A nanometer scale perspective of soil reactions and processes occurring at mineral surfaces: Implications for contaminant fate and transport and carbon cycling.

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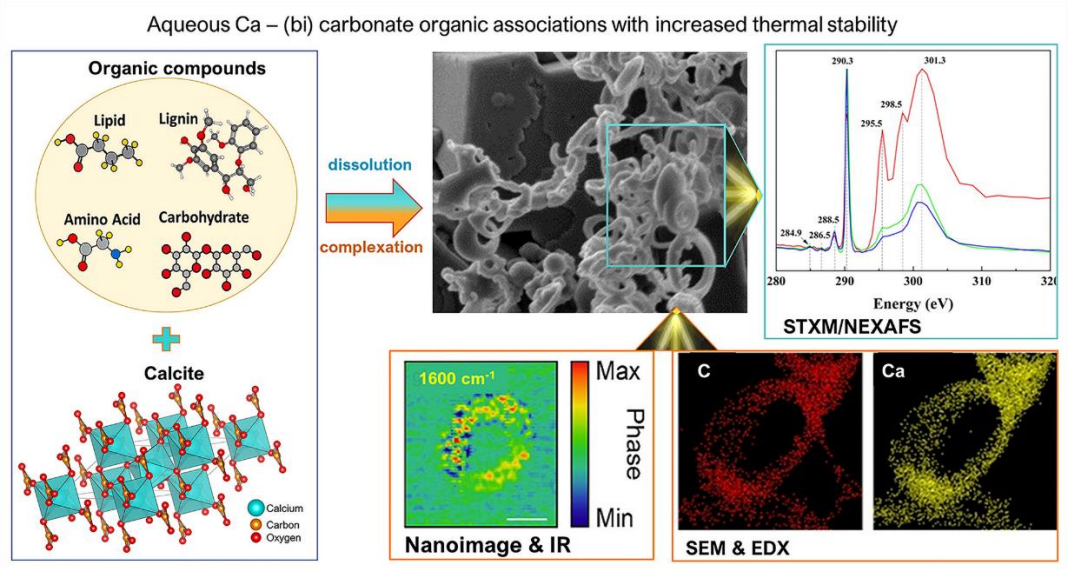
Significant advances have been made over the last years towards a better understanding of the reactions and processes occurring in soils at molecular and nanometer scales which affect and/or control contaminant interactions with minerals and organic matter transformation and persistence in soils. In this presentation, the focus will be, ***firstly***, on a paper published recently in Science about natural, incidental, and engineered nanomaterials and their impacts on the Earth system. ***Secondly***, a summary of recent publications on the role of soil minerals in controlling contaminant mobility (e.g., nano Fe oxides and calcium carbonate), which serve as hosts for different contaminants, will be presented. Iodine, chromium, and uranium are three contaminants of concern at the Hanford site in southeastern Washington (USA) and are part of the clean-up effort of the legacy waste at the site. Geochemically aided remediation by chemically trapping of iodine, chromium, and/or uranium in naturally occurring mineral lattices can help expedite and reduce costs involved in the cleanup and may be a reliable method for similar remediation efforts across the globe. ***Thirdly,*** the presentation will be focused on soil organic matter nano-scale interactions with minerals. With approximately 80% of Earth's terrestrial carbon being stored in soil, this carbon pool contributes significantly to the global scale carbon cycle. Soil organic matter can associate strongly with high surface area minerals, providing a mechanism for aggregation and organic matter stabilization. The presentation will summarize findings included in recent publications, which systematically probed physical, chemical, and molecular-level and nano-scale interactions at the organo-mineral interface, to directly quantify these interactions at the nanometer length scale and provide parameters for models to better predict the role of soil organic matter on the carbon global cycle. Data will be also presented on in-situ observations of soil mineral particles as they form aggregates in the presence and/or absence of organic matter using liquid cell transmission electron microscopy.



Taken from Qafoku et al., 2023 Environmental Science: Nano 10 (5), 1504-1517.