Investigating groundwater by helicopter

NATIONAL CENTRE FOR GROUNDWATER RESEARCH AND TRAINING

This resource introduces a new technique for learning more about groundwater by analysing river chemistry over an entire catchment. The research was completed in far north Queensland, on the Mitchell River. It relates to the NCGRT's technical factsheet Longitudinal stream chemical sampling to estimate groundwater inflow.

THE IDEA

Normally, if you want to learn more about the groundwater in an area, you drill a bore, and sample the groundwater directly.

However, there are limitations to this approach. Perhaps it's not possible to drill a bore, because the location is too remote, or drilling is too expensive. Or perhaps you want more information about where best to drill, before you start.

For these reasons, NCGRT researchers were interested in testing a different technique for learning about groundwater – that is, by sampling river water along the length of a river and analysing its chemistry to learn more about the local groundwater.

Although this technique has been widely used over short distances (hundreds of metres at the most), and in the context of mining contamination, researchers wanted to prove that it could be successfully applied at a basin scale.

THE LOCATION

Researchers chose to work in the Mitchell River, a perennial river in tropical far north Queensland. The Mitchell River region has an interesting, contrasting geology, and being a tropical river, has steady, low-flow conditions towards the end of the dry season.

This location is remote, sparsely populated, and filled with saltwater crocodiles – the world's largest reptiles. It was chosen precisely because of its difficulty; researchers considered that if they could succeeed in applying their technique in such a challenging (but interesting) location, it's likely that it can be useful in many other places too.

THE EXPERIMENT

Researchers hired a helicopter for a day, and loaded it with sample bottles, a submersible pump and marine buoy, and a GPS. As the helicopter hovered, the pump was thrown out and samples were collected – 60 samples over 400 km, or every 5 km for most of the length of the river.

Researchers also obtained measurements for the same time period from flow gauging stations owned by the Queensland Department of Environment and Resource Management. This told them how much water was flowing along the river (and how fast it was moving), and how much was contributed by tributaries at various places.

Having collected all of this information, the researchers sent off the water samples to the lab to be analysed. They also knew that the Mitchell River catchment covers approximately seven different

Want to know more?

This project was led by Dr Jordi Batlle-Aguilar.

In the meantime, for more information on the NCGRT's research, visit www.groundwater.com.au

geologies, which partly determines the chemical composition of the region's groundwater. From this information researchers were able to work backwards to learn more about the groundwater.

The differences between flow gauge measurements allowed them to calculate the volume of water entering the river – water which could only be coming from groundwater seeping through the river banks and the river floor.

They also completed a solute mass balance: an equation which uses the differing chemical composition of the river water in different locations to work out more precisely how much groundwater is discharging into the river, and where it is coming from. Knowing the river chemistry, and knowing that groundwater is typically higher in salts and other chemicals than river water, researchers were able to work out where the groundwater was flowing from to 'fit' that river chemistry.

All of this information contributed to a model (or simulation) of the catchment's groundwater, which helps researchers build up a picture of what the underground architecture looks like, and how the groundwater flows.

THE UPSHOT

The research was concluded successfully, so the main outcome of this project is that this technique can be successfully used to learn more about the groundwater over large areas.

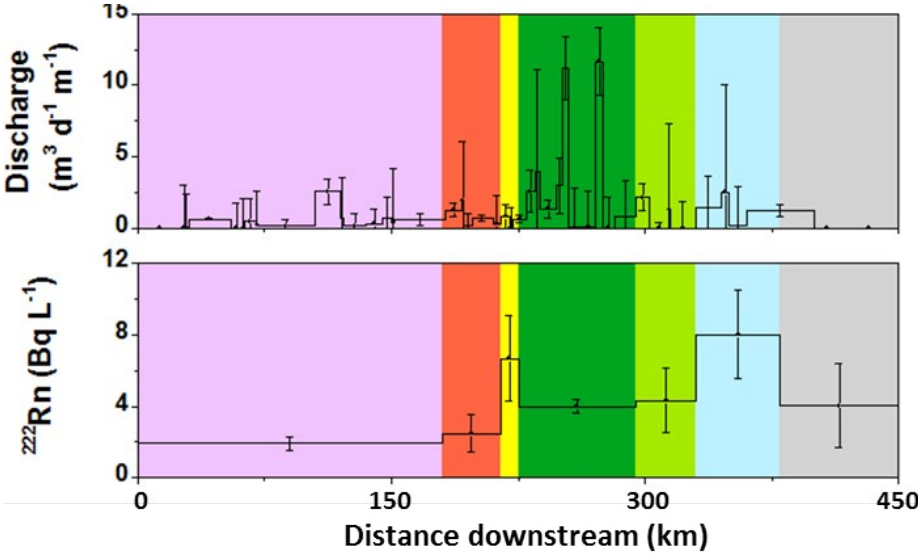

Figure 1. Modelled groundwater discharge and radon concentration for each of the seven geologies along 450 km of the Mitchell River. Error bars represent the confidence interval for the estimated value.

These graphs show the changing quantity and chemical composition of groundwater discharging into the river from aquifers formed of different geologies.

There are a number of reasons why this technique may be useful to others.

In general, groundwater is quite difficult and expensive to study, simply because it is underground. This technique is relatively cheap. Although hiring a helicopter may seem expensive, it is actually extremely cost effective compared to the cost of drilling one or more bores, and may be used in areas where it's not possible to drill a bore.

Knowing more about the groundwater means that you can make decisions about where to sensibly draw water without affecting the natural habitat (i.e. without drying out rivers or streams). This technique might help you in the first place to decide where to drill a bore, or it may mean you can drill fewer bores.

And last but not least, this technique may help pinpoint the sources of any contamination, whether natural or human-influenced.

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