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High CO_2 Abundance in Interstellar Comet 2I/Borisov Inferred from Oxygen Line Ratio Measurements

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The appearance of interstellar comet 2I/Borisov in late 2019 provided an unprecedented opportunity to measure the volatile composition of a cometary object from outside our solar system. Many interesting findings have been discussed in the literature, including a CO abundance higher than most solar system comets, but no direct measurement of CO_2 has been reported, due to the necessity of space-based observations to detect CO_2 directly. Observations of [OI] emission in the optical can be used as a ground-based proxy for CO_2 in comets, but is limited in its accuracy by incomplete knowledge of [OI] photochemistry in cometary comae. Despite this, empirical methods have reproduced observed CO_2 abundances in comets with some success. Analysis of the [OI] emission in Borisov was presented by Opitom et al. 2021, and they found a high value for the flux ratio of the [OI]5577 A line to the sum of [OI]6300 and [OI]6364 A lines of ~0.3, whereas most solar system comets have observed ratios between 0.05-0.1. While such a high ratio could be due to the high CO abundance observed for Borisov, we will present new analysis of the [OI] emission that suggests that this high ratio actually reflects a high CO_2 abundance for Borisov, with a CO_2 production rate on par with its H_2O and CO production rate. This finding is supported by as yet unpublished NEOWISE observations, which are sensitive to CO_2. This, in conjunction with the previously reported high CO production rate, would imply that Borisov is a hypervolatile-rich object compared to most solar system comets (with the combination of CO and CO_2 being more abundant than water), meaning that it perhaps underwent formation in a colder region of its protoplanetary disk compared to solar system comets.