NATIONAL ACADEMY OF SCIENCES

MARCIA McNUTT
PRESIDENT, NATIONAL ACADEMY OF SCIENCES

Marcia McNutt (B.A. in physics, Colorado College; Ph.D. in Earth sciences, Scripps Institution of Oceanography) is a geophysicist and the 22nd president of the National Academy of Sciences. From 2013 to 2016, she was editor-in-chief of *Science* journals. McNutt was director of the U.S. Geological Survey from 2009 to 2013, during which time USGS responded to a number of major disasters, including the Deepwater Horizon oil spill. For her work to help contain that spill, McNutt was awarded the U.S. Coast Guard's Meritorious Service Medal. She is a fellow of the American Geophysical Union (AGU), Geological Society of America, the American Association for the Advancement of Science, and the International Association of Geodesy. McNutt is a member of the American Philosophical Society and the American Academy of Arts and Sciences, and a Foreign Member of the Royal Society, UK, and the Russian Academy of Sciences. In 1998, McNutt was awarded the AGU's Macelwane Medal for research accomplishments by a young scientist, and she received the Maurice Ewing Medal in 2007 for her contributions to deep-sea exploration.

500 Fifth Street NW, Washington, DC 20001

CURRICULUM VITAE
Updated 2019

Marcia K. McNutt
President, National Academy of Sciences (202) 334-2635 (Assistant, Anna)
2101 Constitution Avenue, N.W. (202) 334-2101 (office)
Washington, D.C. 20418-0006
Mailing address:
500 Fifth Street NW
Washington, DC 20001
mmcnutt@nas.edu

2/19/52	Born, Minneapolis, Minnesota
6/70	Graduated from high school, Northrop Collegiate School, Minneapolis, Minnesota.
5/73	B.A. in Physics from Colorado College, Colorado Springs, Colorado.
1/78	Ph.D. in Earth Sciences from Scripps Institution of Oceanography, La Jolla, California. Dissertation title: *Continental and Oceanic Isostasy*.

Awards and Fellowships

1970	Class valedictorian, recipient of awards for mathematics, science and French.
1970-1971	National Merit Scholarship
1973	Phi Beta Kappa, summa cum laude
1973-1976	National Science Foundation Graduate Fellowship
1977-1978	University of California Dissertation Fellowship
1984, 1993	*Journal of Geophysical Research* Editor's Citation for Excellence in Refereeing
1985	Graduate Student Council Award for Teaching
1985-1986	Mary Ingraham Bunting Fellow, Radcliffe College
1988	Macelwane Award, American Geophysical Union
1988	Fellowship, American Geophysical Union
1988	Doctor of Science, *honoris causa*, Colorado College
1989-1990	NSF Visiting Professorship for Women, Lamont-Doherty Geological Observatory of Columbia University
1991-7	Griswold Professor of Geophysics
1993	Outstanding Alumni Award, The Blake Schools, Minneapolis
1996-7	Phi Beta Kappa Visiting Scholar
1996	MIT School of Science Graduate Teaching Prize
1998	Fellowship, Geological Society of America
1997	Science and Technology Fellow, CSU Monterey Bay
1998	Fellowship, American Association for the Advancement of Science
1999	Member, American Academy of Arts and Sciences
1998	Sanctuary Reflections Award, Special Recognition Category, Monterey Bay National Marine Sanctuary

2002	Elected member American Philosophical Society
2003	ARCS Scientist of the Year
2004	National Associate, National Academy of Science
2004	Alumna of the Year, University of California, San Diego
2004	Doctor of Science, *honoris causa*, University of Minnesota
2005	Elected member, National Academy of Sciences
2007	Maurice Ewing Medal, American Geophysical Union
2008	Ocean Hero, Long Marine Lab, University of California Santa Cruz
2009	UC San Diego's 100 Most Influential Alumni
2010	Meritorious Service Medal, US Coast Guard
2010	Doctor of Philosophy, *honoris causa*, Monmouth University
2011	Doctor of Engineering, *honoris causa*, Colorado School of Mines
2012	Outstanding Chick in Science, Montana State University
2013	Ragan Communications, winner for "Best Blog"
2013	Ragan Communications, runner-up for "Best Executive Letter"
2016	*Bathocordaeous mcnutti* named in honor, http://rdcu.be/nRlz
2016	J. Robert Oppenheimer Medal, Los Alamos National Laboratory
2016	Support of Science Award, Council of Scientific Society Presidents
2017	Doctor of Medicine, *honoris causa*, Uppsala University
2017	Doctor of Science, *honoris causa*, University of Miami
2017	Aquarium of the Pacific Ocean Conservation Award
2017	Desert Research Institute (DRI) Nevada Medal
2017	Women's Aquatic Network Woman of the Year Award
2018	Doctor of Science, *honoris causa*, Worcester Polytechnic Institute
2018	Doctor of Science, *honoris causa*, Michigan State University
2018	Doctor of Public Service, *honoris causa*, The George Washington University
2018	Urban Coast Institute Ocean Champion Award

Post-graduate Employment

1/78-6/78	Postdoctoral Research Associate, Scripps Institution of Oceanography.
6/78-7/79	Visiting Assistant Professor, University of Minnesota, Minneapolis.
6/79-6/82	Geophysicist, Branch of Tectonophysics, Office of Earthquake Studies, U.S. Geological Survey, Menlo Park, California.
7/82-7/86	Assistant Professor of Geophysics, Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology.
7/86	Associate Professor of Geophysics, EAPS, MIT.
7/89-3/98	Professor of Geophysics, EAPS, MIT
7/93-7/95	Associate Director, MIT SeaGrant College Program
7/95-8/97	Director, MIT/WHOI Joint Program in Oceanography and Applied Ocean Science and Engineering
9/1997-11/2009	President/CEO Monterey Bay Aquarium Research Institute
6/1998-11/2009	Professor, Department of Earth Science, UC Santa Cruz (on leave)
10/1998-11/2009	Professor of Geophysics, Stanford University
11/2009-2/2013	Director, US Geological Survey

3/2013-5/2013	Visiting Research Scientist, Scripps Institution of Oceanography/IGPP
5/2013-7/2016	Editor-in-Chief, *Science*, American Association for the Advancement of Science
2015 - present	Professor, Georgetown University
7/2016 – present	President, National Academy of Sciences

Special Training

8/74	Completed US Navy UDT and Seal Team training course in underwater demolition and explosives handling. Also, NAUI certified SCUBA diver and Red Cross Water Safety Instructor.

Sea Experience

Participant on 14 oceanographic expeditions on ships from Scripps, Woods Hole, Oregon State University, and Columbia University.
Co-chief scientist on *Crossgrain 2* marine geophysical expedition to the Marquesas Islands, April 1987.
Co-chief scientist on the R/V *Maurice Ewing* EW9103 multichannel seismic expedition to French Polynesia, May, 1991
Chief scientist on the R/V *Maurice Ewing* EW9106 marine geophysical survey of the Marquesas Fracture Zone, September-October, 1991
Chief scientist on the R/V *Maurice Ewing* EW9204 ocean bottom seismometer experiment in the Marquesas Islands, May, 1992
Co-chief scientist on BARGE, a multichannel seismic survey on Lake Mead of the Colorado Plateau - Basin and Range breakaway zone, March, 1994
Chief scientist on R/V *Maurice Ewing* EW9602, multichannel seismic survey of the Austral Islands, March-May, 1996
Chief scientist on R/V *Roger Revelle* expedition to measure hydrothermal heat flux in the Hawaiian Islands, August-September, 1997

Professional Societies

American Geophysical Union (Fellow)
American Association for the Advancement of Science (Fellow)
Geological Society of America (Fellow)
Royal Society, UK (Foreign Member)
Russian Academy of Sciences (Foreign Member)

Teaching Experience

Geophysical Prospecting (U. of Minn., 1978)
Global Tectonics (U. of Minn., 1978)
Inverse Theory (U. of Minn., 1979)
Physics and Chemistry of the Earth (MIT, 1982)
Plate Tectonics and Marine Geophysics (MIT, 1983-present)

Introduction to Geophysics (MIT, 1983-1991)
Essentials of Geophysics (MIT, 1984-present)
Seminar in Plate Tectonics (MIT, 1987)
Exploring the Deep Sea (Freshman seminar, MIT, 1987-1992)
Seminar in Scientific Inference (LDGO, 1989)
How to Build a Habitable Planet (Freshman seminar, MIT, 1993-1997)
Experimental Oceanography at Woods Hole (MIT, 1993-1997)
Computational Data Analysis (MIT, 1994-1997)

Professional Activities

Journal of Geophysical Research Associate Editor, 1980-1983
Journal of Geophysical Research guest editor, 1983
Pure and Applied Geophysics, editorial board, 1987-88
Member, IUGG special studies group on density and stress differences within the earth, 1980-1983
Member, IUGG special studies group on geodynamics of mountain belts, 1983-1987
Member, NSF panel for graduate fellowships in Earth Sciences, 1985, 1986,1987 (Chairman 1988, 1989, 1990)
NSF Ocean Sciences, Panelist, 1986-1988, 1990
NSF Science and Technology Centers Panelist 1989
Member NASA science steering group for the Geopotential Research Mission 1978-1988.
Chairman, Science Working Group, NASA Gradiometer Study Team, 1987
Panel co-chairman, NASA Coolfont Workshop, 1989
Member, Committee on Geodesy, National Research Council, 1982-1984
Member, Geodynamics Committee, National Research Council, 1984-1987
Member, Earth Science Committee, National Research Council, 1987-1989
Member, AGU Tectonophysics nominating committee, 1983, 1985
Member, AGU Budget and Finance Committee, 1986-1988
Chairman, AGU Journals Board, 1988-1990
Chairman, Tectonophysics Fellows Committee, AGU, 1990, 1992
Chairman, AGU Publications Committee, 1990-1992
Member, *Tectonics* editor search committee, 1983
Member, Lithosphere Panel, Ocean Drilling Program, 1986-1988
Member, National Earthquake Hazard Reduction Program Advisory Committee, 1991
Chairman, AGU Publications Committee, 1990-1992
Chairman, Joint Committee for Marine Geology and Geophysics, MIT/WHOI Joint Program, 1984-1988, 1991-1995
President, special study group "Transmission of Stress and Geodynamic Implication", International Association of Geodesy, 1987-1991
Tectonophysics editorial board, 1982-1991
Member, Atolls and Guyots Detailed Planning Group, Ocean Drilling Program, 1991
Member, Performance Evaluation Committee, Ocean Drilling Program, 1991
Member, Organizing Committee for the Frontiers of Science Symposium, National Academy of Sciences, 1991-2, 1994

Chairman, Visiting Committee, Geological Sciences Department, U of Arizona, 1992
Member, Advisory Committee for Earth Sciences, National Science Foundation, 1990-1993
Member, NASA Earth Science and Applications Division Advisory Subcommittee, 1990-1993
Member, Advisory Structure Review Committee, Ocean Drilling Program, 1992-1993
Chairman, Organizing Committee for the Frontiers of Science Symposium, National Academy of Sciences, 1993
Chairman, Visiting Committee, Scripps Institution of Oceanography, 1993
SEI (Study of the Earth's Interior) Committee, American Geophysical Union, 1992-1994
Audit and Legal Affaris Committee, American Geophysical Union, 1992-1994
Nominating Committee, American Geophysical Union, 1992-1994
Member, Board on Earth Sciences and Resources, National Research Council, 1994
Member, Committee on Geophysical and Environmental Data, National Research Council, 1994
Member, National Academy of Sciences Television Advisory Committee, 1994
Member, Committee to Study the Criteria for Federal Support for Research and Development (Press Committee), 1995
President, Tectonophysics section, American Geophysical Union, 1992-1994
Chair, Audit and Legal Affaris Committee, American Geophysical Union, 1994-1996
Member, Organizing Committee for the German-American Frontiers of Science Symposium, 1995, 1996
Chair, External Review Committee, Department of Geological Sciences, UC Santa Barbara, 1997
Member, External Review Committee, Department of Geology and Geophysics, U of Minnesota, 1997
Member, Lincoln Lab Advisory Board, 1994-1997
Member, National Medal of Science Committee, 1995-1997
Member, New England Aquarium Advisory Board, 1995-1997
Co-Chair, NSF-OCE Workshop on the Future of Marine Geosciences, 1995-1998
Vice-Chair, Advisory Committee for Geosciences, National Science Foundation 1996-1998
Chair, Macelwane Award Committee, American Geophysical Union, 1996-1998
Co-Chair, Chinese-American Frontiers of Science Symposium, August, 1998
Member, Government-University-Industry-Research-Roundtable committee on Stress in Universities, 1995-1998
Member, NRC committee on the Science of Earthquakes, 1996-1999
Member, NRC Committee on 50 Years of Ocean Sciences at NSF, 1998
Member, ODP Executive Committee for Drilling Opportunities in the 21st Century, 1998-9
Member, German-American Academic Council, 1994-1999
Member, Independent Review Board of the President's Committee of Advisors on Science and Technology (PCAST) for National Assessment of Climate Change Impacts, 2000
Member, Ocean Research Advisory Panel, National Ocean Partnership Program, 2000-2001

Member, Ocean Science Synthesis Committee, NSF 1998-2001
Chair, NOAA Exploration Panel, 2000-2001
President, American Geophysical Union 2000-2002
Member, Exploration of the Seas Committee, National Research Council, 2001-2004
Member, Review Committee for the Division on Earth and Life Sciences, National Academy of Sciences, 2003-2004
Member, Jackson School Vision Committee, University of Texas at Austin, 2003-2004
Past President, American Geophysical Union, 2002-2004
Member, Visiting Committee, Department of Ocean Engineering, MIT 1999-2004
Chair, Ocean Research Advisory Panel, National Ocean Partnership Program, 2001-2005
Chair, Monterey Bay Crescent Ocean Research Consortium, 2000-2006
Member, External Review Committee for Marine Science Institute, University of California at Santa Barbara, 2006
Chair, Board of Governors, Joint Oceanographic Institutions, 2006-2007
Member, Visiting Committee, Berkeley Geochronology Center, 2006
Member, Visiting Committee, Department of Geological Sciences, Princeton University, 2007
Member, Ocean Council, 2005-2007
Trustee, Consortium for Ocean Leadership, 2007-2008; 2016-present
Chair, University Oceanographic Laboratory System (UNOLS), 2006-2008
Member, PASSCAL Review Committee, National Science Foundation, 2008
Member, Whale Conservation Fund Advisory Council 2004-2008
Member, Visiting Committee, Department of Mechanical Engineering, MIT 2005-2009
Member, Visiting Committee, School of Earth Sciences, Stanford University, 1999-2009, 2013-present
Chair, Visiting Committee, Department of Earth and Planetary Science, Harvard University, 2002-2009
Member, Advisory Board, Winchell School of Earth Sciences, University of Minnesota, 2005-2009
Member, Board of Directors, Monterey Bay Aquarium, 1998-2009
Member, Schlumberger Technical Advisory Committee, 2000-2009
Member, NOAA's Ocean Exploration Advisory Working Group, 2004-2009
Member, Senior Editorial Advisory Committee, *Science* magazine, 2001-2009
Past Chair, University Oceanographic Laboratory System (UNOLS), 2008-2009
Chair, Ocean Studies Board, 2009
Member, Report Review Committee, NAS, 2008-9
Member, Board of Trustees, National Museum of Natural History, 2014-2016
Chair, NRC Committee on Geoengineering, 2013-2015
Member, Advisory Committee for Division on Earth and Life Sciences, NRC, 2015-2016
Member, Advisory Council for Institute at Brown for Environment and Society, 2015-2016
Member, International Science Council (ISC) Elections Committee, 2018
Member, Visiting Committee, Department of Earth, Atmospheric, and Planetary Sciences, MIT, 2016-present
Board Member, Center for Open Science (COS), 2016 - present
Board member, Science, Technology, Society Forum, 2016-present

Trustee, Carnegie Corporation of New York, 2016 - present
Trustee, Center for Open Science, 2017-present
Chair, Kavli Prize Oversight Committee, 2017-present
(Note: From November, 2009 through February 2013 all professional activities were prohibited by US government ethics rules unless they were directly part of the position description for the Director of the USGS.)

Congressional Testimony (Other than frequent testimony as Director of USGS)

Committee on Science, US House of Representatives, April 28, 2005, Ocean Exploration
Committee on Science, US House of Representatives, July 27, 2006, Earth Observing from Space

Invited Lectures (bold for most recent year)

Caltech (1978, 1980, 1997), U. of Minnesota (1978, 1996, 125th Anniversary Lecturer, 1999, IT Distinguished Woman Lecturer, 2003; 2006), Harvard (1978, 1984), U.C. Santa Barbara (1978, 1981), Cornell University (1978, 1983), U. of Michigan (1979, 1989, 1994), Dalhousie (1979), Lamont-Doherty (1980, 1985, 1986, 1989, 1995; 50th Anniversary Lecture 1999, 2007), Stanford (1980; 1984; 1998; 2003; 2007; Conrad von Gugelberg Memorial Lecture, 2011, 2016), Sandia Labs (1981), MIT (1981; Wallace Lecture: 1998; 2005, 2011, Climate Symposium, 2016), Woods Hole (1981; 1985; 1987; 1989; Steinbach Memorial Lecturer, 2011), UC Berkeley (1982; 1989; 1995; 1998), UCLA (1982, 1989), Society of Engineering Science (1982), Washington University at St. Louis (1982), Brown (1983, 1989, 1994), Yale (1983, 1985, 1995), Scripps Institution of Oceanography (80th Anniversary Lecturer, 1983; 1995; 2002; Scripps Day Alumni Talk, 2010, 2012), 27th International Geological Congress, Moscow (1984), Institute of Physics of the Earth, Moscow (1984, 1987), U. of Wyoming (1985, Dedication of Geosciences Building: 1998), Colorado College (1985; 1988; 2003; 2011; "State of the Rockies" 2012, 2014), SUNY Stony Brook (1985), IUGG Workshop in Zurich (1985), U. Lowell (1986), University of Rhode Island (1986, 1994), Radcliffe Summer Science Program (1986, 1987), WHOI College Teachers Workshop (1987), Geological Society of Washington (1988, 2013), IGPP Los Alamos (1989), IPG, Paris (1989, 1996), Institute of Computational Geophysics, Moscow (1989), Institute of Petroleum Research, Tel Aviv (1989), York University (1990), University of North Carolina, Chapel Hill (1990), Northwestern (1990), Penn State (1990), University of New Mexico (1991), University of Texas at Austin (1991, Commencement Speaker, 2012; Distinguished Lecturer, UTIG, 2013), Boston University (1992), Duke University (1992), UMass, Amherst (1992, 1996), U of Washington (1993), Princeton University (1993), National Academy of Sciences (1994, 2012), Keystone *Scientist to Scientist* Colloquium (1994), Berlin Symposium on Issues Facing the German-American Academic Council (1994), U of Toronto (1994; J. Tuzo Wilson Lecture, 2004), MacMaster University (1994), University of Maine (1995), Carnegie Institution (Capital Science Lecturer, 1995), Workshop on Science Education, University of Iowa (1995, 1996), Amherst College (1996), Smith College (1996), University of Brest, France (1996), Western Maryland College (1996), Hiram College (1997), Carnegie-Mellon University (1997), St. Lawrence University

(1997), Birmingham-Southern College (1997), University of Wisconsin at Milwaukee (1997, 2008), Ripon College (1997), College of St. Catherine (1997), University of Hawaii (1998), UC Santa Cruz (1998), Augsburg College (Sverdrup Lectures: 1998), Arizona State University (1998), AAAS (1998, 1999, 2007, Plenary Lecture 2010), Library of Congress (1999), US Geological Survey (2000), Purdue University (Crough Lecture, 2000), White House Millenium Matinee (2000), Trinity University (2000), University of Utah (2001, Frontiers of Science Lecturer 2008), ACM1 Computer Conference (Keynote Speaker, 2001), Revelle Lecture (NAS, 2001), American Academy of Arts and Sciences (2001), Oceans 2001 (Keynote lecture, 2001), University of South Carolina (Convocation Speaker, 2002), Ocean's Symposium, Anchorage, AL (2002); JAMESTEC 30th Anniversary Symposium (2002), Oregon State University (Condon Lecture, 2002; 2005), University of California, San Diego (2002), Illinois Math and Science Academy (2003), ARCS Foundation (2003), Women in Science and Engineering, UCSD (2003), Nuclear and Space Radiation Effects keynote speaker (2003), Division of Planetary Sciences, American Astronomical Society plenary speaker (2003), Barrow Arctic Science Consortium public lecture (2003), Portuguese-American Foundation Annual Lecture in Marine Sciences, Lisbon (2004), 9th Circuit Court Judicial Conference (2004); Marin County Women Lawyers (2004), Santa Fe Institute (2005), Naval Postgraduate School (2005, Steinbeck Auditorium public lecture, 2008), Pop!Tech (2005, 2007,2010), Geological Society of Washington (2005), SeaSpace symposium (2005), Palo Alto Research Center (2006), International Conference on Space Mission Challenges for Information Technology (2006), California and the World Ocean Conference (2006), American Geophysical Union (Symposium on the Anniversary of the International Geophysical Year, 2006; 2009; Symposium on *Deepwater Horizon*, 2010), Maritime Museum of Monterey (2006), US State Department Conference on Women in the Arab World (Kuwait, 2007), California Ocean Protection Council (2007), Sanctuary Currents Symposium (Seaside, CA, 2007), Earthscope Annual Meeting keynote (2007), Monterey Business Council 4th annual Economic Forum (2007), Wittenberg University (IBM Distinguished Lecturer, 2007), Bermuda (2007), NASA-Ames (2007), California Council on Science and Technology (2008), Ecocity Summit (2008), Labs21 (Keynote, 2008), Consortium for Ocean Leadership (2009), SSA President's Invited Address (2010), Arizona Geological Society (2010), Monmouth University Founders Day Convocation (2010), ASLO Plenary (2011), Capitol Hill Oceans Week (2011, 2012), George Wright Society (2011), University of New Mexico (Caswell Silver Distinguished Lecturer, 2011), Colorado School of Mines (2011), Oceans'11 (Plenary, 2011), U of North Carolina-Wilmington (2011), Geological Society of America (Pardee Keynote, 2010, 2011), Arctic Frontiers (Tromso, Norway 2012), National Conference Environment and Security (2012, 2013), U of Indiana (2012), Urbana High, MD ("Nifty Fifty" speaker series, 2012, 2013), American Association of Petroleum Geologists (2012), California Bay Delta Ecosystem Conference (2012), University of Maryland (ADVANCE lecture, 2012; Commencement Speaker, 2014), Mills College (Russell Lecture, 2013), New York Academy of Sciences (Blavatnik Scholars, 2014), Institute of Medicine (2014), Vatican (2014), University of Arizona (Geodaze, 2014), China Medical University (2014), University of New Hampshire (2014), Denison University (2015), University of Southern California (WISE Lecture, 2015), University of Texas-Dallas (Anson Clark Lecture, 2015), UC San Diego (Jim Arnold Lecture, 2015), University of Missouri (2016),

University of Florida (2016), University of Miami (Sea Secrets 2016), Syracuse University (2016), Carnegie Institution of Plant Biology (2016), Los Alamos National Labs (J. Robert Oppenheimer Lecture), German-American GAIN Conference (2016), The Academy of Medicine, Engineering and Science of Texas (2017), ASLO Aquatic Sciences Meeting (2017), Pomona College (2017), Health Research Alliance Meeting (2017), Carnegie Mellon University (Energy Week) (2017), Michigan State University (Rachel Carson Distinguished Lecture) (2017), UC Berkeley (Philomathia Forum on Energy and Environment) (2017), University of Miami (2017), Council of Science Editors Meeting (2017), European Forum Alpbach (Austria, 2017), STS Forum (Japan, 2017), Symposium on Statistical Interference (2017), The Fridtjof Nansen Lecture on Ocean Life (2017), Chemical Heritage Foundation (Ullyot Lecture) (2017), University – National Oceanographic Laboratory System (UNOLS) Fall Meeting (2017), UMass Amherst (2018), NIST Workshop on Unleashing American Innovation (2018), Dr. Lucy Jones Center for Science and Society Symposium (2018), Stanford Woods Institute Environmental Conversation (2018), Kavli Prize Government's Banquet (Norway, 2018), Resources for the Future Public Seminar at the Carnegie Endowment (2018), Southern Methodist University (2018), STS Forum (Japan, 2018), Philadelphia Symposium on Research Credibility & Excellence (2018), American Geophysical Union Fall Meeting (2018), **American Chemical Society Conference of Editors (2019), American Meteorological Society Annual Meeting (2019), UC Davis (2019), Lawrence Berkeley National Laboratory (Women in Science Speaker Series) (2019).**

Students

Anne Judge, M.S. completed 6/88, thesis title "The Relationship Between Plate Dip and Elastic Plate Thickness: A Study of the Peru-Chile Trench"

Sarah Kruse, Ph.D. completed 8/89, thesis title "Deformation of Continental Lithosphere: Investigations in the Urals, Appenines, and Basin and Range"

Paul Filmer, Ph.D. completed 11/91, thesis title: "Flexure of the Oceanic Lithopshere in the Vicinity of the Marquesas Islands"

Carolyn Ruppel, Ph.D. completed 1/92, thesis title "Thermal Structure, Compensation Mechanisms, and Tectonics of Actively-Deforming Continents: Baikal Rift Zone and Large-Scale Overthrust and Extensional Terrains"

Cecily Wolfe, Ph.D. completed 4/94, thesis title "Geophysical Studies of Midplate Volcanism and Plate Boundary Earthquakes in the Ocean Basins" (co-supervised with Sean Solomon)

Paula Waschbusch, Ph.D. completed 9/94, thesis title: "Modes of Continental Deformation: Studies of Foredeep Basins, Continental Hot Spots, and Intracratonic Basins" (co-supervised with Leigh Royden)

Susan Evans, M.S. completed 9/94, thesis title: "Constraints on the Viscosity of the Earth's Mantle Beneath the South Pacific"

Zhou Yu, M.S. completed 3/96, thesis title: "Flexural Strength of Lithosphere in Central Asian the the Development of Intracontinental Orogens: The Tien Shan"

Yu Jin, Ph.D. completed 6/97, thesis title: "State-of-Stress and Rheology of Tibet and its Vicinity from Gravity Anomalies and Numerical Models"

Kelsey Jordahl, PhD. Completed 11/98, thesis title: “Tectonics of the Southern Austral Islands”

Member of thesis committee: Victor Zlotnicki (1983), Eric Bergman (1984), Steve Bratt (1984), Ron Remillard (1985), Lynn Hall (1985), Steven Swift (1985), Helene Lyon-Caen (1985), Adam Freedman (1987), Michael Diament (Paris-Sud, 1987), Douglas Toomey (1987), Karen Meech (1987), Elizabeth Robinson (1987), Cynthia Ebinger (1987), John Collins (1988), Karen Fischer (1988), Vincent Salters (1989), Walter Smith (LDGO, 1990), John Goff (1990), Ginger Barth (LDGO, 1991), Erik Hauri (1992), Gail Christeson (1993), Sang-Mook Lee (1994), Bruno Corneglia (Paris, 1996), Khaled Ouaasa (Brest, 1996), Garrett Ito (1996), Emily Hooft (1996), Daniel Lizarralde (1997)

Undergraduate research (UROP) advisor: Fred Pollitz (1983-84), Shir Filler (1987), Karen Cianciulli (1987, 1988), Rosanna Yuen (1995)

PUBLICATIONS

1. McNutt, M.K. and R.L. Parker, Isostasy in Australia and the evolution of the compensation mechanism, *Science, 199*, 773-775, 1978.

2. McNutt, M.K. and H.W. Menard, Lithospheric flexure and uplifted atolls, *J. Geophys. Res., 83*, 1206-1212, 1978.

3. Shih, J.S.F., T. Atwater, and M.K. McNutt, A near-bottom geophysical traverse of the Reykjanes Ridge, *Earth Planet. Sci. Lett., 39*, 75-83, 1978.

4. McNutt, M.K., Continental and Oceanic Isostasy, Ph.D. thesis, University of California, San Diego, California, 1978.

5. McNutt, M.K. and H.W. Menard, Reply to comments on 'Lithospheric flexure and uplifted atolls' by R.D. Jarrard and D.L. Turner, *J. Geophys. Res.*, *84*, 5695-5697, 1979.

6. McNutt, M.K., Compensation of oceanic topography: An application of the response function technique to the *Surveyor* area, *J. Geophys. Res., 84*, 7589-7598, 1979.

7. McNutt, M.K. and H.W. Menard, Reply to comments on 'Lithospheric flexure and uplifted atolls' by H.T. Stearns, *J. Geophys. Res., 84*, 7698, 1979.

8. Parker, R.L. and M.K. McNutt, Statistics for the one-norm misfit measure, *J. Geophys. Res., 85*, 4429-4430, 1980.

9. McNutt, M.K., Implications of regional gravity for state of stress in the earth's crust and upper mantle, *J. Geophys. Res., 85*, 6377-6397, 1980.

10. McNutt, M.K. and Thomas Heaton, An evaluation of the seismic window theory for earthquake prediction, *California Geology, 34*, 12-16, 1981.

11. McNutt, M.K. and Rodey Batiza, Paleomagnetism of Northern Cocos seamounts: Constraints on absolute plate motion, *Geology, 9*, 148-154, 1981.

12. Rundle, John and M.K. McNutt, Southern California uplift: Is it or isn't it? *EOS, Trans. Amer. Geophys. Union, 62*, 97-98, 1981 (refereed journal article).

13. Chase, C.G. and M.K. McNutt, The geoid: effect of compensated topography and uncompensated trenches, *Geophys. Res. Lett., 9*, 29-32, 1982.

14. McNutt, M.K. and H.W. Menard, Constraints on yield strength in the oceanic lithosphere derived from observations of flexure, *Geophys. J. Roy. Astr. Soc., 71*, 363-395, 1982.

15. Menard, H.W. and M.K. McNutt, Evidence for and consequences of thermal rejuvenation of the lithosphere, *J. Geophys. Res., 87*, 8570-8580, 1982.

16. Dixon, T.H., M. Naraghi, M.K. McNutt and S.M. Smith, Bathymetric prediction from SEASAT altimeter data, *J. Geophys. Res., 88*, 1563-1571, 1983.

17. McNutt, M.K., Influence of plate subduction on isostatic compensation in northern California, *Tectonics, 2*, 399-415, 1983.

18. McNutt, M.K., Reply to comments on "Nasal surgery and airflow", *Plastic and Reconstructive Surgery, 73*, 700-701, 1984.

19. McNutt, M.K., Lithospheric flexure and thermal anomalies, *J. Geophys. Res., 89*, 11, 180-11, 194, 1984.

20. Committee on Geodesy, *Geodesy: A Look to the Future*, National Academy Press, Washington, D.C., 1985.

21. McNutt, M.K., Nonuniform magnetization of seamounts: a least-squares approach, *J. Geophys. Res., 91*, 3686-3700, 1986.

22. Sheffels, B. and M.K. McNutt, The role of subsurface loads and regional compensation in the isostatic balance of the Transverse Ranges, California: Evidence for intracontinental subduction., *J. Geophys. Res., 91*, 6419-6431, 1986.

23. McNutt, M.K. and L. Shure, Estimating the compensation depth of the Hawaiian swell with linear filters, *J. Geophys. Res., 91*, 13915-13923, 1986.

24. Fischer, K., M.K. McNutt, and L. Shure, Thermal and mechanical constraints on the lithosphere beneath the Marquesas swell, *Nature, 322*, 733-736, 1986.

25. McNutt, M.K. and L. Royden, Extremal bounds on geotherms in eroding mountain belts from metamorphic pressure-temperature conditions, *Geophys. J. Roy. Astr. Soc., 88,* 81-95, 1987.

26. Kogan, M.G. and M.K. McNutt, Isostasy in the USSR I: Admittance data, in *The Composition, Structure, and Dynamics of the Lithosphere-Asthenosphere System,* K. Fuchs and C. Froidevaux, eds., Geodynamics Series, AGU, vol. 16, 1987.

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“Maintaining U.S. Leadership in Science and Technology”

Statement of

Marcia K. McNutt
President, National Academy of Sciences
National Academies of Sciences, Engineering, and Medicine

before the

Committee on Science, Space, and Technology
U.S. House of Representatives

March 6, 2019

Chairwoman Johnson, Ranking Member Lucas and members of the Committee, thank you for the opportunity to testify today. I am Marcia McNutt, president of the National Academy of Sciences. I am pleased to be here on behalf of the National Academies of Sciences, Engineering, and Medicine to discuss what I believe is one of the most important issues facing our nation — the health of the U.S. innovation enterprise and the implications for our long-term global competitiveness.

I will begin by providing a brief overview of the National Academies of Sciences, Engineering, and Medicine. We work on a remarkable range of issues that have science and evidence at their core, and we have long been a valuable resource for policymakers and the public.

More than 150 years ago, the National Academy of Sciences was created through a congressional charter signed by Abraham Lincoln to serve as an independent, authoritative body outside the government that could advise the nation on matters pertaining to science and technology. Under that original charter, the National Academy of Engineering (NAE) was founded in 1964 and the National Academy of Medicine (NAM, formerly the Institute of Medicine, IOM) in 1970.

Every year, approximately 6,000 Academies members and volunteers serve pro bono on our consensus study committees or convening activities. Our consensus study process is considered the gold standard of independent, nonpartisan, evidence-based advice. We do not advocate for specific policy positions. Rather, we enlist the best available expertise across disciplines to examine the evidence, reach consensus, and identify a path forward on some of society’s most pressing challenges. In recognition of the fast-changing policy environment in which we all operate, we recently launched an Academies-wide effort to transform our processes, to ensure that our work is even more timely and relevant, without sacrificing the rigor and objectivity you rely upon.

Over the years, our advice informed the formation of the U.S. national park system and national highway system, the launch of the U.S.’s first Earth-orbiting satellite, and the mass-production of penicillin and other lifesaving drugs. More recently, our work strengthened the scientific consensus and public understanding of climate change, provided the blueprint for the Human Genome Project and precision medicine, bolstered the forensic science that underpins the U.S. criminal justice system, and provided a comprehensive estimate of the economic impacts of immigration into the U.S.

In 2018 alone, our advice covered issues as varied as modernizing the nation’s interstate highways, securing the U.S. voting system, assessing the future of quantum computing, identifying the health effects of e-cigarettes, and eliminating lung diseases caused by exposure to coal mine dust. We proposed feasible paths for space exploration and the search for life in our universe, laid out a decadal strategy to enhance space-based observations of Earth and its

complex systems, proposed measures to make prescription drugs more affordable, provided a research agenda for promising net emission technologies that remove carbon dioxide from the air, and recommended actions for fostering more openness and transparency in the research process. We also characterized the profound damage caused by sexual harassment — not only to the careers, health, and well-being of women who are harassed but also to the entire research enterprise. I am proud that our report helped this committee to take action on this front.

This year promises to be just as productive for the National Academies, and on issues such as modernizing the U.S. electric grid, defining the importance of reproducibility in research, helping public transportation adjust to disrupters such as Uber and Lyft, outlining the role of social and behavioral sciences in national security, and developing a blueprint for governance and research of climate engineering strategies. And our work extends far beyond our consensus studies; for example, our new Environmental Health Matters Initiative brings together expertise across the Academies to explore the science about environmental factors and human health, and our new Climate Communications Initiative provides policymakers with an unbiased resource for evaluating the science around global climate change. I invite you to review the attached list of 2018 reports specifically relevant to this Committee's jurisdiction.

Many of our studies originate in legislation; in the last Congress, for example, roughly 240 bills and resolutions were introduced either requiring a new Academies study or citing our previous work, and 26 new studies were ultimately mandated by law. During the 115th Congress alone, our members, volunteer experts, and staff participated in close to 200 congressional briefings. We are grateful that, for a non-governmental entity, this kind of presence on Capitol Hill may be unmatched. It reflects the incredible breadth of policy-relevant domains our vast network of experts can tackle, as well as the indispensable role that scientific inquiry and evidence can play in everyday life, beyond what one might consider to be conventional "science policy" issues.

A Strong U.S. Research Enterprise

Our work at the National Academies often centers on ensuring that advances in scientific knowledge, biomedical research, and technology are employed responsibly, and for the benefit of the nation. However, for those advances to occur in the first place, there must be strong and sustained investments in the people, facilities, and infrastructure that comprise our nation's innovation enterprise. Without this support, our nation will lose its competitive advantage in the global marketplace as the world's top talent will take their talent and ideas elsewhere, and the economic growth they have long generated here in the U.S. will follow. To be clear, this is not about creating jobs for scientists: this is an existential threat to America's greatness and the long-term welfare of our people.

More than 15 years ago, the National Academies released a landmark report called *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Future*, which stressed the importance of research for enhancing American competitiveness in a global economy. The report was instrumental to the development and adoption of the America COMPETES Act, the effort to increase basic research funding, and the creation of the Advanced Research Project Agency (ARPA-E) at the U.S. Department of Energy.

Now, in 2019, the messages from that report resonate more than ever. In an increasingly complex global economy, we simply cannot afford to let U.S. leadership in science slip away. In some cases, it already has. Given the often long lag time from research to applications, we may not realize the impacts of being behind until we are far behind, watching other nations reap the economic rewards and strategic advantages of early S&T investment.

The number of research journal publications by country is one metric to assess the vitality of U.S. research. It reflects a country's research capabilities and ability to generate new knowledge, as well as the potential pathways for that knowledge to technology innovation. According to the National Science Board's most recent Science and Engineering Indicators, the total number of

U.S. articles published began declining around 2014, despite consistent, steady growth in previous decades. At the same time, articles by Chinese researchers continued to increase significantly, ultimately surpassing the U.S. in 2016. This does vary considerably by field; the U.S. and European Union (EU) are still leading in publishing biomedical science articles, and China produces the most engineering articles.

Another measure is the relative output in knowledge- and technology-intensive industries. In the medium-high technology manufacturing fields such as vehicle parts, chemicals, and electrical equipment, China's output surpassed the U.S. in 2008 and the EU in 2011. But perhaps more concerning, in the high-technology industries such as aviation and telecom — where the U.S. has held a clear lead in the past — China is quickly gaining ground because of its substantial investments in research and advanced manufacturing, even as our and other nations' investments have leveled out.

These two metrics are good reminders of how innovation occurs across a spectrum — from knowledge generation through early stage basic research, to applied research and technology development, to deployment or commercial application. And at every step, we are facing increasingly intense competition from other countries, some of which may have more nimble and unconstrained innovation systems.

The U.S. research enterprise has traditionally been supported by a combination of government, university, private foundation and, of course, industry support. For the last few decades, private sector funding of research has indeed comprised an increasingly larger share of total R&D. But, by definition, industrial R&D is focused largely on near-term, more incremental improvements to existing commercial products and systems. In contrast, federally funded research generally generates crucial foundational knowledge for broader societal benefit, in ways that industry cannot or will not do alone. It is worth noting that those functions are not definitive and the process is not necessarily linear. Industry can certainly sponsor basic research, and federal funding can play an indispensable role in some later-stage technology innovation where the societal benefit is clear.

Federally funded research still comprises roughly a quarter of total R&D expenditures in the U.S. With so many competing demands on the federal budget, some question whether research still deserves high levels of continued support. Given the proven return on investment in publicly sponsored research and its role in generating and sustaining the STEM workforce, there can be no doubt: America is clearly served better through robust federal support of our research enterprise.

The STEM Talent Pipeline

Economic prosperity, national security, and advances in public health in the U.S. have for generations depended on a strong and diverse STEM talent pipeline. For decades, the world's top students flocked to U.S. universities to be educated, and the most capable of those have remained here to enrich our research enterprise and economy. Likewise, we did not have to worry about keeping our own domestic talent in the U.S. At one time we held a clear advantage because other countries lacked the resources or motivation to compete with the U.S. That is certainly not the case in 2019. We are in a global race to generate here and attract from abroad the best and brightest, who are looking for stable funding, better facilities, and the promise of lucrative careers.

There are troubling signs that the U.S. research workforce is getting older, U.S.-born students are not entering STEM fields in sufficient numbers, and foreign STEM students are no longer coming to the U.S. and staying to build lives and contribute to the economy as they did before.

The U.S. can maintain its competitive edge if we fix the incentives to improve career paths, attract a more diverse domestic scientific workforce, and keep our doors open to international talent.

Regardless of their country of origin, STEM graduates must see a successful future in their field if we hope to retain them. But far too often, they are discouraged by the high costs of education, decreasing success rates of grant proposals, and the long training phases of their careers. In our 2018 report *The Next Generation of Biomedical and Behavioral Sciences Researchers*, we note:

- The average age of first receipt of a NIH grant, the R01, has risen from 36 years old in 1980 to 43 years old in 2016.
- The share of biomedical Ph.D. recipients able to secure a tenure-track academic research position within six years has fallen from 55 percent in 1973 to 18 percent in 2009.
- The proportion of NIH research project grant dollars awarded to investigators under age 50 has declined from 54 percent in 1998 to 39 percent in 2014.
- While less than half of the current biomedical postdoc population are U.S. citizens, very few NIH postdoctoral and early career awards are available to non-U.S. citizens.

Furthermore, as identified in our 2018 report *Graduate STEM Education for the 21st Century*, the deeply technical graduate education system often does not adequately prepare students with a broad combination of the core competencies needed to lead in the modern workforce.

The cultural diversity of a nation's workforce is a key factor in its ability to innovate and compete in a global economy. We need to look beyond the traditional research universities in cultivating the pipeline of STEM talent, and the research community should better reflect the nation as a whole. One of our most recent reports, *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*, notes that the nation is still falling far short in attracting and retaining students of color to STEM fields. With over 700 MSIs in the U.S., and an ever-expanding range of STEM-related fields, this is talent that we obviously cannot afford to squander. I invite you to review these reports for a comprehensive look at the issues and lists of actions all stakeholders can take to improve the system.

Any discussion about U.S. S&T leadership must acknowledge the critical role that non-U.S. students and workers have to play in our competitiveness. Though U.S. universities remain the destination of choice for international talent, for the first time the numbers have fallen in recent years. According to the last Science and Engineering Indicators, international science and engineering graduate student enrollments dropped 6 percent from 2016 to 2017. Though this is a recent phenomenon, the indications are that the trend may continue. The most recent data from the Council on Graduate Schools indicate a continued decline in temporary visa holder enrollment in 2018. The trends vary across fields, with some of the sharpest drops in engineering and physical and earth sciences. For example, according to a recent survey by the American Physical Society, international applications to U.S. physics Ph.D. programs declined an average of 12 percent in 2018. At the same time, our competitor institutions in Canada, Germany, Australia, and elsewhere saw significant increases. Unfortunately, this comes at a time when both funding for U.S. public universities and entry of U.S-born students into STEM fields have fallen.

Our report *Graduate STEM Education for the 21st Century* states that foreign graduate students who remain here after earning their degrees benefit the U.S. in myriad ways, including contributing to an increase of more than $39 billion to our economy in 2016. Stay rates are highest in fields where temporary visa holders are most prevalent: engineering, physical sciences, and life sciences.

We must also recognize the ever-shifting landscape of risks and the fact that our competitors will continually seek to exploit our open academic research system for their strategic security and economic advantages. Healthy vigilance in this regard will require the close coordination of our national security, law enforcement, and research funding agencies, as well as academic and other research performing institutions, to ensure that we do not underestimate the risks or undermine the deep benefits foreign students and international cooperation provide for our nation. With foreign students making up roughly one-third of science and engineering graduate students in the U.S. — and the clear majority in some S&T fields — we must very carefully

consider the long-term impacts of policy measures that discourage or ban non-U.S. citizens from contributing to our innovation system.

International Cooperation

Across a range of S&T domains, international competition is intense, and with our allies and adversaries alike. Fortunately, the global scientific community has a long tradition of transcending political and economic differences to coordinate or consult on major scientific challenges for the health and welfare of the world, and to push the frontiers of knowledge beyond what one country can do on its own. Examples today can be seen in the International Space Station, the ITER nuclear fusion reactor, the Large Hadron Collider at CERN, Arctic and Antarctic research, and nonproliferation of nuclear weapons. International coordination may well play a critical role in emerging and highly competitive fields with broad societal impacts, such as artificial intelligence, quantum computing, robotics, synthetic biology, nanotechnology, and even lunar exploration.

Fostering these exchanges is more important than ever. Science and engineering are increasingly international endeavors, and are being rapidly transformed by globalization, interdisciplinary team-driven research, and information technology. International collaboration and cooperation are also important for informing the responsible conduct of science, avoiding and identifying fraud and bias, and communicating findings with the public. This is especially critical for fast-moving, cutting-edge areas of research that have global implications. For instance, Human genome editing offers great promise around the world in treating genetic diseases, but it is imperative that we examine the many scientific, ethical, and governance issues raised by powerful new genome editing tools such as CRISPR-Cas9. Of particular concern are heritable genome edits that might be passed down to future generations.

The National Academy of Sciences and the National Academy of Medicine have organized two international summits and a consensus study to explore the complex issues surrounding human genome editing. The Second International Summit on Human Genome Editing — co-hosted last year with the Academy of Sciences of Hong Kong and the Royal Society of the U.K. — brought together in Hong Kong more than 500 researchers, ethicists, clinicians, patient groups, and others from around the world to discuss the issues, and was viewed online in approximately 190 nations

The summit was already generating international headlines when a Chinese researcher — in violation of long established scientific principles and norms — claimed to have edited early embryos that resulted in the birth of twins. The news drew widespread condemnation, but it also served to heighten the urgency for more in-depth analysis of the complex scientific, ethical, and societal issues that surround heritable genome editing. This year, the NAS and NAM are partnering with the Royal Society and other academies around the world to form an international commission tasked with developing stringent criteria and standards to guide responsible decisions about heritable human genome editing research and applications.

Scientific cooperation is just as important as competition if we hope to address large-scale global issues such as human genome editing. However, if the U.S. loses its edge in science and technology, opportunities for international collaboration will also suffer.

Conclusion

As we have for more than 150 years, the National Academies stand ready to serve the nation and the world on these and many other issues. We can provide a science and evidence base as you assess the appropriate functions of agencies and programs, set priorities for research funding, and deliberate on how to strike the right balance between public and private contributions. We can provide guidance for decisions about making the most of federal investments in the research enterprise, including the STEM talent pipeline, facilities, and infrastructure. However, we must all

keep in mind that other nations are not hesitating to debate many of the issues we face. They are examining every metric of competitiveness, and looking years ahead to make large investments in their own expanding research enterprise.

Yes, the U.S. has ceded leadership in some areas, but we remain at the top in many others. As Members of the U.S. House Committee on Science, Space, and Technology, you have the opportunity to make policies and conduct oversight that ensures we do not ever surrender our global leadership in science and technology. The stakes are simply too high for U.S. economic competitiveness, national security, and the health and well-being of our citizens. Together, we must support and maintain a strong, robust U.S. research enterprise.

Additional Resources (with links)

- National Science Board – *Science and Engineering Indicators 2018*
- NASEM Study - *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Future* (2007)
- NASEM Study - *The Next Generation of Biomedical and Behavioral Sciences Researchers: Breaking Through* (2018)
- NASEM Study - *Graduate STEM Education for the 21st Century* (2018)
- NASEM Study - *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce (*2019)
- Council of Graduate Schools – *International Graduate Applications and Enrollment: Fall 2018*
- American Physical Society – *International Applicants Survey Results* (2018)
- The Interacademy Partnership – *Doing Global Science: A Guide to Responsible Conduct in the Global Research Enterprise* (2016)
- NASEM Initiative – *Human Genome Editing*