A Review of The Impact Record of South America.

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Introduction: A visual comparison of the Earth's map of impact structures shows that South America (SAm) is the continente with the least number of identified impact structures. However, considering its general geological characteristics, there is no sound explanation for the lack of a larger number of impact craters on this large continent. This low number has been growing very slowly over the years, mostly based on the discovery of some eroded large impact structures in Phanerozoic sedimentary basins in Brazil [1] [2] [3]. The SAm impact record also comprises two younger and smaller impact craters in the Andean Cordillera (in Chile and Peru), as well as a meteorite strewn field with several small craters (Campo del Cielo), an alleged 'crater field' interpreted to comprise a large number of eolian deflation features (Rio Cuarto), and layers of impact glasses in Argentina. Nevertheless, recent publications, in the form of conference abstracts and a book by a major publisher [4], followed by a book review by [5], have presented some misleading information about the impact record of SAm, mixing confirmed structures, for which sound scientific data are available, with those of sheer speculative characteristics. The objective of this contribution is to review and update the current knowledge about impact structures in SAm and to try to set the impact record of Sam straight. An extensive review paper on the impact record of SAm is currently under preparation, led by the authors of this abstract, for publication later this year, providing an in-depth summary of current research on impact structures in SAm.

Confirmed impact structures by country: *Brazil:* the largest country in SAm also has the largest number of confirmed impact structures. There are currently seven known impact structures in Brazil, geographically distributed in two Paleozoic sedimentary basins: Paraná Basin and Parnaíba Basin. In the Paraná Basin, the largest structure is Araguainha (Ø=40 km), with a well-established age (U–Pb and $^{40}Ar/^{39}Ar$ dating) of 254.7 ± 2.5 Ma. The impact that created this crater occurred in likely shallow estuarine waters and penetrated into a 2 km-thick Permo-Triassic to Devonian sedimentary sequence, reaching the crystalline basement and exposing granite and meta-sedimentary rocks in its 7 km-wide central uplift. Araguainha exhibits a full range of shock deformation features. Its age places this impact at the P-T boundary, associated with one of the largest mass extinction events. The same sedimentary basin contains three other impact structures sharing a common and almost unique characteristic on Earth, i.e. they formed in thick basalts of a large igneous province (LIP). They are the Vista Alegre (Ø=9.5 km), Vargeão (Ø=12.4 km) and Cerro Jarau (Ø=13.5 km) structures, of which the first two exhibit abundant macroscopic (shatter cones formed in basalt) and microscopic shock deformation features (PDF, FF, PF), and the latter is associated with a recent discovery of FF and some PF. All three have unconstrained maximum ages of about 110-130 Ma based on the age of the affected basalts.

In the Parnaíba Basin occur the Serra da Cangalha (Ø=13 km), Santa Marta (Ø=10 km) and Riachão (Ø=4.2 km) structures, all formed in sedimentary rocks (mainly sandstones). The first two exhibit a range of macroscopic and microscopic shock features (including shatter cones, PDF, FF, PF), whereas Riachão, an apparently deeply eroded crater, only showed PDF, FF and PF. Serra da Cangalha and Riachão have unconstrained ages of <270 Ma, whereas the age of Santa Marta can be inferred to 93-112 Ma based on stratigraphic considerations.

Argentina: the country´s impact record shows just a few entries, besides other accounts of non-confirmed impact structures. Two of the entries are sites of meteorite falls: the well-known Campo del Cielo strewn field, and the controversial Rio Cuarto `crater field´. At Campo del Cielo, several "pits" ranging from 20 to 115 m have yielded meteorite fragments and only the largest of them can be considered an impact crater, whereas the others are merely penetration funnels. At Rio Cuarto hundreds of elongated, shallow structures ranging in size from a few meters length to 4.5 x 1.1 km extent have been variably interpreted as the products of very low-angle (grazing) impacts, based on the local occurrence of rare chondrite fragments, or as wind-ablation features with only coincidental occurrence of meteoritic material (likely accumulated in the blowout deflations of an eroded sand dune field). Occurrences of Quaternary impact glasses are also known from the central and eastern regions of Argentina (Centinela del Mar, Mar del Plata, Chasicó, Bahía Blanca and Rio Cuarto).

Chile: Only one young and small crater, Monturaqui (Ø=0.46 km), is known in Chile. It is located in the Salar de Atacama region, has a depth of 34 m, and has yielded numerous fragments of a IAB iron meteorite projectile. Its age is estimated at 660 Ka.

Peru: a meteorite fall on Sept. 5, 2007, near the village of Carancas, close to the southern shores of Lake Titicaca, produced Carancas crater of only 13 m Ø and 4.5 m depth, which was the result of the impact of an ordinary chondrite.

Proposed – but not confirmed – impact structures: A number of proposed structures in Brazil, Argentina and Colombia has been mentioned over the years, for which no confirmation based on bona-fide impact evidence (shatter cones, shock metamorphic effects, physical or chemical traces of the projectile) is available. They are not specifically mentioned here for conciseness of the abstract.

References: [1] Crósta, A. P. (1987) In: Pohl J. *Research in Terrestrial Impact Structures*, pp.30–38. [2] Crósta, A.P. (2004) *Meteoritics & Planet. Sci., 39 (Suplem.)*, p. A27. [3] Crósta, A. P. and Vasconcelos, M. A. R. (2013) LPSC 44th , Abstract #1318. [4] Acevedo, R. D. et al. (2015) *Impact Craters in South America*, Springer, 104pp.; [5] Crósta, A. P. and Reimold, W. U. (2016) *Meteoritics & Planet. Sci.*,51: 996-999.