Using Metal Ion Concentrations to Fingerprint Soil Parent

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Objective of this study

- Examine the efficacy of using relative Ca, Mg, Cr, and Ni concentrations as a fingerprint in order to identify ultramafic parent material.

The Problem

- Large scale soil mapping provides only a general overview of possible soil characteristics.
- Vast implications of the hazards associated with soils of ultramafic parent material.
- A need for a rapid and accurate method to determine the presence of ultramafic material.

Significance of Ultramafic Parent Material

- Elevated concentrations of Fe, Mg, Cr, Co and Ni.
- Low levels of N, P and K
- Low Ca:Mg ratio
- Sandy, homogenous, shallow soils; due to low Al contents (Oze et al., 2008)
- Hindered plant crop quality.
- Metal toxicity in plant

Methodology

Soil and vine tissue samples were collected across several vineyard planting blocks in **Edna Valley, California** and digested via **US EPA Method 3050B** and analyzed via ICP-OES.

Soil and vine tissue was digested via U.S. EPA Method 3050B: Acid Digestion of Soils, Sediments and Sludge.

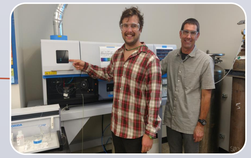


Fig. 1: Photo of collaborators at study site, Tolosa Winery and Vineyards, Edna Valley, CA.

Results and Discussion

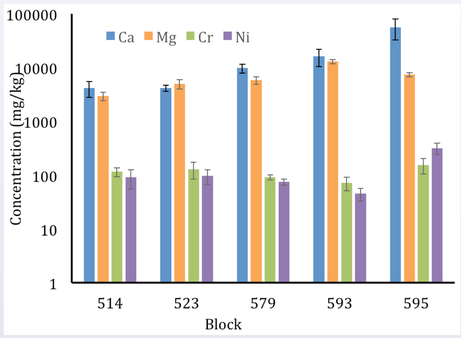
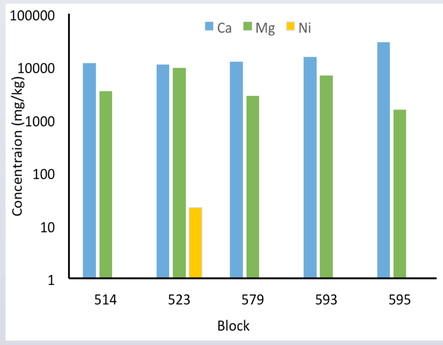


Fig. 2. Histogram of total soil Cr, Ni, Ca and Mg concentrations at each collection site, n=10.

A typical soil has a Ni concentration of 19 mg/kg, and Cr concentration of 54 mg/kg.

All soil blocks showed Ni and Cr levels higher than those values (Alexander et al., 2007).

Fig. 3. Histogram of total vine tissue Cr, Ni, Ca and Mg concentrations at each collection site, n=1.



Block 523 had significant Ni uptake.

In Ca deficient serpentine soils, plants tend to hyper accumulate Ni due to the deficit of necessary divalent macronutrients, i.e. Ca (Chaney 2008).

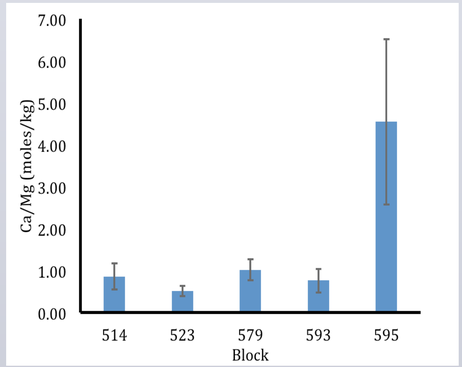
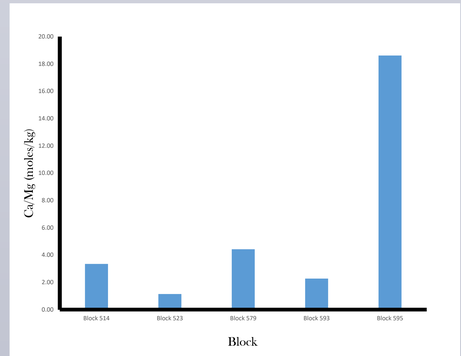


Fig. 4. Histogram of soil Ca/Mg ratios at each collection site, n=10.

A common Ca/Mg ratio for serpentinitic soils is 0.0-0.7, with a ratio of higher than 0.7 needed for agricultural productivity (McGahan et al., 2008; Salihaj et al., 2016).

Block 523 was below the 0.7 threshold.

Fig. 5. Histogram of vine tissue Ca/Mg ratios, n=10.



Figs. 4 and 5 indicated a correlation between soil and vine tissue Ca/Mg ratios.

Low (< 1) Ca/Mg ratios in soils and vine tissue were indicators of ultramafic parent materials.

Discussion

Table 1. Comparison of mapped parent materials (USDA data) and suspected parent materials based on our findings for each planting block.

Planting Block	*Parent Rock† (USDA data).*	*Suspected Parent Material (based on our findings)*	*Clay† (%)*
514	alluvium (shale, sandstone, mudstone)	mixed sedimentary, trace ultramafic	45
523	alluvium (sandstone)	predominately ultramafic alluvium	15
579	sandstone	mixed sedimentary, sandstone	5
593	shale and sandstone/ Igneous	mixed sedimentary, trace ultramafic	45 -47.5
595	sandstone	marine sediments	50

Edna Valley is composed of **alluvium** with **mixed** parent material. We suspect ultramafic materials in **Blocks 514, 523, and 593** based on our chemical data (Figs. 2-5).

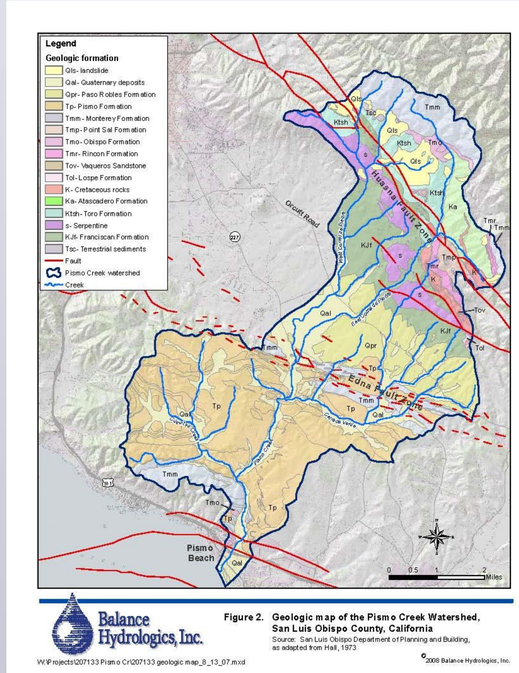


Fig. 6. Geologic map of soil sampling region. Map shows Edna Fault and Huasna Fault, which contribute to presence of serpentinite in Edna Valley, CA.

Acknowledgements

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