

**BASALTIC IMPACT STRUCTURES OF THE PARANÁ BASIN, BRAZIL.** A. P. Crósta<sup>1</sup>, <sup>1</sup>Institute of Geosciences, University of Campinas, Campinas, SP, Brazil ([alvaro@ge.unicamp.br](mailto:alvaro@ge.unicamp.br)).

**Introduction:** The Paraná Basin in southern Brazil contains one of the largest continental flood basalt provinces of the world. The volcanic rocks related to this event correspond to the Serra Geral Formation, with the main activity dated 133-132 Ma. This stratigraphic unit exhibits a large volume of volcanic rocks, comprising mostly basalts of tholeiitic composition, with some sequences of acidic composition (rhyodacites) in the southern portion of the basin.

The impact record of the Paraná Basin includes the Araguainha Dome (d=40km), aged 145 Ma, plus three other impact structures located in the southern portion of the Basin. These three structures are Vargeão Dome (d=12km), Vista Alegre (d=9.5km) and Cerro do Jarau (d=13km), all of them formed on basalts of the Serra Geral Fm. (Figure 1).

Basaltic craters are common in terrestrial planets such as Mars and Venus, as well as in the Moon and a number of smaller planetary bodies. On Earth, basalts are not extensively found on continents and, therefore, the cratering record over this rock type is quite limited. Until recently, the only known impact structure on continental flood basalts was Lonar crater, in the Deccan Traps in India [1]. However, Lonar is a small (d=1.8km) and simple crater and the access to its interior and to the rocks exhibiting impact features is limited, due to the fact that is filled with lake water.

This papers describes the basaltic impact structures of the Paraná Basin and their importance as the only medium-sized complex structures formed over this type of volcanic rocks known on Earth. In addition, it stresses their potential role as analogues for impact cratering studies on basaltic terrains, an important issue for modeling crater formation on terrestrial planets and moons.

**Vargeão Dome:** This complex structure has its center in 26°49'S/52°10'W, with a diameter of 12 km and a 3 km wide central uplift. It has is a multi-ring internal structure due to annular faulting (Figure 2). A number of blocks of Jurassic-Triassic sandstones of the Botucatu/Pirambóia formations, bounded by faulting, are exposed at the central uplift of the structure. Deformation features recognized in the rocks of the interior of the structure include monomict and polymict breccias of basalt/diabase and sandstones, shatter cones in basalt and sandstone, pseudo-tachyllite veins, and shock lamemallae (PDFs) in quartz and feldspar in sandstone [2] [3]. Most of the breccias in Vargeão appear to be para-autochthonous, exposed by erosion.

**Vista Alegre:** The structure is located at 25°57'S/52°42'W, with a diameter of 9.5km, only 100 km away from Vargeão Dome (Figure 3). Vista Alegre was only recently reported as an impact structure [4], and depicts an almost perfectly round morphology and steep internal borders. Impact breccias have limited exposure within this structure, due to extensive soil overburden. However, the few existing outcrops reveal the existence of layers of allochthonous polymictic breccia underneath the top soils, bearing clasts of basalt, diabase and sandstone, as well as fragments of shatter cones. Microscopic analysis of the breccias shows the occurrence of shock lamellae (PDFs) in quartz and the presence of melted material. The central uplift has no topographic expression and its existence is inferred from the occurrences of sandstones of the Botucatu/Pirambóia formations in the central portion, uplifted several hundred meters from their original stratigraphic position.

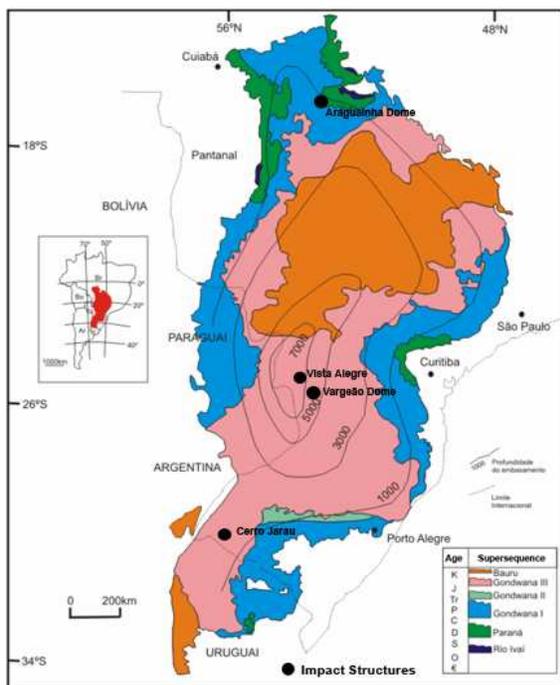
**Cerro Jarau:** The structure has its center in 30°12'S/56°32'W and a diameter of approximately 13km (Figure 4). It has been considered for some time as a possible impact impact site [2][5]. Only recently evidence of its impact origin became available [6]. It is a complex structure, with a 5km central uplift formed on deformed sandstones of the Botucatu Fm, which were uplifted from their original position several hundred meters below their present level. Evidences of the impact origin comprise the formation of breccias in basalts and sandstones, and shock lamellae in quartz and feldspar (PFs and PDFs). The borders of the structure have apparently been entirely removed by erosion.

**Concluding remarks:** The three basaltic impact structures of the Paraná Basin have been formed on the same stratigraphic unit, the Cretaceous Serra Geral Fm, and are relatively well exposed on the present continental surface. Although there are no isotopic ages available, the fact that they show different levels of erosion and degrees of preservation suggests their formation in different times, and are not related to a multiple-impact event, as suggested previously [2]. The exposure of impact-related rocks and deformation features at various scales in these three structures, combined with ease of access to their interiors, represent a unique opportunity for analogue studies of cratering processes in terrestrial planets.

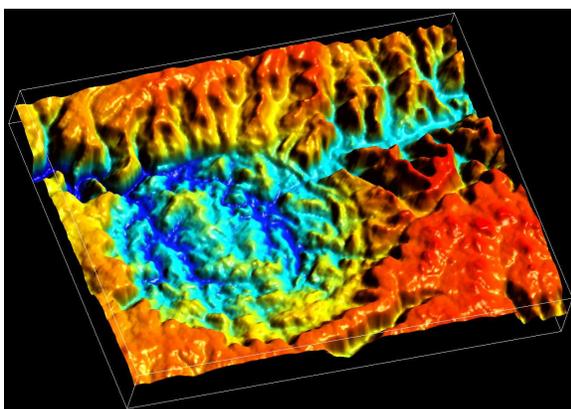
#### References:

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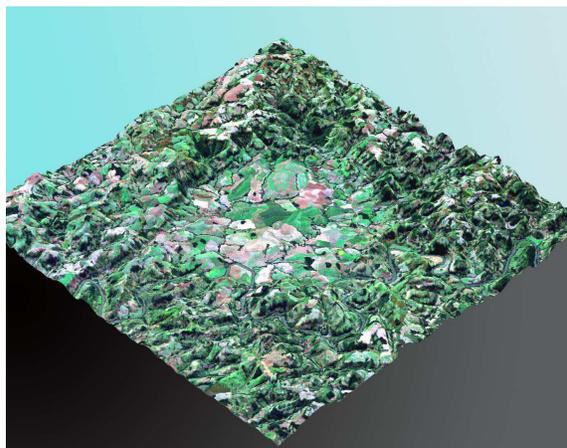
*Sudeste*, Brazilian Geol. Soc., 276-281. [3] Crósta, A.P. et al. (2005), *Geol. & Palaeontol. Sites of Brazil*, <http://www.unb.br/ig/sigep/sitio114/sitio114english.pdf> [4] Crósta, A.P. et al. (2004) *MAPS*, 39-Suppl, p. A28. [5] Romano, R. & Crósta, A.P. (2004) *LPS XXXV*, Abstract #1546. [6] Crósta et al. (2008) *MAPS* (submitted).



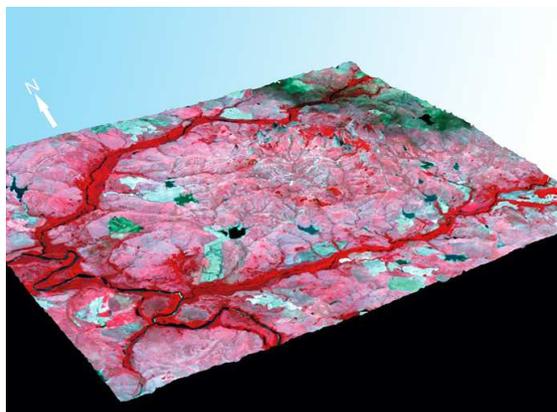
**Figure 1.** Impact structures of the Paraná Basin, Brazil.



**Figure 2.** Vargeão Dome in a perspective view using Shuttle Radar Topographic Mission (SRTM) digital elevation model.



**Figure 3.** Vista Alegre in a perspective view using Landsat ETM+ image draped over Shuttle Radar Topographic Mission (SRTM) digital elevation model.



**Figure 4.** Cerro Jarau in a perspective view using Landsat ETM+ image draped over Shuttle Radar Topographic Mission (SRTM) digital elevation model.