Lunar Imaging
Lab 3
Astronomy 101

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1 Objective

To observe portions of the moon through images and interpret the visuals and craters by using data to locate notable areas.

2 Introduction

This lab includes a large amount of history about the moon, how the lunar knowledge was gathered, and other notable points about the moon. It will include portions about the moon's phases, eclipses, Mare, craters, and the excercises will include lunar charts and historical data about notable areas of the moon.

3 Equipment

- Moon Map
- Large cutout moon pictures
- Ruler
- Calculator

4 Procedure

4.1 Constructing Moon Images

Cut out the sections of the moon and paste them together to form the larger moon picture. Then using the data provided in the lab report, answered the questions in the excercises. This includes finding craters on the moon maps, calculating asteroid sizes, and calculating if a tsunami caused by an asteroid will reach parts of victoria.

4.2 Exercises

2) Identify three Maria, three landing sites, and three craters. Note if there are central peaks in the craters. The numbers denote the corresponding number on the constructed moon map.

1. Mare Crisium
2. Mare Nectaris
3. Mare Fecunditatis
4. A11
5. A17
6. A16
7. 134 Theophilus – Yes, central peaks present
8. 169 Santbech – No, no central peaks
9. 198 Piccolomini – Yes, central peaks present

3) Find and indicate an example of a crater, which was formed after another crater. We know that the dark Maria are about 3.5 Billion years old. Find a crater which formed after this. Find one that formed before 3.5 Billion years ago.
Before
84 Julius Ceasar – The crater looks as though it has been filled in over time and therefore means that it must have been created before 3.5 billion years ago when the dark Maria formed.
After
78 Picard – The crater appears inside the dark mare, meaning it must have formed after they did.
Can you find a crater that is lighter in color? – Yes, one example of such a crater is *140 – Langrenus*
Can you find a crater that has lines of lighter color eminating from the crater? – Yes, one crater is *99 – Taruntius* with lines going towards Mare Fecunditatus.

4) Measure the diameter of a big and a litter crater on the moon and convert them to the kilometers assuming a diameter of the moon of 3476 km. If the diameter of a crater is about 10 to 50 times (average 25) times the diameter of the meteorite depending on the mass and velocity of the meteorite. How big is

the meteorite that made the craters chosen, assuming craters are 25 times the size of the meteorite?

Crater 140

$$d_{crater} = \frac{38.5cm}{3476km} = \frac{1.5cm}{xkm} = 135.43km \tag{1}$$

$$d_{meteor} = \frac{d_{crater}}{25} = 5.41km \tag{2}$$

Crater 110

$$d_{crater} = \frac{38.5cm}{3476km} = \frac{.3cm}{xkm} = 27.1km \tag{3}$$

$$d_{meteor} = \frac{d_{crater}}{25} = 1.1km \tag{4}$$

5) In the Yucatan peninsula a crater has now been identied which is 180 km in diameter and 65 million years old. Is this crater about the right size?

$$km_{avg} = 10 * 25 = 250 \tag{5}$$

$$km_{min} = 10 * 10 = 100 \tag{6}$$

$$km_{max} = 10 * 50 = 500 \tag{7}$$

$$km_{min} < km_{crater} < km_{max} = 100km < 180km < 500km \tag{8}$$

Therefore by 8) the crater in the Yucatan peninsula is a crater within the reasonable range.

6) It has been estimated that most of the people on the earth would be killed by the impact of a much smaller 1 km. diameter object. This is the equivalent of a 1 million megaton explosion and would make a crater about 25 km. across. To estimate how often this happens we can examine our nearest neighbour, the moon. There are 295 craters bigger than 25 km in diameter on the lunar Maria. The maria are 3.5 billion years old, so how often do craters of this size form on the maria? To estimate how often this happens on the earth we need to know how much bigger the earth is compared to the lunar maria. If the area of the maria is about 5 million sq. km, and if the area of the earth is 500 million sq. km, how often would you expect a crater of this size to be formed on the earth and end civilization?

$$d_{Earth} = 100 * d_{Moon} \tag{9}$$

Therefore the number of asteroids that will hit Earth over 3.5 billion years are given by assuming 29 is the average amount of asteroids 29 plus or minus 5

$$asteroids = 29 * 100 \tag{10}$$

By 10) Asteroids / years is given by

$$A_{year} = \frac{2900}{3,500,000,000} = 8.29 * 10^{-8} \tag{11}$$

Therefore there are 8 asteroids of that size every 10 million years.
The lower bound, using 24 as asteroids is given by

$$lower = \frac{24}{3,500,000,000} * 100 = \frac{685.7}{1,000,000,000 years} \tag{12}$$

The upper bound, using 34 as asteroids is given by

$$upper = \frac{34}{3,500,000,000} * 100 = \frac{971.4}{1,000,000,000 years} \tag{13}$$

7) Every year on the 12 August the Perseid Meteor shower occurs. This meteor shower is caused by bits of gravel lost from comet Swift-Tuttle, but still traveling in almost the same orbit. The Earths orbit intersects the comets orbit at the place that the Earth is on 12 August. If the date of perihelion of the periodic comet Swift-Tuttle changes by +15 days (it changed by several years in its last orbit), it will hit the earth on August 14, 2126. It has a diameter of about 2 km, and would hit the earth with a speed of about 50 km/s. How big a crater would it make? There would be a 75% chance that it would land in an ocean. From the table, how large would the tsunami be 300 km from the impact sight? Would you be safe on Mt. Doug (altitude=210 m)?
From the table given in Figure x, we can determine that since we are 210m up, and the impact site is 300km away, creating a Tsunami height = 200m, we would be safe on Mt. Doug.

5 Tables and Measurements

Crater Diameter (km)	150	50	10
Energy (ergs)	1 X 10^{30}	6 X 10^{28}	2.6 X 10^{26}
Distance (km)	Tsunami Height (meters)		
10000	100m	15m	1m
3000	250m	40m	3m
1000	540m	90m	5m
300	1300m	200m	15m

Table 1: Crater and Tsunami Size for Various Impact Energies.

Crater Size	Scale Size (mm)	Real Size (km)	Meteorite Real Size (km)
Small	3mm	27.09km	1.08km
Large	15mm	135.4km	5.41km

Table 2: Measurements of impact craters on the moon.