Synthesized Rock

As an Alternative to Portland Cement for Geothermal (High Temperature) Wells

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Pyramids & Geopolymers

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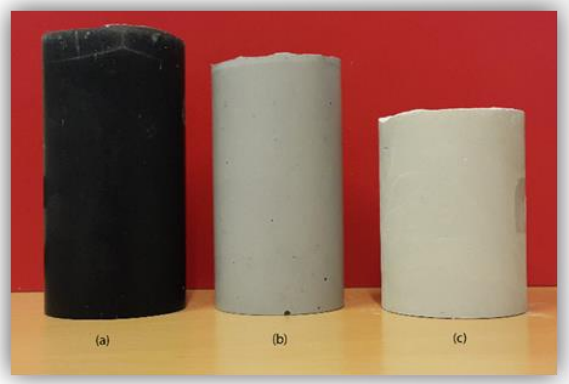
Geopolymers - Synthesized Rock

- Inorganic materials
- What is a geopolymeric material?
  - Low-calcium content
  - Activated by alkali solution
  - $(Na, K)_2O - Al_2O_3 - SiO_2 - H_2O$ N-A-S-H



- What are the differences between alkali activated cement-based binders and geopolymers?
  - High-calcium content
  - Lower concentrations of alkali solutions
  - $(Na, K)_2O - CaO - Al_2O_3 - SiO_2 - H_2O$ C-A-S-H

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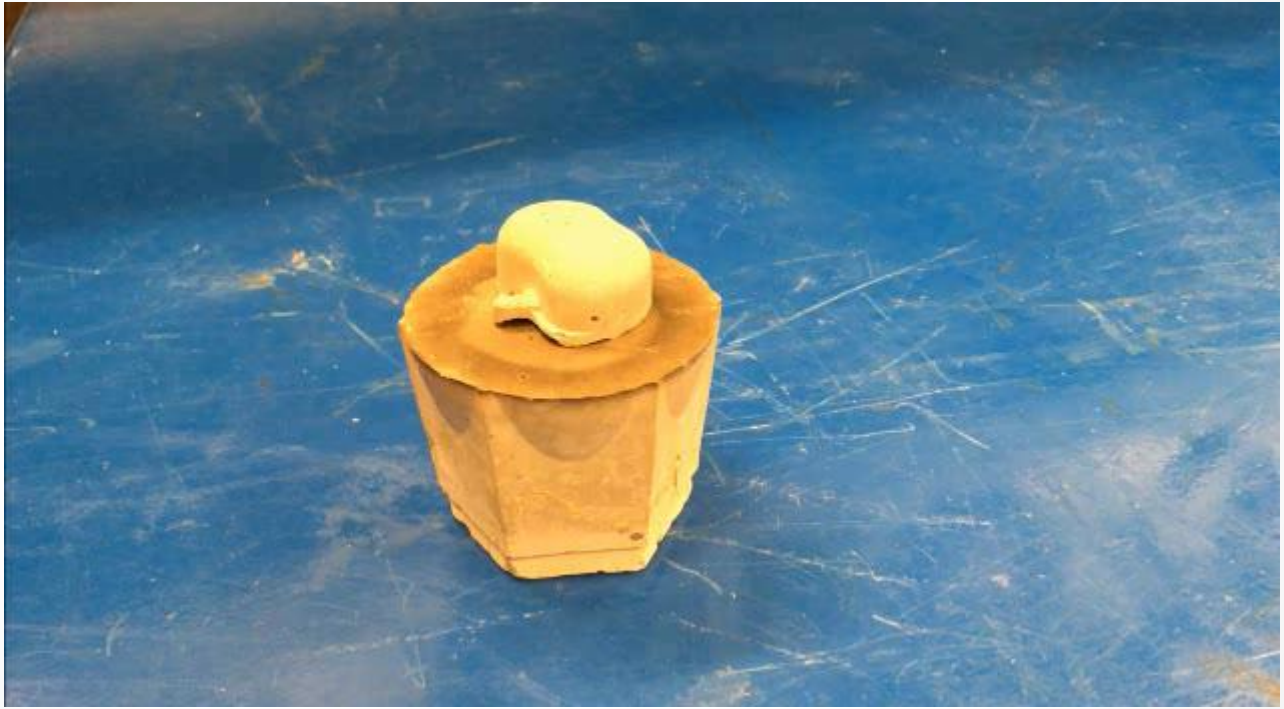
Properties of the synthesized rock



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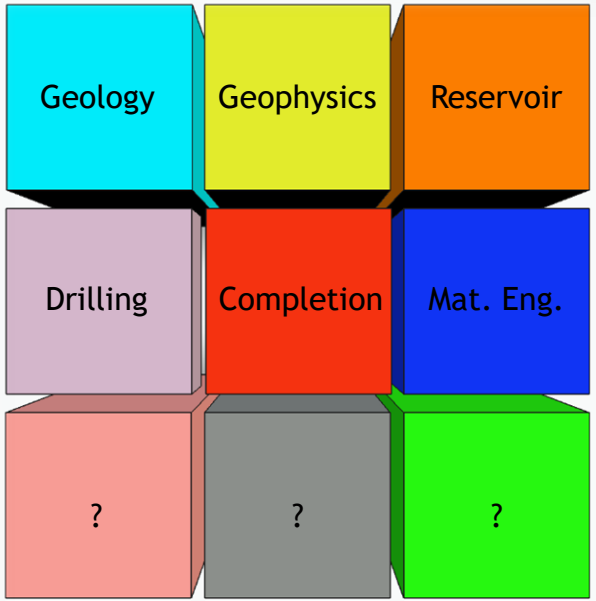
International Collaboration

- Integration of modules in the application.
- Each module consists of different WPs.
- This puzzle could be completed by energy conversion, energy distribution, even techno-economy to illustrate “the whole value chain” and the multi disciplinary aspects.



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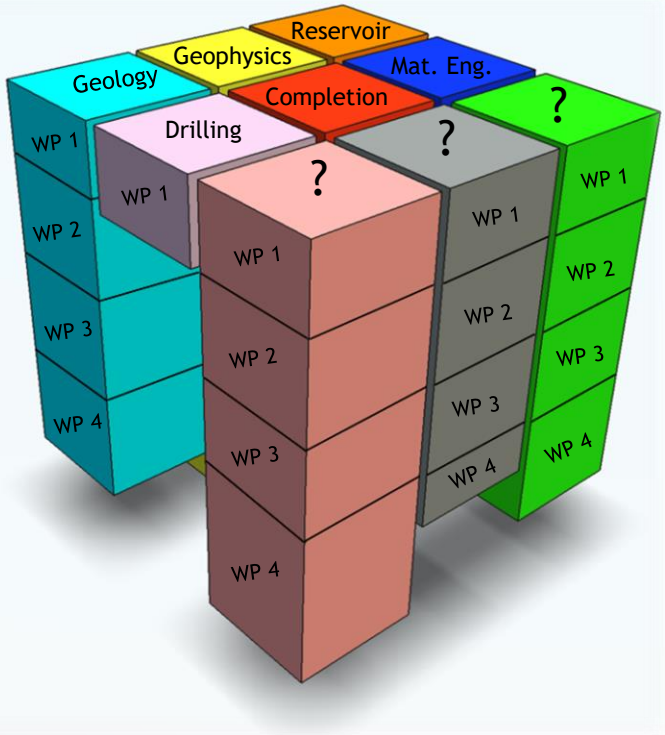
International Collaboration



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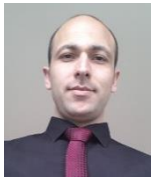

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List of Our Publications

- Khalifeh, M., Todorovic, J., Vrålstad, T., Saasen, A., & Hodne, H. (2016). *Long-term durability of rock-based geopolymers aged at downhole conditions for oil well cementing operations.* Journal of Sustainable Cement-Based Materials. http://dx.doi.org/10.1080/21650373.2016.1196466
- Khalifeh, M., Saasen, A., Vrålstad, T., Larsen, H.B., & Hodne, H. (2015). *Experimental study on the synthesis and characterization of aplite rock-based geopolymers. Journal of Sustainable Cement-Based Materials.* http://dx.doi.org/10.1080/21650373.2015.1044049
- Khalifeh, M., Saasen, A., Vrålstad, T., & Hodne, H. (2014). *Potential utilization of class C fly ash-based geopolymer in oilwell cementing operations.* Cement & Concrete Composites 53 (2014) 10-17. http://dx.doi.org/10.1016/j.cemconcomp.2014.06.014
- Khalifeh, M., Hodne, H., Saasen, A., & Eduok, E.I. (2016). *Usability of geopolymers for oil well cementing applications: reaction mechanisms, pumpability, and properties.* SPE-182354-MS. The SPE Asia Pacific Oil & Gas Conference and Exhibition 2016, held in Perth, Australia, in October. http://dx.doi.org/10.2118/182354-MS
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- Khalifeh, M., Saasen, A., Hodne, H., & Vrålstad, T. (2013). *Techniques and materials for North Sea plug and abandonment operations.* Offshore Technology Conference, OTC-23915, Texas, USA. http://dx.doi.org/10.4043/23915-MS
- Khalifeh, M., Saasen, A., Vrålstad, T., & Hodne, H. (2014). *Potential utilization of geopolymers in plug and abandonment operations.* SPE Bergen OneDay Seminar, SPE-169231-MS, Bergen, Norway. http://dx.doi.org/10.2118/169231-MS
- Khalifeh, M., Hodne, H., Saasen, A., & Korsnes, R.I. (2015) *Cap rock restoration in plug and abandonment operations; possible utilization of rock-based geopolymers for permanent zonal isolation and well plugging.* IPTC-18454-MS International Petroleum Technology Conference Held in Doha, Qatar, December. http://dx.doi.org/10.2523/18454-MS
- Khalifeh, M., Saasen, A., Vrålstad, T., Larsen, H.B., & Hodne, H. (2015). *Cap rock restoration in plug and abandonment operations; possible utilization of aplite-based geopolymers for permanent zonal isolation and well plugging.* SPE-175457-MS. SPE Offshore Europe Conference & Exhibition held in Aberdeen, September. http://dx.doi.org/10.2118/175457-MS

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Thanks for your time & attention

Q&A

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