THE TERRESTRIAL IMPACT CRATER RECORD

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Impact cratering is a fundamental geological process on planet Earth like on other planetary bodies in the Solar system. The recently published atlas of terrestrial impact structures [1] provides a comprehensive compilation of the known impact crater inventory on Earth. It illustrates 208 craters. For a few of them the final confirmation based on the identification of shock features is not yet entirely satisfying. Since its publication in 2020 two large crater structures, namely the 5 km diameter Ora Banda impact structure in Australia [2] and the 7 km diameter Joekjung-Chogye impact structure in South Korea [3] have been discovered and confirmed by the documentation of shatter cones. Moreover, many small impact structures of 10-70 m diameter have been identified in the Wyoming crater field: 31 small impact structures could be confirmed by the documentation of PFs and PDFs and more than 60 possible structures have been detected that await confirmation [4]. All these craters are interpreted to represent secondary craters of a large primary crater, that is not yet discovered but postulated to be deeply buried in the northern Denver basin [4].

The current impact crater inventory has been analyzed statistically, with regard to morphology, structure, and status of erosion or burial [5]. Here is a summary of some of the main results of this statistical survey.
(i) The discovery history of the terrestrial impact structures can be described by either a logistic function or an exponential function (starting in the year 1960) and allows projections to the future. Among the 100-300 missing craters, there are, in particular, many small simple craters that await discovery. Such craters, however, are most difficult to detect.
(ii) The size and age frequency distributions of terrestrial impact structures are mainly controlled by preservation.
(iii) About 20% of the known impact craters are buried and 44% of the craters have a clear morphological expression and show either a preferred radial, a preferred concentric, or a combination of radial and concentric drainage pattern.
(iv) Among the known craters are 28% classified as simple craters, 69% as complex craters, and 3% are tentatively classified as transitional craters. This relationship is also a preservation bias.
(v) New scaling relationships are derived between the apparent crater diameter and the central uplift diameter, stratigraphic uplift, and the ring syncline diameter.
(vi) Among the diagnostic shock effects,PDFs in quartz are the most important shock feature and have been found in about 78% of all known crater structures, followed by PFs in quartz and shatter cones. The latter have been documented in more than 42% of all craters. Monomict and polymict lithic breccia are the most frequently occurring impact lithologies in terrestrial craters.
(vii) The most common target lithologies are sedimentary rocks.
(viii) Of all craters 50-60% have been studied by means of gravity, magnetic, and electro-magnetic surveying, and 43% by seismic investigatons. More than a quarter of all known impact craters are exploited for natural resources

References:

[1] Gottwald, M. et al. (2020). Terrestrial impact structures. The TanDEM-X atlas. 608 p., Verlag Dr. Friedrich Pfeil, München. ISBN 978-3-89937-261-8. [2] Quintero, R. R. et al. 2021. *52nd Lunar Planet Sci Conf.* Abstract #2548. [3] Lim et al. (2021) *Gondwana Res.* 91, doi.org/10.1016/j.gr.2020.12.004 [4] [4] Kenkmann, T. et al. (2022) *GSA Bulletin*. doi.org/10.1130/B36196.1.[5] Kenkmann, T., (2021) *Met. Planet. Sci.* 56, 1024–1070.