We are a team of professionals for **multi-scale gigapixel material analyses**.

**METHODS**

We offer highly accurate multi-scale microstructural investigations of challenging geological, chemical and biological samples down to nanometer resolution. Our analyses combine cutting-edge preparation methodologies with automated processing of the Gigapixel image maps in the cm- to nm-scale for porosity, 3D pore connectivity, pore fluid and microstructural assessment.

**WHY US**

Our offering includes unique in-situ analysis of extremely sensitive materials including pore fluids, possible through experience in handling challenging geological, chemical and biological materials. Our highly automated post-processing suite enables generating representative data at a range of scales with high accuracy and resolution. MaP combines twenty years of experience in a wide area of applications of nano- and microstructural research.

---

Find all of our publications at [m-a-p.expert](http://m-a-p.expert)

**SELECTED PUBLICATIONS**


---

**NETWORK**

[EMR](http://www.Emr-Net.de) · [EQM](http://www.eqm-net.de) · [WZM](http://www.wzm-net.de) · [RothW(ACHEN) UniversiTY](http://www.rwth-aachen.de)
The unique combination of a multi-scale Gigapixel workflow consisting of our Virtual Polarised Microscope (ViP), Argon-Cryo Broad Ion Beam polishers, state-of-the-art Field Emission Cryo Scanning Electron Microscope and Liquid Metal Injection technology and researchers having over twenty years of experience makes our lab one-of-a-kind in the world. We developed the first and only fully integrated Cryo-BIB-SEM workflow on the market today. Our second generation, state-of-the-art facilities enable standardized sample analysis and high-quality image processing at gigapixel resolution.

We are experts in our fields, engaging in cutting-edge research and regularly publishing in top peer-reviewed journals. Our knowledge is ahead of the curve and enables us to focus on only the most promising methods and to invest in the best equipment. Equipment which is not available yet off-the-shelf is developed in close cooperation with vendors and the engineering institutes of the RWTH Aachen University. Our network and customer-oriented approach give us the ability to deliver custom solutions for demanding projects even within a short time-frame.

We are a team of professionals for multi-scale gigapixel material analyses

Our analyses are employed in pore characteristics modeling and quality check of basic measurements. Up-scaling is possible based on the multi-scale investigations. FIB-SEM and MicroCT are complementary to our methods and are integrated depending on the requirements. Additional petrophysical and petrographic measurements are carried out by our partners.

Send us your samples for a quick-scan or a multi-scale integrated imaging project.

CURRENT RESEARCH
New developments are focused on the integration of our imaging tools with various 3D methods to generate Digital Rock models. New developments in Liquid Metal Injection experiments offer a new type in pore connectivity analyses. Cryo-BIB-SEM extends the basic standard methods in SCAL (Special Core Analysis).

From 2007 onwards the Structural Geology, Tectonics and Geomechanics group of the RWTH Aachen University developed a range of world class methods to characterize the in-situ microstructure of wet and fine-grained rocks. These developments are crucial for a comprehensive understanding of fragile and tight materials such as clays, rock salt, oil reservoir sandstone, mudstones, shales and tight sands.

OUR TEAM

Dr. Joyce Schmatz
Geologist
Microstructures in wet rocks
Cryo-BIB-SEM
Microanalytics
Microscopy

Mingze Jiang, MSc.
Algorithm Engineer
Image analysis and Software development

Prof. Dr. Janos L. Urai
Chair of Structural Geology, Tectonics and Geomechanics, Geological Institute, RWTH Aachen University
Advisor

Dr. Jop Klaver
Geologist
Microstructures of organic-rich shales
BIB-SEM
Metal injection methods

Moritz Süh, MSc.
Business Economist
Sales and Business Development

From 2007 onwards the Structural Geology, Tectonics and Geomechanics group of the RWTH Aachen University developed a range of world class methods to characterize the in-situ microstructure of wet and fine-grained rocks. These developments are crucial for a comprehensive understanding of fragile and tight materials such as clays, rock salt, oil reservoir sandstone, mudstones, shales and tight sands.
**Microstructure and Pores**

**Microstructure and Pore Analysis**

**How**
Combining Broad Ion Beam (BIB) sputtering with Scanning Electron Microscopy (SEM) imaging including topography-, phase-, and chemical- mapping using Secondary Electrons (SE), Backscattered Electrons (BSE) and Energy Dispersive X-ray Spectroscopy (EDS). The argon ion sputtered surface allows Gigapixel imaging at nano-scale resolution of the polished microstructure followed by image processing and analysis.

**Applications**
High-resolution microstructural analysis of heterogeneous materials such as tight rock samples from core plugs and cuttings at a representative scale.

**Materials**
Our microstructure and pore analyses are applied particularly on heterogeneous and fine-grained geological materials such as shales or tight sands. With the processing power of our software suite it is possible to analyse representative gigapixel sample cross sections at multi-scale resolution. All materials with microstructural properties such as cements for construction, conductive coatings and membranes for filtration applications are also investigated using our BIB-SEM methodology. This friction-free argon ion sample preparation method is especially well-suited for delicate samples.

**Preparation of Delicate Samples**

**Visible Porosity**

- Matrix pores
- Organic-matter pores

**Pore Size Distributions**

**Products**
Gigapixel image maps
Pore Map
Fabric Map
Element Map

**Pore analyses**
Visible porosity
Pore size distributions
Pore shape and orientation
Surface area
Surface roughness

**Advanced analyses**
Organic-matter porosity
Mineral phase porosity
Inter-/intraparticle porosity
Inferred porosity and permeability
Diagenesis

**Products**
Gigapixel image maps
Pore Map
Fabric Map
Element Map

**Pore analyses**
Visible porosity
Pore size distributions
Pore shape and orientation
Surface area
Surface roughness

**Advanced analyses**
Organic-matter porosity
Mineral phase porosity
Inter-/intraparticle porosity
Inferred porosity and permeability
Diagenesis

**Gigapixel pore-, fabric-, and element maps**

- Micro-cracks
- Organic-matter pores
- Matrix pores

**Visible porosity**

- Matrix pores
- Organic-matter pores

**Pore size distributions**

- Micro-cracks
- Organic-matter pores
- Matrix pores

**Pore analyses**
Visible porosity
Pore size distributions
Pore shape and orientation
Surface area
Surface roughness

**Advanced analyses**
Organic-matter porosity
Mineral phase porosity
Inter-/intraparticle porosity
Inferred porosity and permeability
Diagenesis

**Materials**
Our microstructure and pore analyses are applied particularly on heterogeneous and fine-grained geological materials such as shales or tight sands. With the processing power of our software suite it is possible to analyse representative gigapixel sample cross sections at multi-scale resolution. All materials with microstructural properties such as cements for construction, conductive coatings and membranes for filtration applications are also investigated using our BIB-SEM methodology. This friction-free argon ion sample preparation method is especially well-suited for delicate samples.

**Preparation of Delicate Samples**

**Visible Porosity**

- Matrix pores
- Organic-matter pores

**Pore Size Distributions**

- Micro-cracks
- Organic-matter pores
- Matrix pores

**Gigapixel Pore-, Fabric-, and Element Maps**

- Micro-cracks
- Organic-matter pores
- Matrix pores

**Materials**
Our microstructure and pore analyses are applied particularly on heterogeneous and fine-grained geological materials such as shales or tight sands. With the processing power of our software suite it is possible to analyse representative gigapixel sample cross sections at multi-scale resolution. All materials with microstructural properties such as cements for construction, conductive coatings and membranes for filtration applications are also investigated using our BIB-SEM methodology. This friction-free argon ion sample preparation method is especially well-suited for delicate samples.
How
During Liquid Metal Injection (LMI) the fusible alloy intrudes into and fills the connected pore network. The degree of percolation depends on the critical pore throat diameter in the porous medium. The minimum pore throat diameter which can be filled depends on the injection pressure, following the Washburn equation. After the desired injection pressure is reached, the sample is cooled down under pressure and the metal solidifies in the pore space. The subsequent microstructure and pore investigation allows identifying the connected pore space and interrogating the 3D pore network.

Applications
Characterization of the connected pore network at nanometer resolution on a representative sample scale.

Products
Using our liquid metal injection method we provide, next to the standard microstructure and pore analysis the following:

Pore connectivity analysis
Effective porosity
3D pore connectivity
Percolation threshold

Porosity and permeability assessment
LMI supersedes the conventional Mercury Intrusion Poresimetry (MIP) and therefore we can evaluate MIP data as we visualize what part of the pore space is actually being filled with the liquid metal. Moreover, we can investigate the pore space in cracks and correct for potential core damage. Permeability estimation can be obtained by using the capillary tube model, based on the effective porosity and the percolation threshold gained from the image data.

Materials
This LMI followed by BIB-SEM methodology can be applied on any fine-grained geological material or nanomaterial with sub-millimeter pore throats.
**Microstructure and Pores**

**PORE FLUID ANALYSES**

**How**
Combining Cryo-Broad Ion Beam sputtering with Cryo-Scanning Electron Microscopy and chemical analysis using EDS we are able to image and analyze Cryo-preserved fluids inside pore networks and micro cracks. The Cryo-loading station with Cryo-saw allows performing sample preparation for the Cryo-BIB under LN2 conditions.

**Applications**
High-resolution microstructural characterization of wet or soft materials, like oil/brine-filled reservoir rocks, oil shales, tissue, biological materials, polymers, membranes.

**Products**
Our unique cutting-edge Cryo-BIB-SEM method allows the imaging and investigation of the fluid-filled pores and measuring through a FluidMap the direct in-situ:
- Fluid Chemistry
- Wettability
- Fluid Distribution
- Fluid Saturation

This cutting-edge technology opens new fields of research such as EOR screening or core and formation damage evaluation on fresh samples, such as cuttings.

**CRYO-BIB-SEM**

**Materials**
Cryo-BIB-SEM microstructural investigations are applied particularly on wet heterogeneous and fine-grained geological materials like clays or reservoir rocks. Other wet and soft materials such as tissue, cements and medical/biological preparations can also be investigated using our Cryo-BIB-SEM methodology.

**CRYO PREPARATION**

**CRYO-STABILIZED CEMENT PASTE - ELEMENT MAP**

**SATURATION MAP IN CARBONATE RESERVOIR**

**NANOSCALE CONTACT ANGLE**

**STATISTICAL ANALYSIS**

**Fluid Map: In-Situ Fluid Distribution and EOR Screening**

**Freeze Fracturing**

**Phase Mapping**

**Contact angle [°]**

**Oil Droplet size [µm]**

**Number**

**Frequency**

**Frequency**

**Contact angle [°]**

**Oil Droplet size [µm]**

**Quartz**

**Kaolinite**

**Brine**

**Oil**

**Cryo-Saw with Load Lock**

**Cryo-Vacuum-Transfer**

**Cryo-Stabilized Cement Paste - Element Map**
VIP - VIRTUAL POLARISING MICROSCOPY

How
This system displays mosaic images of thin-sections with 10 nm accuracy at all settings of a conventional polarizing microscope from a highly compressed Gigapixel image file. Using multi-scale automated petrographic analyses we are able to segment fracture networks, minerals, pores and mineral overgrowths. Regions of interest can be selected for enhanced analyses like ion-polishing preparation followed by BIB-SEM.

Applications
Multi-scale, quantitative analysis of petrophysical attributes, automated analysis of sections, digital library.

Digital Viewer

Integrating Multi-Scale Imaging and Quantitative Analysis

Customer Value
Added value of the VIP over conventional optical microscopy is the online expert consultation and rapid analyses. The knowledge-based system enables standardized and transparent reporting. Integrated studies using the combination of the VIP with BIB-SEM investigations allow assessment of diagenetic relations and multi-scale evaluation of porosity and permeability as well as pore connectivity even offline and remotely, without being physically present in the lab.

Carbonate thin section: more than 200,000 pores classified, 16.4 % porosity

INTEGRATED VIP-SEM-EDS ANALYSIS

PORE SIZE DISTRIBUTION

INTEGRATED MULTI-SCALE IMAGING AND QUANTITATIVE ANALYSIS