Understanding and Observing

The Moon, its Origin and Geology

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The Moon is Earth's closest companion in space. The Moon is a cold, rocky body 3,476 km across and can easily fit between Vancouver and Ottawa. Though well studied, to many people, Earth's rocky 'sibling' represents an unknown entity. This brochure will introduce you to the genesis of the Moon and to lunar geology.

Observing the Moon with a Telescope or Binoculars

Because of its brightness, the Moon is an easy target for the unaided eye. Night to night changes its position in the sky and its phases are obvious. Even the smallest optical aid can greatly improve your ability to observe lunar surface features. Binoculars, especially those mounted on tripods for stability, can lead to hours of enjoyable lunar exploration. Small telescopes, many of which may be shunned for other astronomical targets, can excel on the Moon landscape.

Experienced observers know when to take advantage of the Moon's partial phases for their shadows, which highlight topographical features. The Full Moon can require the use of filters to dim the Moon's brightness but allows subtle brightness features, like rays that extend from craters, to be seen.

For safe daytime viewing when the Moon is close to the Sun in the sky, hide the Sun behind a building to ensure that you do not accidentally encounter intense and damaging sunlight with your binoculars or a telescope.

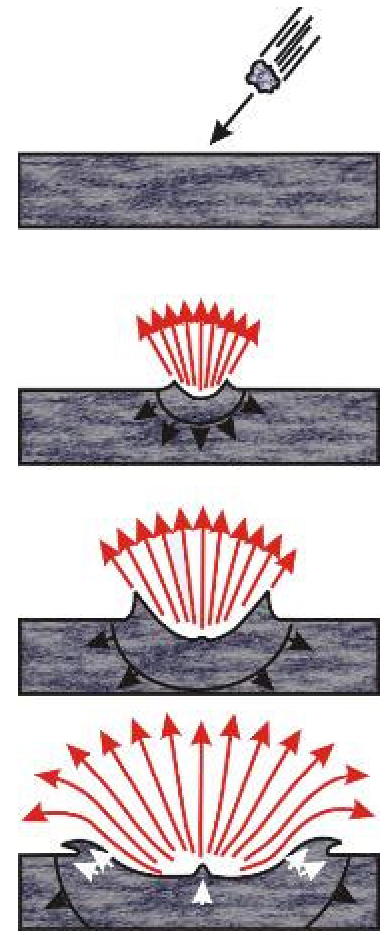
Lunar Geology

The Moon is a Rosetta stone for understanding the history of the inner planets. The virtual lack of atmosphere or erosion means that the Moon's landscapes preserve information from the early history of the solar system. Its proximity allows for extensive studies and has also made it possible for astronauts to retrieve rock samples. By analyzing the lunar rock samples, geologists know how old the returned rocks are, and can use this information to calibrate the geologic history of the Moon. Putting this information together, we know that the Moon consists primarily of igneous rocks – that coarsely crystalline and feldspar-rich in the bright areas and basalts within the dark regions. Lunar rocks turn out to be generally older than almost all rocks on Earth, giving us a glimpse back in time to eras that are no longer preserved on Earth such as the great bombardment by asteroids that created most of the large, dark areas that were later filled in by basalt lavas.

With a telescope, under low to moderate magnification, or even binoculars, the light and dark domains that we recognize with the unaided eye resolve themselves into rugged and highly cratered highlands and into dark, smooth, lightly-cratered plains known as maria (pronounced mar' ee uh, Latin for seas). Maria are essentially giant impact basins that excavated down to, or created deep-seated fractures that tapped into, still-molten layers deep within the young Moon.

Craters

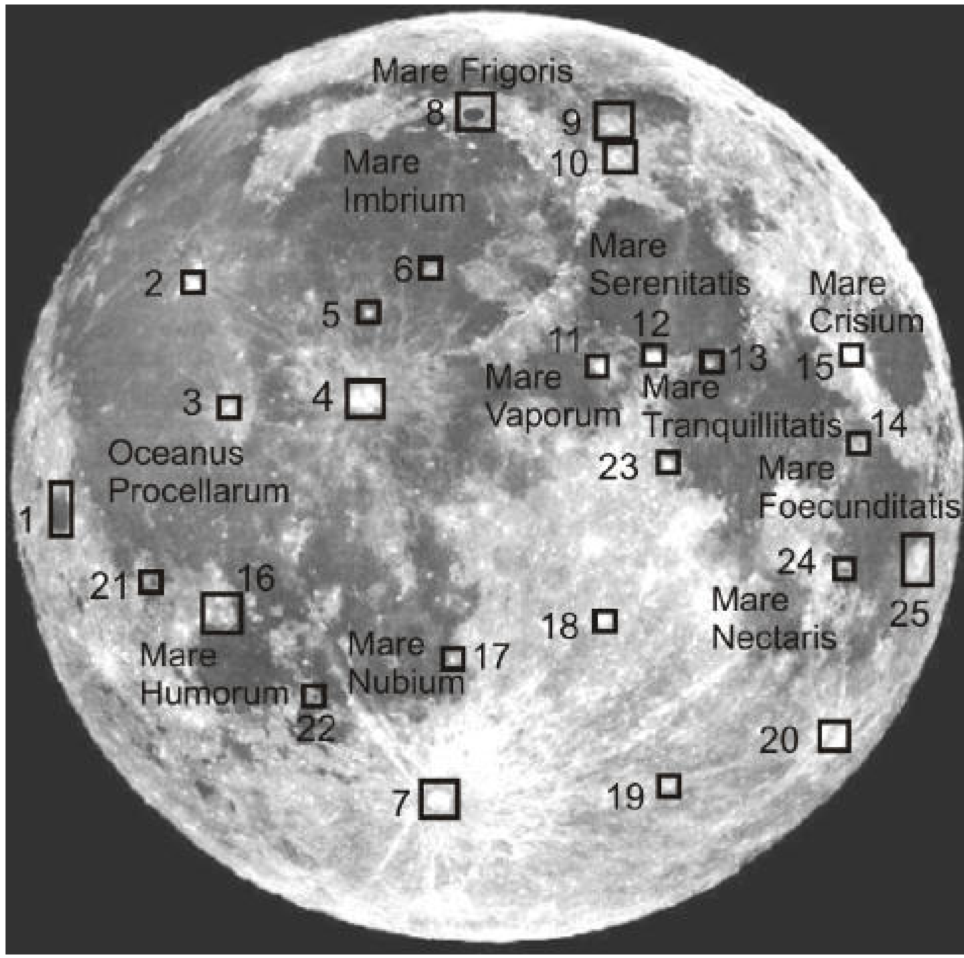
At a finer scale of observation, we see that the lunar surface is strewn with craters. Due to the lack of erosion on the Moon, we can read the cratering history far back in time. Each crater records the collision of a minor body such as an asteroid or comet (the impactor) with the Moon. The tremendous kinetic energy of the impactor, which is travelling at tens of kilometres *per second* relative to the Moon, is converted into explosive heat energy. For this reason, almost all craters are circular, regardless of the angle that the impactor struck the Moon. The crater is excavated by the explosion, not the impact of the body plowing into the Moon.



Although at first glance

one crater may resemble another, upon detailed examination there is much to decipher. Craters less than 10 km across are generally simple cups with raised rims, while progressively larger craters show evidence of internal terraces due to crater wall slumping, central 'rebound' peaks and, in the largest craters, external rings formed by the vibration of the surrounding lunar landscape during the impact. Some larger craters are smooth floored due to later basalt lava flows filling up the depression.

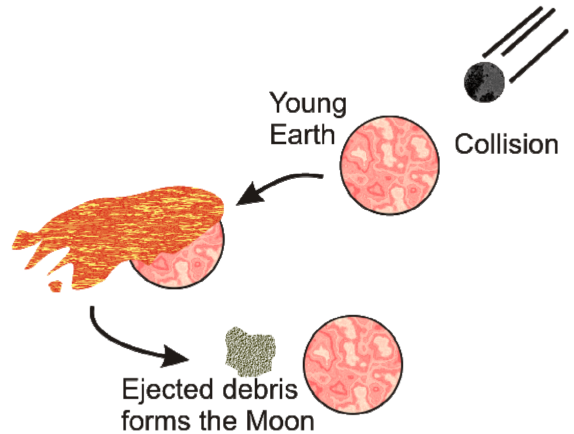
Planetary scientists use crater abundances to estimate relative ages of the two types of terrain. With their plentiful craters, the highlands are interpreted to be ancient, collecting craters for over 3.9 billion years. In contrast, the maria have far few craters and represent younger rock, but still generally more than 3.3 billion years old.



Craters

1. Grimaldi,
2. Aristarchus
3. Kepler
4. Copernicus
5. Pytheas
6. Timocharis
7. Tycho
8. Plato
9. Aristoteles
10. Eudoxus
11. Manilius
12. Menelaus
13. Plinius
14. Taruntius
15. Proclus
16. Gassendi
17. Birt
18. Abulfeda E
19. Nicolai A
20. Stevinus A
21. Billy
22. Campanus
23. Dionysius
24. Goclenius
25. Langrenusabout

Origin of the Moon



Orbital dynamics shows us that it is almost impossible for one astronomical body to 'capture' another in orbit unless an additional force besides the gravitational attraction of the two bodies is involved. This additional force might be rocket propulsion, as used by many space probes visiting the Moon or planets, frictional braking using the atmosphere (Mars Global Surveyor), or tidal distortion (Comet Shoemaker-Levy 9 at Jupiter).

In the case of our Moon, it is postulated that an actual collision between the early Earth and a Mars-sized planet sprayed material into Earth orbit that later collected to form the Moon. This interpretation explains why the Moon and Earth share many elemental and isotopic similarities and why the Moon seems to have too little metallic core material if it formed on its own.

Summary

Lunar observing projects require minimal or inexpensive equipment and thus represent a cost effective way to get into astronomy. Sketching lunar features is an opportunity for amateur astronomers to connect with, and compare to, the drawings made in the early 1600's by Galileo.

More information on the topics covered in this brochure is available in the *Observer's Handbook*, which is included with membership in the Royal Astronomical Society of Canada.

Find out more

To learn more about the Royal Astronomical Society of Canada, or membership in the Society, contact your local Centre or the Society's National Office:

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