

## Gravity Information Sheet

Dr Anna Greve

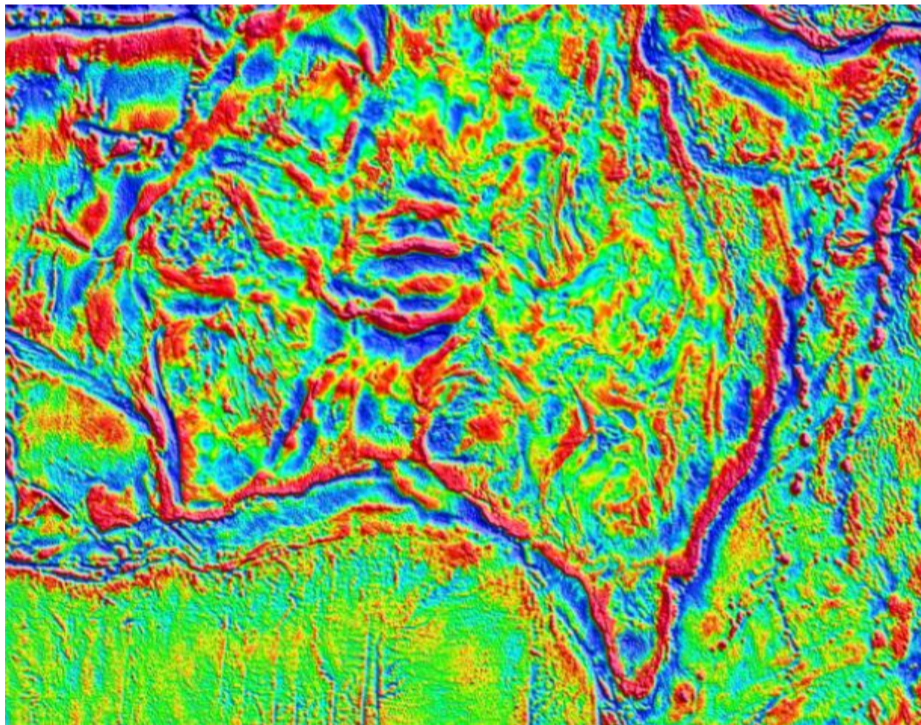
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Affiliated with the National Centre for Groundwater Research and Training



### General Theory

We all know the story of Newton and the Apple. Newton concluded that two bodies attract each other and that this attraction is proportional to the mass of the two bodies and inversely proportional to the distance (to the power of two) between them.

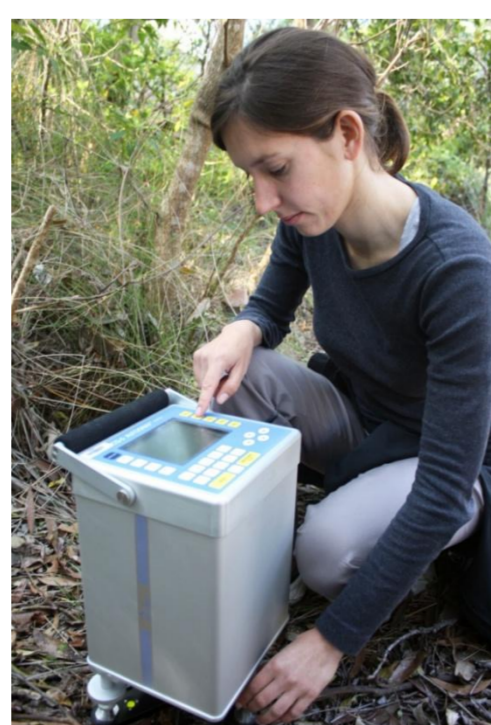
Gravimeters measure the vertical component of the gravity field, which is the force that is directly pulling us downwards. This acceleration due to gravity ( $g$ ) varies between pole and equator due to the rotation and shape of the Earth and is  $9.81 \text{ m/s}^2$  in Australia. In addition to these large scale variations, the gravity field varies locally due to density differences in the subsurface.



Australian gravity variations  
Source: Geoscience Australia,  
high anomalies (red colours):  
higher crustal density or  
thinner crust, low anomalies  
(purple colours): lower  
crustal density or thicker  
crust.

### Two gravimeters

Most gravimeters in use are relative gravimeters, which detect the relative changes in the gravity field. The Connected Waters Initiative has purchased two relative gravity meters, one stationary one for temporal monitoring of the gravity field at the super science site at Breeza, NSW, and one portable meter for ground based micro gravity surveys (e.g. for bedrock mapping).

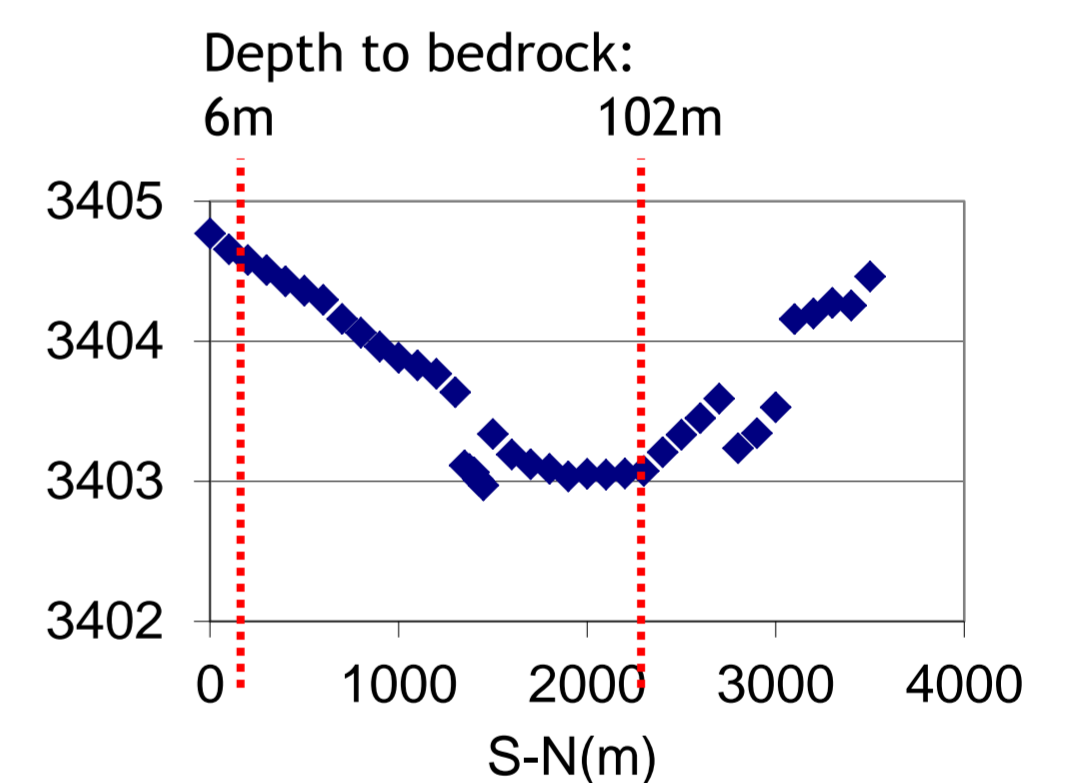


These meters are extremely sensitive and have a standard field reading repeatability of  $<5\mu\text{Gal}$  ( $1 \mu\text{Gal} = 0.00001 \text{ mm/s}^2$ ). This is sensitive enough to detect the local gravity field from our body mass. If we stand above the gravimeter during measurement, the vertical component of the gravity field from our bodies acts opposite to that of the Earth and the gravity reading is reduced. Even though this reduction is minimal we can detect it with the gravimeter!

### Gravity in geophysics for hydrogeology

In geophysics spatial or temporal variations of the gravity field are mapped. A typical hydrogeological application of spatial gravity surveys is mapping the depth to bedrock.

#### Relative gravity transect-depth to bedrock



### Research Focus

An active area of research is the detection of water storage changes through the temporal changes in the local gravity field. Time lapse gravity measurements give an integrated measurement of storage changes, which for ground based measurements is most sensitive to storage changes within a  $\sim 100\text{m}$  radius. The challenge, and the aim of the research at the Breeza super science site, is the separation of the integrated signal to differentiate between different storage components.

### More Information

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