

April 24, 2026

*A Framework for Chemical from Imaging  
Exploration,  
AI-assisted Minerals and Data-worth Analysis (ChIm  
ERA) with applications to Critical Minerals and  
Materials*

Beyer Distinguished Lecture



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*Postdoctoral Research  
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**Seminar Details**

2:30-4:00pm

*UH Campus  
Classroom & Business  
Building  
Room CBB 110*

*Online via Teams*

<https://teams.microsoft.com/meet/28672503493418?p=0CX16bX3BZZ6J5ss6O>

**ABSTRACT**

Understanding the spatial distribution of critical minerals and materials (CMMs) in subsurface environments requires the integration of complementary imaging modalities that capture both structure and chemistry. The Chemical Imaging Exploration, AI-assisted Reasoning, and Data-worth Analysis (ChImERA) framework provides a unified, modular workflow for processing, registration, fusion, and analysis of multimodal image datasets. During the talk, the capabilities of ChImERA using XCT and SEM-EDX soil datasets will be highlighted. Using these methods, the goal is to create 3D structural and chemical models of soil or rock samples, which can then be used for micromodel development, fluid-flow simulation, and upscaling to continuum-scale multiphysics models, such as PFLOTRAN. By aligning pore-scale structure, mineral chemistry, and microbial function, ChImERA would be used to improve signal-to-noise ratios, mineral-phase identification, and upscaled property estimation (e.g., average porosity, average permeability), while capturing the mineral interfaces where reactions occur. This closed-loop workflow allows models to prioritize new experiments and assimilate collected data for multi-physics models. Ultimately, ChImERA advances how imaging and modeling interact by transforming static measurements into dynamic learning systems. This accelerates CMM characterization, improves predictive understanding of mineral transport and extraction, and strengthens the scientific basis for sustainable resource recovery.

**BIOGRAPHY**

Sameera Nalin Venkat is a William R. Wiley Postdoctoral Fellow working with the Environmental Molecular Sciences Laboratory (EMSL), a national user facility at the Pacific Northwest National Laboratory (PNNL) to advance environmental and biological research. Her current research involves implementing image analysis methods to study the behavior of heterogeneous materials systems, such as soils. She completed her Integrated M.Sc in Chemical Sciences at the University of Hyderabad, followed by MS and PhD in Materials Science and Engineering from Case Western Reserve University, and a short-term postdoctoral training at the University of Central Florida. Her multidisciplinary experience spans nanomaterial synthesis, data-driven modeling to investigate degradation in solar panels, and application of AI/ML methods for understanding behavior of fluoropolymers.