GEOSCIENCE CANADA

JOURNAL OF THE GEOLOGICAL ASSOCIATION OF CANADA
JOURNAL DE L'ASSOCIATION GÉOLOGIQUE DU CANADA

March 2006 VOLUME 33 NUMBER 1 GSCNA5 33 1-48
Mars 2006 VOLUME 33 NUMÉRO 1 ISSN 0315-0941

EDITORIAL

It is hard to believe that a year has passed since we became the co-editors of *Geoscience Canada*. Last year was a learning experience and we made some mistakes, some of which appeared in print. However, you caught them and told us, so we are unlikely to make the same mistakes again. Thanks for keeping us on track.

Now that the steep part of the learning curve is behind us, it is time to make good on one of the commitments in our first editorial, and that is to make some changes to the editorial board of *Geoscience Canada*. Most of our associate editors have been in place since 1996, which is ten years – half of a life sentence. We hereby grant parole for good behaviour to Brian Grant, Phil Hill, Andrew Hynes, Tom Pedersen, Patricia Rasmussen, Cindy Riediger, Paul Robinson, Gerry Ross, and Harvey Thorleifson – thank you all for your many years of service to the journal as associate editors. Bruce Broster and Alan Morgan have volunteered to do more hard time! We would like to welcome new appointees to the editorial board: John Greenough, Denis Lavoie and Carmel Lowe – we hope you enjoy your time (sentence) with us. We expect to add several more associate editors in the next few months, and their names will be listed on the inside front cover upon appointment. Our associate editors will be actively campaigning for new submissions to the journal and we hope the geoscience community, especially GAC members, will respond to their calls.

We are also taking this opportunity to evaluate the status of each series and hence the expected terms of the series editors. A status report follows:

Earth Science Education – Five articles have been published beginning in 1999 (v. 26-no. 1) and ending in 2002 (v. 29-no. 2). Last year, we decided to make this series a regular feature called *Education Matters*. Jon Dudley was the original series editor but he has stepped down. We are looking for a new champion.

Economic Geology Models – This series was a follow-up to the very successful *Ore Deposit Models* series (1980 – 1988), initially edited by John Allen and subsequently by Gwilym Roberts, that culminated in a reprint volume by the same name. *Economic Geology Models*, edited by Pat Sheahan, began in 1991 and continued for a few years but effectively has been defunct since 1993 (v. 20-no. 1), when the last new article appeared. Craig Hart and David Lentz have agreed to team up and resurrect this series. If this dynamic duo cannot raise the dead, nobody can. Keep watching for new articles in the future.

Environmental Marine Geoscience – Five articles have been published in this series, beginning in 1999 (v. 26-no. 4) and continuing until present (#5 appeared in the last issue but was mistakenly labelled #4). Phil Hill has been the series editor since the beginning and will continue for the foreseeable future.

Geology and Wine – Ten articles have been published in this series, beginning in 1999 (v. 26-no. 4) and continuing until present (#10 appeared in the last issue and #11 is in this one). Simon Haynes was the series editor of the first four articles; following Simon's untimely death in April 2002, Roger Macqueen took over and has been the editor ever since. There may be one more article in this series and a reprint volume is in the works.

Geology of the Parliament Buildings – Five articles have been published in this series, beginning in 2001 (v. 28-no. 1) and continuing until present (#5 appeared in v. 32-no. 4). Five more are in various stages of completion. Doug vanDine has been the series editor since the beginning and plans to continue.

Igneous Rock Associations – Five articles also have been published in this series, beginning in 2003 (v. 30-no. 2) and continuing until present (#6 is in this issue). Georgia Pe-Piper has been the series editor since the beginning and will continue for the foreseeable future.

Oceanic Lithosphere – Four articles have been published beginning in 1997 (v. 24-no. 2) and ending in 2000 (v .27-no. 3). John Malpas and Paul Robinson co-authored all four papers in the series. Last year, we decided to end this series and treat any further submissions as regular articles.

Thanks and "happy retirement" to series editors Jon Dudley, John Malpas, Paul Robinson and Pat Sheahan. Welcome aboard to series editors Craig Hart and David Lentz.

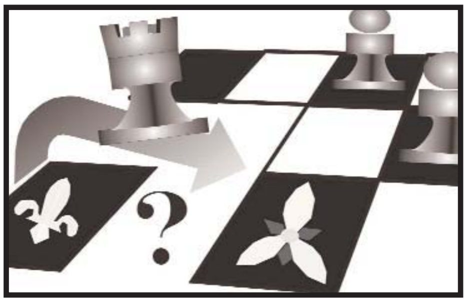
We will be introducing a new series later this year entitled: *Great Mining Camps of Canada*, which will be championed by Bob Cathro. We hope it will have wide appeal but be of particular interest for Mineral Deposits Division members. If you have a burning desire to initiate another new series, we would like to hear your plan.

A final note concerns the *Geoscience Canada* web page (http://www.gac.ca/JOURNALS/geocan.html). We intend to reorganize it this year so that information is easier to find. This includes the *Instructions to Authors* and the new *Procedures and Standards for Associate Editors and Reviewers*. This reorganization will be coordinated with an ongoing review of the entire GAC web site.

We welcome your comments and suggestions at any time.

Sonya Dehler & Steve McCutcheon (S&S)
Editors, Geoscience Canada

ISSUES IN CANADIAN GEOSCIENCE



Mobility of Professional Geoscientists in Canada

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Well before the creation of geoscience regulatory bodies in Canada, Canadian geoscientists were able to practice across the country without constraints other than their own experience and knowledge. Some would say that geology had no borders! Recently, however, the majority of Canadian provinces and territories have regulated the practice of geoscience, by law, for the protection of the public. Today, professional geoscientists cannot ignore this legal reality and so must change the way they practice the profession when outside their home province or territory.

Recently, some practitioners have outlined the lack of efficient, flexible mechanisms to facilitate mobility among jurisdictions for geoscientists working at the national level. The goal of this communiqué is to inform Canadian geoscientists on the latest developments concerning professional mobility.

The Canadian Council of Professional Geoscientists (CCPG) is a national coordinating body created in 1997 by the provincial and territorial geoscientist associations of Canada that deals with professional geoscience issues on the national and international scenes.

In Canada, professional registration of geoscientists falls under the legal jurisdiction of the provinces and territories. The CCPG is not a licensing body and cannot license individuals, and it has no legal authority over the various associations. The CCPG is responsible to its ten constituent associations only. These provincial and territorial associations are our only members.

Definitions and considerations

Due to the many different realities of professional practice, the widely used term "mobility" is understood by professional geoscientists to mean many different things. Some of these are defined below.

"**Transferability**" refers to the capability of a professional geoscientist registered in one jurisdiction (province or territory) to be transferred and registered in other Canadian jurisdictions. Transferability is influenced by several factors such as similarities in the admission criteria and administrative procedures of the governing associations.

"**Exemption**" refers to the capability of a professional geoscientist registered in one jurisdiction (province or territory) to practice (with or without some limitations) in other jurisdictions without necessarily being fully registered in the host jurisdiction. Exemption is applicable in the case of short-term periods of assignment that arise on an irregular basis and without much prior notice. This type of mobility requires a fast and effective authorization procedure.

However, there is an important reality that must be considered when dealing with the issue of mobility. Professional registration in Canada is a provincial and territorial responsibility. Every professional association defines its own admission criteria and *modus operandi*. An association cannot under any circumstances delegate or abandon its legal responsibilities as defined by its legislators.

Updates and examples of mobility

Since the creation of the CCPG, the issue of mobility has been discussed on numerous occasions and several actions have been taken by the CCPG board of directors. Some actions dealt with the transferability issue and others dealt with exemption.

In 2001, a mobility agreement dealing mainly with the issue of transferability, known as the Inter Association Mobility Agreement (IAMA), was signed by all the constituent associations of the CCPG. However, the application of this mobility agreement was extremely variable from one jurisdiction to another. The lack of uniform academic requirements across the country was one of the impediments encountered.

A concept called "Multi-Jurisdictional Registration" (MJR) was recently discussed at the CCPG. This concept addresses the needs of the professional geoscientist who regularly practices in several jurisdictions across the country, and would allow the professional to obtain a valid licence to practice in all Canadian jurisdictions with one single application. The economic impact and legal feasibility of a multi-jurisdictional registration was evaluated by a preliminary study, but more work is required.

The concept of a temporary practice and incidental practice has been discussed by the CCPG since 1998. Despite being strongly supported by practitioners, this type of mobility is the most complex one to implement in

Canada. Most of the professional associations have no tools in their acts to manage this kind of practice. A global implementation of a temporary and/or incidental practice agreement would require changing the engineer/geoscientist acts for most Canadian jurisdictions.

In 2003, the professional associations of Ontario (APGO) and Québec (OGQ) signed a bilateral mobility agreement covering temporary and incidental practice. Why were these two associations successful in implementing fast and efficient mobility mechanisms? The answer is twofold. First, the Québec Profession Act already possessed mechanisms which allowed for mobility of professionals, and second, the Ontario association used this window of opportunity to modify its act to include similar mechanisms.

An important CCPG committee, the Canadian Geoscience Standards Board (CGSB) has just begun to review the existing agreement of Canadian academic requirements used as the basis of the IAMA signed in 2001. One of the goals of the CGSB is to define uniform academic requirements for admission of equivalency across the jurisdictions. If reached, these new standards will improve the 2001 mobility agreement and should lead to new agreements.

Conclusion

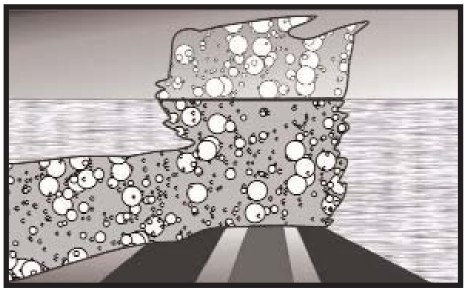
It is clear that any future mobility agreements will involve changes in administrative procedures for most of the provincial and territorial associations. Among other things, these changes will require mutual trust and sharing of legal responsibilities. Accordingly, any national agreement on mobility will have to be in accordance and agreement with the legal acts governing the provincial and territorial associations.

Generally, the differing norms of admission, transfer and management of legal responsibility and internal structure of each association hinder professional mobility. The CCPG continues to promote the need to have efficient mechanisms for managing all forms of mobility across the country.

The CCPG Board of Directors continues to serve and represent the Canadian Geoscientists nationally and internationally, and is constantly looking for new ways to better represent and inform its members. For more information please consult your provincial or territorial association or visit the CCPG website at www.ccpg.ca.

Accepted as received 16 November, 2005

FEATURE



Igneous Rock Associations 6. Modelling of Deep Submarine Pyroclastic Volcanism: A Review and New Results

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SUMMARY
Deep submarine explosive volcanism has been a topic of controversy for over 20 years. The role seawater pressure plays in inhibiting volatile phase expansion and thereby the depth of submarine explosive eruptions has been the topic of rigorous debate. Until now, the water-vapour curve has been interpreted to mean that the pressure exerted by the overlying seawater column is significant enough to inhibit explosive volcanism at depth. This interpretation assumes that pyroclastic eruptions cannot occur below the critical point of seawater (31.5 MPa or 3.15 km water depth) in the region of the two phase liquid-vapour fields. In fact, most eruptions are interpreted to occur at depths much shallower than 3.15 km, i.e., 0.5 to 1.0 km. What has been overlooked, however, is that volatile phase expansion (specific volume changes in P-T space) plays an important, if not dominant, role in explosive eruptions at depths greater than this critical point. This controversy has led to debate on the environment of formation of volcanic massive sulfide deposits (VMS), because "pyroclastics" are recognized in both the footwall and (or) hangingwall sequences of many of them and are commonly interpreted as reworked, mass-flow deposits from shallow water rather than of deep-water origin, i.e., they have no genetic relationship with the formation and distribution of VMS deposits.

To evaluate the possibility that submarine eruptions can occur at depths greater than 1 km, the 1-D numerical model CONFLOW was used. This program uses a specified melt composition, conduit diameter and length, and the initial temperature and pressure at the base of the conduit to calculate the pressure gradient in a conduit of constant cross-sectional area, the enthalpy of the magma, the viscosity of the volatile-magma mixture at specified P-T conditions, the fragmentation depth where the volume fraction gas is 75% ($v_g \cong 0.75$), and the exit velocity of the volatile-magma mixture. Results of the CONFLOW modelling support our hypothesis that magmatic volatile phase expansion is alone capable of providing enough energy and high enough melt/gas ratio, to initiate submarine pyroclastic eruptions in silicic magmas to the water depths typically associated with VMS genesis, i.e., below the two-phase (liquid-vapour) region for seawater.

RÉSUMÉ
Le volcanisme sous-marin explosif a été l'objet de controverse pendant plus de vingt ans. Le rôle inhibiteur de la pression de l'eau de mer, et donc de la profondeur d'eau, sur l'expansion de la phase volatile des éruptions sous-marines explosives a été l'objet d'un rigoureux débat. Jusqu'à maintenant, on a supposé que l'interprétation de la courbe de pression de vapeur d'eau permettait de croire qu'à partir d'une certaine profondeur, la pression de la colonne d'eau de mer était suffisamment importante pour inhiber le volcanisme explosif sous cette profondeur. Cette interprétation implique qu'il ne peut y avoir d'éruptions pyroclastiques en mer à partir d'une profondeur critique (31,5 MPa ou 3,15 km de profondeur) dans la région de la courbe où coexistent les phases liquides et gazeuses. De fait, dans la plupart des cas, on suppose que les éruptions se produisent à des profondeurs bien inférieures à 3,15 km, soit entre 0,5 et 1,0 km. Cependant, on a négligé le fait que l'expansion de la phase gazeuse (le volume spécifique change dans le domaine P-T) joue un rôle important, voire déterminant, dans le phénomène des éruptions explosives aux profondeurs dépassant la profondeur critique. Cette controverse a entraîné un débat sur milieu de formation des gisements de sulfures massifs volcanogéniques (SMV), étant donné qu'on retrouve des les séquences de roches pyroclastiques de l'éponte inférieure et/ou de l'éponte supérieure de nombreux gisements SMV, l'interprétation générale voulant qu'il s'agisse de gisements de mouvement de masse remaniés en milieux peu profonds, plutôt que de milieux profonds - une interprétation qui exclue toute relation génétique concernant la formation et la distribution des gisements SMV.

Dans le but d'évaluer la possibilité que des éruptions sous-marines puissent se produire à des profondeurs

dépassant 1 km, on a eu recours au programme de modélisation numérique 1D CONFLOW. Ce programme permet de tenir compte de la composition magmatique, du diamètre et de la longueur du conduit ainsi que de la température et de la pression initiales à la base du conduit, dans le calcul du gradient de pression dans un conduit de lumière constante, de l'enthalpie du magma, de la viscosité du mélange des composantes magma-volatiles sous des conditions P-T définies, de la profondeur de fragmentation où le volume du gaz fractionné atteint 75 % ($v_g \cong 0.75$), de même que de la vélocité à la sortie du mélange des composantes magmatiques-gazeux. Les résultats de notre étude de modélisation par le programme CONFLOW appuient notre hypothèse selon laquelle la seule expansion de la phase volatile pourrait être suffisamment énergique et avoir un taux magma/gaz assez élevé pour permettre des éruptions pyroclastiques sous-marines au sein de magmas siliceux à des profondeurs d'eau typiques des milieux de genèse des gisements de SMV, soit sous les zones diphasiques (liquides-vapeurs) en eaux de mer.

EDUCATION MATTERS

Kindergarten Dinosaurs and Rocks: An Example of Integrating a Field-tested Lesson Plan for Geoscientists into the Alberta Curriculum

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SUMMARY
Professional geoscientists have to make many presentations to colleagues, engineers, executives and accountants. However, panic is often felt when a note comes home from a child's educator looking for parents to help in teaching elementary school students. For the teacher, this is a chance to integrate many core subjects from the curriculum with the special and exciting resources available to geoscientists. This paper presents guidelines developed over time, and includes an understanding of how children learn and ask questions, the pace of the talk, and what children need to learn. In addition, data sources and gateways available to geoscientists have been included. While the premise outlined in the paper is applicable across Canada, it is based on the Alberta curriculum requirements. With these suggestions, the classroom experience is really no different than presenting to senior management, although you have to remember that your audience is shorter and does not drive a big BMW or Lexus.

RÉSUMÉ
Les géoscientifiques ont souvent à faire des exposés à des collègues, des ingénieurs, des dirigeants et des comptables. Cela dit, il arrive souvent qu'un sentiment de panique s'empare d'eux lorsqu'ils reçoivent une note des enseignants du primaire aux parents faisant appel aux compétences professionnelles des parents. Les enseignants y voient là une occasion de lier les thèmes du programme d'enseignement aux ressources fantastiques dont disposent les géoscientifiques. Le présent article présente les lignes directrices qui ont été validées avec le temps et décrit les modes d'apprentissage des enfants, leurs manières de poser des questions, le rythme particulier de présentation, ainsi que ce qu'ils ont besoin d'apprendre. L'article comporte aussi des références à des sources et des passerelles de données que les géoscientifiques peuvent consulter. Les principes de base présentés dans cet article peuvent s'appliquer partout à travers le pays, simplement, on les a appliqués aux exigences particulières du programme scolaire de l'Alberta. En tenant compte des suggestions offertes, on se rendra compte qu'une classe d'école n'est pas différente d'une d'un auditoire de gestionnaires; il faut simplement se souvenir que les membres de l'auditoire sont plus courts et ne conduisent pas des BM ou des Lexus.

INTRODUCTION
Many geoscientists have sometime in their career mentioned that at university they enjoyed presenting the "Rocks for Jocks", or similar course, to first year non-majors. If this falls within earshot of a schoolteacher, the question of a classroom presentation will invariably arise. This paper discusses the integration of a geoscience presentation with the Alberta kindergarten curriculum (also applicable to the Alberta Grade 3/4 curriculum), outlines the audience and teaching assistance needed, and discusses some of the challenges of presenting to young children. While the presentations have been made by petroleum geoscientists to Alberta students, the authors contend that the lesson plan can be integrated, with suitable modification, into schools across Canada.

A KINDERGARTEN TEACHER'S PERSPECTIVE
Why Dinosaurs and Rocks?
The beauty of the Alberta kindergarten curriculum is that it can co-ordinate the student's learning around themes that capture the interest of 4 and 5 year-old students in the classroom. A kindergarten teacher wants children to become life-long learners with a passion to come to school each day; using "Dinosaurs and Rocks" as a theme is one way to do this. It is an excellent opportunity for the active, hands-on learning that kindergarten children need. Each year in September, students brainstorm about their interests and what they want to learn. Of course, there are topics that must be covered, but "Dinosaurs and Rocks" seem to have universal appeal for both sexes, and it is exciting to have

the flexibility to include this topic as one of the monthly themes during the school year. In addition, Alberta is world-renowned for access to dinosaurs, fossils and rocks due to the proximity of the Royal Tyrrell Museum and the oil industry. Unfortunately, though, some students only study dinosaurs in kindergarten and there are many young students, who may want to become paleontologists, but never get a chance to study fossils in school.

Kindergarten Curriculum Links

In planning a theme, Alberta kindergarten teachers look at seven learning areas:

- early numeracy (mathematics)
- early literacy (English language arts)
- environmental and community awareness
- citizenship and identity
- physical skills and well-being
- creative expression
- personal and social responsibility

Every kindergarten day typically involves large group activities, small group activities, and centre choices including purposeful play. 'Centres' are designated areas where small groups of students or individuals can do particular activities. The seven learning areas are commonly integrated throughout the half-day of school, and a theme ties it all together to help the students learn in a developmentally appropriate way. All centres and activities for each month are planned carefully by the kindergarten team of teachers. If students are provided with rich learning opportunities, some background knowledge, and interesting centres, they will be ready for a special presenter, and then will be able to expand on their learning after the presentation is complete.

The "Dinosaurs and Rocks" Theme

For the "Dinosaurs and Rocks" theme, all seven of the kindergarten learning areas can be easily covered. For example, in the mathematics area, many large group activities can be integrated and a special centre for mathematics provided. At this centre, the children make non-standard rulers using dinosaur stamps on a strip of paper. Children need to measure their own body parts, everyday items, and objects of their own choice. Mathematics is also integrated into a tub toy centre. Students are provided with a tub of plastic dinosaurs that they count and sort according to size, colour and what the dinosaurs ate (meat eaters or plant eaters). In addition, many large group mathematics activities happen regularly throughout the month. An example is the class activity of unravelling a ball of string the length of a Sauropod from head to tip of its tail in the school hallway. Another activity is comparing a model of a *Tyrannosaurus* tooth to the size of a banana.

A further learning area example is language arts, which has special learning centres, along with many other related activities. At the ABC/writing centre, the children have simple research books on the dinosaur of their choice. They can copy text from provided pictures and from text with picture clues in order to provide a simple report about their dinosaur, its choice of food, and prominent physical characteristics. Another centre involving the language arts curriculum is the science centre. Here, a large variety of rocks and fossils are on display, complete with labels. There is also a school microscope (sometimes a stereoscope), hand lenses, assorted sizes of magnifying glasses, and a magnifying stool so that the students can study the samples in detail. In addition to centre time, children also work on language arts areas of the curriculum when they do activities such as:

- "read" poems/songs about dinosaurs that are added into their treasure book (yearly collection of poems),
- share with the class what happened in the centres each day,
- add a story sentence to a drawing or painting,
- look at the classroom collection of fiction and non-fiction books about dinosaurs daily,
- draw and print about dinosaurs in their journals, and
- complete a "*This is my favourite dinosaur*" sheet that is kept in each child's portfolio.

As demonstrated by the above exploration of these two curriculum areas, dinosaurs and rocks can be woven into all areas of the curriculum successfully and memorably. Children are motivated and creatively engaged in their learning for the entire month. They learn many of the curriculum goals, many facts and much extended incidental learning because of their high interest level.

The Special Presentation by a Geoscientist

Presentations brighten and enrich a child's learning and could be the start of a future Phil Currie, Tuzo Wilson or even Isaac Newton. From a teacher's perspective of the topic, there is no chance of "burn-out" when you are able to have young children's eyes light up with excitement daily. When there is a special presenter, the theme becomes much more important and memorable for the children. Without a special presentation, you would not hear the wide-eyed comments from students such as, "*Is that the meteor that killed the dinosaurs?*" that one 5 year old girl asked the presenter when he showed her a meteorite this year. Also, the presentation encourages the children to make a strong connection as to what a scientist does. A kindergarten boy recently answered the question, "*What does a scientist do?*" posed by another student, by answering with, "*Remember the paleontologist that visited us...*" and proceeded to confidently give her examples. When Grade 3/4 students were invited to participate in the presentation, they lined up not only to get special rocks and fossils identified, but to get the presenter's autograph as well. Finally, in years where a special presentation on, "Dinosaurs and Rocks" was made, many students at the end of the year stated that that theme was their favourite and that they wanted to be a paleontologist/geologist/scientist when they grew up.

LESSON PLAN FOR THE GEOSCIENTIST

For the geoscientist visiting a school, the task of presenting can be daunting. However, below are some pointers, all 'field tested', which have assisted the authors during many presentations.

Outline

In Alberta schools, there is normally at least 75 minutes before the lunch break, which is ideal for a presentation. This can be planned as shown in the lesson plan with consideration of the attention span of the audience. Specimens and activity material are best kept out of the way of the children and brought out later in the presentation as needed. If available, place microscopes and black lights not only on desks that an adult can operate from, but also at a height that the young audience can use.

10 minutes: What is a geologist?

A slide show introduction of geologists at work is a great opener. About 10 to 15 slides are probably enough for this section. Show how geologists live and work in the field. Pictures of rigs, mines and big trucks can be mixed in with fieldtrip shots and how geologists travel to isolated places.

5 minutes: What is a dinosaur?

At the kindergarten level the students know that dinosaurs are big animals which lived a long time ago. However, the misconception that all big creatures alive 100 million years ago were dinosaurs is common. Slides of tortoise, crocodiles, dinosaurs and birds can be used to illustrate the differences, and the concept of evolution can be briefly introduced.

Figure 1. Students walking like dinosaurs. Note that the two-legged dinosaurs have three long "fingers".

5 minutes: What did dinosaurs eat? (Carnivores and Herbivores)

Illustrations of dinosaurs often show them with their food. Close-ups of teeth can be talked about as well as what human teeth are used for (molars vs canines).

10 minutes: How did dinosaurs walk?

Most dinosaurs at museums are now mounted with the tail outstretched off the ground counterbalanced by the head and neck. This can be illustrated to the class by a model and by bending at the waist and trying to hold your head up (as humans lack the tail for balance, this is tiring). The class can then be asked to try this and see if walking on two legs in a bent position is as easy as using four legs. Try to look to the left and right for food and to see if a predator (classmate) is creeping up for the kill. Also ask if the neck or back hurts after awhile. As can be seen in Figure 1, the class enjoys the activity and this is also a good "let off steam" activity.

10 minutes: How did dinosaurs see?

The concept of, "how dinosaurs saw," can be illustrated using the concept of eye location on the skull. To show this, two volunteers can be brought to the front of the class. A girl, as in Figure 2, is asked to put on a paper shopping bag in which two holes are cut in the sides to mimic how a herbivore dinosaur would have seen the world. A boy volunteer is asked to put on a similar bag but with two holes cut into the front to illustrate how *Tyrannosaurus* viewed the world. Each student is asked to look at the other and the class shown that predator and prey had different skull shapes to help see, or watch out for each other. The point is then reinforced by showing pictures of dinosaurs' skulls and asking if they were herbivores or carnivores.

Figure 2. Students in dinosaur hats illustrating how carnivore and herbivore eyes are positioned differently on the skulls.

5 minutes: What colour was a dinosaur?

The final full class discussion activity is to show pictures of dinosaurs with different coloured skin in different patterns. Often the best examples can be found at fun fairs and town monuments where blue, pink and purple striped dinosaurs make appearances. The objective is to show that paleontologists do not know if dinosaurs were camouflaged, had display colours or were just a boring green-brown as shown in most reconstructions.

25 minutes: Activities including colouring, looking at fossils, discussing children's specimens and handling fossils

The objective of this section of the presentation is to let the children be creative with the colours of a dinosaur and let a slow trickle of students have one-on-one time with the presenter. Prior to coming to class the students are asked to select a special rock or fossil to show or have identified, and often some quite spectacular examples are presented. The use of a standard wellsite binocular microscope (Fig. 3) can show special parts of the rock as can an oil fluoroscope (both obtainable from most company stores). This is also a good time to show some of your special rocks from your collection (and borrowed from places such as the Geological Survey of Canada (GSC)). A ready supply of adults is useful at this stage in protecting the equipment and fossils, though damage is very rare as most students are careful in handling specimens. About a minute per student is needed for everyone to come up and ask questions (Fig. 4), and the time will fly if you get a keen child.

5 minutes: Wrap up

To complete the learning process it is a good idea to repeat some of the key learnings about dinosaurs and rocks. This can be done with a few more slides or just a discussion. Thank the class for their attention and the teachers for letting you visit their classroom. After the children have left it is permitted to breathe again.

CONSIDERATIONS FOR THE VISITING GEOSCIENTIST

Size of class, boy/girl breakdown, special needs

Calgary Board of Education (CBE) kindergarten classes range in size from about 17 to 26 students, with a teacher and one or more aides. Most classes have a fairly equal mix of boys and girls with both sexes being very inquisitive about science at this age. When you ask for volunteers to come up to the front of the class there are always a lot of hands, but it is best to try to get a mix of the quieter and keener students; both girls and boys.

Kindergarten programs in Alberta are based on the concept that all children can learn. Consequently, there is often a huge diversity (social-emotional, physical, communication and learning level) in any kindergarten classroom. This need not pose a difficulty for any presenter because it is the responsibility of the teacher to ensure that every child is included in an appropriate manner. One year, there was a child with a hearing difficulty who wore a hearing aid and sat at the front. Other years, there have been children with more significant special needs who have had an educational assistant assigned to help them gain the most out of the presentation.

Figure 3. Student viewing a coprolite using a binocular wellsite microscope.

Figure 4. Student listening to the teacher and asking questions about coprolites.

School location, facilities, and equipment

In a school where the presentation is to be made, there should be a large area where the pupils can sit on the floor. As there are often many diversions in the home classroom, the chance to present in a large, separate space might be worth investigating. The extra space is useful when the students explore how dinosaurs walked, and perform the colouring exercises and discuss specimens.

Teachers, aides, volunteers, presenters

Teachers are normally very receptive to geoscientists coming into their classrooms. In kindergarten, the students are only at school for a half-day, so there may be the chance to do two presentations in a day to different classes in the same space. Each class may have a different teacher's aide and often volunteers will be present to help with the set-up of teaching resources, microscopes and projectors.

Most kindergarten students have heard of geologists and have seen them on the television, but their image may be a little coloured by movies such as Jurassic Park. It is best to wear standard work clothes (be that office or field) but do make a point of bringing along a hammer and hand lens.

Presentation Resources

To obtain books aimed at the kindergarten to Grade 4 (K-4) level student, a quick visit to the local toy store can often provide useful material. Other locations available in Alberta include the Royal Tyrrell Museum of Palaeontology Bookstore, the Glenbow Museum Bookstore, the Public Library, and local rock and mineral stores.

The hunt to find good photographs of dinosaurs can be difficult because of copyright issues. However, in Alberta, there are a number of museums and public areas, which have replicas that can be visited. At Calgary International airport there are a number of displays of dinosaurs (and pterosaurs), which can be photographed. This paleontology theme is also used at Chicago O'Hare airport, so travel with a camera can provide usable images. At the Royal Tyrrell Museum of Palaeontology it is possible to take photographs of the collection for educational purposes without the problem of copyright issues and this could be the case at other museums if they are asked. For modern animal analogues the local zoo or even university may be a source. Here, in Calgary, the zoo has many animals as well as dinosaur statues in many colours, although some of the latter are older models which do not represent the current understanding of dinosaur posture.

Web pages are probably the best sources of data on dinosaurs for the geoscientist going into the classroom. There are many available but some of the best and most useful include:

- Geological Survey of Canada (GSC) at gsc.nrcan.gc.ca. This large web site has links to many geological resources. In Calgary, the GSC also has offices and a bookstore. At the former is a collection of teaching rock specimens and fossils which may be borrowed to aid "show and tell". Across Canada similar collections are available at local offices.
- EarthNet at earthnet-geonet.ca. This is a major resource of classroom activities, guides and data for teachers as well as geoscientists.
- Canadian Geoscience Education Network at cgen.bio.ns.ca.
- Dinosaur illustrations can be found at www.search4dinosaurs.com. Some of the pictures do not have copyright restrictions for teachers.

Calgary-based web pages include:

- Calgary Science Network at www.calgarysciencenetwork.ca. This organisation seeks to pair local volunteer scientists with teachers. The web page is an excellent starting point to find resources in the Calgary area.
- Alberta Palaeontological Society at www.albertapaleo.org. The society also has volunteers who can present talks in the classroom, along with fossils and books which can be borrowed.
- Calgary Board of Education outlines the Alberta curriculum at www.edc.gov.ab.ca/parents/handbooks/summaries/kinderbro.pdf
- The Alberta Kindergarten Program Statement can be found at www.education.gov.ab.ca/k_12/curriculum/by subject/kindergarten.pdf

This is not intended as an exhaustive listing but more of a gateway to the many resources available to both the presenter and the teacher. Local resources are always preferable because many students can relate better to places and things that they have seen and touched.

CONCLUSIONS

The lesson plan presented has been given to 12 different classes and has always been well received by all in attendance including students, parents and teachers. For the geoscientist entering the classroom, this is a chance to affect the girls' and boys' lives and perhaps make more scientists in the world. Probably many geoscientists can trace the development of their interest back to a long forgotten person who spent a little time sharing the excitement of discovery. Presentations to young children's classes are a fun and challenging experience and, with the right teaching resources, can be one of the most rewarding parts of a geoscientist's work.

ACKNOWLEDGEMENTS

This paper is an outgrowth of our class presentations at McKenzie Lake School in Calgary, Alberta. We would like to thank the principal, all the classroom aides and volunteers, and especially the students who always surprise and educate us with their insights and enthusiasm for all things "dinosaur". The initial draft of the paper was greatly improved by Geoscience Canada editors and two referees; thank you for your valuable time and thoughts. RPWS and GDM would also like to thank the management of Imperial Oil Resources for letting them volunteer to present on a number of occasions.

Accepted as revised 08 November 2005

Reviews

Early Silurian Trilobites of Anticosti Island, Québec, Canada

By Brian D. E. Chatterton and Rolf Ludvigsen
Palaeontographica Canadiana. No. 22, 2004, Canadian Society of Petroleum Geologists & Geological Association of Canada
ISBN 0-919216-93-5
CDN $109.00, softcover, 264 p.

Reviewed by Brian R. Pratt
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The latest instalment of *Palaeontographica Canadiana* contains 85 plates, making it the largest in the series since its inception in 1983. It is adorned with a fine drawing of an ornate odontopleurid trilobite and the cover is a beautiful dark green, adding one more band to the spectacular rainbow these monographs make on the book shelf. Allow me to say from the outset that this review is surely biased, for not only was the second author my doctoral supervisor, but also I have been intimately involved from the beginning with this now venerable monograph series. *Pal Can* is so wonderfully a feast of Canadian palaeontology and a tribute to Canadian palaeontologists.

Publication of the first monograph in the series was a singular event, a splendid volume in pewter-coloured wraps by Brian Chatterton on silicified Silurian trilobites and edited by Rolf Ludvigsen. Its launch was celebrated boisterously at the Mining Building of University of Toronto by the city's palaeontological elite with beakers and coffee mugs of fine wine (carefully selected by this reviewer from the plonk precinct of the cellars of LCBO). Since then, volume after volume has appeared, dealing with trace fossils, spores, conodonts, sponges, plants, graptolites, foraminifers, brachiopods and, yes, more trilobites (according to some, too many, but never mind). Almost all monograph-length publications on Canadian fossils have been in this series, apart from a few Geological Survey of Canada bulletins and National Research Council books. I can attest that the appearance of every number has been big news across the land, that the quality of editing and production has been high, and that the science is second to none.

This monograph is the fruit of palaeontological labours that began in the middle 1800s with collections made by explorer James Richardson. Elkanah Billings, Canada's first government palaeontologist, studied these collections. That his name pulses through this book, as it does in almost any work on lower Palaeozoic invertebrate fossils of eastern North America, is a testament to his fine powers of observation and his intuitive grasp of taxonomic principles. This is remarkable for a self-taught scientist whose reputation was respected by no less a personage than Charles Darwin.

As recounted in the Introduction, Chatterton and Ludvigsen built on the Richardson collections with material collected during the expedition led by W. H. Twenhofel in the 1920s, and from many later geologists, along with specimens from several seasons of their own field work. This monograph describes and illustrates 52 species belonging to 30 genera, one of which is new. Quite amazingly, two-thirds of the species - 32 - are new, which might surprise the reader who could have assumed that the early 21st century would find trilobite palaeontology in its twilight years.

There are 16 pages of text in this monograph dealing with background geology, biostratigraphy, biofacies and biogeography, with the remaining 58 pages being taxonomic description. The writing is generally good, and the style is quite personal, with scattered asides and liberal use of "we". Some may object to this, but I very much enjoy the conversation, as it were, with the two authors in their dealings with the rocks, their systematic struggles and their quests for historical collections. There are only a few, trivial typographical errors. 'Scotch whisky' is misspelled, but you will have to check the text to find out what this libation is doing in a supposedly dry scientific monograph.

The material is exquisite and the standard of preparation is peerless. Dextrous use of the pneumatic engraving tool was required because many of these trilobites occur on bedding planes that are covered with silty and clayey dolomite. The only way to prepare them is with pressurized air and gentle abrasives like baking soda, an exacting task. The result is plate after plate of superb photographs showing marvellous detail of many whole specimens, both outstretched and enrolled.

The occurrence of each species is pinned to a generalized stratigraphic section to produce a biostratigraphy consisting of six successive "faunas" that are quasi-biozones. Because the nearly flat-lying stratigraphy and nature of the inland exposures governed the way in which most specimens were collected, species ranges are not tied precisely to measured sections but are linked to lithostratigraphic units (members); collection information is in the appendices.

The palaeoecological theme is

picked up with a different slant by using trilobite associations in the form of relative abundances of the various genera. This approach pioneered by Ludvigsen in the 1970s, and rests on the assumption that all species of each genus would have had the same ecological requirements, more or less.

Using this approach, six "biofacies" are defined. Four of them consist of diverse associations but are dominated by species belonging to a single genus, which co-occur with several subordinate genera and a bunch of rare taxa. The two *Stenopareia* species, for example, are present in several biofacies but overwhelmingly dominate the reef-associated *Stenopareia* Biofacies, which is the least diverse of the six. This analysis of biofacies is compared to other Early Silurian associations, especially in Scandinavia and Great Britain. What governed all these distributions is not yet clear, and it would be unreasonable to decouple them from the other faunal and algal elements and sedimentological characteristics. In any case, the observations here stand in stark contrast to some lower Palaeozoic sedimentological work in which marine fossils are lumped together at the class or even phylum level - the palaeontologist winces at this kind of generalization.

If you still adhere to the view that trilobites are virtually exclusively Cambrian, this monograph should dispel that misconception. However, they certainly are different, mostly belonging to quite unrelated families, and are commonly flamboyant with prominent bumps, spines, furrows, knobs and lobes. This fauna occurs with brachiopods and other elements, which have been described by a number of distinguished palaeontologists: the Ordovician and Silurian of Anticosti Island is famous for its fossils and quality of preservation - a good thing that it is a protected area as otherwise naturally weathered slabs would soon vanish.

The historically minded geologist is in his/her element because the synonymies and discussion of each species present a wide-ranging, quasi-legal and historical justification for the pedigree of all species. Higher level taxa are discussed at length. Almost all species entries contain a diagnosis, and many, especially the newly named ones, are backed up by exacting formal descriptions. Discussions are detailed and authoritative. All species turn out to be indigenous to North America, but many genera contain representatives from other continents. Some species are illustrated with handsome line drawings. Unfortunately though, a few of these were scanned before printing which washed out the stippling. The six-page reference list cites virtually everything written on Early Silurian trilobites going back to the early 1800s, and everything about Anticosti Island geology since the 1700s (except, curiously, the excellent sedimentological study on the Lower Silurian by T. Sami and A. Desrochers, published in 1992).

This fine monograph is not just a tour de force by the authors but also an honour to Canadian palaeontology itself: out of the 32 new species fully 23 are named for Canadian palaeontologists and geologists (including field assistants). The one named after me is very handsome indeed; the plate is suitable for framing. I did admit, did I not, that this review would be perceived as biased? But I do know that every trilobite enthusiast, professional and amateur, and just about any person dealing with Ordovician and Silurian marine faunas anywhere on the planet will be thrilled with this tome. With this in hand you could finally convince your impecunious library to pick up the back issues and start subscribing!

Stereographic Projection Techniques for Geologists and Civil Engineers (2nd Edition)

By Richard J. Lisle and Peter R. Leyshon
Cambridge University Press, New York, 2004
ISBN 0-521-53582-4
US $35.00, softcover, 112 p.

Reviewed by Ivan Dimitrov
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When I read this book, it brought to me pleasure and sorrow. It was a pleasure to surf through the simply explained and well-illustrated problems and it was sorrow to remember what I had to endure as a student to acquire sufficient understanding of the stereographic method, without having such a book. I remember well those years back in my native country, when I tried to study the stereographic method from a crystallographic manual, simply because there was not a good book on the geological applications of the projection techniques. Later, I discovered many structural geological manuals with introductory chapters on stereographic projection techniques, but found most of them unsatisfactory.

This lack of satisfaction is not just a personal view. My interactions with geologists of different nationalities and backgrounds indicate that only a few retain any working knowledge of the subject two or three years after graduation, even though all of them studied it; the reason for this is that they had not learned it properly in the first place. This method, no matter how simple it may look to the practicing structural geologist, requires a lot of work and concentration to be perfected and converted into an everyday tool.

Lisle and Leyshon's textbook is a carefully worded and well-illustrated introductory course in stereographic visualization of three-dimensional geological data. It is designed to satisfy the needs of the undergraduate geoscience students, but it also addresses many problems of interest for the practicing geologist. The selection of topics and the order of presentation of the practical problems are arranged in such a way that the reader is introduced painlessly into techniques of increasing complexity. The core of the book contains 46, two-page chapters illustrated with composite figures of high quality. At the end of the book, solutions are given to the exercises that are presented in some of the chapters. There are also seven appendices that have graphical templates, useful formulas and alternative projection algorithms. In light of the new trends in teaching and research, a list of freely available stereographic software is supplied at the end of the book.

The selection of problems is designed to train inexperienced geoscientists in 3-D geometry. In this aspect, the first 25 chapters are critical for the understanding of the entire content; here, all the basic operations with lines and planes are marvellously explained and the road is paved for a better understanding of more complicated problems. Rock-mechanics applications are discussed in brief in the last five chapters of the book. Crystallographic (mineralogical) applications of the stereographic projection are not discussed.

The book fills a gap in the market place. Recently, most of the authoritative manuals in structural geology offer concise introductory chapters in basic stereographic techniques; however, the explanations and the selection of problems are too economic and fail to address the needs of many students. Lisle and Leyshon's book introduces the basic stereographic concepts in a more clear and efficient way than any other textbook of similar content, except perhaps for the classical book of Phillips (1971), which is still an unbeatable short introduction, but it is now out of print. Lisle and Leyshon's book is expanded in scope and has more illustrations than the book of Phillips (1971), and is more focused and internally coherent than that of Ragan (1985). The quality of the book becomes obvious, when the reader examines the chapters dealing with rotation around an inclined axis, analysis of refolded structures or the introduction of cones and small circles. These problems are explained with less detail and efficiency in the other textbooks of Phillips (op. cit) and Ragan (op. cit).

The chapter dealing with geotechnical applications could have been more detailed; the authors include analysis of simple wedge failure, the friction cone solution and some simple analysis of daylighting conditions, but there is no mention of the mechanical basis of these methods. Comments on the resolution of stresses on discontinuity surfaces or the modified Coulomb failure criterion for fractured rocks would have facilitated the understanding of the material.

Some of the methods explained in the book have well entrenched names in the geological literature. For example, the method for finding of preferred direction by observations in arbitrary planes (pp. 38-39) is known in the geological literature as the N-plane method of Lowe (1946), which might have been mentioned in the text.

The book does not include some less common applications of the stereographic method, which can be found in the scientific journals. For example, it does not introduce operations with vectors in stereographic space. However, these applications are beyond the scope of an ordinary undergraduate course and certainly would overburden students unnecessarily.

Based on my experience in teaching structural geology, the information in the book is sufficient for a complete undergraduate course. For purely practical geological mapping projects the book offers plenty of good advice and certainly will be useful to field geologists. In conclusion, I can recommend the book to students and practitioners alike as a thorough and affordable modern introduction in the stereographic projection method.

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Time Series Analysis and Cyclostratigraphy: Examining stratigraphic records of environmental cycles

By Graham Weedon
Cambridge University Press, New York, 2003
ISBN 0-521-62001-5
US $70.00, hardcover, 259 p

Reviewed by Peter S. Giles
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This book provides a very useful and well illustrated introduction to time series analysis and its application to the determination of cyclic behaviour of environmental variables. The author has succeeded admirably in summarizing the main methods used in the examination of quantitative records of ancient environmental change. The book is well-organized and clearly written with a minimum of jargon. The Table of Contents allows easy search for sections cross-referenced in the text. The author has included an index at the end of the book which also makes for easy searching. At the end of each of the six chapters, a brief summary of key issues addressed is presented in point form, an excellent idea for an introductory book. I especially liked the use of bold typeface for terms relating to time series analysis, particularly appropriate for an introductory text. Both the author and the editors are to be commended on production of a remarkably well-edited book.

Weedon demonstrates the applicability of time series analysis to a wide temporal range of palaeoenvironmental data ranging from annual to Milankovitch cycles. The overall balance in the examples presented is quite appropriate to the author's stated aim of encouraging new researchers to venture into the field of cyclostratigraphy and time series analysis. Weedon has drawn extensively on his own experience which, in some respects, strengthens his presentation through personal familiarity with his own time series data and its interpretation. This reviewer would have preferred a somewhat more varied use of examples in order to expose the reader to a broader range of applications using different data sets.

Chapter 1 provides a rather brief history of cyclostratigraphy, followed by an introduction to time series analysis. Weedon's synthetic time series (Figures 1.6 and 1.7) are particularly instructive. The author demonstrates the progressive increase in the graphic visual complexity of perfectly ordered, relatively simple time series in which several cycles are present, and their resolution into simple line spectra with time series analysis. The key bullet at the end of the chapter highlights the ability of spectral analysis to detect multiple regular cycles.

In Chapter 2, the author addresses the construction of time series in cyclostratigraphy. The reader progresses through a concise and very useful section in which discrete- and continuous-signal records are clearly and succinctly described. Three conditions fundamental to the construction of meaningful time series follow and should not be disregarded by those who seriously intend to undertake such an exercise. The chapter ends with a brief discussion of sampling, sample intervals, and aliasing related to sampling procedures. The use of irregularly spaced data is briefly discussed, almost at the level of an aside, and does not sufficiently acquaint the novice with viable alternatives that allow this procedure.

Chapter 3 deals with spectral estimation; it presents a variety of methods for doing spectral analysis of time series with examples of outputs. Preliminary discussion highlights time series that require pre-processing. The determination of statistical significance of spectral peaks completes the chapter. Here the author has, as promised in his preface, kept mathematics to a minimum. Chapter 4 continues in a partially similar vein, but here less familiar methods of time series analysis such as phase spectra, complex demodulation, wavelet analysis and singular spectrum analysis are presented. Much of this chapter deals with methods that allow follow-up analysis after a time series has yielded spectral indications of potentially significant periodicities.

In Chapter 5, Weedon deals with practical considerations and offers a cautionary perspective on environmental cyclicity, its invariable distortion in real stratigraphic records, and limitations on the interpretation of such cyclic signatures. Here synthetic time series, simplified in a mathematical context but still graphically realistic, provide an especially useful illustration of the author's points. This chapter is perhaps the most enlightening for the uninitiated reader. One suspects that Weedon has avoided overt criticism of certain techniques that deal with sediment accumulation rate distortions of natural time series. He cites instances where methods have been shown to give results "other than expected". Such restraint may be appropriate for a general text, but this lack of emphasis does not serve the target audience well.

Weedon finishes strong with Chapter 6 in which he links environmental processes to the cyclostratigraphic record, beginning with an admission that the mechanism through which this is done remains controversial in many instances. Perhaps fewer pages could have been used to address the climate spectrum but this might simply reflect new emphasis in this field in very small scale cyclicity in the stratigraphic record.

With the publication of this introductory book, Weedon has achieved his stated objective of providing a text on methods and concepts in cyclostratigraphy and time series analysis for students and those new to the field. Any disappointment I felt with the text no doubt reflects slightly different personal views, no fault of the author. My only criticism is in Weedon's hesitation to highlight in more detail some of the contentious issues in methodology and in the interpretation of spectral results, an effort that would have served the reader well. For example, Weedon could have usefully addressed very current research where orbital versus radiometric time-scale estimations are dramatically at odds and remain unresolved. The dramatic successes in the development of astronomical time scales receive lots of emphasis, and appropriately so. Why not some of the controversial issues which should be cautionary eye-openers for the neophyte?

Early Earthquakes in the Americas

By Robert L. Kovach
Cambridge University Press, New York, 2004
ISBN 0-421-82489-3
US $90.00, hardcover, 268 p.

Reviewed by John J. Clague
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This book, written by geophysicist Robert Kovach, documents large earthquakes of the last millennium in the Americas and describes their effects. The author's premise is that much can be learned about earthquakes from myths, legends, and accounts and from the effects of past disasters on human settlements.

The book includes 12 chapters. An introduction (Chapter 1) is followed by short summaries of the seismo-tectonic setting of the Americas (Chapter 2), earthquakes in myths and legends (Chapter 3), and earthquake effects (Chapter 4). The next six chapters are a "cook's tour" of earthquakes in different parts of the New World: Mexico (Chapter 5), the Maya empire (Yucatan, Belize, Guatemala, and Honduras; Chapter 6), Costa Rica, Panama, and Colombia (Chapter 7), Peru and Chile (Chapter 8), California (Chapter 9), the North American Cordillera (Chapter 10), and eastern and central America (Chapter 11). A very short concluding chapter is followed by several appendices, a glossary, bibliographic summaries for each chapter, and a list of references.

Cambridge University Press states that "students and researchers in the fields of earth science, archaeology, and history will greatly benefit from this book. I'm not so sure about this assertion, as I had difficulty, as reviewer, identifying the audience for the book. Geologists would like to know what the geological record can tell them about earthquakes in space and time, but this book probably will not interest them. Seismologists may benefit from the useful tables of historical earthquakes included in the book, but there are no new insights into seismicity in the Americas. Archaeologists need to under-stand that damage at settlement sites in Central and South America may be the result of earthquakes rather than post-abandonment decay, but the discussion of archaeological sites and earthquake evidence in Chapters 5, 6, 7, and 8 is uneven and somewhat cursory. Some students would find the material interesting, but it is unlikely that the book will be used in many university courses because it is such a niche product.

Professor Kovach argues that earthquakes played a role in the evolution of early cultures in quake-prone regions in the Americas. Few would dispute this statement, because, as the author shows, the myths and legends of early people include animistic references to earthquakes. Further, it is not surprising that ancient Zapotecan, Mayan, Incan, and other ruins show evidence of earthquake damage, as the areas in which these people lived are seismically active. In my view, a more interesting question is "How did early people in the Americas adapt to the strong earthquakes they must have experienced?" These peoples were very familiar with earthquakes and they must have adjusted their lives to limit the damage that quakes caused. Scientists have argued that large earthquakes and volcanic eruptions ended ancient civilizations. I find such arguments unconvincing as they assume that early peoples were unable to adapt to natural disasters. As Professor Kovach points out, ancient civilizations can fall due to many causes, including climate change, epidemics, foreign and civil wars, cultural and social decay, and agricultural and economic collapse. Earthquakes, at most, are the *coup de grace* of a civilization in terminal decline.

Professor Kovach argues that archaeology can play an important role in extending the historical record of seismicity. I agree, but the book does not demonstrate that this has been, or can be, done in the Americas. The New World record falls far short of that in the Middle East, especially Israel and Jordan, where surface rupture and other earthquake effects can be related to precisely dated events dating back more than 2000 years. Fault offsets and other damage to archaeological sites in the Jordan River valley, for example, has been used to determine the magnitude of biblically important quakes.

The organization and presentation suffer from the book's lack of clearly defined audience and purpose. Chapter 2, on seismo-tectonics of the Americas, is only 11 pages and too general to be useful. Furthermore, some of its content is repeated in the regional earthquake chapters. The regional chapters (5-11) seem somewhat forced, with arbitrary geographic boundaries. Why, for example, separate earthquakes in California from those in the North American Cordillera, especially as the chapter on North American Cordillera includes a section on earthquakes in Death Valley, California? California, of course, is part of the North American Cordillera.

Archaeological sites in quake-prone regions are reviewed in several chapters, but the actual evidence for earthquake damage is not discussed in the detail that I would have liked. Earthquake myths, legends, and damage to famous archaeological sites are included in the chapters dealing with Mexico, the Mayan empire, and Peru and Chile, but are scarcely mentioned in the other regional chapters.

The illustrative material, as a whole, will do little to sell the book. Seventy five of the 135 figures in the book are simple black-and-white maps showing earthquake epicentres, faults, and localities mentioned in the text. Some of the maps could have been combined or better annotated. Thirty six of the remaining figures are photographs; some are very good but others show little and could have been deleted.

Here, then, are my summary and recommendation:

Strong points:
- Earthquake tables
- Description of effects of earthquakes on archaeological sites
- Discussion of relation between earthquake intensity and magnitude
- Reference list

Weak points:
- Lack of clear focus
- Structure
- Figures
- Cost (US$90 is a hefty price for a 268-page book)

Recommendation. Unless you are a real earthquake junkie, I would pass on this book.

Understanding Environmental Pollution, A Primer (2nd Edition)

By Marquita K. Hill
Cambridge University Press, 2004,
ISBN 0-52182-024-3
$110.00, hardcover, 484 p.

Reviewed by Kevin Telmer
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Understanding Environmental Pollution is rich in general information about most forms of pollution at the household, local, and global level. It is written for the non-scientist and non-science student, but is also good reading for those who want generic environmental information beyond their level of expertise. The book's 18 chapters discuss methodically, pollution concepts; major pollutants in air, water and soil; pollution sources; climate change; toxicity and risk assessment, and concepts and efforts to reduce pollution. The concept of pollution is not presented in isolation but rather as a consequence of the integrated actions of society. It is, in this sense, that energy generation and use and its relationship to pollution are presented.

The presentation of material is clear and lively but perhaps, also controversial. Typically, each chapter begins with an appropriate quotation about the right direction forward. This sets the tone for the accuracy about the present situation, which is explained by first presenting the basic concepts about a pollutant e.g., acid deposition, and then by recounting the history of the research and critical debate that have led to our current understanding of the problem – including the skeptics point of view.

The review of each topic spices the reading by adding the human element to what can otherwise be dry material. Also, it goes a long way to explaining the culture of science to the uninformed. For example, in the section on ozone depletion, Hill says, "However, as happens with many environmental issues, there are skeptics. And often, as with ozone, researchers respond to skeptics by doing more research."

Another effective feature of the book is its inset boxes. These appear as context-relevant, self-contained "asides" throughout the book and are full of attention grabbing statistics, ideas, quotations, and scientific explanations.

Each section ends with a set of open-ended questions that forces a certain amount of understanding and analysis and allows the reader to evaluate the issues for themselves; this is very good for students and for initiating discussions. The questions range from very basic ones about the science behind pollution to ethical questions about human behaviour and pollution. The ethical questions are thoughtful and provocative. Geoscience educators might find the latter to be helpful in making their lectures more relevant to students.

On the negative side, the upbeat tone of the book sometimes leads to alarmist and melodramatic statements which diminish the otherwise good writing. An example from chapter 5 on air pollution: "disastrous fires and mammoth dust storms may appear from space as gigantic yellow blobs."

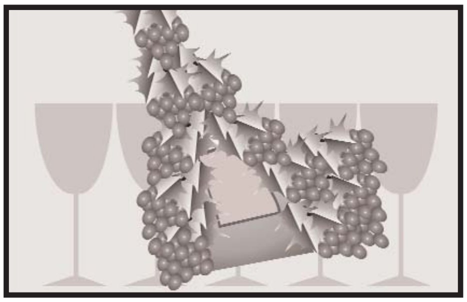
The book claims to be more international than the first edition but remains highly US-centric. Partly, this is unavoidable, simply because so much research has been undertaken in the US, as compared to elsewhere. However, many of the examples provided in the book tend to reinforce the notion that it is in the developing world where the pollution problem lies, and hence the solution, although the contribution to pollution by developed societies and their higher level of consumerism and waste-generation is repeatedly discussed.

In some cases, the description of scientific principles in the introduction has been so oversimplified that it borders on being incorrect. For example, energy is described as something that cannot be created or destroyed, just "dissipated" – rather than converted from one form to another. And organic versus inorganic chemicals are defined based on whether or not they can be destroyed as follows: "Organic chemicals even those difficult to degrade can be destroyed when conditions are right. However, inorganic substances, although they can be converted into other compounds are not destroyed." I suppose Hill was referring to the 92 elements, although it is not clear, as the box on inorganic chemicals that follows includes sodium bicarbonate and sea salts. This is very misleading – particularly as it applies to geochemistry.

The geoscientist, generally, will find this book lacking in scientific rigour, particularly in how it addresses the issues in geoscience; nevertheless, the main attraction is its broad scope and effective teaching format. Most of the material that touches on the geosciences – climate change, metals in the environment, atmospheric chemistry, mining, oil and gas, others – just scrapes the surface and is not presented in a quantitative manner. For example, when the book discusses natural sources of metals in the environment, it borders on being negligent and dismissive. In the discussion on lead, there is actually a subtitle called "some lead is natural" which sounds promising, but the ensuing statement is not: "But remember that lead, like all metals, is a natural element. We cannot totally eliminate it." There is another subtitle called "natural sources" that uses only two sentences to describe them: "Natural sources: these include volcanoes, forest fires, and sea-salt sprays. These are significant but it is human activities that are increasing the environmental load of metals". No further information is provided. Newspaper articles generally give the subject more attention.

Scientists will find the book to be disappointing in its lack of discussion of the methods used to discover the information that is presented, and in its poor referencing. Many points are presented simply as known facts, and worse, these are not referenced. The only references given in the book are provided under the "further reading" section at the end of each chapter. This seems an unnecessary weakness considering the ease of modern citation software. It greatly limits the use of the book as a research tool.

SERIES



Geology and Wine 11. Terroir of the Western Snake River Plain, Idaho, USA

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SUMMARY

This article explores the unique combination of factors that shape the terroir of Idaho's principal wine grape-growing district. Most Idaho wine grape vineyards are located in the Western Snake River Plain (WSRP) rift basin (~43°N, ~117°W) on soils derived from lake, river, volcanic and wind-blown sediments. The underlying Tertiary and Quaternary rocks record the geologic history of ancient Lake Idaho, its interaction with basaltic volcanism, and subsequent Pleistocene fluvial processes and catastrophic floods. The arid to semi-arid, mid-latitude steppe climate of the WSRP provides fewer growing degree days than American Viticultural Areas (AVAs) in Walla Walla, Washington and Napa Valley, California, but still allows cultivation of *Vitis vinifera* grapes. Other differences include lower precipitation, higher solar radiation during the growing season, and greater threat of cold injury. Wine grapes grown in the WSRP require irrigation, and irrigation is used to manage canopy size and manipulate vine physiology. Wine grape acreage in Idaho has increased dramatically since 1993 and is estimated, in 2003, at about 500 ha with the white wine cultivars Riesling, Chardonnay, and Gewürztraminer comprising about 60% of production, and Cabernet Sauvignon, Merlot and Syrah as principal red wine cultivars.

RÉSUMÉ

Le présent article porte sur la combinaison particulière de facteurs qui définit le terroir du principal district viticole de l'État d'Idaho. La plupart des vignobles de l'Idaho sont situés dans le bassin de fossé tectonique (~43°N, ~117°O) de la Western Snake River Plain (WSRP), sur des sols formés de sédiments lacustres, fluviatiles, volcaniques et éoliens. Les couches tertiaires et quaternaires sous-jacentes témoignent des événements constitutifs de l'histoire géologique de l'ancien lac Idaho, de phénomènes interactifs dont il a été le théâtre, soit un volcanisme basaltique, ainsi que des processus fluviatiles et des inondations catastrophiques pléistocènes. Bien que le climat aride à semi-aride de steppe en altitude moyenne de la WSRP comporte moins de degrés-jours de croissance que les zone les zones viticoles étasuniennes (AVA) de Walla Walla de l'État de Washhington et de la vallée de Napa de l'État de Californie, il permet tout de même la culture des raisins de *Vitis vinifera*. De plus, cette région reçoit moins de précipitations, plus d'ensoleillement durant la saison de croissance, et elle est davantage exposée aux meurtrissures du froid. Les vignes de raisins de cuve cultivés dans la WSRP doivent être irriguées, l'irrigation permettant d'agir sur l'ampleur du feuillage et sur la physiologie du vin. La superficie de culture du raisin de cuve en Idaho s'est considérablement accrue depuis 1993 pour atteindre 500 ha environ en 2003, les cultivars à vin blanc de Riesling, Chardonnay, et Gewürztraminer constituant 60 % de la production, et ceux du Cabernet Sauvignon, du Merlot et du Syrah constituant les principaux cultivars à vin rouge.