

# THE VICTORIAN GEOLOGIST

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February 2016

THE GEOLOGICAL SOCIETY OF AUSTRALIA

Victoria Division

General Meeting

**Thursday 25th February at 6:15 p.m.**

## **Non-plate tectonic interpretations for the Superior Craton, Canada, and Yilgarn Craton, Western Australia – exploration implications**

**Prof. Lyal Harris**

**National Institute for Scientific Research (INRS-ETE),  
Quebec City, Canada**

**Fritz Loewe Theatre, School of Earth Sciences, University of Melbourne**

Talk will be preceded by drinks from 5:30 pm in the 4th floor tearoom, cost \$2.

Field, geochronological, isotopic and geophysical studies in both the Yilgarn and Superior cratons do not support modern plate tectonic models of subduction and arc accretion for their formation and deformation.

Previous models for the southern Superior craton (Canada) invoke Neoproterozoic N to S accretion of disparate terranes, interpreted as the result of modern, subduction-related tectonic processes. From geological and geophysical arguments, we propose that instead (i) the western Superior granite-greenstone sequences formed between a series of rifted fragments of a composite Superior I craton, followed by re-accretion to the leading edge of the Hudson Bay terrane. Enhanced seismic tomographic, gravity and aeromagnetic/pseudogravity images show that mafic-ultramafic hosted Cr-PGE, Fe-Ti-V, Ni-Cu-(PGE) mineralization in the 'Ring of Fire' (Ontario) occurs adjacent to a N-S terrane boundary of this early Superior I craton preserved in basement. (ii) The Abitibi Subprovince of the SE Superior similarly formed in a wide plume-related rift. Undoing regional displacements on ductile and discrete brittle-ductile shear zones

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**ABSTRACT CONTINUED...**

interpreted from mapping and enhanced aeromagnetism portrays a N-S to NNE-SSW elongate, denser/mafic dominated crustal block (in which all gold deposits in the Abitibi are situated) which we interpret as a > 300 km long oceanic plateau. The contact between the Abitibi and the Opatoca subprovince (which abuts the Abitibi to its N) is not marked by a high strain shear zone nor by an abrupt change in metamorphic grade, and the Opatoca simply represents basement to the Abitibi (Daoudene et al. 2014, M82014-04, MERN) and not an accreted terrane. Early E-W dextral ductile shear corridors and superposed conjugate shear and reverse faults and related folds in both the SE and W Superior result from the southwards displacement of the Hudson Bay terrane, driven by mantle flow-induced tractions at the base of its deep lithospheric keel.

Similarly, regional geophysical interpretations of the Yilgarn Craton, Western Australia, are not consistent with the general model of arc and continental terrane assembly through subduction-accretion processes. Re-interpretation of seismic and MT data shows that the Narryer Terrane is basement to the Youanmi Terrane, instead of being accreted to its NW margin (i.e. similar to the relationships between the Abitibi and Opatoca subprovinces of the Superior). P-wave seismic tomography portrays domains that correlate with Nd model age domains, and normal displacement in the upper mantle is suggested along the contact imaged between the Youanmi and Kalgoorlie terranes. Komatiite sequences intruded the edges of these distinct continental blocks within mantle plume-related rifts (Mole et al. 2014, PNAS). Enhanced long wavelength gravity images show rifts cut all terrane boundaries, and that major Au deposits overlie rift-related transfer faults. In the Kalgoorlie Terrane, rift margins localize subsequent regional sinistral transpressional shear zones which are reactivated and displaced by dextral transcurrent shears; orogenic Au mineralization occurred during both dextral and sinistral shearing.

The Superior and Yilgarn therefore record rifting of early-assembled "proto-cratons". Greenstone sequences in both developed in plume-related rifts. Rifting in the Yilgarn resulted in thinning (similar to the Basin and Range) followed by oblique inversion of rifts whereas complete separation and reassembly of terrains is recorded in the southern Superior. Our new tectonic models and regional geophysical enhancements open the way for developing new exploration targets in these and other Archaean terrains.

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**SPEAKER BIO**

After undergraduate studies in geology and geophysics at the University of Melbourne and a period working as a geophysicist with Shell in Perth, Lyal completed M.Sc. and Ph.D. degrees in France in structural geology and tectonics. Lyal taught at the University of Western Australia between 1984 and 2000 and since 2003 has been a professor at the National Institute for Scientific Research (INRS-ETE) in Quebec City, Canada. He has consulted extensively and undertaken applied projects for mineral and petroleum exploration companies in diverse tectonic environments. His research integrates field structural studies, geophysical enhancement and interpretation, and analogue modelling applied to regional tectonics, controls on mineral deposits and, recently, deep geothermal energy. Research with his Geological Survey of Canada colleague, Jean Bédard, on new tectonic models for the Archaean with comparisons to the planet Venus was included in the top 10 scientific discoveries in Quebec Science for 2014 and was recognized in 2015 by a team research award from the Earth Sciences Sector of Natural Resources Canada.

## AUSTRALIAN EARTH SCIENCES CONVENTION NEWS



Uncover Earth's Past to  
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26 - 30 June 2016 – Adelaide Convention Centre

[aesc2016.gsa.org.au](http://aesc2016.gsa.org.au)

### Call for AESC theme and session suggestions

An exciting series of themes, symposia, fieldtrips and workshops is being put together by the AESC 2016 Organising Committee.



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A preliminary taste of what is to come and who to contact if you want to make suggestions is outlined below.

- Earth's Environment** – Past to Present
- Tectonics of the Earth and Other Planets** – Craton and Continental Formation and Evolution, Ocean Plate Tectonics, Plate Margin and Plate Interior Tectonism
- Deep Earth Geodynamics** – Core, Asthenosphere and Lithosphere Dynamics, Coupling the Dynamic Deep Earth with Surface Tectonics
- Mineral Endowment** – Formation and Exploration of Mineral Deposits, their Tectonic and Geochemical Environment and Significance
- Geoscience for Society** – Geotourism, Education, Integration and Translation of Earth Sciences for Societal Benefit, Open the Gate, Geoscience and Community Engagement
- The Earth Science of Energy** – From Hydrocarbons to Hot Rocks

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**PHOTO:** Pleistocene sediments of the Hindmarsh Clay (red) and unconformably overlying Bridgewater Formation (white) in cliff exposures at Balgowan, Yorke Peninsula, South Australia. Photo courtesy of Caroline Forbes

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**STUDENT FUNDING OPPORTUNITIES****Geological Society of Australia (Victoria Division) Student Research Scholarships**

The scholarship is valued at up to \$500 for travel within Australia and \$700 for travel outside of Australia. The number of and value of the scholarships awarded each year is made at the discretion of the GSA(Vic) committee.

Funding will not be granted retrospectively and applicants are asked to submit forms no later than 6 weeks prior to their trip to give the committee time to consider the application.

**Eligibility**

Applicants must be members of the GSA and enrolled in a full-time degree at a Victorian Tertiary institution and undertaking research in Geology. The scholarship will be awarded to assist with conference travel for honours and postgraduate students, who are presenting (either poster or talk) at the conference.

Honours and postgraduate students that receive this scholarship will be required to submit a report for publication in 'The Victorian Geologist' newsletter following to their trip. A presentation may also be requested by the committee, which will consist of a short 10-15 minute presentation prior to the monthly seminar.

Students who have previously received a GSAV research scholarship are not eligible. Scholarships and bursaries from other sources are acceptable.

Applications forms can be scanned and emailed to: [secretary@vic.gsa.org.au](mailto:secretary@vic.gsa.org.au)

or mailed to:

Geology Research Scholarships Victoria  
Geological Society of Australia (Victoria Division)  
GPO Box 2355  
Melbourne VIC 3001

More information can be found on our website [www.gsavic.org](http://www.gsavic.org) or by contacting Barbara Wagstaff ([wagstaff@unimelb.edu.au](mailto:wagstaff@unimelb.edu.au)).

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**Something interesting to share? Want to see your name in print?**

Don't be bashful, contribute to the GSA(V) monthly newsletter!

If there are any events, happenings, news, or views that would be of interest to the membership, please send your details and information to Kieran Iles at [kiles@student.unimelb.edu.au](mailto:kiles@student.unimelb.edu.au)

**We'd be glad to hear from you**

## FORTHCOMING SEMINARS AND EVENTS

to be presented at  
GSA (Victoria Division) meetings

Note: unless otherwise indicated, all 2016 talks will be held in the Fritz Loewe Theatre, Earth Sciences Building, University of Melbourne.

February 25th:

**Monthly Meeting:** Lyal Harris

Non-plate tectonic interpretations for the Superior Craton, Canada and Yilgarn Craton, Western Australia – exploration implications.

March 31st:

**Monthly Meeting:** TBA

June 2016:

**Howitt Lecture:** Erin Matchan

Ar-Ar dating of volcanoes and Indigenous oral tradition.

Please welcome our newest members



Visit the GSAV on [www.gsavic.org](http://www.gsavic.org) or the GSA on [www.gsa.org.au](http://www.gsa.org.au)  
• Renewing your GSA membership is easy - it can now be done online. •

### CONSIDER CONTRIBUTING TO TAG!

It is member contributions which make TAG a member magazine – please keep the contributions coming and assist with informing all of the membership (not just your Division) about your activities.

Please send your news to: [tag@gsa.org.au](mailto:tag@gsa.org.au)



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