

NASA

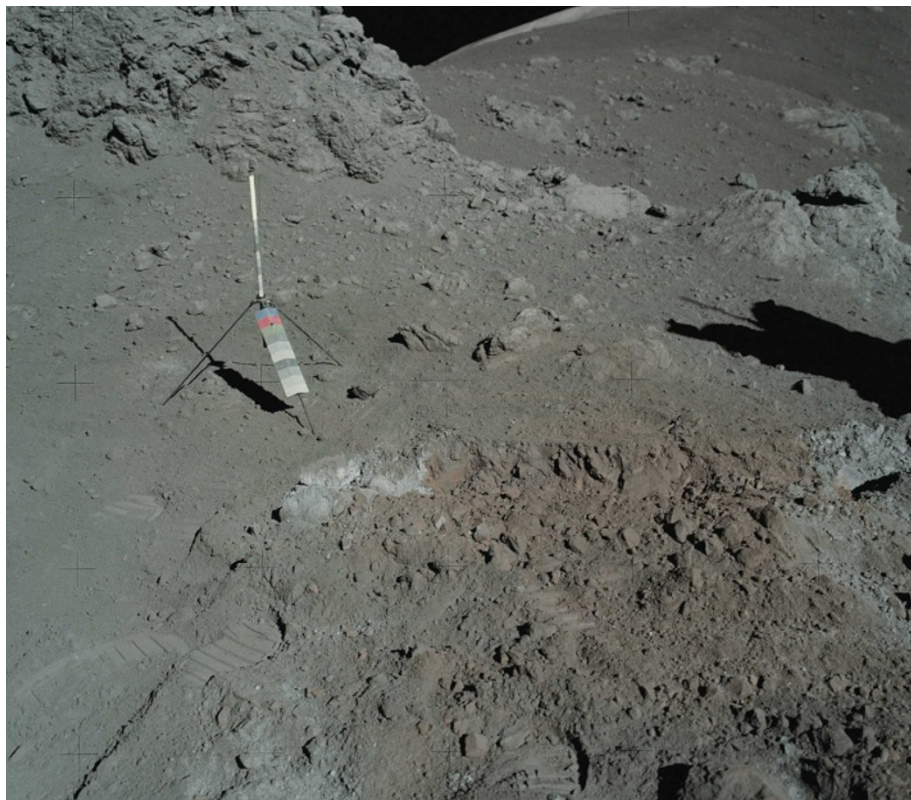


Figure 1 | Glass bead game. Orange soil discovered by the Apollo 17 astronauts on the rim of the Shorty crater on the Moon. The colour is due to the presence of numerous glassy spherules, 0.1–0.4 mm in diameter, which are orange because of their high titanium content. The glasses are thought to be products of volcanic fire fountains. They were buried in the soil after eruption and exposed during the impact responsible for the crater. The high concentrations of water found within the glasses by Saal *et al.*² suggest that the Moon may have had a damper origin than previously thought.

volatiles are assumed to have condensed onto the glasses from hot, transient plumes of gas associated either with lunar volcanism or meteorite impacts. However, Saal *et al.*² have looked for the presence of indigenous volatiles deep within the glasses. Using a technique known as secondary ion mass spectrometry (ion microprobe), the authors found significant amounts of chlorine, fluorine, sulphur and water, with the highest concentrations at the cores of the glass beads. This relationship is the opposite to that which would be seen if the volatiles had been added to the glass by any process, including contamination back on Earth, after its formation. The volatiles are present at depths of between 18 and 140 μm (and presumably deeper in large enough fragments). This also precludes a significant contribution of solar wind, because solar ions penetrate to a depth of only about 0.1 μm , even if hydrogen from the solar wind can diffuse to greater depths after its implantation⁷.

The simplest explanation is that these volatiles were present in the molten glass when it formed. Their distribution profile would then be a result of volatile loss by diffusion from the surface of the glasses during the short period when solidifying droplets were exposed to the lunar vacuum.

Modelling the initial water content before such degassing depends on the size of the

droplets, the diffusion coefficient of the water in the molten glass, and the temperature path encountered between eruption and quenching (the period during which volatiles could be lost). Saal *et al.*² calculate that the observed concentration profiles result from high initial levels of volatiles, although the precise concentrations are uncertain. Initial water contents could have been as low as 260 p.p.m. or as high as several thousand parts per million, with best fits to the data around 750 p.p.m., values similar to those in the MORB glasses. Most of the variations between samples probably resulted from variations in the degassing process.

These results raise many questions. Are the volatile contents of the melts that formed the green and orange glasses typical for the Moon? Can the general scarcity of most volatile elements on the Moon be reconciled with the apparent abundance of sulphur, chlorine, fluorine and especially water in the lunar glasses? What happened to all the water during the Moon's formation? And if the Moon is not bone dry, where did the water come from?

Another mystery in lunar geochemistry is that the relative abundance of the various oxygen isotopes on the Moon is the same as that on Earth to within 0.0005% (ref. 8). Different explanations have been proposed for this puzzling observation (Earth, Mars and all meteorites have different oxygen isotopic



50 YEARS AGO

In the past ten years the number of television licences in Britain has grown from less than 15,000 to nearly eight million, and the estimated number of adults aged sixteen or more in homes with television sets from 80,000 (all in the London region), which was 0.2 per cent of the total adults, to 21,850,000 or 57.9 per cent. For every person who had a television set in 1947 there are five hundred to-day, and six out of ten adults can see television in their own homes ... The United Kingdom now ranks third with Canada in its ratio of persons to television receivers (6); only the United States (4) and Hawaii (5) exceed it ... Published evidence as to the effect of television on social habits and hobbies does not indicate a wide difference between the habits of those owning television sets and those without, in many activities such as sport, gardening, theatre-going and card-playing: the most significant differences appear in reading, attendance at the cinema, church-going and dancing.

From *Nature* 12 July 1958.

100 YEARS AGO

Count Zeppelin last week made a remarkably successful flight in his new airship ... The distance covered is estimated at 250 miles, and the journey lasted twelve hours. The greatest height reached by the airship's own engine-power is stated to be some 750 metres, and the highest speed 15.3 metres per second ... We notice that Count Zeppelin has received a telegram of congratulation from the German Emperor.

ALSO:

The prize of 10,000 francs (400l.) offered by M. Armengaud to the first aeroplane to remain in the air for a quarter of an hour was won by Mr. Farman on Monday ... Mr. Farman made a flight with his apparatus which lasted 20m. 20s. according to official timing. He covered a distance of about eleven miles.

From *Nature* 9 July 1908.

50 & 100 YEARS AGO