

Preliminary studies on melt inclusions and volatile analysis in basalts recovered from Australian-Antarctic Ridge



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Introduction

Australian-Antarctic Ridge (AAR) is an extension of easternmost SE Indian Mid-Ocean Ridge. Jan. 2013, Korea Polar Research Institute (KOPRI) dredged basaltic rocks from the axis and the off-axis seamounts of the AAR using Icebreaking research vessel Araon. Collected basalts contain fine subhedral or anhedral olivine, plagioclase, and pyroxene phenocrysts, while the off-axis seamount basalts contain more olivine phenocrysts compared to the axis basalts. We studied melt inclusions hosted in the olivine phenocrysts in the seamount basalt by EPMA and LA-ICP-MS.

We fused and characterized a halogen-bearing basaltic glass as well, for an external SRM for SIMS microanalysis of halogens in natural basaltic glass and melt inclusions.

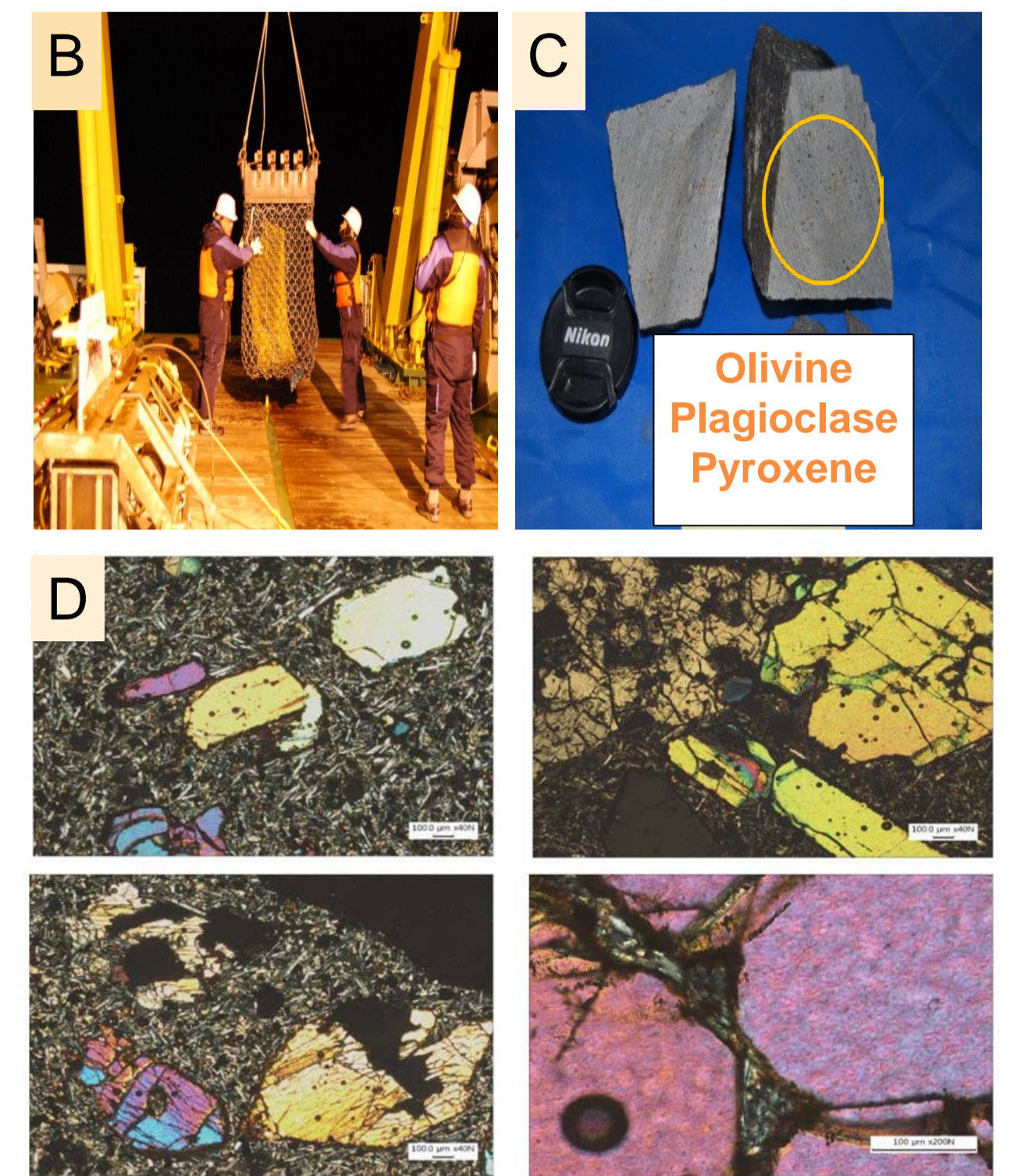
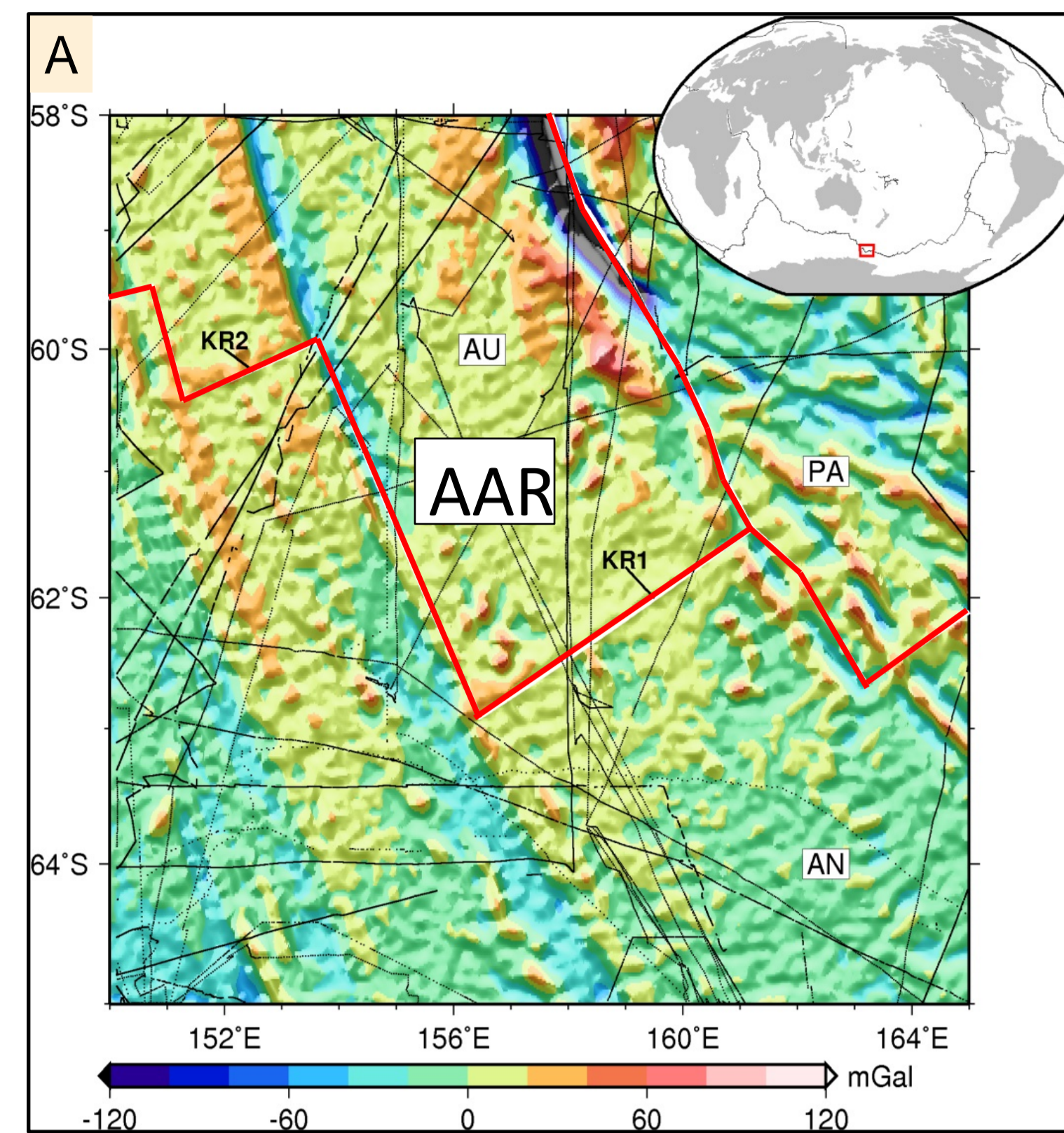


Fig. 1. A) Antarctic mid-ocean ridge (AAR: including KR1 and KR2), B) Dredging basalt rocks, C) Off-axis seamount basalt, D) Petrography of the seamount basalt

Sample preparation

We collected olivine phenocrysts containing glassy melt inclusions, and subsequently analyzed by EPMA and LA-ICP-MS

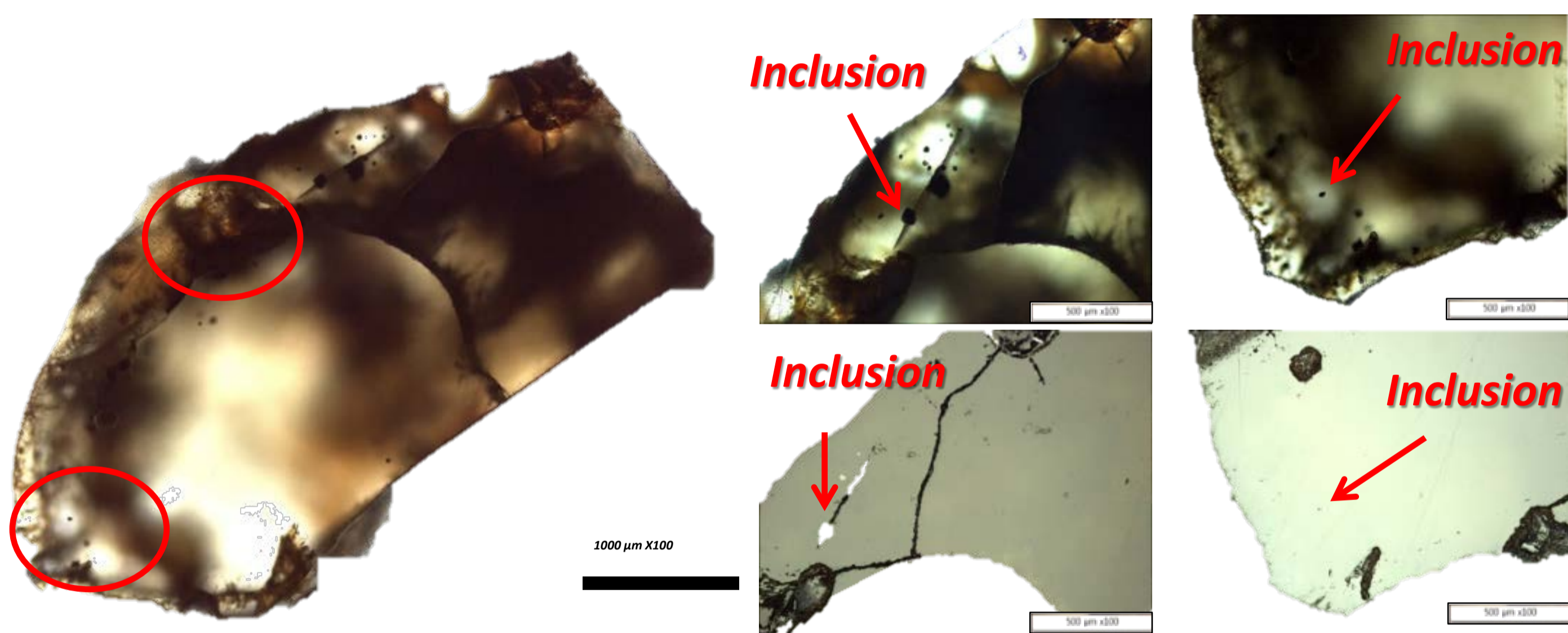


Fig. 2. Inclusions in olivine phenocryst

LA-ICP-MS microanalysis of the inclusions

We found two types of inclusions, one with high Cr concentrations and the other have higher Al, Na, and K with lower Cr.

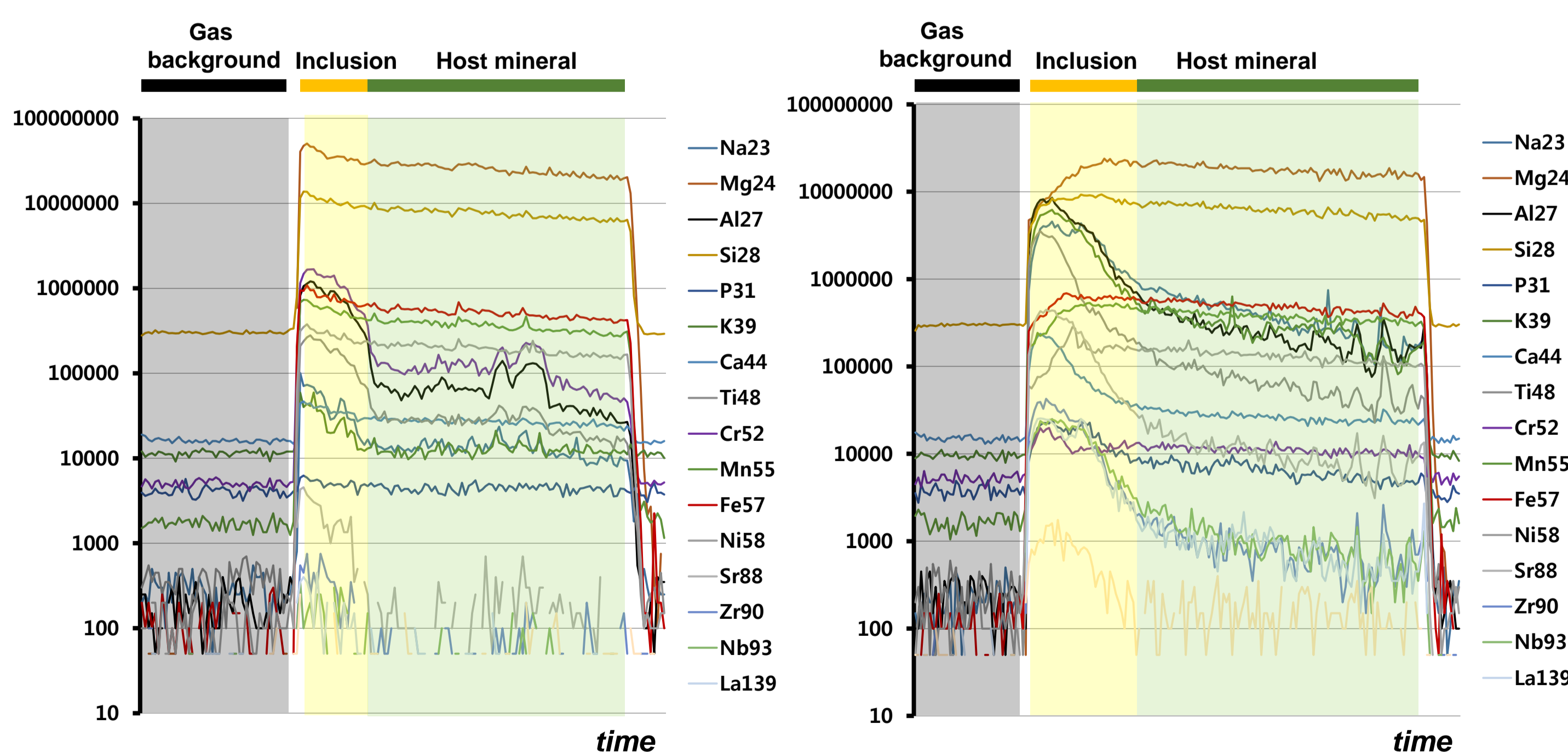


Fig. 3. LA-ICP-MS transient signals of the inclusions

Standard Reference Material (SRM) for halogens

We synthesized a halogen-rich basaltic glass for a Standard Reference Material (SRM). Basalt powder was mixed with compounds such as KI, NaI, CaCl₂, KCl, FeS₂, CaF₂, Fe₃O₄, LiBr to produce the halogen and sulfur-rich basaltic glass. Double polished glass were checked for its halogen and sulfur contents, and its homogeneity.

EPMA analysis of fused SRM (Test5)

Test5 glass was checked for its homogeneity by EPMA. The major elements are generally homogeneous except Fe.

No.	F	Al ₂ O ₃	MgO	Na ₂ O	SiO ₂	FeO	SO ₃	Br	CuO	MnO	TiO ₂	Cl	I	K ₂ O	P ₂ O ₅	CaO	Li ₂ O	B ₂ O ₃	Total
AV.	0.38	9.17	5.51	2.27	32.32	10.70	0.13	0.21	0.02	0.00	0.74	0.34	0.03	3.62	0.15	11.26	3.87	18.11	98.56
STD.	0.19	0.12	0.10	0.04	0.24	2.20	0.02	0.27	0.02	0.00	0.05	0.04	0.02	0.08	0.03	0.09	0.00	0.00	2.45
% ERROR	51.88	1.25	1.85	1.76	0.73	20.51	15.53	126.64	131.83	0.00	7.00	10.80	65.77	2.07	16.65	0.77	0.00	0.00	2.49

Table. 1. AV : average of 10 points analysis, STD. : 1 sigma standard deviation, % ERROR : % of STD/AV

Quantitative analysis (LA-ICP-MS) of Fused SRM (Test5)

Cl, Br, I, and S in Test5 glass was analyzed by a LA-ICP-MS. 20 points analysis in the Test5 glass show the volatile elements is generally homogeneous.

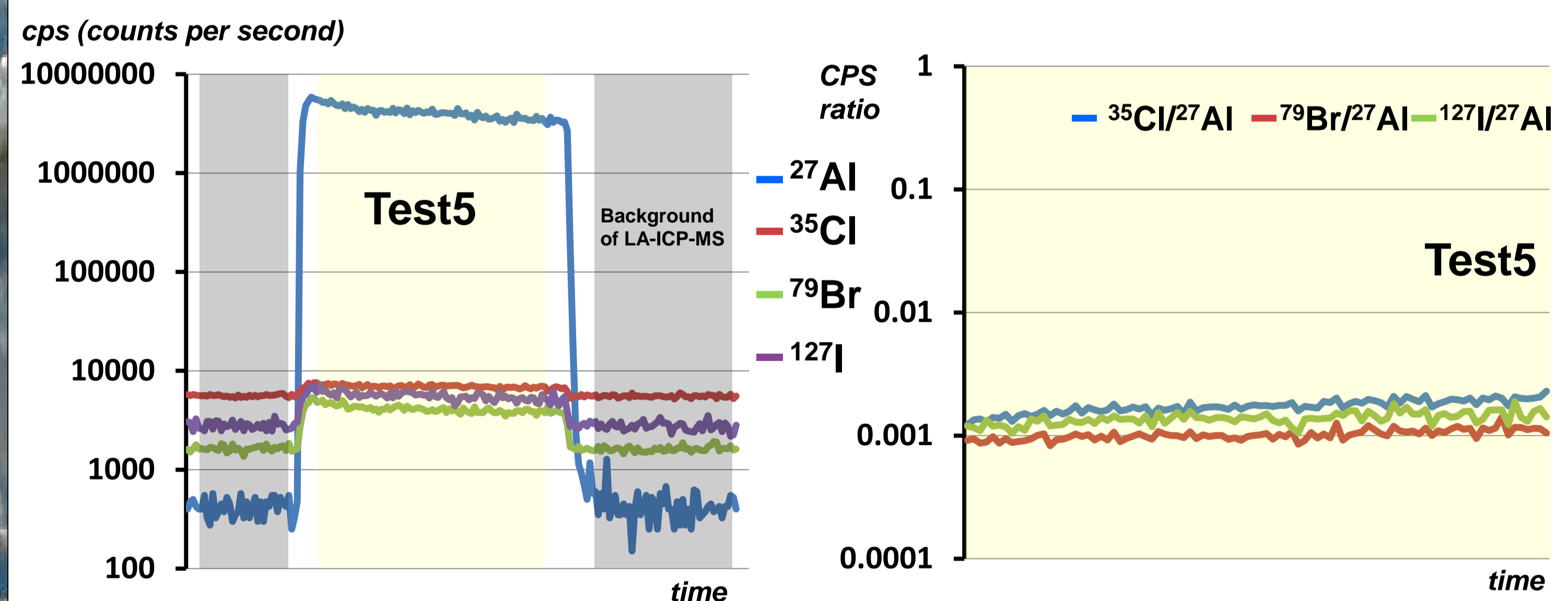


Fig. 4. LA-ICP-MS transient signals and cps ratios of ³⁵Cl/²⁷Al, ⁷⁹Br/²⁷Al, ¹²⁷I/²⁷Al in the fused glass (Test5)

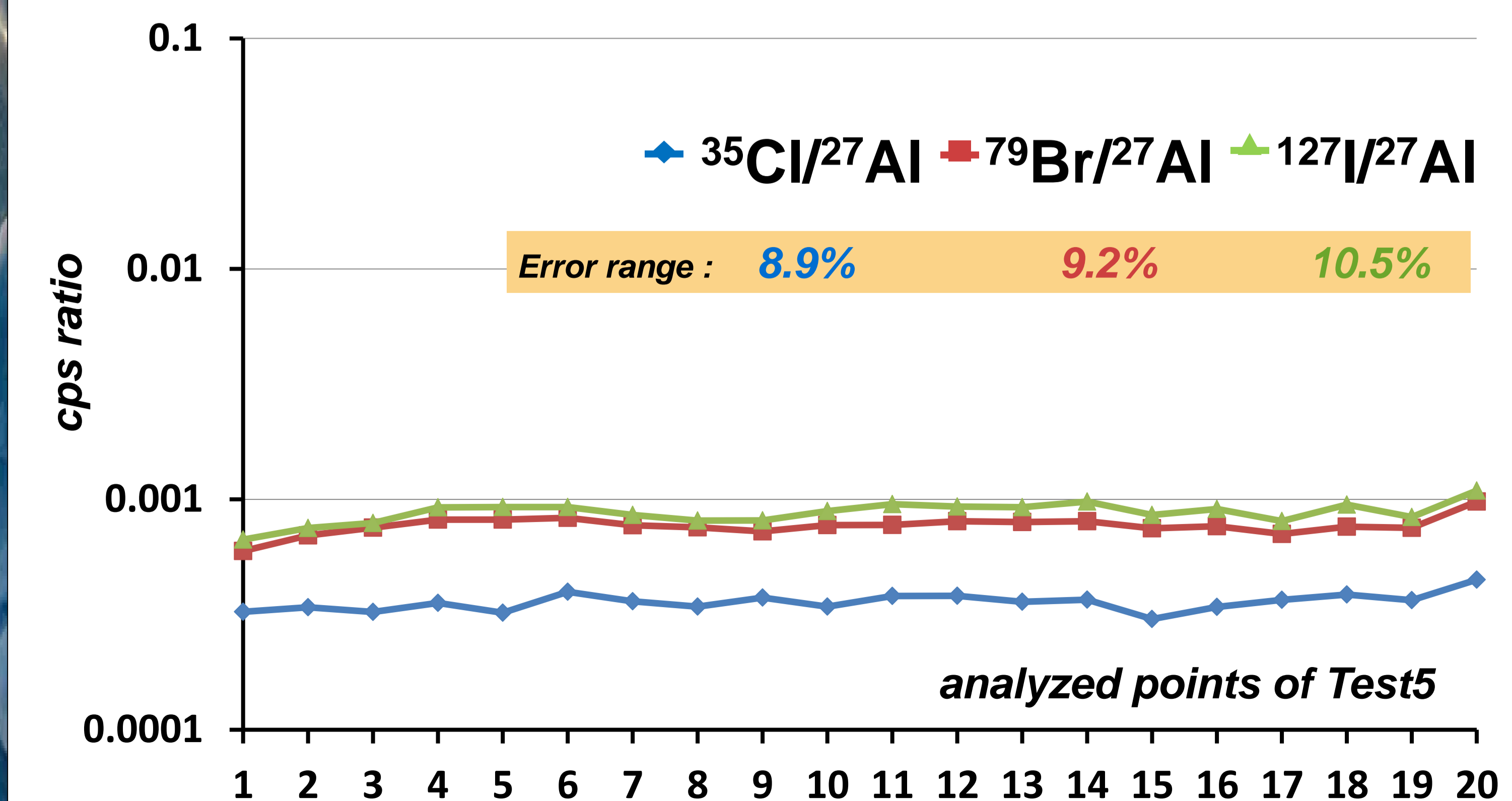


Fig. 5. cps ratios of the 20 points analysis in the glass