PhD RESEARCH STUDENTSHIP PROPOSAL FOR MR. DENNIS BROWN

TO: CURRAGH RESOURCES, WHITEHORSE, YUKON

THE STRUCTURE AND GENESIS OF THE VANGORDA MASSIVE SULPHIDE DEPOSIT, ANVIL DISTRICT, YUKON.

From:

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THE STRUCTURE AND GENESIS OF THE VANGORDA MASSIVE SULPHIDE DEPOSIT, YUKON.

Aims

A three year PhD level research programme is proposed to investigate the structural evolution and genesis of the Vangorda Fe-Zn-Pb massive sulphide orebody, Anvil District, Yukon Territory.

The research programme will aim to -
1). Define the structural geometry of the orebody and the host rocks;
2). Determine the structural evolution of the deposit;
3). Define the distribution of ore types and ore mineralogy and their structural relationships and to develop predictive models for the structural control and distribution of the mineralisation;
4). Determine the nature of any alteration features and their relationships to structure;
5). Develop a genetic model for the Vangorda deposit - the origin and distribution of the sulphide mineralisation and the relationships to structure.

Background

The Vangorda massive sulphide deposit occurs in complexly deformed Lower Palaeozoic meta-sediments of the Anvil District, Yukon. The deposit occurs as a complexly folded orebody of massive sulphides within polydeformed deformed quartz phyllites and graphitic phyllites. The structural relationships are only partially understood. Five phases of folding and faulting have been recognised with the dominant fabric being the S_2 foliation and with significant F_3 folding. The orebody has been deformed by both D_2 and D_3 deformations. Preliminary structural investigations point to significant southwesterly directed shearing in the plane of the deposit during D_2 deformation and also important folding during D_3 deformation.

The Vangorda deposit is an important base metal deposit about which little detail is known. A research programme is urgently needed to elucidate the structural geometry of the deposit for mine development and exploration for extensions to the known mineralisation, and to investigate the genesis of the deposit so that exploration models may be erected and tested elsewhere in the Anvil District. The opportunity exists during the life of the open pit operations to carry out detailed structural mapping of the orebody which would not only directly aid mining operations but would also provide the data for a detailed research project.

Research Programme

The research programme will involve detailed structural analysis, mineralogical, geochemical and isotopic investigations. The structural analysis will include detailed mapping of open pit development and structural logging of drill core. Particular attention will be paid to definition of structurally homogeneous sub-areas, zones of intense fabric and shear zone development, and to definition of F_2 and F_3 fold zones. This programme will be particularly relevant to determining the exact geometry of the orebody, determining the continuity and extent of deformation of the deposit and to interact with the mine development programme. Particular attention will be paid to the construction of cross-sections and the projection of structural data down-plunge. In addition detailed microstructural and fabric analyses will be carried out to analyse the effects of deformation and metamorphism on the ore assemblages. Three extended periods of fieldwork are envisaged for this project.

The studies of the genesis of the deposit will involve limited geochemical analyses of the mineralisation and host rocks, fluid inclusions and stable isotopic studies to determine the effects of metamorphism and deformation combined with collation of existing data sets. These studies will provide constraints on possible genetic models that can be applied to both local and regional exploration.

Timetable

The research programme will run for three years - 1991 to 1994. It will involve extended periods of fieldwork at the Vangorda deposit with supervision by Dr. L.Pigage (Curragh Resources) and Dr. K.R. McClay (RHBNC). The research programme will be carried out in the Department of Geology, Royal Holloway and Bedford New College, University of London and at the Department of Earth Sciences, Memorial University, St. Johns Newfoundland in cooperation with Dr. Tom Calon - (the time spent in each department by the research student will be dependent upon the scholarship/funding details).

Personnel

The research student selected for this project is Mr. Dennis Brown, currently completing an MSc in structural geology at Memorial University. His curriculum vitae is enclosed with this proposal. The project will be supervised by Dr. K.R. McClay in conjunction with Dr. Tom Calon (Memorial) and Dr. Lee Pigage (Curragh Resources).

Resources Required

FINANCIAL

Year 1 **1991-1992**

Personnel - PhD Student

PhD Student Supplement	£2000.00
Bench Fee	£ 500.00
Sub-Total	£2,500.00

Travel and Expenses

Travel to Vangorda	£1600.00
Conference attendances	£ 300.00
Sub-Total	£1900.00

YEAR 1 TOTAL	**£4,400.00**
In Canadian Dollars	Approximately - $C 9,000.00

The PhD student would spend one extended fieldwork period at Vangorda in the first year with one period of supervision (included in travel estimate above). It is anticipated that expenses in the Yukon would be found by Curragh Resources and that the student and supervisor would stay at the Anvil exploration camp.

Year 2	**1992-1993**	
	Personnel - PhD Student	
	PhD Student Supplement	£2500.00
	Bench Fee (Isotopic Analyses)	£1000.00
	Sub-Total	£3,500.00
	Travel and Expenses	
	Travel to Vangorda	£1700.00
	Conference attendances	£ 300.00
	Sub-Total	£2,000.00
	YEAR 2 TOTAL	**£5,500.00**
	In Canadian Dollars Approximately	$C 12,000.00

In year 2 two periods of fieldwork would be undertaken at the Vangorda Mine with one period of supervision.

Year 3 **1993-1994**

Personnel - PhD Student

PhD Student Supplement	£2,500.00
Bench Fee (Isotopic Analyses)	£2,000.00
Sub-Total	£4,500.00

Travel and Expenses

Travel to Vangorda	£1,700.00
Conference attendances	£ 300.00
Sub-Total	£2,000.00

YEAR 3 TOTAL	**£6,500.00**
In Canadian Dollars Approximately	$C14,000.00

In year three a final short field season would be undertaken if required.

Liaison

Close liaison will be maintained with Curragh Resources. It would be appropriate that a Dr. Lee Pigage at Faro/Whitehorse be a joint supervisor of the project in order to monitor the progress of the research. Annual reports on the research programme will be presented to Curragh Resources. Continuation of the project to years two and three will be contingent upon the student making satisfactory progress.

Curragh Resources will be provided with copies of the completed PhD thesis and with copies of all publications arising from this project.

Confidentiality

During the course of this project (3 years) the results of this research programme will not be communicated to a third party (parties) without express permission of Curragh Resources. During tenure of the project publication can only be undertaken with full permission of Curragh Resources. Upon termination of the research grant it is anticipated that the results will be written up for open scientific publication.

Departmental Facilities

The Geology Department at Royal Holloway and Bedford New College has all the field and laboratory equipment necessary for the successful completion of this project. Analytical equipment include microprobe, scanning electron microscopes equipped with EDAX analysers, fluid inclusion apparatus, INNA, 2 x XRDs, 2 x XRFs, 3 x ICPs and two new VG Isotopes Mass Spectrometers - for stable and radiogenic isotopes. In addition the Department has an extensive range of rock and mineral preparation equipment, in house computing, digitising and plotting equipment

Additional Information

This research project will build upon the wide experience gained by Dr. McClay on the geology of massive sulphide deposits in deformed terrannes including - Mount Isa, Australia; Sullivan, J&L and Salmo Camp in SE British Columbia; Driftpile and Cirque deposits of NE British Columbia; Tom, Howards Pass and Faro deposits, Yukon Territory; Buchans deposit Newfoundland and the Black Angel deposit, Greenland.

Recent Publications by Dr. K.R. McClay

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