THE DEEP COMPOSITION OF GIANT PLANETS FROM THERMOCHEMICAL MODELING AND IN SITU EXPLORATION. T. Cavalié[1,2], [1]Laboratoire d'Astrophysique de Bordeaux, Univ. Bordeaux, CNRS, B18N, allée Geoffroy Saint-Hilaire, 33615 Pessac, France (thibault.cavalie@u-bordeaux.fr), [2]LESIA, Observatoire de Paris, PSL Research University, CNRS, Sorbonne Universités, UPMC Univ. Paris 06, Univ. Paris Diderot, Sorbonne Paris Cité, Meudon, France.

The vast majority of the known exoplanets are giant planets. These planets shape their systems because of their gravity, migration, and relatively short formation timescales when compared to terrestrial planets. To understand how planetary systems form, we must first better understand how giant planets form.

There are essentially two formation models for giant planets: core accretion and gravitational collapse. To differentiate these models, gravity and magnetic field measurements are required, along with deep composition. The latter also enables us to constrain the processes that led to the condensation of the primordial ices and the trapping of heavy elements (pure condensates, amorphous ices, clathrates) in the protosolar nebula.

In situ probes are essential in this prospect. The Galileo probe measurement of an overall enrichment in noble gases, and other main elements of a factor of ~3 has been interpreted as the signature of core accretion for Jupiter. The sub-solar measurement of oxygen was attributed to local meteorology of the probe entry site. Apart from the Galileo probe measurements, our knowledge of giant planet deep composition remains very limited. The new Decadal Survey offers us a new perspective with the prospect of in situ probes to Saturn and Uranus as part of the priorities for New Frontiers and Flagship missions.

In the meantime, and while Juno is currently making a new attempt to the global deep oxygen abundance in Jupiter, remote observations combined with thermochemical modeling can help to constrain the deep composition of giant planets. In this paper, I will present recent results on thermochemical modeling of the gas and ice giant planets and make a focus on the possible synergies between in situ measurements and thermochemical modeling to advance our knowledge of giant planet deep composition.

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