

Abstract

The record of the early cratering history of the Earth is poorly preserved with no known crater of Archean age. In this dissertation, signatures of impact, of possible Mesoarchean age, have been documented from the Simlipal Complex, a circular/elliptical ring structure at the northeastern boundary of the Singhbhum Craton in eastern India.

The Simlipal Complex is an elliptical structure with diameters of 40-80 km. It consists of a series of concentric ridges with inward dipping slopes which coincides with a circular region of high gravity. The complex is intensely weathered, densely forested and highly inaccessible. Although earlier studies interpreted the circular ridges to be alternate volcano-sedimentary layers, remote sensing data presented in this study do not indicate any concentric distribution of the lithologies. Melt-rocks and breccias were identified at some widely scattered outcrops. These contain diagnostic shock-metamorphic features such as two to three sets of decorated and annealed Planar Deformation Features (PDFs), diaplectic glass, spall and concussion micro-fractures in quartz, and the presence of coesite. Additionally, microstructures, suggestive of crystallographically-controlled melting/amorphization along two or three planar directions, and within concussion micro-fractures in quartz are documented. The inferred shock pressures in excess of 40–60 GPa are possible only during a bolide impact. The Simlipal structure is thus possibly the remnant of a large complex impact crater having an original diameter of ca. 160 km. The elevated ring structure represents the central uplift, with the crater depression and rim completely eroded away. Zircons from melt-rock yield a concordia age of 3107 ± 14 Ma, which may be the age of the impact. However, in the absence of identifiable shock features in the zircons, which are highly pitted and altered, the ca. 2.76 Ga age of the NNE-SSW mafic dykes cutting across the complex is taken to be the minimum age of the impact. The Simlipal structure is thus one of the largest and oldest known terrestrial impact craters.

Geochemical signatures indicate shallow enriched mantle source for mafic rocks within the complex and melting of the granitic basement giving rise to the granophyre and anorthosite girdling it. The ca. 3.10 Ga age of the magmatic zircons from the granophyres date the emplacement of the granophyres, and probably the associated cratering event.

Keywords: *Simlipal Complex; Singhbhum Craton; bolide impact; shock metamorphism; complex crater; Mesoarchean*