scientific communication is outside the printed word (personal communication, conferences, etc.). Therefore, why the paper? She pleaded for quality control by editors. Improve or replace the review process. She feels that a rejected manuscript should stay rejected but most are resubmitted, unrevised, to another journal and accepted, and end up on the library shelf anyway. She noted that libraries have, so far, cut back on textbook purchases to preserve the journal subscriptions, but this will stop soon - libraries have an obligation to serve the student as well as the researcher.

C. T. Bishop (National Research Council, Ottawa) gave the background and present state of the NRC journals. The first of these journals, the *Canadian Journal of Research*, began in 1929 and has expanded to 11 journals in 1980. He says that the NRC will continue to publish these journals (hear! hear!) at a cost to the taxpayer, but feels it is a worthwhile and legitimate cost of research. (The net cost, after subscriptions is $75-$100 per page.)

Bishop presented some interesting statistics during his talk. After consulting the citations index, he found that only 10 per cent of all journals published are cited even once! Fifty per cent of all citations come from 152 of them and just over 2000 journals account for 80 per cent of the citations. The *Canadian Journal of Earth Science* ranks 594 overall, and 941st on impact factor (citations/paper). He maintains that the rankings of journals have varied little over the years, so it is possible for a library to have a stable subscription list. Canadian scientists publish about one-third of their papers in Canadian journals, but he wishes it would increase. It is the famous Canadian inferiority complex at work (it's Canadian, it can't be that good), or are our world class scientists publishing where they feel they will get the best audience?

Robert Miranda (Pergamon Press, Elmsford, N.Y.) reiterated the point that libraries are essential to the financial survival of research journals. The main thrust of his talk was the emergence of the electronic journal. With the increased use of computer systems and particularly the development of the microprocessor with the floppy disks, it seems inevitable. He predicts that eventually some journals will cease to produce "hard copy" and go to electronic systems. Therefore, if you want to know what is in the latest issue of the Journal of Knowledge, talk to your microprocessor. Marilyn Guin was of the opinion that if not watched, the electronic journal will produce more marginal material, faster.

Finally, Gary Howell (Erico, Tulsa, Oklahoma) proposed that companies should look at the use of editorial consultants. He wondered why they maintain full time editorial staff that are not utilized year round? To save money, perhaps a consultant should be employed for periods when needed. Howell admitted, however, that the consultant editor would not be familiar with the company style of writing, but given proper guidelines by company personnel, the system could work.

Facts and Figures

1) There are over 9000 scientific-technical journals published in the USA, and by 1985 there will be 68,000 world wide (Milo Dowden, Dowden, Inc., Stroudsburg, Pa.). Couple this with Claude Bishop's comments on the 10 per cent rate for single citations, one must wonder if there are really that many ignored journals in the world or is the citation index of limited use in describing the full value of a journal to scientists.

2) Journal titles were increasing at the rate of two per cent per year from 1960-1974. For certain "in fields" of research the growth rate was faster (Marilyn Guin).

An Active Session on the Passive Voice

The conference concluded with a workshop, directed by Thomas Warren (Oklahoma State University, Stillwater), on the use of the "blessed/accursed passive voice". He led a lively discussion on its pros and cons and had all participants analyze some scientific prose. Was there a verdict on this topic? It was concluded that in order to maintain objectivity, the passive voice will continue to be used in scientific literature.

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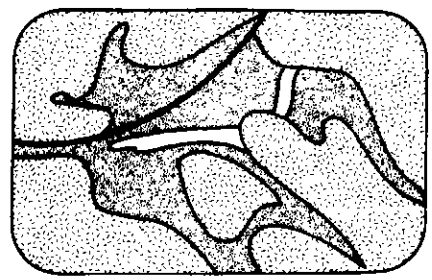

Second International Archaean Symposium

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The Second International Archaean Symposium to take place in Australia, held in conjunction with the Third Annual Field Symposium of the IGCP Project on Archaean Geochemistry, was held in Perth, Australia, May 12-16, 1980. Among the 400 attendees were representatives from at least twelve countries. The First Symposium, held in Perth ten years earlier, heralded major advances in understanding of Archaean sequences. At that time, new emphasis was placed on stratigraphic evolution and chemical characterization of supracrustal sequences. The 1980 conference was held to review advances in our understanding of Archaean tectonic history, and to report advances made in such diverse areas as paleobiology, chemical studies of virtually all Archaean rock types, geochronology, and metallogeny. The application of relatively new analytical techniques such as those used in Nd-Sm isotopic determinations, REE analyses and minor element determinations by neutron activation and isotope dilution, have resulted in a flood of chemical and age data for some Shield areas. Greenland and Minnesota no longer are the sole known areas of very old crust; most Shield areas contain some rocks older than 3400 Ma. Fortunately, structural and stratigraphic investigations seem to be keeping pace with chemical studies, providing a framework for the latter data.

The papers may be divided conveniently into three principal groups. The majority dealt with crustal processes and tectonic syntheses. Contributions to mineral deposits research formed a second significant group, and reviews of many of the recently discovered Archaean stromatolitic sites constituted a third group. Each session was organized about a specific subject matter (e.g., crustal evolution of granitoid gneiss terrains, geoch-

ronology, etc.). However, in synthesizing the proceedings, grouping of the discussions by Shield areas allows for a more comprehensive determination of the principal directions evident in Archaean research.

Attendees benefitted in two ways from having the conference in Perth; large groups of papers from the host country afforded a more detailed description of the Yilgarn and Pilbara regions, and secondly, a large number of participants had the opportunity to attend several exceptionally well-organized field trips in each area.

The Pilbara block is an unusually well-preserved supracrustal sequence. The most impressive feature to a Canadian geologist is the remarkable lateral continuity of the stratigraphic units, described by Hickman. The tholeiitic and komatiitic components (3556 Ma, Nd-Sm, presented by Hamilton *et al.*) were each derived from mantle periodotite, with high level fractionation causing the compositional variations (Barley). The felsic components resulted from melting of mafic source rocks, possibly the lower part of the basal formation (Glikson and Hickman). The extensive Duffer Formation (3452 Ma) has calc-alkaline felsic pyroclastic and epiclastic members, and has local sub-aerial to shallow water features. Exceptionally continuous chert beds at the top of the Duffer Formation with remarkably well-preserved stromatolitic zones (Dunlop and Buick, Walter, Ericksson) provide important marker horizons. Although no "basement" tonalite gneiss has been identified in the large granitoid batholiths within the Pilbara block, Hickman suggests that the basal mafic-ultramafic sequence was deposited on a thin sialic crust. Late (2700-2600 Ma) adamellite and granite differ from their counterparts in other Shield areas in their enrichment in LIL elements and Sn (Davy and Lewis).

The Yilgarn block more closely resembles the Superior Province of the Canadian Shield in respect to lithological content and distribution, as well as structural style. Gee described four major provinces. Within these provinces, greenstone domains, such as those in the Eastern Goldfields Province described by Archibald, appear to have formed as ensialic features, with deposition in rift-controlled elongate basins. Within the Eastern Goldfields area, a very large sub-aerial calc-alkaline volcanic-epiclastic complex (Giles) contains two magma series, a fractionated basalt-andesite suite, and a dacite-rhyolite suite; both series are derived by melting of a wet upper mantle. Jolly and Hallberg outlined the general similarity of the Leonora mafic-ultramafic volcanic succession to the Abitibi belt of Canada; the Australian succession, however, has undergone relatively less subvolcanic fractionation. Gneissic-granitoid domains are composed in part of older sialic basement rocks, such as the granulites in the Jimperding Belt (3340 Ma, Nieuland and Compston) and in the western gneiss domain, and in part of younger adamellite-granodiorite intrusions (Chapman) some of the latter are tin-bearing. These late intrusions and early gneiss are commonly domes which closely resemble diapirs; however, detailed studies by Bettenay *et al.* indicate a complex structural history involving early basement-cover isoclinal interleaving, followed by doming.

Bridgwater and Collerson reviewed the remarkably similar tectonic-stratigraphic development of the Greenland and Labrador areas of the north Atlantic craton, and concluded that the two areas have essentially identical and very long Archaean histories. Evidence for reworking of 3600 Ma Uivak gneisses to form relatively young (ca 2700 to 2900 Ma) Kiyuktok gneisses of Labrador was presented by Collerson, Kerr, and Compston. Gill, Bridgwater and Allaart reviewed the unusual high-alumina magnesian basalts associated with low-K tholeiites in the Isua supracrustal sequence (3700 Ma). Friend, Hall and Hughes indicated that the somewhat younger Malene submarine mafic volcanics (greater than 2800 Ma) are low-K tholeiites that originally were underlain by mantle in the south and overlapped Amitsoq sial in the Godthaabsfjord region of Greenland. The excellent preservation of the layered Fiskenaesset mafic complex (pre 3000 Ma) was documented by Meyers.

The Limpopo belt and Barberton Mountain Land in Southern Africa are both the products of plate tectonic action according to Barton. He suggests that the more northerly Limpopo belt formed at 3700 Ma by rift action related to a triple junction; its present configuration is the result of three periods of compressional shearing. The more southerly Barberton area, however, formed as a back arc basin at approximately 3550 Ma, followed by destruction by partial melting of the oceanic crust and accompanying diapirism. A central zone between these two belts, the northern Natal and southern Swaziland volcanic remnants, may be part of either the rift or the back arc basin-island arc regime. The Pengola Supergroup is a remarkable sequence of shallow water sediments and continental basalts represented an intracratonic rift sequence (2980-3050 Ma) (Kroner, Tegtmeyer, Higner, von Braunn).

DeWit and Stern suggest that the Barberton greenstone belt is a true ophiolite sequence and thus represents Archaean oceanic crust. Their reinterpretation suggests that large amounts of the classic Komati sequence is of an intrusive, sheeted dyke origin. Smith presented chemical data supporting the mantle derivation of these rocks, but indicated that both the low Ti and high Ti groups of each of the volcanic series, tholeiitic and komatiitic, result from mantle inhomogeneity. Robb and Anhaeusser suggest that the "granitic" terrain south of the Barberton Mountain Land is composed in part of a very old tonalite-trondhjemite (3430 to 2900 Ma) which represents variably reworked bodies that may in part be basement to the supracrustal sequence, and may in part also be related to the Komati Formation. Robb indicates that the rift related basement sequence may be intracratonic. Younger, K-rich anatectic intrusions re-intrude the old sodic intrusions and the dominantly mafic supracrustal sequence. The Sand River gneiss of the Limpopo belt is very old (pre 3790 Ma) and is intensely deformed and metamorphosed basement (Fripp).

The oldest Archaean rocks of virtually every Shield area are tonalitic gneiss. Practically all major volcanic sequences, including the oldest basaltic rocks, were formed from primitive, mantle-derived melts in intracratonic rifts. Compositional variations are related to mantle inhomogeneity and crystal separation history prior to magma extrusion. Most depositional settings were ensialic; although some areas may have zones of true oceanic crust. Little evidence was presented for true subduction-generated supracrustal sequences, although in a few areas compressional tectonics may have caused slabs of ocean floor to be obducted onto older sialic basement. Also, melting of sinking basaltic crust may have generated some of the andesitic and felsic magmas. Park suggests that Precambrian Shields were deformed by large-scale transform-type translational movement of large, essentially coherent, blocks. The latter were decoupled from the mantle and transported by mantle convective flow which produced subhorizontal strain and crustal thinning. Lambert suggests that in order to attain sufficiently high heat flow in the Late Precambrian to allow for production of vast amounts of crust, a double convection system, involving separate lower and upper mantle convection cells, is necessary.

The origin of the pre-3700 Ma tonalite remains obscure. The source of late-Archaean batholiths is a volumetric problem but Condie, using major and trace

element modelling, finds that a slightly garnetiferous tonalite-trondhjemite Parent is the most suitable source.

In general, no strong argument was presented for the applicability of the 'Wilson-cycle' type of plate tectonics. The primitive crust may have been sialic; thermal and crustal-thickness conditions allowed for intercratonic rift generation of mafic rocks but did not allow for major lithospheric slabs to descend in a true subduction manner.

The documentation of 3520 Ma stromatolites in the Warrawoona group of the Pilbara block in association with chert, carbonate, and evaporites (Dunlop and Buick) prompted evaluation of both the depositional environment and evidence of micro-fossils at this and other Archean "paleobiological" finds. The Pilbara chert-barite formed in less than 100 m of water, in a periodically restricted, warm, local evaporite basin; biological activity promoted sulphate-ion formation. Ericksson outlined a rift-controlled sedimentation environment, with a very narrow continent to marine transition zone, in the Pilbara. Although stromatolites are well documented in at least 14 pre-2700 Ma terrains, only the Onverwacht and Fig Tree Groups in South Africa have probable filamental forms. Walter and Schopf report bona fida filamentous microfossils from the Fortesque Group (2770 Ma), the oldest such forms yet reported.

In comparing the metallogeny of various Shield areas of Archaean age, important differences and similarities are evient. The Pilbara block (Marston and Groves) has few ore deposits; many small gold deposits occur in the oldest sequence of volcanic rocks, and a few massive sulphide deposits are present in both old (ca 3450 Ma) and young (ca. 2700 Ma) units. However, in contrast with the Yilgarn block and the Canadian Shield, the Pilbara has tin and niobium deposits in fractionated, late (ca. 2700 Ma) adamellite-granite intrusions, a potentially productive porphyry copper deposit, and a producing barite mine in Archaean rocks. The Yilgarn block, with its large komatiite-associated nickel deposits and large Kalgoorlie-area gold deposits, as well as newly discovered massive sulphide deposits, is more similar in age and metallogeny to the Canadian Archaean (Franklin). However, the predominance of nickel, relative to other deposit types, in the Yilgarn is in marked contrast to Canada. The Indian Shield (Nair) also has an ore-deposit spectrum similar to that of Canada, but gold and iron dominate over massive sulphide deposits. The Aldan Shield (Kazansky and Moralev) apparently contains only iron and skarn deposits.

A group of papers dealt primarily with massive sulphide deposits and ultramafic-associated nickel deposits. Alteration under volcanic-hosted massive sulphide deposits is petrologically variable; MacGeehan illustrated that at Mattagami Lake, Quebec significant spilitization in the recharge zone. and chlorite alteration in the discharge zone, apparently cause significant changes in volcanic rock compositions over large areas, leading to erroneous classification of many tholeiitic sequences as calcalkaline assemblages. Thurston noted that REE patterns in volcanic rocks associated with massive sulphide deposits at Timmins and Uchi, Ontario, are relatively unfractionated compared with patterns in unmineralized cycles.

Gresham and Loftus-Hills described the general setting of the Kambalda nickel deposits; the deposits formed by igneous segregation of a sulphide liquid from high magnesium flows; pervasive metamorphism has modified their texture and structure. Textural and chemical changes due to amphibolite grade of metamorphism of the nickel deposits of the Widgiemooltha dome area (McQueen) resulted in reversion of the sulphide assemblage to monosulphide solid solution (MSS) mineralogy, induced a preferred orientation of sulphide grains and redistributed some sulphides. Donaldson, in considering that metamorphic alteration of ultramafic rocks might release nickel to form a deposit, found that this mechanism produces only minor nickel sulphides, insufficient to form an ore body. In the case of komatiite associated nickel deposits near Timmins, Ontario, Green suggested that the assimilation of sulpide-facies iron formation into an ultramafic melt provided the sulphur for MSS formation. Campbell presented a method for prediction of the Ni content of MSS, if the Fe and Ni contents of the co-existing olivine are known.

Summary

This conference not only covered the broad range of topics endemic to the Archaean but illustrated that major advances have been made in understanding upper crustal and exogenic processes. The nature of the pre-3700 Ma crust remains obscure, as do Archaean tectonic processes. Evidence of biological activity in the earliest supracrustal sequences discovered thus far is exciting, and prompts the re-evaluation of the effects of such activity on the atmosphere and hydrosphere during the Archaean. Archaean metallogeny is uniquely constituted, possibly reflecting a relatively intense period of crustal development, dominated by tensional, rather than compressional, tectonic control on those exogenic processes which include mineral deposit formation.

The lack of papers on the Archaean rocks of the Superior and Churchill provinces, the largest Precambrian structural provinces in the world, and the lack of description of research on Archaean related problems in the United States created an unfortunate hiatus in the otherwise extensive coverage of the world's Archaean geology. Consideration of the differences between shield areas may be as important as consideration of the similarities in attempting to define a model for Archaean crustal evolution and in understanding the mantle-crust relations in the first half of the earth's history. Future meetings should attempt to have a balanced complement of papers from each shield area.

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