The role of organic matter in the fractionation of naturally-occurring radionuclides (NOR) in geothermal systems: initial characterization of brine and reservoir rocks

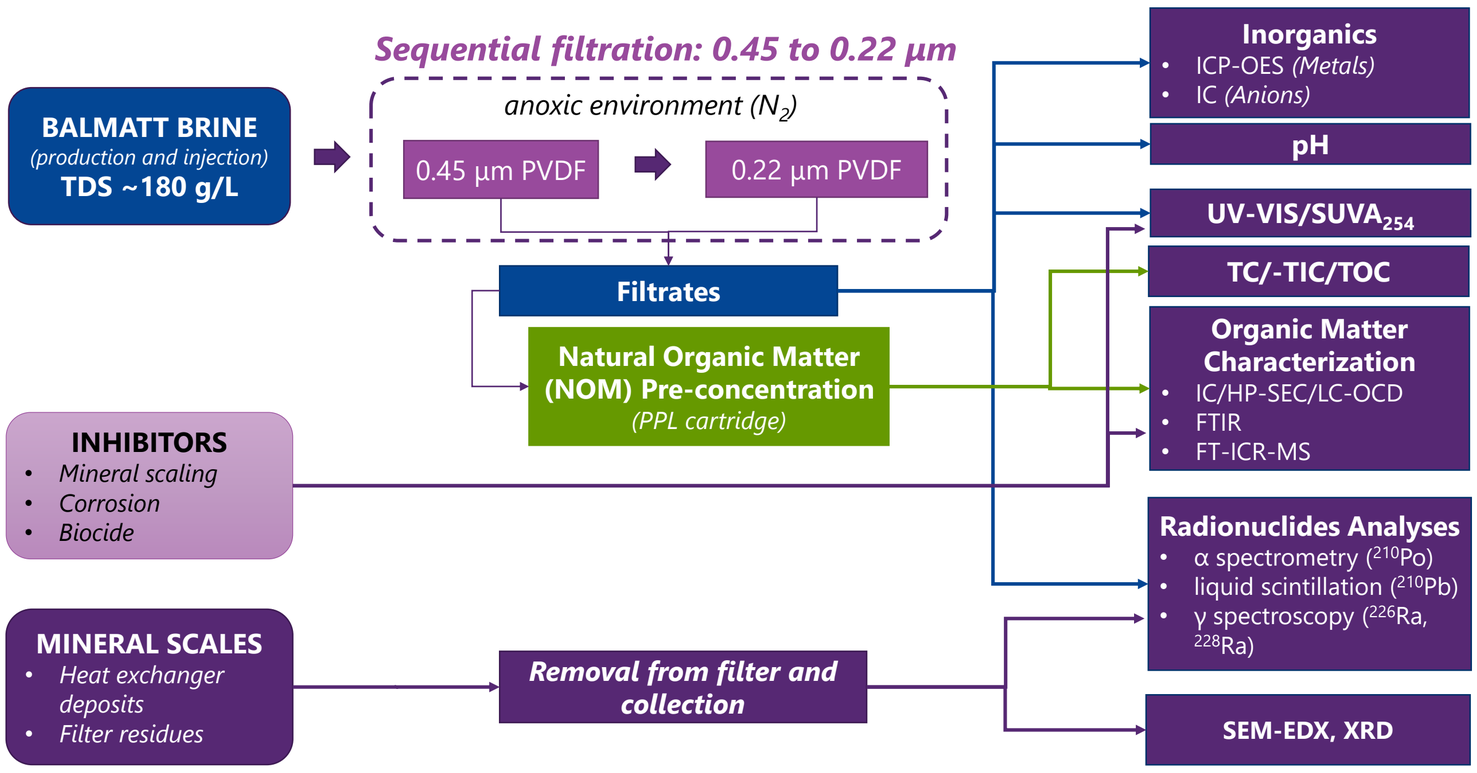
Val Maverick Abecia[1,2,4], Sonia Salah[1], Mirela Vasile[1], Ben Laenen[2], Simona Regenspurg[3], Valérie Cappuyns[4]

[1]Belgian Nuclear Research Centre, SCK•CEN, Mol, Belgium; [2]Flemish Institute for Technological Research, VITO, Mol, Belgium; [3]Helmholtz Centre Potsdam-GFZ German Research Centre for Geosciences, 14473 Potsdam, Germany; [4]KU Leuven, CEDON, 1000 Brussels, Belgium

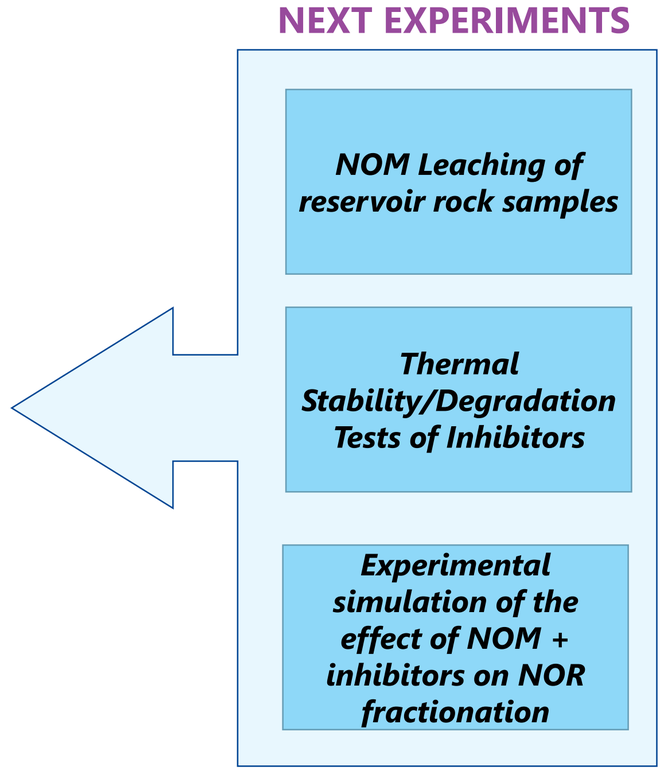
E-mail: *val.abecia@sckcen.be*

Methods

CHARACTERIZATION OF SAMPLES



NEXT EXPERIMENTS



Introduction

- NOR enrichment (^{210}Pb, ^{210}Po) mainly in the sulfide scales – a challenge in numerous geothermal installations along with mineral scaling and corrosion *(Fig 1)*
- Potentially hazardous – from an operational and health, safety, and environmental perspective
- The influence of organic matter on NOR fractionation and enrichment in mineral scales is poorly understood

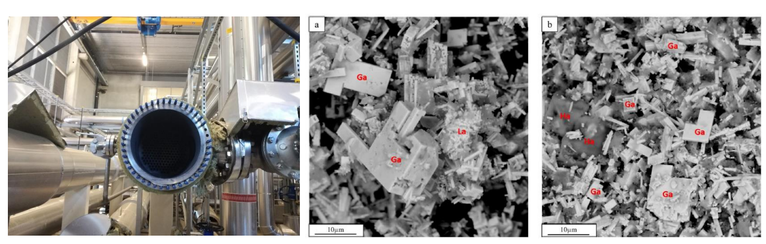
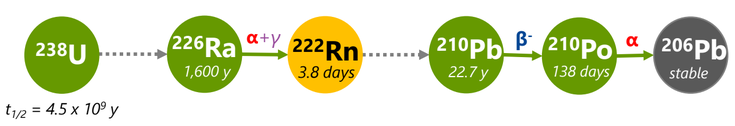


Fig 1. Heat exchanger (HEx) of the Balmatt geothermal installation; SE images (SEM) of mineral scales in the HEx of the Balmatt geothermal installation (taken from Pauwels et al., 2021)

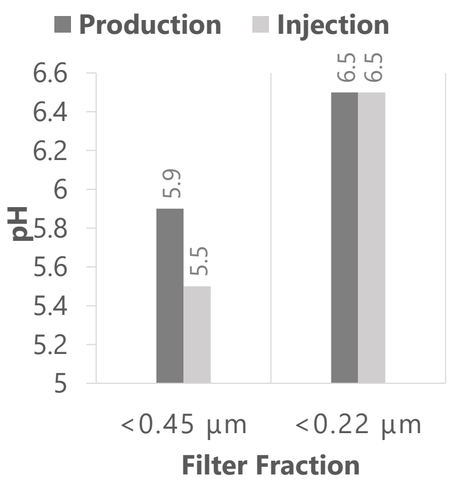


Objectives

- To characterize the organic matter and to determine its concentration in the reservoir rocks and geothermal fluids
- To determine the activities of NORs (*i.e.* ^{226}Ra, ^{228}Ra, ^{210}Pb, and ^{210}Po) in the reservoir rocks and geothermal fluids

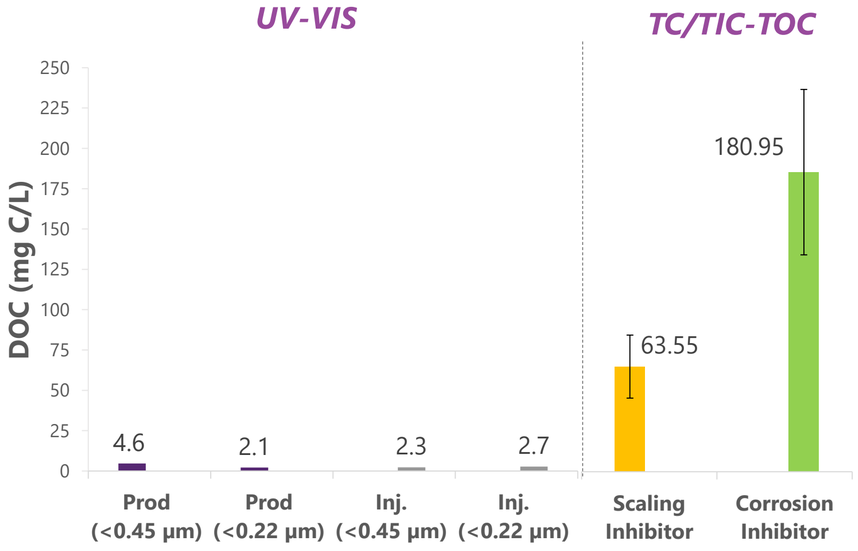
Results

pH per fraction



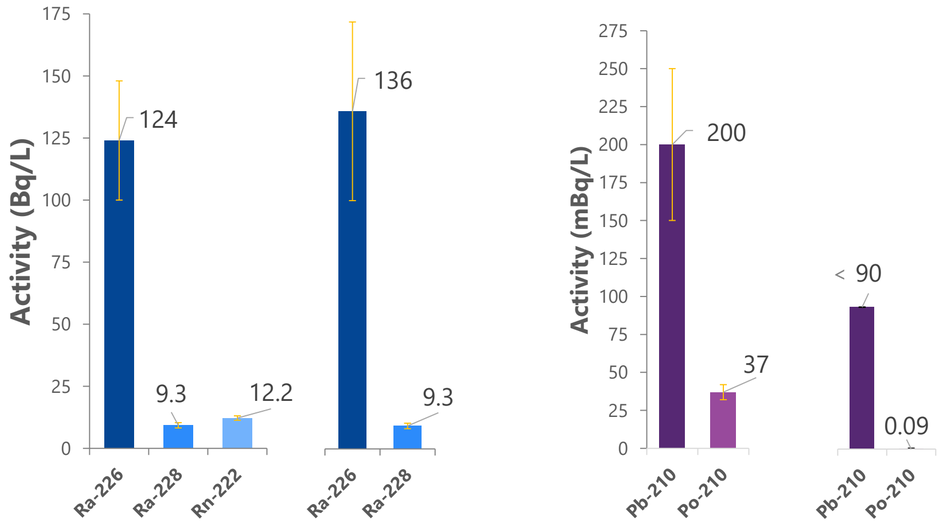
- Slightly lower pH in the <0.45 µm fraction vs the <0.22 µm in both production and injection fluids; pH of the <0.22 µm fraction is the same in both fluids

Dissolved Organic Carbon



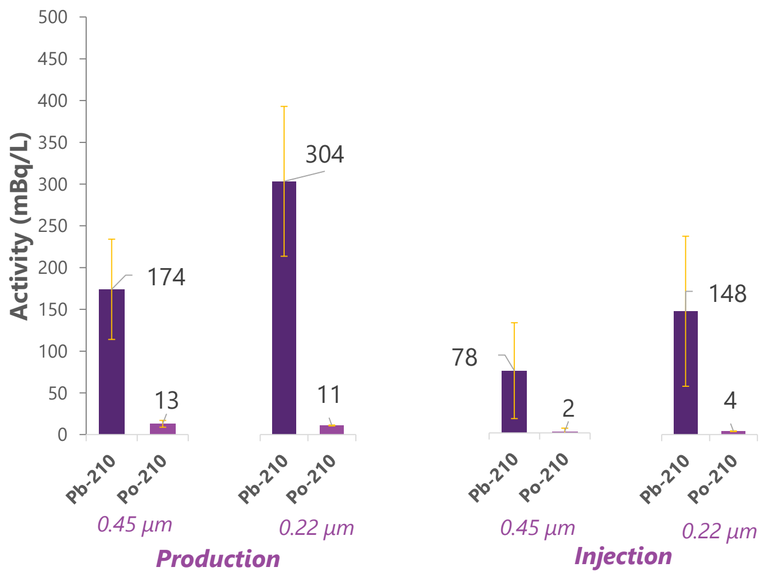
- Balmatt fluids have low DOC (~5 mg C/L); higher DOC present in chemical inhibitors

NOR activities in unfiltered samples



- Similar ^{226}Ra activities in production and injection fluids; higher ^{210}Pb and ^{210}Po activities observed in production fluids

^{210}Pb and ^{210}Po activities per filter fraction



Next Steps

- Continue characterization of inorganic fraction, and detailed characterization of organic matter using HP-SEC or LC-OCD.
- Start the NOM leaching experiments in the autoclave using reservoir rock samples of Balmatt geothermal wells.

References: Pauwels, J., et al. (2021). "Characterization of scaling material obtained from the geothermal power plant of the Balmatt site, Mol." Geothermics **94**.; Haynes, W. M., et al. (2016). CRC Handbook of Chemistry and Physics: a ready reference book of chemical and physical data (2016-2017). Boca Raton, Florida, USA, CRC Press.