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Constraints on the initial composition of low-mass extrasolar planets from the modeling of thermodynamic conditions in protoplanetary disks

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We examine the formation conditions of icy planetesimals in protoplanetary disks in order to determine the composition of ices in small and cold extrasolar planets. Assuming ices are formed from hydrates, clathrate hydrates, and pure condensates, we calculate their mass fractions with respect to the total quantity of ice included in planetesimals, for a grid of disk models. We find that the composition weakly depends on the adopted disk thermodynamic conditions, and is rather influenced by the initial composition of the gas phase. Varying the relative elemental (C/O) or molecular (CO_2/CO/CH_4) abundance ratios in the gas phase allows us to apply our results to a wide range of planetary systems, including cold planets evidenced by microlensing, hypothetical ocean-planets and carbon planets, which could be detected by Corot or Kepler. We find that a so-called 'minor species' like CO_2 or CH_4 can become the major volatile in planetesimals depending on the C/O and CO_2/CO/CH_4 gas-phase ratios.