A Preliminary Analysis of Terrestrial Impact Cratering History

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We present here some ideas relating to the impact crater chronology for planet Earth. Every year, some 3 to 5 new impact craters are discovered during observations by orbiting satellites and space shuttles. To date, about 240 terrestrial impact structures have been cataloged. We have recently compiled up-to-date listings of impact crater properties, and from these we have selected 192 well-defined impact structures, whose diameters and ages are relatively well constrained. Our crater listings supercede previous compilations (e.g., Grieve 1991, Hodge 1994, & the Geological Survey of Canada 1997), reflecting recent additions and corrections to the previously available data. Because terrestrial craters are readily modified, or "vanish", due to active processes (such as erosion, sedimentation, and tectonic drift), it is important to realize that the terrestrial impact record has strong, multiple biases which make clear, direct interpretations difficult.
For this reason, we decided to analyze the impact structures found just in Australia, Europe, and North America; these have been relatively stable for considerably long geological periods, and thus have been best preserved. These three cratons are also areas in which active search programs have been underway for some time. With our newly compiled database in hand, we examined the number and diameter distributions of the craters, as a function of geological epoch. In this study, we confirm a close correlation between the geological epoch boundaries, the epochs of mass extinctions in the fossil record, and the "timing" of impacts. We also found that the cumulative flux of objects larger than 20km to be $1.77\times10^{-15}km^{-2}yr^{-1}$ on the Earth's surface, over the last 120 Myr, which is much smaller than the published values in McEwen (1997) and Shoemaker (1998) ($5.6\pm2.8\times10^{-15}km^{-2}yr^{-1}$). For craters larger than 50km, we found that the apparent cumulative flux for the Earth, since the Precambrian era, is ~40 times smaller than the corresponding value for the Moon. If we assume that the Earth and the Moon have suffered the same level of bombardment, i.e. the same impact cratering flux, this preliminary result implies that the actual flux of impacting bodies, capable of making craters with D > 50 km, was 40 times larger than the apparent flux estimated from the currently known terrestrial records.