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Follow-up Observation of Jupiter's Atmosphere 19 Years after the SL9 Event

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Cometary Impact as the Supply Source of Volatile Gases on Planetary Atmosphere

In 1994, the impact of comet Shoemaker-Levy 9(hereafter SL9) had changed the Jupiter's atmospheric composition. The abundance of CO and HCN had increased vigorously to realize 10ˆ3 to 10ˆ4 times larger value than before the SL9 event. Besides, some S-bearing molecules were found and produced newly(Moreno et al. 2003)?. Similarly, on Neptune, it is expected that similar impact process has realized 50 ? 1000 times as large CO abundance as the other three gas giants(Lellouch et al. 2005)? (A. Marten et al. 2005)?. Studies on such huge disturbance induced by cometary impact is very important because such process can affect the atmospheric composition of gas giant largely. Revealing the chemical evolution of the solar system planet's atmosphere is main issues in planetary science. Detailed studies on the entire chemical processes from cometary impact to the end of reaction are needed.

Our observation in 2012

Studies on the SL9 event and its aftermath are very important especially because it is the only case where the cometary impact can be monitored in detail. Even now, little is known about how long the influence of the SL9 continues to affect on Jupiter's atmosphere. Constructing and examining the chemical evolution are the key for full understanding of cometary impact as part of atmospheric evolution processes.

We have focused on the sulfur chemistry because CS and S-bearing species were known to be produced after the SL9 event. Studies on the chemical evolution of S-bearing species suggest that CS is a daughter species of S2 and CS2, and had been continuously produced for a year after the SL9 event (Moses et al. 1995). This scenario is supported by stable abundance variations measured from 1995 to 1998 (Moreno et al. 2003). However, since no observation was reported since 2003, we have planned a new observation of impact remnant gases to obtain their abundance and derive their decay time in 2012. We observed CS(J=2-1), CO(J=1-0) and HCN(J=1-0) rotational lines in millimeter waveband using Nobeyama 45-m telescope of NAOJ. Our observation found that CS abundance has decreased significantly, placing its upper limit as one tenth of the abundance measured in 1995. The finding may allude to a hypothetical scenario that the CS destruction process has already begun and its destruction mechanism may be due to photochemical evolution.

CS Destruction Processes and Our New Observation Plans

It is suggested that only a few processes can remove CS permanently (Moses et al., 1996). Furthermore, photo-dissociation process is important as well because the lifetime of CS against photolysis is very short at 1AU (Canaves et al., 2001) and as to be taken into account. We have tested the recycling process of photolysis with simple one-box model. The modeled time variation of the CS abundance, assuming the lifetime of CS only, as against photolysis has shown clear discrepancy with the observed result. Thus, dissociated S atom is suggested to be recycled.

We are planning new observation to obtain CS abundance with more sensitive observation in sub-millimeter waveband. Next, survey observation of S-bearing species which are candidates of daughter species of CS. In this presentation, detail of our observation and a model of chemical processes will be presented.

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