STATEMENT OF LEAVE PROJECT
FALL 2017

Sandra Brake
Professor of Geology

SUMMARY

I am requesting sabbatical leave for fall semester 2017. If awarded, this will be my third supported leave at Indiana State University. The proposed leave will provide time to prepare two manuscripts for publication in international peer-reviewed journals, conduct research on two ongoing projects with student co-investigators, investigate research opportunities, and present my research at a professional conference. One of my current research projects is an interdisciplinary study related to environmental geology, geobiology, astrobiology, geochemistry, and environmental pollution, and will be of interest to a wide variety of scientists and potential graduate students. I will also explore additional research opportunities by visiting several mine sites to expand my research on ore mineralization. These trips will be self-funded and accommodations will be provided by alumni that are currently working at the mine sites. The activities related to my sabbatical leave will expand my collaborations with other scientists, aid in student recruitment, provide experiential learning opportunities for ISU students, and enhance my research reputation as well as the reputation of my Department and the University.

OUTCOMES FROM PREVIOUS SABBATICAL SPRING 2010

My previous sabbatical leave provided me with the opportunity to finalize two research manuscripts and to prepare drafts of two coauthored research manuscripts, all of which have been published. These include:

Dasgupta, S., Fang, J., ***Brake, S.S***., and Hasiotis, S.T., 2013, Stable carbon isotopic composition of lipids in *Euglena*-dominated biofilms from an acid mine drainage site: implications of carbon limitation, microbial physiology, and biosynthetic pathways: Chemical Geology, v. 354, p. 15-21.

Brake, S.S.**,** and Hasiotis, S.T., 2012, Potential metal attenuation by eukaryotic-dominated biofilm communities in acid mine drainage at the Green Valley Coal Mine Site, Indiana: *in* J.B. Comer (ed.), Effects of Abandoned Mine Land Reclamation on Ground and Surface Water Quality: Research and Case Histories from Indiana: Indiana Geological Survey Special Report 72, p. 281-298.

Dasgupta, S., Fang, J., ***Brake, S.S.****,* Hasiotis, S.T., and Zhang, L., 2012, Biosynthesis of sterols and wax esters by *Euglena* of acid mine drainage biofilms: implications for eukaryotic evolution and the early Earth: Chemical Geology, v. 306-307C, p. 139-145.

Brake, S.S., and Hasiotis, S.T., 2010, Eukaryote-dominated biofilms and their significance in acidic environments, in Gadd, G.M., and Ravin, J., editors, Special Issue on Eukaryotic Microbiology: Geomicrobiology Journal, v. 27, no. 6 & 7, p. 534-558.

During my previous leave, I also mentored three graduate student research projects and four undergraduate research projects, which resulted in seven meeting presentations/published abstracts with six of these having students as lead

authors/presenters. Additionally, I published a book review, made guest presentations on geologic topics at ISU and Rose Hulman, edited a grant proposal with a colleague at the University of Kansas for a Kansas NASA EPSCor grant, reviewed 42 proposals as chair of the Indiana Academy of Sciences Research Grants Committee, and attended a regional geology conference. I also returned to ISU to advise geology majors for fall 2010 registration and to attend a meeting on the new foundational studies program.

LEAVE NARRATIVE

Specific Objectives and Expected Outcomes

- Finalize a partially written manuscript for publication in *Geomicrobiology Journal.* Since 1999, I have been investigating the microbial activity of a photosynthetic microorganisms living under extreme conditions associated with acid mine drainage. I have accumulated a large volume of microscopic data documenting microbial construction of organo-sedimentary structures (stromatolites) similar to those formed on early Earth over three billion years ago. I will use the sabbatical leave to finalize a partially written manuscript that I am writing in collaboration with a colleague from The University of Kansas for submission to the international, peer-reviewed journal *Geomicrobiology.*

- Manuscript Preparation. I plan to prepare a second manuscript, which is also based on microbial construction of stromatolites. This paper will focus on video recordings of living cells trapping and binding particles to build stromatolites. This paper will document for the first time the processes used by more advanced cells to build structures commonly attributed to bacterial activity. The content of this paper is cutting edge research that fundamentally expands our understanding of how microorganisms coordinate activities and communicate. This research will be submitted to *Nature*.

- Research with Graduate and Undergraduate Students on Geomicrobiology Project. I recently completed an ISU research grant (UNR 343) that funded supplies for a graduate student to collect preliminary data on the exposure of a microorganism to extreme ultraviolet radiation conditions indicative of early Earth and Mars. Her preliminary results indicate that the microorganism survives lethal doses of radiation. I plan to continue collecting research data and working with my research students to better quantify the results and to establish that the microbes are also capable of reproducing after exposure. I will also work with my students to prepare presentations and abstracts that will be submitted to the Geological Society of America (GSA) for their regional conference in spring 2018.

- Research with Undergraduate Students on Zinc Mineralization in Tennessee. Last year I was contacted by an alumnus regarding research on trace element distribution at a zinc mine in Tennessee. I currently have several students working on the trace element content in zinc samples using various analytical methods (i.e., X-ray Fluorescence Spectroscopy, Inductively Coupled Plasma Mass Spectrometry) to quantify concentrations. During my leave, I will continue to work with my students on quantifying the concentration of select elements using Inductively Coupled Plasma

Optical Emission Spectroscopy, which is available in our department. The data will be used to prepare student presentations and abstracts for the GSA regional conference in spring 2018.

- Exploring Research Opportunities. I have been contacted by two alumni working at gold mines in Nevada to develop research projects for students at ISU. During my leave, I plan to travel to Nevada to visit the mines and to discuss research opportunities. This trip will be self-funded and accommodations will be provided by the alumni. The trip will also provide me the opportunity to explore field sites for future field trips for my courses in mineral deposits and volcanology. The outcome of this trip is to develop future research opportunities and field experiences for ISU students that will provide students with the tools needed in their professional careers.

- National Conference. I plan to use a week of my sabbatical leave in October to attend the GSA national meeting in Seattle, WA. This conference offers me the opportunity to presents some of my research and to attend sessions in my areas of expertise. The anticipated outcome of the meeting is to highlight my research for the purpose of developing new collaborations and for recruitment of graduate students as well keeping abreast with the latest research in my areas of specialization.

ANTICIPATED CONTRIBUTIONS to self, the department, and the university

- *With regard to teaching:*
    - My publications and meeting presentations will enhance student recognition for recruitment of graduate students into my research program and into the department and university.
    - Further development of my understanding of geobiology and ore mineralization will make me a more informed instructor and mentor.
    - My continued mentoring of students in research related to my projects will provide students with the hands-on experiences they need to be successful in their professional careers.
    - The trip to Nevada will allow me to establish additional research projects that will attract students to ISU. The field aspect of the trip offers me the opportunity to better develop my field skills for training our students in the practical applications of geology.
- *With regard to research:*
    - The sabbatical leave will allow time to write and submit two research papers, which will enhance my national and international reputation as well as the reputation of the department and university.
    - I will be able to more thoroughly analyze data for future publications.
    - My scholarship activities will improve my ability to attract external funding.
    - This sabbatical leave will enable me to broaden my collaborations and research opportunities, which will facilitate future research opportunities and collaborations for my students.

TIMETABLE

August & September 2017:

- Finalize partially written manuscript and begin a draft of the second manuscript
- Collect research data and continue mentoring undergraduate and graduate students in my laboratory regarding survival of *Euglena* under adverse conditions and preparing zinc samples for analysis
- Prepare presentation for national GSA meeting
- Spend one week in Nevada visiting mine sites and identifying field stops for a future field trip. I will cover travel expenses to Nevada and accommodations will be provided by alumni.

October 2017:

- Continue working on manuscript
- Collect and analyze data and continue mentoring student in my research lab
- Attend the national GSA conference the last week of October. Expenses for the conference will be covered via the department's annual travel budget.

November – December 2017:

- Prepare second manuscript for submission to a peer-reviewed, international journal.
- Collect and analyze data and continue to work with students in my research lab.
- Prepare research abstracts for submission to the regional GSA meeting in spring. Abstracts are due the beginning of January.

LOCATION OF PROJECT

My sabbatical leave will be carried out mostly in Terre Haute where I have access to my laboratory and analytical equipment to conduct research and to mentor students conducting research with me. I will be traveling to Nevada to visit mine sites and to identify field stops. I will also travel to Seattle, WA, for a national conference.

TIME SPECIFIC CHARACTERISTICS

None beyond those mentioned above.

ANTICIPATED SUPPLEMENTARY SUPPORT

None. I checked with my Department, and they confirmed that faculty receive conference reimbursements when on sabbatical leave.

PREVIOUS WORK OR PREPARATION IN DIRECT SUPPORT OF PROPOSED LEAVE PROJECT

I have published 13 papers on microorganisms living in acid mine drainage systems and have authored and coauthored over 55 abstracts/meeting presentations on this topic and on topics related to ore mineralization at gold and zinc mines in the U.S. that attest to my reputation as an

expert in these areas. Additionally, I recently coauthored a NSF proposal for $854,939 to purchase a scanning electron microscope. If we receive this grant, it will significantly expand my research efforts and recruitment of students to our program.