Organics and mineral composition of the interior of 67P

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The scientific objectives of the Comet Nucleus Sounding Experiment by Radiowave Transmission (CONSERT) aboard ESA spacecraft Rosetta was to perform an interior characterization of comet 67P/C-G nucleus. The knowledge of the interior is important to understand formation and evolution of comets. It is also a way to understand remote sensing observation of nucleus' surfaces in optic and microwave domains and in-situ measurements in the coma. The measurements were done by means of a bi-static sounding between the lander Philae seating on the comet's surface and the orbiter Rosetta. CONSERT operated during 9 hours after the landing and have made the measurements through the small lobe (head) of the 67P/ C-G.

The analyses and interpretation have been done using the shape of the received signals and then 3D modeling of the signal that propagated through the comet. The propagation time inside the comet permit to derive the average permittivity (= 1.27) of the cometary interior.

Permittivity data for ices and dusts were compared with our measurement and permitted us to obtain constraints on the possible constituents for comet (ices, silicates and organics) and the porosity (75-85%), showing that the refectory and semi volatile fraction is dominated by the organics material.

The shape of the signal is very close to the shape of the calibration one. The lack of signal broadening, indicating that subsurface inclusions—the primordial building blocks of the nucleus—must be smaller than the radar wavelength and/or sufficiently weak in dielectric contrast to induce no volume scattering. Simulation of wave propagation allows quantifying this maximum of heterogeneity in term of typical size and permittivity contrast when permittivity modelling gives typical composition heterogeneity. This results seems consistent with a thermal origin for the ~3-m surface bumps observed on pit walls and cliffsides.