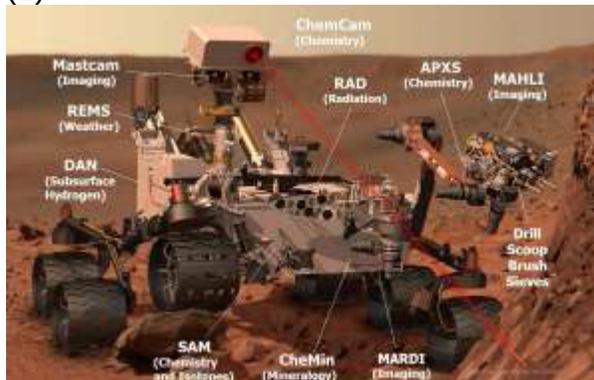


Tuesday 7th February 2017: "Recent Curiosities on Mars" - Pauline Macrae (HAS)

Mariner 4 took the first close up photographs and these showed a disappointingly dry and dusty planet until Mariner 9 and the Viking Orbiters went into orbit around Mars and discovered a world of giant volcanoes, an immense canyon system and indications that Mars was once wet with possible rivers.

The other landers have confirmed that Mars was once wet, so Curiosity was to go a step further and look for places where micro-organisms could have lived.

(1)



Curiosity (1) is a big lander and carries a suite of ten instruments mostly designed to determine the minerals of the rocks and soils – after all Curiosity is taking the place of a geologist. There are also cameras to take photographs. The landing took place in August 2012 after a very complicated set of procedures to set it down on the surface.

Gale crater (2) was chosen because it contained a layered mountain, called Mount Sharp (formally known as Areolis Mons). The Mars Reconnaissance Orbiter satellite had determined that the lower layers had been made of clay minerals, haematite and sulphate minerals, which have all been either laid down by water or altered by water in some way. If searching for habitable environments it's important to choose somewhere that was once wet to give microorganisms the best chance of survival.

(2)



Close to its landing site was an alluvial fan – a deposit of water transported materials – and possible clay minerals. A good place to start exploring, and very quickly Curiosity came across an ancient streambed (3) with sedimentary conglomerate rock. The pebbles cemented in sandy material were too big to have been transported by wind, so must have been moved by water moving at walking pace, for perhaps a few kilometres starting beyond the rim of the crater, and across the floor of the crater in the form of streams or rivers ankle to hip deep.

Further on, Curiosity drove over mudstone, confirmed by taking a sample, which proved to be clay of a type that on Earth is common in lake deposits and found in biologically rich environments. They also found organic molecules, chemicals that are required by life, and are an energy source similar to the one used by rock eating microbes on Earth. The clay was made from eroded basaltic rock (basalt is a volcanic rock which is the most common rock found on Mars) and it is believed that the water would have been fresh water – not the acidic water that may have been in the area where Opportunity is exploring. Mineral veins in the rocks showed that groundwater would have been circulating with a different chemical mix.

(3)



Curiosity drove along the edge of Mount Sharp through some interesting terrain (4). It first explored an area that has been called Glenelg, then came across hills of sandstone, which are called buttes and mesas. At one point it found itself looking at what was most probably a lakebed with sandstone layers at the edge where rivers deposited their load of sediment, and the finer clays would have then gradually fallen to the bottom of the lake to form mudstone.

(4)



The many layers of sand are astonishing (5). They are capped by erosion resistant sandstone that was the same material Curiosity found itself driving over and which necessitated checking its wheels for damage.

(5)



In summary, it is thought that Gale crater was formed around 3.8 billion years ago and the impact cracked the basement rock allowing ground water carrying various chemicals to circulate. Rivers brought sediment from beyond the rim of the crater and gradually began to erode the north rim and wall of the crater. Water poured down the wall bringing in pebbles, sand and fine clay which was deposited in a lake. The lake level rose and fell numerous times and sediment gradually built up at the edge of the lake. During a drier time, sandy material was brought into the crater to form sand dunes around Mount Sharp, and these were subsequently buried by more sandy, dusty material squashing the sediments present to form the conglomerate, sandstone mudstone and petrified dunes. Water circulated within cracks formed in the sediments driving chemical reactions, dissolving some minerals and precipitating others.

Curiosity is still to reach the haematite ridge, clay-rich bedrock and sulphate rich hills beyond. The light rock in this photo is probably sandstone that has not been altered by water. We have been exploring Gale Crater with Curiosity to look for habitable conditions and have found them. Hopefully our curiosity will eventually enable us to find life on a world other than our own.

This was a really interesting talk to research and I find it fascinating just how much our knowledge of Mars has grown in the last 40 years, when the first landers, Vikings 1 and 2, reached the surface. Perhaps one day, we will actually find fossilised remains of microorganisms.