

Electronic Supplementary Material for:

Low temperature leaching behavior of allanite-(Ce) in treating an allanite-concentrate by sulfuric acid

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Table S-I. Quality control procedures for ICP-OES.

Sample	Laboratory	La mg/kg	Ce mg/kg	Pr mg/kg	Nd mg/kg	Sm mg/kg	Eu mg/kg	Gd mg/kg	Tb mg/kg
Allanite concentrate (feed)	University of Oulu (this study)	17735	35324	8011	10746	1934	166	939	138
Allanite concentrate (feed)	Bureau Veritas Ltd, Vancouver	17261	32421	3233	10382	1507	161	1032	113
REE-1 CRM	University of Oulu (this study)	1622	4133	1000	1274	407	18	409	108
REE-1 CRM	Reference values	1661	3960	435	1456	381	24	433	106
Sample	Laboratory	Dy mg/kg	Ho mg/kg	Er mg/kg	Tm mg/kg	Yb mg/kg	Lu mg/kg	Y mg/kg	Sc mg/kg
Allanite concentrate (feed)	University of Oulu (this study)	552	55	221	<i>nd</i>	138	28	2099	<i>nd</i>
Allanite concentrate (feed)	Bureau Veritas Ltd, Vancouver	455	65	153	21	143	20	1961	9
REE-1 CRM	University of Oulu (this study)	863	168	690	<i>nd</i>	697	93	5518	<i>nd</i>
REE-1 CRM	Reference values	847	208	701	106	678	92	5480	8

nd = not determined.

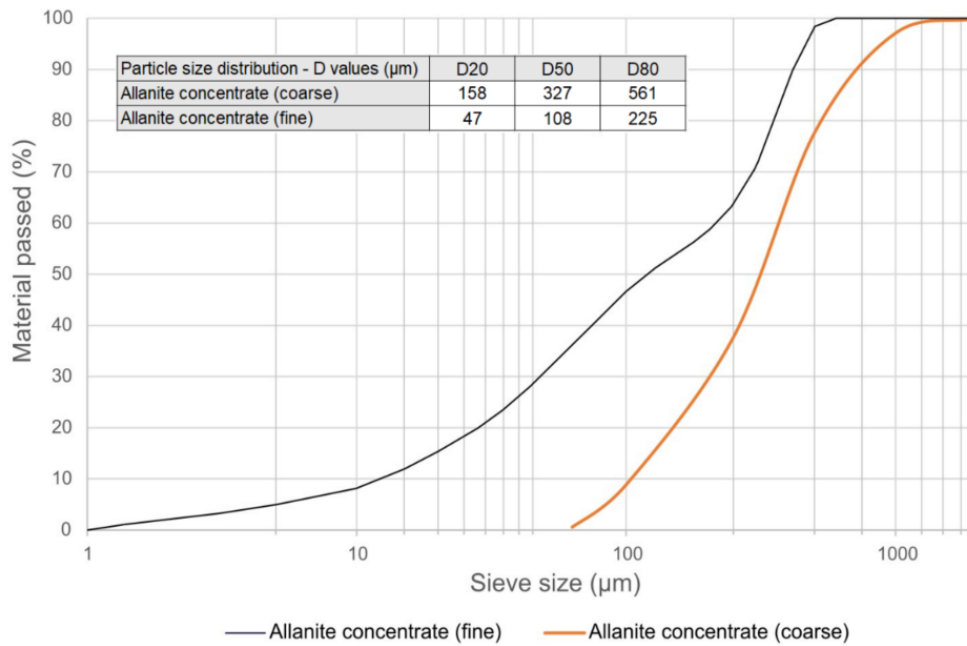


Figure S-1. Particle size distribution curves for the allanite concentrate feed samples. The D values, e.g., D80 represents the 80% of particles in the sample are smaller than this size. Particle size distributions were determined by Retsch analytical sieve shaker and laboratory sieve set and a CILAS 1190 laser diffraction particle size analyser at the University of Oulu.

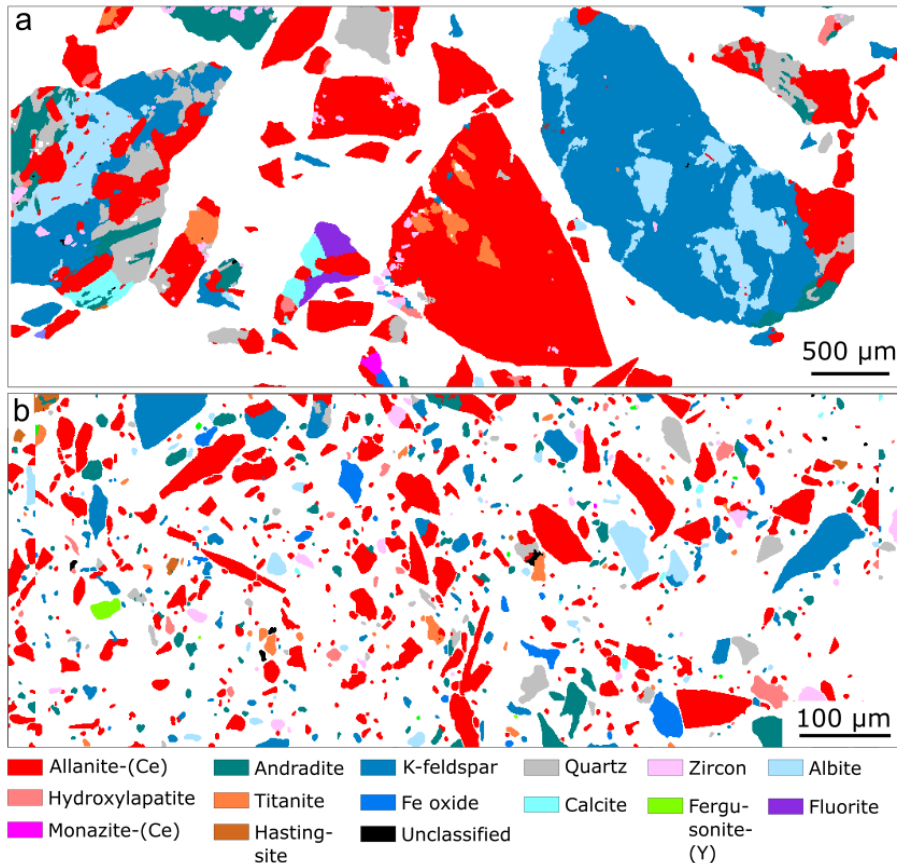


Figure S-2. False color cross-sectional particle images produced by analyzing polished grain mounts with FE-SEM AM tool. (a) “Coarse” and (b) “Fine” allanite concentrate samples.

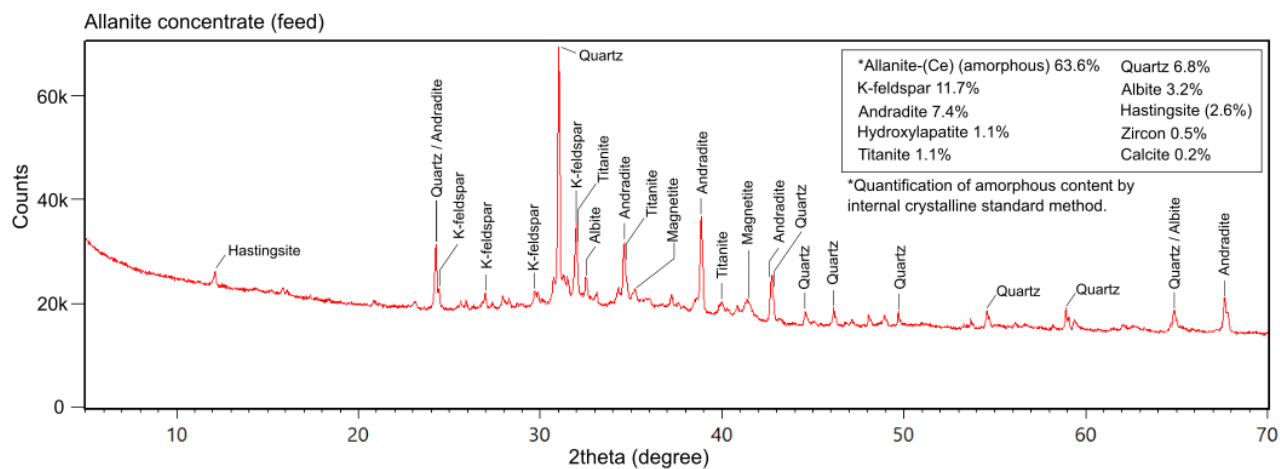


Figure S-3. X-ray diffraction pattern and Rietveld quantification result of allanite concentrate. Diffractogram shown is without added zincite and only explanations of major peaks indicated here.

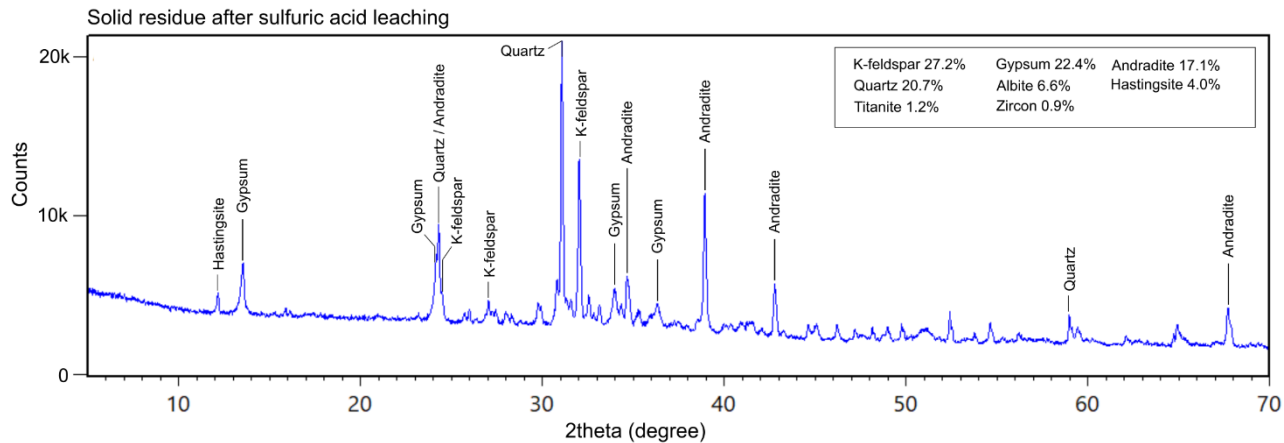


Figure S-4. X-ray diffraction pattern and Rietveld quantification result of solid residue after sulfuric acid leaching (100 g coarse feed after 3 hour leaching time with 2M H₂SO₄ at room temperature with continuous stirring). Explanations of the major peaks are marked on the presented diffractogram.