GEOCHEMICAL ORIENTATION AND RECONNAISSANCE SURVEYS FOR URANIUM IN CENTRAL YUKON

Project 750051: Uranium Reconnaissance Program

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Introduction

Reconnaissance and detailed surveys were carried out in central Yukon in the summer of 1976 in support of the Uranium Reconnaissance Program (Darnley *et. al.*, 1975). Since this was the first year of this long-term program, it was desirable to obtain experience in a variety of terrains. To obtain representative coverage of the different physiographical and geological regions, reconnaissance surveys were conducted in the Wernecke, Ogilvie, Tombstone and Richardson mountains as well as the Bonnet Plume and Eagle Plains basins (Fig. 45. 1). The reconnaissance survey involved helicopter-supported sampling of approximately 2200 stations for stream sediment and water over an area of 28 490 km^2. During the detailed survey, which included traversing streams, 1000 stations were sampled for stream sediments and waters in areas that were previously chosen on the basis of geology, physiography, and the presence or absence of particular mineral occurrences. The detailed survey of eight areas, comprising a total of 2072 km^2 within the reconnaissance survey area (Fig. 45. 2), was designed in conjunction with the reconnaissance survey to give as much information as possible of the processes affecting the dispersion elements in the secondary environment.

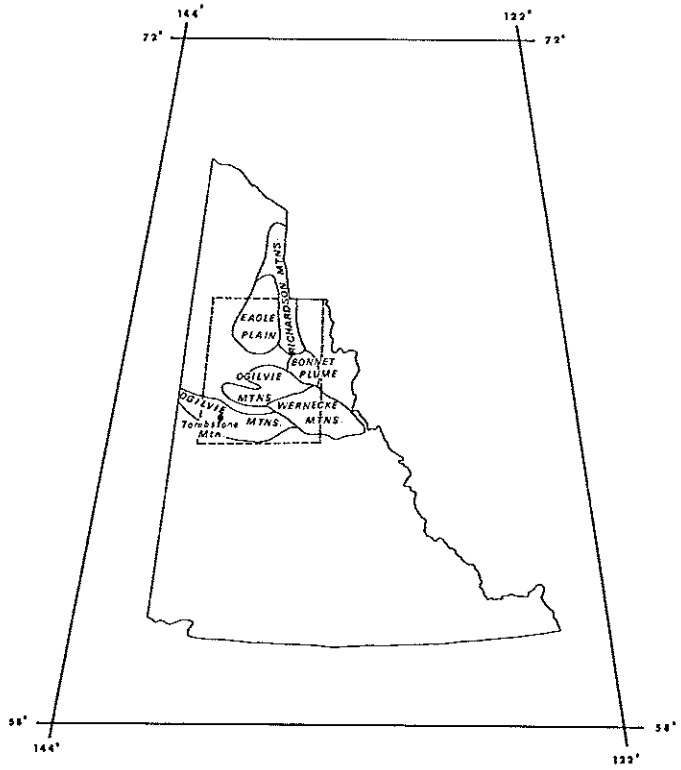

Figure 45. 1. Physiographic divisions of the central Yukon (adapted from Bostock, 1961). Dashed line outlines area in Figure 45. 2.

Water samples were shipped to Barringer Laboratories in Whitehorse in order to obtain a rapid turnabout of U, F and pH determinations. Upon completion of U, F and pH analyses, the samples were acidified and shipped to Geological Survey laboratories in Ottawa to be analyzed at a later date for Cu, Zn, Co, and Ni. The stream sediments were shipped directly to the Survey in Ottawa to await analyses for U, Zn, Cu, Pb, Ni, Co, Ag, Mn, Fe, Mo, W, and Ba.

General Geology

The geology of the central Yukon most recently described by Green (1972) and by Norris (1975) is composed of rocks ranging in age from Proterozoic (Helikian) to Quaternary with rocks from almost every period represented. In the Helikian volcanic and sedimentary rocks, uranium mineralization occurs near unconformities with younger Precambrian and possibly Cambrian sedimentary rocks. The uranium mineralization in the areas investigated occurs either in quartz-pyrite or barite-magnetite-hematite veins filling fractures in the older rocks. Uranium mineralization has also been reported to occur in cherty breccias with a hematitic matrix. The older Precambrian rocks are commonly rich in brannerite which often occurs as knobs protruding from the iron formation matrix while the younger rocks are regarded as containing appreciably more pitchblende.

Formations in the Phanerozoic considered geologically favourable for uranium mineralization, but lacking known occurrences, include the following: -

(1) the Cambrian conglomerate-sandstone sequence as a host for secondary uranium mineralization

(2) the Ordovician Road River shales which were shown by Gleeson and Jonasson unpublished manuscript to have abnormally high concentrations of uranium

(3) the Cretaceous syenitic and quartz-monzonitic stocks of the Tombstone Mountains which have been shown by Garrett (1971) to have high concentrations of uranium. Sediments from streams draining syenitic stocks in the Tombstone Mountains are also concentrated in uranium (Gleeson and Jonasson, unpublished manuscript)

(4) the Cretaceous-Tertiary Eagle Plains and Bonnet Plume Basins composed of semi-consolidated gravels, sands and coal seams as hosts for secondary uranium mineralization.

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Geol. Surv. Can., Paper 76-1C (1976)

Detailed Surveys

To date, exploration for uranium in the central Yukon by private companies included both geophysical and geochemical methods. Geochemical techniques included sampling at ¼ to ½ mile intervals and analyzing the minus 80-mesh fraction of stream sediments by fluorometric methods. Follow-up of stream sediment anomalies included sampling stream sediments in greater detail in addition to talus and soil. The exploration for uranium has had mixed success undoubtedly due to the absence of orientation surveys necessary to interpret the analytical data. For example no detailed investigations were conducted to determine what size fraction of stream sediment should be analyzed and the methods of analysis for the varied types of uranium occurrences of the central Yukon. Uranium occurring in resistate minerals such as brannerite will be mechanically dispersed and concentrated in the coarse fraction. Consequently, the fluorometric method of analysis after a nitric acid leach would account for a small percentage of the total uranium present in resistate minerals such as brannerite.

Because of the difficulty of interpreting analytical data in the past, detailed surveys of stream systems from eight areas within the reconnaissance survey area were conducted with the following objectives:

(1) to determine the processes whether they be mechanical, chemical or a combination of both affecting element migration from known uranium and base metal occurrences. An understanding of the mechanisms of element migration is necessary in selecting the optimum size fraction of stream sediment that will best reflect the uranium potential of an area, and also in determining the possible benefits of the use of water.

(2) to determine the length and intensity of uranium dispersion trains reflected in stream waters and the various size-fractions of stream sediments. This aspect of the detailed survey was necessary to determine the optimum sample density on a reconnaissance scale.

(3) to determine which accessory elements may be useful in a given geological environment as 'path-finders' to uranium mineralization.

(4) to determine background and threshold levels for uranium and associated elements in stream waters, stream sediments and rocks from representative geological formations. This aspect of the detailed survey was done in conjunction with the reconnaissance survey.

To achieve these objectives sediment and water from streams intersecting a variety of geological environments both with and without known uranium occurrences were sampled at ¼ mile intervals. Rock samples from the known occurrences of uranium as well as representative lithologies were collected to aid in interpreting the stream geochemistry. It is interesting to note that radioactive rocks of the central Yukon commonly contain barite and visible chalcopyrite which is significant considering the number of Cu showings in Helikian rocks of the Yukon. To determine further the possible association of copper and uranium of the central Yukon, one detailed survey was conducted

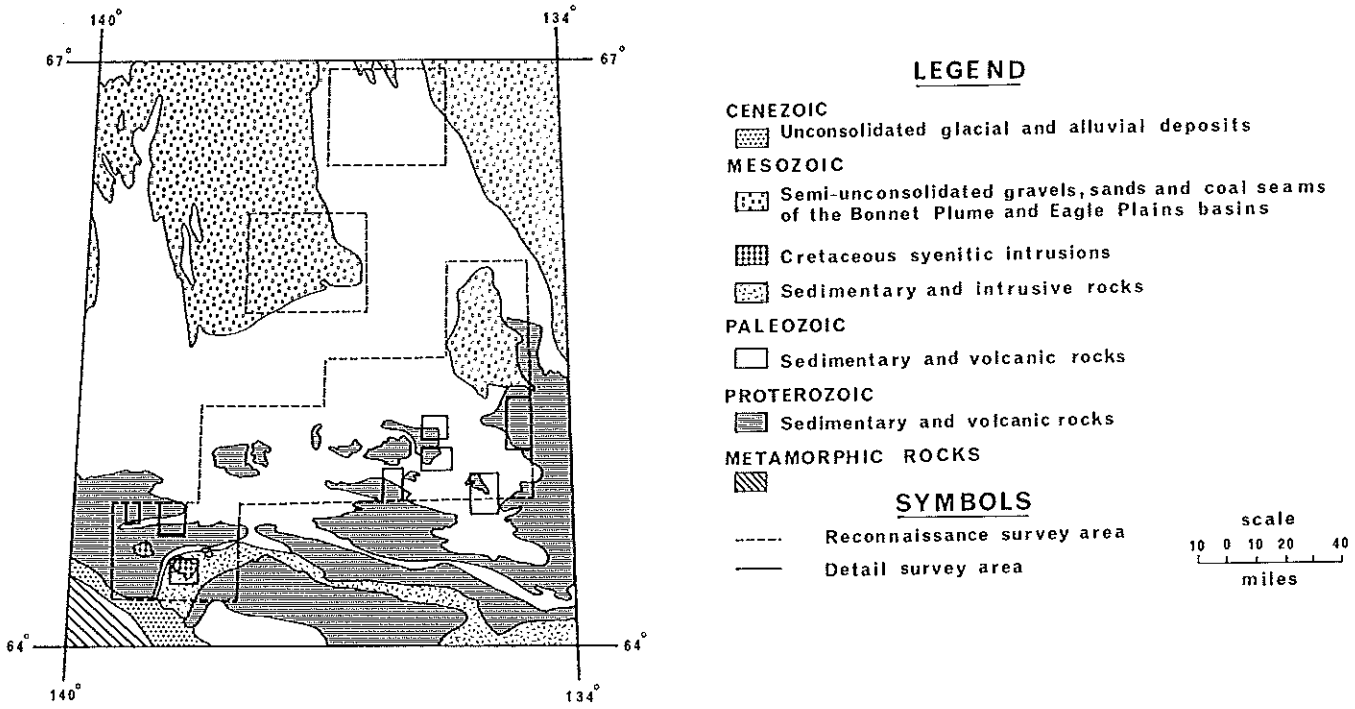

Figure 45. 2. General geology of central Yukon with the locations of reconnaissance and detailed survey areas (geology after Green (1972) and Norris (1975)).

in the Kiwi Lake area which included copper and uranium showings in chalcopyrite-hematite and barite-magnetite-hematite mineral assemblages respectively (Fig. 45. 3). Preliminary analytical results for uranium show a subtle anomaly in stream waters draining the uranium showing and extending at least three miles downstream. Past the confluence with the main stream, the high uranium is undoubtedly derived from streams draining the uranium showing and from streams draining the north slope of the stream valley. The source of

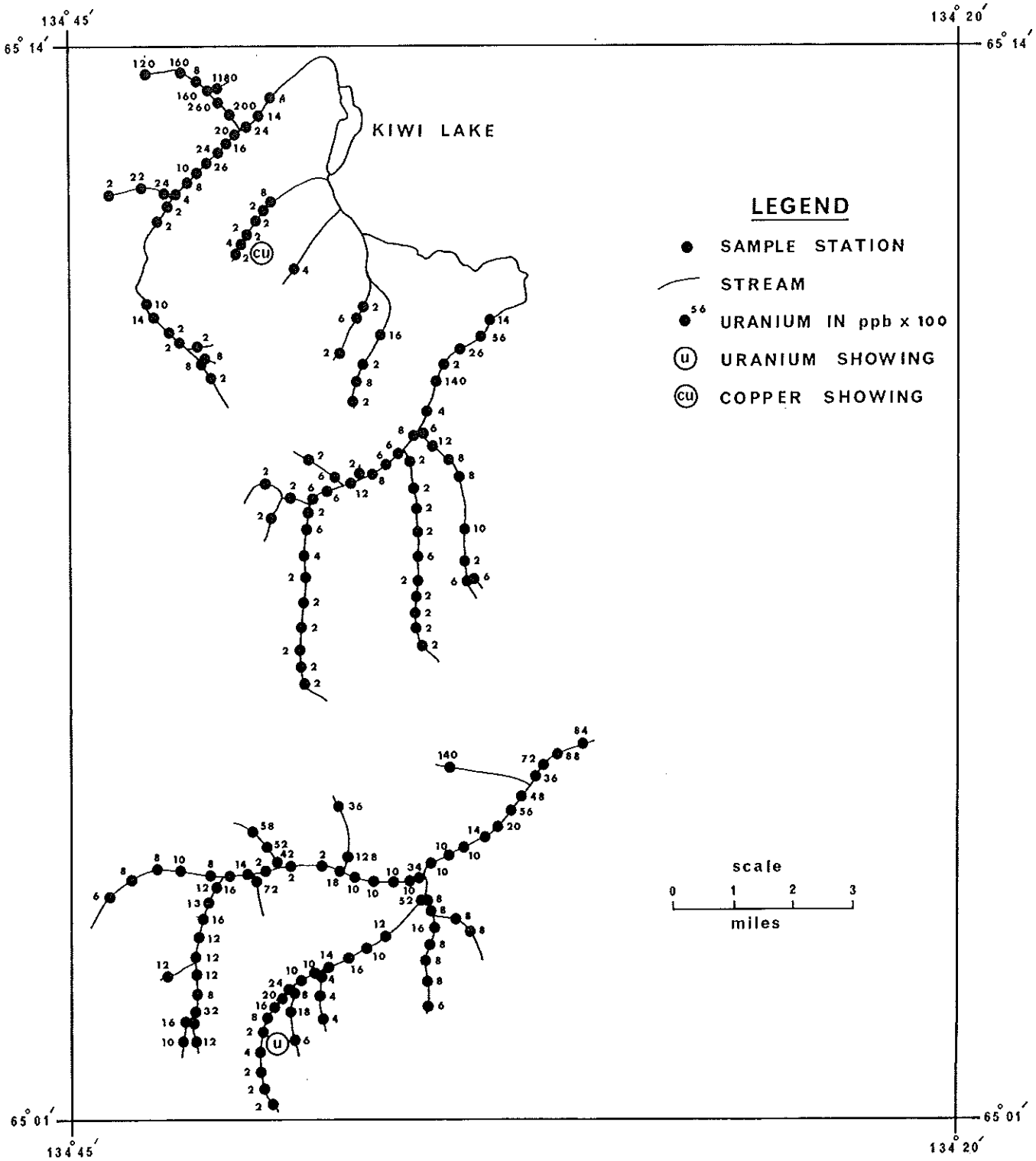

Figure 45. 3. Uranium concentration (ppb x 10^2) in stream waters from the Kiwi Lake detailed survey area of central Yukon.

uranium in streams draining the north slope of the stream valley is as yet unexplained. A second area of interest is the primary stream immediately west of Kiwi Lake where the uranium concentration is several orders of magnitude greater than streams draining the known uranium occurrence. In this stream the uranium concentration ranges up to 11.8 ppb compared to a high of 0.24 ppb from the stream draining the known uranium occurrence and an apparent background concentration of less than 0.06 ppb. Although the source of uranium in this stream is unknown, it is interesting to note the rapid dilution of uranium upon intersecting the main tertiary stream. The stream draining the known copper showing immediately southwest of Kiwi Lake has a low concentration of uranium which is supported by the absence of significant radioactivity at this showing.

A more rigorous treatment of the Kiwi Lake detail area will result when all the analytical data is received for stream sediments, waters and rocks collected in the area.

Reconnaissance Surveys

Reconnaissance surveys of stream sediments and waters were carried out over an approximately 28 490 km^2 area of central Yukon. The objectives of the reconnaissance survey were: -

(1) to determine the feasibility and logistics of carrying out a helicopter-supported survey sampling stream sediments and waters at a density of one sample in five square miles. This becomes of paramount importance when determining contract specifications for any future geochemical surveys conducted in the Yukon.

(2) to determine, in conjunction with the detailed surveys, the various physical and chemical factors affecting the secondary dispersion of uranium and associated elements from known mineral occurrences.

(3) to establish background and threshold levels of concentration for the various elements in waters and sediment from streams intersecting different geological formations.

Objectives 2 and 3 can be evaluated only after analytical data for stream sediment and water are available. As far as objective 1 and the technical aspects of conducting a low density stream sediment and water survey, this is possible at an average sampling rate of 16 sites per hour in mountainous terrain and 12 sites per hour in flat-lying areas. In contrast to mountainous areas where the helicopter could land within feet of the stream, the relative abundance of trees in the Bonnet Plume and Eagle Plains basins made helicopter landing difficult. Consequently, the sample collection rate and sample density decreased in these areas. Also, the stream sediment and water were commonly organic-rich which may make interpreting the geochemical data difficult.

Samples were generally collected at a break in slope where fine sediment was deposited behind boulders and/or near the margins of streams. In situations where the streams were torrential and/or the underlying bedrock was such that it contributed minor fine sediment to the stream, the moss common along the stream bank, as noted by Gleeson and Jonasson (unpublished manuscript), proved invaluable in trapping fine sediment. Except for some streams drying up in late July and August water sampling posed no problem in the central Yukon.

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