THE LOCATIONS OF MINI-OUTBURSTS ON THE NUCLEUS 9P/TEMPEL 1: THE CASE FOR COMETARY CRYO-VOLCANISM

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Abstract

Data on the UT 2005 June 14 mini-outburst of comet 9P/Tempel 1 taken from different viewpoints (HST, Deep Impact, and Calar Alto, Spain) has been examined for morphological and parallax differences. The outburst source region was found to be located near 218+/-6E, 6+/-5N on the shape model of Thomas *et al*. (2007). The outburst occurred in the afternoon at ~1 pm local solar time. The distribution of light in the outburst is similar to that expected for an optically thin inverted cone-like sheet of material (presumably an ejecta curtain) suggesting a localized source.

We have also computed tracks of possible source regions for nine other mini-outbursts seen from DI. We find that five of these tracks converge on the same region where the June 14 event occurred. Three of the tracks converge at a second location near (60E, 20S). These two locations coincide with the regions of lowest surface gravity on the nucleus, *i.e.,* at places where the principal axis of minimum moment of inertia cut the surface. These results are consistent with the hypothesis that multiple outbursts occur at each location emanating from a single source or from a few sources in close proximity. Given this hypothesis, the outbursts are found to occur both during the day and night indicating at most weak, or no, control by direct sunlight. The times of outburst appear to be non-random with a preference for early afternoon, dusk and near midnight. None of the outbursts occurred near dawn when the surface temperature is rising. The region responsible for the strongest outbursts lies adjacent to a portion of the surface that was imaged at moderate resolution during the DI encounter that is characterized by circular depressions, the source regions of smooth flows, and by water – rich ice patches. There is no imaging information for the second location but it is possible that NExT may soon provide such information.

To explain these results we consider active cryo-volcanism in the interior of the nucleus as a cause of the outbursts. Our concept is based on aspects of surface morphology revealed in the DI images, the ideas of Prialnik *et al*. (2004) for a source of high pressure gas in the interior of the nucleus, and an interior structure based on the talps hypothesis (Belton, M.J.S. *et al*., 2007) that could allow spatially localized traps of high pressure gas to form. Providing the interface between talps layers has less permeability to gas diffusion than the material in the bulk of the layers themselves a qualitative explanation can be achieved.