Groundwater hydrology at Wellington Caves

Scientists from the University of New South Wales have recently started investigating groundwater hydrology at Wellington Caves. This research uses the caves as a "natural laboratory" to investigate the nature and rate of water infiltration from surface into the groundwater system and the connectivity of groundwater stores.

Figure 1 shows, some possible flow routes that water can take through the limestone bedrock to the cave. Stalagmites A, B, C and D in the cartoon are all fed by different flow pathways.

Water dripping onto stalagmite A comes from the overlying limestone bed. No fissures can be seen in this limestone bed, and it is therefore likely that the stalagmite is mostly fed by diffuse flow, through either the limestone matrix or through very fine fractures.

Stalagmite B is fed by a greater proportion of fracture flow. Flow is likely to be a mixture of relatively fast fracture flow, as shown by the dotted line, as well as slow diffuse flow from the overlying strata.

Water at stalagmite C has taken a more complex flow route, which also includes passing through an overlying cave which is full of sediment, labelled '1'. This sediment filled 'paleocave' would be similar to what can be seen in the Phosphate Mine. The sediment in the cave can hold water and therefore act as a water store.

Stalagmite D has the most complicated flow route. As well as passing through two sediment filled caves ('1' and '2'), the water also passes through an active, water filled cave ('3'). All three caves may varying in their size and the way they fill with water and subsequently drain.

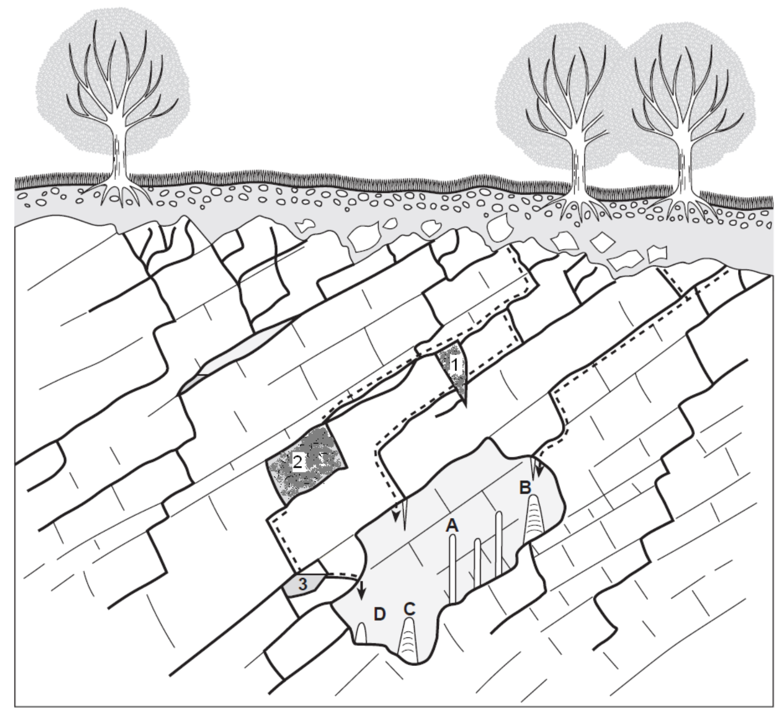

Figure 1: a cartoon showing how water might travel from the surface to cave stalagmites at the Wellington Caves. Not drawn to scale – for letters and numbers see main text.

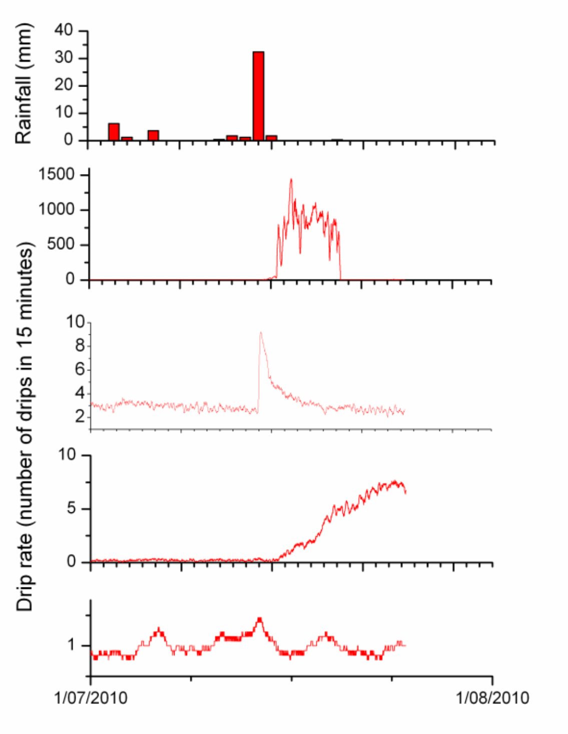

Figure 2: Four different cave drip water responses to a rain event in July 2010. The top graph is the amount of rainfall recorded at the BOM station at Wellington. The lower four graphs show different drip water responses (the number of drips in a 15 minute period).

These varied flow paths leads to a complexity of drip water response to rain events. An example of this is shown in figure 2. Some drips will drip all year and at a relatively constant rate, whilst others speed up after heavy rainfall. Some do not drip at all until a certain amount of rainfall is received. Evaporation from the soil, and transpiration from trees also affect the amount of water researching the groundwater. Some drips could respond quickly to rainfall in winter when surface evaporation is lower, and not at all in summer.

The data from figure 2 is obtained from state-of-the-art loggers that automatically measure the water flow rates of drip waters that emerge in the cave. Systems are also in place to collect these drip waters for chemical analyses as shown in figure 3. This will allow researchers to quantify the variability of the flow and relate it to properties of the aquifer such as depth below surface, geological structure and the fracturing of the bedrock. This research is vital to better understand water resources in limestone regions of SE Australia.

Figure 3: Cave drip water monitoring. Data loggers sit in the yellow tubes and water is collected in bottles underneath.

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For further information:
www.connectedwaters.unsw.edu.au

National Centre for Groundwater Research and Training

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