



GAA WIRELINE

All You Wanted to Know About Prompt Fission Neutron (PFN) Tools But People Have Been Afraid To Tell You!

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Outline

What is the problem?

- Nuclear Radiation and Fission/ U^{238} Decay Series and Gamma Radiation/Gamma Logging. The Disequilibrium Problem

The Solution

- Detail On PFN Technology & History
- Calibrations and Example Logs (Roll Front)

Gen 2 PFN and current developments

- Limitations and further Development of the Technology
- Overall Benefits

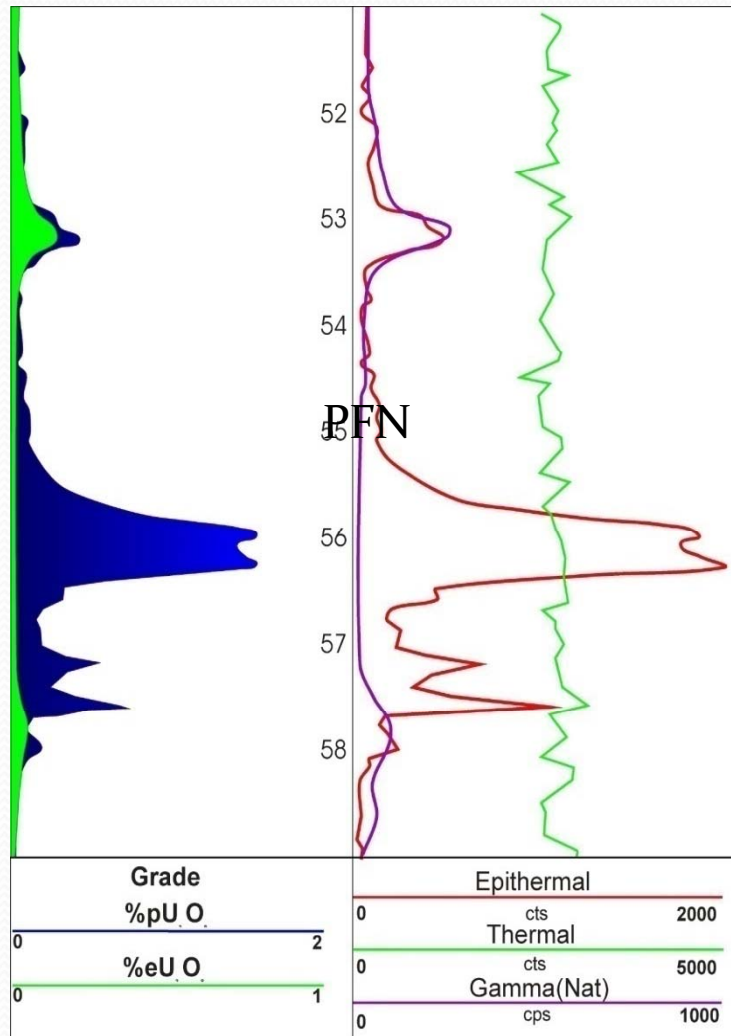
Gamma Logging



- Total Gamma tools suffer from **disequilibrium** inherent in some types of uranium deposits, principally Sandstone-hosted U deposits, which account for 15% of world U production.

It is necessary to have a faster assaying technique than waiting for your core results to come back. **You have a drill waiting!**

PFN and Gamma logging The Disequilibrium Problem



Many uranium deposits are too young for the gamma emitting daughter elements to be in equilibrium with uranium (rule of thumb: *Around one million years to restore equilibrium with no other physical or chemical influence*)

Uranium may also have migrated away from its daughter elements by chemical action – moving ground waters

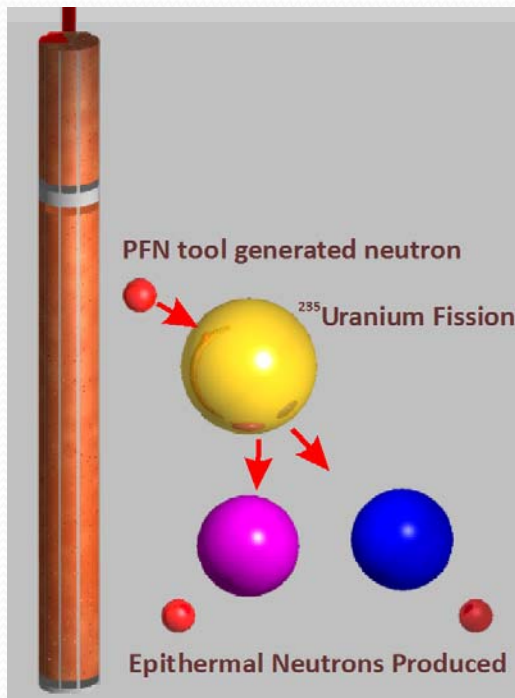
Gamma, in this example, “misses” a significant zone of uranium

What is PFN?

Google and YouTube suggest the following:

- **Pro Fight Network**
- **Point For Negotiation**
- **Pennsylvania Football News**

But it is definitely not **Pay For Nothing**

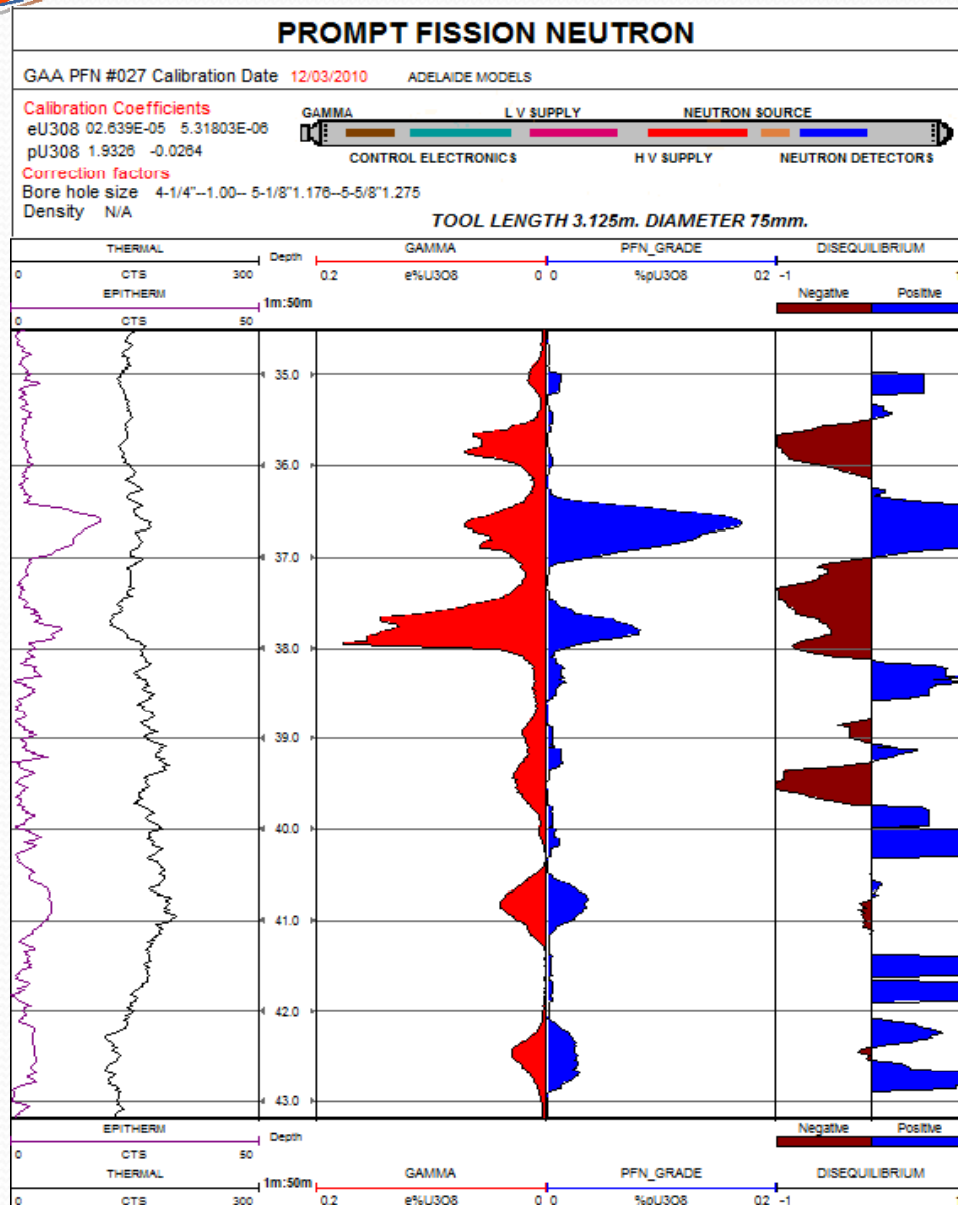


Prompt Fission Neutron

- Creates very fast neutrons (14MeV) and fires 10^8 neutrons per second
- Neutrons are slowed (Thermal) by collisions with the rock
- Generated neutrons collide with ^{235}U and split the atom (Fission)
- Fast (Epithermal – 2MeV) neutrons are produced
- Measures the ratio of epithermal(fast) and thermal(slow) neutrons to provide direct % U^{235}

So Where Did This PFN Tool Come From?

- Nothing new really. Designed in the early 70's.
- The technology had been around for the neutron generators since the end of the war in the Pacific and the concept of splitting a U^{235} atom was obviously behind it.
- During the 80's the technologies were refined and methods for calibrating the results for subsurface conditions were designed.
- It was well understood many years ago that a problem existed with traditional gamma techniques and that a result could be measured from the fission of Uranium directly



Log of U in Disequilibrium

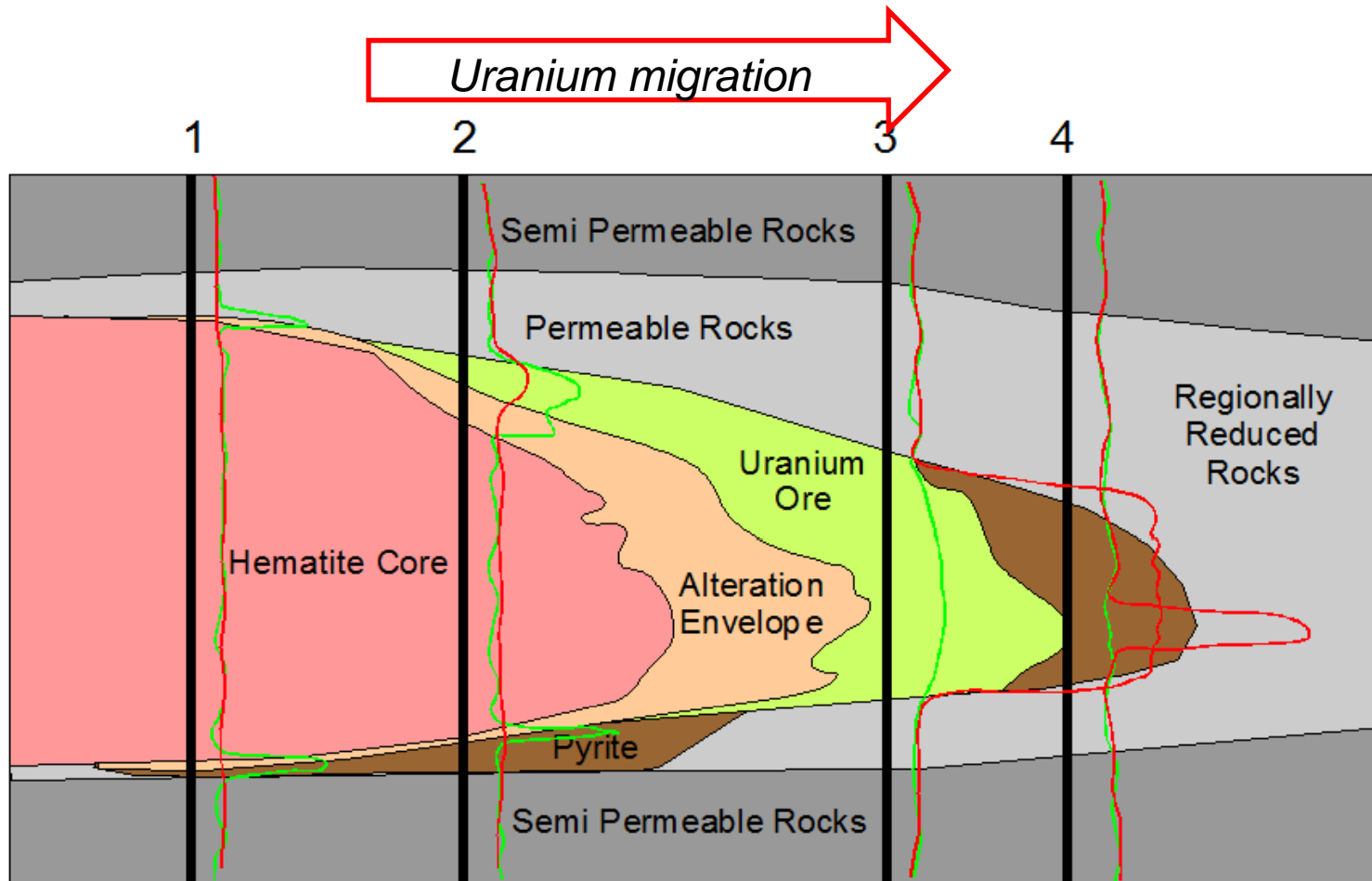
An absence of Uranium occurs at a gamma peak at 35.8m

This log demonstrates the necessity of PFN in defining uranium, and in quantifying the amount of uranium.

Note the “Negative” or “Positive” Disequilibrium in the right hand column

PFN = Blue Line
 Gamma = Red Line

Roll Front Geology and the PFN Log

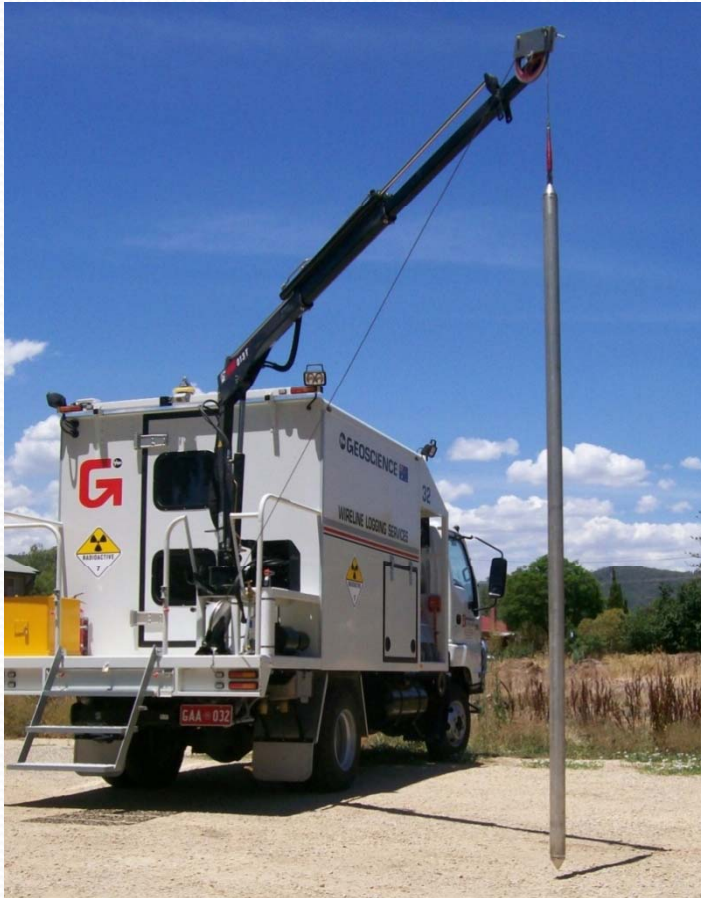


PFN (red) shows the strong disequilibrium with little uranium (but strong gamma) in the "wings" of the deposit

What Most Don't Know

- Calibration required for the dampening effect of chlorine associated to PVC casing
 - Study completed in 1982 but formal charts still required. In progress for 2011 R&D program.
- Low levels of U^{235} create difficulty in quantifying or creating an assay. This is due to background thermal neutron counts “Noise”. Can be reduced by a voltage increase. More in = More out
 - Voltages reduced to increase tool life
 - Gen 2 tools have modifications significantly reducing background noise picked up by detectors.
- Slow speed of assay compared to a gamma run
 - Run the tool when needed. Not the primary exploration technology on all holes. Part of a tool set and not a single silver bullet.
- Tool diameter in areas of swelling clays and unstable/unconsolidated sediments.
 - Gen 2 has miniaturized/hardened electronics but the limitation is the neutron canister diameter

The Advantages Of The PFN Tool



- Gain certain knowledge of the presence and amount of Uranium downhole as opposed to measuring ^{214}Bi and ^{214}Pb with gamma
- Provides instant results to aid drill program adjustments instead of waiting for geochemical analysis
- Analyses a larger mass of host rock than core or cuttings (up to 700mm diam.)
- Reduces analytical costs – (reduce labour cost from collecting, handling and transporting radioactive substances and in geochemical assay costs and storage)
- Reduces drilling costs (no need for extensive core)
- Available in Australia and U.S.A. and potentially elsewhere

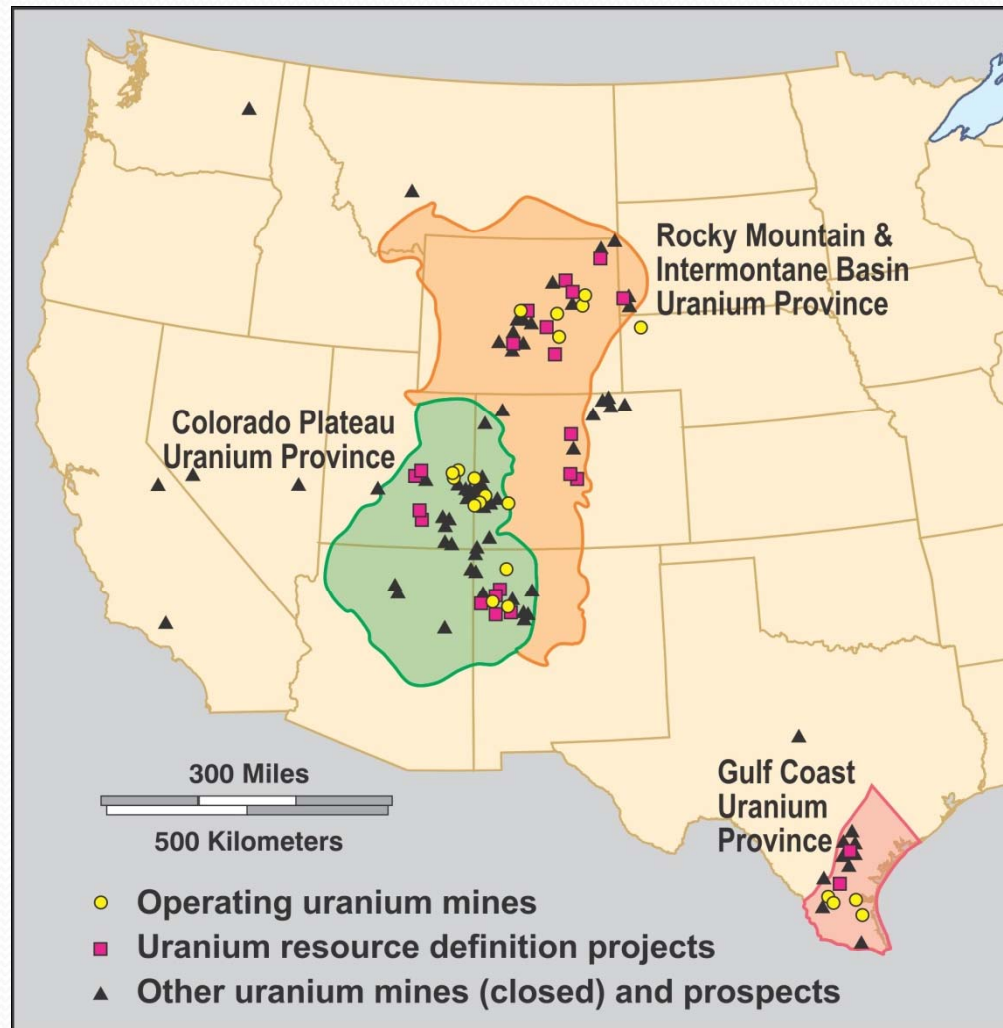
GAA Wireline in the US



Sandstone-hosted uranium provinces of the US

Many operating mines and development projects offer significant potential for utilizing PFN technology

PFN has been in use in the US for some years and is also a major part of the Australian mine and exploration process. Uptake in other international locations is also in progress





Summary

- Traditionally gamma has been used for uranium exploration
- Using gamma alone could lead to missing a uranium intercept and stepping over a uranium deposit
- Unlike gamma tools, PFN
 - measures uranium directly
 - provides immediate uranium analysis within the borehole
- GAA Wireline is the sole commercial provider of PFN and we would love to talk to you about your disequilibrium!
- PFN does not stand for **Pay For Nothing** and cannot be found on YouTube



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