



The background features a technical drawing of a composite part, likely a rain erosion test specimen. The drawing includes various dimensions and features: a diameter of $\phi 35$ with a tolerance of $+0.021/0$, a length of 200, a total length of 390, a width of 40, a radius of R1, a radius of R0,6, a length of 100, a thickness of 9, and a thread specification of M24. The drawing is rendered in white lines on a dark blue background.

R&D

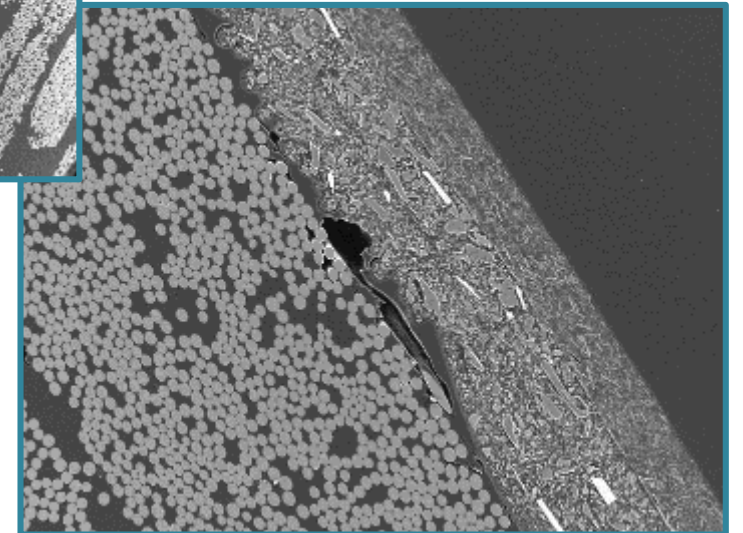
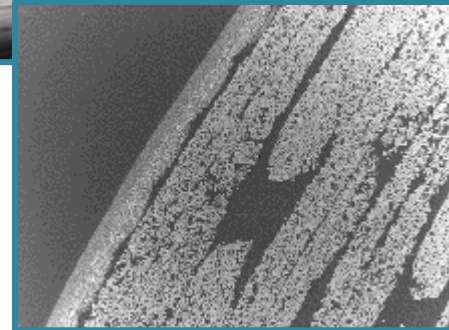
Rain Erosion Laboratory Testing of Glass Fibre Composites

Offshore Energy Conference, DTU Risoe - 22-02-2018

Engineering Solutions & Consulting

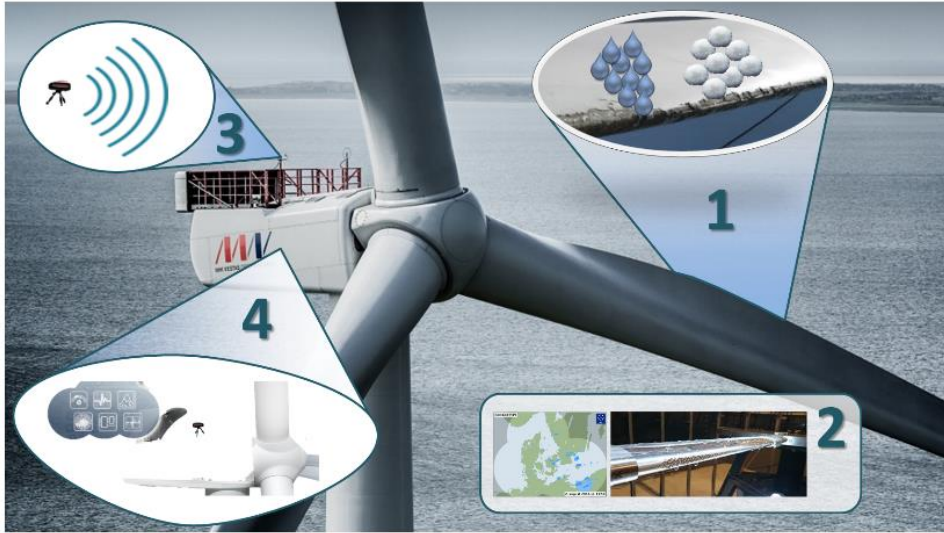
Agenda

- EROSION project
- WP2 – Lab testing and modelling
- Laboratory test equipment
- Test specimen and parameters
- Characterization of erosion
- Project road map



EROSION

Wind Turbine Blade Erosion: Reducing the largest uncertainties



Research hypothesis

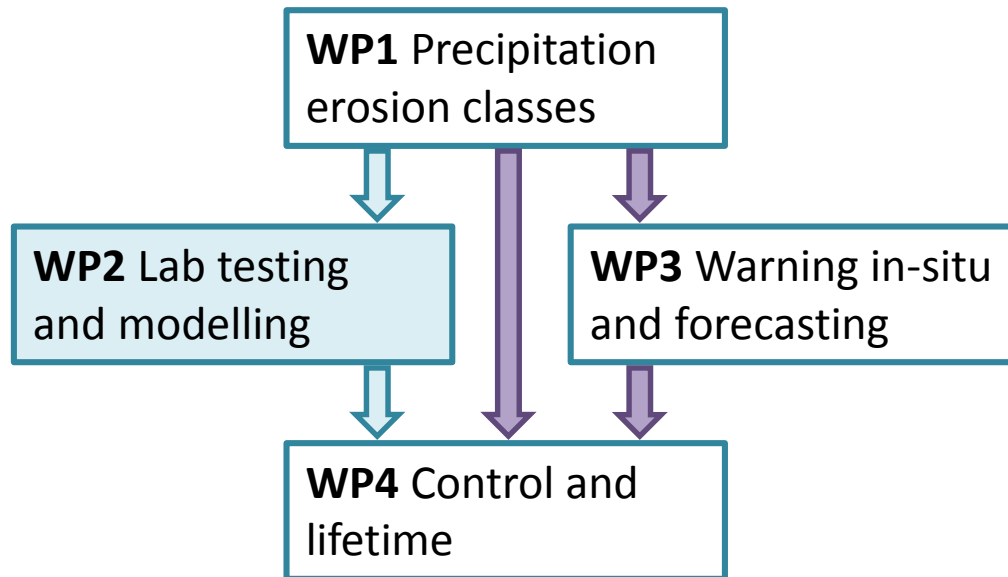
- By reducing the tip speed of the blades during rainfall, a significant extension of blade lifetime can be obtained with drastically reduced maintenance cost and minimal loss of production

Specific goals

1. Define precipitation erosion classes
2. Apply in lab experiments on blade materials
3. Develop and demonstrate a cheap prototype for rainfall detection as input for the 'erosion safe mode' control on site
4. Demonstrate business case on cost reduction for wind farm developers

EROSION - Work Package 2

Project structure



Aim

- Rain impact fatigue testing in rain erosion test facilities
- Characterize morphological characteristics in eroded material

Method

- Identification of the microscopic failure mechanisms in the material using optical and electron microscopy and x-ray tomography
- Investigation of the compositional and structural characterization classification results to understand the erosion and damage of the blades

Laboratory test equipment

R&D Test Systems – Rain Erosion Tester

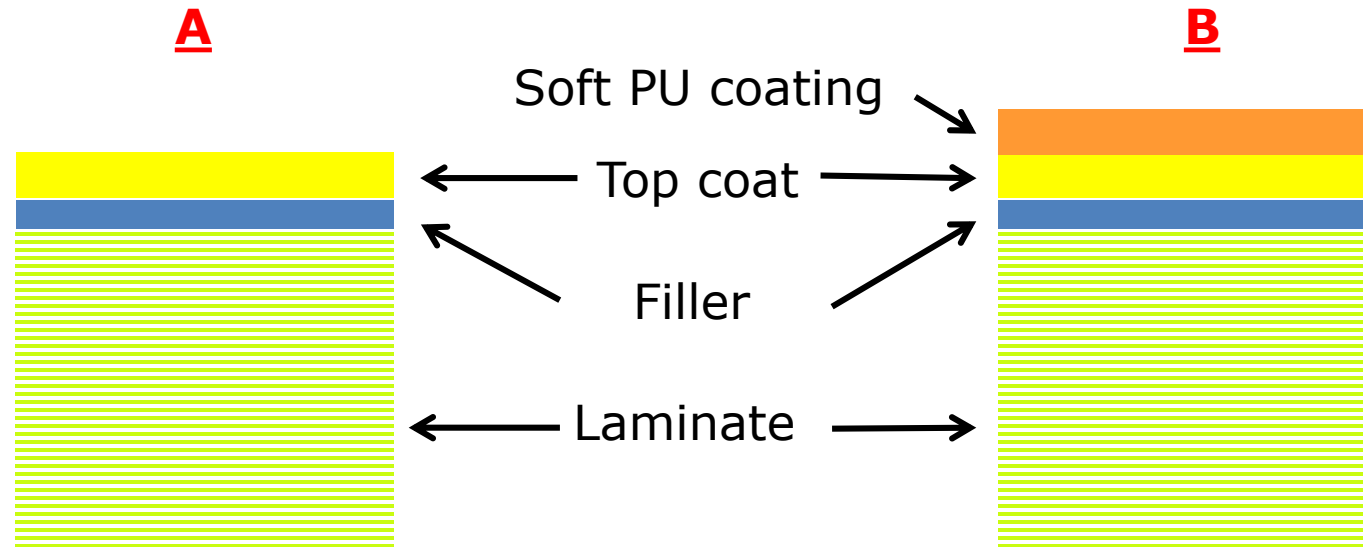
Specification	Unit	Value
Rotor speed	[RPM]	500-1386
Tip speed	[m/s]	63-173
Equivalent amount of rainfall	[mm/hour]	29-56
Droplet diameter with G20	[mm]	≈3.5
Droplet diameter with G27	[mm]	≈2
Free falling height	[mm]	200 - 400
Specimen length	[mm]	450
Exposed specimen length	[mm]	390



Test specimen and test parameters

Specimen Type A – Generic type specimen

Specimen Type B – LEP type specimen



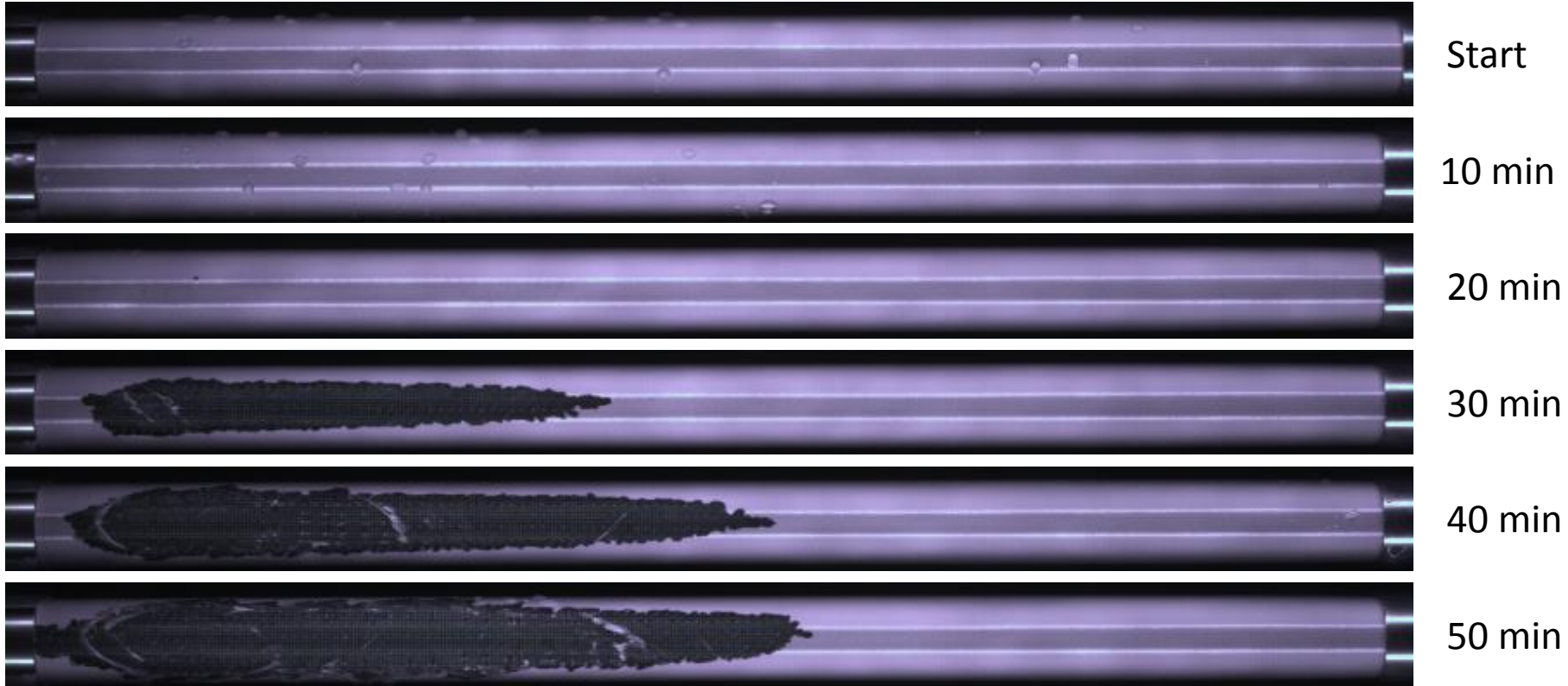
Test parameters

- Droplet size: 2,3 mm and 3,5 mm
- Impact velocity: 83 m/s, 112 m/s, 125 m/s, 141 m/s

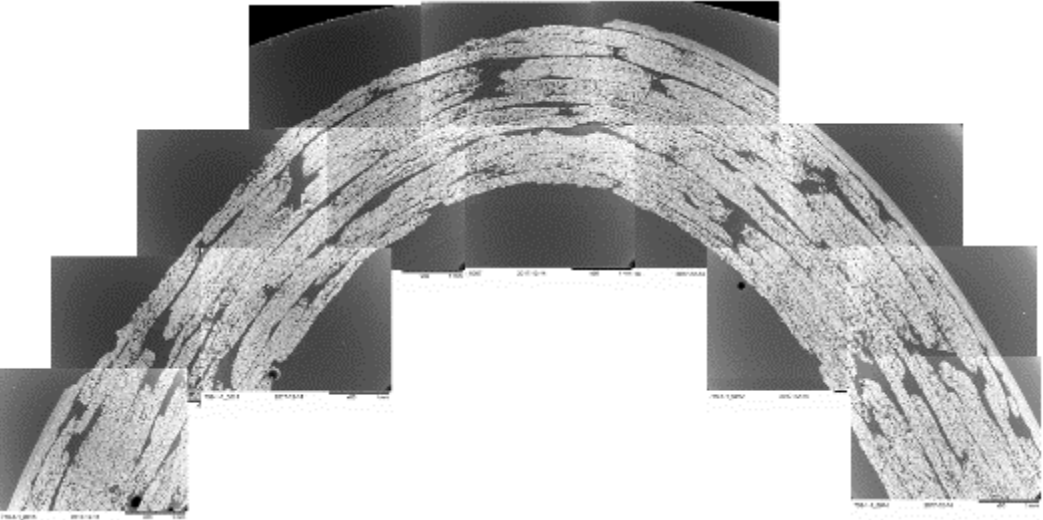
Characterization of erosion

Erosion development

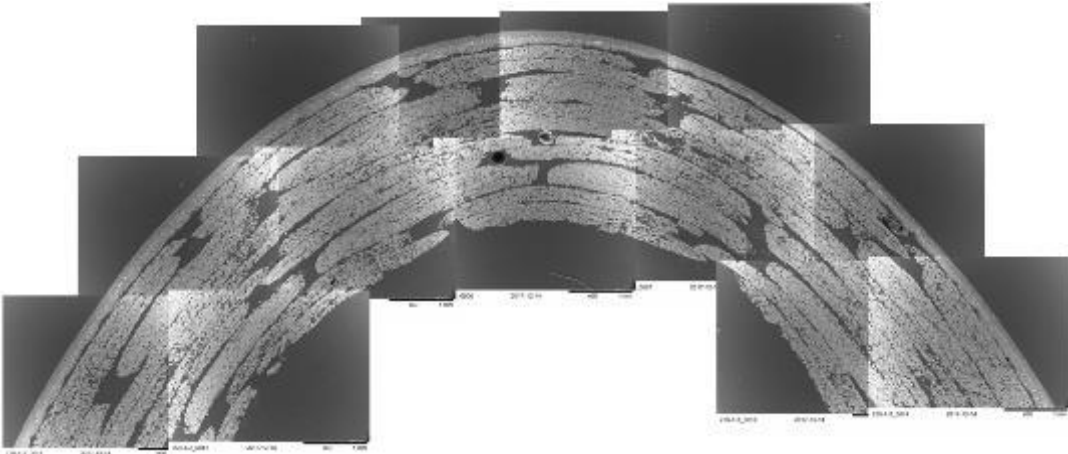
Type A specimen – Tested @ 1065 RPM with 3.5 mm droplets



Characterization of erosion

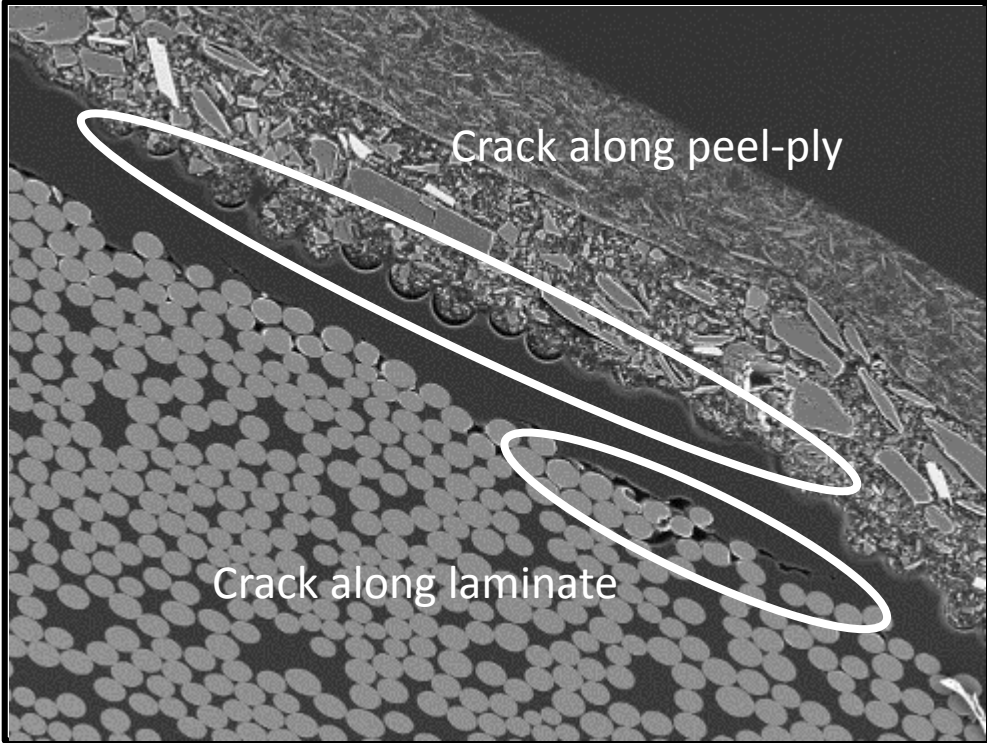
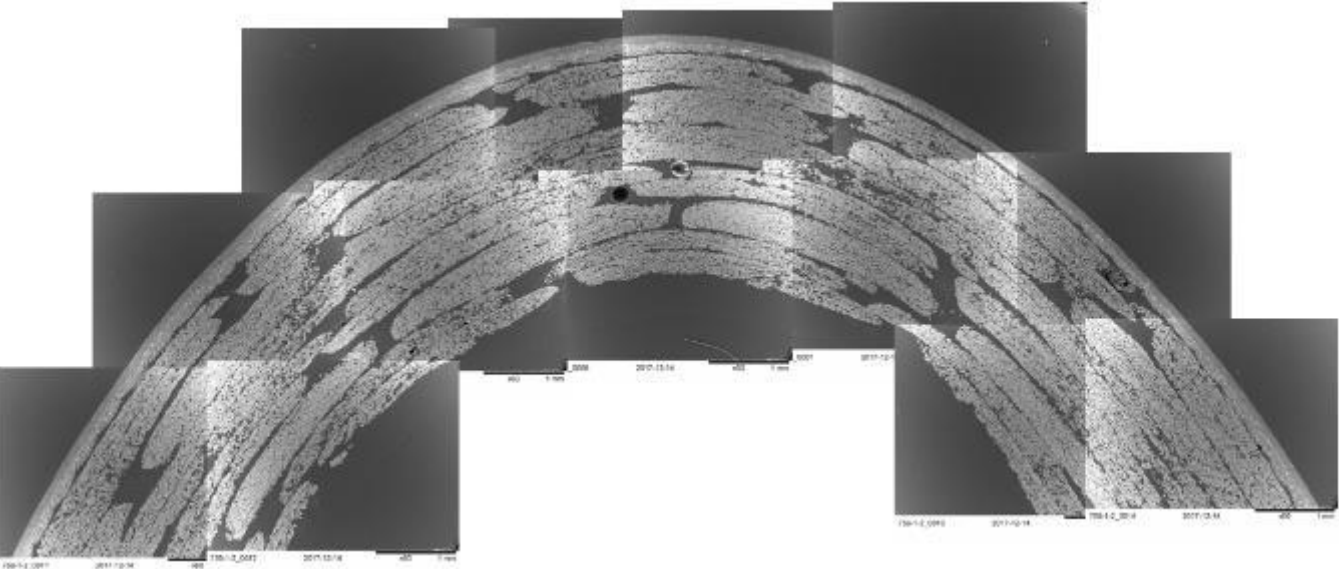


Section 1

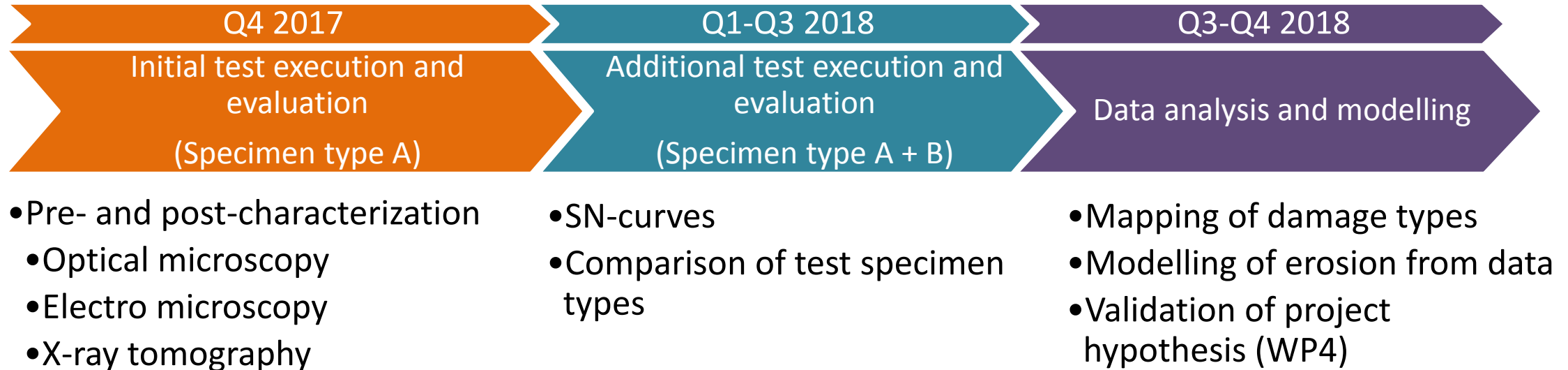


Section 2

Characterization of erosion



Project road map



Acknowledgements

Thank you for contributions made by EROSION participants:

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- *Jakob Ilsted*, DTU

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Further information and project dissemination:

www.rain-erosion.dk

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