

Nitrogen Budget of the Earth's Upper Mantle

Hunter Garcia

Advisor: Ananya Mallik

Background

- ◇ Estimate present-day nitrogen abundance in the Earth's upper mantle using San Carlos peridotites as representative samples.
- ◇ Understand fundamental questions such as habitability and paleoclimate
- ◇ Estimate Earth's nitrogen budget

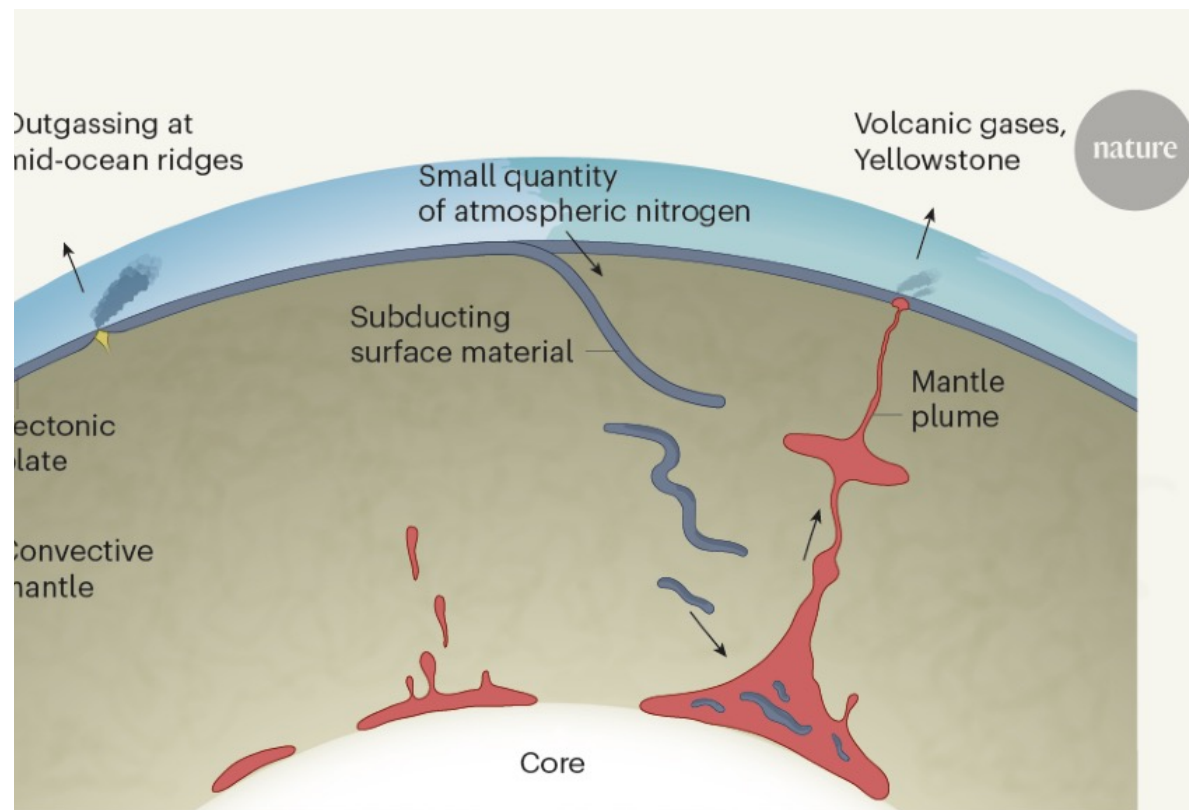


Figure 1. How Nitrogen from the atmosphere and crust gets to the mantle. "Nitrogen variations in the mantle might have survived since Earth's formation" Rita Parai

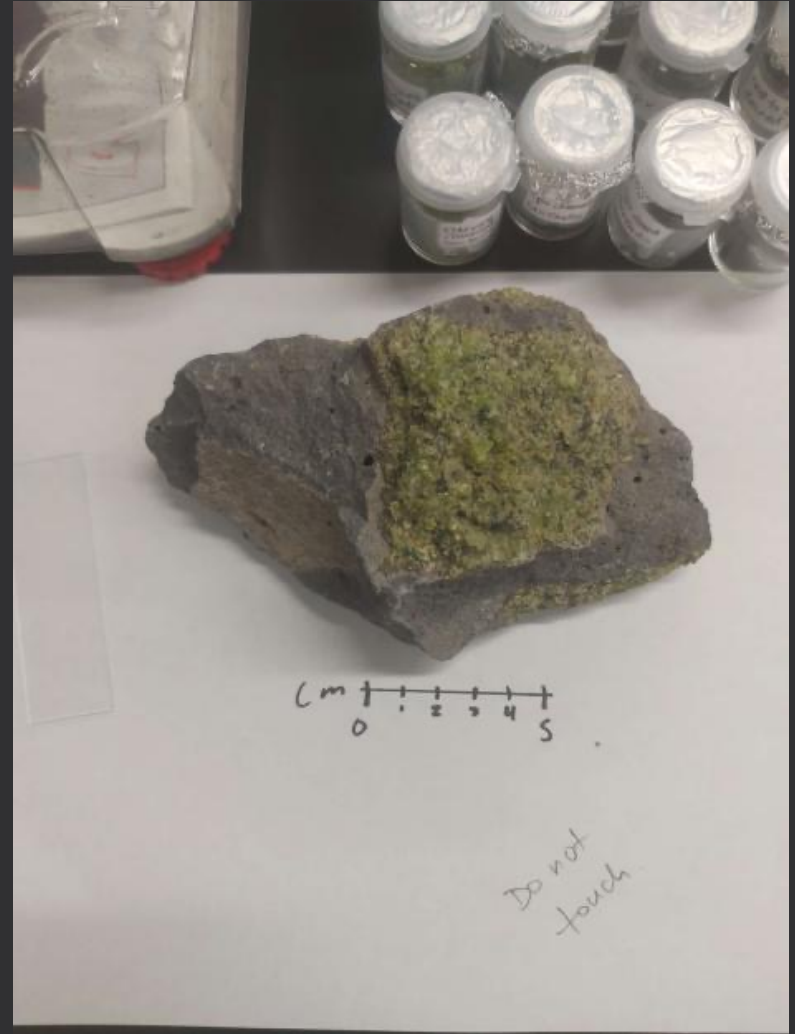
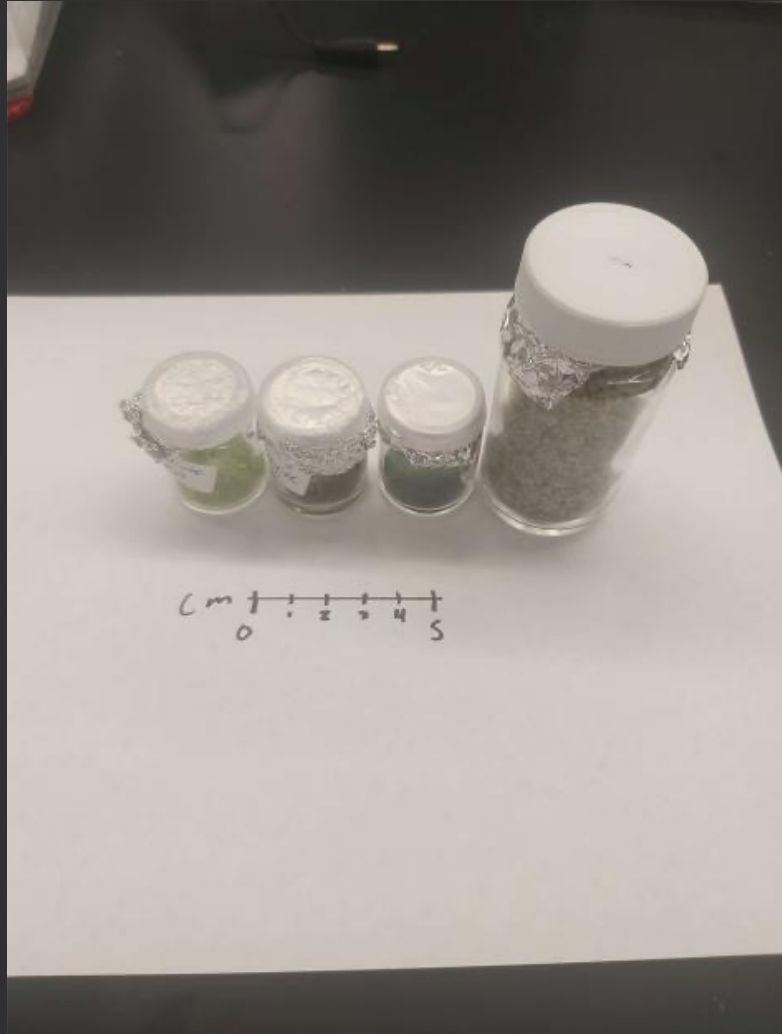
Nitrogen in the Earth



Most work on Nitrogen has been on the surface/near-surface which is likely $<1\%$ of total nitrogen.

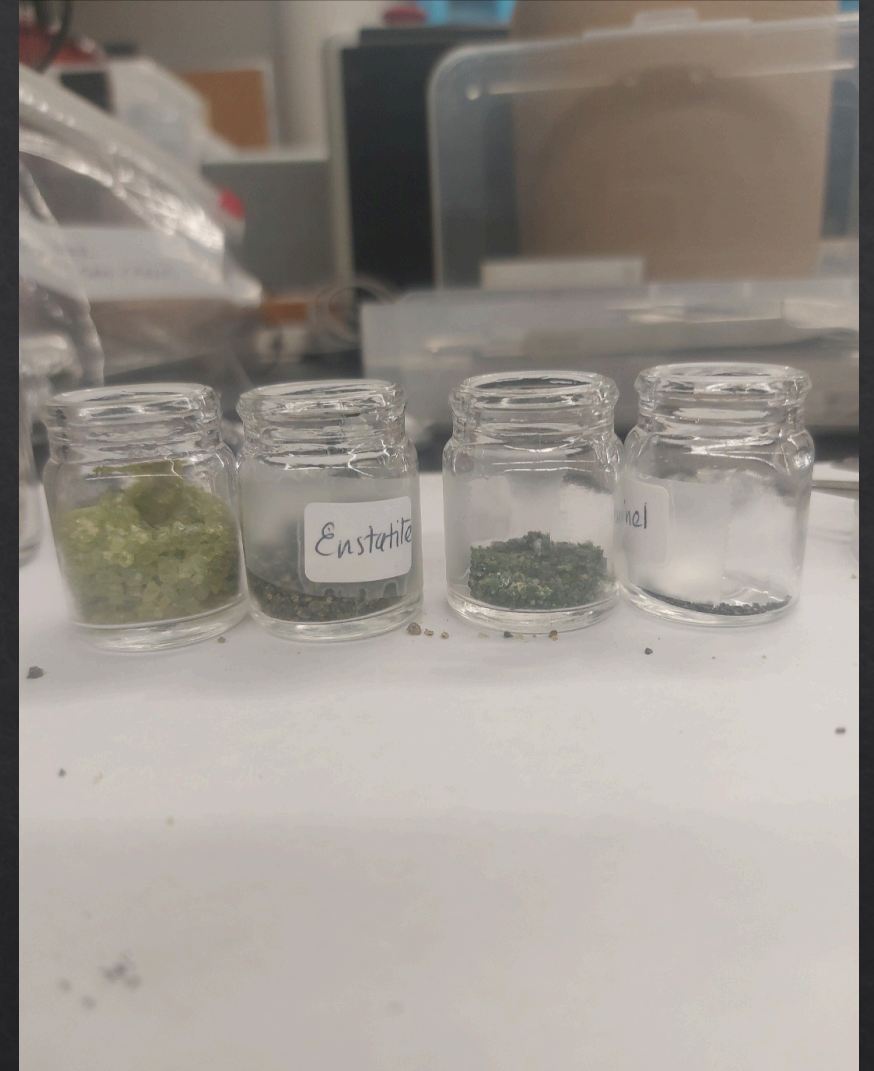


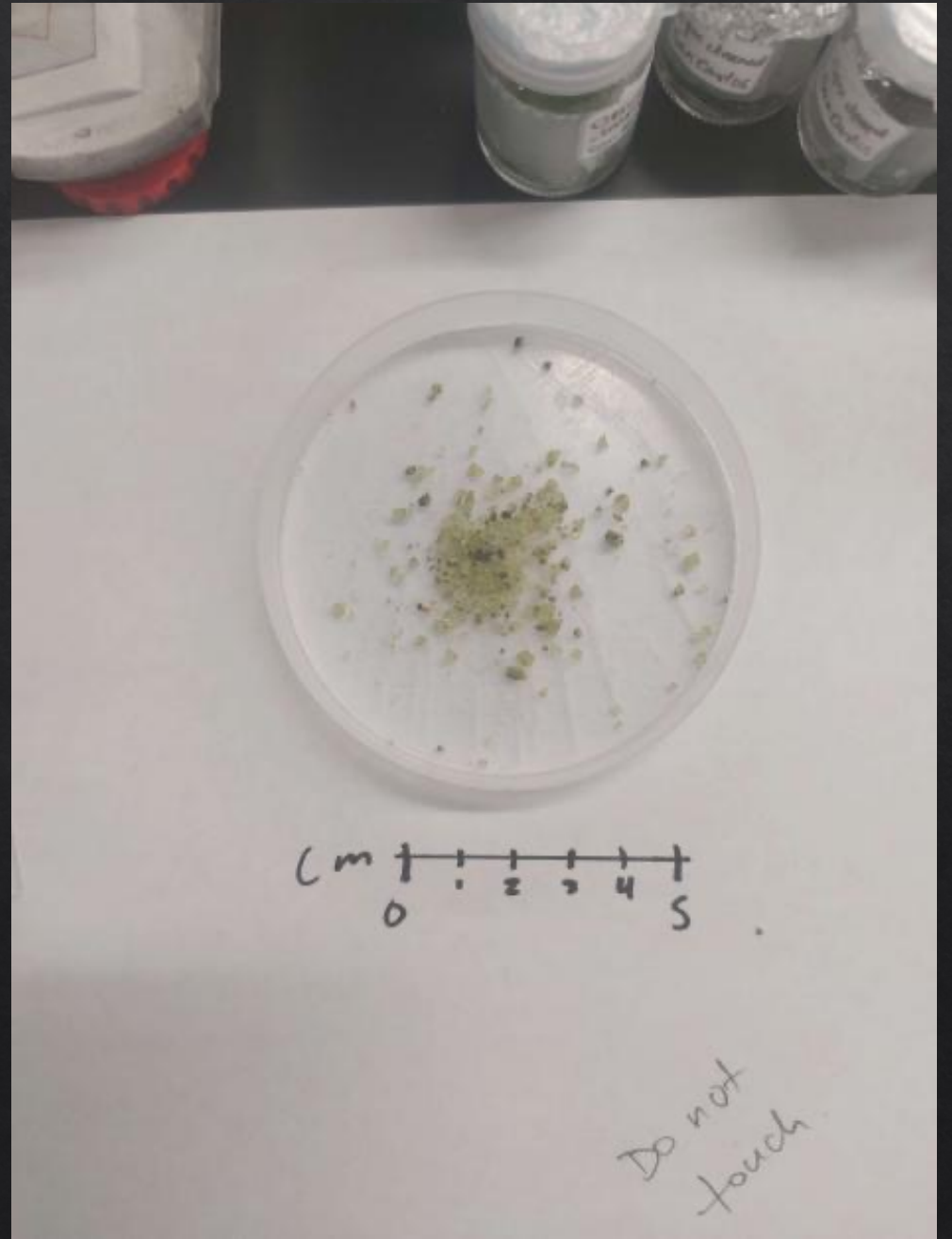
Earth's atmosphere may have been more concentrated in nitrogen gas billions of years ago.



Methods

- ◆ Collection of the 4 minerals involved smashing the San Carlos peridotites with a hammer.
- ◆ Collect the peridotites, separate them by species and scrape off any contamination.





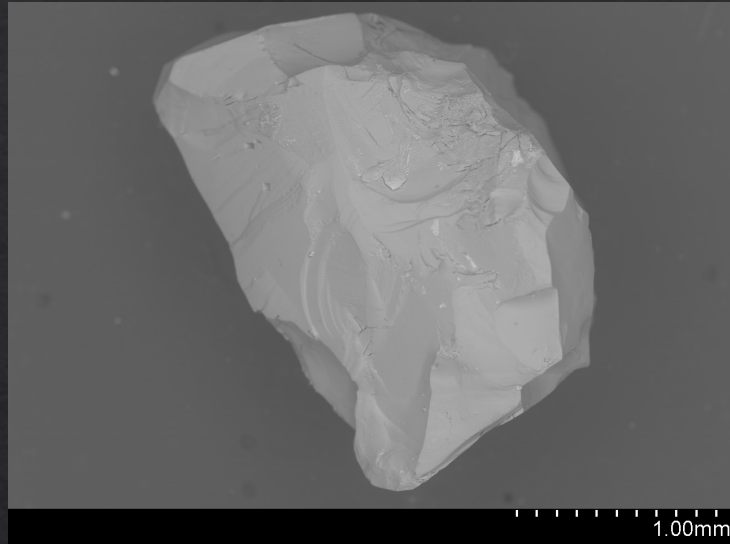
Methods continued

- ◊ Wash the minerals in 1-part tap water, 1-part hydrochloric acid (37%) on a hot plate for 45 minutes at ~180 degrees C.
- ◊ Soak in deionized water for 45 minutes at ~200 degrees C twice.
- ◊ Place on glass petri-dish/glass vial in oven to dry off for 10-25 minutes.

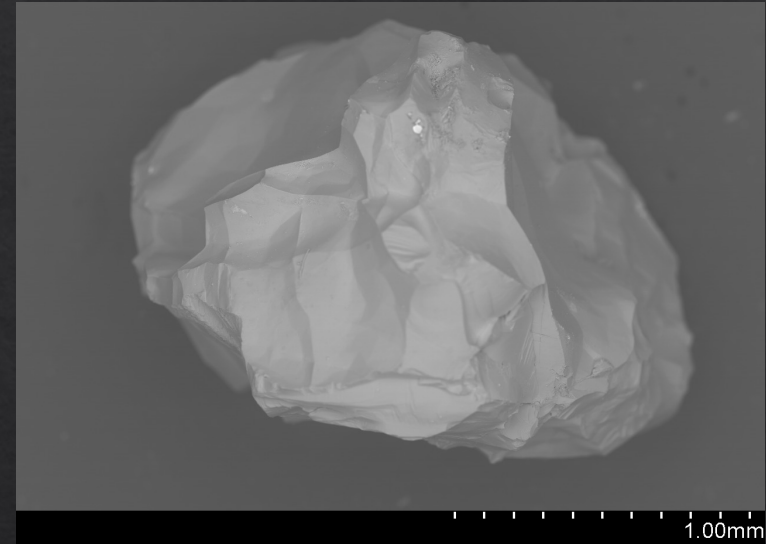


Secondary Electron images

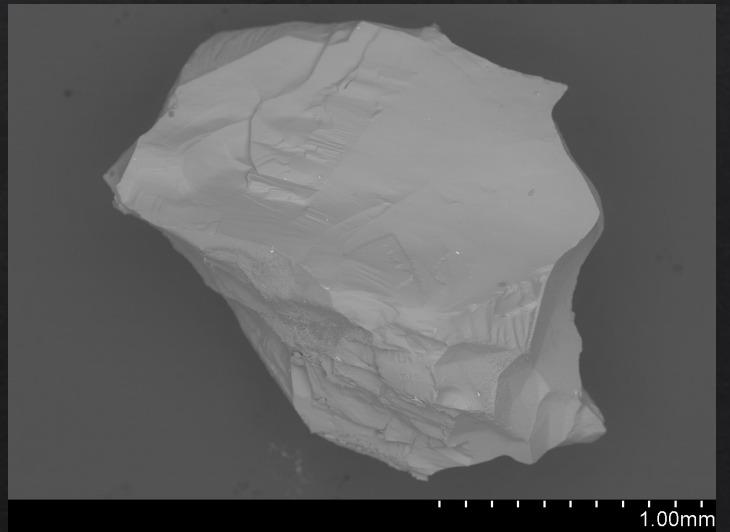
Olivine



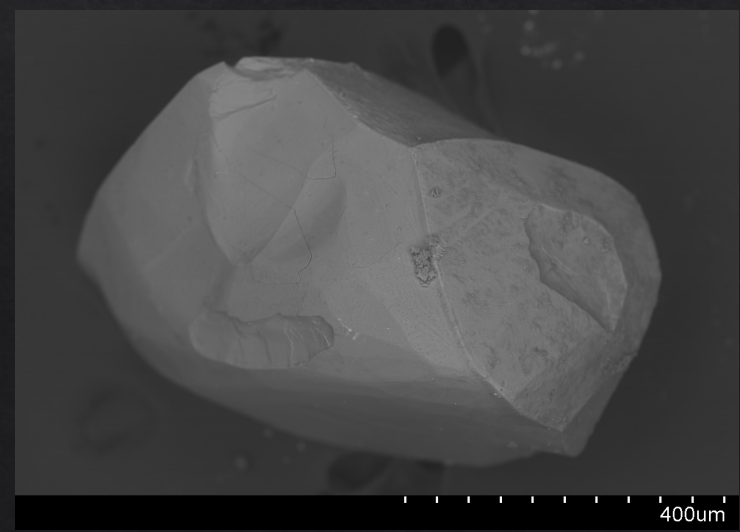
Enstatite



Cpx

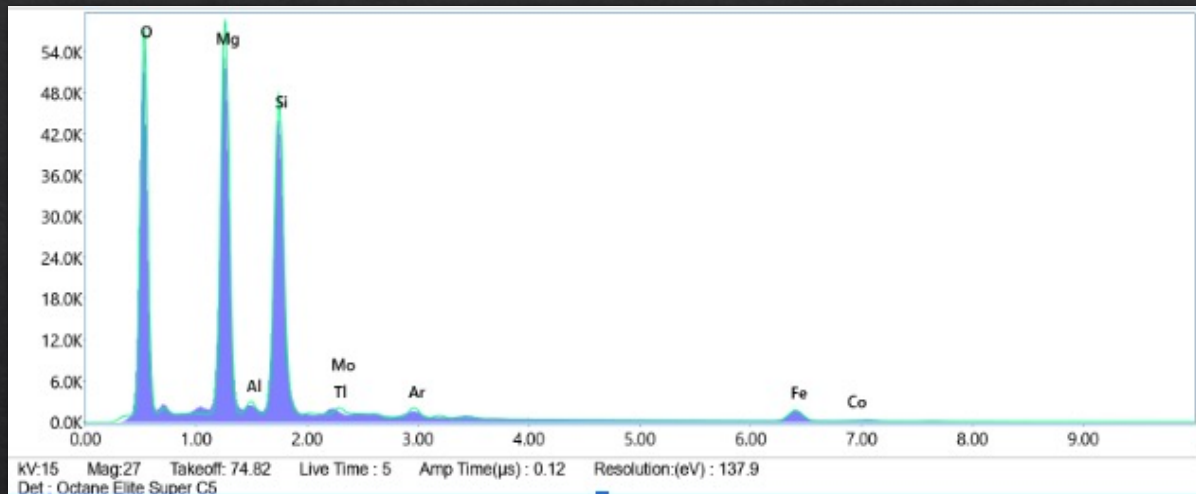


Spinel

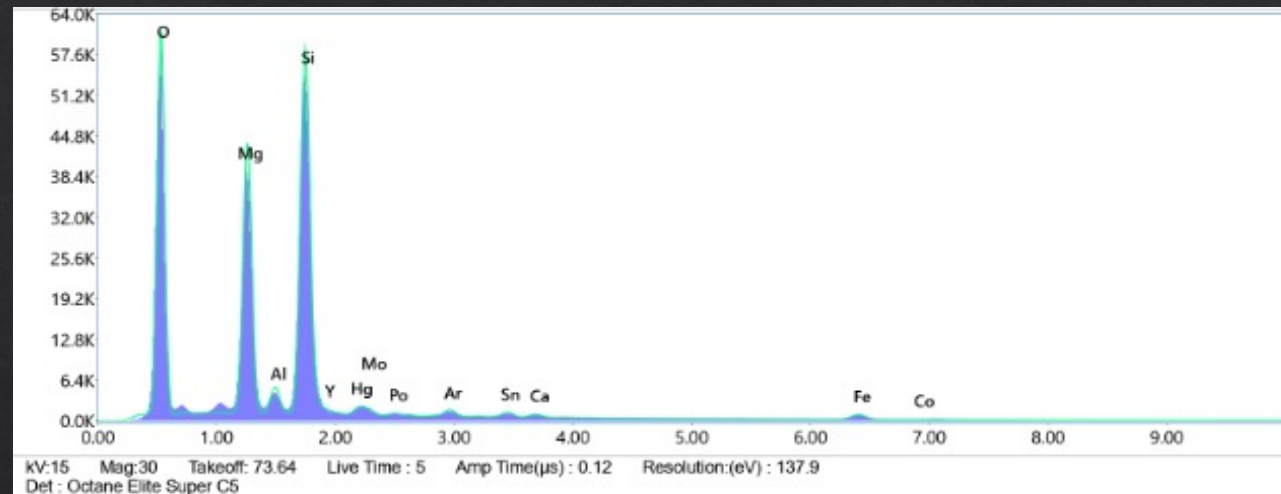


Composition

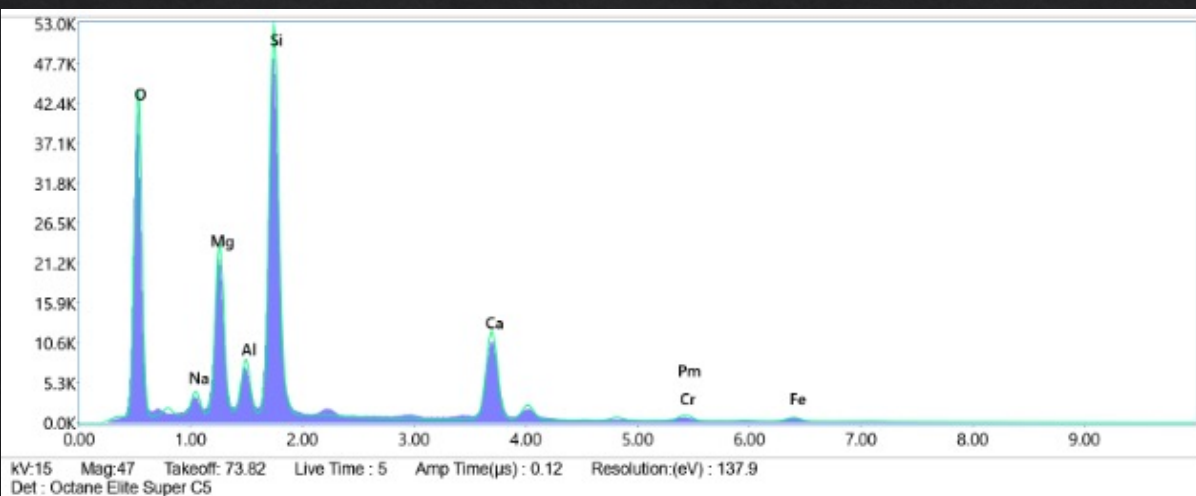
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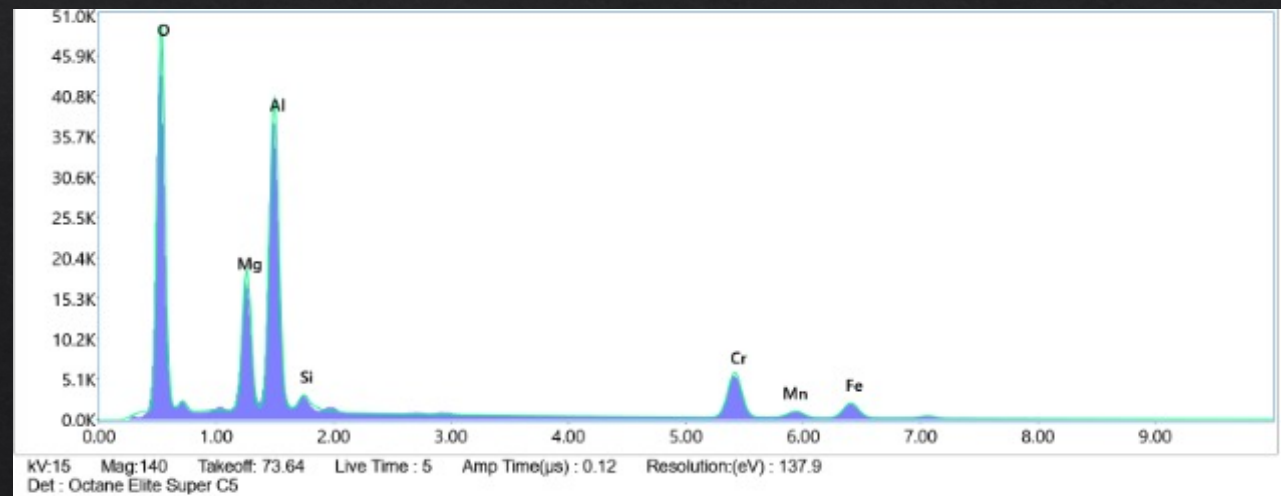
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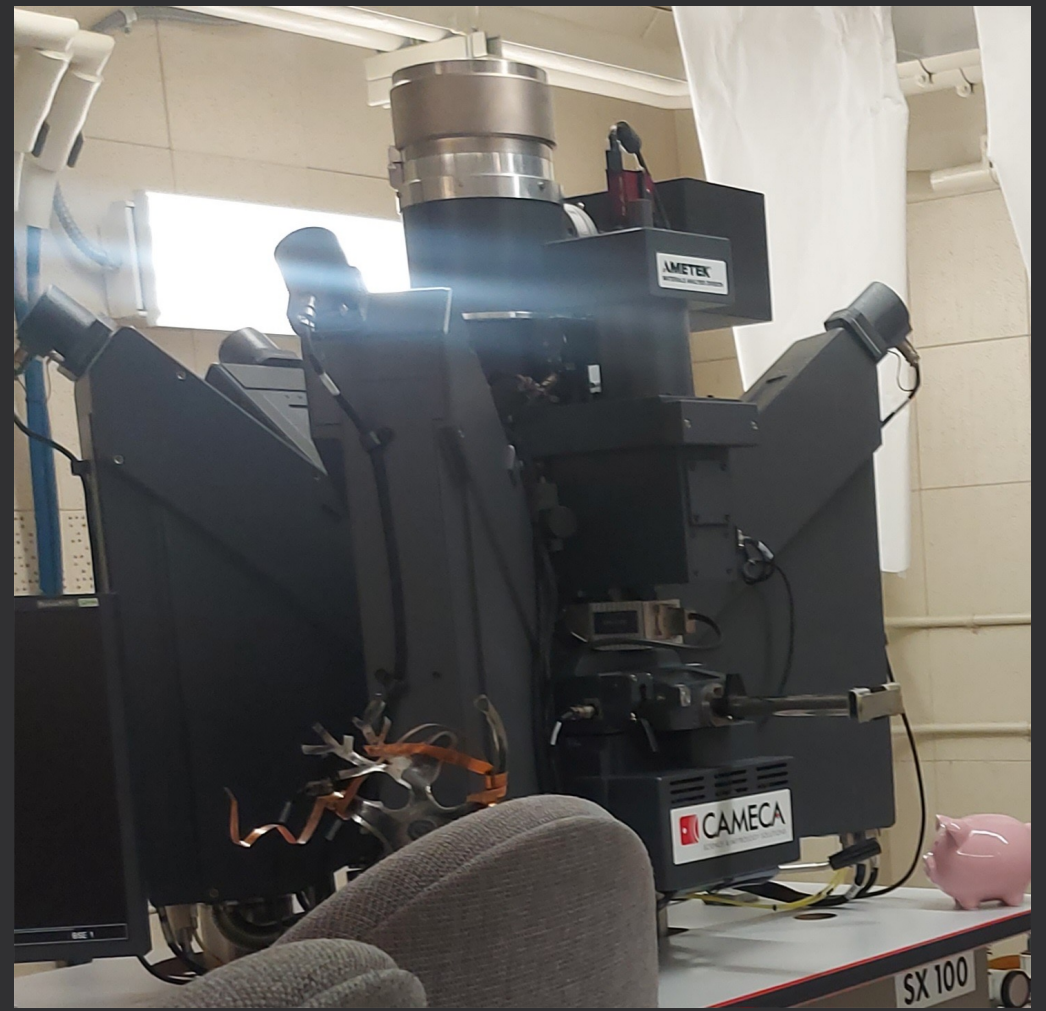


Spinel





Scanning electron microscope
Geoscience Department



Electron microscope
Kuiper Building

- ◇ The Samples were sent to the Woods Hole Oceanographic Institution to be measured for the ratio of nitrogen 14 and 15 isotopes using mass spectrometry as well as to measure the abundance of nitrogen present in the samples



Photo © Woods Hole Oceanographic Institution

Nitrogen in the atmosphere vs upper mantle

