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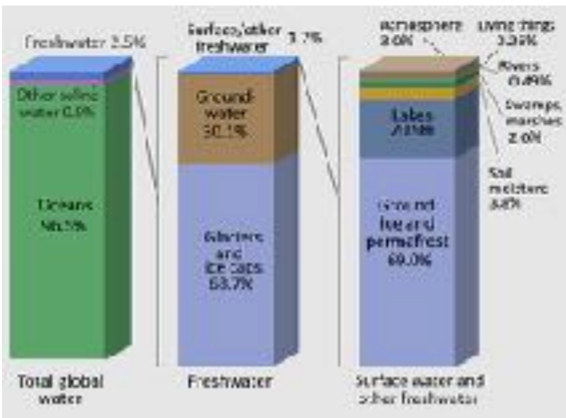
GOING GREEN TO FIND BLUE

By Liam Clark

The world is run by water, the liquid that fuels mankind covers over 70% of the earth surface and even large water deposits are stored in the earth's mantle. So how is it that there is a water shortage?

According to the US geological survey, there are 332,519,000 cubic miles[1] of water on the planet. The vast majority of this water is held within the oceans. Roughly 96% of earth's water is held within the vast oceans that dominate the planet's surface. The rest exists in various different forms throughout the globe.

That leaves 4% of all water on the planet, not in the oceans and of this only 2.5% of all earth's water is fresh water (Figure 1[2] shows how globally, water is distributed). This is mainly held in glaciers and ice caps (accounting for 68.7% of all freshwater). The rest, a mere 0.7825% of all water on the planet is fresh, and within the ground or on the surface.



However, what does this mean volumetrically? The fresh water, which is stored within the ground water, atmosphere, lakes and other (accessible water), makes up roughly 2,602,961[3] miles cubed, (or 1.08454473 × 10^{19} litres).

This however is further reduced when you think of what water is accessible for direct human usage (Water that is shallow enough to be trapped at an affordable cost).

Groundwater makes up 90% of this readily available freshwater, roughly 1.5 billion people depend on fresh water for their drinking supply and roughly 140-170 Miles is extracted from the ground each year.[3]

So what's the problem?

Currently we live in a global water crisis[4], nearly one third of the population live in countries where the availability of water is a constraint on human activity. More than 840,000 people die every year from lack of availability of clean water. The water crisis also has economic implications. For example, Brazil who extracts 60-70% of their energy from hydro-electric dams forced consumers to cut their energy consumption by 10% in 2015 and 20% in 2001 which in turn has a negative effect on the entire GDP[5].

The water crisis is the #1 global risk based on impact to society (as a measure of devastation) and is also rated as #8[6] global risk based on likelihood of occurring in the next 10 years as announced by the world Economic forum in 2015.

Many believe there is a deficiency in long term and medium term planning of the water budget, and there is much to be done to find alternative water supplies. The main problems can be summed up in two points:

- Demand is increasing (increasing populations is putting major strain on already producing reservoirs. According to the United Nations, water use has grown at more than twice the rate of population increase in the last century.)
- Supply is decreasing (The amount of available water is effectively shrinking with contamination and pollution, deforestation and irrigation.)

Climate change is also having an effect on the water crisis, the US alone is expected to see an increase in "mega-droughts[7]" this century placing already strained areas under more pressure to find new water sources.

Some of the problem lies with finding new reservoirs, tracking aquafers, and monitoring the movement of water within aquafers.

–Where does the water come from?
- Where does the water go?
-Where is the water stored?

Much of the exploration for water is based upon highly complex, destructive large machines, utilising conventional geophysical techniques, drilling and remote sensing. However, this is unwieldy for many of the areas of exploration, which are either too remote, or too close to population centres. This makes conventional geophysical methods to be uneconomical, unsafe or impractical.

So what we need to be done?

A new method is being developed which is a non-destructive and portable. A remote sensing device to monitor water in areas too inhospitable or too close to high density population centres for conventional techniques to work.

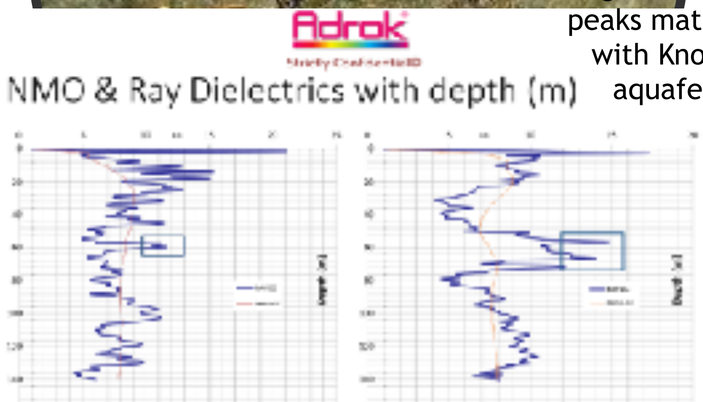


Figure 2 Dilectrics of Prince Edward Island showing distinctly high dielectric Peaks in known water depths. The Peaks near the top also indicate the water saturated near surface.

Here at Adrok we have been working on a new method of water identification and discovery. Adrok is a small Edinburgh based Geophysical Company with large dreams. The water project, one of many, is utilising the Adrok patented Atomic Dielectric Resonance scanner to identify, track and monitor water within the subsurface. Tests are being carried out in Prince Edward Island and the results so far are looking promising.

Unlike conventional remote sensing techniques, the Adrok technology is green, non-destructive, portable and highly accurate. The technique involves sending a beam of electromagnetic waves into the subsurface and then, analysing the return signals. Much like a spectrometer, the Adrok scanner is ideal for determining the compositional makeup of a material, as the frequency and energies are distorted by the materials it passes through. This results in high resolution imaging and spectral information on the makeup of the subsurface.

On the small Canadian province of Prince Edward Island, Adrok has been working on identifying, locating and monitoring sustainable supplies of water with the Adrok system. The technology works on the analysis of return energy and frequency to determine the composition. The system allows the calculation of dielectrics from a beam of electromagnetic waves. The dielectrics are determined by the makeup of the material the Adrok beam passes through. Every material has a different dielectric, it is fortunate for Adrok that the dielectrics for water are relatively high compared to that of the surrounding rock. The water project, although still in its infancy is already yielding promising results. Building upon work that has been done for Scottish Water, Adrok has identified that the dielectrics, when passing through subsurface aquafers, are noticeably higher than those of the surrounding waterless rocks. Additionally, subsurface imaging of the return energies and frequencies of the

Adrok system may indicate areas of water filled Aquafers (Figure 4).

The blue squares from figure 2 show the increased dielectrics as the Adrok beam hits the aquafer. The dielectrics then return to the lower units as the beam is transmitted into rock containing less water.

In figure 4, Adrok has produced a subsurface 2D 25m profile scan of the subsurface. It is clear there is a distinct change in the return signal which can be followed across the profile. This is a good indication that the Adrok scanner can image and track the extent of the aquafer.

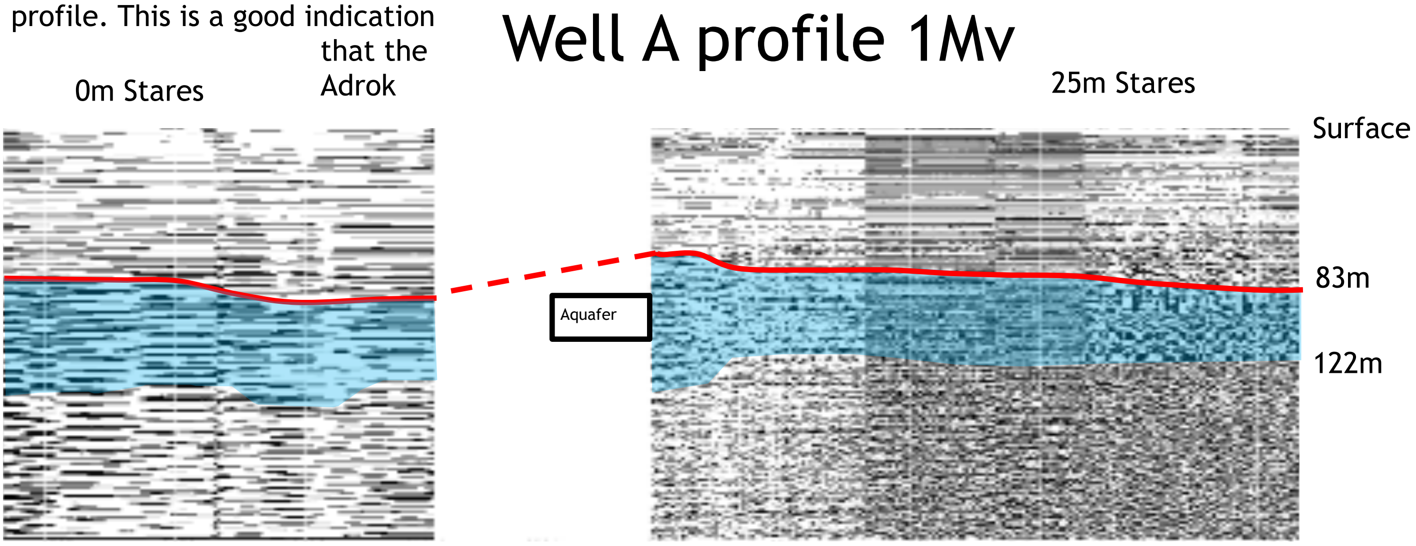


Figure 4 Remote sensing imaging data from the Adrok Scanner with the change in the return signal in blue.

The Adrok scanner can also act as a spectrometer, sampling the spontaneous emissions as they occur from different molecules. Adrok is researching intensely to detect spectral lines that could be representative of water molecules in the sub-surface. Soon it is hoped that Adrok will be able to sample the composition of the subsurface to give great accuracy in its subsurface mapping.

This has huge implications for water exploration. By being able to detect water using portable scanning equipment (figure 3) in the subsurface, the need for huge drilling operations and, geophysical exploration is greatly reduced. The green technique that only leaves behind footprints could pave the way for a revolution in water exploration. There are huge areas of urban, remote and deep potential aquafers that need to be explored. The Adrok technology could reduce the cost and risk of exploration.

[1] **National Ocean Service**. How much water is in the ocean? *NOAA National Oceanic and atmospheric Administration*. [Online] March 11, 2014. http://oceanservice.noaa.gov/facts/oceanwater.html

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[3] **Perlman, Howard.** How much water is on Earth? *U.S. Geological Survey.* [Online] USGS, May 02, 2014. http://water.usgs.gov/edu/gallery/global-water-volume.html.

[4] **Shortage, Global Water.** WATER SCARCITY & THE IMPORTANCE OF WATER. *The Water Project*. [Online] global water shortage, 2015. http://thewaterproject.org/water_scarcity.

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