

Lee R. Kump
Professor of Geosciences
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Education

A.B. Honors, University of Chicago, 1981, Geophysical Sciences
Ph.D., University of South Florida, 1986, Marine Sciences

Professional Experience

2017- Dean, College of Earth and Mineral Sciences, Penn State
2016-2021 Editorial Committee, *Annual Reviews of Earth and Planetary Sciences*
2011-2017 Head, Department of Geosciences
2010-2014 Editor for Earth and Environmental Sciences, *Nature Scientific Reports*
2005-2011 Reviewing Editor, *Science*
2004-2015 Associate Director, Earth System Evolution Program, Canadian Institute for Advanced Research
2003-2010 Editor, *Virtual Journal of Geobiology*
1997- Professor of Geosciences, Penn State
1996-2000 Co-Editor, *Geology*
1994-2000 Associate Head, Department of Geosciences, Penn State
1991-1997 Associate Professor of Geosciences, Penn State
1986-1991 Assistant Professor of Geosciences, Penn State
1981-1986 Research Assistant, University of South Florida
1981-1983 Geologist, United States Geological Survey Fisher Island Station (summers)
1979-1980 Research Assistant, University of Chicago

Honors and Awards

2017 Robert M. Garrels Award, Geobiology Society
2014 Fellow of the American Geophysical Union
2012 Fellow of the Geochemical Society and the European Association of Geochemistry
2009 Distinguished Alumnus, University of South Florida
2007 Wilson Research Award, Penn State College of Earth and Mineral Sciences
2005 Faculty Mentoring Award, Penn State College of Earth and Mineral Sciences
2001 Fellow, Geological Society of London
2000 Distinguished Service Award, Geological Society of America
1997 Fellow, Geological Society of America
1994 Deike Research Award, Penn State
1991-1995 Marine Biological Association of the U.K., Geophysiology Modeling Fellowship
1992 Provost's Award for Collaborative Instruction and Curricular Innovation
1990 Bursary Fellowship, Marine Biological Association of the UK
1986-1987 Faculty Research Award
1985-1986 John B. Lake Fellowship in Marine Science
1982-1983 Graduate Council Fellowship, University of South Florida
1981 National Association of Geology Teachers Summer Field Training Program Award
1981 Special Honors in Geophysical Sciences, University of Chicago

Membership in Professional Organizations

Geological Society of London, Fellow

European Association of Geochemistry, Fellow

Geochemical Society, Fellow

American Geophysical Union, Fellow

Geological Society of America, Fellow

American Academy of Underwater Sciences

Member, Board of Oceans, Atmosphere and Climate, Association of Public and Land Grant Institutions

Publications

Articles in Referred Journals

1. Kump, L.R. and Garrels, R.M., 1986. Modeling atmospheric O₂ in the global sedimentary redox cycle. American Journal of Science, 286:337-370.
2. Kirwan, A.D. and Kump L.R., 1987. Models of geochemical systems from mixture theory: diffusion. Geochimica et Cosmochimica Acta, 51:1219-1227.
3. Kump, L.R., 1988. Terrestrial feedback in atmospheric oxygen regulation by fire and phosphorus. Nature, 335:152-154.
4. Byrne, R.H., Kump, L.R. and Cantrell, K.J., 1988. The influence of temperature and pH on trace metal speciation in seawater. Marine Chemistry, 25:163-181.
5. Kump, L.R., 1989. Chemical stability of the atmosphere and ocean. Global and Planetary Change, 1:123-136.
6. Kump, L.R., 1989. Alternative modeling approaches to the geochemical cycles of carbon, sulfur and strontium isotopes. American Journal of Science, 289:390-410.
7. Kump, L.R. and Byrne, R.H., 1989. Palladium chemistry in seawater. Environmental Science and Technology, 23: 663-665.
8. Bluth, G.J.S. and Kump, L.R., 1991. Phanerozoic paleogeology: A new dimension to geochemical cycling models. American Journal of Science, 291:284-308.
9. Kump, L.R., 1991. Interpreting carbon-isotope excursions: Strangelove oceans. Geology, 19:299-302.
10. Kump, L.R., Kasting, J.F., and Robinson, J.M., 1991. Atmospheric oxygen variation through geologic time--introduction. Global and Planetary Change, 97:1-3.
11. Kump, L.R. and Holland, H.D., 1992. Iron in Precambrian rocks: Implications for the global oxygen budget of the ancient Earth. Geochimica et Cosmochimica Acta, 56:3217-3223.
12. Byrne, R.H. and Kump, L.R., 1993. Comment on "Speciation of aqueous palladium (II) chloride solutions using optical spectroscopies" by C.D. Tait, et al., Geochimica et Cosmochimica Acta, 57:1151-1156.
13. Kump, L.R., 1993. Oceans of change. Nature (News and Views Section), 361:592-593.
14. Kump, L.R., 1993. Bacteria forge a new link. Nature (News and Views Section), 362:790-791.
15. Bluth, G.J.S. and Kump, L.R., 1994. Lithologic and climatologic controls of river chemistry. Geochimica et Cosmochimica Acta, 58:2341-2359
16. Gibbs, M.T. and Kump, L.R., 1994. Global chemical erosion during the last glacial maximum and the present: Sensitivity to changes in lithology and hydrology. Paleoceanography, 9:529-543.
17. Lovelock, J.E. and Kump, L.R., 1994. Failure of climate regulation in a geophysiological model. Nature, 369:732-734.
18. Slingerland, R., Kump, L.R., Arthur, M., Fawcett, P., Sageman, B., and Barron, E., 1996. Estuarine circulation in the Turonian Western Interior Seaway of North America. Bulletin of the Geological Society of America, 108: 941-952
19. Mackenzie, F.T. and Kump, L.R., 1995. Reverse weathering, clay mineral formation, and ocean element cycles. Science (Perspectives), 270: 586-587.
20. Kump, L.R. and Mackenzie, F.T., 1996. Regulation of atmospheric O₂: Feedback in the microbial feedback. Science (Perspectives), 271: 459-460.

21. Richards, P. and Kump, L.R., 1997. Application of geographic information systems approach to watershed mass balance studies. Hydrological Processes, 11: 671-694.
22. Gibbs, M., Barron, E.J., and Kump, L.R., 1997. An atmospheric pCO₂ threshold for glaciation in the Late Ordovician. Geology, 25: 447-450.
23. Machusak, D. and Kump, L.R., 1997. Environmental controls on groundwater chemistry in an offshore island aquifer: Fiesta Key, Florida. Aquatic Geochemistry, 3: 129-167.
24. Kump, L.R., Arthur, M., Patzkowsky, M., Gibbs, M., Pinkus, D.S., and Sheehan, P., 1999. A weathering hypothesis for glaciation at high atmospheric pCO₂ in the Late Ordovician. Palaeoclimatology Palaeoecology Palaeogeography, 152: 173-187.
25. Kump, L.R. and Arthur, M.A., 1999. Interpreting carbon-isotope excursions: Carbonates and organic matter. Chemical Geology 161: 181-198.
26. Gibbs, M.T., Bluth, G.S., Fawcett, P.J., and Kump, L.R., 1999. Chemical weathering over the last 250 Myr: Variations due to paleogeography, paleoclimate, and paleogeology. American Journal of Science 299: 611-651.
27. Corbett, D.R., Kump, L.R., Dillon, W., and Chanton, J., 2000. Fate of wastewater-borne nutrients under low discharge conditions in the subsurface of the Florida Keys, USA. Marine Chemistry 69: 99-115.
28. Kump, L.R., Brantley, S.L., and Arthur, M.A., 2000. Chemical weathering, atmospheric CO₂, and climate. Annual Reviews of Earth and Planetary Sciences, 28: 611-667.
29. Hotinski, R.M., Kump, L.R., and Najjar, R.G., 2000. Opening Pandora's Box: The impact of open system modeling on interpretation of anoxia. Paleoceanography 15:267-279.
30. Suits, N.S., Arthur, M.A., and Kump, L.R., in revision. A numerical simulation of sulfur isotopic fractionation during sulfate reduction and sulfide oxidation in modern sediments. American Journal of Science.
31. Dillon, K.S., Corbett, D.R., Chanton, J.P., Burnett, W.C., and Kump, L.R., 2000. Bimodal transport of a wastewater plume injected into saline ground water of the Florida Keys. Ground Water 38(4): 624-634.
32. Hotinski, R.M., Bice, K.L., Kump, L.R., Najjar, R.G., Arthur, M.A., 2001. Ocean stagnation and end-Permian anoxia. Geology, 29: 7-10.
33. Kump, L.R., Kasting, J.F., and Barley, M.E., 2001. Rise of atmospheric oxygen and the "upside-down" Archean mantle. Geochim. Geophys. Geosyst., 2, Paper number 2000GC000114.
34. Kump, L.R., 2001. What drives climate? Nature (News and Views section) 408: 651-652.
35. Kump, L.R., 2001. Chill taken out of the tropics. Nature (London), vol.413, no.6855, pp.470-471, 04 Oct 2001.
36. Beerling, D.J., Lomax, B.H., Royer, D.L., Upchurch, G.R. Jr., and Kump, L.R., 2002. New constraints on atmospheric CO₂ changes following the terminal Cretaceous biotic crisis. Proc. Nat'l. Acad. Sci. **99**, 7844-7847.
37. Kump, L.R. 2002. Reducing uncertainty about carbon dioxide as a climate driver. Nature, v. 419, pp. 188-190.
38. Hotinski, R.M., Kump, L.R., and Bice, K.L., 2002. Comment on "Could the Late Permian deep ocean have been anoxic?" by R. Zhang et al. Paleoceanography 17: 1052, doi:10.1029/2001PA000680.
39. Dillon, K., Burnett, W., Kim, G., Chanton, J., Corbett, D.R., Elliott, K., and Kump, L., 2003. Groundwater flow and phosphate dynamics surrounding a high discharge wastewater disposal well in the Florida Keys. Journal of Hydrology, 284: 193-210.
40. Hotinski, R.M., Kump, L.R., and Arthur, M.A., 2004. A $\delta^{13}\text{C}$ gradient from platform carbonates of the Pethei Group (Great Slave Lake Supergroup, N.W.T. Bull. Geol. Soc. Amer. 116: 539-554.
41. Griggs, E.M., Kump, L.R., and Bohlke, J.K., 2003. The fate of wastewater-derived nitrate in the subsurface of the Florida Keys: Key Colony Beach, Florida. Est. Coastal Shelf Sci. 58: 517-539.
42. Richards, P. and Kump, L.R., 2003. Soil pore-water distributions and the temperature feedback of weathering in the field. Geochim. Cosmochim. Acta. 67: 3803-3816.

43. Kurtz, A.C., Kump, L.R., Arthur, M.A., Zachos, J.C., and Paytan, A., 2003. Early Cenozoic decoupling of the global carbon and sulfur cycles. *Paleoceanography* 18(4), 1090, doi:10.1029/2003PA000908.
44. Anderson, S.P., Blum, J., Brantley, S.L., Chadwick, O., Chorover, J., Derry, L., Drever, J., Hering, J., Kirschner, J., Kump, L., Richter, D., and White, A., 2004. Proposed initiative would study Earth's weathering engine. *EOS* 85: 265-269.
45. Herman, E.K. and Kump, L.R., 2005. Numerical models of microbial mats under Precambrian oceanic conditions: a modeling study. *Geobiology* 3: 77-92.
46. Zachos, J.C. and Kump, L.R., 2005. Carbon cycle feedbacks and the initiation of Antarctic glaciation in the earliest Oligocene. *Global and Planetary Change* 47: 51-66.
47. Kump, L.R. and Seyfried, W.E., 2005. Hydrothermal Fe fluxes during the Precambrian: Effect of low oceanic sulfate concentrations and low hydrostatic pressure on the composition of black smokers. *Earth and Planetary Science Letters* 235: 654-662.
48. Kump, L.R., 2005. Ironing out the oxidation of the biosphere. *Science (Perspectives)* 307: 1058-1059.
49. Panchuk, K.M., Holmden, C., and Kump, L.R., 2005. Sensitivity of the epeiric sea carbon isotope record to local-scale carbon cycle processes: Tales from the Mohawkian Sea. *Palaeogeography Palaeoclimatology Palaeoecology* 228: 320-337.
50. Kump, L.R., 2005. Foreshadowing the glacial era. *Nature (News and Views)* 436: 333-334.
51. Melezhik, V.A., Fallick, A.E., Hanski, E.J., Kump, L.R., Lepland, A., Prave, A.R., and Strauss, H., 2005. Emergence of the aerobic biosphere during the Archean-Proterozoic transition: Challenges of future research. *GSA Today* 15: 4-11.
52. Bowen, G.J., Bralower, T.J., Dickens, G.R., Delaney, M., Kelly, D.C., Koch, P.L., Kump, L.R., Meng, J., Sloan, L.C., Thomas, E., Wing, S.L., and Zachos, J.C., 2006. Eocene hyperthermal event offers insight into greenhouse warming. *EOS* 87: 165, 169.
53. Kump, L.R., Pavlov, A., and Arthur, M.A., 2006. Reply to Berner and Ward comment on Kump et al., 2005. *Geology*, on line forum.
54. Riccardi, A.L., Arthur, M.A., Kump, L.R., and D'Hondt, S., 2006. Sulfur isotopic evidence for chemocline upwater excursions during the end-Permian. *Geochimica et Cosmochimica Acta* 70: 5740-5752.
55. Riccardi, A.L., Kump, L.R., Arthur, M.A., and D'Hondt, S., 2007. Carbon isotopic evidence for chemocline upward excursions during the end-Permian event. *Palaeogeography Palaeoclimatology Palaeoecology* 248: 73-81.
56. Payne, J.L., Lehrmann, D.J., Follett, D., Seibel, M., Kump, L.R., Riccardi, A., Altiner, D., Sano, H., Wei, J., 2007. Erosional truncation of uppermost Permian shallow-marine carbonates and implications for Permian-Triassic boundary events. *Bulletin of the Geological Society of America* 119: 771-784.
57. Payne, J.L. and Kump, L.R., 2007. Evidence for recurrent Early Triassic massive volcanism from quantitative interpretation of carbon isotope fluctuations. *Earth and Planetary Science Letters* 256: 264-277.
58. Kump, L.R. and Barley, M.E., 2007. Continental tectonics, increased subaerial volcanism and the rise of atmospheric oxygen. *Nature* 448: 1033-1036.
59. Panchuk, K.M., Ridgwell, A., and Kump, L.R., 2008. Sedimentary response to Paleocene-Eocene Thermal Maximum carbon release: A model-data comparison. *Geology* 36: 315-318.
60. Hilting, A. K., Kump, L.R., and Bralower, T. J., 2008. Variations in the oceanic vertical carbon isotope gradient and their implications for the Paleocene-Eocene biological pump. *Paleoceanography* 23(3) PA3222, doi:10.1029/2007PA001458.
61. Meyer, K. J. and Kump, L. R., 2008. Oceanic euxinia in Earth history: Causes and Consequences. *Annual Reviews of Earth and Planetary Sciences* 36:251-88.
62. Meyer, K.J., Kump, L.R., and Ridgwell, A., 2008. The biogeochemical controls on photic-zone euxinia during the end-Permian mass extinction. *Geology* 36: 747-750.
63. Kump, L.R., 2008. The rise of atmospheric oxygen. *Nature* v. 451: 277-278.

64. Kump, L.R. and Pollard, D., 2008. Brevia: Amplification of Cretaceous warmth by biological cloud feedbacks. *Science*, 320: 195.
65. Ohmoto, Hiroshi; Runnegar; Bruce; Kump, Lee R.; Fogel, Marilyn L.; Kamber, Balz; Anbar, Ariel D.; Knauth, Paul L.; Lowe, Donald R.; Sumner, Dawn Y.; Watanabe, Yumiko, 2008. Biosignatures in Ancient Rocks: A Summary of Discussions at a Field Workshop on Biosignatures in Ancient Rocks. *Astrobiology* 8: 883-907.
66. Kump, L.R., 2009. Tipping pointedly colder. *Science (Perspectives)* 323: 1175-1176.
67. Kump, L.R., Bralower, T.J., and Ridgwell, A., 2009. Ocean acidification in deep time. *Oceanography* 22: 94-107.
68. Luo, Genming, Lee R. Kump, Jinnan Tong, Yongbiao Wang, Michael A. Arthur, Yang Hao, Qinxian Wang, Junhua Huang, Hongfu Yin, Shucheng Xie, 2010. Isotopic evidence for an anomalously low oceanic sulphate concentration following end-Permian mass extinction. *Earth and Planetary Science Letters* 300: 101-111.
69. Jiang, S., Bralower, T.J., Patzkowsky, M.E., Kump, L.R., and Schueth, J.D., 2010. Geographic controls on nanoplankton extinction across the Cretaceous/Palaeogene boundary. *Nature Geoscience* doi:10.1038/ngeo775.
70. Zerkle, A., Kamysny, A. Jr., Kump, L.R., Farquhar, J., Oduro, H., and Arthur, M., 2010. Sulfur cycling in a stratified euxinic lake with moderately high sulfate: Constraints from quadruple S isotopes. *Geochimica Cosmochimica Acta* 74: 4953-4970.
71. Kump, L.R., 2010. Earth's second wind. *Science (Perspective)* 330: 1490-1491.
72. Saltzman, M., Young, S., Kump, L., Gill, B., Lyons, T. and Runnegar, B., 2011. A pulse of atmospheric oxygen during the late Cambrian and implications for plankton and animal biodiversification. *Proc. Nat'l Acad. Sci.* 108: doi/10.1073/pnas.1011836108
73. Gill, B., Lyons, T., Young, S., Kump, L., Knoll, A., and Saltzman, M.R., 2011. Geochemical evidence for widespread euxinia in the Later Cambrian ocean. *Nature* 469: 80-83.
74. Young, S.A., Saltzman, M.R., Foland, K.A., Linder, J.S., and Kump, L.R., 2009. A major drop in seawater $^{87}\text{Sr}/^{86}\text{Sr}$ during the Middle Ordovician (Darriwilian): Links to volcanism and climate. *Geology* 37: 951-954.
75. Luo, G., Yongbiao Wang, Hao Yang, Thomas J. Algeo, Lee R. Kump, Junhua Huang, Shucheng Xie, 2011. Stepwise and large-magnitude negative shift in $\delta^{13}\text{C}_{\text{carb}}$ preceded the main marine mass extinction of the Permian-Triassic crisis interval. *Palaeogeography Palaeoclimatology Palaeoecology* 299: 70-82.
76. Luo, Genming, Yongbiao Wang, Thomas J. Algeo, Lee R. Kump, Xiao Bai, Hao Yang, Le Yao and Shucheng Xie, 2011. Enhanced nitrogen fixation in the immediate aftermath of the latest Permian marine mass extinction. *Geology* 39: 647-650.
77. Konhauser, K.O., Stefan V. Lalonde, Noah J. Planavsky, Ernesto Pecoits, Timothy W. Lyons, Stephen J. Mojzsis, Olivier J. Rouxel, Mark E. Barley Carlos Rosiere, Phillip W. Fralick, Lee R. Kump, and Andrey Bekker, 2011. Aerobic pyrite oxidation and acid-rock drainage during the Great Oxidation Event. *Nature* 478: 369-373.
78. Charles, A., Daniel J. Condon, Ian C. Harding, Heiko Pälike, John E. A. Marshall, Ying Cui, Lee Kump, Ian W. Croudace, and the WUN pACE Group, 2011. Constraints on the numerical age of the Paleocene/Eocene boundary. *Geochem. Geoph. Geosys.* 12, Q0AA17, 19 PP., 2011 doi:10.1029/2010GC003426
79. Cui, Y., Kump, L.R., Ridgwell, A., Charles, A.J., Junium, C.K., Diefendorf, A.F., Freeman, K.H., Urban, N.M., and Harding, I.C., 2011. Slow release of fossil carbon during the Palaeocene-Eocene Thermal Maximum. *Nature Geosciences* 4: 481-485 DOI: 10.1038/NGEO1179.
80. Meyer, K.M., Kump, L.R., Macalady, J., Schaperdoth, I., and Freeman, K., 2011. Carotenoid biomarkers as an imperfect reflection of the anoxygenic phototrophic community in meromictic Fayetteville Green Lake. *Geobiology* 9: 321-329.
81. Honisch, B., Ridgwell, A., Schmidt, D., Thomas, E., Gibbs, S., Sluijs, A., Zeebe, R.E., Kump, L., Martindale, R., Greene, S., Kiessling, W., Ries, J., Zachos, J., Royer, D., Barker, S., Marchitto, T.,

- Moyer, R., Pelejero, C., Ziveri, P., Foster, G., and Williams, B., 2012. The geological record of ocean acidification. *Science* 335: 1058-1063.
82. Schneider, L.J., Bralower, T.J., and Kump, L.R., 2011. Response of nanoplankton to early Eocene ocean deoxygenation. *Palaeogeogr. Palaeoclim. Palaeoecol.* 253: 152-162.
 83. Falkowski, P.G. and 17 others (including Kump), 2011. Ocean deoxygenation: Past, present, and future. *EOS* 92: 409-410.
 84. Kump, L.R., Junium, C., Arthur, M.A., Brasier, A., Fallick, A., Melezhik, V., Lepland, A., Crne, A., Luo, G., 2011. Isotopic evidence for massive oxidation of organic matter following the Great Oxidation Event. *Science* 334: 1694-1696.
 85. Horodyskyj, L.B., White, T.S., and Kump, L.R., 2012. Substantial biologically mediated phosphorus depletion from the surface of a Middle Cambrian paleosol. *Geology* 40: 503-506.
 86. Haluszczak, L.O., Rose, A., and Kump, L.R., 2013. Geochemical evaluation of flowback and production waters from Marcellus gas wells in Pennsylvania. *Applied Geochemistry* 28: 55-61.
 87. Loope, G., Kump, L.R., and Arthur, M.A., 2013. Shallow-water redox conditions from Permian-Triassic boundary microbialites. *Chemical Geology* 351: 195-208.
 88. Kump, L.R., 2013. Sulfur isotopes and the stepwise oxygenation of the biosphere. *Elements* 8: 410-411.
 89. Weiczorek, R., Fantle, M.S., Kump, L.R., and Ravizza, G., 2013. Osmium isotopic evidence for volcanic activity prior to and enhanced terrestrial weathering during the Paleocene Eocene Thermal Maximum. *Geochimica et Cosmochimica Acta* 119: 391-410.
 90. Olson, S.L., Kump, L.R., and Kasting, J.F., 2013. Quantifying the areal extent and dissolved oxygen concentrations of Archean oxygen oases. *Chemical Geology* 362: 35-43.
 91. Cui, Y., Kump, L.R., and Ridgwell, A., 2013. Initial assessment on the carbon emission rate and climatic consequences during the Permian-Triassic mass extinction. *Palaeogeography, Palaeoclimatology, Palaeoecology* 389: 128-136.
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 93. Pollard, D., Kump, L.R., Zachos, J.C., 2013. Interactions between carbon dioxide, climate, weathering and the Antarctic ice sheet in the earliest Oligocene. *Global and Planetary Change* 111: 258-267.
 94. Song, H., Tong, J., Algeo, T.J., Song, H., Qiu, H., Zhu, Y., Tian, L., Bates, S., Lyons, T.W., Luo, G., Kump, L.R., 2014. Early Triassic seawater sulfate drawdown. *Geochim. Cosmochim. Acta* 128: 95-113. doi: <http://dx.doi.org/10.1016/j.gca.2013.12.009>.
 95. Luo, G., Junium, C.K., Lee R. Kump, Junhua Huang, Chao Li, Yuansheng Du, Qinglai Feng, Xiaoyin Shi, Xiao Bai, Shucheng Xie, 2014. Stratified shallow ocean prevailed from late Paleoproterozoic to middle Mesoproterozoic: Evidence from organic carbon isotopic composition. *Earth and Planetary Science Letters* 400: 219-232.
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 101. Cui, Y., Bercovici, A., Yu, J., Kump, L., Freeman, K., Shangguo, S., and Vajda, V., 2016. Carbon cycle perturbation expressed in terrestrial Permian-Triassic Boundary sections in South China. *Global*

- and Planetary Change* 148: 272-285, DOI: 10.1016/j.gloplacha.2015.10.018.
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 112. Kump, L.R., 2018. Prolonged Late Permian – Early Triassic hyperthermal: failure of climate regulation? *Phil. Trans. Royal Soc. A.* 376: 20170078.
 113. Li, M., Kump, L.R., Hinnov, L.A., and Mann, M.E., 2018. Tracking variable sedimentation rates and astronomical forcing in Phanerozoic paleoclimate proxy series with evolutionary correlation coefficients and hypothesis testing. *Earth Planet. Sci. Lett.* 501: 165-179.
 114. Hantsoo, K. G., Kump, L. R., Haupt, B. J., & Bralower, T. J., 2018. Tracking the Paleocene-Eocene Thermal Maximum in the North Atlantic: A shelf-to-basin analysis with a regional ocean model. *Paleoceanography and Paleoclimatology*, 33: 1324-1338.
 115. Bralower, T. , Kump, L.R., Robinson, M.M., Self-Trail, J.M., Lyons, S., Babila, T., Ballaron, E., Freeman, K., Hajek, E., Rush, W. and Zachos, J.C., 2018. Evidence of shelf acidification during the onset of the Paleocene-Eocene Thermal Maximum. *Paleoceanography and Paleoclimatology* 33: 1408-1426. <https://doi.org/10.1029/2018PA003382>.
 116. Li, Mingsong, Kump, L.R., Hinnov, L., and Mann, M., 2018. Tracking variable sedimentation rates and astronomical forcing in Phanerozoic paleoclimate proxy series with evolutionary correlation coefficients and hypothesis testing. *Earth and Planetary Science Letters.* 501: 165-179.
 117. Lyons, S.L., Baczynski, A., Babila, T.L., Bralower, T.J., Hajek, E.A., Kump, L.R., Polites, E.G., Trampush, S.M., Vornlocher, J.R., Zachos, J.C. and Freeman, K.H., 2019. Paleocene–Eocene Thermal Maximum prolonged by fossil carbon oxidation. *Nature Geoscience* 12: 54-60.
 118. Li, Mingsong, Hinnov, L.A. and Kump, L.R., 2019. Acycle: time-series analysis software for paleoclimate research and education. *Computers and Geosciences* 127: 12-22.
 119. Isson, T.T., Planavsky, N.J., Coogan, L.A., Steward, E.M., Ague, J.J., Bolton, E.W., Zhang, S., McKenzie, N.R., and Kump, L.R., 2020. Evolution of the global carbon cycle and climate regulation on Earth. *Global Biogeochemical Cycles* 34: e2018GB006061.

120. Kanzaki, Y., Brantley, S.L., and Kump, L.R., 2020. A numerical examination of the effect of sulfide dissolution on silicate weathering. *Earth and Planetary Science Letters*. 539: 116239.
121. Ajayi, S., Kump, L.R., Ridgwell, A., Kirtland Turner, S., Hay, C.C. and Bralower, T.J., 2020. Evaluation of Paleocene-Eocene Thermal Maximum carbon isotope record completeness – An illustration of the potential of dynamic time warping in aligning paleo-proxy records. *Geochem. Geophys. Geosys.* 21 (doi.org/10.1029/2019GC008620).
122. Bralower, T.J., Cosmidis, J., Heaney, P.J., Kump, L.R., and 17 others, 2020. Origin of a global carbonate layer deposited in the aftermath of the Cretaceous-Paleogene boundary impact. *Earth and Planetary Science Letters* 548: 116476.
123. Cui, Y., Diefendorf, A.F., Kump, L.R., Jiang, S., and Freeman, K.H., 2021. Synchronous marine and terrestrial carbon cycle perturbation in the High Arctic during the PETM. *Paleoceanography and Paleoclimatology* 36: e2020PA003942.

Books, Book Chapters, and non-refereed Publications

1. Kump, L.R. and Hine, A.C., 1986. Ooids as sea-level indicators. In: van de Plassche, O. (ed.), Sea Level Research, Geobooks, Norwich, England. (Principal Author)
2. White, T.S., Morrison, J.L., and Kump, L.R., 1990. Formation of iron sulfides in modern salt marsh sediments (Wallops Island, Virginia). Chapter 11 in: Orr, W.L. and White, C.M. (eds.) Geochemistry of Sulfur in Fossil Fuels, ACS Symposium: Series 429, pp. 204-217.
3. Kump, L.R., 1990. Neogene geochemical cycles; Implication concerning phosphogenesis. In: Burnett, W. and Riggs, S.R. (eds.), Phosphate Deposits of the World, Vol. 3, Cambridge University Press, England, pp. 273-282.
4. Kump, L.R. and Volk, T., 1991. Gaia's garden and BLAG's greenhouse: global biogeochemical climate regulation. In: Schneider, S.H. and Boston, P.J.O (eds.), Scientists on Gaia, MIT Press, p. 191-199.
5. Kump, L.R., 1991. Biogeochemical cycle of oxygen. In: Nierenberg, W.A. (ed.) Encyclopedia of Earth System Science, Vol. 3 (M-Re), Academic Press, NY.
6. Kump, L.R., 1992. Coupling of the carbon and sulfur biogeochemical cycles over Phanerozoic time. In: Wollast, R. (ed.), Interactions of C, N, P and S Biogeochemical Cycles, NATO ASI Series, Springer-Verlag, Berlin, pp. 475-490.
7. Kasting, J.F., Holland, H.D., and Kump, L.R., 1992. Atmospheric evolution: the rise of oxygen. Chapter 4.6 in Schopf, J.W. and Klein, C. (eds.), The Proterozoic Biosphere: A Multidisciplinary Study. Cambridge University Press, England, pp. 159-165.
8. Kump, L.R., and Alley, R.B., 1994. Global chemical weathering on glacial time scales. In: Usselman, T.M. and Hay, W.W. (eds.), Material Fluxes on the Surface of the Earth, National Research Council, Washington, DC, pp. 46-60.
9. Kump, L.R. and Lovelock, J.E., 1995. The geophysiology of climate. In: Henderson-Sellers, A. (ed.), Future Climates of the World, V. 16, World Survey of Climatology, Elsevier Science BV, Amsterdam, Chapter 14p. 537-553.
10. Kump, L.R., Gibbs, M., Arthur, M., Patzkowsky, M., and Sheehan, P., 1995. Hirnantian glaciation and the carbon cycle. In: Ordovician Odyssey: Short Papers for the Seventh International Symposium on the Ordovician System, Society of Sedimentary Geology, p. 299-302.
11. Kump, L.R. and Arthur, M.A., 1997. Global chemical erosion during the Cenozoic: Weatherability balances the budget. In: W. Ruddiman (ed.), Tectonics Uplift and Climate Change, Plenum Publishing Co., pp. 399-426.
12. Kump, L.R., Kasting, J.F., and Crane, R.H., 1999. The Earth System. Prentice Hall, New Jersey, 350 pp.
13. Kump, L.R. and Slingerland, R.L., 1999. Circulation and stratification of the Early Turonian Western Interior Seaway: Sensitivity to a variety of forcings. In: Barrera, E. and Johnson, C. (eds.), The Evolution of Cretaceous Ocean/Climate Systems, Special Paper of the Geological Society of America 332: 181-190.

14. Gibbs, Mark T; Bice, Karen L; Barron, Eric J; Kump, Lee R, 2000. Glaciation in the early Paleozoic "greenhouse"; the roles of paleogeography and atmospheric CO₂. In: Huber, B.T., MacLeod, K.G., and Wing, S.L., eds., *Warm Climates in Earth History*, Cambridge Univ. Press, U.K., 386-422.
15. Kump, L.R., Kasting, J.F., and Crane, R.G., 2004. *The Earth System*, 2/e. New Jersey: Prentice Hall, 419 pp.
16. Kump, L.R., 2004. Self-regulation of ocean composition by the biosphere. In: Schneider, S.H., Miller, J.R., Crist, E. and Boston, P.J. (eds.) *Scientists Debate Gaia II*. MIT Press, Cambridge Mass. pp. 93-100.
17. Kump, L.R., 2004. The geochemistry of mass extinction. In: Turekian, K.K. and Holland, H.D. (eds.) *Treatise on Geochemistry*. Holland: Elsevier, Ch. 7.14, p. 351-368.
18. Kump, L. R., 2008. The role of seafloor hydrothermal systems in the evolution of seawater composition during the Phanerozoic. In: Lowell, R.P., Seewald, J.S., Metaxas, A., and Perfit, M.R. (eds.), *Magma to Microbe: Modeling Hydrothermal Processes at Ocean Spreading Centers*. Geophysical Monograph Series 178, Amer. Geoph. Union, pp. 275-284.
19. Mann, M. and Kump, L., 2008. *Dire Predictions: Understanding Global Warming*. DK Publishing, New York, 208 pp.
20. Slingerland, R.L. and Kump, L.R., 2011. *Mathematical Modeling of Earth's Dynamical Systems: A Primer*. Princeton University Press, 231 pp.
21. Kump, L.R., Kasting, J.F., and Crane, R.G., 2010. *The Earth System*, 3/e. New Jersey: Prentice Hall, 420 pp.
22. Kump, L.R., 2011. The last great global warming. *Scientific American*, July, 2011, pp. 56-61.
23. Melezhik, V., Prave, A., Hanski, E., Fallick, A., Lepland, A., Kump, L., Strauss, H. (eds.), 2012. *Reading the Archive of Earth's Oxygenation. Volume 1: The Palaeoproterozoic of Fennoscandia as Context for the Fennoscandian Arctic Russia - Drilling Earth Project*. Springer, Heidelberg, 490 pp.
24. Melezhik, V., Prave, A., Fallick, A., Hanski, E., Lepland, A., Kump, L., Strauss, H. (eds.), 2012. *Reading the Archive of Earth's Oxygenation. Volume 2: The Core Archive of the Fennoscandian Arctic Russia - Drilling Early Earth Project*. Springer, Heidelberg, 550 pp.
25. Melezhik, V., Kump, L., Fallick, A., Strauss, H., Hanski, E., Prave, A., Lepland, A. (eds.), 2012. *Reading the Archive of Earth's Oxygenation. Volume 3: Global Events and the Fennoscandian Arctic Russia - Drilling Earth Project*. Springer, Heidelberg, 512 pp.
26. Canfield, D.E., and Kump, L.R., 2013. Carbon cycle makeover. *Science* 339: 533-534.
27. Kump, L.R., 2014. The Geochemistry of Mass Extinction. Chapter 6.12 in Holland, H.D. and Turekian, K. (eds.) *Treatise on Geochemistry*, 2nd ed., Oxford University Press, UK, vol. 6, pp. 269-280, <http://dx.doi.org/10.1016/B978-0-08-095975-7.01313-9>.
28. Cui, Y., Kump, L.R., and Ridgwell, A., 2015. Spatial and temporal patterns of ocean acidification during the end-Permian mass extinction – an Earth system model evaluation. In: Schmidt, A., Fristad, K.E., and Elkins-Tanton, L.T. (eds.), *Volcanism and Global Environmental Change*. Cambridge University Press, Cambridge, UK, pp. 291-306.
29. Mann, M. and Kump, L.R., 2016. *Dire Predictions: Understanding Climate Change (A Visual Guide to the Findings of the IPCC)*, 2/e. DK/Pearson, New York, 224 pp.
30. Kump, L.R., 2016. Resilient planet: Reading the Earth's medical chart. In: Lovelock, J.E. (ed.) *The Earth and I*, Taschen, Cologne, Germany, 42-49.
31. Kump, L.R., 2016. Rock Stars: Robert M. Garrels. *GSA Today* Feb. 2016, p. 20-21.
32. Larsen, L., Hajek, E., Maher, K., Paola, C., Merritts, D., Bralower, T., Montanez, I., Wing, S., Snyder, N., Hochella, M., Kump, L., and Person, M., 2015. Taking the pulse of Earth's surface systems. *Eos*, 96, doi:10.1029/2015EO040525. Published on 2 December 2015.
33. Kump, L.R., 2016. Mineral clues to past volcanism. *Science (Perspectives)* 352: 411-412.
34. Kump, L.R., 2018. Climate change and marine mass extinction. *Science (Perspectives)* 362: 1113-1114.

- Kump, L.R., 1988. It's a small world (Review of "Global Biogeochemical Cycles"). *Nature*, 335:466.
- Kump, L.R., 1989. Review of "History of Earth's Atmosphere." *Terra Nova*, 1, 383-384.
- Kump, L.R., 1992. Review of "Numerical Adventures with Geochemical Cycles." *Journal of Geological Education*, 40, p. 33.
- Kump, L.R., 2009. A second opinion for our planet. *Science (Book Reviews)* 325: 539-540.
- Kump, L.R., 2011. "Paleoclimates: Understanding Climate Change Past and Present" (by T. Cronin). *EOS* 92: 318-319.
- Kump, L.R., 2014. Earth's oxygen unraveled. *Nature Geoscience* 7: 248.

Departmental and Program Reviews

- Eckerd College, Program in Marine Sciences, 2000
- University of Kansas, Dept. of Geology (AAAS Review), 2000
- Northwestern University, Dept. of Geological Sciences, 2001
- University of South Carolina, EPSCOR review, 2001
- University of North Carolina, Dept. of Geological Sciences, 2006
- University of Toronto, Dept. of Earth Sciences, 2013
- University of Minnesota, School of Earth Sciences, 2019
- Harvard University, Dept. of Earth and Planetary Sciences, 2020
- NSF ANT Committee of Visitors Chair, 2020

Grants and Contracts

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|-----------|--|
| 1983-1984 | American Association of Petroleum Geologists, Grant-in-Aid, \$700, A Study of the Geology of West Florida |
| 1986-1987 | Pennsylvania State University, Faculty Research Award, \$3,000, A Study of the Iron Stable Isotopes |
| 1987-1989 | Petroleum Research Fund, \$18,000, A Study of the Iron Stable Isotopes |
| 1988-1990 | National Science Foundation, \$140,000, Coupled Models of Geochemical Cycles and Climate (with E. Barron) |
| 1988-1989 | Texaco, \$15,000, Isotopic Modeling of Carbon and Sulfur Cycles |
| 1989-1992 | National Science Foundation, \$145,900, Minority Recruitment Outreach Demonstration Project (J.J. Cahir, Principal Investigator) |
| 1989-1990 | National Science Foundation, \$23,611, Global Change Course Development (NCAR) |
| 1990-1991 | National Science Foundation, \$13,406, Natural Variability in Iron Stable Isotopes |
| 1990-1992 | Gas Research Institute, \$130,000, Clay Conversion in the Formation of Pressure Chambers in Sedimentary Basins |
| 1990-1992 | National Science Foundation, \$97,000, Phanerozoic Chemical Weathering and Paleoclimate (with E. Barron) |
| 1991-1992 | PAC of Clays, \$2,500, Faculty Research Award |
| 1992 | Gas Research Institute, \$360,213, Clay Conversion in the Formation of Pressure Chambers in Sedimentary Basins |
| 1992-1994 | National Science Foundation, \$250,000, Global Change in Cretaceous Seaways (one of four co-PIs) |
| 1992-1995 | National Science Foundation, \$218,695, Kinetics of Smectite-Illite Transformation |

1992-1996 Shell Research Limited (Marine Biological Association of the UK), \$40,000, Geophysiology Modeling

1993-1995 National Science Foundation, \$112,768, Atmospheric CO₂ and Glaciation

1994-1997 Penn State University, \$45,000, Nutrient Behavior in Saline Groundwater of the Florida Keys

1994-present NASA, \$1,830,000, Global Water Cycle: Extension Across the Earth Sciences (E.J. Barron, Principal Investigator)

1995-1997 Environmental Protection Agency, \$100,000, Fate of Wastewater Nutrients in the Florida Keys.

1996-1997 NASA, \$9480, Investigation of isotopic evidence for an active planktonic biota in the Paleoproterozoic (seed grant)

1997-1999 EPA, \$100,000, Behavior of Wastewater Nutrients in Groundwater of the Florida Keys.

1998-2000 NSF, \$97,203, Quantitative Assessment of Ocean Stagnation Hypotheses.

2002-2006 NASA, ~\$4.5M, Penn State Astrobiology Research Center (co-PI; H. Ohmoto, Principal Investigator)

2002-2005 NSF, \$158,047, Upgrading Computing Hardware to Support Geoscience Initiatives, (one of 11 co-PIs)

2002-2007 NSF, \$260,936, The Consequences of Greenhouse Warming on Biocomplexity and Biogeochemical Cycles across the Paleocene-Eocene Boundary (Penn State share; J. Zachos, UC Santa Cruz PI, 6 other co-PIs)

2002-2006 NSF, \$250,000, Extremes of Ocean Biogeochemistry: Focus on the Permian-Triassic Boundary (Kump, PI; M. Arthur, co-PI)

2003 Florida Dept. of Environmental Protection, \$90,000, Assessment of the impact of wastewater injection on nearshore waters of the Florida Keys

2005-2007 Understanding carbon isotope excursions in the Paleozoic (co-PI with M. Saltzman, Ohio State) NSF, \$61,946 (PSU part)

2006-2010 *Collaborative Research: The Dynamics Of Carbon Release And Sequestration: Case Studies Of Two Early Eocene Hyperthermals.* NSF-Carbon and Water Cycle, (T. Bralower, Co-I), \$605,145.

2008-2012 Collaborative Research: The Siberian Traps and the end-Permian Extinction: Coincidence and Causality, one of several co-PIs, NSF Continental Dynamics, Kump part \$410,732, funded.

2007-2008 FAR-DEEP: Fennoscandian Arctic Russia Drilling Early Earth Project, NSF and NASA, Kump PI on US part, \$76,250 to each agency, funded.

2007-2009 Boundary Numerical Modeling of the Greenhouse-Icehouse Transition: Eocene-Oligocene (D. Pollard, co-PI), NSF Geobiology and Environmental Geochemistry, \$250,266, funded.

2008-2010 *Collaborative Research: Environmental and Biogeochemical Reorganization During the Rise of Atmospheric Oxygen* (NASA/NSF; Kump, PI; PSU part \$100,000) funded.

2009-2013 *Signature of Life from Earth and Beyond* (Kump one of several co-PIs, NASA Astrobiology Institute, Kump part \$349,342) funded.

2013	Evaluating atmospheric oxygen levels during the Great Oxidation Event. NASA Astrobiology Director's Discretionary Fund, \$19,997.
2009-2013	<i>Collaborative Research: Environmental and Biogeochemical Reorganization During the Rise of Atmospheric Oxygen</i> (NSF and NASA, Kump part \$102,000).
2008-2014	<i>Collaborative Research: The Siberian Traps and the end-Permian Extinction: Coincidence and Causality</i> , one of several co-PIs, NSF Continental Dynamics, Kump part \$410,732.
2014-2017	<i>Evaluating Atmospheric Oxygen Levels During the Great Oxidation Event</i> , Kump PI, NSF Geobiology and Environmental Geochemistry, \$228,174.
2014-2017	<i>Perturbation of the Marine Food Web and Extinction During the Oceanic Anoxic Event at the Cenomanian/Turonian Boundary</i> , NSF Earth-Life Transitions (Bralower PI, Kump co-PI), \$407,640.
2014-2017	<i>Ocean Acidification: during the Paleocene-Eocene Thermal Maximum: Observing and modeling the impact on nannoplankton in a shelf transect</i> (NSF, co-PI with T. Bralower and K. Freeman), \$747,063
2016-2017	<i>Modeling of Earth's Dynamic Systems: Letting Genie out of the Box: A Short Course</i> (Heising-Simons Foundation) \$15,000.
2016-2017	<i>Modeling of Earth's Dynamic Systems: Letting Genie out of the Box: A Short Course</i> (Agouron Institute) \$15,000.
2016-2019	<i>iMUDS: Instigating a Mechanistic Understanding of the Dynamics of the Sedimentary record</i> (Heising-Simons Foundation, co-PI with A. Ridgwell and S. Kirtland-Turner), Kump part \$319,444
2016-2020	<i>Paleoclimate data assimilation for deep time</i> (Heising-Simons Foundation, co-PI with many others non-PSU) Kump part \$340,026.
2020-2023	<i>Quantifying the impact of shallow wastewater injection on groundwater nutrient fluxes to surface waters in the Florida Keys National Marine Sanctuary: a pilot study</i> (US EPA, Miquela Ingalls, PI, \$322,946).

Course Instruction

Sedimentary Geochemistry, Geosciences 523
 Field Methods in Sedimentary Geochemistry, Geosciences 597B
 Gaia - The Earth System, Earth 2
 Chemical Evolution of Atmosphere and Ocean, Earth 402
 Marine Biogeochemistry, Geosciences 497D
 Modeling the Carbon Cycle, Geosciences 497A
 Advanced Earth System Science Seminar, Geosciences 597C
 Physical and Chemical Sedimentology, Geosciences 497A
 Mathematical Modeling in the Geosciences, Geosciences 561
 The Cause of Coral Reef Demise, Earth 497 (CAUSE 097)
 Evolution of the Biosphere, Geosc 502
 Ocean Biogeochemical Dynamics, Geosc 597
 Astrobiology Seminar, Geosc 597
 Himalayan Uplift: Tectonic and Climate Implications, Geosc 597
 Freshman Seminar, EMS 100S

Introductory Geochemistry, Geosc 202
Astrobiology Field Course, ABIOL 570

Membership on Graduate Degree Candidates' Committees

Doctoral Candidates in Progress

Seyi Ajayi	Major Advisor
Benjamin Barnes	Major Advisor

Doctoral Candidates, Program Completed

Kyle Rybacki	Major Advisor
Jonathon Schueth	Member
Elizabeth Denis	Co-Advisor with Freeman
Ying Cui	Major Advisor
Heather Graham	Co-Advisor with Freeman
Lev Horodyskyj	Major Advisor
Leah Schneider	Co-Advisor (with Bralower)
Katja Meyer	Co-Advisor (with Freeman)
Karla Panchuk	Major Advisor
Matt Bachmann	Major Advisor (BRIE Advisor: Regan, CEE)
Anthony Riccardi	Co-Advisor (with Arthur)
Roberta Hotinski	Major Advisor
Mark Gibbs	Major Advisor
Gregg Bluth	Major Advisor
Paul Richards	Co-Advisor
Shelby Lyons	Member
Gregory Wong	Member
Heather Jones	Member
Rebecca McCauley	Member
Karen Whelley	Member
Clayton Magill	Member
Jennifer Williams	Member
Moshe Rhodes	Member
Joel Moore	Member
Vyllinniskii Cameron	Member
Daniel Hummer	Member
Heidi Albrecht	Member
Aaron Diefendorf	Member
Chris Junium	Member
Jamey Fulton	Member
Libby Hausrath	Member
Pushker Kharecha	Member
Erin McMullin	Member (Biol)
Nikolai Pedentchouk	Member
Aubrey Zerkle	Member
Heather Buss	Member
Alex Pavlov	Member
Kosei Yamaguchi	Member
Jennifer Lewicki	Member
Alexander Pavlov	Member
Byong-Hun Jeon	Member (CEE)

Shuhei Ono	Member
Persa Batra	Member
Atsu Ennyu	Member
Matt Hurtgen	Member
Benjamin Turner	Member
Timothy White	Member
Mark Pagani	Member
Yingjie Guo	Member
Karen Bice	Member
Richard Pancost	Member
Neil Suits	Member
Greg Tucker	Member
Tetsuya Kato	Member
Wolfgang Albrecht	Member
Susan Altman	Member
Peter Fawcett	Member
Daniel Greeman	Member
Michael Guebert	Member
Rigel Lustwerk	Member
Wofgang Polster	Member
Armando Ramirez	Member
Martin Schoonen	Member
Chie Soong	Member
Peter Schultz	Member
Ruth Robinson	Member

Masters Degree Candidates, Program In Progress

Masters Degree Candidates, Program Completed

Brandon Clark	Major Advisor
Chloe Stanton	Major Advisor
Kalev Hantsoo	Major Advisor
Stephanie Olson	Major Advisor
Garrison Loope	Major Advisor
Stamatina Hunter	Major Advisor
Anna Hilting	Co-Advisor (with Bralower)
Ellen Herman	Co-Advisor (with White)
Kay Elliott	Major Advisor
Mike Moreland	Major Advisor
Erin Griggs	Major Advisor
Lea Monaghan	Major Advisor
Don Machusak	Major Advisor
Virginia Seymour	Major Advisor
Elizabeth Andrews	Member
Melinda Foland	Member
Katie Brennan	Member
Louise Miltich	Member
Mary Howard	Member
Jennifer Aring	Member
Sharon Givens	Member

Stacey Hoeltje	Member (Agriculture)
Erin Matlack	Member
Jaime Whitlock	Member
Jane Lock	Member
Simmy Yau	Member
Myrna Martinez	Member
Jennifer DeLurio	Member
Egide Nizeyemana	Member
Wanda Kapsner	Member
Rebecca Mellinger	Member
Melissa Nugent	Member