Equation of state and optical reflectivity of shock-compressed C-H-N-O planetary ices

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Water, ethanol, and ammonia are amongst the key components of Uranus and Neptune. Knowing their equation of state, conductivity, and transport properties at planetary interiors conditions (a few Mbar and a few 1000 K) is required for developing precise structure and evolution models of the two planets as well as for explaining their puzzling magnetic fields and luminosities. The physical and chemical behaviour of such mixtures at extreme pressures and temperatures is not only important for planetology but also interesting on its own, since those conditions are characterised by the coexistence of dissociated atoms, atomic clusters and chains. This regime is very difficult to study via *ab initio* simulations and experimental verifications are required.

We studied pure water, a C-H-O and a C-H-N-O mixture, compressed up to 3 Mbar via laser-driven shock loading. The principal Hugoniot has been explored using the decaying shock technique. Moreover, off-Hugoniot states have been reached via a double-shock technique and through coupling of dynamic and static compression in diamond anvil cells. The experiments were performed at the GEKKO XII and LULI 2000 laser facilities using standard rear-side optical diagnostics (VISARs, SOP, reflectometer) to characterise the equation of state (a relation between density, pressure, internal energy, and temperature) and optical reflectivity of the shocked state.

The results show that water and C-H-N-O mixtures share the same equation of state with a trivial density scaling, while the reflectivity behaves differently in both the onset pressure and the saturation value. From the reflectivity measurements an estimation of a conductivity will be given using a Drude model. The consequences for the icy giants interiors will be addressed.