S1 LA-ICP-MS analytical techniques and complete analyses

S1.1 In-situ LA-ICP-MS elemental analysis

The LA-ICP-MS analyses on chrysoberyl grains (Table S2) were performed at the Science department, Roma Tre University LA-ICP-MS lab using a Teledyne Photon Machine Analyte Excite (193 nm) + ArF excimer laser ablation system coupled to a Thermo-Scientific iCAP RQ (Single Quad). All analyses were performed at low oxide production rates ($^{232}Th.^{16}O/^{232}Th$ <0.5%). Helium carrier gas stream of ~0.5 and 0.3 l/min are set for the cell and the cup, respectively. Laser spot sizes of ~35 μm and ~20 μm (circles' diameters) were used for glass standards and unknown samples, respectively, with a 7 Hz pulse repetition rate and an energy density of 4 J/cm^2.

The ablation time was set at 60 seconds comprises a background acquisition lasting 15 seconds, succeeded by a sample ablation period of 25 seconds, followed by a 20 second washout phase. The measured masses include ^{7}Li, ^{9}Be, ^{11}B, ^{23}Na, ^{24}Mg, ^{27}Al, ^{29}Si, ^{31}P, ^{33}S,^{44}Ca, ^{49}Ti, ^{51}V, ^{52}Cr, ^{55}Mn, ^{57}Fe, ^{66}Zn, ^{71}Ga, ^{73}Ge, ^{75}As, ^{85}Rb, ^{88}Sr, ^{89}Y, ^{90}Zr, ^{93}Nb, ^{118}Sn, ^{139}La, ^{140}Ce, ^{141}Pr, ^{146}Nd, ^{147}Sm, ^{153}Eu, ^{157}Gd, ^{159}Tb, ^{163}Dy, ^{165}Ho, ^{166}Er, ^{159}Tm, ^{172}Yb, ^{175}Lu, ^{181}Ta, ^{208}Pb, ^{232}Th, ^{238}U. The dwell times are 2-3 ms for the major elements' masses and 4 ms for the rest. Synthetic glass NIST-SRM-612 and NIST-SRM-610 reference material (Jochum et al., 2011) were used to bracket analyses of unknowns, both used as external calibration, drift correction and quality control. In fact, for elements with concentrations exceeding double those in NIST-SRM-612, NIST-SRM-610 was employed.

As for elemental calibration the Iolite software version 4.8.6 (Paton et al., 2011) was used for data reduction and calibrations. both background subtraction and drift corrections are made using a step forward factor determined from repeat analysis. The stoichiometric Be, Al, and

Fe oxide contents of 100 wt.% of in chrysoberyl was used as the internal standard for LA-ICP-MS calibration.

The limit of detection (LOD, Table S1) was determined for each element using the following:

LOD = 3 x (STDev background signal)/ Sensitivity (per analyte element, per session)

Where 'STDev background signal' is the standard deviation of the signal for a given element collected before ablation for each sample (gas blank), and 'Sensitivity' is the calibrated sensitivity determined from used reference glasses.

Table S1: Limits of detections (LOD; µg/g) for elemental analysis for measured elements in the chrysoberyl samples (~20 µm diameters ablation spots)

Li7	Be9	B11	Na23	Mg24	Al27	Si29	P31	S33	Ca44	Ti49	V51	Cr52	Mn55	Fe57	Zn66
5.11	2.36	11.29	238.42	0.36	55.56	12,38	371.22	9,367	1,270	32.45	4.87	33.73	4.48	304.8	43.15
Ga71	Ge73	As75	Rb85	Sr88	Y89	Zr90	Nb93	Sn118	La139	Ce140	Nd146	Sm147	Eu153	Gd157	Tb159
1.51	16.59	12.65	1.11	0.18	0.06	0.13	0.08	5.99	0.04	0.04	0.19	0.22	0.06	0.21	0.03
Dy163	Ho165	Er166	Tm169	Yb172	Hf178	Ta181	W182	Pb208	Th232	U238					
0.12	0.03	0.09	0.03	0.13	0.09	0.03	0.13	0.68	0.03	0.03					

The calculated precisions using NIST610 glass standard (Jochum et al., 2011) which was measured at the beginning and end of each 6-8 unknown samples bracket are mainly below 10% except for B, S and Fe due to various isotopic and molecular interferences.

REFERENCES

Jochum, K.P., Weis, U., Stoll, B., Kuzmin, D., Yang, Q., Raczek, I., Jacob, D.E., Stracke, A., Birbaum, K. and Frick, D.A.,: Determination of reference values for NIST SRM 610–617 glasses following ISO guidelines. Geostandards and Geoanalytical Research, 35(4): 397-429, 2011.

Paton, C., Hellstrom, J., Paul, B., Woodhead, J. and Hergt, J.: Iolite: Freeware for the visualisation and processing of mass spectrometric data. Journal of Analytical Atomic Spectrometry, 26(12): 2508-2518, 2011.

Table S2. Complete LA-ICP-MS analyses for chrysoberyl samples (μg/g)

	C1_1	C1_2	C1_3	C1_4	C1_5	C1_6	min	max	average
Li7	3.18	bdl	bdl	bdl	bdl	bdl	bdl	3.18	0.53
Be9	71617.73	70491.67	73262.91	70384.19	71529.15	68757.29	68757.29	73262.91	71007.16
B11	68.18	66.57	52.60	64.99	81.99	77.82	52.60	81.99	68.69
Na23	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Mg24	192.76	179.75	153.14	155.65	193.81	141.27	141.27	193.81	169.40
Al27	377305.4	373311.2	376519.6	367012.4	352111.9	365908.9	352111.9	377305.4	368694.9
Si29	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
P31	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Ca44	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Ti49	1373.91	760.46	5027.72	602.15	964.04	2437.54	602.15	5027.72	1860.97
V51	144.45	173.30	177.31	187.72	248.31	232.06	144.45	248.31	193.86
Cr52	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Mn55	51.51	50.93	50.12	51.37	102.26	91.40	50.12	102.26	66.26
Fe57	66182.57	70386.21	62882.93	79547.29	100941.7	84718.13	62882.93	100941.70	77443.14
Co59	1.03	0.42	1.01	bdl	bdl	bdl	bdl	1.03	0.41
Zn66	118.12	101.28	157.77	135.37	212.09	127.21	101.28	212.09	141.97
Ga71	1035.06	1125.89	1103.93	1168.64	1285.98	1106.45	1035.06	1285.98	1137.66
Ge73	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
As75	bdl	bdl	bdl	bdl	0.92	bdl	bdl	0.92	0.15
Rb85	0.10	0.58	bdl	bdl	bdl	bdl	bdl	0.58	0.11
Sr88	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Y89	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Zr90	0.54	bdl	bdl	0.17	6.41	1.26	bdl	6.41	1.40
Nb93	bdl	0.13	0.86	0.38	7.68	0.73	bdl	7.68	1.63
Sn118	301.17	254.00	604.56	177.60	183.02	544.25	177.60	604.56	344.10
La139	bdl	bdl	bdl	bdl	1.55	bdl	bdl	1.55	0.26
Ce140	bdl	bdl	bdl	bdl	1.08	bdl	bdl	1.08	0.18
Nd146	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Sm147	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Eu153	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Gd157	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Tb159	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Dy163	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Ho165	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Er166	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Tm169	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Yb172	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Hf178	bdl	bdl	0.82	bdl	bdl	0.20	bdl	0.82	0.17
Ta181	6.18	3.39	21.71	0.85	3.71	11.58	0.85	21.71	7.90
W182	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Pb206	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Pb207	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Pb208	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Th232	bdl	bdl	bdl	bdl	0.03	bdl	bdl	0.03	0.01
U235	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
U238	bdl	bdl	bdl	bdl	0.08	bdl	bdl	0.08	0.01