Contribution ID: **857**

Type: **Oral 20 Minutes**

Design of Pneumatic Fracturing Experiments for Rare Earth Elements Recovery by Support of X-ray Micro Computed Tomography Imaging

Wednesday, 16 May 2018 14:37 (15 minutes)

Introduction

The Development of an environmentally sustainable method for the extraction and processing of Rare Earth Elements (REE) is an ongoing study as the state of the art exploration like e.g. in China leads to a significant impact to the environment in terms of water pollution, destruction of the biosphere and erosion. For a mining project in Madagascar it is therefore planned to induce fractures and fissures in the subsurface deposit by pneumatic fracturing for improvement of permeability to be able to extract REE by controlled leaching (European Commission, 2014, SGS, 2016). To perform lab experiments clay samples were collected on site. For preconditioned humidity and pressure values inside a triaxial test device (see figure 1) tailored pneumatic pulses were injected by using compressed inert gas.

Figure 1 Triaxial test device

Experimental Setup

The equipment used is a modified large triaxial cell for soil sample diameter of 7 cm and height of 14 cm. Its modification was mainly on the bottom base wherein a hole was made through the center to facilitate access to the bottom of the specimen while under an applied confining stress. A needle of 3.8 cm length was used to create an injection well inside of the sample. The loading conditions shall simulate an overburden pressure for deposit depth (d) between 5 m and 20 m. The focus of these tests was to investigate fracture-initiation pressure as well as fracture growth. Parameter variations are pulse loading height, time period and number of individual pulses. Depending on the loading, different fractures for anisotropic and isotropic conditions have been observed.

Results

Due to X-ray micro-computed tomography (μ-CT) the structure of fractures and fissures inside of the sample have been very well monitored according to each experimental loading step. For test series 1 (see figure 2) the resulting fractures are located close to the top of the injection well as shown in the 3 orthogonal slice views. The 4th view gives a zoomed 3D visualization of the segmented fracture system.

Figure 2 This X-ray CT result indicates smaller cracks with punctual origin (d = 17.5 m).

For another test series (no. 3) the pulse loading height was 3 times higher which led to a continuous fracture through the whole sample width along the injection well (see figure 3).

Figure 3 Another CT result shows a disruptive fracture in all 4 views (d = 10 m).

Conclusions and Outlook

Therefore, as a result of our research, we are confident that starting with deposit conditioning by pneumatic fracturing it is possible to apply a leaching mining and processing procedure, which is environmental friendly, more efficient and faster than those methods applied traditionally.

References

1 European Commission, 2014: Communication from the commission to the European Parliament, the Council, The European Economic and Social Committee and the committee of the regions on the review of the list of critical raw materials for the EU and the implementation of the raw materials initiative, //eur-lex.europa.eu/legal-content, pp. 7.

[2] SGS, 2016: Resources for the Tantalus Rare Earth Ionic Clay Project Northern Madagascar, Updated NI 43-101 Technical Report.

References

Acceptance of Terms and Conditions

Click here to agree

Primary author: ZACHER, Gerhard (GE Sensing & Inspection)

Co-authors: Dr HALISCH, Matthias; Dr HÜLS, Wilfried

Presenter: ZACHER, Gerhard (GE Sensing & Inspection)

Session Classification: Parallel 8-E

Track Classification: MS 1.24: Pore structure characterization and micro-scale effect on fluid flow in unconventional reservoir