Qualifications

Dr. Stephen R. Brown

In my current position as Research Scientist at MIT my work on the geophysical properties of fractures has found particular relevance to two major projects, one concerning fractured reservoir characterization with seismic funded by Eni and the other evaluating the applicability of hybrid medical imaging technologies to borehole geophysics funded by Weatherford. In my former position at New England Research I participated in several focused research projects in collaboration with the oil and gas industry, notably Exxon-Mobil, Repsol-YPF, and my former employer Schlumberger. I was also involved in geomechanics equipment sales, laboratory installations, and technical training at overseas laboratories primarily in Russia, Saudi Arabia, and China. Also, throughout a significant part of my career I worked for Sandia National Laboratories. There I gained funding from DOE and performed research on the role of rock physics, the physics of multiphase fluid flow and transport, and near surface geophysical imaging in DOE waste site characterization and design, fractured oil and gas reservoir modeling, carbon sequestration, and geothermal reservoir modeling.

In most of my areas of interest the themes of natural geologic heterogeneity, scaling, and the coupling between fluids and deformation in heterogeneous rocks are key. I see much of my future research through fostering collaborations with others to build insight and practical solutions to problems. For example, building models to describe basin deformation and subsidence due to fluid withdrawal, must begin with a description of the intrinsic micro- and meso-scale structure of the rock, so that ultimately the spatial variability of fluid permeability and mechanical properties can be modeled. Applications must begin with data - often seismic sections combined with well bore geophysical records and drill core. These data must be interpreted and then used as constraints for populating the models. An ideal situation would be to have as collaborators those with the experience sedimentology and geomorphology allowing us to build sediment deposition simulation models based on well-understood processes. Having such information would provide a means to classify rock structures sampled in well bore data. The inferred structures could then be used in flow and transport simulations and the resulting heterogeneous distribution of pore pressures could further be used in analyses of basin deformation. Further, collaborators with expertise in geochemistry could provide links to fluid-rock interactions which are important for processes operating over long time periods and under temperature gradients.

I want to now discuss my training and experience in geosciences. This experience is one of the key benefits I have to bring to collaborations as a researcher and as a consultant. I have solid training as a geologist graduating from the University of Utah with a degree in geology and special emphasis in structural geology, geophysics, and mathematics. I worked during this time as an intern with U.S. Bureau of Reclamation geological engineers mapping soils during earth-fill dam construction and mapping fractures in water-supply tunnels in Utah. I later attended Columbia University's Lamont-Doherty Geological Observatory in the Tectonophysics program where I earned my M.A., M.Phil., and Ph.D. degrees. At Columbia, aside from further training in geophysics and structural geology, I studied solid-state physics and materials science in preparation for my research in the physics of fractured rock.

After graduating I became a post-doctoral researcher at Los Alamos National Laboratory in New Mexico where I developed an interest in and did research on fluid flow in fractured rock under the auspices of the Hot Dry Rock Geothermal Project active there at the time. After this, I worked at Schlumberger-Doll Research in Ridgefield, Connecticut, where I studied the potential of electrical geophysical well logs to infer fracture permeability. I then worked as a senior member of the technical staff at Sandia National Laboratories in Albuquerque, New Mexico for over 10 years studying many problems concerning fluid flow, geophysics, and frictional properties of fractures and faults. This included varied projects concerning such things as fracture hydrology, fault-controlled ore deposits, earthquake source mechanisms, and geophysical monitoring of subsurface fluid flow. Finally, prior to coming to MIT as a Research Scientist I worked for nearly 12 years at New England Research, a small research-oriented company in Vermont. In this capacity, I performed both basic and applied research on fluid flow and geophysics of fractured rock for problems of importance to energy resources and the environment in the near surface and upper crust.

All of this brings up two major points. First, I have broad and sustained experience in performing research executed from an academic point of view, yet at the same time I have remained closely tied to economic and engineering needs. I always strive to transfer my research findings and technology to those who can put it to practical use. Throughout my career, in parallel to my academic pursuits I have developed and maintained important collaborations and ties to applied scientists and engineers.

Secondly, I have a sustained track record of supporting my research through competitive research grants. My thesis was funded by a grant where I wrote much of the technical discussion. My post-doc was funded 100% by writing a research proposal to a competitive program at Los Alamos. More than 85% of my tenure at both Sandia National Laboratories and New England Research were funded through U.S. DOE Basic Energy Sciences, U.S. DOE Environmental Sciences, and NSF and U.S. DOE Small Business (SBIR) research grants. Most recently, over the past several years my research at MIT has been supported by the MIT Energy Initiative (MITEI). These high-risk, yet successful and productive, projects stemmed from my original ideas and were developed, proposals written, funded, and executed by myself as a key member of a small working group.

My research interests are broad. My research involves the use of principles of geology, geophysics, and physics to understand Earth's processes - specifically those involving coupling among fluid flow, rock strength, and deformation in the presence of natural geologic heterogeneities. Tectonically-active regions are of primary interest to me because of their economic importance (sites of mineral and energy resources) and since they represent regions of high human population where geologic and environmental hazards become important to understand and mitigate. Understanding various kinds of natural heterogeneity in geologic, geophysical, and physical properties is, I believe, the key to understanding natural processes and understanding our ability to observe and quantify them. As I mentioned, I try to maintain a connection in my research to economic and engineering applications. My research has typically involved some combination of numerical modeling, hands-on bench-scale laboratory experimentation, and field study.

My training and research goes beyond that of the traditional geologist. I have advanced training in applied mathematics and statistics. I have studied how rocks and minerals fit into the more general fields of solid mechanics and materials science. I also have extensive experience in the use of computers to solve theoretical and practical problems. I have brought several new ideas and inventions from prototype to product stages. Finally, I enjoy working with others and welcome collaborations with colleagues within and outside my immediate circles. I am a member of several professional societies to aid in developing professional relationships, to learn and thus broaden my interests, and to participate in the exchange of information through technical presentations and publications.