DISC DARK MATTER IN THE GALAXY AND CYCLES OF EXTRATERRESTRIAL IMPACTS, MASS EXTINCTIONS AND GEOTECTONIC EVENTS

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For the past 30 years, I have been trying to reconcile several disparate facts about the Earth in an attempt to produce a general theory of the Earth's geology within a larger astrophysical framework. The search began with the discovery, by the Alvarez group, of evidence for a large comet or asteroid impact at the time of the end-Cretaceous mass extinction. Subsequent studies provided evidence that mass extinctions and impact craters showed similar cycles of about 26 to 30 Myr for the past 540 Myr. Richard Stothers of NASA and I hypothesized that the periodicity was related to the vertical oscillation of the Solar System through the Galactic mid-plane every ~30 million years. Galactic tidal forces from visible and Dark Matter concentrated in the plane could lead to perturbations of the Solar System's Oort comet cloud, creating comet showers, and increased impacts on the Earth every ~30 Myr.

Surprisingly, in further studies with Stothers and Ken Caldeira at Stanford, we found that time-series analyses of a number of geological events including tectonism, flood basalt volcanism, magnetic reversals, climate and sea level showed a similar ~27 to 32 Myr cycle. We originally thought that this meant that impacts were somehow affecting global tectonism, although this is difficult to envision. Now it has become clear that Dark Matter, occurring as a thin but clumpy disc in the Galactic plane, would accrete into the Earth's core, where the Dark Matter particles would build up and eventually self-annihilate. The accretion of the Dark Matter and its annihilation would add a significant amount of internal heat to the Earth that could affect global tectonism, sea levels, geomagnetism, climate and life. Since the Dark Matter is concentrated in the plane of the Galaxy, these events should all show an ~30 Myr cyclicity, and should be correlated, occurring preferentially at times when the Earth passes through the Galactic plane region. Thus, the evidence from the Earth's geological history supports a unified model with an astrophysical driver for terrestrial geological and biological evolution.