UNIVERSITY OF CAMBRIDGE
Department of Engineering

GEOTECHNICAL SOCIETY

How safe is underground nuclear waste storage in claystones?

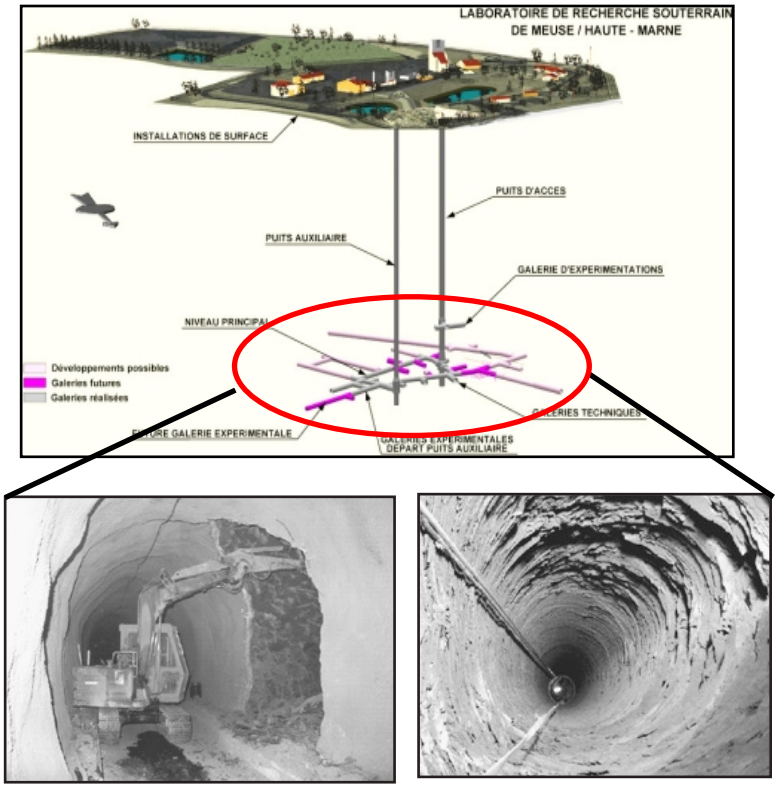
Professor Catherine A. Davy

Civil Engineering Department, Ecole Centrale de Lille, France

Seminar overview:

In all industrialized countries using nuclear power plants, spent radioactive fuel exists under several forms. Those representing the greatest issues are long lived (with half lives from 31 to millions of years) and of intermediate to high activity. In France, these peculiar waste are currently expecting a long term storage solution, which has been studied for a number of years as potentially occurring in an underground tunnel structure, located at 500m depth in the East of France (at Bure). It is the CIGEO project, for *Centre Industriel de Stockage Géologique*, made of galleries drilled in a Callovo-Oxfordian (COx) claystone, coupled to a whole Engineered barrier made of concrete, seals of swelling bentonite clay, steel casings, etc. There, the waste could be placed after being encapsulated in glass (vitrified waste) or in steel and concrete canisters.

This concept is similar to the Swiss project foreseen in an Opalinus clay (which is also a claystone), or to the Belgian project (Boom clay), or to the Hungarian project (Boda claystone). Other concepts are within crystalline rocks (e.g. granite), for instance in Finland or Sweden, with seals and complementary filling of the tunnels with swelling bentonite clay. The seminar will show experimental evidence of the very low transport properties of COx claystone, its self-sealing ability, all allowed by its nanoscopic pore structure.



When and where:

Wednesday, 29 November, 19:00

Harrods Room, Emmanuel College

Queries:

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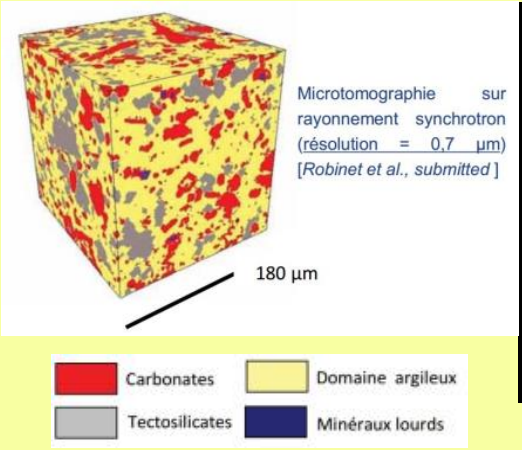
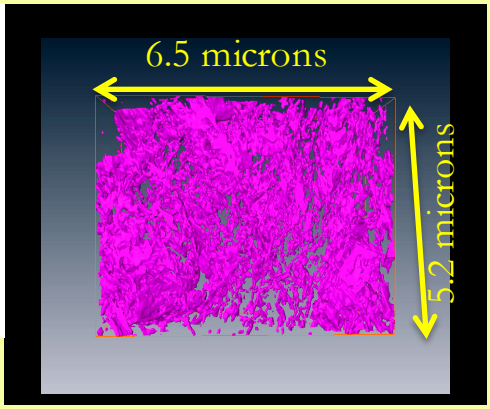
Biography:

Catherine A. Davy is Full Professor of Civil Engineering at the French Engineering School "Ecole Centrale de Lille", located in Villeneuve d'Ascq, 10kms from the Belgian border (North of France). Her interests are in contributing to the safety assessment of nuclear waste storage, upgrading and developing cement-based materials (e.g. geopolymers) out of industrial by-products and calcined clays, as alternatives to Portland-based cements. She is a trained French generalist Engineer and a Higher Education Teacher (qualified for *Agrégation de Mécanique*).



3D Microtomography of COx claystone (resolution 0.7microns) [Robinet et al. WRR, 2012]

0.5% porosity out of 18% average (non percolating)



3D FIB/SEM imaging of the pore network of the COx (resolution 10nm) [Song et al. JMPE-2015; Song et al. MMM 2016]

The biggest scale for a percolating pore network (<2% porosity)

2D STEM imaging of the COx (resolution <1nm) [Song et al.-2015]

10-25% porosity

Smaller and smaller scale

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