AuScope Australian Geophysical Observing System

Introduction

Development of AuScope's Australian Geophysical Observing System is funded through the Education Investment Fund (EIF3) designed to augment existing NCRIS AuScope infrastructure with new capability that focuses particularly on emerging geophysical energy issues. It will build the integrated infrastructure that facilitates maximum scientific return from the massive geo-engineering projects that are now being considered – such as deep geothermal drilling – in effect building the platform for treating these as mega geophysical science experiments. AuScope AGOS infrastructure will enable collection of new baseline data including surface geospatial and subsurface imaging and monitoring data, thereby providing for better long-term management of crustal services, particularly in Australia's energy-rich sedimentary basins.

Project Description

AuScope AGOS will build a nationally integrated research infrastructure platform focused on delivering the understanding of the physical state of the accessible crust that is crucial to meeting secure, sustainable future energy needs. It focuses on boosting knowledge generation in the geosciences – already Australia's leading research field by international measures.

The Earth's crust provides many crucial services essential to the wealth and health of human society: the platform on which we live, the mineral, energy and groundwater resources on which we depend and, increasingly, a secure repository for our hazardous waste. A new level of understanding is required to comprehend the capacity of, and threats to, existing and emerging crustal services. In particular, the provision of cheap and secure, reliable and sustainable energy into the future will be predicated on our success in meeting this challenge.

To achieve this, AGOS will deliver new, cheaper ways of monitoring, imaging and modelling the accessible crust and its resource inventories in unprecedented level of detail. It will build on the estimated multibillion-dollar investment in deep drilling through provision of a national subsurface observatory, making existing deep boreholes available to the geoscience research community. Allowing both direct and indirect probing of the upper 5km of the crust, AGOS will provide the first integrated crustal observatory, augmenting remote geophysical methods with new capability in direct subsurface methods.

AGOS will provide the infrastructure that will underpin the geophysical research communities, and provide a platform for training the next generation of geophysical researchers. Strengthening geophysics research and training is a major national issue. Capacity-building is required for the next generation of geophysical and geoscience challenges. More than 100 researchers based in the 14 partner organisations, together with collaborating scientists from all national geophysics centres, will have access to the infrastructure and, through research projects, deliver new PhD graduates across the country, while also delivering new possibilities for the broader community in energy provision through geothermal, waste storage and groundwater.

Understanding the accessible crust, and the services it can provide, will provide crucial information as we rebuild our energy production infrastructure to insure that it best serves the needs of both present and future generations. In providing new options for secure energy supply AuScope AGOS will help underpin a modern productive competitive economy.

Description of Infrastructure

AuScope AGOS will create specific capability for enhanced data acquisition, and simulation capabilities,for the geophysics of the shallow crust of the Australian continent. And will deliver a new

geophysical observing capability designed to characterise and monitor the physical state and behaviour of the accessible crust..

It will build on the infrastructure developed by AuScope in geospatial and imaging areas making available new seismometers, borehole strain meters, GPS stations, and a host of other scientific instruments to provide new capability exploring new realms of the continent – from the ocean fringe to the deepest levels of the crust accessible by drilling. This targeted investment will deliver an integrated observing system across the Nation involving:

- Geospatial Observatory: lead nodes ANU and GA
- Earth Sounding Network: lead nodes ANU and University of Adelaide
- Subsurface Observatory: lead nodes Univesity of Melbourne
- Geohistory Laboratory: lead nodes University of Melbourne and JdL Centre Curtin University
- Inversion Laboratory: University of Queensland and ANU
- Geophysical Education Observatory: Macquarie University, ANU and Geoscience Australia

It will add new capabilities through the first national subsurface observatory, designed to allow geosciences researchers to conduct experiments at depths of up to 5 km.

AuScope AGOS infrastructure will include (refer Table 1):

- The ***Geospatial Observatory*** – involving a GNSS intrumentation pool of including GPS stations, high precision monuments; corner cube reflectors; establishment of monitoring sites; library of remote sensed data and robotic antenna systems all designed for improved precision and accuracy for geospatial science.
- The ***Earth Sounding Network*** - will build new generation seismic recorders, and purchase or build a pool of Ocean-Bottom Seismometers, Earth data recorders and electric field multichannel loggers. It will make available 100 new temporary seismometers and a host of other scientific instruments to provide new capability exploring new realms of the continent.
- The ***Subsurface Observatory*** – including infrastructure to facilitate access to deep drill holes and establish equipment for downhole tests, including a downhole logging toolkit, the facility for in situ stress measurement and laboratory equipment for acquiring petrophysical measurements on material recovered from depth.
- The ***Geohistory Laboratory*** – infrastructure for automated thermochronology e.g. AFTA and U-Th—Pb- He analysis by double-dating techniques.
- The ***Inversion Laboratory*** - will create 2 classes of inversion software for analysing and modelling the physical state of the crust and to allow solution of generic inversion problems.
- The ***Geophysical Education Observatory*** - will develop digital real time connection to existing teaching laboratories through the siesmometers –in-schools program to use the national observatory. It will, provide a unique opportunity for integrating scientific research and education by engaging students, teachers, and the public in a national experiment that is going onacross the country.

AGOS Partners

The partners listed below will support AuScope AGOS as cash and in-kind co-investors

Australian National University	GeoScience Victoria
University of Queensland	Geological Survey Queensland
University of Adelaide	PIRSA
University of Melbourne	Petratherm Limited
Curtin University (JdLCMS)	AuScope Limited
Macquarie University	CSIRO
Geoscience Australia	

Proposed Equipment and Instrumentation List at application(Table1)

	AuScope Australian Geophysical Observing System Equipment List			
	Description	**Cost**	**Location**	**Total Cost**
AGOS-Spatial	**GNSS instrumentation pool**	100 units x $18,000 = $1,800,000	ANSIR	$1,800,000
	Robotic calibration system	1 x $800,000	ANSIR	$800,000
	Precision total station	1 x $84,000	ANSIR	$84,000
	Survey targets	10 targets x $2,000 = $20,000	ANSIR	$20,000
	Environmental enclosure	1 x $3,000	ANSIR	$3,000
	Temperature sensors and loggers	3 x $15,000 = $45,000	ANSIR	$45,000
	GNSS monuments	$1,000,000 ($1,000 to $10,000 per target)	Permanently deployed to AuScope+ study areas.	$1,000,000
	Radar reflectors	$900,000	Permanently deployed to AuScope+ study areas.	$900,000
	Permanent GNSS CORS station	4 x $90,000 = $360,000	Permanently deployed to AuScope+ study areas.	$360,000
	Remote sensing data	5000 scenes x $40 = $200,000	Geoscience Australia will be the custodian.	$200,000
subtotal				**$5,212,000**
AGOS-Inversion	**Generic inversion software toolkit**	Estimated costs for development $500k over four years. Development by 1.25FTE programmers	location of development ANU and UQ, usage national/internationa	$500,000
	Geophysical software suite for AuScope data	Estimated costs for development $500k over four years. Development by 1.25FTE programmers	location of development ANU and UQ, usage national/internationa	$500,000
	24 IBM x3550 M2 server compute nodes for TerraWulf inversion platform	Estimated costs $300k	location ANU, usage national	$300,000
	Escript inversion software suite	Estimated development costs $300k over four years	location UQ, usage national/international.	$300,000
subtotal				**$1,600,000**
AGOS-Sounding	**100 Seismic Recorders**	Estimated costs $12K each (including development costs)	location of storage ANU, usage national	$1,200,000
	20 Ocean Bottom Seismometers	Estimated cost $100K each	location of storage ANU, usage national/international	$2,000,000
	16 Earth Data Recorders (compatible with existing AuScope data loggers)	$25K per unit	location of storage ANU, usage national/international	$400,000
	100 Electric field loggers (MT)			$350,000
subtotal				**$3,950,000**
AGOS-Subsurface Observatory	**Workover rig collar**	1x$400,000	UoM	$400,000
	borehole logging toolkit	Summed costs based on assembling components from individual suppliers = $1,071,000	UoM	$1,071,000
	borehole seismometry	6 x$54,000 and 20x $15,200	UoM	$627,000
subtotal				**$2,348,000**
AGOS-Education	**seismomemters**	45x$10,0000	Various secondary schools	$450,000
	GPS receiver and antenna and mount point	20x$40,000	Various secondary schools	$800,000
subtotal				**$1,250,000**
AGOS-Geohistory	**Agilent 7700X ICP-Mass Spectrometer**		UoM	$310,000
	Zeiss LSM700 Laser Scanning Microscopy attachment		UoM	$180,000
	Struers Tegra System Automated polishing Unit		UoM	$53,000
	ICP-MS with solution chemistry ability		Curtin	$330,000
	Excimer laser + chiller		Curtin	$381,000
subtotal				**$1,254,000**
Total				**$15,614,000**