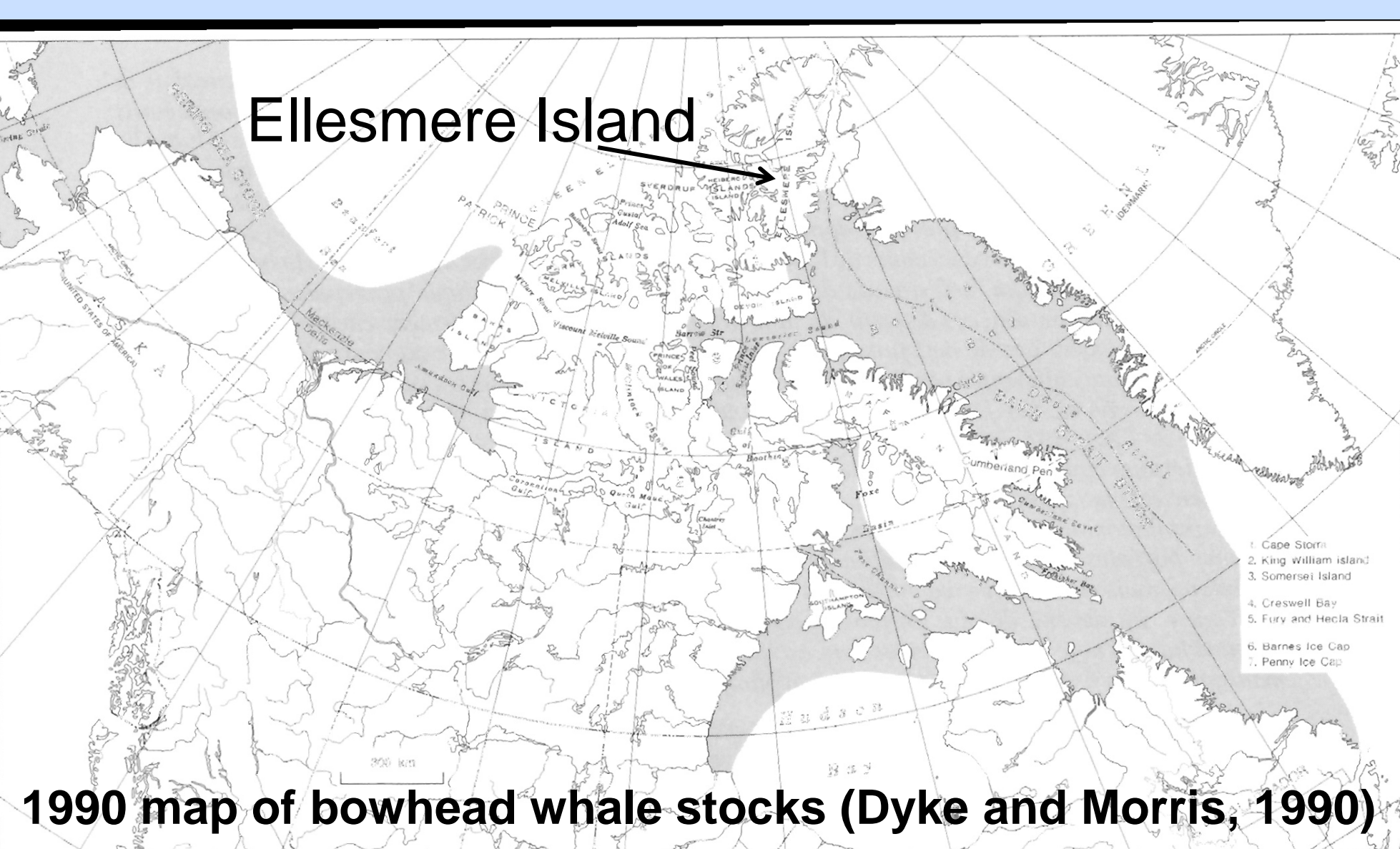
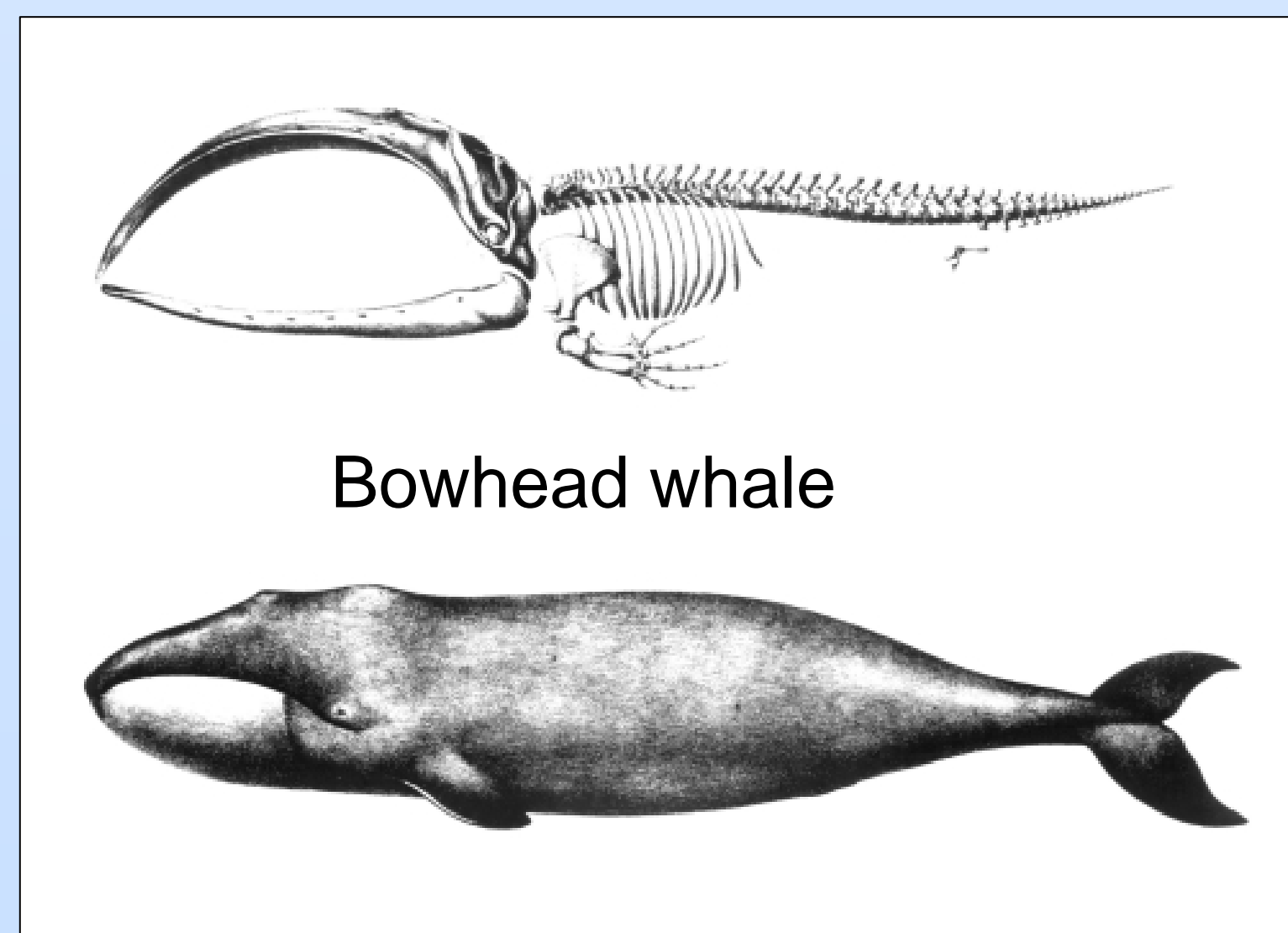
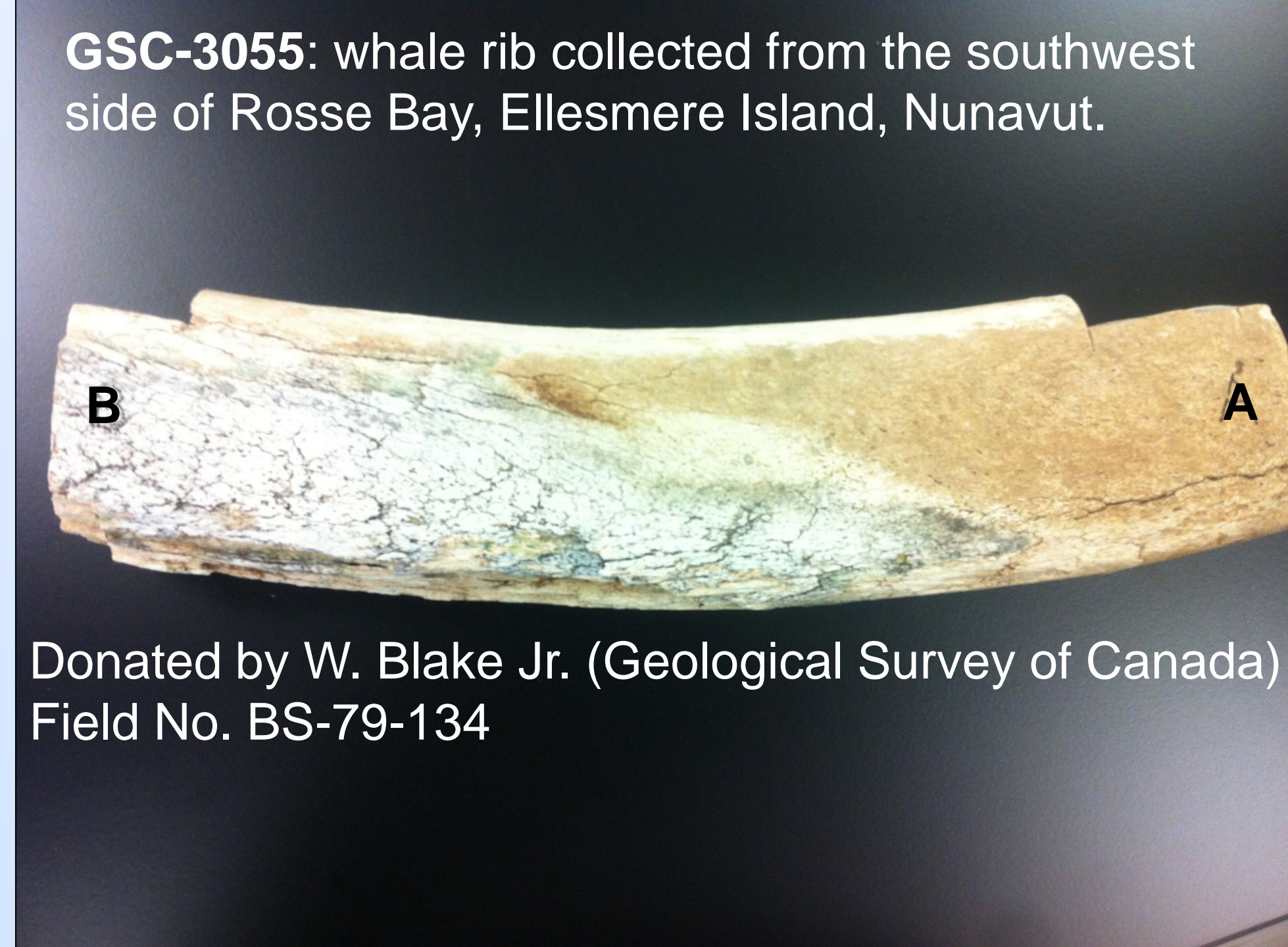


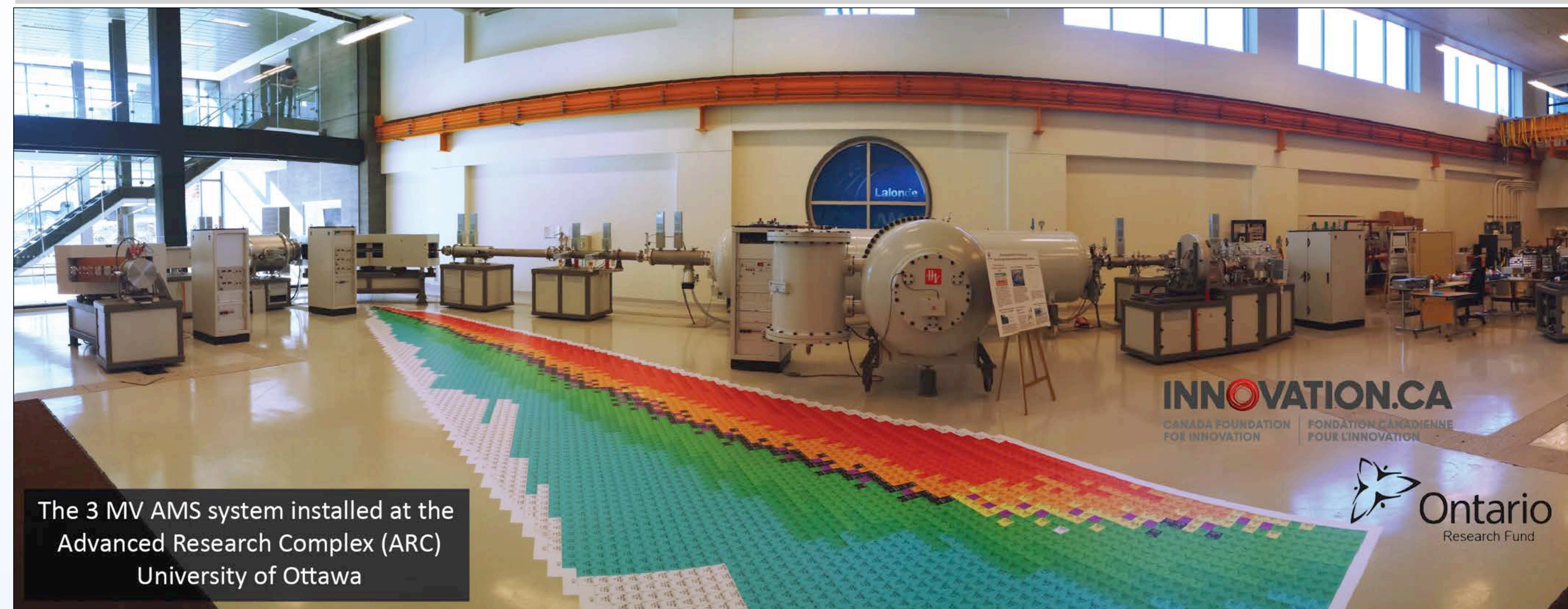
Introduction

Quality control in a radiocarbon (^{14}C) laboratory is critical to ensure that samples have not been contaminated during their journey through the lab from raw material (e.g. bone, antler, wood, peat, pottery, groundwater) to elemental carbon (graphite), which is used for analysis by **accelerator mass spectrometry (AMS; see right)**. Radiocarbon samples must be processed with a very old sample to assess background levels of ^{14}C and a **secondary standard** to ensure quality control at the younger end of the spectrum. The A.E. Lalonde AMS Laboratory at the University of Ottawa currently uses two background standards for bone (SIRI-B and SIRI-C), but there is no readily available international secondary standard.

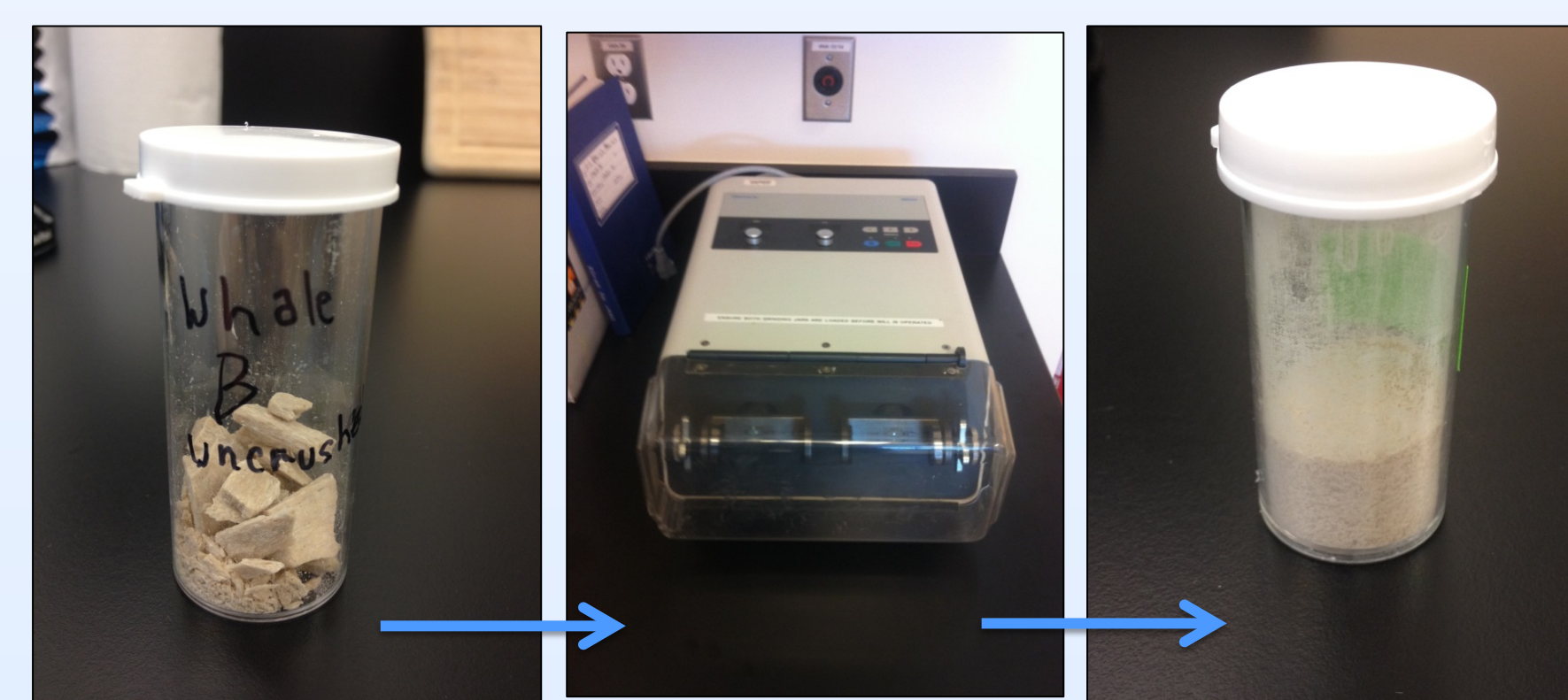
We therefore analyzed five samples of a large bowhead whale bone (**GSC-3055**). Results from two samples at one end and three at the other (see below: **A, B**) demonstrated internally consistent radiocarbon ages at ~7400 years old. We therefore recommend GSC-3055 as an in-house secondary standard for radiocarbon dating of collagen materials in the future.



Methods

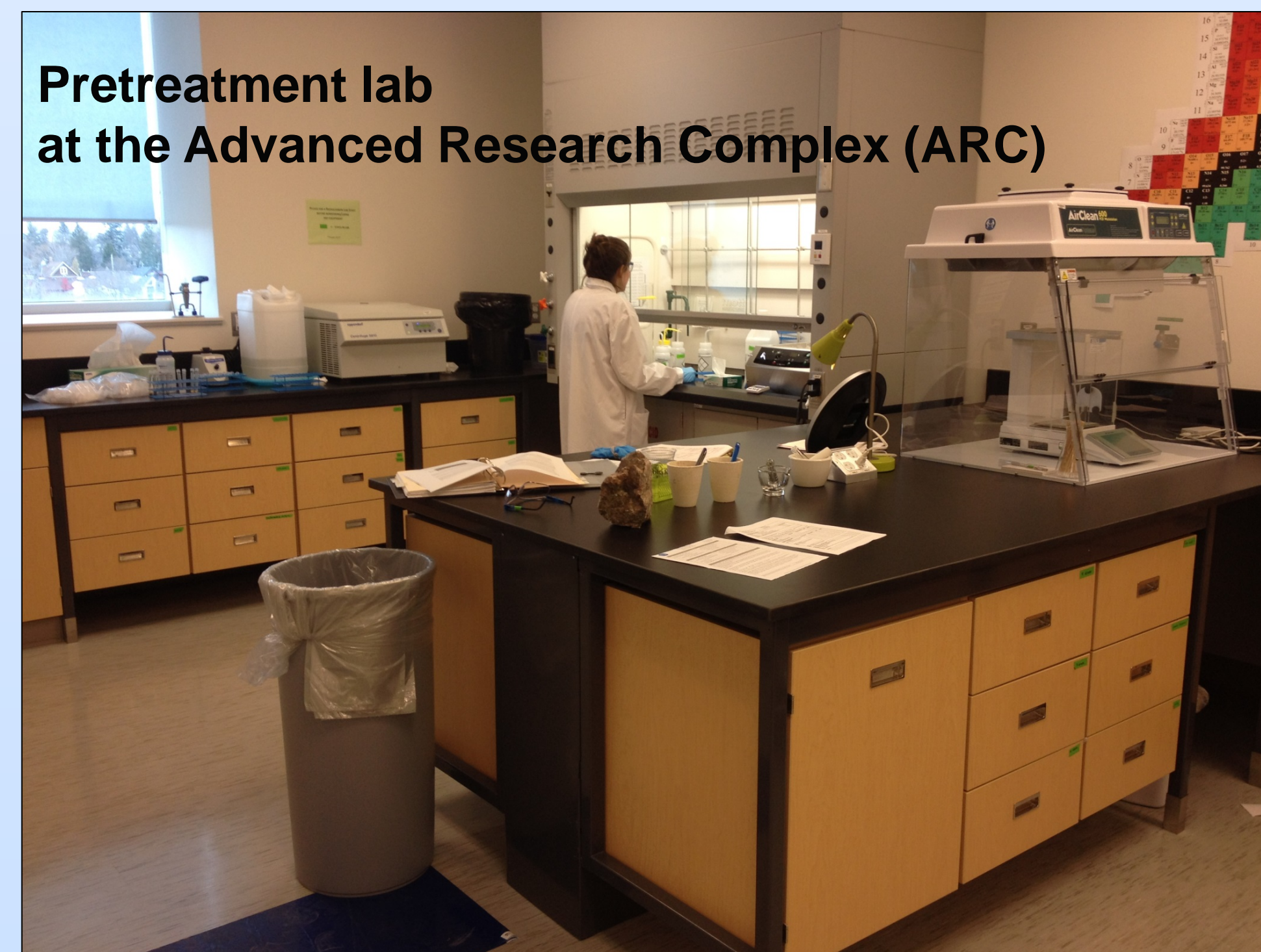


Sampling: The surface of the bone was cleaned before sampling with a saw. The samples were then pulverized a ball mill (bottom right).

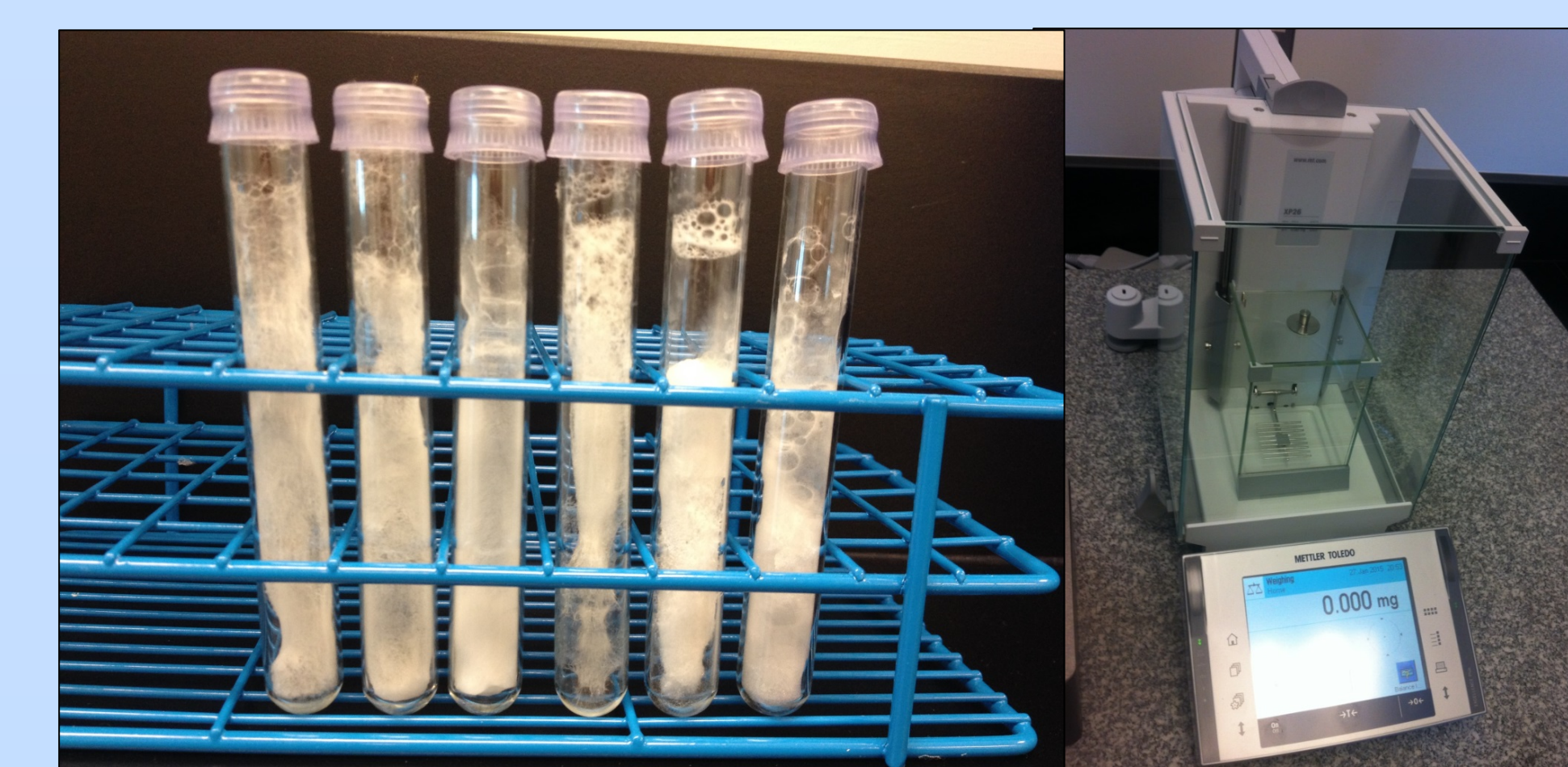


Acid-alkali-acid pretreatment (Brock et al., 2010)

- Decalcification: HCl (0.5N, room temp, ~18h)
- Humic acid removal: NaOH (0.1N, room temp, 30 mins)
- Neutralize base and remove CO_2 (0.5N room temp, 1h)



Collagen extraction: Collagen was filtered out and freeze dried (see below). The samples were weighed on a microbalance (bottom right) into tin capsules for combustion.



Combustion: Samples were combusted using an elemental analyzer (bottom left) connected to an extraction line (bottom right) where the sample is trapped into a breakseal (inset).



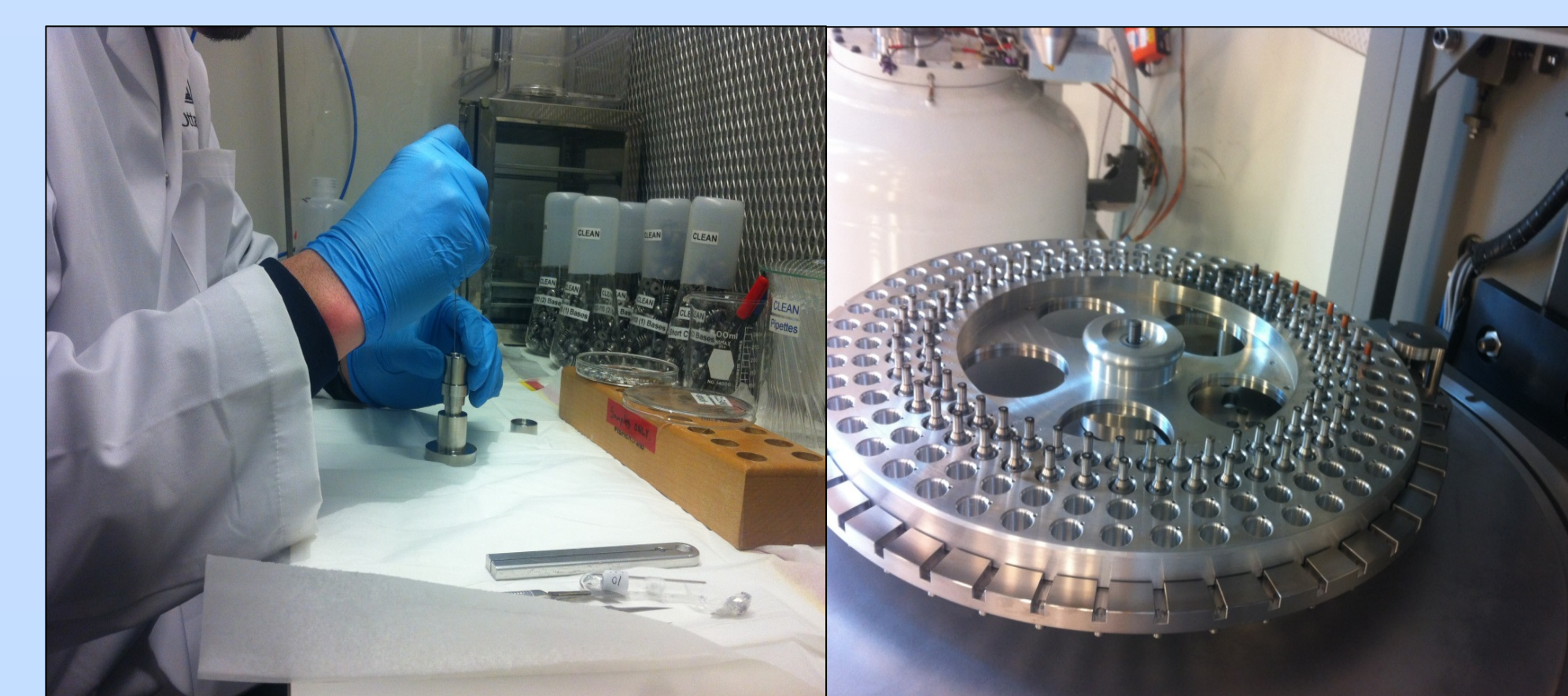
Graphitization:

$$\text{CO}_2 + 2\text{H}_2 \xrightarrow{600^\circ\text{C}} \text{C (graphite)} + 2\text{H}_2\text{O}$$

- CO_2 (sample in breakseal)
- H_2 (added)
- Graphite adheres to Fe powder at 600°C
- H_2O is trapped in a cold finger at -40°C



AMS measurement: Samples are pressed into targets (below left), loaded into the wheel (bottom right) and analyzed by AMS (top of poster).



Results and discussion

Lab ID	Sample ID	^{14}C age \pm	F14C \pm
UOC-0414	GSC-3055A	7339 58	0.4011 0.0029
UOC-0415	GSC-3055A	7404 62	0.3978 0.0031
UOC-0416	GSC-3055B	7419 52	0.3971 0.0025
UOC-0417	GSC-3055B	7351 58	0.4005 0.0029
UOC-0419	GSC-3055B	7427 58	0.3967 0.0029

(above) Radiocarbon results from the GSC-3055 preliminary analysis. There is about 100 years between the youngest and oldest dates, but no distinguishable difference between A and B. The radiocarbon lab will therefore begin to analyze a sample of GSC-3055 with every collagen batch.

Conclusion

Results from the preliminary analysis of GSC-3055 are promising and suggest that the bone is isotopically homogeneous. The lab will begin to use it as an in-house standard for bone.

But it needs a name! This name will be used to track the sample through the lab and a unique name will make the new standard easy to recognize in scientific literature.

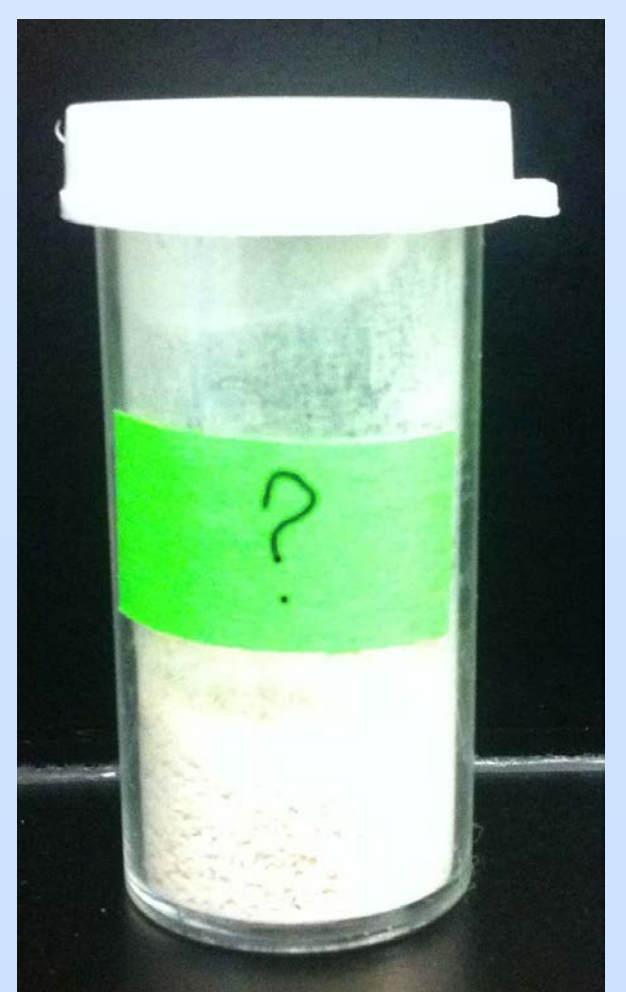
Help name the new secondary bone standard at the A.E. Lalonde AMS lab!

ACWB
Arctic Canada Whale Bone

WRAC
Whale Rib, Arctic Canada

UWB
Umingmak Whale Bone

EWB
Ellesmere Whale Bone



References

- Brock et al. "Current pretreatment methods for AMS radiocarbon dating at the Oxford Radiocarbon Accelerator Unit (ORAU)." *Radiocarbon* 52.1 (2010): 103-112.
- Dyke and Morris "Postglacial history of the bowhead whale and of driftwood penetration; implications for paleoclimate, central Canadian Arctic." *Geological Survey of Canada Paper* (1990): 89-24

Acknowledgements

We would like to thank the organizers of the UROP program for their support with this project and Xiaolei Zhao and Chris Charles for their help with target preparation and AMS analysis.