# Creating python tools to process spectral induced polarization data for contaminant monitoring and subsurface characterization

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Project Background

SIP is being used for contaminant monitoring and subsurface characterization. It is the only geophysical method sensitive to biogeochemical parameters. The project that I worked on was linked to studying soil organic matter (SOM) complexation, and the potential applications of SIP in monitoring these processes.
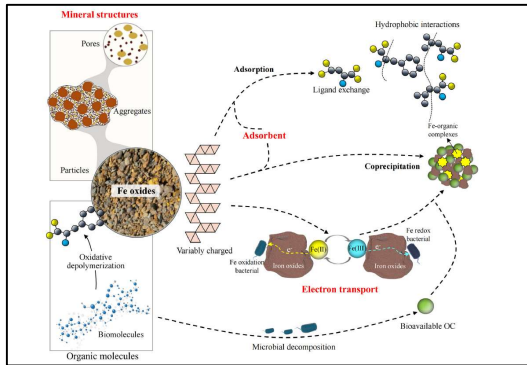
Li et al. 2023)

SOM plays a vital role in maintaining soil health and ecosystem sustainability:

- Acts as a reservoir for essential nutrients
- Increases the diversity of microorganisms used to degrade organic pollutants
- Aids in pesticide absorption
- Helps organo-mineral complexation, which acts as a carbon sink for atmospheric CO_2
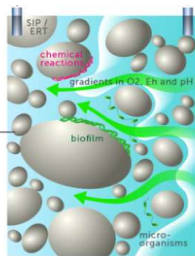
© ENIGMA: European training network for in-situ imagine of dynamic processes in heterogeneous subsurface environments

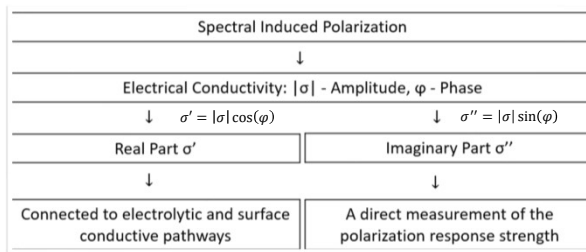## Spectral induced polarization (SIP)

SIP is a geophysical technique that measures the polarization response of subsurface material over a frequency range when an external electric field is applied.
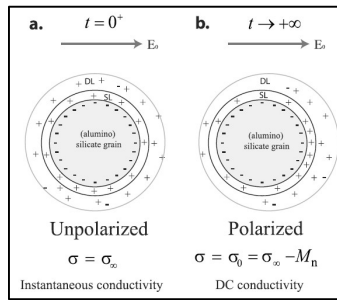
Polarization of the Electric Double Layer (EDL) surrounding mineral grains

(Coperey et al. (2019)
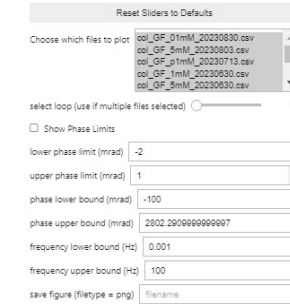
Relationship to physical properties

The SIP measurement consists of a spectra across frequencies of complex electrical conductivity $|\sigma|$ and phase angle φ, which is the phase lag between the transmitted and received current signal.

SIP Data Examiner

PNNL staff required an interactive way to efficiently examine data produced in laboratory experiments.

Jupyter notebook widgets allow the user to load one or more datasets a single time, then manipulate plots according to multiple defined criteria.

Single dataset with showing repeatability

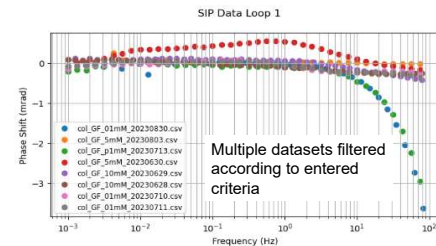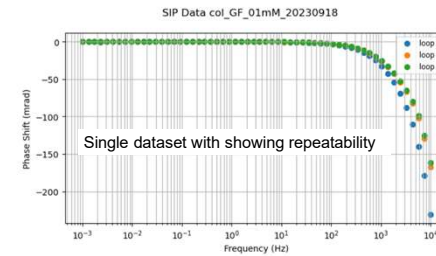Multiple datasets filtered according to entered criteria

References
Coperey, A., A. Revil, F. Abdulsamad, B. Stutz, P. A. Duvillard and L. Ravanel (2019). "Low-Frequency Induced Polarization of Porous Media Undergoing Freezing: Preliminary Observations and Modeling." Journal of Geophysical Research: Solid Earth **124**(5): 4523-4544.
Li, Q., W. Hu, L. Li and Y. Li (2023). "Interactions between organic matter and Fe oxides at soil micro-interfaces: Quantification, associations, and influencing factors." Sci Total Environ 855: 158710.

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