

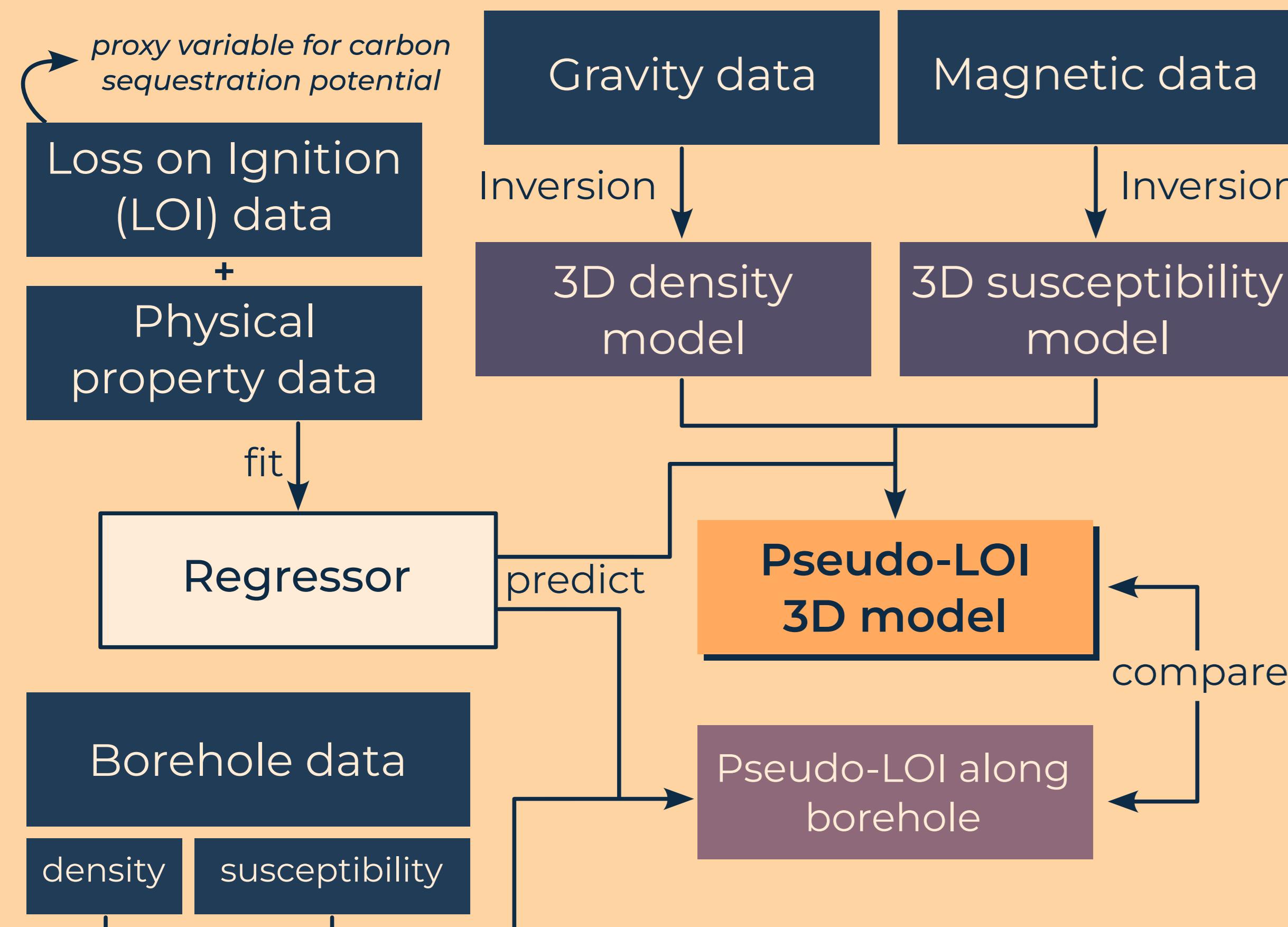
3D geophysical inversions to characterize carbon sequestration potential of ultramafic rocks

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Goals

- Apply geophysical inversions to estimate the carbon sequestration potential of buried altered ultramafic rocks.
- Generate a workflow that can be applied to other areas of interest.

Workflow

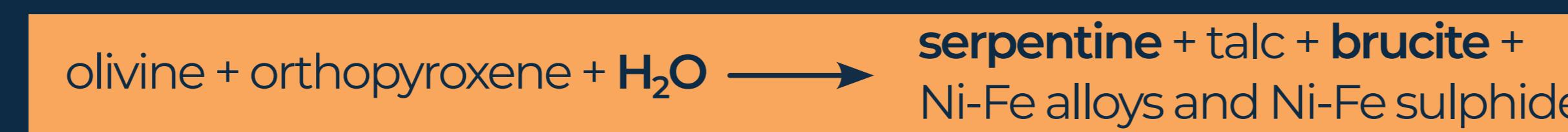


Conclusions

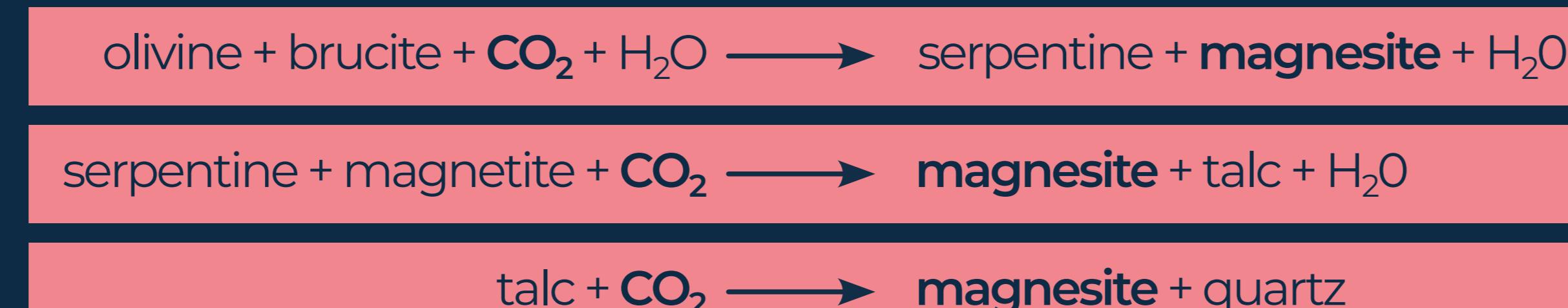
- Applied geophysical inversions to gravity and magnetic data over ultramafic complex in Timmins, ON, Canada.
- Estimated carbon sequestration potential from the inverted models.
- Compared estimations with borehole samples.
- Geophysical inversions are a valuable technique to characterize carbon sequestration potential of buried ultramafic rocks.

CO₂ sequestration in ultramafic rocks

Serpentinization:

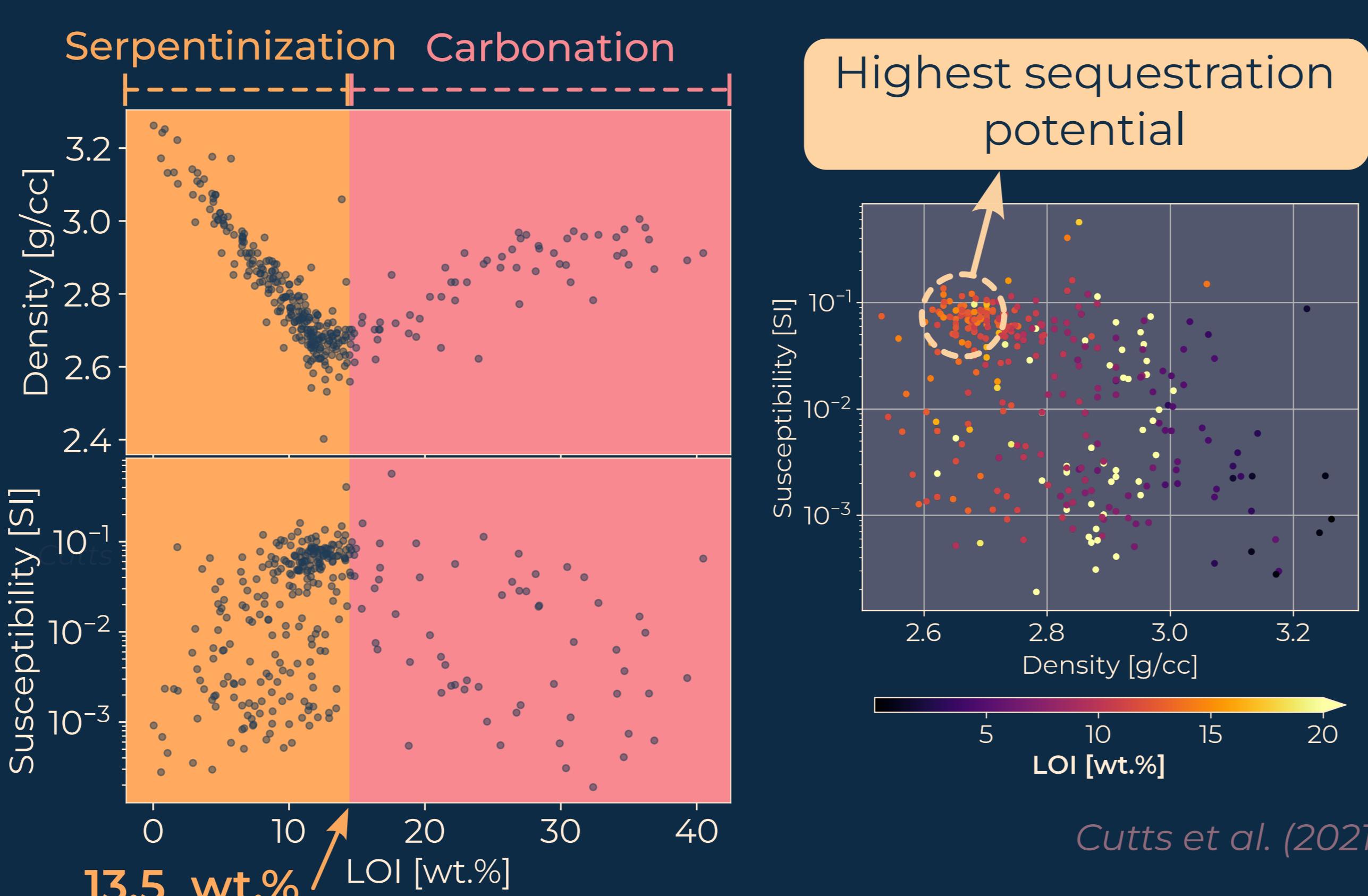


Carbonation:



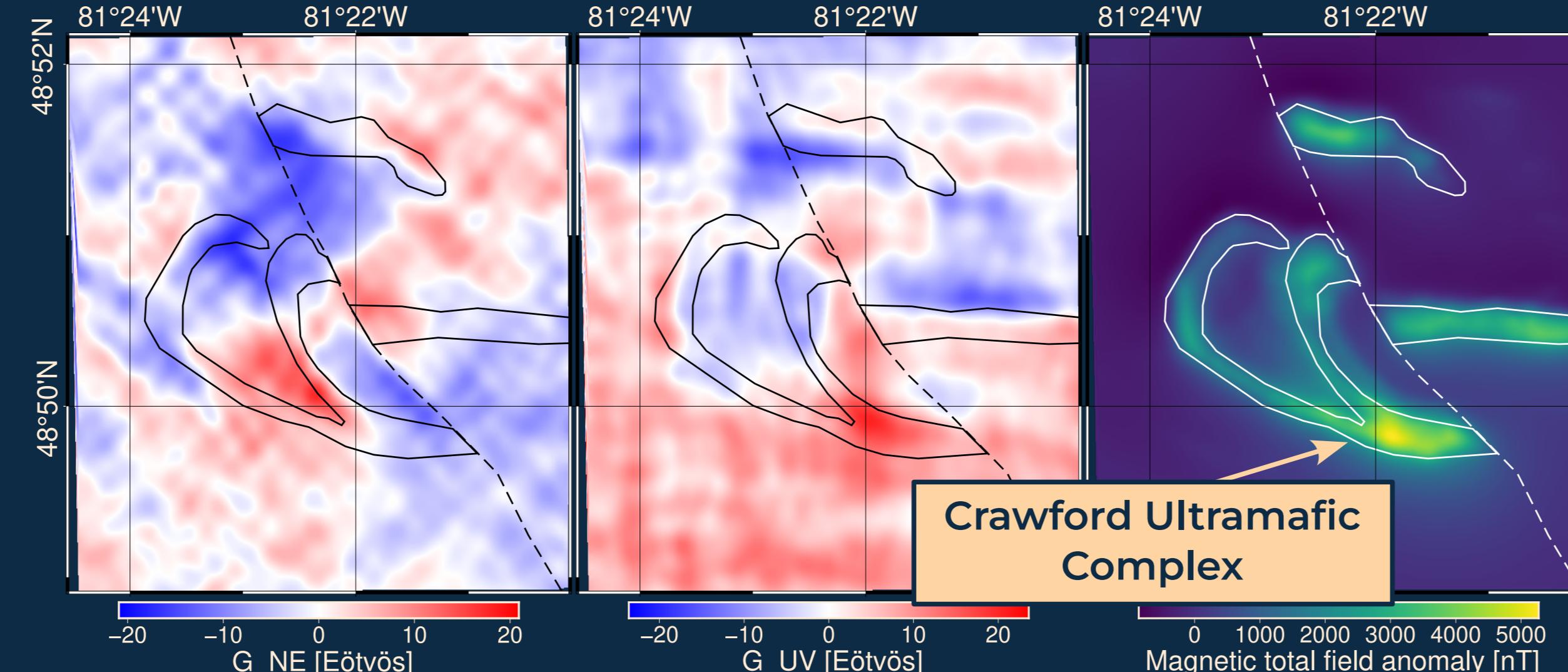
Physical Properties

- Loss on Ignition (LOI) as a proxy variable for level of alteration.
- Density and magnetic susceptibility vary with LOI.
- Highest sequestration potential at LOI of 13.5 wt.%.



Geophysical Inversions

- Airborne gravity gradiometry and magnetic data.

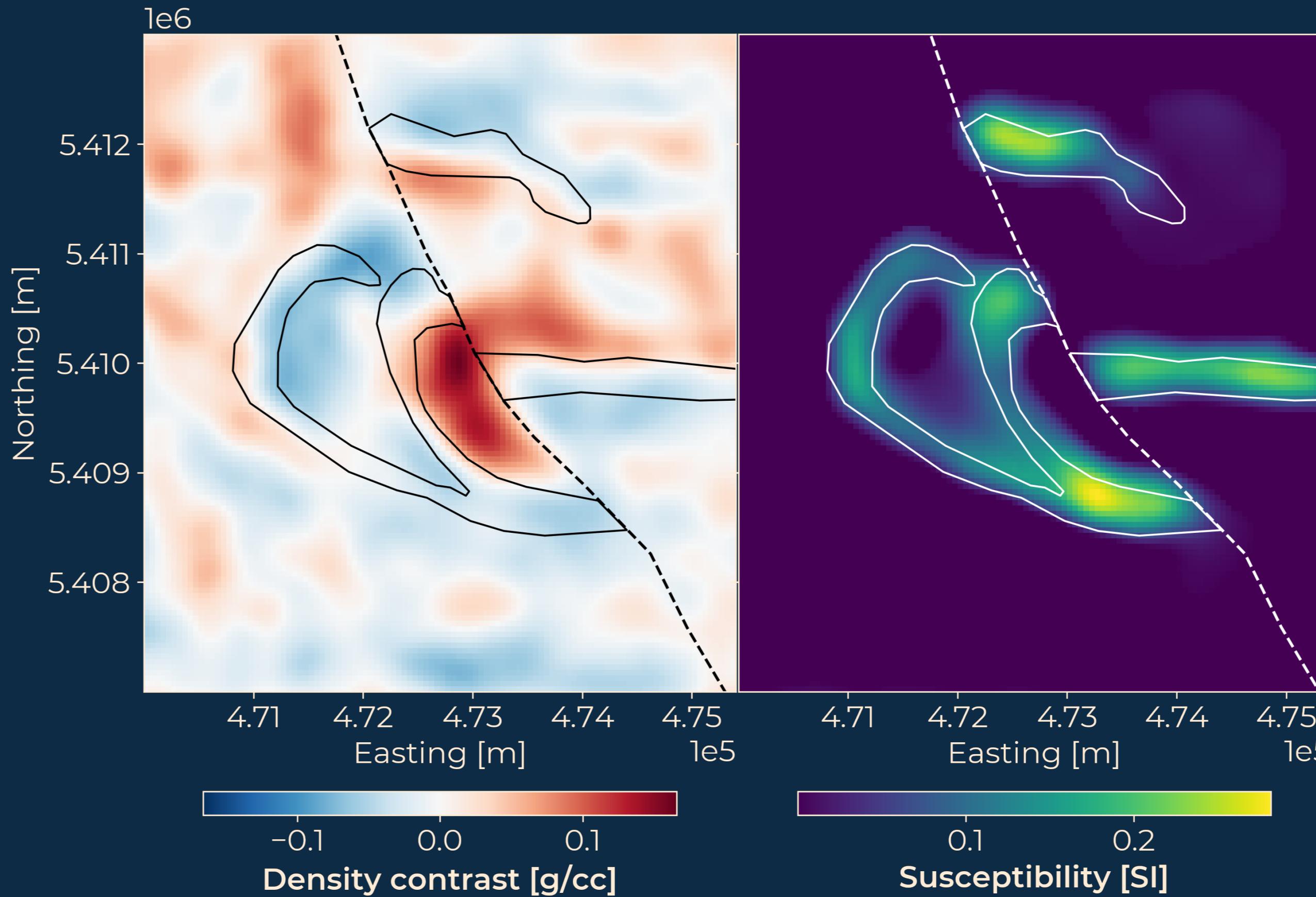


- Independent inversions of gravity gradiometry and magnetic data with SimPEG.

$$\min_{\mathbf{m}} \phi(\mathbf{m}) = \underbrace{\phi_d(\mathbf{m})}_{\text{data misfit}} + \underbrace{\beta \phi_m(\mathbf{m})}_{\text{regularization}}$$

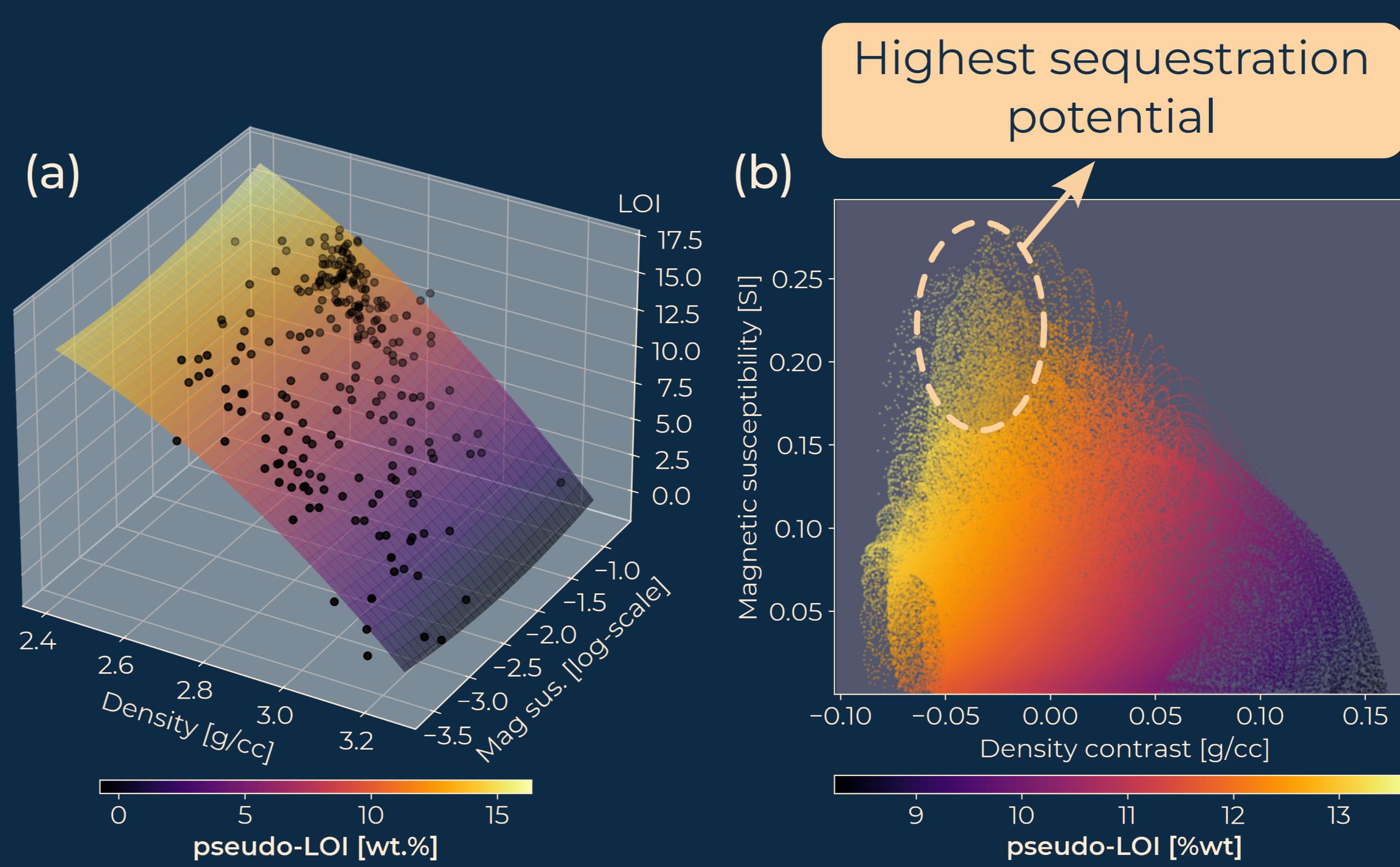


- Recovered models (slices at 12.5m of elevation):



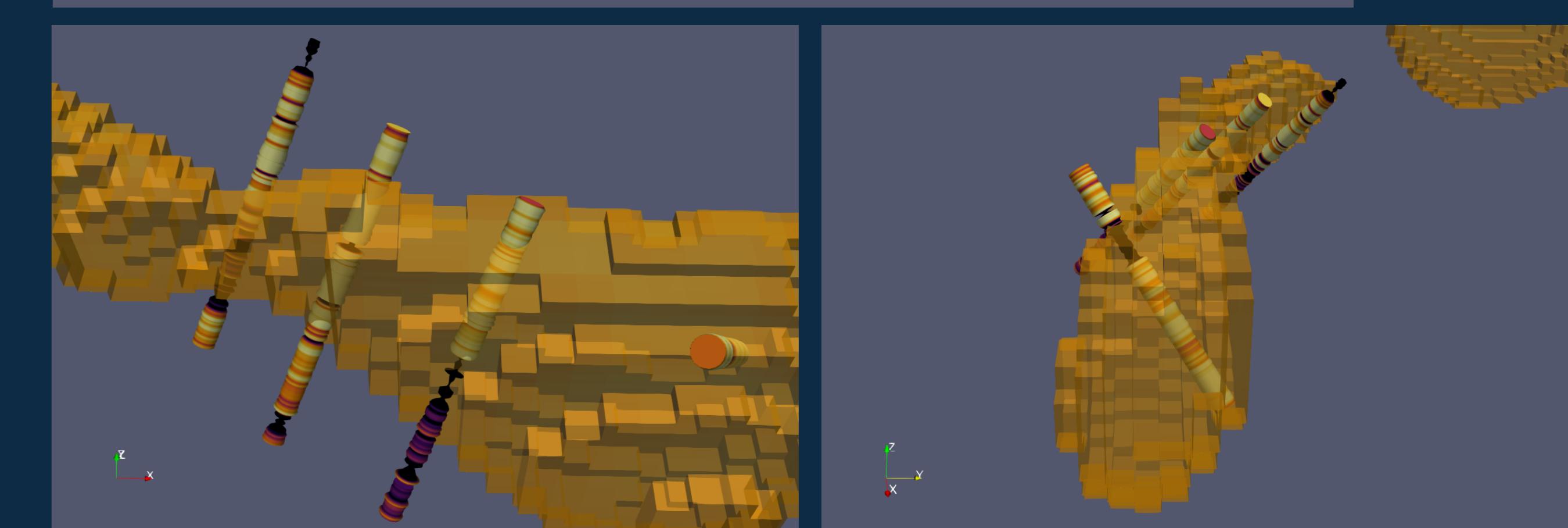
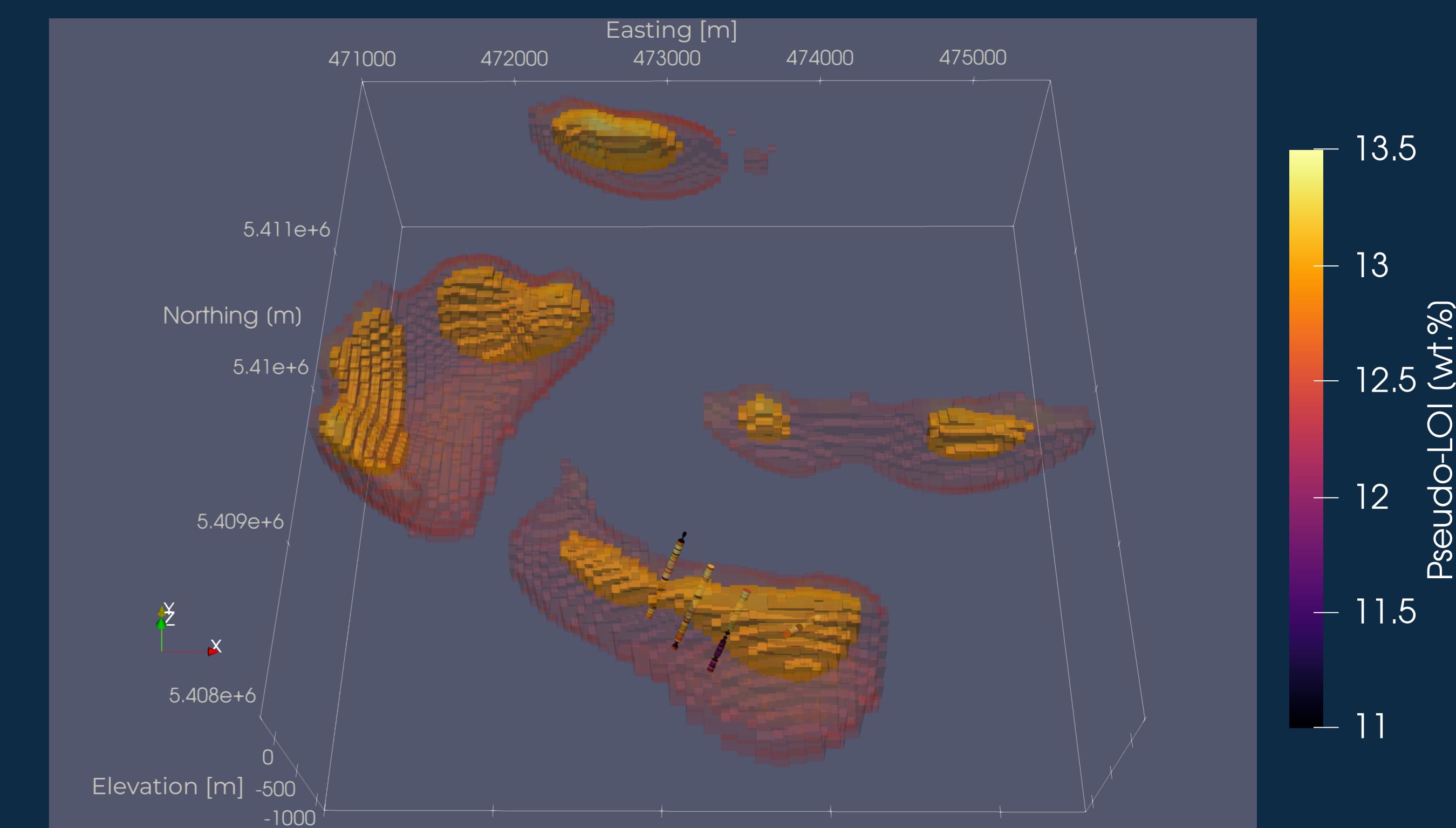
Estimating carbon sequestration potential

- Fit a polynomial regressor on LOI data from Cutts et al. (2021) (Figure a).
- Used the regressor to predict pseudo-LOI values from inverted models of density and magnetic susceptibility (Figure b).



3D Representation and Comparison with Borehole data

- Pseudo-LOI values close to 13.5 wt.% are interpreted as rocks with high sequestration potential.
- Borehole data measurements of density and magnetic susceptibility.
- Used the regressor to predict pseudo-LOI values from borehole data, to compare estimated pseudo-LOI from inversion results.
- Good agreement between estimated sequestration potential and borehole data.



References

- Cockett et al. (2015), doi: 10.1016/j.cageo.2015.09.015
- Cutts et al. (2021), doi: 10.1029/2021GC009989
- Mitchinson et al. (2020), ISBN: 978-0-88865-470-0