

## SHOCK DEFORMATION CONFIRMS THE IMPACT ORIGIN OF THE SÃO MIGUEL DO TAPUIO STRUCTURE (PI)

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**ABSTRACT:** São Miguel do Tapuio is a remarkable, 20 km diameter, circular structure centered at 5°37.6'S, 41°23.3'W in Piauí State. It was first noticed on airborne radar images in the 1970's, but its origin, albeit already suggested to be related to a meteorite impact event, has never been confirmed by the discovery of shock deformation evidence. The structure was formed in sedimentary strata of the Phanerozoic Parnaíba Basin, mostly sandstones of the Devonian Pimenteiras and Cabeças formations. The structure exhibits a rugged inner morphology when viewed on remote sensing images, in contrast to the smoother surrounding terrain. In addition, São Miguel do Tapuio shows several distinct annular and radial drainage patterns, with a raised rim and concentric inner rings. The rim rises ~120 m over the terrain surrounding the structure. The central ring has a diameter of ~5 km and rises up to 150 m above the elevation of the terrain around the structure. The potential impact origin of São Miguel do Tapuio was suggested based on indirect aspects, such as its morphology (outer rim, inner rings and a central peak), and also the fact that some of the sandstones found in its interior seemed to have been structurally deformed and were found to be recrystallized. Geophysical data did not lend further support to an endogenous origin for the structure. A few geological reconnaissance surveys were conducted over the years, yielding evidence of extensive brittle deformation of the sandstones, which could not be observed in the same strata outside the structure. Aspects such as difficulty of access to the central elevated portion of the structure, extensive supergene alteration of the sandstone, with replacement by laterite, as well as intense silicification have hampered comprehensive geological analysis including sampling for a search for shock evidence. Recently a ground survey conducted by the authors yielded samples of monomict sandstone breccias from locations near the center of the structure, which, after a very thorough optical microscopic study, finally unveiled the confirming evidence for the impact origin of São Miguel do Tapuio. This evidence comprises abundant occurrences of planar fractures (PF) in up to three different orientations per host grain, ample detection of feather features (FF), and some findings of planar deformation features (PDF), all in quartz grains. Particularly the latter shows that these quartz grains have undergone pressures of, at least, 7-10 GPa that can only be produced in supracrustal rocks by meteorite impact. With this evidence, São Miguel do Tapuio becomes the eighth large impact structure confirmed in Brazil, and the second largest known in South America.

**KEYWORDS:** SÃO MIGUEL DO TAPUIO; IMPACT STRUCTURE; SHOCK DEFORMATION.