Geophysical Research Abstracts
Vol. 16, EGU2014-16004, 2014
EGU General Assembly 2014

Brazilian Sugarloaf Mountains: A geomorphological expression of Neoproterozoic and Cretaceous structural architectures

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Brazilian sugarloaf mountains form part of a geomorphological family of landforms known as inselbergs, or isolated hills. They are characterised by steep-sided, dome-shaped monoliths that often stand in isolation from the surrounding plains. They can be symmetrical or elongate in plan and generally are composed of igneous or metamorphic crystalline rock. The mountains can rise as high as 1200 meters above the surrounding region thus form spectacular and iconic landscapes such as Pão de Açúcar, Rio de Janeiro, and Ayres Rock, Australia. Although inselbergs are principally recognised in Africa and Australia throughout geomorphology literature, the geological and resultant morphological development of Brazilian sugarloaf mountains along the eastern Atlantic margin is poorly understood. No studies have yet attempted to document the regional distribution of sugarloaf mountains in Brazil nor the controlling factors that limit their distribution.

The Pancas region of Espirito Santo state, eastern Brazil ($19^0$12'S, $40^0$50'W), is characterised by concentrated mountain monoliths, scoured and divided by tens of kilometres long linear valley floor segments. Thus this region forms an ideal natural laboratory to investigate the interplay of structural crustal architecture and the subsequent morphology of landforms moulded through tropical weathering and erosion, due to the abundant and varied mountain morphologies present.

Geological structural case studies of sugarloaf mountains in Pancas, show that the controls upon the evolutionary fragmentation of the Brazilian coastal plateau and subsequent morphologies of these spectacular monoliths are controlled by a five stage crustal architecture: D1 a magmatic foliation across the granite gneiss basesment; D2 and D3 Neoproterozoic NNW and WNW sinsitral transpressive shears of the Colatina-Vitoria Pan-African convergence zone producing synthetic and antithetic reidel shears; D4 late Jurassic rifting causing brittle faulting and dyke intrusion and overprinting of D2 and; D5 a three phase late Cretaceous felsic veinlet and jointing regime. The architecture of these D1 - D5 structures, repeatedly exploited by tropical weathering and erosion during Eocene and Miocene exhumation events, exert a strong architectural control on the fragmentation of the plateau and the morphology of the mountains. This is the first documentation of the geomorphological evolution of these Brazilian landforms tracking the formation of the mountains from their Neoproterozoic roots to their present day spectacular sugarloaf mountain surface expression.