EXPLORE

Newsletter for the Association of Exploration Geochemists

NUMBER 98 FEBRUARY 1998

PRESIDENT'S MESSAGE

Peter Simpson

It is said that 'Every scientist rises from the shoulders of those who went before' and it is a great honour and pleasure to be assuming the presidency of the AEG following so many illustrious predecessors and also to have the opportunity to work alongside many world class geochemists who have put a lifetime of experience and effort into the success of the Association of Exploration Geochemists (AEG). David Garnett, my immediate predecessor in particular deserves all our thanks for the outstanding contribution he made to AEG as President during a very busy year which included the excellent 18th International Geochemical Exploration Symposium (IGES) meeting in Jerusalem and the highly successful 4th International Symposium on Environmental Geochemistry (ISEG) meeting in Vail, while at the same time continuing to manage his company, Becquerel Laboratories. He has, in particular, focussed our attention on the negotiations concerning the future of the Journal of Geochemical Exploration (JGE), which is one of the most important decisions to be made by the AEG this year. I look forward to benefiting from his advice on this and other matters as he continues to serve on Council.

Perhaps the most important milestone in the history and joint development of the AEG and JGE, however, has just been been too quietly passed over with the retirement from active duty of the JGE's founding Editor-in-Chief, Eion Cameron. His lifetime contribution to the JGE including the promotion of JGE Special Issues, over more than a quarter of a century, has been one of the keystones to and vital ingredients of the success and development of exploration geochemistry worldwide.

Thanks are due to Sherman Marsh as Secretary of AEG and both he and Tom Nash for editing **EXPLORE** and especially for pioneering the use of colour publishing wherever possible. Gwendy Hall our Treasurer, expertly advised by Eion Cameron, and Betty Arseneault our Business Manager, have jointly reorganised the office of the AEG into an efficient and professional business. Thanks are also due to our retiring Councilors most of whom will continue to serve the AEG in other important roles. The network of Regional Councilors helps to ensure AEG representation in strategic regions of the world, and this network provides a vital link with the membership in the development and promotion of AEG-sponsored activities.

The active membership (voting fellows and non-voting members) has held fairly constant in recent years at about 1,150, up somewhat from 985 in 1993. Membership is predominantly based in North America with 595 members, however other regions are well represented with Australia 250, Europe 121 Asia 110, South America 97 and Africa 38 members. The AEG attracts substantial numbers of new members who recognize the

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PAST-PRESIDENT'S MESSAGE

David Garnett

Are we witnessing the end of the gold exploration boom? Busang and a drop in the gold price have combined to send a shudder through the market and the prophets of doom and gloom have emerged from their long hibernation. Mines are closing, funding for new ventures is harder to find than it was a year ago, and both mineral exploration groups and laboratories are shedding staff. My guess is that this is no more than a temporary setback but it does give many of us the chance to *draw breath* and perhaps look around at the challenges involved in exploring for commodities other than gold. We have to look back a long way to remind ourselves that there were base metal and uranium exploration booms before gold came to dominate many exploration budgets, and it is sobering to reflect on the fact that a significant number of our members will have spent their entire professional careers looking solely for the yellow metal.

Change is inevitable and while it can be disruptive in the short term it can also open up new opportunities and interests. It may also offer greater freedom to do no more than stop and think, and perhaps to write up some of the results that have accumulated over the last few years. For those of you who find yourselves in that position, please remember that we are always looking for papers for the *Journal of Geochemical Exploration* (or its successor), and for **EXPLORE**. The 19th IGES will be held in Vancouver in 1999 and we would like to make it the biggest and best yet, so start planning to be there, preferably with a paper to tell us what you have been doing.

Change is also inevitable in the Presidency of the AEG, which now passes into the extremely capable hands of Peter Simpson. I look forward to continuing to serve on Council as we confront the challenges that lie ahead. The most immediate of these involves a decision on the future of the *Journal of*

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Information for Contributors to EXPLORE

Scope This Newsletter endeavors to become a forum for recent advances in exploration geochemistry and a key informational source. In addition to contributions on exploration geochemistry, we encourage material on multidisciplinary applications, environmental geochemistry, and analytical technology. Of particular interest are extended abstracts on new concepts for guides to ore, model improvements, exploration tools, unconventional case histories, and descriptions of recently discovered or developed deposits.

Format Manuscripts should be double-spaced and include camera-ready illustrations where possible. Meeting reports may have photographs, for example. Text is preferred on paper and 5- or 3-inch IBM-compatible computer diskettes with ASCII (DOS) format that can go directly to typesetting. Please use the metric system in technical material.

Length Extended abstracts may be up to approximately 1000 words or two newsletter pages including figures and tables.

Quality Submittals are copy-edited as necessary without re-examination by authors, who are asked to assure smooth writing style and accuracy of statement by thorough peer review. Contributions may be edited for clarity or space.

All contributions should be submitted to:
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EXPLORE

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Past-President's Message

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Geochemical Exploration. I would like to acknowledge all who responded to my last President's message on this topic, as indeed I thank all who have sent me comments throughout the year on a variety of topics. I would also like to thank all members of Council, Regional Councillors and our various committees for their input throughout the year, and express particular thanks to Gwendy Hall, Sherman Marsh, Tom Nash and Betty Arseneault for the major contribution that they have made. Charles Butt and Ray Smith have been outstanding as our Distinguished Lecturers and have put enormous amounts of time and effort into delivering lectures on every continent, with the possible exception of Antarctica. We thank them both.

As I step down after a single year I am accompanied by Eion Cameron who has occupied the position of Editor-in-Chief of *The Journal of Geochemical Exploration* since its inception in 1972. I suspect he may have been a marathon runner in his youth for it must take someone with that mental strength to survive in such a demanding job for so long. What is even more impressive is that he has still retained his sense of humour. It is not unreasonable to claim that he has done more to promote the science of exploration geochemistry than any other geochemist and I know I speak on behalf of all members, past and present, when I express our deepest thanks to Eion for his commitment and his intellectual rigour over the years.

I have been fortunate to be President in a year that featured two outstanding meetings, with their associated field trips — in Jerusalem and Vail — and my thanks go to all who worked so hard to make these meetings such a success. It really has been a great privilege and pleasure to meet so many talented geochemists over the last year and it has certainly reinforced my belief that exploration geochemistry is in good health. My best wishes to Peter for the year ahead.

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President's Message

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many advantages and benefits of membership of a dynamic scientific and professional learned society become more widely appreciated. However, these gains tend to be offset by the loss, for various reasons, of members. The vital need for the highest technical and professional standards in geochemical exploration, especially in the light of recent events in the exploration industry (Busang), has never been greater than it is today. Fellowship of the AEG is therefore likely to become increasingly important where evidence of professional and technical competence and integrity in the practice of exploration geochemistry is required.

As the first President to be based in Europe, where 10% of the membership is presently located, this is both an opportunity and a challenge. European exploration geochemistry has a proud history with many world class geochemists such as, Fersman, Brundin, Rankama, Sahama, Webb and others. European exploration geochemists frequently work internationally on mineral exploration projects and have also played a major role in adapting methods designed initially for mineral exploration to a wide range of mainly environmental studies, often with spectacular results. Their professional experience can be very variable and reflects current economic priorities since exploration geochemistry has a high priority in Spain, France, Scandinavia (including Greenland) and eastern Europe generally, whereas in other countries such as the UK and Benelux countries, interest in environmental geochemistry presently predominates, as it is becoming increasingly useful and relevant to the well being of society.

The application of and need for these studies however is largely driven by new legislation, enacted nationally, but following on from the need to meet goals established by the European Environment Agency, which has resulted in an increase in the cross linking and exchanges between geochemists, industry, government and many other scientific disciplines. The main objective is to develop legislation and a practical methodology which will be effective in predicting and minimising the environmental harm due to pollution incidents arising primarily as a consequence of human activities. These can arise either by contamination of the environment or by the action of disturbing a pre-existing environment, or both, especially in areas characterised by high natural baseline levels for potentially harmful elements. Since both the methodology used and the media studied are often common to environmental and exploration geochemistry, this provides a wide and diverse opportunity for applying these skills. Hence geochemistry is becoming particularly attractive to younger scientists seeking career opportunities, but who may be concerned at entering a profession, which on the exploration side alone, may appear to be unduly at the mercy of the business cycle.

We are greatly indebted to Arthur Darnley for his help in adjusting to these new challenges. He had the foresight and persistence to start work over fifteen years ago in collaboration with other geochemists who were strategically located across the world, to establish the International Geological Correlation Programmes 259 (International Geochemical Mapping) and 360 (Global Geochemical Baselines). These projects have now completed their primary function of developing and establishing a suite of internationally agreed methods and standards since it is vital to ensure that baseline studies are founded on sound scientific principles. These are required; 1) to identify where mineral resources are located on the global scale, 2) for further resource assessment, 3) for the sustainable management of natural resources from both the scientific and legislative viewpoints, and, 4) for provision of geochemical baselines, which are required by both the public sector and private companies to deal with future environmental and legislative issues. The international work will be carried forward in the future through the establishment of an IUGS Working Group on Global Geochemical Baselines.

In Europe, these programmes have stimulated the organisation and establishment of metadatabases which describe existing geochemical datasets held in national archives, through the sponsorship of the Forum of the Directors of European Geological Surveys (FOREGS). It is equally important to follow this up and to ensure that the strategic significance of these databases as a source of geochemical standards and their natural variation, is recognised by the European Environment Agency, when developing legislation for the protection of the European environment. The European expectation of exploration geochemistry, which was designed primarily as a practical and effective tool for mineral exploration, is that it will emerge in the future, as a highly sensitive and sophisticated exploration method, which can be simultaneously used for measuring, minimising and ultimately controlling the impact of man in a developing world.

The AEG is an international association which has always encouraged international membership and has fostered the take up and dissemination of best practice in exploration geochemistry world wide. It is very encouraging to see the extent to which many countries, which are beyond the main centres of membership activity in North America and Australia, especially China, Brazil, Ecuador, Columbia, Argentina and the Caribbean region to name but a few, are now surging forward with the development of major new programmes of work, which are the key to wealth creation and the hope and means of a better and healthier lifestyle for many who have the greatest need.

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NOTES FROM THE EDITORS

Sherman Marsh and Tom Nash

This issue brings word of changes in the Association. The Presidency has moved to England for the first time, into the capable hands of Peter Simpson. A new group of Councilors was elected. Gwendy Hall steps out of one role on Council into new roles. Fortunately for AEG, rotation out of office does not mean the end of activity by David Garnett, Gwendy, Steve Cook, and Dick Glanzman. Communication among the past and present officers and councilors is very active and facilitated by frequent email messages.

Communication of technical materials for **EXPLORE** and other AEG needs have been expedited by Vivian Heggie. This month she rescued us several times with rapid international transfer of complex files. Final layout and production of **EXPLORE** has been handled by Vivian for many years, and we come to count on her magic in transforming bland drafts into the attractive newsletter that you read. And at times we become complacent, expecting Vivian and computers to be perfect. **EXPLORE** Number 97 contained many printing errors that were created by computer gremlins that failed to properly translate special Greek characters. The real error was by humans, of course, when the editorial group here in Denver failed to check the final proof carefully enough to catch the characters. Vivian, thanks for your many creative contributions to **EXPLORE** and AEG.

ERRATA AND APOLOGY

The Technical Note in **EXPLORE** 97, *Scale effects in geochemical haloes of hydrothermal mineral deposits*, by Sandomirsky and Karger was printed with numerous errors that were not created by the authors. Many Greek symbols in equations, text, and figure captions, were inadvertently confused when the document file was imported into the word processor used for final layout, and the errors were not caught by us in final proofs. Some of the Greek symbols were converted to Latin ones, and some were not converted at all and were printed as blank spaces. For example the function $\gamma(h)$, for "semivariogram", is used many times and in the printed version appears as blank spaces.

In this era of electronic word processing we tend to become complacent, assuming that computers don't make mistakes. In the early stages of assembling and editing of **EXPLORE**, we utilize one brand of word processor that happened to reproduce the symbols in documents submitted by Sergey Sandomirsky; we even sent the documents back and forth several times by email with no problems on special characters. When the Technical Note seemed to be in good final form, we assumed the next stage of layout on another word processing system would reproduce the document faithfully. Not so. Also, the final checking of page proof, done while Sherm and I were on travel, was by two geochemists who did not have a copy of the original document, and they had no reason to believe that the proof needed to be checked letter by letter, symbol by symbol (which is very tedious work).

We apologize to the authors, Sergey Sandomirsky and Mir Karger, who worked diligently to provide us with material that was in very good English and free of technical errors. The errors were introduced by the Editorial Staff of **EXPLORE** here in Denver.

We hope that the technical information in the note is understandable, despite the printing errors. Anyone wishing to read a complete and correct version of the note can obtain a paper copy by mail, or a digital file by email, by contacting me at 303-236-5515, or email to tnash@usgs.gov.

Tom Nash
Co-Editor.

AEG COUNCIL ELECTIONS

Votes cast by Association of Exploration Geochemists (AEG) Fellows in November and December for Councilors (1998-2000 term) were counted and declared final on January 5, 1998. A total of five Councilors were elected and David Garnett, our past President, was appointed to Council as *ex officio.* This gives us a full compliment of six Councilors for the term. Re-elected for a second term were M. Beth McClenaghan and J. Thomas Nash. Three new Councilors were elected: Eric Hoffman, Ray Lett, and David B. Smith. Eric and Ray are long-time Fellows who have served on Council and the Executive before, whereas Dave Smith is serving for the first time. We welcome the new and returning Councilors and look forward to their input for the next two years.

The Association would like to thank two retiring Councilors, Dick Glanzman and Steve Cook, for their excellent service over the past two years. Many thanks to Dick and Steve for their comments and help. Gwendy Hall also deserves our thanks as she steps down from being *ex officio* Councilor. She will continue to serve in many ways, including roles as Treasurer and as co-editor of *Journal of Geochemical Exploration.*

Sherman Marsh
Secretary, AEG

AEG CO-SPONSORS MEETING

Geology and Ore Deposits 2000: The Great Basin and Beyond will be co-sponsored by The Association of Exploration Geochemists. The meeting will be held in Reno/Sparks, Nevada, May 15-18, 2000, with field trips and special courses before and after the meeting. A short course on exploration geochemical methods is being organized by Clark Smith, and Clark is the AEG representative on the planning committee of the Geological Society of Nevada. Stay tuned for further announcements; will gold still be the major theme? Interested persons can contact Clark by email: sheaclarksmith@compuserve.com

TECHNICAL NOTE

Behavior of Gold Anomalies in Stream Sediments of Peloritani Mountains (Northeastern Sicily, Italy)

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INTRODUCTION

This report concerns a geochemical stream sediment follow-up survey conducted along an "anomalous belt," occurring in the Peloritani Mountains, northeastern Sicily. Anomalous Au values were found recently, mostly in the catchment basins of Fiumara Dinarini and Vallone Monastri by means of a follow-up survey (De Vivo et al., 1993), distributed in a belt along the thrust contact of two metamorphic Hercynian Units: the Aspromonte and Mela Units (mostly high-grade metamorphic rocks) and the Mandanici Unit (mostly low-grade metamorphic rocks). In addition to Au anomalies in stream sediments, Au flakes (between 100 and 400 μm in size) have been identified as well along this "auriferous belt".

The present follow-up survey was conducted in the eastern tributaries of the Vallone Pularlo (draining Pizzo Ruggeri, Rocca di Vernava, Pizzo Cipolla, Pizzo Mualio mountains) and the catchment basin of Fiumara Dinarini (draining Pizzo Cipolla, Pizzo Cappara, Pizzo Cafi mountains), covering an area of ≈ 7 km^2 with a nominal sampling density of 14 samples per km^2. The aim of this survey was: a) to check the results reported in the previous detailed survey (De Vivo et al., 1993); b) to better identify the source areas of the anomalous samples; c) and, mostly, to determine which grain size fraction gives the best response for the presence of Au anomalies.

GEOLOGY

The Peloritani Mountains constitute the southernmost portion of the Calabria-Peloritani Arc (CPA), which is an arc-like structure connecting the NW-SE trending Italian Apennines with the E-W trending Sicilian and North Africa Maghrebids. The Arc consists of several Alpine thrust sheets, involving pre-Alpine continental crust, with slices of their sedimentary cover, and minor oceanic lithosphere fragments (Amodio-Morelli et al., 1976; Bonardi et al., 1993).

According to the most recent tectono-stratigraphic interpretation (Messina, 1995) the Peloritani Mountains are formed by Austro-Alpine thrust sheets, made up of Variscan low- to high-grade metamorphic rocks (phyllites, micaschists, amphibolites, gneiss) (Fig. 1). The Alpine nappes, from bottom to top, are the following: Longi-Taormina Unit, Fondachelli Unit, Mandanici Unit, Ali Unit, Mela Unit, and Aspromonte Unit.

The most important metamorphic event, which affected all the basement rocks, is related to the Variscan orogenesis, developed peculiarly in each basement unit. A pre-Variscan acidic to intermediate intrusive magmatism is evidenced by the presence of a metaplutonic complex in the Aspromonte Unit, whereas effusive magmatism is documented by meta-volcanic levels in the lower grade units. A pre-Variscan or eo-Variscan eclogitic metamorphism is recorded in the Mela Unit. A late-Variscan intrusive magmatism is evident only in the Aspromonte Unit. Cataclastic to mylonitic shear bands, related to Alpine tectogenesis, are widespread in all the units. They are accompanied by retrogressive processes or by relatively H-P and variable T metamorphic re-equilibration (Messina, 1995; Messina et al., 1992, 1995). Three of the Alpine units outcrop in the investigated area (Fig. 1). These are, from top to bottom: the

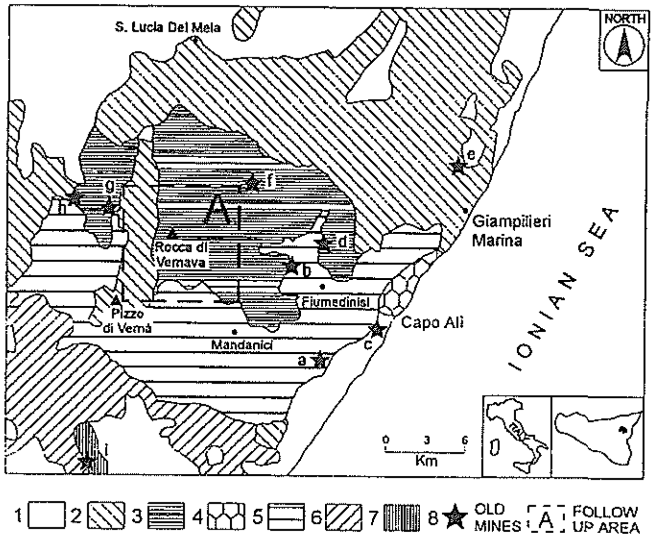

Fig. 1 - Geological sketch map of the Peloritani Mountains. 1. Upper Tortonian to Recent deposits; 2. Aspromonte Unit; 3. Mela Unit; 4. Ali Unit; 5. Mandanici Unit; 6. Fondachelli Unit; 7. Longi-Taormina Unit; 8. Areas of past mining activities (a. S. Carlo; b. Vacco and Migliuso; c. Tripi; d. Budali; e. Giampilieri; f. Malonado; g. Val Pomia; h. Val Carbone; i. Fonderia d'Antillo. *Continued on Page 6*

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Aspromonte Unit, the Mela Unit and the Mandanici Unit; these units occupy the higher structural position of the Peloritani Mountains.

The Aspromonte Unit consists of a Variscan crystalline basement made up of heterogeneous low to upper amphibolite facies metamorphics intruded by syn- to post-tectonic plutonites. The Mela Unit, tectonically interposed between the Mandanici and Aspromonte Units, consists of a metamorphic basement made up of beds of paragneiss passing to mica schist, with subordinate lenses of metabasite and layers of impure marble.

The Mandanici Unit is geometrically interposed between the overlying medium-grade Mela Unit and the underlying low grade Fondachelli Unit; locally it is tectonically overlain by the Aspromonte Unit. The Mandanici Unit consists of a Variscan basement, made up of greenschist to amphibolite facies metamorphics, with a localized Alpine greenschist facies overprint, and of a Mesozoic sedimentary cover.

MINERALIZATION

The follow-up survey area (Fig. 2) is made up by two catchment basins: 1) a north-western one, occupied by the Vallone Monastri and smaller tributaries of Vallone Pularlo; the creeks of this catchment basins drain the Pizzo Mualio, Pizzo Cipolla, Pizzo Acquabianca, Rocca di Vernava, Pizzo Ruggeri mountains; 2) a southern one occupied by the Vallone Mangiarano, a tributary of Fiumara Dinarini; this creek drains Pizzo Mualio, Pizzo Cipolla, Pizzo Cafi, Pizzo Rotolia mountains. In the areas surrounding the follow-up area survey, Pb, Zn, Ag, Sb (with Au as by-product) were mined in the past at several localities, notably Bafia - Val Pomia and S. Carlo - Tripi (Fig. 1) (De Vivo et al., 1993).

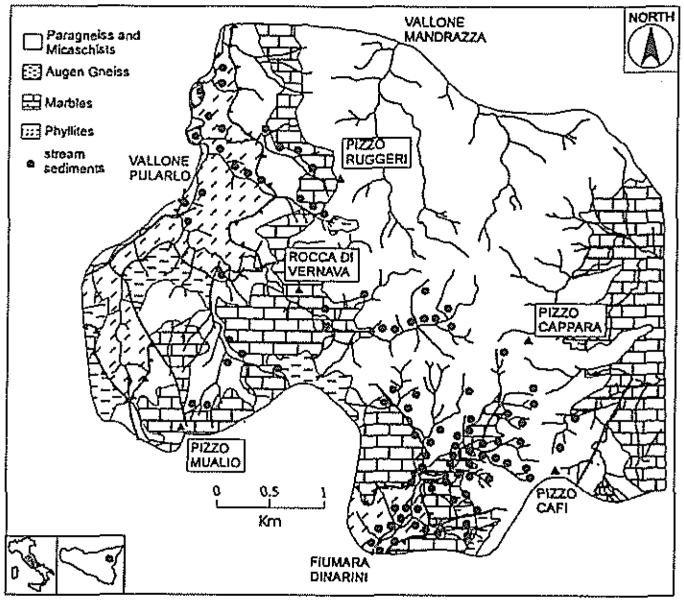

Fig. 2 - Geological sketch map of the investigated area showing the location of follow-up stream sediment samples.

In the Mandanici Unit the mineralization occurs in all the three lithotypes making up the Unit: a) in phyllites, as galena, antimonite, fluorite, sphalerite, pyrrhotite, chalcopyrite, pyrite, arsenopyrite, tetrahedrite and some Au (as by-product up to 0.2 ppm at Tripi, Bafia, Vacco and Migliuso); since the 1960's scheelite anomalies have been identified in many localities (IDROGEO Int., 1986a, b); b) in phyllites at the contact with overlying Mela Unit, as pyrite, chalcopyrite, arsenopyrite, Ag-sulfosalts, with Au content lower than 1 ppm (Torrente Vacco and Fiumedinisi); c) in the marble horizons, as an association of tetrahedrite, antimonite, scheelite and Fe-Mn carbonates (at Fiumedinisi). At Fiumedinisi, Sacca et al. (in press) report incredibly high Au concentrations (up to 17.5 ppm) in a quartz layer associated with pyrite, chalcopyrite, rare arsenopyrite, and Fe-oxide (hematite, goethite, limonite).

In the Mela Unit, specifically in the follow-up area, mineralization occurs at Pizzo Mualio, in marbles as dykes containing arsenopyrite and pyrite (with 0.02 ppm Au), with traces of Zn, Pb, Ag and Cu. At Pizzo Cafi, in the marbles, occur barite with Zn, Ag and Au traces. Polymetallic sulphides occur as well in mica schists and gneiss. In dykes crosscutting schistosity, arsenopyrite (with Au traces) with Cu, Zn and Ag occurs at Pizzo Ruggeri. The same mineralization occurs at Pizzo Cipolla and Pizzo Acquacalda.

Evidence of disseminated mineralization in dykes and "stockworks" of sphalerite with galena, chalcopyrite (with presence of Ag and Au) occurs in the shear zone along the contact between the Mela and Mandanici Units.

Other evidence of mineralization in the follow-up survey area is given by small oxidized gossans (limonite) over altered sulphides (mostly pyrite).

PREVIOUS GEOCHEMICAL SURVEYS

Before this study two geochemical surveys were conducted in this sector of the Peloritani Mountains, one at regional level and one as follow-up, by the State Group ENI-RIMIN on behalf

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	Grain fraction A					Grain fraction B					Grain fraction C				
Elements	N.	Range	Mean	St.dev.	Geom.M.	N.	Range	Mean	St.dev.	Geom.M.	N.	Range	Mean	St.dev.	Geom.M.
Fe (%)	95	1,83 - 7,47	4,17	0,78	4,1	95	2,05 - 7,5	4,44	0,78	4,37	95	2,7 - 7,5	5,10	0,79	5,04
Mg (%)	95	0,7 - 3,65	1,82	0,40	1,78	95	0,8 - 3,6	1,94	0,40	1,90	95	0,9 - 3,6	2,2	0,42	2,17
Al (%)	95	6,4 - 11,8	8,22	0,71	8,2	95	6,9 - 11,8	8,52	0,72	8,49	95	7,3 -12,2	8,82	0,81	8,78
Ca (%)	95	0,2 - 7,5	1,48	0,86	1,33	95	0,27 - 6,15	1,52	0,78	1,37	95	0,37 - 6,8	1,94	1,24	1,67
Ti (%)	95	0,34 - 0,8	0,5	0,09	0,49	95	0,38 - 0,95	0,54	0,10	0,53	95	0,47 - 0,98	0,62	0,10	0,62
Zn (ppm)	95	58 - 731	135	121	112	95	42 - 870	147	133	122	95	59 - 848	182	143	155
Mn (ppm)	95	469 - 1310	697	151	683	95	357 - 1330	755	172	737	95	619 - 2400	981	307	945
Cu (ppm)	95	20 - 152	46	18	43	95	25 - 134	51	18	48	95	36 - 141	65	16	63
Co (ppm)	95	8,9 - 44	17	6	17	95	10 - 57	20	7	19	95	13 - 71	27	10	26
Cr (ppm)	95	26 - 201	82	24	79	95	30 - 188	87	23	84	95	45 - 186	101	22	99
Ni (ppm)	95	14 - 146	45	16	43	95	14 - 142	48	15	46	95	18 - 187	56	18	54
Ag (ppm)	55	0,04 - 1,4	0,2	0,3	0,2	57	0,04 - 56	5	12	0,4	66	0,05 - 35	3,5	9,5	0,3
Sb (ppm)	55	0,5 - 8,9	1,8	1,8	1,3	47	0,5 - 8,5	2	2	1,6	59	0,5 - 12	2,3	2,3	1,7
As (ppm)	55	9,3 - 220	54	51	39	47	14 - 260	66	60	49	59	14 - 432	92	86	66
Pb (ppm)	83	14 - 430	40	59	29	71	15 - 620	46	78	32	73	17 - 840	56	103	38
Au (ppb)	95	1 - 2900	87	397	11	95	2 - 2500	55	272	12	95	2 - 3300	81	347	21
Hg (ppb)	95	20 - 70	21	6	21	95	20 - 70	21	7	21	95	20 - 130	22	12	21

Table 1 - Summary statistics of stream sediment data.

of the Ministero dell'Industria, del Commercio e dell'Artigianato (MICA) (De Vivo et al., 1993). In the regional survey a total of 1198 stream sediment samples were collected covering a total of 435 km² at a nominal density of 2.8 samples per km². As a result of the univariate and multivariate evaluation of the analytical data, the area between Vallone Pularlo, Pizzo Mualio and Pizzo Cafi, covering about 14 km² was identified as a priority target because of diffuse, consistent anomalies for Au, most of them being associated as well with As, Hg and Sb. These anomalies were distributed along the "tectonic belt" marking the contact between the Mandanici, the Mela and the Aspromonte Units.

In the follow-up survey, in the target area of 14 km² we collected 118 stream sediment samples, at a nominal density of 8.5 samples per km². Univariate and multivariate evaluation of the analytical data indicated highly anomalous concentrations for Au (up to 1500 ppb), Ag (up to 5.1 ppm) and As (up to 621 ppm), associated with anomalous values for Cd, Pb, W and Zn (Fig. 4; De Vivo et al., 1993). Of particular relevance are the Au anomalies in the drainage basin of Vallone Monastri and in the upper portion of Fiumara Dinarini, along Vallone Mangiarano. Here, in addition to Au values up to 1500 ppb, Au flakes have been found as well in pan concentrates (De Vivo et al., 1993).

The present follow-up survey is concentrated on ≈7 km² covering the Fiumara Dinarini drainage basin and the catchment basins (among which Vallone Monastri) draining Pizzo Mualio, Rocca di Vernava and Pizzo Ruggeri (Fig. 2), heading to Vallone Pularlo.

SAMPLING AND ANALYTICAL METHODS

A total of 95 stream sediment samples have been collected over an area of ≈7 km², at a nominal density of 14 samples per km², along the small creeks, tributaries of Fiumara Dinarini and Vallone Pularlo. The steep slopes of the investigated area have hampered the use of soils as a sampling media in this stage of the project. In establishing the sampling grid, some sampling sites were located in the same place of the previous survey, in order to check the validity of analytical results already obtained (De Vivo et al., 1993).

At each sampling site about 20 kg of sediments, to a depth of 50 cm below the surface, were collected. The samples were dried and sieved to obtain 3 grain fractions: A: > 250 μm (60 mesh); B: between 250 and 177 μm (60 - 80 mesh); C: <177 μm (80 mesh). Various chemical techniques have been utilized to analyze the samples discussed in this report, including atomic absorption spectrometry (AA), flame atomic absorption spectrometry (FAA), graphite furnace atomic absorption spectrometry (GFAA), and inductively coupled plasma atomic emission spectrometry (ICP-AES).

ICP-AES multi-element analysis was done using the procedure of Lichte et al. (1987). Arsenic was determined by chemical separation/GFAA using the procedure for coal developed by Aruscavage (1977). Silver was determined by chemical separation/GFAA following the method of Aruscavage and Campbell (1979). Lead was done by FAA (Aruscavage and Crock, 1987). Analysis of Pb (< 20-ppm) was by GFAA using an ammonium phosphate matrix modifier. Mercury was analyzed by cold vapor AA using the method of Flanagan et al. (1982). Gold was extracted into MIBK, then the organic layer was analyzed for Au by GFAA (Meier, 1980). Precision expressed as percent relative standard deviation is as follows; ICP-AES = 5-15, As and Sb = 2-15, Ag = 3-8, Pb = 10, Hg = 10, and Au = 10. Abundance levels of some elements were at or below their detection limits; Au = 2 ppb, Hg = 20 ppb, Co = 10 ppm (for most analyses) and Sb = 0.5 ppm.

Univariate and multivariate statistical techniques have been used to assist in interpreting the geochemical data (Davis, 1988; De Vivo et al., 1984; 1993). Cumulative frequency plots have been used to determine the anomaly thresholds (Stanley, 1987).

RESULTS

The statistical parameters from the data of the three grain fractions are presented in Table 1. Figures 3, 4 and 5 show the distribution of anomalous Au values for the three grain fractions analyzed. The grain fraction A indicates highly anomalous concentrations for Au (> 80 ppb and up to 2.9 ppm) in the Fiumara Dinarini draining Pizzo Cappara and Pizzo Cipolla catchment areas (Fig. 3). Fraction B indicates as well anomalous values in the same area but the number of markedly anomalous samples is lower, and with lower concentrations (> 80 ppb and up to 2.5 ppm) (Fig. 4). Fraction C indicates anomalous values

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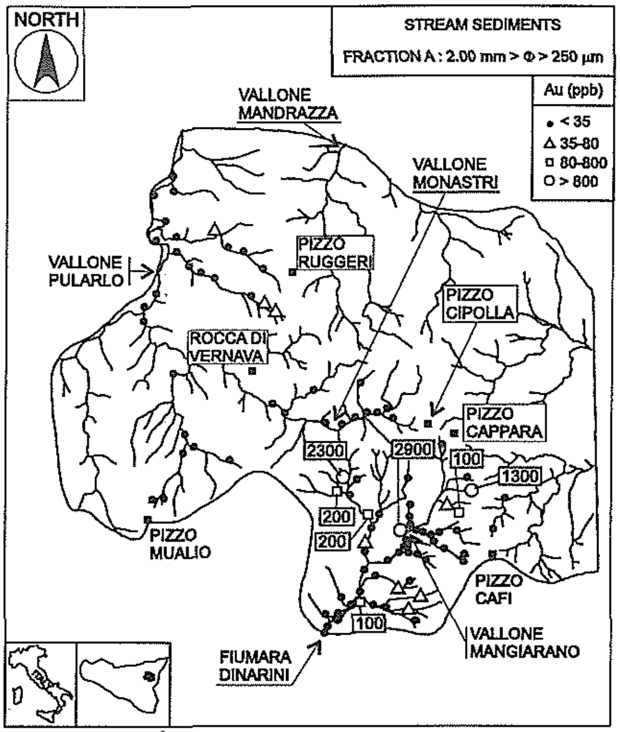

Fig. 3 - Distribution of anomalous Au values in stream sediments (grain fraction A).

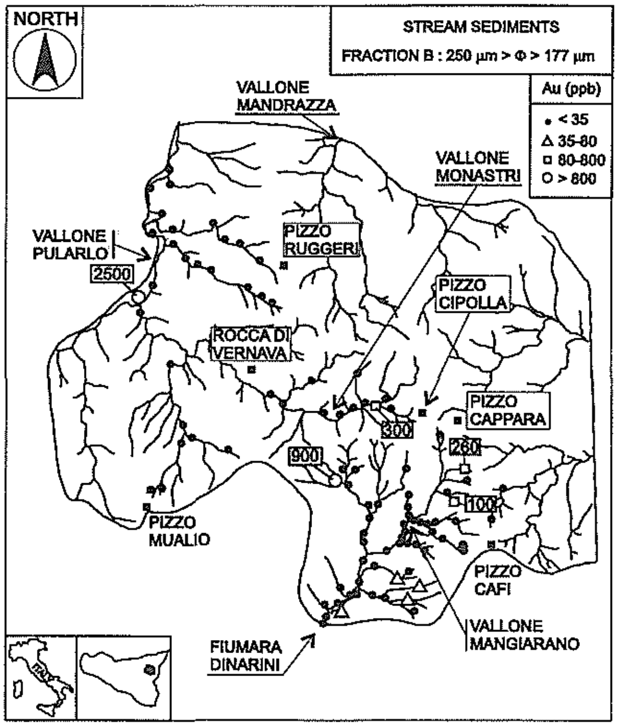

Fig. 4 - Distribution of anomalous Au values in stream sediments (grain fraction B).

with generally lower concentrations compared with fraction A (Fig. 5), but the anomalies are much more spread all over the catchment area of Fiumara Dinarini draining Pizzo Cappara and Pizzo Cipolla (> 80 ppb and up to 3.3 ppm). In the same drainage basins (i.e., Vallone Monastri and the upper portion of Fiumara Dinarini) occur anomalous values for Fe, Zn, Mn, Cu,

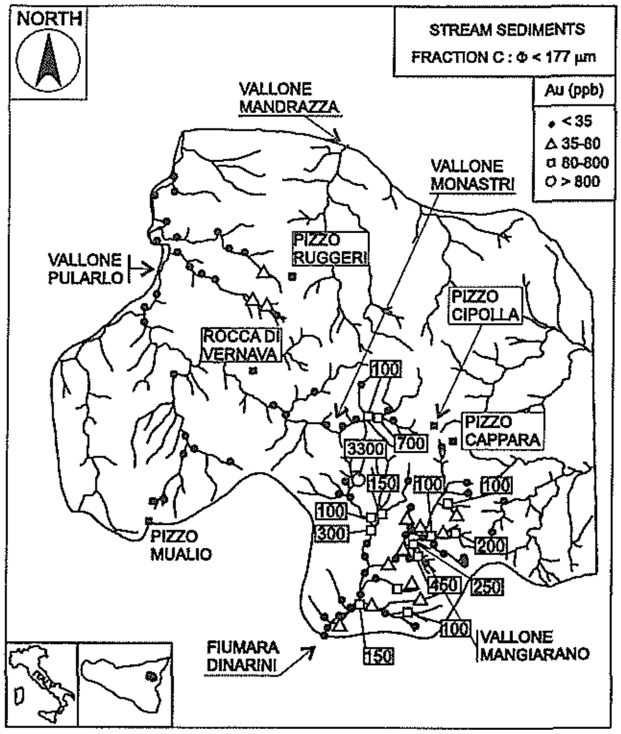

Fig. 5 - Distribution of anomalous Au values in stream sediments (grain fraction C).

Co, Cr, Ni, Ag, Sb, As and Pb for the three analysed grain fractions, but the concentrations are markedly higher for the finer fraction C (<177 μm). Worth mentioning is the grouping of high values for elements such as As, Sb, and Ag in the same drainages where Au anomalies occur.

The distribution of the elements in different grain-size fractions shown on the box plots (Fig. 6) indicates that elements such as Cu, Co, Ni, Sb, As, Cr, Mn, Pb and Zn have concentration values which progressively increase from the coarser fraction (A) to the finer fraction (C), whereas this is not true in the same extent for Au and Ag. The box plots of Au shows that a trend of increasing Au values is recorded in the finer fraction. Probably the benefits of using the finer fraction to check the variability of Au distribution, would have become more apparent if fractions finer than 100 μm were used.

At each sampling site in a stream network, the mineral content of the sediments can be influenced by a number of factors. Active stream sediments are subjected to various sorting processes related to the ability of the flow to differentially transport grains of variable physical characteristics. The deposition or entrainment can be influenced by grain size, density and shape (Reid and Frostick, 1985; Slingerland and Smith, 1986), but the effectiveness of each process varies according the geomorphological control (Hughes et al., 1995). In our case the data show that the median value of the box plot increases, though not markedly, in the finer fraction (< 177 μm) compared with the other two coarser fractions (A and B). This is not surprising; in fact, the use of fine-grained fractions for search for Au, has been used successfully elsewhere for gold prospecting, as in Australia and China (Elliott and Towsey, 1989; Salpeteur and Sabir, 1989; Xie and Wang, 1991).

R-mode factor analysis of results for the grain fractions A, B and C, using 16 variables indicates a 4-factor model as the most appropriate to explain mineralization in the area (Table 2). As for the single element anomaly distribution, the highest factor

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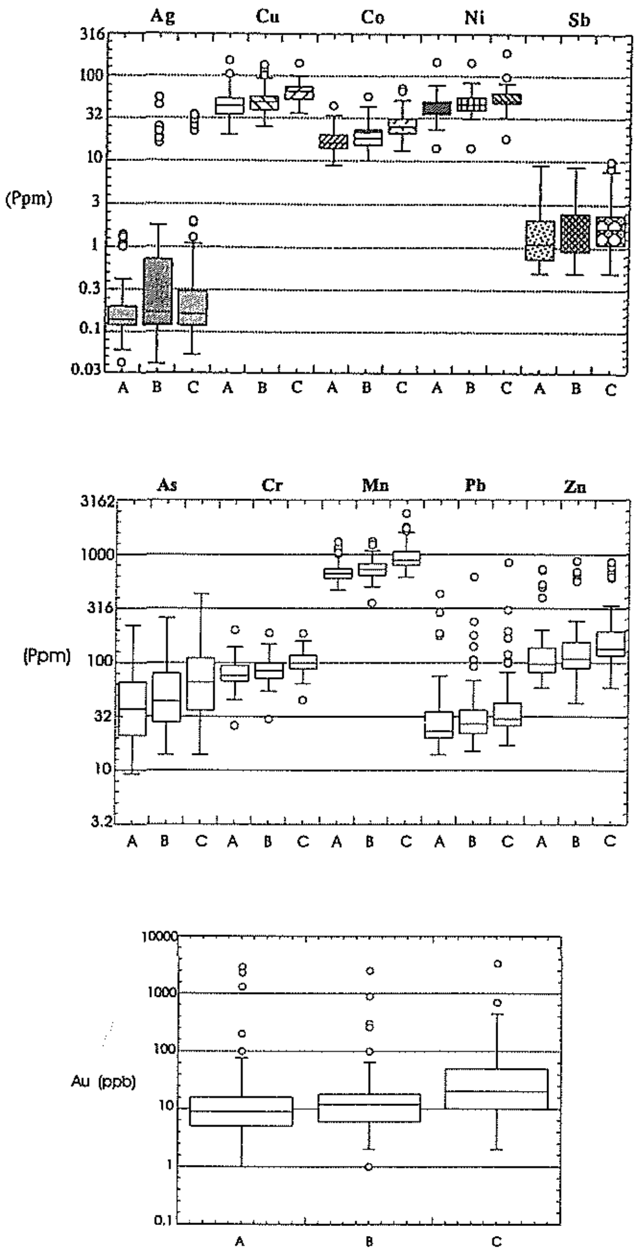

Fig. 6 - Box plots showing the distribution of Ag, Cu, Co, Ni, Sb, As, Cr, Mn, Pb, Zn and Au in grain fractions A, B and C

scores fall in the upper portion of Fiumara Dinarini, namely in the drainage area of Pizzo Cappara and Pizzo Cipolla. The associations F3 (As-Au-Cu-Sb), F1 (Sb-Ag-Au-As-Pb) and F3 (Au-As-Sb-Ag), respectively for the grain fractions A, B and C, represent precious metal mineralization, whereas the other factor associations (F2 for fraction A; F2 for fraction B and F4 for fraction C) represent base-metal sulphide mineralization. Also for R-mode factor analysis the best response to the presence of base metal sulphide and Au mineralization is given by the data from the finer fraction(C; < 177 μm). The distribution of association factor scores interpreted as the most appropriate to explain the base metal sulphide and Au mineralization in the area for the grain fraction C is shown on figure 7.

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	Grain fraction A				Grain fraction B				Grain fraction C			
Elements	F1	F2	F3	F4	F1	F2	F3	F4	F1	F2	F3	F4
Fe	0,93	-0,01	-0,20	0,07	0,95	0,08	0,03	0,08	0,90	0,13	-0,26	-0,19
Mg	0,92	-0,09	-0,14	-0,07	0,91	0,03	0,12	0,03	0,92	-0,1	-0,03	-0,12
Al	0,41	0,10	-0,26	0,75	0,47	0,02	-0,64	0,45	0,21	0,53	-0,59	0,34
Ca	0,24	0,19	-0,38	-0,78	0,24	-0,12	0,89	0,10	0,19	-0,73	0,03	0,23
Ti	0,76	-0,07	-0,19	0,29	0,67	0,34	-0,14	0,09	0,63	0,44	-0,30	-0,01
Zn	-0,19	0,73	-0,10	-0,01	-0,11	-0,06	-0,02	0,85	-0,18	-0,08	0,08	0,86
Mn	0,48	0,75	0,07	0,01	0,14	0,86	0,25	0,08	0,10	0,61	0,18	0,56
Cu	0,29	0,13	0,66	0,21	0,14	0,69	-0,29	0,08	0,19	0,77	0,25	0,17
Co	0,30	0,61	0,23	0,40	0,07	0,82	-0,15	-0,16	0,11	0,84	-0,06	0,09
Cr	0,91	-0,16	-0,07	0,10	0,93	0,19	-0,04	-0,07	0,92	0,11	-0,21	-0,18
Ni	0,95	-0,06	-0,02	0,00	0,92	0,22	0,16	-0,07	0,95	0,06	-0,07	-0,12
Ag	-0,47	0,68	0,33	-0,13	-0,74	0,40	0,20	0,36	-0,54	0,15	0,40	0,62
Sb	-0,37	0,49	0,61	-0,25	-0,76	0,47	0,18	0,04	-0,49	0,15	0,68	0,38
As	-0,31	0,36	0,80	0,00	-0,65	0,60	-0,05	-0,07	-0,41	0,40	0,70	0,11
Pb	-0,44	0,73	0,25	-0,14	-0,65	0,46	0,18	0,40	-0,41	0,25	0,23	0,76
Au	-0,26	-0,11	0,68	-0,01	-0,69	0,02	-0,05	0,29	-0,06	-0,04	0,75	0,22
Var. %	51,5	25,0	13,8	8,4	53,5	24,1	12,2	10,1	51,1	27,3	11,3	10,2

Table 2 - Varimax-rotated factor matrix (4-factor model), log-transformed stream sediment data. Loadings > |0.4| are underlined.

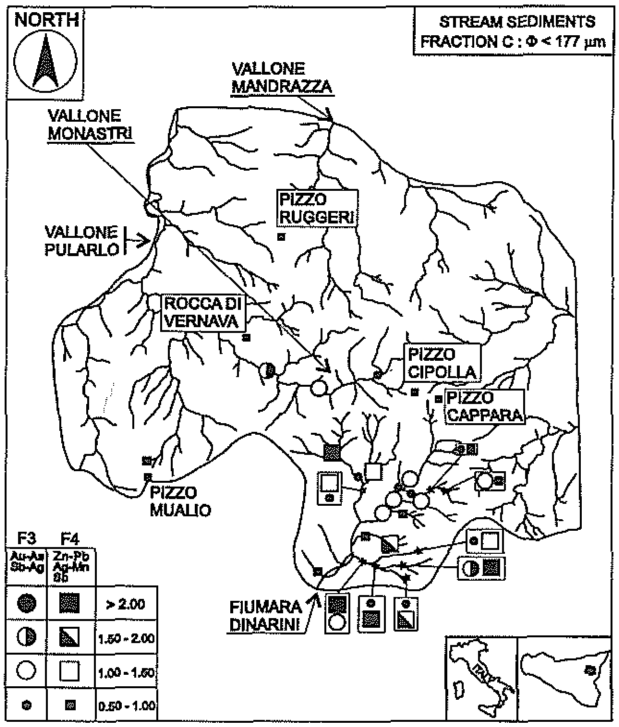
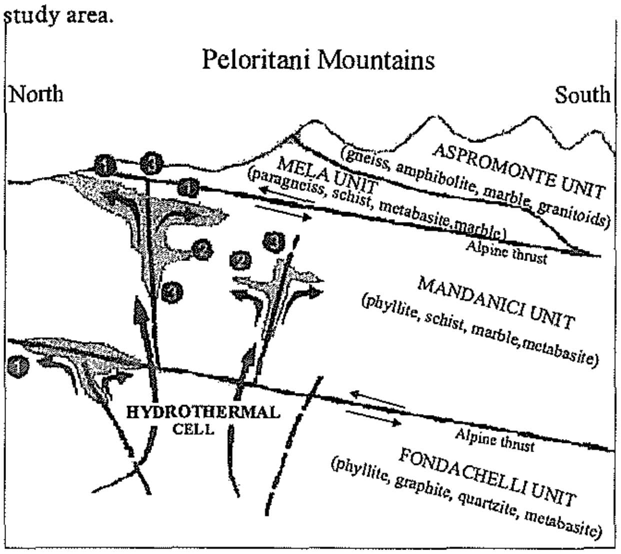


Fig. 7 - Distribution of F3 (Au-As-Sb-Ag) and F4 (Zn-Pb-Ag-Mn-Sb) association factor scores from log-transformed stream sediment grain fraction C.

CONCLUSIONS

The most relevant result of this geochemical study is the confirmation of the results already obtained in the previous study by De Vivo et al. (1993). Specifically, the concentrations of Au found in this follow-up survey are even higher than the previous study. In addition, it has been demonstrated that the finer grain fraction size is most effective for the identification of Au anomalies in the study area. The median values of Au concentrations tend in fact to increase in the finer fraction (< 177 μm). The finer fraction also is a critical factor in the control of the distribution of the other anomalous elements (As, Sb, Zn, Cu and Pb)

An additional confirmation of the results obtained in the previous survey, has been a clear identification of the source of the Au anomalies. The anomalous samples drain the thrust front of three tectonic units: the Mela and Aspromonte Units over the Mandanici Unit, specifically the front along the watershed which extends from Pizzo Cafi, to Pizzo Cappara, Pizzo Cipolla and west of Pizzo Cipolla (Figs. 3 - 5). This thrust front is thus the primary target for a detailed exploration program. The anomalous area identified by means of the previous (De Vivo et al.;1993) and the present follow-up survey is now covered by a research permit (released by the Regional Sicilian Mining Authority) designed to evaluate the economic potential of the study area.



1- Thrust controlled Au mineralisation; 2- Bedding controlled Au mineralisation
3- High angle faults localising fluid flow and Au mineralisation

Mineralisatins flow.................... Gold mineralisation..................

Fig. 8 - Mineralisation model of Peloritani Mountains.

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The primary source of Au anomalies remains still speculative, but the presence of intercalations of basic volcanics in Aspromonte, Mela and Mandanici Units, make these rocks plausibile candidates for such origin (Fig. 8). In this view, the auriferous anomalies might be related to primary Hercynian volcanogenic deposition; Au and As, Sb, Ag + base metal sulphides might have been remobilized during subsequent metamorphic processes (Sacca et al., in press) and deposited along the shear zone, occurring along the thrust between the Aspromonte, Mela and Mandanici Units.

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REFERENCES

Amodio Morelli L., Bonardi G., Colonna V., Dietrich D., Giunta G., Ippolito F., Liguori V., Lorenzoni S., Paglionico A., Piccareta G., Russo M., Scandone P., Zanettin-Lorenzoni E. e Zuppetta A., 1976. L'Arco Calabro-Peloritano nell'orogene appenninico-maghrebide. Mem. Soc Geol. It., 17: 1-60.

Aruscavage, P. J. (1977) Determination of arsenic, antimony, and selenium in coal by atomic absorption spectrometry with a graphite tube atomizer. *J. Research U.S. Geol. Survey*, vol. 5, p. 405-408.

Aruscavage, P. J. and Campbell, E. Y. (1979) The determination of silver in silicate rocks by electrothermal atomic absorption spectrometry. Anal. Chim. Acta, vol. 109, p. 171- 175.

Aruscavage, P. J. and Crock, J. G. (1987) Atomic absorption methods, in *Methods for Geochemical Analysis* (Baedecker, P.A., ed.), U.S. Geol. Survey Bulletin 1770, p. C1-C6.

Bonardi, G., Giunta, G., Messina, A., Perrone, V. and Russo S., 1993. The Calabria-Peloritani Arc field trip guidebook. 6th Field Meeting IGCP Project n. 276 "The Calabria - Peloritani Arc and its correlation with Northern Africa and Southern Europe", Messina, 27/9 - 2/10 1993, Newsletter 5: 1 - 81 (in press).

De Vivo, B., Lima, A., Catalano, G. and Chersicla, A., 1993. Detailed geochemical survey in the Peloritani Arc (northeastern Sicily, Italy): Evidence of gold anomalies. J. Geochem.Explor., 46: 309 - 324.

Elliott, S. M. and Towsey, C. A., 1989. Regional drainage geochemical gold exploration techniques used in Queensland, Australia. In: North Queensland 89 Gold Conference, Townsville, Qld., pp. 51 - 61.

Flanagan, F. J., Moore, R., and Aruscavage, P. J. (1982) Mercury in geologic reference samples. Geostand. Newslett., vol. 6, p. 25-46.

Hughes, N., Coats, J. S. and Petts, G. E., 1995. Local variability of gold in active stream sediments. J. Geochem. Explor., 54: 137 - 148.

IDROGEO Int. SRL, 1986a. Progetto di ricerca EMS - CEE: mineralizzazioni a tungsteno e metalli associati nel cristallino dei Monti Peloritani (Sicilia nord-orientale). Rapporto Finale. *Internal Report EMS, SCL, 242, 220 p.*

IDROGEO Int. SRL, 1986b. Prospezioni geominerarie per scheelite nella Sicilia Nord-Orientale. Rapporto Finale, Indagini geofisiche. Concvenzione EMS - CEE, 1985 - 1986. Convenzione EMS - IDROGEO 8/10/85, SCL, 249, 56 p.

Lichte, F. E., Golightly, D.W., and Lamothe, P.J. (1987) Inductively coupled plasma-atomic emission spectrometry, in *Methods for Geochemical Analysis* (Baedecker, P.A., ed.), U.S. Geol. Survey Bulletin 1770, p. B1-B10.

Meier, A. L. (1980) Flameless atomic absorption determination of gold in geologic samples materials. J. Geochem. Explor., vol. 13, p. 77-85.

Messina A., Compagnoni R., De Francesco, A.M. and Russo S., 1992. Alpine metamorphic overprint in the Aspromonte Unit (Calabria - Peloritani Arc - Southern Italy). IGCP Project n. 276, Newsletter, 5: 353 - 380.

Messina A., 1995. The crystalline basements of the Peloritani Mountains (Sicily): the state of the art. Congresso Soc. It. Miner. Petrol., Venezia, 1995. Plinius, 14: 223 - 225.

Reid, L. and Frostick, L. E., 1985. Role of settling, entrainment and dispersive equivalence and dispersive equivalence and of interstice trapping in place formation. J. Geol. Soc. London, 142: 739 - 746.

Sacca, C., Sacca D., Messina A. and Cimino G. Au in the Mandanici Units, northeastern Sicily (Calabrian-Peloritan Arc). Eur. J. Miner. (submitted).

Salpeteur, I. and Sabir, H., 1989. Orientation studies for gold in the central pedi-palin of the Saudi Arabian shield. J. Geochem. Explor., 34: 189 - 215.

Slingerland, R. and Smith, N. D., 1986. Occurrence and formation of water-laid placers. Annu. Rev. Earth Planet. Sci., 14: 113 - 147.

Stanley, C. R., 1987. Probplot. An interactive computer program to fit mixtures of normal (or lognormal) distributions with maximum likelihood of optimization procedures. Assoc. Explor. Geochem., Spec. Vol. 14, 39 pp.

Xie, X. and Wang, X., 1991. Geochemical exploration for gold: a new approach to an old problem. J. Geochem. Explor., 40: 25 - 48.

RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 97. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); the USGS Circular (USGS Cir): and Open File Report (USGS OFR); Geological Survey of Canada Papers (GSC Paper) and Open File Report (GSC OFR); Bulletin of the Canadian Institute of Mining and Metallurgy (CIM Bull.); Transactions of Institute of Mining and Metallurgy, Section B: Applied Earth Sciences (Trans IMM). Publications less frequently cited are identified in full. Compiled by **L. Graham Closs**, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401-1887, Chairman AEG Bibliography Committee. Please send new references to Dr. Closs, not to **EXPLORE**.

Bonham-Carter, G.F., 1997. GIS Methods for integrating exploration data sets. in Gubins, A.G. (Ed.) Proceedings of Exploration '97: Fourth Decennial Conference on Mineral Exploration. GEO F/X: 59-64.

Carranzas, E.J.M. and Hale, M., 1997. A catchment basin approach to the analysis of reconnaissance geochemical-geological data from Albay Province, Philippines. J. Geochem. Explor. 60(2): 157-171.

Cook, J.J., 1997. A comparison a differing lake sediment field sample sizes: application to geochemical exploration for epithermal gold deposits in central British Columbia. J. Geochem. Explor. 60(2): 127-138.

Darnley, A.G., 1997. A global geochemical reference network: the foundation for geochemical baselines. J. Geochem. Explor. 60(1): 1-5.

Darnley, A.G., Plant, J.A., and Garrett, R.G., 1997. Global geochemical baselines: Their importance for the mineral industry. in Gubins, A.G. (Ed.) Proceedings of Exploration '97: Fourth Decennial Conference on Mineral Exploration. GEO F/X: 817-820.

De Vivo, B., et al., 1997. Baseline geochemical mapping in Sardinia (Italy). J. Geochem. Explor. 60(1): 77-90.

Gregorauskiene, V. and Kadunas, V., 1997. Experience and goals of geochemical mapping for environmental protection in Lithuania. J. Geochem. Explor. 60(1): 67-76.

Harris, J.R., Grunsky, E.C., and Wilkinson, L., 1997. Developments in the effective use and interpretation of lithogeochemistry in regional exploration: Application of GIS technology. in Gubins, A.G. (Ed.) Proceedings of Exploration '97: Fourth Decennial Conference on Mineral Exploration. GEO F/X: 285-292.

Hutchins, D.G., Milner, S.C., and Korkiakoski, E., 1997. Regional airborne geophysics and geochemistry: A Namibian perspective. in Gubins, A.G. (Ed.) Proceedings of Exploration '97: Fourth Decennial Conference on Mineral Exploration. GEO F/X: 779-792.

Jana, D. And Walker, D., 1997. The influence of sulfur and partitioning of siderophile elements. GCA 61(24): 5255-5277.

Jayawardhana, P.M. and Sheard, S.N., 1997. The use of airborne gamma ray spectrometry by M.I.M. Exploration - A case study from the Mount Isa Inlier, Northwest Queensland, Australia. in Gubins, A.G. (Ed.) Proceedings of Exploration '97: Fourth Decennial Conference on Mineral Exploration. GEO F/X: 765-774.

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Recent Papers *Continued from Page 12*

Killeen, P.G., 1997. Nuclear techniques for ore grade estimations. in Gubins, A.G. (Ed.) Proceedings of Exploration '97: Fourth Decennial Conference on Mineral Exploration. GEO F/X: 677-684.

Lefebure, D., 1997. New Mineral Deposits Models of the Cordillera (Conference Report). Geoscience Canada 24(3): 143-149.

Leistel, J.M., Marcoux, E., Deschamps, Y., and Joubert, M., 1998. Antithetic behavior of gold in the volcanogenic massive sulphide deposits of the Iberian Pyrite Belt. Min. Deposita. 33(1/2): 82-97.

Lightfoot, P.C., Keays, K.K., Morrison, G.G., Bite, A., and Farrell, K.P., 1997. Geologic and Geochemical Relationships between the Contact Sublayer, Inclusions, and the Main Mass of the Sudbury Igneous Complex: A Case Study of the Whistle Mine Embayment. EG 92(6): 647-673.

Lis, J., Pasieczna, A., Strzelechki, R., Wolkocwicz, S., and Lewandowski, P., 1997. Geochemical and radioactivity mapping in Poland. J. Geochem. Explor. 60(1): 39-53.

Mullen, T.V., Jr. And Parrish, I.S., 1998. Short history of man and gold. Min. Eng. 50(1): 50-56.

Odor, L., Horvath, I., and Fugedi, U., 1997. Low-density geochemical mapping in Hungary. J. Geochem. Explor. 60(1): 55-66.

Pell, J.A., 1997. Kimberlites in the Slave Craton, Northwest Territories, Canada. Geoscience Canada 24(2): 77-89.

Prohic, E., Hausberger, G., and Davis, J.C., 1997. Geochemical patterns in soils of the karst region, Croatia. J. Geochem. Explor. 60(2): 139-155.

Robinson, B.H., Brooks, R.R., Howes, A.W., Kirkman, J.H., and Gregg, P.E.H., 1997. The potential of the high-biomass nickel hype accumulator Berkheya coddii for phytoremediation and phytomining. J. Geochem. Explor. 60(2): 115-126.

Robson, D.F. and Lewis, P.C., 1997. Regional geophysics and geochemistry as an exploraiton initiative in New South Wales, Australia. in Gubins, A.G. (Ed.) Proceedings of Exploration '97: Fourth Decennial Conference on Mineral Exploration. GEO F/X: 793-804.

Ryan, B., 1997. The Mesoproterozoic Nain Plutonic Suite in Eastern Canada, and the Setting of the Voisey's Bay Ni-Cu-Co Sulphide Deposit. Geoscience Canada 24(4): 173-188.

Continued on Page 14

Recent Papers *Continued from Page 13*

Salminen, R. and Tarrainen, T., 1997. The problem of defining geochemical baselines: A case study of selected elements and geological materials in Finland. J. Geochem. Explor. 60(1): 91-98.

Spatz, D.M., 1998. Multidisciplinary teams aid minerals exploration. Min. Eng. 50(1): 57-60.

Srivastrava, P.K. and Sinha, A.K., 1997. Geochemical characterization of tungsten-bearing granites from Rajasthan, India. J. Geochem. Explor. 60(2): 173-184.

Thompson, A.J.B. and Thompson, J.F.H. (Eds.), 1996. Atlas of Alteration - A Field and Petrographic Guide to Hydrothermal Alteration Minerals. Geol. Assoc. Canada. 119 p.

Turner, D.D., 1997. Predictive GIS model for sediment-hosted gold deposits, North-Central Nevada, USA. in Gubins, A.G. (Ed.) Proceedings of Exploration '97: Fourth Decennial Conference on Mineral Exploration. GEO F/X: 115-126.

Vrana, K., et al., 1997. Geochemical Atlas of the Slovak Republic at a scale of 1:1,000,000. J. Geochem. Explor. 60(1): 7-37.

Wellmer, F.W., 1998. Statistical Evaluations in Exploration for Mineral Deposits. Springer. 379 p.

Xuejing, X., Xuzhan, M., and Tianxiang, R., 1997. Geochemical mapping in China. J. Geochem. Explor. 60(1): 99-113.

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Private Bag, Rondebosch, 7700, South Africa, 7IKC@GEOLOGY.UCT.AC.ZA, FAX: +27 21 650 3783, TEL: +27 21 650 2931. Secretary/Treasurer: James Gurney +27 21 531 03162 FAX: +27 21 531 9887.

■ May 18-20, 1998, **Geological Association Canada/Mineralogical Association Canada,** Quebec, Canada. INFORMATION: A Morin, Dept. Geologie et de genie geololoque, Universite Laval, Pavillon Adrein-Pouliot Sanite-Fay, Quebec, G1K 7P4 Canada. TEL. 418-656-2193. FAX 418-565-7339; includes a 2.5 day pre-meeting MAC short course entitled **Mineralized Porphyry-Skarn Systems,** INFORMATION (for the short course only) Dave Lentz, TEL: (506) 547-2070; FAX:(506) 547-7694.

■ May 22-27, 1998, **Geochemistry of Crustal Fluids: Characterization of Reactive Transport in Natural Systems,** Aghia Pelaghia, Crete. INFORMATION: J. Hendekovic, European Science Foundation, 1 Quai Lezay-Marnesia, 67080 Strasbourg Cedex, France, e-mail: euresco@esf.org.

■ May 25-26, 1998, **Rocky Mountain Section, Geological Society of America,** Flagstaff, Arizona. INFORMATION: Michael Ort, Dept. of Geology, Northern Arizona University, Flagstaff, AZ 86011.

■ May 26-29, 1998, **American Geophysical Union,** Spring meeting, Boston, Mass. INFORMATION: AGU meetings dept., 2000 Florida Ave., NW, Washington, DC 20009. TEL. 800-966-2481, FAX: 202-328-0566, e-mail: meetinginfo@kosmos.agu.org.

■ June 1-4, 1998, **Pan American Current Research on Fluid Inclusions (PACROFI) VII,** Las Vegas, Nevada. INFORMATION: Jean Cline, Dept. of Geosciences, University of Nevada, Las Vegas, Nevada 89154-4010, FAX: 702-895-4064.

■ June 6-11, 1998, **Clay Mineral Society 35th Annual Meeting,** Cleveland, Ohio. INFORMATION: Samuel M. Savin, Dept. of Geological Sciences, Case Western Reserve Univ., Cleveland, OH 44106, 216-368-4413. FAX: 216-368-3832.

■ July 4-11, 1998, **Geological Society of America Penrose Conference on "Processes of Crustal Differentiation: Crust-Mantle Interactions",** Verbania, Italy. INFORMATION: T. Rushmer, Dept. of Geology, University of Vermont, Burlington, VT 05405, 802-656-8136, FAX: 802-656-0045, e-mail: trushmer@zoo.uvm.edu.

■ August 9-14, 1998, **General meeting of the International Mineralogical Association,** Toronto, Canada, INFOMATION: E. Schandl, Dept. of Geology, University of Toronto, Toronto, Canada M5S 3B1. TEL 416-978-7084, FAX 416-978-3938.

Continued on Page 16

CALL FOR PAPERS / POSTERS

19TH INTERNATIONAL GEOCHEMICAL EXPLORATION SYMPOSIUM, VANCOUVER, APRIL 11-16, 1999

EXTENDED ABSTRACTS ARE REQUIRED BY OCTOBER 1, 1998.

The Technical Sessions will include the following topics but authors are encouraged to submit papers on all aspects of exploration geochemistry. Contributions from the mineral exploration industry and comparative studies of different methodologies are especially welcome.

- **Integrated exploration case histories – discoveries and disappointments**
- **Search for concealed deposits (including diamonds)**
- **New sampling methodologies at all scales**
- **Data presentation & interpretation**
- **Analytical methods (including quality control)**
- **Lithogeochemistry**
- **Envirogeochemistry related to the minerals industry.**

Details of the abstract format will be posted at our web site site http://aeg.org/aeg/aeghome.html. If possible submit your abstract as an e-mail attachment to fletcher@unixg.ubc.ca. If this is not possible, send a paper and an electronic copy on disc (in Word or WordPerfect) to Dr. I. Elliott, Cominco Ltd., 700-409 Granville Street, Vancouver, BC, Canada, V6C 1T2 (ivor.elliott@cominco.com). Please indicate whether the abstract is intended for either oral presentation or as poster.

Calendar of Events *Continued from Page 15*

■ September 22-25, 1998. **International Meeting of Gold Exploration and Mining in Nw Spain,** Oviedo, Spain. INFORMATION: Daniel Arias Prieto, Facultad de Geología. Universidad de Oviedo C/Arias de Velasco s/n, 33005 Oviedo, Spain. FAX (34)8-5103087. Email: arias@asturias.geol.uniovi.es.

■ October 26-29, 1998, **Annual Meeting of the Geological Society of America,** Toronto, Ontario, Canada. INFORMATION: Pierre Robin, Dept. of Geology, 22 Russell St., Toronto, ON M5S 3B1, Canada, TEL 416-978-3022, FAX 416-978-3938.

■ April 11-16, 1999, **19th International Geochemical Exploration Symposium,** Vancouver, Canada. INFORMATION: Venue West Conference Services Ltd., #645-375 Water Street, Vancouver, BC, Canada V6B5C6, TEL. 604-681-5226, FAX 604-681-2503.

■ May 26-28, 1999, **Geological Association of Canada-Mineralogical Association of Canada Joint Annual Meeting,** Sudbury, Ontario, Canada. INFORMATION: Dr. P. Copper, Dept. of Earth Sciences, Laurentian University, Sudbury, Ontario P3E 2C6, TEL. 705-675-1151 (ext. 2267), FAX: 705-675-4898, e-mail: gacmac99@nickel.laurentian,ca.

■ October, 25-28, 1999, **Annual Meeting of the Geological Society of America,** Denver, Colo. INFORMATION: TEL 1-800-472-1988, eMAIL: meetings@geosociety.org.

■ April 24-28, 2000, **5th International Symposium on Environmental Geochemistry,** Cape Town, South Africa. INFORMATION: 5ISEG, Department of Geological Sciences, University of Cape Town, Private Bag, Rondebosch, 7701, South Africa, FAX 27-21-650-3783. Email: 5iseg@geoglogy.uct.ac.za.

Please check this calendar before scheduling a meeting to avoid overlap problems. Let this column know of your events.

Virginia T. McLemore
New Mexico Bureau of Mines and Mineral Resources
801 Leroy Place
Socorro, NM 87801 USA
TEL: 505-835-5521
FAX: 505-835-6333
e-mail: ginger@gis.nmt.edu

Regolith '98
Third Australian Regolith Conference
New Approaches to an Old Continent
2-9th May 1998 in Kalgoorlie

- Have you or your company discovered any new mineral deposits using regolith based exploration?
- Do you have any observations of value to colleagues about using regolith geology in exploration programs?

Regolith '98 will include workshops:
- Remote techniques for regolith mapping and characterisation (Leaders: Ian Tapley and John Wilford)
- *Sampling media in various Australian regolith regimes* (Leader, Keith Scott)

Technical sessions:
- Regolith exploration - needs for the future
- The gold 'n regolith (including case studies)
- Basemetal, Ni and PGE exploration in the regolith (including case studies)
- Regolith development models (process, climate, *tectonics, landscape evolution, mapping and dating*)
- Mineral weathering - importance for exploration of the regolith and exploration
- The living regolith (microbiology, plants and animals)
- Advances in analytical geochemistry
- Posters

Field trips to interesting regolith sites in the Kalgoorlie region.
Abstracts for papers or posters from individuals and groups should be sent by 31 October 1997 to - Regolith '98 c/- AMF, 63 Conyngham Street, Glenside SA 5065

Further Information:
Graham Taylor or Bernadette Kovacs
CRC LEME, University of Canberra, ACT 2601
Phone: 02 6201 2031/02 6201 5453.
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e-mail taylor@science.canberra.edu.au or
kovacs@science.canberra.edu.au

GEOLOGY AND ORE DEPOSITS 2000: The Great Basin and Beyond

A Geological Society of Nevada Symposium

Reno/Sparks, Nevada, USA
May 15-18, 2000

Co-sponsored by:

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For more information: 702/323-3500, fax 702/323-3599
e-mail gsnsymp@nbmg.unr.edu http://www.seismo.unr.edu/GSN

NEW MEMBERS

To All Voting Members:
Pursuant to Article Two of the Association's By-Law No.1, names of the following candidates, who have been recommended for membership by the Admissions Committee, are submitted for your consideration. If you have any comments, favorable or unfavorable, on any candidate, you should send them in writing to the Secretary within 60 days of this notice.If no objections are received by that date, these candidates will be declared elected to membership. Please address comments to Sherman P. Marsh, Secretary AEG, U.S. Geological Survey, Mail Stop 973, Box 25046, Federal Center, Denver, Colorado 80225, U.S.A.

Editors note: Council has decided that all new applicants will receive the journal and newsletter upon application for membership. The process of application to the Nepean office, recommendation by the Admissions Committee, review by the Council, and publication of applicant's names in the newsletter remains unchanged.

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Consulting Geochemist
WMC Chile
Santiago, CHILE

Simpson, Peter R.
University Prof/BGS Research Assoc
British Geological Survey
Keyworth, UK

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Rio Tinto Exploration
Bangalore, INDIA

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Apex Geoscience
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George, Neil G.
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Geo-Analytical Consultants
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North York, ON, CANADA

Lieth, Frank
Geochemist
BHP Minerals
Denver, CO, USA

Menzies, Douglas
Principal/Geologist
Menzies Geological Services
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Ortega-Osorio, Alex
Geochemist
Penoles
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Senior Project Geologist
Falconbridge Ventures of Africa
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STUDENT

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Southampton, UK

AEG APPLICATION FOR NON-VOTING MEMBERSHIP*

to the Association of Exploration Geochemists

Please complete the section relevant to the class of membership sought and supply your address on this form. Mail the completed application, together with annual dues, to the address below.

MEMBER

I ______________________ wish to apply for election as a Member of the Association of Exploration Geochemists. I am presently employed by:

______________________ as a ______________________.

(employer) (employment title)

I am actively engaged in scientific or technological work related to geochemical exploration and have been so for the past two years. Upon receipt of the Code of Ethics of the Association I will read them and, in the event of being elected a Member, agree to honour and abide by them. Witness my hand this_____day of__________19_____. ______________________

(Signature of applicant)

STUDENT MEMBER

I ______________________ wish to apply for election as a Student Member of the Association of Exploration Geochemists. I am presently engaged as a full-time student at ______________________, where I am taking a course in pure or applied science. Upon receipt of the Code of Ethics of the Association and in the event of being elected a Student Member agree to honour and abide by them. Witness my hand this_____day of__________19_____.

____

(Signature of applicant)

Student status must be verified by a Professor of your institution or a Fellow of the Association of Exploration Geochemists. I certify that the applicant is a full-time student at this institution.

______________________ ______________________

(Signature) (Printed Name and Title)

NAME AND ADDRESS

(to be completed by all applicants)

Name: ______________________

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Annual Dues

All applications must be accompanied by annual dues. Select one or two below:

1	1997 member dues	US$	70	_______
2	1997 student member dues		40	_______
	If you require a receipt, include a self-addressed envelope and add		2	_______
	If your check is not drawn from a U.S.A. or Canadian bank, add		15	_______
			TOTAL	_______

All payments must be in US funds. Payment by check, International Money Order, UNESCO Coupons, International Postal Orders, VISA and Master Card are acceptable. For users of VISA or Master Card, minor variations in your billing may reflect currency exchange rate fluctuations at time of bank transaction.

If you pay by charge card, please provide the following information: type: Master Card _____ VISA _____

Credit card account number:______________________ Expiration date: __________.

Name:______________________Signature:______________________

Please note: Your completed form should be mailed to the Business Office of the Association and will be acknowledged upon receipt. The Admissions Committee reviews all applications and submits recommendations to Council, who will review these recommendations at the next Council Meeting or by correspondence. If no objection is raised the names, addresses and positions of candidates will be listed in the next issue of the Association Newsletter. If after a minimum of 60 days have elapsed following submission of candidate information to the membership no signed letters objecting to candidates admission are received by the Secretary of the Association from any Member, the Candidate shall be deemed elected, subject to the receipt by the Association of payment of required dues. Send completed application, together with annual dues to:

Association of Exploration Geochemists, P.O. Box 26099, 72 Robertson Road, Nepean, Ontario, CANADA K2H 9R0
TEL: (613) 828-0199, FAX: (613) 828-9288, email: aeg@synapse.net

*Application for voting membership requires the sponsorship of three voting members. Request a voting member application from the Association office.

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