Estimating the formation region of the cometary nuclei based on the infrared observations of cometary dust

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Comets are made of ice and dust and are the frozen relics of the early solar nebula. Determination of the properties of cometary dust provides us insight into both the early solar nebula environment and the formation process of planetesimals and planets. Dust grains of crystalline silicate, which is rarely presented in an interstellar space, were found in cometary nuclei as the spectral features in the 10-μm wavelength region. It is thought that these crystalline silicates had formed by annealing of amorphous grains and/or condensation from gas phase near the Sun in the inner solar nebula, and incorporated into a cometary nucleus in the cold outer region by the radial transportation in the solar nebula. An abundance of the crystalline dust grains was therefore expected to be smaller as far from the Sun. We carry on infrared observations of comets to understand the formation mechanism of minerals incorporated into a cometary nucleus based on its mineral abundance. To derive the mineral abundance of comets, we applied a thermal emission model for cometary dust grains to mid-infrared spectra of comets taken with the COMICS mounted on the Subaru Telescope. Based on our toy model, we discuss the possibility that the minerals of comets formed under non-equilibrium condensation in the early solar nebula, and compare this result with theoretical experimental predictions for the vaporization and condensation of silicate grains in the solar nebula.