



# RockSolid Bismuth-Based P&A Barriers: A Risk-Based Assessment of Performance & Long-Term Integrity

Dr. Darren Wilkinson  
Geologist / Snr R&D Scientist  
Interwell P&A

# Overview

- 01 RockSolid™ Recap
- 02 Threat Identification & Management
- 03 Capabilities & Threats
- 04 Field Trials
- 05 Summary

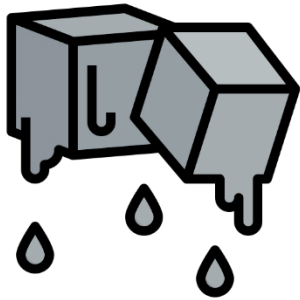


# Bismuth Deployment Concepts



## Bismuth Production

An thermite reaction produces "new" bismuth as a reaction product, along with surplus heat resource



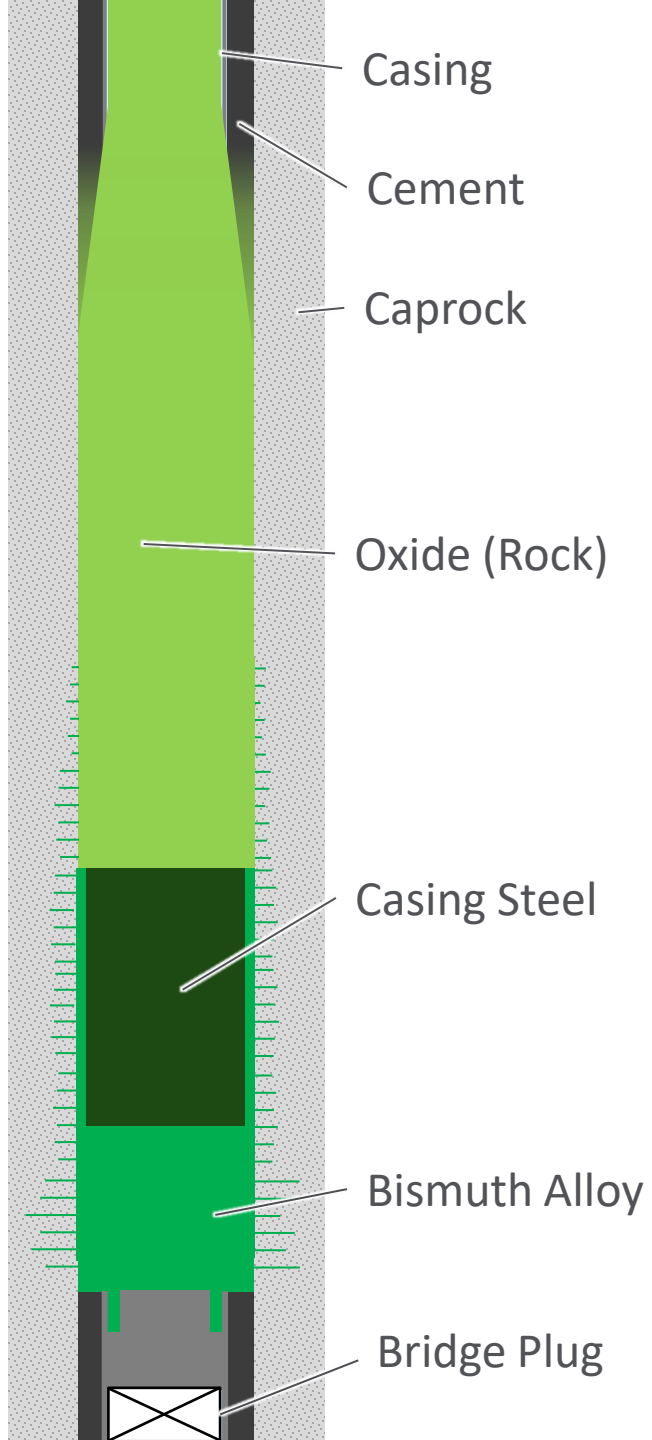
## Bismuth Melting

External energy source slowly heats up & melts solid bismuth alloy

# Demonstrated Tech

- ✔ Thermite magma excavates away all man-made materials
- ✔ Solidifies to form a **new** barrier
- ✔ Bismuth produced via thermite reaction
- ✔ On a single wireline run

Qualified Technology (DNV RP-A203) Q1 2023  
Commercially available **Technology Demonstrator**



# Threat Identification & Management

## DNV-RP-A203 Technology qualification

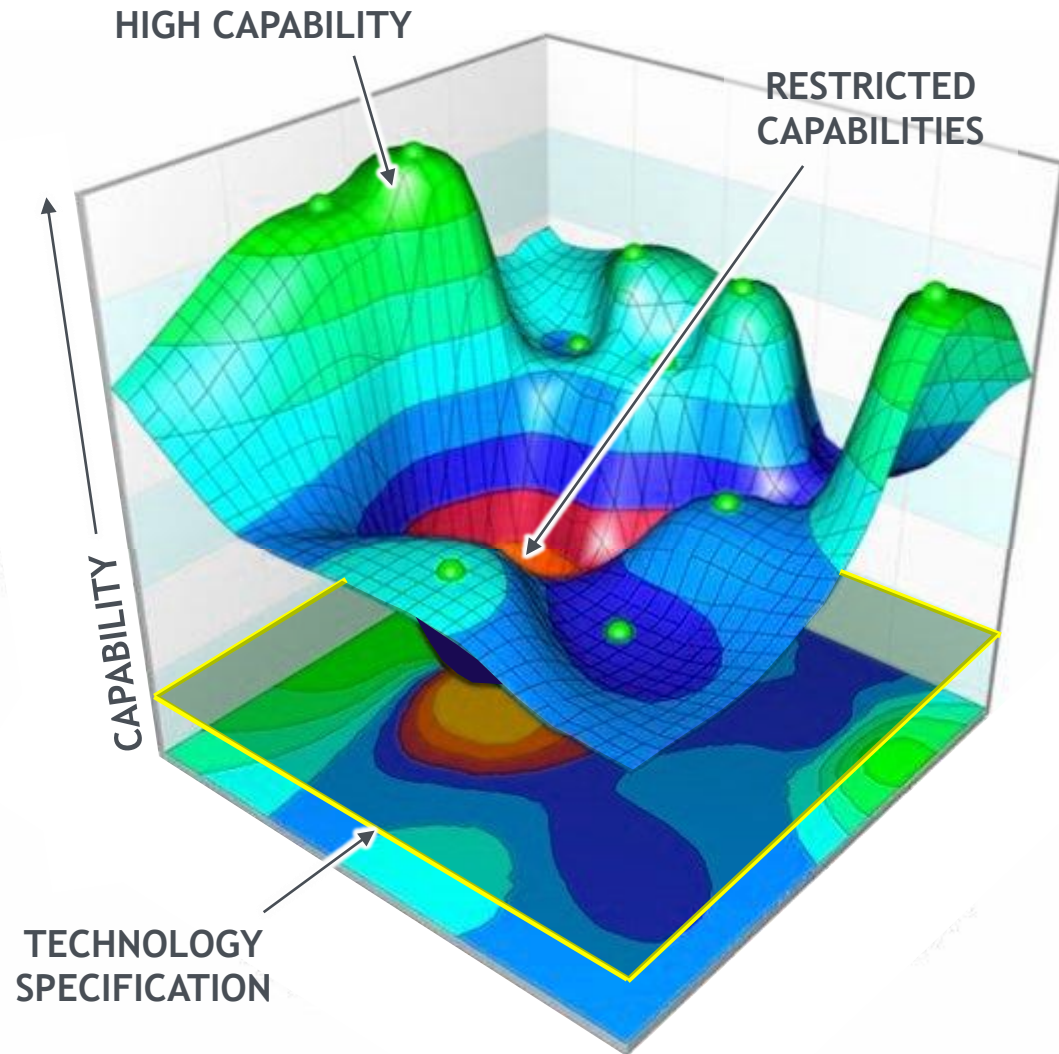
The objective of this recommended practice (RP) is to provide a systematic approach to technology qualification in a manner that ensures traceability throughout the process, from the determination of functions, targets and **expectations to relevant failure modes**, qualification activities and evidence.

Its aim is to ensure that the **failure modes and the qualification activities are relevant and complete**. This, in turn, should improve confidence in novel technology, and improve the likelihood of its commercialization. Thus, this RP adds value by both facilitating the development of technology and by underpinning its business case.

- SAFE OPERATION ✓
- WIRELINE COMPATIBLE ✓
- TOOL CONTROL ✓
- IGNITION CONTROL ✓
- REACTION CONTROL ✓
- PERMANENT BARRIER ✓
- BARRIER VERIFICATION ✓

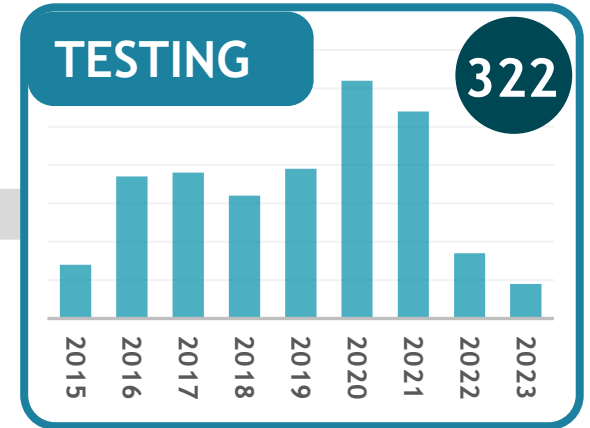


# Capability Mapping



**TQP**

CORROSION	LOADING	DECOMPOSITION	BREAKDOWN
METASTABILITY	FLUIDS	PRESSURE	CREEP
DEPLOYMENT	PLACEMENT	GEO ACTIVITY	ACTIVITIES



# Corrosion Resistance

## Methodology

- Conducted by Sintef
- Upper mean North Sea
  - 5 mol.% CO<sub>2</sub>
  - 1 mol.% H<sub>2</sub>S
- 12-months exposure
  - 100°C / 11 bar
  - pH <5

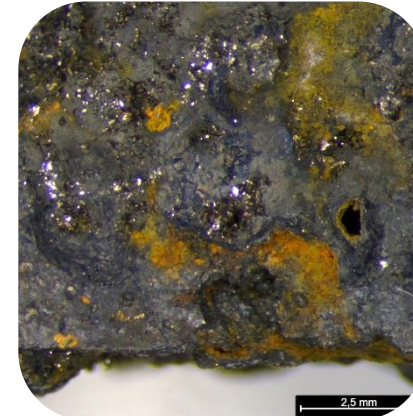
✓ Compliant to NACE/ANSI MR0175-1-2015

## Results

- ✓ No measurable corrosion
- ✓ No failure mode due to corrosion
  - Corrosion resistance independent of pH
  - Well suited for sour gas and CO<sub>2</sub> storage well



BISMUTH ALLOY



CASING STEEL

**TU**

*Artificial lava provides safe sealing of oil and gas wells*

A Norwegian company is now plugging abandoned petroleum wells using artificial lava - so far with success.



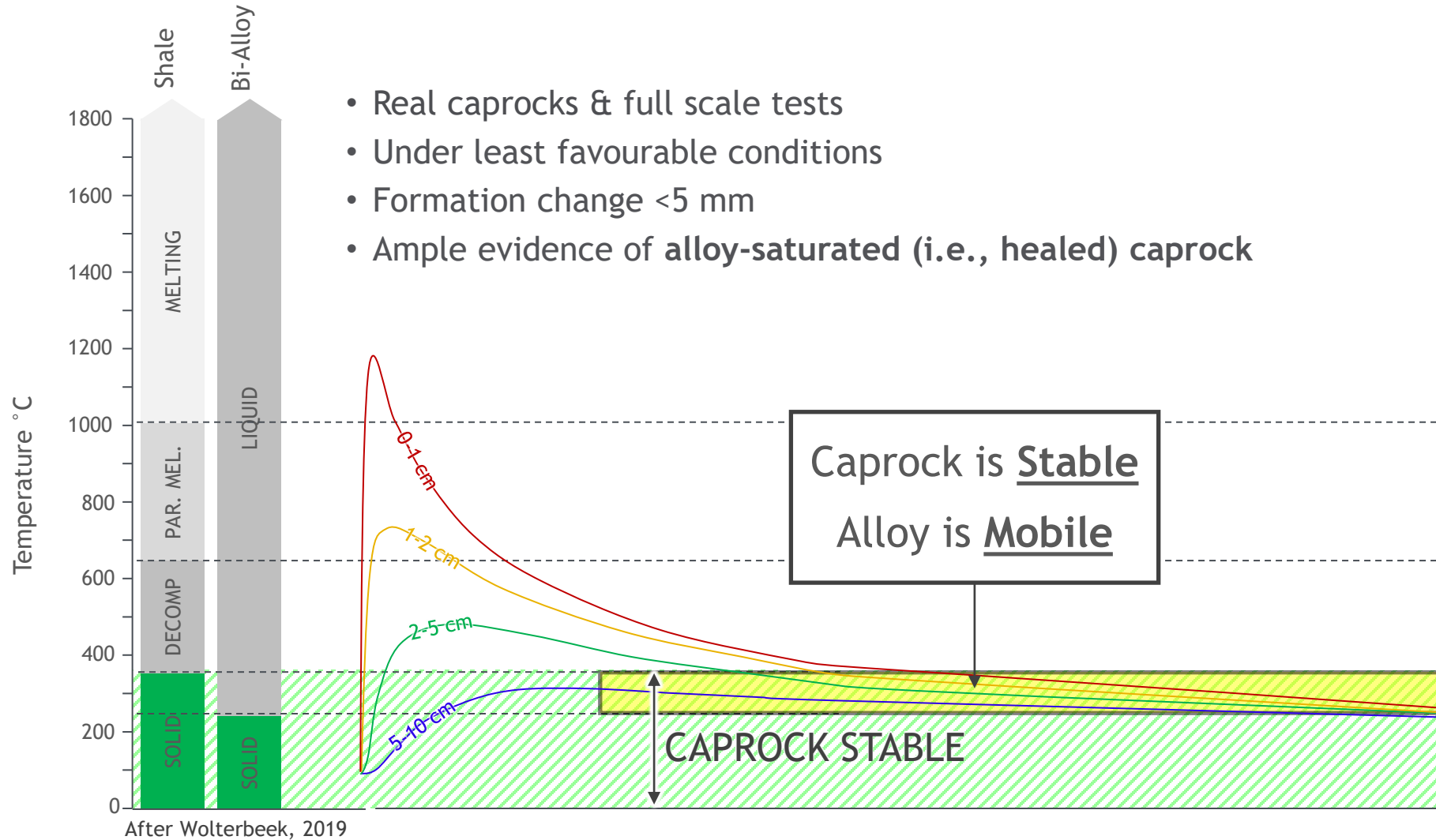
Ox

Casing

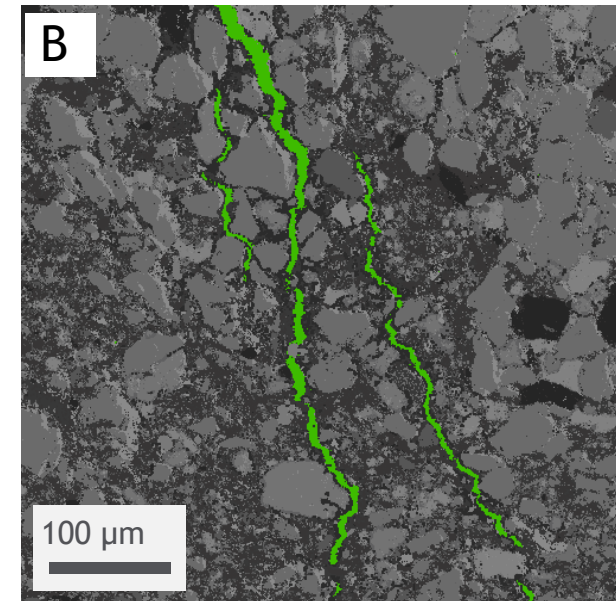
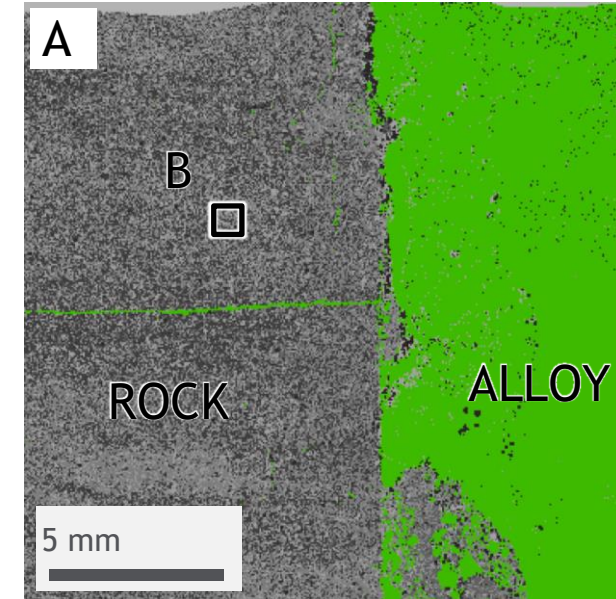
Bi



# Heat Affected Zone



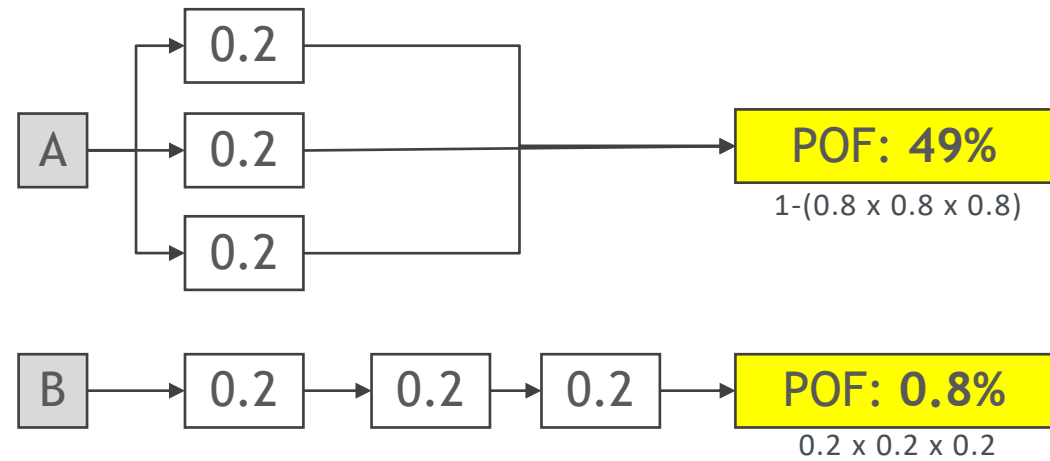
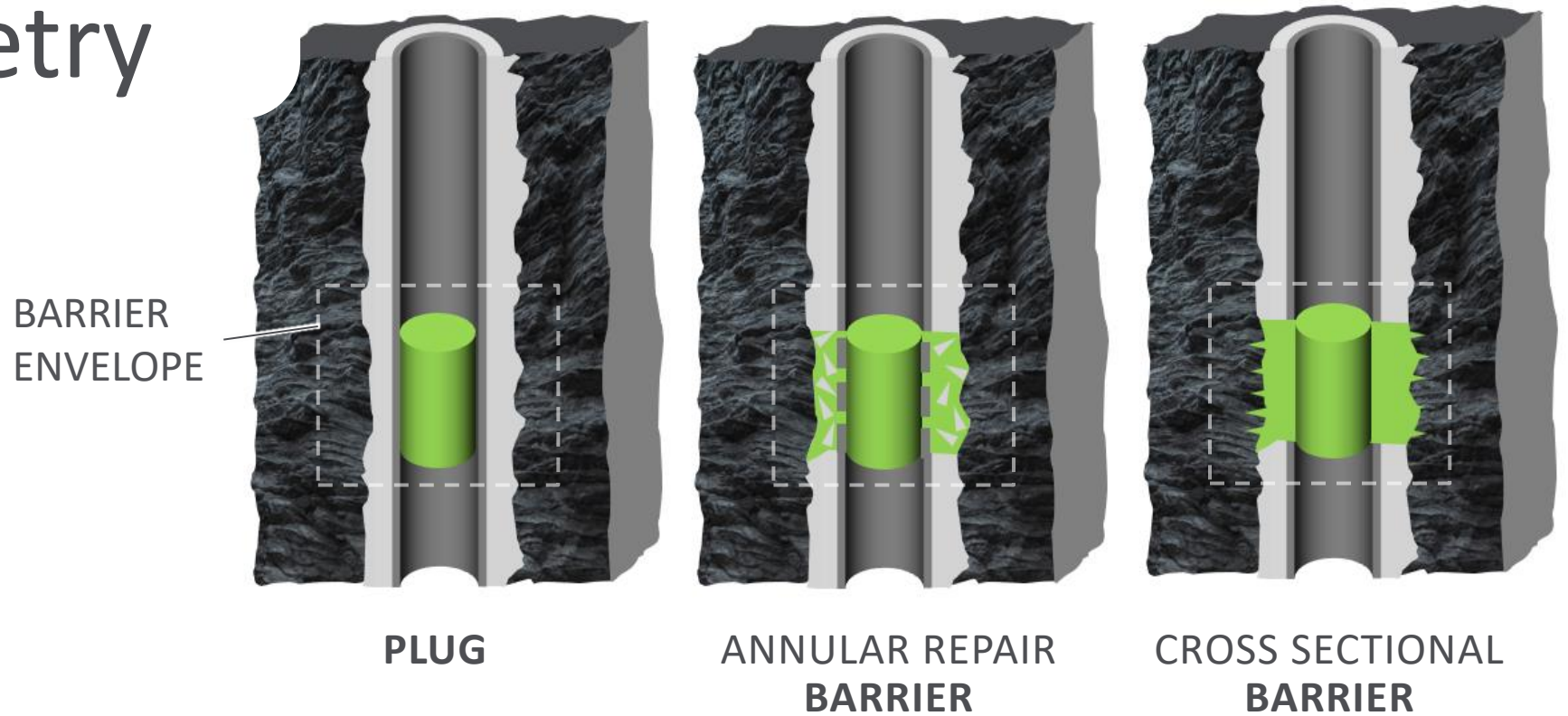
- Real caprocks & full scale tests
- Under least favourable conditions
- Formation change <5 mm
- Ample evidence of alloy-saturated (i.e., healed) caprock





# Barrier Geometry

- Wellbore Preparation
- Deployment Method
- **Barrier Geometry**
- Alloy Chemistry
- Mechanical Properties
- Corrosion Resistance
- Bonding & Seal
- Operational Requirements
- **Barrier Integrity Risks**



**61x**  
GREATER RISK

# Field Trials & Run Record



VERIFIED



PENDING

## GIROUXVILLE

NOV 2020  
AB  
5.5" 15.5#  
1706 m

## GROUNDBIRCH

DEC 2020  
BC  
5.5" 15.5#  
672 m

## KAKUT

MAR 2021  
AB  
5.5" 17#  
1507 m

## GROUNDBIRCH

MAR 2021  
BC  
5.5" 17#  
773 m

## ENCHANT

MAR 2021  
AB  
5.5" 17#  
642 m

## GILBY

NOV 2021  
AB  
5.5" 17#  
1833 m

## WROSES

NOV 2021  
AB  
5.5" 17#  
1247 m

## PEMBINA

MAR 2022  
AB  
5.5" 15.5#  
879 m

## SWIFT CURR.

SEP 2022  
SK  
5.5" 15.5#  
1150 m

## GILBY

NOV 2022  
AB  
5.5" 17#  
1650 m

## PEMBINA

NOV 2022  
AB  
5.5" 17#  
953 m

## VULCAN

NOV 2022  
AB  
5.5" 17#  
1625 m

## PROVOST

NOV 2022  
AB  
4.5" 9.5#  
900 m

13

SCP  
WELLS

13

DEPLOYMENT  
SUCCESS

12

VERIFIED  
BARRIERS

1

PENDING

ALL

SUCCESS ON FIRST  
ATTEMPT

# Summary

- ✓ Risk and failure mode assessment is a **fundamental** part of Interwell's TQP
- ✓ The RockSolid™ technology, including tool, deployment and ultimately barrier are **qualified in accordance with DNV-RP-A203**
- ✓ Detailed **testing** & quality-focused **field trials** are essential for understanding, demonstrating, and qualifying new technologies
- ✓ Currently working on next generation RockSolid™ for offshore, deep-set reservoir barriers

