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1 The origin and evolution of Titan: The View from Cassini

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From the concentrations in noble gases measured by the Huygens GCMS experiment, Niemann *et al.* (Nature, 438, 779, 2005) concluded that molecular nitrogen (N_2) in Titan's atmosphere is not primordial, but produced from ammonia (NH_3). However, ammonia has yet to be detected elsewhere in the Saturn system; in particular molecular nitrogen and methane, but not ammonia, were among the products ejected by the geysers of Enceladus. Could Enceladus and Titan have derived their present-day nitrogen in the same way? This is now among the outstanding questions related to Titan's origin that must be tackled with modeling and Cassini data. In this presentation we consider two possible starting points for the nitrogen in these two bodies—primordial N_2 and primordial NH_3—and with the help of interior models follow the overall evolution. The presence or absence of short-lived radioactivities—a timing issue for formation—and the initial abundance of ammonia (from 0 to several percent) are key not only to the source and abundance of molecular nitrogen, but the timing and mechanism of methane outgassing as well, as shown by Tobie et al. (Nature, in press, 2006). A wide variety of Cassini data ranging from future INMS sampling of Enceladus' plumes to mapping the gravitational field of Titan are relevant to addressing this issue.