The Simulation of The Mars Polar Cap Formation

Tomonori Hayakawa[1]

[1] Astro.,Kyoto Univ.

The polar caps have a difficult problem. The northern remnant cap is made of H20. On the other hand, the southern remnant cap is made of CO2. Some models for the cap formation have been constructed. They couldn't explain why CO2 was rest in the southern remnant cap, although they showed the seasonal behavior of the caps well. So in order to understand the southern remnant cap, we simulated the cap formation with the thermal balance model containing Mars Pathfinder's data.

The polar caps are made of CO2 which is a main component in the Mars atmosphere. As to the simulations, Leighton and Murray(1966) proved that CO2 certainly condensed under Mars atmospheric condition, and showed the seasonal behavior of the polar caps. Then in their calculations, they expected that the atmospheric pressure would decrease while the CO2 condensation season and increase while the CO2 sublimation season. This pressure's behavior was confirmed by Viking's measurement(1976). So Leighton and Murray model could explain most of Mars polar caps.

But a new problem occured after the data reduction of Viking. In Leighton and Murray model, no CO2 cap was rest in summer. So people expected that the remnant caps were made of H2O. From the surface temperature profile of the northern remnant cap taken by Viking, it's confirmed that the component of the northern remnant cap was H2O. Since summer of the southern hemisphere coincides with the perihelion, people thought that the component of the southern remnant cap should be H2O. But Viking's measurement showed that the main component of the southern remnant cap was CO2. Why CO2 ice is rest in the southern remnant cap, although the southern hemisphere receives more solar isolation than the northern one? There are two possibilities for this question. One is that the albedo of the southern cap is higher than that of the northern cap. The other is that the dust storms which occur at the southern hemisphere in summer have something to do. Both causes decrease the heat absorbed in the ground and delay CO2 sublimation. Since this problem couldn't be tested with Leighton and Murray model which ignored the atmospheric effect, Narumi constructed the 1D thermal balance model considering the atmospheric effect and the dust effect. Then we simulated the cap formation with Narumi model and the new data of Mars Pathfinder. Although we tested with the dust optical depth 0.1-10.0, the dust didn't have anything to do with the cap formation so much. Rather if the albedo of the southern cap is higher than that of the northern cap by about 0.2, the southern remnant cap could be rest. Here we report this simulation in detail.