

## **CV: Michael E. Purucker**

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### ***CURRENT POSITION***

Chief Scientist, Geodynamics, Geophysics, and Space Geodesy Program, Raytheon, Greenbelt, MD, 1986-present. Located within the Planetary Geodynamics Lab, Goddard Space Flight Center, NASA, Greenbelt, MD

### ***PAST POSITIONS***

Invited Professor (1st Class), Laboratoire de Planetologie et Geodynamique, Univ. de Nantes, Nantes, France, 2005, 2008, 2009

Visiting scientist, GeoForschung Zentrum, Potsdam, Germany, Feb.-Mar., 2005; Aug.-Sept, 2006, Oct, 2007, Nov, 2008, Feb, 2009

Invited Professor (2<sup>nd</sup> class), Institut de Physique du Globe de Paris, Laboratoire de geomagnetisme, Paris, France. Summers of 2000 and 2001.

Visiting scientist, Geological Survey of Japan, Tsukuba and Kyoto, Japan, March, 1997.

Chief Geologist, Phoenix Corp, McLean, VA, March 1984-November, 1985

Geophysicist, U.S. Geological Survey, Flagstaff, Arizona, Sept. 1976-August, 1981.

### ***Education***

Ph.D., Geology, Princeton University, Princeton, NJ, 1980-1984

M.A., Geology, Princeton University, Princeton, NJ, 1980-1982

M.S., Planetary Science, California Institute of Technology, Pasadena, CA, 1975-1976

B.S., Geophysics, California Institute of Technology, Pasadena, CA, 1971-1976

### ***RESEARCH INTERESTS***

The role of magnetic fields as fingerprints of processes in planetary lithospheres and ionospheres. See NASA web page at [http://geodynamics.gsfc.nasa.gov/personal\\_pages/purucker.html](http://geodynamics.gsfc.nasa.gov/personal_pages/purucker.html) for further information.

### ***PROFESSIONAL ACTIVITIES***

Project Scientist: Microsatellite Constellation working group, 2008-present

Mission Advisory Group (Phases A, B..) for SWARM, a satellite constellation to study the dynamics of the Earth's magnetic field and its interaction with the Earth System. Selected for implementation by ESA in May, 2004. Launch is planned for late 2010.

Participating Scientist: Mercury Messenger, 2008-present

Co-Investigator, CHAMP satellite magnetic field mission, 2001-present.

Co-Investigator and member of the calibration team, Oersted satellite magnetic field mission to map the near-Earth magnetic field, 1999-present.

Co-Investigator and member of the calibration team, SAC-C satellite magnetic field mission, 2001-present

Executive committee, World Digital Magnetic Anomaly Map, 2005-present; Vice-Chair, 2007-present

Co-Chair, International Association of Geomagnetism and Aeronomy, Working Group V-7, Earth and Planetary Magnetic Field satellites, 1999-2003. As part of this service, I maintain web pages at

[http://denali.gsfc.nasa.gov/research/mag\\_field/purucker/mag\\_missions.html](http://denali.gsfc.nasa.gov/research/mag_field/purucker/mag_missions.html)

devoted to 'Magnetic Field missions for Solid-Earth/Near-Earth Space Geophysics' and 'Magnetic Field missions for the terrestrial planets and moons'.

Proposal Review:

NASA Mars Data Analysis Program Review, Geophysics Panel chair, 2004  
NASA Mars Fundamental Research Program Review, Geophysics Panel chair, 2007  
NASA Mars Data Analysis Program Review, Geophysics Panel member, 2002, 2007  
NASA Solid Earth and Natural Hazards Program Review, 1996-2003  
NASA Earth Science student fellowships, 2007, 2008  
NASA Instrument Incubator Program Review, 2001  
NASA EPSCOR Program Review, 2008  
NASA LUNAR Program Review, 2008

Service on a panel evaluating the U.S. Geological Survey program in geomagnetism, 2004-2005.

Service on professional assessment committees for the Technical University of Denmark, Lyngby, Denmark (2003) and the Indian Institute of Geomagnetism (2005).

Service on a Ph.D. thesis committee of the Universite de Nantes, Nantes, France. I served as the Rapporteur on a thesis by Y. Quesnel entitled 'Interpretation des donnees magnetiques martiennes : Contraintes sur l'evolution primitive de Mars', Nov, 2006

Service on a Ph.D. thesis committee of University of Sydney, New South Wales, Australia. (Jon Turner, 'Signal processing of satellite magnetic data', May, 2003).

Service on a Ph.D. thesis committee of the Institut de Physique du Globe, Paris, France. I served as the Rapporteur on a thesis by B. Langlais entitled 'Les Champs magnetiques de la Terre et de Mars: Apport des satellites Orsted et Mars Global Surveyor', Oct, 2001.

Service on a Ph.D. thesis committee of the Universite de Bretagne Occidentale, France. I served as the Rapporteur or external examiner on a thesis by N. Grammatica entitled 'Induction electromagnetique globale dans une Terre heterogene: etudes a partir de donnees d'observatoires et de donnees du satellite MAGSAT'. Sept, 2000.

Advisor for a Ph.D. student (Ruth Carley) from University of Edinburgh. 2006-present  
Advisor for a Ph.D. student (Cathrine Fox Maule) from Copenhagen University, Dept. of Physics, 2003-2005  
Advisor for a Ph.D. student (Benoit Langlais) from the Institut de Physique du Globe de Paris (1999-2001)

Advisor for a M.S. student (David Lowe) at Scripps Institute of Oceanography, University of California, San Diego, 1998-2000.

Advisor for students (David Benveniste, Sebastien Catz) from the Ecole Polytechnique, near Paris, France. Benveniste completed a thesis for his Bachelor's degree under my supervision in June, 2001 entitled 'The magnetic signature of possible dikes associated with the Pavonis Mons center, Mars'. Catz' thesis was in 2007.

Advisor for a University of Maryland, Physics Dept. Senior, Joseph Covington, in 1992. The project resulted in a peer-reviewed publication 'Improvement of equivalent source inversion technique with a more symmetric dipole distribution model' (Physics of the Earth and Planetary Interiors, v. 76, 199-208, 1993).

Advisor for National Space Club High School students, Philip Goodman, June to August 1998.  
Barry Huang, June to August 2002  
Christine DeLong, June to August 2003  
David Peterson, June to August 2004.  
Joseph Nicholas, June, 2005- August 2006, & 2007  
Chris Bodine, 2008

Advisor for Montgomery-Blair Science/Math magnet student, Ethan Schaler, May 2006-Sept., 2006  
Schaler was named a semi-finalist in the 2007 Intel Science and Engineering Fair for his project with me entitled 'Lunar South Pole Hydrogen & Water Ice Deposits: Constraints from Lunar Prospector magnetic field observations'

Advisor for Montgomery-Blair Science/Math magnet student, Chris Bodine, Summer, 2008  
Schaler was named a semi-finalist in the 2009 Intel Science and Engineering Fair for his project with me and Herbert Frey entitled 'Magnetization of Lunar Basins and Crater Retention Age: New Analyses of the Pre-Nectarian Lunar Dynamo'

Program Committee, American Geophysical Union, 2000-2002 Spring meetings

Member: American Geophysical Union, Society of Exploration Geophysicists

Chair or co-chair of the following special symposia:

- 1) First Swarm International Science Meeting, 2006, Nantes, France, Local organizing committee
- 2) Near-Earth magnetic field from multiple spacecraft observations, 2006, Fall AGU, San Francisco
- 3) Magnetic interpretation: Continental to Planetary Scales, 2003, Fall AGU, San Francisco
- 4) Analysis of the Oersted, CHAMP, and SAC-C magnetic field constellation, a virtual session held in conjunction with the Spring meeting of the American Geophysical Union, May 28-31, 2002. Available online at <http://www.dsri.dk/multimagsatellites> and on CD
- 5) Earth and Planetary Magnetic Survey Satellites, Spring AGU, 2001, Boston
- 6) Geophysical Data Fusion, Birmingham, United Kingdom, Int. Union of Geodesy and Geophysics, 1999
- 7) Space age geomagnetism, 1997, Spring AGU, Baltimore
- 8) Satellite geomagnetism, 1997, Int. Assoc. of Geomagnetism and Aeronomy, Uppsala, Sweden
- 9) Lithospheric magnetic fields, Boulder, Int. Union of Geodesy and Geophysics, 1995

Journal reviewer for manuscripts submitted to Science, Nature, Journal of Geophysical Research (Solid Earth, Space Physics, and Planets), Earth Planets and Space, Geophysical Research Letters, and Geochemistry Geophysics Geosystems, Earth and Planetary Science Letters

## **PUBLICATIONS**

Friis-Christensen, E., Luehr, H., Hulot, G., Haagmans, R., and Purucker, M., 2009, Past as Prologue: Swarm and the Decade of Geopotential Research, *EOS*, 2009, 5 pages, 1 fig.

Purucker, M.E., Sabaka, T.J., Solomon, S.C., Anderson, B.J., Korth, H., Zuber, M.T., and Neumann, G.A., 2008, Mercury's internal magnetic field: Constraints on large- and small-scale fields of crustal origin, *Earth and Planetary Science Letters*, doi:10.1016/j.epsl.2008.12.017.

Anderson, B.J., Acuna, M.H., Korth, H., Purucker, M.E., Johnson, C.L., Slavin, J.A., Solomon, S.C., McNutt, R.L., 2008, The structure of Mercury's magnetic field from MESSENGER's first flyby, *Science*, v. 321, pp. 82-84, 4 July 2008

Purucker, M., 2008, A global model of the internal magnetic field of the Moon based on Lunar Prospector magnetometer observations, *Icarus*, 197, 19-23.

Purucker, M., Sabaka, T., Le, G., Slavin, J.A., Strangeway, R.J., and Busby, C., 2007, Magnetic field gradients from the ST-5 constellation: Improving magnetic and thermal models of the lithosphere, *Geophys. Res. Lett.*, 34, doi:10.1029/2007GL031739

Purucker, M., 2007, Magnetic Anomaly Map of the World, *Eos Trans. AGU*, 88(25), 263.

Korhonen, J.V., Fairhead, J.D., Hamoudi, M., Hemant, K., Lesur, V., Manda, M., Maus, S., Purucker, M., Ravat, D., Sazonova, T., and Thebault, E., 2007, *Magnetic Anomaly Map of the World (and associated DVD)*, Scale: 1:50,000,000, 1st edition, Commission for the Geological Map of the World, Paris, France.

Purucker, M., and Whaler, K., 2007, Crustal Magnetism, Chapter 6, Volume 5: Geomagnetism, M. Kono (ed.), Elsevier, *Treatise on Geophysics*, 195-237.

Nicholas, J. B., M. E. Purucker, and T. J. Sabaka, 2007, Age spot or youthful marking: Origin of Reiner Gamma, *Geophys. Res. Lett.*, 34, L02205, doi:10.1029/2006GL027794.

Langlais, B., and Purucker, M., 2007, A polar magnetic paleopole associated with Apollinaris Patera, Mars, *Planetary and Space Science*, 55(3), 270-279

Purucker, M., Lithospheric magnetic fields: Accomplishments of the Decade of Geopotential Research, *ESA Publication WPP-261*, 4 pages, 2006

Purucker, M., A new global magnetization model: validation and science results, ESA Publication WPP-261, 4 pages, 2006

Le, G., Slavin, J.A., Wang, Y., Strangeway, R.J., Sabaka, T., and Purucker, M., The ST-5 magnetic field constellation: First results, ESA Publication WPP-261, 4 pages, 2006

Olsen, N, R Haagmans, T J. Sabaka, A Kuvshinov, S Maus, M Purucker, M Rother, V Lesur, and M Manda, The Swarm End-to-End mission simulator study: A demonstration of separating the various contributions to Earth's magnetic field using synthetic data, Earth, Planets and Space, 58(4), 359-370, 2006

Maus, S, Luhr, H., and Purucker, M., Simulation of the high degree lithospheric field recovery for the Swarm constellation of satellites, Earth, Planets and Space, 58(4), 397-407, 2006

Manda, M., and M. Purucker, Observing, Modeling, and Interpreting Magnetic Fields of the Solid Earth, Surveys in Geophysics, <http://dx.doi.org/10.1007/s10712-005-3857-x>, 2005

Fox Maule, C., Purucker, M., Olsen, N., and K. Mosegaard, Heat flux anomalies in Antarctica revealed by satellite magnetic data, Science (and Science Express), 309, 464-467, July 15, 2005 and (June 9, 2005).

Waler, K. and Purucker, M., A spatially continuous magnetization model for Mars, J. Geophys. Res., Vol. 110, No. E9, E09001, <http://dx.doi.org/10.1029/2004JE002393>, 02 September 2005

Purucker, M. and Ishihara, T., Magnetic images of the Sumatran region crust, EOS, Transactions of the American Geophysical Union, 86 (10), 8 March 2005, 101-102.

Chassefiere, E., ..., Purucker, M, and 43 co-authors, DYNAMO: A Mars upper atmosphere package for investigating solar wind interaction and escape processes, and mapping Martian fields, Advances in Space Research, 33, 2228-2235, 2004.

Fox Maule, C., Purucker, M., and Olsen, N., Magnetic crustal thickness in Greenland from CHAMP and Oersted data, in Earth Observation with CHAMP: Results from Three Years in Orbit, (Reigber, C., et al., eds), 255-261, published Sept 21, 2004.

'Long-wavelength anomalies', 'Magsat', and 'R.A. Langel' entries in Encyclopedia of Geomagnetism and Paleomagnetism, Gubbins, D., and Herrero-Bervera, E. (eds), 2007

Sabaka, T., Olsen, N., and Purucker, M., Extending Comprehensive Models of the Earth's Magnetic Field with Oersted and CHAMP data, Geophys. J. Int., 159, 521-547, Nov. 2004, <http://dx.doi.org/10.1111/j.1365-246X.2004.02421.x>

Langlais, B., Purucker, M., and Manda, M., Crustal magnetic field of Mars, Jour. Geophys. Res- Planets, 109(E2), E02008, doi:10.1029/2003JE002048, 2004.

Waler, K., and Purucker, M., Martian magnetization-preliminary models, The Leading Edge, 22(8), 763-765, August, 2003.

Vennerstrom, S., Olsen, N., Purucker, M., Acuna, M.H. and Cain, J.C., The magnetic field in the pile-up region at Mars, and its variation with the solar wind, Geophy. Res. Lett., 30(7), 1369, doi: 10.1029/2003GL016883, 2003.

Stauning, P., Luhr, H., Ulte-Guerard, P., LaBrecque, J., Purucker, M., Primdahl, F., Jorgensen, J.L., Christiansen, F., Hoeg, P. Lauritsen, K.B. (editors). OIST-4 Proceedings, 4<sup>th</sup> Oersted International Science Team Conference, 2003, DMI Scientific Report 03-09, Copenhagen, 370 pp.

Purucker, M., Sabaka, T., Olsen, N., and Maus, S., How have Oersted, CHAMP, and SAC-C improved our knowledge of the oceanic regions, OIST-4 Proceedings, 2003, 89-95.

Purucker, M. and Olsen, N., Modeling of the Earth's magnetic field and its variation with Oersted, CHAMP, and Oersted-2/SAC-C, OIST-4 Proceedings, 2003, 319-327.

Purucker, M., McCreddie, H., Vennerstrom, S., Hulot, G., Olsen, N., Luehr, H., and Garnero, E., Highlights from AGU's Virtual Session on New Magnetic Field Satellites, EOS, v. 83, no. 34, p.368, August 20, 2002 (with associated CD-ROM).

Purucker, M. and N. Olsen, Improving the definition of cratonic boundaries utilizing the lithospheric magnetic field derived from CHAMP Observations, in 'First CHAMP Mission Results for Gravity, Magnetic, and Atmospheric Studies', Reigber et al (eds), Springer, 2003, 275-280.

Ravat, D. and M. Purucker, Unraveling the magnetic mystery of the Earth's lithosphere: The background and role of the CHAMP Mission, in 'First CHAMP Mission Results for Gravity, Magnetic, and Atmospheric Studies', Reigber et al (eds), Springer, 251-260, 2003

Purucker, M., Langlais, B., Olsen, N., Hulot, G., Manda, M., The southern edge of cratonic North America: Evidence from new satellite magnetometer observations, Geophys.Res.Lett., 29(15),8000, doi:10.1029/2001GL013645,2002  
[part of a special issue on results from the Oersted satellite. Plate 3 from this paper is the cover of a special Orsted issue on August 1, 2002 (Issue #15).]

Voorhies, C.V., Sabaka, T.J., and Purucker, M., On magnetic spectra of Earth and Mars, Journal of Geophysical Research-Planets, 107(E6), 5034, doi:10.1029/2001JE001534, 2002.

Ravat, D., Whaler, K., Pilkington, M., Sabaka, T., and Purucker, M., Compatibility of high-altitude aeromagnetic and satellite altitude magnetic anomalies over Canada, Geophysics, 67, 546-554, March-April, 2002

Chassefiere, E., .. Purucker., M., and 67 other authors, Scientific Objectives of the Dynamo Mission, Adv. Space Research, 27, 1851-1860, 2001.

Lowe, D.A.J., Parker, R.L., Purucker, M.E., and Constable, C.G., Estimating the crustal power spectrum from vector Magsat data, Journal of Geophysical Research, v.106, 8589-8598, May 10, 2001.

Chassefiere, E., and 68 co-authors, Scientific objectives of the DYNAMO mission, Advances in Space Research, 27, 1851-1860, 2001.

Golynsky, A., M. Chiappini, d. Damaske, F. Ferraccioli, J. Ferris, C. Finn, M. Ghidella, T. Isihara, A. Johnson, H.R. Kim, L. Kovacs, J. LaBrecque, V. Masolov, Y. Nogi, M. Purucker, P. Taylor, M. Torta, 2001, "ADMMap – Magnetic Anomaly Map of the Antarctic," 1:10 000 000 scale map, in Morris, P., and R. von Frese, eds., BAS (Misc.) 10, Cambridge, British Antarctic Survey.

Luhmann, J., Acuna, M., Purucker, M., Russell, C., and D. Lyon, The Martian magnetosheath: How Venus like?, Planetary and Space Science, 50, 489-502, 2002.

Olsen., N., Holme, R., Hulot, G., Sabaka, T., Neubert, T., Toffner-Clausen., L., Primdahl, F., Jorgensen, J., Leger, J-M., Barraclough, D., Bloxham, J., Cain, J., Constable, C., Golovkvov, V., Jackson, A., Kotze, P., Langlais, B., Macmillan, S., Manda, M., Merayo, J., Newitt, L., Purucker, M., Risbo, T., Stampe, M., Thomson, A., and Voorhies, C., Orsted Initial Field Model, Geophysical Research Letters, v. 27, 3607-3610, Nov. 15, 2000.

Purucker, M. and Dyment, J. Satellite magnetic anomalies related to seafloor spreading in the South Atlantic Ocean, Geophysical Research Letters, v. 27, 2765-2768, Sept. 1, 2000.

Purucker , M., Ravat, D., Frey, H., Voorhies, C., Sabaka, T., and Acuna, M., An altitude-normalized magnetic map of Mars and its interpretation, Geophys. Res. Lett., v. 27, 2449-2452, Aug. 15, 2000.

Purucker, M. and Clark, D. Exploration Geophysics on Mars: Lessons from magnetics, in The Leading Edge, pp. 484-487, May 2000.

Taylor, P., and M. Purucker, Robert A. Langel III (1937-2000), EOS, v. 81, no. 15, p. 159, April 11, 2000.

Purucker, M., Von Frese, R. and Taylor, P., Mapping and interpretation of satellite magnetic anomalies from POGO data over the Antarctic region, Annali di Geofisica, v. 42, p.215-228, April, 1999.

Ravat, D., and M. Purucker, The future of satellite magnetic anomaly studies is bright, The Leading Edge, March, 1999, p. 326-329

Purucker, M., R. Langel, M. Rajaram, and C. Raymond, Global magnetization models with a priori information, Journal of Geophysical Research, v.103, 2563-2584, 1998.

Purucker, M., T. Sabaka, R. Langel, and N. Olsen, The missing dimension in Magsat and POGO anomaly studies, Geophysical Research Letters, v. 24, p.2909-2912, 1997

Purucker, M., T. Sabaka, and R. Langel, Conjugate Gradient Analysis: A New Tool For Studying Satellite Magnetic Data Sets, Geophysical Research Letters, v. 23, p.507-510, March 1, 1996 .

Ravat, D., R. Langel, M. Purucker, J. Arkani-Hamed, and D. Alsdorf, Global vector and scalar Magsat magnetic anomaly maps, Journal of Geophysical Research, 100, 2011-20136, 1995

Arkani-Hamed, J., Langel, R., and M. Purucker, Scalar Magnetic Anomaly Maps of Earth derived from Pogo and Magsat Data, Journal of Geophysical Research, 99, 24075-24090, 1994.

Langel, R., M. Purucker, and M. Rajaram, The Equatorial Electrojet and Associated Currents as Seen in Magsat Data, Jour. Atm. Terr. Physics, V.55, p.1233-1269, 1993 .

Purucker, M., The Computation of Vector Magnetic Anomalies: A Comparison of Techniques and Errors, Physics of the Earth and Planetary Interiors, V. 62, p. 231-245, 1990.

Purucker, M., Petrologic, paleomagnetic, and structural evidence of a Paleozoic rift system in Oklahoma, New Mexico, Colorado, and Utah, Discussion, Geol. Soc. Amer. Bull., v. 100, p.1846-1847, 1988.

Purucker, M., Interpretation of an Aeromagnetic Survey along the Wichita Frontal Fault Zone, Oklahoma Geological Survey Guidebook 23, p. 129-136, 1986.

Van Houten, F., and M. Purucker, Glauconitic Peloids and Chamositic Ooloids—Favorable Factors, Constraints, and Problems, Earth Science Reviews, vol. 20, p. 211 - 250, 1984

Purucker, M., Time of Formation of Soft Iron Ore on the Gunflint and Mesabi Ranges (Ontario, Canada and Minnesota, U.S.), Economic Geology, vol. 78, p. 502 506, 1983.

Oolitic Ironstones and Banded Iron Formation: Controls on Chemical Sedimentation, Ph.D. thesis, Princeton University, 1983.

Purucker, M., D. Elston, and S. Bressler, Magnetic Stratigraphy of Late Cenozoic Glaciogenic Sediments, Taylor Valley, Transantarctic Mountains, AGU Antarctic Research Series, vol. 33, p.109 - 140, 1981

Purucker, M., Elston, D., and E.M. Shoemaker, Early Acquisition of Characteristic Magnetization In Red Beds of the Moenkopi Formation (Triassic), Gray Mountain, Arizona, Journal of Geophysical Research, vol. 85, p. 997 - 1012, 1980.

Elston, D., and M. Purucker, Detrital magnetization in red beds of the Moenkopi Formation (Triassic), Gray Mountain, Arizona, Journal of Geophysical Research, vol. 84, p.1653-1665, 1979.

## **AWARDS**

Green Prize for "Outstanding Ability and Achievement in the Field of Creative Scholarship," California Institute of Technology, 1976