Lunar Rock

Northwest Africa 482 Extraterrestrial History

Northwest Africa 482 (NWA 482) was originally part of the moon. In order to understand the history of this lunar meteorite, we must first understand the origin of the moon.

The most accepted theory on how the moon was created is referred to as the "Giant Impact" theory. Most scientists believe the moon was created when a small planet-sized body impacted the Earth.

This happened during the very early history of the Earth about 4.5 billion years ago. This impacting body was destroyed during the collision, ejecting material from itself as well as Earth, into space. The fragments from this event were trapped by the Earth's gravity, orbiting in a large array of debris. Through a gravitational process called accretion, the pieces were brought back together to form the moon.

We know from observation and the Apollo missions that there are two main classes of rocks from the moon. The first type is referred to as "mare" (meaning "sea"), pertaining to the darker areas of the moon mainly composed of ancient (3.0 to 3.8 billion year old) basalt lava flows. The second type referred to as "highlands" pertains to the lighter colored areas of the moon mainly composed of feldspar-rich anorthosite rocks. NWA 482 is a highlands-breccia (meaning a type of rock made of fragments of other rocks and composed mainly of anorthosite). The moon is believed to be about 4.5 billion years old and for about 600 million years during its early history was bombarded by pieces left over from formation of the planets. Impacts continued to pulverize the surface of the moon at a decreasing rate, creating the heavily cratered surface. During this time, melting of the lunar mantle produced basalt magma that erupted into the larger basins producing the dark areas of the moon, again referred to as "mare". Knowing this history of the moon, we know that NWA 482 is over four billion years old, making it older than most known Earth rocks.

The next period of NWA 482's existence was relatively quiet, with moderate impact events creating what is referred to as lunar regolith (soil created by fragmentation of rocks). These events caused brecciation of NWA 482 and also remelted most of it, producing its distinctive matrix. This also created the brecciated composition of NWA 482 as noted by some impacting material left over from prior impact events in its matrix. Then came a larger impact event that ejected this rock from the moon. According to cosmogenic radionuclide and noble gas concentration tests, this happened 900 thousand years ago plus or minus 200 thousand years.

After floating for about one million years in space, NWA 482 intercepted the Earth's orbit and was pulled in by its gravity. At first it was probably the size of a grapefruit. When it hit the Earth's atmosphere at cosmic

velocity (an estimated 11-30 kilometers per second) the surface began to heat up. As it heated up, it gave off light, making it a meteor (a shooting star). At this point, material began to ablate from its surface and spalled off as a glowing trail of meteoritic material. During this entry phase into the atmosphere it lost about half of its mass, eventually becoming the size of a potato. It also oriented itself during its few moments of entry, meaning that it stabilized during its flight rather than tumbled randomly. We know this because of the nice flow lines and a characteristic called a lip-over rim on the trailing edge of this lunar meteorite.

Oriented meteorites are rare, and NWA 482 is the only known lunar example that displays this property. Eventually the atmosphere, acting as a brake, slowed it down to about 300 kilometers per hour at about 12 – 16 km altitude, arresting the ablation process. Most meteoroids do not survive this part of the trip thus never becoming meteorites. NWA 482 dropped to Earth only under the influence of gravity, landing in the sands of Northwest Africa and thus becoming a meteorite.

Because a terrestrial age of 60-120 thousand years was measured, we know how long it lay in the desert. This age is remarkable considering how well preserved this specimen is. The glass crust and dry Sahara desert conditions have preserved this meteorite well.