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Super-adiabatic Temperature Gradient at Jupiter's Equatorial Zone and Implications for the Water Abundance

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The temperature structure of a giant planet was traditionally thought to be an adiabat because convective mixing homogenizes entropy. The only in-situ measurement made by the Galileo Probe detected a near-adiabatic temperature structure within one of Jupiter's 5 hot spots with small but definite local departures from adiabaticity. We analyze Juno's microwave observations near Jupiter's equator (0 ~ 5 ^{o}N) and find that the equatorial temperature structure is best characterized by a stable super-adiabatic temperature profile rather than an adiabatic one. Water is the only substance with sufficient abundance to alter the atmosphere's mean molecular weight and prevent dynamic instability if a super-adiabatic temperature gradient exists. Thus, from the super-adiabaticity, our results indicate a water concentration (or the oxygen to hydrogen ratio) of about 4 times solar with a possible range of 2 ~ 7 times solar in Jupiter's equatorial region.