“SPOTLIGHT ON EARTH SCIENCE” SYMPOSIUM: AN OVERVIEW

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Abstract

On September 18-19, 2006, James Madison University (JMU) hosted a one and half day symposium entitled, “Spotlight-on Earth Science,” highlighting current resources and technology available for earth science teachers, and invited teachers to share effective practices learned in their program coursework through the two Mathematics and Science Partnerships (MSP) funded by the Virginia Department of Education. The symposium supported a pooling of expertise among participants to initiate the definition and resolution of the persistent issues in earth science education in Virginia. A total of ninety-six teachers, university faculty, curriculum supervisors, policymakers, and business/government/industrial representatives participated. Three themes were addressed: 1) Best Practices in Earth Science Teaching, 2) Curricular and Assessment Issues in Earth Science, and 3) Earth Science Teacher Education. The two MSP projects, Virginia Earth Science Collaborative (VESC) and Innovative Teachers in Earth Science in Tidewater (iTEST), addressed only one aspect of the earth science issues in Virginia: the shortage of qualified earth science teachers. Building on the successes of these projects and the symposium, the Virginia Mathematics and Science Coalition commissioned a task force to explore the problems and potential solutions raised by participants in symposium. Future anticipated outcomes include the development of graduate programs in geoscience education and engagement in funded projects in geoscience education to suit the needs of students, teachers, and school divisions.

Introduction

In light of the range of curricular demands in science education, from the expansion of life science content to the foundations of physical sciences content, one might ask, “What is the need for an earth science education?” The simple answer is perhaps, “none,” in that the earth sciences represent a synthesis of other sciences, applied to the physical world around us. However, given that many students will not continue in science learning beyond compulsory requirements in high school or college, the vital need to include this synthesis should not be overlooked. For example, understanding where, in fact, the basic materials of the economy originate is fundamental to basic living. This applies to gas, coal, and petroleum, metals, aggregates, dimension stone, fertilizers, and water. Access to these materials is a requirement, at the most fundamental level, of our civilization. Disruption of the supplies of these materials has historically proven to have deep negative impacts on society as a whole. Wars have been won and lost over such resources, and famines have resulted for the lack of one resource or another. By the same token, the extraction of these basic materials has both short- and long-term environmental implications. Any disruption of a natural system creates the
prospect of negative consequences or feedback, resulting in an erosion of quality of life. As the implications have a broad impact on society as a whole, they typically fall under the purview of policymakers and elected officials. Thus, having an electorate knowledgeable of these impacts vital if policymakers are to be guided in making appropriate decisions, particularly for the long term for the health of the environment.

Virginia is in a paradoxical position with respect to earth science. While earth science is required for high school graduation, roughly 70% of Virginia students take earth science, one of the highest rates in the nation. At the same time, the need for qualified earth science teachers has exceeded the need for mathematics, special education, and foreign language teachers. In order to increase the pool of qualified earth science teachers in Virginia, the Mathematics and Science Partnership (MSP) grant program, funded by the U.S. Department of Education and managed by the Virginia Department of Education, supplied funding to two projects. In order to disseminate results of these projects, a symposium entitled, “Spotlight on Earth Science,” was planned to highlight current resources and technology available for earth science teachers, and invite teachers to share effective practices learned in their program coursework. Over the course of a day and a half, the symposium allowed for a pooling of expertise among participants to begin defining and resolving persistent issues in earth science education in Virginia. This article summarizes the planning, execution, and outcomes, both immediate and projected, of this symposium.

Rationale and Planning for the Symposium

Over the last few years, several issues have emerged in earth science education at the middle and high school levels in Virginia. While the population of Virginia continues to grow and schools are expanded or built, the number of new teachers receiving a certification in earth science has remained in the single digits on an annual basis. As a result, many schools have been forced to use underqualified teachers in earth science classes. Furthermore, there is some correlation between students placed in earth science and those students with weak mathematics skills. Earth science is perceived as “easy,” as ostensibly lower cognitive demands are placed on students. Little quantification or application of scientific methodology is expected or, in fact, used. Some school divisions opt not to use earth science for lab science credit for graduation requirements; or, they even allow their students to bypass earth science completely, enabling them to take more “real” science in the form of Advanced Placement (AP) science classes later in their high school career. In addition, many colleges do not recognize earth science as a lab science in admission decisions, decreasing the desirability of earth science among more capable or advanced students.
These issues have not gone unnoticed by education policymakers, curriculum supervisors, and teachers. In order to help increase the pool of qualified earth science teachers in Virginia, the Mathematics and Science Partnership (MSP) grant program funded two projects in the second year of the program. The first project, “Virginia Earth Science Collaborative (VESC)” is directed by the MathScience Innovation Center (formerly Mathematics & Science Center) in Richmond, Virginia and was a statewide initiative with eight partner institutions, non-profit organizations, and eighty-three school division partners. A suite of five courses was offered by the participating higher education institutions in the VESC that included the following: Physical Geology, Geology of Virginia, Oceanography, Meteorology, and Astronomy. Additional coursework was offered on integrating instructional technologies in earth science and inclusion strategies in earth science [1].

The second project, “Innovative Teachers in Earth Science in Tidewater” (ITEST), is under the direction of Portsmouth City Public Schools with the Virginia Space Grant Consortium providing a key role in the partnership. This project was more regional and partners included six school divisions in Superintendents’ Region II. Through area higher education institutions, coursework in geology, oceanography, and meteorology was offered. Specialized experiences were developed to assist in addressing the needs of the local schools, including the enhancement of reading strategies in earth science classrooms.

In furthering support of earth science education in Virginia, a dissemination symposium was planned to share the successes of these two programs, and to help teachers and administrators be aware of the need that still exists for qualified earth science. Rather than serving as a “dog and pony show” for the projects by showing off simple classroom activities, the symposium was structured to support dialogue among experts and stakeholders, such that a consensus on curricular, assessment, and policy issues, and professional development specific to earth science education in Virginia, could be at least initiated. This symposium was also intended to highlight current resources and technology available for earth science teachers, and invited leaders in earth science education to share effective practices learned in their program coursework.

In planning the symposium in a manner that would support the two missions, three themes were adopted:

1) Best Practices and Effective Strategies — What are some innovative or effective practices for teaching earth science in grades 6-16?

2) Curricular and Assessment Issues — What is the structure of earth science learning experiences in grades 6-16 in Virginia?
3) Earth Science Teacher Preparation and Development — What are the persistent issues recruiting and providing professional development for earth science teachers?

In order to articulate responses to these thematic questions, the symposium was organized around concurrent and general sessions. Once the general structure of the symposium was provided, participants on the first day, they would then be free to participate in concurrent sessions highlighting the individual courses offered by both VESC and ITEST, concentrating on the Geology, Oceanography, Meteorology, and Astronomy course offerings. After the context of the courses was established, teachers who had participated in the courses would be given the opportunity to share how they have utilized their experiences in their own classrooms. The first day was to be capped off by a general speaker, who would provide a sense of mission, building on the discussion of what work and had so far been learned as a result of the MSP funding.

The second day would utilize participants’ experiences, either as part of the projects outside them, to refine the sense of mission of what the next steps for earth science education in Virginia should be. A panel of leaders, including representatives of business and governmental interests, was to be formed to provide additional perspective to the discussions. Participants would then be invited to articulate regional problems, responses, and solutions to the issues raised by the panelists, along the lines of the symposium themes. With these discussions fresh in their minds, “jigsaw puzzle” model could be employed, as these now regional “experts” could tackle directly the thematic questions, refining their parameters and potentially offering solutions. A final general session would summarize the findings of the thematic group discussions.

With such an ambitious agenda and only a limited time in which to fully flesh out responses to the thematic questions, the projected outcomes of the symposium were of short- and long-term scope. Certainly, the basic goal of information dissemination about the two MSP projects was expected, from sharing the scope and sequence of current classes to informing participants of future offerings. While long-term outcomes were not expected to emerge from these meetings, it was hoped that the following goals would be achieved:

- Define general concepts and action plan for a white paper on policy recommendations related to earth science education in Virginia — This mission has subsequently been adopted by the Virginia Mathematics and Science Coalition in the formation of the Earth Science Teacher Force;
- Create opportunities for the promotion of a recognized earth science education community
Virginia — The Earth Science Committee of the Virginia Association of Science Teachers has begun work in this area by generating a communications database of earth science teachers in Virginia;

- Inform planning for the Statewide Master’s Degree in Earth/Environmental Sciences (based upon MSP and other expansions) — The MathScience Innovation Center and Virginia Commonwealth University, as well as James Madison University, are in advanced planning stages for such degrees; and,
- Map out and write an article for the Special Issue of *The Journal of Mathematics and Science: Collaborative Explorations*, which would share best practices in earth science teaching and professional preparation — This article is part of this Special Issue.

Once the dates for the symposium at James Madison University (JMU) were established, invitations were circulated. A Principal’s Memo was issued by the Virginia Department of Education (VDOE) and circulated by the Virginia Association of Science Teachers (VAST) and the Virginia Science Education Leadership Association (VSELA). Both VESC and ITEST staff encouraged members to attend. A total of ninety-six people indicated that they would be able to attend the symposium. These attendees included teachers, curriculum supervisors, higher education faculty, principals, and representatives from the business community and government agencies (see Table 1). Each attendee received a notebook with an agenda, curricular references, session overviews and instructions, and VESC and ITEST project descriptions.

<table>
<thead>
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<td>Higher Education</td>
<td>17</td>
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<td>Administration (school or division)</td>
<td>12</td>
</tr>
<tr>
<td>Other (state administration, government, business)</td>
<td>7</td>
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Symposium Session One: Overview and Welcome

This general session was intended for the host institution, James Madison University (JMU) to welcome participants, provide a purpose for the overall meeting, share the themes of the meeting and layout of the sessions, and give a brief overview of funded earth science Mathematics and Science Partnerships. Presenters and session leaders included representatives from JMU, VDOE, the Virginia Earth Science Collaborative (VESC), and Innovative Teachers of Earth Science in Tidewater (ITEST). Welcoming remarks were presented by Eric Pyle (JMU), Phillip Wishon (JMU College of Education), David Brakke (JMU College of Science & Mathematics), Paula Klonowski (VDOE), Julia Cothron (VESC/MathScience Innovation Center), and Dan Lewandowski (ITEST/Portsmouth City Schools). Specific directions for each session were explained and desired outcomes delineated. General themes for the meeting (outlined below) were shared.

Best Practices and Effective Strategies — What are some innovative or effective practices for teaching earth science in grades 6-12? For the content preparation of teachers? What characterizes these as “best practices?” What elements are exportable or disseminative? What new technologies are available to enhance earth science teaching? How can diverse populations (e.g., special education students) be best served by these practices?

Curricular and Assessment Issues — What is the structure of earth science learning experiences in grades 6-12 in Virginia? How does the content preparation of teachers integrate with this structure? How does this structure reflect current understanding of earth processes and systems? How are these experiences supported by best practices? To what extent does the assessment of student learning inform us? Are the assessments reflective of classroom learning? How can earth science be developed into a “lab science” in high school to become a “core” science in the curriculum?

Earth Science Teacher Preparation and Development — What is the status of the earth science teacher shortage? What are the persistent issues in recruiting and providing professional development for earth science teachers? What structural barriers exist to restrict the numbers of available earth science teachers? What are potential solutions? To what extent will graduate programs in geoscience education impact these issues?

Symposium Sessions Two and Three: VESC and ITEST Course Highlights

These concurrent sessions allowed the courses in VESC and ITEST to be shared. Faculty involved in the design and/or delivery of these courses provided an overview of the courses in each domain of earth science (geology, meteorology, astronomy, oceanography). This overview include
descriptions of materials, lessons, activities, field trips, and teacher products. Presentations of each project’s courses lasted approximately fifteen to twenty minutes, and were followed by five to ten minutes of discussion and questions. A final ten minutes in each session was allowed for session leaders to solicit information from participants on the need for future course offerings, as well as delivery options for these courses.

**Symposium Session Four: Teacher Applications from MSP Course**

In this set of concurrent sessions, teachers who benefited from their participation in the MSP classes shared activities they have used in their own classrooms, including hands-on activities, laboratory-based lessons, and field trips. This was a chance for the real “stars” from each project to shine and show others what they have learned, gained, had confirmed, or otherwise been able to use to advance their students’ knowledge of earth science. The schedule for these concurrent sessions mirrored the other course sessions, with one session in each course area: Geology, Meteorology, Astronomy, and Oceanography.

**Symposium Session Five: Promise and Challenge of Specialized MSP Courses**

Both VESC and ITEST had courses designed to serve the needs of their respective populations. These courses were designed to integrate earth science content with effective strategies in reading, special education, and instructional/science-based technology. Like the content course sessions, these three concurrent sessions were presented by faculty responsible for their design and/or delivery, as well as by invited experts. This session was designed to showcase their particular structure, outcomes, and impact on the intended audiences.

**Symposium Session Six: Practical Aspects of Statewide Changes in Earth Science Education**

The dinner session had, as an invited speaker, Dr. Geoffrey Feiss, the Provost of the College of William & Mary. Dr. Feiss has experience in the reorganization of earth science education in North Carolina, and was asked to speak about this experience from the perspective of state-level changes (opportunities, barriers, facilitation, etc.) in earth science education (see Appendix A). The content of this presentation served as a bridge between Monday’s “showcase” of the MSP projects and the projection of the lessons learned into Tuesday’s work sessions on best practice, curriculum and assessment, and teacher education.
Symposium Session Seven: Building on the MSP’s—Panel Discussion of Central Issues in Virginia Earth Science Education

The Day 2 sessions were intended to synthesize the information learned from the Day 1 sessions (e.g., what works/worked in courses and with students, reconciliation of work with the SOL relationship of courses to earth science teacher education, etc.), and to generate the basis for policy recommendation documents along the lines of the three themes of the meeting. Session Seven started with an overview of the tasks and outcomes to be attended to during Tuesday’s sessions, followed quickly by a panel discussion with panelists from VESC, ITEST, VDOE, the Virginia Mathematic: and Science Coalition, and other parties interested in earth science education. Panelists summarized their perspectives in light of the first day’s sessions and offered their views on the theme-related questions (and others), describing current, pending, or considered policies and programs that address central problems in earth science education. Pending events (SOL and testing changes) and potential solutions (teacher preparation curricula and the Statewide Master’s Degrees Program in GeoScience Education) were all shared. Participants were then charged with drafting specific responses to the theme-based questions in the subsequent sessions.

Symposium Session Eight: Regional Issues in Earth Science Education

In order to categorize and determine general (statewide) and regional challenges and interests in earth science education, participants worked in VDOE Superintendents’ Regional groups, with the participants articulating and prioritizing these issues. In expanding upon them, they drew particular attention to challenges and successes in their home regions. The regional focus allowed more direct ownership by participants of the subsequent discussions. Individual participants in this session subsequently took the summarization of regional parameters to the theme working groups in Session Nine and Ten.

Symposium Session Nine: Dimensions of Earth Science Education—Articulating Issues, Problems, and Solutions

This concurrent session featured smaller groups suggesting responses to specific questions for each theme. In answering these questions, participants first presented their regional issues/responses to the initial theme questions, then provided additional questions as needed, informed by group members’ own experiences and regional priorities. This was then followed by a discussion of the specific barriers that exist to resolving the questions/problems, what funding could/should exist to support solving the issues, and how state agencies could assist with their final resolution. The product of Session Nine was a set of three brainstorming lists for each strand, informed by the previous day’s presentations and panel discussions.
In order to facilitate each theme session, a single individual was named to coordinate the work of the theme group, distributing instructions, providing charge clarification, maintaining master “brainstorming” lists, and drafting the text of Session Nine consensus statements. They were aided by “table” leaders, who carried the conversations forward for “role-alike” sub-groups (higher education table, curriculum coordinator table, teacher table, other table). Each table leader also served as the spokesperson for the table in support of the theme group leader’s efforts to synthesize responses and solutions.

**Symposium Session Ten: Dimensions of Earth Science Education—Reaching Consensus**

Session Ten was used to synthesize the solutions offered in Session 9, first by prioritizing each of these lists, and then building consensus on how to present them in specific statements to teachers, curriculum supervisors, higher education content faculty, teacher education faculty, state policymakers, and others that wish to support geoscience education. The outcome of Session Ten was a series of statements by each breakout (themed) group that could be used to define funding priorities for professional development, frameworks for teacher education, working drafts of potential SOL changes, and templates for the evaluation and support of high quality earth science teaching. The leader of each group provided one to two PowerPoint slides of their group’s discussion summarizing these statements.

**Symposium Session Eleven: Final Sharing Lunch**

This final session allowed each theme group coordinator to share the consensus statements of their respective groups with the group as a whole through the PowerPoint slides developed in Session Ten. A brief discussion followed, drawing connections across each set of consensus statements. After lunch, the meeting leadership and Session Seven panelists discussed how these group findings would be parsed and placed in policy statements, white papers, and published work, especially through the VMSC journal.

**Outcomes of the Sessions**

Per the instructions for Sessions Nine and Ten, each of the theme-related breakout groups brainstormed and compiled a list of what they saw as priority issues and potential responses to the questions posed for each theme. Not all of the sessions progressed smoothly, however, as some participants held strong and passionate views about some of the questions, and this prevented smooth brainstorming activities. In other cases, the scope of the questions raised responses that were so broad as to be overwhelming and defied simple solutions. Nevertheless, there was some consensus
within each of the themes, to the point that it was now possible to develop more refined questions that would lead to solutions. As intended, however, the responses of each group were overlapping, such that issues of best practice had relationships to curriculum and assessment, and teacher education issues related to best practices. A preliminary analysis of the responses by each thematic group is presented below.

**Best Practices in Earth Science Teaching** — A fundamental consideration for this group was the need for any instruction in earth science to be as student centered as possible. To fully know one’s students was seen as the basis for differentiation of instruction. One key to supporting this as a best practice was through sharing effective strategies within instructional communities, such that teacher themselves are not isolated, but are able to communicate on a variety of levels (school, division, an region). Participants also stated that building an earth science-related skill set in students, particularly through experiential learning, would allow students to build better general science habits. A possible avenue would be to more fully utilize instructional technologies that can be related to earth phenomena, such as Google Earth™, and implementing these in the classroom through Internet technologies and podcasting.

**Curricular and Assessment Issues** — A central issue that arose from this group was the need for the SOL to better reflect real earth phenomena through data analysis and technological applications so that instructional materials could be selected or developed to capture these elements. A central concern was that the scope and sequence of earth science, as currently reflected in the SOL, was too much for students in the ninth grade to fully appreciate or learn. Instead, suggestions were made to either move earth science to a junior-/senior-level course, or to split the earth science curriculum to provide a basic as well as an advanced experience for students—an “Earth Science I” and “Earth Science II.” Special enmity was reserved for the current SOL as having too little depth to have meaning for students, with participants urging a reconsideration of the Earth Science SOL to provide more integration of concepts through linkages with other science content, as well as building an earth systems mindset. Assessments should subsequently focus more on the relationships between concepts rather than on a vocabulary-based list without context. A prototype model for recasting the Earth Science SOL in a national standards-based manner that captures earth systems is presented (see Figure 1).
Figure 1. Prototype for standards-based earth systems SOL.

Earth Systems and the Virginia SOL's

Super-continent Cycles
4.0 Ga of tectonic evolution

PLATE TECTONICS → WILSON CYCLE → WEATHER CLIMATE → CARBON CYCLE

SYSTEMS (Qualitative)
MODELING (Quantitative)

Fractionating Evolution
Pre-algebraic math
- Proportions/Ratios
- Rates of plate movement
- Rates of uplift

ALGEBRA
Dynamic Modeling
Complex Systems

- (ES 5) rock forming minerals
- (ES 6) rock cycle
- (ES 8) physiographic provinces and plate tectonic processes
- (ES 10) evolution of Earth and life, fossils and rock record, age determination
- (ES 11) features of the seafloor
- (ES 4) sun-earth relationships
- (ES 9) water cycle
- (ES 10) evolution of life and earth
- (ES 11) ocean circulation, energy transfer
- (ES 12) atmospheric change over geologic time
- (ES 13) energy transfer and weather phenomena
- (ES 6) rock cycle
- (ES 2) fossil fuels in Earth systems
- (ES 8) salt water cycle
- (ES 11) ocean upwelling

What would the SOL's look like if they were approached from a systems viewpoint?

(ES 1) analyzing how science explains and predicts the interactions and dynamics of complex earth systems

AAAS Project 2061

Benchmarks
Common Themes

One of the essential components of higher-order thinking is the ability to think about a whole in terms of its parts and, alternatively, about parts in terms of how they relate to one another and to the whole.

Children tend to think of the properties of a system as belonging to individual parts of it rather than as arising from the interaction of the parts. A system property that arises from interaction of parts.

The main goal of having students learn about systems is not to have them talk about systems in abstract terms, but to enhance their ability (and inclination) to attend to various aspects of particular systems in attempting to understand or deal with the whole system.

The usefulness of conceptual models depends on the ability of people to imagine that something they do not understand is in some way like something that they do understand. Imagery, metaphor, and analogy are every bit as much a part of science as deductive logic.
Earth Science Teacher Education — In order to strengthen earth science teacher education, in both pre-service and in-service settings, this group offered a number of central considerations. A central concern was over information on the guidelines for certification, with teachers having been supplied with either confusing or conflicting information. It was apparent to participants that there was no clear shared understanding of requirements at either the school division or the university level. With little clear understanding of Virginia Department of Education (VDOE) requirements, or for that matter, the federal No Child Left Behind legislation requirements, the current framework does not appear to support teachers pursuing an earth science endorsement. Furthermore, there is no incentive for higher education institutions to even provide the relevant coursework, whether prospective earth science teachers used traditional or non-traditional entries into teacher education. Another central element in this discussion were the PRAXIS requirements. Where requirements were understood, the amount of work required of teachers was out of proportion with the recognition. Many participants felt that a master’s degree in geoscience education would provide this recognition. The availability of such a degree should also consider the mode of delivery of coursework, with distance options being considered when the course content was compatible, such as with the online meteorology studies. However, coursework alone would be insufficient without appropriate support at the division level through earth science specialists. Supply issues could also be addressed through curricula approaches, utilizing dual enrollment courses between high school and college so that students might see earth science teaching as an option upon entering college.

A far-reaching outcome of the symposium was the formation of the Earth Science Task Force by the Virginia Mathematics and Science Coalition, whose main charge was to refine the findings and concerns generated in the symposium. This Task Force was composed of leading participants in the symposium, as well as members of VMSC. This group met twice in 2007, and has meeting projected for 2008. Currently, tasks have been defined for which data will be collected. These data collection tasks are centered on policies, practices, and needs (see Table 3). It is anticipated that the summarization of the results of these data collection activities will be used to better inform changes to earth science in Virginia by matching concerns, data, and possible solutions in a manner that speaks equally to policymakers and educators.
Table 3
Data Collection Tasks for VMSC Earth Science Task Force

<table>
<thead>
<tr>
<th>Task Area</th>
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<td>Policies</td>
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<td>Policies at the college admissions office</td>
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<tr>
<td>Practices</td>
<td>Structure and implementation of earth science curricula in classrooms</td>
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<td>Distribution and background of qualified/underqualified ES teachers</td>
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<tr>
<td>Needs</td>
<td>Perceived need for and placement of earth science education</td>
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<td>Need for advanced degrees/credentials in earth science</td>
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Building for the Future

Clearly, only in the most wildly optimistic dreams could the “Spotlight on Earth Science” symposium provide answers to the issues facing earth science education in Virginia. The two MSP projects, VESC and ITEST, were designed to address only one aspect of the growing earth science issues in Virginia: namely, the shortage of qualified earth science teachers. The successes of both projects have been won by hard work by many parties, but the quality of the coursework provided has also served to make additional issues in earth science education apparent, going beyond the symptoms of the problems and allowing educators to articulate the problems more clearly. The themes of the “Spotlight on Earth Science” symposium and the related sessions were well positioned to do just that. Building on these questions and issues, the Virginia Mathematics and Science Coalition has organized two task forces to more fully explicate the problems and potential solutions in Virginia earth science education, as well as to take the MSP projects to the next level, that of devising graduate programs in geoscience education to suit the needs of students, teachers, and school divisions. In the long term, we must define an agenda and timetable for action on the themes, developing task force teams for gathering additional information to inform possible actions. In support of these long-term steps, we as an earth science community must cultivate policy links that are based on team-generated data, as well as developing external funding proposals. The symposium was never intended as an answer, but it certainly produced a clearer definition of issues, acting as initial firm footing for the
solution of what promises to be a very large problem for the future of the Commonwealth of Virginia.

Acknowledgments

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Reference

Appendix A
Synopsis of Remarks by Dr. Geoffrey Feiss at the Evening General Session

Synopsis of Remarks: At a congenial moment in the late 1980s, the interests of K-12 educators, university-level earth scientists, the state's minerals industry, and professional geologists aligned with the realization that earth science was dropping like a stone from the curriculum of many of North Carolina's public schools. This was seriously impacting enrollments in freshman geoscience courses at the state universities. Practicing geologists were finding that the deep ignorance of matters geological was hampering their ability to get their work done, whether that be work with local zoning boards, dealing with well-intentioned, but regressive, legislation or sounding reasonable warnings and changing behaviors relating to natural hazards.

With leadership from the chief lobbyist (!) for the North Carolina Aggregates Association, a group of business and academic (K-16) geoscientists formed an alliance to increase the presence of earth science in the high school curriculum. The prior existence of cooperative programs among the state's universities, the presence of a strong cohort of well-trained and committed secondary school earth scientists, and some monetary resources provided by the North Carolina Aggregates Association resulted in the successful implementation of a high school earth science requirement for graduation. This, in turn, led several of us to obtain a multi-year, multi-million dollar implementation grant from the National Science Foundation (NSF) that resulted in the creation of a robust network of well-trained and creative earth science teachers across the state; significant content and curriculum development; and, in expansion of models and materials for field-based work in secondary-level courses. I believe as well that this has infused earth science into the North Carolina Department of Education in terms of curriculum and standards.