



Sean Paling
STFC Boulby Underground Science Facility

Dark Matter search & ultra low background studies



Multi-disciplinary studies: geology, climate, the environment, life on earth & elsewhere



Deep Science at Boulby Underground Laboratory:

Multidisciplinary deep science: From astrophysics to geology, climate the environment, life on Earth and beyond.



Underground lab @ Boulby

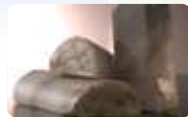


Boulby Underground Laboratory

The UK's deep underground science facility operating in a working polyhalite & salt mine.

1.1km depth (2805 mwe). With low background surrounding rock-salt

Operated by the UK's Science & Technology Facilities Council (STFC) in partnership with the mine operators ICL



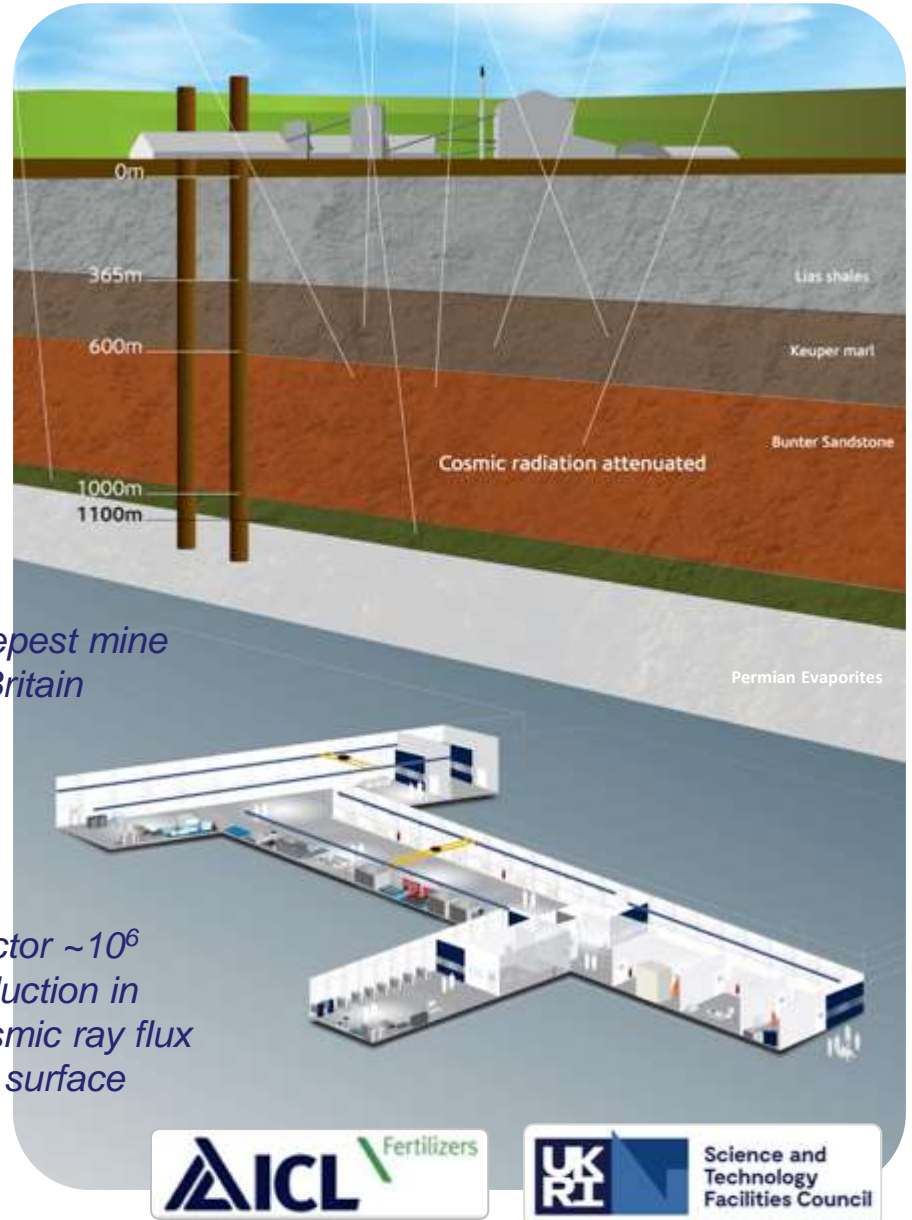
Polyhalite



Deepest mine in Britain

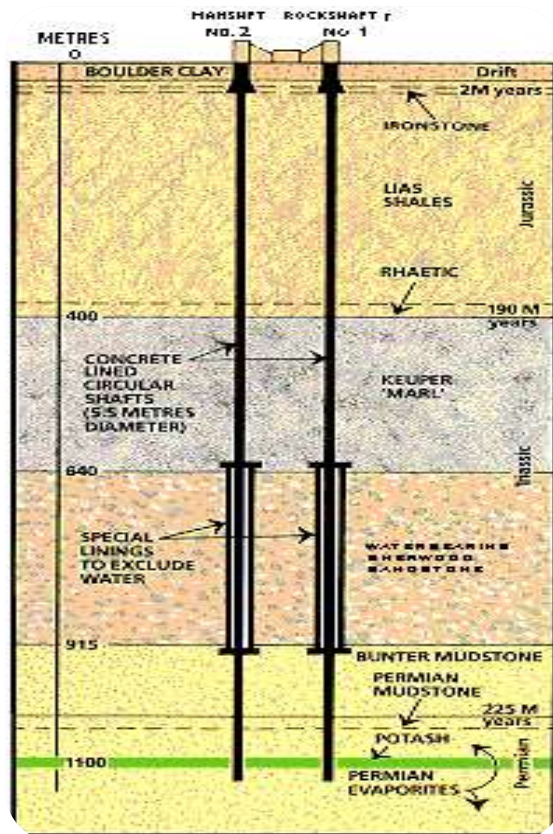
Factor $\sim 10^6$ reduction in cosmic ray flux vs. surface

A **QUIET** place in the Universe



Boulby Geology & Mining

Major local employer. Open since 1968.
Originally mining potash (KCl) for fertiliser.
Now first and only producers of polyhalite
Excavations are in Salt (NaCl) & Potash (KCl) Permian evaporite layers left over from the Zechstein Sea.



Boulby Geology

Potash



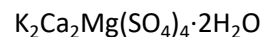
KCl

Rock-Salt



NaCl

Polyhalite



Typical Boulby Salt Roadway



Zechstein Sea

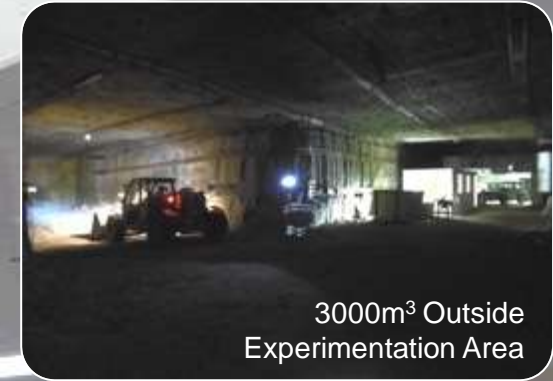




Surface support and staging building



Office space, chemistry & clean prep lab, storage and staging space, IT room, conference room,

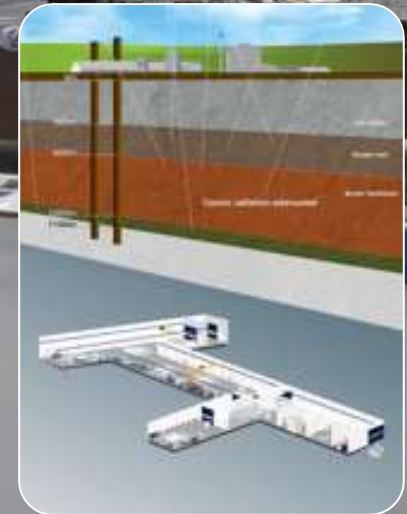


3000m³ Outside Experimentation Area



BUGS+ Material screening

Boulby Underground Lab Facilities 2019:
>4000m³ class 1k & 10k clean room lab space
100Mb Internet AC, Air filtration, 5T & 10T lifting, LN generation, fume hood & clean prep
3000m³ Outside Expt. Area. Power & internet



Underground Science @ Boulby Mine

- DRIFT/CYGNUS: Directional Dark Matter
- BUGs: Ultra-low background material screening (for LUX-ZEPLIN and Super-K-Gd and more)
- ERSaB: Environmental gamma spectroscopy
- NPL-C14: ULB C14 half-life measurement
- RESOURCE: Salt cavity energy storage study
- BISAL: Geomicrobiology / Astrobiology studies
- MINAR: Space Exploration Tech. Development
- Misc. Geology / Geoscience
- Etc... (More to come).



CYGNUS Dark Matter R&D



Astrobiology & planetary exploration



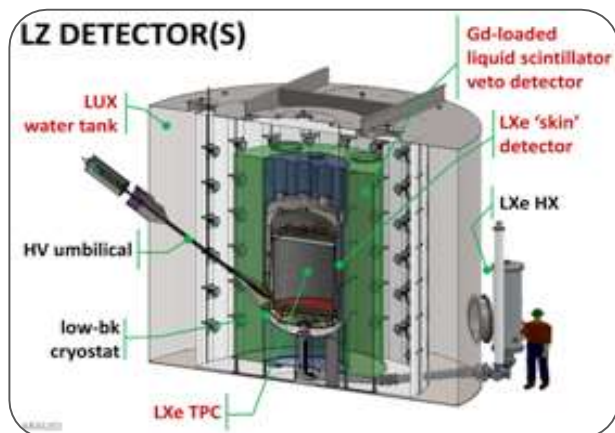
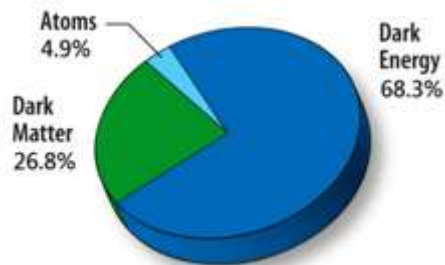
A busy & growing multi-disciplinary science programme: from astrophysics (Dark Matter) to studies of geology, climate, the environment, life on Earth & beyond.



Boulby Dark Matter Studies



CYGNUS Directional Dark Matter Detector



LUX-ZEPLIN (LZ)



BUGS: Ultralow Background Material Screening Suite

LZ PMTs



Ultra-Low-Background germanium detectors for ULB rare-event detector material screening...

Boulby Multi-Disciplinary Studies



Environmental Gamma Spec.

Ultra-Low background counting
environmental radioactivity studies

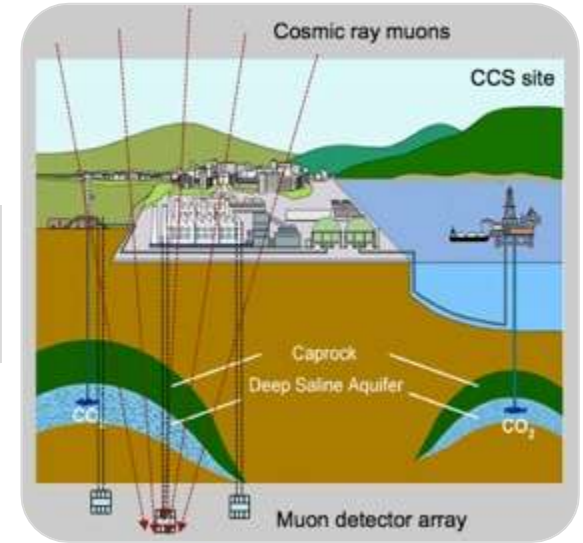
*Boulby, Scottish Universities Env.
Research Ctr (SUERC), AWE,*

Geoscience: Inc: Muon Tomography for
deep geological mapping. Also
compressed gas energy storage in salt



*Boulby, Durham,
Sheffield, Bath,
Premier Oil.
BGS, Cambridge*

**From astrophysics to geology,
geophysics, the environment, life
on Earth & beyond...**



Planetary Exploration Technology

MINAR: Space Technology
Development Programme

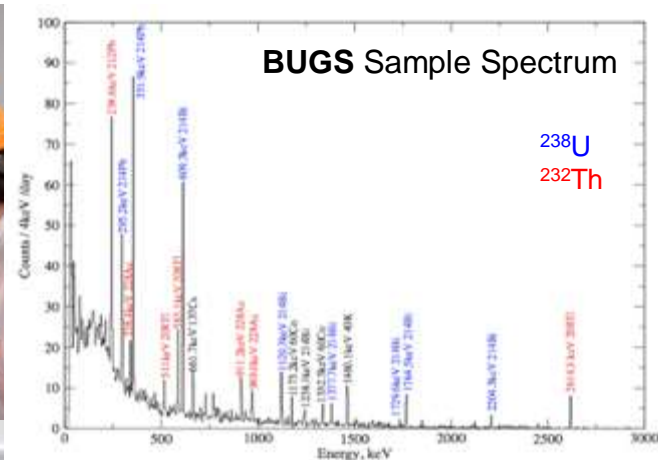
*Edinburgh, NASA,
ESA, DLR, ICL etc.*

Plus Misc. Geology &
Geoscience (& more to
come)...

Life in Boulby Salt...



BioScience: BISAL: Astrobiology / Geo-
microbiology. Studies of life in salt, life on Earth
& beyond





Thank You....



Laboratory space, low background counting, science support @ Boulby



Sean Paling
STFC Boulby Underground Laboratory



Please Contact us...

Email: Boulby@stfc.ac.uk

Web: www.stfc.ac.uk/boulby

Facebook: Boulby Underground Laboratory