Biogeochemical Cycling from Source to Sea

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INTRODUCTION

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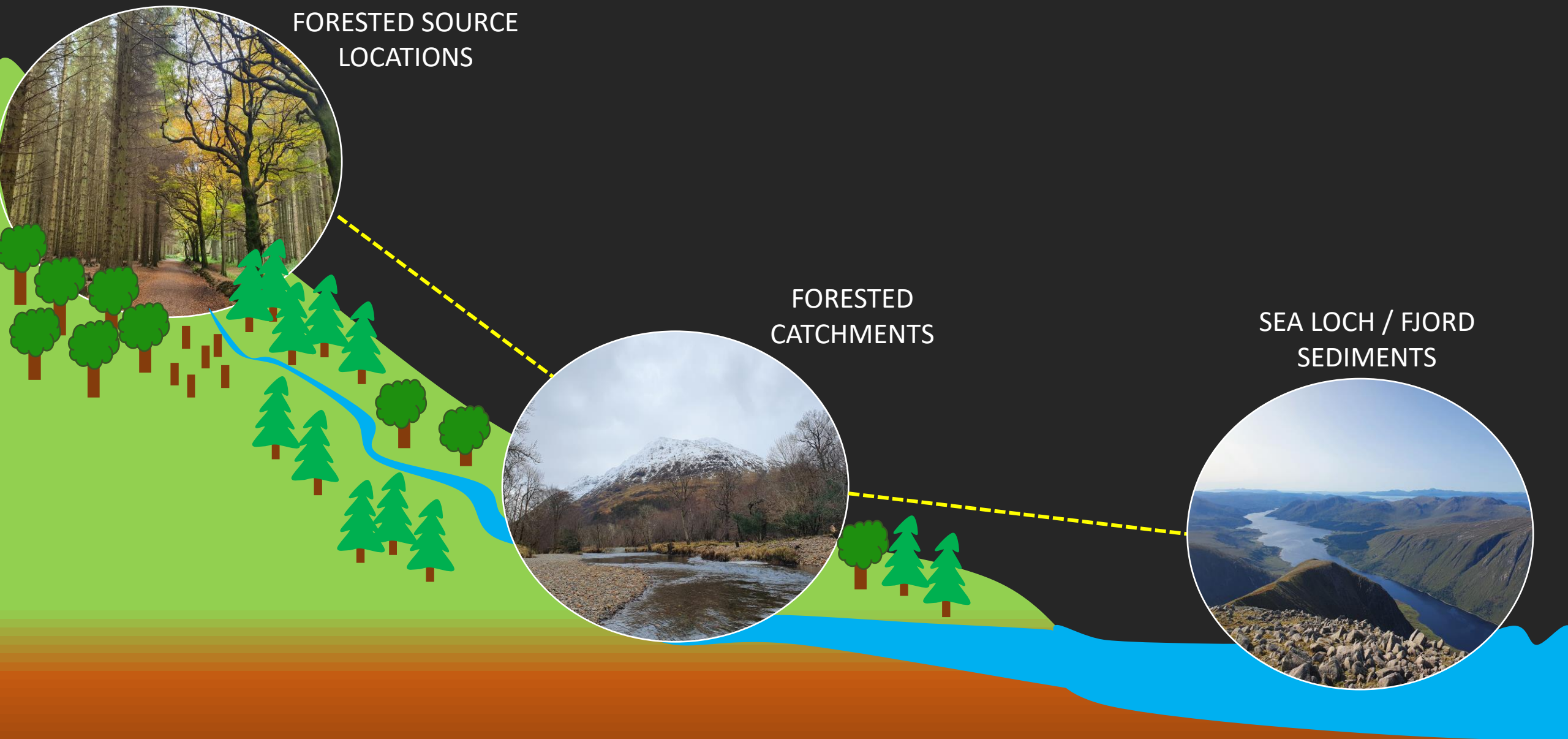

RESEARCH FOCUS

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- FINGERPRINTING THE SOURCE OF ORGANIC CARBON
- ASSESSING HOW IRON AND ORGANIC CARBON MOVE LATERALLY FROM SOURCE TO SEA
- INVESTIGATING HOW AND WHERE IRON AND CARBON BIND IN THE SOURCE TO SEA JOURNEY
- EXPLORING THE DURABILITY OF THE CARBON AND IRON BONDS
- EVALUATING THE EXTENT TO WHICH IRON INFLUENCES ORGANIC CARBON TRANSPORT, PRESERVATION AND BURIAL

FORESTED SOURCE LOCATIONS

Fe C

FORESTED CATCHMENTS

Fe C

SEA LOCH / FJORD SEDIMENTS

Fe C

Refers to Smeaton et al., 2016, 2017, 2019, Lalonde et al., 2012, Friggens et al., 2020,

RESEARCH FOCUS

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FORESTED SOURCE LOCATIONS

Fe

C

FORESTED CATCHMENTS

Fe C

SEA LOCH / FJORD SEDIMENT SAMPLES ARE THE FOCUS OF THIS PRESENTATION

Fe C

Refers to Smeaton et al., 2016, 2017, 2019, Lalonde et al., 2012, Friggens et al., 2020,

LOCATION OF SAMPLES – LOCH CRERAN

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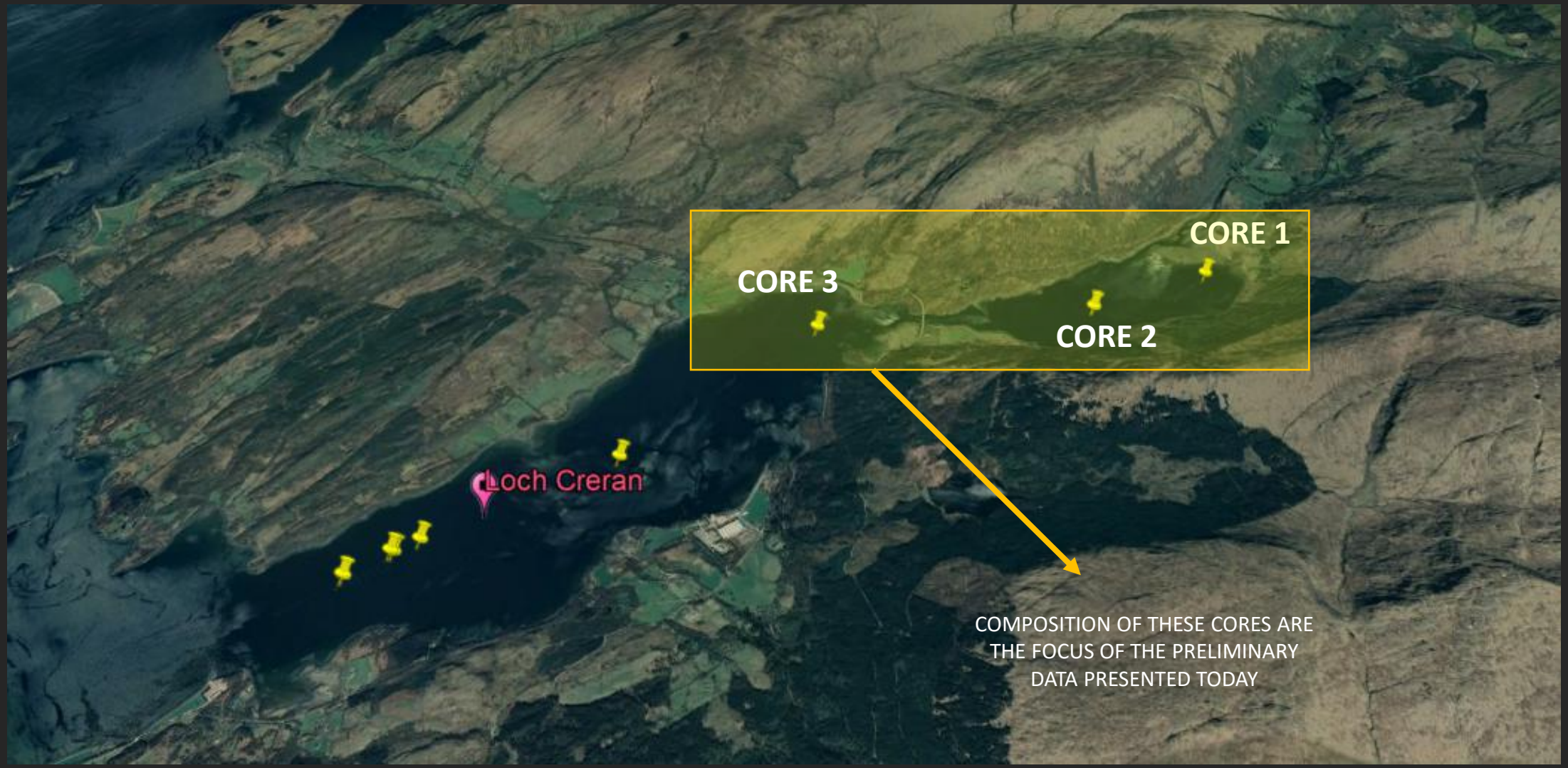
SEA LOCH ON THE WEST COAST OF SCOTLAND



XRF ELEMENTAL DATA FOR CORE 1 – LOCH CRERAN

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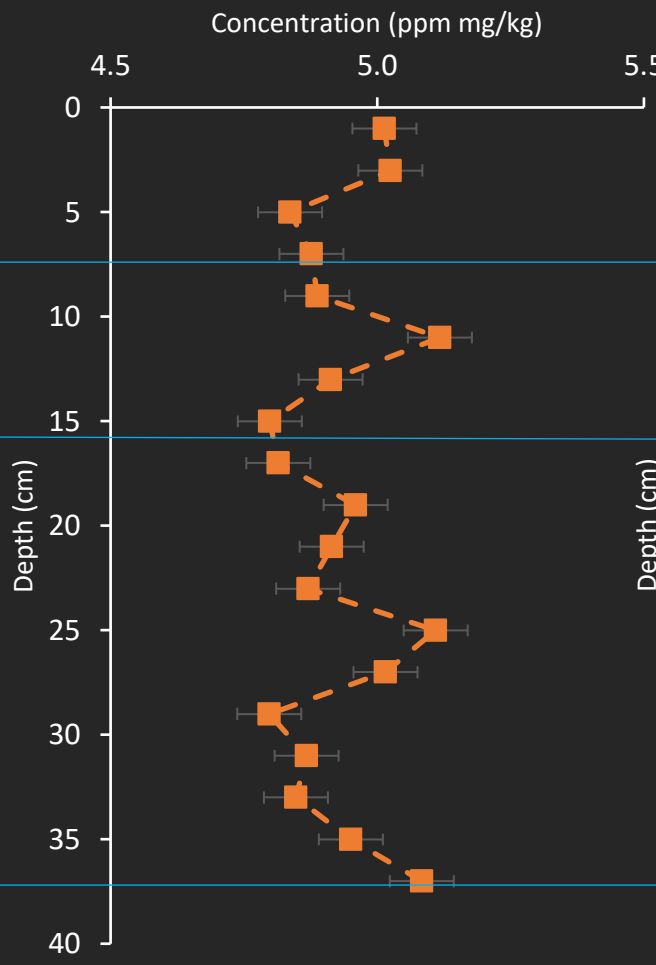
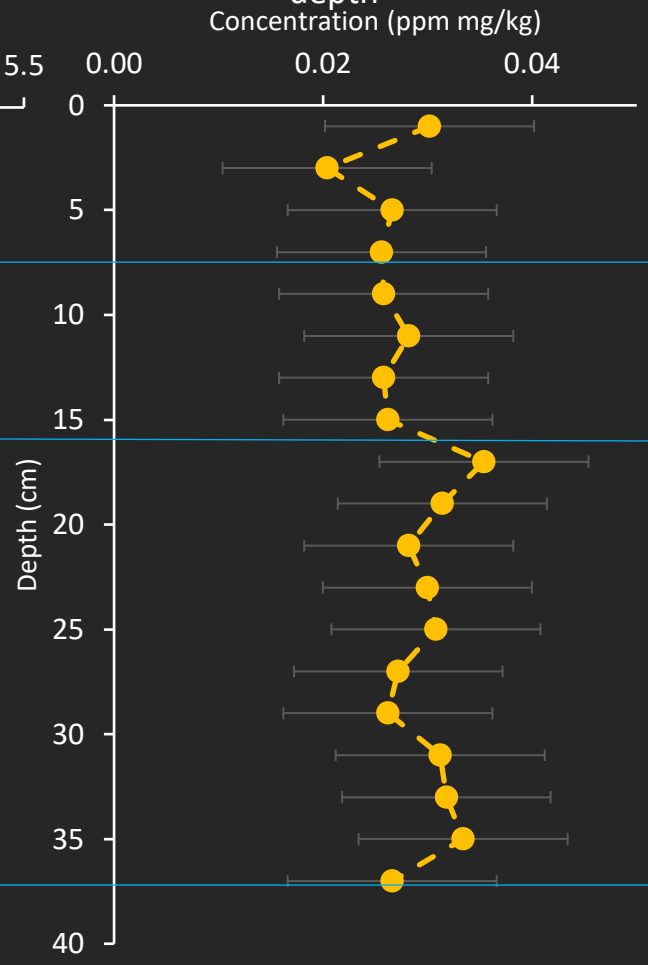
Iron concentration with depth



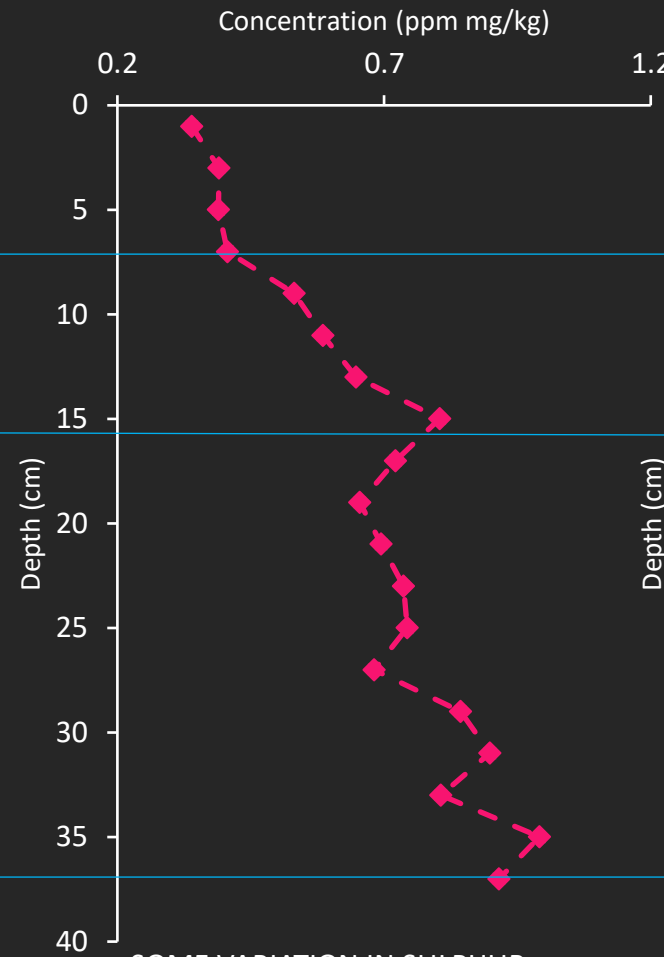
SOME VARIATION DOWNCORE. SAMPLES WITH HIGHEST IRON CONCENTRATION SELECTED FOR FOLLOWING MOSSBAUER ANALYSIS.

Manganese concentration with depth



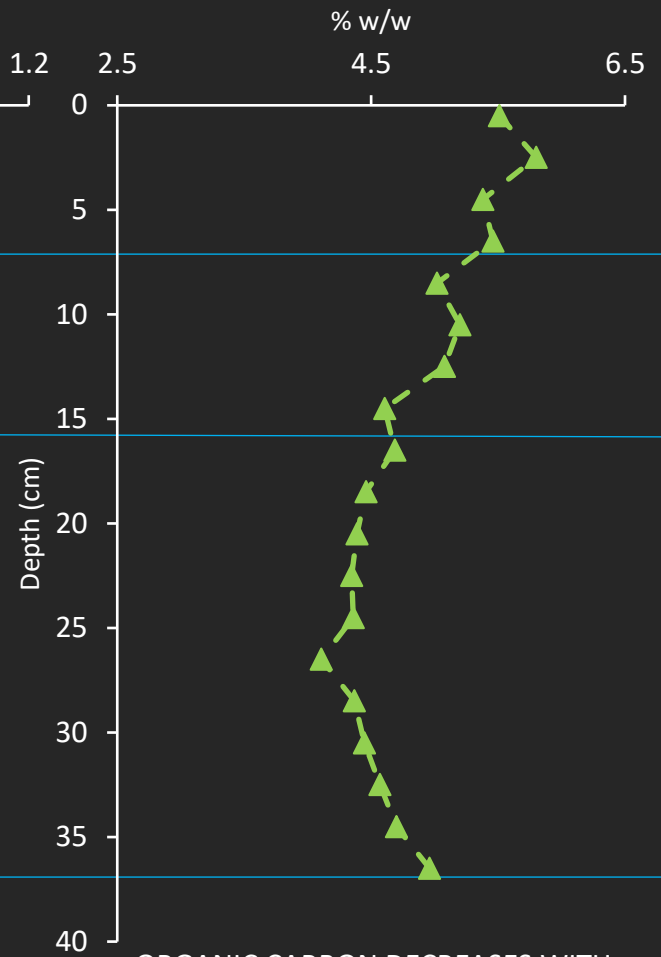
LOW CONCENTRATION AND MINIMAL VARIATION.

Sulphur concentration with depth



SOME VARIATION IN SULPHUR CONCENTRATION DOWNCORE. WHETHER THIS AFFECTS REDOX IS TO BE DETERMINED. PROMPTED THE CORE TO BE SEPERATED IN THREE MAIN ZONES, AN IRON SAMPLE WAS SELECTED FROM EACH.

Organic Carbon with depth



ORGANIC CARBON DECREASES WITH DEPTH.

XRF ELEMENTAL DATA FOR CORE 2 – LOCH CRERAN

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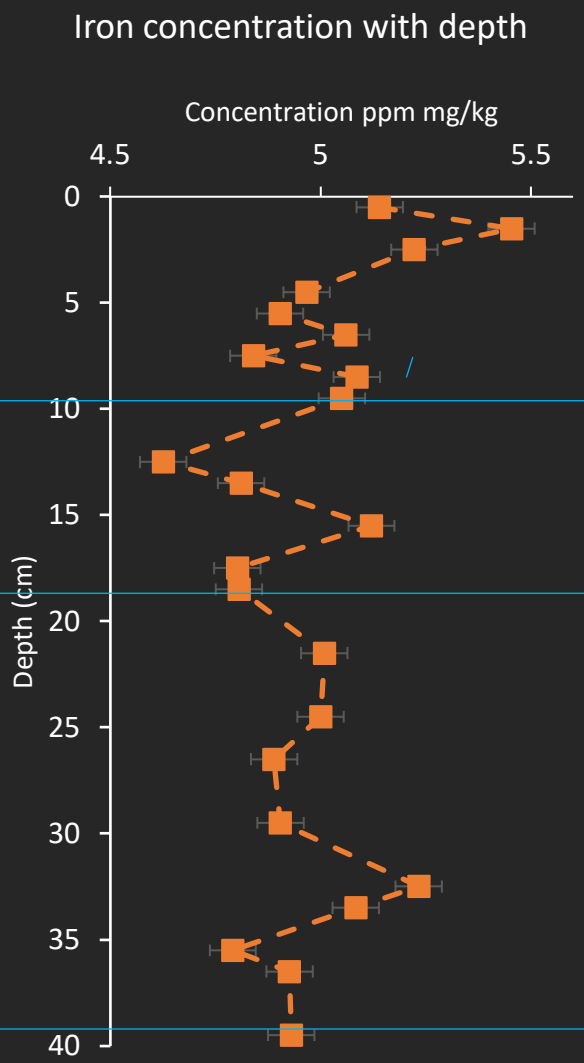
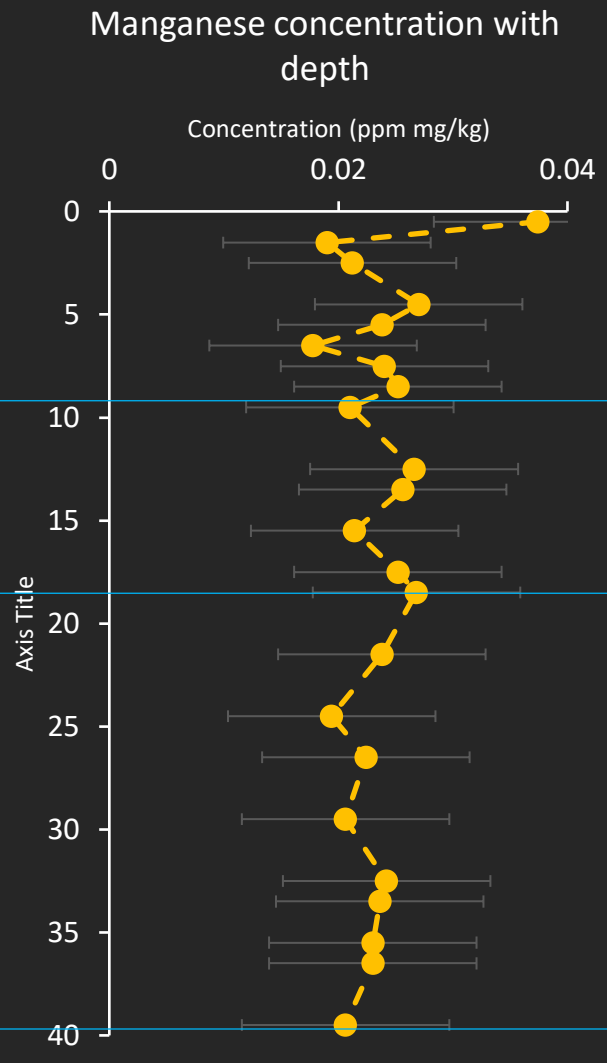
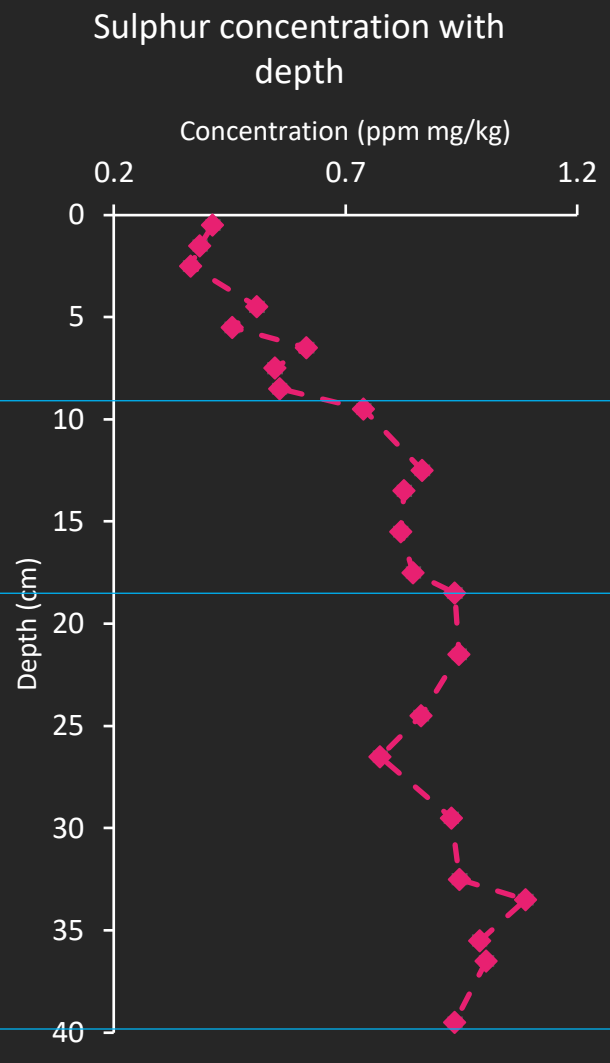


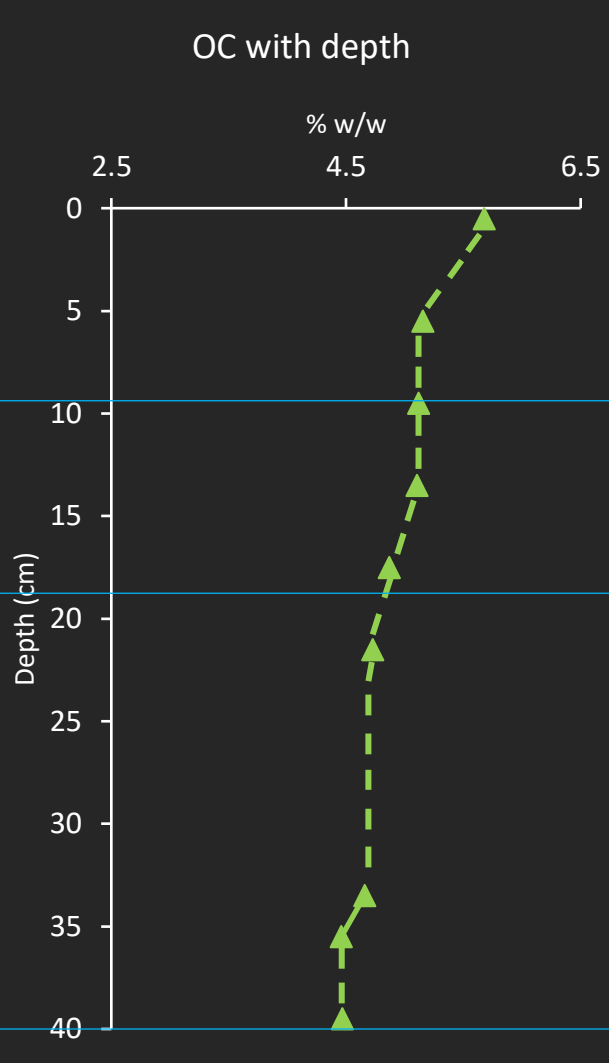
SOME VARIATION DOWNCORE. SAMPLES WITH HIGHEST IRON CONCENTRATION SELECTED FOR FOLLOWING MOSSBAUER ANALYSIS. IRON CONCENTRATIONS SIMILAR TO CORE 1



INITIAL CONCENTRATION DECREASE AT THE SURFACE OF THE CORE, THEN LOW CONCENTRATIONS AND MINIMAL VARIATION.



SULPHUR CONCENTRATIONS INCREASING DOWNCORE.



ORGANIC CARBON PRESENT IN SIMILAR CONCENTRATIONS TO CORE 1, REPRESENTATIVE OF THE UPPER BASIN.

XRF ELEMENTAL DATA FOR CORE 3 – LOCH CRERAN

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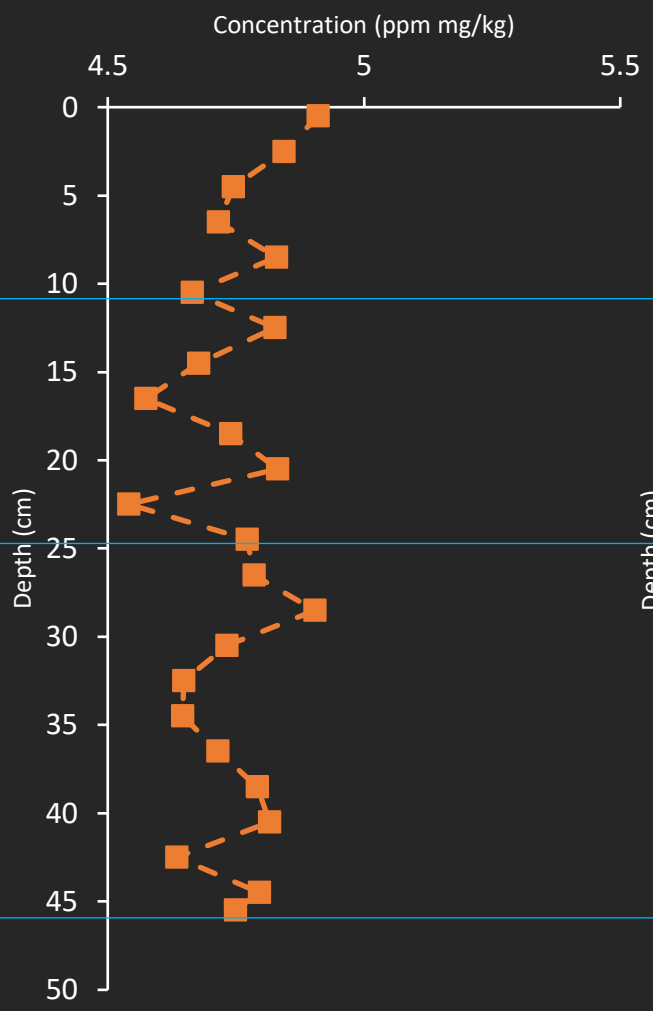
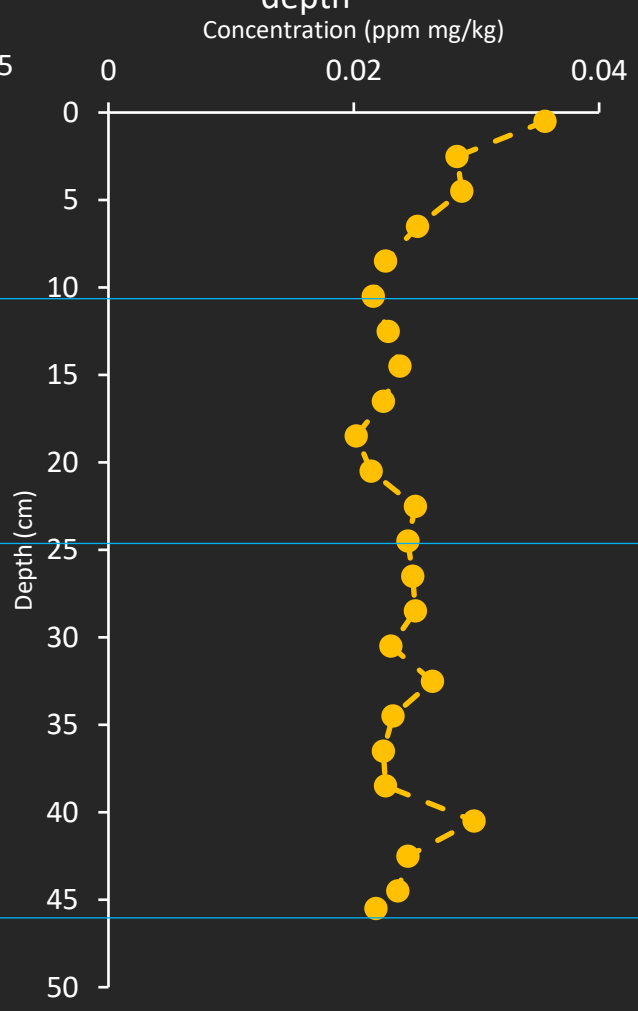
Iron concentration with depth



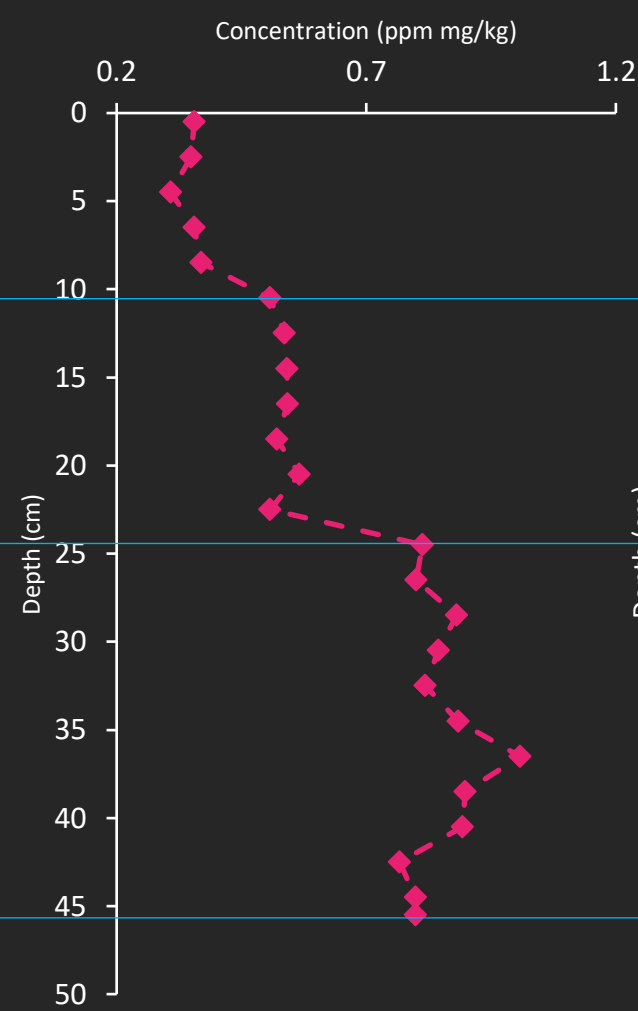
SOME VARIATION DOWNCORE. SAMPLES WITH HIGHEST IRON CONCENTRATION SELECTED FOR FOLLOWING MOSSBAUER ANALYSIS. IRON CONCENTRATION IN LOWER BASIN APPEARS TO SHOW LITTLE / NO DIFFERENCE FROM UPPER BASIN.

Manganese concentration with depth



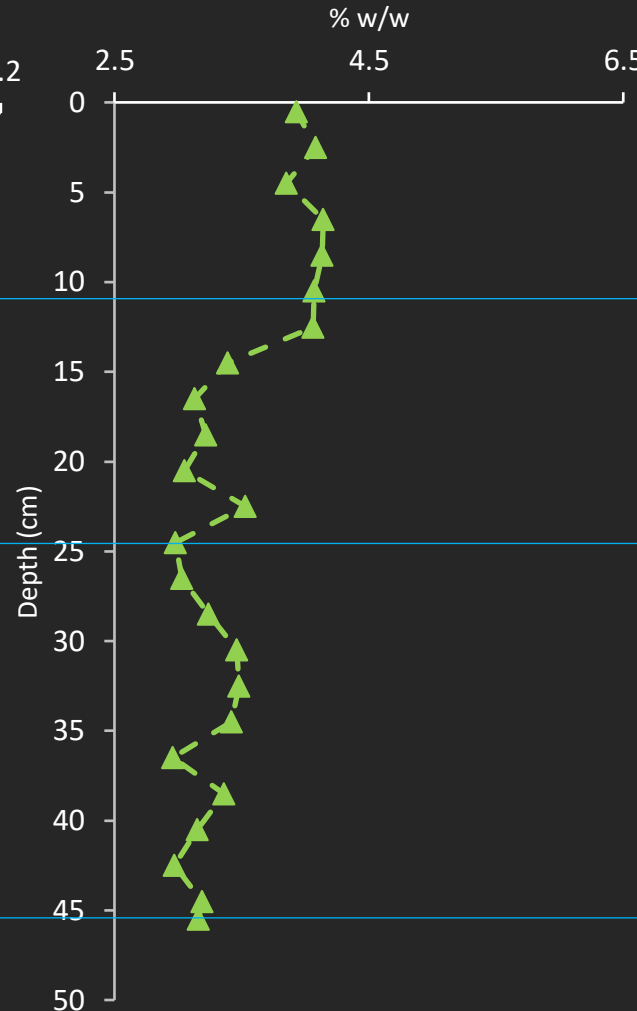
INITIAL CONCENTRATION DECREASE AT THE SURFACE OF THE CORE, THEN MINIMAL VARIATION.

Sulphur concentration with depth



MORE SEVERE / CLEAR CHANGES IN SULPHUR WITH DEPTH IN COMPARISON TO THE UPPER BASIN.

OC with depth



ORGANIC CARBON CONCENTRATIONS SIGNIFICANTLY LOWER IN LOWER BASIN IN COMPARISON TO UPPER BASIN.

ELEMENTAL DATA COMPARISON– LOCH CRERAN

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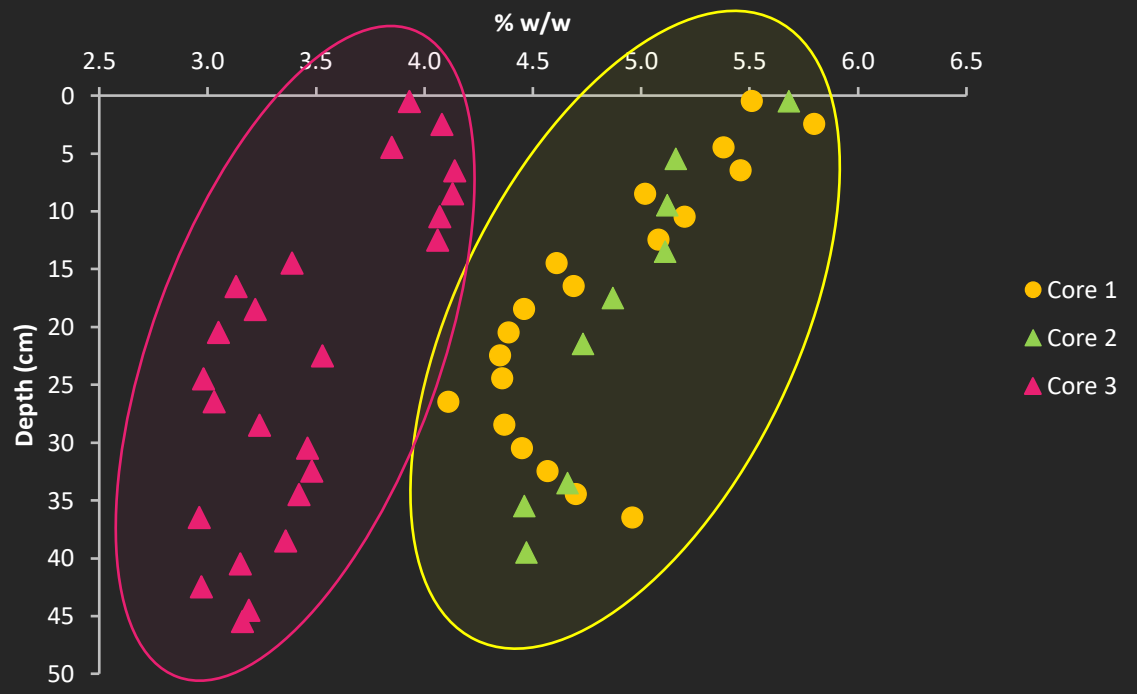
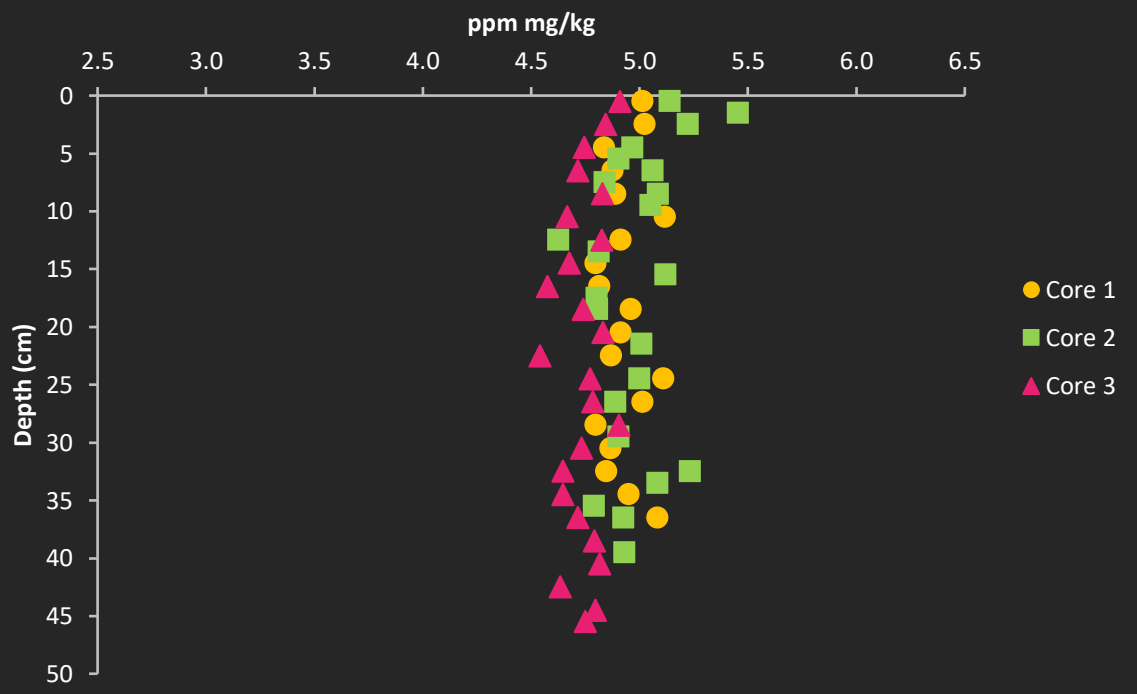
OC with depth



WE OBSERVE A CHANGE IN CARBON CONCENTRATIONS BETWEEN THE INNER AND OUTER BASINS OF LOCH CRERAN

Fe with depth



WE OBSERVE NO CHANGE IN IRON CONCENTRATIONS BETWEEN THE INNER AND OUTER BASINS OF LOCH CRERAN

OC:Fe ACROSS CORES– LOCH CRERAN

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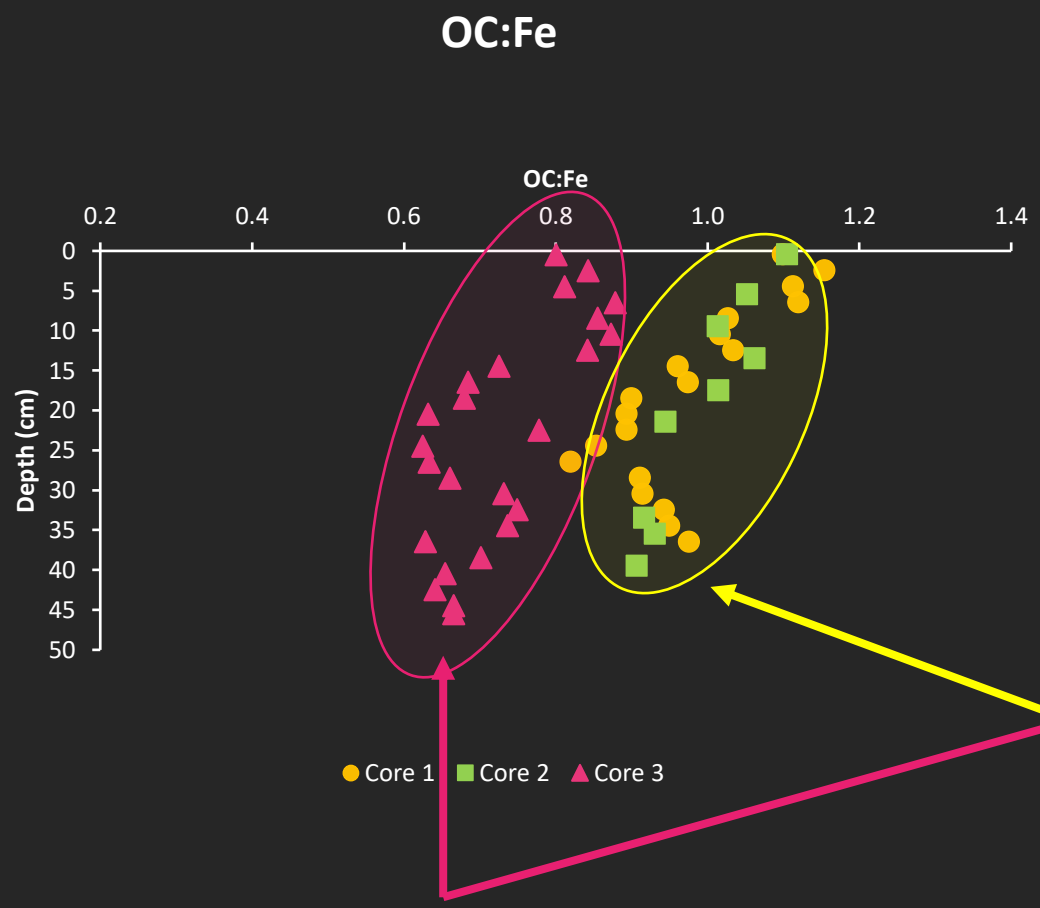

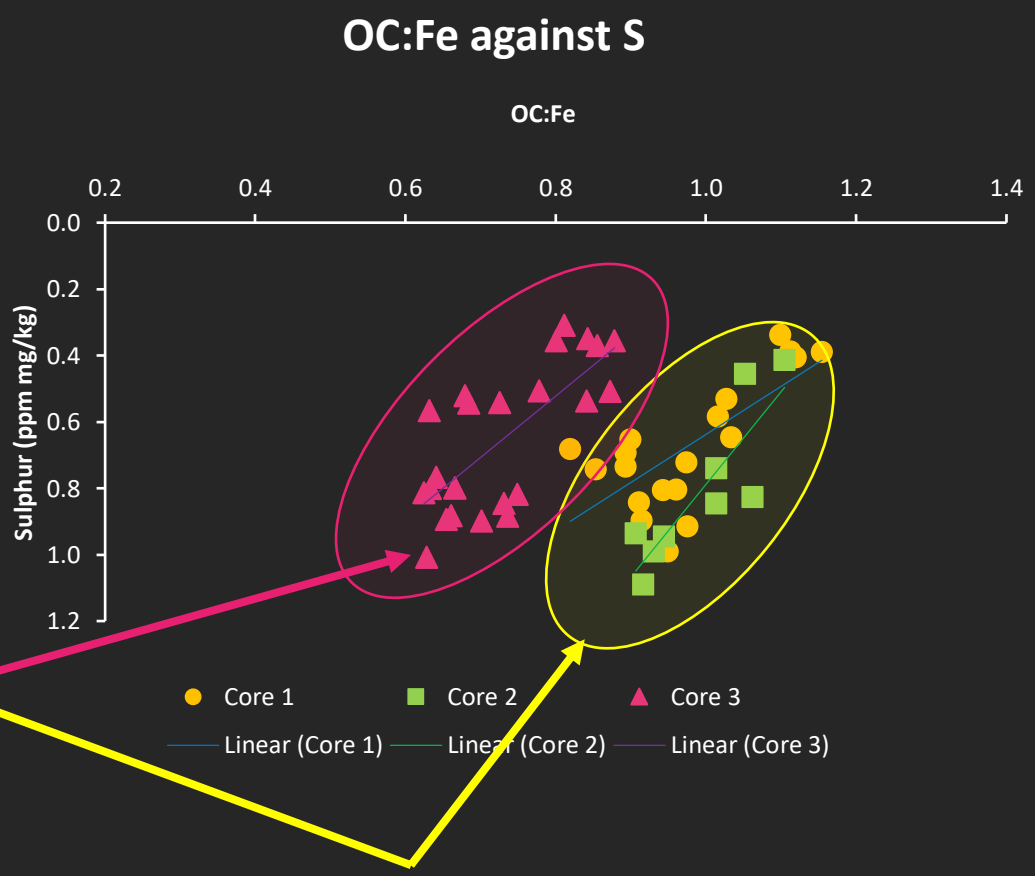

CORE 3 FROM THE OUTER BASIN DISPLAYS DIFFERENT BEHAVIOUR THAN 1 AND 2, WITH OVERALL LOWER FE:OC RATIOS

CORES 1 AND 2 FROM THE INNER BASIN DISPLAY VERY SIMILAR BEHAVIOUS: A DECREASE IN Fe-OC ASSOCIATIONS WITH DEPTH AND IN RELATION TO SULPHUR / CHANGES IN REDOX

LOW TEMPERATURE MOSSBAUER MEASUREMENTS– LOCH CRERAN

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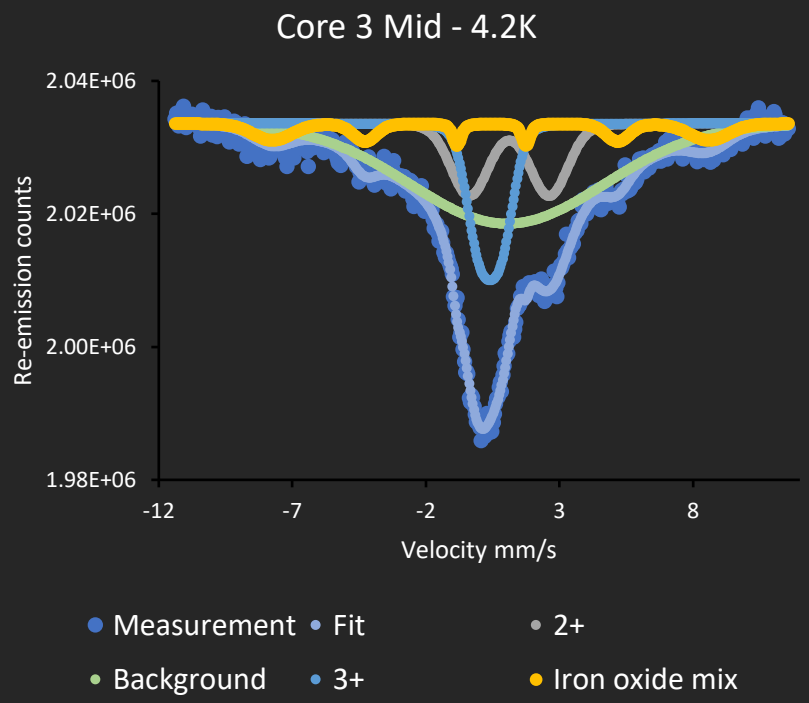

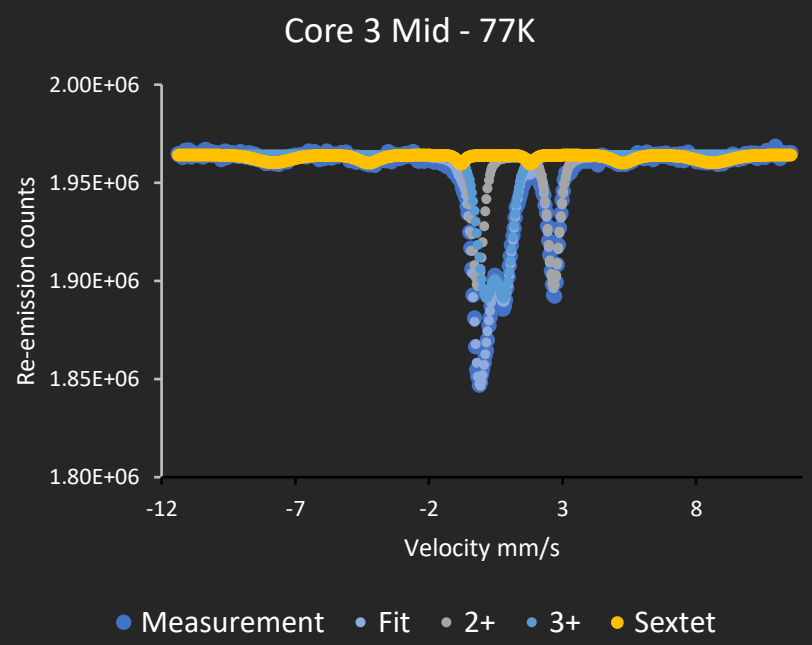

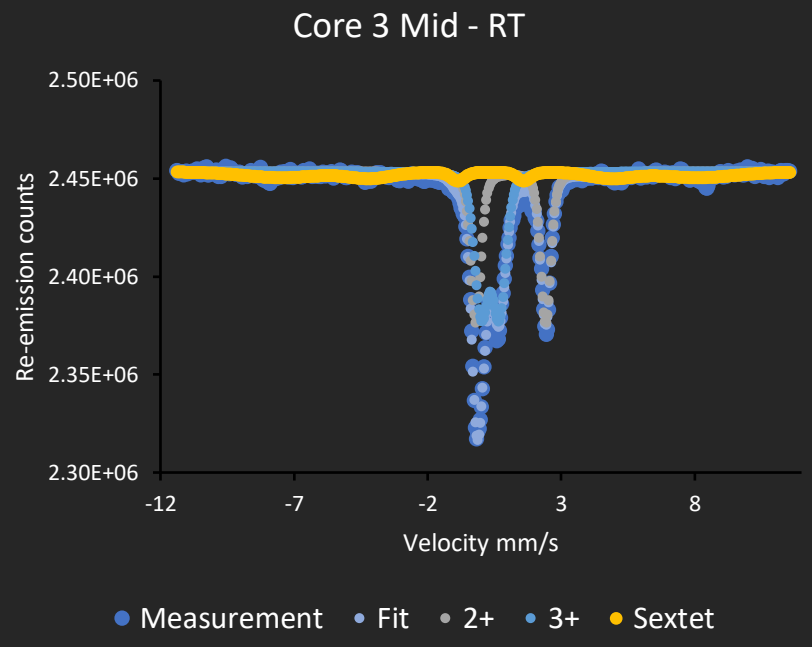

- IRON OXIDES ARE REPRESENTED BY THE ORANGE LINE, SHOWING A SEXTET
- WE ASSOCIATE THE PRESENCE OF THE IRON OXIDES WITH REACTIVE IRON SPECIES, ONLY AT LOW TEMPERATURES
- THIS IS DEMONSTRATED AT 4.2K BECAUSE THEY EXHIBIT SUPERPARAMAGNETIC BEHAVIOUR
- ABOVE THE SEXTET IS VISIBLE AT ROOM TEMPERATURE, 77K AND 4.2K, BUT IT IS ONLY ITS APPEARANCE AT 77K, AND IN PARTICULAR 4.2K THAT DEMONSTRATES THE PRESENCE OF REACTIVE IRON IN THE SAMPLE

LOW TEMPERATURE MOSSBAUER MEASUREMENTS– LOCH CRERAN

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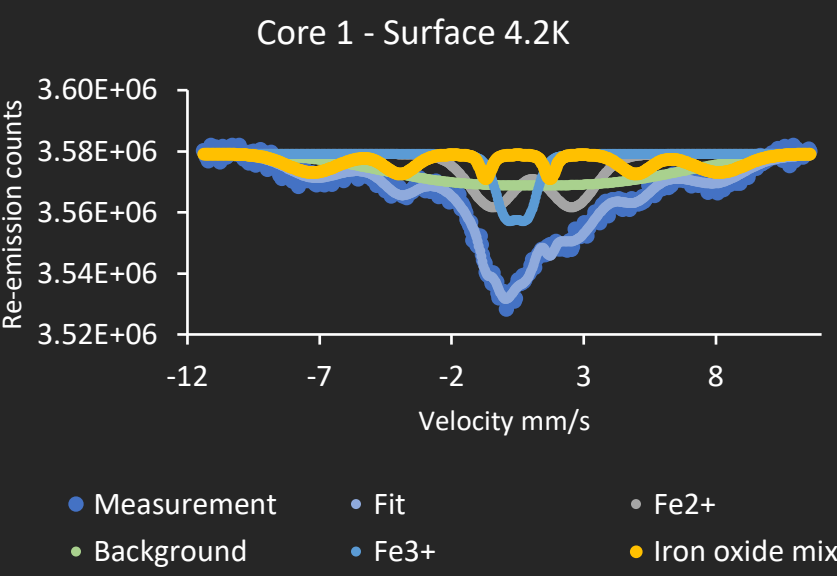

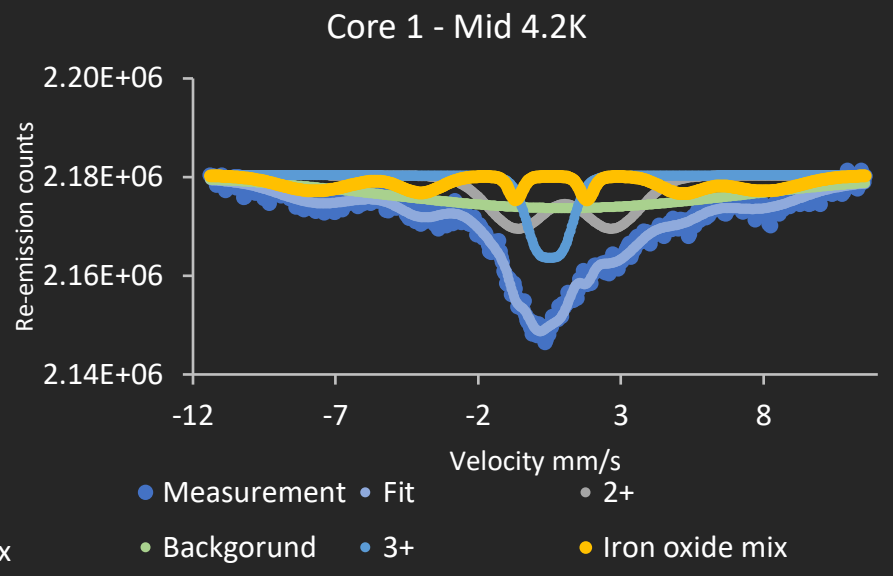

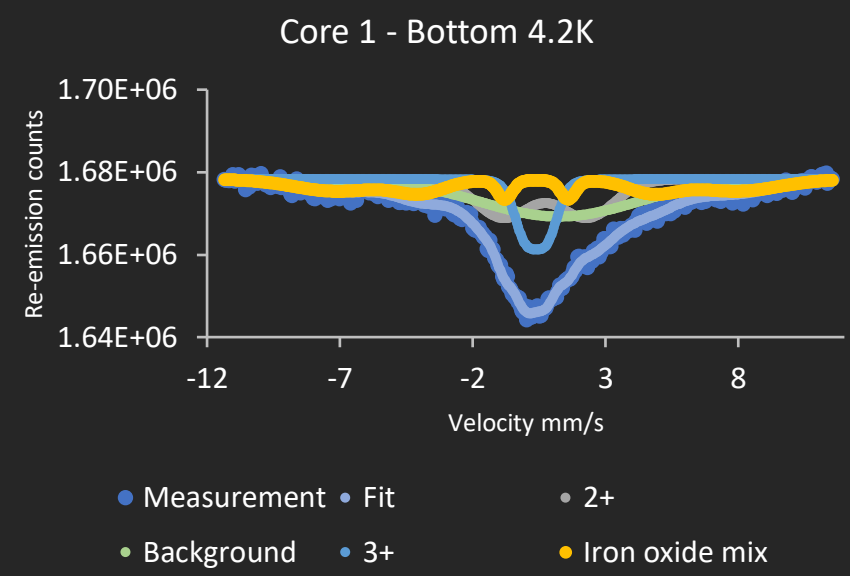

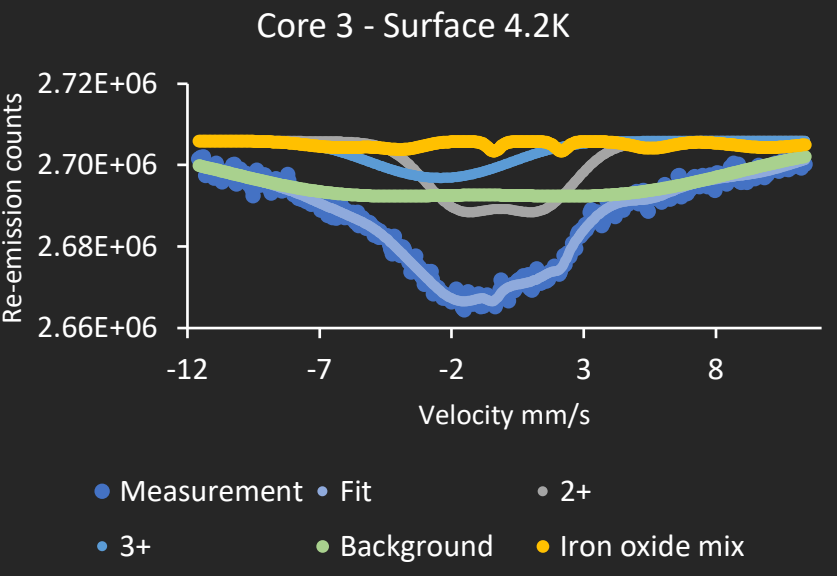

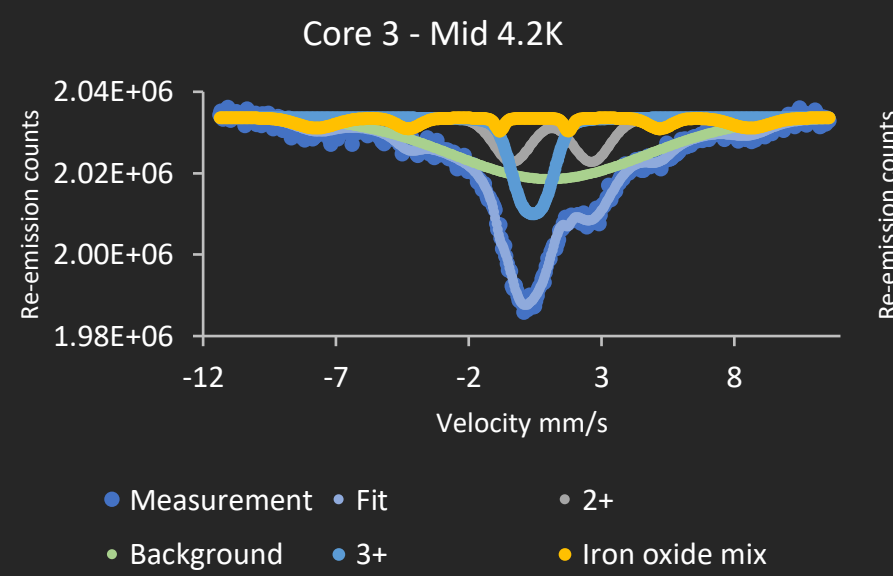

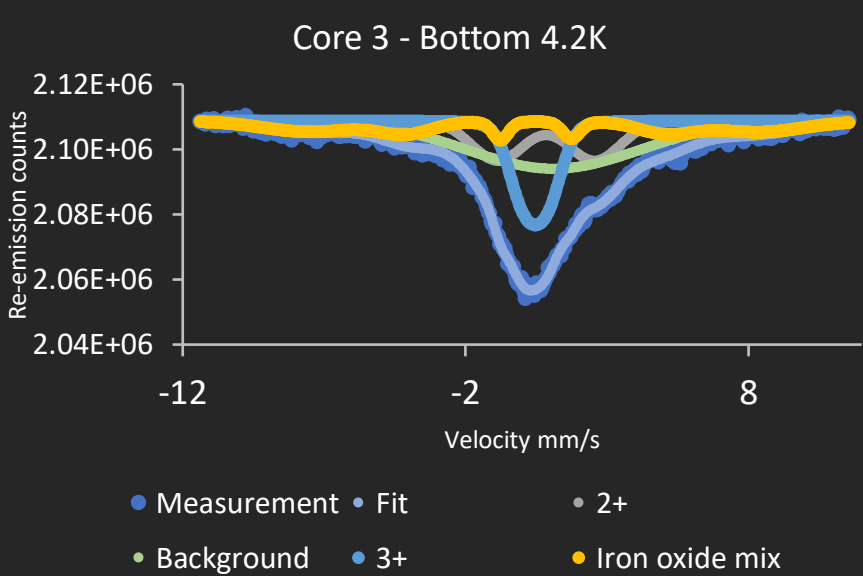

NEXT STEPS– LOCH CRERAN

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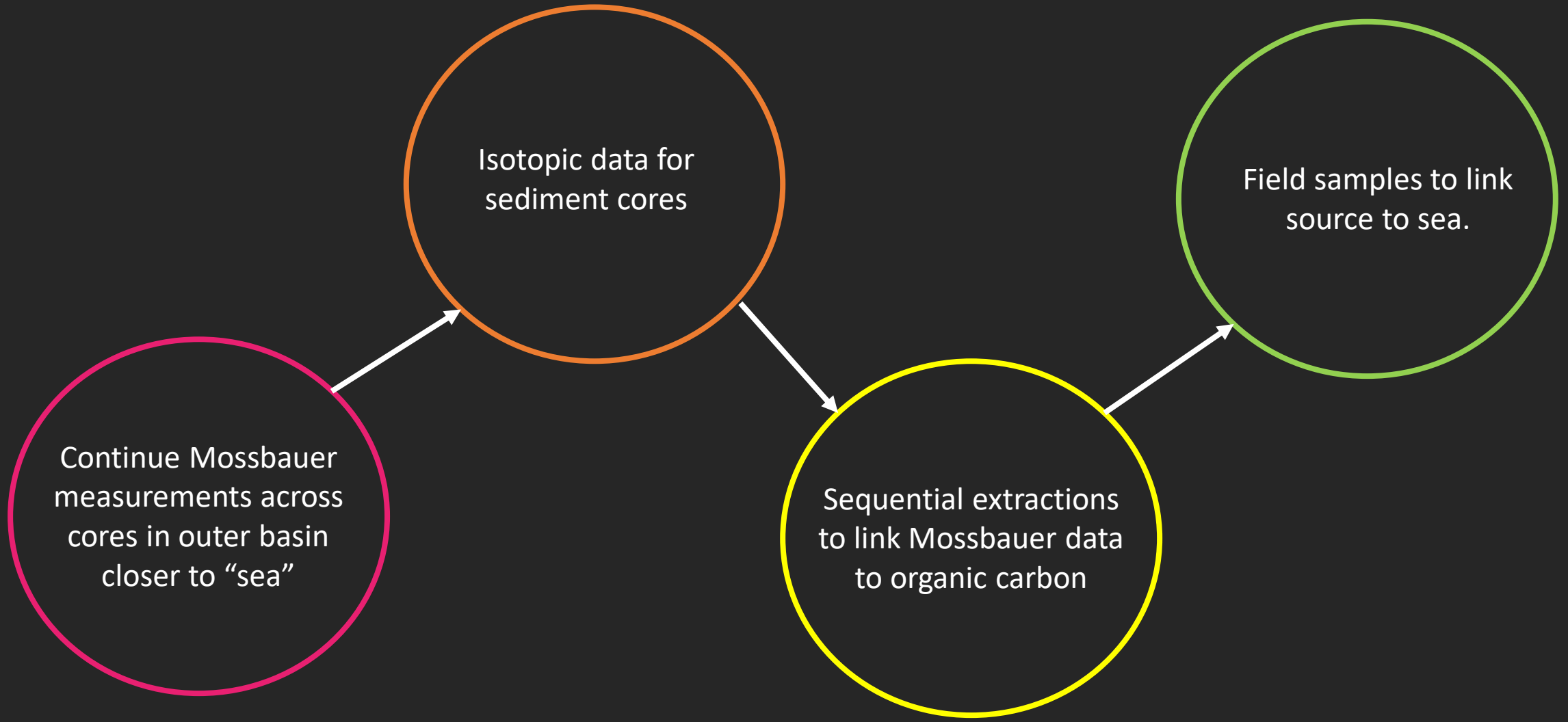

CONCLUSIONS

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SIGNIFICANT CHANGE IN ORAGNIC CARBON BETWEEN UPPER AND LOWER BASINS

LITTLE TO NO CHANGE IN IRON CONCENTRATIONS BETWEEN UPPER AND LOWER BASIN

IRON AND CARBON LIKELY TO PREDOMINANTLY BE FROM DIFFERENT SOURCES. C – FROM LAND, FE – FROM SEDIMENTS

REACTIVE IRON MINERALS ARE PRESENT ACCORDING TO MOSSBAUER, LIKELY ON VERY SMALL NANOMETER SCALE.

REACTIVE IRON PARAMETERS SUGGEST A MIXTURE OF LEPIDOCROCITE AND GOETHITE.

THANK YOU FOR TAKING THE TIME, ANY QUESTIONS PLEASE SEE THE CONTACT DETAILS BELOW

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SAGES Scottish Alliance for Geoscience, Environment and Society
IAPETUS Doctoral Training Partnership