COCKPIT COUNTRY GEOHYDROLOGY AND HYDRODYNAMICS

Fact Sheet Prepared By:
Michael J. Day, DPhil
Professor Emeritus, University of Wisconsin-Milwaukee
&
M. Sean Chenoweth, PhD
Assistant Professor of Geosciences, University of Louisiana at Monroe

Cockpit Country karst hydrogeology is complex and unpredictable, with integrated surface and underground components, and with distinct seasonal variations in volume and local direction

Overall, flow is towards the north, although there is local variability

Most Cockpit Country water ultimately emerges via terrestrial or marine springs

Exterior (allogenic[1]) water from the south passes under in relatively deep caves

Interior (autogenic[2]) water from within Cockpit Country follows a complex but integrated flowpath from the surface via the near-surface soils, sediments and rocks (epikarst) to the underlying caves:

- Rainfall is directed by vegetation and surface topography
- "Rafting" of rain and moisture condensation via the leaves of the forest canopy results in up-to 14% more water reaching cockpit bottomlands than the surrounding hillsides
- Surface drainage enters near-vertical cracks and fissures on hillslopes
- These increasingly focus towards cockpit bases – centripetal subsurface drainage
- Under cockpit bases are near-vertical shafts, which direct water to underlying caves

All this is influenced by surface deposits – soil, regolith, bauxite

These deposits attenuate/moderate water inputs, retaining moisture for vegetation and reducing variability in inputs and outputs from the underground hydrological system

This hydrological system is complex and dynamic

Interference will lead to unpredictable, but possibly undesirable outcomes:

- Mining and quarrying cause hydrologic changes in karst
- Clearance of natural vegetation decreases spring flow
- Surface modification (excavation/mining/levelling) will impact the water input dynamics in the critical near-surface/epikarst zone
- Bauxite mining will increase volatility in the hydrologic system, with greater risks of both short-term high intensity events (floods) and long-term shortages (droughts). These will be compounded by predicted Climate Change

Cockpit Country Geomorphology, Hydrology & Mining: One Example from Trelawny

The Martha Brae River is 32.5 km long and is the only significant river in Trelwany Parish. It is a popular day trip attraction for airline and cruise ship tourists. Any bauxite mining in the northern Cockpit Country will likely destroy the normal flow of water in the Martha Brae River. The headwaters of the Martha Brae River originate from two main tributaries the first near Windsor and the second near Dromilly.

The Windsor Rises (locally known as Riverhead) are a series of springs emanating from sinkholes in a pocket valley south of the Great House. Springs in this valley (Figure 1) form multiple small surface streams that converge to form a single large channel. In addition, there are at least two springs that emerge from the Windsor Great cave

[1] Geology (of a mineral, sediment, or water): transported to its present position from elsewhere
[2] Geology (of a mineral, sediment, or water): determined by or developed under strictly local conditions

for bauxite it will destroy the surface and subsurface hydrology of the Martha Brae River headwaters. Surface hydrology is destroyed by removing the sediments and subsurface hydrology is destroyed by the mitigation process which clogs the springs with crushed gravel. The long term importance of the Martha Brae's fresh water resource would outweigh any short term Bauxite mining revenues.

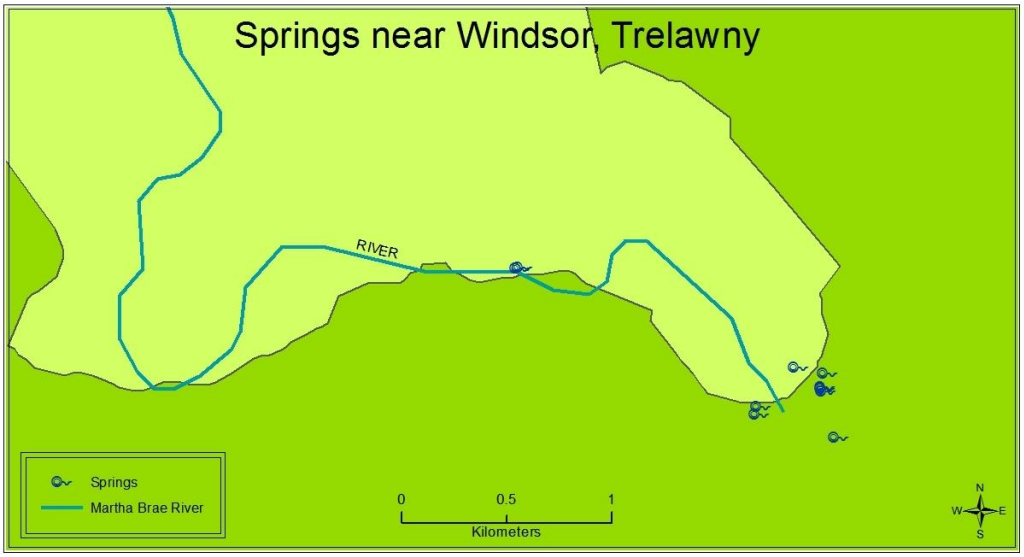

Figure 1. *Freshwater springs that create the headwaters of the Martha Brae River. Bauxite mining would destroy these springs.*

FURTHER READING

Windsor Research Centre highlights a few references which outline the dynamic processes between climate and karst geomorphology, the routeways by which water is transported through Cockpit Country, and the relevance this has not only for biodiversity but also for ecosystem services valued by humans.

Aub, C.F.T. 1969. The nature of cockpits and other depressions in the karst of Jamaica.

Proceedings of the 5th International Speleological Congress, edited by Verband der Deutschen Hohlen - und karstforscher e. V.

Brown, M.C. & D.C. Ford, 1973: Caves and groundwater patterns in a tropical karst environment: Jamaica, West Indies.- American Journal of Science 273: 622–633.

Day, M.J., 1979: The hydrology of polygonal karst depressions in northern Jamaica.- Zeitschrift fur Geomorphologie N.F., Supplementbande, 32, 25–34.

Day, M.J. 2007(a). Natural and anthropogenic hazards in the karst of Jamaica. Geological Society, London, Special Publications, 279, 173-184. https://doi.org/10.1144/SP279.14

Day, M.J. 2007(b). Human interaction with Caribbean karst landscapes: past, present and future. Acta Carsologica 39: 137-146. https://ojs.zrc-sazu.si/carsologica/article/viewFile/119/109

Day, M.J. & M.S. Chenoweth, 2004b: Cockpit Country cone karst, Jamaica.- In: Gunn, J. (ed.) The Encyclopedia of Caves and Karst Science. http://www.encyclopedias.biz/encyclopedia-of-caves-and-karst-science/23895-cockpit-country-cone-karst-jamaica.html

Fincham, A. (1997). Hydrology of Jamaican caves. Pp. 34-46. *In* A.G. Fincham (ed.) *Jamaica underground.* The Press, University of the West Indies, Kingston, Jamaica.

Fleurant, C., G.E. Tucker and H.A. Viles. 2008. A model of cockpit karst landscape, Jamaica. Géomorphologie 14: 3-14. https://geomorphologie.revues.org/5653?lang=en

Stemmer M. and Schubart C.D., 2016. Genetic analyses determine connectivity among cave and surface populations of the Jamaican endemic freshwater crab *Sesarma fossarum* in the Cockpit Country. International Journal of Speleology, 45 (1), 35-41. http://dx.doi.org/10.5038/1827-806X.45.1.1912

Williams, P.W. 1983. The role of the subcutaneous zone in karst hydrology. Journal of Hydrology 61: 45-67. https://doi.org/10.1016/0022-1694(83)90234-2

Please contact Dr. Susan Koenig, Windsor Research Centre windsor@cwjamaica.com if you have any questions.