An alternative approach to partial geochemical extractions:

The Pink Leach

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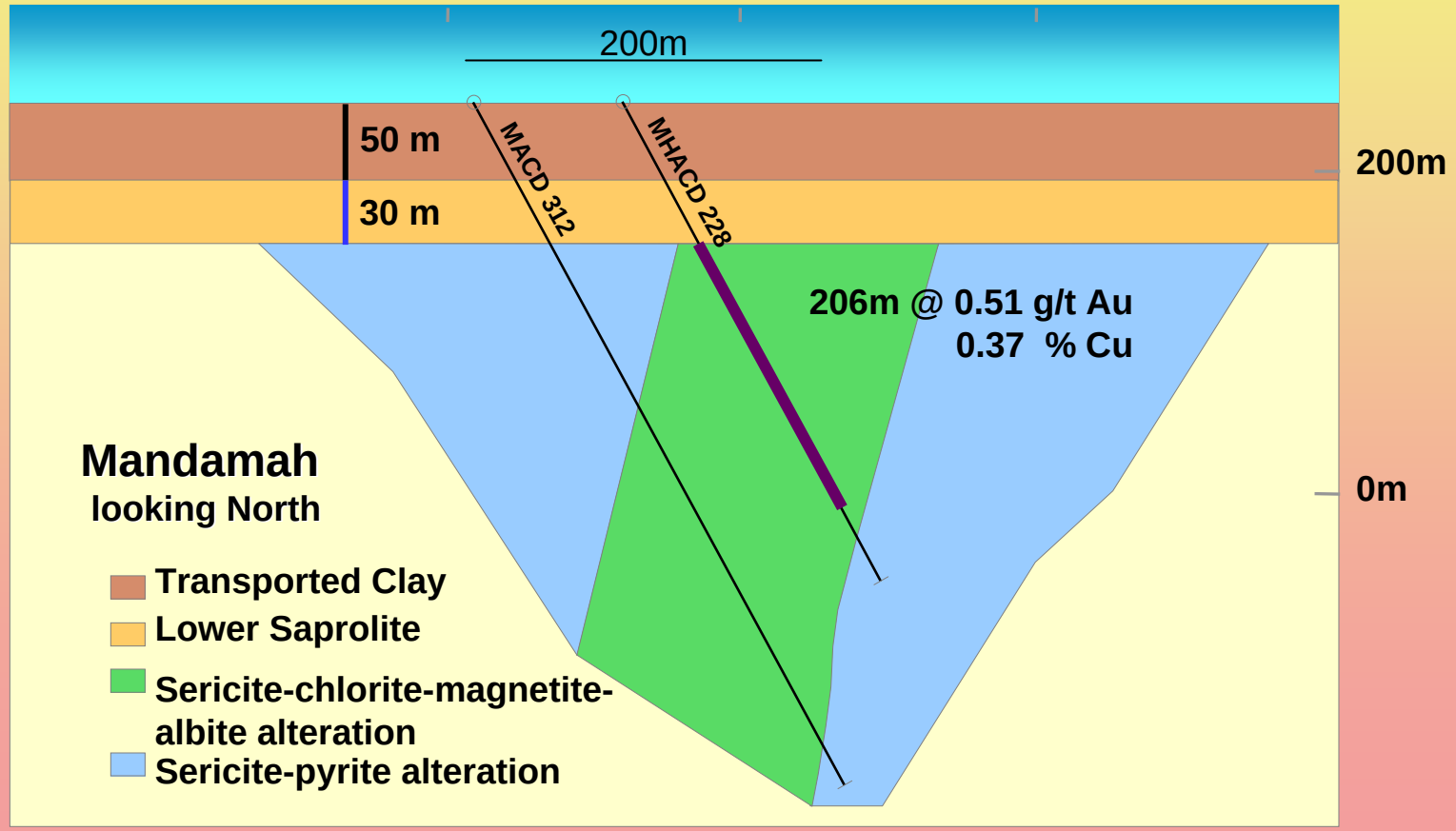
Location – Mandamah

Mandamah

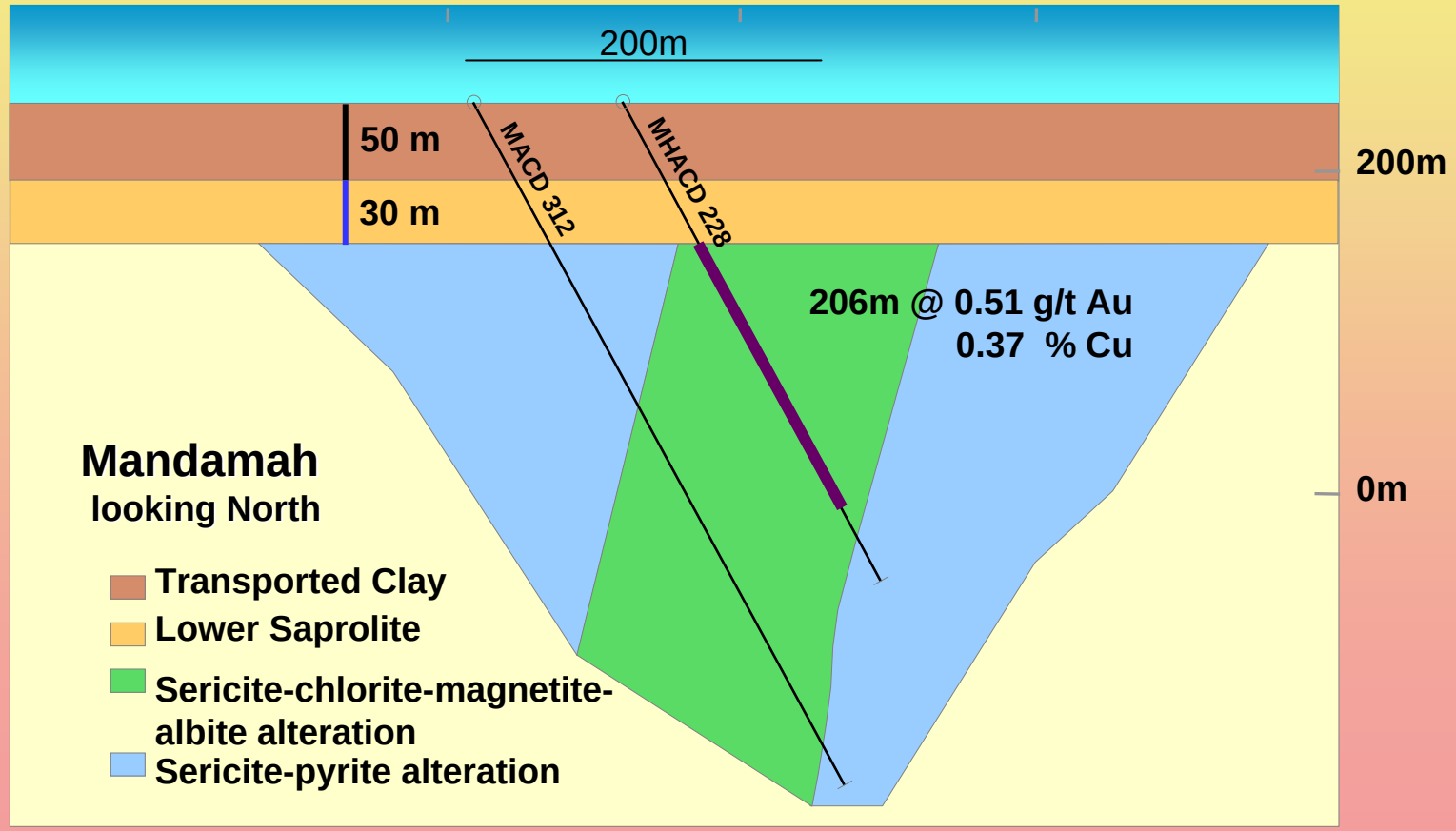
Mandamah – Geology

- Cu-Au porphyry style mineralisation, possibly E. Silurian.
- Mineralisation hosted in quartz stockworks in coarse plagioclase-phyric quartz diorite.



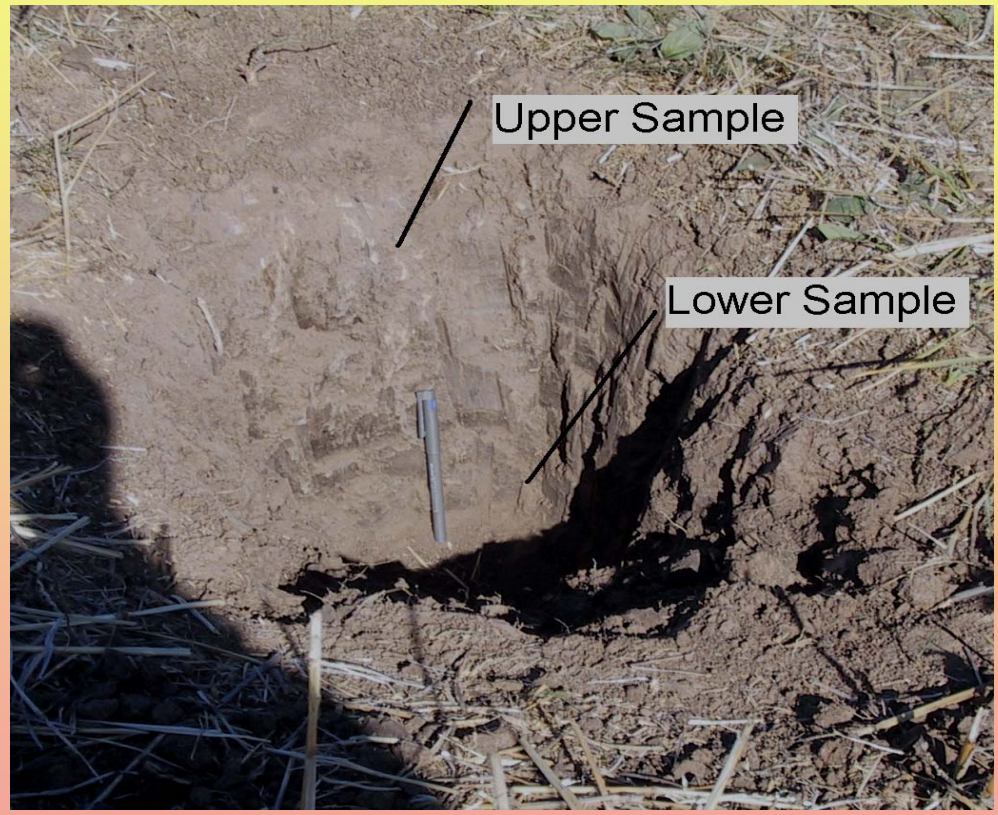
Mandamah – Geology

- 30m of saprolite developed on the diorite.
- Area covered by ~50m ?post Miocene clay-rich alluvium.
- Supergene Cu Au development at alluv-sap boundary.



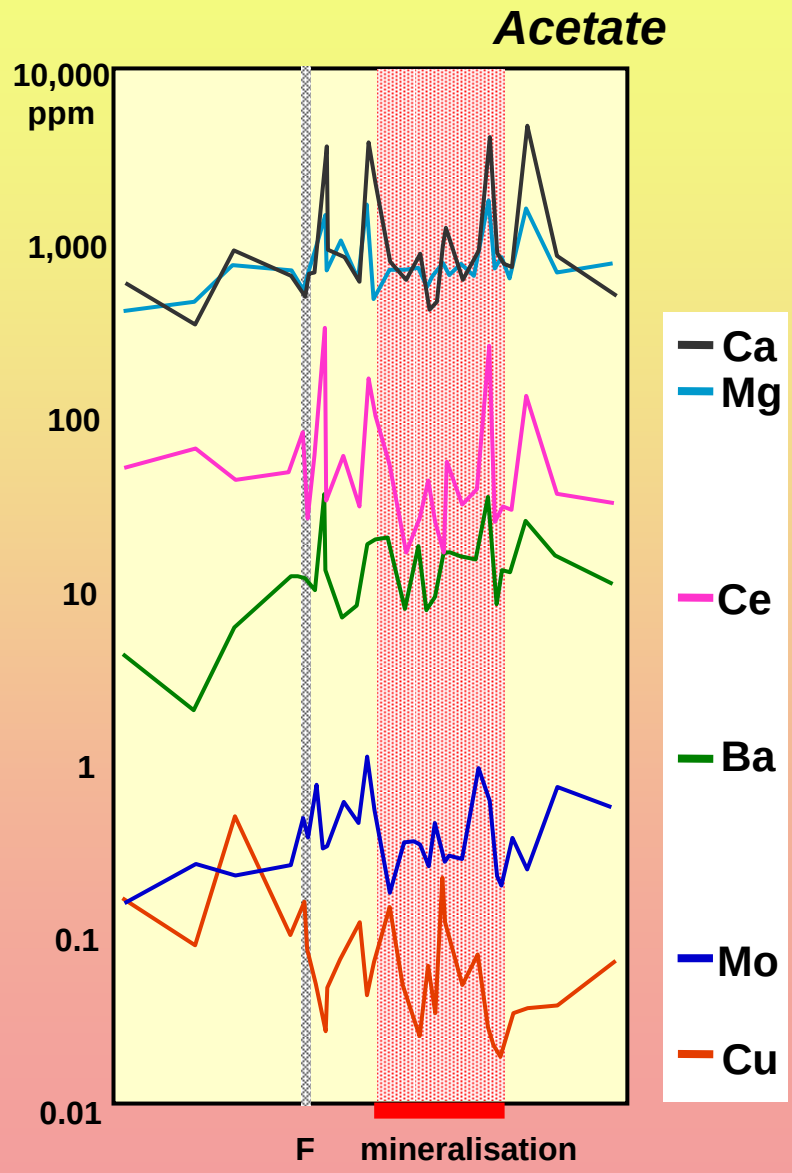
Mandamah – Samples

- Grey to beige, massive and well sorted alluvium.
- >70% by weight clays and -180µm quartz fragments.
- Quartz and lithic fragments < 1mm.
- Carbonates both as cements and nodules at selected locations.



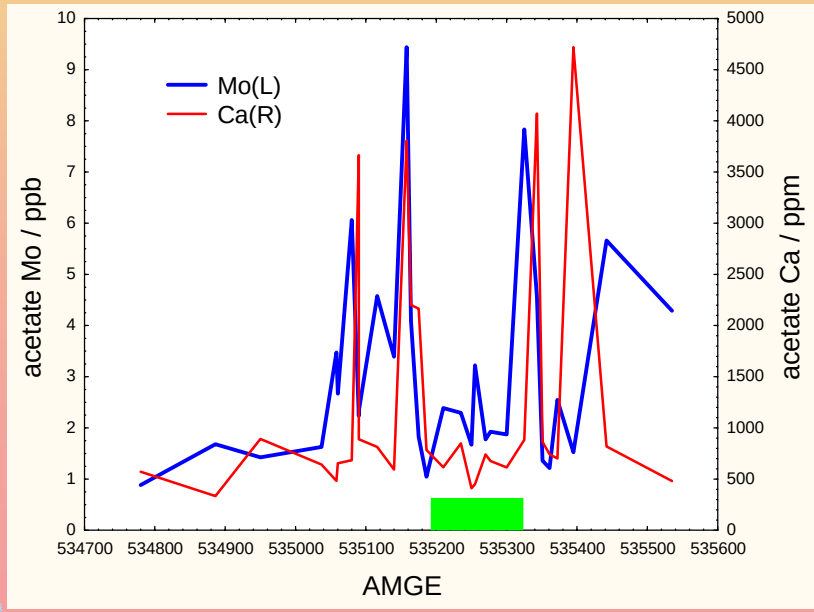
Mandamah – Orientation Study

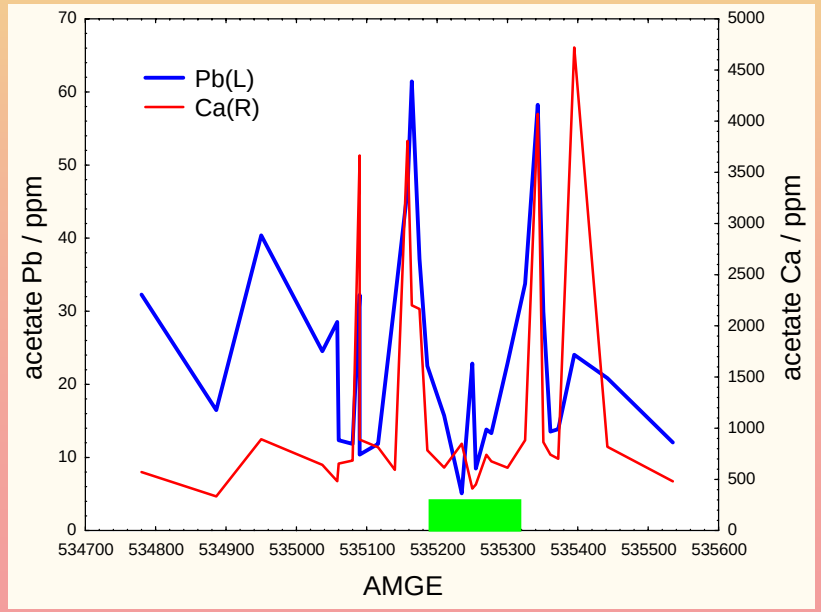
- Extensive survey performed with 5 leaches that did not display patterns of ore related metals definitively related to mineralisation.
- Significant variability seen in the traverses, particularly over and around structural features and the periphery of mineralisation.
- Subtle leaches appeared to offer the greatest variability that might be related to mineralisation.



Mandamah – Orientation Study

- The distribution of many major and trace metals appears to be affected by the distribution of carbonates.
- The carbonate distribution may be a affected mineralisation but also may affect the redistribution of trace elements in the sample or extractability in the leach.





Mandamah – Orientation Study

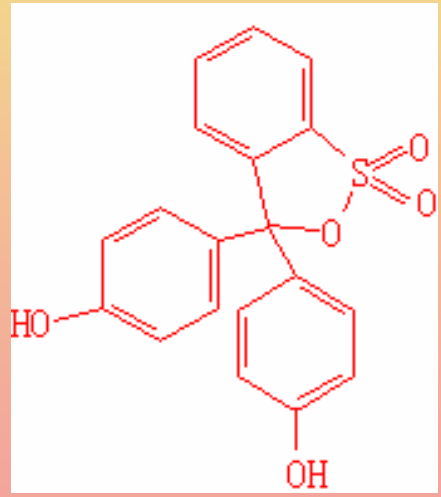
- It was concluded that we needed a weak leach that would be unaffected by local variations in the soil's capacity to consume acid or base.
- Buffering appeared to not offer the required control in the acetate buffer pH range.
- A leach was required that would be tailored for each sample while not taking an excessive amount of time or significantly affecting the natural background soil chemistry.

Pink Leach – Theory

- In regions of uniform cover, local changes in a soil's buffering capacity may be a consequence of an active geochemical system.
- The Pink Leach is a $Ca(NO_3)_2$ based exchange leach with no chelating agents.
- The Pink Leach reacts all samples at the same pH irrespective of the sample alkalinity or acidity.

Pink Leach – Chemistry

- Concentrated $Ca(NO_3)_2$ solution ~10g/L.
- Neutral, acidic and alkaline $Ca(NO_3)_2$ solutions are prepared
- Trace concentration of phenol red in each
  - Indicator with a pH range of 6.8 to 8.4
  - Equivalence point pH of 7.3 to 7.8
  - This indicator was chosen as pH slurries for samples distant to mineralisation at Mandamah are within this pH range and most metals are mobile



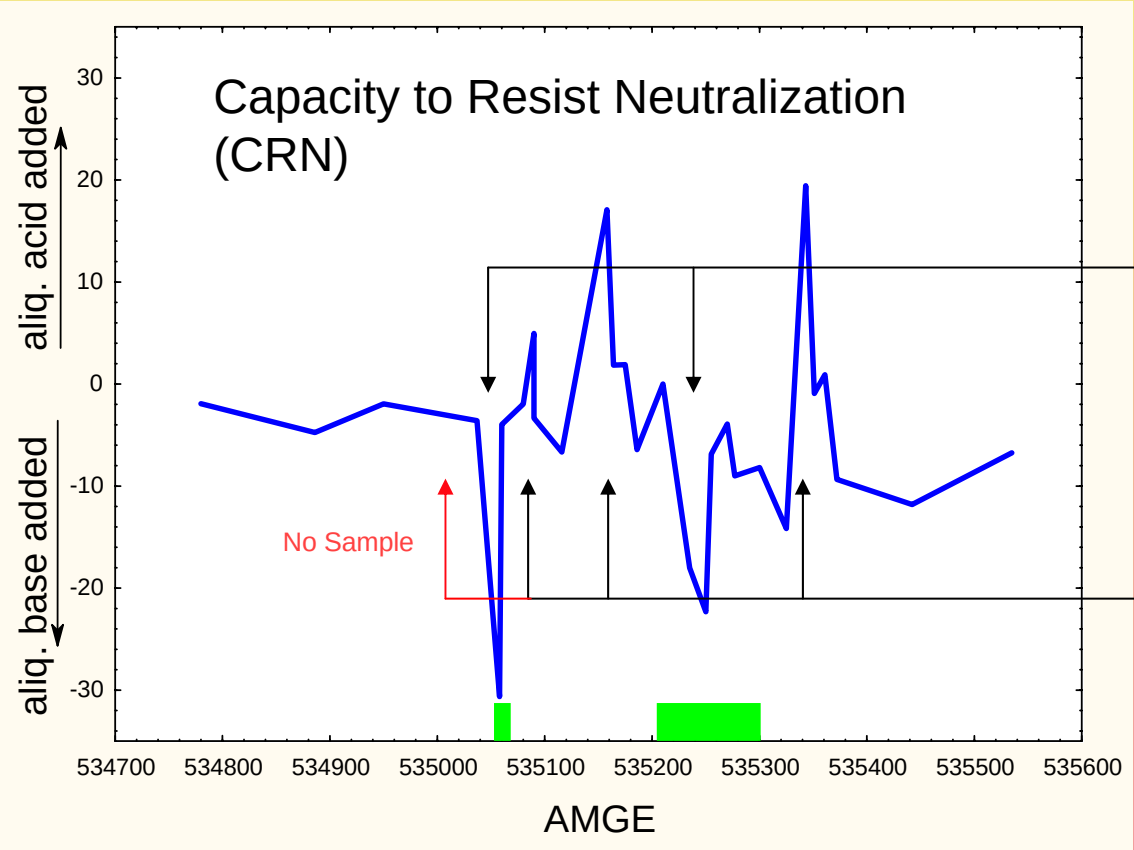
- This is now referred to as the **PR-**$Ca(NO_3)_2$ reagent.

Pink Leach - Method

- A “standard solution” is made at a known pH in the transition range for the indicator.
- Add 20mL of neutral **PR-**$Ca(NO_3)_2$ reagent to 1g of sample.
- The solution pH quickly equilibrates with the sample.
- If the solution is yellow, it is too acidic.
- If the solution is red, it solution is too alkaline.
- Acidic or alkaline **PR-**$Ca(NO_3)_2$ reagent is added in small measured quantities until the colour of solution matches the standard solution.
- The leachate is removed when the fine material flocculates, typically within 5 minutes.

Pink Leach - Results

- Addition of acid or base indicates a capacity to resist change in soil conditions.



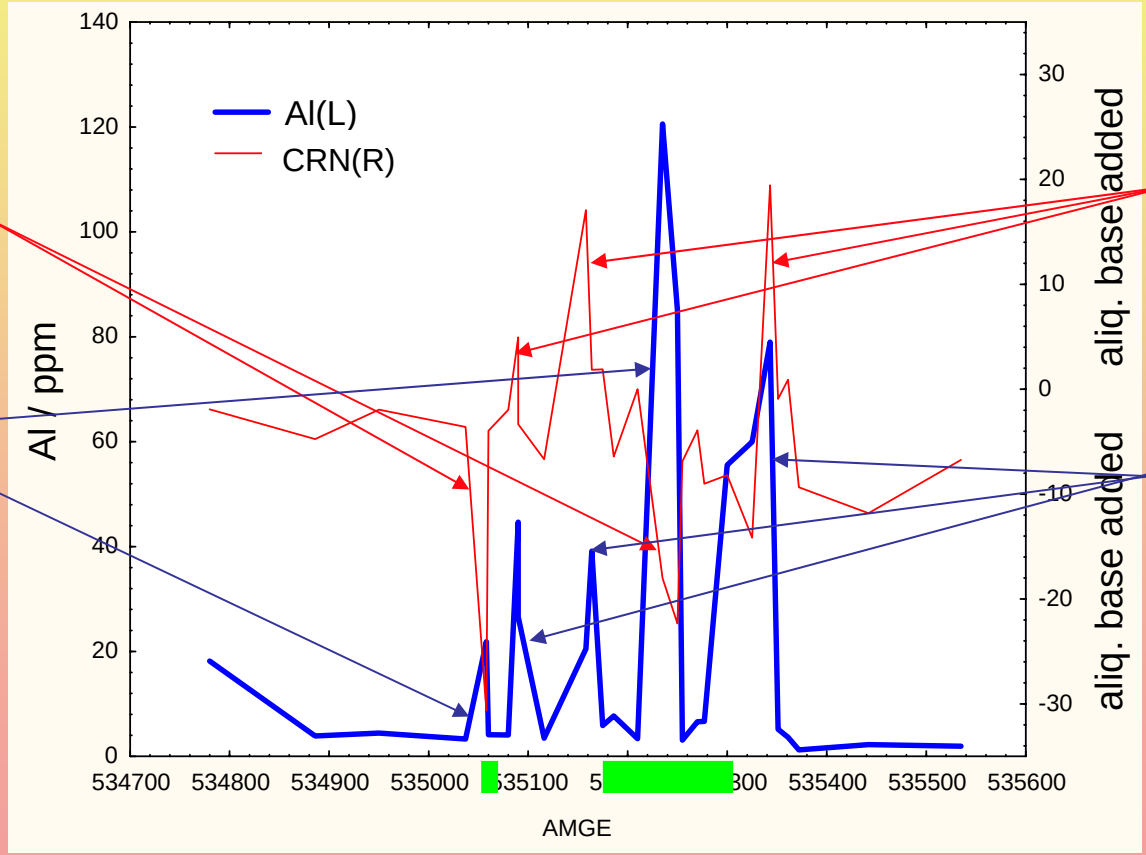
Pink Leach - Results

- Aliquot measurement is significantly different to a simple pH measurement on a slurry.
- pH measurements give an indication of the dominant acid-base species in a sample.
- The amount of acid or base required to neutralise a sample is a measure of the soil's capacity to generate base or acid.
- It is therefore a fundamental soil property rather than a consequence of soil solution interaction.

Pink Leach - Results

- High extractable mobile Al at all zones of non-neutrality.

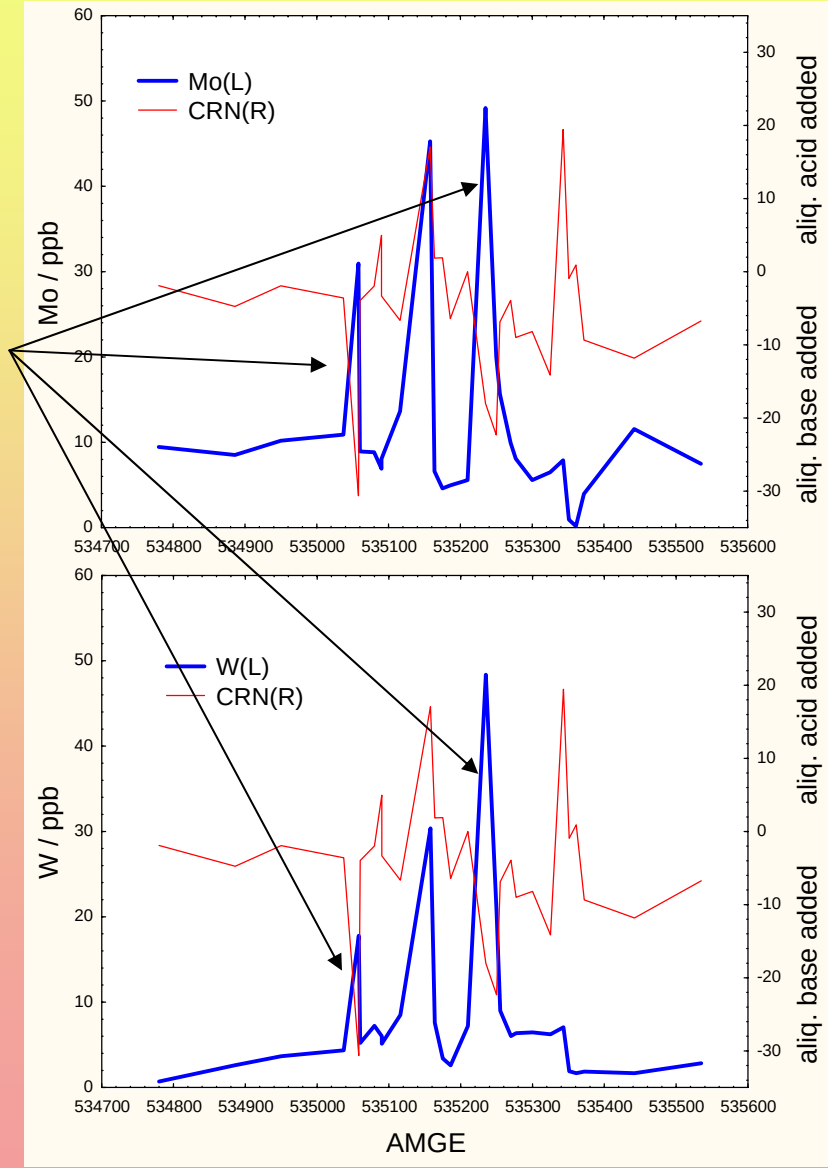
Zones of acid generation correspond to zones of high Al extraction.



Zones of acid consumption correspond approximately to zones of high Al extraction.

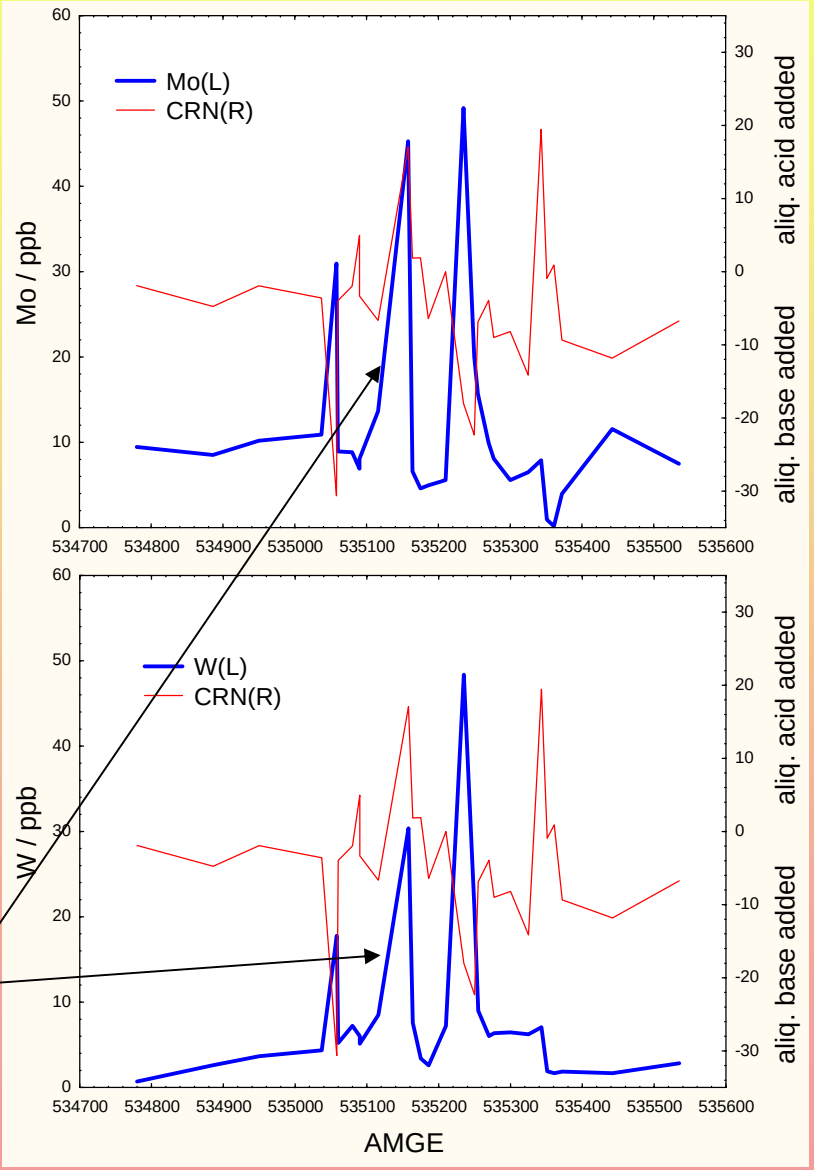
Pink Leach - Results

- Mo and W have a high extraction in the samples that generate acid.



Pink Leach - Results

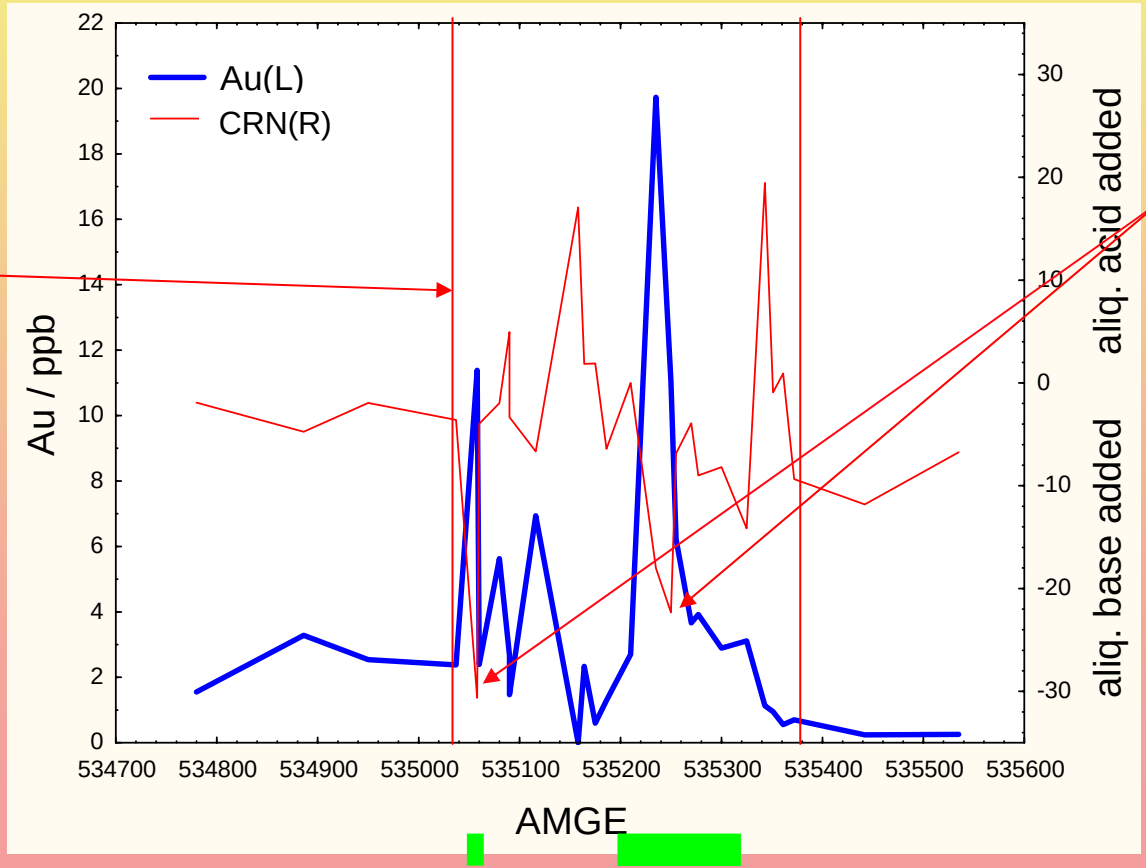
- Mo and W also accumulate in the acid consumption zone between the acid generation zones.
  - This may be a consequence of the limited directions for these elements to diffuse away.



Pink Leach - Results

- Au has a high extraction in the samples which generate acid.

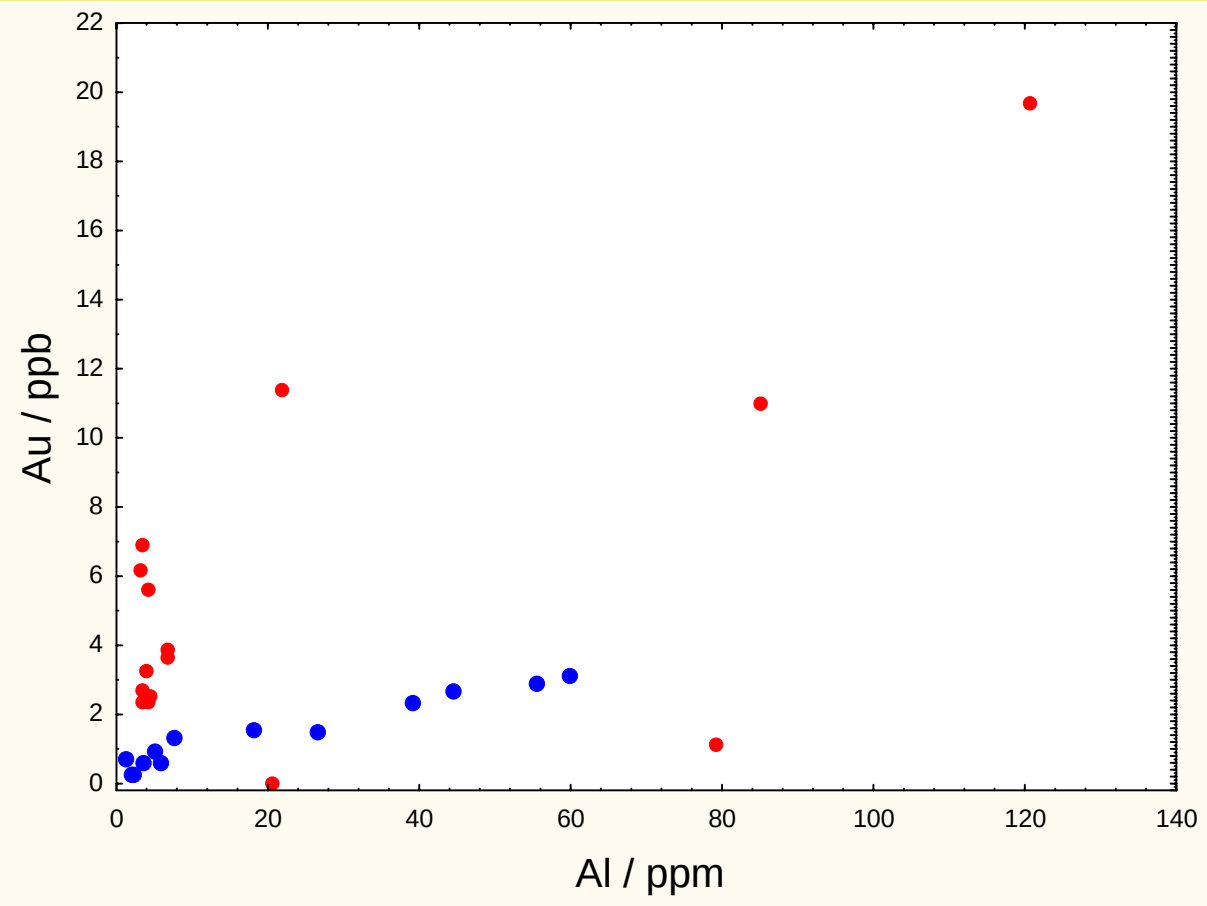
The high Au variability lies within the zone of non neutrality.



The major Au peaks correspond to the high acid generation samples.

Pink Leach - Results

- In a selection of samples (blue), the extraction of mobile Au is related mobile Al. Local residual Au minima correspond to the alkaline generation zones.



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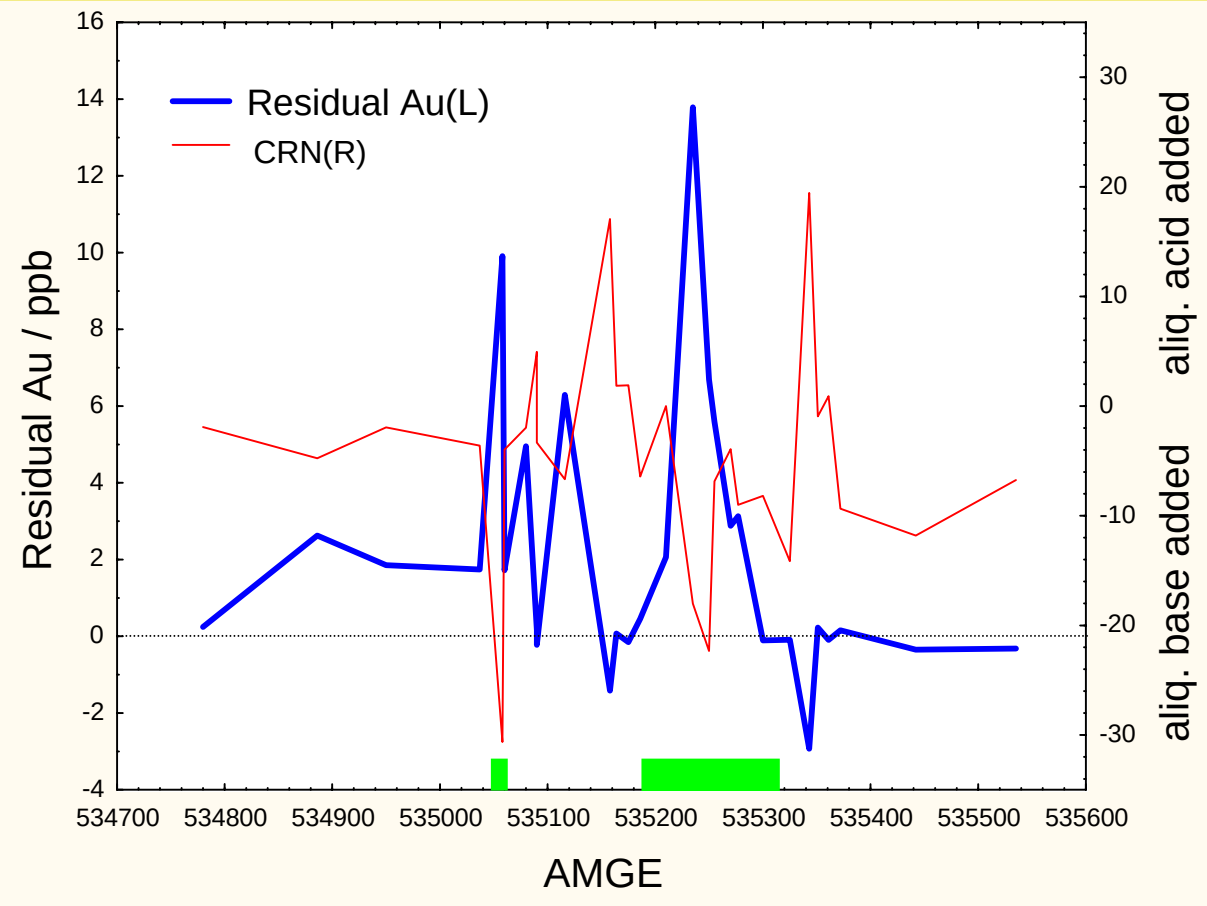
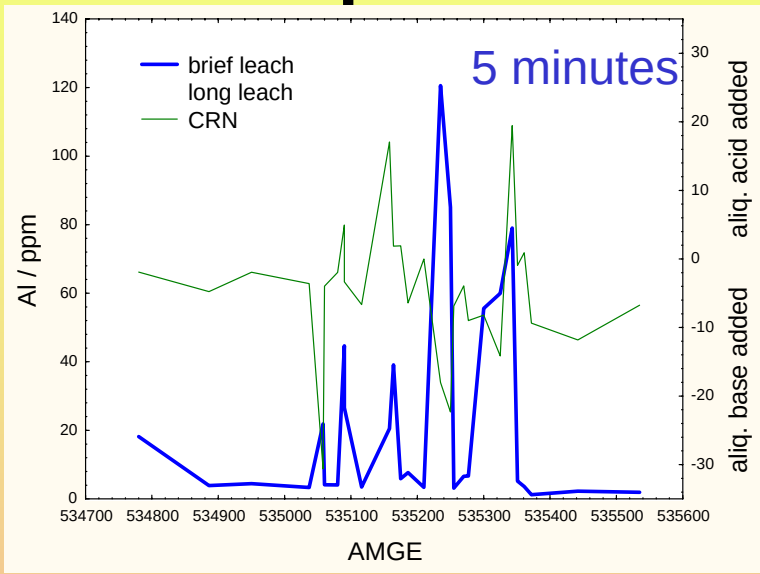
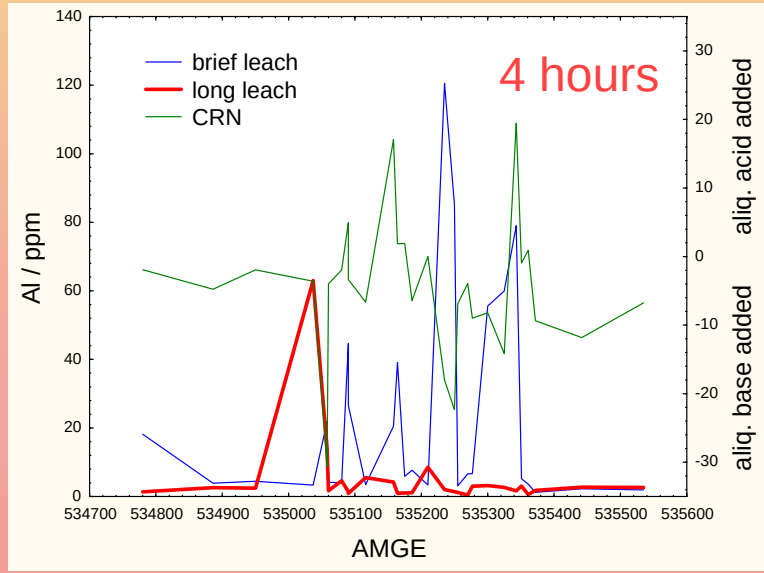


Pink Leach – Time Dependence

- Al quickly destabilises out of solution.
- Au, Mo and W also destabilise quickly out of solution, particularly over mineralisation. Patterns are obscured in a high background.





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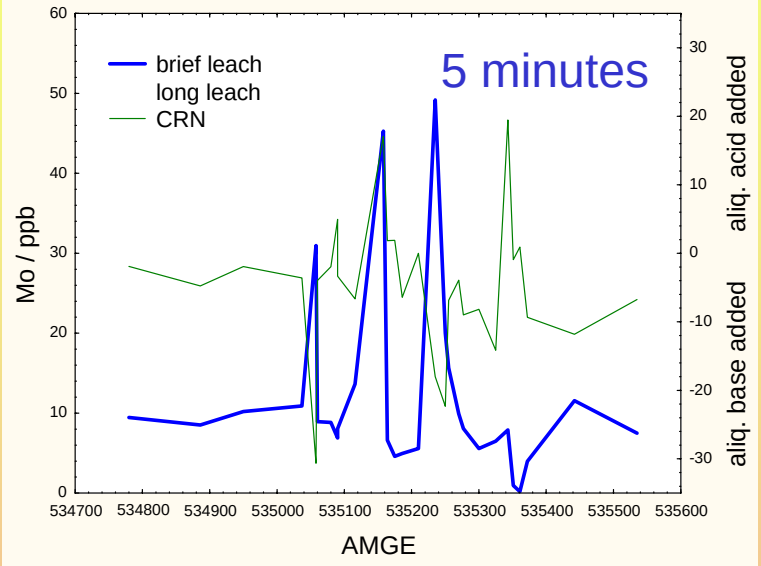

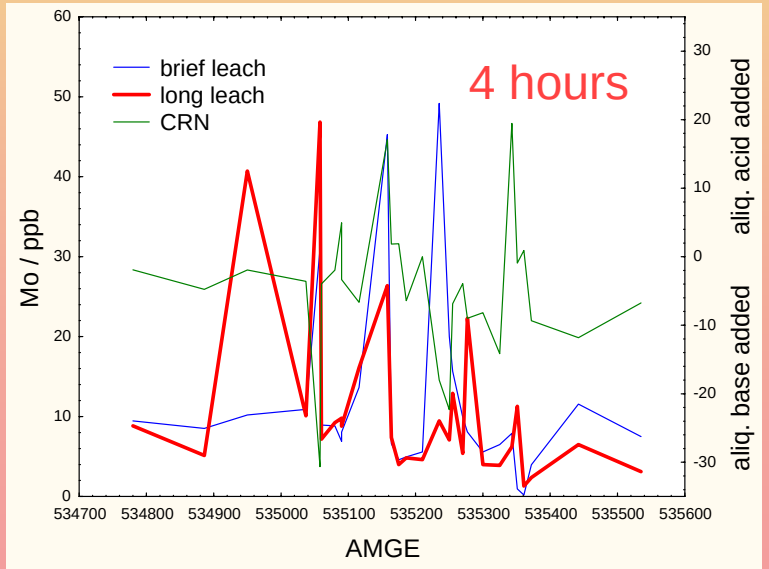

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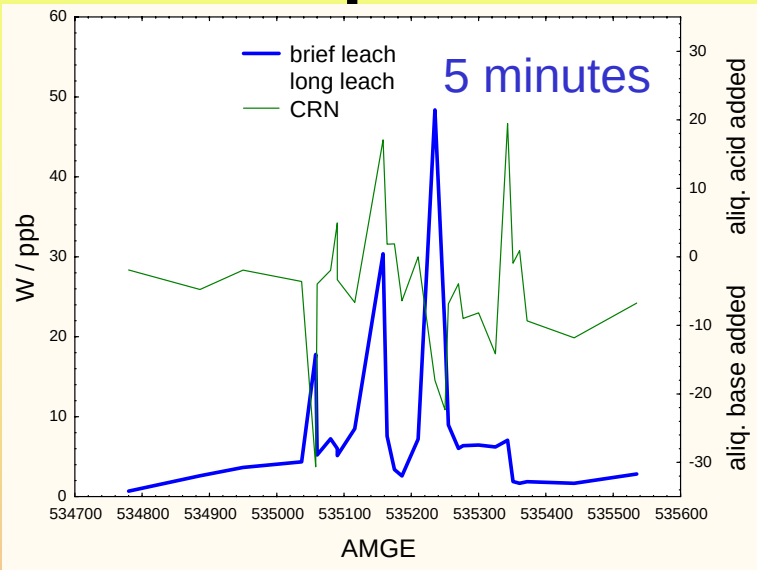

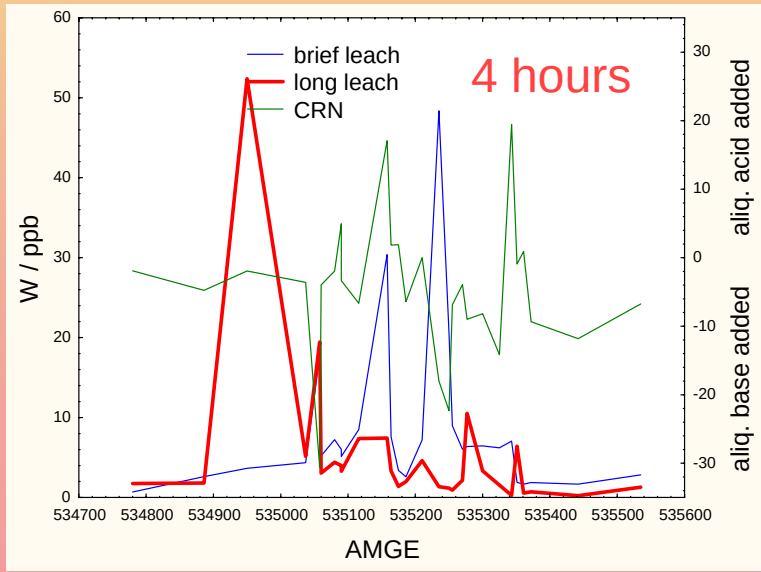

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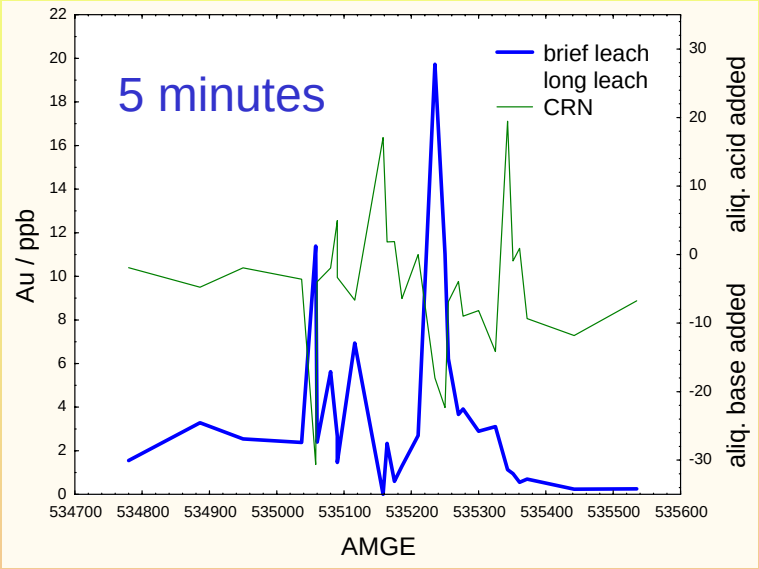
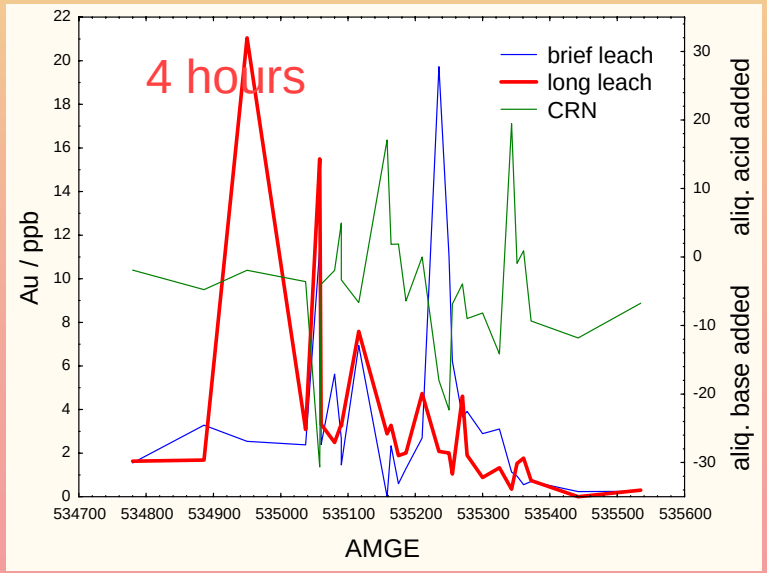
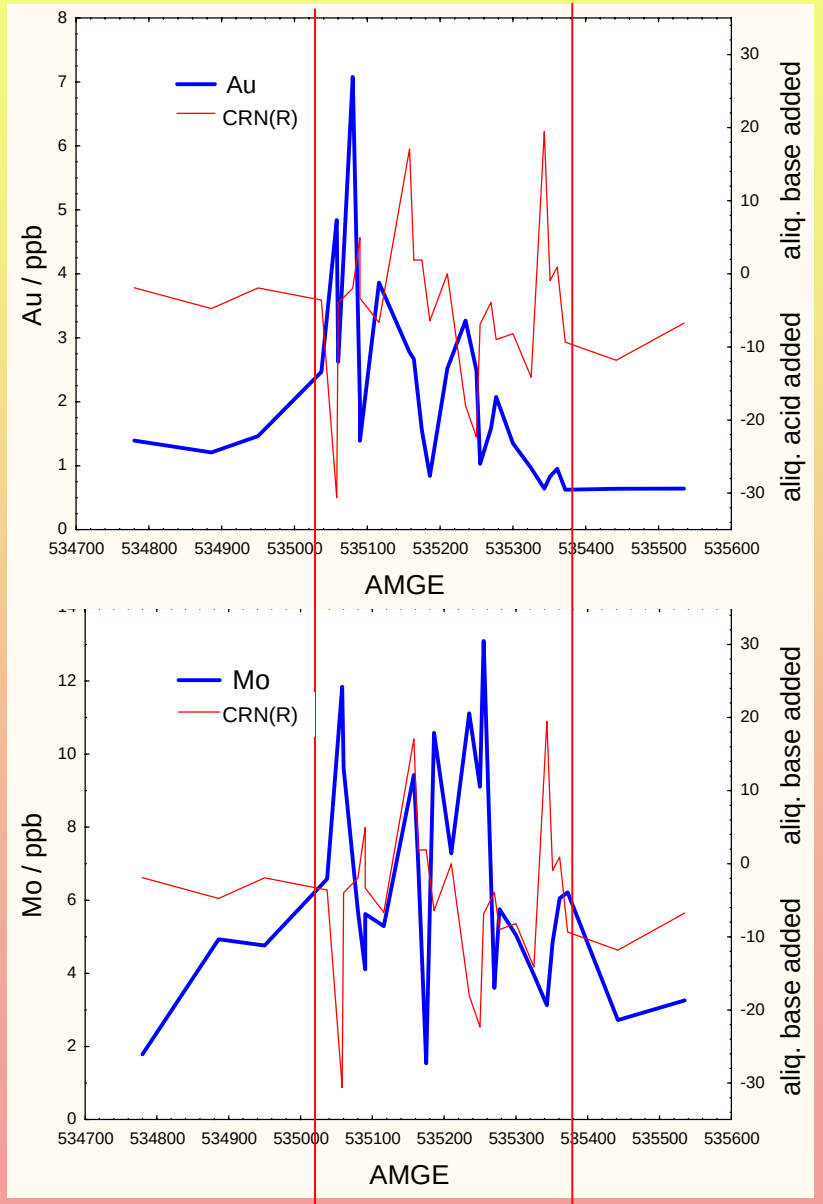




Pink Leach – Other Leaches

- The local acid-base conditions can be used to interpret the results other leaches.
- Fine detail which might otherwise be interpreted as variability is related to the local acid-base system.



Pink Leach

- Local acid base variations are efficiently illustrated by the capacity of a sample to consume or generate acid.
- The theory behind this leach assumes that local acid base variations may be related to the movement of acid from an oxidising ore body at depth through local structures.
- This subtle leach appears to simply reverse these acid base processes.

Pink Leach

- If the background pH is different from 7.5 or a different suite of elements was targeted, an alternative indicator could be used.
- The acid base consumption can be used as an inexpensive field technique to screen for potential partial leach responses.

Pink Leach - Conclusions

- An understanding of how an individual sample location relates to the local geochemical system enhances the interpretability of the partial leach results.
- An anomalous response related to mineralisation was seen at Mandamah, where other techniques had failed.

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