

# Detection of the Crystalline Silicates in Periodic Comet 78P/Gehrels 2: Evidence of effective radial mixing in the proto-solar disk

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The existence of crystalline silicates in comets is one of the unsolved problems in astronomy. The crystalline silicates were generally believed to be formed from the amorphous silicates in the inner hot region of the proto-solar disk. Several mechanisms have been proposed to incorporate them into comets, which were formed in the outer, low-temperature region. The transportation efficiency together with the mechanism of radial mixing can be studied by determining the quantity of the included crystalline silicates, not only in the Oort cloud comets, which were formed in the giant-planets region, but also in Edgeworth-Kuiper Belt comets, which were born in the much outer region. Here we report the first quantitative result of the detection of crystalline silicates in comet 78P/Gehrels 2, which is a typical members of the latter class. The mass ratio of the crystalline silicates was 12%, which suggests that the radial mixing in the proto-solar disk should have been efficient enough to transport crystalline silicates into the Edgeworth-Kuiper Belt region.