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Ecology

Great Wall of China is protected by a coat of lichen and moss

James Woodford

THE Great Wall of China is being protected from erosion by a "biocrust" of moss, lichen and cyanobacteria, much as the wall once shielded the country from northern invasions.

The wall, built and rebuilt many times between about 200 BC and the Ming dynasty, which lasted from 1368 until 1644, once stretched for more than 8800 kilometres. Today, less than 6 per cent of its total length remains well-preserved, and much has vanished.

Many sections of the wall were built with rammed earth, which is when natural materials such as soil and gravel are compacted to create structures.

Bo Xiao at China Agricultural University in Beijing and his colleagues have sampled a 600-kilometre-long section of the wall and observed that more than two-thirds of it is covered in biocrust. The team found that this layer of lichens, mosses and cyanobacteria contributes to strengthening the wall, keeping it dry and protected from wind and water erosion. The biocrust also acts as an insulator, reducing temperature extremes and lowering the effects of salinity.

Biocrust-covered sections were less porous, with reduced water-holding capacity, erodibility and salinity, says the team. These areas also showed increased resistance to various forms of mechanical assault (*Science Advances*, doi.org/k8df).

The findings could change the way managers of heritage sites around the world regard vegetation on ancient structures, says Xiao.

The biocrusts may mitigate the extremes of hot and cold the wall faces, says Brett Summerell at the Botanic Gardens of Sydney. "They would provide an environment that helps buffer and protect the stability of the structure of the walls." ▮

Geology

The moon may enter a new geological period thanks to us

Matthew Sparkes

NASA

US astronaut Buzz Aldrin on the surface of the moon in 1969

HUMANITY'S influence on the moon is so great that we should define a new geological epoch, just as we are doing on Earth by creating the Anthropocene, argue researchers.

The Anthropocene is the name given to the epoch in which humans began having a significant impact on Earth's geology and ecosystems. Most researchers suggest Earth entered this period in 1950, marked by the presence of plutonium isotopes from nuclear weapons tests in sediments of a relatively untouched lake in Canada.

Now, Justin Allen Holcomb at the University of Kansas and his colleagues say the moon has entered its own Anthropocene, as the effects of spacecraft, lunar rovers and other human activity displace more surface regolith than natural processes such as meteoroid impacts (*Nature Geoscience*, doi.org/k74h).

Humans began having an effect on the moon in September 1959 when the Soviet Union crash-landed its Luna 2 probe on the surface, leaving a crater. India became the fourth country to make a soft landing on the moon this year, and a range of national and private missions are planned in the near future. To date, we have caused surface disturbances in at least 59 locations on the moon and have discarded objects including spacecraft components, flags, golf balls and bags of human excrement.

1959

When humans began to have an effect on the moon

Holcomb says the weight of human-made objects left on the moon and the amount of regolith displaced are both likely to dramatically increase in the coming years as colonisation and mining efforts begin.

"We really do need to slow down and talk about what the consequences are," he says.

Ingo Waldmann at University College London says that the moon has certainly entered its equivalent of the Anthropocene, because lunar geology isn't very dramatic: weak quakes happen sporadically and water is only deposited in the surface regolith over aeons by solar winds.

"There might be an [asteroid] impact once every couple of million years or so," he says. "But apart from that, not much happens." Just us walking on it has a bigger environmental impact than anything that would happen in hundreds of thousands of years, he says.

The current lunar geological division, the Copernican Period, dates back to more than a billion years ago. By contrast, Earth has passed through about 15 geological periods in this time.

Waldmann is concerned that missions such as NASA's Artemis III, which aims to put astronauts on the moon for the first time since Apollo 17 in 1972, will contaminate the lunar surface. He says there should be an international agreement for the creation of the equivalent of a national park on the moon.

"The lunar surface is the most pristine environment that we have access to, because the regolith builds up so slowly and erosion happens so slowly that you do have the whole imprint of the solar system on the moon as geological records, which we don't have on the Earth," says Waldmann.

Mark Sephton at Imperial College London supports the proposal, but says a balance is needed. You want to at least have the equivalents of national parks that can be used to study the moon's history, he says. "But at the same time, human beings need to explore and move out into the solar system." ▮