



Caroline: A Search for the Source of Earth's Water

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Where does Earth's water come from? There are few questions about our planet's history that are more fundamental. Here, we describe an ESA M-class mission proposal that aims to address this question, by visiting for the first time a member of a newly-discovered family of objects in our Solar System: Main Belt Comets. These perplexing objects have stable orbits within the asteroid belt, but during certain seasons behave like comets, possessing a dust coma and tail. This strongly suggests that volatiles at their surfaces are sublimating, driving off the dust. This volatile material is likely to be water ice. Dynamical models suggest that bodies from this region brought water to Earth. The remaining Main Belt Comets hold a frozen record of the source of Earth's water. The mission's name – Caroline – is in honour of Caroline Lucretia Herschel (1750-1848), arguably the first great female astronomer, and discoverer or co-discoverer of at least six comets. The spacecraft would travel to 133P/Elst-Pizarro, over three times the Earth's distance from the Sun, capture material from its dust tail, and bring it back to Earth for highly detailed laboratory analysis. The capture of the dust will be achieved through the use of aerogel – an extremely low density material whose application to the collection of cosmic dust was very successfully demonstrated by NASA's Stardust mission to Comet Wild 2.