

Short Description

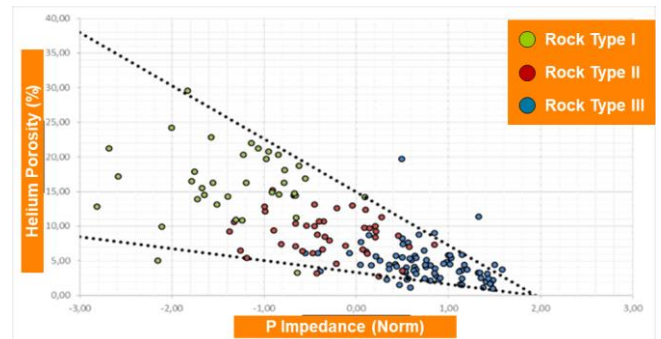
ETHOS (rEservoir properTies from Hybrid wOrkflowS) is our **Data Driven** solution for properties estimation. It is a hybrid (digital + experimental) product based on AI and very fast laboratory protocols to estimate reservoir properties by linear and nonlinear models generation using available lithological material.

Deliverable

Estimated Rock Properties as upscaled scalars and probability distributions. Depending on the seed dataset and customers needs the output can be shaped as pseudo-logs in normal and very high resolution (up to mm) , RCAL/SCAL datasheets and lithotypes/lithofacies abundance and distribution.

Benefits

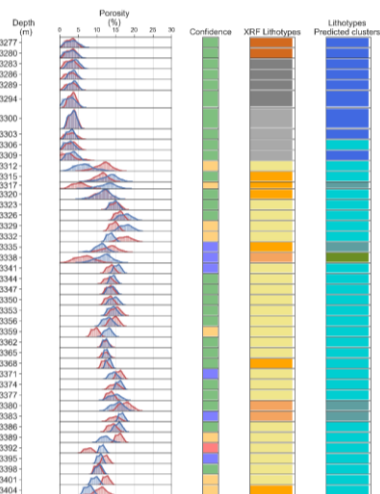
- Speed up lab campaigns up to 80% faster.
- Reduce up to 60% RCAL/SCAL campaigns costs.
- Propagate/use previous known information (models) into analog samples at different scales (plugs, wells, etc.).
- Reduce reservoir static model uncertainty by incorporating and generating data in missing spots.
- Obtain comprehensive heterogeneity description and rock groups vertical distribution by integrating AI and very fast laboratory acquisition procedures.



Example of ETHOS_[TechLab] technology application to plug samples (ETHOS_[PLUG]) for P Impedance/Porosity estimation. P wave velocities and densities measurements were performed 75% faster than conventional laboratory protocols. Also a meaningful rock typing was obtained which could help in QI efforts.

Differential Features

- Can be adapted for virtually any needed property.
- Cuttings ready solution. No commercial service is available to generate equivalent data with cutting samples.
- In plug properties estimations exploits unique multi-energy X-ray acquisition which allows the prediction of void phase (i.e porosity and permeability) and solid phase (i.e acoustic velocity, Young's modulus) related properties.
- In core scale properties estimations can provide up to very high resolution (up to mm) estimated log.



Example of ETHOS_[TechLab] technology application in cutting samples (ETHOS_[CUTT]) Porosity distributions [1st track] and lithotypes [3rd and 4th] log. Blue distributions are estimated porosities from cutting material, red ones are obtained from wireline data for output comparison. Model cross validation procedures also provides output confidence level [2nd track].



Requirements

- Hard data (properties to estimate i.e.: permeability, SW_{irr}) for initial model building. This can be provided by the customer or can be obtained in our facilities.
- Soft data (fast properties using X-Rays and/or multi-physics bulk samples response) in all sample population. Not specific preparation is needed for any sample type.
- For Cuttings: wet (250 grs) or dry (50 grs). Can work even with powdered samples.
- For Plugs: 10-25% of the sample populations needs to have hard data.
- For high resolution profiles (Core): Multi-energy CT scan and/or 3 high resolution properties maps.

Limitations

- This product needs a database to start running. Can be from an analog sample from previous exercises, delivered by the customer or acquired in our lab.
- Soft data acquisition needs to be run in house for plugs and cores.
- In cuttings, samples quality and depth uncertainty can be an important issue to address.
- Final results quality are tied to quantity and quality of initial hard data.
- Built model can be use in analogs for even faster time to market.

The Product in Depth

An initial database of “Hard” data (target property, i.e. permeability, UCS) is provided or acquired in a small population or known samples/space. Then “Soft” data (a faster, cheaper, high throughput property, i.e. XRF, multi energy radiographies) is acquired in the same samples/space than hard data but also in the required larger samples/space. Hard and Soft data in the small known database are compared and by using Machine Learning and other Linear and Non Linear approaches a model is built between them. Cross validation and Optimization processes are conducted to minimize errors and choose proper model refinements. Once the model is refined, now it can be applied in the larger unknown samples/space to estimate the hard data with the reduced time, cost and fewer limitations of soft data thus minimizing overall time to customer, investment and sample bias. In order to satisfy a wider pain points scenarios we have developed solutions tailored to specific samples characteristics. ETHOS_[CORE]: It is suited to full/slabbbed core to estimate petrophysical/mechanical properties up to mm scale in continuous measurements. ETHOS_[PLUG]: It is focused on the acceleration of conventional RCAL/SCAL campaigns and high throughput value for 1” and 1.5” samples even when not lab suitable. ETHOS_[CUTT]: Our state of the art technology aiming to extract meaningful information from highly available and cost effective cutting material per wells.

Some Use Cases

Use Case / Model	Client	User	Coste (K€)	TimeToMk (m)
<i>Acoustic Impedance, Density and Porosity prediction for P-Impedance/Porosity modeling using X-Rays for reduced time to market and overall costs. 200+ carbonate samples; 2018</i>	• PERTAMINA/MIGAS	• Petrophysicist • Reservoir Geomodeller • Geophysicist	35	1.0
<i>Porosity and permeability prediction in low perm sandstones reservoirs wells. Properties correlation between horizontal wells; 2019</i>	• Norway (Yme)	• Petrophysicist • Reservoir Geomodeller	25*	1,5*
<i>Porosity prediction in turbiditic sandstones where grain coatings has a significant impact in reservoir quality; 2019</i>	• GOM (Buckskin)	• Petrophysicist • Reservoir Geomodeller	25*	1,5*

*Wet cuttings
Dry cuttings: Cost 15K € / Time to Mk 1 m