Optical dating sediments from coastal British Columbia:

Successes, challenges and plans for the future

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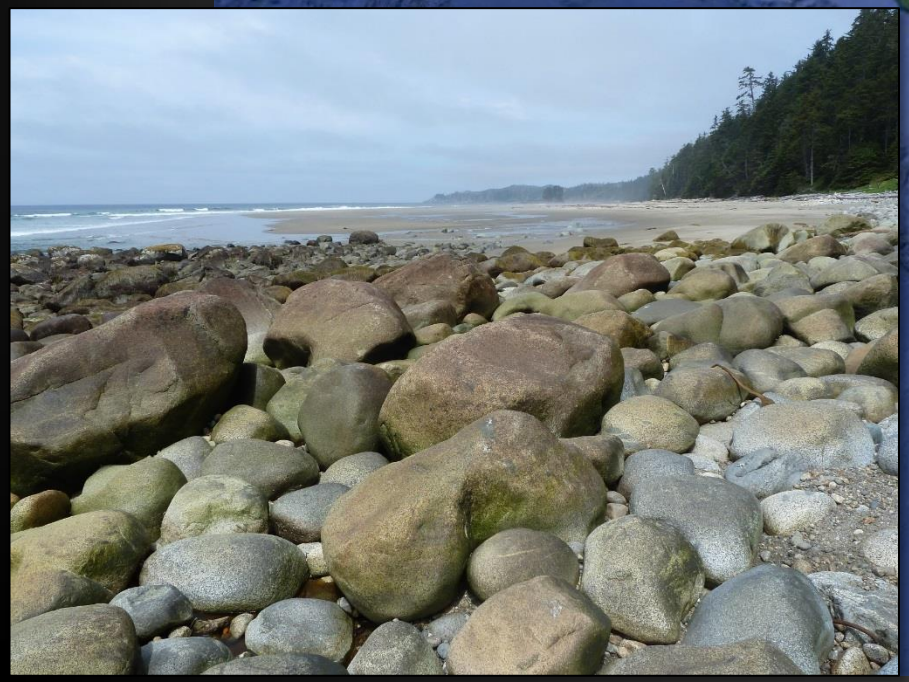


Coast Mountain Belt

British Columbia

Hunter Isl.

Calvert Isl.

Quadra Isl.

Savary Isl.

Pacific

Vancouver, BC

Previous work….
TL dating and/or IRSL dating of KF multi-grain aliquots using MA methods

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus

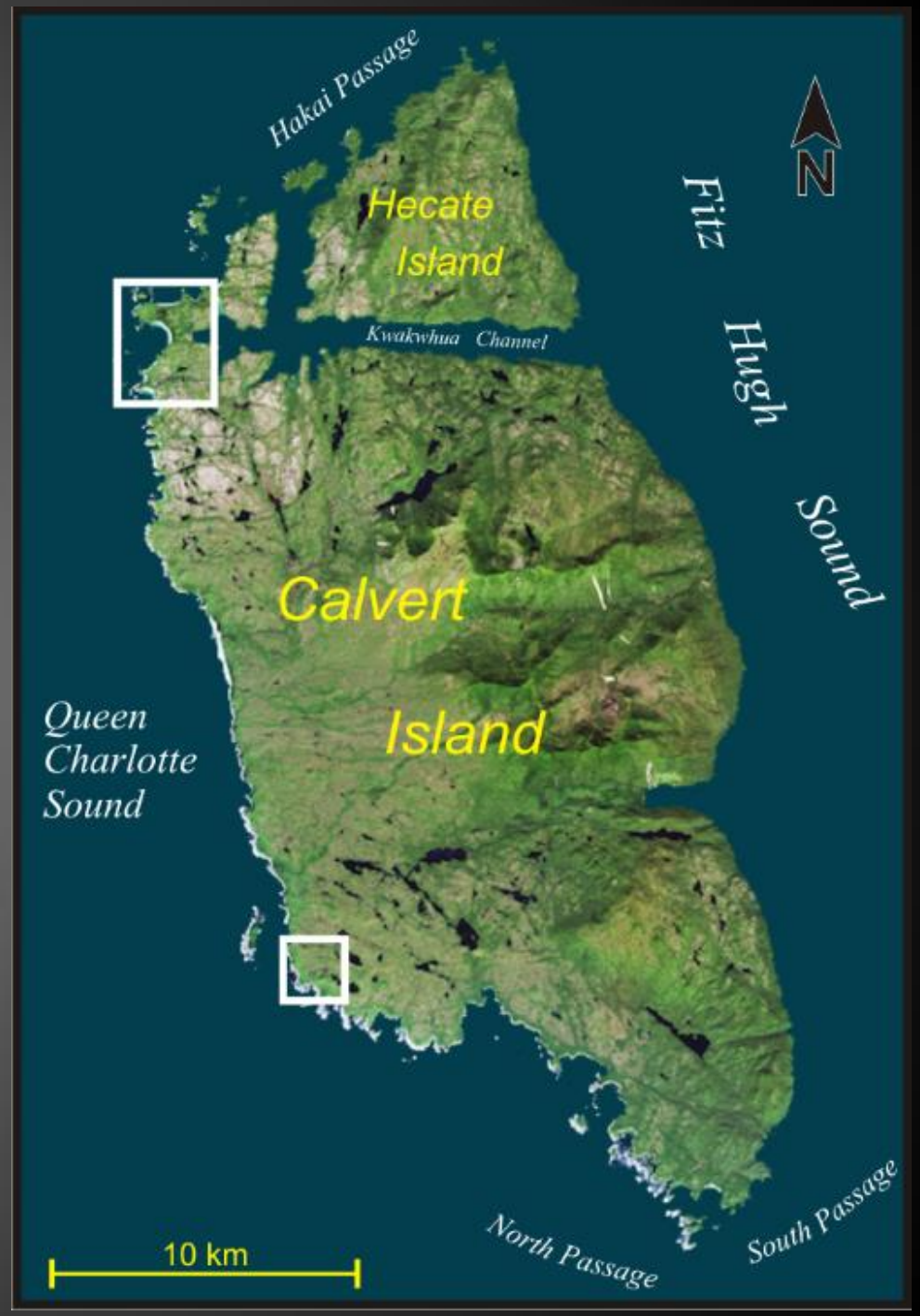
Data LDEO-Columbia, NSF, NOAA

Google Earth

SAR was first tested and refined on Calvert Island

(Neudorf et al., 2015, Quat. Geochronol.)

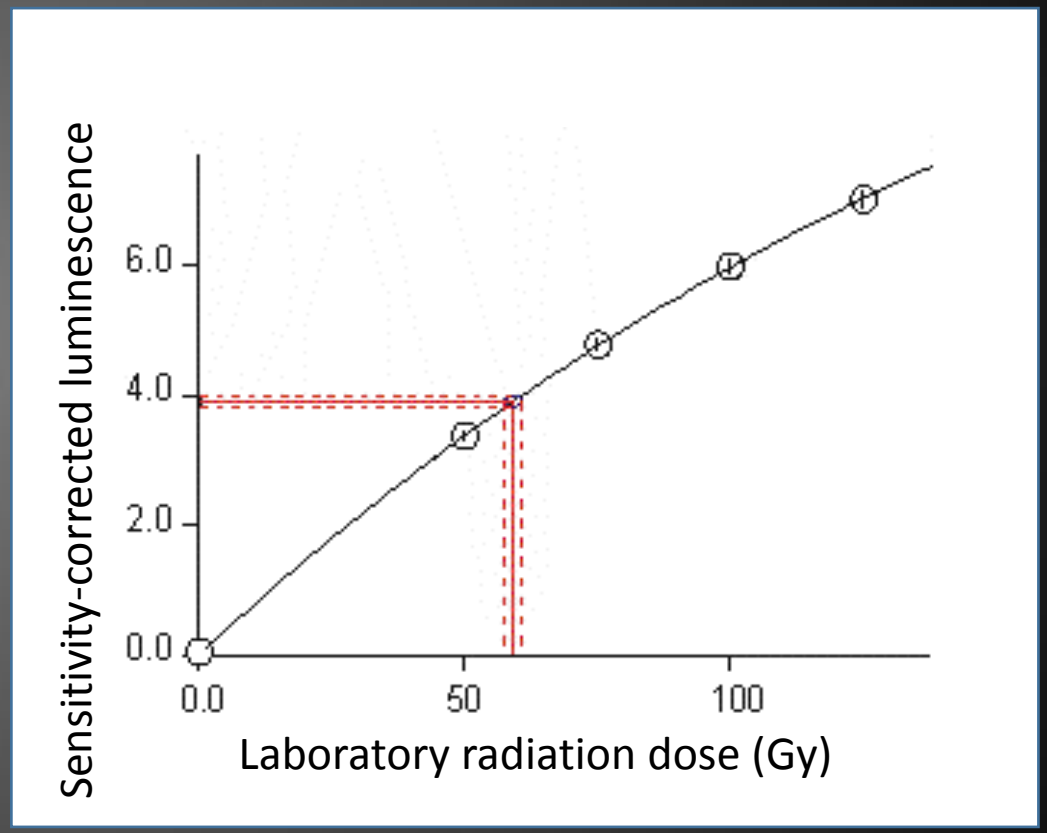
- Holocene beach and dune sediments



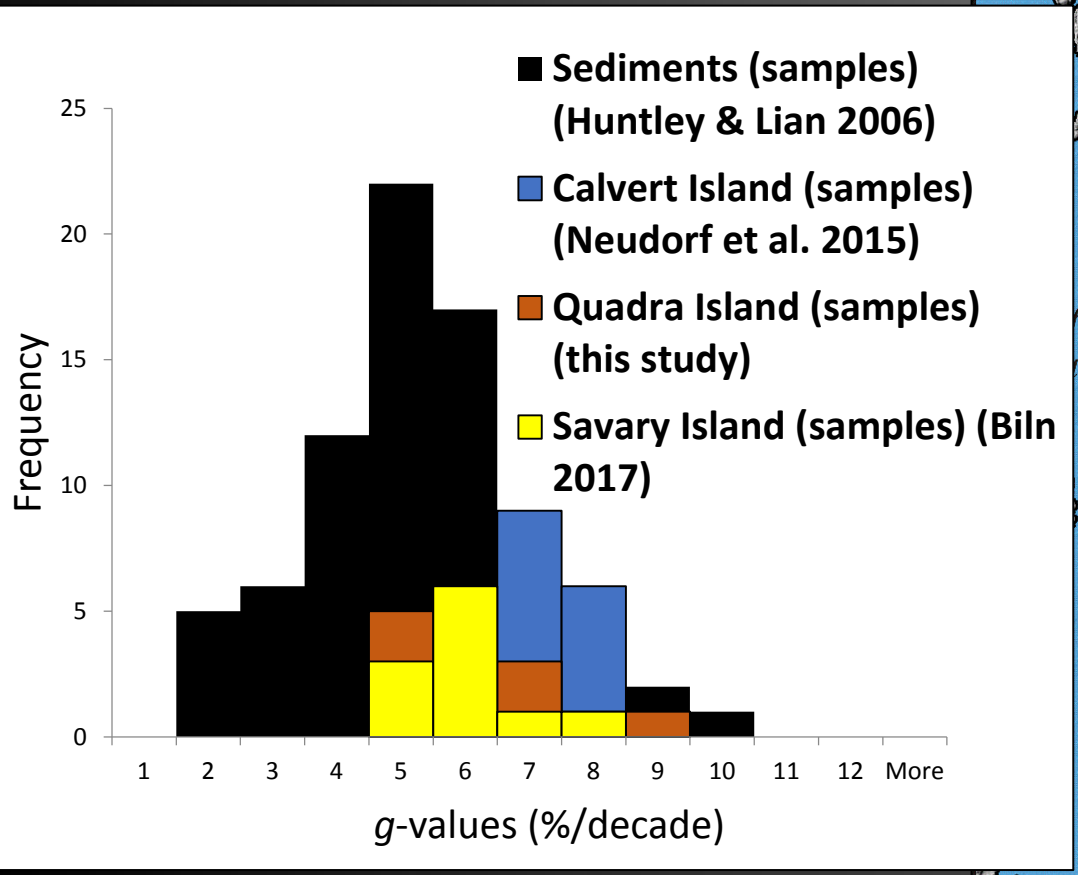
The Calvert Island (CI) SAR protocol

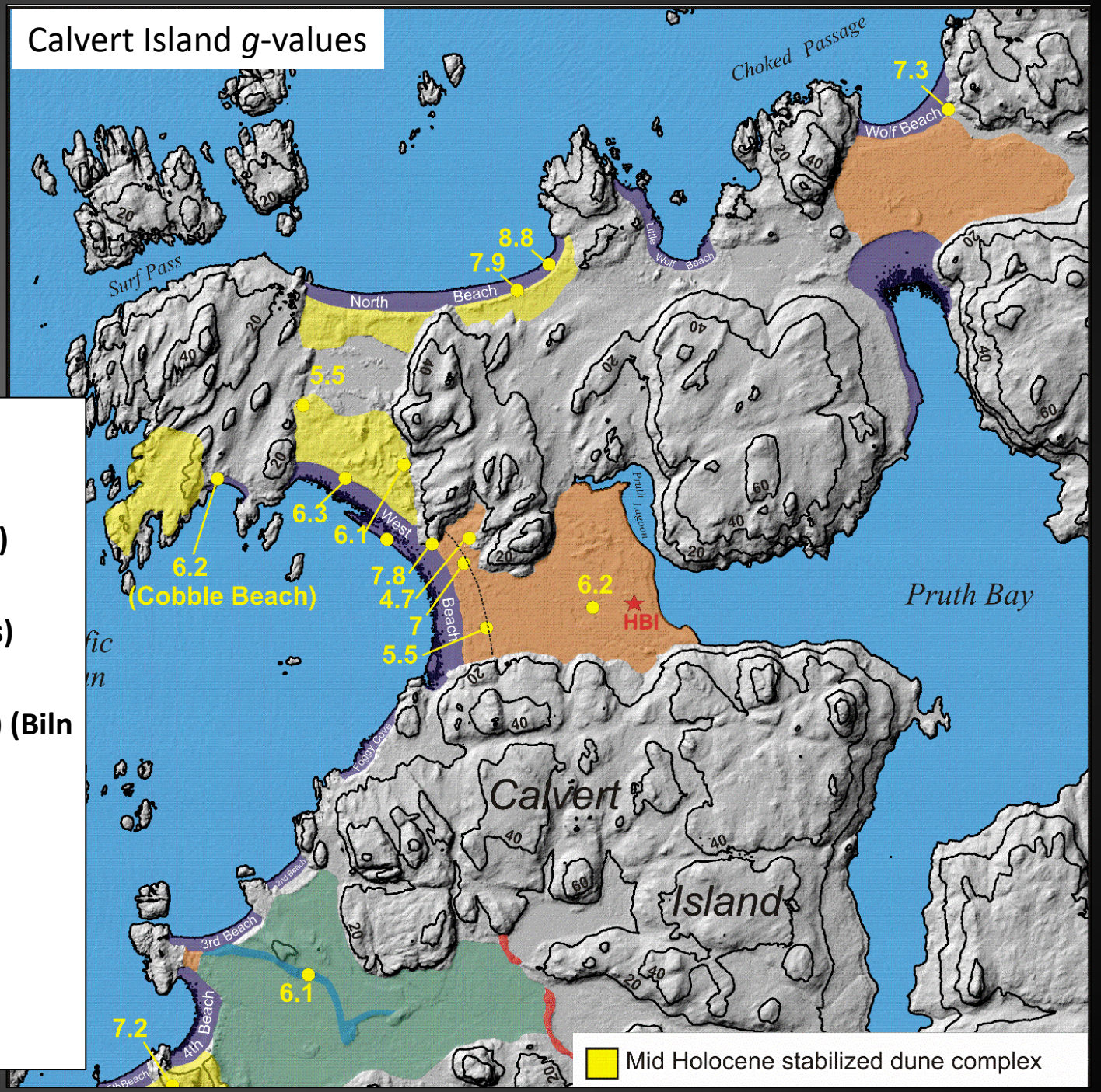
Steps

1. Preheat 160 deg/ 10 s
2. Stimulation *(Measurement of natural)*
3. Test dose
4. Cutheat 160 deg/ 10 s
5. Stimulation *(Sensitivity correction)*
6. Repeat to generate dose response curve
7. Hotwash (180 deg/40 s)

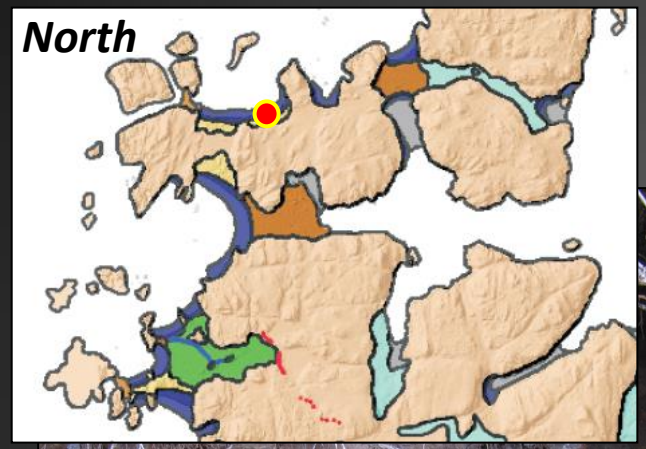


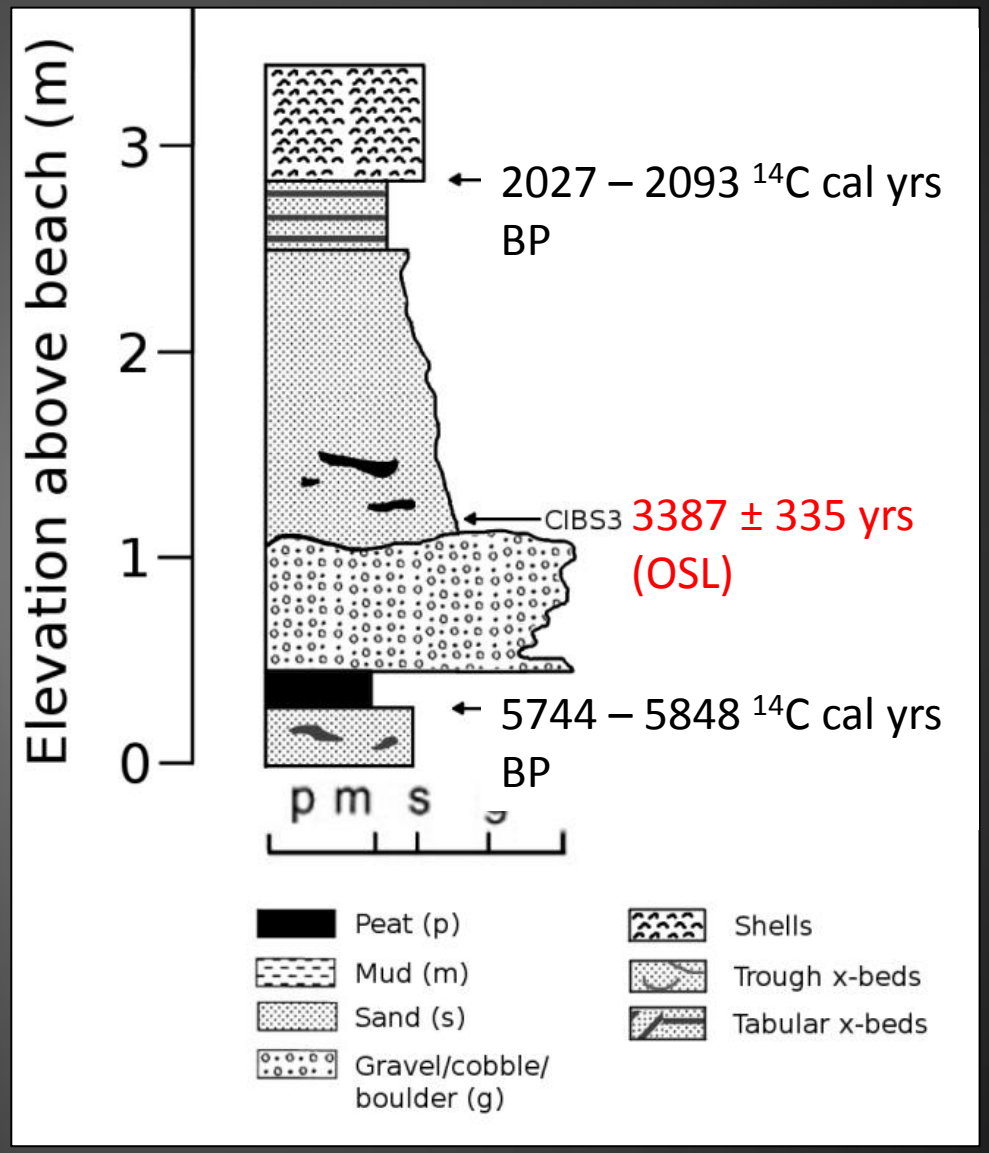
Fading rates





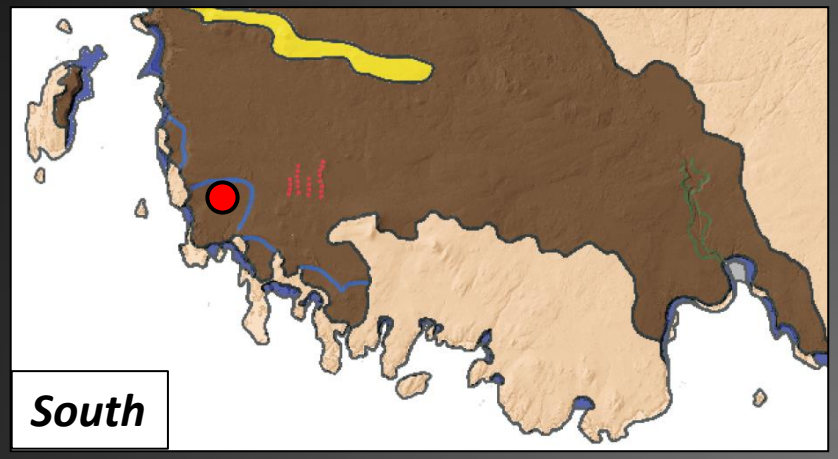
^{14}C ages provided some limiting age control





(Neudorf et al., 2015, Quat. Geocrhonol.)

^{14}C ages provided some limited age control



?

1584 – 1678 ^{14}C cal yrs BP

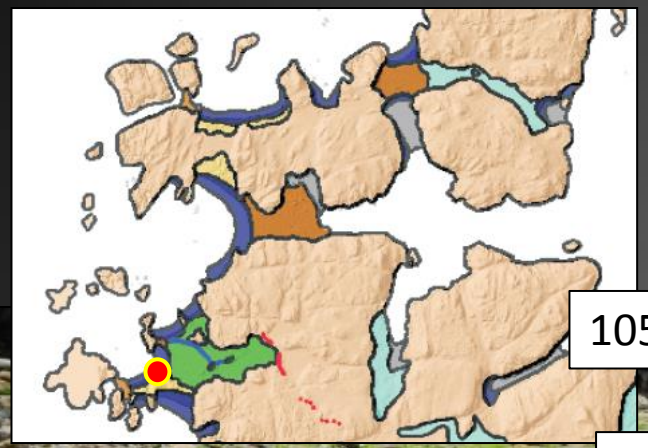
10853 – 11053 ^{14}C cal yrs BP

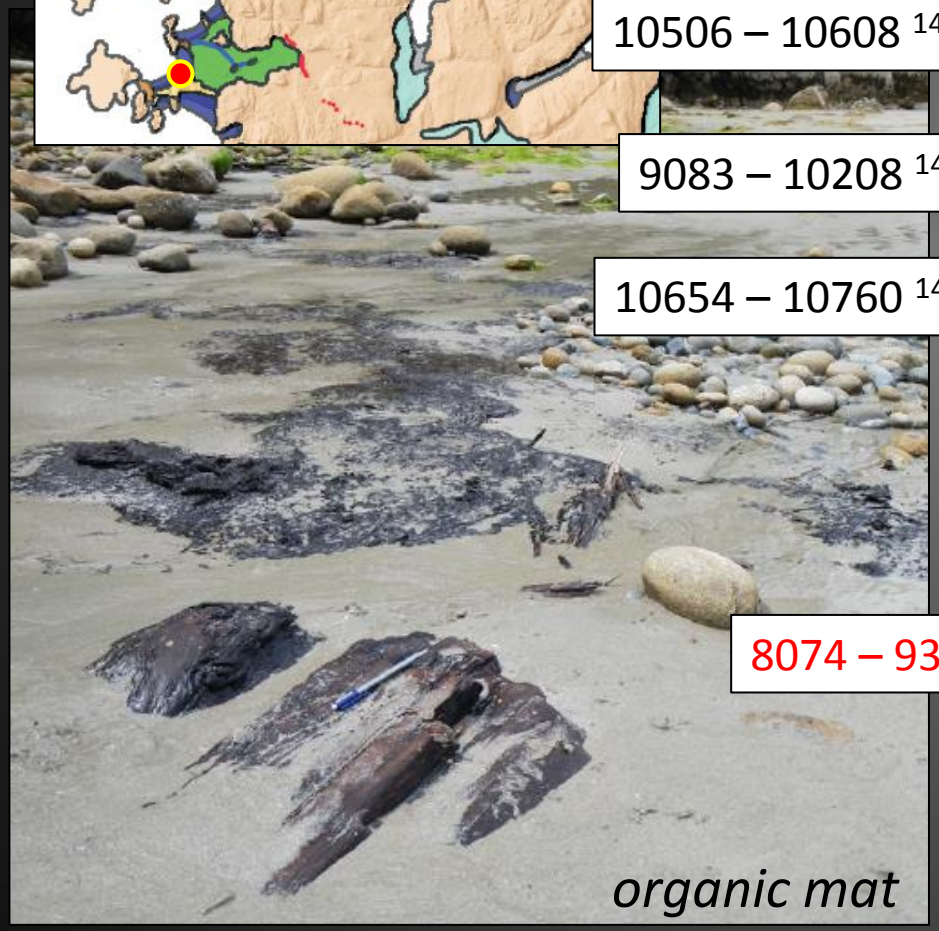
299 – 399 ^{14}C cal yrs BP

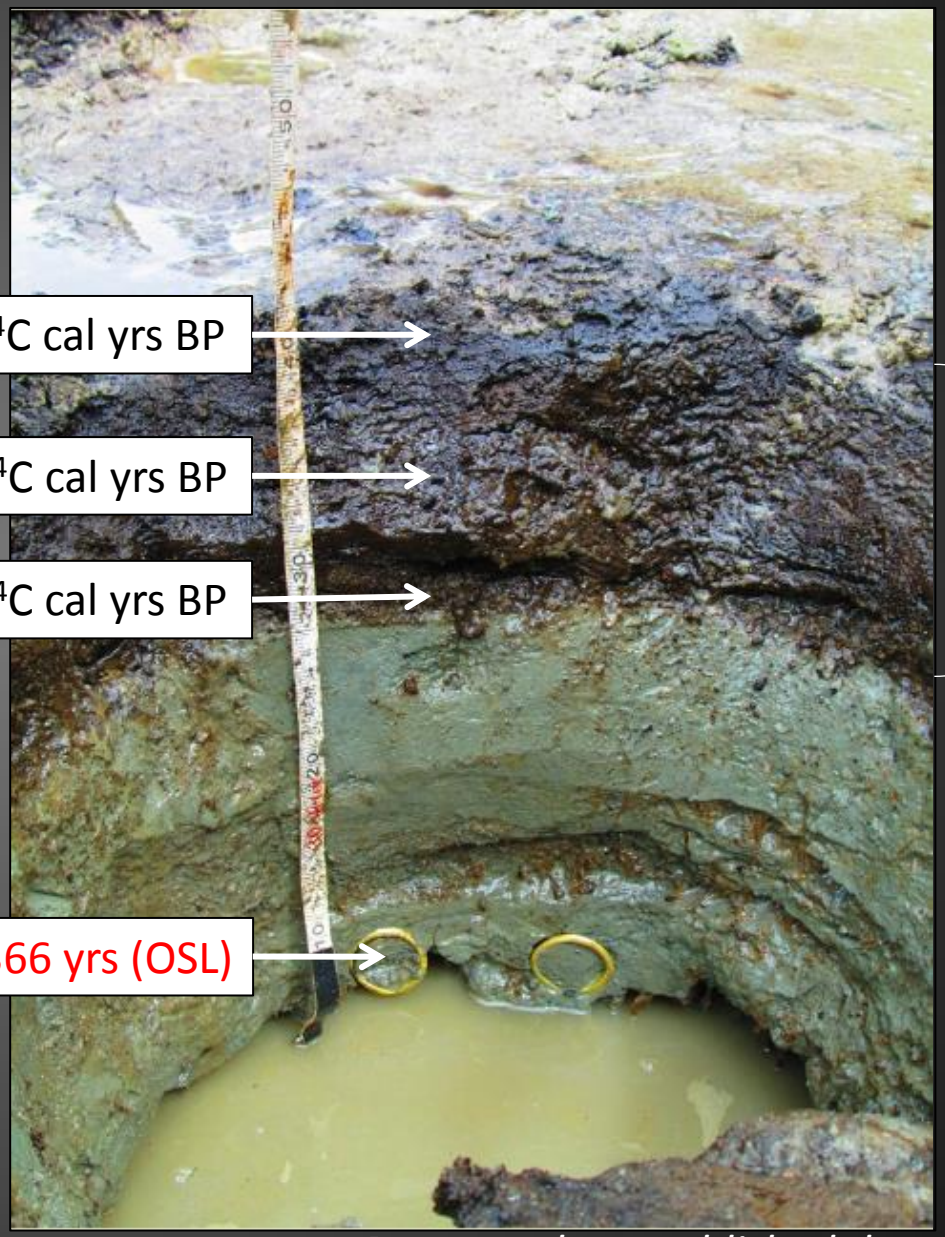
12306 ± 1155 yrs (OSL)

Neudorf et al., unpublished data

^{14}C ages provided some limited age control







10506 – 10608 ^{14}C cal yrs BP

9083 – 10208 ^{14}C cal yrs BP

10654 – 10760 ^{14}C cal yrs BP

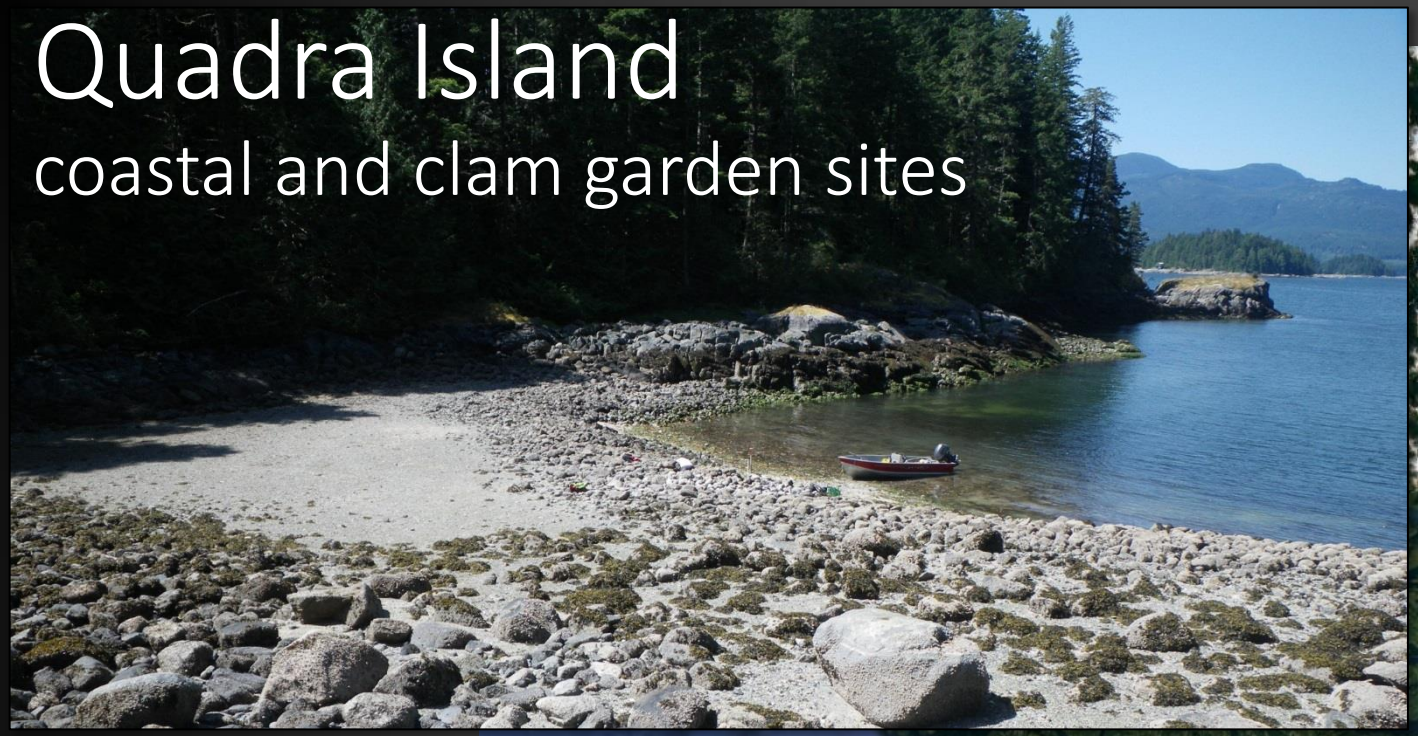
8074 – 9366 yrs (OSL)

reworked?

Bryce et al., unpublished data

Quadra Island

coastal and clam garden sites



Applied CI SAR protocol *(Neudorf et al., 2017, PLoS One)*

^{14}C age control

- ^{14}C ages from clam gardens are not present or from complicated contexts precluding stringent control

  (Neudorf et al., 2017, PLoS One)

- ^{14}C ages and sea level history and from other coastal sites <u>suggest that our IRSL ages are too young</u>

  (Fedje et al., unpublished data)

Clam gardens

Photo: C. Neudorf

Clam gardens

Photo: C. Neudorf

Coastal site (KGP)

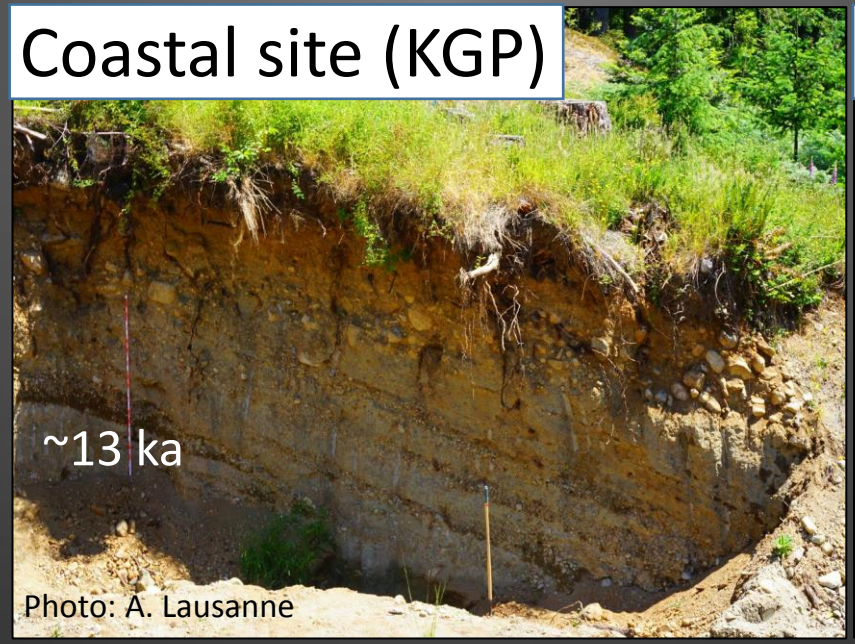
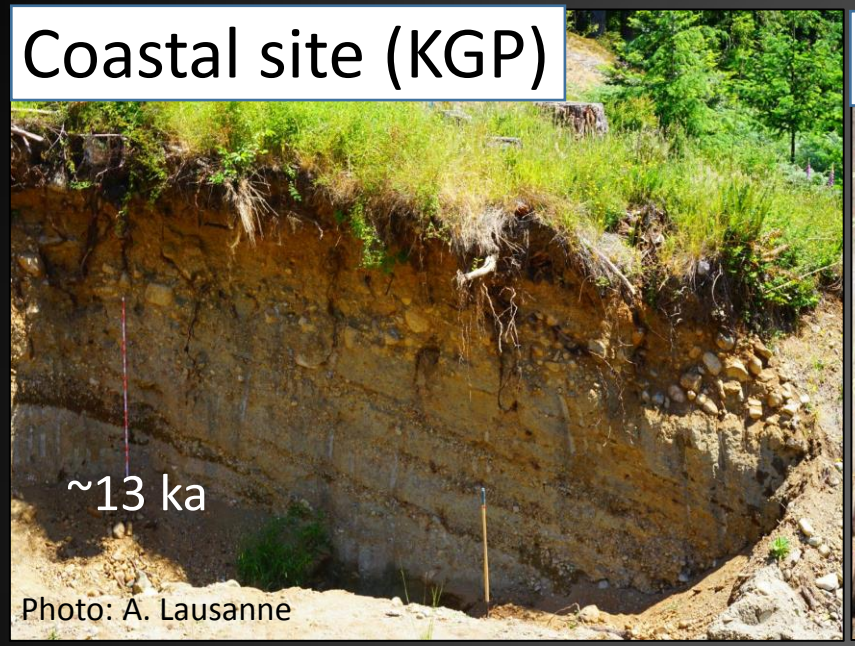


Photo: A. Lausanne

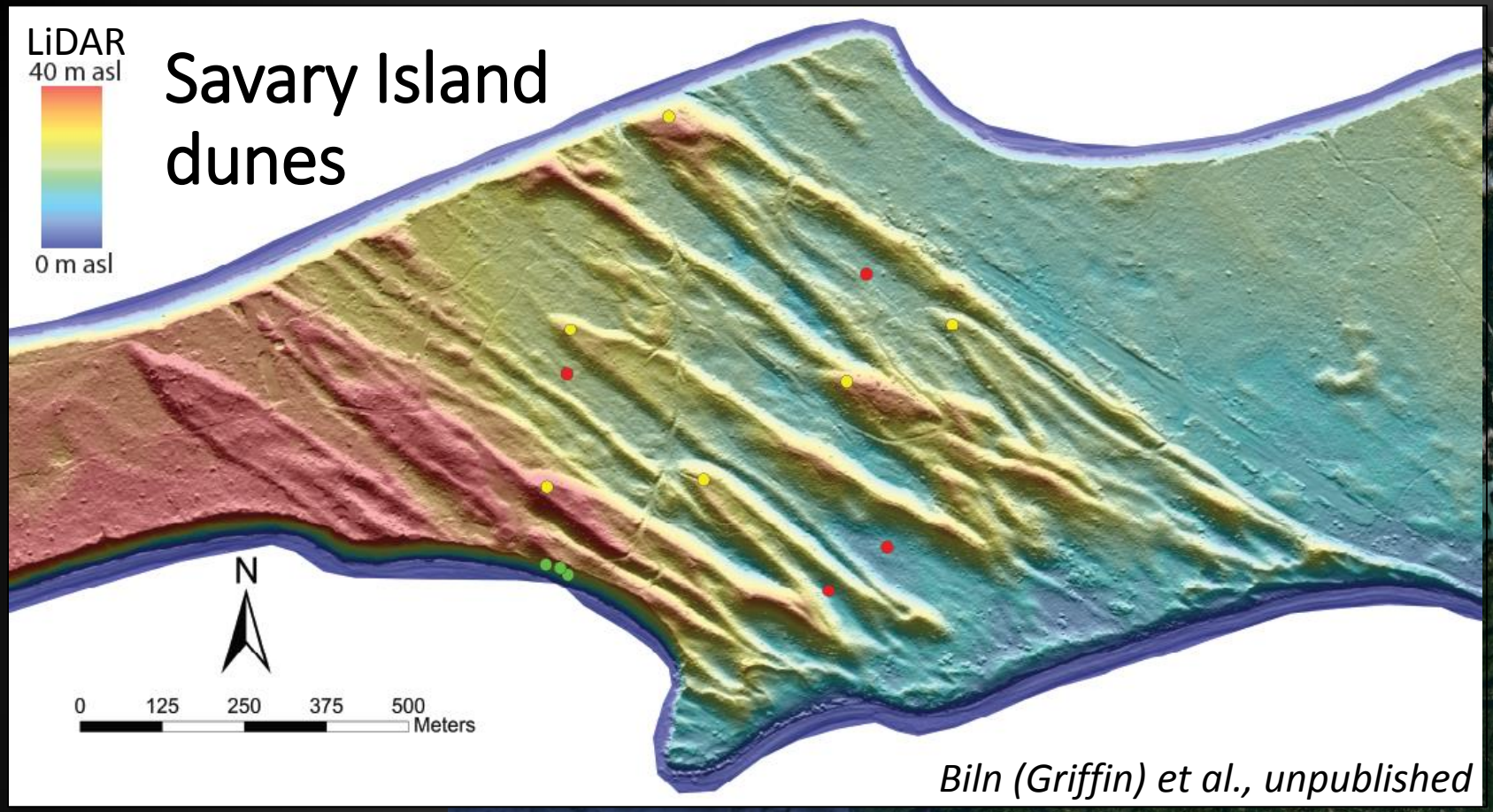
Coastal site (Crow)

Photo: A. Lausanne

Quadra Island coastal sites

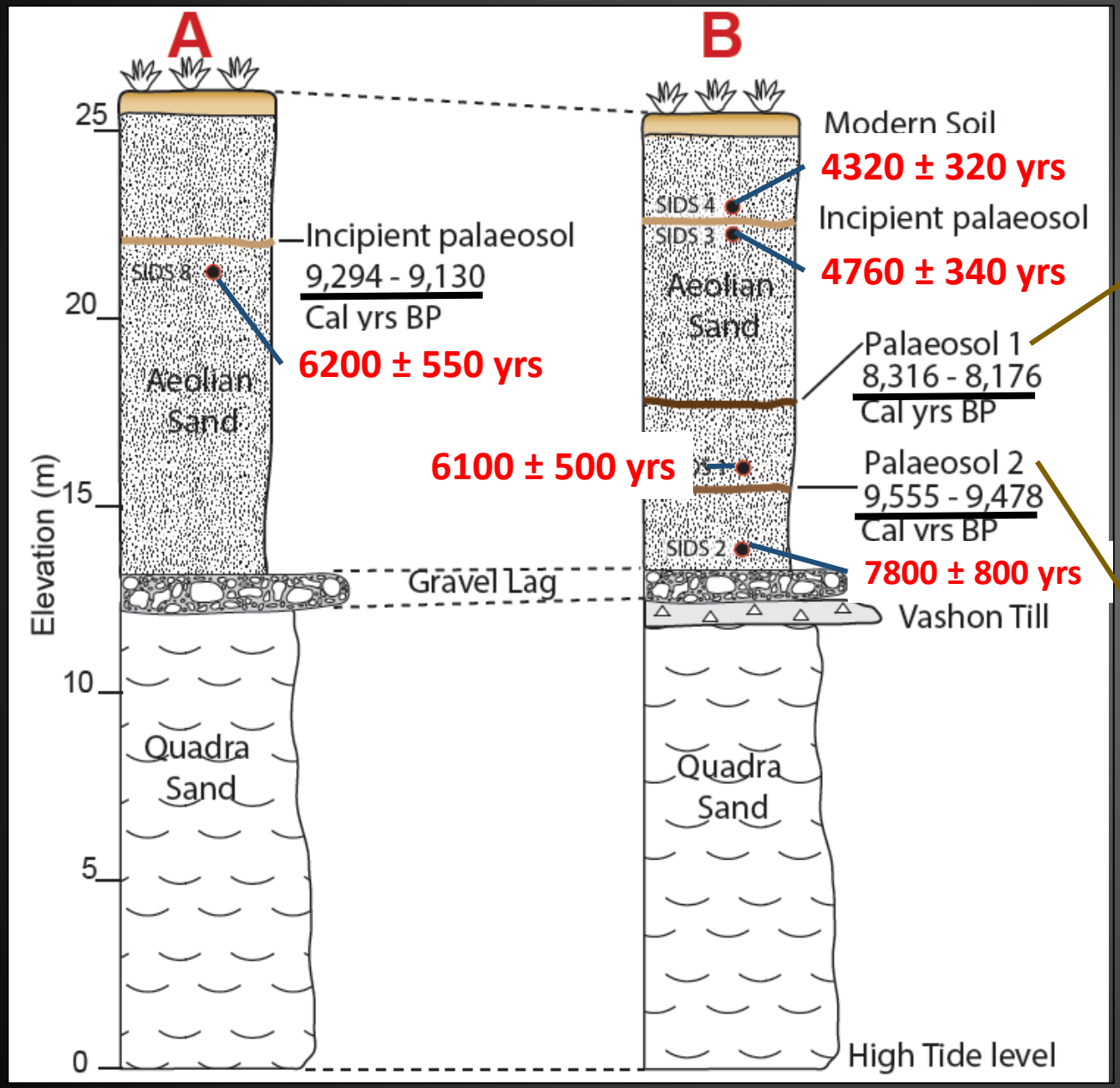


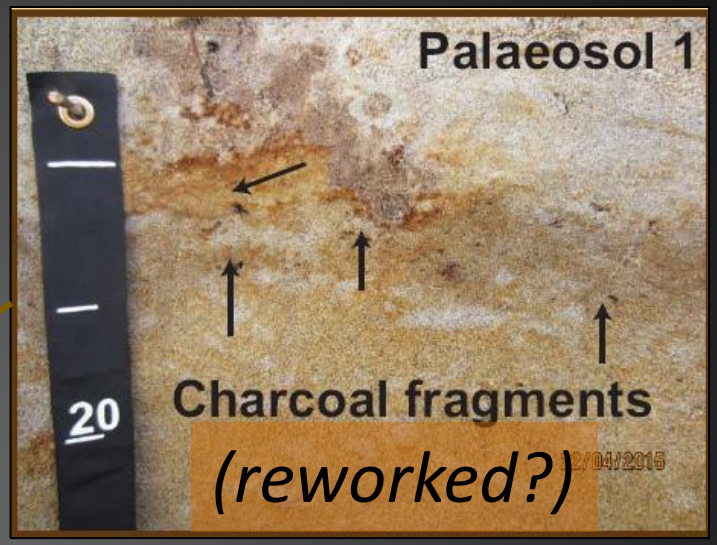
Sample	Elevation (m asl)	Expected Age (ka)	Measured Age (CAM) (ka)	Measured fading rate (*g*)
CROW-1	~13	~12.5	8.9 ± 0.7	4.3 ± 0.1
CROW-3	~13	~12.5	7.7 ± 0.7	5.7 ± 0.1
KGP-1	~33	~13	9.6 ± 0.9	4.5 ± 0.1
LRDS-1	~27	~8.8	4.7 ± 0.5	4.8 ± 0.1


LiDAR
40 m asl
0 m asl
Savary Island dunes
N
0 125 250 375 500
Meters
Biln (Griffin) et al., unpublished

British Columbia
Savary Island
N
100 km
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Data LDEO-Columbia, NSF, NOAA
Google Earth

IRSL ages underestimate ^{14}C ages





Biln (Griffin) et al., unpublished

Savary Island

Additional tests….

i. Laboratory lighting conditions
ii. Grain size
iii. Higher preheat (220°C/60 s)
iv. Post-IR signal

Sample	Protocol	Fading rate (*g*)	Uncorrected age (ka)	Corrected age (ka)
SIDS1 (180-250 µm)	CI SAR	6.20 ± 0.36	3.40 ± 0.27	**5.75 ± 0.42**
SIDS1C (180-250 µm)	CI SAR **Dimmer lab light**	7.49 ± 0.10	3.02 ± 0.23	**6.38 ± 0.45**
SIDS1C (300-400 µm)	CI SAR **Larger grain size**	5.51 ± 0.11	3.64 ± 0.26	**6.13 ± 0.42**
SIDS1C (180-250 µm)	CI SAR with **higher preheat**	6.13 ± 0.17	3.30 ± 0.25	**5.93 ± 0.44**
SIDS1C (180-250 µm)	**Post-IR$_{150}$**	3.99 ± 0.40	5.15 ± 0.45	**7.44 ± 0.71**

Biln (Griffin) et al., unpublished

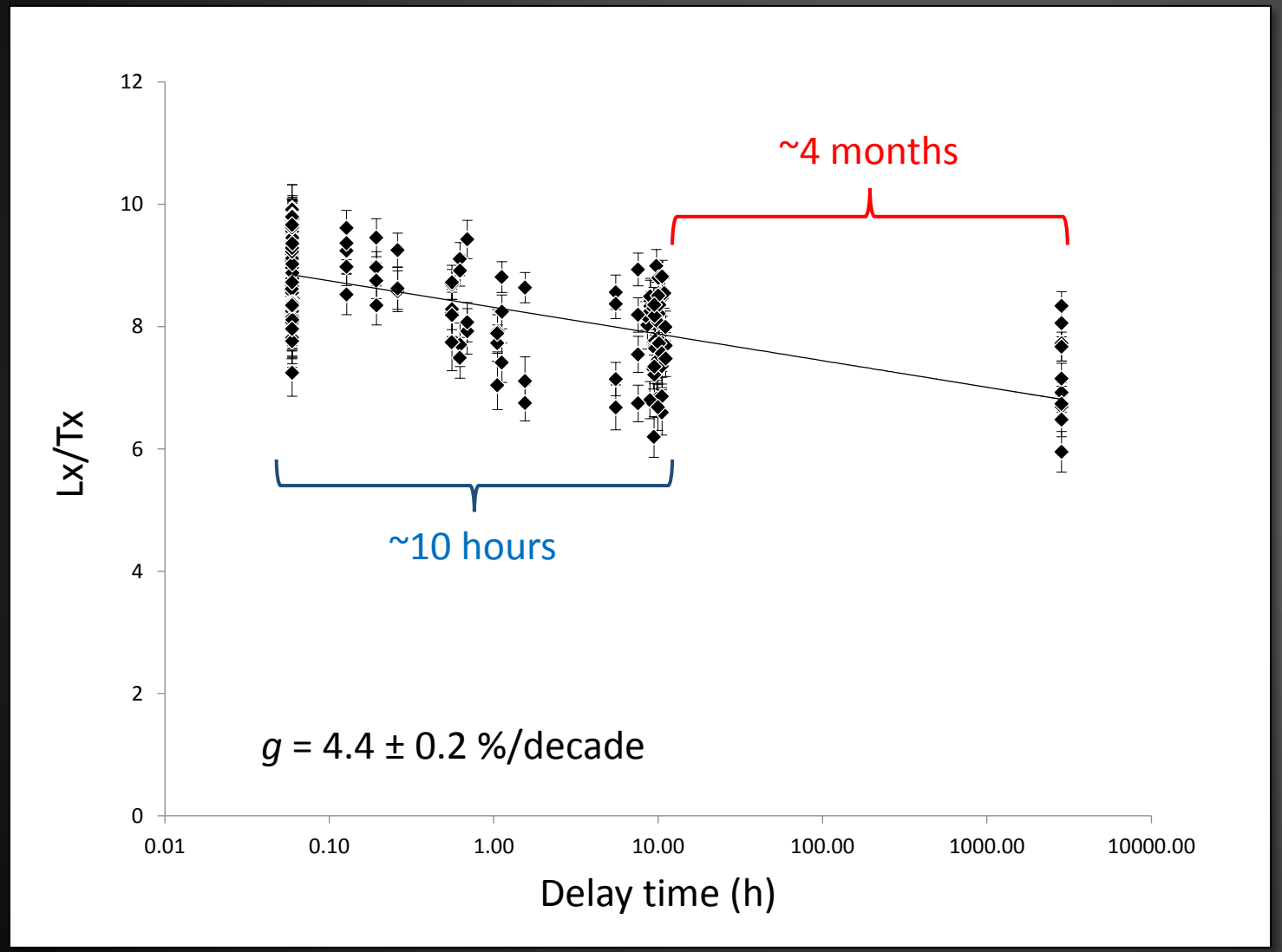
Are our fading rates accurate?

Tested….

i. Fading measurement delay times
ii. Reproducibility of fading measurements
    - including ambient laboratory temperature effects

Fading delay times

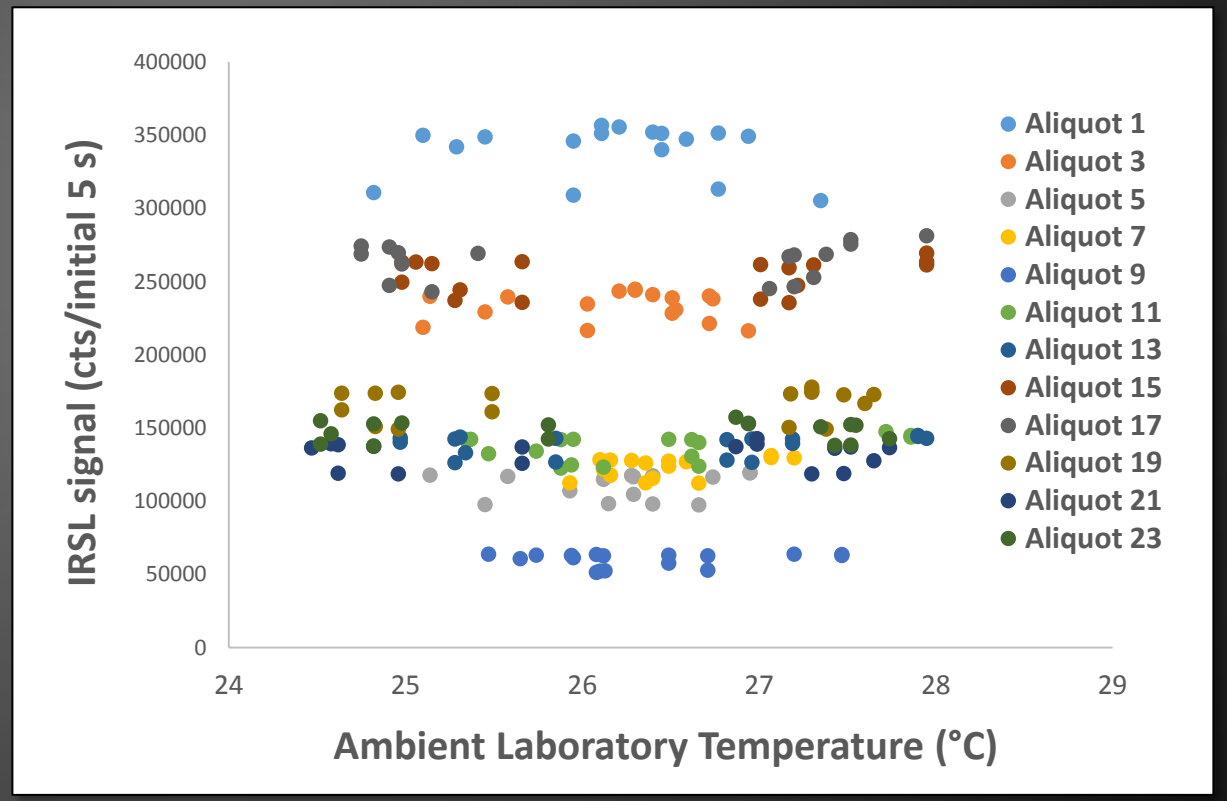
12 aliquots of sample KGP1



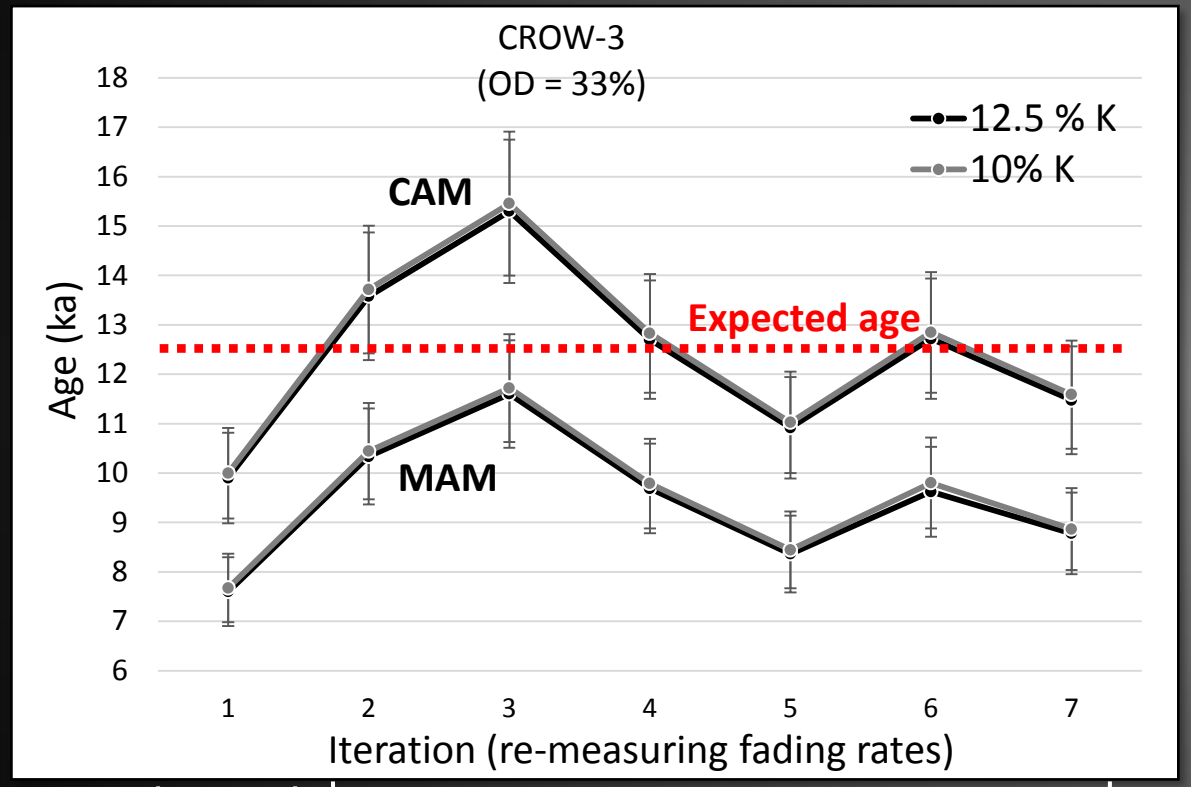
- delay times of several months yield fading rates that are the same (within error) as those obtained after ~10 h

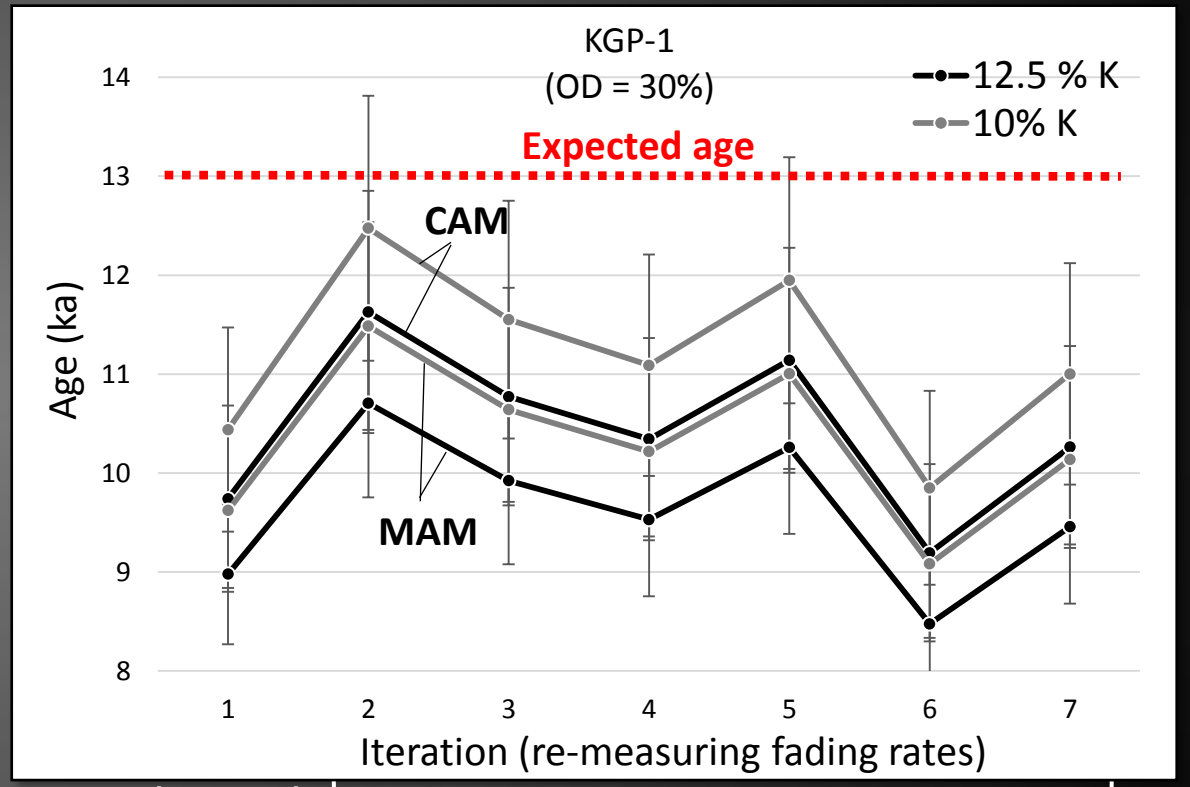
Testing the reproducibility of fading measurements…

- Laboratory temperature fluctuations



Testing the reproducibility of fading measurements…





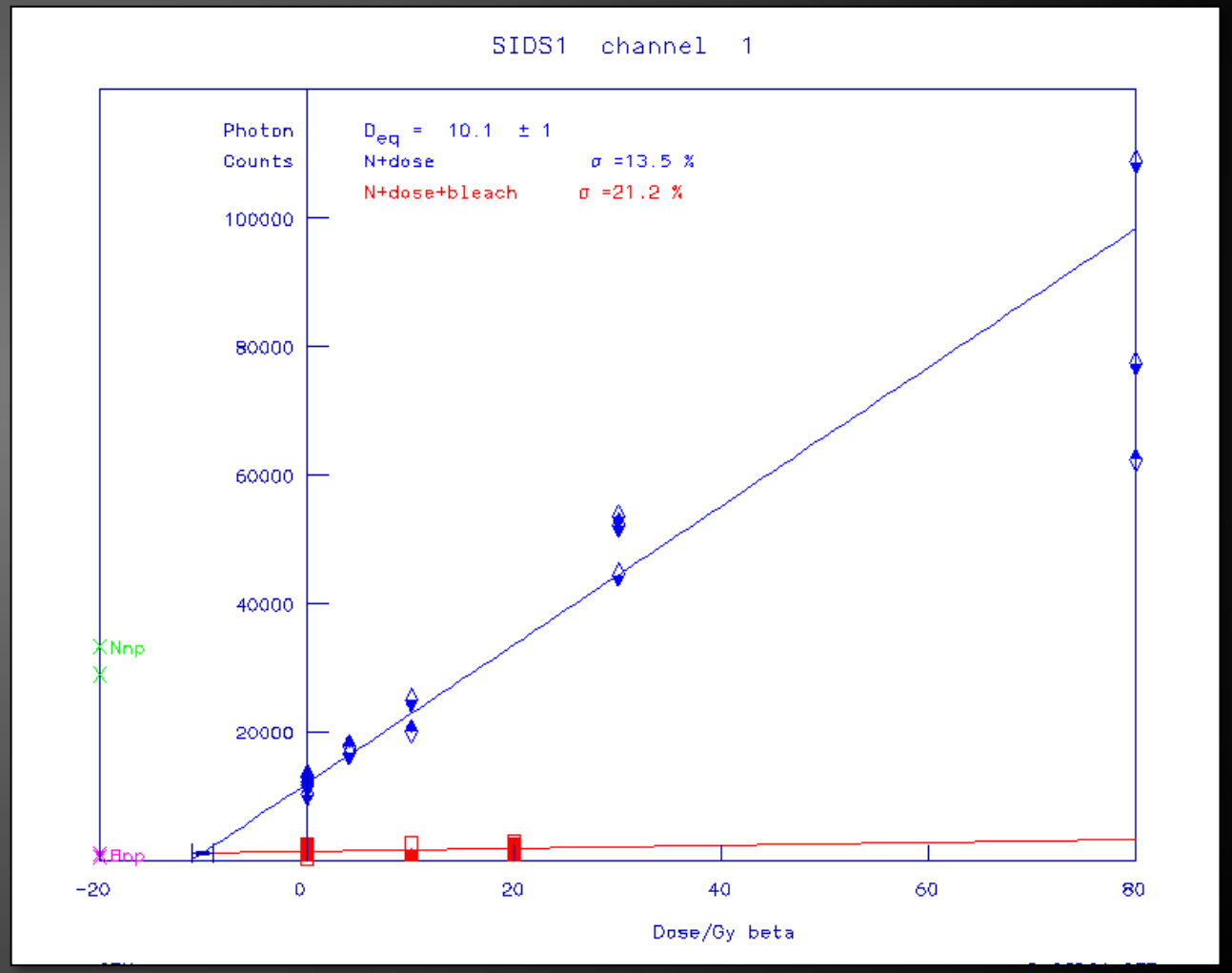
Something wrong with SAR?

Tests with the ADTT method…

Savary Island - SAR

Sample	Protocol	Corrected age (ka)
SIDS1 (180-250 µm)	CI SAR	**5.75 ± 0.42**

Savary Island –
ADTT method: 10.0 ± 1.0 ka
^{14}C age 9555-9478 cal yrs BP



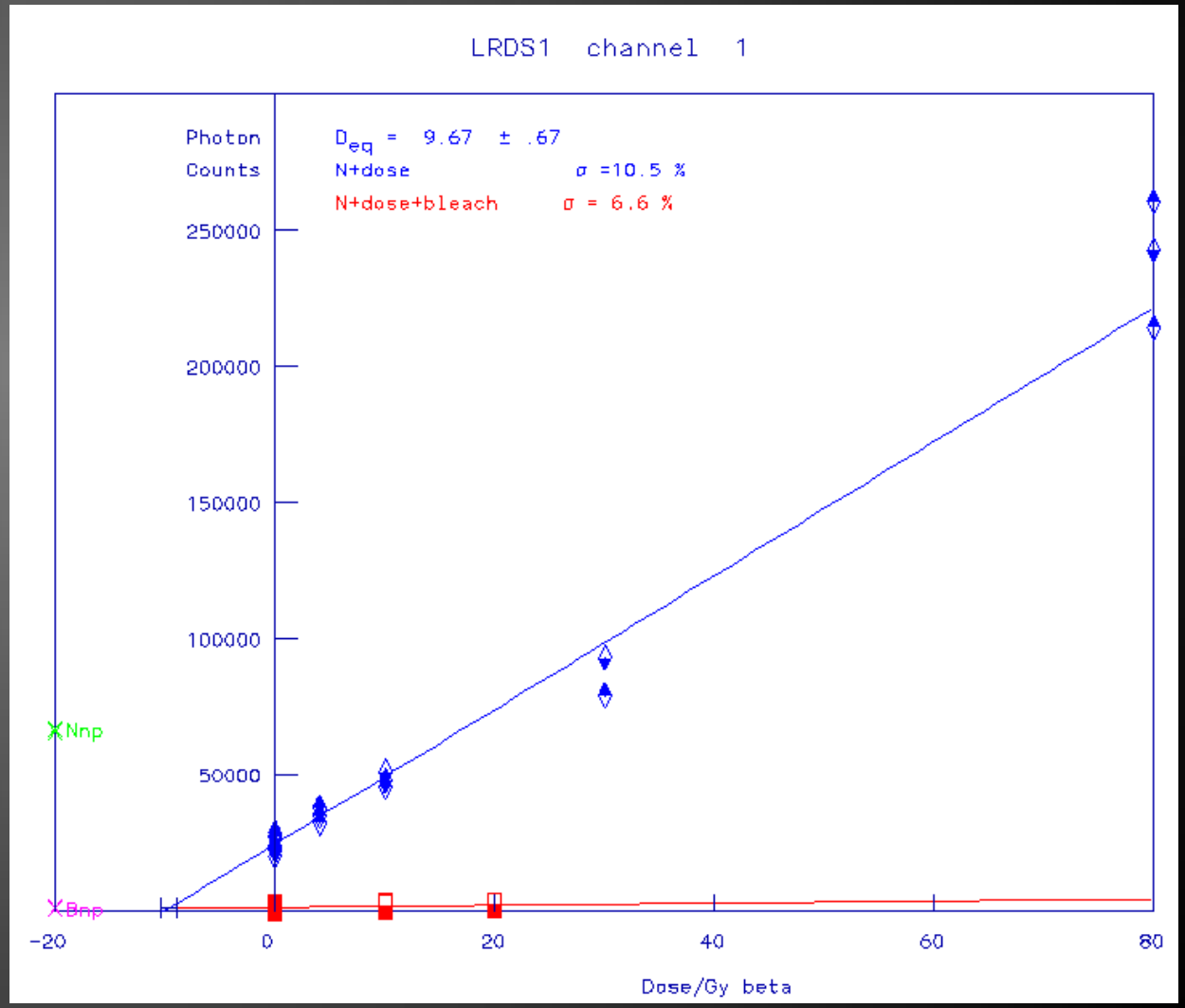
Something wrong with SAR?

Tests with the ADTT method…

Quadra Island - SAR

Sample	Protocol	Expected Age (ka)	Measured Age (CAM) (ka)
LRDS-1	CI SAR	~8.8	**4.7 ± 0.5**

Quadra Island –
ADTT method: 7.2 ± 0.6 ka
^{14}C age 8855 ± 20 cal yrs BP



Future work…

- Investigate potential of MAR techniques
- Mineralogy? It may be possible to investigate influence of contaminating minerals on ages (e.g., NaF)
- An evaluation of the residence time of organic material in coastal environments
- More thorough examination of the geomorphology of Quadra Island coastal sites and how they relate to sea level history

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These studies took place in the traditional territories of:

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