MICROSCOPIC IMPACT FEATURES IN THE CENTRAL UPLIFT OF SERRA DA CANGALHA. Marcos A.R. Vasconcelos[1,2], Wolf U. Reimold[2], Alvaro P. Crósta[1] and Thomas Kenkmann[3], [1]Institute of Geosciences, University of Campinas, Campinas, SP, Brazil. (vasconcelos@ige.unicamp.br, alvaro@ige.unicamp.br),[2] Museum für Naturkunde, Leibniz Institute at Humboldt University Berlin, Berlin, Germany (uwe.reimold@mfn-berlin.de),[3] Institut für Geowissenschaften, Albert-Ludwigs-Universität Freiburg, Freiburg, Germany.

Introduction: The Serra da Cangalha (SdC) structure is the second largest Brazilian impact structure with a 13.7 km diameter and a central uplift of 5.8 km diameter [1]. It is located in Tocantins state, northeastern Brazil, and formed in undisturbed Phanerozoic sedimentary rocks of the Parnaíba Basin. Impact features, such as shatter cones and PDFs, had been described in SdC rocks in the 1980s [2, unpublished]. In the early 1970´s, the Brazilian Department of Mineral Production (DNPM) carried out mineral exploration in the central part of the structure. This resulted in three boreholes that all reached depths of 200 m. During a field campaign to SdC in 2009 we collected samples at outcrops within and outside of the central uplift, and studied additional drill core samples. Our preliminary analysis by optical microscopy resulted in the discovery of some diagnostic shock deformation features, thus confirming the meteorite impact origin of the Serra da Cangalha structure.

Petrographic analysis: The three principal lithotypes occurring in the Serra da Cangalha structure comprise siltstones, sandstones and impact breccias. We observed a strong microdeformational contrast among the rocks from the central uplift and from outside of the central uplift. The samples from outside of the central area are characterized by quartz grains that are mostty coarse-grained and rounded, and practically without any deformation features. There are no planar microdeformations and only minor brittle deformation (fracturing) could be registered. The samples from the center are derived from blocks of sandstone, as well as from monomict and polymict breccias, which were found in close proximity to locations showing shatter cones. Both, breccias and shatter cones, were only found within the inner depression of the central uplift, which corresponds to the area of occurrence of the lowermost stratigraphic unit, the Longá Formation shale. The main characteristic of quartz shocked in the 10-30 GPa pressure regime is the presence of planar microdeformations, which include planar fractures (PFs) and planar deformation features (PDFs). The formation of PFs starts at low shock pressure(< 8 GPa), whereas PDFs are formed at higher pressures (>8 GPa) [3].

Preliminary analysis of thin sections from the central uplift showed that sandstones exhibit intense cataclasis of quartz and feldspar grains. In general, the grains exhibit angular margins and are often fractured internally. Especially samples of breccias and shatter cones show intense fracturing with distinctive PF development, with up to three sets of different orientations in quartz grains. PFs are also frequent in sandstone samples from the collar along then outside of the central depression, and also in quartz of drill core samples. The drill core samples comprise fine-grained sandstones, shales, siltstones, and breccias. One of the samples, from approximately 90 meter depth, exhibits strong brittle deformation with extensive PF development. Thin section analysis of the lithologies from the central uplift also revealed the presence of feather features with planar fractures mostly parallel to (0001) in quartz. Furthermore, we found intersecting sets of PDF in quartz. According to these observations we can determine general isopachs representing shockm levels attained by the rocks of the Serra daCangalha impact structure. The strata exposed in the central region was subjected to considerable shock pressure of 10-30 GPa, whereas the collar rocks experienced <10 GPa pressures, and the samples from exposures in the annular basin and crater rim only having experienced weak brittle deformation, likely <1-2 GPa.

Conclusions: Only the presence of diagnostic shock-metamorphic effects, such as shatter cones and PDF, are generally accepted as unambiguous evidence for an impact origin [4]. Our preliminary study allowed to identify some these diagnostic impact features in the field (shatter cones) and at the microscopic scale. The recognition of these features allows to conclude beyond doubt that Serra da Cangalha was formed by a meteorite impact event. This event subjected the strata of the central region of Serra da Cangalha to shock pressures in excess of 10-30 GPa.

References: [1] Kenkmann, T. et al. (2010) 41st LPSC, abstract #1237. [2] McHone, J. F. Jr. (1986), PhD thesis. University of Illinois at Urbana-Champaign, 210 pp. [3] Stöffler, D. & Langenhorst, F.(1994), *MAPS* 29:155-181. [4] French, B.M. and Koeberl, C. (2010) *Earth-Sci. Rev.* 98, 123-170.