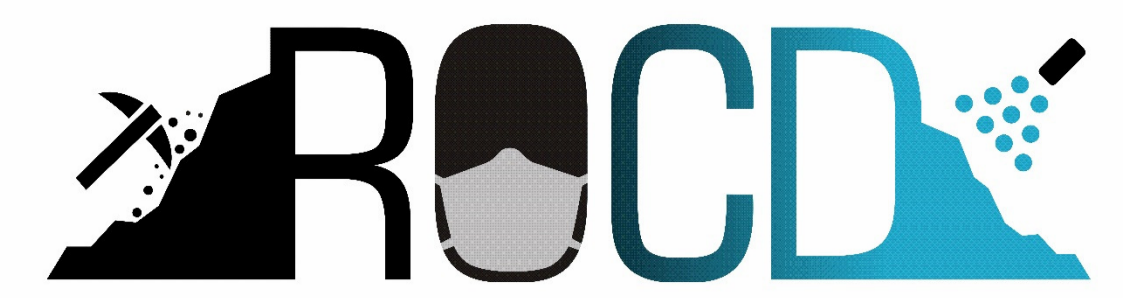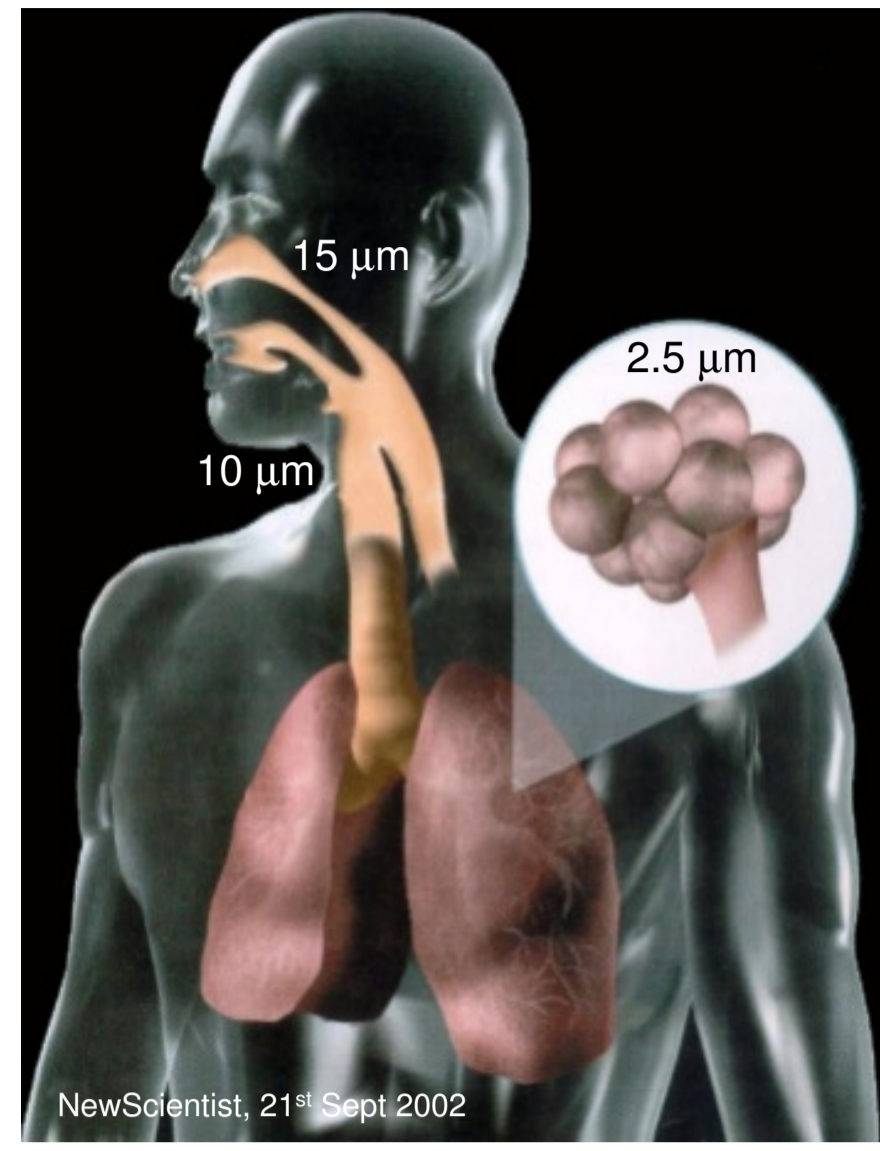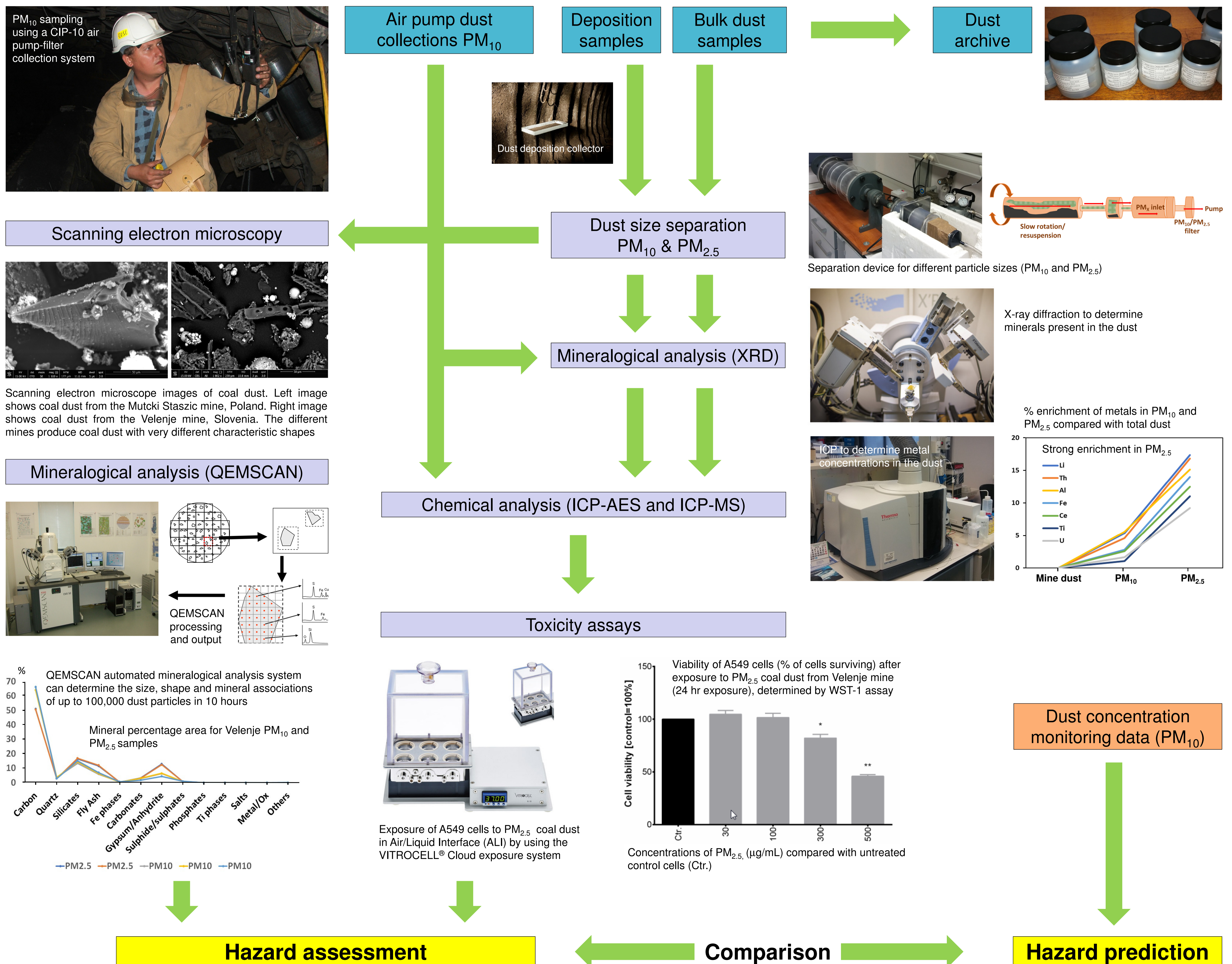# PROTECTING COAL WORKERS FROM MINE DUST

The ROCD project (**R**educing Risks from **O**ccupational Exposure to **C**oal **D**ust) is an EU-funded contract (2017 to 2020) to address current concerns about the health impacts of dust in coal mines.

- Despite international efforts, coal mine dust continues to impact the health of thousands of miners.

- Interdisciplinary project involving a world-leading consortium of 10 university and industry partners from UK, Poland, Slovenia, Germany and Spain.

- Project will develop modern assessment methods and devices to control dusts and protect workers.

- First detailed study of $PM_{2.5}$ (nominally dust with a diameter <2.5 microns), which is increasingly implicated in human, mainly cardiovascular, diseases.

- Case studies at hard coal mines in Poland and a lignite mine in Slovenia.

- Global dissemination of developed dust characterisation methods, new devices for monitoring and dust suppression and training tools for the proper use of dust masks to reduce incidences of coal mining-related disease.

http://emps.exeter.ac.uk/csm/rocd

15 µm
10 µm
2.5 µm
NewScientist, 21st Sept 2002

Workflow for coal dust characterisation and health hazards prediction

PM_{10} sampling using a CIP-10 air pump-filter collection system

Air pump dust collections PM_{10}

Deposition samples

Bulk dust samples

Dust archive

Dust deposition collector

Scanning electron microscopy

Scanning electron microscope images of coal dust. Left image shows coal dust from the Mutcki Staszic mine, Poland. Right image shows coal dust from the Velenje mine, Slovenia. The different mines produce coal dust with very different characteristic shapes

Dust size separation PM_{10} & $PM_{2.5}$

Separation device for different particle sizes (PM_{10} and $PM_{2.5}$)

Slow rotation/ resuspension
PM_x inlet
$PM_{10}/PM_{2.5}$ filter
Pump

Mineralogical analysis (XRD)

X-ray diffraction to determine minerals present in the dust

Mineralogical analysis (QEMSCAN)

QEMSCAN processing and output

QEMSCAN automated mineralogical analysis system can determine the size, shape and mineral associations of up to 100,000 dust particles in 10 hours

Mineral percentage area for Velenje PM_{10} and $PM_{2.5}$ samples

Carbon, Quartz, Silicates, Fly Ash, Fe phases, Carbonates, Gypsum/Anhydrite, Sulphide/sulphates, Phosphates, Ti phases, Salts, Metal/Ox, Others

PM2.5 PM2.5 PM10 PM10 PM10

Chemical analysis (ICP-AES and ICP-MS)

ICP to determine metal concentrations in the dust

% enrichment of metals in PM_{10} and $PM_{2.5}$ compared with total dust

Strong enrichment in $PM_{2.5}$
Li
Th
Al
Fe
Ce
Ti
U

Mine dust PM_{10} $PM_{2.5}$

Toxicity assays

Exposure of A549 cells to $PM_{2.5}$ coal dust in Air/Liquid Interface (ALI) by using the VITROCELL® Cloud exposure system

Viability of A549 cells (% of cells surviving) after exposure to $PM_{2.5}$ coal dust from Velenje mine (24 hr exposure), determined by WST-1 assay

Cell viability [control=100%]

Ctr. 30 100 300 500

Concentrations of $PM_{2.5}$ (µg/mL) compared with untreated control cells (Ctr.)

Dust concentration monitoring data (PM_{10})

Hazard assessment

Comparison

Hazard prediction

Results will be linked to ROCD research on the efficiency and recommended use of dust masks

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DMT
UNIVERSITÄTS KLINIKUM FREIBURG
CSIC Consejo Superior de Investigaciones Científicas
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