Activity of Distant Comets

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Comets played an important role in the origin and evolution of the solar system and individual planets. We know that by spreading volatile materials to different parts of the solar system, comets significantly influenced the development of life on Earth. Studying the physical properties of cometary nuclei and coma are also equally important to our understanding of the outer solar system environment during the era of its formation. Recently, NASA's Discovery Programs have documented the importance of cometary research. The success of these missions is enhanced by ground-based cometary research and by laboratory simulations. We present observational evidence of cometary coma development and the activity of comets at large heliocentric distances. We observed two short-period comets and thirteen long-period, dynamically new comets that have entered the inner solar system directly from the Oort cloud for the first time. Some of these comets have been observed before perihelion, some after perihelion, and some both pre- and post-perihelion. We focus on five dynamically new comets that have been observed to develop coma on their in-bound leg at heliocentric distances of 5.80 to 11.49 AU. This research includes observations of the level of nucleus activity as a function of distance. We will propose an explanation based on experiments carried out on amorphous, gas-laden ice samples that are 0.1 to 100 microns thick and formed by flowing water vapor and CO onto a cold surface. The activity was found experimentally to be associated with gas release during the annealing of the gas-laden amorphous ice.