

The Triceratops that Roared!

ARPS 2023

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Project Overview

- Triceratops 'Horridus' 67 million years ago
- Fossils discovered in Montana, USA in 2014
- Most complete specimen discovered
- Acquired by Museums Victoria for exhibition
- Bones contain porous organic material that readily absorbs uranium
- Preparation + Exhibition











Health physics challenges

- Risk assessment based on problematic data
- Sample analysis data provided:

| Soil Sample Location | Radionuclide Activity (becquerel per gram) | | | | |
|----------------------|--|-----------------------|-------------------------|-------------------------|-------------|
| | Uranium (238 U) series | | | Thorium (232 Th) series | |
| | Th-234 | Ra-226 | Pb-210 | Ac-228 | Pb-212 |
| BONE (MVT.1.148) | <mark>200 ± 20</mark> | <mark>390 ± 40</mark> | ∕ <mark>150 ± 20</mark> | 3.0 ± 1 | 2.5 ± 0.4 |
| SEDIMENT (MVT.1.080) | 0.5 ± 0.1 | 1.6 ± 0.2 | 1.7 ± 0.2 | 0.03 ± 0.02 | 0.02 ± 0.01 |

Curators require prolonged periods in contact with specimens

'Time' and 'Distance' not a viable control method



Anticipated specimen tasks

- Unpack and stock-take
- Condition report
- Photograph and 3D scanning.



- Physically label and attach object tags with barcodes
- Repair components if damaged
- Mold and casting
- Install each piece on the armature in the exhibition space
- Maintenance including regular cleaning and condition checking



Mobilisation to Australia

- Preparation for transport in accordance with IATA
- 226 fossils (910 kg) shipped in 3 crates
- Precious cargo arrival in 2021
- Steel armature fabricated
- ...all during a pandemic!





Gamma radiation exposure

| Distance from Item | Dose rate measurements (µSv/h) | | | | |
|-----------------------|--------------------------------|---------------------|--|--|--|
| MVT.1.085.001 | Radiation Solutions RS-220 | Rotem RAM GENE-1 | | | |
| Contact | 3.6 - 6.8 | 6 - 12 | | | |
| 30 cm | 1.3 – 2.7 | 1.2 – 2.9 | | | |
| 100 cm | 0.43 – 0.46 | 0.47 – 0.50 | | | |







Dosimeter Results



B



| Task | Total External Dose, background corrected | | | | |
|--|---|--|--|--|--|
| | (mSv) | | | | |
| Collection Management - Palaeontologist | | | | | |
| Individual A | 0.27 | | | | |
| Individual B | 0.16 | | | | |
| Individual C | 0.17 | | | | |
| Conservation Team – Preservation of individual for | sils | | | | |
| / Individual D | 0.22 | | | | |
| Individual E | <0.05 | | | | |
| Individual F | 0.13 | | | | |
| Individual G | 0.22 | | | | |
| Photography Team – Documentation of each fossil | | | | | |
| Individual H | <0.05 | | | | |
| Individual I | 0.13 | | | | |
| Individual J | <0.05 | | | | |
| Exhibition Installation – Erecting complete specimen | | | | | |
| Individual L | 0.15 | | | | |
| Individual M | 0.23 | | | | |
| Individual N | <0.05 | | | | |
| Individual O | <0.05 | | | | |
| Curatorial – Overseeing process for entire period | | | | | |
| Individual P | 0.17 | | | | |
| Individual Q | 0.24 | | | | |
| Individual R | 0.16 | | | | |

Other exposure potentials

Airborne particulate exposure

 Radon-222 (including temporary Store)





Radon assessment





Radon assessment



Some of the controls...

- Safe Work Procedure developed
- Minimizing source material on bench
- Appropriate PPE whilst handling
- Store restrictions
- Radiation Safety Training to personnel (2-day)
- Provision of contamination monitoring equipment including training
- Consideration of generated waste





Exhibition display



Projected Average dose Annual dose, rate, background background Task Location and occupancy per annum corrected corrected (µSv⋅h⁻¹) (µSv) Visitor Engagement Officers (VEOs) Public engagement 1 hr per day, 250 days per year, ground floor 0.26 65 Public engagement 0.5 hr per day, 250 days per year, 1 m from barrier 0.31 38 Public engagement 0.69 86 0.5 hr per day, 250 days per year, at barrier Total: 189 **Technical Operations Staff Replacing lights** 0.26 15 hrs per week, quarterly, ground floor 16 Roaming checks 10 min. per day, 125 workdays per year, gnd floor 0.26 5.4 Total: 21 DMS (Digital Media Systems) Staff **Digital systems** 0.26 12 4 hrs over 2 days, each month, ground floor Cleaners General cleaning 0.26 65 2 hrs per day, 125 days per years, ground floor Security Roaming security 2 hrs per day, 40 days per year, ground floor 0.26 21 **Collections Staff** 2 hrs at specimen, 8 times per year (ie every 6 Cleaning 5.2 41 weeks) Moving plinth 0.69 5.5 1 hr at barrier, 8 times per year **Cleaning plinth** 1 hr at barrier, 8 times per year 0.69 5.5 Total: 53

Dose rate 1m above ground (µSv/h)

DR

Special thanks to:

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https://youtu.be/klm1w_6JPgc

https://www.youtube.com/watch?v=klm1w_6JPgc&list=PPSV





Questions ?



