INTERNATIONAL GEOSCIENCE PROGRAMME (IGCP)

Annual Report* of IGCP Project No.493 (2009)

IGCP project short title: The Rise and Fall of the Vendian (Ediacaran) Biota
Duration: 2003-2009 (OET for 2008-2009). **New project requested for 2010-2014**
Project leader(s):

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Annual Report

1. Website: http://www.geosci.monash.edu.au/PreCsite/index.html

2. Summary of major past achievements of the project: See website for more detail of individual country accomplishments and refer to annual reports on that website for 2003-2009 reports for past achievements. These are varied: significant scientific and popular publications (including 2 books), field trips (several each year), traveling exhibitions (2) and education kits for primary and secondary students, stamp issue (Australia post with international editions), documentaries (2), media interviews and meetings (1-3 or more per year). See attached review of two books in *Science*.

3. Achievements of the project this year only

3.1. Countries involved in this project:

Argentina, Australia, Brazil, Canada, Peoples Republic of China, Germany, India, Iran, Iraq, Ireland, Italy, Japan, Korea (Republic of Korea), Namibia, New Zealand, The Netherlands, Norway, Poland, Russia, Saudi Arabia, Singapore, Spain, South Africa, Sweden, Taiwan (Republic of China), United Kingdom, United States, Uruguay. **See website for individual country reports.**

3.2. General scientific achievements and social benefits

Filming of documentary on the origin and early evolution of life and the first animals with a team from the Fukui Prefectural Dinosaur Museum, Japan. Filming carried out with researchers in the Flinders Ranges, Western Australia with the Conservation and Land

Management staff, at Monash and Museum, the Geological Survey of Western Australia, the South Australian Museum, Curtin University and the University of Western Australia. This documentary finalized in 2009 and on show in the Fukui Prefectural Dinosaur Museum in western Honshu.

Filming of documentaries in the Flinders Ranges of South Australia & Newfoundland with Atlantic Productions (UK) (with the BBC & Discovery Channel) and **David Attenborough.** Filming will continue into 2010 with further locations being Russia (the White Sea collections in particular), Namibia and the UK. Attenborough is using *The Rise of Animals* published by Johns Hopkins University Press (Fedonkin, Gehling, Grey, Narbonne & Vickers-Rich) as the documentary "script" and has involved the research scientists in the planning. Under the direction of J. M. Bayon and J. A. Gamez (Universidad de Zaragoza) another documentary entitled *On the Tail of Primitive Life. The Cambrian Period* was filmed in 2009.

Work continues towards setting aside heritage areas that have produced prime Ediacaran/Vendian assemblages as **heritage sites**, protected and yet available for ecotourism, particularly in the Flinders Ranges of South Australia and the Aus region of Namibia. A small regional museum on a rural property near Aus is assisting in conserving these sites and encouraging limited **ecotourism** – several groups visited the property in 2009 while research work was underway in October and November – from Germany, Switzerland, Canada. Scientists engaged the visitors as well as continued to train local herders on the property for a possible future as rangers and explainers if the national heritage proposal now before the Nambian Government is successful. Talks were also begun with Monash University South Africa to provide training on this property as an exemplary project. Monash South Africa has a strong program for youth in the area already.

*Continued involvement of IGCP493 to **Casting Project** in Charnwood Forest.* This project is outstanding and there are hopes of liasing with this group in future to insure continued casting of the extensive exposures yielding a new array of Ediacarans under study by Trevor Ford and Helen Boynton and their colleagues – this continues from 2008.

***Continued Field Efforts** in South Australia, Newfoundland, Namibia, Argentina, China, UK, and Saudi Arabia* providing a significant better understanding of the environments hosting Ediacarans as well as continuing to increase biodiversity.

3.3. List of meetings with approximate attendance and number of countries:

Working groups in India, Australia, Russia, Namibia and Canada remained outstandingly active, both in meetings and field excursions in 2009. Because of the project being on OET, only one meeting was organized – a field meeting in Namibia during early November – 14 attendees including representatives from Australia, the UK, the USA, Canada, Russia and Germany. Participants in IGCP493 attended a number of other meetings in Japan, Germany, Australia, the USA, Canada, reporting on research carried out under the umbrella of this project. Field Meeting in September to Mistaken Point as part of the "Evolution of Complex Life" working group in affiliation with the NASA Astrobiology Institute (NAI) at the Massachusetts Institute of Technology (MIT).

3.4. Educational, training or capacity building activities

See above and below. Examples also include: Several invited keynote lectures were given at these conferences by participants in IGCP493, examples being the Sprigg Lecture in Adelaide during Dec. 2009, one the "Frontiers of Science" lectures for the Year of Planet Earth at Ludwig-Maximilians-Universitat in Munich Jan. 09), the Walcott Symposium (100th Ann. Of the Discovery of the Burgess Shale) in Banff, Canada, Keynote address at the meeting for the Bicentennial of Charles Darwin's Birth (Kyoto, Japan, Oct. 09), amongst many others.

3.5. Participation of scientists from developing countries, and in particular young and women scientists

Outstanding throughout this project is the involvement of a number of young people, including young women. In Namibia young women members of the Geological Survey of Namibia have been involved in the field work. In Kurdistan, Profs. Rund Hammoudi and Nazar Nauman have made a continuing effort to train young geologists despite the uncertainties of that nation. Our colleagues in Iran continue their participation and the Geological Survey has invited two scientists and one student to participate in field work, with their full support in 2010. Other young participants include graduate students (e.g. Australians David Elliott (Ph.D), Chris

Wemmers and Nicole Founie (Undergraduates) and Mike Meyer from West Virginia State Universitywhose projects were carried out in Namibia on Ediacarans and Neoproterozoic sedimentology) with staff from the Geological Survey of Namibia.

3.6. List of most important publications (including maps) – a limited list of exemplary publications (peer reviewed)

Bamforth, E.L. and Narbonne, G.M. 2009. New Ediacaran rangeomorphs from Mistaken Point, Newfoundland, Canada, *Journal of Paleontology* 83: 897-913.

Buatois, L.A., Mángano, M.G., Brussa, E., Benedetto, J.L. & Pompei, J., 2009. The changing face of the deep: Colonization of the Early Ordovician deep-sea floor, Puna, northwest Argentina. *Palaeogeography Palaeoclimatology Palaeoecology* 280: 291-299.

Cohen, P.A., Bradley, A., Knoll, A.H., Grotzinger, J.P., Jensen, S., Abelson, J., Hand, K., Love, G., Metz, J., McLoughlin, N., Meister, P., Shepard, R., Tice, M. & Wilson, J.P. 2009. Tubular compression fossils from the Ediacaran Nama Group, Namibia. *Journal of Paleontology* 83: *110-122. DOI: 10.1666/09-040R.1*

Cortijo, I. Marti Mus, M. Jensen, S. & Palacios, T. 2009. A new species of *Cloudina* from the terminal Ediacaran of Spain. *Precambrian Research*. DOI:10.1016/j.precamres.2009.10.010

Denyszyn, S.W., Halls, H.C., Davis, D.W. & Evans, D.A.D., 2009. Paleomagnetism and U-Pb geochronology of Franklin dykes in High Arctic Canada and Greenland: A revised age and paleomagnetic pole constraining block rotations in the Nares Strait region. *Canadian Journal of Earth Sciences*, 46: 689-705.

Dong, L., S. Xiao, B. Shen, C. Zhou, G. Li. & J. Yao, 2009. Basal Cambrian microfossils from the Yangtze Gorges area (South China) and the Aksu area (Tarim Block, northwestern China). *Journal of Paleontology* 83: 30-44.

Evans, D.A.D., in press. The palaeomagnetically viable, long-lived and all-inclusive Rodinia supercontinent reconstruction. In: Murphy, J.B., Keppie, J.D., and Hynes, A. (Eds). *Ancient Orogens and Modern Analogues. Geological Society of London Special Publication* 327: 371-405.

Fedonkin, M. A., 2009. Eukaryotization of the early biosphere: a biogeochemical aspect. *Geochemistry International* 47 (13): 1-69.

Fedonkin, M., *et al*., 2009. Paleo-piracy endangers Vendian (Ediacaran) fossils in the White Sea-Arkhangelsk region of Russia. In: Lipps, J.H. & Granier, B.R.C. (Eds.). *The Protection and Conservation of Fossil Sites Worldwide.* Notebooks on Geology, Brest, Book 2009/03. Chapter 9. Also in *Paleontologica Electronica*, 2008.

Gaucher, C. & Germs, G.J.B., 2009. Skeletonised Metazoans and Protists. Neoproterozoic-Cambrian biota. In: Gaucher, C., Sial, A.N., Halverson, G.P., Frimmel, H.E. (Eds). Neoproterozoic-Cambrian Tectonics, Global Change and Evolution: a focus on southwestern Gondwana. *Developments in Precambrian Geology* 16, Elsevier: 327-338

Gaucher, C. & Poiré, D.G., 2009. Biostratigraphy. Neoproterozoic-Cambrian evolution of the Río de la Plata Palaeocontinent. In: Gaucher, C., Sial, A.N., Halverson, G.P., Frimmel, H.E. (Eds). Neoproterozoic-Cambrian Tectonics, Global Change and Evolution: a focus on southwestern Gondwana. *Developments in Precambrian Geology* 16, Elsevier: 103-114.

Gaucher, C. & Sprechmann, P., 2009. Neoproterozoic acritarch evolution. Neoproterozoic-Cambrian biota. In: Gaucher, C., Sial, A.N., Halverson, G.P., Frimmel, H.E. (Eds). Neoproterozoic-Cambrian Tectonics, Global Change and Evolution: a focus on southwestern Gondwana. *Developments in Precambrian Geology* 16, Elsevier: 319-326.

Gehling, J.G. & Droser, M.L., 2009. Textured organic surfaces associated with the Ediacara biota in south Australia. *Earth Science Reviews* 96: 196-206.

Germs, G.J.B., Miller, R.McG., Frimmel, H.E. & Gaucher, C., 2009. Syn- to late-orogenic sedimentary basins of southwestern Africa. Neoproterozoic to Early Palaeozoic evolution of southwestern Africa. In: Gaucher, C., Sial, A.N., Halverson, G.P., Frimmel, H.E. (Eds). Neoproterozoic-Cambrian Tectonics, Global Change and Evolution: a focus on southwestern Gondwana. *Developments in Precambrian Geology* 16, Elsevier: 183-203.

Grey, K & Sugitani, K, 2009, Palynology of Archean microfossils (>3.0 Ga) from the Mount Grant area, Pilbara Craton, Western Australia: further evidence of biogenicity, Special issue on World Summit on Ancient Microscopic Fossils, University of California, Los Angeles. Schopf, J.W., Walter, M. & Bottjer, D. (Eds.). *Precambrian Research* 173: 60-69.

Kendall, B., Creaser, R.A., Calver, C.R., Raub, T.D. & Evans, D.A.D., 2009. Correlation of Sturtian diamictite successions in southern Australia and northwestern Tasmania by Re-Os black shale geochronology and the ambiguity of "Sturtian"-type diamictite - cap carbonate pairs as chronostratigraphic marker horizons. *Precambrian Research* 172: 301-310.

Laflamme, M., Xiao, S. & Kowalewksi, M., 2009. Osmotrophy in modular Ediacara organisms. *Proceedings of the National Academy of Sciences USA* 106: 14438-14443 [cover article].

Leonov, M.V., Fedonkin, M.A., Vickers-Rich, P, Ivantsov, A. Yu., Trusler, P. & Hoffmann, K.-H., 2009. Discovery of the first macroscopic carbonaceous algal assemblage in the Terminal Proterozoic of Namibia, southwest Africa. *Communications of the Geological Survey of Namibia* 14: 1-7.

Li, Z.X., Bogdanova, S.V., Collins, A.S., Davidson, A., De Waele, B., Ernst, R.E., Evans, D.A.D., Fitzsimons, I.C.W., Fuck, R.A., Gladkochub, D.P., Jacobs, J., Karlstrom, K.E., Lu, S., Natapov, L.M., Pease, V., Pisarevsky, S.A., Thrane, K. & Vernikovsky, V., 2009. How not to build a supercontinent: A reply to J.D.A. Piper. *Precambrian Research* 174: 208-214.

Liu, P., Xiao, S., Yin, C., Tang, F. & Gao, L., 2009. Silicified tubular microfossils from the upper Doushantuo Formation (Ediacaran) in the Yangtze Gorges area, South China. *Journal of Paleontology* 83: 630-633.

Laflamme, M., Xiao, S. & Kowalewski, M., 2009. Osmotrophy in modular Ediacara organisms. *Proceedings of the National Academy of Sciences*, USA. 106: 14438-14443.

McFadden, K.A., Xiao, S., Zhou, C. & Kowalewski, M., 2009. Quantitative evaluation of the biostratigraphic distribution of acanthomorphic acritarchs in the Ediacaran Doushantuo Formation in the Yangtze Gorges area, South China. *Precambrian Research* 173: 170-190.

Naarbonne, G.M., Laflamme, M., Greentree, C. & Trusler, P., 2009. Reconstructing a lost world: Ediacaran rangeomorphs from Spaniard's Bay, Newfoundland. *Journal of Paleontology* 83: 503-523 [Cover photograph of journal]

Peterson, K., Cotton, J.A., Gehling, J.G. & Pisani, D., 2009. The Ediacaran emergence of bilaterians: Congruence between the genetic and the geological fossil records. In: Telford, M.J. & Littlewood, D.T.J. (Eds.). *Animal Biology: Genomes, Fossils and Trees*. Oxford University Press, Chap. 2: 15-23.

Peterson, K.J., Dietrich, M.R. & McPeek M.A., 2009. miRNAs and metazan macroevolution: insights into canalization, complexity, and the Cambrian explosion. *Bioessays* 31: 736-747.

Rich, T.H. & Vickers−Rich, P., 2009. Animal proxies, vertebrates, in Gornitz, V. (Ed.) *Encyclopedia of Paleoclimatology and Ancient Environments*, Springer: 13-5.

Shen, B., Xiao, S., Zhou, C. & Yuan, X., 2009. *Yangtziramulus zhangi* new genus and species, a carbonate-hosted macrofossil from the Ediacaran Dengying Formation in the Yangtze Gorges area, South China. *Journal of Paleontology* 83: 575-587.

Sharma, M., Mishra, S., Dutta, S., Banejee, S. & Shukla, Y., 2009. On the affinity of *Chuaria-Tawuia* complex: A multidisciplinary study. *Precambrian Research* 173: 123-136.

Sharma, M. & Shukla, Y., 2009. Mesoproterozoic coiled megascopic fossil *Grypania* spiralis from the Rohtas Formation, Semri Group, Bihar, India. *Current Science* 96 (12): 1636-1640.

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Sharma, M. & Shukla, Y., 2009. The evolution and distribution of life in the Precambrian eon-Glabal perspective and the Indian record. *Journal of Biosciences* 34 (5): 765-776.

Sperling, E.A., Peterson, K.J., & Pisani, D. (2009). Phylogentic-signal detection of nuclear housekeeping genes supports the paraphyly of sponges and monophyly of Eumetazoa. *Molecular Biology and Evolution* 26: 2261-2274.

Sperling, E.A., Vinther, J., Wheeler, B.M. Sémon, M., Briggs D.E.G., & Peterson, K.J., 2009 (in press). MicroRNAs resolve an apparent conflict between annelid systematics and their fossil record. *Proceedings of the Royal Society, London,* B.

Sperling, E.A., Robinson, J.M., Pisani, D. & Peterson, K.J., 2010 (in press). Where's the glass? Biomarkers, molecular clocks and microRNAs suggest a 200 million year missing Precambrian fossil record of siliceous sponge spicules. *Geobiology*.

Sugitani, K, Grey, K, Nagaoka, T & Mimura, K, 2009. Three-dimensional morphological and textural complexity of Archean putative microfossils from the northeastern Pilbara Craton: Indications of biogenicity of large (>15µm) spheroidal and spindle-like structures*: Astrobiology* 9: 603-615.

Sugitani, K, Grey, K, Nagaoka, T. Mimura, K. & Walter, M.R, 2009. Putative Archaean microfossils (>3.0 Ga) from the Mount Goldsworthy and Mount Grant area in the Pilbara Craton, Western Australia: Taxonomic reinterpretation and implications of ancient biotic diversity and

evolution: Special issue on World Summit on Ancient Microscopic Fossils, University of California, Los Angeles. Schopf, J.W., Walter, M.R. & Bottjer, D (Eds.). *Precambrian Research* 173: 50-59.

Vickers-Rich, P., 2009. Painting the past: From scientific research to art. *GSA Today* 19(6): 50-51

Vickers-Rich, P., Kattan, F., *et al*., 2009 (in press). In Search of the Kingdom's Ediacarans: Expeditions exploring the Neoproterozoic Jibalah Group and related sequences on the Arabian Shield – 1429-1430 AH, 2008-2009 AD, *Technical Reports, Geological Survey of Arabia*, Jeddah: 1-37.

Wheeler, B.M., Heimberg, A.M., Moy, V.N., Sperling, E.A., Holstein, T.W., Heber, S. & Peterson, K.J., 2009. The deep evolution of metazoan microRNAs. *Evolution & Development* 11: 50-68.

Xu, B., Xiao, S., Zou, C., Chen, Y., Li, S.-X, Song, B., Liu, D., Zhou, C. & Yuan, X., 2009. SHRIMP zircon U-Pb age constraints on Neoproterozoic Quruqtagh diamictites in NW China. *Precambrian Research* 168: 247-258.

Xiao, S. & Laflamme, M., 2009. On the eve of animal radiation: Phylogeny, ecology and evolution of the Ediacara biota. *Trends in Ecology & Evolution* 24: 31-40.

Zhuravlev, A. Yu., Gamez, V.J.A. & Ivantsov, A. Yu., 2009. First finds of problematic Ediacaran fossil from Gaojiashania in Siberia and its origin. *Geological Magazine* 146 (5): 775-780.

3.7. Activities involving other IGCP projects, UNESCO, IUGS or others

Members and co-leaders of IGCP493 also interact with IGCP478 (Neoproterozoic-Early Paleozoic Events in SW Gondwana), IGCP497 (the Rheic Ocean: Its Origin, Evolution and Correlatives), IGCP512 (Neoproterozoic ice Ages) and the ICS Subcommission of Ediacaran and Cryogenian Stratigraphy

4. Activities planned for 2010-2014

Further field work in India, the White Sea of Russia, Saudi Arabia, Newfoundland, Australia, Namibia, Argentina, Iraq, the UK was carried out in 2009, especially targeting the first and last occurrences of the Ediacarans and attempting to understand the reasons for their origin and their demise. Traveling of the *Wildlife of Gondwana Exhibition* in Australia, an exhibition in which Ediacarans have been highlighted and final planning for an exhibition on palaeo-reconstruction art was finalized and this exhibition will begin traveling in mid-2010. Accompanying the launch of this exhibition will be the release of a new book by Peter Trusler, Patricia Vickers-Rich and T. H. Rich (*The Artist and the Scientists. Bringing the Past to Life*), now in press with Cambridge University Press – which contains much of the art dealing with the Neoproterozoic. This exhibition will showcase much of the research carried out under the umbrella of IGCP493.

5. Project funding requested

Project was on OET status

6. Request for extension, on-extended-term-status, or intention to propose successor project.

As noted in 7 (below) critical funding was secured from a number of sources this year as a result of our project being listed as an active IGCP project (on OET). a A successor project proposal was submitted in October 2009.

7. Financial statement ($ USD only)

Project on OET but funds secured to support some student and academic attendance at several meetings; $US200,000 was secured to support two traveling exhibitions, one of which remains in Timor Leste helping in the rebuilding of the National Museum destroyed in the 1999 disturbance in that country the second being the Wildlife of Gondwana; an Australian Research Council grant to Gehling, Droser and Jensen for $90,000 (Flinders Ranges of South Australia); a National Geographic grant to Vickers-Rich for $US29,500 (Namibia,); >$70,000 for field work in the Neoproterozoic of Saudi Arabia, support provided by the Geological Survey of Saudi Arabia; > $40,000 for filming of documentary by the Fukui Prefectural Museum (Japan) exemplify the support for this project. Listing of this project as a UNESCO IGCP project was of great value in helping secure such critical funding; funding has been provided by Atlantic Productions for filming with David Attenborough to underwrite field work and researcher participation in this documentary – funding for both 2009 and 2010. These are only exemplary grants, and there were many others to participants in this project.

8. Attach any information you may consider relevant

Reference to our website will provide additional data on the outcomes of his project both in 2009 and over its entire history. It is of note that one of the main books resulting from IGCP493 (*The Rise of Animals. Evolution and Diversification of the Kingdom Animalia*, by Fedonkin, Gehling, Grey, Narbonne & Vickers-Rich) published in 2008 by Johns Hopkins University Press, won the **Victorian Premiers Prize (Australia) for the best science book of 2008-2009** and was short listed (one of 5) for the Queensland Premier's Prize for Science Writing.