The rather lively and emotional debate which took place at our annual general meeting in Townsville is still fresh in my mind. It centred on whether the AEG should embrace environmental geochemistry as a sister discipline in its activities and publications, and if so, to what degree. My personal opinion is that we should, not to attract more members to fill the void created by declining North American explorationists (actually we are quite healthy these days!), but rather to bring our expertise and experience to the attention of those working in the "environmental field". Let me show you why.

Together with about 20 colleagues from the Geological Survey of Canada, I recently attended a 2-day workshop at York University on issues related to long range transport of atmospheric pollutants (LRTAP), specifically dealing with mercury. It was organized by the Ecological Monitoring Coordinating Office (EMCO) of Environment Canada and was probably the first meeting of its kind where so many "geological types" came together with "traditional environmentalists", for want of better labels. Presentations were made by both "camps" in such areas as atmospheric modelling of Hg transport, use of the lake sediment core as an historical record of Hg input, levels of Hg in various media and health concerns for those living in the aquatic and terrestrial ecosystems (sport fish, otter, loon, whale, seal, homo sapiens...). Actually, it was very unclear as to whether there was need to worry about Hg levels in any of these species, the data being sparse and inconclusive. It was interesting to hear Hg described as a "persistent chemical" and that "it gets into the environment", as if it wasn't there already. The language is completely different, with its own slant. Watersheds are not "exporters" or "retainers" of Hg (deposited from the atmosphere), the term "leaching" is absent. The surficial environment is seen more in a static than kinetic mode, as passive rather than active. I saw a diagram of a tree where the input through the root system was given negligible importance compared to wet or dry deposition from above. It begs the questions: why is phytoremediation being seen as a way to clean up pollution around landfill sites and why are we bothering to use vegetation as a geochemical exploration tool?

As natural or geogenic fluxes of Hg have been so difficult to measure or estimate, they are usually left out of the input equation to the model(s). We, the geoscientific community, have a plethora of data on the diverse elemental compositions (not just Hg) of various media and we have at least some understanding of the complex interactions of metals in the environment (geochemical cycling). This meeting and others have highlighted the vital need for these two disciplines to come together in scientific collaboration to address some of the issues which are being brought to the fore now. One obvious and potentially enormous task is to come to grips with the relative contributions of anthropogenic and geogenic sources of metals, in air, water, soil etc., from a long and short range perspective, in a global, regional and local context.

Geoscientists may scorn the concept of "zero discharge of metals" and shrug, but more attention is needed. There are, from several organizations, criteria levels being proposed for metals in sediments which are so low that much of Canada's lakes would require action (dredging of greenstone belts?). The same criteria which have been used to assess whether certain organic chemicals are potentially dangerous to the environment are being transferred to the metal arena, with little regard to such facts that: metals occur naturally; many are essential to life; and they are involved in complex equilibria within their particular environment which dictates their species distribution. A crystal ball is not needed to deduce the ramifications of current environmental activities and future legislation for the mining industry.

This is not a Canadian issue, it is worldwide. Canada, through the Mining Association, the Ottawa headquarters of the International Council for Metals in the Environment (ICME) and the Federal Government, is hosting a series of workshops internationally to illustrate the weaknesses of these approaches and to encourage the development of more appropriate guidelines and criteria for metals. I believe we, the geoscientific community including the AEG, have an important role to play in bringing our expertise to the table, to improve the scientific database and understanding of the reactions occurring on our planet. Ultimately this should lead to better interpretation and decision-making.

Gwendy E. M. Hall
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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NOTES FROM THE EDITORS

Sherman Marsh and Tom Nash

The Technical Note by Ravi Anand of CSIRO carries an acknowledgment that we would like to see more often: collaboration with the mineral industry and assistance and support of the mineral industry for his government-sector research. The science summarized in this Technical Note is evidence of the synergism that comes from this cooperation. In a similar manner, the AEG and EXPLORE play an important role in facilitating cooperative research programs among the mineral industry, academia, and government sector, chiefly through friendships and exchange of ideas through our publications and our regional and international meetings. These interchanges foster a sense of trust and integrity that are cornerstones of professional careers in geochemistry, and are especially important in environmental studies, as noted in President Hall's Message. Much work remains to be done on geochemical baselines and on processes operating in mineral environments to provide a realistic and valid basis for regulatory actions.

Ironically, environmental studies, and earth science in general, are being cut during current major budget reforms. EXPLORE v. 48 is being assembled during a period of unprecedented upheaval in North American government-sector geochemistry. The U.S. Geological Survey and the Geological Survey of Canada have suffered large cuts in staff, particularly in mineral resource programs, the U.S. Bureau of Mines is being eliminated and its functions and people are being assigned to other agencies. The U.S. Biological Survey is being dismembered, apparently because some politicians do not appreciate the economic impact of their science on private property and business. The role of government sciences in environmental research is being decided by politicians, while managers scramble to redefine programs that are politically correct. Capable scientists are in limbo at a time when the majority of the public does indeed care about the environment.
Genesis and classification of ferruginous regolith materials in the Yilgarn Craton of Western Australia: Implications for mineral exploration

R.R. ANAND

Introduction

Ferruginous regolith materials are abundant and widespread in the deeply weathered landscapes of the Yilgarn Craton. Many of these materials preserve geochemical dispersion patterns from concealed mineral deposits (Smith, 1989; Anand, 1993). A wide variety of ferruginous materials exist, and their geochemical response to mineralisation and bedrock differs according to their mode of origin. They occur as crusts, as lag, as a gravel component in soil, colluvium and alluvium, and as segregations and infusions in saprolite. Several types may occur in a single weathering profile, having developed in different parent materials or substrates. Understanding these materials is important for selection of suitable sampling media and subsequent interpretation of geochemical data in mineral exploration. In addition, close study of the relationship of ferruginous materials to the landscape contributes to the general understanding of landscape evolution in the Yilgarn Craton.

Classification and environments of formation

The topographic relationships, position within the weathering profile, mineralogical, chemical, and mesoscopic characteristics of ferruginous materials suggest four main groups of material formed in different environments (Fig 1).

1. Lateritic residuum. Lateritic residuum is a collective term for lateritic duricrust and loose lateritic nodules and pisoliths. All of these are thought to have formed, during lateritic weathering, within the zone of water table fluctuation. Ferrous iron, released by breakdown of the primary minerals under relatively reducing conditions has been redistributed and precipitated as pisoliths and nodules under oxidising conditions in this zone. As a result, a ferruginous horizon typically develops in upper parts of the deeply weathered profile. Nodules and pisoliths commonly have thin (1 mm)

Continued on Page 4
goethite- and kaolinite-rich cutans, which are rinds that have developed by deposition of Fe and Al around a core. Pisoliths with multiple cutans are rare, being found mainly at the base of palaeo-channel infill.

Major minerals are hematite, goethite, maghemite, kaolinite, and gibbsite with some quartz and other resistant minerals. Maghemite, which is formed by heating of goethite, for example during bush fires, is restricted to surface or near-surface pisoliths. Where maghemite-rich pisoliths are found at depth, it is probable that they have spent some time at the surface. Lateritic pisoliths and nodules contain highly Al-substituted goethites, indicating ample availability of aluminum during their formation. The major and trace element composition of these materials is largely litho-dependent at a landscape scale; Fe and Al are largely derived from the underlying rocks. However, lateral accumulation of Fe and Al also occurs.

Several types of lateritic duricrusts (massive, vermiform, fragmental, nodular, and pisolithic) have been identified in the Yilgarn Craton. Some are related to pisolithic-nodular lateritic residuum; others to ferruginous saprolite (Fig 1).

2. Ferruginous saprolite and mottled zone. Ferruginous saprolite is commonly developed over mafic and ultramafic rocks by infusion of kaolinite-rich saprolite with goethite and is hard, massive to mottled. This saprolite occurs below the ferruginous zone and is younger than overlying pisoliths and nodules. Fragmentation and collapse of ferruginous saprolite may lead to the generation of nodules. The mottled zone is characterised by hematite-rich mottles in a kaolinite-rich matrix. Mottles may evolve into nodules and pisoliths.

3. Iron segregations. These include stratabound and discordant to sub-horizontal Fe-rich bodies and lenses occurring dominantly in saprolite (Fig 1). They are dense, dark brown to black and rich in Fe, Mn, Zn, Cu and Co. They are non-magnetic and are dominated by low Al-substituted goethite (< 5 mole %), with variable amounts of hematite and quartz; maghemite and kaolinite are absent.

Iron segregations are the result of extreme ferruginisation, the Fe being derived from a variety of sources, including weathering of Fe-rich and/or sulphidic rocks, and by lateral enrichment by groundwater. Very low Al substitution in the goethites of iron segregations indicates that they must have developed in an environment that was very poor in Al.

4. Ferruginous materials characteristic of sub-aqueous environments consist of Fe-oxides that have impregnated and indurated sediments of various ages and may overlie either complete or truncated profiles (Fig 1). The Fe is contributed by broad-scale lateral movements so that there is no genetic relationship between these ferruginous materials and the underlying geology. Typical examples include bog iron ore, and mega-mottles in palaeo-channel sediments. These commonly mark former lakes, valley floors, swamps, rivers, streams and channels. Some now occur on low hills as a result of relief inversion.

Modification and distribution

These ferruginous materials were formed within the regolith but their present distribution in the landscape has been affected by later erosional and depositional processes (Figs 1 and 2). The distribution can thus best be described by establishing a framework and regolith-landform regimes (Anand and Smith, 1992; Anand, 1993).

Lateritic duricrusts, lateritic gravels, and lag of lateritic nodules and pisoliths outcrop in relict regimes, whereas outcrop and lag of hardened mottles and ferruginous saprolite occur in transitional to erosional regimes. (Fig 2). Lateritic duricrusts, ferruginous saprolites, and mottled zones are commonly present beneath colluvium and alluvium in depositional regimes that have not suffered post-lateritic erosion.
Technical Note

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Erosion of the upper saprolite has led to exposure of bodies of iron segregations at the surface, where they disintegrated and contributed to a coarse lag in the erosional regimes.

Where erosion has removed most of the pre-existing lateritic regolith, more recent weathering has led to the formation of indurated, goethite- and hematite-rich bedrock. This later weathering has not been intense, and weatherable primary minerals are retained as important components. Disintegration has formed a coarse lag of ferruginous, lithic fragments.

Horizons of lateritic pisoliths and nodules are generally developed above, or laterally associated with, indurated, lateritic duricrust. This gravelly horizon commonly arises from in situ breakdown of pisolithic-nodular duricrust, followed by limited colluvial transport. However, if the lateritic residuum in upland areas is entirely dismantled, the resultant gravels may be deposited in flanking low lying areas. These gravels progressively lose their cutans on transport and are incorporated, with other clasts of diverse origin, within colluvial-alluvial units or occur as gravelly lenses (Fig 1). These lenses may be recemented by Fe-oxides and resemble the residual duricrusts from which they were derived.

There are also regional trends in the distribution of ferruginous materials in the Yilgarn Craton. For example, in the Leonora-Wiluna region, lateritic residuum and ferruginous saprolite commonly form extensive buried blankets whereas, in the Kalgoorlie region, ferrigenous materials are much less widespread. Similarly, iron segregations are abundant in erosional regimes of the Leonora-Wiluna region but rare to absent in the Southern Yilgarn Craton, around Kalgoorlie. These differences may reflect contrasts in the tectonic history, geomorphology and/or weathering conditions between the two regions. Thus, it may be that neither lateritic residuum nor Fe segregations were ever extensively developed in the Kalgoorlie region or that subsequent weathering has caused their modification or destruction.

Relief inversion

There is no evidence of large scale relief inversion within the Yilgarn Craton despite reports to the contrary (Ollier et al., 1988). Dendritic patterns are lacking in exposed or buried duricrust, and palaeo-drainage systems dominantly occupy lower parts of the present landscape. However, very localised relief inversion is indicated by small hills formed by detrital duricrusts and mega-mottled zones along edges of some lakes.

Geochronology

The ferruginous materials are of varying ages but none has been dated precisely. However, stratigraphic relationships suggest that some pisoliths and nodules may date from at least the late Mesozoic. Transported maghemite-rich, pisolithic and nodular gravels occur in basal sediments of palaeo-channels that elsewhere contain late-Eocene lignites. The transported pisoliths were presumably derived by erosion of the earlier lateritic regoliths that predate incision of the palaeo-drainage. Eocene sediments themselves have been further weathered to form mega-mottles, probably during Oligocene and Miocene time.

Sampling strategies, regolith mapping, and identification of ferruginous materials

Understanding the nature and distribution of ferruginous materials helps to develop geochemical sampling strategies for weathered terrain. This knowledge can be obtained by regolith-field mapping and by establishing regolith stratigraphy. When regolith-field regimes are mapped in an area, it generally becomes clear which geochemical sampling media are the most appropriate (Anand, 1993).

Where preserved, lateritic residuum is an ideal sampling medium to detect the widespread dispersion haloes from Au and base metal deposits. Lateritic nodules and pisoliths may be collected from the surface or near-surface in relic regimes or by drilling in depositional regimes. Mechanical dispersion of loose nodules and pisoliths (5-50 m) is very common and thus results in a wider anomaly than does the underlying duricrust. There appears to be no special advantage in sampling magnetic nodules and pisoliths despite the greater homogeneity of the sample. On the contrary, some non-magnetic materials are more useful because both target and pathfinder elements are associated with goethite and hematite that can comprise either the core or cutans of nodules and pisoliths (Anand and Smith, 1992).

In drilling to sample buried laterite, an explorationist must be able to recognise and distinguish transported lateritic...
Technical Note
Continued from Page 4

debroids from residual laterite. Nodules and pisoliths with yellowish-brown to olive green cutans are believed to be confined to residual or minimally transported laterite. Layers of well-sorted lateritic gravels and a large proportion of nodules and pisoliths with chipped cutans may indicate transported laterite. Similarly, layers of maghemite-rich gravels within clay-rich units are indicative of transported laterite (Fig 1).

Where the profile has been truncated, ferruginous saprolite, mottles and iron segregations are suitable sampling media, although much closer sample intervals are necessary. Drilling is necessary in depositional regimes. Different thresholds must be applied for each sample type.

Pisolitic and nodular lateritic residuum can be distinguished from ferruginous saprolite by loss of the primary fabric and by the presence of abundant hematite and less kaolinite. Maghemite is typically absent in mottles and ferruginous saprolite. Ferruginous saprolite differs from iron segregations in that it generally has yellow-brown colour, and less Fe; some have diffuse motting and incipient nodular structures.

Ferruginous materials formed in sub-aqueous environments may not be suitable sampling media because they are not genetically related to the underlying lithologies. Low Al-substituted goethite is the dominant Fe-oxide mineral in bog iron ore, whereas hematite dominates mega-mottles of palaeo-channels. Hematite present in mega-mottles may reflect age differences; older materials are generally higher in hematite content than younger ones, and may reflect an ageing or warmer conditions during formation. Ferruginised wood fragments commonly occur in bog iron ore.

In some situations, motting and pisoliths have developed in younger transported horizons overlying older lateritic residuum, mottled zone or saprolite. Small manganese nodules may also occur at the base of such units. Transport is indicated by unconformable contacts. Where no obvious unconformity is present, mineralogical data may demonstrate different origins of units in which separate parts of weathering profiles have developed.

This approach to geochemical sampling in regolith terrain, which was developed during the course of a series of AMIRA projects, played a part in the discovery of the world class Plutonic and Bronzewing gold deposits by Great Central Mines NL.

Acknowledgements

Most of the work reported in this paper was carried out between 1987 and 1993, in collaboration with the mineral industry, through AMIRA projects, played a part in the discovery of the world class Plutonic and Bronzewing gold deposits by Great Central Mines NL.

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References


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The A.E.G. Exploration Geochemistry Bibliography — A hands-on review

compiled by
Eric C. Grunsky, L. Graham Closs and Dorthe Jakobsen
by Graham C. Wilson

The surprise arrival of a bibliographic diskette in the mail has provided many explorationists with a new tool to evaluate. The price is certainly right (free to A.E.G. members!) but is it possible to justify the time required? The reviewer thinks it is, and argues that this handy literature guide can rapidly be installed in exploration offices, everywhere.

The dramatic advent and evolution of the ‘personal computer’ has been followed closely by an explosive rise in the volume of technical publishing, from a variety of commercial, academic, government and private sources. A natural response to the glut of information, new and old, would seem to be some kind of ‘watchdog’ bibliographic service, whether wide-flung (GeoRef for Earth Sciences, INSPEC for Physics, etc) or specialized. A number of organizations, such as the U.S.G.S., have from time to time released collections of references, compiled by specialists, on a number of thematic and/or geographic topics, most commonly as readily-accessible ASCII files on diskette. An argument can be made for topical bibliographic databases aimed at an intermediate level of specialization. Such is the case of Grunsky et al., whose laudable effort addresses the broad field of geochemical exploration. The success of the ‘AEGbib’, as I’ve come to think of it, and similar products, is largely a function of content and accessibility. A combination of ease of use and demonstrated retrievability of relevant information is critical. To see how the AEG product performs, this review addresses aspects of installation, structure and content, interactive use and possible future development.

Installation

The bibliography, plus an A.E.G. membership list, comes in the compact form of 3 files, 1.2 MB total size, on a single diskette. Transferred to the user’s hard disk, the data files are readily decompressed to 14 MB, of which 13.5 MB is a .dbf file containing the bibliography. Unlike the earlier paper versions (dating to the original publication by Herbert E.Hawkes in 1972, subsequently updated by Hawkes and others) what follows depends in a broad sense on the reader/user’s computer resources, and especially on the database management system into which the .dbf file is imported. For the record, this review was conducted on a 486/66 system with an old version of a ‘flat-file’ DBMS (Symantec’s Q&A 3). When imported (a 7-minute operation), the resultant file size was 2.5 MB, <20% of the original .dbf file. With a little tweaking, each record was made to fit into a single 21x80 display screen. While details will vary, the product should work with most common database software which can import .dbf files, on any platform 286 and up.

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Review
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Data Structure

The database structure is very simple: each of the 11,114 records contains standard bibliographic data, viz. Author, Title, Reference (source) and Date (year of publication). In detail, there are 14 data fields: a unique number for each reference (1), author fields (2-8), year (9), title (10), publication name (11), volume and page numbers (12, 13) and a notes / keywords / memo field (14). Provided the fields are correctly filled in, this structure allows the user to search the database and construct their own desired bibliographic output using the facilities of their DBMS. The use of multiple Author fields makes for cumbersome name searches, unless the user’s DBMS can concatenate the 7 fields and search them as one. There are 99 "et al."s in the first author field, a practice I have used myself where there are >>8 authors! In practice, most searches will probably address the Title field, perhaps using the Date field to limit the volume of output. There are minor typos, inevitable in this kind of compilation: sorting and displaying the records in assorted tabulations revealed only 9 records with errors in the date field, and 3 duplicates: not significant problems. There is a certain amount of blurring between the publication, volume and page fields. 1,161 records have additions a-n in the date field ("1991a", etc), useful in paper format but of questionable utility in a digital product (unless separated from the date in some fashion, or as one). There are 99 "et al."s in the first author field, a practice I have used myself where there are >>8 authors! In practice, most searches will probably address the Title field, perhaps using the Date field to limit the volume of output. There are minor typos, inevitable in this kind of compilation: sorting and displaying the records in assorted tabulations revealed only 9 records with errors in the date field, and 3 duplicates: not significant problems. There is a certain amount of blurring between the publication, volume and page fields. 1,161 records have additions a-n in the date field ("1991a", etc), useful in paper format but of questionable utility in a digital product (unless separated from the date in some fashion, or as one).

The 'Date' field unfortunately fails to meet its potential: only 21 records possess 'notes', variously addressing synonyms (10), corrections, cross-references and availability (1 each). Only one record has a note containing a useful 'keyword', the proper name of a species of plant.

Scope of the Bibliography

A brief review of AEGBIB revealed major strengths in geochemical sample types (rock, soil, stream sediment, till and water samples). 756 records have "soil" in the title. There are at least 80 on laterites; 83 on weathering; 187 on "till" (excluding 14 on scintill., still.); at least 414 on stream sediments; 81 on lake sediments; 21 on humus; and 127 on ground waters. There are at least 425 on biogeochemistry and geochemistry, with 207 on plants ("plant", excluding 3 for pilot plants!). Key topics include the chemistry of surficial deposits and waters, geochemical analysis, lithogeochemistry and hydrothermal alteration, mineral exploration case studies, and sampling methods. Because the title field is the principal key to the content of the entries, a certain amount of ingenuity is required to obtain the maximum return of relevant entries. Skirting the more obvious pratfalls of nomenclature (Mexico versus New Mexico, etc), successive searches on geographic themes returned 1,056 records on Canada, 318 on Latin America (sensu lato, from the U.S.southern border down to Cape Horn, including the Caribbean region) and 236 for the Indian subcontinent. In terms of commodities, elements and lithological associations, two popular examples are gold (search for "gold", " Au ", and " Au", 839 records) and diamonds and potential host rocks ("diamond", "kimberlite", "lambrool", 83).

User Amendments

It must be stressed that the basic database is a workable, 'no-frills' product, and thus the utility of the system depends to a large degree on the user, who has the option to customize this product for his or her own requirements. A simple form of optimization is described here. Because there is only one useful primary search field (besides the author fields), I found it helpful to set up small 'logical fields' to flag entries covering key topics or geographic areas. Each such manoeuvre employs semantic trickery, but a single example will suffice. On creating a field to flag all items referring to Canada, I traced all items in which occur 'Canada'/Canadian'/Canadian', or the names of the 12 provinces and territories, and found 955 records. There is no sure way to update ALL records reliably without scanning each record individually, a daunting task, but another 100-odd Canadian records were easily found by title-searching for famous mining camps such as Timmins and Noranda, and automatically flagging the new 'Canada' field. Similar sleight-of-hand can be used to construct flags for other geographic entities, commodity groups and other specialties.

The peak in the 1970s is significant, reflecting the original compilation by Hawkes and its release by the A.E.G. in 1972, and most likely guaranteeing a maturity of selections which might not be found in more recent compilations (as curators and librarians will know, the retroactive entry of older material can be far more daunting, and more easily postponed, than the cataloguing of new acquisitions).

A brief review of AEGBIB revealed major strengths in geochemical sample types (rock, soil, stream sediment, till and water samples). 756 records have "soil" in the title. There are at least 80 on laterites; 83 on weathering; 187 on "till" (excluding 14 on scintill., still.); at least 414 on stream sediments; 81 on lake sediments; 21 on humus; and 127 on ground waters. There are at least 425 on biogeochemistry and geochemistry, with 207 on plants ("plant", excluding 3 for pilot plants!). Key topics include the chemistry of surficial deposits and waters, geochemical analysis, lithogeochemistry and hydrothermal alteration, mineral exploration case studies, and sampling methods. Because the title field is the principal key to the content of the entries, a certain amount of ingenuity is required to obtain the maximum return of relevant entries. Skirting the more obvious pratfalls of nomenclature (Mexico versus New Mexico, etc), successive searches on geographic themes returned 1,056 records on Canada, 318 on Latin America (sensu lato, from the U.S.southern border down to Cape Horn, including the Caribbean region) and 236 for the Indian subcontinent. In terms of commodities, elements and lithological associations, two popular examples are gold (search for "gold", " Au ", and " Au", 839 records) and diamonds and potential host rocks ("diamond", "kimberlite", "lambrool", 83).
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Summary

It would appear that the most potent general use for AEGBIB lies in designing field sampling programs for soils, sediments, waters, plants and rocks, using keywords such as those tested here: this alone more than justifies the small investment in time needed to explore the database. With 12 years’ experience of compiling an ongoing keyword-oriented bibliography which has partial overlap with the subject matter of AEGBIB’, I can appreciate the work taken to produce the first AEG digital bibliography. The 11,000-entry selection represents hard work, and also a foundation on which an improved digital product can be developed progressively. Retrograde changes are difficult: adding a few logical fields, as described above, might help the cause without adding appreciably to the long-term work load. Last but not least, in the course of this review I added ERROR and DUPLICATE comments to the Notes field: if other keen users do the same, and send in their lists when solicited, the future compilers will have an easier time in assembling the next digital release. Happy browsing!

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NEWS RELEASE

The U. S. Senate Energy and Natural Resources Committee cleared by a 13 to 7 vote the path for a royalty of 2.5 percent of net proceeds for minerals taken from Federal land, and specifies the payment of fair market value of surface rights for mine patent s. An earlier vote in a House committee approved a somewhat different royalty scheme that would require payment of 3.5 percent of net proceeds from minerals taken from Federal land.

Yet, Interior Secretary Bruce Babbitt said both royalty proposals are inadequate, characterizing them as “token payments.” Babbitt said that companies still would be able to purchase mining rights worth billions of dollars for only the surface value of the land. The concept of valuation of natural resources expressed in the bills may be applied to oil and gas.

“We are on dangerous grounds here,” stated John B. Gustavson, Certified Minerals Appraiser and Instructor at the University of Tulsa. “Our elected legislators may certainly vote on new rules; however, messing around with apportionment between the surface and oil and mineral rights will totally nullify a century’s worth of progressive court decisions. In short, as appraisers we will have to start over fresh.”

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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.

FELLOWS

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Goldberg, Isaai S.
Geoelectrochemist
Ionex
Sydney, NSW, AUSTRALIA

Hefton, Kristopher K.
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PT Freeport Indonesia
Tembagapura, Irian Jaya, INDONESIA

McGregor-Dawson, James L.
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CPRM
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Bristow, D.M.
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Aitkenvale, AUSTRALIA

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Kabette, Joas
BHP Minerals
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Townsville, QLD, AUSTRALIA

Poulsen, John
James Cook University
Townsville, QLD, AUSTRALIA

E CALENDAR OF EVENTS

International, National and Regional Meetings of Interest to Colleagues Working in Exploration and Other Areas of Applied Geochemistry.

- Nov. 6-8,'95, Int'l Symposium on Brazilian Mining, Salvador, Bahia (Conference Coordinator, Institute for International Research, 708 Third Ave., 4th Floor, New York, NY 10017-4103; TEL: (212) 661-6777; FAX: (212) 661-8740)

- Nov. 6-9, '95, Geological Society of America, ann. mtg., New Orleans, LA (Vanessa George, 3300 Penrose Place, Boulder, CO 80303; TEL: (303) 447-2020; FAX: (303) 447-1133)

- Nov. 19-22, '95, PACRIM '95, Auckland, New Zealand (Mrs. Charmayne Perera, The Australasian Institute of Mining and Metallurgy, P.O. Box 660, Carlton South, Victoria 3053, Australia; TEL: +61-3-662-3166; FAX: +61-3-662-3662; E-mail: J.Mauk@Auckland.ac.nz)

- Dec. 5-8, '96, Northwest Mining Association, int'l conf., Spokane, Washington (NWMA, Suite 414, 10N. Post, Spokane, WA 99201-0772; TEL: (509) 624-1158; FAX: (509) 623-1241)

- Jan. 16-19, '96, Conference on Tailings and Mine Waste, Fort Collins, CO (L. Hinshaw, Department of Civil Engineering, Colorado State University, Fort Collins, CO 80523; TEL: (970) 491-6081; FAX: (970) 491-7727)


- Mar. 14-17, '96, International Workshop and Exhibition on Geophysics, Hanoi, Vietnam by Geophysical Society of Viet Nam (T. Muoi, Geophysical Society of Viet Nam, Thanh Xuan - Dong Da, Hanoi, Viet Nam; TEL: 84.4544311; FAX: 84.4.542223)

- Mar. 27, '96, Environmental and Legislative Uses of Regional Geochemical Baseline Data for Sustainable Development, IGCP 360 Global Geochemical Baselines Workshop, Keyworth, Nottingham, UK (Peter Simpson, British Geological Survey, Keyworth, Nottingham, NG12 5GG; TEL: (0115) 9363532; FAX: (0115) 9363200; E-mail: kprs@va.nkw.ac.uk)
4th International Symposium on Environmental Geochemistry
October 5 - 10, 1997 - Vail, Colorado
Organized by
U.S. Geological Survey (USGS)
Association of Exploration Geochemists (AEG)
Society for Environmental Geochemistry and Health (SEGH)
in collaboration with
USGS Center for Environmental Geochemistry and Geophysics (CEGG)
and International Association of Geochemistry and Cosmochemistry (IAGC)

Introduction
Since the 3rd Symposium in Krakaw, Poland, 1994, interests in environmental geochemistry have developed in areas that are driven by human and ecosystem health considerations. For example, in the Rocky Mountains of North America, abandoned mines on public lands and mine drainage that affects surface and ground water resources, as well as wildlife, are of great concern. Air quality is being affected by rapidly growing urban centers and the high reliance on the automobile for transportation. Radon gas that is emitted naturally from certain geologic terranes is being mapped and the effect is might have on human health is debated. Hazardous materials disposal (including radionuclides) remains a hotly debated issue and an understanding is needed of the processes and technologies that confine toxins. Experience has shown that interaction needs to be strengthened between scientists and regulators of environmental laws—especially at this time when revisions to laws are being made.

Aims
To provide a forum for the discussion of current investigations and new methodologies that focus on geochemical and biogeochemical processes that affect the health of humans and ecosystems through soil, sediment, water, plants, and the atmosphere.

Proposed Themes
1. Environmental analytical techniques
2. Mine-drainage formation and geochemistry
3. Use and determination of baselines and backgrounds
4. Natural and man-made radiogenic hazards
5. Methods of geochemical monitoring, modeling, and mapping
6. Geomedical research
7. Industry/government cooperation
8. Environmental models (mineral deposits, global change, pollution migration, waste disposal)
9. The “acid” problem (air deposition, natural and mine drainage, ecosystem buffering)
10. Trace substances, ecosystems, and bio-accumulations
11. Environmental geochemistry and health
12. The importance of geology in environmental geochemistry.

Scientific Program - October 6-10, 1997
The program will include invited and keynote speakers as well as oral and poster presentations.

Excursions
A 2-1-2 format will be followed (2 days of meetings—1 day of excursions—2 final days of meetings). Pre- or post-conference field trips and workshops are also planned.

Preliminary Registration
To remain on our mailing list, please complete and return this preliminary registration form by January 1, 1996. Reply by mail: 4th ISEG, c/o USGS/CEGG, Federal Center, Box 25046, MS 973, Denver, CO 80225 USA; fax (303) 236-3200; or e-mail: iseg@helios.cr.usgs.gov.

Name ____________________________
Address ____________________________
Phone ____________________________ Fax: ____________________________ e-mail: ____________________________

Intend to participate in the pre- or post-conference field trips Yes □ No □

Intend to submit an oral presentation Yes □ No □
Under which theme 1-12 (see "Proposed Themes" above) Theme No. ______

Intend to submit a poster presentation Yes □ No □
Under which theme 1-12 (see "Proposed Themes" above) Theme No. ______

will be accompanied by ________ persons.

am interested in being a corporate sponsor Yes □ No □

am interested in purchasing commercial space Yes □ No □
Venue
The Westin Resort and Convention Center, Vail, Colorado, is located 160 km west of Denver, Colorado, in the scenic Rocky Mountains. It is easily accessible by public transportation from Denver International Airport (DIA). Vail village is world-renowned for its beauty, outdoor activities, shops, and accommodations.

Accommodations
Full details and a booking form will be included in the next circular. The Westin Resort in Vail is a 5-star hotel with more than 300 rooms and first-class meeting facilities. They are offering a very attractive conference rate for this Symposium.

Publishing
Papers presented by invited and volunteer speakers and poster presenters will be published, following peer review, in special issues of Environmental Geochemistry and Health and (or) the Journal of Exploration Geochemistry.

Deadlines and Key Dates
Return of First Circular .................................. Jan. 1, 1996
Second Circular mailing/call for papers ....................... June 1996
Submission of abstracts .................................... March 1997
Final registration and payment .............................. March 1997
Confirm payment and hotel ................................ May 1997
Final Circular and preliminary program .................... July 1997
Submission of manuscripts ................................. Oct. 6, 1997
Symposium ................................................. Oct. 6, 1997
Publication of papers ...................................... July 1998

Language
English

Registration Fees
This information will be included in the Second Circular.

Chairpersons of the Symposium
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Dr. Larry Gough, USGS
Mr. Richard Sanzolone, USGS
Ms. Cathy Ager, USGS
Mr. Sherman Marsh, USGS

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Please share this information with colleagues.

4th International Symposium on Environmental Geochemistry
c/o U.S. Department of the Interior—USGS
MS 973, Box 25046, Federal Center
Denver, CO 80225-0046
Calendar of Events
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- Mar. 28-29, '96, BGS Minerals Industry Forum, Keyworth, Nottingham, UK (Peter Simpson, British Geological Survey, Keyworth, Nottingham, NG12 5GG; TEL: (0115) 9363532; FAX: (0115) 9363200; E-mail: k-prs@va.nkw.ac.uk)


- April 22, '96, Societal Needs and the Environment: Earth Sciences and Public Health, Forum, Washington, D.C. (Frederic R. Siegel, Department of Geology, George Washington University, Washington, D.C. 20052; FAX: 202-994-0450; E-mail: NDFRS@GWUVM.GWU.EDU)

- April 28-May 2, '96, International Mining Trade Show and 99th Annual Meeting of the Canadian Institute of Mining, Metallurgy, and Petroleum, Edmonton Convention Centre, Edmonton, Alberta, Canada (Ian Muirhead, General Chairman, c/o University of Alberta, 606 CME Building, Edmonton, Alberta T6G 2G6, Canada; TEL: (403) 492-3810; FAX: (403) 492-3405; email: inam@cominco.mineral,ualberta,ca)


- May 27-29, '96, Geological Association of Canada/Mineralogical Association of Canada, joint ann. meet., Winnipeg, Manitoba (G.S. Clark, Dept. of Geological Sciences, University of Manitoba, Winnipeg, R3T 2N2; TEL: (204)-474-8857; FAX: (204)-261-7581).


- Aug. 4-14, '96, 30th International Geological Congress, Beijing, China (Prof. Zhao Xun, Deputy Secretary General, 30th International Geological Congress, P.O. Box 823, Beijing 100039, P.R. China; TEL: 86-10-8227772; FAX: 86-10-8328928; E-mail: zhaox@beipc2.ihep.ac.cn)

- Nov. 4-8, '96, International Symposium on the Industrial Application of the Mössbauer Effect, Johannesburg, South Africa (Prof. Herman Pollak, Mössbauer Laboratory, Private Bag 3, POWITS 2050, Johannesburg, South Africa; TEL: (27-11) 716-4053; FAX: (27-11) 339-6282; email: islame@physnet.phys.wits.ac.za

- Oct. 5-10, '97, 4th International Symposium on Environmental Geochemistry, Denver, CO (U.S. Geological Survey, The Association of Exploration Geochemists, the Society for Environmental Geochemistry and Health and the International Association of Geochemistry and Cosmochemistry, Dr. Ronald C. Seversen or Dr. Larry F. Gough, U.S. Geological Survey, MS973 Denver Federal Center, Denver, CO 80225; TEL: (303) 236-5514; FAX: (303) 236-3200; E-mail: lgough@helios.cr.usgs.gov)

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

Fred Siegel
The George Washington University
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USA
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Contributors's deadlines for the next four issues of EXPLORE are as follows:

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<td>November 30, 1995</td>
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This list comprises titles that have appeared in major publications since the compilation in EXPLORE Number 88. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochemistry 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 references to Dr. Closs, not to EXPLORE.


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Recent Papers

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