vein-type deposits. The many short reports published on the AEC work give a useful survey of the uranium content of granites and gravels in many areas.

Strata bound uranium deposits -- Since the exploration in the 50's, it has become evident that relatively flat-lying deposits in porous permeable sedimentary rocks are the most productive source of uranium, and that such deposits are most likely to occur "down stream" from exposures of acid intrusive or extrusive rocks (roughly granites and rhyolites).

In Alaska such areas are most likely to be found in the Cenozoic basins which form great lowlands and possibly on the Arctic Slope. Deposits would probably be most likely where acid igneous rocks are present over large areas of the surrounding hills (e.g. Western Copper River basin, Eastern Susitna River valley, and Bristol Bay area). The likely host rocks would be sandstone or conglomerate of Tertiary or possibly of Quaternary age and deposits would be expected to occur within a few tens or hundreds of feet from the surface.

Locally, the higher beds in the great Cretaceous conglomerate basins are nonmarine and younger than nearby granites. Some of these beds (e.g. Western Koyukuk basin) may have been favorably situated at some time in their history to act as host rock for uranium deposits.

Hydrothermal uranium deposits -- The abundance of granitic intrusive rocks in Southeastern Alaska, the Interior, and elsewhere in the State suggests that prospecting of such areas for the hydrothermal type of deposit has a reasonable chance for success.

Methods of detection

Radioactive elements (mainly uranium, thorium, and potassium) emit alpha and beta particles and gamma rays which can be detected by Geiger counters, scintillation counters, and other radiation detectors. The range in air of alpha particles emitted from uranium is only a few inches, but for beta particles it is several feet and for gamma rays several hundred feet. Gamma rays emitted from uranium are stopped by 3 inches of lead, 1 foot of rock, 2 1/2 feet of water and about 15 feet of snow. Direct sensing of the gamma rays is one of the principal means of detecting uranium deposits, but their limited range and penetration power through a thin cover of rock or water seriously limits the effectiveness of radiometric surveying from the air or ground.

Stream sediment and soil sampling offers a means of detecting uranium deposits which might be missed by aerial radiometric surveying. Work done in France indicates that sediment samples taken at one-mile intervals along streams would effectively detect significant uranium deposits in the stream drainage. Analyses of the sediment samples should sensitive down to a few ppm uranium to detect all anomalies. U.S.G.S. Bulletin 1036-L describes a relatively simple chromatographic technique for determining uranium down to 4 ppm. This sensitivity would be adequate for stream sediment analyses in most areas. To date stream sediment sampling has been little used in the United States due to the fact that the development of stream sediment geochemistry has, to a great extent, taken place after the uranium boom was over.
Conclusions

The newly favorable outlook for uranium prospecting finds Alaska with large and apparently favorable areas in topographic basins which have never been seriously prospected for uranium. These should be a fertile field for the prospector.

Further Reading

If this brief account of the geology and detection of uranium and its expanding market outlook whets anyone's appetite for prospecting, he can find more detailed (if somewhat dated) information on prospecting in general, and prospecting for uranium in particular, in two well-written books:


The November 1966 Engineering and Mining Journal has several articles discussing uranium resources and economics as they are today.

The Geological Survey reports on Alaskan uranium field investigations are listed below. Many of these are out of print but they are available for reading at the Division of Mines and Geology and U. S. Geological Survey offices in Alaska.

Southeastern Alaska:


Bulletin 1154, Geology and ore deposits of the Gokan Mountain uranium-thorium area, Southeastern Alaska, by E. H. MacKeever, Jr., 1963


Northwestern Alaska:


Circular 244, Reconnaissance for radioactive deposits in the vicinity of Teller and Cape Nome, Seward Peninsula, Alaska, 1946-47, by H. G. White, W. S. West, and J. J. Hatzko, 1953, 8 p

Circular 250, Reconnaissance for radioactive deposits in the northeastern part of the Seward Peninsula, Alaska, 1946-47 and 1951, by H. R. Gault, P. L. Killeen, W. S. West, and others, 1953, 31 p

Circular 300, Reconnaissance for radioactive deposits in the Darby Mountains, Seward Peninsula, Alaska, 1948, by W. S. West, 1953, 7 p

Circular 319, Reconnaissance for uranium in the Lost River area, Seward Peninsula, Alaska, 1951, by H. G. White and W. S. West, 1953, 4 p

South-Central Alaska:
Circular 1024-A, Radioactivity investigations in the Cache Creek area, Yentna district, Alaska, 1945, by G. D. Robinson, Helmut Hedow, Jr., and J. B. Lyons, 1955, p 1-23

Circular 184, Reconnaissance for radioactive deposits in South-Central Alaska, 1947-49 1952, 14 p

North-Central Alaska:
Circular 185, Reconnaissance for radioactive deposits along the upper Porcupine and lower Coleen Rivers, northeastern Alaska, by H. G. White, 1952, 13 p

Circular 195, Radioactivity of selected rocks and placer concentrates from northeastern Alaska, by H. G. White, 1952, 12 p

Circular 255, Reconnaissance for radioactive deposits in the lower Yukon-Kuskokwim highlands region, Alaska, by H. G. White and P. L. Killeen 1953, 18 p


Circular 316, Reconnaissance for radioactive deposits in the Eagle-Nation area, Alaska, 1948, by Helmut Hedow, Jr., 1954, 9 p


Circular 328, Reconnaissance for radioactive deposits in the lower Yukon-Kuskokwim region, Alaska, 1952, by W. S. West, 1954, 10 p

Circular 331, Reconnaissance for radioactive deposits in eastern interior Alaska, 1946, by Helmut Hedow, Jr., P. L. Killeen, and others, 1954, 36 p

Circular 335, Reconnaissance for radioactive deposits in east-central Alaska, 1949, by Helmut Hedow, Jr., H. G. White, and others, 1954, 22 p

General:


Bulletin 1155, Contributions to economic geology of Alaska, 1963


Circular 243, Preliminary summary of reconnaissance for uranium and thorium in Alaska, 1952, by Helmut Wedow, Jr., and others, 1953, 15 p