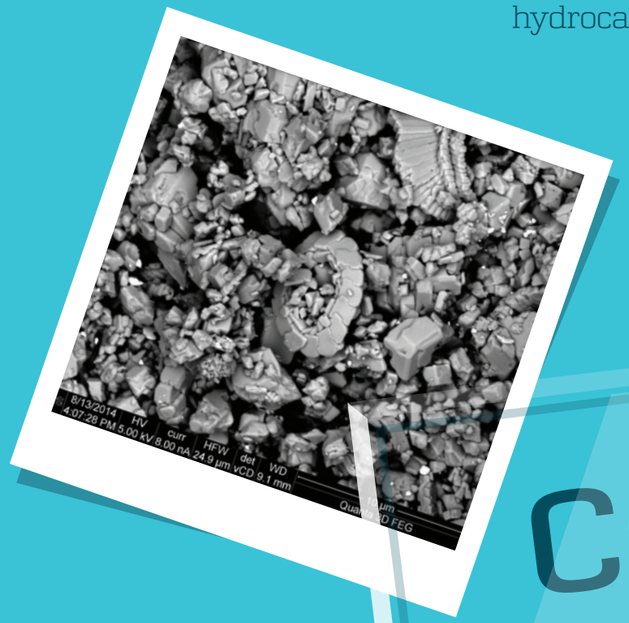
# SECRETS OF CHALK'S MICROSCOPIC STRUCTURES

Taking core samples is an expensive way to ascertain the properties of a rock formation. Now a pioneering new approach is using nanoscopic X-ray tomography to assess chalk formations – offering more cost effective ways to access currently unviable hydrocarbon accumulations.



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The larger-scale properties of a porous rock – its macroscopic matrix – are a key factor when it comes to assessing the economic viability of a hydrocarbon reservoir. The macroscopic matrix controls the amount of hydrocarbons a reservoir can contain, how fast it can be produced, and how much oil or gas will be left in the reservoir by any given production mechanism. In turn, the properties of the macroscopic matrix are controlled by the rock's microscopic porous network of mineral particles (called grains), spaces (pores) and pore throats (the smaller spaces that connect two larger pores).

## COMBINING X-RAY TOMOGRAPHY AND COMPUTER SIMULATION

However, ascertaining these properties in a given field involves an expensive process of obtaining core samples of rock. The P³ project aims to find a new way of understanding the macroscopic matrix properties of chalk using a combination of high-resolution X-ray tomography at the nano level (nanoCT) and computer simulation.

The project is part-funded by Innovationsfonden (IF), Maersk Oil (MO) and University of Copenhagen (KU) and has Henning Osholm Sørensen (KU) as project leader and Finn Engstrøm (MO Applied Technology) as co-project leader. The work at KU is centred around the NanoGeoScience Group.

## THE P³ PROJECT: FROM MICRO TO MACRO

The P³ project is based on the observations made during the NanoChalk project – an earlier collaboration between MO, KU and IF – that demonstrated that the properties of the micro-scale porous network in sub-millimeter chalk samples is similar to the properties of the larger scale porous network in larger (1 inch) chalk samples. In other words, 'chalk is homogeneous in its heterogeneity'.

The project also takes advantage of recent progress in X-ray tomography that now makes it possible to produce X-ray tomograms at a very fine resolution – potentially fine enough to reveal the pore network in chalk. The overall objective is to develop a technique to derive the pore network properties of chalk, including porosity, permeability, capillarity and relative permeability, from nanoCT on sub-millimeter chalk samples

> "The project takes advantage of recent progress in X-ray tomography that enables tomograms to be produced at a very fine resolution."

– and then scale up these properties to describe chalk's macroscopic matrix properties. The technique will be supported by computer simulations and other experimental techniques like BET, XRD and SEM.

## ASSESSMENTS USING DRILL CUTTINGS ALONE

The driver for the P³ project is the idea that if all the relevant petrophysical properties can be derived from nanoCT tomography of small chalk samples, then a hydrocarbon accumulation in chalk could be assessed with drill cuttings alone. This could reduce the need for expensive cores, so that hydrocarbon accumulations in chalk, discovered while drilling for a deeper target, could be assessed without the need to drill and core an appraisal well. It may also open up the possibility of drilling slim hole exploration/appraisal wells, as penetrated formations could be evaluated by a combination of slim hole logging and drill cutting analysis.

If successful, the P³ project may unlock some of the currently stranded discoveries in chalk, reduce the cost for coring and allow drilling of cheaper exploration/appraisal wells. ■

## At a glance

**Impact:**
Move marginal chalk discoveries from 'not possible to evaluate' to drill or drop

**Technology:**
NanoCT and computer simulations

**Completion date:** 2018