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Book Reviews

Archean Greenstone Belts

By Kent C. Condie
Elsevier, 434 p., 1981, US \$122.00

Reviewed by Charles F. Gower
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Archean Greenstone Belts is the 3rd volume in Elsevier's series, *Developments in Precambrian Geology*. The book starts with a useful review of general features of Archean greenstone belts including brief, but worthwhile summaries of worldwide occurrences. This is followed by a summary of the stratigraphic features of greenstone belts which paves the way for a step-by-step treatment of the lithological characteristics found from the base to the top of an idealized greenstone belt. Lithological aspects are rounded off by a summary of granitoid rocks, inseparable from any treatment of Archean greenstones. Chapters on structure and metamorphism, mineral deposits and Archean life complete the descriptive portion of the book. The final two chapters are more theoretical, dealing respectively with the origin and source of Archean magmas and crustal evolution of greenstone belts.

Readers unfamiliar with Archean rocks and concepts will find the descriptive and mildly interpretive approach of the first two-thirds of the book readable, informative and up-to-date. Workers having longer acquaintance with the Archean will be familiar with most of the material presented but are likely to discover information of which they were unaware. The more interpretive final third of the book has considerable merit with a wide range of ideas reviewed, including some to which, one suspects, Condie may personally give little credence. However, Condie has managed to thread his way successfully between an uncritical

acceptance of some of the more improbable proposals concerning the genesis of Archean rocks on one hand, and an overpersonalized viewpoint on the other.

Although it is a well organized and well presented volume some aspects could have been improved. A complete standardization of lithological symbols on maps, stratigraphic columns and crustal evolution diagrams would have been advantageous — the risk that redrafting of original figures might have introduced errors would have been worth taking. Also a standard normalization of REE data against chondrite, rather than the variety of rock types actually used would have improved clarity.

Furthermore, although most readers have long since learned to live with LIL, MORB and REE, is it really necessary to extend this to Archean lithotypes (PK, BK, TH, AND, F, etc.)? Readers unversed in Archean geology will find this especially irritating, particularly if they do not start at the beginning of the book. Finally, please give the number of analyses on which an average analysis is based.

It is a considerable achievement that Condie has managed to produce this well-balanced and broad-ranging treatment of Archean greenstone belts which will have appeal to students and faculty, as well as government and industrial geoscientists. It should be in the library of every geologist who devotes a part of his time to Archean geology.

Proceedings of the Gold Workshop, Yellowknife, N.W.T.

Edited by Roger D. Morton
*334 p., 1979
Available from Yellowknife Workshop
Committee, Box 2397, Yellowknife,
N.W.T., XOE 1H0
\$10.00 per copy plus \$2.50 surface mail
or \$5.00 air mail*

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The Proceedings of the Gold Workshop is a compilation of 13 papers and one extended abstract arising from a conference on gold held in Yellowknife in December of 1979. Nature's best efforts to chill the thin blood of the many southern visitors attending was more than matched by the warmth and hospitality of the Workshop Committee and Department of Indian Affairs and Northern Development hosts. The accomplishments of the workshop were many but perhaps among the most important to geologists with an interest in gold metallogeny is the collection and publication of a group of papers presenting an update and current status report on gold deposits of the Northwest Territories. Eight of the 13 papers report on, or include some discussion of, gold deposits of the Northwest Territories and/or the geology of the Yellowknife greenstone belt. The analysis, assaying and economics of gold deposits are considered in five papers while an extended abstract discusses the general geochemistry of gold.

The papers dealing with Territories gold deposits and geology include two informative contributions by W.A. Padgham (DIAND), one of which presents an overview of Territories gold deposits with emphasis on the relative

economic importance of different deposit types in the Slave Province. Padgham in his other paper, discusses the geological evolution, structure and economic geology of the Yellowknife Volcanic Belt, the host to most of the important gold deposits in the Northwest Territories. The geology of the southwest end of the Yellowknife Volcanic Belt is also dealt with by H. Helmstaedt, J. King (Queen's University), J. Goodwin and J. Patterson (DIAND). This paper presents the preliminary results of recent mapping with emphasis on stratigraphic and structural relationships in the Yellowknife Supergroup within the map area.

Specific mines or deposit types are considered in four papers. D. Myers (Cominco Ltd.) presented the results of geochemical studies on host rocks, and auriferous quartz veins and chlorite schists from the Con Mine environment. Silver, Pb and As were identified as useful pathfinder elements for Au in rock geochemistry studies although Au alone was thought to be the best single parameter indicative of gold mineralization. The B-Zone Deposit, Cullaton Lake, N.W.T. was described by C.E. Page (O'Brien Energy and Resources Ltd.). The deposit is a gold occurrence hosted in sulphide facies banded iron formation of Archean age in the Kaminak greenstone belt of the Churchill Structural Province. It is suggested that the iron formation is a volcanic-exhalative derivative and that gold and silver represent primary sedimentary accumulation on the sea floor. A survey of economic gold occurrences of the Northwest Territories hosted in iron formation was presented by W. Gibbins (DIAND). Similarities with the Homestake Mine were pointed out and a depositional mechanism involving fumarolic brine emission on the sea floor suggested.

Other aspects of gold mineralization with special reference to the Yellowknife greenstone belt were presented by J. Allison and R. Kerrich (Universities of Strathclyde and Western Ontario, respectively) and R. Kerrich. The former paper offered a structural analysis, illustrated by Mohr diagrams, of vein systems within the main mineralized shear zones such as the Con and Campbell structures. Three stages of vein formation were recognized and analyzed in terms of varying stress fields, geochemical regimes and mineralization significance. The latter paper by Kerrich presented a synthesis of trace element and isotopic studies on over 700 auriferous samples from the Yellowknife, Red Lake, Porcupine and Val d'Or-Malartic camps. Kerrich suggests that

many Archean volcanic hosted gold-quartz veins are deposited from fluid dominated hydrothermal systems originating by metamorphic dehydration. Specific application to the Campbell shear zone, Con Mine is presented.

A group of 5 papers consider analytical and economic aspects of gold deposits. Although the interpretation of gold assays is recognized as difficult and often ambiguous surprisingly few examples of acceptable statistical analyses combined with actual application at the mine evaluation level are available. M. Vallee, M. Filion and M. David (SOQUEM, Exploritech Ltd. and Ecole Polytechnique, respectively) provide such a paper in their account of assay problems at the SOQUEM - Silverstock gold deposit, Bousquet Township, Quebec. Their study is a persuasive argument that sampling practices should be designed with some knowledge of the nature and distribution of gold carrier phases, and with collaboration between assayers, geologists and mining engineers if serious problems at the prospect evaluation, grade control and metallurgical balance stages are to be avoided. An informative paper by E. Hoffman, E. Brooker and M. White (Nuclear Activation Services, X-ray Assay Laboratories Ltd. and X-plor International Corp., respectively) drew the attention of the workshop to important developments in commercial methods of gold analysis which combine lead or nickel sulphide fire assay with a largely instrumental neutron activation finish. Application to a wide spectrum of sample materials including soils, lake bottom sediments, rock and heavy mineral concentrates and biogeochemical samples were noted. Economic forecasters had their day as well. In an assessment of the Canadian scene J. Hancock (Cominco Ltd.) argues that Canadian gold mines in general have limited ore reserves - 6 to 7 years - and that the industry is suffering from very limited exploration during the fixed price years which must now be offset by an intensive exploration effort if the Canadian contribution to world production is to significantly increase. The banker's perspective, presented by R. Fagan (Toronto-Dominion Bank), might be described as cautious, but the reasons for caution and the interface between the banking and exploration communities as seen from the banking side are well laid out in this presentation. A review of the significance and performance of conglomerate hosted gold deposits, particularly those of the Witwatersrand region, was presented by P. Kavanagh (Riocanex) and a comparison drawn with other types of Precambrian gold deposits. An evalua-

tion of the prospectus of several new deposits was also included in Kavanagh's paper.

Finally, R. Boyle (GSC) presented an overview of gold geochemistry following his recently published GSC Bulletin 280. His presentation is included in the proceedings in extended abstract form.

In summary, the Workshop provided a forum for the exchange of viewpoints and ideas from a widely diversified group of people. Such exchanges are all too infrequent. A major accomplishment of the meeting is the Proceedings document itself which brings together much current geological data on gold deposits from the Northwest Territories and the Yellowknife camp.

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Volcanoes

By Robert Decker and Barbara Decker
W.H. Freeman and Company, San Francisco, 244 p, 1981
\$17.95 U.S. Hard Cover,
\$8.95 Paper Cover

Reviewed by M.B. Lambert
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Books on volcanoes that have flourished in the last two or three years tend to be highly descriptive and to emphasize the spectacular. Authors of this book look behind the spectacular phenomena and emphasize processes. They state that the book is written for everyone - from student to expert - who is interested in learning more about how volcanoes work.

The book begins by putting volcanoes into the global setting provided by the plate tectonic theory. Constant reference of all topics to this framework provides continuity between the 15 chapters.

Chapter 1, *Seams of the Earth*, traces the evolution of thought from Wegener's theory of continental drift to the present theories of plate tectonics, and shows the relationship of volcanism to "... the creaking and leaking margins ..." of plates. Chapters 2 (*Surtsey, Iceland*) and 3 (*Fire under the Sea*) discuss the origin of volcanoes along oceanic rift systems, both at great depth and where they emerge above sea level, and their role in forming new crust. Chapter 4 describes the catastrophic eruptions of Krakatau in 1883. Chapter 5, *Ring of Fire*, is a

simplified account of volcanism along subduction zones and how it differs from that along rift zones.

Chapter 6 describes the eruption of Kilauea in 1959-60 in which magma flowed horizontally through fracture zones. The formation of the Hawaiian volcanic chain is then discussed in Chapter 7 as an example of volcanism within plates above "hot spots".

Chapter 8, *Lava, Ash and Bombs*, is an introduction to lava flows and pyroclastic deposits. The main emphasis is on basaltic lavas and little mention is made of more siliceous lavas and domes. The brief account of pyroclastic flows does not leave the reader with a clear concept of their origin. *Crater and Cones* is a somewhat misleading title for Chapter 9, which discusses a mixture of topics regarding volcanic landforms, nature of vents, as well as craters and calderas. In the discussion of lava flows (p. 120) the distance of travel is related solely to viscosity of the lava without mention of rate and volume of effusion.

Chapter 10, *Roots of Volcanoes*, presents an interesting account of the place where magma is generated, depth of magma chambers and methods for locating them. In Chapter 11, after discussing the origin of the atmosphere and oceans, the authors conclude that perhaps we owe our hospitable atmosphere to the delicate balance between volcanism and tectonism and that present volcanoes may recycle the air and the oceans rather than create them. In Chapter 14, they remain uncommitted as to the effect of volcanism on climate. Chapter 12 outlines geothermal energy and power. Chapter 13, *Volcanic Treasures*, is an incomplete summary of the role of volcanism in the formation of ore deposits. Chapter 15 discusses methods for monitoring volcanoes, the probability of forecasting eruptions, and ends with a summary of the 1980 eruption of Mount St. Helens.

A 101 word glossary adequately serves the purpose of making the text intelligible to the layman. Eighteen pages of appendices list the 101 most notorious volcanoes and volcano information centres in 29 countries.

Although the text is generally accurate and includes many interesting numerical facts regarding volumes, rates of effusion and growth, a few statements may be disputed by the purist: for example, seismic waves (tsunami) are equated to tidal waves; the structural picture in subduction zones is oversimplified in the statement that rock layers are scraped off the ocean floor and squeezed into accordion folds against the upper plate; and deaths at Pompeii during the 79 A.D. eruption

are ascribed to glowing avalanches rather than to ash falls - it is not clear whether this is a new discovery or surmise.

This handsome, high-quality production is inviting and comfortable to read. A surprising amount of information is packed into the short, lucid text, beautifully clear illustration (about equal space is given to each) and brilliant half-tone photographs. The authors have achieved the difficult task of presenting complex concepts simply and clearly without being pedantic.

Putting volcanoes into a global perspective and emphasizing volcanic and tectonic processes sets this book apart from many others on the subject. This up-to-date volume is of interest to a wide readership and is a welcome addition to books on volcanoes.

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Cretaceous Research

Editors-in Chief: E.G. Kauffman and R.A. Reymont

Published quarterly by Academic Press, London and New York. Volume 1, number 1, March, 1980, 92 p.

Price per annum: U.K. £30.00, elsewhere \$88.50, inclusive of postage and handling

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For considerably more than a decade, the events of the Cretaceous Period have been recognized as exceptional and of unusual importance to establishing the relation between the continental masses and the marine basins and to understanding the evolution of the Earth. Never before has the stratigraphical record of a single period been the subject of so much focussed research on a world-wide basis. In 1974, this research was given further impetus by the establishment of IGCP Project 58, Mid-Cretaceous Events, which now has won the co-operation of more than three-hundred collaborators. Not surprisingly, the burgeoning of research on the Cretaceous System has led to a demand for more vehicles to carry the publishable results. More than half-a-dozen special volumes have appeared in as many years, containing the substantial proceedings of international symposia on many and varied aspects of Cretaceous geology; and there has been a notable increase in the number of Cretaceous papers published in regular serial publications

(see G.N. Rassam in *Geotimes*, 1977, v. 22, no. 10, p. 12). The new journal, *Cretaceous Research*, is a response to international demand to provide a forum for the rapid publication of research findings in all aspects of Cretaceous geology. Particularly strong pressure came from the contributors to IGCP Project 58. Those who would condemn the establishment of yet another serial publication in what may seem a narrow specialization should note that, before launching the journal, Academic Press conducted a year-long survey to test the demand for, and potential viability of, the journal.

The editorial in the first number of *Cretaceous Research* makes it clear that the journal is to be devoted not only to "the more classical fields of regional geology, stratigraphy, structural geology, and descriptive palaeontology" but also to contributions, *inter alia*, in geochemistry and petrology, the tectonics of the ocean floors, deep-sea deposits, evolutionary palaeobiology, palaeoecology, palaeogeography, sedimentology, mineral deposits, petroleum geology, and geophysics. Presumably the only unifying requirement is that all contributions should provide new information leading to a better understanding of the events of the Cretaceous Period. The editorial policy also states that methodological contributions may be accepted when they have a demonstrable application to Cretaceous problems. The journal carries a Short Communications Section and a Book Review Section to keep readers abreast of new discoveries and new publications, and it reproduces abstracts of important and pertinent papers published elsewhere. There is no limit to the length of articles, but preference will be given to shorter research papers. Contributions, which may be submitted in English or French, will be refereed.

Volume 1, number 1 of *Cretaceous Research* runs true to the declared editorial policy. It includes papers by S. Lipson-Benitah on the "Albian to Coniacian Zonation of the Western Coastal Plain of Israel", M. Tashiro, A. Taira, and T. Matsumoto on "Biostratigraphy and Depositional Facies of the Cretaceous-Tertiary Boundary Strata in . . . Western Japan", R.A. Reymont on "Trends in Cretaceous and Tertiary Geomagnetic Reversals", H. Ivert on "Biometrical Analysis of Generation Differences in the Cretaceous Foraminiferal Species *Gabonella elongata*", and T.N. Norman, G.L. Gökçen, and M. Senalp on "Sedimentation Patterns in Central Anatolia at the Cretaceous-Tertiary Boundary".

The journal has a 22 cm x 13 cm single-column format with clear readable type. Text-figures are well reproduced. Plate quality is adequate but may be a cause for concern to contributors, such as systematic palaeontologist, who may have stringent requirements for fine detail. In E.G. Kauffman of the United States and R.A. Reymont of Sweden, *Cretaceous Research* has two distinguished initial editors-in-chief, and they have put together an international panel of associate editors which includes some of the leading figures, representative of a variety of disciplines, in modern Cretaceous research.

Whether one approves of the proliferation of new journals or not, *Cretaceous Research* will be required reading for every serious student of the Cretaceous System world-wide, and many of its contributions should prove vital to those concerned with the newer concepts of global evolution.

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Macroevolution: Pattern and Process

By Steven M. Stanley
W.H. Freeman and Company, 332 pages, 1979
 \$22.95 (hard cover)

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This book is one of the most important and controversial recent contributions to the study of Evolution. Stanley declares that the object of the book is to stimulate interaction between neontology (study of Recent forms) and paleontology; and that it should be used in advanced courses and seminars. It should serve all of these purposes well. It is well written and adequately illustrated.

The book contains a wealth of information. It is a good introduction to some of the better known examples of evolution in the fossil record and an excellent introduction to literature on the patterns, processes and mechanisms of evolution.

Stanley believes in the punctuational model. This model states that new species originate through the rapid evolution of small isolated populations around the periphery of larger ancestral populations. If the new species produced survive they expand in numbers and area

and then evolve very slowly (stasis). A weakness of this book is Stanley's use of negative evidence to support the punctuational model. He does this by attempting to demonstrate that established species survive for too long a time and evolve too slowly phyletically (generation to generation change with natural selection) to account for most of the major change that has taken place. He does not stress the fact that species ranges may be artificially lengthened by few collections, poor preservation, few characters or the desire to name specimens; and even picks "living fossils" as one of the examples used to demonstrate slow rates of evolution. It is much more difficult to demonstrate convincingly rapid evolution in the fossil record whether it is punctuational or phyletic.

A second major premise in the book is that genera and higher taxa originate through punctuational evolution of new species. Stanley believes, therefore, that phyletic transitions from one genus to another are rare to absent in the fossil record. He grudgingly agrees that Gingerich may have demonstrated that *Plesiadapus* gave rise to *Platycherops* phyletically. He discounts, however, phyletic transitions that have been demonstrated for the Ammonitina by inferring that they were too variable to be able to demonstrate transitions convincingly, using as his example the atypically variable endemic ammonite *Neogastropilites*.

Another important point made in the book is that major evolutionary change requires both the rapid change produced by speciation events and species selection by differential extinction. Species selection takes place in response to competition, predation and change of environment in a manner analogous to natural selection. Stanley considers that this "decouples" the evolution of higher taxa from that which gives rise to new species and justifies the title, *Macroevolution*. Stanley eloquently marshals evidence in support of his beliefs but all too often relies on supporting his beliefs by attacking extreme forms of alternate hypotheses.

Chapters 1-3 are largely introductory, provide a number of useful definitions and introduce important hypotheses. Chapter 4 points out that most evolution occurs in bursts during adaptive radiation; and suggests that most species survive too long and change too slowly during evolution by natural selection to account for these evolutionary bursts. In Chapter 5, Stanley considers numerical methods of examining rates of change, rates of speciation and exponential increase during adaptive radiation; and

uses "living fossils" to demonstrate how slow natural selection can be. In Chapter 6, he considers how speciation takes place through the rapid evolution of small isolated populations; and invokes the actions of regulatory genes, chromosomal rearrangements and macromutations, as well as Chance, the Founder Effect and Genetic Drift. He also considers Ecoinsular Radiations and The Bottleneck Effect. In Chapter 7, he discusses species selection and its importance in major trends in evolution; and the importance of predation, competition and changes in the physical environment to species selection. In Chapter 8, he discusses the role of sex, the reasons that sex is retained in the majority of higher taxa, and the punctuational viewpoint of the role of sex in evolution (that sex is vital to speciation in small populations, and allows production of new species to outstrip extinction of species in a higher taxon). In the last two chapters, Stanley examines rates of speciation, rates of extinction and net rate of diversification. He discusses the variation of these rates in different groups of organisms and their roles in time and space.

This book is interesting and provocative. It should encourage many of us to produce empirical data from the fossil record that can be used to estimate rates of evolution and transition from one taxon to another, if only to demonstrate that phyletic evolution is much more important than is envisaged by Stanley. All serious biologists and paleontologists should read this book.

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