

# STEPPE: Earth's Past, Our Future

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It's no secret that the sciences are facing significant existential challenges today. But beyond the headlines and sound bites, there is a path forward that will place the geosciences, specifically the deep-time geosciences, on a more solid foundation for the future.

## **In a word, that path is called “collaboration.”**

The first step (pardon the pun) in this process, we believe, was the formation of STEPPE ([www.steppe.org](http://www.steppe.org)), an NSF-funded consortium charged with promoting multidisciplinary research and education on the Earth's deep-time sedimentary crust. Officially, STEPPE is an acronym that stands for Sedimentary Geology, Time, Environment, Paleontology, Paleoclimatology and Energy. The breadth of research (and needed research) in these areas is critical addressing future energy sources, global climate change and species adaption -- vital issues for both science and society.

On a “people level,” the STEPPE community includes biologists, sedimentologists, geochemists, geochronologists, modelers, stratigraphers, and many more specialized, dedicated scientists. In fact, nearly one-third of earth science faculty employed at U.S. universities is working within one of the STEPPE disciplines (AGI, 2010). However, despite this deep pool of talent, many of us have found that it can be difficult to find partners for large collaborative groups. There has been little connection between those conducting basic and applied research. Add to the mix limited and possibly dwindling funding resources, and we find that maintaining a research program today can be a steep challenge, especially for early career scientists, those who most need to pursue their research interests during the pivotal years ahead.

Responding to these stark realities, and offering a positive path forward for the community, STEPPE has been charged with supporting the establishment and maintenance of multidisciplinary research and education teams. The goal is that these groups will be able to tackle the Big Science questions through the creation of new collaborative tools; workforce development; outreach across campuses, generations and continents; and the ability to more effectively communicate the benefits of deep-time science to the public and politicians.

STEPPE itself was born out of collaborative community workshops that brought together scientists from across the disciplines to discuss the big questions and how best to address them. Emerging from these meetings was the clear need for increased funding and broader coordination (Badgley et al., 2011; NRC, 2012, Parrish et al., 2012).

The STEPPE coordinating office is funded through a cooperative agreement from the NSF's Paleo Perspectives on Climate Change (P2C2) program. Initial funding is for three years (beginning in March 2013) and the funds from NSF support primary personnel and the majority of current STEPPE activities. STEPPE began with three consortium members: SEPM, Geological Society of America, and the Paleontological Society. But even before the change of the calendar marks STEPPE's second year, STEPPE has already added a new consortium member, the Geological Society of London, officially making STEPPE an international program anchored by some of the most prestigious geoscience organizations on the planet.

Behind the scenes, STEPPE is working hard to build partnerships with more industry and academic institutions, lending our grant-writing, online, organizational and communications skills to bring geoscientists together in new and exciting ways.

Although STEPPE has been around for a relatively short amount of time, much has been accomplished. The main focus areas have included the creation and maintenance of a website that serves as a central information and collaborative portal; the support of new research synergies; international travel grants for students to expand their research and personal horizons; and exciting education/outreach collaborative projects that bring the tools and benefits of deep-time research to a wider group of scientists, teachers and students.

## **STEPPE WEBSITE: AN INFORMATION GATEWAY**

The STEPPE website serves as a central portal to information for the community. A variety of materials have been synthesized and made more easily accessible via the website. The most prominent have been a searchable database of funding and fellowship opportunities, an archive



*Figure 1: 2014 STEPPE Interns. Picture clockwise from the upper left; Lindsay Bowman, Katie Nold, Erin Leckey and Wassim Benhallam.*

of STEPPE-discipline white papers and workshop reports, and an events calendar gathering opportunities from around the world for geoscientists to connect, learn and share.

The funding and fellowship database provides information and links to opportunities that are available across the STEPPE disciplines and includes NSF programs from both inside and outside the Geosciences Directorate; from other government agencies; and several non-profits, many on the periphery of deep-time science, but excellent opportunities that many overlook. This database can be sorted based on due dates, discipline areas or granting agency and is kept up-to-date by the STEPPE team.

White papers and workshop reports have come from NSF and NRC

workshops, from funded Research Collaboration Networks (RCNs) and other gatherings in our field. Participants in these efforts can be assured that their hard work, findings and conclusions are now available to a wider audience and will not be forgotten. New materials are added on a regular basis.

The events calendar provides information about upcoming professional society meetings, workshops, webinars, educational opportunities, field trips and gatherings. It is international in scope. List and calendar views make it easy to search for upcoming events and the STEPPE team is always interested in learning about new events to include in the calendar.

In addition to serving as an information portal, the STEPPE

website also includes novel content that is meant to not only inspire and inform community members, but also to bring the complex topics our community addresses down to the individual, personal level. Our Featured Researcher section, for example, highlights community members and their work. These prestigious deep-time researchers come from across the STEPPE disciplines. In addition to discussing their science, these individuals provide advice to early career scientists and address the dynamics of today's research environment.

Original content has also been posted through the STEPPE blog, written by STEPPE staff members, interns and student awardees. Posts from STEPPE interns have provided policy updates from Washington, D.C., new research findings, and presentations from events and workshops. Last year's STEPPE student travel grant awardees provided posts on their adventures from Mendoza, Argentina, where they presented their research to an international audience during the 4th International Palaeontological Congress. These posts radiate the enthusiasm and drive that our top early career scientists harbor, an inspiring affirmation of the future of our science. Finally, the STEPPE news digest includes links to current research, information and announcements.

The STEPPE website also includes opportunities for direct participation from community members in a neutral, supportive environment free from institutional constraints. STEPPE members can join to publicize research and collaborate with others. The online collaborative group feature (powered by the familiar and robust WordPress platform) is an outstanding resource created by the STEPPE team. Online collaborative groups



allow users to manage their multi-institution projects through calendaring services, communication platforms, and document and file sharing. Additionally, collaborative groups can disseminate highlights from their projects through blogging and social media tools. This amazing resource is available and customizable for your research or lab group's needs, with STEPPE support to guide you.

### **NEW RESEARCH SYNERGIES**

STEPPE supports new research collaboration through a variety of means, including funding to support workshops that bring together multidisciplinary groups to develop proposals for external funding agencies. STEPPE provides grants of up to \$15,000 to help set-up, organize and fund participation in the workshops. Successful workshop proposals link multiple domains that commonly

operate independently and focus on processes and prediction. Proposals can also focus on better methods of analysis and characterization that are linked to physical, chemical or biological processes. Thus far, STEPPE has funded a workshop, "Biological and Environmental Transitions During the Neoproterozoic and Paleozoic," organized by Dr. Sarah Pruss of Smith College in the spring of 2014 ([http://steppe.org/wp-content/uploads/2014/08/NSF-reports/STEPPE\\_Workshop\\_Neoprot\\_Pz\\_2014.pdf](http://steppe.org/wp-content/uploads/2014/08/NSF-reports/STEPPE_Workshop_Neoprot_Pz_2014.pdf)). STEPPE expects to be able to fund three to four workshops per year.

STEPPE also supports research through partnership with other groups and initiatives that are interested in community cyberinfrastructure needs. The STEPPE coordinating office is in the process of writing collaborative grants which facilitate and build

capacity for meaningful work across the STEPPE discipline areas. Data repository and accessibility, cross-platform integration, modeling, and the development of new tools and user interfaces are all a part of these initiatives.

For already existing collaborative groups and funded RCNs, STEPPE has committed to serve as the online repository of all associated documents (white papers/reports, papers, etc.) and to provide continuing online virtual collaboration space for these groups when their project funding ends. Projects such as the NSF EarthCube-funded RCN, Cyberinfrastructure for the Paleogeosciences (C4P), and the geothermal-focused SedHeat, are working with STEPPE to build in a sustainability component for the longer-term life of their projects. This will allow these groups to continue their important work even after NSF funding has ended.



*Figure 2: STEPPE student travel grant awardees at the 4th International Palaeontological Congress in Mendoza, Argentina.*



*Figure 3: Participants in the “Collaboration for Change: Fossil Plants and Ancient Climates” project collecting fossils at the Florissant Fossil Quarry, Colorado.*

STEPPE works to support symposia, townhall meetings, special sessions and workshops at a variety of professional meeting venues. For example, the coordinating office organized a symposium of deep-time research presentations at the Society for the Advancement of Chicanos and Native Americans in the Sciences (SACNAS) annual meeting in Los Angeles in the fall of 2014; hosted a townhall meeting for the CP4 group at the GSA 2014 annual meeting in Vancouver; and organized and moderated an Earth Life Transition-themed session at the 2015 American Association for the Advancement of Science (AAAS) meeting in San Jose, Calif. STEPPE

will co-sponsor future workshops at the 2nd International Conference on Stratigraphy, the Paleontological Society’s short course, and collections-themed symposia at the GSA 2015 annual meeting. STEPPE is eager to assist with deep-time sedimentary crust-themed events and opportunities and would be happy to discuss the possibility of co-hosting, sponsoring, and/or advertising your upcoming events.

### **EDUCATION & OUTREACH COLLABORATIVES**

Collaboration that supports workforce development, education and outreach is another important facet

of the STEPPE mission. STEPPE has made great strides in this area through collaboration with consortium members and partners from academic institutions across the country and the world. As a result, STEPPE has been able to initiate an internship program; support student researchers to participate in international conferences; and develop education and outreach programs focused on K-12 students and teachers.

STEPPE’s founding consortium members contributed additional funding to STEPPE in support of the establishment of the STEPPE internship program. The first group of interns began in the summer of 2014 and consisted of four geology graduate



students (Figure 1). One intern was based at GSA's Washington, D.C. office and focused on public policy under the guidance of Kasey White. The other three interns were based at GSA headquarters and were focused on science communication and education/outreach. They worked to expand all of the website features and collaborated on the development of the STEPPE online collaboration platform. A new call for summer 2015 STEPPE Interns has gone out and applications will be reviewed in early March. There are four internship positions available this year: a policy position based in Washington, D.C., a non-profit administrator, a communications project manager, and a science journalist/social media administrator (the latter three based in Boulder).

STEPPE interns participate in the GSA annual meeting, giving presentations about the program and helping to man the STEPPE exhibit booth. This gives the interns an opportunity to interact with a diversity of STEPPE colleagues and to serve as peer mentors to other early career scientists, as well as interact with the exceptional staff at GSA headquarters.

STEPPE, GSA, SEPM, Paleontological Society, the Society for Vertebrate Paleontology and the paleobotanical section of the Botanical Society of America were successful in applying for NSF funding to support student travel to attend the 4th International Palaeontological Congress in Mendoza, Argentina in September 2014. Fifteen students were able to attend and present their research at this meeting (Figure 2). They wrote about the importance of this opportunity and their own experiences in several blog posts that are featured on the STEPPE website (<http://steppe.org/category/ipc4/>). In addition, the STEPPE travel



*Figure 4: The Colorado team at Geosciences Congressional Visits Day.*

awardees authored a collaborative paper (Luque et al., 2015), published in GSA Today (January 2015) and other society venues such as The Stratigraphic Record (SEPM) and PRISCUM (Paleontological Society) describing their experiences.

This year, STEPPE is working with the American Geosciences Institute (AGI), GSA, the Paleontological Institute and SEPM to obtain travel funding for students to attend the 2nd International Congress on Stratigraphy (STRATI 2015) and participate in a workshop on archiving the stratigraphic record to be held in Graz, Austria this summer.

Finally, STEPPE has partnered with science educators, teachers, the NSF-funded FOSSIL (Fostering Opportunities for Synergistic STEM with Informal Learners) Project, and the National Park Service to provide earth science teachers with a field-based professional development opportunity. This multi-day program,

“Collaboration for Change: Fossil Plants and Ancient Climates,” was created to provide middle school teachers with fossil-collecting experience, adaptable classroom modules consistent with the Next Generation Science Standards (NGSS), and the training and confidence to teach Earth Science Concepts to students from a variety of backgrounds (Figure 3). This successful program is now part of a larger, national project that is focused on middle school teachers and students from urban schools with high-underrepresented minority (URM) populations in Chicago, metro Denver, Philadelphia and the San Francisco Bay area. This multi-institution collaborative grant includes STEPPE, Bowling Green State University, Bryn Mawr, the University of California at Berkeley, the University of Colorado Boulder and the University of Illinois at Chicago and is now pending with the NSF's Directorate for Education and Human Resources.

Although this is a paleontology-

focused K-12 program, the same model that was used to develop this project is clearly transferable to other STEPPE discipline areas. With the NGSS' increased focus on earth system sciences, the need to develop materials that incorporate the breadth of STEPPE discipline content has only increased.

## **A VOICE FOR THE DEEP-TIME SEDIMENTARY CRUST COMMUNITY**

At its core, STEPPE is charged with being a voice for the community and building connections between groups that are at the forefront of communicating science. Science advocacy through the STEPPE policy internship and associated blogs has allowed the coordinating office to keep the community informed regarding important policy decisions and to discuss the need to organize and advocate on behalf of all STEPPE disciplines at all levels. Last year, members of the STEPPE coordinating office participated in Geoscience Congressional Visits Day (Figure 4). The opportunity to speak to members of Congress and their staffers about the important work that is being accomplished by STEPPE scientists, and how our disciplines uniquely contribute to society today and into the future, is invaluable. It is clear that the survival of our disciplines and the maintenance of funding to support this important work are largely contingent upon our own ability to engage effectively on this larger national stage.

Further, STEPPE is working with our professional society consortium members to provide greater exposure to the important research that is being accomplished by members of the community and published in our society journals. Items for the STEPPE new digest and blogs are actively solicited and further highlighted through the

consortium research (<http://steppe.org/consortium-news/>) and publication sections (<http://steppe.org/publications/>) of the website.

In the future, the STEPPE office will work to coordinate with professional society journals, institutional press offices and individual researchers to more fully coordinate the messaging of STEPPE disciplinary science. Additionally, current research results and associated images will be made available to faculty and other educators for use in their classrooms, further demonstrating the timeliness and relevance of STEPPE disciplinary science to younger scientists, teachers, administrators.

## **THE FUTURE**

Building collaboration and partnership is central to the mission of STEPPE. Bringing together professional societies, academic institutions, industry partners and government agencies allows for greater coordination and creativity to support the scientific needs of the diverse STEPPE research and education community. Currently funded NSF initiatives often provide tailored support to specific portions of the STEPPE community, but each is easily adaptable to suit the needs of other discipline areas. If you, or members of your group, are interested in adapting any STEPPE activities to meet the needs of your project or specific discipline area, be sure to get in touch with our office.

In its short life, STEPPE has focused on creating a diversity of programs, all in support of Big Science. The STEPPE coordinating office is working to build consortium membership and to diversify the services that are provided, while staying true to the mission of serving the deep-time sedimentary crust community. STEPPE plans increased partnerships with other NSF-funded offices and initiatives and to begin

collaborating on projects to avoid duplication and provide opportunities for greater efficiency. Working together will allow the community to streamline resources and allow all partners to accomplish much more together than any would be able to accomplish alone. While still in its infancy, the STEPPE coordinating office is poised to become a dynamic hub where members of the sedimentary crust community can find resources and build connections to tackle the Big Science questions in new and exciting ways.

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