SUPPLEMENTARY INFORMATION

Reuse of iron ore tailing to potassium silicate synthesis and to the production of geopolymers

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1. Determination of $\%K_2O$ and $\%SiO_2$ contents

The K_2O and SiO_2 contents in mass were quantified by titration. For this, 8 g of the product obtained in each of the routes were diluted in distilled water and quantitatively transferred to a 250 mL volumetric flask. This solution was called the "mother solution".

The titration is divided into two steps:

a) Determination of K_2O content

In an Erlemeyer flask, 50 mL of the "mother solution" and the methyl red indicator were added. The K_2O content was determined by titration with a 1 $mol.L^{-1}$ HCl solution, according to equation 1.

$$\%K_2O = \frac{Vol_{HCl} \times [HCl] \times 23{,}5}{ma} \qquad \text{Equation 1}$$

Where:

Vol_{HCl}: volume of HCl solution used in the titration (in mL);

[HCl]: concentration of the HCl solution used (in $mol.L^{-1}$);

ma: mass of the sample weighed and transferred to the 250 mL flask (in grams);

b) Determination of SiO_2 content

In an Erlenmeyer flask, 200 mL of distilled water, 5 g of sodium fluoride, 1 mL of HCl solution 1 $mol.L^{-1}$, methyl red indicator and 50 mL of the "mother solution" were added. The solution is then titrated with HCl until a persistent change in color from yellow to red. The SiO_2 content can be calculated according to equation 2.

$$\%SiO_2 = \frac{Vol_{HCl}\,(C - B) \times [HCl] \times 7{,}5}{ma} \qquad \text{Equation 2}$$

Where:

Vol_{HCl} (C – B): volume of HCl solution used in the SiO_2 titration (C) subtracted from the volume of HCl solution used in the K_2O titration (B) (in mL);

[HCl]: concentration of the HCl solution used (in $mol.L^{-1}$);

ma: mass of the sample weighed and transferred to the 250 mL flask (in grams);

2. *Geopolymers Synthesis*

Table S1. Geopolymeric materials produced using standard activator solution, activating solution obtained from solid SR18–3h and use of tailings as filler.

Sample	Composition
G_{SAS}	50% metakaolin and 50% standard activator solution.
G_{SR18}	50% metakaolin and 50% activator solution obtained from solid SR18–3h.
$G_{SAS}F_{25}$	37.5% metakaolin, 37.5% standard activator solution and 25% IOT as filler.
$G_{SR18}F_{25}$	37.5% metakaolin, 37.5% activator solution obtained from the solid SR18–3h and 25% IOT as filler.
$G_{SAS}F_{50}$	25% metakaolin, 25% standard activator solution and 50% IOT as filler.
$G_{SR18}F_{50}$	25% metakaolin, 25% activator solution obtained from the solid SR18–3h and 50% IOT as filler.

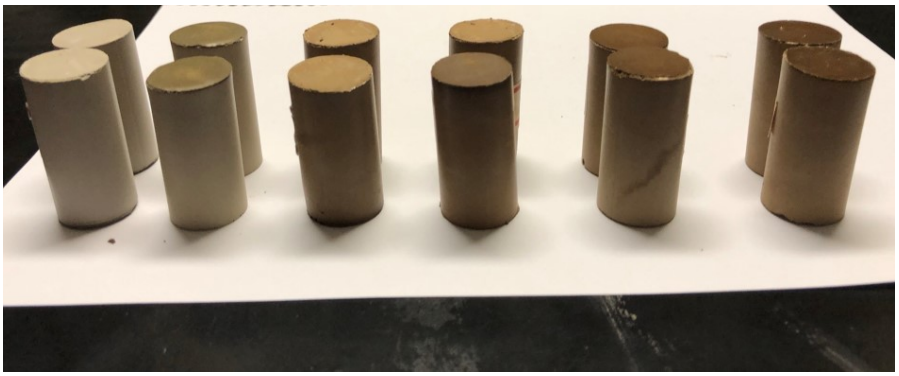

Figure S1. Geopolymers produced and demolded after 72 hours.

3. Additional information for topic 3.1: *Synthesis of Potassium Silicate*

Table S2. Chemical composition of the IOT by XRF analysis

Mineral Phase	Content / wt%
SiO_2	52.84
Fe_2O_3	25.74
Al_2O_3	15.56
MgO	2.89
TiO_2	0.56
K_2O	0.55
CaO	0.47
MnO	0.15
SO_3	0.15
Cr_2O_3	0.08
ZrO_2	0.01

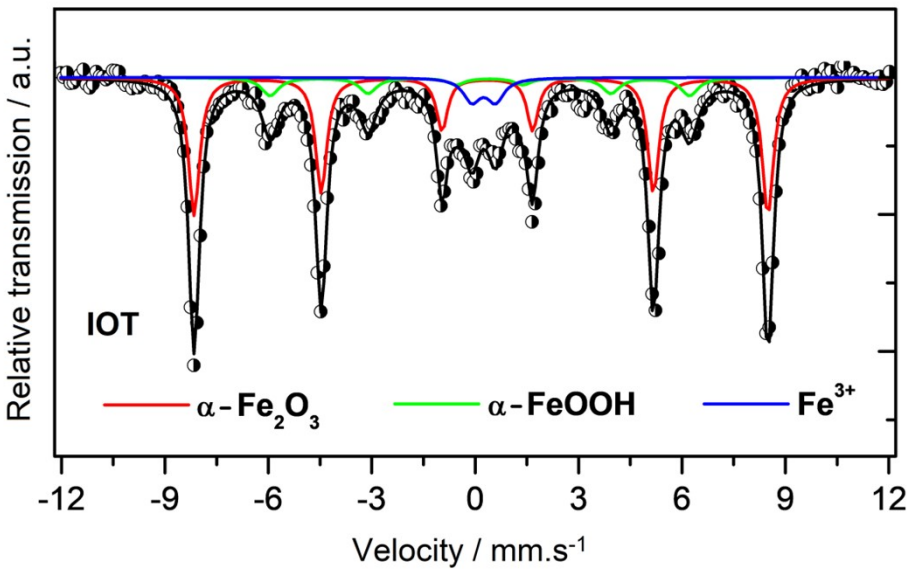

Figure S2. Mössbauer spectrum of ^{57}Fe obtained at room temperature for the IOT.

Table S3. Hyperfine parameters obtained by Mössbauer spectroscopy for the IOT sample.

Sample	Site	δ (± 0.05) / mm s^{-1}	Δε (± 0.05) / mm s^{-1}	B_{HF} (± 0.5) / T	RA (±1) / %
IOT	α-Fe_2O_3	0.36	- 0.18	51.6	67
	α-FeOOH	0.37	- 0.27	37.7	21
	Fe^{3+}	0.34	0.68	-	12

δ = isomeric shift for α-Fe; Δε = quadrupole splitting; B_{HF} = hyperfine field; RA = relative spectral area.

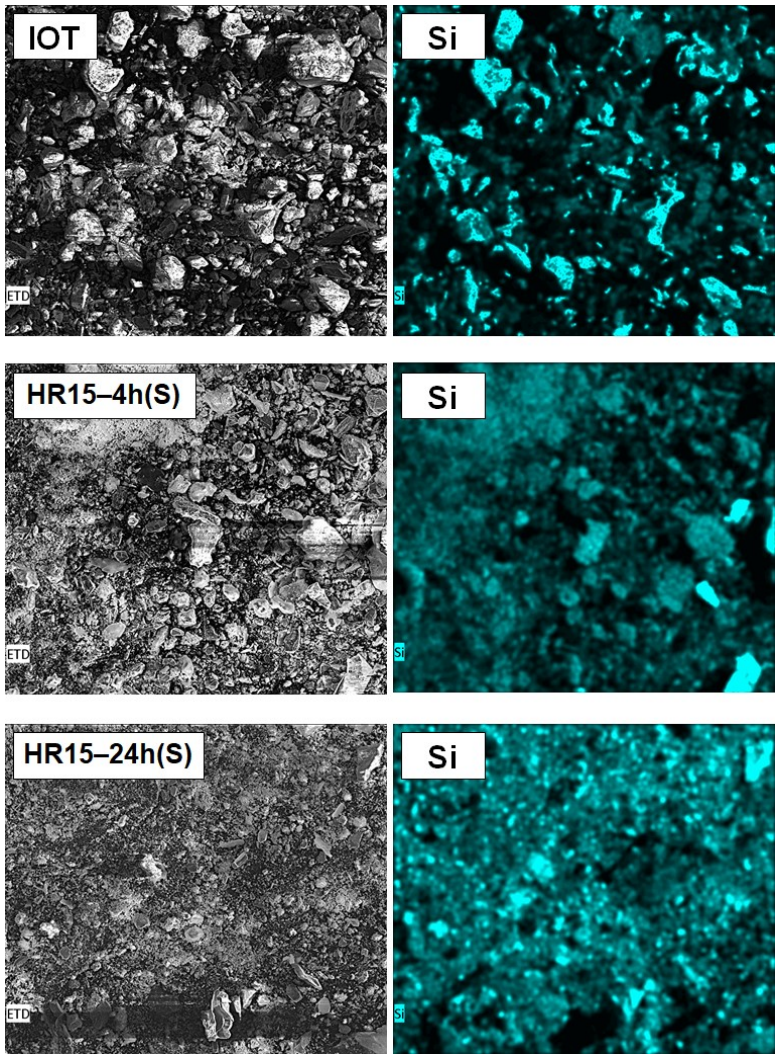

Figure S3. EDS mapping for Si of the IOT and of the solid fractions HR15–4h(S) and HR15–24h(S).

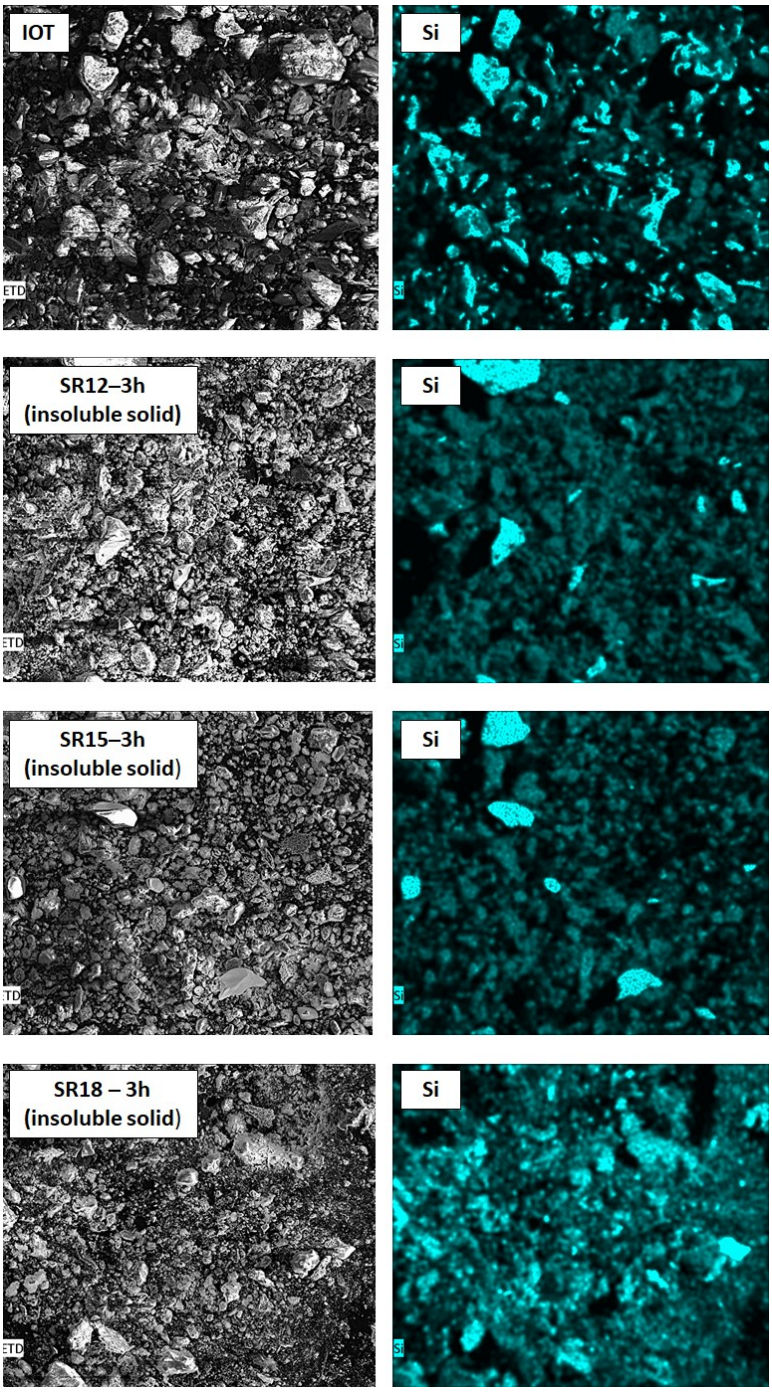

Figure S4. EDS mapping for Si of the IOT and residual insoluble solid fractions from SR12–3h, SR15–3h and SR18–3h.

4. Additional information for topic 3.2: *Geopolymers Synthesis*

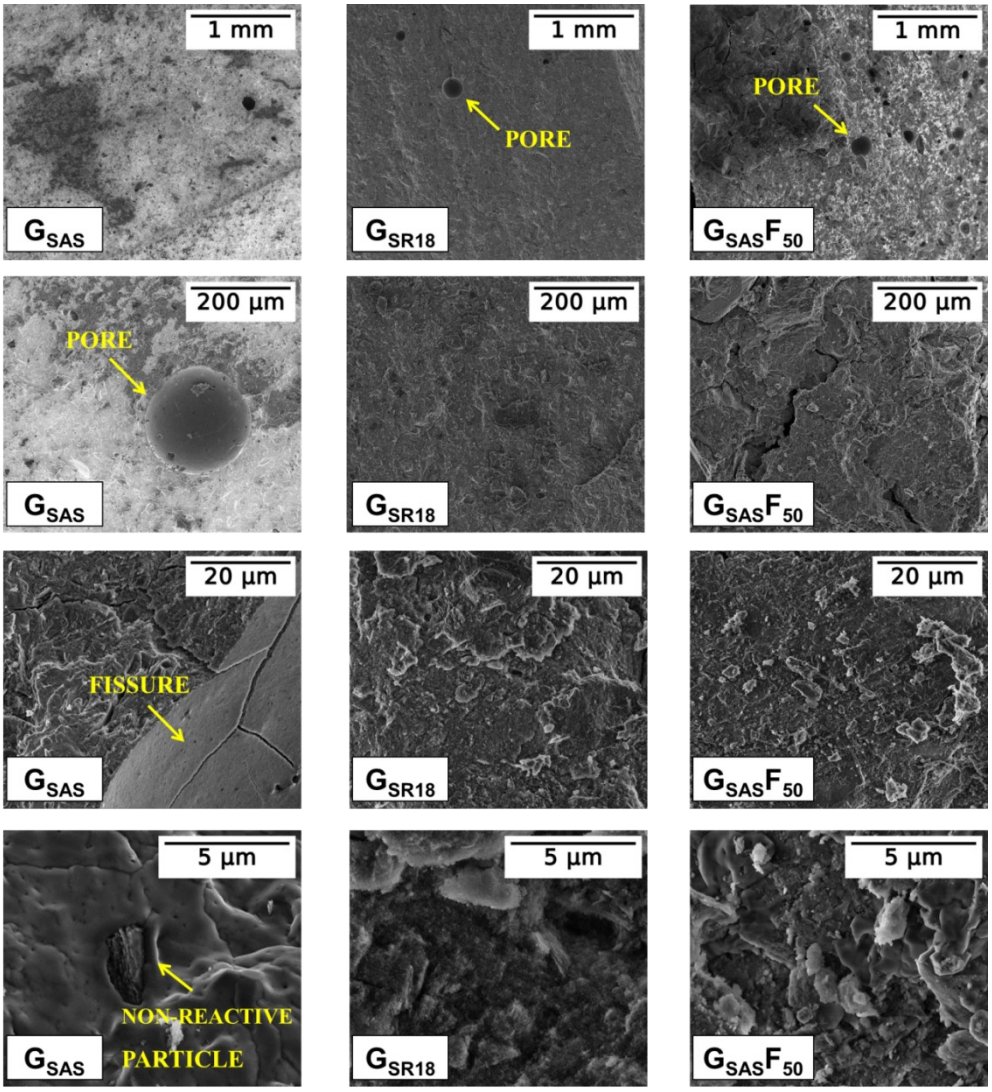

Figure S5. SEM images of G_{SAS}, G_{SR18} and $G_{SAS}F_{50}$ geopolymers.