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Water on Jupiter and the Formation of the Giant Planets

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Models for the formation of giant planets depend on a knowledge of atmospheric composition. While the Galileo Probe into Jupiter's atmosphere gave us global abundances of He, Ar, Kr, Xe, C, N, and S, its descent through an anomalous, downwelling region of the atmosphere only permitted it to set a lower limit on the global abundance of O, as derived from H2O. We will review this measurement and compare it with previous remote sensing observations of H2O. The probe measurements reveal that the water vapor abundance continues to increase well below the lowest atmospheric level that can be sounded by the infrared spectroscopy used for the remote observations. As a result , we do not yet know the global, well-mixed value of O/H on Jupiter. As O is the third most abundant element in the universe, this is a major loss. We will discuss the significance of this gap in our knowledge for models of giant planet formation, presenting alternative predictions from different models. Finally, we show how remote sensing by Juno, a dedicated orbiter equipped with microwave antennas, can sound levels of 50–100 bars in Jupiter's atmosphere, thus yielding the missing global value of O/H.