

LETTER

Igneous Ca-rich pyroxene in comet 81P/Wild 2

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ABSTRACT

The Stardust spacecraft successfully returned dust from comet 81P/Wild 2 to Earth in January 2006. Preliminary examination of the samples showed abundant crystalline silicates comparable to those found in chondritic meteorites presumably formed in the asteroid belt. Here, we report results of a transmission electron microscopy (TEM) study of a pyroxene-bearing terminal particle, which contains lamellar intergrowths of pigeonite and diopside on the (001) plane. This microstructure is typical for an igneous process and formation by exsolution during cooling. Width and wavelength of the lamellae indicate a cooling rate within the range 10–100 °C/h, in close agreement with those of chondrules or lava from an asteroidal igneous rock. This observation shows that some Stardust material experienced periods of igneous processing similar to material found in the inner early solar system. This implies that igneous materials were common materials in a large region of the protoplanetary disk and were not restricted to the asteroid belt. Their presence in comet Wild 2 also supports the favored view of large radial mixing from the inner to the outer regions before the comet's accretion.

Keywords: Comet dust, electron microscopy, pyroxene, Stardust, phase transformation