ROCKS IN THE SOLAR SYSTEM.

*Not to scale

Planetary geology is the study of planets, moons, meteorites, asteroids and comets and the processes that shaped them. It encompasses areas of traditional geology including geochemistry, geophysics, geomorphology, volcanology and sedimentology, whilst using innovative technology such as rovers and orbiting spacecraft to obtain high-resolution data. This helps scientists gain invaluable insights into our solar system.

Planetary geologists seek to answer some of the most profound scientific questions: how did the solar system form? How did our planets come to be? Is there life on Mars or elsewhere in the solar system? How did life first evolve on Earth? To answer these questions, researchers use geological skills such as observation, taking samples, and even conducting geological fieldwork to analyse clues found in the rocks, dust, and other matter in our solar system.

SUN

At the centre of our Solar System sits the sun, a powerhouse of energy. The Sun is a ball of plasma made from hydrogen and helium, fuelled by nuclear fusion reactions. It is composed of different layers:

- Core - hottest part of the star at 15 million°C. Nuclear fusion reactions happen here, generating energy.Around the core is a radiative zone, followed by a convective zone, through which energy escapes into the photosphere.
- Photosphere, 6000-4000°C, here the Sun's energy is released as light and is the source of solar flares.
- Chromosphere, 3000 – 40,000°C, gets hotter the further out from the core. Emits a reddish glow seen during a total solar eclipse.
- Corona, outermost layer of the Sun's atmosphere which appears as a white glow during an eclipse.

MERCURY

Asteroids entering the Earth's atmosphere burn up and get broken into smaller pieces. However, since Mercury has no atmosphere, it is bombarded by asteroids and its surface is covered in impact craters. Mercury also has large areas of smooth plains formed from flood basalts. You can also see cracks, folds and ridges over Mercury's surface thought to have formed as it cooled down and contracted in size, in the first 700-800 million years of its geological history.

VENUS

Venus has more than 1,600 known volcanoes, more than any other planet in the solar system. 90% of Venus's surface is made from the igneous rock basalt and is home to shield volcanoes, like the ones we have on Earth, but also strange flat pancake-like domes.

Venus's volcanoes release greenhouses gases, like carbon dioxide and methane, into its atmosphere. Greenhouse gases absorb infrared light (heat) and radiate it back down to the surface thereby heating the planet. Venus's greenhouse effect is so strong its average surface temperature is 464°C, making it hotter than Mercury! On Earth, the increase in greenhouse gases and the strengthening of our own greenhouse effect is causing current climate change.

MOON

The Moon is made from igneous rock. The pale coloured lunar highlands are formed from a rock called anorthosite and the darker coloured lunar seas or 'maria' are made from the rock basalt, similar to what erupts from volcanoes in Hawaii. The Moon is thought to have formed during a collision between the Earth and another small planet in the early formation of the solar system. The gas and debris from this impact started to orbit the Earth and gradually accreted to form the Moon.

EARTH

The Earth is composed of four layers:

- Inner core - 5,000 – 6,000°C, is composed of solid iron and nickel metal under extreme pressure and heat.
- Outer core, 4,500 – 6,000 °C, is composed of liquid iron and nickel metal which can flow and gives rise to our magnetic field.
- Mantle - 200 – 4,500°C is composed of solid rock but small pockets can occasionally melt to form magma (liquid rock).
- Crust - broken up into plates that move around on top of the mantle.

MARS

We know quite a lot about Martian geology because as of 2021 six rovers have landed on its surface, each one exploring and photographing the surface of Mars, gathering data on the composition of its soil, atmosphere and surface geology. The rovers have also detected sedimentary rocks that show Mars was once home to vast flowing rivers, deltas and large lakes of water.

Mars's surface is mostly basalt and its colour comes from iron in the rock, which rusts to a red colour in the thin Martian atmosphere. Evidence of past hotspot volcanism can be seen on Mars, where a plume of magma rose up from near the planet's core and formed huge volcanoes on the surface. This is how Olympus Mons, the largest volcano in the solar system, formed. It stands at 25 km above the Martian surface!

JUPITER

Jupiter is the largest planet in our solar system. It is mostly made from hydrogen and helium, but scientists believe there may be some rock in its core. We have no idea what form this rock could take, as the pressure there is so much higher than on Earth. Jupiter has 79 moons, and the four largest have some fascinating geology. For example, the icy surface of Europa has large cracks where ice has broken up into icebergs and refrozen. This cracked surface indicates that beneath the ice Europa has a vast ocean of liquid water. This ocean exists because Europa has a slightly elliptical orbit, causing the interior of the moon to be repeatedly squashed and squeezed depending on its distance from Jupiter. Friction causes the interior to heat and melts the ice.

EUROPA

TITAN

Titan is Saturn's largest moon, larger even than the planet Mercury. Titan is unique for a moon because it is the only other body in the solar system, apart from Earth, to have rivers and lakes on its surface today. However, Titan's lakes are not made of water but methane, ethane and other organic molecules.

Enceladus, another one of Saturn's moons, is much smaller. There are many trenches and cracks in its southern hemisphere including four prominent parallel trenches known as the 'Tiger Stripes'. The Cassini space probe photographed huge plumes of ice erupting from ice volcanoes in the Tiger Stripes, and even flew through these plumes to measure their composition! The heat that drives these volcanoes is thought to come from the gravitational pull of Saturn, which flexes the moon as its travels around its elliptical orbit, giving rise to friction and heat.

SATURN

Saturn is the solar system's second largest planet, famous for its characteristic rings formed from rock, dust and ice. Saturn is also orbited by 82 known moons. The rings provide an analogue for the early solar disc from which our sun and planets formed. Some physical processes and interactions occurring in Saturn's rings today are similar to what may have occurred in the birth of our solar system, just on a smaller scale. By studying Saturn's rings we can gain valuable insights into the formation of the solar system over 4.5 billion years ago.

ENCELADUS

URANUS

Uranus and Neptune are the two most distant planets in the Solar System. They both have deep atmospheres of hydrogen, helium and methane gas and icy interiors of high pressure ammonia, water and methane ice surrounding a small rocky core. Uranus and Neptune's blue colours come from atmospheric methane.

NEPTUNE

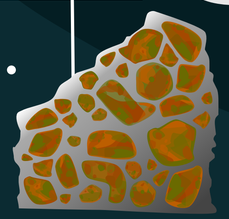
PLUTO

Pluto isn't classed as a planet now, but fantastic geology happens there. Most of its crust is made from water-ice, but some areas are dominated by ices made of nitrogen, methane and carbon monoxide. Some parts are even stained red by organic tar. One amazing feature is Sputnik Planum, where an ancient impact appears to have pierced the crust, creating a basin which is now filled by nitrogen-ice. The surrounding mountains are made of rigid water-ice, and glaciers formed from other types of ice can even be seen flowing from these mountains into the basin.

The asteroid belt spans 240 million km between the orbits of Mars and Jupiter. It is made from bits of rock and metal that once made up a planet and later broke up in an impact collision.

Planets form from the gradual accumulation of dust and gas into clumps. They collide together over millions of years creating larger and larger bodies. After reaching a critical size of 1 km in diameter, these bodies accumulate more mass as their gravity gets stronger, eventually becoming planets.

Meteorites are bits of rock from space that come through the Earth's atmosphere and land on its surface. Most meteorites come from the asteroid belt and formed at the same time as the solar system around 4,570 million years ago! Other rare examples are fragments ejected from the Moon and Mars by large impacts there. Studying these meteorites can help us understand how our early planets formed.



The Geological Society

2021 YEAR OF SPACE