005204 → DA

cc Fred Daley

DEPARTMENT OF GEOLOGY

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA
T6G 2E3
(403-432-5071)

QUAECUMQUE VERA

26 April 1985

Mr. R. Dujardin
Kerr-Addison Mines Limited
1112 West Pender
VANCOUVER, B.C.
V6E 2S1

perhaps you could call Nesbitt — I think we should help if it fits in with our plans — discuss with me

Dear Ray:

Enclosed is a research proposal outlining a project on the distribution and origin of precious metal veins in the Wheaton River District, Yukon. The proposal was written by Paul Rucker, a student of mine, and the project will constitute the research component of Paul's M.Sc. program. In particular he is proposing to attempt to fit the various types of mineralization in the Wheaton River District into a unified picture of regional metallogeny. The proposed project is obviously quite ambitious; however, I believe that Paul can accomplish the work in the time available and the resulting thesis should have significant implications to further exploration and development in the District.

The purpose of the proposal is twofold. In order to carry out the project it is essential to obtain permission to visit, sample and conduct a limited amount of mapping on as many occurrences as possible. If such access to your claims is agreeable to you, we would appreciate receiving a letter giving approval to visit the claims and any limitations that you believe are necessary. In addition we have at our disposal only a limited amount of funding to cover field as well as analytical expenses. We estimate an approximate cost of $5500 to cover an eight week field program with an additional cost for the subsequent analytical work in Edmonton of approximately $3000. The total cost is in excess of our available resources at this time which will probably necessitate a reduction in the duration of the field work. If it is possible for you to assist us in meeting the principal field expenses of transportation and subsistence, it would be greatly appreciated and will contribute significantly to a successful and useful result.

We would certainly welcome any suggestions you or your staff have as to approaches to the project or areas to examine.

If you have any questions concerning the project or Paul's plans, please contact me at 403-432-5071.

Sincerely,

Bruce Nesbitt

Bruce Nesbitt
Assistant Professor

BEN/amf
encl.

The University of Alberta
75th Anniversary
1982-83

PROPOSAL FOR THE STUDY OF METALLOGENESIS IN THE WHEATON RIVER DISTRICT

The Wheaton River mining district in the southern Yukon has been shown to include at least three types of mineralized veins (Cairnes, 1912; Wheeler, 1961). Although these veins have been described in some detail by Cairnes(1912) and to lesser extent by Cockfield and Bell(1944), and Wheeler(1961), no study of the relationships among the three vein types nor the relationship of the veins to their host rocks has been done to this time. Neither has the genesis of the veins been definitely established. It is the purpose of the study being proposed to examine the three types of veins, their host rocks and their regional setting in order to determine the nature of their origin and their interrelationships. It is hoped that in accomplishing the above goals that exploration in the district will be greatly facilitated.

The three types of veins in the Wheaton River District are gold-silver, antimony-silver and silver-lead. The first type is found chiefly in Coast Range granitic intrusives (e.g. Wheaton Mountain and Mount Anderson) and in metamorphic rocks of greenschist facies associated with the granitic rocks, the Mt. Stevens Group of Cairnes,(e.g. Mt. Stevens and Gold Hill). The veins in the intrusives are persistent horizontally and vertically and are remarkably uniform compositionally throughout their extent. Quartz is the dominant gangue mineral with calcite present only rarely. The chief metallic minerals are pyrite and galena with the former being more abundant in the veins enclosed by schists while the latter is more abundant in the veins hosted by the intrusives. In addition, there is often minor native gold and gold-silver tellurides(sylvanite, hessite and petzite). The galena is most often argentiferous. The metallic minerals are usually disseminated through the vein, but they may also form thin stringers and, rarely, even massive pods (Cairnes, 1912).

The antimony-silver veins are limited to a small area at the head of the Wheaton River where they outcrop on Carbon and Chieftain Hills. In these outcrops, they strike generally eastward with dips which are steep to vertical. The veins are hosted by Coast Range intrusives and are cut by numerous granite-porphyry and rhyolite-porphyry dikes.

The veins are hosted by Coast Range intrusives and "volcanics of uncertain age" (Wheeler, 1961). The veins are cut by numerous granite-porphyry and rhyolite-porphyry dikes. Again, quartz is generally the most dominant gangue mineral but calcite is present in more significant quantities and may even be locally dominant . Barite is also present in significant amounts. Stibnite, which is often argentiferous, is the chief metallic mineral with galena, sphalerite, jamesonite, tetrahedrite, arsenopyrite and various Ag-Pb-Sb sulfides being present to varying degrees. In some veins, certain sections may be composed almost entirely of stibnite (Wheeler, 1961).

The silver-lead veins are found only in the vicinity of Idaho Hill in Laberge Group greywacke. The veins are parallel to bedding planes within the greywacke and are generally tabular in shape. The presence of large irregular pods and the penetration of vein minerals deep into the greywacke suggest that the veins may have formed as a result of replacement as ore fluids moved along the bedding surfaces. Quartz is the chief gangue mineral with only minor calcite present, although again, calcite may be dominant in certain areas. Galena and arsenopyrite are the most abundant sulfides in the veins and are always associated. Both minerals are also silver-bearing. Some sphalerite, pyrite and even chalcopyrite may be present, but only in very limited quantities (Wheeler, 1961).

The three vein systems are situated in such close proximity to both the Bennett Lake Cauldron complex to the south and the Skukum volcanic complex to the west that it would seem highly probable that one or the other(possibly both) of the complexes served as the source of heat which drove the system and the source of the metals in the fluids. The above observation can be made on the basis of the strong similarities which can be seen between the Wheaton River area and intensively studied areas such as the San Juan Mountains, Colorado (Rytuba, 1981); southwestern New Mexico (Rytuba, 1981) and Guanajuato, Mexico (Buchanan, 1980). In each case mentioned above, quartz vein systems possessing characteristics both physically and compositionally similar to the Wheaton River veins have been linked to late stage caldera development. The volcanic complexes presumably act as loci for hydrothermal veins for three principal reasons. The first is that they provide the physical space for the veins through the development of fracture systems due to subsidence and doming phenomena. The second reason is that they provide the heat engine(in the form of a shallow magma chamber) needed to drive the hydrothermal system. Thirdly, the intruding magma serves as a source for metals which can be leached by the circulating meteoric water. Magmatic water contributions have generally been found to be minor, Sillitoe(1977).

Mineral zoning, both lateral and vertical, is probably the most important concept to come out of the studies done on these areas at least as far as practical exploration methods are concerned. Base metal zoning seems to follow the classic patterns developed by Lowell and Guilbert(1970) for porphyry coppers with copper being deposited at higher temperatures near the heat source and lead-zinc(with or without silver) being deposited further away. Precious metal mineralization and zonation has been shown by Buchanan(1980) to be controlled to a large extent by boiling within the system which results in a vertical zonation. Boiling causes a rapid rise in pH and f(O2) and a drop in f(CO2) and temperature in the remaining fluids which results in the precipitation of the majority of sulfides present in the solution. The extremely low pH, high sulfate fluids which are derived from the vapor phase produce strong characteristic alteration which can be used as an exploration guide.

In the study which I am proposing, I will look at the mineralogy, petrology, field relationships, fluid inclusions and possibly stable isotope data for each of the three types of veins to try to determine whether they are genetically related and whether they indeed fit the criteria for caldera associated veins. If the veins can be shown to represent one or more episodes of genesis related to caldera development, it should then be possible to formulate a regional scheme for the zonation of the major metals. If on the other hand the veins are shown to bear no relationship whatsoever to the calderas of the region this fact would obviously be equally important.

In order to gather the necessary data, I plan to spend eight to ten weeks in the field this summer. Field work will entail visiting each of the major sites in the area (Mount Stevens, Wheaton Mountain, Tally-Ho Gulch, Mount Anderson, Gold Hill, Mineral Hill, Chieftain Hill, Carbon Hill, and Idaho Hill) to obtain samples and to prepare maps. One field season naturally seems a rather limited amount of time to accomplish a comprehensive study of an area as large as the Wheaton River district, but I beleive that it should afford ample time to gather sufficient data for the scope of this study. In the fall of 1985, I will proceed with the microscopic study of the samples obtained during the summer; this will include determination of mineralogy and petrography using transmitted and reflected light techniques. In addition, a fluid inclusion analysis will be conducted to ascertain temperatures and pressures of formation, along with composition of ore fluids. Fluid inclusions will provide the best evidence for boiling in the system. Stable isotope determinations may prove necessary to definitively establish genetic relationships among the veins.

Of course, it is necessary to obtain permission from the companies currently working in the areas mentioned above, before any visits can be made to those areas; to request that permission is the primary reason for this thesis proposal. I hope that there will no problem foreseen in granting this permission, since the information gained from this study should benefit all companies working in the Wheaton River area. The results of the study will be published as a Master's Thesis at the University of Alberta upon completion of all necessary requirements(tentatively, Spring of 1986).

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Phone (403) 433-9621

Rm 158 Earth Sciences Center

University of Alberta

Edmonton, AB

T6G 2E8

RESUME of PAUL D. RUCKER

PERSONAL DATA:
Born 1/4/58, U.S. citizen, single, excellent health

OBJECTIVE:
To perform basic field and laboratory research in metalliferous ore deposits directed toward an understanding of ore genesis and the possibility of developing exploratory models.

EDUCATION:
Bachelor of Science degree in Geology, University of Kentucky, Lexington, KY, December 1983. Courses: Field Studies in Geology, Mineralogy I(Introductory), Stratigraphy and Sedimentation, Mineralogy II(Optical), Paleontology(Invertebrate), Structural Geology, Field Work in Regional Geology, Field Report in Regional Geology, Petrology(Igneous and Metamorphic), Ore Deposits, General Coal Geology.

Attained 3.77 index out of 4.0 in Geology courses, 3.5 overall, degree "with Distinction", Graduate Record Examination scores: Verbal 800, Math 730 (out of 800 in each case).

Currently: graduate student in the Department of Geology at the University of Alberta, teaching assistant in Introductory Mineralogy and Optical Mineralogy.

FIELD EXPERIENCE:
Six week field camp in St. John, New Brunswick in the summer of 1983; two areas were mapped, one in a Helikian metamorphic terrane, one in a dominantly Hercynian granite terrane.

WORK HISTORY:
Various jobs in construction(primarily as a carpenter's helper) during the period 1976 to 1982, summers of 1978 and 1979 general laborer for Smith-Douglass Div. of Borden, Inc., Hampshire, IL.