



Lecture 1: Course introduction

1. Introductions

A. Who am I?

B. Who are you?

2. Course structure

3. Geochemistry

A. What does it mean?

B. What can it tell us?

C. What are the tools of the trade?

4. Making the Earth

A. Chemical composition of the solar system

We acknowledge and respect the $lək^wəŋən$ peoples on whose traditional territory the university stands and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day.



Who am I?

- Blake Dyer (he/him/his)
 - I prefer Blake over Dr. Dyer or Professor Dyer
- Undergraduate at Rice University 2006-2010
- PhD at Princeton University 2010-2015
- Postdoc at LDEO (Columbia University) 2016-2019
- Started in SEOS at UVic in Nov 2019
- Seventh time teaching EOS 240
 - Also teach Advanced Sed/Strat (EOS 423), Marine Geology (EOS 408), and The Dynamic Earth (EOS 120)



Research interests: the geologic history of climate and life



Research interests: the geologic history of climate and life



Who are you?

- Name

and some optional prompts:

- What is something you find interested about Earth Science?
- What program are you in and/or why?
- What do you hope to learn in EOS 240?
- What challenges do you anticipate?



Course Outline, Brightspace, and Course Webpage

Brightspace: All important announcements, assignments, and grades will be managed through Brightspace.

Course Webpage: Lecture slides and other course materials can be found on the course webpage, updated shortly after each class. There is a link to this page under Course Materials on Brightspace.

Go through course outline



Geochemistry: what does it mean?



Geochemistry: what does it mean?

geology + chemistry



Geochemistry: what does it mean?

geology + chemistry

In geochemistry, we use the **tools** of chemistry to solve geological problems. In other words, we use chemistry to understand the **Earth** and how it works.

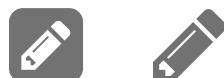


Geochemistry: what does it mean?

geology + chemistry

In geochemistry, we use the **tools** of chemistry to solve geological problems. In other words, we use chemistry to understand the **Earth** and how it works.

Earth doesn't limit us to *just* Earth, as understanding the *origins* and *history* of Earth means we also study meteorites, stars, other planets, etc.



Geochemistry: what can it tell us?



Geochemistry: what can it tell us?

- quantify the geologic timescale
- depth and temperature of magma chambers
- that sediments are subducted into the mantle
- the temperature and pressure that metamorphic rocks form at, and as one example this knowledge can help determine the displacement along faults
- how fast mountain belts have risen
- how fast mountain belts are eroding
- how and when the crust formed
- how the mantle convects
- how cold the ice ages were and what caused them
- when life began on Earth
- the impact and causes of acid rain, the ozone hole, greenhouse effect, and global warming
- sources and solutions to environmental contamination



Geochemistry: what are the *tools* of the trade?



Geochemistry: what are the *tools* of the trade?

- physical tools such as instruments that make chemical measurements
- chemical experiments
- interpretive tools (models) that explain observations
 - primarily based in thermodynamics, but can include kinetics, aquatic chemistry, trace element geochemistry, isotope geochemistry

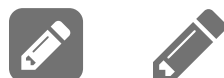


Thermodynamics: why is thermodynamics useful to a geochemist?



Thermodynamics: why is thermodynamics useful to a geochemist?

- thermodynamics allows us to predict the outcome of chemical reactions under a given set of conditions
 - predict the sequence of minerals that will crystallize from a magma
 - may seem purely academic except that we can use this predictive power to work backwards:
can determine the temperature, pressure, and composition of the magma or water from which minerals crystallized
 - allows us to understand how Earth has come to its present condition

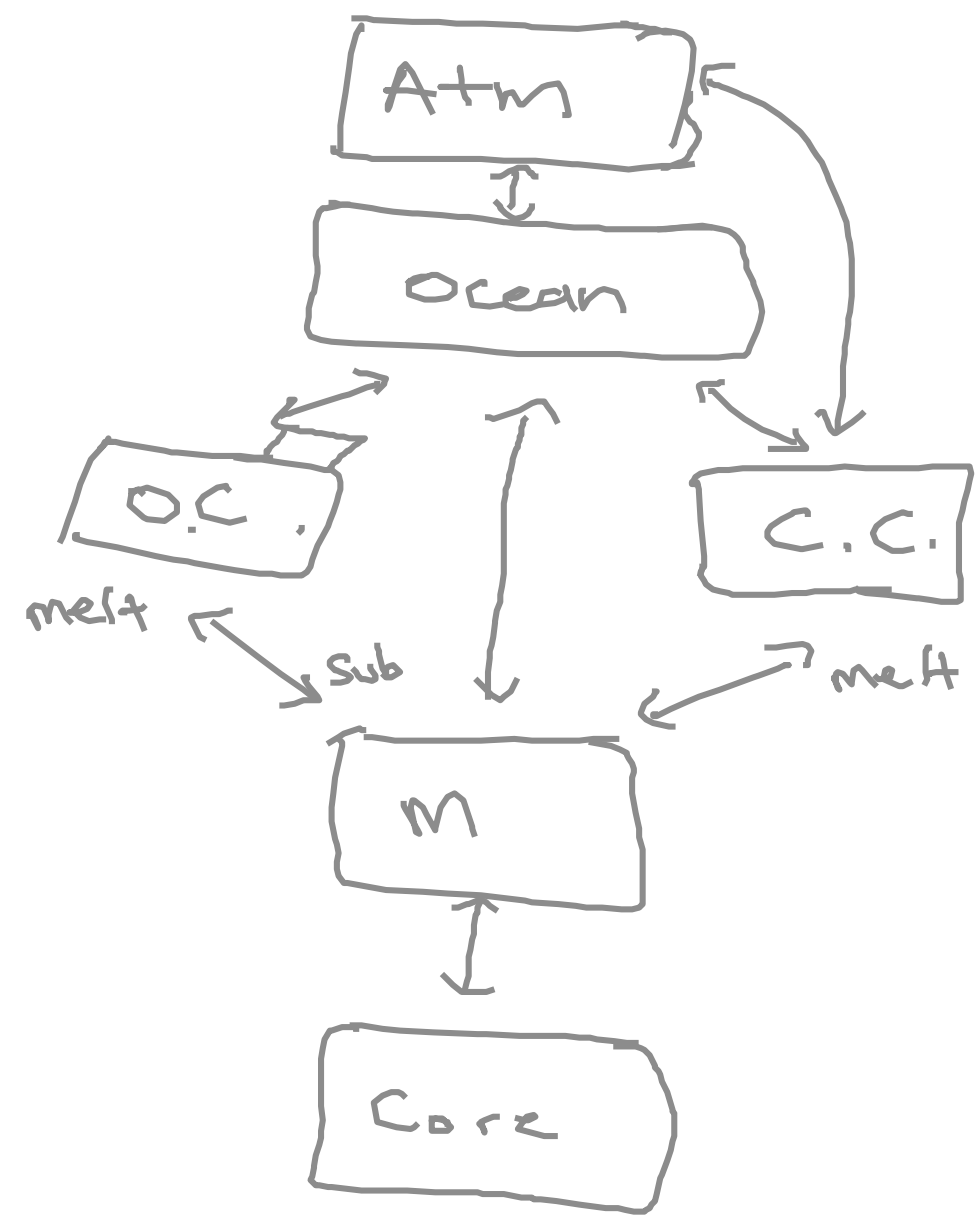


Schematic of Earth.



Schematic of Earth.

Core < ^{inner}_{outer}
Mantle
Crust < ^{oceanic}_{continental}
Oceans
Atmosphere



Bulk Earth
?
What is the
chemistry of
Bulk Earth



What is the chemical composition of Earth?



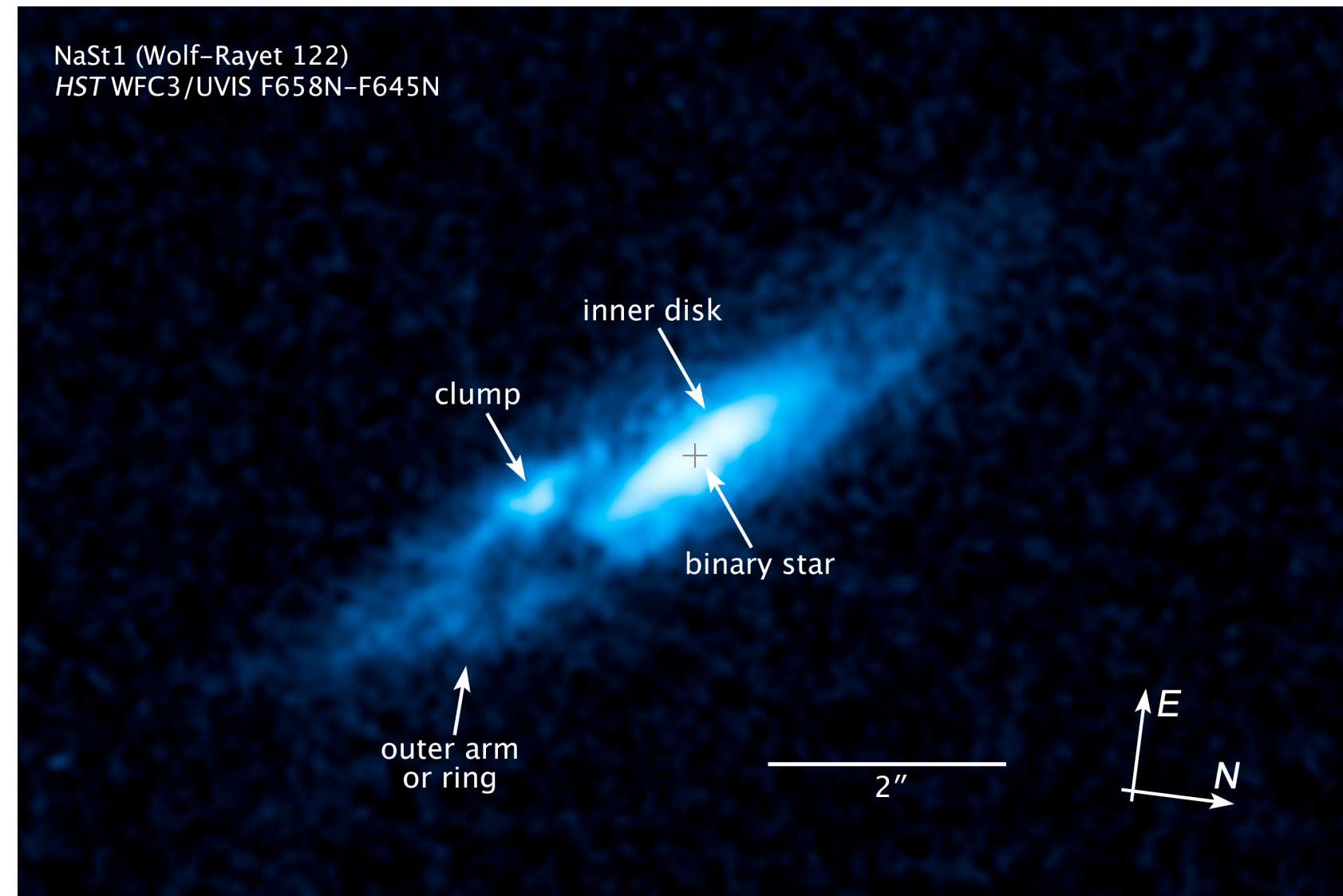


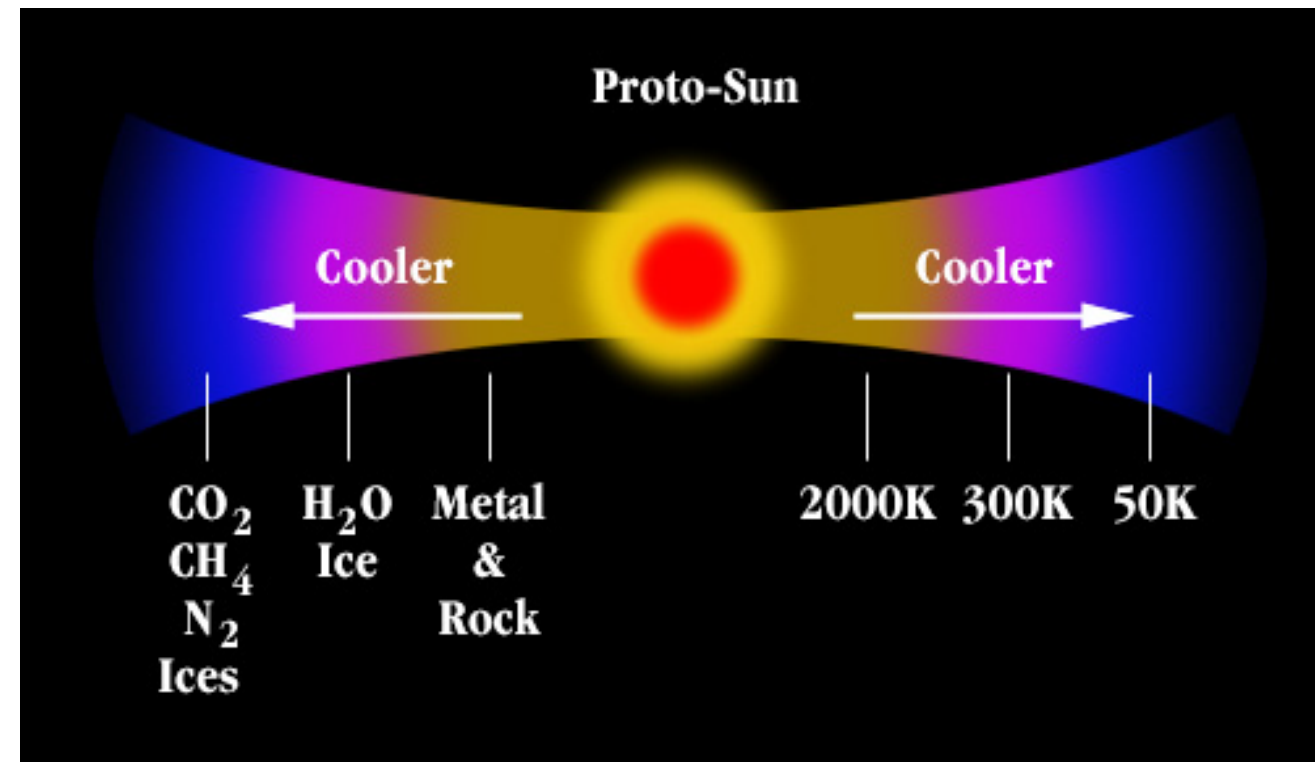
What is the black rock? What are the green bits?





NaSt1 (Wolf-Rayet 122)
HST WFC3/UVIS F658N-F645N





The hot disk begins to emit radiation to space, rapidly cools, and a temperature gradient develops.



The Solar System:

Sun
Ø 1 392 684 km

Mercury
Ø 4 879,4 km

Venus
Ø 12 103,6 km

Earth
Ø 12 756,3 km

Mars
Ø 6 792,4 km

Moon
Ø 1 081,6 km

Phobos
Ø 22,4 km

Deimos
Ø 12,6 km

Moons with colored frames are not to scale.

☼ = distance of the planet to the sun
Ø = average- or equatorial diameter

Vesta

Juno

Asteroid belt

Ceres

Pallas

The major objects in the belt;
not in scale

Callisto

Ganymede

Europa

Io

Jupiter
Ø 142 984 km
79 moons in total



ring system of Saturn; not in scale

Enceladus

Mimas

Tethys

Dione

Rhea

Titan

Hyperion

Iapetus

Saturn
Ø 120 536 km
62 moons in total

Uranus
Ø 51 118 km
27 moons in total

Neptune
Ø 49 528 km
14 moons in total

Miranda

Ariel

Umbriel

Titania

Oberon

Triton

Makemake

Pluto

Charon

Haumea

The major dwarf
planets (including the
biggest moon of Pluto);
in scale.



Eris

