

Multi-Element Analysis of River Sediment Digestions Using the Attom

- Switching resolutions within samples
- Wide dynamic range
- Reproducible data over a month of re-runs
- Excellent agreement with accredited laboratory results
- Flexible data processing software

The Attom from Nu Instruments is a high performance ICP-MS capable of undertaking work in both high precision isotope ratio analysis and high resolution elemental analysis. It is commonly used in laboratories where there is not one fixed application so there is always a desire to have an instrument with the flexibility to switch easily between tasks without impairing the performance and ease of use. In order to confirm the ability of the Attom to conduct reproducible multi-element analysis over a long period whilst also being used for other applications, an experiment was devised where a set of samples previously analysed at British Geological Survey (BGS), an accredited laboratory, were re-analysed on the Attom on several occasions over the period of a month.

The samples were a series of river sediments with common reference materials which were HF/HClO₄ digested, reduced to dryness and delivered to Nu Instruments as 0.25 g in 25 mls (5% HNO₃ and 2.5% HCl). For each batch analysis, the samples were further diluted 1:500 in 2% HNO₃ and spiked with 10 ppb of ⁶Li, In and Re as internal standards. A range of calibration solutions was prepared with the same diluent for each batch. The Attom was tuned for stability and the methods optimised for peak-jumping with flat topped low resolution peaks and two additional methods with resolutions of 5000 and 10000.

The methods were developed so that elements which might have interferences were measured with combinations of multiple isotopes and multiple resolutions so both quantitation and confirmation of interference removal was possible. For each batch, the AttoLab software was able to combine each of the methods with each introduction of a sample in the user defined order Peak-Jumping, 5000 resolution and 10000 resolution (the software allows for more methods to be combined during one sample uptake up to the total number of resolutions defined in the instrument setup). Over a period of a month, the batch analysis was repeated 4 times in overnight runs and the instrument was then used for other work during the days. The data from each batch was processed using Nu Quant quantitative analysis software and some example calibrations and spectra are shown opposite:

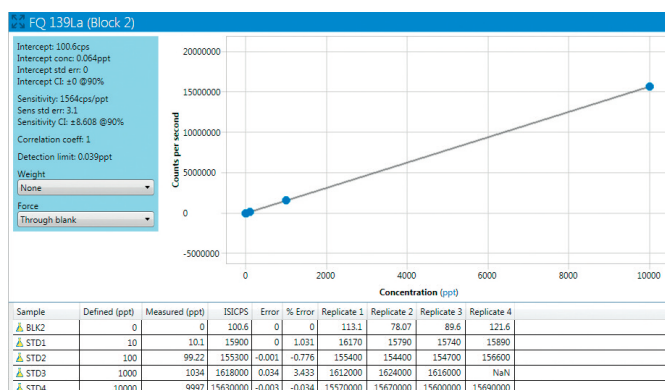


Figure 1: Lanthanum calibration from the low resolution, flat-top peak-jumping method.

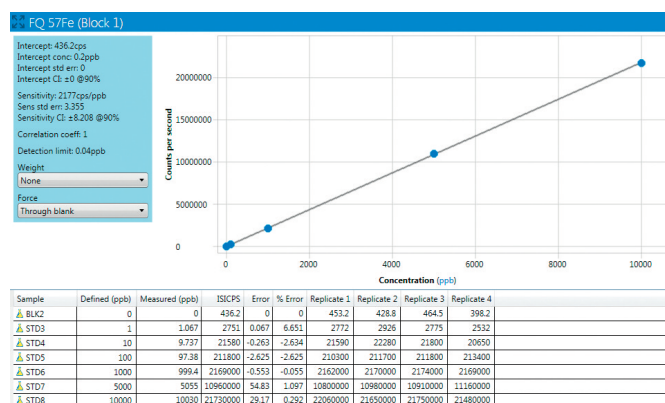


Figure 2: Iron calibration from the 5000 resolution method.

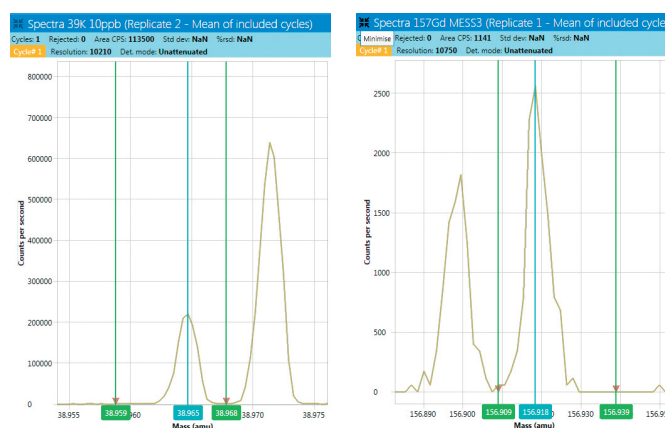
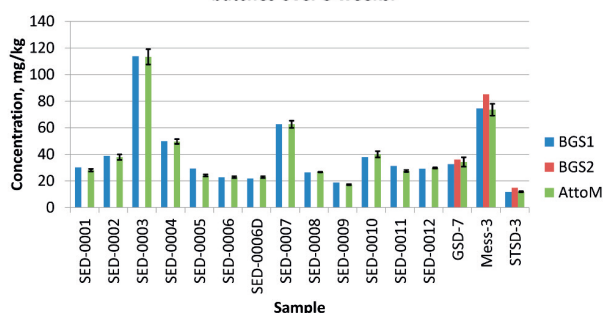


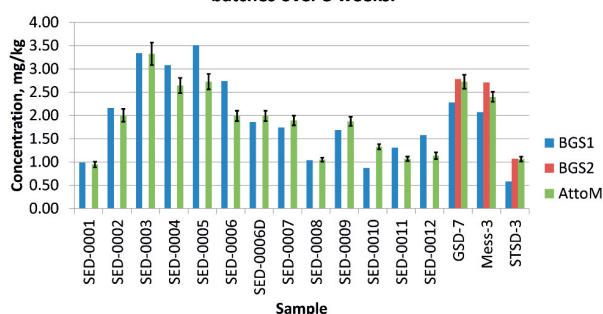
Figure 3: Examples of 10000 resolution spectra resolving ³⁹K from ArH and ¹⁵⁷Gd from CeOH.

The charts below show the comparison data for the various samples for all of the elements measured in the batches in both laboratories. The reference materials GSD-7, Mess-3 and STSD-3 were measured twice in the BGS batch so are shown twice in this data. The Attom data is displayed as the mean of the batches, isotopes and resolutions where there was no significant interference with the error bars being ± 1 standard deviation from the mean.

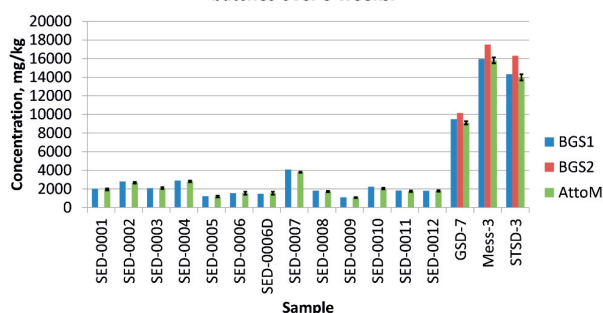
Li data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



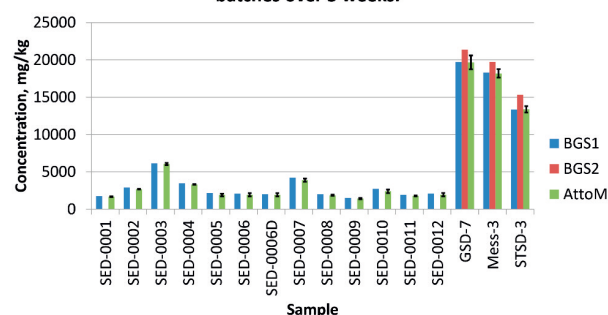
Be data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



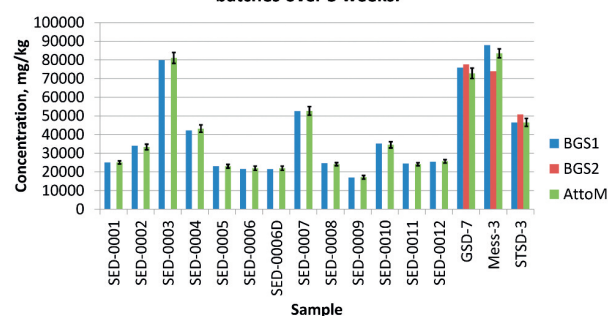
Na data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



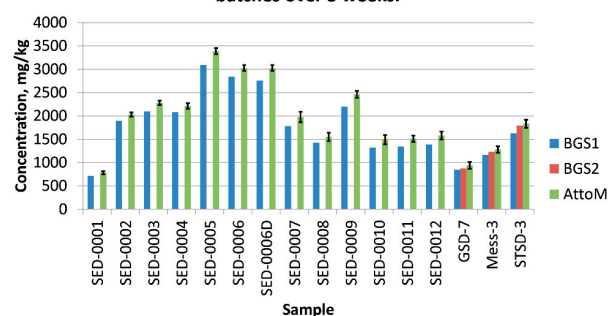
Mg data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



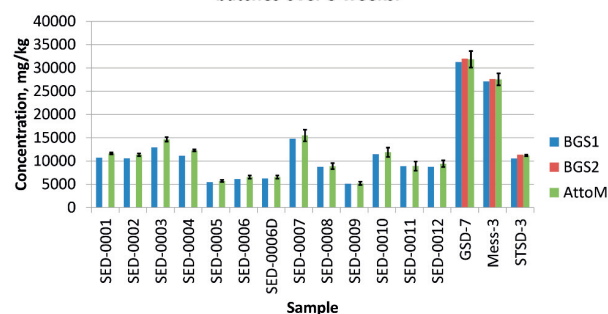
Al data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



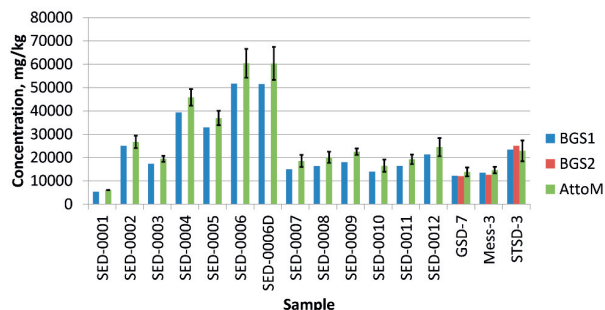
P data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



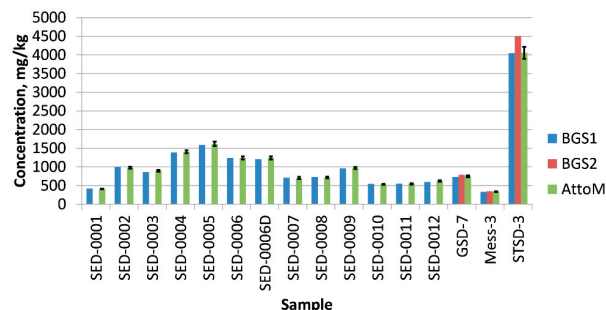
K data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



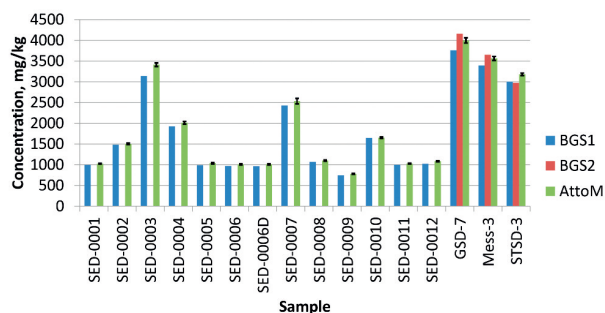
Ca data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



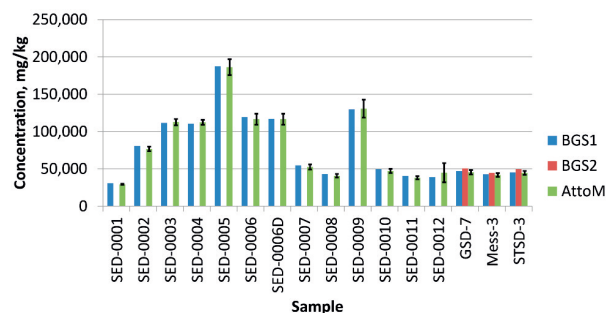
Mn data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



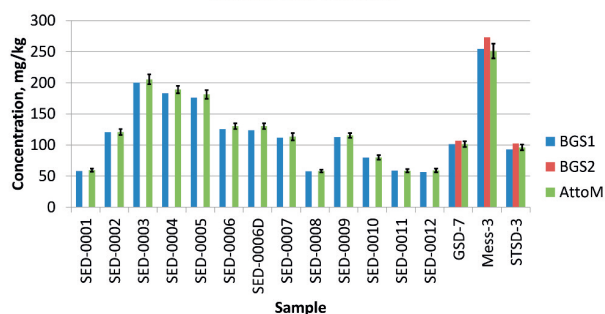
Ti data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



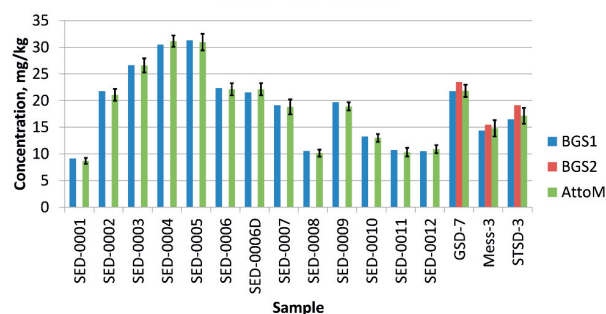
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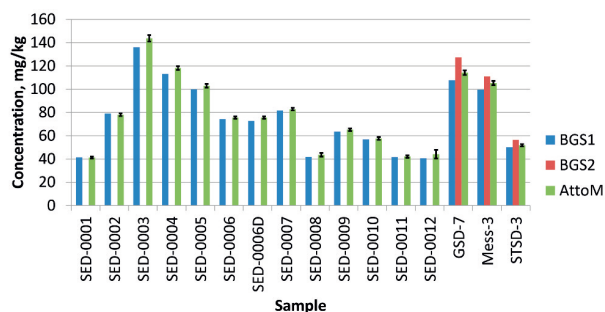
V data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



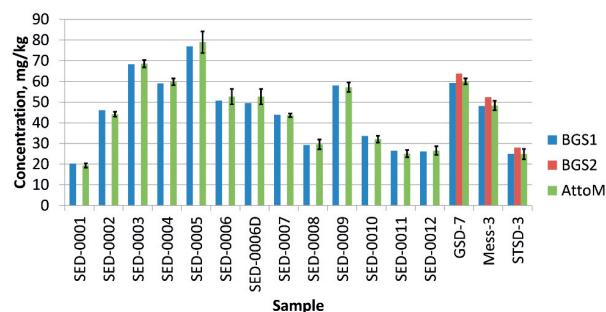
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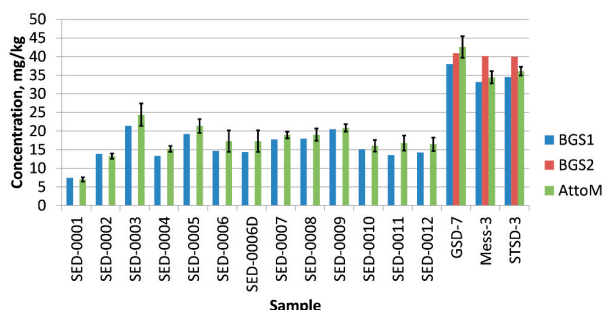
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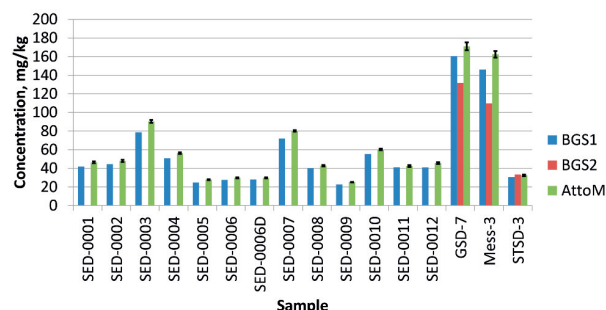
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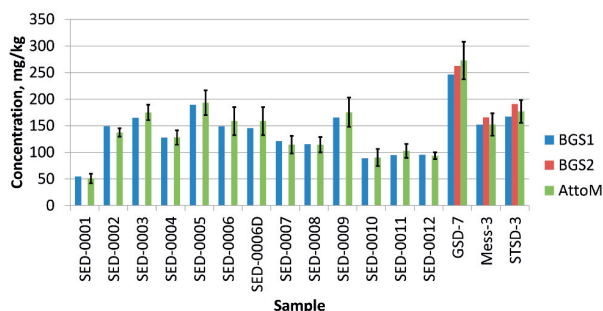
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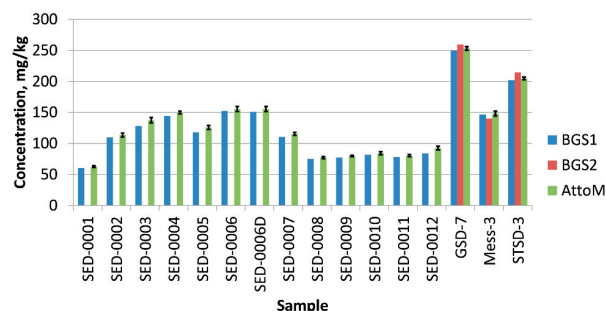
Rb data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



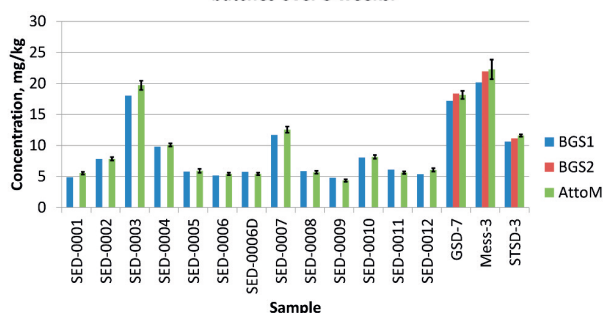
Zn data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



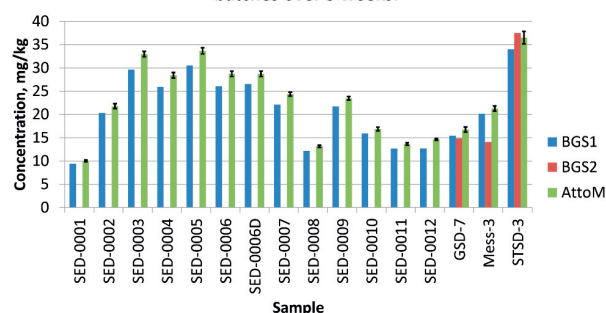
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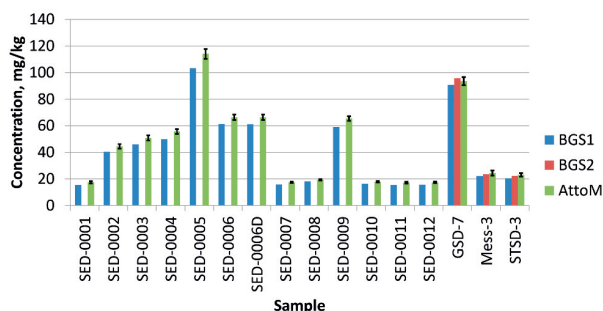
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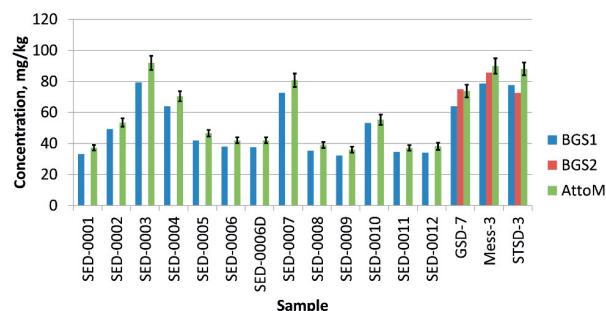
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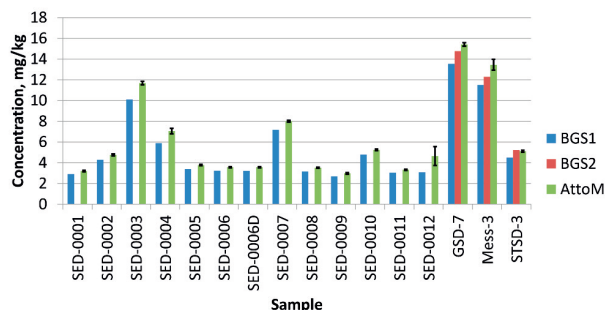
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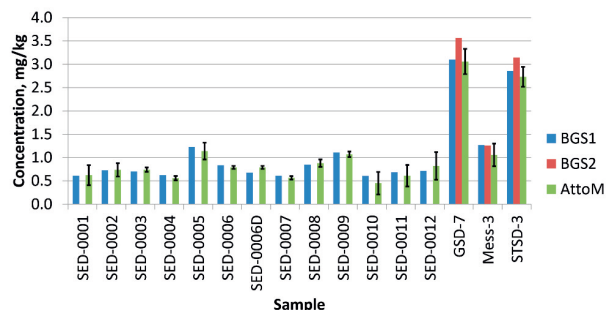
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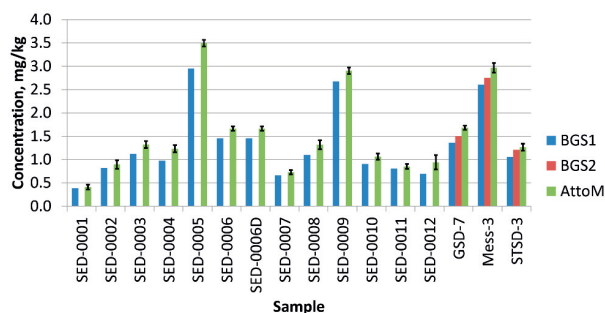
Nb data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



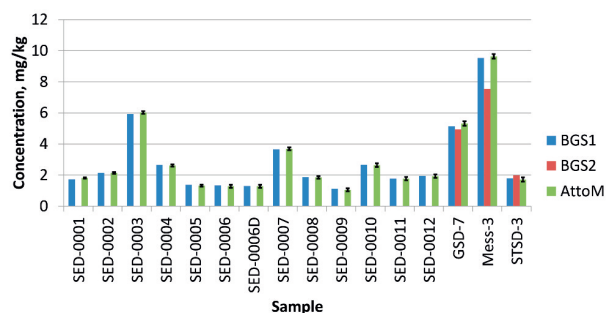
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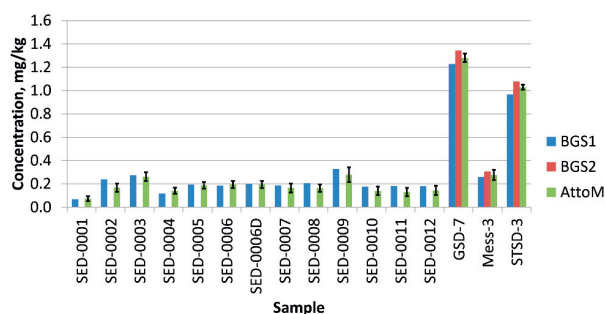
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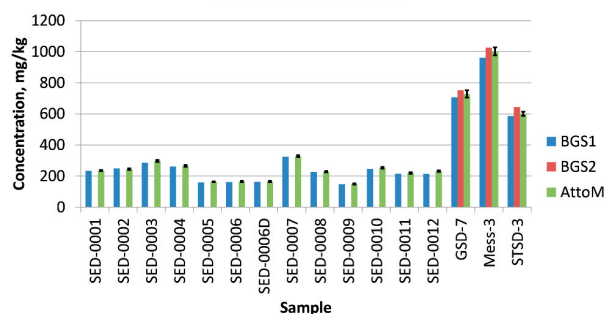
Cs data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



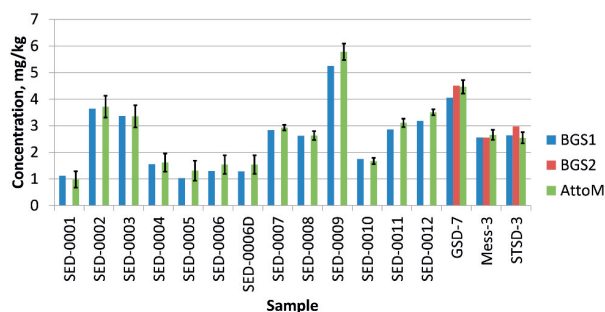
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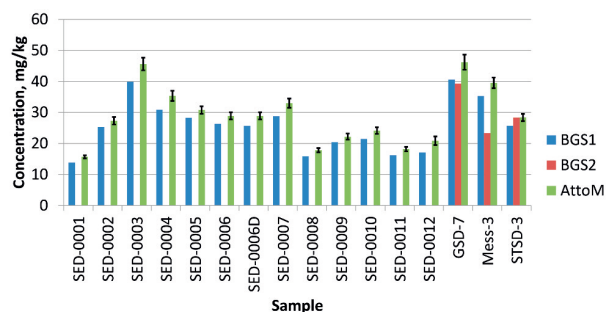
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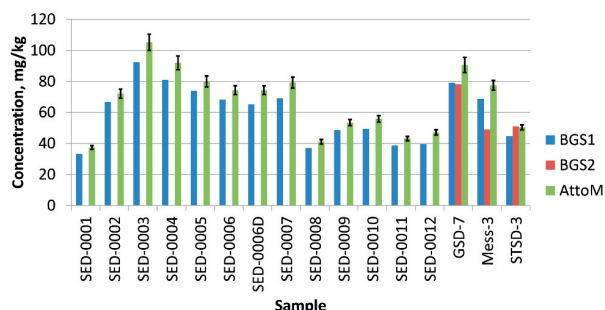
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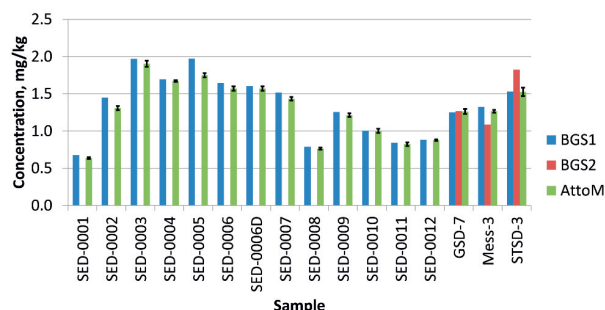
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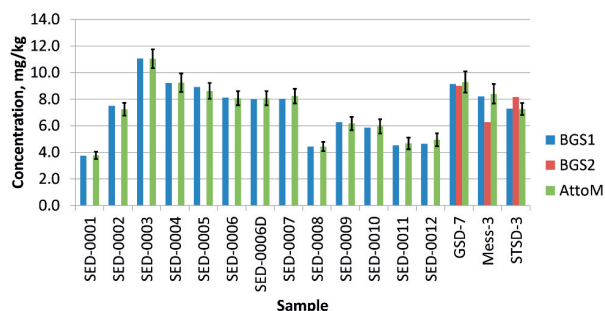
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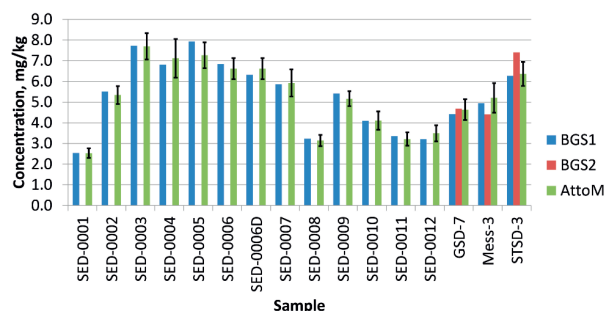
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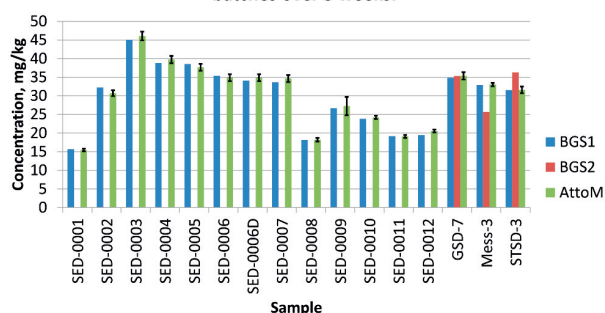
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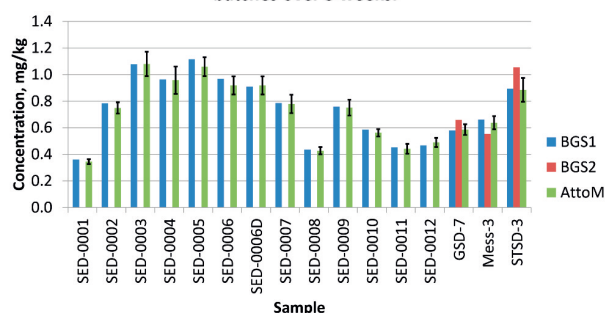
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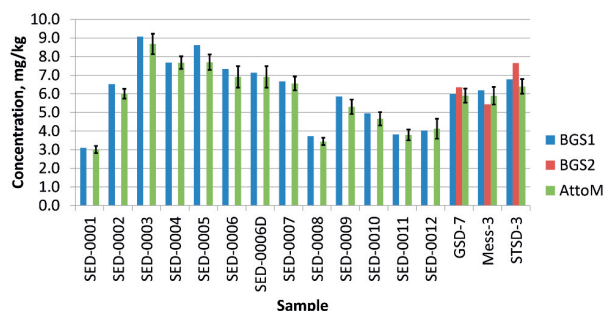
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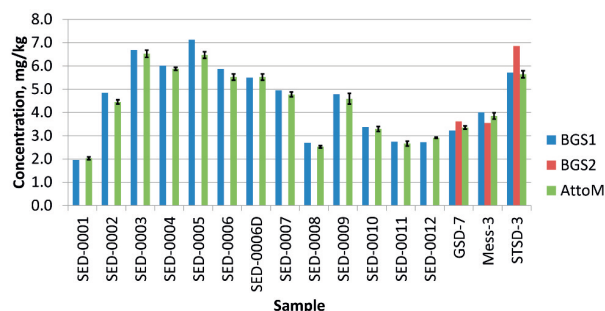
Tb data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



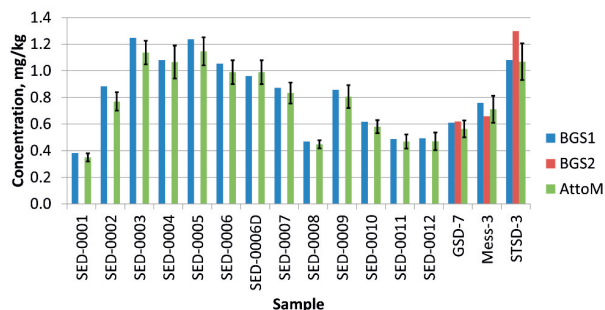
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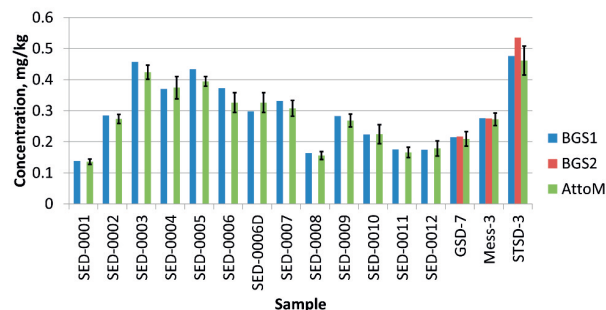
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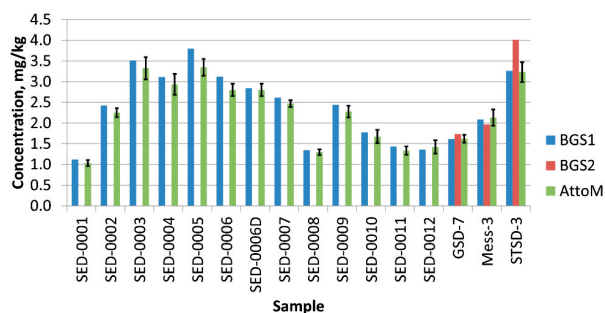
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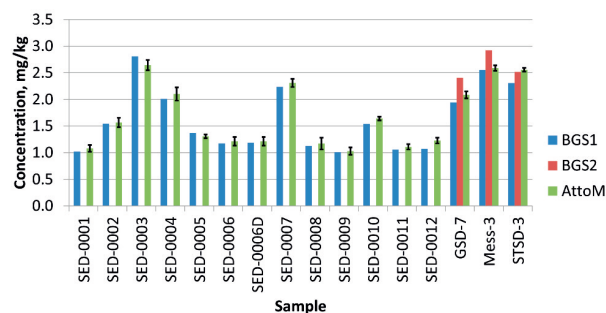
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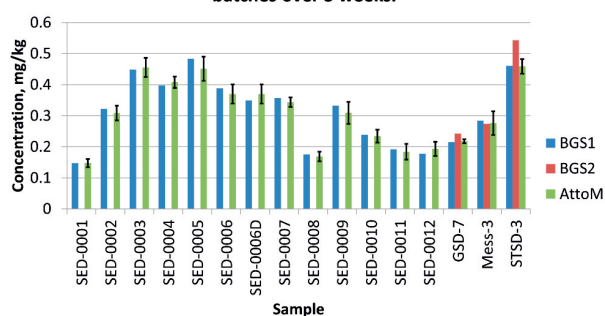
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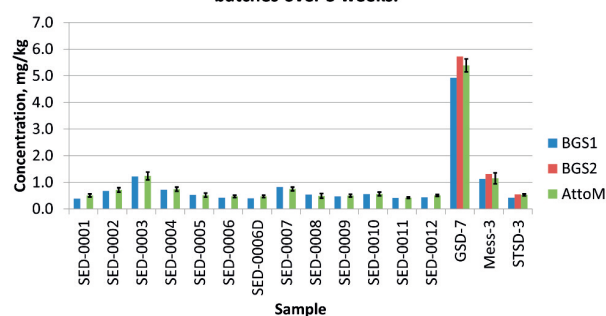
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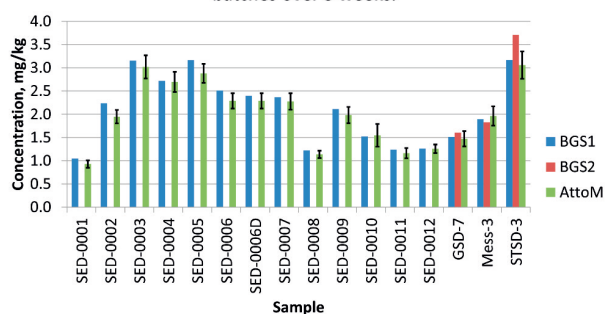
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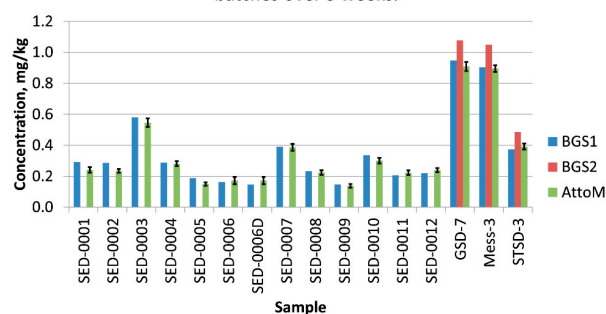
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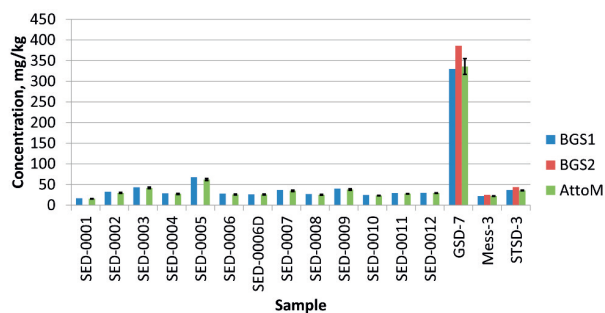
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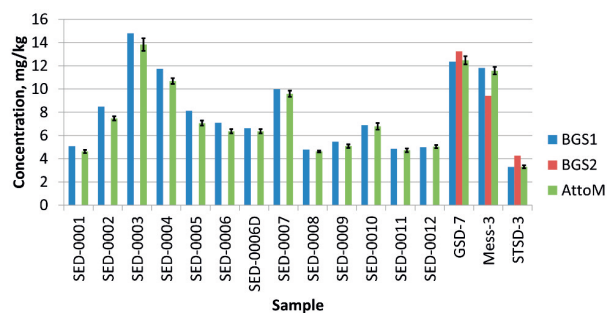
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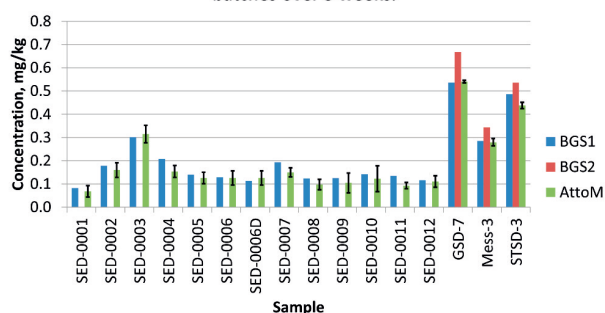
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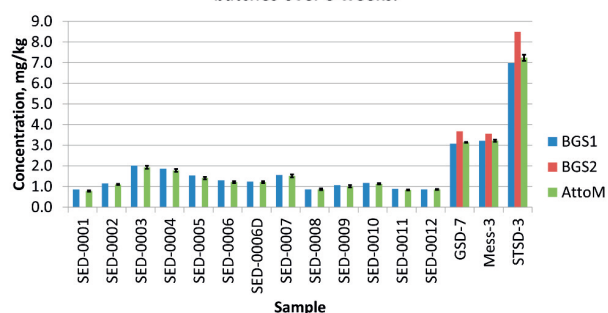
Th data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



Bi data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



U data for a range of sediment samples and reference materials, BGS data from one batch, AttoM data from 4 batches over 3 weeks.



Acknowledgements:

Our thanks go to Dr. Simon Chenery of the British Geological Survey (BGS), Keyworth, UK for providing the digested samples and comparison data.