

STEPHEN JAMES MOJZSIS



Citizenship: USA, Hungary, Ireland

Married to Kathleen Ebert, three children (Anna, James and John)

Professor of Geology, and Chair of Arts & Sciences

University of Colorado, Collaborative for Research in Origins, Department of Geological Sciences, 2200 Colorado Avenue, UCB 399, Boulder, Colorado 80309-0399 USA

mojzsis@colorado.edu smojzsis@gmail.com http://isotope.colorado.edu

tel: +13034925014 fax: +13034925014 mobile: +13038590309

Skype: steve.mojzsis ISI Web of Science *h-index* = 30; Google scholar *h-index* = 40, *i10-index* = 66 (6508 citations)

RESEARCH INTERESTS

I am a geologist. My research is field-, laboratory- and modeling-based, and explores the planetary-scale geodynamic conditions that give rise to a biosphere on Earth and Earth-like planets. I use the ancient geologic and meteoritic record to explore the natural world, and use whatever means necessary to interrogate these records. My studies in planetary crustal processes have led me to broad applications, especially coupled U-Th-Pb zircon geochronology and crystal chemistry with other isotopic techniques (Lu-Hf, Sm-Nd, C-, O-, S-, Si-isotopes) applied to minerals and rocks. I am also a field geologist, and document field relationships in gneiss terranes by high-resolution mapping at the appropriate scale (1:5-1:1000) to guide detailed sampling for geochemistry and geochronology. I have led novel instrument applications development, mostly with secondary ion mass spectrometry (multi-collector ion microprobe; SIMS) and multi-collector inductively coupled plasma mass spectrometry (MC-ICP-MS) for combined U-Pb zircon, Lu-Hf, $^{147,146}\text{Sm}$ - $^{143,142}\text{Nd}$ and W isotope studies rocks and meteorites. Similarly, I have used SIMS for multiple S-, Si- and O-isotope studies of the oldest minerals of Earth, Mars and asteroidal meteorites. I use solar system solids as chemical, thermal and chronological archives. As such, I investigate pre- and post- closure temperature thermal chemical diffusion models of the important accessory minerals. My work has tracked the evolution of atmospheric oxygen as it relates to evolution of biogeochemical cycles using multiple S isotopes and trace metals (Ni, Co). My field area is the inner solar system, but is not confined to it because I also have my eye on exoplanets; I term this new science *Geoastronomy*. To this end, I have constructed geochemically- and cosmochemically-plausible models for the thermal structure of planetary objects including Earth, Moon, Mars, Mercury, and various asteroids, and have extrapolated to Kuiper Belt/Trans-Neptunian Objects. New work involves better understanding the nature of Exoplanets. Lately, I have been actively working on planet formation theory and planetary dynamics coupled with cosmochemistry, and galactic chemical evolution models.

PROFESSIONAL PREPARATION

University of California Los Angeles; Postdoctoral Scholar with T.M. Harrison	2000
Scripps Institution of Oceanography; Ph.D. Earth Sciences with G.O. Arrhenius	1997
Boston University, Boston, Massachusetts; M.A. Geology with F. El-Baz	1992
Boston University, Boston, Massachusetts; B.A. Geology with L. Margulis	1988

PROFESSIONAL APPOINTMENTS

2019-present Invited Professor, University of Lorraine & CNRS-CRPG, Nancy, France
2019-present Scholar, Erwin Schrödinger Institute for Mathematics and Physics, Vienna, Austria
2018 Visiting Professor, Department of Earth Sciences, ETH, Zürich, Switzerland
2017-present Chair, College of Arts & Sciences Council of the University of Colorado
2016-present Director, the Collaborative for Research in Origins (CRiO)
2000-present Assistant (2000), Associate (2007), Full (2014) Professor of Geology
2015-2017 Visiting Professor, Earth-Life Science Institute, Tokyo Institute of Technology, Japan
2013-present Distinguished Professor, Hungarian Academy of Sciences, Budapest, Hungary
2011-2013 Professeur des universités (2^e), Université Claude Bernard Lyon 1, France
2008-2009 Director, Science Education Initiative, Geological Sciences, University of Colorado
2007-2008 CNRS & Fulbright Visiting Professor of Geochemistry, CNRS-CRPG Nancy, France
2001-2008 Associate Director, University of Colorado Center for Astrobiology
1999-2000 Adjunct Assistant Professor of Geochemistry, University of California Los Angeles
1998-2000 NSF Earth Sciences Postdoctoral Fellow, University of California Los Angeles
1997-1998 President's Postdoctoral Fellow, UCLA
1998-2000 Asst. Researcher, Institute for Pure & Applied Physical Sciences, UCSD
1995-1997 NSCORT Graduate Research Fellow, Scripps Institution of Oceanography, UCSD
1993-1997 Graduate Research Assistant, Scripps Institution of Oceanography, UCSD
1992-1993 Research Associate, Scripps Institution of Oceanography, UCSD
1988-1992 Graduate Research Assistant in Geology, Boston University
1988 Research Associate Hydrogeochemist, United States Geological Survey, Cape Cod, MA
1987 NASA Summer Undergraduate Intern, Lunar and Planetary Institute, Houston, TX

MEMBERSHIP IN PROFESSIONAL SOCIETIES

American Geophysical Union	European Association of Geochemistry
Geochemical Society	International Fulbright Association
Sigma Xi	International Society for the Study of the Origin of Life

PROFESSIONAL SERVICE ACTIVITIES (2007-2019)

- **Departmental and College Service:** *Director of the Science Education Initiative Geological Sciences Node (2008-2009); Chair Graduate Admissions Committee (2013-2015); Chair, Arts & Sciences Council of the University of Colorado at Boulder (2017-present)*
- **Editorial Board:** *Geobiology, Astrobiology (until 2014); Associate Editor: Central European Geology (formerly Acta Geologica Hungarica); Associate Editor: Central European Journal of Geosciences; Heliyon (Elsevier, until 2017)*
- **Subject Editor:** *Geobiology, Space Science Reviews, and Precambrian Research*
- **Voting/Participating Member:** *International Commission on Stratigraphy, Sub-commission on Precambrian Stratigraphy; Interim Board Member, European Astrobiology Institute*

- **Regular peer reviewer:** *Nature, Nature Geoscience, Science Communications, Science, Earth & Planetary Science Letters, Geochimica et Cosmochimica Acta, Journal of Geophysical Research – Planets, Journal of Geology, Chemical Geology, Geochemistry Journal, Astrobiology, Geobiology, Precambrian Research, Contributions to Mineralogy and Petrology, American Journal of Science, Reviews in Geochemistry and Mineralogy, Proceedings of the National Academy of Sciences, Journal of Asian Earth Sciences, Geology, Tectonophysics, Meteoritics and Planetary Science*
- **Regular external reviewer:** *NASA programs in Solar System Workings, Habitable Worlds, Emerging Worlds, Exobiology and Astrobiology, Mars Fundamental Research; NSF programs in Instrumentation and Facilities, Geology and Paleontology, Geochemistry and Petrology, Geobiology and Low-temperature geochemistry; NRC (UK) Programs in Environmental Sciences; NWO (Netherlands) Program in Chemistry & Biochemistry; Australian Research Council (ARC); Agence Nationale de Recherche (French National Science Foundation); European Science Foundation; European Research Council; Swiss National Science Foundation; Deutsche Forschungs Gemeinschaft (German National Science Foundation), National Science Foundation of Poland*
- **Panelist:** *NASA Exobiology, and Cosmochemistry; NSF Graduate Student Research Fellowship Program; NASA Postdoctoral Program; NASA Astrobiology Roadmap Planning Committee 2014; DFG Schwerpunkt Programme, Germany 2015 & 2018*
- **Conference Program Chair:** *Early Life (École thématique ‘Debut de la Vie’) The Lyon Spring School 2012 (50 international participants, organized in France). “Astrobiology 2004”, Boulder, Colorado (500 participants); “Before the Moon 2016”, Tokyo, Japan (30 participants), “Before Life” 2017, Boulder, Colorado (30 participants); Erwin Schroedinger Institute “Origins” 2019, Vienna, Austria (60 participants).*
- **Theme Chair**, “Early Earth Processes”: *2008 V.M. Goldschmidt International Geochemistry Meeting, Vancouver, BC (Canada); “Primitive Earth: From core to atmosphere”: 2011 V.M. Goldschmidt International Geochemistry Meeting, Prague, (Czech Republic); “Planetary Formation”: 2015 Origins of Solar Systems GRC, Mt. Holyoke, MA; “Early Earth”: 2016 Goldschmidt Conference, Yokohama, Japan.*
- **Program Organizing Committee Member:** *Impact Processes in the Solar System I, Lunar & Planetary Institute, 2008; Delivery of Volatiles to Earth and Exo-Earths, Space Telescope Science Institute, 2010; COST Action conference Life3E Search for life: from Early Earth to Exoplanets, to be held in Quy Nonh on march 25-29th 2019.*
- **Session Chair**, topics in geochemistry, geobiology and cosmochemistry: *2013 EGU; 2018 AOGS; 2008 AGU; 2007, 2017 GSA; 2007, 2008, 2009, 2011, 2013, 2015, 2016, 2018 Goldschmidt Conferences*

RECENT PRESENTATIONS (2017-2019)

Keynotes:

Gordon Research Conference, Origin of Life. Galveston, TX. January 2018

Earth-Life Science Institute, Tokyo Institute of Technology. May 2018

Ludwig-Maximilians-Universität München, Simons Foundation, Munich, Germany, October 2018

The John Templeton Foundation/FfAME Origins Program, Atlanta, GA October 2018

MISASA International Symposium, Okayama, Japan December 2018

Search for life: from Early Earth to Exoplanets, Quy Nonh, Vietnam March 2019.
The Nordic Astrobiology Network, Siljan, Sweden June 2019

Invited:

European Geosciences Union, Vienna, AT. April 2018
Earth-Life Sciences Institute, Tokyo, Japan. May 2018
Asia-Oceania Geosciences Conference, Hawai'i. June 2018
University of Bern, CH. Earth Sciences, June 2018
University of Manchester, UK. Earth Sciences, June 2018
University of Heidelberg, Germany. Earth Sciences, June 2018
Max-Planck-Institute for Astronomy, Germany. June 2018
ETH, CH. Earth Sciences, June 2018
University of Zurich, CH. Physics, July 2018
Syracuse University, Earth Sciences, New York. December 2018
LMU Munich, Chemistry, July 2019

HONORS AND AWARDS (with year of award)

Full Member, Hungarian Academy of Sciences, 2016 (seated, 2017)
Distinguished Visiting Professor, Earth-Life Science Institute (ELSI), Tokyo, 2015
University of Colorado ASSETT Outstanding Teacher Award, 2014
Distinguished Visiting Professor, Geological Institute of the Hungarian Academy of Sciences, 2013
Fulbright Faculty Scholar (France), 2007
University of Colorado, Residence Life Teaching Award, 2004
Fellow, Institute of Geophysics and Planetary Physics (IGPP), University of California, 1998
Hickok-Radford Award for Geological Research in Polar Regions, SEG Foundation, 1997
Geological Society of America, Graduate Research Award, 1996
Edward A. Frieman Prize, Best Graduate Student Paper, Scripps Institution of Oceanography, 1996
Sigma Xi, San Diego Chapter Science Award, 1995
Boston University Graduate Award for Excellence in Geology, 1987

BIBLIOGRAPHY

BOOKS

Mojzsis, S.J. (near completion) Origin of the biogeochemical cycles. *Wiley-Blackwell*. (Fall 2019)
Mojzsis, S.J. (IN PREP) Early life. *Elsevier Developments in Precambrian Geology* (Spring 2020)

PEER-REVIEWED MANUSCRIPTS

Explanation: * Peer-reviewed Book chapters Underline = past or present Student or Postdoc author
Martins-Pimentel, R., Kelly, N.M., Mojzsis, S.J. (IN PREPARATION) A mid-Carboniferous age for the Santa Fe Impact Structure.

Morrisson, P., Kelly, N.M., Rosing, M.T. and **Mojzsis**, S.J. (IN PREPARATION) The antiquity of elemental sulfur reduction. *for EPSL*.

Mojzsis, S.J. and Brasser, R. (IN PREPARATION) Irreconcilable differences in the solar system. *for EPSL*.

Greer, J.C., Cates, N.L., Caro, G., Bleeker, W., Kelly, N.M., **Mojzsis**, S.J. (IN PREPARATION) Archean granitoid gneisses and supracrustal enclaves of the southern Inukjuak Domain, Quebec (Canada). *for EPSL*.

Brasser, R., Werner, S.C., **Mojzsis**, S.J. (SUBMITTED) Impact bombardment chronology of the terrestrial planets from 4.5-3.5 Ga. *for Icarus*.

Brasser, R., Armitage, P., **Mojzsis**, S.J. (SUBMITTED) Structured protosolar disc divides inner and outer solar system. *for Nature*.

Mojzsis, S.J., Brasser, R., Kelly, N.M., Abramov, O., and Werner, S. (IN REVIEW) Onset of giant planet migration ca. 4.48 Ga. *Proceedings National Academy of Sciences*.

Woo, J.M.Y., Genda, H., Brasser, R., **Mojzsis**, S.J. (IN REVIEW) Mars in the aftermath of colossal impact. *Icarus*.

Böhm, C., Cates, N.L., **Mojzsis**, S.J., Bourdon, B., Roth, A., Hartlaub, R.P., Heaman, L.M. (2019) The Assean Lake complex: ancient crust at the northwestern margin of the Superior craton, Manitoba, Canada. *In Earth's oldest rocks II* (Van Kranendonk, M.J., Hoffmann, E. and Bennett, V. Eds.) *Developments in Precambrian Geology*.

Woo, J.M.Y., Brasser, R., Matsumura, S., **Mojzsis**, S.J., Ida, S. (2018) The curious case of Mars' formation. *Astronomy & Astrophysics*. <https://doi.org/10.1051/0004-6361/201833148>.

Brasser, R., Dauphas, N., **Mojzsis**, S.J. (2018) Jupiter's influence on the building blocks of Mars and Earth *Geophysical Research Letters*, **45**, <https://doi.org/10.1029/2018GL078011>.

Mojzsis, S.J., Abramov, O., Frank, E.A., Brasser, R., (2018) Thermal consequences to Mercury's mantle by impact bombardment. *Earth and Planetary Science Letters* **482**, 1-9.

Kelly, N.M., Metcalf, J.R., Flowers, R.M., **Mojzsis**, S.J. (2018) Late accretion to the Moon recorded in (U-Th)/He zircon thermochronometry. *Earth and Planetary Science Letters* **482**, 222-235.

Michalski, J., Onstott, T.C., **Mojzsis**, S.J., Mustard, J., Chan, Q., Niles, P.B., Stewart-Johnson, S. (2018) The martian subsurface as a potential window into the origin of life. *Nature Geoscience*. <https://doi.org/10.1038/s41561-017-0015-2>.

Genda, H., Brasser, R., and **Mojzsis**, S.J. (2017) The terrestrial late veneer from core disruption of a lunar-sized impactor. *Earth and Planetary Science Letters* **480**, 25-32.

Brasser, R., **Mojzsis**, S.J. (2017) A colossal impact furnished Mars with a late veneer. *Geophysical Research Letters*, **44**, <https://doi.org/10.1002/2017GL074002>.

Brasser, R., **Mojzsis**, S.J., Matsumura, S., Ida, S. (2017) The cool and distant formation of Mars. *Earth and Planetary Science Letters* **468**: 85-93.

Frank, E.A., Potter, R.W.K., Abramov, O., James, P.B., Klima P.B., **Mojzsis**, S.J., Nittler, L.R. (2017) Evaluating an impact origin for Mercury's high-magnesium region. *Journal of Geophysical Research – Planets*. [10.1002/2016JE005244](https://doi.org/10.1002/2016JE005244)

Hynek, B.M., **Mojzsis**, S.J. (2017) The great Mars climate paradox redux. *Geology*. doi:10.1130/focus102016Y.1.

Caro, G., Morino, P., **Mojzsis**, S.J., Cates, N.L., Bleeker, W. (2016) Sluggish Hadean geodynamics: Evidence from coupled $^{146,147}\text{Sm}$ - $^{142,143}\text{Nd}$ systematics in Eoarchean supracrustal rocks of the Inukjuak domain (Québec). *Earth and Planetary Science Letters* **457**:23-37.

Barge, L.M., Branscomb, E., Brucato, J.R., Cardoso, S.S.S., Cartwright, J.H.E., Danielache, S.O., Galante, D., Kee, T.P., Miguel, Y., **Mojzsis**, S.J., Robinson, K.J., Russell, M.J., Simoncini, E., Sobron, P. (2016) Thermodynamics, disequilibrium, evolution: Far-from-equilibrium geological and geochemical considerations for Origin-of-Life Research. *Origins of Life and Evolution of Biospheres* doi: 10.1007/s11084-016-9508-z

Brasser, R., **Mojzsis**, S.J., Werner, S.C., Matsumura, S., Ida, S. (2016) Late veneer and late accretion to the terrestrial planets. *Earth and Planetary Science Letters* **455**:85-93.

Petrash, D.A., Robbins, L.J., Shapiro, R.S., **Mojzsis**, S.J., Konhauser, K.O. (2016) Chemical and textural overprinting of ancient stromatolites: timing, processes, and implications for their use as paleoenvironmental proxies. *Precambrian Research* **278**: 145-160.

Brasser, R., Matsumura, S., Ida, S., **Mojzsis**, S.J., Werner, S.C. (2016) Analysis of terrestrial planet formation by the Grand Tack model: System architecture and tack location. *Astrophysical Journal* **821**:75.

Frank, E.A., Maier, W.D. and **Mojzsis**, S.J. (2016) Highly siderophile element abundances in Eoarchean komatiite and basalt protoliths. *Contributions to Mineralogy and Petrology* **171**: 29

Abramov, O. and **Mojzsis**, S.J. (2016) FRONTIERS PAPER: Thermal effects of impact bombardments on Noachian Mars. *Earth and Planetary Science Letters* **442**, 108-120.

Willbold, M., Elliot, T. and **Mojzsis**, S.J. (2015) The W isotope composition of the Acasta Gneiss Complex (Northwest Territories, Canada). *Earth and Planetary Science Letters*. doi:10.1016/j.epsl.2015.02.040

Hopkins, M.D., **Mojzsis**, S.J. (2015) A protracted lunar bombardment (4250-3800 Ma) lunar bombardment from combined mineral chemistry, Ti-thermometry and U-Pb zircon geochronology of Apollo 14 melt breccia zircons. *Contributions to Mineralogy and Petrology* **169**:30 DOI 10.1007/s00410-015-1123-x.

Polgári, M., Németh, T., Pál-Molnár, E., Futó, I., Vigh, T. and **Mojzsis**, S.J. (2015) Correlated chemostratigraphy of manganese-carbonate microbialites (Úrkút, Hungary). *Gondwana Research* **29**: 278-289.

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Guitreau, M., Blichert-Toft, J., **Mojzsis**, S.J., Roth, A.S.G., Bourdon, B., Cates, N.L. and Bleeker, W. (2014) The Lu-Hf isotope system in the Acasta Gneiss Complex (Northwest Territories, Canada) *Geochimica et Cosmochimica Acta* **135**, 251-269.

Mojzsis, S.J., Cates, N.L., Bleeker, W., Hopkins, M.D., Guitreau, M., Blichert-Toft, J., Trail, D. and Abramov, O. (2014) Component geochronology of the ca. 3920 Ma Acasta Gneiss. *Geochimica et Cosmochimica Acta* **133**, 68-96.

Swanner, E.D., Planavsky, N.J., Lalonde, S.V., Robbins, L.J., Bekker, A., Rouxel, O.J., Kappler, A., **Mojzsis**, S.J. and Konhauser, K.O. (2014) Cobalt and marine redox evolution. *Earth and Planetary Science Letters* **390**, 253-263.

Swanner, E.D., Cates, N.L., Pecoits, E., Bekker, A., Konhauser, K.O. and **Mojzsis**, S.J. (2013) Geochemistry of pyrite from diamictites of the Boolgeeda Iron Formation, Western Australia with implications for the GOE and Paleoproterozoic ice ages. *Chemical Geology* **362**, 131-142.

Abramov, O., Kring, D.A., and **Mojzsis**, S.J. (2013) INVITED REVIEW: The impact environment of the Hadean Earth. *Chemie der Erde-geochemistry* **73**: 227-248.

Mloszewska, A.M., **Mojzsis**, S.J., Pecoits, E., Papineau, D., Dauphas, N. and Konhauser, K.O. (2013) Chemical sedimentary protoliths of the >3.75 Ga Nuvvuagittuq Supracrustal Belt (Quebec, Canada). *Gondwana Research* **23**, 574-594.

Guitreau, M., Blichert-Toft, J., **Mojzsis**, S.J., Roth, A.S.G. and Bourdon, B. (2013) A legacy of Hadean silicate differentiation inferred from Hf isotopes in Eoarchean rocks of the Nuvvuagittuq supracrustal belt (Quebec, Canada). *Earth Planet. Sci. Lett.* **362**, 171-181.

Roth, A.S.G., Bourdon, B., **Mojzsis**, S.J., Touboul, M., Sprung, P., Guitreau, M. and Blichert-Toft, J. (2013) Inherited ¹⁴²Nd anomalies in Eoarchean protoliths. *Earth Planet. Sci. Lett.* **361**, 50-57.

Cates, N.L., **Mojzsis**, S.J., Ziegler, K. and Schmitt, A.K. (2013) Reduced, reused and recycled: Detrital zircons define a maximum age for the Eoarchean (ca. 3750-3780 Ma) Nuvvuagittuq supracrustal belt, Québec (Canada) *Earth. Planet. Sci. Lett.* **362**, 283-293.

Mloszewska, A.M., Pecoits, E., Cates, N.L., **Mojzsis**, S.J., O'Neil, J., Robbins, L.J. and Konhauser, K.O. (2012) The composition of Earth oldest iron formations: The Nuvvuagittuq Supracrustal Belt (Quebec, Canada). *Earth and Planetary Science Letters* **317**, 331-342.

Abbott, S.S., Harrison, T.M., Schmitt, A.K. and **Mojzsis**, S.J. (2012) A search for thermal excursions from ancient extraterrestrial impacts using Hadean zircon Ti-U-Th-Pb depth profiles. *Proc. Nat. Acad. Sci.* **109**, 13486-13492.

Guitreau, M. Blichert-Toft, J., Martin, H., **Mojzsis**, S.J. and Albarède, F. (2012) Hafnium isotope evidence from Archean granitic rocks for deep-mantle origin of continental crust. *Earth and Planetary Science Letters* **337-338**, 211-223.

Maier, A.C., Cates, N.L., Trail, D. and **Mojzsis**, S.J. (2012) Geology, age and field relations of Hadean zircon-bearing supracrustal rocks from Quad Creek, eastern Beartooth Mountains (Montana and Wyoming, USA). *Chemical Geology* **312**, 47-57.

Konhauser, K.O., Lalonde, S.V., Planavsky, N., Pecoits, E., Lyons, T.W., **Mojzsis**, S.J., Rouxel, O.J., Barley, M.E., Rosiere, C., Fralick, P.W., Kump, L.R. and Bekker, A. (2011). Aerobic bacterial pyrite oxidation and acid rock drainage during the Great Oxidation Event. *Nature* **478**, 369-373.

- Abramov, O. and **Mojzsis**, S.J. (2011) Abodes for life in carbonaceous asteroids? *Icarus* **213**, 273-279.
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- Turner, G., Busfield, A., Crowther, S., Harrison, T.M., **Mojzsis**, S.J. and Gilmour, J. (2007) Pu-Xe, U-Xe, U-Pb chronology and isotope systematics of ancient zircons from Western Australia. *Earth and Planetary Science Letters* **261**, 491-499.
- Trail, D., **Mojzsis**, S.J. and Harrison, T.M. (2007) Thermal events documented in Hadean zircons by ion microprobe depth profiles. *Geochimica et Cosmochimica Acta* **71**, 4044-4065.
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- Papineau, D., **Mojzsis**, S.J., Coath, C.D., Karhu, J.A. and McKeegan, K.D. (2005) Multiple sulfur isotopes of sulfides from sediments in the aftermath of Paleoproterozoic glaciations *Geochim. Cosmochim. Acta* **69**, 5033-5060 (doi: 10.1016/j.gca.2005.07.005).

Papineau, D., Walker, J.J., **Mojzsis, S.J.** and Pace, N.R. (2005) Composition and structure of microbial communities from stromatolites of Hamelin Pool in Shark Bay, Western Australia *Appl. Environ. Microbio.* **71**, 4822-4832 (doi: 10.1128/AEM.71.8.4822-4832.2005).

Papineau, D., **Mojzsis, S.J.**, Karhu, J.A. and Marty, B. (2005) Nitrogen isotopic composition of ammoniated phyllosilicates: Case studies from Precambrian metamorphosed sedimentary rocks *Chem. Geol.* **216**, 37-58 (doi: 10.1016/j.chemgeo.2004.10.009).

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OTHER PUBLICATIONS

Mojzsis, S.J. (2011) Earth, formation and early evolution. *Encyclopedia of Astrobiology*.

Mojzsis, S.J. (2010) Leftover lithosphere. *Nature Geosciences* **3**, 148-149. [N&V]

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Mojzsis, S.J. (2004) The First Billion Years: New insights from geochemistry: *Precambrian Research* **135** (4), 245-250. [preface to a special issue for which I was guest editor]

Mojzsis, S.J. (2004) Life in the first billion years: *Journal of High School Science (Canada)* **3** (1), 46-51. [public service/outreach activity]

Mojzsis, S.J. (2003) The Early Earth: Physical, Chemical and Biological Development: *Eos – Trans. Amer. Geophys. Union* **88** (36), 358. [Book review]

Mojzsis, S.J. (2003) Probing early atmospheres: *Nature* **425** (6955), 249-251 doi:10.1038/425249a. [N&V]

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PRESENT RESEARCH ASSOCIATE, POSTDOCTORAL AND STUDENT SUPPORT

Current Research Associates (Research Faculty)

Dr. Ramon Brassier Visiting Associate Research Professor

Dr. Nigel Kelly Associate Research Professor

Dr. Oleg Abramov Visiting Associate Research Professor

Current Graduate students

Michael Zawaski Ph.D. student (since 2016) supported by the GEOL department

Patrick Morrison Ph.D. student (since 2018) supported by the EBIO department

GRADUATE STUDENT SUPERVISED & CO-SUPERVISED – COMPLETED

Papineau, Dominic (Ph.D. graduated April 2006) “The rise of atmospheric oxygen and the evolution of the sulfur and nitrogen cycles on the Archean and Proterozoic Earth”. *Prof. Papineau is now a University Lecturer at the University College of London, UK.*

Cates, Nicole (Ph.D. graduated July 2009) “Geology age and origin of Eoarchean rocks from the Itsaq Gneiss Complex (West Greenland) and the Nuvvuaguituq Belt (northern Québec)”. *Dr. Cates is now a Lecturer at the University of Manitoba, Winnipeg (Canada).*

Swanner-Smith, Elizabeth (Ph.D. graduated July 2010). *Prof. Swanner is now an assistant professor at Iowa State University. I co-advised her with A. Templeton*

Trail, Dustin (M.A. graduated July 2006) “Geochemical and thermal history of pre-4 Ga zircons from Western Australia.” *Prof. Trail is now an Assistant Professor of Geochemistry at the University of Rochester, and Visiting Assistant Professor of Geochemistry at UCLA.*

Glaser, Steven (M.A. graduated June 2011) “Trace elements in stromatolitic sulfides through time record changes in microbial community structure”. *Mr. Glaser is now a graduate student with E. Shock at ASU.*

Maier, Analisa (M.A. graduated June 2012) “Geology, age and origin of the Beartooth Mountain Quartzite (southern Montana)” *Mrs. Bermel (née Maier) is now a staff geologist with Apache Oil & Gas Corporation.*

Hopkins, Michelle (Ph.D. graduated June 2014). “Investigating the bombardments on the Moon and Asteroid Belt from the thermal response of zircon”. *Dr. Hopkins is now an adjunct researcher at the University of Alabama.*

Frank, Elizabeth (Ph.D. graduated September 2014). “Habitability of Earth-like worlds in the cosmos *Dr. Frank was a MESSENGER postdoctoral fellow at the Department of Terrestrial Magnetism, Carnegie Institution of Washington. Dr. Frank is now a chief scientist at Planetary Resources in Seattle.*

Greer, Jennika (M.A. graduated May 2016). "Multiple generations of Archean granitoid gneisses hosting supracrustal enclaves in the southern Inukjuak domain, Québec (Canada)". *Ms. Greer is now an NSF graduate Ph.D. fellow at the University of Chicago with Phillip Heck.*

Oulton, Jonathan (M.A. graduated May 2017). "The enigma of extraterrestrial granites." *Mr. Oulton now works for the American Alpine Club and Scarpa Inc in Boulder, Colorado.*

Schug, Line (M.Sc. graduated May 2017 from University of Weinegigen, Netherlands). "Petrographic domains in martian meteorite NWA7034". *Ms. Schug will be entering a Ph.D. program in Fall 2019.*

POSTDOCTORAL SCHOLARS SUPERVISED - COMPLETED

Oleg Abramov	National Research Council (2007-2010) <i>now at PSI</i>
Nicole L. Cates	NASA Lunar Science Institute (2008-2014) <i>now at Manitoba</i>
Leilani Arthurs	Science Education Initiative (2007-2009) <i>now Asst. Prof. at CU Boulder</i>
Andrea Bair	Science Education Initiative (2006-2010) <i>now at Central Michigan University</i>
Jennifer Stempien	Science Education Initiative (2006-2009) <i>now Senior Lecturer at CU Boulder</i>

GRADUATE STUDENT THESIS COMMITTEES – EXTERNAL

Black, Sarah (graduated Spring 2018) Geological Sciences (Postdoctoral at SwRI)
Hara, Ellie (arrived August 2017) Geological Sciences
Miller, Hannah (graduated Spring 2017) Geological Sciences (Hydrogeochemist)
Haughsjaa-Hughes, Anna (graduated 2011) Astrophysics and Planetary Sciences
Holl, Christopher Ph.D. (graduated 2006) Geological Sciences (now at Northwestern University)
Knowles, Emily (graduated 2012) Geological Sciences (Postdoctoral scholar at NASA-JPL)
Putzig, Nathaniel Ph.D. (graduated 2006) Astrophysics and Planetary Sciences (now at SwRI)
Mayhew, Lisa (graduated 2012) Geological Sciences (Research Associate at CU)
Wolf, Eric (graduated, Spring 2014) Atmospheric and Ocean Sciences (Researcher at LASP)

UNDERGRADUATE HONORS THESES

Singer, Kelsi N. B.A. (graduated 2006) "Cyclic Rhythmites: Quantitative record of the ancient Earth-Moon system" latin honors: *magna cum laude* (now a research associate at the Southwest Research Institute, Boulder).

Greer, Jennika B.A. (graduated 2013) "Paleoarchean – Mesoarchean assembly of the Inukjuak terrane, northern Quebec" latin honors: *summa cum laude*. (now at the University of Chicago with Philip Heck).

Warren, Nicholas. B.A. (graduated 2016) "Stromatolites of the Lykins Formation, Colorado": latin honors: *cum laude*

Martins-Pimentel, Rayssa. B.A. (graduated 2018) "Geochronology of the Santa Fe Impact Structure, northern New Mexico": Latin honors: *summa cum laude*. (now at IPG-Paris with Fred Moynier).

Alexander, Amanda. B.A. (will graduate 2018) “Mars’ late veneer impactor” Latin Honors: *Magna cum laude*. (now a research associate at the Southwest Research Institute, Boulder).

RECORD OF UNDERGRADUATE MENTORSHIP

Jon Adam	M.Ed. graduate in Science Education
Amanda Alexander	B.A. student in Astronomy
John Braswell	B.Sc. student in Geology (University of Michigan), UNAVCO intern 2009
Laurie Carmack	B.A. graduate in Anthropology
Jennika Greer	B.A. student in Astrophysics & Geology
Michael Gross	B.A. student in Chemistry & Geology
Jeffrey Jennings	B.A. student in Astrophysics
Wilder Lavington	B.A. student in Applied Mathematics
Analisa Maier	B.A. student in Geology
Rayssa Martins	B.A. student in Geology & Astronomy
Cole Pozar	B.A. student in Geology
Diana C. Prado	B.Sc. student in Geology (University of Puerto Rico), UNAVCO intern 2010
Katie Quinn	B.A. student in Geology and Astronomy
Heather Sickels	B.A. graduate in Biology and Geological Sciences
Samuel Simon	B.A. student in Geology
Kelsi Singer	B.A. graduate in Astrophysics
Nick Strohecker	B.A. graduate in Accounting
Dustin Trail	B.A. graduate in Computer Science
Nicholas Warren	B.A. student in Geological Sciences and Business

CURRICULUM DEVELOPMENT

I have developed or re-created 20 new courses, seminars and field courses since I arrived at the University of Colorado in early 2001. During this time, the new graduate (3 cr.) level courses I developed were: Critical Thinking: Early Earth/Origin of Life, Cosmochemistry, The Moon, Geobiology, Archean/Proterozoic Geology, and Late Accretion. In Fall 2013 I reformed the graduate level (3 cr.) Planetary Surface and Interiors course. Graduate seminars (1 cr.) that I have created are: Planetary Habitability, Planetary Diversity, and Planetary Water, as well as four of the 2 cr. Planetary Field Geology courses (Death Valley/Mojave; Northern Arizona/New Mexico; Yellowstone; Iceland). Furthermore, I created or re-created a number of 3 cr. undergraduate classes: Historical Geology class and Earth System History, Extraterrestrial Life, and the Search for Life in the Universe. I also offer the Introduction to Planetary Field Geology (2 cr.) and Introduction to Cosmochemistry (3 cr.) to our undergraduates.

I regularly update my course curricula with updates of the lecture notes and presentations into a permanent Powerpoint collections of lectures, model simulations, as well as pdf documents of homeworks, quizzes, exams and handouts; these are all stored in the CU Boulder Data Repository and in hard disks. These pedagogical resources are available at request to other faculty worldwide on my website (isotope.colorado.edu) under “courses”. I have consistently improved the curriculum of all my courses to better match students' needs, which I believe is reflected in my increasingly favorable student scores over

the years as well as a University of Colorado Residence Life Teaching Award in 2004, and the University of Colorado's ASSETT Award for Excellence in Teaching in 2014. In the time I have been at CU, I calculated that approximately 4000 students have passed through my classrooms and I have accumulated about 7500 Student Credit Hours. I use D2L, CANVAS and personal response devices (iClickers).

Described below are the courses I have developed and taught in the undergraduate and graduate programs of Geological Sciences at the University of Colorado.

GEOL 1010 Introduction to Geology 1 – Physical Geology (3 credit lecture). It reviews the physical and chemical structure of Earth materials, mineralogy, geophysics and fluid processes in the Earth and at the surface. Lower division undergraduate.

GEOL 1020 Introduction to Geology 2 – Earth System History (3 credit lecture). This introductory course builds on knowledge of physical geology with a more biogeochemical perspective. It is meant to tie the different pieces of evidence for the evolution of the geosphere and biosphere together into a coherent whole so that beginning students in the earth sciences can recognize the inter-connectedness of geology with chemistry and physics. Lower division undergraduate.

GEOL/ASTR 2040 Life in the Universe (3 credit lecture). A re-organization of the previous GEOL/ASTR 3300 course for a lower-division cohort.

GEOL/ASTR 3300 Extraterrestrial Life (3 credit lecture). Explores the scientific basis for the possible existence of extraterrestrial life by reviewing the origin and evolution of life on Earth. The geologic record is treated as the natural baseline for understanding the possibility for life to have emerged elsewhere in the solar system and beyond the solar system. We also explore societal issues concerning the origin of life as well as the philosophical basis for looking for other life in the Universe. Upper division undergraduate level.

GEOL 4500 Critical Thinking in the Earth Sciences: Early Earth/ Origin of Life (3 credit lecture). Students read, analyze and present material in a seminar format that explores what is known about conditions on the early Earth's surface at the time of the emergence of life. The time period explored in this course follows from planetary accretion to the establishment of a permanent oxygenated atmosphere. Students probe controversies and discuss scientific issues in the interpretation of Earth's early geological and biological history. Upper division undergraduate and beginning graduate level.

GEOL 4700/5700_001 Introduction to Archean & Proterozoic Geology (3 credit lecture). Explores the character of Precambrian geology and geochemistry and associated igneous, metamorphic and sedimentary assemblages. We contrast the observations of the Earth from Precambrian geology with that seen in the Phanerozoic of North America and elsewhere. The economic importance of Precambrian studies as well as its central role in understanding the emergence and evolution of the biosphere is emphasized. Reading lists will be prepared in advance, with student-led discussion and final paper preparation and presentation. Undergraduate and Graduate level.

GEOL 4350 Introduction to Planetary Field Geology (2 credit field course). The course provides students with an introduction to the techniques used to "ground-truth" data returned from space missions to planetary surfaces (e.g. Mars) to actual examples in a geologic field context. The course takes the form of 2-3 overview lectures, followed by a 1 week camping excursion (self-catering) to relevant field study sites that extend from southern Wyoming (Laramides; Snowy Pass Group), to central (Lykins Fm; P-Tr boundary stromatolites) and southern Colorado (K-Pg boundary; Florrisant fossil beds; Great Sand Dunes) and finishing up in northern New Mexico (Rio Grande Rift; Santa Fe impact structure). Field

presentations by the students are coupled with practical experience and introductory material on the regional geology of each locale. Undergraduate level.

GEOL 4330/5330 Cosmochemistry (3 credit lecture and laboratory). This course explains the origin, history and transformation of matter in the solar system including the biologically important elements. We survey the various forms in which this matter occurs as primitive bodies (meteorites, comets), planets and stars and then focus on the history of that matter. Explains basic concepts of nucleosynthesis (the origin of elements) and devotes this knowledge to the chemistry and mineralogy of the planets and meteorites. Since I teach this material under the auspices of Geological Sciences, the majority of this course is therefore devoted to traditional geological topics. For astronomy students, it should be a useful introduction to concepts of geology. For geology students, it will be a new application of their knowledge towards astrophysical phenomena. For other advanced students of the physical sciences and engineering, it provides a springboard to a whole new field. Both upper division undergraduate & Graduate level sections are offered. At the present time, I teach the courses *separately* so that the graduate and undergraduate courses are offered alternate years.

GEOL 5350 Planetary Field Geology (2 credit field course). This is a field course in geological methods of interest to planetary scientists. Over a five-year span, I lead trips to Death Valley, northern Arizona, eastern Utah, Yellowstone and Hawai'i.

GEOL 5700 Geobiology (3 credit lecture). A course that explores the co-evolution of the biosphere with the geosphere and atmosphere, and contemporary examples of mineral-microbe interactions in the crust and hydrosphere. Graduate level.

GEOL/ASTR 5830 Special Topics in Planetary Science: Late Accretion (3 credit lecture). This course reviews the dynamical, geophysical, geochronological and geochemical basis for our current understanding of the nature of post-primary accretion of the planets, with special emphasis on the sampled inner solar system. Graduate level.

GEOL/ASTR 5830 Special Topics in Planetary Science: Geology, Age and Origin of the Moon (3 credit lecture). In this course we explore the geology, age and origin of the Moon with a mixture of topical lectures and guest lecturers from experts in the field of lunar science. Graduate level.

GEOL/ASTR 5835 Planetary Habitability (1 credit seminar). This course explores the criteria used to describe a "Habitable Planet" and critically analyzes the assumption used in the search for Earth-like worlds by remote methods. Graduate level.

GEOL/ASTR 5835 Planetary Water (1 credit seminar). This seminar reviewed the evidence for the role of water in past and present solar system objects. Graduate level.

GEOL/ASTR 5835 Planetary Diversity (1 credit seminar). This seminar examines the evidence for the diverse origins of the planetary building blocks, and what this means for exoplanets. Graduate level.

GEOL/ASTR 5800 Planetary Surfaces and Interiors (3 credit lecture). Examines the processes operating on the surfaces of solid planets and their interiors. Emphasizes spacecraft observations, their interpretation, the relationship to similar processes on Earth, the relationship between planetary surfaces and interiors, and the integrated geologic histories of the terrestrial planets and satellites. Graduate level.