Sample return of primitive matter from the outer Solar System

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The last thirty years of cosmochemistry and planetary science have shown that one major Solar System reservoir is vastly undersampled in the available suite of extra-terrestrial materials, namely small bodies that formed in the outer Solar System (>10AU). Because various dynamical evolutionary processes have modified their initial orbits (e.g., giant planet migration, resonances), these objects can be found today across the entire Solar System as P/D near-Earth and main-belt asteroids, Jupiter and Neptune Trojans, comets, Centaurs, and small (diameter <200km) trans-Neptunian objects. This reservoir is of tremendous interest, as it is recognized as the least processed since the dawn of the Solar System and thus the closest to the starting materials from which the Solar System formed. Some of the next major breakthroughs in planetary science will come from studying outer Solar System samples (volatiles and refractory constituents) in the laboratory. Yet, this can only be achieved by an L-class mission that directly collects and returns to Earth materials from this reservoir. It is thus not surprising that two white papers advocating a sample return mission of a primitive Solar System small body (ideally a comet) were submitted to ESA in response to its call for ideas for future L-class missions in the 2035-2050 time frame. I will present an overview of the ideas listed in one of these two white papers and discuss how such a mission would be complementary to current and future ground based observations of primitive Solar System small bodies.