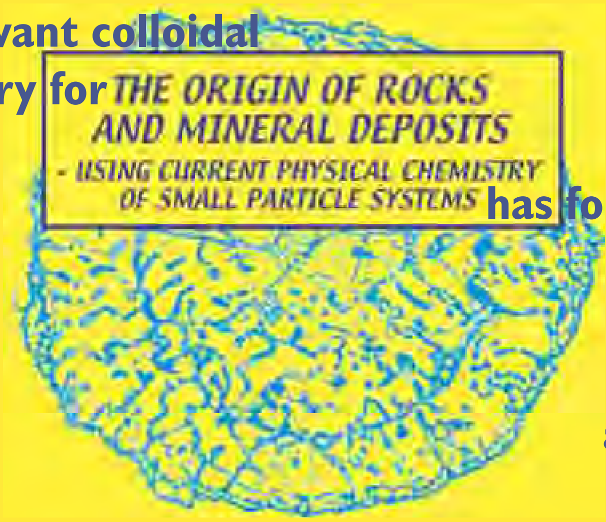
CODES
ARC Centre for Ore Deposits and Exploration Studies
University of Tasmania

PFPC
ARC Particulate Fluids Processing Centre
University of Melbourne

VERIFICATION REPORTS



Each scientist who has examined the examples illustrated and considered the relevant colloidal chemistry for *THE ORIGIN OF ROCKS AND MINERAL DEPOSITS - USING CURRENT PHYSICAL CHEMISTRY OF SMALL PARTICLE SYSTEMS* has found the new interpretations completely satisfactory and correct.

by

John Elliston

This project is proudly supported by

An Australian Government Initiative

AusIndustry

This pdf booklet lists scientists and organisations that support effective publication and promulgation of these significant research results as an Australian Preview Edition for prior use in Australian resource development.

Elliston Research Associates

Mineral Industries Consultants Association Founded 1980

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Verification Reports and Evaluation for: -

The Origin of Rocks and Mineral Deposits
- using current physical chemistry of small particle systems

by

John Elliston

Elliston Research Associates Pty Limited (ACN 000 547 900) has been an Approved Research Organisation and registered research agency (No. R2002937 for 2005-2006) since 1st July 1984. The company warrants that the images reproduced in this e-book and associated documents are true photographic records of the structures, textures and geological phenomena observed in the rocks, mineral deposits, drill cores and specimens at the locations recorded for each example. The company's image library has been assembled in the course of numerous field studies to test the central hypothesis and scales or objects that have been included in the photographs indicate sizes. The company further warrants that the scientific method applied at all times in this research is through a program of systematic, investigative and experimental activities based on principles of current physical chemistry and rheology from hypothesis to practical testing of the hypothesis by direct observation and evaluation of factual data to reach logical conclusions.

Supporting and contributing Scientists

A number of outstanding scientists have encouraged and supported the interpretation of porphyroidal rocks as lithified mudflows or intrusions in which accretionary ovoids have crystallised. In many cases they have undertaken the personal studies and field work necessary to confirm it. Leading scientists who have acknowledged the importance and recognised the far-reaching consequences of the initial discoveries at Tennant Creek in central Australia include: -

Professor A.E. Alexander
Professor S.W. Carey
Professor T.F.W. Barth
Sir John Proud
Professor Beryl Nashar
Professor R.L. Stanton
Sir Rutherford Robertson
Professor John Bradley
Professor S.S. Augustithis
Assoc. Professor K.L. Williams
Mr. John Collier
Mr. K. Wright
Dr. G.H. Sherrington
Mr. John Love
Mr. R.D. McNeil
Mr. Paul LeMessurier
Mr. Jacob Rebek
Mr. Phil Rosengren
Dr. Neil Herriman
Mr. Dermot Ryan
Dr. Joe Ostwald
Dr. K.H. Wolf
Professor Barry Ninham
The Industrial Research and Development Board of AusIndustry
Professor T.W. Healy
Assoc. Professor R.J. Hunter
Professor J.C. Jaeger
Professor David Williams
Dr. H.W. Fander
Professor Anton L. Hales
Dr. Ralph K. Iler
Dr. S.J. van Biljon
Professor Z. Pouba
Mr. Dominic O'Sullivan
Dr. Haddon F. King
Mr. G.R. Ryan
Mr. R.L. Richardson
Dr. E.E. Swarbrick
Mrs. Wendy L. Corbett
Dr. Phil McSharry
Dr. Ian Gould
Dr. Timothy McConachy
Dr. Marjorie Muir
Mr. Ray Twist
Dr. Mike Doyle
Dr. Don Findlay
Dr. Nevil Byrne
Dr. Tom Honeyman
Mr. Brian Williams

Over the years many more colleagues, friends, and staff have made significant contributions to various aspects of the work. These include furnishing photographs, specimens, literature references, technical books, maps and diagrams. The writer has been assisted with travel arrangements, visits to mines, prospects, and with access to drill core, and field locations. Visits to some extremely remote locations and otherwise inaccessible mine workings and field outcrops have been achieved. The courtesy, encouragement, and material contributions of all these supporters are gratefully acknowledged.

A letter from the Department of Industry Tourism and Resources (AusIndustry) to Elliston Research Associates Pty Limited on 28th November 2005 contained the following: -

Australian Government
Department of Industry
Tourism and Resources
AusIndustry

"It is recognised that Mr. Elliston has made seminal contributions to the mineral exploration industry in his investigations into, and development of hypotheses for, the role of colloidal, rheological, chemical and physical processes by which rocks and mineral deposits are formed. The list of publications by Mr. Elliston in prestigious scientific journals of his work, and the successful confirmation of his theoretical findings by mineral exploration companies is proof of his outstanding achievements in this field of science."

Karen Kuschert
Manager
Research, Development & Commercialisation Branch

However, AusIndustry also required current research work of the company to continue systematic testing of its hypothesis by proper scientific method and experimentation. The central hypothesis being tested is that the features and structures observed in all rocks and mineral deposits formed from ancient sediments (including porphyroids, metamorphics, and granites) must reflect and be consistent with the principles of physical chemistry now established for small particle systems. This hypothesis is fundamental in nature and global in its application. Rigorous testing must therefore be done by applying the scientific method in a systematic progression of work based on principles of physical chemistry for small particle systems from hypothesis to valid and repeatable experimentation, observation and evaluation, followed by logical conclusions.

Further information sent to AusIndustry pointed out that the accompanying e-book presents a selection of primary data that are records of factual observations showing evidence of former plasticity, diffusion, mobilisation, rheopexy, rimming structures, aggregation, syneresis, concretion, Liesegang banding, brecciation, ptygmatic vein intrusion, colloform textures, etc. A sufficient number of examples are used to test and establish the central hypothesis as correct and to show the principles apply universally. This experimentation is repeatable. Other geologists can also see and record this or similar evidence preserved in rocks and mineral deposits.

A certificate stating that recording of experimental results in the project entitled "Application of Surface Chemistry to the Release of Ore Minerals in Various Geological Environments" does satisfy these requirements was issued by the same officer on behalf of AusIndustry on 8th September 2006.

The significant outcome of this rigorous evaluation by AusIndustry is that the IR&D Board have recognised the use of factual observational data to substantiate an innovative hypothesis. There is no clearer evidence of origin than the actual textures and structures preserved in the rocks and this will be recognised by progressive and competent geologists everywhere.

Better Understanding of Ore Forming Processes - the Key to Improving Success Rates in Mineral Exploration

(in the context of John Elliston's Book on Ore Formation)

John Elliston has worked in mineral exploration and geological research for over 45 years. His book presents geological concepts related to ore forming processes that have been developed over this period. They remained proprietary until John's retirement from a very successful career in practical exploration. For a majority of geologists they are therefore still new. They are highly relevant to current mineral exploration, especially for improving area and target selection and the search for new types of deposits with better combinations of tonnage and grade.

Over recent years mineral exploration has been through major changes with adverse consequences. Initially, external factors of cyclical nature were blamed for budget cuts. However, the price of gold has now returned to previous levels and industry has adjusted to current economic conditions. This has revealed a fundamental reason for what is turning out to be a long-term decline of investment in mineral exploration.

Geologists can no longer blame external factors for the decline of interest in exploration investment. The time has come to honestly look at the reasons for the decline in discovery rates and to re-examine the internal factors that geologists are able to fully control. The main factors for improved exploration are: -

- selection of area and targets
- assessing the likelihood of economic mineralisation and the type of deposit that may occur in the exploration area
- selection of commodity (considering existing ore reserves)
- selection of methods for identifying and testing targets.

The measure of performance is the return achieved by funds invested in exploration. The value of new ore reserves discovered must justify the total cost of exploration programs. Since 1990 an increasing proportion of exploration programs have concluded with drill holes that have tested targets thought to be the best without intersecting mineralisation, or mineralisation that was so weak that it is obviously of no further interest. This has occurred in spite of improved technology for collecting geophysical, geochemical and remote sensing data. Improved drilling technology and improved management of data base systems has not resulted in improved exploration success rates.

Area and target selections made in the last twelve years are clearly the reason for the lack of new discoveries. Area and targets are selected on basis of understanding the ore forming processes. Most of the ore deposit models used in exploration are based on so-called 'genetic classification' of ore deposits where the genesis of the deposit is implied in the name for the type of deposit.

Due to the lack of credibility of genetic models, exploration has become increasingly empirical. It tends to be focused on areas with known deposits and by testing targets that are similar to known deposits in their geophysical, geochemical and remote sensing response. But success rates have continued to decline.

There is no substitute for understanding the geological processes that have led to the creation and subsequent modifications of ore deposits. John Elliston's book provides that understanding. Government funded geological research needs to be complemented by privately funded work. The most significant advances in understanding the formation of ore deposits in Australia have been achieved by exploration teams of (privately owned) mining companies and the active participation in research and development of company management and senior geological staff.

No industry can make progress without innovation. In mineral exploration the focus has been on the use of computers and significant advances in the testing of targets have been achieved. However, area and target selection have not benefited from computer technology.

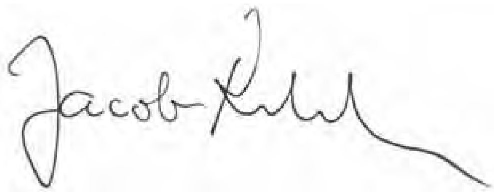
John Elliston is one of the few researchers who have maintained a balance between the various aspects of practical and fundamental geology, geophysics, geochemistry and computing technology. For 45 years he has coordinated academic and practical research to develop an effective understanding of ore forming processes in order to provide an adequate basis for area and target selection.

The results of this life-time work are now presented in his book which is based on his wide range of experience as a chemist, and then as a geologist and exploration manager. He led a team that made a series of discoveries in a number of different geological settings, he then became an executive director of a major company responsible for a number of its technical subsidiaries. He was then able to further develop the successful research for another major company.

The publication of a book resolving fundamental problems of how ore deposits are formed is timely. The geological fraternity is beginning to realise that area and target selection must be improved. A better understanding of ore forming processes is the key to better area and target selection and to accurate appraisal of the potential for any significant discovery.

The book is of interest to every mineral exploration geologist because it addresses the basic chemistry and properties of the natural sedimentary particle systems from which the rocks and orebodies are formed. It will also be of interest to petroleum exploration geologists because it examines sedimentary materials in detail through all stages of diagenesis to mature and metamorphosed rock. Consolidated rocks with intrusive bodies and ore deposits that are re-exposed by erosion start a new cycle of weathering, erosion and sedimentation

I commend this book to every exploration geologist. Geologists working in academic or other fields of geoscience will find that the new principles provide a simple and logical basis for mineralisation and for geological interpretations generally.



Jacob Rebek
Group Chief Geologist (now retired),
Rio Tinto Exploration Limited.)
Sydney.   August 2003

Thomas W. Healy, AO,
FRACI, FAA, FTSE, FJSPS,
Emeritus Professor of Physical Chemistry,
University of Melbourne.

THE UNIVERSITY OF MELBOURNE

Professor Thomas W. Healy is a graduate of the University of Melbourne, Australia and Columbia University, New York, USA. He has held academic posts at the University of California, Berkeley and at the University of Melbourne. Over a career of some 40 years he has published more than 200 papers in many areas of colloid and surface science .

During the period from 1991 to 1999 he was Director of the Advanced Mineral Products Special Research Centre of the Australian Research Council (ARC), and in 2000 was appointed Deputy Director of the Particulate Fluids Processing Centre, also a Special Research Centre of the ARC.

He has served on Advisory Boards of all the major international journals in the field of colloid and surface chemistry and was the Founding Regional Editor of the journal “Colloids and Surfaces”. He has held visiting positions at the University of California, Berkeley, USA, Clarkson University, USA, the University of Bristol, UK, and at the ICI(UK) Corporate Colloid Science Group. He has received many honours and awards including membership as a Fellow of the Australian Academy of Science, the Australian Academy of Technological Science and Engineering, the Royal Australian Chemical Institute, and the Japan Society for the Promotion of Science. In 1999 he was awarded the Ian Wark Medal of the Australian Academy of Science for his contributions to basic and applied colloid and surface science. The University of Melbourne awarded him an Honorary Doctor of Science Degree for his contributions to science and science education.

He has been recognised as a world leader in colloid science and was awarded the distinction of Officer of the Order of Australia in June 2005.

After detailed examination of the current manuscript and the diagrams, definitions and formulae it contains, Professor Healy prepared a formal report on his findings dated 1st May 2004. The following extracts are from this report: -

I spent a large part of last weekend re-reading John Elliston's manuscript. As best I could, I challenged each and every statement of fine particle science on which he bases his work and did not find it wanting in any way.

The colloid and surface science–nanoscience and technology in the book is impeccably correct. I am impressed with the breadth and depth of understanding he shows. The application of colloid science has now with this book embraced the geological sciences in a coherent and fascination way.

THE CENTRAL HYPOTHESIS

Elliston proposes that geological theory needs to consider that during the process of lithification, sedimentary masses will endure a much wider range of chemical and physical processes than normally presented in textbooks. Standard texts consider such topics as sedimentation leading to alluvial, detrital or placer deposits, weathering of mineral masses to produce sedimentary stratified layers, isomorphous substitution in clay synthesis, synthesis of chain, sheet and 3D mineral structures, synthesis of carbonates, phosphates and so on.

The detailed mapping of the turbidite sequences around Tennant Creek convinced Elliston that they had an association with the Tennant Creek porphyroids, and that the changes during diagenesis of these formations were linked to the origin of the several significant orebodies around the region.

MY RECENT EVALUATION WORK

When John Elliston sent me an early draft of his book, I believed I owed to him and to our science to review in detail the exposition he was giving in the text of various colloidal processes. I concluded that he had demonstrated a deep and clear understanding of what are standard topics in colloid science. He has reproduced standard theory and experiment. The illustrations that he has included are first class. If I were still teaching I would use them in lectures to classes in colloid and surface science.

The University of Melbourne,
Parkville. 3052 Victoria
AUSTRALIA
May 1st, 2004.

Thomas W. Healy, AO, FRACI, FAA, FTSE,
Emeritus Professor of Physical Chemistry.

David V. Boger, Laureate Professor of Chemical Engineering, Director, Particulate Fluids Processing Centre, Department of Chemical and Biomolecular Engineering, The University of Melbourne (15 December 2003) wrote: -

"Tom Healy has passed on a copy of the manuscript of your book. … I have now had a chance to work through the sections that fall more into my own area of science, viz, non-Newtonian fluid mechanics and rheology of particulate fluids. Again, I am most impressed with the understanding you display in these sections. It is refreshing to see interest by geoscientists in processes well known to rheologists."

The Origin of Rocks and Mineral Deposits

by

John Elliston

I first encountered Mr Elliston and his theoretical notions of the origin of certain rock formations in the Australian interior, in the 1963 at a conference on "Syntaphral Tectonics" organised by the late Professor S. Warren Carey in Hobart, Tasmania. My knowledge of geology was, and remains, rudimentary but I had studied colloid and surface chemistry with the late Professor A.E. Alexander and it was at his suggestion that I attended the conference.

I was struck by the very large body of material that John Elliston had already accumulated even then, and the striking similarity between the texture and structure of the rock formations and the colloidal material with which I was more familiar. Many of the structures he exhibited seemed to be almost certainly the result of the flow of particulate suspensions.

Since that time he has accumulated an enormous body of material not only from Australia but also from sources around the world, to illustrate the reasonableness, indeed the - necessity, of his model of the way these structures are formed. Many of them were previously thought to be the result of the direct crystallisation of mineral particles from high temperature solutions under pressure whereas Elliston was arguing that they formed by colloid chemical processes including flocculation or coagulation, syneresis (the gradual expulsion of water from the floc) and the flow of sediments in response to gravitational forces in sedimentary beds at quite modest temperatures and pressures. Even rocks which were earlier assumed to be of purely volcanic origin (like the granites) have now been shown by Elliston to contain tell-tale structures and inclusions which could not be present in a material of volcanic origin. The 'anomalies' are, on the other hand, quite explicable when it is understood that the granites can also be generated from low temperature sedimentary deposits by the operation of characteristically colloidal (i.e. small particle) processes.

In this book he brings together the enormous body of material that he has collected and binds it with a detailed description of the many processes by which ore bodies and their associated rock formations are generated. He has elaborated over the years on the many aspects of colloid and surface chemistry, which are involved in this genesis and here it is all collected together in a format that is not merely plausible but compelling. The early chapters introduce the necessary solution chemistry and the colloid and surface chemistry and rheology (flow behaviour) with some excellent 'cartoons' and some quite beautiful illustrative photographs of geological structures. Emphasis is placed on those processes that can explain how these low temperature processes can lead to the observed rock formations. A key feature of many of these systems is that, in the final stages of the particle rearrangement processes, adsorbed mineral species are released from the particle surfaces and concentrated in crystalline form as ore bodies. The important economic point of the exercise is that a proper understanding of the origins of the rock formations enables estimates to be made of the likely position, and even the possible size, of the associated commercial ore bodies.

Although many senior people in the field have accepted Elliston's main tenets (and some had made similar suggestions earlier), there are evidently some in the geological community who remain unconvinced of the validity of these new ideas and still believe in the earlier (high temperature) descriptions of this process. They may remain so convinced for the remainder of their careers. That is often the way when anew paradigm is put forward. Only a few of the older members of the profession are open to the new ideas and they begin the process of passing them on to the next generation. That has already begun as is clear from Elliston' s references. It is only when the younger members, who have grown up with the new ideas, become the leaders in the field that the new paradigm becomes fully accepted and then it seems difficult to understand why it took so long for that acceptance to occur. It is a hard row for the paradigm shifter to hoe but it was ever thus.

The only criticisms I have of the book are (i) I think it could still do with some rigorous editing and (ii) some of the history of colloid science is rather scantily treated. Elliston no doubt believes strongly that he can win the argument by piling example on example and to some extent this may be true but I think there is still some unnecessary repetition. On the second point, the author doesn't claim to be a colloid scientist so some of that is understandable. I would date the beginning of the scientific study of colloids from the early 19th century rather than midway through the 20th. Einstein's famous paper on the Brownian motion of colloidal particles in 1905 provided the basis for Perrin to establish the first real evidence for the kinetic-molecular theory of matter (and hence the real existence of atoms) so one would have to go back at least that far. But the first demonstration of the electric charges on particle surfaces was provided by the demonstration of electro-osmosis in the early 1800s. But this is a minor quibble.

The book has a plethora of magnificent illustrations and the text is much more accessible than I have found in my earlier attempts to tackle geological treatises. Much of geology remains a foreign language to me but that is always a difficulty with our profession. It is a tribute to John Elliston that he has the tenacity to have absorbed such a large slice of the theory and observations of colloid and surface chemistry and has been able to use it so effectively in his own field. I should also remark on the extraordinary effort he has made to make this electronic version of the book so easy to read, to consult and to get around in. The illustrations, including photographs of cores and polished sections of ore samples are clear enough to allow considerable zooming to reveal small-scale features. Technical terms are highlighted and clicking on them sends one immediately to an explanatory glossary. Figure numbers also provide direct links to the figure by a mouse click and the references can also be consulted in the same way.

This book is an impressive achievement and the author is to be heartily congratulated on his tenacity, his diligence and his rigorous application of investigative technique in the development of an understanding of this important field.

Robert J. Hunter

Dr Robert J. Hunter FAA. FRACI,
Honorary Associate Professor

9th December 2005

ENDORSEMENT

The advancement of science can be gradual and with easy acceptance. Sometimes, it is abrupt and then it is usually resisted. Papal declarations such as that the earth is the centre of the Universe come to mind. The more important advancements have tended to be both abrupt and resisted.

This book by John Elliston AM is causing resistance in the community of Earth Scientists because it requires honest scientists to put aside long-held personal views and to read with an open mind, an abrupt revision of geological knowledge.

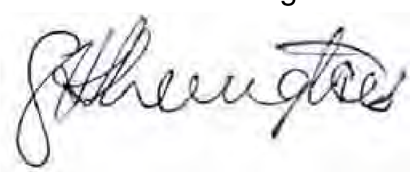
I was privileged to be part of the exploration team that worked under John Elliston and I can attest to the success that his theories contributed to making Geopeko one of the world leaders in exploration. As Chief Geochemist I was expected to engage in discourse about colloid chemistry, which had formed but a small part of my undergraduate courses. Much of what I know today was learned from John and his associates whose skills far exceeded mine.

There is no mental discomfort involved in the adoption of the Elliston postulates. They are relatively simple chemistry and physics, but they have been set into an unfamiliar field, namely geology, which has had a long period of comparative mental inertia. Without detriment to the geological researchers of the past several decades, the trend has been to study more about less, while disregarding the fundamental overview. This is strange, because the older conventional wisdom is so riddled with observations that cannot be explained with rigour.

It is asking too much of an individual like John Elliston to provide an improved geological model that answers all of the questions that thinking people can put. It is rather like asking a single scientist to decode the human genome sequence. So, there are unanswered aspects of the Elliston postulates, but they are there to excite the curiosity and research of future scientists. The groundwork has been done, the infilling is proceeding.

The infilling should have the scientific veracity that John Elliston displays in his book. If an explanation is given for a process or observation, then plausible alternatives should be discussed, discounted or adopted, with supporting evidence. It is no longer acceptable to shrug off an observation that does not fit the theory. As in the world of medical research, there are true and false positives and their opposites and each piece of evidence requires classification into the correct compartment.

For those with a genuine desire to learn, I fully endorse this book as an exciting challenge. Its study is much more rewarding than the current darling named “Intelligent Design”. This is Actual Design!



Geoffrey H Sherrington.
Scientist.
Melbourne, December 2005.

Keeping the good times rolling – finding the next generation ore deposits

(from the AusIMM Bulletin, No. 6, Nov/Dec, 2005)

COMMENTARY BY: -

Ian G. Gould BSc (Hons), PhD, FAusIMM
President, The AusIMM, 2004, 05
Chairman, The Parker Centre
for Integrated Hydrometallurgical Solutions
Chair, Australian Institute of Marine Science.

ON: - THE ORIGIN OF ROCKS AND MINERAL DEPOSITS by John Elliston

I first became aware of John Elliston's work in 1970, just as inconsistencies between some accepted petrological theories with observed textural features in rocks associated with ore formation in the Lachlan Fold Belt, were beginning to puzzle me. At that time, a volcanogenic origin for these deposits of the Captain's Flat (and then Woodlawn) type was beginning to "conventionalise" in academic thinking, but within this content there were features that required explanations beyond the primary volcanogenic environment.

These included the concentration and migration of heavy metal compounds and the origin of the "cold granites" in this suite of Palaeozoic rocks and the presence of colloform and accretionary textures and lack of high temperature melt effects. The existence of pipe-like bodies of magnetite and chlorite associated with copper mineralization similar to those of Tennant Creek made the connection to John Elliston's unconventional theories on the important role of colloids and thixotropic reliquefaction within dewatering sediment piles, leading to the formation of ore deposits and "igneous looking" rock types.

Almost twenty years later, then as the Group Executive for Exploration with CRA Limited, I met up with John Elliston, who was consulting with this well resourced and innovative group. John's role was not just to assist the search for ore deposits by identifying geological settings, which were favourable for the operation of ore-forming systems, but to mentor and stimulate the team to observe carefully and critically in the field and to follow those messages, rather than pre-determined theories. He is, himself an outstanding and insightful observer.

Throughout this period, John Elliston has not been able to engender widespread mainstream geological support for his theories, particularly in their application to granitic and porphyroidal rock formation. Much of the resistance has lacked specificity or open debate.

John's response has been to redouble his efforts and to match his textural observations with the known physical chemistry of very fine particles and colloids, an area of science that is attracting increasing attention, as the importance of surface reactions, is being recognised in many processes. His explanations have become very convincing through this interdisciplinary research. His theories deserve a prominent place in explaining many features relating to the formation of rocks and orebodies.

His persistence and the linkage of geology with the enabling science of fine particle and colloid chemistry are particularly worthy of praise. Australia needs innovative thinking like this to find the next and more elusive generation of orebodies and thereby sustain the minerals industry that is both the foundation and the future of our national prosperity.

Ian Gould 24th November, 2005

CONTRIBUTIONS FROM OTHER SCIENTISTS AND ACADEMICS

to Peko-Wallsend and CRA-RTZ research projects co-ordinated by John Elliston

Many outstanding senior academics have recognised the scientific validity of the new approach to ore genesis and the origin of crystalline rocks. Their guidance and support at each stage has been essential to the initiation and continuance of research programs.

Forty four of these senior scientists, including fourteen university professors, a further sixteen PhD's, three members of the Australian Academy of Science, and nine senior company executives have been listed for specific acknowledgment. Over the years many more scientists in other countries, colleagues, friends, and staff have made significant contributions to various aspects of the work. The meticulous and systematic work of Professor R.L. Stanton has independently confirmed the new approach to the genesis of metamorphic and crystalline rocks by direct observation of the ordered hydrous precursor minerals from which they crystallised. He established the composition of these precursors by microprobe analysis.

John Elliston initially, and Mr. Dominic O'Sullivan in fulfilment of an independent research contract initiated by Dr. Neil Herriman, Chief Geologist CRA Research Group, have confirmed the formation of accretions in natural sediments experimentally. However, Professor T.W. Healy conducted a more extensive experimental program to demonstrate the formation of accretions in sediment components and associated colloidal materials in his laboratories at Melbourne University.

Laboratory experiments to demonstrate the behaviour of trace metal species adsorbed on sediment particle surfaces were initiated by Associate Professor K.L. Williams. Assisted by Associate Professor R.J. Hunter, Mr. Peter Savio was able to show that sulphidised zinc ions (hydroxy-sulphide particles) adsorbed on the surfaces of clay platelets were released into the fluid phase by ion/charged particle exchange at increased salinities.

The research is interdisciplinary. Its outstanding success is not only due to the original guidance in chemistry by Professor A.E. Alexander and endorsement by Associate Professor R.J. Hunter, it is particularly attributable to Professor T.W. Healy. His laboratory work and his detailed examination of field evidence ensured that interpretations were properly made in accord with the principles of colloid and surface chemistry. On one occasion he climbed Mt. Vesuvius unaccompanied by any geologist to make sure that volcanic ejecta do not include large round single crystals of either quartz or feldspar!

Geologists generally may now like to consider the concept that current principles of colloid and surface chemistry must be relevant to the formation of crystalline rocks and orebodies derived from high-energy sedimentary particle systems. The concept of preconsolidation structures and textures is a radical departure from the long-held conventional view that refractory rocks and rock minerals must have been liquefied, deformed and changed to the actual minerals, structures and textures preserved in the rocks.

All scientists immediately recognise that any major advance in our understanding must represent a material departure from the presently held consensus view. Our work has been criticised on the basis of its departure from conventional views but significantly, all those who have attempted to test the relevant chemical principles, have found that they do apply. The processes suggested can produce the observed textures and structures. The principles apply to all rocks and ores that have been derived from sedimentary materials.

Research began with the first important observation by a colloid chemist in 1959: -

Professor A.E. Alexander, Professor of Physical Chemistry, Oxford University and University of Sydney. Co-author of "ALEXANDER, A.E., and JOHNSON, P., 1950. *Colloid Science.* Oxford University Press, London. 852 pp."

Verbal communication 1959 (referring to the specimen of a Tennant Creek porphyroid illustrated on the left): -

"Mr. Elliston, those are not concretions. They are accretions!"

Professor Beryl Nashar, Professor of Geology, University of Newcastle. (From her report on the petrology of the Tennant Creek porphyroids, "The Origin of the Megacrysts in Some Low Grade Schists from Tennant Creek, Northern Territory", 1963, p. O1): -

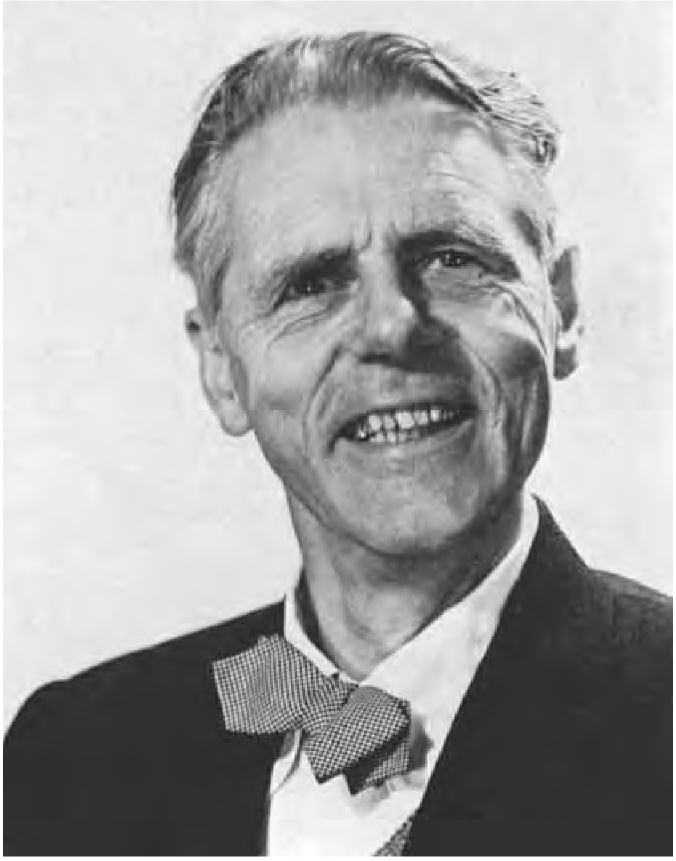
"Although the end product of metamorphism appears to be a quartz felspar porphyry, careful examination of this product and intermediate stages reveals evidence of a sedimentary origin."

Dr. W.H. Fander, Petrologist, Australian Mineral Development Laboratories, Adelaide (From his report on the petrology of the Tennant Creek porphyroids, "Tennant Creek Pseudo-porphyries", 1963, p. P4): -

"The ovoid bodies which constitute such a prominent feature of these rocks are believed to have formed authigenically, probably before the consolidation of the host rock."

Associate Professor R.J. Hunter, Professor of Physical Chemistry, University of Sydney. (From his report on the papers presented to the symposiumon "Syntaphral Tectonics and Diagenesis", University of Tasmania, 1963, p. R4):-

"The theory presented to account for the genesis of orebodies in association with sedimentary beds is, if valid, of very great importance. ... Most of the colloidal processes referred to are well documented and could be expected to occur in a material with the supposed composition of the sediment."



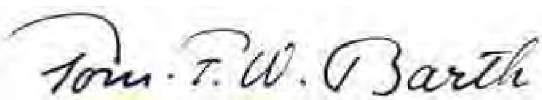
BARTH, T.F.W., 1924 - 1971.
Professor of Geology
University of Oslo,
University of Chicago

D.Sc., Research Associate Goldschmidt's Laboratories, University of Berlin, University of Liepzig, International Rockefeller Fellow at Harvard, Carnegie Institution of Washington, Professor and Director Mineralogisk-Geologisk Museum Oslo, President 23rd International Geological Congress.

Author of: - BARTH, T.F.W., 1969. *Feldspars.* Wiley, New York, N.Y., 261pp.

BARTH, T.F.W., 1962. *Theoretical petrology.* Wiley, New York, N.Y., 416pp.

(p. 51): - "But the century-old idea that all so-called igneous rocks had congealed from a molten magma has, in the light of modern knowledge, met with severe criticism. The composition of many "igneous" rocks is such that a corresponding magma becomes a physico-chemical impossibility."


August 1965

Professor T.F.W. Barth from Oslo was a Visiting Fellow to the Australian Academy of Science in 1965. He was a world leader in feldspar petrology at that time and he had been elected as President for the 23rd International Geological Congress scheduled to be held in Prague in 1968. During his visit to Canberra he was persuaded by Professor J.C. Jaeger, Head of the Research School of Earth Sciences at ANU to accept an invitation from Sir John Proud, Chairman of Peko-Wallsend Ltd., to make a visit to the company's operations at Tennant Creek in the Northern Territory. Important new principles of ore genesis and the origin of feldspars in the Tennant Creek porphyroids had been questioned by some petrologists unfamiliar with diagenetic processes and the properties of sedimentary particle systems. It was hoped that Professor Barth would advise on the suggested origin of the porphyroid feldspars.

Professor S.W. Carey joined a group of company geologists and other scientists assembled at Tennant Creek to welcome Professor T.F.W. Barth for his visit. Professor Barth was at first rather reserved but after a week inspecting mines, drill cores, outcrops, and in-depth discussions and technical presentations each evening, he became keenly interested and enthusiastic. On the evening prior to his departure, his remark became a legend in company history and a turning point in Peko-Wallsend's exploration and research. He said: -

"They told me in Canberra I was coming on a wild goose chase, but now I know where the gooses are!"

Barth’s endorsement of the new technical work supported the earlier advice of Professors A.E. Alexander (University of Sydney), S.W. Carey (University of Tasmania), David Williams (Imperial College of Science and Technology, London), and R.J. Hunter (University of Sydney). Confirmation of the importance of the new research findings provided the basis for additional expenditure on further research programs totalling some A$23 million.

As President elect for the 23rd International Geological Congress in 1968, Professor Barth invited presentation of the following meaningful basic papers to introduce the new technology: -

ELLISTON, J.N., 1968. *Re-textured sediments,* Proceedings 23rd Int. Geol. Congress, 8: 85–104.

ELLISTON, J.N., 1969. *The genesis of some epigenetic type ore deposits*, 23rd Session of Int. Geol. Congress, Prague, August 1968. Published in Organ. Czech. Soc. of Min. and Geol., 14(2): 129–139.

The Russian invasion of Czechoslovakia in August 1968 interrupted Congress and diverted attention from all scientific matters including presentation of these significant new discoveries.

Extract from Professor Barth’s book

(Barth, T.F.W., 1969. *Feldspars,* Wiley & Sons, New York, page 5):-

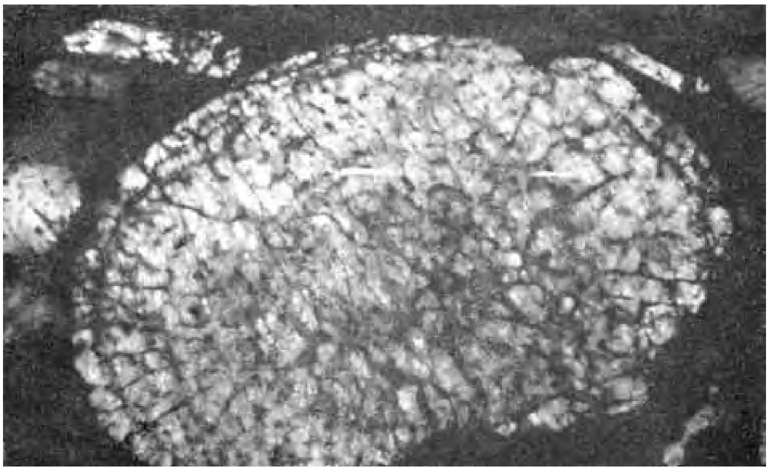


FIGURE 1.7 Authigenic orthoclase, Peko Mine, Northern Territory, Australia. A large ovoid-shaped colloidal accretion which has now crystallized with optical continuity to feldspar. A radial and concentric shrinkage crack pattern is well developed. Largest dimension = 2·5 cm. (From Elliston, 1966)

The significance of this reference from Professor Barth’s 1969 book is that it recognises that six examples of large ovoidal feldspars from the Tennant Creek porphyroids published in “ELLISTON, J.N., 1966. The genesis of the Peko orebody, Proc.Aust.Inst. Min.Met., 218: 9–17.” were correctly interpreted as authigenic.

A PhD candidate in his detailed review of the Tennant Creek porphyroid feldspars also confirmed their non-igneous origin: -

DUNCAN, D. McP., 1970. *Selected porphyroidal and granitic rocks at Tennant Creek, Northern Territory*. Ph.D. Thesis, University of Tasmania. (Unpub.)

From his study of the relevant silicate melt experiments and petrological literature Duncan wrote (p. 159) “experimental results suggest that it is unlikely that feldspars having compositions similar to the K-feldspars and albite in the porphyroids could have crystallised from a silicate melt”. Further down this page he writes: - “experimental information indicates that the plagioclase megacrysts in the porphyroids are unlikely to have formed with their present composition as a result of magmatic processes”.

CAREY, S.W., 1946 to 2002.

Professor and Emeritus Professor of Geology,

University of Tasmania.

Appears to have been the most highly qualified Australian geologist of recent times: –

AO., DSc (Syd)., Honorary Doctorates Universities Papua-New Guinea and Urbino (Italy), Fellow Australian Academy of Science, Honorary Life Fellow of Geological Society of Australia, Geological Society of London, Geological Society of America, Australian and New Zealand Association for the Advancement of Science, Indian National Science Academy, Royal Society of New South Wales, and Royal Society of Tasmania. Professor Carey served as President Geological Society of Australia, Australian and New Zealand Association for the Advancement of Science, and Chairman of the School Board of Tasmania, Trustees of the Tasmanian Museum and Art Gallery, and Professorial Board of the University of Tasmania. He was awarded Clarke Medal of the Royal Society of New South Wales, Johnston Medal of the Royal Society of Tasmania, Browne Medal of the Geological Society of Australia, Gondwanaland Gold Medal of the Mining, Metallurgical and Geological Society of India, and Weeks Gold Medal of the Australian Petroleum Products and Exploration Association.

Professor Carey achieved an extraordinary distinction in his relation with the Australian Academy of Science. As a Fellow of the Australian National Research Council he was excluded when this Council was disbanded and other members were transferred to the reconstituted Australian Academy of Science in February 1954. His advanced work in geotectonics was not acceptable at that time. Subsequently in 1958 and again in 1969, Carey pointedly refused to accept nomination for election to the Academy. He is likely to be the only man in Australian history to have been excluded, twice refused nomination, and after pointing out that the Academy falls far short of the goals of its charter and calling it a "moribund mutual admiration society", to be admitted to Fellowship in 1989 by special resolution of the Academy itself!

(Point 1 in the Academy charter is 'To promote, declare and disseminate scientific knowledge, to establish and maintain standards of scientific endeavour and achievement in the natural sciences in Australia; and to recognise outstanding contributions to the advancement of science.' Carey's later work sets new standards that the Academy has been unable to confirm or deny.)

Carey's edict to his colleagues and students: -

"We are blinded by what we think we know;
disbelieve (your present convictions) ***if you can."***

In 1962 when **Professor S. WARREN CAREY** first encountered the new interdisciplinary work now described in this book, he recognised it's potential importance. He immediately proposed convening an international symposium at which he predicted: - *"Once these premises and processes are granted, I cannot see any discontinuity short of profound revision of many of our cherished concepts on ores and a wide group of 'igneous' rocks."*

He then monitored and assisted company research for many years during investigations into the origin of orebodies and their derivation from pre-crystalline igneous-looking rocks in accord with current principles of surface chemistry. He has recorded the following remarks in his published work.

Extracts from the published work of Professor S.W Carey

Extract from Carey's book: -

CAREY, S.W., 1976. *The expanding earth.* Developments in Geotectonics, 10. Elsevier, Amsterdam, 488pp. (p. 148).

"Here again granite of sedimentary origin is logically an ultimate product. Initial recognition and intensive investigation of this problem is due to brilliant work by J.N. Elliston, who encountered such rocks in the Warramunga geosyncline in the Tennant Creek region of the Australian Northern Territory (Elliston, 1963, 1968). His study involved three separate problems. First, the field problem of structural and tectonic mass movement in a geosyncline, on all scales from normal bottom traction, turbidity currents, surface slumps and slides, closed-cast quickstone transport and injection, to regional nappes of Alpine dimensions in non-orogenic environment (e.g. Heezen and Drake, 1963 & Korn and Martin, 1959). Second, the automatic recrystallisation of the quick sediments to quasi-igneous porphyroids with megacrysts of quartz and feldspars. This involved the full range of silica hydration, and the gel-sol inversion, and crystallisation with energy release. Third, the desorption from the phyllosilicates and other colloid-size minerals of heavy metal ions, which are then transported by the dewatering process to form ore bodies in adjacent structural or chemical traps."

Extract from Carey's book: -

CAREY, S.W., 1988. *Theories of the Earth and Universe: A History of Dogma in the Earth Sciences.* Stanford University Press, Stanford, California. 413pp. (p. 55)

"Sir Archibald Geikie (1834-1924), observed that the question of the transformation of country rocks into granite had again come up for debate. Early in this century only the magmatic version was seriously taught, but during the 1930's and 1940's granitization of sediments was again strongly supported and widely debated.

Only in this decade have these questions been finally answered. John Elliston has for many years pointed to the uncertainty of the common assumption that intrusive rock is necessarily "igneous". In a brilliant series of benchmark papers in *Earth Science Reviews* beginning in 1984 he first discussed exhaustively orbicular granites, crystalline rocks with the same minerals as granite (and some other combinations) arranged concentrically, onionlike, to form a coherent mass of orbicules. Using advanced knowledge of the surface chemistry of siliceous sols and gels, Elliston demonstrated that the orbicules were formed from mobilised sediments, that the fluid mass was intruded in the precrystalline state, and that the higher temperatures were attained during crystallisation after intrusion. In his second paper, he examined with similar thoroughness a specific category of granites, the rapakivi granites, and demonstrated that they too had a similar genesis and history. Thus the rapakivi granites are both intrusive *and* derived from sediments, but were never molten. Finally Elliston applied this new knowledge to granites generally."

Extract from Carey's book: -

CAREY, S.W., 1996. *Earth, Universe, Cosmos.* Geology Department, University of Tasmania, Hobart. 231pp. (p. 26).

"Petrologists think of magma entirely as complex melts or solutions, ignoring the role of colloids. But John Elliston has emphasised that a one-meter cube of rock has a surface area of 6 m^2, but that the similar block of wet clayey sediment has a surface area of 60 million square meters, and that the several phenomena of surface chemistry wholly dominate.

If such sediment is made into a stiff cream consistency and beaten in a cake mixer, clots form like those commonly seen in disturbed geosynclinal sediments, which may be seen to develop into felspar and quartz phenocrysts, while the rock develops into "porphyroid", called by petrologists quartz-felspar porphyry (Elliston, 1963). …

Elliston 1984 after years of intensive world-wide study of porphyroids, orbicules, and rapakivi granites demonstrated how these developed through colloidal processes in the water-saturated, but non-molten state; he believes that granites generally develop in this way. Wherever fully hydrolysed sedimentary materials are sheared by flow, as in the central belts of orogens, silica and felspars separate from hydrous ferromagnesian minerals. Silica from the residual tetrahedral layers of clays reaggregate as the precursors of felspars and quartz and separate physically from the more mobile water-rich ferromagnesian hydrates and hydroxides, which form basic dykes and "basic fronts".

Elliston maintains that rapakivi granites and orbicular structures generally are quite impossible to derive from granite melts. Exothermic crystallization generates adequate heat for the observed 600°C thermal metamorphism. Colloidal processes are the key to granite genesis. …"

December 1996

The following remarks are brief extracts from some of the letters retained from earlier stages in the program and those after March 2000 that relate to the current compilation of the supporting evidence and research results in book form: -

Professor John Bradley, Professor of Geology, Victoria University of Wellington, NZ., (12th October 1966): -

"Thank you for your article on the Peko ore and congratulations on having achieved this. I have the greatest pleasure in showing this to everyone I meet and endorsing it for you."

Dr. S.J. van Biljon, Senior Lecturer in Geology, PO Box 2726, Pretoria, Transvaal, South Africa. (3rd November 1966): -

"I read your work with great pleasure and interest. … You are quite right in my opinion – there is no magmatic water. The source of the water etc. is the sediments."

Dr. Henry Pantin, Institute of Geological Sciences, Ring Road Halton, Leeds, Yorkshire, England. (26th November 1968): -

"I was very interested indeed to read your recent paper "Retextured Sediments" submitted to the 23rd International Geological Congress in Prague. Not only did the paper itself make an important contribution, but I realised, as soon as I saw your illustrations, that the processes which you describe in your paper provide a very good explanation of some peculiar structures which I myself described (some years ago) from the Scottish Dalradian."

Professor R.L. Stanton, Professor of Geology, University of New England, Armidale, NSW. (15th December 1983): -

"I think our two lines of work are beautifully complimentary though I feel I am a long way behind you."

(25th February 1990): - "…our thoughts … have evolved in a complimentary way. I have not really referred to the whole vast aspect of colloids – I recognise their enormous importance, but you know immeasurably more than I about that aspect and any serious treatment of this should come from you."

(11th October 1993): - "Your own work I find most interesting, and I really cannot understand why people do not – will not – pick it up."

Dr. Konrad Moelle, Senior Lecturer in Geology, The University of Newcastle, NSW. (23rd May 1985): -

"You have turned an audience of many sceptics around and you have delivered what many teachers rarely achieve, namely to make your listeners think."

Dr. Haddon F. King, Chief Geologist, Advisor to CRA Ltd., and holder of many senior positions during a long and distinguished career. (12th July 1985): -

"I had known, of course, for 20 years of your interest in pseudo-igneous textures but I did not know, when we met in Sydney in March, that it had gone so far. I am glad to be one of those who had assumed a non-molten origin for (most) granites and I am even gladder to see someone propose a general mechanism for such an origin."

Dr. G.H. Sherrington, Senior Consultant, Chief Geochemist, Geopeko and North Broken Hill Ltd,. (27th August 1985): -

"I re-read your paper with the comments of the Sydney Uni (*actually Macquarie University*) in mind and I can't agree with their comments. There are many fundamental problems in geology which are conveniently swept under the carpet and I think that your efforts (not only to expose some of them but to provide alternative answers) deserve better than a few snide comments. … You are certainly setting a high standard of scholarship."

Dr. V.B. Koval, Institute of Geochemistry , Physics and Mineralogy, 34 Palladin Prospect, Kiev, USSR. (5th June 1990): -

"Your ideas are concordant with our notions about the role of metamorphism in forming Precambrian deposits."

Dr. Marek W. Lorenc, Polish Academy of Sciences, Laboratory of Geology of the Sudetes, 50-449 Wroclaw, Poland. (6th September 1990): -

"I am really very glad knowing your stand-point on the enclave/granite problem. All informations and theoretical advices that you have pointed out in your letter are very useful and they are in agreement with my point of view."

Professor Anton H. Hales, Research School of Earth Sciences, The Australian National University, Canberra, ACT. (From a letter to Professor S.W. Carey dated 5th December 1990): -

"Many years ago you introduced me to John Elliston. We travelled together from Hobart to Melbourne and he talked about his ideas on granites and gneisses. Later I read his article in the Journal of the Geology Club of the University of Tasmania. I was impressed and even more so by the Geopeko display at I.G.C. Sydney in 1976. … I am convinced that he is right in thinking that granites and gneisses were formed from sediments while they were wet."

(From a letter to John Elliston dated 5th June 1991): - "I read an article by you in the Geology Club of Tasmania Journal. It seemed to me that at the very least it was an entirely viable alternative to the molten hypothesis of the origin if granites. … In your case, I thought that you were right right away."

Dr. Ian G. Gould, Group Executive *(responsible for all CRA exploration and staff including some 180 professionally qualified earth scientists*), CRA Limited, 55 Collins Street, Melbourne, Vic. (10th January 1992): -

"Ever since Kim Wright introduced me to your theories 20 year's ago, I have been impressed with how neatly, within one system, they explain so much of what occurs in nature. I found this sympathy had the capacity to get me into a fair bit of trouble with my academic superiors and I am ashamed to say I backed off. Congratulations on your latest work. It is CRAE's continuing challenge to apply your concepts so as to improve our chances of discovery."

(28th August 1992): - "I am dismayed that your theory has not gained the scientific recognition it demands."

Dr. Chris Morrissey, Chief Research Geologist, RTZ Mining and Exploration, Lower Castle Street, Bristol, UK. (31st December 1996): -

"…you can rest assured that your writings have given many geologists new eyes and new ways of understanding what they see."

RTZ CRA
HEAD OF EXPLORATION

Mr. John Collier, Head of Exploration, RTZ-CRA Limited, 6 St. Jame's Square, London, UK. (9th January 1997): -

"There is no doubt whatsoever that the contributions you made to the physical chemistry of ore formation during your work for CRAE has been much appreciated by many … who have been influenced by your ideas. … The key to success in the exploration business rests with innovative thinking, good observation skills, and focusing of work on those field activities which ultimately result in the discovery of orebodies. I firmly believe that your work has made a tremendous contribution to our thinking about the evolution of orebodies."

Head of Exploration

Graeme Broadbent, Exploration Geologist, CRA Exploration, Mt. Isa, Qld. (8th July 1996):-

"The evidence for the various colloidal behaviours of silica species in quartz veins is very compelling. Anybody who has taken the time to carefully examine just about any quartz vein in any environment can recognise the truth from the textures."

Sir Rutherford Robertson (*Former President of the Australian Academy of Science*), "Muirhead", Binalong, NSW. (28th December 1992): -

"… you are introducing ideas that appear so revolutionary to many other geologists that they are unable to believe them and even resist their being promulgated. … you are in good company if you are having difficulty "selling" interpretations which run counter to beliefs long held. Darwin is perhaps the classic example."

Professor S.S. Augustithis, Theophrastus Publications S.A., 33J Theologou Street, Athens, Greece. (22nd October 1996): -

"It was a great pleasure for me to meet you in Beijimg. At that time though I did not realise that I stood before the man who has written the most important paper in 1963 concerning collocrysts and which was a subject I had so much emphasised based on your paper in my Sphaeroidal Atlas. I wanted always to congratulate in person the author of the collocrysts."

(From his letter to Professor Lorence G. Collins, California State University, dated 22nd October 1996): - "One of the most interesting people I met in China was Mr. John Elliston. I would suggest you contact him; this man has been quoted in my Sphaeroidal Atlas for his excellent contribution on Collocrysts, and he has sent me also some first class papers on colloform textures, and I believe collaboration with him on the Granite Problem would be a great asset."

Joe Potter, Exploration Geologist, CRA Exploration, Mt. Isa, Qld. (28th June 1996): -

"Thanks for your recent paper on silica – it's fantastic!"

Mrs. Wendy L. Corbett, Senior Geologist, PlatSearch NL, St. Leonards, NSW. (3rd March 2000): -

"I am enjoying your book immensely … it is great – very readable. We think it is good having a logical story as to why there was a need for new thinking."

Mr. G.R Ryan, Geological Consultant (*formerly Managing Geologist, Geopeko Limited responsible for the discovery and development of Ranger and other north Australian uranium deposits*), Atherton, Qld. (24th July 2001): -

"…it is a cause of great satisfaction that the ideas that first came to you in Tennant Creek, and were tested and endorsed by Tom Healy and Prof Carey, have stood the test of time and rigorous examination."

Dr. Don Findlay, Consulting Geologist, Findlay (C.S.S.G.) Pty Ltd, South Perth, WA. (31st July 2001): -

"Thank you for sending me the preview disc of your book. I must say the clarity of the textural detail is excellent. It is a beautifully illustrated work with more than just geological appeal. … this work of yours (being from the viewpoint of a physical chemist and gathered over a lifetimes) makes available a perspective most geologists (and their teachers) would never have the opportunity to see. … It's a truly seminal work, and sure to endure."

Dr. Karl Wolf *(former Editor for Elsevier Science Publishers B.V. and Australian Geoscience publications*), Wolf's Geological Consultants, 6 Parer Street, Springwood, NSW. (4th August 2001): - "The purpose of this letter is to demonstrate my longstanding support of your research … you have claimed for many years that your ideas (hypotheses or theories) are unique and offer an alternative and at the same time a new approach. I fully agree. I have read the correspondence you received over the years from highly qualified experts fully agreeing with your basic/fundamental chemistry, i.e. they can not find any flaw in your reasoning! This should be continually emphasized as you do."

Mr. Kim Wright (*formerly Managing Geologist Eastern Australia, Geopeko Limited*), General Manager, Earth Resources Foundation, The University of Sydney, Sydney, NSW. (13th August 2001): -

"… your extensively illustrated book is important because it quite elegantly communicates the relationship between the chemistry of particle surfaces and its role in producing numerous rock features. While it should not be the case, much of the chemistry applied to explain the features is new to very many geologists. … The successful discovery record of exploration teams led and advised by you demonstrates that significant portions of this work can be important in ore search. … In order to find the next generation of ore deposits we really do need to understand the rocks much better and to discern the most probable processes that have produced what we see. … This book makes an important contribution to that process."

Mr. R.L. Richardson, Managing Director, PlatSearch NL, St. Leonards, NSW. (16th August 2001): -

"Now after half a lifetime in the mineral exploration industry, I am more convinced than ever as to the importance of your work and the validity of the hypothesis. … it is my view that the exploration industry is hugely disadvantaged by an almost universal adherence to classical plutonist theories and explanations of ore forming processes based on solution chemistry. … I hope that you are able to progress publication of the book as soon as possible. The exploration industry needs it desperately."

Mr. Phil Rosengren (*former senior exploration geologist CRA*), Consultant, 1/55 Locksley Road, Ivanhoe, Vic. (21st December 2001): -

"All I hope is that as the years roll on sooner rather than later we get to see the work you have done in a permanent and accessible place. We were fortunate in Rio to see the papers you prepared."

Professor Ross Large, Director, CODES, University of Tasmania, Hobart. (7th December 2003): -

"I have enjoyed scanning through the CD of your forthcoming book. It looks to be a very major contribution, which will have major implications for ore genesis theory. I look forward to reading it in more detail when the hard copy appears."

Professor Emeritus Barry W. Ninham, Australian National University, Foundation Professor and Head, Dept. of Applied Mathematics, Institute of Advanced Studies, ANU, Guest Professor at CEA Saclay, France, University of Lund, Swedish National Tage Erlander NFR, Malmo University. University of Florence, and Humboldt Distinguished Professor, Regensburg, Germany.

(12th Decenber 2006): - "Now concerning your book, ...my reaction is that this is magnificent, even magisterial, erudite, easy to read, and ....it is entirely convincing. Lovely stuff."

Potentially important new interdisciplinary studies are not readily recognised by earth science organisations where decision-making includes board or committee members unfamiliar with data and current developments in basic science. Intellectually honest and realistic individual scientists within such organisations strongly endorse the innovative work that has led to the discovery of the origin of igneous-looking rocks and mineral deposits: -

Peter J. Davies, Director, and **Roger Henderson**, President, The Earth Resources Foundation, The University of Sydney. (18th December, 2003): -

"The Earth Resources Foundation recognizes the extent and duration of the research programs which have contributed to the formulation of the book and endorses your attempt to publish it. ….. We look forward to seeing the fruits of your prodigious labours in print."

John Foden, President, Geological Society of Australia, University of Adelaide. (8th January, 2004): -

"First let me congratulate you on your work, both personally and on behalf of the Society. I find the surface chemical concepts and colloidal chemistry and the potential these processes might have in geology to be fascinating. …. I wish you every success with your project."

The Australasian Institute of Mining and Metallurgy offered to consider this manuscript for publication possibly as one of their monograph series on 4th December 2003. The Institute by their letter of 19th January 2004 assured the author that AusIMM was supportive of publicising new, multidisciplinary research that has the potential to revolutionise our understanding of how rocks and orebodies are formed. They gave assurances that their Publications Task Force would conduct the refereeing by an open-minded process of discussion, exchange of information, and resolution of differences. On the basis of their assurances that appropriate referees (having the necessary skills in both disciplines) would be appointed, that there would not be consensus voting, and that refereeing would be to identify technical defects in the text, the manuscript and associated documents were submitted on 26th January 2004.

It was hoped this would result in publication of a monograph like Haddon King's "The Rocks Speak" but apparently when it was discovered that this manuscript made them "shout" the publication project was abandoned by decision of the AusIMM Board that was notified on 8th July 2004. Consideration of the manuscript contrary to their assurances is fully documented but it has resulted in delaying the refereeing process and publication by seven months.

Don Larkin, Chief Executive Officer, The Australasian Institute of Mining and Metallurgy, Melbourne. (8th July, 2004): -

"Your work is clearly at the cutting edge of geoscience. Like many other concepts at the cutting edge, The Institute understands that it has yet to be accepted into the mainstream of professional geoscience practice. ….. The Institute thus wishes you every success with this publication and thanks you for bringing it to our attention. Few technical people have the expertise or calibre to write such a book and The Institute appreciates how much time, effort and experience has gone into its preparation."

(16th August 2004): - "There were no technical defects identified by the referees or by the Publications Task Force and thus your manuscript was not rejected on technical grounds. ... both Ian Gould and I are prepared to support an application for funding or publishing as and when appropriate."

Presentation and use of current rheology and physical chemistry of small particle systems (colloid chemistry) as set out in the accompanying e-book has been by checked by rheologists, geologists, chemists, and other scientists as indicated in the foregoing pages. A copy of one of the formal evaluation reports prepared by Professor T.W. Healy in May 2004 is included here because he is an outstanding scientist and a world leader in nanotechnology and colloid chemistry.

"The Formation of Ore Deposits from Sediments"

by

John Elliston

A Report to the Publications Committee of the AusIMM.

From: Thomas W. Healy FAA, FTSE, FRACI, MAusIMM
Deputy Director and Professor
The Particulate Fluids Processing Centre
Department of Chemical and Biomolecular Engineering
The University of Melbourne, Vic 3010. AUSTRALIA.

BACKGROUND

I am pleased to provide this report to the Institute regarding the possible publication of the above manuscript provided by Mr John Elliston.

At the outset I need to give you my background regarding the chemistry rather than the geology, that Mr Elliston has presented in this book. First, he asked me to write a Forward to the book. I was very happy to do this and I am still delighted to have my Forward included.

My very first interaction was when I was recruited in 1965 by the late Professor Sam Carey to take a Senior Lectureship in the Department of Geology at the University of Tasmania. Prof. Carey suggested I might take the position and set up a research group directed at colloidal processes in ore genesis. Around that time the role of sedimentary diagenesis in the formation of the Broken Hill and other ore bodies was a debate of some energy and colour. Carey sent me some notes and some papers written by John Elliston regarding the dynamics of processes that had taken place in the turbidite sequences around Tennant Creek. He also sent me a set of papers-comments on the debate around the syngenetic origin of the Broken Hill and Mt Isa ore bodies. I was fascinated to read this material and to think about processes that could happen as wet sediments underwent flow and changes in their chemistry and physics during diagenesis.

I did not take Carey's position, preferring to take one of the inaugural Queen Elizabeth II Fellowships at the Department of Physical Chemistry, The University of Melbourne. Some few years later I met John Elliston in person and we have stayed scientific colleagues and friends ever since.

I give you this background to establish that in some ways it is difficult for me to be totally objective in providing this report. But, I have taken the task very seriously and re-read the text and spent considerable time on the sections that relate to my expertise, viz. colloid and surface chemistry.

THE CENTRAL HYPOTHESIS

Elliston proposes that geological theory needs to consider, that during the process of lithification, sedimentary masses will endure a much wider range of chemical and physical processes than normally presented in textbooks. Standard texts consider such topics as sedimentation leading to alluvial, detrital or placer deposits, weathering of mineral masses to produce sedimentary stratified layers, isomorphous substitution in clay synthesis, synthesis of chain, sheet and 3D mineral structures, synthesis of carbonates, phosphates and so on.

The detailed mapping of the turbidite sequences around Tennant Creek convinced Elliston that they had an association with the Tennant Creek porphyroids, and that the changes during diagenesis of these formations were linked to the origin of the several significant ore bodies around the region.

MY INTRODUCTION

I am not a geologist; but at the time I first met John Elliston, it seemed to me that the rocks that I saw in the field were indeed recording a history of the kinds of colloidal processes I knew about from my laboratory studies. Elliston asked me to describe the physicochemical basis of accretionary and concretionary processes, nucleation and growth of colloidal sulphide mineral precursors, silica synthesis, the effect of particle shape on segregation processes in flowing suspensions, desorption equilibria to generate pore fluids, thixotropy and rheopexy in the flow of non-Newtonian fluids, rhythmic precipitation processes and many other topics. I delighted in the challenge he gave me to think through with him, the role of colloidal processes in geological environments.

MY RECENT EVALUATION WORK

When John Elliston sent me an early draft of his book, I believed I owed to him and to our science to review in detail the exposition he was giving in the text of various colloidal processes. I concluded that he had demonstrated a deep and clear understanding of what are standard topics in colloid science. He has reproduced standard theory and experiment. The illustrations that he has included are first class. If I was still teaching I would use them in lectures to classes in colloid and surface science.

When ever I found any errors I let him know, and they were corrected. I stress that there were very, very few errors of substance. There are some comments he makes concerning the approach to zero separation in colloidal aggregates that are still a topic of debate amongst colloid scientists. In a paper I presented recently to an international colloid and surface science meeting in Brazil entitled, “ The Problem of Zero Separation”, I canvassed the forces that control the release of the last hydrated ions and water molecules as separations move down to the nanometer scale. While we all agree on the theory, I and others are pursuing experimental evidence with vigour. It might be that the conventional attractive force has a finite rather than infinite value at the real zero separation. I stress that the outcome of this new work in no way detracts from Elliston's concepts. I present it as evidence of the current excitement that colloidal science, or nano-science and technology as it is now called, is experiencing. Interestingly, Elliston's work on sulphide mineral synthesis has been substantiated very recently in work on the synthesis of a range of metal sulphide nano-particles being used in clever photonic devices; they have crystallinity just like Elliston suggested, even though they are particles of 4 nm diam.

I did have concerns with the original title that he was proposing. I am very happy now with either ***"The Origin of Rocks and Orebodies – using current physical chemistry of small particle systems."*** or the title I have listed above, viz. ***"The Formation of Ore Deposits from Sediments"*** Both titles capture Elliston's long standing work on the origin of ore mineralization; the second title encompasses as well his much respected work on the origin of granites. I therefore prefer the title ***"The Origin of Rocks and Orebodies – using current physical chemistry of small particle systems."***

Last year John Elliston asked me to pass on a copy of the manuscript to my colleague David Boger, Laureate Professor at the University of Melbourne. David gave Mr Elliston permission to use our Australian Research Council, Special Research Centre Logo, noting that he looked forward to seeing publication of the book in the near future, and adding, ***"….I have now had a chance to work through the sections that fall more into my own area of science, viz: non-Newtonian fluid mechanics and rheology of particulate fluids. Again, I am most impressed with the understanding you display in these sections. It is refreshing to see interest by geoscientists in processes well known to rheologists".***

CONCLUDING REMARKS.

The colloid science in the book is impeccably correct. I concede that the application of such processes, which seems obvious to me and other colloid scientists has proved controversial. I remember being greatly impressed by the late Haddon King. I heard him speak on one particular occasion and I have a copy of his book, "The Rocks Speak" published by AusIMM in 1989.

In the Preface to his book, King comments, ***"....geology is taught largely with no more than book knowledge, and without understanding of the best sources of geological information" .***

He is referring to the understanding that exploration geologists develop as they immerse themselves in the deposits with which they are working. King, by the way, was well aware of Elliston's work and refers to it in his book, and in particular was attracted to Elliston's very challenging ideas on the origin of granites. King, the great, late US (Stanford University) geologist, Krauskopf and Elliston are as one in pointing out the inconsistencies in most conventional theories of granitic intrusions.

I do note various typos that still appear in the copy of the text that I have. I am sure that these can be eliminated during editorial review, for which AusIMM publications are famous and well versed. I also believe that in the further review a significant number of duplications of arguments, etc would be eliminated.

I would urge the Institute to publish this book. It is a seminal work of great breadth and impact that will bring great credit to our Institute and to Australian science.

Thomas W. Healy
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