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CO₂ in Ganymede's exosphere revealed by JWST

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Jupiter's icy moon Ganymede has been seen to have a tenuous exosphere produced by sputtering and possibly sublimation of water ice. To date, only hydrogen and oxygen have been detected in this exosphere (Barth et al., 1997; Hall et al. 1998; Roth et al. 2021). Here, we report on the first detection of CO₂ in Ganymede's exosphere through observations of the 4.3 microns band with the NIRSpec/IFU instrument of the James Webb Space Telescope. Maps of the CO₂ gas distribution over the leading and trailing hemispheres reveal an unexpected patchy CO₂ exosphere. CO₂ gas is observed over different terrain types, principally those exposed to intense Jovian irradiation, but also over some bright or dark terrains. The highest CO₂ column density is found over the north polar cap of the leading hemisphere, which also has unique surface ice properties. The distribution and production mechanisms of CO₂ vapor will be discussed using simulations of Ganymede's exosphere (Leblanc et al. 2017) and through comparison with maps of surface ice properties obtained with JWST (Bockelée-Morvan et al. 2024).

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