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UNSTABLE GIANT COMETS IN THE OUTER SOLAR SYSTEM AS A FUTURE CONCERN FOR PLANETARY DEFENCE

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ABSTRACT

Whilst most current planetary defence discussions focus on the known and anticipated overall population of Earth-approaching asteroids in cis-jovian orbits, it does not follow that what we observe in the current epoch is diagnostic of the population of asteroids and comets that have affected the terrestrial environment across the palaeozoic. That is, imagining that faunal mass extinctions (such as the K/T boundary event 65 million years ago that marked the end of the dinosaurs and the rise of the mammals) are due to random asteroid impacts with the source region being the main belt between Mars and Jupiter represents a model which is over-simplistic.

Over the past two decades a very large number of objects classified by the International Astronomical Union (IAU) as being ‘minor planets’ (a synonym for ‘asteroids’) have been discovered in the outer solar system, many of them having orbits that cross at least one of the giant planets, in most cases rendering these newly-found bodies dynamically unstable and leading to them being informally termed ‘centaurs’. These objects are also very large – mostly in the range 50 to 300 km across – implying that their individual masses are greater than the total mass of the NEO complex as now observed.

In terms of their physical nature these objects are clearly dissimilar to the predominantly rocky asteroids/minor planets in the inner solar system, and so warrant a separate form of classification. The IAU confused matters further when it re-classified Pluto as being a ‘dwarf planet’, putting it into a new category that includes (1) Ceres, that being a body of quite different composition. Pluto and the

centaurs and the near-Neptune objects are clearly *giant comets*: if they were to stray closer to the Sun, they would display the familiar properties of comets due to the sublimation of their constituent ices and other volatiles.

Comets demonstrate another property under the influence of solar heating (or sometimes for no apparent reason): they fragment, breaking into myriad smaller pieces. The idea of a comet greater than 100 km in size entering an inner solar system orbit and disintegrating into thousands of asteroid-sized lumps plus a meteoroid and dust complex many times as dense as the current interplanetary complex of such small particles should give the reader pause when thinking about the full complexity of planetary defence that humankind should be considering, once we have dealt with the comparatively straightforward problem of rogue asteroids.

In this paper I will present some background on the scenario outlined above, provide an estimation of how often such vast perturbations of the inner solar system's interplanetary environment should be anticipated, and also discuss what they mean for our understanding of past mass extinction episodes.

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