Spatial distribution and accumulation of nickel in serpentinite soil horizons

http://www.sonoma.edu/geology/wright/serp.html

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Outline

- Background Information
- The Big Question
- Current Research
- Methods
- Results
- Future Research

Background Information

- Name is self explanatory: very “snakelike”, green, narrow bands
- Rock has oily feel, very brittle, flaky
- Significant levels of nickel and chromium
- Soil and vegetation very distinct
- Serpentinite occurs in bands along the western Sierra Nevada mountains of California

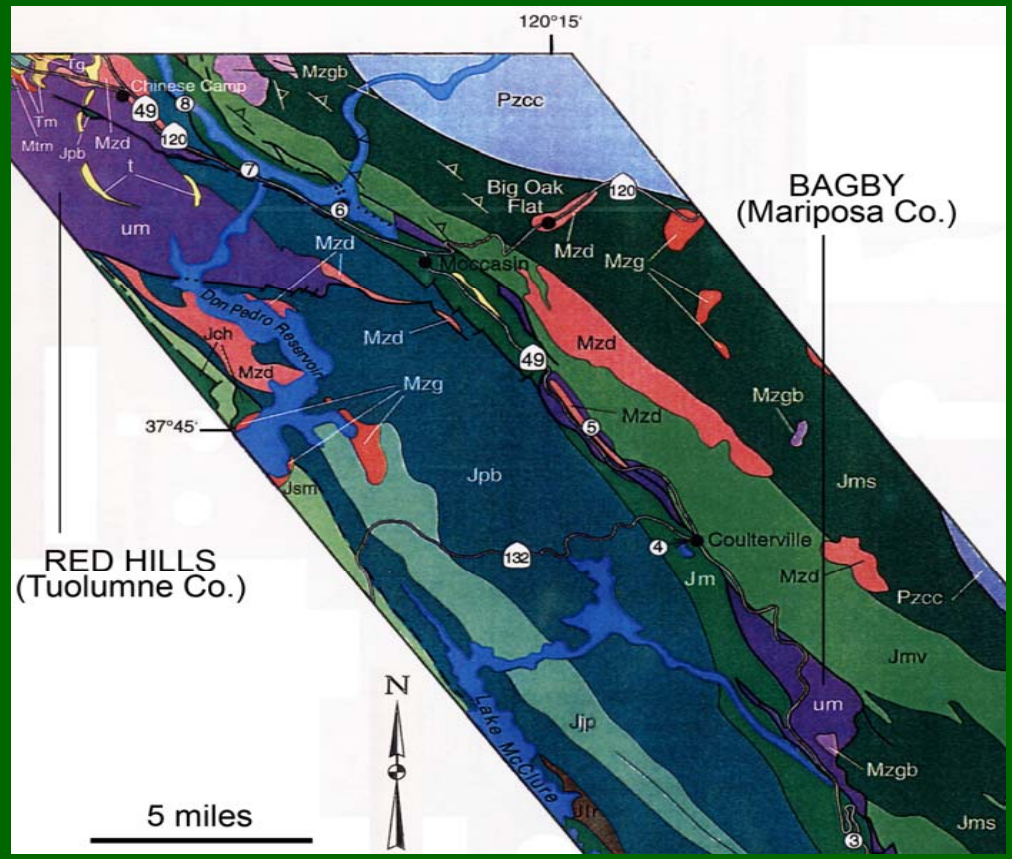

Figure 1: Location of the Red Hills (RHMA) and Bagby sites on the geological map of the Sierra Nevada foothills. Thick black lines are faults.

Background Information Cont.

- Galicia, Spain
  - Serpentinite Regions
    - More weathered
    - Agriculture
    - Annual crop burning
  - Nickel showing up in mother's milk
  - Possible carcinogen

http://www.bsactravelclub.co.uk/reports/pics/spain/spainmap.jpg

The Big Question

What is the nickel accumulation and distribution in the RHMA and Bagby sites?

- Nickel accumulation in soil is linked to potential bioavailability.

Field Work

- Conducted at two sites, RHMA and Bagby
- Field tests were conducted to collect samples of rock, soil, water and vegetation
- Soil was collected at multiple depths when possible, to examine nickel distribution at different depths
- Rocks were collected to test nickel content
- Water was collected from nearby stream to test the nickel content
- Vegetation was collected to examine if the plants were absorbing the nickel from the soil
  - Collected endemic species and known nickel hyperaccumulator, Streptanthus polygaloides

Figure 2: *Streptanthus polygaloides* photographed on 3/15/07 (left) and 5/30/07 (right) on a rocky area of the Bagby site. March individual is 90 cm tall, and late May individual is 13 cm tall.

Methods

- All samples were size-sieved.
- All samples were digested
  - Aqua regia
    - 3:1 HCl to HNO_3
  - Microwave
- Digested samples were run on ICP-MS to analyze total metal concentration

http://www.udg.edu/ServeisTecnicsdeRecerca/Tecniquesiserveis/AnalisiQuimica/ICPMS/tabid/3042/Default.aspx

Soil Results

- RHMA had elevated nickel content in soil, compared to non-serpentine sample.
- Nickel content higher in the low-lying areas with more soil development
- Not much variability in nickel content between depths
  - Preliminary data

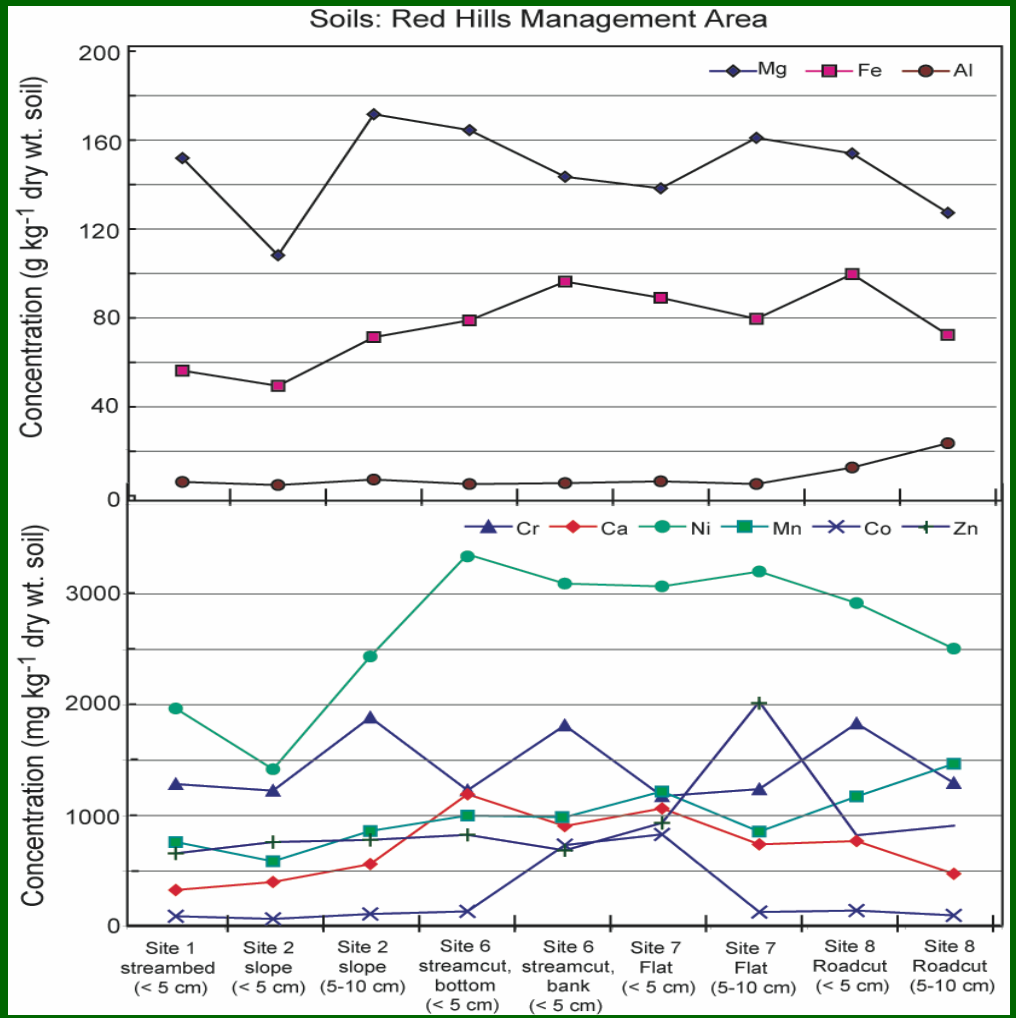

Figure 3: Major and trace element concentrations in soil samples from the RHMA.

Plant Results

- Most species of plants collected did not show an accumulation of nickel
- *Lupinus spectabilis*, not known for nickel hyperaccumulation, showed elevated nickel content
- Known hyperaccumulator, *Streptanthus polygaloides*, showed significant nickel accumulation

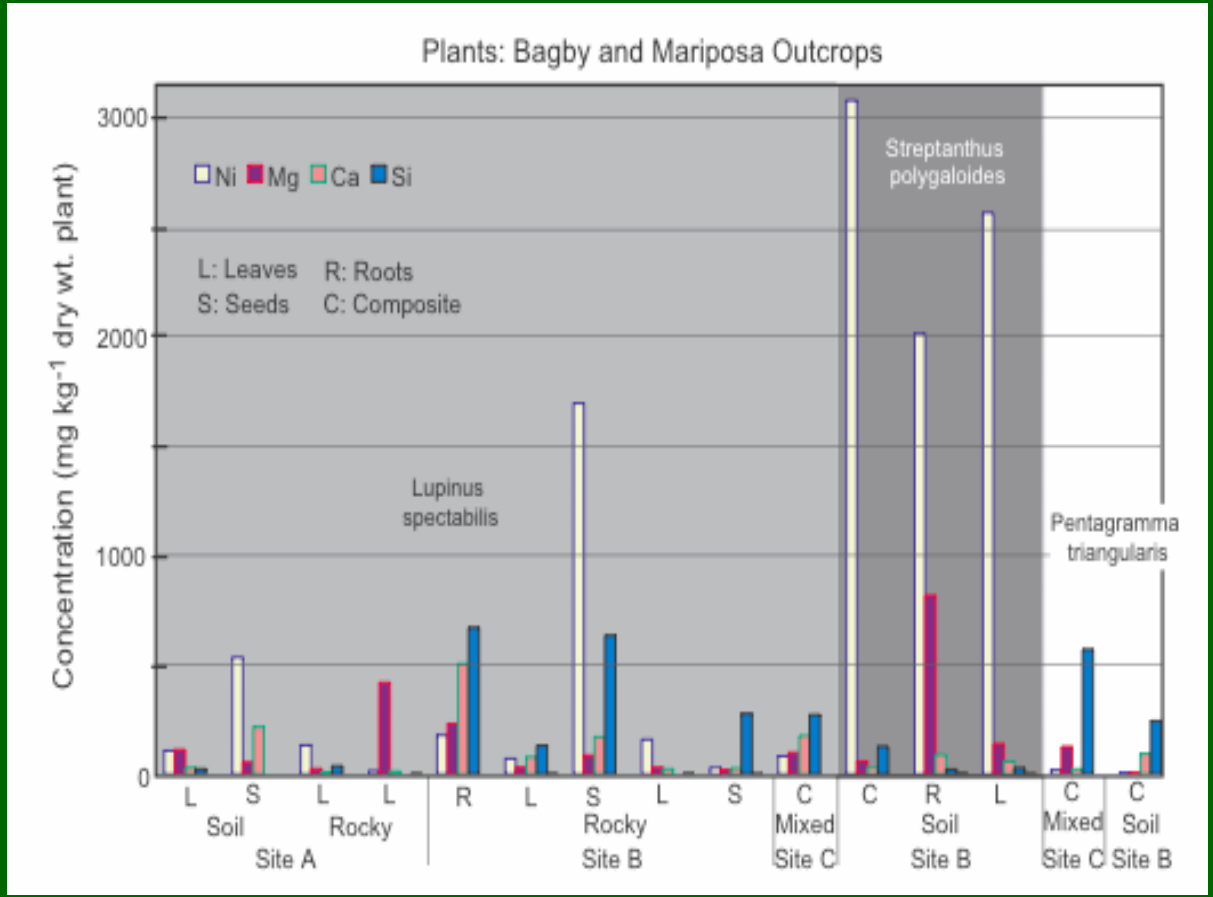

Figure 4: Trace element concentrations in root and shoot parts of three plant species from the Bagby Site (Site B), as well as two other nearby outcrops along Highway 49 (sites A and C).

Future Research

- Characterize and compare changes in plant community, soil properties, bioavailable elements, and element uptake by plants during the spring (February-June) change from wet to dry conditions (a) between RHMA and Bagby sites, and (b) between rocky sites and those with soil development within each site.
- Investigate the response of the plant community during a spring flowering season to changes in water availability and addition of black carbon using field experimental plots.

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