SO_2 ON VENUS: IUE, HST AND GROUND-BASED MEASUREMENTS, AND THE ACTIVE VOLCANISM CONNECTION: C. Y. Na, Southwest Research Institute, E. S. Barker, McDonald Obs. UT Austin, S. A. Stern, Southwest Research Institute, L. W. Esposito, LASP, U. of Colorado, Boulder.

I. SO_2 and volcanism on Venus

UV observations by Pioneer Venus from 1978 to 1986 detected a large decline of SO_2 above the clouds of Venus [1]. The decline of SO_2 has been confirmed by the International Ultraviolet Explorer (IUE) observations made in 1979 and 1987 [2]. Pioneer Venus also observed a decline in sulfuric acid aerosols from the polar regions of Venus [3]. Further still, both Pioneer Venus and Galileo have detected radio signals that have been attributed to lightning activities in the atmosphere of Venus [4,5]. Based on these observations, Esposito [6] proposed that the Venus may be volcanically active, and the large decline of SO_2 above the clouds can be interpreted as the recovery of the atmosphere following the injection of SO_2 from a volcanic eruption. If this hypothesis is correct then remote sensing of the Venus atmosphere may provide important clues to the current state of Venus geology.

In early November 1991, we obtained IUE spectra of Venus with the Long Wavelength Prime (LWP) spectrograph. On the same days, we obtained spatially resolved spectra and images of Venus using the 2.7m telescope at McDonald observatory [7]. As shown in the accompanying figure, these two observations seem to indicate that the mixing ratio of SO_2 above the cloud increased by about a factor of 2 since 1990.

More coordinated IUE and ground-based observations are planned for 1993 to determine whether the increase of SO_2 has continued. The first of the planned observation is to take place using IUE and the 2.7m telescope at McDonald observatory from 8 January to 12 January. The results from these new observations will be presented. At the time of Venus' western elongation in early June 1993, we hope to obtain (i) IUE spectra, (ii) ground-based spectra, and (iii) the first-ever Hubble Space Telescope (HST) spectra of Venus. If SO_2 is indeed increasing above the clouds, then these measurements may help us to determine the rate of increase in SO_2 above the clouds.

II. SO, S_2O and dark markings

IUE observations of Venus were used to identify SO (sulfur monoxide) in the atmosphere Venus for the first time [2]. According to photochemical models [8], SO plays an important role in the chemical processes in the upper clouds. The mixing ratio of SO was determined from IUE and rocket observations to be about 10% of SO_2 [9]. The disulfur monoxide, S_2O, which is produced from photochemical reactions involving SO may be responsible for the dark markings in the clouds [10]. Thus the IUE observations of Venus are not only important in documenting the long-term change in SO_2 and SO, but are also important in understanding the chemistry and dynamics of the Venus atmosphere.

HST observations of Venus are critical because, with the end of the Pioneer Venus mission, HST will be only instrument capable of making regular observations beyond IUE which is starting its 16th year in orbit. HST can both make images and take spectral observations. The imaging capability of HST will make a valuable contribution to understanding the connection between the atmospheric dynamics and the distribution of photochemically active species.

III. Conclusion

Magellan images have shown that the volcanic features are widespread over the surface of Venus. The question of whether there is active volcanism is important for understanding both the atmospheric and the geological processes on Venus. The thick cloud cover of Venus precludes any direct observation of active volcanoes even if they exist. The only means of monitoring the active volcanism on Venus at present seems to be remote sensing from Earth. Continuous of monitoring of SO_2 is important to establish the long term trend of SO_2 abundance and to understand the physical mechanism responsible for the change.

References
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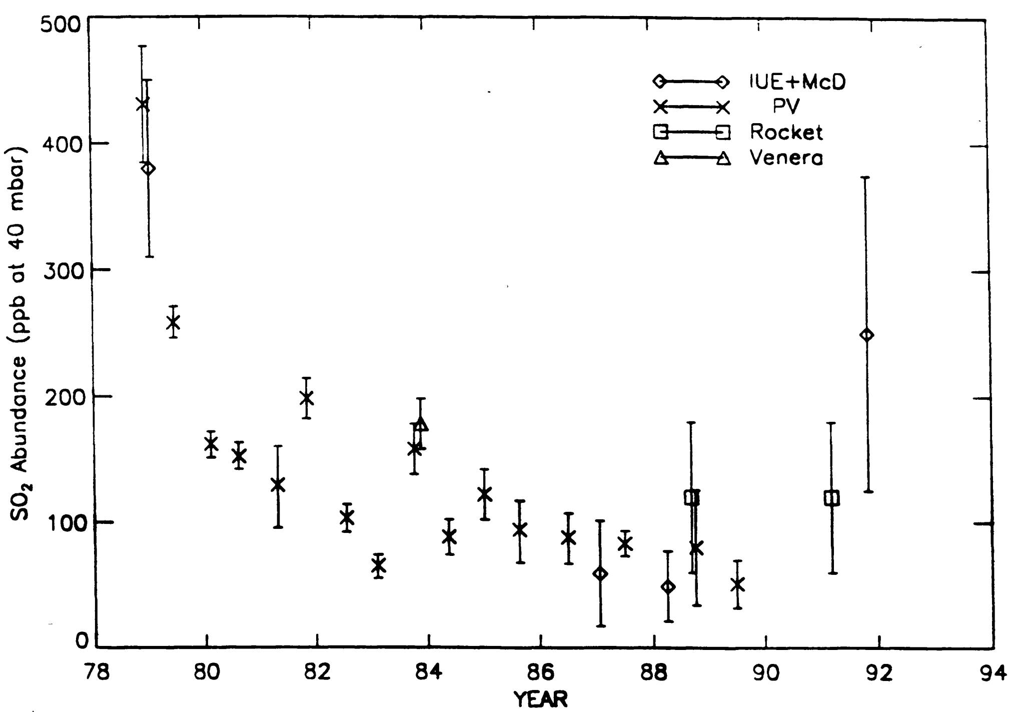

Mixing ratio of SO_2 at the cloud top level in the Venus atmosphere derived from the IUE, rocket, Pioneer Venus, Venera-15, and ground-based observations.