**THE LUIZI STRUCTURE (DEMOCRATIC REPUBLIC OF CONGO) – FIRST CONFIRMED METEORITE IMPACT CRATER IN CENTRAL AFRICA.**

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**Introduction:** Although millions of impact craters are known on Mars and on the Moon, only 181 confirmed meteorite impact structures are currently recognized on Earth, with only 18 being located in the African continent.

Here we report on a detailed analysis of the Luizi structure, combining a remote sensing study with geological field observations and petrographic examination of rock samples collected during our 2010 field campaign. We demonstrate that this structure, in which unambiguous shock deformation features occur, is a complex meteorite impact crater, the first one to be recognized in Central Africa.

**Previous work:** The Luizi structure, centered at 10°10'13.5"S and 28°00'27.0"E, on the Kundelungu Plateau of the Katanga province, lies in an underexplored region of southeastern Democratic Republic of Congo (DRC).

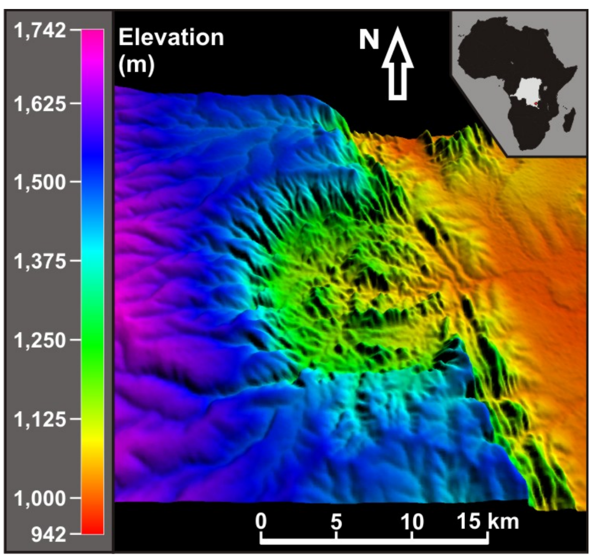


**Fig. 1:** Digital Elevation Model (DEM) of the Luizi impact structure, based on the Shuttle Radar Topography Mission (SRTM) data.

The first and only field geological report on the Luizi structure was published in 1919 [1]. The structure is described as an ~20 km semi-circular basin, with the dominant rocks consisting of thick-bedded quartzitic arkose, with dips from 5 to 20° at the basin edge and from 60 to 90° in the inner basin. Since that time, due to the political situation and extreme logistical challenges of working in the DRC, the study of the Luizi structure has been restricted to remote sensing techniques [2,3]. Considering that on Earth, unambiguous shock deformation features, such as planar deformation features (PDFs) in quartz, or traces of extraterrestrial matter, are needed to confirm the impact origin of a structure, we decided to organize an expedition there.

**Results and discussion:**

*Remote sensing study:* Based on available imagery and topographic data (Fig. 1), we estimate the rim diameter of the structure to be ~17 km. The Luizi structure exhibits, from the periphery to the center, a rim elevated up to ~300–350 m above the crater interior, an annular depression, an intermediate ring with a diameter of ~5.2 km, and a ~2 km wide circular central ring around a central depression (see further discussion in companion abstract [4]).

*Field data:* Field investigations were conducted by two of us (L.F. & P.K.K.), but because of the challenging field conditions, only a part of the structure was explored, including a NNW–SSE transect from the periphery to the center of the structure. All together more than 30 outcrops were studied. Exposed rocks consist in tabular massive arkosic sandstone beds (cm- to dm-thick), with intercalated laminated argillaceous sandstones, locally displaying cross-laminations. We were able to immediately confirm the impact origin in the field due to the presence of *in-situ* well-developed shatter cones in sandstone (up to 40 cm in length; Fig. 2). They occur at several locations within the central part of the structure, and up to 1.6 km from the center. Monomict lithic breccia dikes, up to ~2 m thick, and cross-cutting sandstone beds, occur up to ~3 km from the center of the structure. Other monomict lithic breccia occurrences (i.e., *in-situ* brecciated target rocks) were noted locally, as well as more or less abundant pervasive fractures, generally perpendicular to the bedding of the sandstone, and occurring up to ~6 km from the center of the structure. No melt-bearing impact breccias, neither impact melt rock were found and, thus, for the moment, only a maximum Neoproterozoic age, of ~573 Ma – the maximum age of sedimentation of the target rocks [5] – can be established for the structure.

*Petrographic investigations*: Petrographic observations of the collected samples has resulted in the detection of microscopic shock-metamorphic features in minerals, including abundant PDFs in quartz grains (Fig. 3) and rare shock deformations in perthitic alkali feldspar grains (i.e., PDFs oblique to the perthite exsolution lamellae). Kink banding in muscovite grains was also observed for most of the studied samples, even in the ones collected at several kilometers from the center.

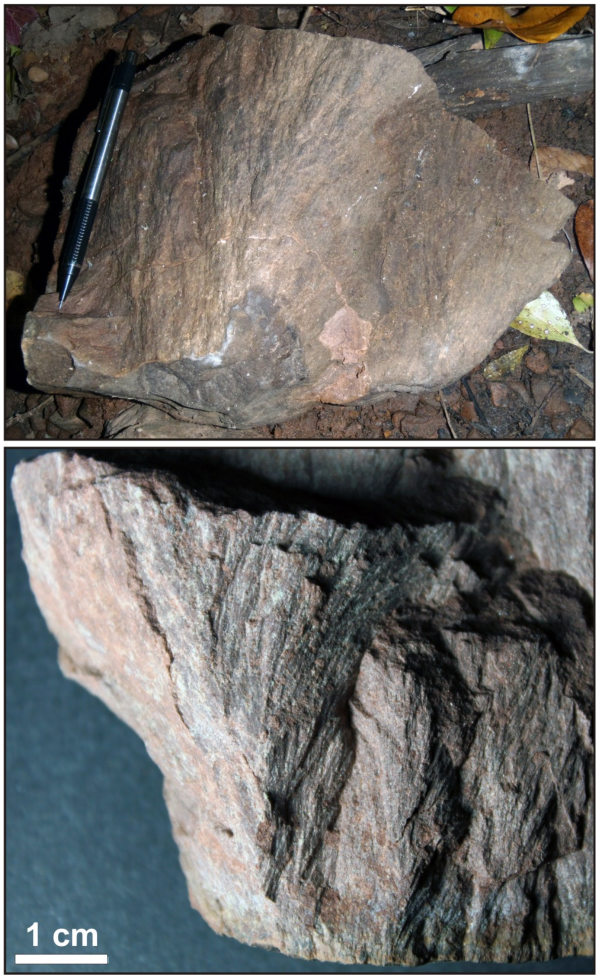


**Fig. 2:** Photographs of shatter cones in arkosic sandstone from the Luizi impact structure.

Quartz grains with up to five PDF sets were observed under the universal stage (U-stage) microscope. The decoration of many of the PDFs with fluid inclusions (Fig. 3) indicates that they were subjected to postshock alteration. The crystallographic orientations of 185 PDF sets in 104 quartz grains were determined using the U-stage. The PDFs are dominated by planes with $\omega\{10\bar{1}3\}$-equivalent crystallographic orientations, which comprise approximately 80% of the indexed PDF sets. In decreasing abundance, other measured PDF set orientations include $e\{10\bar{1}4\}$, c(0001), and $\pi\{10\bar{1}2\}$. Thus, we can estimate that the more heavily shocked sampled target rocks have experienced peak shock pressure slightly above 20 GPa. No PDFs in quartz were detected in samples collected at distances greater than ~2 km from the center of the structure.

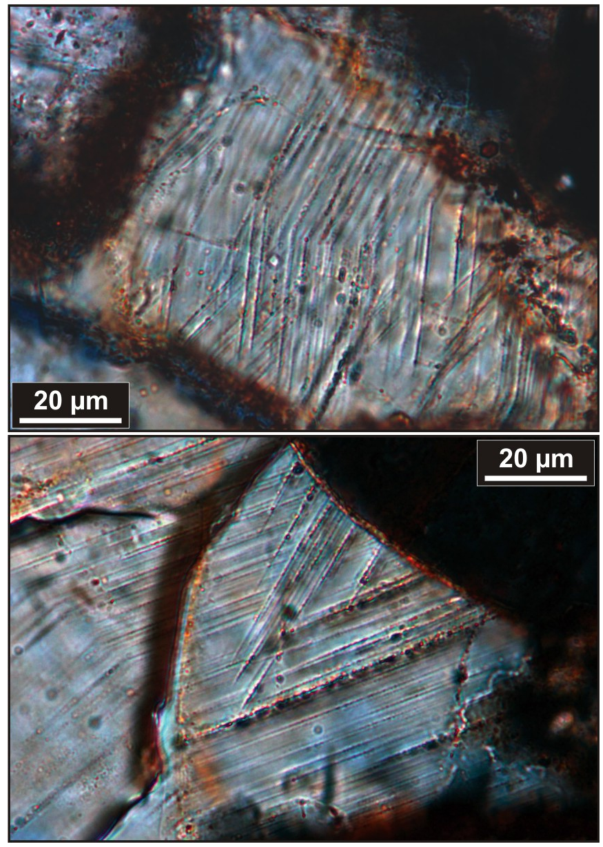


**Fig. 3:** Photomicrographs (crossed polars) of quartz grains with two PDF sets with $\omega\{10\bar{1}3\}$-equivalent orientations in shatter cones from the Luizi structure.

**Conclusion:** The impact origin of the Luizi structure is confirmed by the presence of (1) shatter cones, (2) multiple sets of PDFs in quartz grains, and (3) shocked feldspar grains. The confirmation of the impact origin of the Luizi structure fills also a gap in the terrestrial cratering record since impact structures of this size in sedimentary lithologies are underrepresented on Earth. Because of its preservation state, its moderate size, its complex crater morphology, and its relatively simple geology, we propose that Luizi is an ideal site for furthering our understanding of the formation of mid-sized impact craters on Earth and on other planetary bodies (see discussion in [4]).

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**References:** [1] Grosse E. (1919) *Neues Jahrb. Mineral. Geol. Palaeontol.*, 42, 272–419. [2] Dumond P. (1990) *Bull. Soc. belge Géol.*, 99, 57–65. [3] Claeys P. et al. (2008) *LPS XXXIX,* Abstract #1720. [4] Ferrière L. and Osinski G.R. (2011) *LPS XXXXII* (this meeting). [5] Master et al. (2005) *J. Afr. Earth Sci.,* 42, 41–60.