Proposal for the establishment of a
Coordinating Committee of the

International Lithosphere Program (ILP) for 2021-2025

Lithosphere of East Antarctica

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I. Introduction

East Antarctica is the least investigated region of continental lithosphere on Earth. At the heart of the former supercontinent of Gondwana, much of the landmass has yet to be observed directly, and many terranes remain enigmatic under the cover of ice.

Although its location is remote from centres of human habitation, melt water from the great ice sheets of East Antarctica will significantly impact sea level rise in low-lying areas of many countries within a generation, and have a profound, extensive impact on generations to come. The lithosphere, together with the oceans and atmosphere, interacts with the ice sheets through feedbacks between coupled systems.

We propose to aid international programmes to combine their field, data-compilation, and computer modelling activities, drawing on best practice established in other continents, through the establishment of an ILP Coordinating Committee for the Lithosphere of East Antarctica.

II. Objectives

The overall objective is a step-change in knowledge that underpins plate tectonic structure, and the role of the lithosphere as it impacts and responds to ice sheet change. The key challenge to be addressed by the here-proposed Coordinating Committee is international coordination over 5 years to address data gaps in East Antarctica. During 2021-2025 we will write a 'white paper' and commence coordinated initiatives.

II. Objectives (continued)

Key topics to be addressed through gaining a more complete understanding of East Antarctica's lithosphere are (with indicative references only due to space constraints):

1. 3D Architecture of the Crust and Lithospheric Mantle
    a. to improve the understanding of East Antarctica's assembly through successive supercontinent cycles (Goodge et al., 1992; Reading, 2006; Boger, 2011; Peacock and Selway, 2016; Maritati et al., 2019).
    b. to inform the variation of physical properties, notably rheology, and the likely response to ice loading (Stål et al., 2019).
2. Current Plate Motions and Local GPS Site Velocities
    a. local motions including glacial isostatic adjustment (King and Santamaria-Gómez, 2016).
    b. impact of dynamic topography (Austermann et al., 2015).
3. Heat Flow
    a. as an indication of past and present tectonic processes (Martos et al., 2017).
    b. and its lateral heterogeneity as a boundary condition for ice sheet modellers.
4. Sedimentary Basins and Deposits
    a. as a record of erosion, uplift and flexure (Paxman et al., 2019).
    b. defining the basal conditions of major ice sheets and the likely response of ice sheets to global change (Whitehouse et al., 2018).

While East Antarctica is subject to a relatively low influence of active plate boundary processes, it has a complex and poorly constrained tectonic history, and its lithosphere has a significant influence on the ice sheets that hide much of the surface geology. Recent progress in Antarctic Earth Sciences has shown that integration of imaging, monitoring, plate reconstructions and process modelling (one of the main themes of ILP) is absolutely essential in progressing the understanding of the lithosphere in East Antarctica (Stål and Reading, 2019).

The strong interaction and feedbacks between the solid-Earth and non-solid Earth (a stated ILP challenge) is central to the key topics, outlined above, to be addressed through this coordinating committee. Further, the societal relevance of lithosphere research for East Antarctica (addressing a second ILP challenge) is clear with the potential to provide better quantified predictions of sea level rise. These world class problems are best addressed with a diverse coordinating committee and the involvement of Early and Mid-Career Researchers (EMCRs) at the outset is confirmed (a third ILP challenge).

III. Cooperation

We plan to hold our inaugural ILP ***Lithosphere of East Antarctica*** Coordinating Committee meeting at the Scientific Committee on Antarctic Research (SCAR) Open Science meeting in late July 2020, Hobart, Tasmania. Thereafter, we will hold workshops associated with the Annual EGU General Assembly and/or the SCAR Open Science meetings depending on year. The workshops will feature a showcase of recent contributions by EMCRs. Funds from ILP will leverage further contributions to these events and, in particular, will target diverse participation.

IV. Outreach

Outreach to the interdisciplinary research community will be directed through the appropriate SCAR working group, with the result that the ILP support for the Coordinating Committee for the Lithosphere of East Antarctica would provide a means of connecting the Antarctic community with best practice in other continents.
We are fortunate that co-Chair Dr Kate Selway is a Science and Technology Australia *Superstar of STEM* with exceptional talent and skills development experience in the public visibility of STEM, and in exemplifying inclusion, diversity and equity in Earth Sciences. Dr Selway will lead the public outreach for this coordinating committee.

V. Key partners in the planned coordinating committee / East Antarctica

- New partners are welcome in this initiative and should contact the named Chair.
- The Chair, and 13 of 32 (40%) of the planned coordinating committee, are female.

Name / Institute	**Expertise Area**	**Additional Notes / Diversity**
Anya Reading, UTAS Kate Selway, Macquarie U Matt King, UTAS	Seismology / Integrated Geosci. Magnetotellurics / Sci. Comm. Geodesy	**Chair** **Co-Chair, Mid- Career** **Co-Chair**
Jaqueline Halpin, UTAS Nathan Daczko, Macquarie U Tom Raimondo, U SA Ian Fitzsimons, Curtin U Steve Boger, U Melbourne John Goodge, U Minnesota Joachim Jacobs, U Bergen Mark Fanning, ANU Affiliate Alessandro Maritati, UTAS	Geology / Geochronology	Mid- Career Early Career / Finishing PhD
Joanne Whittaker	Plate Tectonics / Sed. Basins	Mid- Career
Doug Wiens, Washington U Weisen Shen, Stoneybrook Erica Emry, New Mexico Tech Samantha Hansen, U Alabama	Seismology	 Early Career Early Career Mid- Career
Yasmina Martos, NASA Fausto Ferraccioli, BAS Antonia Ruppel, BGR	Magnetics	Mid- Career Early Career
Alan Aitken, UWA	Gravity / Sedimentary Basins	Mid- Career
Jörg Ebbing, Kiel Tobias Stål, UTAS	Satellite / Integrated Geoscience	 Early Career / Finishing PhD

Ricarda Dziadek, AWI	Heat Flow (liaison)	Early Career
Pippa Whitehouse, U Durham Catherine Ritz, Grenoble	Modelling (liaison)	Mid- Career
Alex Burton-Johnson, BAS Christine Smith-Siddoway, CC	West Antarctica (liaison)	Mid- Career
Erdinç Saygin, CSIRO	Australia (liaison)	Mid- Career
Andrew Nyblade, Penn State U	Africa (liaison)	
Takuji Nakamura, NiPR	Japan (liaison)	
Alessia Maggi, U Strasbourg	France (liaison)	
TBC	India (liaison)	
TBC	China (liaison)	
TBC	Russia (liaison)	

VI. References

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Boger, S. D., 2011: Antarctica — Before and after Gondwana, Gondwana Research, 19, 335–371, https://doi.org/10.1016/j.gr.2010.09.003.

Goodge, J. W., Hansen, V. L., and Peacock, S. M., 1992: Multiple petrotectonic events in high-grade metamorphic rocks of the Nimrod Group, central Transantarctic Mountains, Antarctica, Recent Progress in Antarctic Earth Science. Terra Scientific, Tokyo, pp. 203–209.

King, M.A. and Santamaria-Gómez, A., 2016, Ongoing deformation of Antarctica following recent Great Earthquakes. Geophysical Research Letters 43 (5), 1918-1927.

Maritati, A., Halpin, J. A., Whittaker, J. M., and Daczko, N. R., 2019: Fingerprinting Proterozoic bedrock in interior Wilkes Land, East Antarctica, Scientific Reports, 9, 10 192.

Martos, Y. M., Catalán, M., Jordan, T. A., Golynsky, A., Golynsky, D., Eagles, G., and Vaughan, D. G., 2017: Heat Flux Distribution of Antarctica Unveiled, Geophysical Research Letters, 44, 11,417–11,426, https://doi.org/10.1002/2017gl075609.

Reading, A. M., 2006: The Seismic Structure of Precambrian and Early Palaeozoic Terranes in the Lambert Glacier Region, East Antarctica, Earth and Planetary Science Letters, 244, 44–57, https://doi.org/10.1016/j.epsl.2006.01.031.

Paxman, G. J. G., Jamieson, S. S. R.,Ferraccioli, F., Bentley, M. J., Ross, N.,Watts, A. B., et al., 2019; The role of lithospheric flexure in the landscape evolution of the Wilkes Subglacial Basin and Transantarctic Mountains, East Antarctica. J. Geophys. Res.,124, 812–829.https://doi.org/10.1029/2018JF004705.

Peacock, J.R. and Selway, K., 2016: Magnetotelluric Investigation of the Vestfold Hills and Rauer Group, East Antarctica. Journal of Geophysical Research: Solid Earth 121 (4), 2258-2273

Stål, T. and Reading, A. M., 2019: A grid for multidimensional and multivariate spatial modelling and processing., Journal of Open Research Software, https://doi.org/10.5281/zenodo.2553966, https://github.com/TobbeTripitaka/agrid.git.

Stål, T., Reading, A. M., Halpin, J. A., and Whittaker, J. M., 2019: A multivariate approach for mapping lithospheric domain boundaries in East Antarctica, Geophysical Research Letters, https://doi.org/10.1029/2019gl083453.

Whitehouse, P. L., 2018: Glacial isostatic adjustment modelling: historical perspectives, recent advances, and future directions, Earth Surface Dynamics, 6, 401–429, https://doi.org/10.5194/esurf-6-401-2018.

Curriculum Vitae Chair:
Professor Anya M. Reading

Current Positions:

Professor of Geophysics, Physics, University of Tasmania
Associate Head of Research, School of Natural Sciences, University of Tasmania
Adjunct Professor, Institute for Marine and Antarctic Studies, University of Tasmania
Immediate-past Director, ANSIR Facility for Earth Imaging, Australia

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Education & professional experience

Education

1997 Ph.D. Seismology, University of Leeds
1991 B.Sc. Geophysics (Hons), University of Edinburgh

Professional Appointments

2018-present Professor of Geophysics, Physics, University of Tasmania
2018-present Associate Head of Research, School of Natural Sciences, University of Tasmania
2007-2017 Senior Lecturer / Professor of Geophysics, Earth Sciences, University of Tasmania
2000-2007 Research Fellow/Fellow, Res. Sch. of Earth Sciences, Australian National University
1998-2000 Lecturer in Geophysics, University of Edinburgh
1995-1998 Higher Scientific Officer, British Antarctic Survey

Responsibilities

Chair of the ILP ***Lithosphere of East Antarctica*** Coordinating Committee; Lead integration of seismology; Lead integration of heat flow and sediments/tectonics components; Lead integration of multiple techniques including geological and geochronological observations with geophysics; Dissemination of computational innovation and coordination of training; Liaison with international partners and organisations; Oversight of funds; Coordination of ILP ***Lithosphere of East Antarctica*** workshop events.

5 Recent Key Publications by the Proponent Relating to the Proposed Coordinating Committee

Kennett, B. L. N., Salmon, M., Saygin, E., and Working Group including Reading, A. M., 2011: AusMoho: the variation of Moho depth in Australia, Geophysical Journal International, vol. 187, no. 2, pp. 946-958.

Reading, A. M., 2006: The seismic structure of Precambrian and early Palaeozoic terranes in the Lambert Glacier region, East Antarctica, Earth and Planetary Science Letters, vol. 244, 44–57, https://doi.org/10.1016/j.epsl.2006.01.031.

Reading, A. M. 2007: The seismicity of the Antarctic plate, in, Continental Intraplate Earthquakes: Science, Hazard, and Policy Issues: Geological Society of America Special Paper, vol. 425, Geological Society of America, United States, pp. 285-298.

Reading, A. M. & Heintz, M. 2008: Seismic anisotropy of East Antarctica from shear-wave splitting: Spatially varying contributions from lithospheric structural fabric and mantle flow?, Earth and Planetary Science Letters, vol. 268, no. 3-4, pp. 433-443.

Stål, T., Reading, A. M., Halpin, J. A., and Whittaker, J. M., 2019: A multivariate approach for mapping lithospheric domain boundaries in East Antarctica, Geophysical Research Letters, https://doi.org/10.1029/2019gl083453.

Curriculum Vitae co-Chair:
Dr Kate Selway

Current Positions:

Australian Research Council Future Fellow
Senior Lecturer, Macquarie University
Science and Technology Australia Superstar of STEM
Adjunct Associate Research Scientist, Lamont-Doherty Earth Observatory, Columbia University

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Education & professional experience

Education:
2007: PhD in geophysics from the University of Adelaide
2002: B. Sc (Hons) in geology and geophysics from the University of Adelaide

Professional appointments:
2017-present: ARC Future Fellow and Senior Lecturer in geophysics, Macquarie University (Sydney)
2016: Postdoctoral research associate, Centre for Earth Evolution and Dynamics, University of Oslo
2013-2015: Associate research scientist, Lamont-Doherty Earth Observatory, Columbia University (New York)
2012: Postdoctoral research associate, Yale University
2009-2012: ARC Postdoctoral Fellow, University of Adelaide2007-2009: Postdoctoral research associate, University of Adelaide

Responsibilities

Lead integration of magnetotellurics and potential field geophysics; determination of lithospheric thermal and chemical state from geophysics within the Coordinating Committee; lead the strategic development and implementation of outreach plans via social media, the mainstream media, and public engagements.

5 Recent Key Publications by the Proponent Relating to the Proposed Coordinating Committee

O'Donnell, J.P., Selway, K., Nyblade, A.A., Brazier, R.A., Wiens, D.A., Anandakrishnan, S., Aster, R.C., Huerta, A,D., Wilson, T., Winberry J.P., 2017: The uppermost mantle seismic velocity and viscosity structure of central West Antarctica, *Earth and Planetary Science Letters 472*.

O'Donnell, J.P., Stuart, G.W., Brisbourne, A.M., Selway, K., Yang, Y., Nield, G.A., Whitehouse, P.L., Nyblade, A.A., Wiens, D.A., Aster, R.A., Anandakrishnan, S., Huerta, A.D., Wilson, T., Winberry, J.P., 2019: The uppermost mantle seismic velocity structure of West Antarctica from Rayleigh wave tomography: Insights into tectonic structure and geothermal heat flow, *Earth and Planetary Science Letters 522.*

Peacock, J. and Selway, K. 2016: Magnetotelluric investigation of the Vestfold Hills and Rauer Group, East Antarctica, *Journal of Geophysical Research: Solid Earth 121*.

Selway, 2014: On the causes of electrical conductivity anomalies in tectonically stable lithosphere, *Surveys in Geophysics 31 (1)*.

Wannamaker, P., Hill, G., Stodt, J., Maris, V., Ogawa, Y., Selway, K., Boren, G., Bertrand, E., Uhlmann, D., Ayling, B., Green, A.M., Feucht, D., 2017: Uplift of the central Transantarctic mountains, *Nature Communications 8 (1)*.

Curriculum Vitae co-Chair:
Professor Matt King

Current Positions:

Professor of Polar Geodesy, University of Tasmania
Head of Discipline, Geography and Spatial Sciences
Co-Chair SCAR SERCE Scientific Research Program and member SCAR Geodetic Infrastructure of Antarctica (GIANT) expert group
IUGG Council Member and co-chair of IAG Sub-commission 3.4 "Cryospheric Deformation"

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Education & Professional Experience

Education
2002 Ph.D. Geodesy, University of Tasmania
1996 B.Surv. (1st Class Hons.) Surveying and Spatial Information Science, University of Tasmania

Professional appointments
2012-present Professor of Polar Geodesy, University of Tasmania
2017-present Head of Discipline, Geography and Spatial Sciences, University of Tasmania
2017-present Deputy Director, Antarctic Gateway Partnership
2012-2016 ARC Future Fellow, University of Tasmania
2012-2013 Professor of Polar Geodesy, University of Newcastle upon Tyne
2009-2012 RCUK Academic Fellow, University of Newcastle upon Tyne
2008-2012 Reader in Polar Geodesy, University of Newcastle upon Tyne
2005-2008 NERC Fellow & Senior Research Associate, University of Newcastle upon Tyne
2002-2005 Research Associate, University of Newcastle upon Tyne
2001-2002 Junior Research Associate, University of Newcastle upon Tyne

Responsibilities

Lead integration of geodesy within the Coordinating Committee; Coordination of effort and communication across International Association of Geodesy (particularly Commission 3), IUGG more broadly, SCAR GIANT Expert Group and SCAR SERCE (and subsequent Scientific Research Programs); provision of three-dimensional surface bedrock velocity field from GNSS.

5 Recent Key Publications by the Proponent Relating to the Proposed Coordinating Committee

King, M.A., P.L. Whitehouse and W. van der Wal 2016. Incomplete separability of Antarctic plate rotation from glacial isostatic adjustment deformation within geodetic observations. *Geophysical Journal International*, **204**(1): 324-330.

Martín-Español, A., M.A. King, A. Zammit-Mangion, S.B. Andrews, P. Moore and J.L. Bamber 2016. An assessment of forward and inverse GIA solutions for Antarctica. *Journal of Geophysical Research: Solid Earth*, **121**(9): 6947-6965.

Nield, G.A., V.R. Barletta, A. Bordoni, M.A. King, P.L. Whitehouse, P.J. Clarke, E. Domack, T.A. Scambos and E. Berthier 2014. Rapid bedrock uplift in the Antarctic Peninsula explained by viscoelastic response to recent ice unloading. *Earth and Planetary Science Letters*, **397**: 32–41.

Whitehouse, P.L., N. Gomez, M.A. King and D.A. Wiens 2019. Solid Earth change and the evolution of the Antarctic Ice Sheet. *Nature Communications*, **10**(1): 503.

Zhao, C., M. King, C.S. Watson, V.R. Barletta, A. Bordoni, M. Dell and P.L. Whitehouse 2017. Rapid ice unloading in the southern Antarctic Peninsula and its effect on bedrock uplift rates. *Earth and Planetary Science Letters*.