

FAX TRANSMISSION

SEACOR ENVIRONMENTAL ENGINEERING, INC.



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To: Mr. Larry Connell
Manager of Environmental Services
Royal Oak Mines Inc.

Date: August 17, 1995

Fax #: (206) 822-3552

Pages: 4, including this cover sheet.

From: Vivian Au, E.I.T.
Environmental Engineer

Subject: Response to Request for Proposal

Dear Mr. Connell,

Serena Domvile has prepared the following draft proposal as a response to your fax request.

We trust the information presented meets your current needs. Serena will be more than happy to address your questions if you require more detailed or additional information. I expect Serena to be returning to our Richmond office on Monday.

Regards,

A handwritten signature in cursive script that reads "Vivian Au".

Vivian Au

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August 17, 1995

Royal Oak Mines Inc.
5501 Lakeview Drive
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98034-7314
U.S.A.

SEACOR
ENVIRONMENTAL
ENGINEERING, INC.

Attention: Mr. Larry Connell
Manager of Environmental Services

Dear Mr. Connell:

RE: RESPONSE TO REQUEST FOR PROPOSAL AND ANALYTICAL ADVICE
SEACOR PROPOSAL NO. 201-260

We are pleased to respond to the two requests we discussed on August 14, 1995 and summarized in your recent fax:

- Submission of a proposal for consulting services to provide a third party review on the physico-chemical, toxicological and ecological effects of arsenic generally and arsenic trioxide specifically; and
- Advice on analytical methods and approaches for speciation of arsenic in soil.

We have provided a brief discussion on the scope of work, budget and schedule to satisfy the first request, producing a reference document on *Arsenic Properties and Behaviour*.

On the subject of the second matter, we have provided the techniques we recommend for arsenic speciation. SEACOR Environmental Engineering, Inc. (SEACOR) could do this work for Royal Oak within our geochemistry laboratory in Sacramento, California.

1. DOCUMENT ON ARSENIC PROPERTIES AND BEHAVIOUR

SEACOR understands that Royal Oak's objective is to produce a reference document on arsenic. This document would serve as a guide in the interpretation of environmental monitoring programs and in the development of management plans and strategies for arsenic trioxide type wastes stored in the underground mine at Giant Mine, in Yellowknife, N.W.T.

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The tasks involved in compiling a document of this nature are listed below (Task 6 being optional). We have prepared budgets for each of the tasks, including the optional one (see Table 1).

Task 1	Literature Search
Task 2	Summary Chapter on Physical Properties of Arsenic
Task 3	Summary Chapter on Chemical Properties of Arsenic
Task 4	Summary Chapter on Ecological Effects of Arsenic
Task 5	Summary Chapter on Toxicological Effects of Arsenic
Task 6	Summary Chapter on Analytical Techniques for Arsenic Speciation (Optional)

TABLE 1: TASK BUDGET				
Task No.	Description	Fees	Disbursements	Total Budget
1	Literature Review	4,500	500	5,000
2	Physical Properties	1,000	250	1,250
3	Chemical Properties	1,000	200	1,200
4	Ecological Properties	3,500	200	3,700
5	Toxicological Properties	3,500	200	3,700
6 (optional)	Arsenic Speciation Techniques	2,500	200	2,700
Budget Total (excluding option)		\$ 13,500	\$ 1,350	\$ 14,850
Budget Total (including option)		\$ 16,000	\$ 1,550	\$ 17,550

Notes: • All costs are exclusive of all applicable taxes

2. ANALYTICAL METHODS FOR SPECIATION OF ARSENIC

Sample Preparation

Soil samples should be air dried at room temperature for 48 hours (this prevents alteration and oxidation).

Samples can then be subjected to grain size analysis:

- ▶ greater than 212 μm (65 Mesh)
- ▶ between 212 and 37 μm
- ▶ less than 37 μm (400 Mesh)

Samples subjected to analysis with the 400 Mesh may require the use of an ultrasonic sieve or a wet screen procedure followed by air drying.

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Total Arsenic Analysis

Determine total arsenic in all grain size fractions using conventional methods for sample preparation and detection (flame atomic absorption spectroscopy).

X-Ray Diffraction

Conduct x-ray diffraction analysis on all samples and all grain size fractions. This is a qualitative technique for identifying arsenopyrite present at concentrations greater than 1%.

Scanning Electron Microscopy (SEM)/Microprobe/Light Element Detector System

Arsenic-rich particles can be examined by SEM to determine the relative abundance of As, Fe, S and O. Minerals (such as arsenopyrite) can be deduced from chemical spectra (using point counting). This method would provide the percentage of arsenic present as arsenopyrite in each sample. Arsenic present as arsenopyrite could then be compared to *total* arsenic values reported for soil samples.

Arsenic Solubility Tests

To further support the results obtained from the foregoing methods for speciation of arsenic in soil, solubility tests can be conducted. This would involve the subjection of soil samples to standard leaching protocols (such as the Special Waste Extraction Procedure, SWEP) to correlate the pH/Eh - arsenic solubility relationship to the relative abundance of arsenopyrite in soil samples. Low solubility would be expected in soil samples in which arsenic is present as arsenopyrite. This is the technical approach that we would recommend. As mentioned earlier, the speciation work could be conducted by SEACOR (at a cost of \$780/sample) within our Sacramento laboratory. Otherwise, we would be pleased to assist Royal Oak in the interpretation of the results reported by other laboratories using a similar analytical.

I hope this is the kind of information you are requiring, both for the summary document on arsenic and on analytical techniques for speciation of arsenic. If you need more detail in any area, either on tasks budgets or proposed deliverables, please contact me directly.

We very much look forward to working with Royal Oak.

Yours truly,
SEACOR Environmental Engineering, Inc.

Kiran An for Serena Domville

Serena Domville
Principal Scientist