NEW GROUND-BASED NIGHTGLOW OBSERVATIONS OF VENUS AND THEIR INTERPRETATION

T. G. Slanger, P. C. Cosby, D. L. Huestis
Molecular Physics Laboratory, SRI International, Menlo Park, CA
Email: tom.slanger@sri.com

The mesosphere/lower thermosphere region of Venus is similar to that of the earth in that the active component is oxygen atoms, although in a buffer of CO₂/N₂ rather than O₂/N₂. As a result, there are comparable UV emissions from NO, and the Herzberg states of O₂ are important emitters in both atmospheres. Compared to the earth’s rotation period, Venus is static, and atoms are replenished not by periodic exposure to sunlight, but by high altitude winds that sweep atoms from the sunlit side to the dark side. The emissions arise as atoms recombine.

The visible nightglow of Venus was first viewed by the Venera 9/10 orbiters, in 1974. The strong emission was ultimately shown to be the v’ = 0 progression of the Herzberg II system of molecular oxygen. This is the weakest of the emissions from the Herzberg states in the terrestrial atmosphere, yet at Venus has a system intensity on the order of 5 kR, much larger than the total terrestrial Herzberg state emission.

The O₂ Infrared Atmospheric system can be immensely strong in the Venus nightglow, corresponding to intensities equivalent to the atom recombination rate. It is also quite variable, exhibiting changes in relative intensity much larger than those seen with terrestrial emissions. The source of this variability has not yet been clarified. Ultraviolet measurements were carried out by the Pioneer Venus Orbiter, and the morphology of the NO emissions resulting from N + O recombination were studied, again showing considerable variability across the dark disk.

One of the most characteristic features of the terrestrial nightglow is the oxygen green line emission at 558 nm, which was not identified in the Venera spectra. Measurements carried out at the Keck I telescope in Nov. 1999 [1] and at the APO telescope in Feb. 2001 [2] show that the green line is another highly variable feature. In the former observation the green line was quite strong, with a zenith intensity comparable to the terrestrial value, while in the latter instance it was weak or absent altogether. Nevertheless, in all measurements to date, including those from the orbiters, the O₂(c-X) Herzberg II emission is strong and roughly constant; the new ground-based spectra providing full rotational resolution. Possible reasons for these effects will be discussed.
