Blaise A.F. Mibeck
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Senior Scientific Investigator

Principal Areas of Expertise

X-ray Powder Diffraction (XRPD), X-ray Fluorescence (XRF), Non-ambient XRD, Quantitative Phase Analysis and Mineral ID, Optical Microscopy, Scanning Electron Microscopy and Energy Dispersive Spectroscopy (SEM-EDS), measurement and instrumentation, advanced data and image analysis, Defect Analysis, 3D data sets from FIB-SEM and Computed Tomography, Purchasing Equipment, CAD, Designing for CNC and Additive manufacturing, design and construction of scientific apparatus, microcontrollers, electronics, signal analysis, and inorganic material science.

Professional Experience

2023-present: Senior Scientific Investigator, X-ray Crystallography, Triclinic Labs, Lafayette, IN

- Subject Matter Expert for:
    - XRPD instruments, including configuring, aligning, and working with vendor representatives to troubleshoot and resolve issues
    - XRF, including sample preparation, data analysis, and interpretation
    - SEM-EDS, including sample preparation, imaging, gathering and interpreting spectra, data analysis, including advanced image and statistical analysis
    - Planned and executed variable humidity and temperature XRD experiments
- Assist scientific staff with the interpretation of XRPD, XRF, and SEM-EDS data
- Analyze and interpret data to draw conclusions and provide scientific reports and guidance to clients
- Assist with or manage complex statistical applications, machine learning for classification, and image analysis
- Maintain and improve in-house materials modeling capabilities, including implementation of computational and software systems
- Manage direct reports as needed, mentor and train junior scientists, contribute to annual profit and operating goals
- Provide timely execution of projects
- Be the critical scientific and administrative contact for clients as requested
- Develop strategic guidance on possible areas of expansion for Triclinic Labs in PXRD usage
- Oversee the production of R&D data, whitepapers, and scientific talks for BD and marketing activities as requested

2002–2023: Research Scientist, Energy & Environmental Research Center, Grand Forks, ND

In 22 years at the EERC, I have directly contributed to 33 Abstracts, 57 Articles, 51 Proposals, and 51 Final Reports. Below are some examples of projects and business opportunities I helped make successful by applying my technical expertise to various problems in collaboration with people from business, academia, and my colleagues throughout the EERC.

NMARL: In my last year, I performed or oversaw the analysis of several hundred XRD, XRF, and thin-section samples. Using Project Network Diagrams, I doubled sample throughput speed and developed methods for: 1. using SEM-EDS to detect contamination on solid-oxide fuel cells, 2. supporting the development of synthesis methods for Cerium Ultra-phosphate Proton Exchange Membranes, and 3. developing methods to characterize coal-derived graphite. During scheduled weekly sessions, I trained colleagues in X-ray Diffraction and image analysis techniquesg. I was responsible for our uninterrupted XRD and XRF capabilities. I repaired, calibrated, and aligned nearly every piece of major and minor equipment in the NMARL, including two x-ray diffractometers, an x-ray fluorescence spectrometer, a fusion pellet furnace, a computer-controlled optical polarization microscope, and an optical profiler, as well as minor equipment for sample preparation. I routinely used advanced X-ray methods such as Rietveld Structural Refinement and High-Temperature XRD to test engineered materials such as proton-exchange membranes, processes that produce graphite from coal, and other novel materials. I continue to process and analyze images and data (including data generated outside the EERC, such as x-ray computed tomography, FIBSEM, and mechanical indentation. I manage the EERC's collection of thin-section optical, electron, and x-ray images (over 10TB of digital assets). I designed and maintained a laboratory database to streamline the reporting process and became part of a center-wide initiative to standardize laboratory data storage and use. Over the last three years, I developed an image analysis workflow for characterizing porosity in unconventional reservoirs and organic-rich shale using calibrated BSE SEM images. The latest version of this workflow is written in Python and applies advanced machine-learning tools for image segmentation.

Applied Geology Laboratory: I brought in-house laboratory capabilities for characterizing geological samples to the EERC Sub-surface group, including equipment acquisition, lab space organization, and refurbishing a 400,000-lb load frame for geomechanical testing. I developed test methods for proppant strength, particle size, shape, and image segmentation of proppant with optical microscopy. I have a working knowledge of rock core analysis methods, including experience safely operating high-pressure systems for permeability and porosity and preparing raw data for reporting. I designed macros for automated labeling of microscope images for reporting. I addressed significant issues with the NMARL XRD capabilities, organized the purchase of a new XRD in 2012, and developed the in-house ability to perform quantitative phase analysis. Before I accomplished this, all XRD results were qualitative, i.e., concentrations were reported as major, minor, or trace. I designed and built a functional gas pycnometer and developed procedures for calibrating a high-end pycnometer using silicon crystal test volumes. I worked on a team to operate a custom flammable gas permeability experiment to study natural gas separation in shales. I designed procedures for collecting gas samples for analysis by Gas Chromatography. I ordered and processed data from GS and combined it with PVT data from the flowthrough apparatus to provide our team with timely visualizations for hundreds of hours of experiments. I routinely supported different laboratories throughout the EERC, building custom apparatus, suggesting design changes, and advising the selection of minor equipment and materials. I sourced the acquisition of X-ray Computed Tomography data from the NDSU EML and developed tools to correct CT artifacts in-house. I updated CCSEM methods to classify particulate-containing rare-earth elements using machine learning software. I was part of a team that developed a pressure-pulse-decay permeameter and was responsible for a detailed

theoretical understanding of the system that allowed automated data processing and instrument control.

Bench Scale Flue Gas Simulator: I characterized sorbents and catalysts for mercury oxidation and capture. I was responsible for the day-to-day operation of this laboratory, which involved maintaining, calibrating, and modifying equipment, ordering supplies, and scheduling experiments, often with visiting researchers. The five-year period during which I cared for this system was the most productive regarding samples tested (1117) and the number of citations received by published articles (294 citations of 14 papers). I directly interfaced with principal investigators and experts at the EERC, academia, government, and commercial entities and provided them with proposed experiments, technical reports, and analysis of processed data. Chemists used my contributions to model sorbents' and engineers' flue-gas/solid interactions to develop pilot and field-scale reactors.

Relationship with Marvin Windows and Doors: Small fixed-price projects grew into two large research projects and a yearly blanket purchase agreement. I led a staff of the EERC- NMARL and ARL in developing a procedure for measuring the surface concentration of chromium on painted aluminum extrusion. The results of this allowed Marvin W&D to pursue, with confidence, a legal case against their supplier. I also enlisted the cooperation of the UND Department of Electrical Engineering to characterize the microwave absorption of treated wood samples to help Marvin W&D process engineers evaluate microwave heating options. Many of the smaller projects were time-sensitive and provided Marvin scientists with mission-critical information regarding their manufacturing processes. I encouraged visits to and from Marvin W&D with my EERC colleagues to foster new ideas for future collaboration and the presentation of results.

Center for Air Toxic Metals: Early in my career at the EERC, I proposed, managed, and investigated the laser-induced fluorescence of mercury in flue gas over two years, an effort involving the planning and safe operation of a Type 3b laser. While also contributing to other CATM projects at the lab, pilot, and field scales. In cooperation with CATM and a mercury emission monitor company (Horiba), I developed/patented a method for testing continuous emission monitors for measuring mercury chloride (US Patent 7829047). CATM also funded much of my work trying carbon sorbents. I helped maintain the most extensive collection of mercury emission monitors worldwide. The highlight of my CATM work involved operating emission monitors onboard an airplane that flew through the plume of a power plant.

Aug 2011 – Jun 2012 Adjunct Lecturer (Introduction to DC and AC Electronic Circuits), University of North Dakota, Department of Technology

2002–2003: Research Instrumentation Technician, EERC, UND. My responsibilities included installing, maintaining, repairing, and operating instruments and equipment used in field-, pilot-, and bench-scale testing. I also participated in research, including assisting with test programs, adapting equipment for nonstandard applications, and developing new sampling technologies. I was often sent to power plants on short notice and was responsible for the daily maintenance and calibration of mercury continuous emission monitors.

2001–2002: NASA Space Grant Graduate Fellowship recipient. I cooperated with the EERC on behalf of the High-Altitude Balloon Group in the initial design and operation of a balloon-borne mercury detection mission. Many balloon missions reached altitudes over 100,000ft.

2000–2001: Graduate Research Assistant, Department of Space Studies, UND. I pursued improved methods for low-cost high-altitude scientific ballooning for basic research and education; designed electronics for global positioning systems (GPSs), Geiger counter, temperature/pressure sensors, microcontrollers, communication and tracking electronics, Single Board Computers, cameras, and various digital and analog devices; and performed georectification on balloon imagery via collection and use of field GPS data and GIS software.

1999–2000: Graduate Teaching Assistant, Department of Space Studies, UND. I maintained the astronomical observatory-supporting asteroid and comet Internet telescope (ACIT) operations.

1996–1999: Graduate Research Assistant, Department of Physics, UND. I designed, built, and tested a cryostat for performing in situ low-temperature x-ray diffraction (LTXRD); I determined the low-temperature structure of a thallium-based superconductor, $T1_2Ba_2CuO_{6+d}$. I regularly volunteered for education and public outreach activities as a UND Society of Physics Students member.

1991–1996: Laboratory Assistant, Department of Physics, Lake Forest College, Lake Forest, Illinois. During the school year, I assisted in research, maintained teaching equipment, and interacted with various equipment manufacturers and technical support services. In the summer, I conducted independent research projects in atomic beams,

Education
M.S., Physics, University of North Dakota, 1999.
B.A., Physics, Lake Forest College, Lake Forest, Illinois, 1996.

Software/programming languages
X-ray Crystallography: Rigaku Smart Lab II, MDI Jade, Bruker EVA and TOPAS, PDF, and COD structure databases
Languages: Python, Java, Visual Basic
Image Analysis: ImageJ, OpenCV, Sci Kit Learn, NumPy, TensorFlow, PyTorch
Data Analysis: Excel, Para View, Origin, Weka
Database: MS Access, PostgreSQL
CAD: AutoCAD and Fusion 360, Free Cad, Eagle PCB, and KiCad

Licenses/Certificates/Training
Polarized Light Microscopy, Hooke College of Applied Microscopy - 2025
ICDD Virtual XRD Clinic - 2020
Bruker Operator and Maintenance Training - 2010
UND Radiation Safety Training

Selected Publications
Google Scholar