

## Global mapping of the CO<sub>2</sub> isotopologues in the Martian atmosphere as observed Subaru/IRCS

Hiromu Nakagawa<sup>1\*</sup>, Shohei Aoki<sup>1</sup>, Yasumasa Kasaba<sup>1</sup>, Hideo Sagawa<sup>2</sup>

<sup>1</sup>Geophysics, Tohoku University, <sup>2</sup>National Institute of Information and Communications Technology

We investigated Martian CO<sub>2</sub> isotopic ratios at 2-4 micron spectra observed by Subaru IRCS.

The determination of the isotopic ratios on Mars is important to study atmospheric evolution. The relative abundance of isotopes of CO<sub>2</sub> provides insight into the loss of Mars primordial atmosphere. In addition, the distributions and variations of C and O isotopes can constrain the information about the magnitude and distribution of sources and sinks of CO<sub>2</sub>, i.e. the global coupling between surface, aerosols, and atmosphere. Photochemical reaction, condensation into the polar caps and aerosols, soil and subsurface reservoir respiration impart C and O isotope signals to the atmosphere that can be used as a tracer at various temporal and spatial scales.

High-resolution global imaging spectroscopy of Martian CO<sub>2</sub> isotopologues has been achieved at 2-4 micron (2970-3050 cm<sup>-1</sup>) by IRCS with Subaru telescope on 30 November 2011 (Ls=37), 4-5 January 2012(Ls=52), and 12 April 2012 (Ls=96). Owing to its wide wavelength coverage, our measurements obtained a comprehensive dataset of CO<sub>2</sub> isotopes (626, 627, 628, and 636) & water vapor isotopes (H<sub>2</sub>O and HDO) simultaneously, providing a global perspective on their near-surface distributions.

Spectra were collected in the northern hemisphere at a spectral resolution of R=20,000. The diameter in these periods of Mars was more or less 9 arcsec. The seeing was 0.5-0.8 arcsec (pixel scale: 0.06 arcsec). We used two slit positions. The slit along the N-S direction on Mars covered the region between the northern polar cap and the equator, in order to investigate the sublimation of the polar cap and condensation into the CO<sub>2</sub> ice clouds at mid-latitude. The W-E direction of the slit position was also selected in order to clarify the local-time dependence surrounding of sub-solar area. The mud volcanic regions, Utopia/Isidid Nilli Forssae, Sytris Major, were also covered by these observing runs.

Terrestrial absorptions were reduced using standard-star calibrations in order to retrieve the Martian isotope lines. After that, we could successfully obtained clear CO<sub>2</sub> isotopes (626, 627, 628) absorptions in the range of 3330-3380 cm<sup>-1</sup> for 626, 2620-2640 cm<sup>-1</sup> for 627, and 2630-2660 cm<sup>-1</sup> for 628, respectively. The 3400 cm<sup>-1</sup> range shows lines of 636. Finally, the chosen spectral range involves plenty good enough lines of the Martian CO<sub>2</sub> isotopes.

In this paper, we will present these isotopologues, their distributions, and seasonal variations. Their S/N will be quantitatively discussed.

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