Duricrust origin of South American table mountains (tepuis): Evidence from field and experimental data

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Geoscientific research was performed in the largest sandstone cave systems in Venezuelan table mountains (tepuis). It showed that erosion of non-cemented layers. Softer beds in which the caves were initially formed show a lack of cementation. The hard overlying and underlying beds, as well as the pillars which penetrate the uncemented arenite beds, are cemented by opal and quartz cements. The pillars indicate that the main diagenetic phase was represented by descending silica-bearing fluids. The pillars originated when the fluid flow reached coarse-grained arenitic bed, where the continuous fluid front splited to narrow channels (so-called "finger-flow" pillars). This caused lithification of the arenitic material in the channels and the rest of arenites in these beds escaped from lithification (softer beds) and was easily erodable.
This brought a new view on the origin of whole tepuis. They consist of hard quartzites and sandstones of the Matauí Formation, which are underlain by arkoses of the Uaimapué Formation. These are the uppermost formation of the Roraima Supergroup which is the Paleoproterozoic detritic cover of the Archean Guyana Shield. The main lithification phase of the Matauí Formation deposits, which caused their hardening to quartzites, was represented by descending silica-bearing fluids which did not penetrate to the underlying arkoses which remained almost unlithified. When looking for the best source of fluids, tepuis likely originated in places where there was an intensive descending fluid flow leaking from surface water reservoirs, such as rivers or lakes, This continuous flow carried SiO_2 from the lateritized surface beds and caused strong lithification of the underlying upper part of the Roraima Supergroup. These indurated parts of the formation remained as tepuis, while the remainder of the formation was removed by erosion. The softness of the underlying, non-lithified sediment below the tepuis caused undercutting of their margins thus maintaing steep walls.
To verify the new theory, an experimet was performed, using layered sands and sodium-silicate solution. Fine to medium sand fraction was used (0.08-0.5 mm), along with coarse (0,5-1 mm) to very coarse (1-2,5 mm) fraction. The sands were layered and compacted in a transparent plastic box (14 l volume), with the latter forming the thickest layer (10 cm in the centre). The coarsest layer was limited by two 3 cm thick layers of fine- to medium-grained sand; top and bottom of the layerded packet was formed by 2 cm thick layers of coarse sand. 3 liters of sodium-silicate solution (so-called water glass) were left to drip for several hours to the top of the sediment. Each liter was stained with a different ink to reveal the individual phases of impregnation. The fine-grained layers were perfectly impregnated all through their volume, whereas thedescending fluid flow has split to "fingers" in the very coarse layer, forming thus small "finger-flow" pillars. Results of this experiment, which was designed to mimic as close as possible the real diagenesis by descending silica-bearing fluids, perfectly match the real phenomena observed on the tepuis.