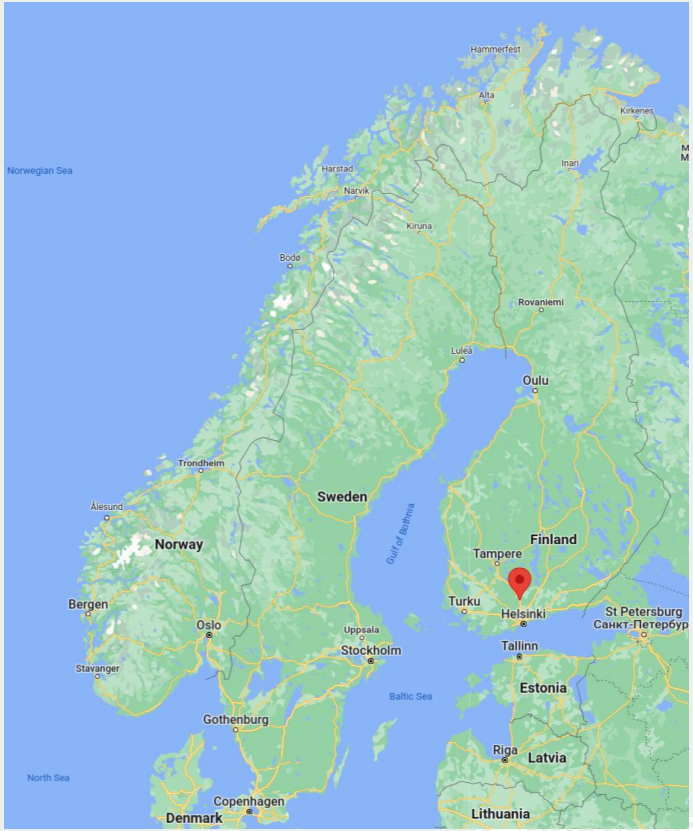
ANALYZE - OPTIMIZE - IMPROVE

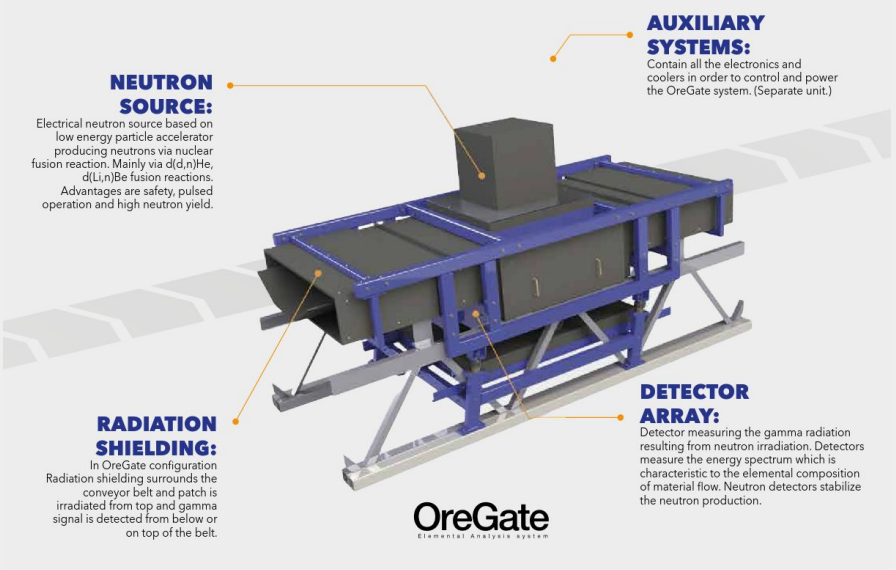
ABOUT THE COMPANY

- FINNISH COMPANY (2014)
- EXPERTISE IN NUCLEAR PHYSICS & ITS APPLICATIONS IN ELEMENTAL ANALYSIS
  - combine neutron sources with detectors to create measurement systems.
  - The modular nature of the system allows customization of neutron production, detectors and analysis algorithms to meet client's specific applications.
- REFERENCES:
  - OUTOKUMPU TORNIO FERRO CHROME WORKS
  - total annual ferrochrome production capacity of 530,000 tonnes and includes the largest FeCr furnace in the world.



NeutronGate technology in short

1. 100% of material volume
2. IN-LINE
3. REAL TIME
4. Measure almost all solids and liquids
5. Non contact and non disruptive.
6. Radiation safety, no radioactive sources



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Working principle: Elemental analysis

PARTS

PLASMA ①
Energy is fed in to low density gas that ionizes via electron collisions forms plasma

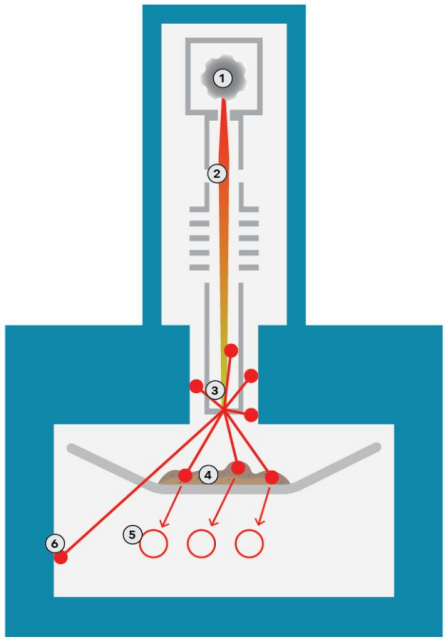
ACCELERATOR ②
Beam is extracted from plasma focused and accelerated to beam target.

BEAM TARGET ③
nuclei collide at the beam target forming neutrons via nuclear fusion

SAMPLE ④
mass on the conveyor is irradiated with neutrons.

DETECTION ARRAY ⑤
Detector array detects the gammas comming from irradiated material.

SHIELDING ⑥
Remainig neutrons are shielded from the environment by radiation shielding



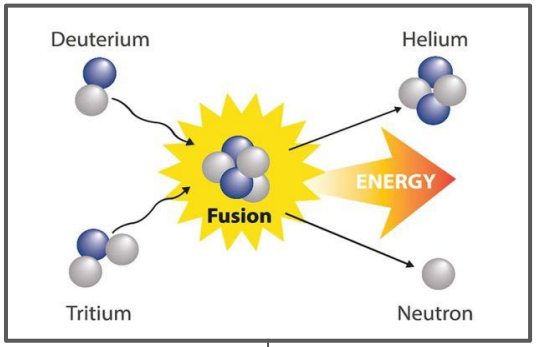
PROCESS

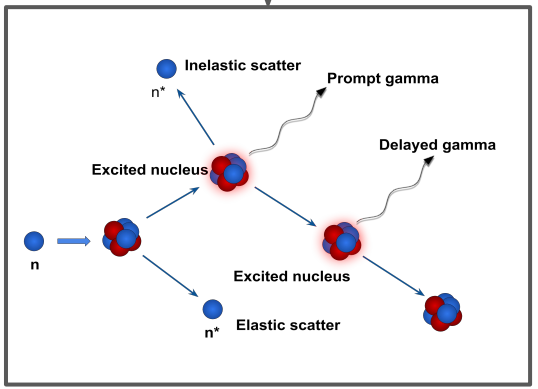
NEUTRON PRODUCTION
Neutron beam is produced by innovative new accelerator produced by NeutronGate

NEUTRON ACTIVATION
Neutrons interact with nuclei in the material flow exiting them and inducing gamma emission that is element specific.

DATA ACCUISITION
Gamma signals from detector array are filtered and analysed in order to provide raw data and spectrums.

ELEMENTAL DATA
Raw data from detectors is filtered, calibrated and analysed providing elemental identification, elemental ratios and concentrations to the client.





Detection thresholds for thermal PGNAA, DGNAA rough estimate

PGNAA detection thresholds.

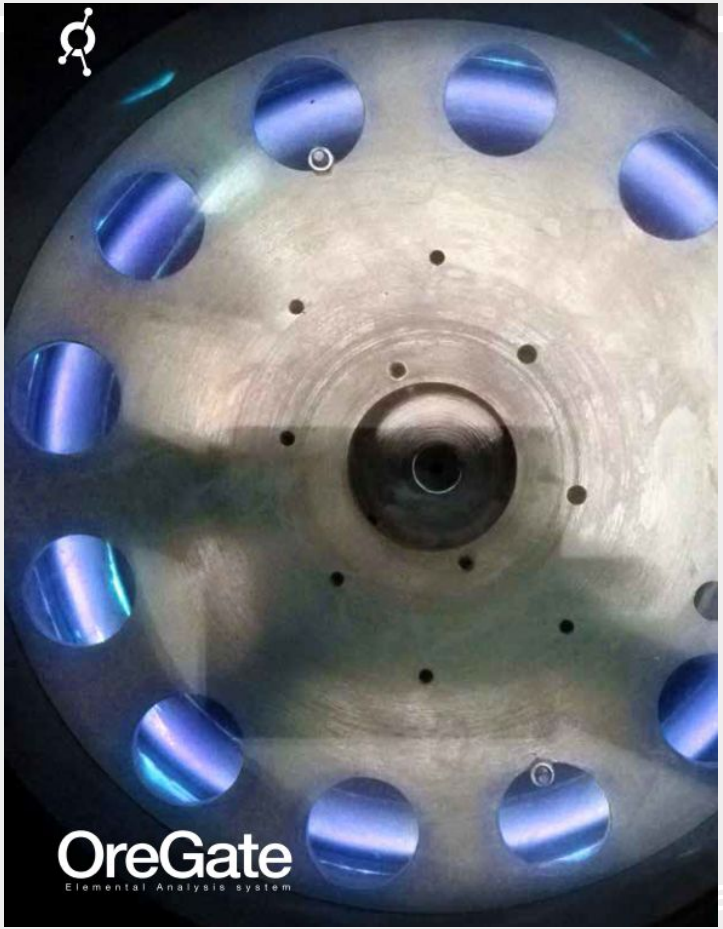
Detection threshold %-w	Element
<0.01	H,In,Au,Hg,Hf,Er,B,Cd,Nd,Sm,Eu,Gd,Dy
<0.1	Li,Na,Mg,Al,Si,S,K,Ca,Cr,Fe,Ni,Cu,Se,Br,Kr,Sr,Ru,Pd,Te,Xe,Cs,W,La,Tb,U, Cl,Sc,Ti,V,Mn,Co,Rh,Ag,Ta,Re,Pt,Ho,Yb,Lu
<1	Be,N,F,P,Ar,Zn,Ga,Ge,As,Rb,Y,Zr,Nb,Mo,Tc,Sn,Sb,I,Ba,Tl,Ce,Pr,Tm,Th,Np,Pu,Am
>1	C,O,Ne,Pb,Bi

DGNAA detection thresholds, measurement time usually at least 10% of element half life.

Detection threshold %-w	Element
<1ppm	Mn,Rh,Ag,Hf,Sc,V,Kr,In,Eu,Dy
<10ppm	Na,Cu,Ga,As,Br,Sr,Y,Nb,La,W,Os,U,Sc,Sm,Ho,Lu,Re,Ir,Au,Al,I,Ba
<100ppm	Co,Ge,Ru,Pd,Sb,Te,Xe,Nd,Er,Yb,Pt,Hg,Ar,Mg,Mo,Cd,Pr,Gd,Ta
<0.1%	Ne,K,Ca,Ni,Rb,Tm,F,Cl,Ti,Zn,Se,Sn,Ce,Th

When NAA is competitive

1. Large liquid and solid sample volumes.
2. In-line and real-time analysis is needed.
3. Surface- or sample analysis is not enough.
4. Representative analysis/sampling is needed.
5. Nondestructive or non-contact measurement is needed.
6. Element mass is important, regardless of material phase or chemical bonds.



HOW TO FIGURE OUT IF WE CAN BENEFIT YOU?

1. Sanity check questionnaire
2. Preliminary lab analysis
3. Review of the lab analysis
4. Tailored proposal from NeutronGate

Thank You

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