

**Application for Consent to Conduct Marine Scientific Research
in Areas Under National Jurisdiction of**

Tonga

**Date: 5-22-09
Updated**

1. General Information

1.1 Cruise name and/or #:	Collaborative Research: Crustal accretion and mantle processes along the subduction-influenced Eastern Lau Spreading Center
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1.2 Sponsoring institution:	
Name:	National Science Foundation
Address:	4201 Wilson Boulevard, Arlington, Virginia 22230 Division of Ocean Sciences (GEO/OCE)
Name of Director:	Julie D Morris, Division Director

1.3 Scientist in charge of the project (include CV and passport photo):	
Name:	Douglas A. Wiens, Professor and Chair
Address:	Dept. of Earth and Planetary Sciences Washington University 1 Brookings Drive St. Louis, MO 63130 USA
Telephone:	314-935-6517
Fax:	314-935-7361
Email:	doug@wustl.edu

1.4 Scientist(s) from coastal state involved in the planning of the project:	
Name(s):	Kelepi Mafi, (kelepi2562@gmail.com or geology@kalianet.to)
Address:	Tonga Ministry of Lands, Survey, Natural Resources and Environment, Nuku'alofa, Tonga

1.5 Submitting officer:	
Name and address:	Elizabeth Brenner/Rose M. Dufour Scripps Institution of Oceanography University of California, San Diego La Jolla, California 92093-0210
Nationality:	USA
Telephone:	(858)534-2841
Fax:	(858) 822-5811
Email:	shipsked@ucsd.edu

2. Description of Project (Attach additional pages as necessary)

2.1 Nature and objectives of the project:

As part of the global pattern of mantle convection and lithospheric motion, mid-ocean ridges and back-arc spreading centers mark the boundaries where oceanic plates separate from one another. As the mantle rises beneath the ridges to replace material that moves laterally away, the melting-point of the mantle decreases and it undergoes pressure-release partial melting. The newly formed melt, being less viscous and less dense than the surrounding solid, segregates from the residual mantle matrix and buoyantly rises toward the surface, where it forms new oceanic crust. The generation and volcanic expulsion of melt along mid-ocean ridges is perhaps the most important geological process shaping the earth; it produces over two thirds of the global crust and is a primary means of geochemical differentiation in the Earth. Around the global mid-ocean ridge system, heat from the mantle drives vast hydrothermal systems that influence ocean water chemistry and nourish enormous ecosystems. By affecting the chemical and thermal make-up of our oceans, mid-ocean ridges may influence global climatic conditions. Understanding cycles of mass and energy flux through the mid-ocean ridge systems helps us understand the history of our planet and predict its future. The RIDGE 2000 program was developed within the National Science Foundation to facilitate the study of mid-ocean ridges and back-arc spreading centers. Within this program, the Lau Integrated Studies Site (Lau ISS) initiative is an interdisciplinary research program focused on understanding the combined mass, fluid, thermal, and biological processes interacting within the Eastern Lau Spreading Center (ELSC). Our proposed seismic survey is part of the Lau ISS initiative and its main purpose is to image the magmatic systems and thermal structure of the Eastern Lau Spreading Center. These images will be used to build up a framework of understanding of the magma supply and volcanic processes along the ridge and the source of heat for the hydrothermal systems that support the biological communities. The survey will involve one vessel, the R/V *Melville*, which will operate in the Lau Basin within a box demarcated by the latitudes 19°S - 22°S and longitudes 174°W – 179°W. The *Melville* will deploy a network of 54 Ocean Bottom Seismometers (OBS). Each OBS will record with a 3-component broadband or semi-broadband seismometer and a hydrophone or differential pressure gauge. The locations of some OBSs on the seafloor will be determined by acoustic navigation. The *Melville* will also deploy 4 ocean bottom EM instruments. The OBSs and OBEMs will remain deployed at the end of the cruise and will be recovered in a cruise late in 2010. The instruments record passively so there will be no use of an airgun or other seismic source. A multibeam echosounder (MBES) will also be operated during most of the deployment to ensure that the bathymetry at the OBS drop site is appropriate.

2.2 Relevant previous or future research cruises:

R/V Langseth (MGL09-003) January-February 2009 An OBS pickup cruise will be scheduled in late 2010

2.3 Previously published research data relating to the project:

Martinez, F., and B. Taylor, Mantle wedge control on back-arc crustal accretion, *Nature*, 416, 417-420, 2002. Martinez, F, Taylor, B, Modes of crustal accretion in back-arc

basins: inference from the Lau Basin, Geophysical Monograph Series, 166, 5-30, 2006. Conder, J. A., and D. A. Wiens, Seismic structure beneath the Tonga arc and Lau back-arc basin determined from joint Vp. Vp/Vs tomography, *Geochem., Geophys. Geosyst.*, 7 Q03018, doi:10.1029/2005GC001113, 2006. Martinez, F., Taylor, B., Baker, E. T., Resing, J. A., Walker, S. L., Opposing trends in crustal thickness and spreading rate along the back-arc Eastern Lau Spreading Center: Implications for controls on ridge morphology, faulting, and hydrothermal activity, *Earth and Planetary Science Letters*, 245, 655-672, 2006. Allison M. Jacobs, Alistair J. Harding and Graham M. Kent, Axial crustal structure of the Lau back-arc basin from velocity modeling of multichannel seismic data, *Earth and Planetary Science Letters*, 259, 3-4, 239-255, 2007.

3. Methods and Means to be Used

3.1 Particulars of vessel:	
Name:	R/V <i>Melville</i>
Nationality (Flag state):	USA
Owner:	Office of Naval Research
Operator:	Scripps Institution of Oceanography
Overall length (meters):	85 m
Maximum draught (meters):	5 m
Displacement/Gross tonnage:	2,516
Propulsion:	Two 1385 hp Z-Drive
Cruising & Maximum speed:	11.7 knots, 14 knots
Call sign:	WECB
Method and capability of communication (including emergency frequencies):	<p><u>Email</u> <u>master@rv-melville@ucsd.edu</u></p> <p>F77 Voice</p> <p>Telephone</p> <p>Pacific 011-872-763452498</p> <p>F-77 FAX</p> <p>Pacific 011-872-</p> <p>81600255637</p> <p>Telex 81600255637</p> <p>(AnsBk=WECB)</p> <p>Vessels guard standard GMDSS frequencies for calling, distress and dissemination of marine safety information.</p> <p>MMSI # 366784000</p> <p>SELCAL # 11024</p>
Name of master:	Capt. Christopher Curl
Number of crew:	23
Number of scientists on board:	15

3.2 Aircraft or other craft to be used in the project:	
none	

3.3 Particulars of methods and scientific instruments		
Types of samples and data	Methods to be used	Instruments to be used
Digital Seismograms	Continuous digital recording with using a ocean bottom seismographs	54 OBSs will be provided by the Lamont-Doherty and Woods Hole OBSIP instrument facilities. Each instrument will record 4 channels – a 3 component broadband seismograph and a hydrophone or differential pressure gauge.
Electromagnetic (EM) data	Continuous digital recording with ocean bottom EM sensors	4 OBEM instruments will be supplied by N. Seama (Kobe University)
Digital Seafloor topography	<i>Melville's</i> multi-beam sonar system	EM120 multibeam
Underway (UW) multibeam and single beam	Swath mapping Sub-Bottom Profiler	EM120 multibeam, 12khz and Knudsen 320 B 3.5 / 12
UW Mags if available.	Magnetometer deployment	Marine Magnetics total field gradiometer
UW Gravity if available	Gravimeter	Bell Gravimeter

3.4 Indicate whether harmful substances will be used:
None

3.5 Indicate whether drilling will be carried out:
None

3.6 Indicate whether explosives will be used:
No

4. Installations and Equipment

Details of installations and equipment (dates of laying, servicing, recovery; exact locations and depth):

54 ocean bottom seismometers will be deployed over the period Nov 20-Dec 4, 2009.
The positions of the instrument deployments are (longitude/latitude):

1	-176.8096686	-19.17393817
2	-175.4386847	-19.24755688
3	-176.0140195	-19.5491184
4	-176.0838957	-19.89897689
5	-177.6214825	-19.62785423
6	-177.1179071	-19.79826476
7	-176.8960923	-19.85951945
8	-176.7016114	-19.93726578
9	-176.533518	-19.99380856
10	-176.3885588	-20.04250133
11	-176.2660187	-20.08569059
12	-176.0050055	-20.16972259
13	-175.9227515	-20.19720239
14	-175.8455333	-20.22547378
15	-175.7255212	-20.26474275
16	-175.5828382	-20.31343551
17	-175.4292477	-20.36604857
18	-175.2756572	-20.41787946
19	-175.1480814	-20.46186032
20	-174.4279686	-20.71551126
21	-176.8283513	-20.14458933
22	-176.3860409	-20.29772604
23	-176.1166281	-20.26316897
24	-175.8648404	-20.4626425
25	-176.7184006	-20.42730325
26	-176.1913284	-20.49091389
27	-176.1543962	-20.62127328
28	-175.6365495	-20.80974923
29	-174.7922248	-20.90869911
30	-176.1695035	-20.72022316
31	-176.997885	-20.58178757
32	-176.589153	-20.7327945
33	-176.2240608	-20.88906934
34	-175.9798268	-20.98566326
35	-176.2643469	-21.04142387
36	-177.5971397	-20.71551126
37	-177.1075939	-20.87257769
38	-176.8182798	-20.96917162
39	-176.6873502	-21.02335845
40	-176.5838755	-21.05791552
41	-176.48592	-21.09561071
42	-176.3919126	-21.12466428
43	-176.3155403	-21.15686539

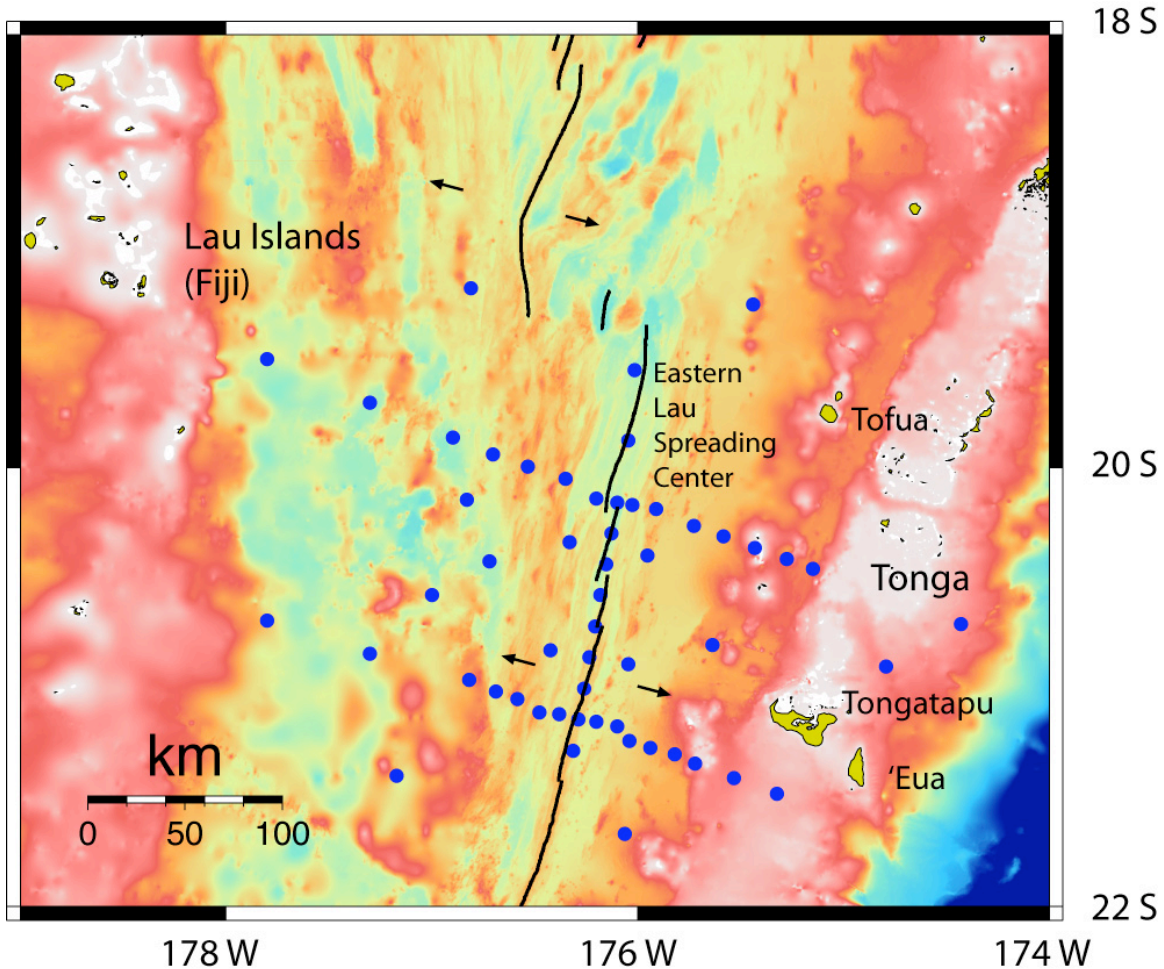
44	-176.2248968	-21.18827491
45	-176.1292174	-21.21419035
46	-176.0385739	-21.24717365
47	-175.9370229	-21.28093911
48	-175.8203948	-21.30847545
49	-175.721553	-21.35146681
50	-175.5305267	-21.41595386
51	-175.3231745	-21.48892233
52	-177.1724746	-21.40576674
53	-176.3907745	-21.42953355
54	-176.0613053	-21.66992521

5. Geographical Areas

5.1 Indicate geographical areas in which the project is to be conducted (with reference in latitude and longitude):

Operations will be conducted in a box with latitudes 19°S - 22°S and longitudes 174°W – 179°W

5.2 Attach chart(s) at an appropriate scale (1 page, high-resolution) showing the geographical areas of the intended work and, as far as practicable, the positions of intended stations, the tracks of survey lines, and the locations of installations and equipment.



OBS locations are shown on the above map as blue circles.

6. Dates

6.1 Expected dates of first entry into and final departure from the research area of the research vessel:

20 November to 8 December 2009

6.2 Indicated if multiple entry is expected:
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No.

7. Port Calls

7.1 Dates and names of intended ports of call:
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Nuku'alofa, Tonga 18-20 November 2009

Suva Harbor, Fiji Islands 5-8 December 2009

7.2 Any special logistical requirements at ports of call:

To re-provision and possibly fuel.

7.3 Name/Address/Telephone of shipping agent (if available):

Nuku'alofa, Tonga

Dates

25-27 November 2009

Ship's Agent

Eckington Ltd.

T/A PFL Tonga

Street Address

Suite 1-5, South Building

Fakafanua Centre, Cnr Vuna Rd and By Pass Road

Nuku'alofa, Tonga

Postal Address

PO Box 1346

Nuku'alofa, Tonga

Tel: (+ 676) 23-012 / 24-341

Fax: (+ 676) 23-345

Web: www.pflnz.co.nz

POCs

Captain Latu Lui, Operations Manager, latul@forumshipping.to

Derek Leonard, General Manager, derek1@forumshipping.to

Agency Oversight by: australia@iss-shipping.com.au

Note: include all three POCs on all email correspondence regarding MELVILLE at Nuku'alofa.

8. Participation:

8.1 Extent to which coastal state will be enabled to participate or to be represented in the research project:

A representative from Tonga is welcome to participate in the cruise

8.2 Proposed dates and ports for embarkation/disembarkation:

Nov 20, 2009 Nuku'alofa, Tonga

Dec 5, 2009 Suva, Fiji

9. Access to data, samples and research results

9.1 Expected dates of submission to coastal state of preliminary reports, which should include the expected dates of submission of the final results:

Preliminary reports shall be delivered no more than 60 days from the end date of the cruise

9.2 Proposed means for access by coastal state to data and samples:

CD or DVD provided.

9.3 Proposed means to provide coastal state with assessment of data, samples and research results or provide assistance in their assessment or interpretation:

Assessment of data, samples and research results will be provided through a Scientific Report (the final Cruise Log and Report), through personal communication, and through publication in international, peer-reviewed scientific journals.

9.4 Proposed means of making results internationally available:

Results will be published in international, peer-reviewed scientific journals.

Results will also be presented at various international scientific meetings.



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PERSONAL: Born May 1, 1958, Minneapolis, Minnesota

EDUCATION:

Wheaton College (Ill.), Physics, B.S., 1980
Northwestern University, Geological Sciences, M. S., 1982

Northwestern University, Geological Sciences, Ph. D., 1985

PROFESSIONAL EXPERIENCE:

Department Chair, Earth & Planetary Sciences, Washington U, 2008-present
Professor, Earth & Planetary Sciences, Washington University, 1996-present
Visiting Fellow, Australian National University, 2005
Associate Professor, Washington University, 1991-1996
Assistant Professor, Washington University, 1984-1991

RECENT HONORS: Elected American Geophysical Union Fellow, 2007
NSF - Ridge2000 Distinguished Lecturer, 2007

5 CLOSELY RELATED PUBLICATIONS

- Wiens, D. A., and N. O. Snider, Repeating deep earthquakes: Evidence for fault reactivation at great depth, *Science*, 293, 1463-1466, 2001.
- Wiens, D. A., P. J. Shore, S. H. Pozgay, A. W. Sauter, and R. A. White, Tilt Recorded by a Portable Broadband Seismograph: The 2003 Eruption of Anatahan Volcano, Mariana Islands, *Geophys. Res. Lett.*, 32, L18305, doi:10.1029/2005GL023369, 2005.
- Wiens, D.A., K. Kelley, and T. Plank, Mantle temperature variations beneath active back-arc spreading centers inferred from seismology, petrology, and bathymetry, *Earth Planet. Sci. Lett.*, 248, 30-42, 2006.
- Wiens, D. A., S. Anandakrishnan, J. P. Winberry, and M. King, Simultaneous teleseismic and geodetic observations of the stick-slip motion of an Antarctic ice stream, *Nature*, 453, 770-774, 2008.
- Wiens, D. A., J. A. Conder, and U. H. Faul, The seismic structure and dynamics of the mantle wedge, *Ann. Rev. Earth. Planet. Sci.*, 36, 421-455, 2008.

5 OTHER PUBLICATIONS

- Smith, G. P., D. A. Wiens, K. M. Fischer, L. M. Dorman, S. C. Webb, and J. A. Hildebrand, A complex pattern of mantle flow in the Lau backarc, *Science*, 292, 713-716, 2001.
- Wiens, D. A., Seismological constraints on the mechanism of deep earthquakes: temperature dependence of deep earthquake source properties, *Phys. Earth Planet. Int.*, 127, 145-163, 2001.
- Wiens, D. A., and G. P. Smith, Seismological constraints on structure and flow patterns within the mantle wedge, in *Inside the subduction factory*, J. Eiler, editor, *AGU Monograph*, 138, 59-82, 2003.
- Tibi, R., D. A. Wiens, and H. Inoue, Remote triggering of deep earthquakes in the 2002 Tonga sequence, *Nature*, 424, 921-925, 2003.
- Wiens, D. A., N. Seama, and J. A. Conder, Mantle structure and flow patterns beneath active back-arc basins inferred from passive seismic and electromagnetic methods, in *Back-arc Spreading Systems: Interactions among Physical, Chemical, Biological, and Geological Processes*, D. M. Christie et al., editors, *AGU Monograph*, 166, 43-62, 2006.

SYNERGISTIC ACTIVITIES:

American Geophysical Union, Secretary of the Seismology Section, 2008-2009
National Academy International Polar Year Planning Committee, 2003-2006
Incorporated Research Institutions in Seismology (IRIS):
Executive committee, Global Seismic Network standing committee,
Nominations committee (chair), IRIS workshop program director
PASSCAL center selection committee, Data Management committee (chair)
Polar Networks Science Committee (chair)
Ocean Drilling Program (ODP)
Science steering and evaluation committee (ISSEP)
Science committee (SCICOM)
MARGINS program steering committee, 1997-2002, 2006 (chair)
RIDGE2000, steering committee 2002-2004; Executive committee 2004-2006
Ocean Bottom Seismograph Inst. Pool Oversight committee (chair), 2001-2003

COLLABORATORS AND FORMER ADVISORS:

S. Stein (thesis advisor), Northwestern University, A. Nyblade, Penn State University,
S. Webb, Lamont-Doherty, S. van der Lee, Northwestern

ADVISING:

Postdoctoral: Dapeng Zhao, Gideon Smith, James Conder, Rigobert Tibi

Graduate Students: David Petroy (M.A., 1988), Aristeo Pelayo (PhD., 1990), An-Ning Zhu (PhD., 1993), Megan Flanagan (PhD. 1994), Keith Koper (PhD., 1998), Erich Roth (PhD., 1999), Stacey Robertson Maurice (PhD, 2003), Jesse Fisher Lawrence (PhD, 2004), Sara Pozgay (PhD, 2007), Moira Pyle (PhD, 2009), Mitchell Barklage (current), Erica Emry (current), David Heeszel (current), Garrett Euler (current), Amanda Lough (current)

Undergraduate Research Advisees: Jeffrey McGuire, Hersh Gilbert, Tom Bawden, Brian Park-Li, Mark Wuenscher, Nathan Snider, Phil Skemer, Rebecca Stiles, John Russell, Franklin Koch (current)

TEACHING: Introduction to Geophysics, Seismology, Advanced Seismology, Structural Geology, Plate Tectonics, Geodynamics, Inverse Theory, Geophysical Data Analysis, Earth Forces, Exploration and Environmental Geophysics, Quantitative Methods in Environmental Sciences, Ideas and Controversies in the Geosciences