Chapter 06: Surfaces of Terrestrial Objects

Common rock-forming minerals link #1 link #2

Ices

Common in the outer Solar System due to the low temperatures.
Comes in multiple forms (not just water ice), e.g., ammonia and methane.
Adding salts or ammonia can lower the freezing point of water by as much as _____ , making _____ possible in the outer Solar System.

Silicates

Common in Earth's lithosphere.
Examples include sand, glass, computer circuitry, …

Feldspars are common in lunar and terrestrial rocks. It is the most common mineral in Earth's _____ .

Both quartz and feldspar have such low density (2.6-2.8 g/cm³). that it is not surprising that they _____ and thus are found in Earth's crust.

Pyroxenes are common in Earth's lithosphere, asteroids, and meteorites.

Micas, amphiboles, olivene, clay, ...

mica

<u>Carbon and Carbonates</u>

e.g., graphite and diamond

_____ breaks apart methane and ethane, leaving behind dark brown-red surfaces of outer Solar System objects.

Iron oxides

Magnetite gives Mars its reddish hue

Hematite is associated with water on Earth, and thus the presence of hematite on Mars is further evidence for _____ .

Sulfur

Provides the bright _____ on Io.

Halides

Halite, salt, fluorite

Broad range of colors and also appears in a clear form used in lenses.

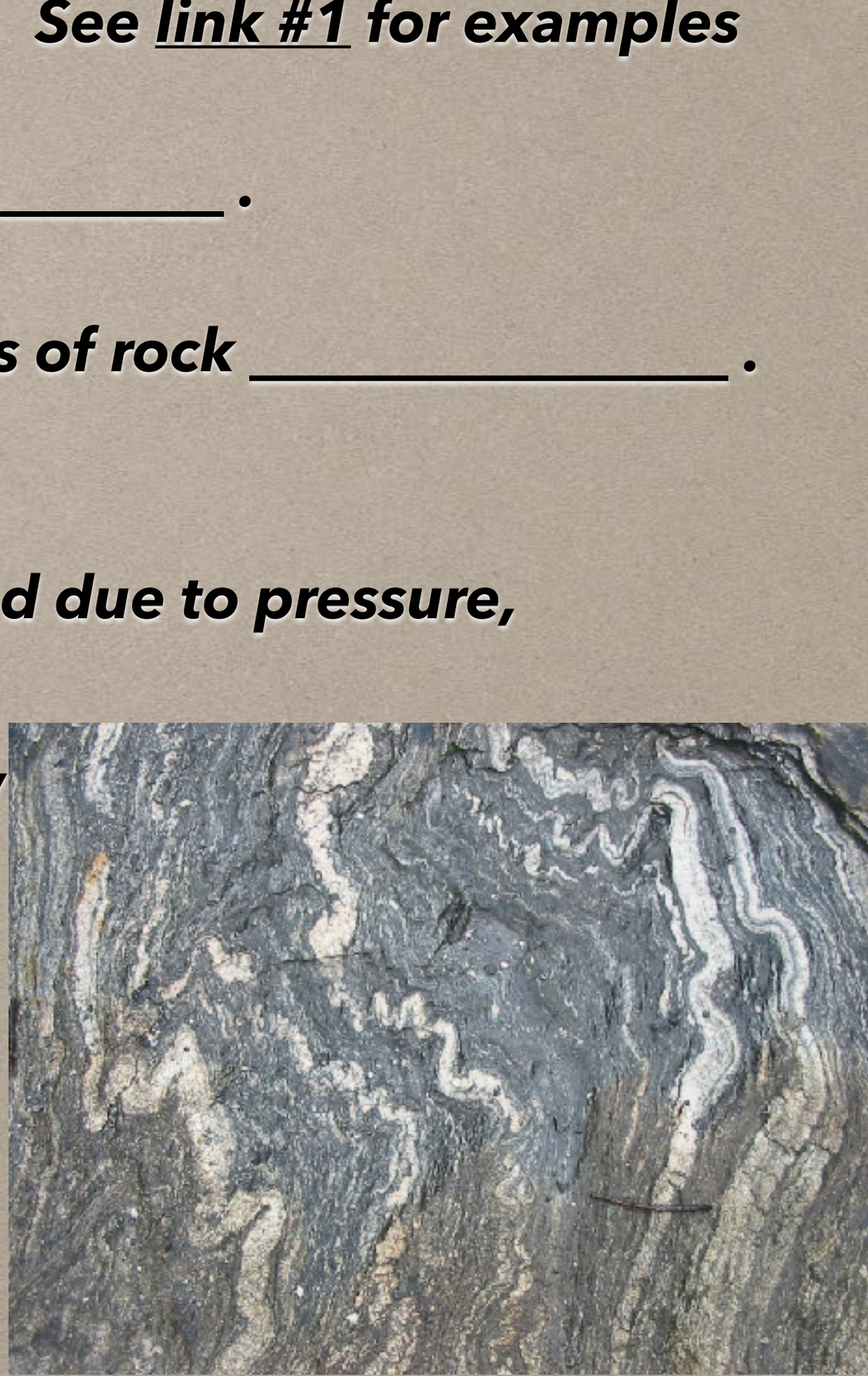
halite cubes

***Rocks:* aggregates of minerals** **See *link #1* for examples**

Igneous – formed from cooled _____ .

Sedimentary – layers of small pieces of rock _____ .
sandstone

Metamorphic – rock that has evolved due to pressure, temperature, or chemical changes.
Quartzite started out as sandstone, slate was shale, and marble was limestone or dolomite.



folded metamorphic rock

Igneous rocks

Intrusive (plutonic) igneous: rocks that have cooled _____ . Typically this cooling occurs slowly, resulting in large crystals.

Extrusive (volcanic) igneous: rocks formed from ejected magma that cools from the lava flowing on the surface. _____ cooling implies smaller crystals.

The Sherman granite at _____ is a popular local example of intrusive igneous. Some of the oldest Wyoming rock at 1.4 billion years old, it became exposed during the Laramie Uplift 70 million years ago.

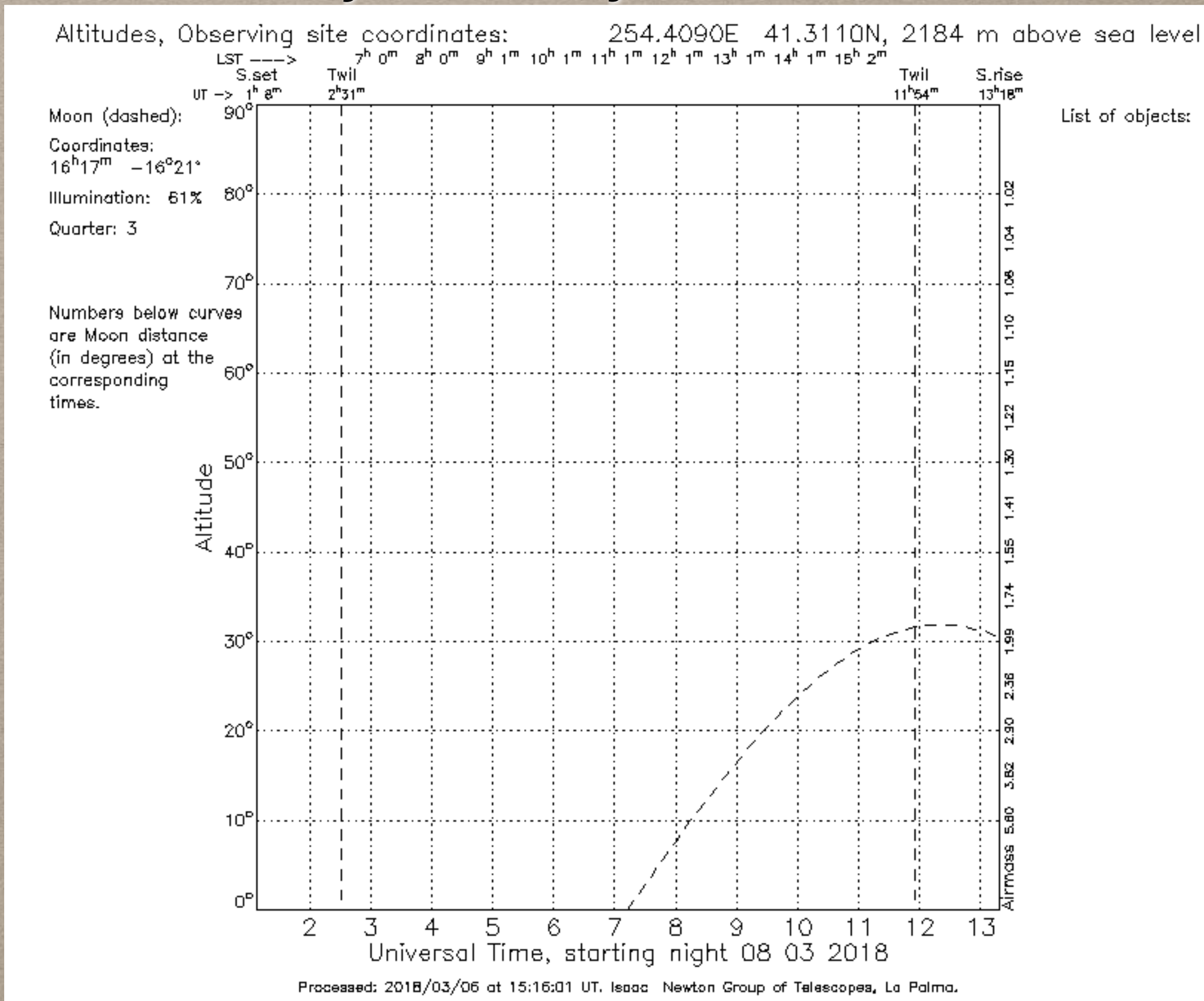
Sherman granite

Take a rocks & minerals quiz – treat this more as a learning experience than as a test of your knowledge.

Let's take a field trip and identify some rocks!
Our goal: find examples of igneous, sedimentary, & metamorphic
Grab a laptop, Geiger counter, physics box and USB cable.
Check the read-out rate within Logger Pro, and start sampling rocks!

Moon observation lab tomorrow night?

My favorite astronomical object visibility website



<u>Danny's notables from reading Dobson Chapter 06a & 06b</u>

Page 5: decompression melting & phase changes
Figure 6.13: Pu'u 'O'o volcano & my hike in Volcanos Nat'l Park
Figure 6.21: collapsed lava tube (?)
Figure 6.22: pit crater & collapsed lava tube
Figures 6.30 & 6.33: collapsed calderas & cinder cones
Page 16: "not unreasonable for us not to see tall lunar volcanos"

Page 4: The ages of lunar rocks with evidence of impact melting suggest a "late heavy bombardment" period 3.9 bya. —> Perhaps the moon experienced major impacts while still warm enough inside for molten material to flood the impact craters.

Danny's notables from reading Dobson Chapter 06a & 06b (cont)

Page 6: 1700 8.0 magnitude earthquake in Cascadia
Figures 6.48 & 6.49: beautiful example of fault similarities
Figure 6.52: the "car door handle" & less erodible rock
Page 11: glacial erratics

Short calculations

Compute the tidal force between your 5 kg head and feet at the event horizon of our Galaxy's $4 \cdot 10^6$ M_{sun} black hole.

Dobson explains that the cave in Figure 6.22 must be at least 20 m deep, given the 35 m diameter and the angle of the Sun's rays. Compute the Sun's altitude above the local Martian horizon for that image. Does your answer seem reasonable?

I've posted a science publication on Mercury volcanism by Prockter+2010 at the course website (Chapter 06 Tutorials and Group Questions). See Figure 1 and compute the minimum speed for material to be ejected to the outermost extent of the Rachmaninoff Deposit. Is this consistent with the 690 m/s estimated in Thomas+2014?

Short calculations

One of Io's volcanos ejects material upward at 134 m/s to a maximum height of 5.00 km above the surface. Use this information to estimate the mass of Io. Compare to Io's mass of $8.93 \cdot 10^{22}$ kg.

Video clips

Lava lake

Explosive planet Io

ice age floods

searching for liquid water

tectonic faults on Enceladus

Titan cryovolcano