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12.002 Physics and Chemistry of the Earth and Terrestrial Planets  
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# Venus

1761 – First knowledge of intrinsic properties from observations by Russian astronomer M. V. Lomonosov. Observed Venus transiting Sun, sunlight refracting around disk, --> Venus has a thick atmosphere!

By 1932 – CO<sub>2</sub> known as major atmospheric constituent

CO<sub>2</sub> is 95% of atmosphere. 95 bar surface pressure.

1930s – Rupert Wildt proposed CO<sub>2</sub> greenhouse effect: surface well above H<sub>2</sub>O boiling point

1962 - Carol Sagan - microwave thermal emission indicates surface temperatures >700 K

Water in atmosphere < 0.1%

More than dozen orbiters, 7 landers since

Orbit is prograde, period of 225 days, retrograde spin with 243 day period. Venusian "day" lasts 117 Earth day

Venus topography is not compensated! First order observation

So dynamically supported: mantle upwelling (plumes)!

Very young surface (500 million years old), but no evidence of plate tectonics

Was resurfaced at 500 Ma. Resurfacing took place within a period of only 100 million years

Virtually no craters because of young surface and because small impactors cannot survive atmospheric passage

Flood basalts

Thick lithosphere

Russian Venera landers: detected K, U, Th and major elements: roughly basaltic

No obvious trenches, volcanic arcs, or other signatures of plate tectonics.

More than a thousand volcanoes

Coronae - usually 100 km across. Age? (surface possibly 200 my - 1 billion years old)

Two hypotheses for origin, related to the geodynamics of the interior - are they rising or falling features (anomalous high density differences causing falling or hotspot plume causing rising?). No Earth analogs.

Are these features of a very small hot lithosphere? (but it is pretty thick now)

Partly compensated area on Venus, depth of compensation is about...200-300km thick lithosphere, with a deep mantle root - effective in inhibiting tectonics

One scenario for Venus evolution: maybe Venus did have plate tectonics which stopped as planet progressively cooled and the lithosphere thickened. Once plate tectonics stopped, volcanism would likely have dropped dramatically (stagnant lid regime). Perhaps this is what happened 500 million years ago? Eventually, lithosphere became so thick it founders back into mantle and plate tectonics could start anew.