

Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *The Venera missions*.

Well folks it's time to settle back for some lead melting, super-rotating, 1500 psi atmospheric stories of the Russians' early explorations of Venus. The sixteen Venera probes carried a string of interplanetary firsts which, like a lot of Russian space exploration activities, probably deserve a lot more attention than they generally get.

To give some historical context, Venera 1 was actually launched from an orbiting space platform which was in fact Sputnik 8 – and of course launching from an orbiting space platform made Venera 1 the first spacecraft deployed from low Earth orbit on February 12th 1961.

Venera 1 provided the first evidence that the solar wind pervaded throughout interplanetary space, but perhaps as a consequence, its telemetry then failed. We know that it passed within about 100,000 km of Venus, but otherwise that was that. Venera 2 launched in 1965, passed within about 25,000 km of Venus, but its electronics had also failed well before that time. Venera 3 though - was the first ever landing, albeit a crash landing, on another planet in March 1966. But once again, its telemetry had failed, well before crashing, so it returned no data about the planet.

Venera 4 was the first spacecraft to return data about another planet's atmosphere and was initially claimed as a successful landing by the Russians - except that the Americans came back with atmospheric occultation data collected by Mariner 5 - which indicated that Venus' atmospheric pressure at ground level was somewhere between 75 to 100 Earth atmospheres. And since Venera 4 was only rated to survive 25 atmospheres of pressure, well... The Russians conceded that Venera 4 was at least their second successful interplanetary crash-land in October 1967.

Venera 5 and 6 avoided the whole landing issue and just sampled Venus' atmosphere. Venera 7 though, finally pulled it off. It's lander was hugely over-engineered, substituting scientific instruments for lots and lots of structural integrity - so even when its parachute failed and it ended up landing toppled over on its side, it could still report on the temperature and atmospheric pressure (and not much else) at the surface of Venus. So, in December 1970 Venera 7 was the first spacecraft to more-or-less soft-land on another planet and return data. The data showed that Venus's surface had a temperature of 470 degrees Celsius and a pressure of 90 atmospheres. The Venera 7 lander managed to transmit data for about 58 minutes before succumbing to these extreme conditions - which was not too shabby.

Venera 8 was pretty much a copy cat mission - most of these early missions were paired to maximise the chances that at least one of them would work. Venera 8 managed only 50 minutes of data transmission before it succumbed, but this data included the fact that Venus' dense cloud layers didn't extend down to the ground - and that the amount of light reaching the surface was roughly equivalent to an overcast day on Earth. This of course meant... photo opportunity.

Venera 9 was one of next generation of Venera landers that included cameras. Venera 9 took the first ever close-up photo of the surface of another planet in October 1975. Venera 9 also confirmed that Venus' atmospheric chemistry included hydrochloric acid, hydrofluoric acid, bromine and iodine. Yum.

Venera 10, was the twin mission to Venera 9 and landed only 2,200 km from it three days later. Just like Venera 9, it was able to sustain itself at the surface by virtue of a system that circulated coolant to distribute the heat load - so that it managed to transmit data for a record 65 minutes.

But, from there, the Americans started catching up. In July 1976 - Viking landed on Mars and sent back a colour image of the Martian surface.

So of course, in 1978 and 1980, Venera 11 and 12 successfully landed on Venus with colour cameras. But... the lens caps didn't come off - and being almost identical twins the lens caps didn't come off any of the cameras for either of the missions. Ouch. This became an iconic warning to all future space missions – that it's all very well building all this cool technology and clever engineering to land on another planet - but if the lens cap doesn't come off, no vodka for you.

Anyhow, for Venera 13 and 14 both landing in March 1982 - the lens caps came off. Venera 13 delivered the first color photo from the surface of Venus and analysed the first ever soil sample - which was a composition of alkaline gabbroids, if you really want to know. The lander maintained active transmission for a whole 127 minutes. Venera 14 was similarly successful, apart from its soil sampler swinging out onto one of the discarded lens caps and conducting an analysis of a terrestrial artifact on a different planet.

Venera 15 and 16 - again twins - were both orbiting-only space craft which set about radar mapping a section of the surface of Venus from orbit in 1983 over an eight month period. Although clever and ground breaking and all that - the bland, grainy greyscale images produced didn't quite capture the public imagination. The Americans followed a similar strategy using the Magellan spacecraft. Magellan entered Venus' orbit in 1990 and radar-mapped the entire surface of Venus for a four year period - delivering a spectacular suite of images in both colour and 3d.

Although that was the end of the Venera program - as a bit of a postscript, it was followed by the Vega missions - being Vega 1 and 2, which were roughly based on the Venera 9 and 10 design - and which arrived at Venus in 1985. Both had Venera-style landers, although Vega 1's lander commenced its surface survey program at 20 kilometres altitude after being hit by a strong wind jolt.

Vega 2's lander though, did land successfully and determined from a soil sample (of anorthosite-troctolite, if you want to know) that it had sampled the oldest Venus surface material of any Russian probe.

Both Vega mission also had balloon-aerobots - three metre balloons with a suspended gondola of scientific instruments beneath - which could float at a 54 kilometre altitude. Both aerobots were whizzed horizontally around the planet from nightside to dayside in Venus' hurricane-speed upper atmosphere over a 45 minute period before the batteries ran out.

Both aerobots confirmed that the air pressure and temperature at this altitude were roughly equivalent to Earth surface conditions, apart from the atmosphere being largely CO₂ with a trace of sulphuric acid. So it is potentially a habitable zone - if you have your own air supply and an acid-proof balloon.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website where we'll never say nyet to a space mission. No ads, no profit, just good science. Bye.