UPDATE ON THE CURRENT KNOWLEDGE OF THE BRAZILIAN IMPACT CRATERS A. P. Crósta[1], M.A.R. Vasconcelos[1]. [1]Institute of Geosciences, University of Campinas, P.O. Box 6152, 13083-970, Campinas, SP, Brazil, alvaro@ige.unicamp.br

Introduction: The Brazilian territory, with 8.5 million km^2, comprises a significant proportion of terrains older than Mesozoic which have not being subject to subsequent tectonic processes. The territory is, therefore, prone to contain a significant number of impact craters. Yet, the number of confirmed and suspected impact structure in Brazil is still relatively small when compared to other regions of the world with similar geologic conditions.

However, this number has increased significantly in recent years, as a result of the work being developed by the impact crater research group at the University of Campinas (Unicamp), in collaboration with other national and international research groups.

We present here an update on the current knowledge of the Brazilian impact craters, including confirmed ones and also some of the potential impact structures which have been recently disclosed.

Confirmed Impact Craters: There are currently seven confirmed impact craters in Brazil. This number has increased from 2004, when only five confirmed impact craters were known [1].

The best known Brazilian impact structure is Araguainha Dome (16º49'S/52º59'W), which is also the largest one in South America. This 40 km wide complex crater, with a 7 km wide central uplift, was formed 247 Ma ago, in Paleozoic sediments of the Paraná Basin and underlying basement rocks. Widespread impact deformation features were recognized by several authors, including several types of impact breccias, shatter cones in sandstones, planar deformation features (PDFs) in several minerals, and microspherules [2] [3] [4]. The age of Araguainha has recently been reviewed [5], confirming that the impact occurred at a time close to the Permian-Triassic boundary.

Serra da Cangalha (8º05'S/46º52'W) is a 13 km complex impact crater with a 3 km wide central uplift, formed in Paleozoic sediments of the Parnaíba Basin, first described by [6]. A remote sensing study of this structure is reported by [7]. In recent years, this structure has been studied in detail by [8] [9], adding a significant amount of new geological information. A number of impact features have been unveiled, including impact breccias, shatter cones, PDFs in quartz and other planar deformation features (PF and feather features). Also, the geophysical characteristics of Serra da Cangalha have been analyzed by [10] [11] [12]. The age of the impact event has not yet been established.

Riachão (7º 43'S/46º 39'W), with a diameter of 4.2 km, is located only 40 km from Serra da Cangalha and has a 1.5 km wide elliptical shaped central uplift. It was formed in Paleozoic sedimentary rocks of the Parnaíba Basin and first described by [6]. Together with Serra da Cangalha, this structure has been recently subject to detailed geological studies, which provided signicant insight into its morphological, geological and deformational characteristics [13] [14]. The structure appears to be deeply eroded and few shock deformation features have been preserved. Nevertheless, PDF and other planar deformation features (PF and feather features) have been found.

Vargeão Dome (26º49'S/52º10'W) was formed in Juro-Cretaceous lava flows of basic to intermediate composition of the Serra Geral Fm. in the Paraná Basin. This structure has a diameter of 12.4 km, with a 3 km wide central uplift where Jurassic-Triassic sandstones (Botucatu/Pirambóia Fm.) are exposed with a vertical displacement of approximately 1 km. Extensive occurrences of impact breccias have been recognized in the interior of the structure, including monomict and polymict breccias of basalt/diabase and sandstones, as well as shock deformation features such as shatter cones in basalt and sandstones, PDF, PF and feather features [15].

Vista Alegre (25º57'S/52º42'W) was also formed in the same igneous litho-stratigraphic unit as Vargeão, the Serra Geral Fm., comprising basaltic lava flows. It has a diameter of 9.5 km and in its interior there are outcrops of deformed and recrystallized sandstone, possibly related to the Juro-Triassic sandstones of the Botucatu/Pirambóia Fm., suggesting the existence of a central uplift with a vertical displacement of nearly 900 m. The occurrence of polymict crater-fill impact breccias containing shatter cones aggregates formed in basalt and PDF in quartz grain was presented by [16]. An attempt at dating this structure was done by [17] using the Ar/Ar method, providing an age of 115 Ma.

Cerro Jarau (30º12'S/56º32'W), also formed in the same basaltic unit as the two previous structures, has a diameter of 10 km. The analysis of the geological and deformational characteristics of this structure is still ongoing, but the preliminary results presented by [18] indicate the occurrence of impact breccia and shock deformation features.

Santa Marta (10º10'S/45º15'W) is the latest confirmed impact structure in Brazil [19]. It is a 9-10 km wide complex structure, with a central elevated area, formed in Carboniferous and Cretaceous sedimentary rocks of the Parnaíba and São Francisco basins in northeastern Brazil. Field data recently acquired by

Unicamp´s impact research group unveiled the occurrence of polymict impact breccias and shatter cones, as well as PDF in quartz grains from the shatter cones and other planar structures (PF, feather features). A gravity survey of Santa Marta was conducted by [20] and shows an asymmetrical signature, with a low-gravity anomaly coincident with the central elevation.

Other Potential Impact Structures: A number of potential impact sites have been proposed in Brazil, mostly based on the morphological features. We selected four of these structures among the several proposed, based on the fact that they all have available geophysical data. Three of them are partially or completely buried, one of which is located offshore.

<u>Colônia</u> (23º52'S/46º42'W) is a 3.6 km wide circular depression formed in Precambrian metamorphic rocks of the Açungui group, with an outer rim standing 125 m above the inner portion. Its interior is filled with young (Quaternary) sediments, preventing access to possible impact breccia fill and shock metamorphic features therein. [20] presented the interpretation of recently acquired geophysical data (seismic), together with previous geophysical data and shallow drilling, indicating a sedimentary fill of approximately 280 m thick and the presence of two intermediate zones between sediment and basement: an upper zone 65 m thick interpreted as a possible crater-fill breccia, and a lower zone 50 m thick possibly represents fractured / brecciated basement. Direct confirmation of the impact origin of Colônia is still pending on drilling into the sedimentary filling and the upper portion of the basement.

<u>São Miguel do Tapuio</u> (05º38'S/41º24'W) is a 22 km diameter circular structure in the Parnaíba Basin. Preliminary field data presented by [21], as well as the geophysical signature based on low-resolution aerial geophysical data (magnetic and gravimetric methods) presented by [11], do not favor, at present, the impact origin of this structure. However, as these results were not conclusive, and evidence of an endogenous origin has not been found, this structure remains as a potential impact crater.

<u>Tefé</u> (04º57'S/66º03'W) is a buried circular structure in the Solimões Basin in northern Brazil, identified by [22] during oil exploration surveys using seismic methods. It has a diameter of 15 km, with a central elevation 4 km wide, and shows all the morphological features of an impact crater. Tertiary sedimentary strata 350 m thick were deposited after the formation of the structure. It was formed in Cretaceous-Paleozoic sedimentary rocks and the deformation seems to reach the basement at a depth of at least 3.2 km.

<u>Praia Grande</u> (25º39'S/45º37'W) is a 20 km diameter structure located in the offshore Santos Basin in southeastern Brazil. It is covered by 1.4 km of water and 4 km of younger sedimentary strata, having being found by 3-D seismic data during oil exploration surveys [23]. The central uplift is well defined, with a diameter of 4.5 km, which is surrounded by concentric annular troughs. It was formed in Mid Cretaceous strata (Albian-Santonian) and it is covered by undeformed Campanian-Maastrichtian strata, which places its formation in the Santonian (88.8-83.5 Ma).

Concluding Remarks: Recent research has increased to seven the current number of confirmed impact structures in Brazil. There is a good potential in finding more impact structures, as data from more detailed geological mapping and geophysical surveys become available. At least four other circular structures can be considered as potential new impact structures.

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