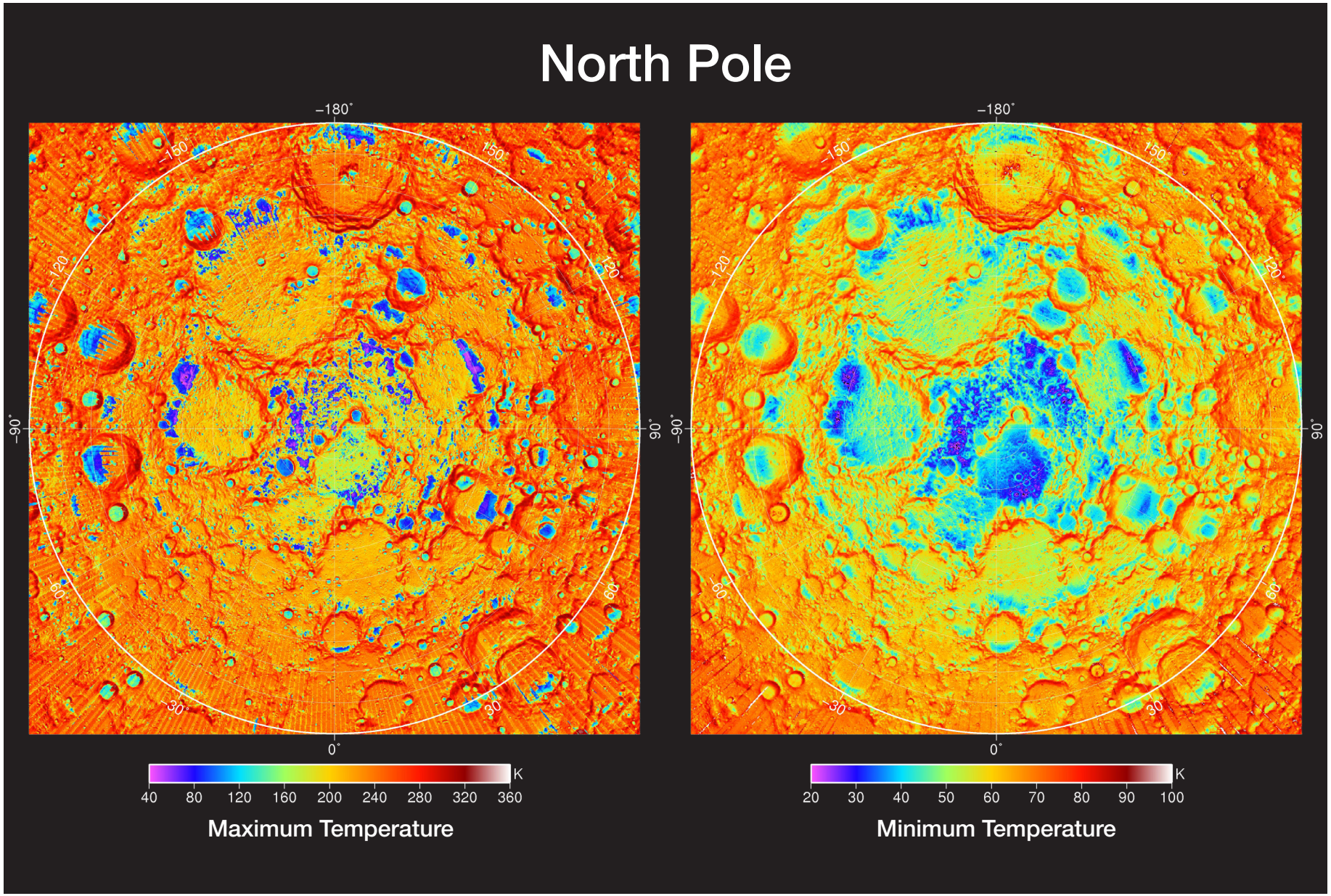
National Aeronautics and Space Administration




**LUNAR RECONNAISSANCE ORBITER: Temperature Variation on the Moon**

**www.nasa.gov**

### Taking the Moon's Temperature

Our nearest neighbor has a surprisingly wide range of temperatures on its surface. The Diviner Lunar Radiometer instrument onboard the Lunar Reconnaissance Orbiter (LRO) has been mapping the temperature of the Moon since its launch in 2009.

Daytime temperatures near the lunar equator reach a boiling 250 degrees Fahrenheit (120° C, 400 K), while nighttime temperatures get to a chilly -208 degrees Fahrenheit (-130° C, 140 K). The Moon's poles are even colder. Diviner even found a place in the floor of the Moon's Hermite Crater that was detected to be -410 degrees Fahrenheit (-250° C, 25 K), making it the coldest temperature measured anywhere in the solar system! Extremely cold regions similar to the one in Hermite Crater were found at the bottoms of several permanently shadowed craters at the lunar south pole and were measured in the depths of winter night.

### The Lunar Day

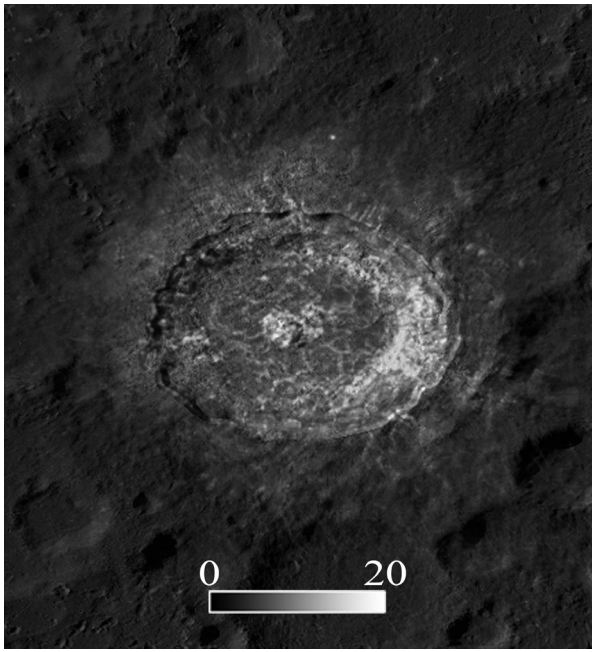
The Moon takes approximately 28 days to make one orbit around the Earth. As the Moon orbits the Earth, it also makes one complete revolution about its axis. This unique relationship results in the same side of the Moon always facing the Earth. It also means that each lunar day lasts 14 Earth days (one-half of the amount of time it takes the Moon to rotate once about its axis). Similarly, a lunar night lasts 14 Earth days. The Moon lacks an atmosphere that would limit extreme temperatures by transferring heat around the planet. Measuring how the Moon heats up and cools down therefore says a lot about what is on the surface.

Everything has its own unique amount of time it takes to heat up and cool down. For example, lunar rocks take longer to heat up and cool down than lunar regolith (soil). The different heating and cooling rates makes it possible for scientists to identify areas with large quantities of rocks. The amount of rocky material in an area is called rock abundance.

In order to determine the rock abundance of a surface, scientists must first account for other controls on the Moon's temperatures. In addition to rock abundance, the temperature on the surface of the Moon is controlled by latitude and elevation. Once latitude and height factors are removed, scientists can examine the relative heating and cooling rates of different areas on the surface to determine rock abundances.

### Diviner – the LRO Rock Hound

The Lunar Reconnaissance Orbiter (LRO) orbits the Moon once every 120 minutes. In each orbit, LRO is able to see portions of the Moon's day and night sides. Over time, scientists have built up a global map of the Moon's temperatures that covers an entire lunar day. By observing the way the lunar surface heats and cools over the course of a day, the Diviner instrument on board LRO is able to distinguish between areas with high amounts of rocky material compared to areas that have fewer rocks. As expected, most of the Moon's surface has a low abundance of large rocks. Billions of years' worth of impacts from meteoroids of all sizes have broken the rocks on the Moon's surface into smaller and smaller pieces. However, there are several areas near geologically young craters that contain an abundance of rocks.



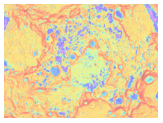

*Rock abundance map of Tycho crater from Diviner data. Black represents no rocks, while white represents 20% coverage. Image credit: NASA/GSFC/UCLA*


**More Information**
**http://nasa.gov/lro**
**https://www.facebook.com/LunarReconnaissanceOrbiter**
**Twitter:** @LRO_NASA

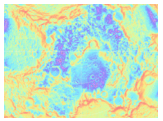
Goddard Space Flight Center manages the Lunar Reconnaissance Orbiter for NASA's Science Mission Directorate.

---

**Image credit info:**



Front left image: Maximum daytime temperatures from X North–90 North on the Moon, as measured by the Diviner instrument onboard LRO.
Credit: NASA/GSFC/UCLA



Front right image: Minimum daytime temperatures of the north pole of the Moon, as measured by the Diviner instrument onboard LRO.
Credit: NASA/GSFC/UCLA

LG-2013-11-084-GSFC