# Uranium and thorium in Tertiary alkaline volcanic rocks in south-central British Columbia

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A geological survey and lithogeochemical study of the Tertiary volcanic rocks in south-central British Columbia has been undertaken as a follow up to a Federal-Provincial geochemical reconnaissance program for uranium in waters and stream sediments (URP).

Results of the 1976 URP program show anomalous uranium values over broad areas in the Okanagan-Boundary region. Particularly high concentrations were detected in stream waters and some alkaline ponds. It is speculated that the uranium was derived from underlying fractured Tertiary volcanic rocks or leached from scattered glacial deposits containing eroded fragments of the same material.

The area is considered to have good potential for a fissure controlled, bedded, or basal-type uranium deposit and warrants further exploration.

## GEOLOGY

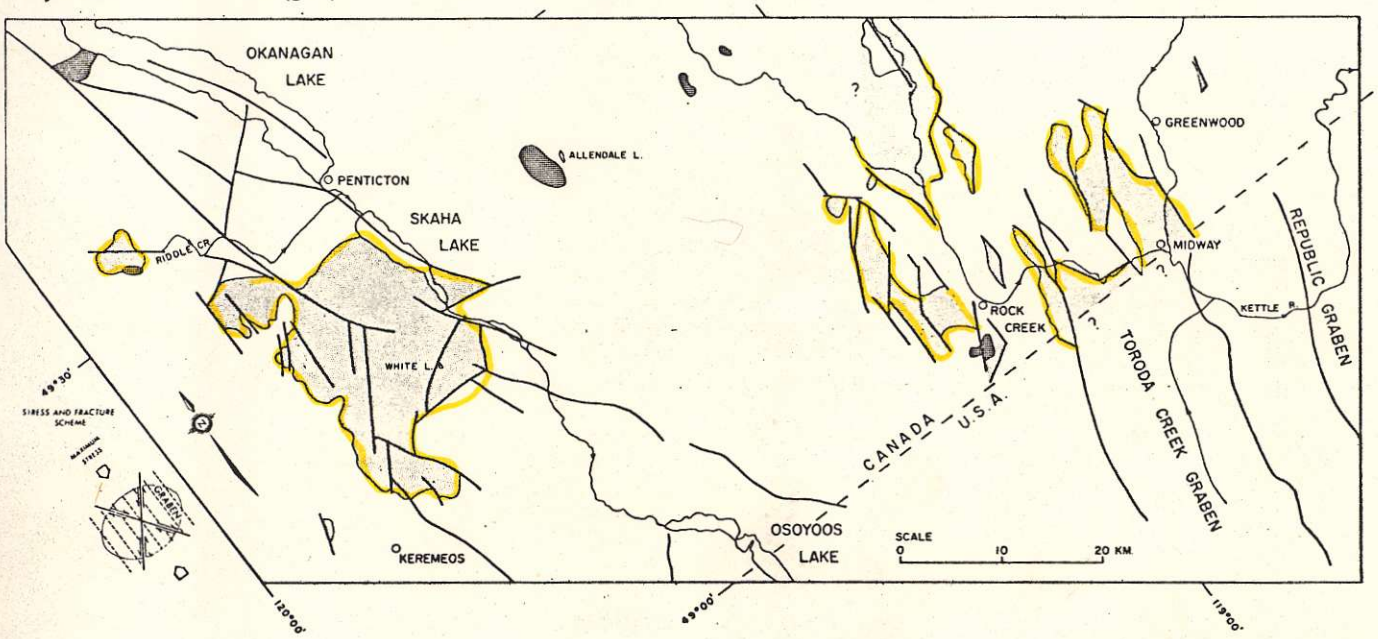
Geological mapping by the Ministry of Mines and Petroleum Resources to delineate units of anomalous radioactivity has indicated a wide distribution of Eocene undersaturated alkaline lavas (Fig 1). These rocks are stratigraphically low in the Tertiary volcanic section and have been assigned to the Yellow Lake member of the Marron Formation, dated as being 51.6 ± 1.8 m.y. (Church 1973). It is estimated that this unit, comprising as many as 20 consecutive flows and locally attaining a thickness of 500 metres, underlies approximately 600 square kilometres in the Okanagan-Boundary region. Source of the lavas is believed to be the composite necks and stocks of Coryell monzonite, shonkinite, and syenite such as exposed near Rock Creek, Riddle Creek, and Allendale Lake (Church 1972).

Structural control of the Tertiary volcanic outliers relates to a pattern of north-south gravity faults and pronounced conjugate shears of northeast and northwest orientation. These fractures are viewed as essential elements in a north-south directed stress scheme and are thought to be responsible for the many graben and half graben structures of the region.

## LITHOGEOCHEMISTRY

Particular interest in the Yellow Lake lavas as a source of uranium was aroused when it was noted that these rocks displayed several times normal background radioactivity. Random testing during the course of the geological survey, using a model GRS-101 Exploranium scintillometer, gave an average reading of 164 ± 32 c.p.s. for 127 stations. Some consistent differences

Fig 1. Distribution of downfaulted Yellow Lake volcanic rocks (stippled) and Coryell source intrusions (grid)



were observed when comparing the readings from the various volcanic outliers. These differences were small, however, except in a few instances such as in the Riddle Creek area where the level of radiation ranged between 200 and 300 c.p.s. A few quite high measurements, in excess of 1000 c.p.s., were recorded near the headwaters of Riddle Creek and west of Skaha Lake.

A suite of 202 rock samples was collected and submitted to the government analytical laboratory in Victoria for quantitative uranium and thorium analysis during the course of the geological survey. The determinations required a gamma-ray spectrometer consisting of a 5 x 5 cm sodium iodide (thallium) phosphor detector and a 1024 channel analyzer. The regions of the energy spectrum used are between 0.023 and 0.700 MeV (Davies 1978).

The results show a mean composition of 11.15 ± 4.63 ppm uranium and 43.09 ± 9.97 ppm thorium, with an average uranium equivalent of 27.65 ± 5.20 ppm. Detection limits of the method and equipment are 3 and 7 ppm for uranium and thorium respectively, using a 5 gram sample and a 1000 second counting interval. The equivalent uranium value is a rough guide to the overall radioactivity that would be measured by a scintillation counter in field survey.

## DISCUSSION

The actual presence of mobilized uranium was first detected in water samples by the 1976 URP survey. This showed that Ingram Creek, which follows a strong Tertiary fault lineament near Midway and similar streams associated with Tertiary rocks in the Penticton area, are enriched in uranium as are a number of nearby springs and alkaline ponds (Church 1977). These results are confirmed by more recent analyses which also show a positive uranium-pH correlation:

| Sample | U ppm | pH |
|---|---|---|
| 1 | 9.1 | 8.4 |
| 2 | 17.5 | 8.6 |
| 3 | 0.6 | 7.2 |
| 4 | 2.3 | 8.2 |

The release of uranium is probably achieved by weathering and leaching of the Yellow Lake volcanics and associated intrusive formations from bed rock or the comminuted equivalent in glacial drift. The mobilization of uranium would certainly be enhanced by the simultaneous removal of alkalies from the host assemblage although thorium would probably remain fixed (Gabelman 1977 p46).

The large potential source area for uranium such as offered by the Yellow Lake lavas does not itself prove a significant uranium concentration. This would require the interplay of suitable stratigraphic and structural factors with favourable climatic and weathering conditions. The concentration of uranium in ponds is interesting, if not commercially important, because this may reflect similar conditions recorded earlier in the local Tertiary stratigraphy. Possible traps for dispersed uranium are numerous and may be zeolite fillings or pyritiferous accumulations on fissures, manganese pitch on cracks in weathered source rocks, zeolitized tuff beds, or carbonaceous sediments etc.

Certainly additional research into the effectiveness of lateral secretion of uranium from alkaline volcanics in the generation of fissure controlled and bedded or basal-type deposits is warranted.

**References**


Church B N 1972; Lynx, Late, in BC Dept Mines and Pet Res, GEM, p386-396.

— 1973; Geology of the White Lake Basin; BC Dept Mines and Pet Res, Bull. 61, 120p.

— 1977; Tertiary stratigraphy in south-central British Columbia, in BC Dept Mines and Pet Res, Geological Fieldwork, p7-11.

Davies J B, Johnson W M, and Ralph P H 1978; Determination of uranium and thorium by gamma-ray spectrometry (in preparation).

Department of Energy, Mines and Resources and BC Ministry of Mines and Petroleum Resources; Regional stream sediment and water geochemical reconnaissance data, southeastern British Columbia (NTS 82E), National Geochemical Reconnaissance Map No. 5-1976.

Gabelman J W 1977; Migration of uranium and thorium — exploration significance; Amer Assoc Pet Geologists, Studies in Geology No. 3, 168p. WM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**Nuclear power:** 2nd Pacific Basin Conference 'Nuclear power plant construction, operation and development', Tokyo, Japan; **24 Sept to 3 Oct'78.** Chmn: Akira Oyama, PNC-FBR, 1-9-13 Akasaka, Minato-ku, Toyko, Japan. American Nuclear Soc, 555 North Kensington Ave, La Grange Park, IL 60525.

**Offshore petroleum:** First SPE European Offshore Petroleum Conference and Exhibition; Earls Court, London, England; **24-27 Oct'78.** Data from: The Institute of Petroleum, 61 New Cavendish St, London W1M 8AR, England; or SPE, 6200 North Central Expressway, Dallas, Texas 75206.

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## BENDIX BUYS INTO ASARCO

ASARCO Incorporated and The Bendix Corporation announced (Apr'78) an agreement under which ASARCO will sell Bendix 3,800,000 shares of its common stock at a price of $23 per share, for a total of $87.4-million. Bendix now owns approximately 1,300,000 shares of ASARCO. Following completion of this transaction, Bendix will own 16.7% of ASARCO's outstanding stock. Under the agreement, Bendix' holdings of ASARCO shares will not exceed 21% of ASARCO's outstanding shares through 1 January 1985.

## URANERZ ANNOUNCEMENT

### Dr. M.Y. el Baroudi

The appointment of Dr. M.Y. el Baroudi as Vice-President and General Manager of Uranerz Exploration and Mining Limited (EUM) is announced by Dr. Peter Young, Chairman of the Board of Directors. Dr. el Baroudi joined UEM from Brinco Limited, Toronto, where he was, successively, Director of Uranium Enrichment; Vice-President, Asbestos; and Vice-President in charge of natural resource projects. Dr. el Baroudi, located at UEM headquarters in Saskatoon since January 1, 1978, earned undergraduate and graduate degrees in engineering at the Massachusetts Institute of Technology and University of Toronto. UEM is active in the search for and development of minerals, particularly uranium, in the Northwest and Yukon Territories, and northern British Columbia, Alberta, Saskatchewan and Quebec. It has discovered, and is the operating developer, of several large uranium ore bodies in northern Saskatchewan. UEM has permanent regional offices in Calgary, La Ronge, Saskatchewan, and Montreal, and operates seasonal explorations activities from Yellowknife, N.W.T., and Chibougamau, Quebec.