MINISTÉRIO DE MINAS E ENERGIA
Secretaria de Minas e Metalurgia

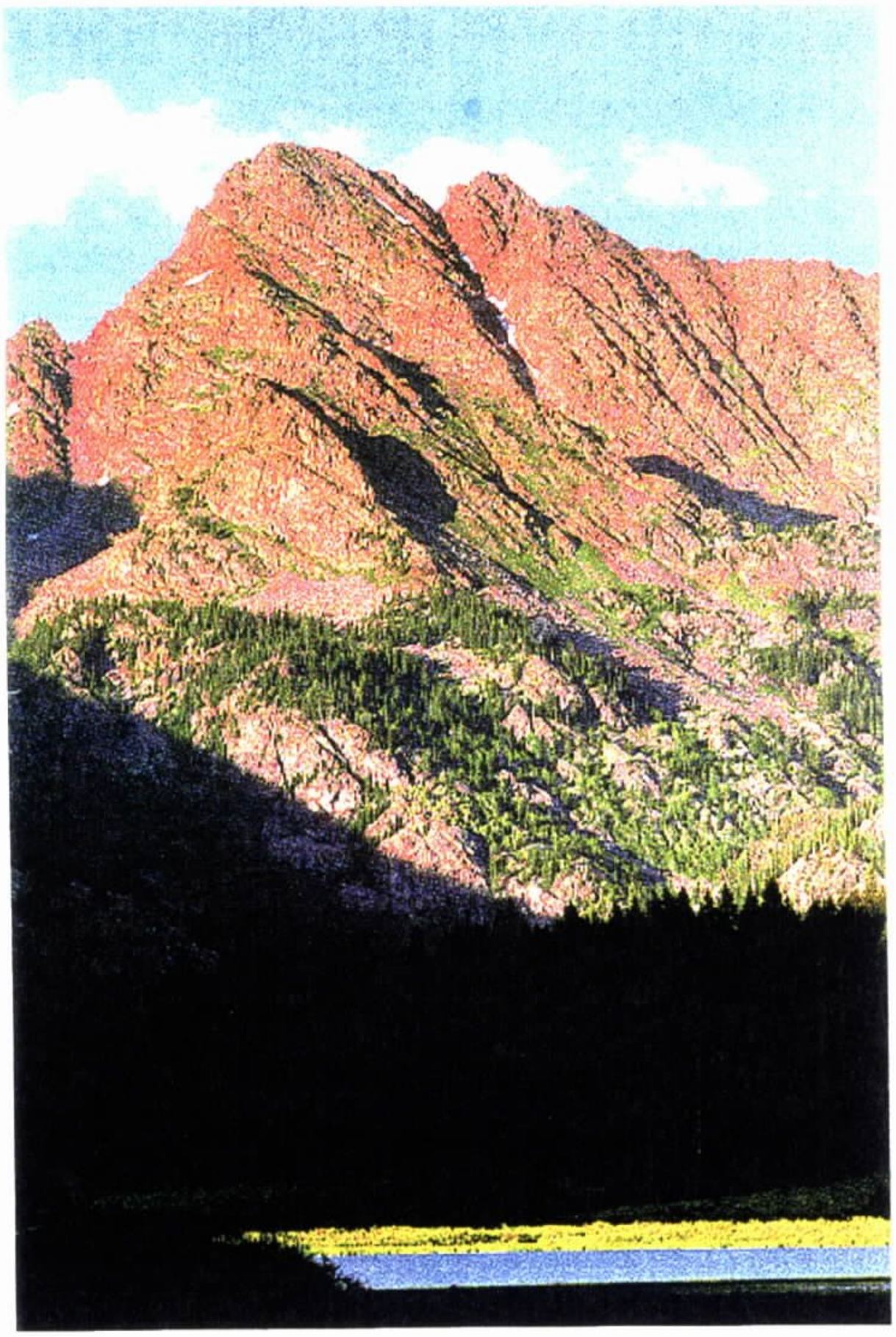
Companhia de Pesquisa de Recursos Minerais

CPRM
Serviço Geológico do Brasil

Relatório de Viagem ao Exterior

Vail - Colorado - USA

GILBERTO JOSÉ MACHADO



Outubro de 1997

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RELAÇÃO DAS FIGURAS E ANEXOS

I - INTRODUÇÃO

A atividade de geoquímica ambiental está em grande expansão no mundo atual. Isto se deve ao fato de que esta ferramenta de pesquisa dá uma resposta mais rápida para a sociedade nas questões que afetam a sua relação com o meio ambiente. As atividades de mineração, industrialização, agricultura, desflorestamento e urbanização levam a problemas de degradação da terra e contaminação de grandes áreas. A concentração natural de determinados elementos químicos podem afetar tanto o homem como os animais que se alimentam continuamente de produtos de uma mesma região.

A Companhia de Pesquisa de Recursos Minerais atenta à evolução dessa forma de conhecimento, iniciou um estudo de geoquímica ambiental através do DEGEO/DIGEOQ - Departamento de Geologia / Divisão de Geoquímica utilizando dados regionais de projetos históricos para testar a possibilidade de sua aplicação no meio ambiente.

Este estudo foi iniciado em novembro do ano passado com o Projeto Geoquímica e Meio ambiente no PLGB, com dois relatórios já publicados. O primeiro referente a Pesquisa Bibliográfica e o segundo com os resultados da primeira fase. A segunda fase terá prosseguimento com o estudo geoquímico detalhado em Poços de Caldas, em convênio com Indústria Nucleares do Brasil - INB. Este trabalho foi submetido à Diretoria Executiva da CPRM, que aprovou a sua apresentação no IV th ISEG (International Symposium on Environmental Geochemistry). Foi enviado o trabalho "The Application of Geochemistry to Environmental Concerns in the Minas Gerais State - Brazil" para a Comissão Organizadora do IV ISEG que o aprovou para apresentação como Poster Presentation.

O presente relatório mostra os resultados obtidos durante o evento realizado entre os dias 05 de outubro a 10 de outubro de 1997 na cidade de Vail no estado do Colorado, USA, assim como as atividades desenvolvidas pelo geólogo Gilberto José Machado, chefe da Divisão de Geoquímica .

A viagem foi autorizada pelo Excelentíssimo Sr. Ministro de Minas e Energia, Dr. Raimundo Brito e publicada no Diário Oficial da União no 173, em 09 de setembro de 1997, folha no 687, seção 2.

II - OBJETIVOS

O técnico em questão viajou aos Estados Unidos entre os dias 05 a 10 de outubro de 1997, para participar do IV ISEG, onde apresentou o poster presentation "The Application of Geochemistry to Environmental Concerns in the Minas Gerais State - Brazil". Participou da segunda reunião do IUGS/IAGC Working Group on Global Geochemical Base Lines - IGCP Project 360 Global Geochemical Baselines e divulgou o 31 th INTERNATIONAL GEOLOGICAL - BRAZIL 2000, que será realizado no Rio de Janeiro. Assistiu também a apresentações orais de geoquímica ambiental e

manteve contato com profissionais de diversos Serviços Geológicos sobre assunto de interesse mútuo.

III - PROGRAMA DE VIAGEM

O programa de viagem elaborado está descrito na tabela abaixo. No deslocamento foram percorridos dois trajetos, um por avião até a cidade de Denver no Colorado, e o último percurso por terra até a cidade de Vail.

O programa de viagem foi o seguinte:

Dia 05 (Domingo - 21:30 horas)	-	Viagem Rio/São Paulo/Atlanta
Dia 06 (Segunda-feira)	-	Viagem Atlanta/Denver/Vail Montagem do Post Presentation
Dia 07 (Terça-feira)	-	Atendimento ao Post Presentation Assistiu a apresentações orais
Dia 08 (Quarta-feira)	-	2a reunião do IGCP 360 - Inter-National Geochemical Baselines
Dia 09 (Quinta-feira)	-	Assistiu a apresentações orais
Dia 10 (Sexta-feira)	-	Assistiu a apresentações orais Viagem retorno Vail/Denver/Atlanta Atlanta/São Paulo/Rio
Dia 11 (Sábado)	-	Chegada Rio de Janeiro

Foram mantidos contatos com diversos pesquisadores, como: Dr. John Fortescue (vide curriculum vitae anexo 1); Drs. Richard K. Glanzman (CH2M Hill) e L. Graham Gloss (Colorado School of Mines), coordenadores do Workshop Collecting Geochemical Data for both Exploration and Environmental Purposes - realizado no Domingo dia 05 de outubro; Dr. David Smith responsável pelas bases de dados de geoquímica do USGS e atual Project Leader do IGCP Project 360 Global Geochemical Baselines; Dra. Jane Plant - BSC UK, Dr. Arthur Darnley Project Leader, Dra. Gloria Prieto Engeominas Colômbia, Dra. Gwendy Hall GSC Canada, Dr. Pavel Koval Vinogradov Institute of Geochemistry - URSS, Dr. P. K. Govil (Índia), Dr. Timo Tarnavian GSF Finlândia, e Dr. Maurice Chafee - USGS, que participaram da reunião do IGCP 360.

IV - LOCAL DO EVENTO

O simpósio foi realizado na cidade de Vail no Estado do Colorado na região central dos Estados Unidos (figura 1). Esta cidade está localizada a cerca de 160 km a oeste da capital Denver, no aprazível cenário das Montanhas Rochosas. É facilmente acessível por serviço de transporte de van ou por carro alugado, que pode ser feito no próprio aeroporto internacional de Denver. A cidade de Vail é mundialmente conhecida por sua beleza, atividades ao ar livre e rede hoteleira.

O simpósio foi realizado no Vail Cascade Hotel que possui um número considerável de suites de luxo, confortáveis apartamentos (figura 2) e apartamentos padrões. Tendo em vista que os conferencistas ficaram hospedados neste hotel, não houve dificuldades de acesso aos locais das palestras, apesar do hotel ficar distante do comércio local e não oferecer muitas opções de locais de alimentação.

A organização do Simpósio foi perfeita, principalmente as facilidades que o hotel oferecia para realização de eventos desse porte.

V - DESCRIÇÃO E ANÁLISE DAS ATIVIDADES DESENVOLVIDAS

V.1 - POSTER PRESENTATION - 'The Application of Geochemistry Data to Environmental Concerns in the Minas Gerais State, Brazil'

A sessão Poster Presentation foi realizada em duas partes. A primeira, da qual participei, iniciou-se às 15 horas do domingo e terminou às 19 horas de terça-feira. Nessa primeira sessão foram exibidos perto de 60 trabalhos. Na segunda sessão, iniciada quarta-feira, estendeu-se até sexta-feira, com o mesmo número de painéis.

Tive a oportunidade de observar que o trabalho apresentado neste Simpósio 'The Application of Geochemistry Data to Environmental Concerns in the Minas Gerais State, Brazil (Anexo 2) é apropriado para ser executado por Serviços Geológicos, onde pude observar trabalhos semelhantes. O poster estava com uma boa apresentação quando comparado aos outros painéis exibidos no local. Neste trabalho ficou evidenciado que 100 ppm de molibdênio encontrados nos sedimentos de corrente na região de Poços de Caldas (figura 3) podem ser indicativos de problemas de saúde no gado da região. Segundo a publicação 'Understanding Our Fragile Environment - USGS Circular 1105' - foram encontrados até 40 ppm de molibdênio na grama do pasto região de Dakota do Sul, causando problema de molibdenose no gado (figura 4). O Projeto Geoquímica e Meio Ambiente terá prosseguimento na área de Poços de Caldas em parceria com a INB (Indústria Nucleares do Brasil), que possui um escritório técnico e laboratório nesta cidade, onde realiza um monitoramento ambiental na área ao redor e nas bacias de drenagens na fazendas circunvizinhas da mina de urânio, atualmente paralisada. A minha proposta é verificar se o elemento químico molibdênio presente em grande

quantidade nas rochas do Complexo Alcalino de Poços de Caldas, uma vez sendo liberado pela ação do intemperismo para o solo e águas (superficiais e subterrânea), está causando problemas de molibdenose no gado e na população. Sabe-se que na região nascem animais com deformações nas patas dianteiras. Além do molibdênio, existe também grande concentrações de manganês, presente nos gonditos que ocorrem na região, que é liberado do rejeito da mina desativada, no tratamento das drenagens ácidas, que pode estar contribuindo para causar anomalias congênitas deformativas nas patas de animais, conforme registrado na literatura.

V.2 - REUNIÃO DO IGCP PROJECT 360 - GLOBAL GEOCHEMICAL BASELINES

Na quarta-feira, dia 08 de outubro foi realizada a segunda reunião do Grupo de trabalho do Global Geochemical Baselines (figura 5). A primeira reunião foi realizada no domingo, dia 05 de outubro, das 9 horas da manhã até as 5 horas da tarde, cuja agenda está apresentada em anexo 3. Na quarta-feira, a reunião foi reiniciada no item 4 da agenda: ***Review of expanded regional field manuals and additional climatic field methods,*** que foi apresentado pelo Dr. Timo Tarvainen do Serviço Geológico da Finlândia. O sumário do que foi tratado está apresentado no anexo 4. O Dr. Timo já enviou para o escritório do Rio de Janeiro o documento definitivo que será distribuído aos Coordenadores de Geoquímica da CPRM.

O item 5, Analytical Strategies, foi apresentado pela Dra. Gwendy Hall do Serviço Geológico Canadense. A Dra. Gwendy informou que a escolha definitiva dos elementos que deverão compor o pacote analítico para o Mapeamento Geoquímico Internacional será decidido no próximo FOREGS (*Forum of European Geological Surveys*) que será realizado em 1988. Haverá uma padronização de procedimentos analíticos para muitos países. Do mesmo modo, em relação ao item 6, Data Processing, a escolha do pacote estatístico será decidido na próxima reunião.

O item seguinte da agenda: Funding and PR foi conduzido pelo Project Leader, Dr. A. Darnley e Dra. Jane Plant. Foi tratado da continuação do projeto e discutida a sua Organização. O Dr. Darnley informou que o IGCP 360 terminará no final deste ano, devendo ser feito um Review em fevereiro do ano seguinte. O Projeto deverá ter continuidade com a criação de uma Associação denominada International Association for Global Geochemical Baselines que será afiliada a International Union of Geological Sciences. A proposta anexa apresenta os Objetivos, Métodos e uma condicionante: 'ter uma provisão suficiente de suporte financeiro pelas organizações interessadas públicas e comerciais". O Dr. Darnley mencionou um suporte de cerca de US $ 2000,00 anuais. Com este fundo será patrocinado workshops e treinamentos em países em desenvolvimento. Essa Associação teria mais sucesso de levantar fundos do que um IUGS Working Group. (Anexo 5)

Em seguida houve a escolha do novo Coordinate leader, sendo escolhido o Dr. David Smith do USGS para substituir o Dr. Arthur Darnley. Foi escolhida a cidade

de Roma para sediar o próximo FOREGS.

V.3 - WORKSHOP - COLLECTING GEOCHEMICAL DATA FOR BOTH EXPLORATION AND ENVIRONMENTAL PURPOSES

Este Workshop foi realizado no domingo, 05 de outubro não foi possível assistir o curso. No entanto, devido ao tema ser de grande interesse para a CPRM e, tendo em vista os projetos atuais da empresa serem de cunho social, envolvendo também a área ambiental, procurei os Drs. Richard K. Glanzman e L. Graham Gloss que foram os organizadores desse workshop e solicitei que me fosse fornecido o material didático distribuído durante o curso. Ambos gentilmente me entregaram esses documentos, que são coletâneas de trabalhos técnicos versando sobre o assunto do workshop. Esses trabalhos serão posteriormente enviados aos Coordenadores de Geoquímica. No anexo 6 temos o Sumário dos assuntos tratados durante este evento.

V.4 - 31 ST INTERNATIONAL GEOLOGICAL CONGRESS - BRAZIL 2000

Uma das missões da viagem foi a divulgação do Congresso Internacional de Geologia, que será realizado no Rio de Janeiro, em agosto do ano 2000. A divulgação foi através do fornecimento de material de propaganda do evento como posters e bottoms. Este material ficou exposto em uma mesa especial (figura 6), ao lado dos materiais de propaganda de outras empresas, Órgãos Governamentais e dos próximos eventos. O interesse foi grande, haja vista esgotados todos os posters. Os pesquisadores que compareceram ao último Congresso Internacional de Geologia, na China elogiaram o esforço da comitiva brasileira para trazer o Congresso para o nosso país. Eles estão bastante interessados em comparecer ao Congresso do ano 2000, visto que o nosso país já possui uma grande experiência em sediar grandes eventos, como foi lembrado o conclave da ECO-92, onde o Brasil recebeu Chefes de Estado de todo mundo e um grande número de cientistas, militantes de Organizações Não Governamentais e o público em geral. Naquela ocasião a organização foi perfeita com bastante segurança para os participantes. Acreditamos que o resultado positivo da ECO-92 certamente trará ao Brasil um grande número de participantes ao 31 st International Geological Congress - Brazil 2000.

V.5 - APRESENTAÇÕES ORAIS

No Anexo 7 temos o *Abstract* do IV ISEG. Dentro do possível procurou-se assistir às palestras que tratavam de estudos ambientais, que utilizavam dados regionais e estudo de tratamento de áreas degradadas por atividades de mineração. Verificou-se uma grande preocupação dos estudos de pesquisadores dos países

desenvolvidos em preservar o meio ambiente. Um exemplo bem documentado é o da Mina Summitville no estado do Colorado (Figuras 7 e 8). Esta mina funcionou entre 1985 e 1992 produzindo ouro de baixo teor utilizando a técnica moderna de lixiviação de pilha de minério por cianeto para retirar o ouro presente no rejeito da mina. O governo americano calculou que gastará entre 100 e 120 milhões de dólares para limpar a região dos efeitos da atividade de mineração. Neste Simpósio foram apresentados diversos trabalhos de pesquisa visando a remediação na região de Summitville.

Muitos dos profissionais que na década passada só desenvolviam atividades de geoquímica relacionadas com exploração mineral hoje realizam estudos que voltados para a geoquímica ambiental. O anexo 8 mostra a programação do Simpósio na sessão de encerramento.

VI - CONCLUSÕES E RECOMENDAÇÕES

1 - Creio ter sido altamente positiva a minha participação neste evento, em vrrtude da oportunidade de apresentar o trabalho que está sendo desenvolvido na CPRM utilizando a Geoquímica Ambiental. Somente dois trabalhos provenientes do Brasil foram apresentados neste Simpósio, sendo um da CPRM e outro da Universidade de Pernambuco;

2 - Quase 300 conferencistas de todo o mundo atenderam ao Simpósio de natureza tão específica. Foi possível estar em contato com diversos cientistas que há décadas vem realizando pesquisas na área ambiental (anexo 9).

3 - Isto evidencia que devemos dirigir nossos esforços para esta crescente atividade de Geoquímica Ambiental, sem no entanto esquecer que a geoquímica exploratória é uma atividade necessária para o crescimento do nosso país tão pouco explorado. Esta é a missão de um Serviço Geológico, fomentar a pesquisa geológica para atrair novos investimentos na área mineral e cuidar para que a terra seja preservada para que todos possam desfrutá-la da melhor maneira e deixá-la bem cuidada para nossos filhos e netos.

4- As pesquisas que estamos iniciando na empresa na área da geoquímica ambiental mostra que estamos no caminho certo. Deveremos utilizar métodos analíticos de maior precisão e de limite de detecção bem baixos para que possamos observar as variações discretas dos elementos, mais precisamente naqueles meios de amostragem onde os elementos químicos podem estar em concentrações a nivel de ppb ou mesmo ppt, como é o caso da água.

5 - A participação de profissionais da empresa em eventos internacionais serve também para treinamento, pois os coloca em contato com profissionais que realizam importantes estudos de ponta e utilizam equipamentos de última geração. Nossos geólogos podem divulgar os seus estudos e atrair empresas interessadas em investir em nosso país.

6 - A experiência brasileira em organizar eventos internacionais de grande porte nos qualifica a pleitear em futuro próximo que seja realizado no Brasil o Simpósio Internacional de Geoquímica Ambiental, que até o presente momento não é um evento de muitos cientistas;

7 - O próximo Simpósio será realizado na Africa do Sul no ano 2000. Sugiro que seja preparada uma apresentação do Brasil naquele evento para candidatarmos a sediar o Simpósio seguinte, provavelmente a ser realizado no ano 2002;

8 - Esses Simpósios são uma grande oportunidade de divulgar o Simpósio Internacional de Geologia - Brazil 2000 assim como o nosso país, atraindo oportunidades de negócios e de turismo, melhorando a nossa balança comercial.

9 - A participação de geólogos da CPRM em eventos dessa natureza e em reuniões como as do Mapeamento Geoquímico Internacional consolida a presença do Serviço Geológico do Brasil junto à Comunidade Científica Internacional gerando oportunidades de parcerias com outros Serviços Geológicos;

VII - AGRADECIMENTOS

Agradeço ao Exmo. Ministro das Minas e Energia, Dr. Raimundo Brito, e ao Exmo. Secretário das Minas e Metalurgia, Dr. Giovanny Toniati a permissão para ausentar-me do país.

Da mesma forma agradeço ao Diretor Presidente, Dr. Carlos Oiti Berbert, ao Diretor de Geologia e Recursos Minerais, Dr. Antonio Juarez Milmann Martins, ao Diretor de Administração e Finanças, Dr. Augusto Wagner Padilha Martins, ao Diretor de Relações Institucionais Dr. Gil Pereira de Souza Azevedo, e ao Diretor de Hidrologia e Gestão Territorial, Dr. Idelmar Cunha Barbosa a oportunidade de participar do Simpósio de Geoquímica Ambiental, onde foi possível apresentar o trabalho desenvolvido na empresa, divulgar o 31 st International Gelogical Congress - Brazil 2000, bem como participar da reunião do IGCP IGM -360 (International Geochemical Mapping), que congrega cientistas de vários partes do mundo, manter contatos com geólogos de outros serviços geológicos e assistir palestras de interesse na área ambiental.

Agradeço, também, à ASSUNI na pessoa do Dr. Samir Nahass que preparou todo o processo que permitiu a viagem.

Finalmente, agradeço aos funcionários Sylvio Sergio Ferreira e Gerson José de Souza da ASSUNI que providenciaram as passagens, diárias e o passaporte junto à Embaixada Americana.

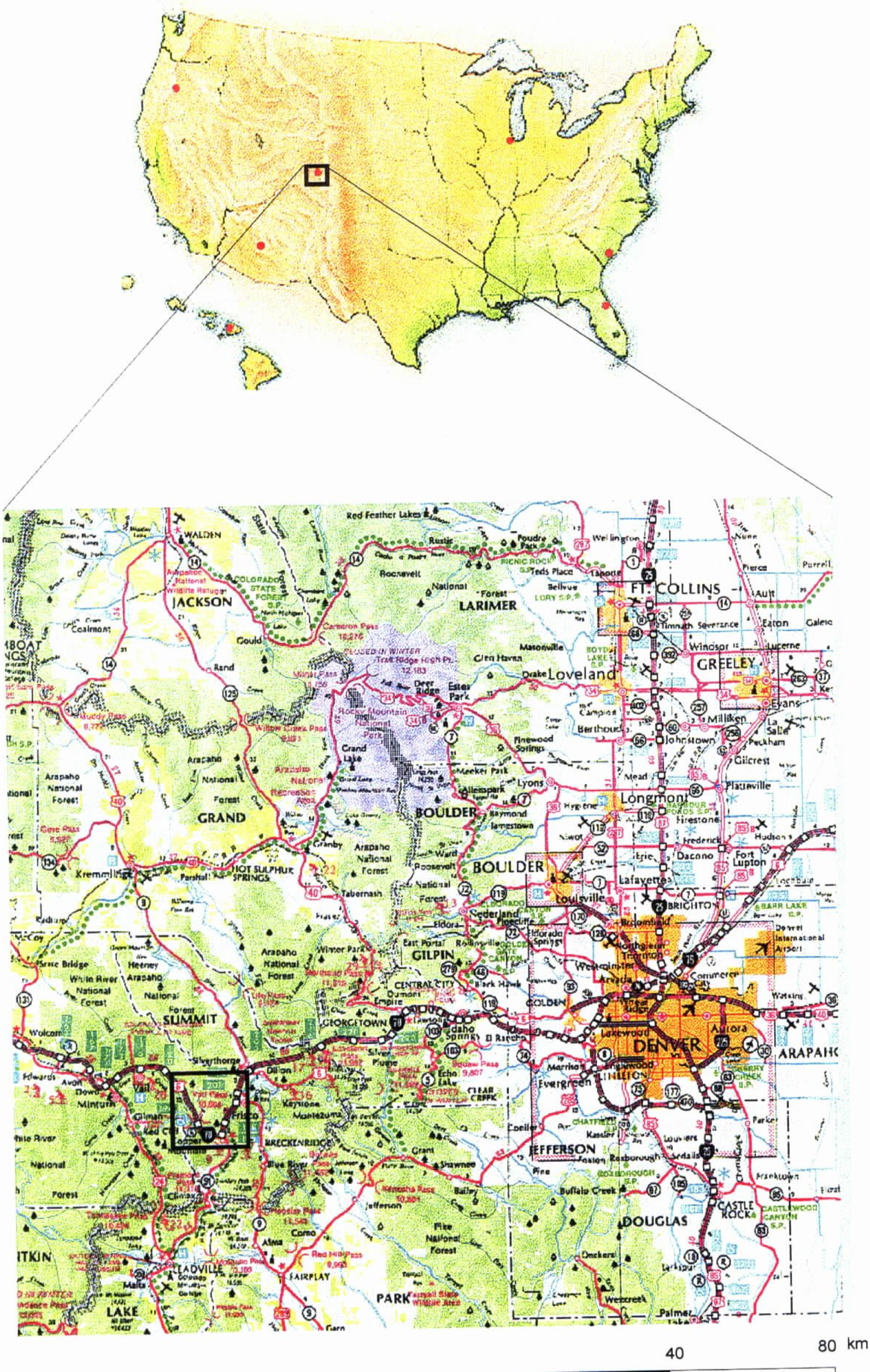
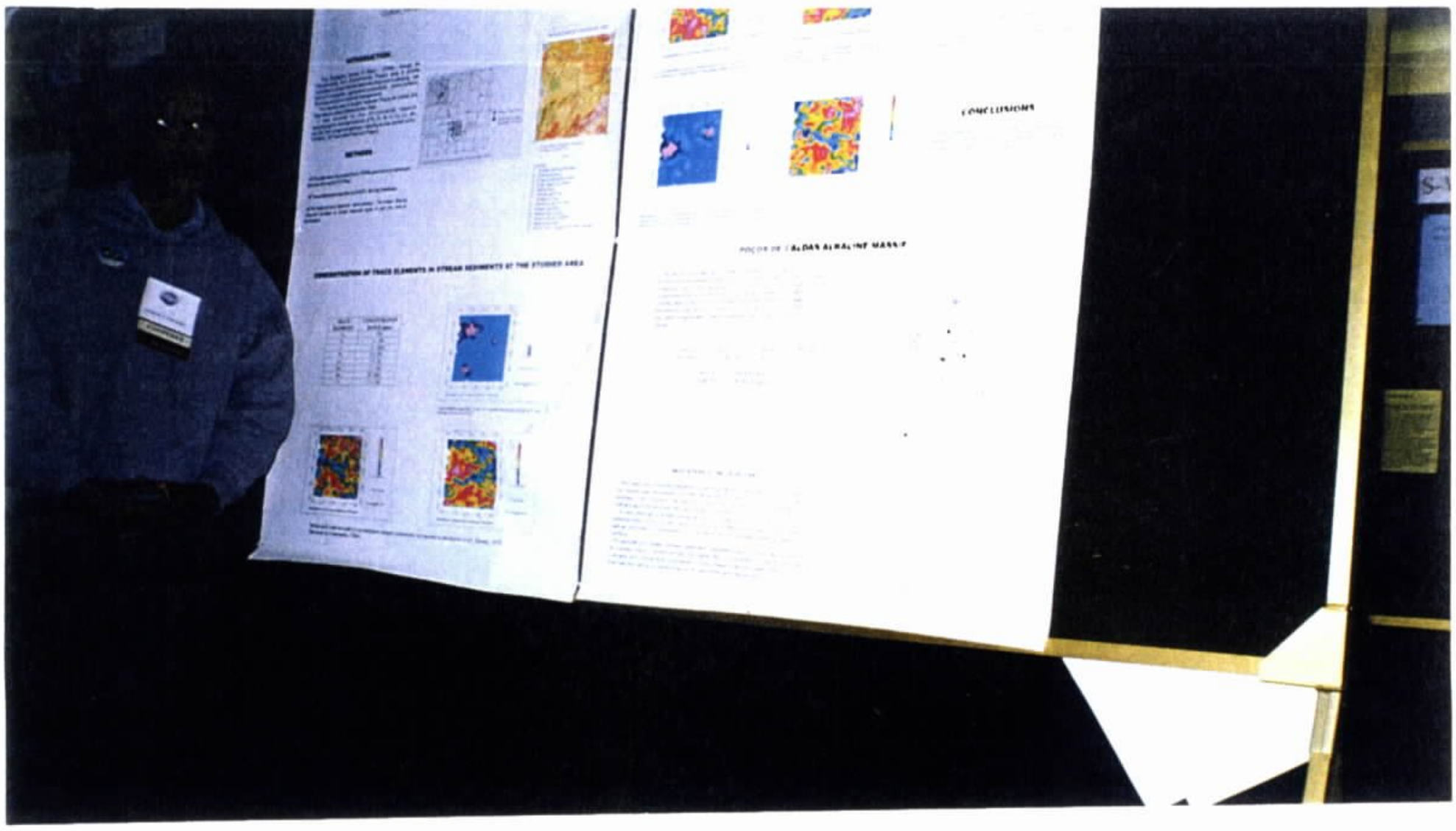
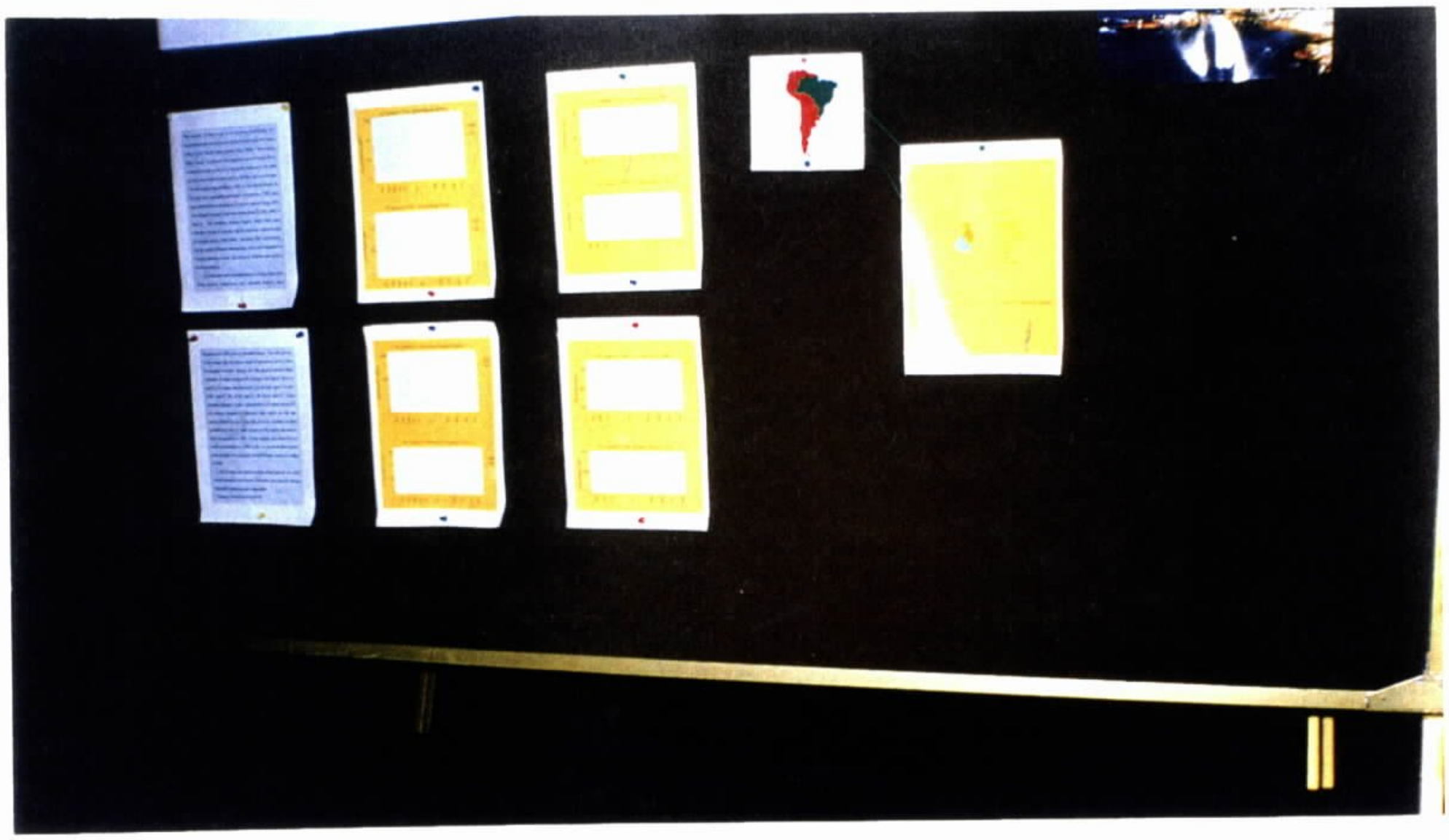


Figura 1 - Mapa de Localização de Vail - Colorado - USA

Figura 2 - Local de realização do Simpósio - Hotel Cascade



Painel "The Application of Geochemistry Data to Environmental Concerns in the Minas Gerais State, Brazil" de Cunha, F. G., Machado, G. J. e Mello, C.S.B. – CPRM



Painel "Trace-element Contamination in the Environment of Recife Metropolitan Area, Pernambuco, Brazil - Delima, Edmilson S. et alii - UFPE

Figura 3- Poster Presentation – Brasil

Participantes da Reunião do IGM – Mapeamento Geoquímico Internacional
Primeiro plano da esquerda para direita: agachado, Gilberto J. Machado (Brasil)
Em pé: G. Ottonelo, (Ita), D. Smith (USA), Gloria Prieto (Col), T. Tarvanien (Fin),
G. Hall (Can), e J. Plant (UK). No segundo plano temos P. Kovil (India), 3°
A. Darnley (Can), J. Fortescue (antepenúltimo) e P. Koval (URSS)

Detalhe do Início da Reunião

Figura 5 – Reunião do IGCP 360 – Mapeamento Geoquímico Internacional

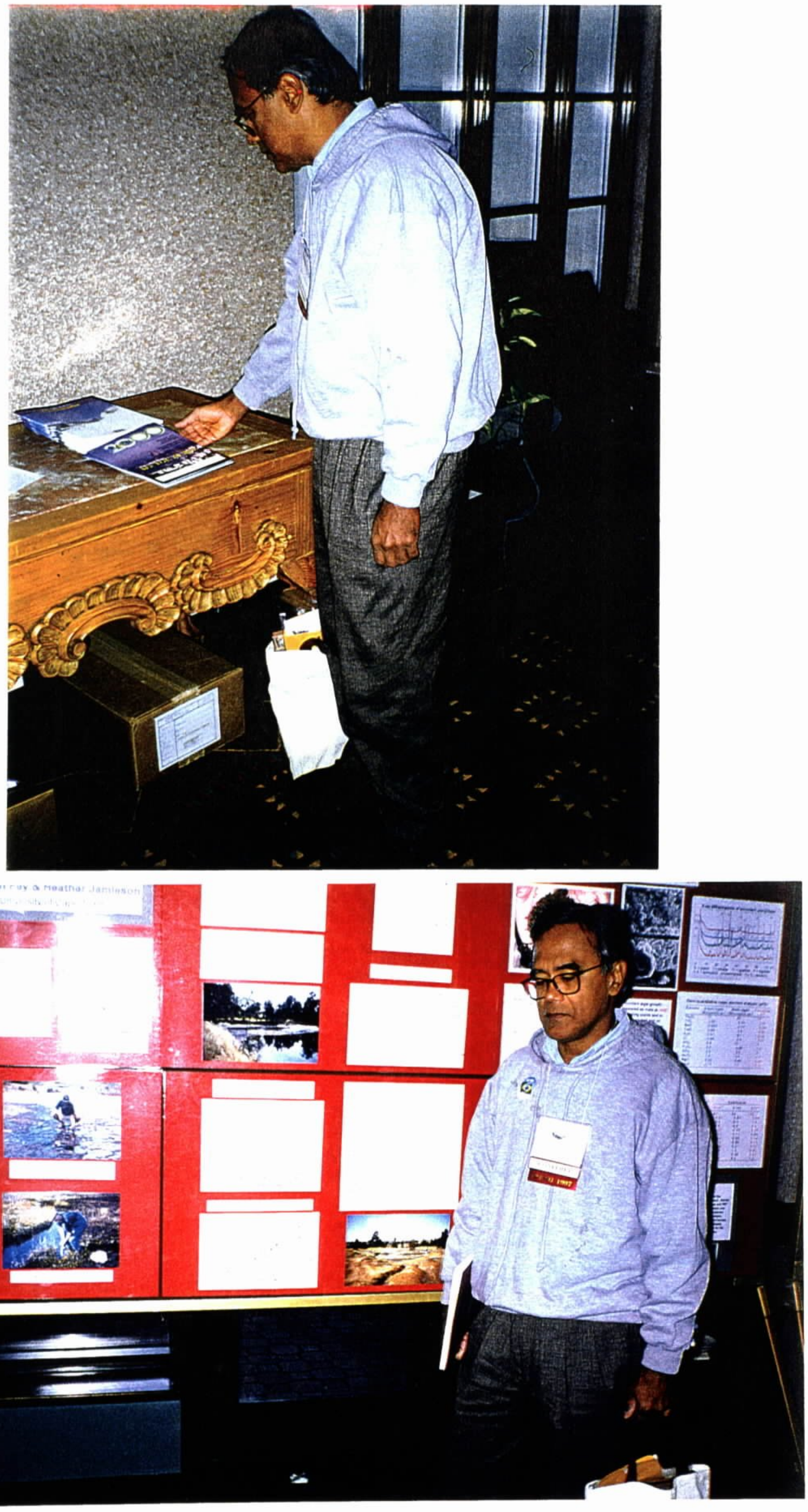
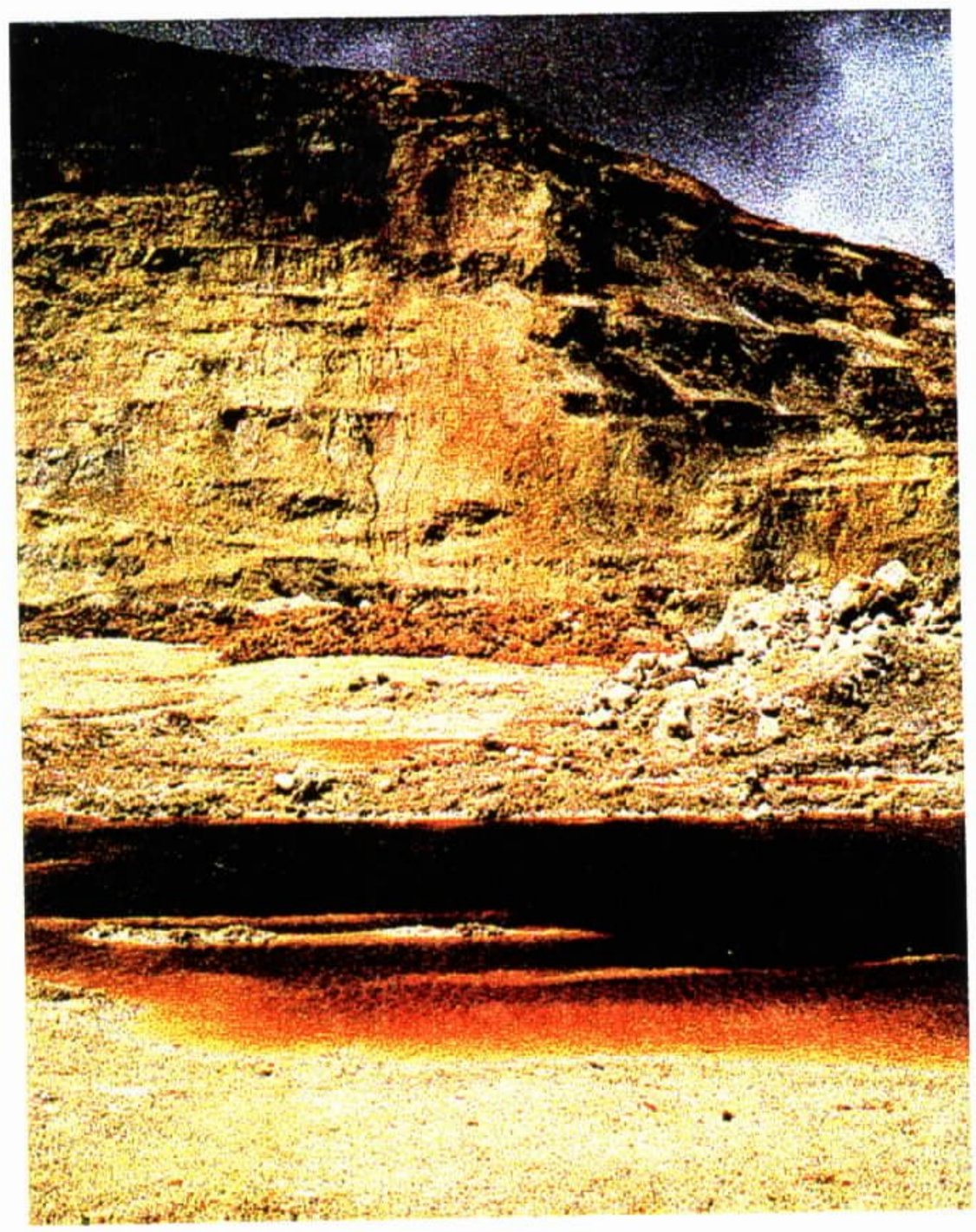


Figura 6 – Divulgação do IGC – BRAZIL 2000 – Poster e Bottom

Vista Aérea da Mina Summitville, 1991- Colorado

Fotografado pela Intrasearch



Poça vermelha escura rica em metais na Mina Summitville

Fotografado por Geoff Plumlee

Figura 7 - Mina Summitville - Colorado - USA

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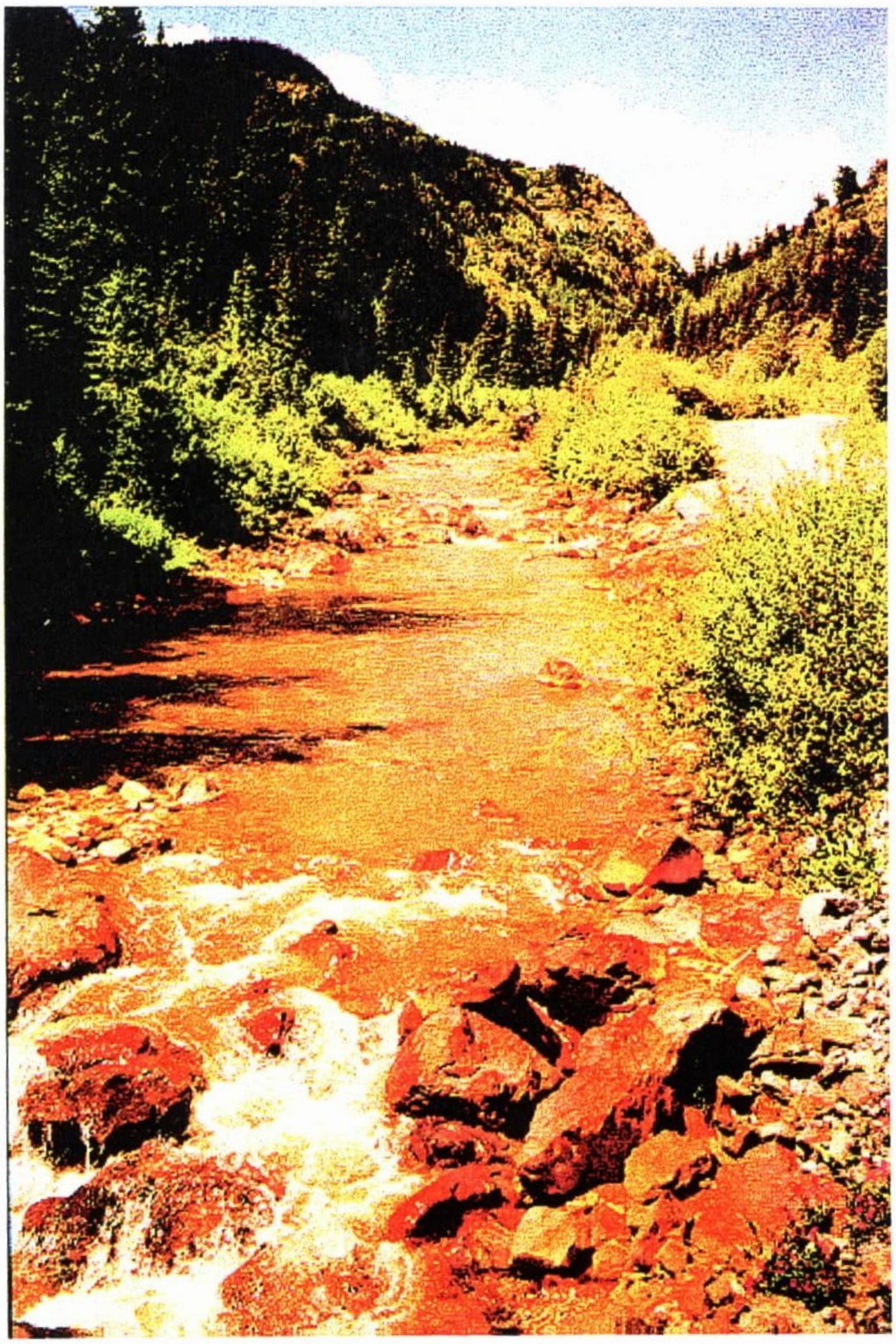

Figura 8 - Rio Alamosa Próximo à Mina Summitville - Colorado - USA

USGS BULLETIN 2220

Anexo 1

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INTERESTS

Independent writer and teacher in environmental geoscience. Major goal: to write books on environmental geochemistry. Prepared to give introductory courses on environmental geology, environmental geochemistry and geochemical mapping. Research interests: landscape geochemistry, global geochemical mapping. Plans to offer lectures and 1, 2, or 3 day workshops in environmental geochemistry in 1998.

UNIVERSITY EDUCATION

1961 D.Phil.(Geochemistry) Oxford University, England.

1954 M.Sc.(Geology) University of British Columbia, Canada.

1953 B.A. (Hons. Geology) University of British Columbia, Canada.

ADDITIONAL EDUCATION

1962 Diploma (Applied Geochemistry) Imperial College of Science and Technology, London, England.

TEACHING AND ACADEMIC RESEARCH EXPERIENCE

Associate professor: (Geochemistry) Department of Geological Sciences, Brock University, St Catharines, Ontario, Canada (1970-1977)

Visiting research professor: (Environmental Geochemistry) Environmental Trace Substances Research Centre, University of Missouri, Columbia (1977-1978).

Guest lecturer: Environmental Geochemistry,(Half course) Department of Geological Sciences, Laurentian University, Sudbury, Ontario, Canada (Jan.- April, 1994)

Invited lecturer : "Landscape Geochemistry" (2-day course) - Department of Geology, Parana Federal University, Curitiba, Brazil (June, 1994).

Invited lecturer : "Geochemical Mapping for Multiple Purposes"(3-day course) - V Congresso Brasileiro de Geoquimica, Fluminense Federal University Niteroi, Brazil (October, 1995).

EXPERIENCE

Geochemist : Ontario Geological Survey, Sudbury, Ontario, Canada (1982-1994).

Independent Consultant : 'Enviroquest', Vancouver, Canada (1977-1982).

Anexo 2

The Application of Geochemical Data to Environmental Concerns in the Minas Gerais State, Brazil

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The Geological Survey of Brazil (CPRM) has an extensive geochemical data base covering all of the Brazilian territory. The database, in conjunction with the Geochemistry and Environmental Project, assists in land-use planning such as uses of soil and agricultural productivity related to the control of endemic diseases, and environmental management. In 1977 the area for the Sapucai Project was selected as the Poços de Caldas and Varginha cities, Minas Gerais, (MG) State. The region encompasses an area of about 44,880 km^2 and has geological and geochemical coverage made by CPRM. This study was based on the results from the chemical analyses of Pb, Zn, Ni, Cr, Cu, Co and Mo based on an environmental study of 590 stream sediment samples. Using GEOSOFT software, geochemical maps for the selected elements were created. After data analysis, two areas for detailed examination were selected: Poços de Caldas showed high concentrations of Mo and low contents of Cu (possible problems for livestock and human health, such as molybdenosis and hypocuprosis); and Sao Goncalo de Sapucai. These areas represent old mining activities and new agricultural activity. The correlation between these geochemical data sets and those available from public heath sources are being examined for the Poços de Caldas area. The study examines the utility of these data sources in assisting local governments to solve environmental geochemical problems.

Application of Mine Fire Diagnostics

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[1]Federal Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236, USA
[2]Pittsburgh Research Center, NIOSH, P.O. Box 18070, Pittsburgh, PA 15236, USA

Mine Fire Diagnostics is based on the assumptions: (1) measurable changes in the emission of low molecular weight hydrocarbons from coal are temperature dependent, and (2) analysis of controlled underground air flow between borehole sampling points can determine the source of the hydrocarbons. Gas composition, temperature, and pressure are determined before and during operation of a suction fan attached to one of a network of cased boreholes. Fan suction influences gas movement at the base of neighboring boreholes, and differences in measured pressure indicate the degree of communication between the suction and other boreholes. A fire signature is based on a ratio of C_2-C_5 hydrocarbons to total hydrocarbons. Using a gas chromatograph, the detection level for hydrocarbons is 1 ppm; a sample can be analyzed in less than 2 minutes. Laboratory studies confirm that changes in hydrocarbon emission are detectable at temperatures below 100°C. Integrating fire signatures from multiple tests, with different underground gas flow orientations, produces a two-dimensional map of heated and cold zones.

The methodology has been used at four abandoned coal mine sites, three bituminous and one anthracite. Three noncontiguous combustion zones were delineated at the first site. At the second site, it was determined that heating extended several hundred feet into the mine and along more of the buried outcrop than indicated by surface expression. The third evaluation indicated possible heating near some houses; assessment was complicated by apparent low permeability in the mine. In the anthracite mine, changes in methane concentrations indicated the presence of seven noncontiguous heated zones.

Environmental Applications of the Regional Geochemical Mapping of Soils and Stream Sediments in South Africa

de BRUIN, D., ELSENBROEK, J.H., and LOMBARD, M.
Council for Geoscience, Private Bag X 112, Pretoria, 0001, South Africa

A regional geochemical mapping program has been conducted in South Africa since 1973 by the Council for Geoscience. A total area of 280,000 square kilometers have been covered to date at a sampling density of one sample per km^2. This represents coverage of 23 % of the surface area of South Africa. Samples from first order streams are preferentially collected, but representative soil samples are taken if these are not present within the designated square kilometer. The <75 µm fraction of samples is collected by dry sieving and analyzed for 24 elements (TiO_2, MnO, Fe_2O_3-T, Sc, V, Cr, Co, Ni, Cu, Zn, As, Rb, Sr, Y, Zr, Nb, Mo, Sn, Sb, Ba, W, Pb, Th, U) by simultaneous XRF on pressed powder pellets. Samples from selected areas have also been analyzed for additional elements (Pt, Pd, Au and major elements) using other analytical techniques. The results are processed by using a Geographical Information System (GIS). The XRF results show an excellent correlation between soil chemistry and underlying geological formations. Geological units are clearly demarcated even on 1:50,000 scale maps (700 samples), and on larger scales the chemistry clearly reflects regional geological patterns. Apart from geological correlations the data set can also used for exploration purposes, the establishment of environmental baselines within geological units, and agricultural applications. An advantage of the methodology followed by this program is that all sample materials are stored and archived, which allows for samples to be analyzed by other and future advanced analytical techniques for additional elements as the need arises.

Prominent anthropogenic contamination can be readily detected in two separate mining areas. The area surrounding

Anexo 3

IUGS/IAGC WORKING GROUP ON GLOBAL GEOCHEMICAL BASELINES
IGCP PROJECT 360 GLOBAL GEOCHEMICAL BASELINES

Business meetings of the above project will be held in the Centennial Ballroom at the Vail Cascade Hotel and Resort from 9.00 AM to 5.00 PM on Sunday (5 October) and Wednesday (8 October) 1997.

A G E N D A

1.	Welcome and brief position statement (maximum 20 minutes)	A Darnley/ J A Plant
2.	Present structure	A Darnley/ J A Plant
3.	Regional progress reports:	
	Europe FOREGS	T Tarvainen on behalf of R Salminen; M J Battista; A Demetriades; M Duris; F M Fordyce; V Gregorauskiene; G Klaver; H Klein; J Locutura; K Marsina; L Martins; C Mouvet; L Odór, S-Å Ohlsson; G Ottonello; A Pasiecsna; M Pinto; J A Plant; C Reimann; U Sievers; J Van der Sluys; O Schermann; A Steenfelt.
	Russia	P Koval
	Asia China	X Xie
	India	P K Govil
	S.E. Asia	J A Plant on behalf of Y K Hong (Korea); C Johnson & M Muchsin (Indonesia)
	Australia	J A Plant on behalf of B Minty
	South America	G Prieto (Colombia) & A Darnley (on behalf of Brazil)
	North America	R Garrett; Dr G Hall (Canada) & D Smith (USA)
	South Africa	D De Bruin
4.	Review of expanded regional field manuals and additional climatic field methods	Discussion
5.	Analytical strategies	G Hall on behalf of the analytical committee
6.	Data processing	R Garrett & T Tarvainen on behalf of the data management committee
7.	Funding and PR	I Thornton on behalf of the PR committee
8.	Future Activities	A Darnley & J A Plant

IUGS/IAGC WORKING GROUP ON GLOBAL GEOCHEMICAL BASELINES
IGCP 360 GLOBAL GEOCHEMICAL BASELINES

Business Meeting, 5th & 8th October 1997, Vail, Colorado, USA.

ATTENDANCE

Arthur Darnley	Canada
Jane Plant	UK
David Smith	USA
Lorraine Williams	UK
Ottmar Schermann	Austria
Jan Van der Sluys	Belgium
Gilberto J. Machado	Brazil
Gwendy Hall	Canada
Prof X. Xie	China
Luz Maryan Gonzalez	Colombia
Gloria Prieto	Colombia
Timo Tarvainen	Finland
Manfred Birke	Germany
Dinelli Enrico	Italy
Benedetto de Vivo	Italy
P.K. Govil	India
Luis Martins	Portugal
Pavel Koval	Russia
Deon de Bruin	South Africa
Olle Selnius	Sweden
Joy Rae	UK
Iain Thornton	UK
Maurice Chaffee	USA
John Fortescue	USA
Robert R. Craig	USA

Anexo 4

GEOLOGICAL SURVEY OF FINLAND
DEPARTMENT OF GEOCHEMISTRY
P.O. BOX 96
FIN-02151 ESPOO
FINLAND
PHONE: +358-2055020
FAX: +358-2055012
INTERNET: Timo.Tarvainen@gsf.fi

15 October 1997

Dear members of the FOREGS Geochemistry Task Force and the IUGS Working Group on Global Geochemical Baselines.

As agreed in the Working Group meeting in Vail, we send the enclosed manuscript of the FOREGS field manual for your evaluation. Because this is already the 6th version of the manual and some countires have already taken part of the samples according to these instructions, only minor revision is possible. However, some parts were added to this manuscript very quickly and there are certainly some errors, both typing errors and unlogical instructions. Analytical part will not be added to this manual.

Please send your comments to me before 1 November 1997. The guide book will be printed in January 1998, and the full text with figures will be available on the web site of the Geological Survey of Finland (http://www.gsf.fi) on the same time.

Yours faithfully,

Timo Tarvainen
Senior Research Geologist

LIST OF CONTENTS

Anexo 5

A proposal for an

International Association for Global Geochemical Baselines

to be affiliated to the International Union of Geological Sciences

Objectives:

- implement the general recommendations of the UNESCO report, as identified by the UN Committee on Natural Resources;

- facilitate the assembly of a standardised global geochemical database pertaining to surface materials;

- facilitate the distribution and use of the data.

Method:

- provide continuity, information, training and quality assurance, by means of a small secretariat working in conjunction with regional, national or other organisations, as appropriate, under the general guidance of an international Steering Committee;

Conditional upon:

- **the provision of sufficient financial support by interested public and commercial organisations.**

Rationale:

The UN Committee on Natural Resources has passed a resolution stating that there is an urgent need for a global land monitoring program based on the UNESCO report. A strong case can be made for this activity.
The organizations which might be expected to provide financial support for such a program are unwilling and/or unable to do so for reasons such as the following:

- no money for new projects;
- must give priority to existing activities;
- currently reducing their activities;
- are concerned with process studies rather than systematic data collection;
- consider it outside their mandate.

Global geochemical baselines cannot be established without funds earmarked for the purpose. A direct approach must be made to those with money who will benefit from the existence of baseline data. A new international association created specifically for the purpose could be more successful at fund raising than an IUGS Working Group , even if the objectives are the same.

1 October, 1997

Anexo 6

COLLECTION GEOCHEMICAL DATA FOR BOTH EXPLORATION AND ENVIRONMENTAL PURPOSES

1. NATURAL VARIABILITY

Outline

Introduction -
Geochemical Cycle
Basic Principles of Applied Geochemistry
Survey Components - Orientation Surveys
Sampling and Sampling Design
Summary

Introduction

The Geochemical Cycle:
- Deep-seated bedrock
- Surficial

Bedrock Geochemistry
- Start with igneous rocks - crystal chemistry
- Geochemical Variability
  - rock types
  - mineral deposits types
  - geochemical associations
- Data Compilations
- Mineral deposit models

Surficial Geochemical Environment
- Sedimentary geochemical differentiation - aqueous chemistry
- Range of environments - morphogenetic systems
- Weathering and Soil Formation
- Principle sampling media - definitions
- Sources of variability
  - Soils - e.g., climate, catena, horizon
  - Drainage - e.g., Eh/pH, sorption, site setting, seasons

Conceptual/Landscape Geochemistry Models

Geoenvironmental Mineral Deposit Models

Basic Principles of Applied Geochemistry

Introduction
- General - ala Goldschmidt
- Landscape Geochemistry

Exploration geochemistry
Environmental geochemistry
Geoepidemiology

Key: nature of the problem!

Basic Concepts
- Geochemical Cycle
- Mobility(Solubility) - chemical and physical
- Dispersion
- Geochemical Associations
- Pathfinder or Indicator Elements

Patterns of Geochemical Dispersion
- Geochemical Landscape
- Geochemical Relief/Contrast
- Background/Baseline
- Threshold/Pattern Recognition
- Anomaly (Significant/Non-Significant)
- Classification
  - Environment (Deep-seated vs surficial)
  - Stage (syngenetic vs epigenetic)

Survey Components
- Design and Planning
- Field Sampling
- Sample Preparation
- Chemical analysis
- Data Management and Presentation
- Interpretation and Recommendations

Key: Only as good as the weakest link!

Orientation Surveys
- Objectives
  - establish geochemical dispersion operative, at appropriate scales
  - establish optimum geochemical techniques for detecting dispersion, considering both technical and economic factors

Questions to be addressed
Types of Orientation Surveys
- traditional, case history, consultation

Result
- does geochemistry work
- how, why?
- routine survey specifications

technically and economically sound solution

Sampling and Sampling Design

Introduction
- Definitions
  - Populations: conceptual/target/sampled
  - Sample: geological/statistical
  - Geological Sample - A composite!
    - Physical isolation
    - chemical speciation
    - geochemical fingerprints (association/statistics)
  - Sample representativity - of what?, for what purpose?

Sample Design
- Objectives of GX Program
  - Anomaly identification detection and definition
- General Statistical Model
  - Data distributions
  - Independence of samples/randomizing: Miesch 1976
- Analysis of Variance (ANOVA) Evaluation
  - $V_T = V_R + V_S + V_A$
  - Balanced vs Unbalanced Design
  - Do we have a problem?

Sampling: Geological & Statistical
- Objectives
- Types of Samples
- Representativity
  - Homogeneous vs heterogeneous
  - Nugget Effect - precision vs # of particles
  - Factors - sample weight/grain size/concentration
- Trouble Shooting
  - Design/Monitoring
  - Analytical Precision
  - Geological Representativity - process appreciation (natural & anropogenic)
  - Statistical Representativity - natural heterogeneity (larger samples/compositing); sample preparation (procedure assessment)
  - Geochemical Associations - an alternative approach

Geostatistics
- Regionalized vs Random variables
- Area of influence, continuity, anistropy
- Variogram - regional vs local effects model

Kriging - weighting factors for samples via geostatistics
contouring and error estimate.

Summary

Assessment
How representative is the sample/your data
Significance to project

Summary

Geochemical Cycle: deep-seated and surficial environmental
Models - Conceptual and Geoenvironmental
Basic Principles - dispersion
Survey components - orientation surveys
Sampling: geological and statistical
Assumption: geological samples are composite

L. Graham Closs
10/2/97

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Anexo 7

4th International Symposium on Environmental Geochemistry

October 5-10, 1997
Vail, Colorado USA

organized by the
United States Geological Survey
Association of Exploration Geochemists
and
Society for Environmental Geochemistry and Health

in collaboration with the
International Association of
Geochemistry and Cosmochemistry

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

4th International Symposium on Environmental Geochemistry

Program with Abstracts

By

Richard B. Wanty, Sherman P. Marsh, and Larry P. Gough

Open File Report 97-496
1997

Welcome to the 4th International Symposium on Environmental Geochemistry

Welcome to colorful Colorado. This Rocky Mountain valley is an area once used to train soldiers of the 10th Mountain Division for Alpine combat in Europe during World War II. After the war, one of those soldiers came back with the dream of starting a ski area. In 1962, Vail opened and has grown into the largest, single-mountain ski resort in North America. During your stay we hope you will be able to visit the surrounding regions and enjoy American hospitality, food, and beautiful scenery.

It is an honor to host the 4th International Symposium on Environmental Geochemistry and we are eager for you to have a successful and productive conference. You can rest assured that every member of the Organizing Committee will see to accommodating your needs. Details of the scientific program and social events are given in the following pages. If you need assistance or have any questions, please feel free to go to the Registration Desk or ask any Organizing Committee member.

The support from sponsors, exhibitors, and attendees is gratefully acknowledged. A special thank you is extended to the Association of Exploration Geochemists, the Society for Environmental Geochemistry and Health, and the International Association of Geochemistry and Cosmochemistry for their interest and financial support. The United States Geological Survey also gave significant financial support in allowing members of the Organizing Committee time to devote to the Symposium.

The Organizing Committee

This proceedings volume is published as U.S. Geological Survey Open-File Report OF97-496. Literature citations can appear as follows:

> Amacher, M.C., Kotuby-Amacher, J., and Brown, R.W., 1997, Reactions and transport of copper in headwater streams receiving acid rock drainage, in, Wanty, R.B., Marsh, S.P., and Gough, L.P., eds., 4th International Symposium on Environmental Geochemistry Proceedings: U.S. Geological Survey Open-File Report OF97-496, 100 pp.

USGS science for a changing world

United States Geological Survey

The Association of Exploration Geochemists

Society for Environmental Geochemisty and Health

International Association of Geochemistry and Cosmochemistry

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4th International Symposium on Environmental Geochemistry

ORGANIZING COMMITTEE

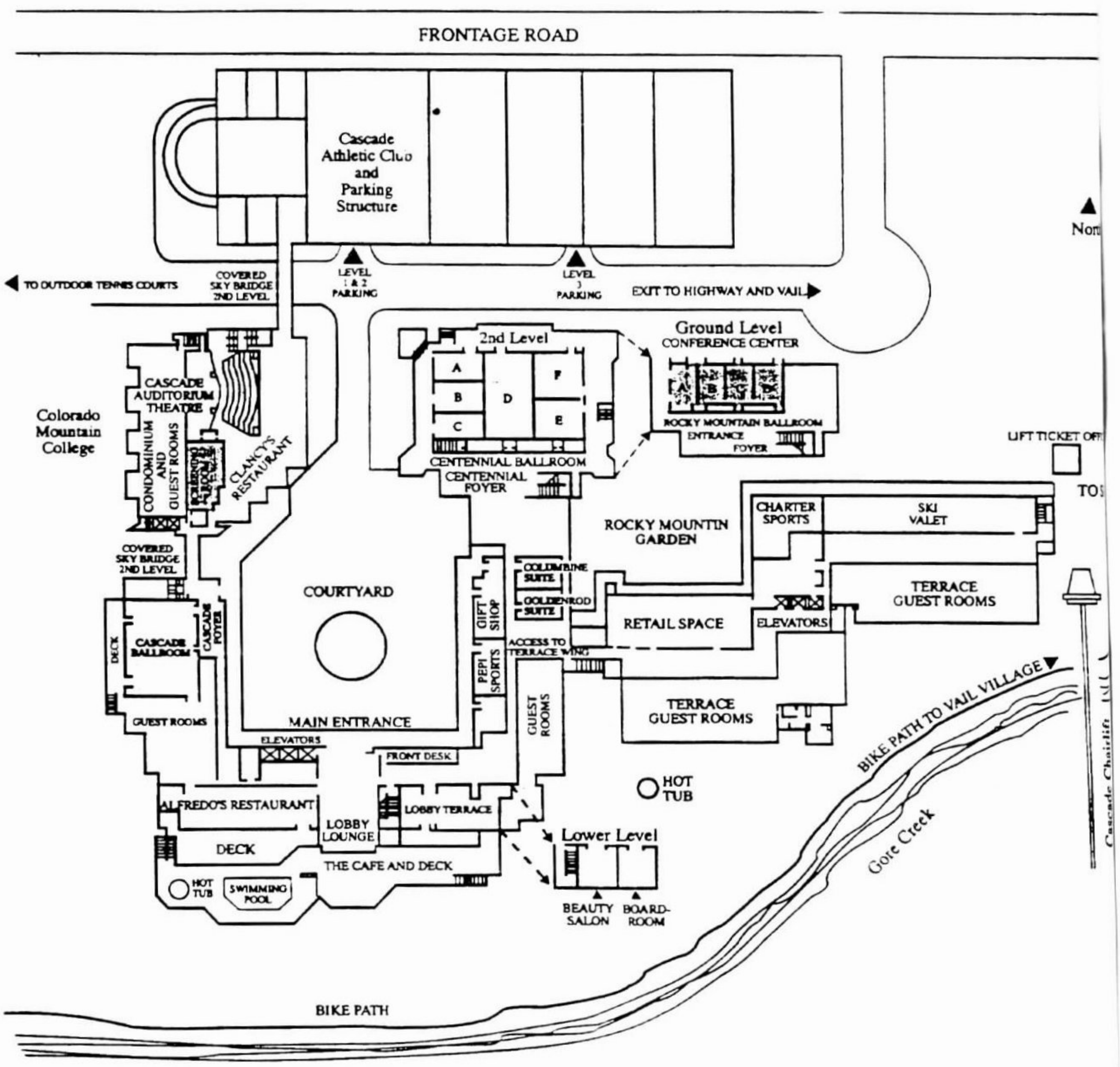
Ms. Cathy Ager
Dr. James Crock
Mr. David Detra
Dr. Larry Gough
Ms. Susan Kropschot
Ms. Pat Krupa
Dr. Paul Lamothe
Mr. Sherman Marsh
Ms. Coleen Schmitt
Mr. Richard Sanzolone
Dr. Ronald Severson
Dr. David Smith

SCIENTIFIC COMMITTEE

Dr. Willard Chappell
Dr. Brian Davies
Dr. Ron Fuge
Dr. Robert Garrett
Dr. Gwennyth Hall
Dr. Betsy Kagey
Dr. Donald Runnells
Dr. Olle Selinus
Dr. Iain Thornton
Dr. Richard Wanty

Graphical Design by
Ms. Barbara J. Ramsey

SITE MAP


FRONTAGE ROAD
Cascade Athletic Club and Parking Structure
TO OUTDOOR TENNIS COURTS
COVERED SKY BRIDGE 2ND LEVEL
LEVEL 1 & 2 PARKING
LEVEL 3 PARKING
EXIT TO HIGHWAY AND VAIL
Colorado Mountain College
CASCADE AUDITORIUM THEATRE
CONDOMINIUM AND GUEST ROOMS
CLANCY'S RESTAURANT
2nd Level
A
B
C
D
E
F
CENTENNIAL BALLROOM
CENTENNIAL FOYER
Ground Level
CONFERENCE CENTER
ROCKY MOUNTAIN BALLROOM
ENTRANCE FOYER
ROCKY MOUNTIN GARDEN
CHARTER SPORTS
SKI VALET
LIFT TICKET OFF
COLUMBINE SUITE
GOLDENROD SUITE
COURTYARD
GIFT SHOP
PEPI SPORTS
ACCESS TO TERRACE WING
RETAIL SPACE
ELEVATORS
TERRACE GUEST ROOMS
DECK
CASCADE BALLROOM
CASCADE FOYER
GUEST ROOMS
MAIN ENTRANCE
ELEVATORS
FRONT DESK
GUEST ROOMS
TERRACE GUEST ROOMS
HOT TUB
ALFREDO'S RESTAURANT
LOBBY LOUNGE
LOBBY TERRACE
DECK
THE CAFE AND DECK
HOT TUB
SWIMMING POOL
Lower Level
BEAUTY SALON
BOARD-ROOM
BIKE PATH TO VAIL VILLAGE
Gore Creek
Cascade Chairlift
BIKE PATH

4th International Symposium on Environmental Geochemistry Conference

October 5 - October 10, 1997

Vail Cascade Hotel & Club
Vail, Colorado

GENERAL INFORMATION

ACCOUNTS—All incidental expenses for items not covered by your registration fee are your responsibility and must be settled directly between you and the Hotel. These expenses include items such as: meals, telephone calls, room service, bar bill, additional accommodations, golf green fees, etc.

ACUTE MOUNTAIN SICKNESS—Please take the time to read the Colorado Altitude Research Institute information included in your registration bag. Vail Valley starts at 8,000-foot (2500-m) elevation, with surrounding terrain rising higher. Depending upon the altitude, 20 to 30% of all visitors from sea level have one or more symptoms of acute mountain sickness. The Organizing Committee would like your stay to be safe and enjoyable.

- ✔ Increase Fluid Intake
- ✔ Decrease Salt Intake
- ✔ Moderate Your Physical Activity
- ✔ Eat Low Fat Meals
- ✔ Reduce Alcohol and Caffeine Consumption
- ✔ Feeling Lousy? Seek Help through Hotel
- ✔ Have Fun!

CASCADE ATHLETIC CLUB—For a nominal daily usage fee of $12.00 ($20/4 days, $30/week), delegates have privileges to the sports, fitness, and health facility. Located adjacent to the Hotel, the Club provides a variety of spa and recreation facilities including indoor/outdoor tennis, racquetball, squash, basketball, aerobics, Nautilus equipment, steam rooms, and more. Passes can be purchased at the front desk.

HOTEL CHECK-IN AND CHECK-OUT TIME—Hotel check-in time is 4:00 p.m. on day of arrival and check-out time is 12:00 p.m. on day of departure or Friday, October 10. Luggage may be stored at the front desk. Delegates staying in their rooms beyond check-out time will be charged for an additional room night.

MESSAGE CENTER—A message center will be maintained in the Centennial Foyer for the convenience of conference attendees. Incoming messages for attendees will be posted on individual room phones or the message center board, near the Registration Desk. To call the center, dial 970-476-7111 and ask for the 4th ISEG Message Center.

NO SMOKING—For the comfort of all, please refrain from smoking in the meeting rooms, eating areas, and foyer.

BUSINESS CENTER—Fax, photocopying, or transparencies. Check at Hotel Registration Desk.

EXHIBITS—The 4th International Symposium on Environmental Geochemistry will feature an exhibition of scientific equipment, accessories, and supplies. Exhibits will be located in the Centennial Foyer. Exhibits will be open Monday, Tuesday, Thursday, and Friday during conference hours with coffee and soft drinks served each day during breaks.

EXHIBIT HOURS:		
	Monday, October 5	**9 a.m. to 8 p.m.**
	Tuesday, October 7	**9 a.m. - 5 p.m.**
	Thursday, October 9	**9 a.m. - 6:30 p.m.**
	Friday, October 10	**9 a.m. - 12 noon**

ORAL PRESENTATIONS—The Conference Center Centennial Ballroom will be the site for all lectures.

Because of the parallel sessions, Session Chairs have been asked to keep strictly to the schedule time table, which allows 20 minutes for presentations. Authors are requested to make themselves known to the Session Chairs before the session begins.

Speakers will be able to preview their slides in the Goldenrod Suite. Viewers will be available.

POSTER PRESENTATIONS—Posters will be on display in the Rocky Mountain Ballroom Sunday evenings throug morning. Authors will be asked to attend their posters during the Monday mixer and Thursday social hour. Session 1, 3 and 10 authors may put up their posters between 3:00 and 5:30 p.m. on Sunday and should take them down before noon Wednesday to ensure that the boards are available. Session 2, 4, 6, and 9 authors may put up their posters Wednesday af and should take them down by 1:00 p.m. on Friday.

REGISTRATION—Registration Badges are required for admission to all technical sessions, exhibits, and functions appropriate badge is required for admittance and will be checked at the entrances of all activities. Everyone attending th Conference, including speakers and exhibitors, is required to register. Advance registration pickup and on-site registrati be conducted during the following hours:

Sunday, October 5 ..... 1 p.m. to 6 p.m. ..... Lobby Terrace
Monday, October 6 ..... 7 a.m. to 5 p.m. ..... Centennial Foyer
Tuesday, October 7 ..... 8 a.m. to 5 p.m. ..... Centennial Foyer
Later registration will be available.

REGISTRATION FEE—The registration fee is $325. This includes the published program with abstracts, refreshm breaks, opening reception on Sunday, October 5, and banquet on Thursday, October 9, and all other social functions. On passes will be available for attendance at the presentation sessions and refreshments breaks for $150 per day. Students m register for $100 with a valid student card (excludes banquet); spouses for $100 (social functions including banquet).

SESSION CHAIRS—Please meet briefly with the Organizing Committee on Monday, October 6 at 12 noon in Cent ABCD.

SHUTTLE BUS—The Hotel operates a complimentary shuttle from 7 a.m.-12 midnight to Vail Village and LionsHe general guest use. Shuttles operate on 20-minute intervals, depending on distance and weather conditions. Van transport from the Hotel to Denver International Airport is available from Colorado Mountain Express at Tel: 1-800-525-6363. W making your reservation, mention the special group code "4th ISEG" and receive a discount.

SOCIAL FUNCTIONS

Opening Reception—Sunday, October 6, from 6:00-8:00 p.m. in the Cascade Ballroom.

Mixer (in conjunction with Posters)—Monday, October 7, from 5:30-7:00 p.m. in the Centennial Foyer.

Social Hour (in conjunction with Posters)—Thursday, October 9, from 5:30-6:30 p.m. in the Centennial Foyer

Banquet—Thursday, October 9, from 6:30-8:30 p.m. in the Cascade Ballroom.
Please notify the Organizing Committee by Monday evening if you have any special food requirements for the b

A presentation for guests on Vail Valley activities will be given by the Hotel concierge in the Lobby Terrace from 9: a.m., Monday, October 6. Recreation information will be available at the Conference Registration Desk Monday during lunch break and during the mixer.

FOOD SERVICE—Breakfast will be available between 6:30 and 8:00 a.m. in the Cascade Ballroom every morning. Lunch will be served from 12:00 noon to 1:40 p.m. in the Cascade Ballroom. Refreshments will be served during the morning and afternoon breaks in the Centennial Foyer, where the exhibits will be displayed.

MENU—*(All prices include tax and gratuity)*

Breakfast options October 6-10

A la Carte Quick breakfast
Coffee $2.00
Juice $2.00
Bagel $3.00
Muffin, Danish, Doughnut $2.00

Full Continental breakfast $11.00
Coffee, juice, fresh fruit, cold cereals, breakfast breads, Danish, muffins, toast, hard breads, and international and domestic cheeses.

Full Buffet Breakfast $13.00
includes all of the above plus fluffy scrambled eggs, Colorado hash browns, sugar cured bacon or country sausage, and a daily griddle item.

Lunch option Monday, October 6

Italian Pasta Buffet $13.00
Two pastas, tomato basil and alfredo sauce, Caesar salad, garlic bread, Chef's choice of Italian dessert, and iced tea.

Lunch option Tuesday, October 7

Executive Deli Buffet $13.00
Assorted cold cuts, soup du jour, assorted cold salads, appropriate condiments, tossed salad with two dressings, breads, brownies, and iced tea.

Lunch option Thursday, October 9

Mountain Grill Buffet
Grilled hamburgers and hot dogs, corn on the cob, cowboy beans, tossed salad, fresh lettuce and tomato, appropriate condiments, fruit cobbler, and iced tea.

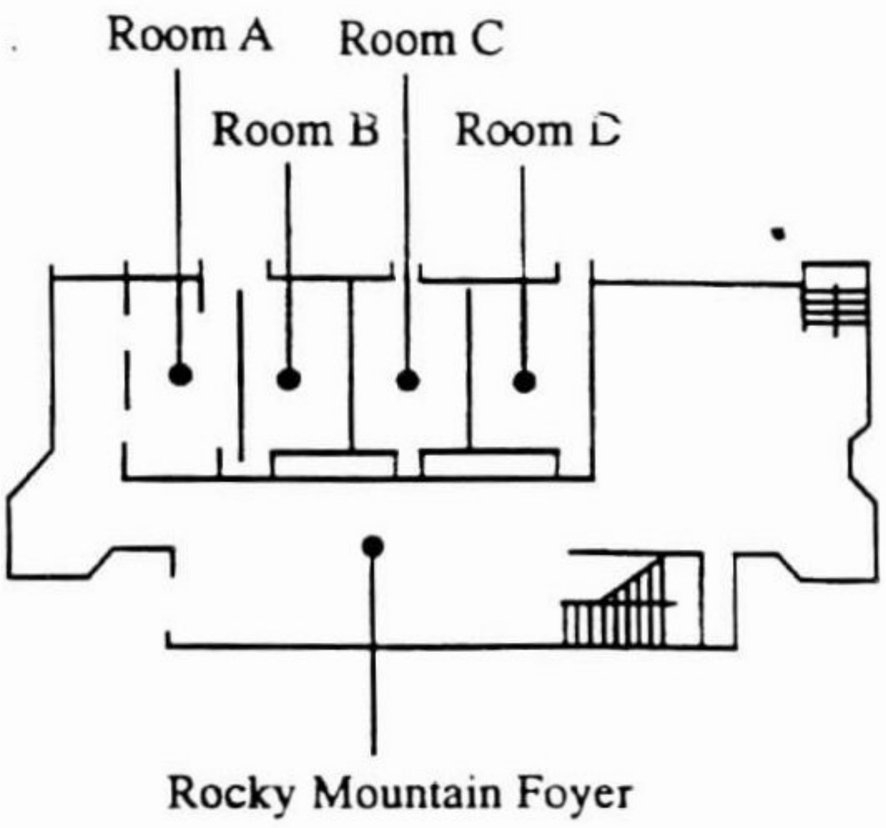
Lunch option Friday, October 10

Mexican Madness Buffet $13.00
"Build-your-own-taco-station" with flour and corn tortillas, ground beef, shredded cheese, diced fresh tomatoes, onions, peppers, sour cream, guacamole, etc., tossed salad, sugared churros, and iced tea.

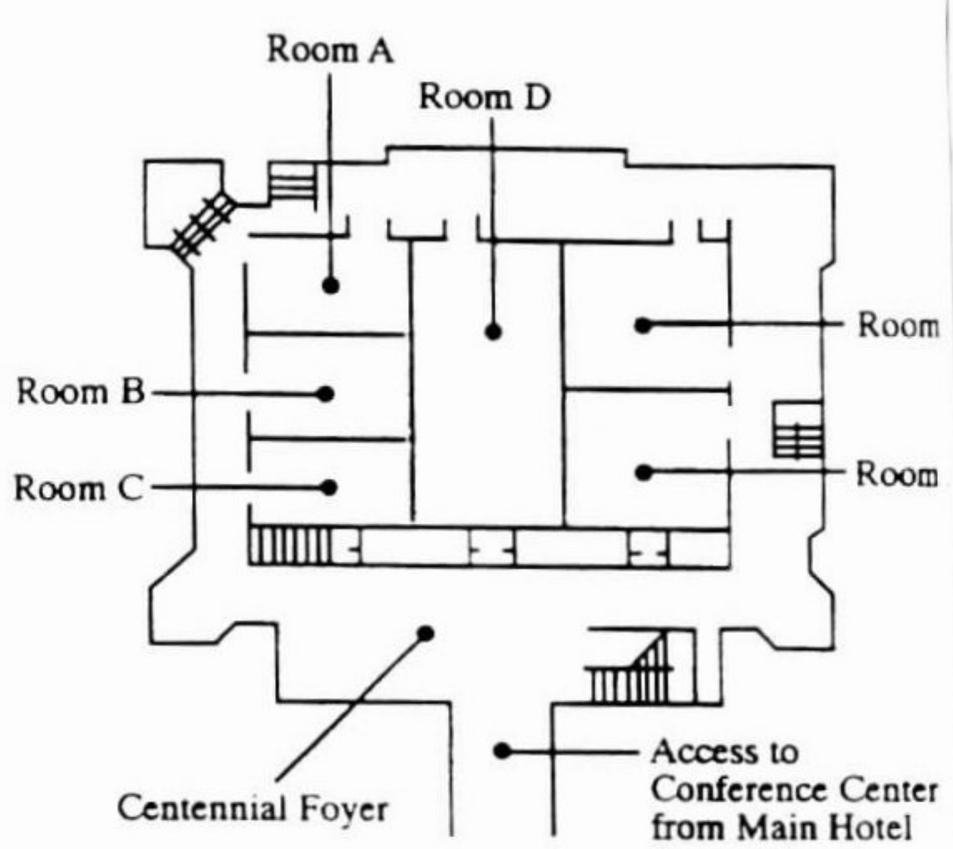
MEETING AND BANQUET FACILITIES

CONFERENCE CENTER

ROCKY MOUNTAIN BALLROOM
First Level

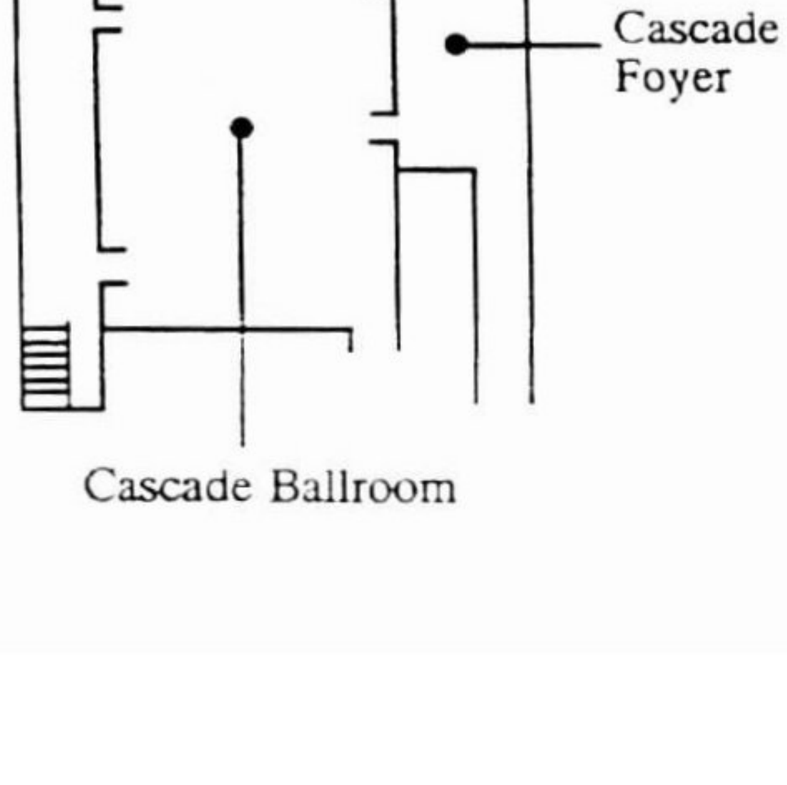


CENTENNIAL BALLROOM
Second Level

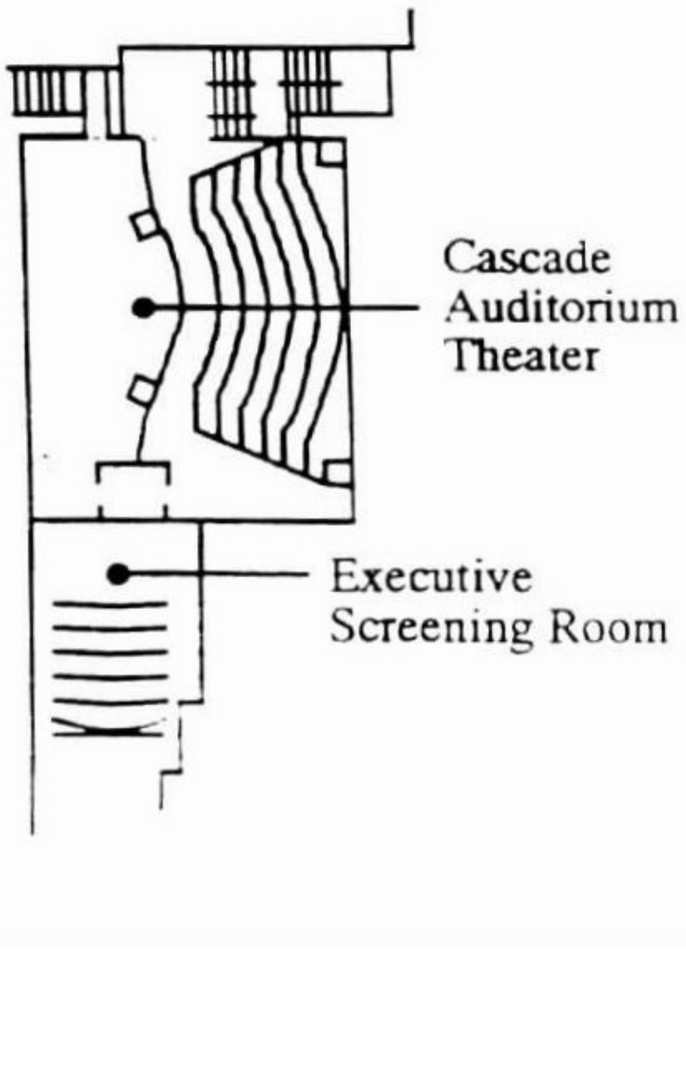


MAIN HOTEL

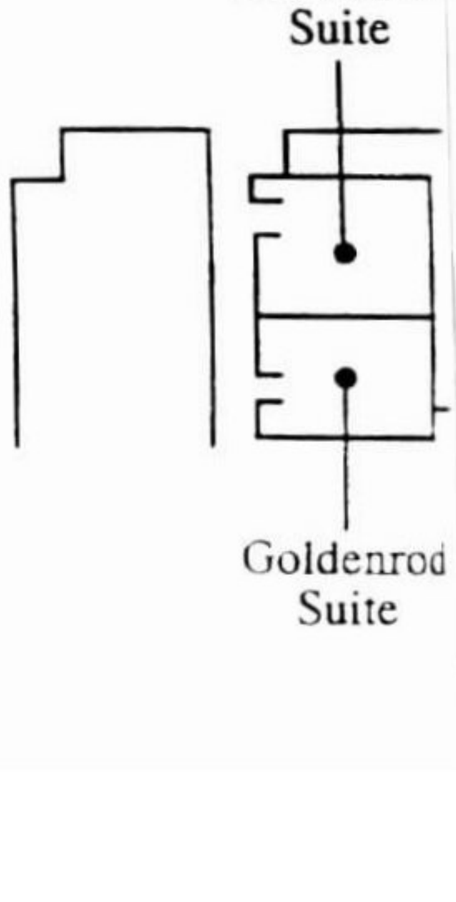
CASCADE BALLROOM
First Level



THEATERS
Second Level



MEETING SUITI



CALENDAR OF EVENTS

SUNDAY, OCTOBER 5, 1997

9:00 a.m.- 5:00 p.m.	Global Baselines Meeting	Centennial B
9:00 a.m.- 5:00 p.m.	SEGH Meeting	Centennial C
9:00 a.m.- 5:00 p.m.	Acid Forming Materials Workshop	Centennial E
1:00 p.m.- 6:00 p.m.	Registration	Lobby Terrace
1:00 p.m.- 5:00 p.m.	Geochemical Data Workshop	Centennial F
3:00 p.m.- 5:30 p.m.	Poster (Sessions 1, 3, 5, 7, 8, 10) and Exhibit Setup	Rocky Mountain Ballroom and Centennial Foyer
6:00 p.m.- 8:00 p.m.	Opening Reception	Cascade Ballroom

MONDAY, OCTOBER 6, 1997

6:30 a.m.- 8:00 a.m.	Breakfast on your own	Cascade Ballroom
7:00 a.m.- 5:00 p.m.	Conference Registration	Centennial Foyer
7:00 a.m.- 5:00 p.m.	Speaker Ready Room	Goldenrod
8:00 a.m.- 8:00 p.m.	Poster Session (1, 3, 5, 7, 8, 10)	Rocky Mountain Ballroom
8:20 a.m.-10:00 a.m.	General Session	Centennial ABCD
9:00 a.m.-10:00 a.m.	Vail Valley activity presentation	Lobby Terrace
9:00 a.m.- 8:00 p.m.	Exhibits	Centennial Foyer
10:00 a.m.-10:20 a.m.	Refreshment Break	Centennial Foyer
10:20 a.m.-12:00 noon	Session 1-1 to 1-4	Centennial ABCD
10:20 a.m.-12:00 noon	Session 2-1 to 2-4	Centennial EF
12:00 noon- 1:40 p.m.	Lunch on your own	Cascade Ballroom
12:00 noon- 1:40 p.m.	Tourist Information—Reg. Desk	Registration Desk
12:00 noon	Chairperson meeting	Centennial ABCD
1:40 p.m.- 3:20 p.m.	Session 1-5 to 1-9	Centennial ABCD
1:40 p.m.- 3:20 p.m.	Session 2-5 to 2-9	Centennial EF
3:20 p.m.- 3:40 p.m.	Refreshment Break	Centennial Foyer
3:40 p.m.- 5:10 p.m.	Session 1-10 to 1-13	Centennial ABCD
3:40 p.m.- 5:10 p.m.	Session 2-10 to 2-13	Centennial EF
5:30 p.m.- 7:00 p.m.	Mixer	Centennial Foyer
5:00 p.m.- 6:30 p.m.	Tourist Information	Main Centennial Foyer

TUESDAY, OCTOBER 7, 1997

6:30 a.m.- 8:00 a.m.	Breakfast on your own	Cascade Ballroom
7:00 a.m.- 5:00 p.m.	Speaker Ready Room	Goldenrod
8:00 a.m.- 5:00 p.m.	Registration	Centennial Foyer
8:00 a.m.-10:00 a.m.	Session 3-1 to 3-6	Centennial ABC
8:00 a.m.-10:00 a.m.	Session 4-1 to 4-6	Centennial D
8:00 a.m.- 5:30 p.m.	Poster Session (1, 3, 5, 7, 8, 10)	Rocky Mountain Ballroom
9:00 a.m.- 5:00 p.m.	Exhibits	Centennial Foyer
10:00 a.m.-10:20 a.m.	Refreshment Break	Centennial Foyer
10:20 a.m.-12:00 noon	Session 3-7 to 3-10	Centennial ABC
10:20 a.m.-12:00 noon	Session 4-7 to 4-10	Centennial D
12:00 noon- 1:40 p.m.	Lunch on your own	Cascade Ballroom
1:40 p.m.- 3:20 p.m.	Session 3-11 to 3-15	Centennial ABC
1:40 p.m.- 3:20 p.m.	Session 4-11 to 4-15	Centennial D
3:20 p.m.- 3:40 p.m.	Refreshment Break	Centennial Foyer
3:40 p.m.- 5:10 p.m.	Session 3-16 to 3-19	Centennial ABC
3:40 p.m.- 5:10 p.m.	Session 4-16 to 4-19	Centennial D
5:30 p.m.- 7:00 p.m.	SEGH Business Meeting	Centennial E

WEDNESDAY, OCTOBER 8, 1997

6:30 a.m.- 8:00 a.m.	Breakfast on your own	Cascade Ballroom
	Field Trips	
8:00 a.m.-12:00 noon	Poster Take Down (Sessions 1, 3, 5, 7, 8, 10)	Rocky Mountain Ba
9:00 a.m.- 5:00 p.m.	Global Baseline Meeting	Centennial E
12:00 noon- 5:00 p.m.	Poster Setup (Sessions 2, 4, 6, 9)	Rocky Mountain Ba
1:00 p.m.- 5:00 p.m.	International Geoscience and	Centennial F
	Health Working Group	

THURSDAY, OCTOBER 9, 1997

6:30 a.m.- 8:00 a.m.	Breakfast on your own	Cascade Ballroom
7:00 a.m.- 2:00 p.m.	Speaker Ready Room	Goldenrod
8:00 a.m.- 5:30 p.m.	Poster Session (2, 4, 6, 9)	Rocky Mountain Ba
8:00 a.m.-10:00 a.m.	Session 5-1 to 5-6	Centennial ABC
8:00 a.m.-10:00 a.m.	Session 4-20 to 4-25	Centennial D
9:00 a.m.- 6:30 p.m.	Exhibits	Centennial Foyer
10:00 a.m.-10:20 a.m.	Refreshment Break	Centennial Foyer
10:20 a.m.-12:00 noon	Session 6-1 to 6-4	Centennial ABC
10:20 a.m.-12:00 noon	Session 8-1 to 8-4	Centennial D
12:00 noon- 1:40 p.m.	Lunch on your own	Cascade Ballroom
1:40 p.m.- 3:20 p.m.	Session 6-5 tp 6-9	Centennial ABC
1:40 p.m.- 3:20 p.m.	Session 8-5 to 8-9	Centennial D
3:20 p.m.- 3:40 p.m.	Refreshment Break	Centennial Foyer
3:40 p.m.- 5:10 p.m.	Session 6-10 to 6-13	Centennial ABC
3:40 p.m.- 5:10 p.m.	Session 8-10 to 8-13	Centennial D
5:30 p.m.- 6:30 p.m.	AEG Business Meeting	Cascade Ballroom
5:30 p.m.- 6:30 p.m.	Social Hour	Rocky Mountain Fo
6:30 p.m.- 8:30 p.m.	Banquet	Centennial Ballroon

FRIDAY, OCTOBER 10, 1997

6:30 a.m.- 8:00 a.m.	Breakfast on your own	Cascade Ballroom
7:00 a.m.- 2:00 p.m.	Speaker Ready Room	Goldenrod
8:00 a.m.-10:00 a.m.	AEG Council Meeting	Lobby Terrace
8:00 a.m.-10:00 a.m.	Session 5-7 to 5-12	Centennial ABC
8:00 a.m.-10:00 a.m.	Session 7-1 to 7-6	Centennial D
8:00 a.m.- 5:30 p.m.	Poster Session & Take Down (2, 4, 6, 9)	Rocky Mountain Ba
9:00 a.m.- 12:00 noon	Exhibits	Centennial Foyer
10:00 a.m.-10:20 a.m.	Refreshment Break	Main Centennial Fo
10:20 a.m.-12:00 noon	Session 9-1 to 9-5	Centennial ABC
10:20 a.m.-12:00 noon	Session 10-1 to 10-4	Centennial D
12:00 noon-12:30 p.m.	Closing General Session	Centennial ABCD
12:30 p.m.	Lunch on your own	Cascade Ballroom

WORKSHOPS—SUNDAY, OCTOBER 5

Acid-Forming Materials and Land Reclamation
9:00 a.m. - 5: 00 p.m.

Scott Fisher
River Bend Assoc.

Centennial E
Fee: $75

The workshop will provide the participant with an overview of the importance and types of pre-disturbance planning procedures. It will discuss methods of mitigation of acid forming materials (AFM) resulting from mining and related forms of drastic-land disturbance. Emphasis during the program will be placed on the identification of AFM and its proper handling during the mining operation. Integration of mining procedures with reclamation plans will be stressed. The limited potential for ecosystem reclamation where AFM contamination has taken place is an important thesis that will be stressed throughout the program.

Elements of the course will include a broad introduction, a discussion of pyrite and related mineral formation, processes associated with the weathering of pyrite, impact of acid plant growth media on land reclamation, and acid mine drainage. In addition, topics to be discussed include the sampling and analytical characterization of earthen materials potentially containing AFM, mitigation of terrestrial and aquatic impacts from AFM oxidation, and a review of several case studies involving AFM in the western United States.

Workshop leaders and their topical areas of expertise include: Dr. Terry Brown, Western Research Institute , Laramie, WY (analytical, mitigation, agronomy, and case studies); Margaret Condron, formerly with the Office of Surface Mining, Denver, CO (analytical, planning, agronomy); Scott Fisher, River Bend Associates and Arid Lands Reclamation Newletter, Medicine Bow, WY (planning, analytical, mitigation).

Collecting geochemical data for both exploration and environmental purposes
1:00 p.m. - 5: 00 p.m.

Richard K. Glanzman
CH2M Hill,
L. Graham Gloss,
Colorado School of Mines
and
Jeff Jaacks
BHP Minerals

Centennial E
Fee: $50

Data collected and analyzed for exploration purposes can be even more cost-effective and useful when it is used for environmental purposes. The seminar provides exploration and environmental professionals with the information to acquire more useful data for both purposes and to fulfill regulatory agency requirements. A few relatively minor changes can make exploration data not only more accurate and precise, it can also make the same data useful for environmental purposes. This approach can be used during reconnaissance but is intended for use on properties under serious exploration scrutiny.

Topics addressed in this four hour seminar include: definition of sampling objectives, orientation/background surveys, methods of efficiently collecting appropriate data of various media, sampling representativeness, background/baseline issues, analytical considerations/requirements, commercial standards versus site-specific standards (preparation/usefulness), statistical analysis, and risk/liability considerations. Exploration case histories illustrate the usefulness and advantages of this approach.

Decisions made based on the exploration data can be significantly improved. However, of considerably greater importance, the data can significantly reduce the cost and improve the effectiveness of environmental considerations. These considerations involve not only future environmental evaluation(s) but also provide data to support more effective design/evaluation of mine waste disposal to control and minimize environmental concerns.

FIELD TRIPS

David B. Smith, Coordinator

All trips start and end at the *Vail Cascade Hotel & Club*. Departure times will be announced and posted. If you ha pre-registered for a trip, on-site registration ***may*** be possible; check at the Registration Area, *Vail Cascade Hotel & Cl* participants will be accepted on a first-come, first-served basis.

Clear Creek Watershed—Wednesday, October 8

Clear Creek extends from the Continental Divide near the Loveland Ski Area to the confluence with the South Plat in metro Denver. Waters in Clear Creek are impacted by abandoned mines and dumps within the Colorado Mineral Be industrial and municipal wastewater, stormwater and sewer overflows, and accidental leaks and spills of toxic substanc deal with these pollution issues. Clear Creek has a nationally recognized, award-winning watershed initiative underway field trip will capture both the substance of the initiative as well as the spirit of the effort. Major sources of pollution s mine drainages and tailings piles will be visited as well as major cleanup sites using both active and passive treatment t The fee is $70, which includes a box lunch.

Leadville, Colorado—Wednesday, October 8

The historic mining town of Leadville sits near one of the world's largest polymetallic replacement deposits. Sinc discovery of gold in 1858, more than $5.4 billion (1989 prices) of gold, silver, lead, and zinc have been extracted from the Leadville mining district. This large-scale mining also extracted its toll on the environment. In 1983, the town was an 18-square-mile (46.6-square kilometer) Superfund site by the U.S. Environmental Protection Agency as a result of c for impacts to water quality and human health due to heavy metal contamination. This field trip will explore the minin and current remedial activities in and around Leadville. The fee is $55, which includes a box lunch.

Eagle Mine—Wednesday, October 8

The Eagle Mine is an inactive mining and milling facility located on the Eagle River between the towns of Redcliff Minturn. Silver-lead and gold-silver ores attracted miners to the area in the late 1870's. Lead-zinc sulfide ore was enc in the 1890's with mining of zinc ore continuing until the early 1980's. The environmental impact of more than 100 ye mining and milling operations on the Eagle River and adjacent areas was very evident and caused the U.S. Environmen Protection Agency to place the site on its Superfund list in 1986. Since that time a remedial action plan has provided f flooding of the mine workings, consolidation of eight tailings piles into one, placement of a multi-layer clean soil cap o remaining consolidated pile, and construction of a water treatment plant. This field trip will provide an overview of th doned mine site, its environmental and public health impacts, and the ongoing remedial actions. The fee is $35. Antic duration is about 3 hours—no lunch will be provided.

Climax Molybdenum Mine—Wednesday, October 8

The Climax Mine is the world's largest molybdenum mine and rests atop the Continental Divide at an altitude of 1 (3,440 m). At the headwaters of three drainages, the Eagle and Arkansas Rivers and Tenmile Creek, Climax was stake late 1800's for gold before uses of molybdenum had been developed. Gold was never recovered at the Climax Mine, b production of molybdenum began in 1918. The mine is currently not in production, but a small staff is conducting care maintenance with reclamation and water management being major activities. Capping of tailing impoundments, water ment, and revegetation activities take place in the short construction season afforded by this extreme climate. Climax r average of 260 in. (660 cm.) of snow annually and manages water discharges in excess of 200 million gallons (757,000 meters) per day. This field trip will provide the opportunity to learn about the history, geologic setting, and current env tal activities at the mine. The fee is $55, which includes a box lunch.

Upper Animas Watershed—Friday through Sunday, October 10-12

The Upper Animas Watershed, in the heart of the rugged San Juan Mountains of southwest Colorado, has been ser impacted from metals in sediments and surface waters. The upper basin was heavily mined for gold, silver, and base m the past 120 years and thousands of inactive mine sites remain. The Animas River Stakeholders Group has developed rative process (involving local, State, and Federal agencies, mine corporations, land owners, and citizens) for character sources of metals-related contamination throughout the watershed. The inactive mine sites are being characterized, eva remediation potential, and prioritized for cleanup. The field trip will focus on the Silverton area, the last remaining mi San Juan country. Sites will be visited that demonstrate the extent of the existing problems as well as those that reflect mining conditions. Presentations will be given on the history, geology, and ecology of the basin and the numerous geo biological, and physical habitat studies underway. A number of sites that are undergoing remediation will be viewed. $310, which includes 3 lunches and 2 nights lodging—double occupancy.

ACKNOWLEDGMENTS

Sponsorship

The Organizing Committee would like to express their gratitude to the following companies, organizations, and professional societies for their generous support of the 4th International Symposium on Environmental Geochemistry.

The **United States Geological Survey (USGS)** is the leading earth-science organization in the United States. Its mission, since its creation in 1879, has been to investigate, analyze, and disseminate earth-science information needed to solve geological and environmental problems, and to identify and assess resources. The USGS has a long tradition of providing accurate and impartial information to all customers. The USGS conducts investigations and research in geology, geophysics, hydrology, mapping, remote sensing, environmental hazards, environmental issues, and related disciplines. The USGS also conducts mineral and energy resource assessment studies.

The **Association of Exploration Geochemists** (AEG) was founded in 1970 to provide an international forum for persons working in the field of applied geochemistry. It is a professional, non-profit organization promoting interest in the application of geochemistry to mineral and petroleum exploration, resource evaluation, environmental issues, and related fields around the world. The AEG encourages membership and/or contributions from individuals or organizations working with or providing geochemical data for a variety of uses including mineral exploration, analytical technology, computer processing, environmental issues, agriculture, geobotany, biochemistry, and other applications. The AEG disseminates timely information on geochemistry through its journal, the Journal of Geochemical Exploration and through its quarterly newsletter, EXPLORE.

The **Society for Environmental Geochemistry and Health** (SEGH) was founded in 1972 to provide a forum for scientists from various disciplines (geology, biology, epidemiology, medicine, risk assessment, ecology, etc.) to study the relationship between the geochemical environment and health and disease in plants, humans and animals. SEGH recognizes the importance of this approach in opening the lines of communication between academia, industry and regulatory agencies. SEGH, through annual conferences, our journal Environmental Geochemistry and Health, and Task Forces, provides our membership the opportunity to address environmental geochemistry and health issues from their representative disciplines and, at times, conflicting points of view.

The **International Association of Geochemistry and Cosmochemistry** (IAGC) is affiliated with the International Union of Geological Sciences and has been one of the preeminent international geochemical and cosmochemical organizations for over twenty-five years. The principal objective is to foster cooperation in, and advancement of, geochemistry and cosmochemistry in the broadest sense. This is achieved (1) by working with any interested group in planning symposia and other types of meetings related to geochemistry and cosmochemistry; (2) by sponsoring publications in geochemistry and cosmochemistry of a type not normally covered by existing organizations; and (3) through the activities of working groups which study problems that require, or would benefit from, international cooperation.

The scientific thrust of IAGC takes place through its Working Groups (many of which organize regular symposia) and the official journal APPLIED GEOCHEMISTRY. The interests of the Working Groups cover a wide spectrum of geochemical and cosmochemical activities, including (1) geochemical prospecting; (2) water-rock interaction; (3) interaction between water and living matter; (4) extraterrestrial geochemistry; (5) geochemistry of the earth surface; (6) geochemistry of isotopes; (7) thermodynamics of natural processes; (8) cooperation in applied geochemistry-special training for the developing countries; (9) geochemistry of health and disease. Although partial financial support for the Working Groups comes from IAGC, most are self-sustaining. Participants in the Working Groups may include geochemists who are not Individual Members of IAGC.

Session Chairpersons

The 4th ISEG Organizing Committee thanks the session chairs named below for their contribution:

Session 1: ***Mine Drainage Formation and Geochemistry—***
Kathleen Smith, Jenny Webster, Donald Runnells, and Willard Chappell

Session 2: ***Geochemistry of Fresh Water & Marine Environments—***
Frank Manheim, Edeltrauda Helios-Rybicka, Joy Rae, and Martin Fey

Session 3: ***SEGH-Sponsored Session—Environmental Geochemistry and Health***
Betsy Kagey, Iain Thornton, Brian Davies, and Ron Fuge

Session 4: ***Methods of Environmental Geochemical Monitoring, Modeling, and Mapping*** and ***Use and Determination of Geochemical Baselines***
Olle Selinus, Alina Kabata-Pendias, Jörg Matschullat, and Dave Smith

Session 5: ***Trace Substances, Ecosystems, and Bioavailability—Aquatic/Atmosphere***
Laurie Balistrieri, David Levy, John Gray, and Gianni Cortecci

Session 6: ***AGE-Sponsored Session—Environmental Geochemistry of Ore Deposits***
Sherman Marsh, Eion Cameron, Robert Garrett, and Maurice Chaffee

Session 7: ***Environmental Analytical Techniques & Applications***
Gwennyth Hall and James Crock

Session 8: ***Trace Substances, Ecosystems, and Bioavailability—Terrestrial***
William Orem, Irina Stangeeva, Harald Püchelt, and Rama Kotra

Session 9: ***Remediation of Mining-Related Disturbances***
Harry Posey and Suresh Kumar

Session 10: ***Natural and Man-Made Radiogenic Hazards***
Rich Wanty and John Glendinning

GUEST SPEAKERS

P. Patrick Leahy. Chief Geologist
U.S. Geological Survey
Reston. Virginia

Dr. P. Patrick Leahy was named Chief Geologist of the Geologic Division of the U.S. Geological Survey in 1995. He has been with the U.S. Geological Survey since 1974. having served in various technical and managerial positions. including Chief of the National Water-Quality Assessment Program.
Dr. Leahy was born in Troy. New York. in 1947. He holds undergraduate and graduate degrees in geology (1968) and geophysics (1970) from Boston College. He received his doctorate in geology (1979) from Rensselaer Polytechnic Institute where he specialized in regional ground water studies and hydraulics.
Dr. Leahy is a Fellow in the Geological Society of America and is a member of the American Geophysical Union and the American Institute of Hydrology. He has received many awards and is active in numerous professional organizations. Currently he is President of the International Association of Hydrogeologists.

Linda C. Gundersen
U.S. Geological Survey
Mineral Resources Program
Reston. Virginia

For the last 18 years. Linda Gundersen has worked as a geologist with the US Geological Survey. She is Coordinator of the Mineral Resources Program which is a $58 million domestic program with a staff of 440 people and a $12 million international mission in Saudi Arabia. She started with the USGS as a field assistant working on diverse projects in sedimentology. stratigraphy. and economic geology. She spent 12 years conducting research and heading projects in the field of radionuclides—from determining the origin of hard rock uranium deposits to studying radon. uranium. and radium in soil. rocks. and water. and eventually assessing the geologic radon potential of the United States. In 1995. she took a temporary assignment as Coordinator of the Energy Program and in 1996 became the Coordinator of the Minerals Program—overseeing a major reorganization. Currently she also serves on a National Academy of Sciences Committee on Risk Assessment of Exposure to Radon in Drinking Water and on the Steering Committee of the IUGS-UNESCO Deposit Modeling Program. Her academic background includes undergraduate and graduate work in structural geology and geochemistry at the State University of New York at Stony Brook and at the University of Colorado in Boulder.

Alina Kabata-Pendias
Trace Element Laboratory
Pulawy. Poland

Professor Kabata-Pendias is Professor of Soil Chemistry and head of the Trace Element Laboratory of the Institute of Soil Science and Plant Cultivation in Pulawy. Poland. where she has worked for over 30 years. She is an author of more than a hundred publications on the occurrence of trace elements in natural and contaminated environments including the much-acclaimed book "Trace Elements in Soils and Plants" (CRC Press). Professor Kabata-Pendias also works in the Geological Institute in Warsaw on the mobility of trace elements and on the alteration of minerals in weathered zones of various geological formations. She has been involved in analytical and methodological studies on trace elements and clay minerals. Dr. Kabata-Pendias continues to be very active in numerous scientific societies as both councilor and committee member.

Thomas J. Noel
Banquet Speaker
University of Colorado at Denver
Denver. CO

Dr. Noel is a professor of history at the University of Colorado. Denver who specializes in Colorado history. He has authored over 60 publications including articles. books. reviews. and television scripts. He has won numerous awards for both his writing and his teaching. He is a recognized expert on the mining camps and "Old West" flavor of Colorado. He is active in many professional associations many of which are dedicated to the preservation of the architecture and culture of historical Colorado.

EXHIBITORS

Paul Lamothe, Coordinator

The 4th International Symposium on Environmental Geochemistry thanks vendors for providing an opportun and discuss their products and services. The following exhibitors will be in attendance:

5th ISEG	University of Cape Town Department of Geological Sciences Rondebosch, South Africa 7700
ACZ Laboratories, Inc.	30400 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493
Canadian Certified Reference Materials Project	555 Booth Street Ottawa, Ontario, Canada K1A 0G1 (613) 992-1055
Crystals Unlimited	P.O. Box 5054 Golden, CO 80401 (303) 278-1218
Quanterra Enviromental Services, Inc.	4955 Yarrow Street Arvada, CO 80002 (303) 421-6611
Shepherd Miller, Inc.	3801 Automation Way Fort Collins, CO 80525 (970) 223-9600
U.S. Geological Survey	Mineral Resources Program 12201 Sunrise Valley Dr., MS-913 Reston, VA 20192 (703) 648-6620
AEG	P.O. Box 26099 72 Robertson Road Nepean, ON K2H 9R0 Canada

4th International Symposium on Environmental Geochemistry
Program Matrix

Senior authors consult table of titles for presentation time
(please note that some changes have been made since the publication of the preliminary program matrix)

	Sun.	Mon. 10/6		Tues. 10/7		Wed.	Thurs. 10/9		Fri. 10/10	
	////	/////// ///////		Sess. 3	Sess. 4	////	Sess. 5	Sess. 4	Sess. 5	Sess. 7
Time:	////	/////// ///////		/////// ///////		/////	/////// ///////		/////// ///////	
8:00 - 8:20	////	/////// ///////		3-1	4-1	////	5-1	4-20	5-7	7-1
8:20 - 8:40	////	8:20 -- Opening		3-2	4-2	////	5-2	4-21	5-8	7-2
8:40 - 9:00	////	Remarks:		3-3	4-3	////	5-3	4-22	5-9	7-3
9:00 - 9:20	////	*General*		3-4	4-4	////	5-4	4-23	5-10	7-4
9:20 - 9:40	////	*Plenary*		3-5	4-5	////	5-5	4-24	5-11	7-5
9:40 - 10:00	////	*Session*		3-6	4-6	////	5-6	4-25	5-12	7-6
10:00 - 10:20	////	/////// ///////		/////// ///////		/////	/////// ///////		/////// ///////	
	////	Sess. 1	Sess. 2	Sess. 3	Sess. 4	/////	Sess. 6	Sess. 8	Sess. 9	Sess. 10
10:20 - 10:40	////	1-1	2-1	3-7	4-7	////	6-1	8-1	9-1	10-1
10:40 - 11:00	////	1-2	2-2	3-8	4-8	////	6-2	8-2	9-2	10-2
11:00 - 11:40	////	1-3	2-3	3-9	4-9	////	6-3	8-3	9-3	10-3
11:40 - 12:00	////	1-4	2-4	3-10	4-10	////	6-4	8-4	9-4/9-5	10-4
12:00 - 1:40	////	/////// ///////		/////// ///////		/////	/////// ///////		12:00 - 12:30	
	////	Sess. 1	Sess. 2	Sess. 3	Sess. 4	/////	Sess. 6	Sess. 8	Closing Remarks	
1:40 - 2:00	////	1-5	2-5	3-11	4-11	////	6-5	8-5	*General*	
2:00 - 2:20	////	1-6	2-6	3-12	4-12	////	6-6	8-6	*Session*	
2:20 - 2:40	////	1-7	2-7	3-13	4-13	////	6-7	8-7	///////	///////
2:40 - 3:00	////	1-8	2-8	3-14	4-14	////	6-8	8-8	///////	///////
3:00 - 3:20	////	1-9	2-9	3-15	4-15	////	6-9	8-9	///////	///////
3:20 - 3:40	////	/////// ///////		/////// ///////		/////	/////// ///////		///////	///////
3:40 - 4:00	////	1-10	2-10	3/16	4-16	////	6-10	8-10	///////	///////
4:00 - 4:20	////	1-11	2-11	3-17	4-17	////	6-11	8-11	///////	///////
4:20 - 4:40	////	1-12	2-12	3-18	4-18	////	6-12	8-12	///////	///////
4:40 - 5:00	////	1-13	2-13	3-19	4-19	////	6-13	8-13	///////	///////
	////	/////// ///////		/////// ///////		/////	/////// ///////		///////	///////
Poster sessions	1, 3, 5, 7, 8, 10					2, 4, 6, 9				

4th International Symposium On Environmental Geochemistry — PROGRAM

SENIOR AUTHOR			TITLE	COUNTRY	P/O*	Oral: Session-Sequence*	Post Date Seq
			SPECIAL SESSION—Guest Speakers				
Leahy	P.		Patrick (USGS Chief Geologist, Reston, VA—INVITED) The role of environmental geochemistry in the U.S. Geological Survey	USA	O		
Gundersen	Linda	C.	(USGS Mineral Resources Program, Reston, VA—INVITED) Environmental geochemistry—a vital component of the U.S. Geological Survey Mineral Resources Program.	USA	O		
Kabata-Pendias	Alina		(Trace Element Laboratory, Pulawy, Poland—INVITED) Soil parameters as a basis for the assessment of trace metal pollution	POLAND	O		
			Session 1. Mine Drainage Formation and Geochemistry				
			Session Chairs: Kathleen Smith and Jenny Webster (a.m.); Donald Runnells and Willard Chappell (p				
Smith	Kathleen	S.	Geochemical characterization of a fluvial tailings deposit along the Arkansas River, Colorado, USA	USA	O	1-1	
Balistrieri	Laurie	S.	A comparison of the geochemistry of water draining from adits and tailings piles in the Coeur d'Alene mining district—information for the geoenvironmental component of mineral deposit models	USA	O	1-2	
Kelley	Karen	D.	Natural acid drainage associated with shale-hosted Ag-Pb-Zn massive sulfide deposits in the Brooks Range, northern Alaska, USA	USA	O	1-3	
Overly	Bryan	M.	Variations in chemical and bacterial species of acid mine drainage affecting the Snow Fork drainage basin, Ohio—the Esco #40 underground mine	USA	O	1-4	
Pearce	Nicholas	J.G.	Behavior of heavy metals and REE in acid mine drainage—implications for the behavior of transuranic metals	WALES UK	O	1-5	
Evangelou	V.	P.	Influence of bicarbonate on pyrite oxidation	USA	O	1-6	
Webster	Jenny	G.	Trace metal adsorption onto schwertmannite (iron oxyhydroxysulfate) in acid mine drainage systems	N. ZEALAND	O	1-7	
Stanton	Mark	R.	Mineral crusts or microbial mats? Alteration of surficial mine tailings in the Leadville District, Colorado	USA	O	1-8	
Hammarstrom	Jane	M.	Formation of gossan and oxidation of sulfide ores as analogs of oxidation of tailings piles	USA	O	1-9	
Odor	L.		Mobilization and attenuation of metals downstream of a base-metal mining site in the Mátra Mountains, northeastern Hungary	USA	O	1-10	
Lind	C.	J.	In-situ alteration of minerals by acidic ground water resulting from mining activities	USA	O	1-11	
Church	Stanley		Geochemical and lead-isotopic studies of the environmental effect of mining at Summitville, Colorado	USA	O	1-12	
Fricke	James		Biotreatment of metal mine waste waters—case histories	USA	O	1-13	
Amacher	M.	C.	Reactions and transport of copper in headwater streams receiving acid rock drainage	USA	P		S-W
Bliss	Linda	N	Buffering of acid rock drainage by silicate minerals	USA	P		S-W
Gray	Floyd		Source chemistry and characteristics of intermittent stream waters having low pH and elevated metal concentrations, Patagonia Mountains, Arizona	USA	P		S-W
Hälbich	Torsten		Biogeochemistry of acid drainage from coal mining operations in the Witbank area	S. AFRICA	P		S-W
Lanyon	Ruth		Dispersal of arsenic by gold mining near Barberton, South Africa	S. AFRICA	P		S-W
Kempton	J.	H.	Moisture and salinity limits on pyrite oxidation in semi-arid climates	USA	P		S-W
Lee	Gregory	K.	Geoenvironmental assessment of Montana—potential for acidic, metal-rich drainage	USA	P		S-W
Miller	Rebecca	A.	Geochemistry and water quality prediction for skarn deposits in the New World Mining District		P		S-W
Pride	Douglas	E.	Identification and characterization of mine effluent in streams of the Colorado mineral belt—the Snake River, Montezuma mining district	USA	P		S-W
Ratsep	Aavo		The influence of mine-drainage formation on the geochemical and hydrogeological state of the environment in Estonia	ESTONIA	P		S-W
Ridley	William	I	An integrated environmental geosciences project in the Santa Cruz River drainage basin, southern Arizona	USA	P		S-W

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Session 2. Geochemistry of Fresh Water & Marine Environments

Session Chairs: Frank Manheim and Edeltrauda Helios Rybicka (a.m.); Joy Rae and Martin Fey (p.m.)

McLemore	V.	T.	Geology and geochemistry of water and stream-sediment samples of the upper Pecos River Wilderness area, eastern New Mexico	USA	O	2-1	
Reid	Caroline		Lead and zinc contamination of sediments in Zoar Vlei, Cape Peninsula, South Africa	S. AFRICA	O	2-2	
Birch	Gavin	F.	Towards a contaminant model for Port Jackson—Sydney's main estuary	AUSTRALIA	O	2-3	
Klavins	Maris		Metal fluxes and accumulation in lakes of Latvia	LATVIA	O	2-4	
Zober	Steffen		Hydrological explanation of the heavy metals concentration in the Wyszogrod Island, Vistula River, Plock, Poland	GERMANY	O	2-5	
Parsons	Michael	B.	Hydrogeochemical controls on trace element release from the Penn Mine base metal slag dump, Calaveras County, California—linking field, laboratory, and geochemical modeling studies	USA	O	2-6	
Manheim	Frank	T.	Mapping chemical contaminants in estuarine and coastal marine sediments—new approaches to validating and using historical data	USA	O	2-7	
Lambeth	Robert	H.	Metal release and recolonization characteristics of tailings in a marine environment—a laboratory study and site demonstration	USA	O	2-8	
Knesl	Oliver		A geochemical investigation of the water and sediments of Barber's Pan, North West Province	S. AFRICA	O	2-9	
Matthai	C.		The application of the equilibrium partitioning method in surficial sediments near a deepwater ocean outfall off Malabar, Sydney, Australia	AUSTRALIA	O	2-10	
Sullivan	Annett	B.	Temporal variation in the concentrations and speciation of metals in Peru Creek, Summit County, Colorado	USA	O	2-11	
Schettler	Georg		Lacustrine records of heavy metal pollution—problems of dating	GERMANY	O	2-12	
Taylor	S.	E.	Contaminant dynamics in Port Jackson Estuary, Sydney, Australia	AUSTRALIA	O	2-13	
Brown	Kevin	L.	Metals in an estuarine system—sources and sinks	N. ZEALAND	P		W-F-1
Margolina	Sofia	E.	The determination of heavy metal fractions in estuarine sediments	RUSSIA	P		W-F-2
Majer	Vladimir		Pollution of Czech freshwaters by trace elements	CZECH REP.	P		W-F-3
Helios Rybicka	E.		Impact of the Pb-Zn industry on the contamination of the Przemsza River, Upper Silesia, Poland	POLAND	P		W-F-4
Kim	Kyoung-Woong		Heavy metal contamination in dusts and stream sediments, Taejon area, Korea	KOREA	P		W-F-5
Kralik	Martin		Unique ground water (karst) monitoring system as an important tool of drinking water protection in Austria	AUSTRIA	P		W-F-6
Rosales-Hoz	L.		Distribution of trace and major elements in surface sediments from Coatzacoalcos River, Mexico	MEXICO	P		W-F-7
Savchenko	Vladimir		Low-water sediment in rivers of Belarus—origin, mineralogical and geochemical composition, potential for use in environmental assessments	BELARUS	P		W-F-8
Savchenko	Vladimir		Some approaches to the biogeochemical study of contaminated river ecosystems	BELARUS	P		W-F-9
Schettler	Georg		Lead isotope anomalies in Maar Lake sediments—indications of extensive lead mining in the Northwestern Eifel (Germany) during the time of the Roman Empire	GERMANY	P		W-F-10
Perkins	W.	T.	Monitoring marine pollution and determining paleoclimate: the application of laser ablation ICP-MS studies to marine bivalve molluscs	WALES UK	P		W-F-11
Shakhverdov	V.		Heavy metals as indicators of anthropogenic pollution of bottom sediments in Neva Bay	RUSSIA	P		W-F-12
Zhamoida	Vladimir	A.	Modern shallow-water Fe-Mn concretions as an indicator of the contamination of marine environments—a new type of environmental geochemical monitoring	RUSSIA	P		W-F-13

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Session 3. SEGH-Sponsored Session — Environmental Geochemistry and Health
Session Chairs: Betsy Kagey and Iain Thornton (a.m.); Ron Fuge and Larry Gougi

Woodling	John	D.	Recovery of brown trout (*Salmo trutta*) and brook trout (*Salvelinus fontinalis*) populations in the Eagle River, Colorado, USA during and following CERCLA recovery actions	USA	O	3-1	
Farago	Margaret	E.	Exposure to platinum from vehicle catalytic converters and possible health implications	ENGLAND UK	O	3-2	
Gauthier	E.		Relationship between Alzheimer's disease and aluminum speciation in drinking water—a case-control study in Saguenay-Lac-St-Jean, Quebec (IMAGE Project)	CANADA	O	3-3	
Schaefer	Joerg		Emissions of platinum-group elements (PGE) from automobile catalytic converters in soils along highways	GERMANY	O	3-4	
Thornton	Iain		Risk assessment related to metals—the role of the geochemist	ENGLAND, UK	O	3-5	
Kolker	Allan		Geochemistry of coals causing arsenism in Southwest China	USA	O	3-6	
McCaffrey	Lewis	P.	Distribution and origin of fluoride in rural drinking water supplies in the western Bushveld area of South Africa	S. AFRICA	O	3-7	
Rae	Joy	E.	Pesticide adsorption onto aquifer sediments	ENGLAND UK	O	3-8	
Gulson	Brian	L.	Mobilization of lead from maternal skeleton during pregnancy	AUSTRALIA	O	3-9	
Hunt	A.		Source attribution of lead particles in pre- and post-lead paint abatement interior dusts	USA	O	3-10	
Smith	Barry		Geochemical factors controlling infantile exposure to cerium and its implications to the aetiology of of Endomyocardial Fibrosis in Uganda	ENGLAND UK	O	3-11	
Kavanagh	P.	J.	Arsenic exposure in southwest England, UK—significance for human health	ENGLAND UK	O	3-12	
Hoogewerff	Jurian		Use of archaeological bone in present-day baseline human exposure studies	NETHERLANDS	O	3-13	
Li	Xiangdong		Concentration and chemical partitioning of heavy metals in road dusts and urban soils in Hong Kong	HONG KONG	O	3-14	
Wang	Yong		Exposure of children to lead in the home environment—a comparative study in Shanghai and Birmingham	ENGLAND UK	O	3-15	
Zhang	Fuquing		Lead in the environment, China	PR CHINA	O	3-16	
Pooley	Justin		Soil chemical patterns possibly linked to Mseleni Joint Disease among rural inhabitants in northern Kwazulu-Natal, South Africa	S. AFRICA	O	3-17	
Heinrichs	Gerold		Natural arsenic in Triassic sediments as source of drinking water contamination in Bavaria, Germany	GERMANY	O	3-18	
Li	Shan-Fang		The application of regional geochemical data in environmental studies	PR CHINA	O	3-19	
Malkhazova	S.	M.	Methods of monitoring environmental health	RUSSIA	P		S
Pearce	Nicholas	J.G.	Vehicle related emissions of heavy metals and platinum group elements in the urban environment—examples	WALES UK	P		S
Hutchinson	E.	J.	Changes in urban geochemistry in Nottingham and Birmingham between 1982 and 1997	ENGLAND UK	P		S
Bieniulis	Carol		Evaluation of baseline soils geochemistry in support of environmental health studies in the Rocky Mountain Region	USA	P		S
Cameron	Eion	M.	Recent (1930's) natural acidification and fish kill in a lake that was an important food source to the population of Akulivik, northern Quebec	CANADA	P		S
Cunha	F.	G.	The application of geochemical data to environmental concerns in the Minas Gerais State, Brazil	BRAZIL	P		S
Martin	Lori	M.	Allozyme variation upstream and downstream of metal contaminants in the brown trout (*Salmo trutta*) and caddis fly (*Arctopsyche grandis*) in Clear Creek, Colorado, USA	USA	P		S
Zhang	Licheng		Environmental geochemical features in the coal mine areas in China	PR CHINA	P		S
Fordyce	F.	M.	Geochemistry and human selenium imbalances in China	ENGLAND, UK	P		S
De Lima	Edmilson	S.	Trace-element contamination in the environment of Recife metropolitan area, Pernambuco, Brazil	BRAZIL	P		S
Kralik	Martin		Fine dust (PM10) composition in a major city—mineralogy, lead-isotope and PAH-composition in Vienna	AUSTRIA	P		S
Basnkin	Vladimir	V.	Biogeochemical heavy metal regionalization and human risk assessment	RUSSIA	P		S

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Wang	Yanxin	Remediation of high fluoride groundwaters from arid regions using heat-treated soils: a column experiment study in Xinzhou, China	PR CHINA	P	S-W-24
Hoogewerff	Jurian	Quantification of environmental exposure vectors by geochemical methods	NETHERLANDS	P	S-W-25
Tristán	E.	Application of exposure assessment models to Shipham, Somerset, UK—an area with soil contaminated by lead and cadmium	ENGLAND, UK	P	S-W-26

Session 4. Methods of Environmental Geochemical Monitoring, Modeling, and Mapping and Use and Determination of Geochemical Baselines

Session Chairs: Olle Selinus and Alina Kabata-Pendias (a.m.); Jörg Matschullat and Dave Smith (p.m.)

Talbot	D.	K.	A comparison of field and laboratory analytical methods of radon-potential mapping in areas with and without glacial drift coverage	ENGLAND UK	O	4-1
Chaffee	Maurice	A.	Discriminating between natural and anthropogenic anomalies in the surficial environment in Yellowstone National Park, Idaho, Montana, and Wyoming	USA	O	4-2
Ander	E.	L.	Temporal variability in the geochemistry of waters from abandoned coal mines, County Durham, United Kingdom	ENGLAND UK	O	4-3
Swennen	Rudy		Unravelling the degree and the history of environmental pollution based on the evaluation of vertical geochemical profiles in overbank sediments	BELGIUM	O	4-4
Selinus	Olle		Integrating GIS and multivariate statistics in environmental geochemistry	SWEDEN	O	4-5
Wang	Bronwen		Trace Elements in the Kuskokwim River, Alaska	USA	O	4-6
Van Tienhoven	Mieke		Baseline survey of air pollution impacts on soil and water quality in Mpumalanga Province, South Africa	S. AFRICA	O	4-7
Hudson-Edwards	Karen	A.	The use of Holocene floodplain sedimentary sequences for geochemical mapping	ENGLAND UK	O	4-8
Russ	Jon		A new paleoclimate indicator based on AMS ^{14}C dates of biogenic whewellite	USA	O	4-9
Posey	Harry		Establishing pre-disturbance water quality standards in areas of natural acid-metal contamination, upper Alamosa River, southern Colorado	USA	O	4-10
Caron	Francois		A large-scale laboratory experiment to determine the mass transfer of CO_2 from a sandy soil to moving ground water	CANADA	O	4-11
Dodds	Heather	A.	Classifying and mapping the sensitivity of South African highveld soils to acidification	S. AFRICA	O	4-12
Matschullat	Jörg		Crustose lichens—capable of monitoring the atmospheric deposition of trace elements and organohalogens?	GERMANY	O	4-13
Zielinski	Robert	A.	Uranium and uranium isotopes as tracers of nutrient addition—a case study in south Florida	USA	O	4-14
Reimann	C.		The "Kola Ecogeochemistry" Project	NORWAY	O	4-15
Runnells	D.	D.	Determination of natural background concentrations of dissolved components in water at mining, milling, and smelting sites	USA	O	4-16
McMartin	I.		Distribution of trace metals in soils near the base metal smelter at Flin Flon, Manitoba—natural and anthropogenic enrichments from a remote single point source area	CANADA	O	4-17
de Bruin	D.		Environmental applications of the regional geochemical mapping of soils and stream sediments in South Africa	S. AFRICA	O	4-18
Seal, II	Robert	R.	Stable isotope characteristics of waters draining massive sulfide deposits in the eastern United States	USA	O	4-19
Smith	Barry		High resolution baseline mapping of hydrochemical processes and their correlation with geochemical anomalies and anthropogenic activities—Wales and Welsh borders	ENGLAND UK	O	4-20
Wawrzynski	Alecia	L.	The utilization of high spectral resolution imagery and field spectra for the detection and monitoring of mining sites	USA	O	4-21
Magnuszewski	Artur		Ground truth versus a GIS model—the ground water quality of the Vistula River floodplain near the city of Plock, Poland	POLAND	O	4-22
Hirner	A.	V.	Testing contaminant mobility in soils and waste materials	GERMANY	O	4-23
Tarvainen	Timo		Delineating risk areas of contaminated ground water using geochemical databases	FINLAND	O	4-24
Holmes	Charles		Ecological changes in Florida Bay—can we tell when it happened?	USA	O	4-25

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Birke	Manfred		Environmental geochemistry in the surroundings of the central waste deposit of Berlin	GERMANY	P	W
Matschullat	Jörg		What is backgound? A statistical approach, introduced with data for the Baltic Sea	GERMANY	P	W
Lin	Zhixun		Investigation of the environmental impact from industry wastes deposited in an urban area of Falun, Sweden	SWEDEN	P	W
McNeal	James	M.	The spatial reliablity of geochemical maps	USA	P	W
Bonham-Carter	G.	F.	Mass-balance study of the Flin Flon smelter emissions—calculations on metals in humus in the Flin Flon-Snow Lake region, Manitoba and Saskatchewan	CANADA	P	W
De Vivo	Benedetto		Environmental geochemical mapping in Sardinia, Italy	ITALY	P	W
Fuge	Ron		Temporal and spatial variations in the chemistry of ochres derived from an abandoned metalliferous mine	WALES UK	P	W
Havis	Robert	N.	Leaching of contaminants from an aggregate	USA	P	W
Jerz	Jeanette	K.	Laboratory leaching behavior of an Arkansas River fluvial tailings deposit, Leadville, Colorado	USA	P	W
Jordan	David	L.	Geochemical transport modeling of mine tailings pore water	USA	P	W
Kapinus	Evgeny	I.	Environmental monitoring of geochemical changes in ash-dumps and silage-heaps	UKRAINE	P	W
Komov	Igor	L.	Environmental geochemical mapping in the Ukraine	UKRAINE	P	W
Locke	W.	W.	Comparison of the measured and modeled geochemical composition of a Nevada pit lake	USA	P	W
Luukkonen	A.		Regression methods in bedrock groundwater composition estimation from hydrogeological parameters	FINLAND	P	W
Mukherjee	P.	K.	Heavy metal distribution and environmental status of Doon Valley soils, Uttar Pradesh, India	INDIA	P	W
Niskavaara	Heikki		The use of two leaches in environmental geochemical mapping to assess the concentration and mobilities of elements in soils	FINLAND	P	W
Reimann	C.		A geochemical atlas of the central parts of the Barents region	NORWAY	P	W
Roulier	Leanne	M.	A survey and analyses of the oxygen and carbon isotope composition of selected shells from core tops at five locations in Florida Bay	USA	P	W
Shakhverdov	V.		Principles of landscape geochemical map composition and landscape geochemical zonality of the Aral Sea rim	RUSSIA	P	W
Staines	Russell		Small scale spatial relationships between geology, stream water chemistry and stream sediment chemistry in small upland catchments	ENGLAND UK	P	W
Talbot	D.	K.	Radiometric risk mapping using existing geoscience datasets	ENGLAND UK	P	W
Turner	David	R.	Perched water zones in arid environments—geochemical constraints on hydrological modeling for high-level radioactive waste disposal	USA	P	W
Birke	Manfred		Geochemical mapping in the new Federal States of Germany	GERMANY	P	W
Wen	Dongguang		Possibilty of geological disposal of CO_2—results from geochemical modeling	PR CHINA	P	W

Session 5. Trace Substances, Ecosystems, and Bioavailability — aquatic/atmosphere

Session Chairs: Laurie Balistrieri and David Levy (Thursday a.m.); John Gray and Gianni Cortecci (Fri

Gray	David	J.	Acid/saline ground waters in the southern Yilgarn Craton, western Australia	AUSTRALIA	O	5-1
Varsányi	Iren		Contamination of ground water in a varying hydrogeochemical environment, southeast Hungary	HUNGARY	O	5-2
Bourg	Alain	C.M.	Solubility of heavy metals in relation to the geological context—a theoretical approach	FRANCE	O	5-3
Edwards	Robert	J.	The development of a biological toxicity based test for water quality	ENGLAND, UK	O	5-4
Rasmussen	Pat	E.	Emissions of mercury to the atmosphere—natural sources and pathways	CANADA	O	5-5
Dinelli	Enrico		Isotopic and chemical compositions of rain and snow precipitation at Bologna, Italy	ITALY	O	5-6
Lee	Jin-Soo		Dispersion and enrichment of potentially toxic elements in areas underlain by black shales and slates in Korea	KOREA	O	5-7
Levy	David	B.	Geochemistry of arsenic and fluorine in shallow ground water—eastern Owens Lake, California	USA	O	5-8
Domagalski	Joseph	L.	Mercury occurrence, transport, and speciation in the Sacramento River Basin, California	USA	O	5-9

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Fannin	Craig		A study of the rare earth elements in aqueous carbonate and chloride systems	ENGLAND, UK	O	5-10	
Montoroi	J.	P.	Aluminum and iron mobility in an acid sulfate environment and consequences for the local population—the case of the Lower Casamance (Senegal)	FRANCE	O	5-11	
Gurrieri	J.	T.	Distribution of metals and effects on aquatic biota in the upper Stillwater River Basin, Montana	USA	O	5-12	
Bourg	Alain	C.M.	Migration of heavy metals away from landfills in leachate—observations at the near- and far-field scale	FRANCE	P		S-W-27
Bezuidenhout	Nico		Chemical and mineralogical changes associated with leachate production at Kriel power station ash dam, Mpumalanga, South Africa	S. AFRICA	P		S-W-28
Harck	Terry		Denitrification of nitrate-rich ground water entering Verlorenvlei Lake on the west coast of South Africa	S. AFRICA	P		S-W-29
Gray	John	E.	Environmental geochemistry and mercury speciation of abandoned mercury mines in southwestern Alaska	USA	P		S-W-30
Hall	G.	E.M.	Preservation of arsenic species in natural waters	CANADA	P		S-W-31
Kedziorek	Monika	A.M.	Solubilization of heavy metals (Cd, Ni, Pb) during the percolation of the chelating agent EDTA through polluted soils and sediments	FRANCE	P		S-W-32
Magiera	Tadeusz		The connection of some heavy metals with the magnetic phase of fly ash from two Polish thermal power plants	POLAND	P		S-W-33
Tagutschi	Yuhsaku		Ground water flow system estimated by water quality	JAPAN	P		S-W-34
Finch	Steven	T.	Identification of arsenic-rich ground water using geochemical signatures and geophysical log analysis, Albuquerque, New Mexico	USA	P		S-W-35
Yao	Huan		Environmental and hydrogeological problems caused by over exploitation of geothermal ground water in coastal cities of south-eastern China—a case study in Fuzhou Basin	PR CHINA	P		S-W-36
Guerin	Marianne		Application of a three dimensional coupled transport and equilibrium chemistry model to the fate and transport of contaminants in the Konigstein Uranium Mine	AUSTRALIA	P		S-W-37
Guerin	Marianne		Coupling three dimensional transport with geochemistry—MT3D and PHREEQE	AUSTRALIA	P		S-W-38

Session 6. AGE-Sponsored Session — Environmental Geochemistry of Ore Deposits
Session Chair: Sherman Marsh and Eion Cameron (a.m.); Robert Garrett and Maurice Chaffee (p.m.)

Loukola-Ruskeeniemi		Kirsti	Natural analogue for bedrock pollution—environmental impact of Ni-Cu-Zn-rich black shales at Talvivaara, Finland	FINLAND	O	6-1	
Berner	Zsolt		Manifold heavy metal and As contamination by a German Zn-Pb deposit with a two thousand year-old mining history	GERMANY	O	6-2	
Rytuba	James	J.	Environmental geochemistry of mercury deposits in the Coast Range mercury belt, California	USA	O	6-3	
Steele	Kenneth	F.	Comparison of ground water chemistry from the carbonate platform region of the Ozark Mountains, USA	USA	O	6-4	
Klassen	Rodney	A.	The effects of glacial dispersal and global processes on till geochemistry, Labrador, Canada	CANADA	O	6-5	
Ashley	Roger	P.	Environmental geochemistry of gold deposits in the Mother Lode Belt, California	USA	O	6-6	
Prieto	Gloria	R.	Geochemistry of heavy metals derived from gold sulfide minerals, Marmato District, Columbia	COLUMBIA	O	6-7	
Fuge	Ron		The behavior of Cd and Hg during weathering of sphalerite—environmental implications	WALES UK	O	6-8	
Atkins	David	A.	Measurement and simulation of pyrite oxidation in the blasted rock of an open-pit mine	USA	O	6-9	
Klusman	Ronald	W.	Measurement of gas exchange processes between soils and the atmosphere and applications in environmental and exploration geochemistry	USA	O	6-10	
Gray	John	E.	Environmental studies of mineral deposits in Alaska	USA	O	6-11	
Eary	L.	E.	Effects of evapo-concentration on water quality in mine pit lakes	USA	O	6-12	
Glässer	Walter		Environmental impacts of lignite open-cast mining areas in eastern Germany	GERMANY	O	6-13	
Brandvold	Lynn		A study of the analytical variation of sampling and analysis of stream-sediments from mining and milling contaminated areas	USA	P		W-F-38

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Dalverny	Louis	E.	Application of mine fire diagnostics	USA	P	
Leybourne	Matthew	I.	Variable geochemical responses to water-rock interactions at two undisturbed Zn-Pb massive sulphide deposits. Bathurst Mining Camp. N.B., Canada	CANADA	P	
OPEN					P	
Hirner	A.	V.	Organometaloid species in geochemical exploration—preliminary qualitative results	GERMANY	P	
Klassen	Rodney	A.	A comparison of regional geochemical surveys of till and lake sediment, Labrador, Canada	CANADA	P	
Kovalevskii	Alexander	L.	Ecological-biogeochemical status of the Baikal region	RUSSIA	P	
Kovalevskii	Alexander	L.	Ore fields, deposits and zones of deep faults as probable geopathogenic biogeochemical provinces and belts	RUSSIA	P	
McCartan	Lucy		Lithogeochemical map of the Chesapeake Bay watershed—an example of usable repackaging of traditional geologic information	USA	P	

Session 7. Environmental Analytical Techniques & Applications (Session Chairs: Gwennyth Hall and James Crock)

Ingram	Jani	C.	Contaminant detection in soils using static SIMS	USA	O	7-1
Taylor	Howard	E.	The use of sedimentation field flow fractionation-inductively coupled plasma mass spectrometry for the chemical characterization of suspended particulate matter in environmental hydrologic systems	USA	O	7-2
Glanzman	Richard	K.	Multimedia environmental geochemical mapping using field portable x-ray fluorescence	USA	O	7-3
Helios Rybicka	E.		Direct methods used for the identification of the heavy metal forms	POLAND	O	7-4
Leinz	Reinhard	W.	NEOCHIM—an electrogeochemical method for environmental applications	USA	O	7-5
Matschullat	Jörg		Solid phase AAS—a new old technique: first results with environmental material	GERMANY	O	7-6
Krüger	Gero		Multistage reflectance spectroscopic analyses of central German lignite overburden dumps (first results)	GERMANY	P	
Ping	Ren		Determination of lead in environmental matrices by hydride generation atomic fluorescence spectrometry (HGAFS)	PR CHINA	P	
Viman	Vasile		Atomic emission spectrometry-inductively coupled plasma used in the analysis of pollutants from a non-ferrous extraction and processing facility	ROMANIA	P	

Session 8. Trace Substances, Ecosystems, and Bioavailability — terrestrial (Session Chairs: William Orem and Irina Stangeeva (a.m.); Harald Püchelt and Rama K

Fuge	Ron		Platinum group elements in road-side dust	WALES UK	O	8-1
Van der Sluys	Jan		Geochemistry of overbank sediments in Belgium and Luxembourg—a way to assess environmental pollution	BELGIUM	O	8-2
Makino	T.		The investigation of the redox reactions and adsorption of chromium in soils	JAPAN	O	8-3
Asami	Teruo		Pollution of sediments, soils, and plants by thallium	JAPAN	O	8-4
Garrett	Robert	G.	Some methods for estimating phytoavailable cadmium in prairie soils	CANADA	O	8-5
Räisänen	Marja	L.	The response of the interlayering of clay minerals to the mobility of Al in acidified podzols	FINLAND	O	8-6
Mielke	Howard	W.	Soil Pb, Zn, and Cd in metropolitan New Orleans—their geochemical characterization and association	USA	O	8-7
Dinelli	Enrico		Plant-soil relationships in the serpentinite screes of Mt. Prinzera, northern Apennines, Italy	ITALY	O	8-8
Orem	William	H.	The biogeochemistry of sulfur in the freshwater Florida everglades—sources, cycling, and relation to mercury methylation	USA	O	8-9
Harrison	Wendy	J.	Acid buffering capacity and metals mobility in acid-impacted agricultural soils, San Luis Valley, Colorado	USA	O	8-10
Pucheit	Harald		Uptake of trace elements by plants from soils contaminated by mining activities in southwest Germany and north-central Mexico	GERMANY	O	8-11
Hall	G.	E.M.	Compatibility of data derived from different selective extraction schemes	CANADA	O	8-12

**Presentation type (O=oral; see program matrix for session number, date, and time. P=poster; see program matrix for session dates)*
***Poster presentation times (S-W=Sunday - Wednesday; W-F=Wednesday - Friday)*

Govil	P.	K.	Effect of industrial effluents on trace element mobility in soil	INDIA	O	8-13	
Äyräs	Mätti		Distribution of sulphur and heavy metals in podzolized tills in northern Finland	FINLAND	P		S-W-42
Bailey	E.	A.	Mercury speciation in soils and vegetation, southwest Alaska	USA	P		S-W-43
Bondar	Galina	S.	Assessment of suitability of some disturbed land for herb cultivation	UKRAINE	P		S-W-44
Carranza-Edwards	Arturo		Textural analysis and its importance as an indicator of energy levels in environmental geochemistry	MEXICO	P		S-W-45
Evans, Jr.	Andrew		Biodegradation of ^{14}C labeled organic acids and organo-metal complexes in soil	USA	P		S-W-46
Nicholson	Keith		Environmental geochemistry of boron	SCOTLAND UK	P		S-W-47
Nowicki	Tom		Afforestation-induced enhancement of soil-solution aluminum and manganese concentrations in South African highland catchments	S. AFRICA	P		S-W-48
Gao	Xiaojiang		Environmental geochemistry of rare earth elements in a typical landscape, Jiangxi, southern China	PR CHINA	P		S-W-49
Gennadiyev	A.		Behavior of polycyclic aromatic hydrocarbons in soil ecosystems	RUSSIA	P		S-W-50
Gonzalez	Luz Miryan		Heavy metals in soils of the Sabana de Bogota, Columbia	COLUMBIA	P		S-W-51
Kadatsky	Valery	B.	Heavy metals in humus and soil organic layers with different human activities	BELARUS	P		S-W-52
Kasimov	N.	S.	The behavior of rocket-fuel components in soil and plants in the Kazakhstan and Altay region of Russia	RUSSIA	P		S-W-53
Kotra	Rama	K.	Geochemistry of mercury and trace elements in organic-rich sediments and vegetation from the everglades, south Florida	USA	P		S-W-54
Fumoto	T.		Sulfate adsorption model for predicting soil acidification	JAPAN	P		S-W-55
Rashed	M.	N.	Biogeochemistry of trace elements in plants and interactions with soil around Nasser Lake, Egypt	EGYPT	P		S-W-56
Rechcigl	Jack	E.	Environmental impact of phosphogypsum use in agriculture	USA	P		S-W-57
Semenov	Yury	M.	Differentiation of heavy metals as a reflection of landscape-use levels	RUSSIA	P		S-W-58
Sakurai	Yasuhiro		Laboratory measurements of the absorption and oxidation of sulfur dioxide by the soil surface	JAPAN	P		S-W-59
Savchenko	Vladimir		Trace element distribution in soils and factors affecting metal uptake by plants in the contaminated flood plain of the Svisloch River, Belarus	BELARUS	P		S-W-60
Sonke	Jeroen		A chemical and mineralogical reconstruction of emissions from Zn-smelters in the Kempen region (Belgium), based on peat cores	NETHERLANDS	P		S-W-61
Shtangeeva	Irina		Some pecularities of chemical element bioaccumulation in different environmental samples	RUSSIA	P		S-W-62
Strzyszcz	Zygmunt		Iron deposition and magnetic susceptibility of forest soils, Katowice Province, Poland	POLAND	P		S-W-63
Wang	Lijun		Environmental geochemistry of rare earth elements in common soils of China	PR CHINA	P		S-W-64

Session 9. Remediation of Mining-Related Disturbances (Session Chairs: Harry Posey and Suresh Kumar)

Rebedea	Irina		An investigation into the mechanism by which synthetic zeolite amendments reduce soil phytotoxicity	ENGLAND, UK	O	9-1	
Deissmann	Guido		Geochemical assessment of passive treatment methods for acid mine waters from a flooded uranium mine	GERMANY	O	9-2	
Vandiviere	M.	M.	Comparative testing between conventional and microencapulsation approaches in controlling pyrite oxidation	USA	O	9-3	
Cheong	Young-Wook		Metal removal efficiencies of substrates for treating acid mine drainage of the Dalsung Mine, Korea	KOREA	O	9-4	
Bowell	R.	J.	A review of sulfate removal options from mine waters	WALES UK	O	9-5	
Joshi	D.	C.	Characterization of gypsum mine wastelands and their rehabilitation	INDIA	P		W-F-47
Kumar	Suresh		Rehabilitation induced vegetation progression at gypsum mined land in western Rajasthan—analytical approaches and empirical evidence	INDIA	P		W-F-48
Lund	D.		Uses of chemical speciation for impact evaluation and remediation of mining waste	ENGLAND UK	P		W-F-49
Ni	Dagang		Purification of toxic metal contaminated ground water using Chitosan in partially converted crab shells	USA	P		W-F-50
Edwards	Robert	J.	Biogeochemical mechanisms influencing metal mobility in natural and constructed wetlands	WALES UK	P		W-F-51

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Thompson	Bruce		Adsorption of metal cations on manganese oxide-coated filter sand: a novel method for water treatment	SCOTLAND UK	P		\
Nord, Jr.	Gordon	L.	Three-dimensional nanocrystalline networks limit limestone drain remediation—a role for environmental mineralogy	USA	P		\

Session 10. Natural and Man-Made Radiogenic Hazards (Session Chairs: Rich Wanty and John Glendinning)

Kagan	Leonid	M.	Chernobyl nuclides in soils and gamma-dose rate in the air of Belarus	BELARUS	O	10-1
Glendinning	John		Weathering and colloid mobility as factors influencing the migration of radioactive elements at Steenkampskraal Mine in the Northern Cape Province, South Africa	S. AFRICA	O	10-2
Smith	Barry		The distribution of natural radioelements in ground waters and post Cretaceous sediments from the southern Mediterranean margin	ENGLAND UK	O	10-3
Shvartsev	Stepan	L.	The experience and the results for the disposal of liquid radioactive waste (LRW) on the Siberian Chemical Industrial Plant	RUSSIA	O	10-4
Mazeika	Jonas		Radiogeochemical mapping in the Ignalina Nuclear Power Plant region— bottom sediments and soils	LITHUANIA	P	
Shumlyanskiy	Vladkslav	O.	The radioactive mineral encrustation on the casings in the oil producing wells in the Dnieper-Donets depression, Ukraine	UKRAINE	P	
Golovko	Natalia	V.	Organic substances and the migratory processes of radionuclides	UKRAINE	P	
Kadatskaya	Olga	V.	Chernobyl contamination as a new geographical factor in Belarus	BELARUS	P	
Kadatsky	Valery	B.	Re-suspension of the radionuclides in the Belarus soils distant from the Chernobyl Nuclear Power Plant	BELARUS	P	

**Presentation type (O=oral; see program matrix for session number, date, and time. P=poster; see program matrix for session dates)*
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ABBREVIATIONS USED IN THE ABSTRACTS:

a	year	M	molar
Bq	Becquerel	mg	milligram (10^{-3} gram)
dL	deciliter	µg	microgram (10^{-6} gram)
dpm	disintegrations per minute	ML	megaliter (10^{6} Liter)
dS	decisiemens	µm	micrometer (10^{-6} meter)
DW	dry weight	ng	nanogram (10^{-9} gram)
g	gram	‰	permil (parts per thousand)
ha	hectare (10,000 m^2)	pg	picogram (10^{-12} gram)
kg	kilogram	rsd	relative standard deviation
L	liter	s	second
m	meter or molal (context-dependent)	wk	week

Abstract Title Index

Reactions and Transport of Copper in Headwater Streams Receiving Acid Rock Drainage

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Acid rock drainage (ARD) from Fisher Mountain near Cooke City, Montana has severely contaminated Fisher Creek, a headwater stream of the Clark's Fork of the Yellowstone River. The pH of Fisher Creek increases from 3.0 at the Glengarry Mine adit to near neutral about 4500 m downstream. Tributaries in the upper part of the watershed dilute ARD from the Glengarry Mine, but because they flow through acidic igneous rock, they have low alkalinity levels and do not increase stream pH. Tributaries in the lower part of the watershed flow through more calcareous rock and add sufficient alkalinity to increase the pH of Fisher Creek to near neutral levels. Ferrihydrite precipitates in the upper part of the stream but particulate ferrihydrite and ferrihydrite-coated sediment fines are transported downstream during periods of high flow resulting in a high iron oxide content of sediments along a 4500 m length of stream. Hydrologic mass balance calculations indicate that downstream decreases in Cu concentrations in the upper part of Fisher Creek result from dilution by tributaries. Further downstream as tributaries add some alkalinity and the pH increases to near neutral levels, decreases in Cu concentrations in Fisher Creek are the result of adsorption by ferrihydrite in streambed sediments. These decreases were predicted using the diffuse-layer adsorption model, a surface-complexation model included in the equilibrium chemical speciation computer program MINTEQA2. The Cu content of the ferrihydrite fraction of Fisher Creek sediment increased as pH increased over the stream reach where Cu adsorption was predicted to occur.

Temporal Variability in the Geochemistry of Waters from Abandoned Coal Mines, County Durham, UK

ANDER, E.L.[1], THORNTON, I.[1], FARAGO, M.E.[1], and RICHARDS, D.G.[2]
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The County Durham coalfield, NE England, has a long history of subsurface mining of Carboniferous coal. The recent closure of all remaining deep mines in this coalfield has raised the possibility that ground-water withdrawal (for mine dewatering) may be discontinued. Research into the hydrogeology of the coal measures by other workers has established that much of the rebounded ground wa drain into the river Wear, a regionally important w course, directly or via tributaries. The occurrence dissolved pyrite oxidation products in flooded mir ings has been widely studied by many other resear When such ground water enters surface water cou precipitation of ochres and some reduction in the waters in the river Wear catchment may be expect This study aims to assess the potential occurrence dispersion of elements, some of which may be tox tributary waters of the river Wear. Uncontrolled spoil heap drainages from previously abandoned the west of County Durham have provided eight p discharge and three downstream traverses. Sampl undertaken at these sites on several occasions, in hydrological conditions, and was followed by mul analyses of water, suspended sediment and stream The results have shown that there is much chemic ity between deep mine and spoil heap issues. Ter chemical variations of up to several orders of mag (examples of value ranges observed at one site: p Fe 8,110-69,400 µg L^{-1}, Mn 1,600-20,300 µg L^{-1} 820-74,400 µg L^{-1}) were observed at some sites a of emergence and marked changes were also obse downstream hydrogeochemistry seasonally. The are such that they strongly alter the potential toxi waters and the nature of the minerals precipitatin them. These differences have been attributed to hydrological behavior of the mine spoil heaps an mines and to seasonal effects.

Pollution of Sediments, Soils, and Pl Thallium

ASAMI, Teruo, MIZUI, Chizuru, NOGAMI, Naoko, a Masatsugu
School of Agriculture., Ibaraki Univ., Ami, Ibaraki 3

Thallium (Tl) is a highly toxic element. Pollutio thought to be restricted to places such as non-fer mines, smelters, and factories using Tl. Howeve discovery of high-temperature superconducting c in the system Tl-Ca-Ba-Cu-0, Tl has attracted gr attention as a potential pollutant on a large scale future. Therefore, we established a method for d Tl content in sediments, soil, and plants, and det concentrations of Tl and other harmful metals in and soils of Japan. Effects of Tl on some crops studied.

Method of Tl determination: The determina sediment and soil by FAAS, involving extractio 5 g of sediment or soil by digestion with HClO followed by separation of extracted Tl into 5 ml isopropylether from HBr solution including Ce the organic phase is determined by direct aspira AAS. The geometric mean (range) of 18 Japane paddy surface soils was 0.31 (0.10-0.56) mg Tl k ent (DW) (*Fresenius J. Anal. Chem.*, 356: 3

Anexo 8

4th ISEG

FRIDAY OCTOBER 10, 1997

CLOSING GENERAL SESSION

"Conference Summary and a Look to the Future"

12:00 noon	DavidGarnett	***President, Association of Exploration Geochemists***
	GeoffreyPlumlee	***Mineral Resources Program Chief Scientist, U.S. Geological Survey***
	Ron Fuge	***President, Society for Environmental Geochemistry and Health***
	Martin Fey	***5th International Symposium on Environmental Geochemistry***
	ArthurDarnley	***Geological Survey of Canada, IUGS Global Geochemical Baselines***

Anexo 9

Attendee List

4th International Symposium on Environmental Geochemistry

Vail, Colorado October 1997

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