Seven Wonders of the Hydrogeological World – Submission

Title: A vast expanse of groundwater with surprising intricacies - The Great Artesian Basin.

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Text:

One hundred and seventy million hectares of Eastern Australia are comprised of the Great Artesian basin. Within the thickness of this basin, averaging 1000m, exists a vast expanse of groundwater which is trapped within sandstone and conglomerate layers interleaved with clayey layers. The groundwater can only penetrate the clayey layers at some geological faults and through man-made bore holes. Where pressure is sufficient the water erupts at the surface forming mound springs and artesian bores. The hot temperature and dissolved minerals within the erupting water are evidence of the deep pathways through which it has flowed. Pressure has been created as water has infiltrated into sandstones and conglomerates along the upturned edges of the basin or simply by settling of fault-bound basin sediment. The vast horizontal uniformity of these layers permits this pressure to be transferred thousands of kilometres down into the lower-lying parts of the basin. This uniformity, reflected by much of the surface terrain, gives testimony to deposition processes without parallel in the present day. Further, across the basin, there exist table-top shaped hills (mesas) that reflect prior land or sea-bed surfaces and give testimony to vast watery erosion on a scale that is difficult to comprehend. Travellers crossing the expanse of the basin are awe-struck by plainness yet within such apparent plainness there exist surprising intricacies such as localized sites where dazzling light refraction phenomenon is created by opal, formed by percolation of the basin's groundwater. Silicate minerals dissolved within the groundwater, under the right conditions, precipitate opal into various sites within the weathered portion of the basin rocks. Rare occurrences of opal crystal structure within the otherwise very common silicate rich weathering profile refract light in such a way as to create intricate plays of colour. Observations of miners have determined that opal forms in places where specific silicate rich groundwater penetrates into margins of clayey layers. Geological faults, buried vegetation, buried shells and even buried dinosaur bones have been suitable for opal formation. Groundwater has played a role in the preservation, by the process of opalization, of a record of life and processes that existed during the late stages of formation of the Great Artesian basin. It also sustains life today through the many hot artesian bores and springs that provide water for grazing animals and townships across the basin.

Figure 1 Mound springs, such as are common along the Oodnadatta Track in South Australia, erupting hot mineral-rich groundwater give testimony to vast underground flow pathways pressurized by either connection to recharge sites far away or simply by settling of fault-bound basin sediment.

Figure 2 Table-top shaped hills (Mesas) reflect prior sea-bed or land surfaces and indicate the extensive erosion that has taken place across the vast basin while it has been folded and faulted to form the host to the groundwater flow system we now observe (The Breakaways – Coober Pedy, South Australia).

Figure 3 Opals, formed by groundwater processes, add surprising intricacy to the otherwise vast plainness of the Great Artesian Basin.

Figures:

Figures are placed here and also will be supplied separately at greater resolution. Royalty-free licences have been purchased from Dreamstime. Alternative figures can be supplied with more effort if required.

Key points of interest:

1. Vast uniformity – testimony to origin beyond equal in modern day geological processes;
2. Opals – created by groundwater;
3. Mound springs – temperature indicative of groundwater flow through great depths;
4. Artesian bores.

Other Articles I think should be written:

1. Microfauna and flora living in groundwater
2. Caves extending deeply indicate groundwater discharge pathways and indicate much more extensive groundwater flow systems.
3. Uranium enrichment and precipitation explained by groundwater processes.
4. Hard basalt rock makes permeable aquifers.
5. The extent of freshwater recharge surrounding recharge points is of very limited extent within far more extensive basins of saline groundwater.

NOMINATION OF THE GREAT ARTESIAN BASIN SPRINGS AS ONE OF AUSTRALIA'S SEVEN HYDROGEOLOGICAL WONDERS

The Great Artesian Basin (GAB) of Australia is one of the largest groundwater basins in the world covering 22 % of the Australian continent. The GAB is an iconic aquifer system of both national and international significance. The hydrogeology of the Basin supports the world famous GAB Springs. There are more than 600 springs and spring groups mostly around the northern and western margins of the Basin where the water bearing aquifers and aquitards are nearer the surface. These springs range in size from small soaks to spring complexes with large pools and hundreds of individually flowing vents. Some springs provide base flows to rivers during the dry season. Natural discharge from the Basin through springs supports natural communities containing a wide variety of endemic species in isolated water dependent ecosystems surrounded by an otherwise largely waterless landscape.

The isolated nature of the GAB Springs has resulted in the preservation of many endemic, rare and relict species of great ecological, evolutionary and biogeographical significance both to the nation and the world. The lake Eyre Basin (LEB) is a surface water catchment that overlies the GAB. Many water holes, lakes and rivers within the LEB are supported by upward leakage form groundwater from the GAB aquifers. This interconnection between groundwater from the GAB and surface water in the LEB is of great environmental significance though largely unknown and unexplored.

As well as their ecological significance, these natural springs are culturally very important. Historically the GAB springs have provided the only reliable source of fresh water for human all activity in arid parts of Australia. GAB springs were the only reliable water source for Aboriginal people in central Australia for thousands of years. These vital water sources set the boundaries for dreaming lines and trade routes and remain important sights of cultural significance for local indigenous groups. The string of springs along the western boundary of the Basin in central Australia also guided European exploration and development through the central inland during the 19th and early 20th centuries; beginning with early explorers to afghan trading routes, the overland telegraph and the Ghan railway.

The greatest challenge in the management of the GAB is the maintenance of pressure to supply the GAB springs. Small changes in pressure near springs can cause springs to cease to flow or change flow patterns resulting in immediate or subtle changes to plant and animal populations that result in local extinctions of populations and ultimately species. These pressure changes can occur as a result of water extractions near the springs or as a result of decreases in potentiometric head caused by large water extractions from bores many kilometres from the springs.

As well as changes in flow, unacceptable impacts on spring-dependent ecosystems can also occur as a result of current or historical land-use in and around the springs. Current land use includes mechanical disturbance or impacts from grazing and other changes that that effect natural processes or population dynamics. Historical land use has introduced excavations, weeds and feral animals that threaten biological relationships and spring flows. .

Springs and the ecosystems that depend on them are very dynamic. Major spring complexes can have hundreds of vents through which water discharges. The rate of flow from individual vents and the number of vents within the complex that flow at any time naturally changes causing moist habitat patches that support populations to shift and change along with them. This natural variability makes it difficult to predict and identify unacceptable changes caused by water extraction and land use.

Lynn Brake
Water Advisory Consultant
South Australian Arid Lands Natural Resource Management Board

The Great Artesian Basin

Applicant: Rachael Wroe

WHAT

The Great Artesian Basin is one of the largest underground water reservoirs in the world covering an area of ~1.7 million km^2. It stretches from the most northern point of Queensland down past central South Australia (Figure 1). The basin underlies ~20% of the Australian continent and a large portion (~40%) of the Darling River Basin. The basin stores ~64900 million megalitres of water, enough water to fill Sydney Harbour ~130 000 times! The total recharge area of the basin is ~10% of its' total area with the major recharge area is located along the eastern margin of Queensland and New South Wales.

WHY SO WONDEROUS?

1. It is a vital water resource in our predominantly semi-arid/arid climate and provides water in many inland areas.
2. It contains extremely old groundwater that ages up to 2 million years old in the central portion of the basin near the South Australia–Queensland border (Herczeg 2008)
3. The sheer extent and size is incredible!

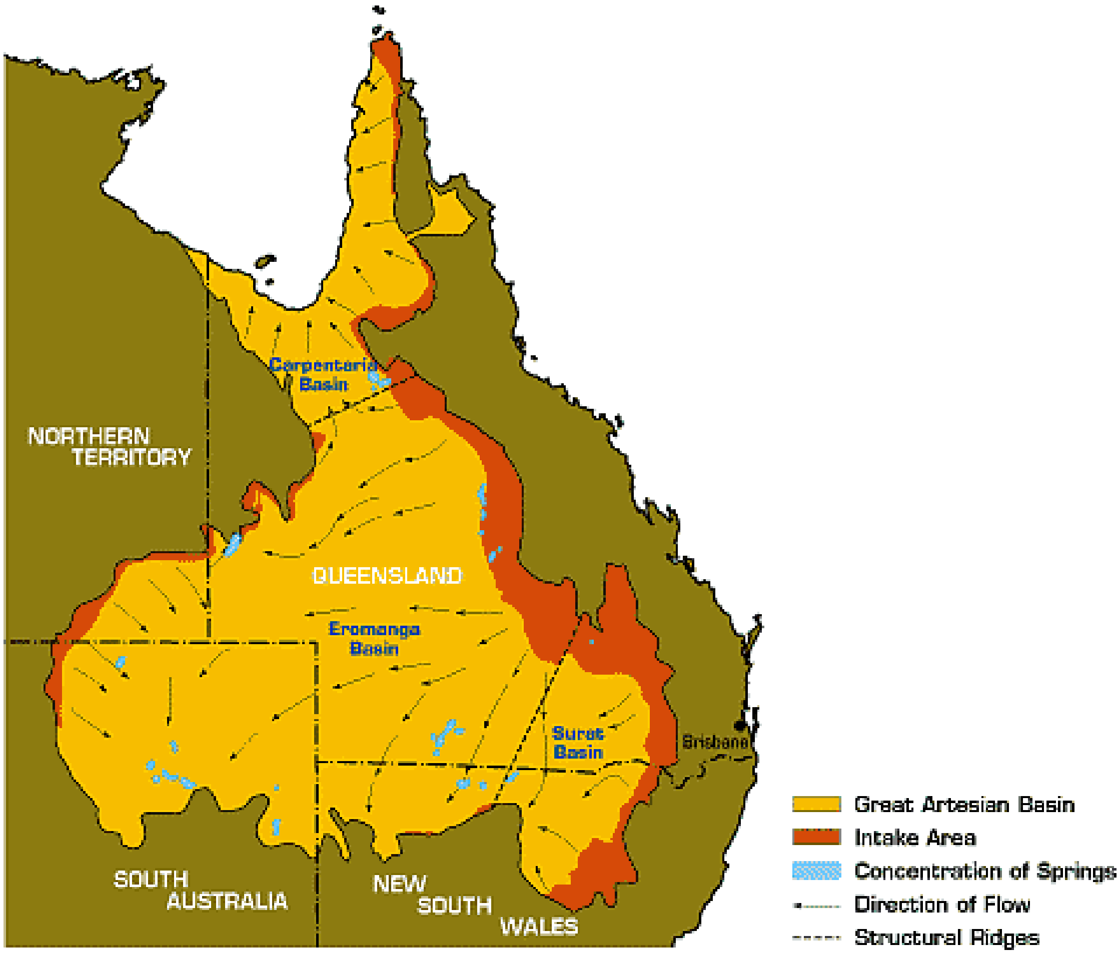


Figure 1: Map showing extent and structure of the Basin, and direction of flow
http://www.gabcc.org.au/public/content/ViewCategory.aspx?id=52

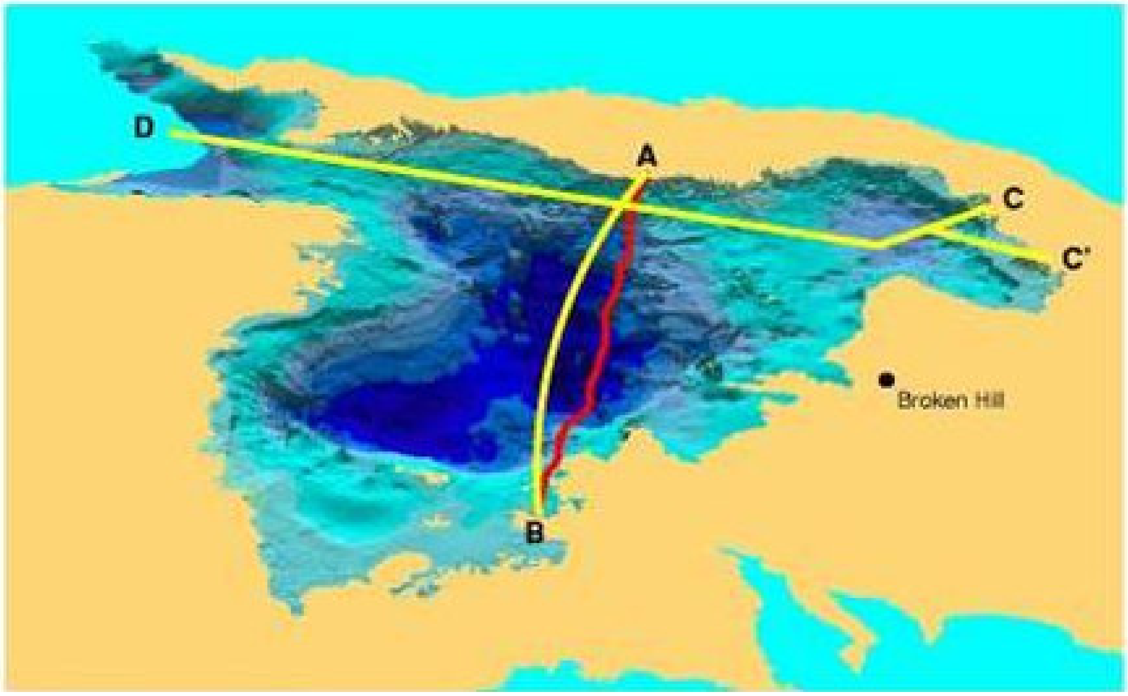


Figure 2: The pale blue-green areas on the central map depict relatively thin sedimentary sequences, whereas the dark blue area is the thickest part of the basin (Radke et al., 2000).

References

Department of Environment and Resource Management Queensland, Great Artesian Basin Fact Sheets, [http://www.gabcc.org.au/public/content/ViewCategory.aspx?id=92] Accessed online 11/3/2011

Great Artesian Basin Coordinating Committee Website [http://www.gabcc.org.au/public/content/ViewCategory.aspx?id=52] accessed online 11/3/2011

Herczeg A. 2008. Background report on the Great Artesian Basin. A report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project. CSIRO, Australia. 18pp.

Radke BM, Ferguson J, Cresswell RG, Ransley TR, Habermehl MA (2000) Hydrochemistry and implied hydrodynamics of the Cadnaowie – Hooray Aquifer, Great Artesian Basin. Bureau of Rural Sciences, Canberra ISBN 0 642 47554 7

NOMINATION OF THE GREAT ARTESIAN BASIN NATURAL MINERAL SPRING BATHS IN NORTH WEST NSW AS ONE OF AUSTRALIA'S SEVEN HYDROGEOLOGICAL WONDERS

NOMINATION BY: Australian Local Government Association
NOMINATION TO: George Gates representing IAH

"There is nothing so peaceful, so relaxing, so all encompassing. Its not like having a bath at all, its like surrendering your body for a while, letting it drain of all residual energy knowing it will come back fully charged". That's the experience of one of the many hundreds of thousands of visitors to one of the Great Artesian Basin (GAB) natural mineral spring baths in north western NSW.

The most famous of these is the Hot Mineral Baths located at Moree. Originating in 1895 and discovered accidentally when searching for irrigation water, the Moree Hot Mineral Baths attract 300,000 visitors of all ages and nationalities each year. Drawing mineral laden water (which could be up to two million years old) from almost a kilometre down, many believe in the healing and rejuvenating properties of Baths, long recognised in other countries around the world.

Equally importantly though, the Baths have iconic social significance:

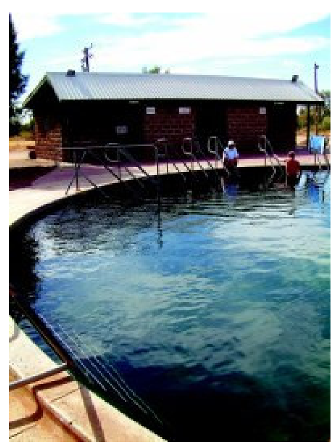
- they have significant cultural heritage for indigenous Australians
- they are a major social gathering point for non-indigenous locals
- they have undoubtedly provided the first visual appreciation of the wonders of the GAB to millions of Australian and overseas visitors alike
- they figured prominently as a focal point during the Freedom Rides which provided powerful and symbolic impetus to the pursuit of indigenous equality.

Beyond Moree there are other GAB natural mineral springs baths located across the north-west including those at Boomi, Pilliga and Lightning Ridge.

The rejuvenating water that flows up from the GAB at about 43 degrees C to the Pilliga Artesian Bore Baths, has being doing so for well over a century. This facility is found just east of the village of Pilliga.

The Artesian Baths at Lightning Ridge have been an iconic local attraction for the diverse population of Lightning Ridge as well as its many thousands of visitors for many years. The ancient, mineral rich GAB water arrives at the surface at around 50 degrees C and is allowed to cool to a more comfortable 42 degrees C before entering the main bath.

Moree Hot Mineral Baths



Lightening Ridge Artesian Bore Baths