

S1 Sample description

In the following paragraphs are provided detailed description of the study samples as well as tables summarizing their metamorphic evolution.

S1.1 IC - FG1324 Omphacite, garnet, glaucophane and rutile micaschist (Settimo Vittone, Valle d'Aosta).

- 5 Mode: quartz ~ 40%, phengite ~20%, omphacite ~15% glaucophane ~10%, garnet ~10% + minor epidote, chlorite, albite, rutile, opaques and zircon.

It displays a foliation with a spacing <mm marked by phengite, glaucophane and omphacite.

Glaucophane has a rim of green amphibole; omphacite is rimmed by albite + white mica. The garnet is 0.2-0.5 mm in size.

Allanite is aligned in the main foliation and rimmed by epidote. It preserves pre-Alpine monazite at the core.

10

MINERAL	Pre	Foliation	Post
QUARTZ		—	
PHENGITE	- - - -	—	
GLAUCOPHANE		- - - -	- - - -
OMPHACITE		- - - -	
GARNET	- - - -	- - - -	
EPIDOTE		Allanite - - - -	Epidote - - - -

Table S1: Metamorphic evolution of sample FG1324.

S1.2 IC - FG1315 Garnet, epidote and rutile quartz-micaschist (Rechantier, Lys Valley).

Mode: quartz ~ 50%, micas (2/3 phengite, 1/3 paragonite) ~30%, garnet ~15%, minor epidote, chlorite, albite; accessory rutile, graphite, and zircon.

- 15 A strong foliation is highlighted by with quartz rich bands and phengite and paragonite rich layers with spacing <1 mm. In the field a stretching lineation is well visible, marked by micas and quartz as confirmed below the optical microscope where the quartz crystals show an optical preferred orientation. Garnet is from ca. 100 µm to several mm in size, with a pre-Alpine core and several Alpine rims. Atoll garnet occurs with phengite and quartz located inside the core. Allanite crystals are elongated in the main foliation; they show a clinzoisite rim, some tens of microns in size, and rare relics of pre-Alpine 20 monazite preserved in the core. Chlorite and albite mark greenschist retrogression.

MINERAL	Pre	Foliation	Post
QUARTZ	- - - -	—	—
WHITE MICAS	- - - -	—	- - - -
GARNET	—	—	
EPIDOTE		Allanite	Clinozoisite
CHLORITE		—	—
RUTILE	—	—	
ALBITE			—

Table S2: Metamorphic evolution of sample FG1315.

S1.3: IC - FG12157 Garnet, glaucophane, epidote and rutile micaschist (Lillianes, Lys Valley).

Mode: quartz ~ 40%, phengite ~30%, garnet ~15%, ~10% glaucophane + epidote, remaining ~5% chlorite, albite, rutile,

5 zircon, titanite, ilmenite and graphite.

The foliation is marked by phengite, glaucophane and allanite and is subsequently deformed by open folds. The glaucophane shows two growth zones, the second of which is more pleochroic (darker blue compared to the first one) with higher iron content than the first generation. Some crystals are rimmed by green amphibole. The allanite crystals show a core and one or two rims; these are rimmed by clinozoisite, some tens of microns in size.

10 The garnet (from ca. 100 µm to several mm in size) displays a pre-Alpine core and several Alpine rims.

Chlorite and albite occur marking the greenschist retrogression. Rutile is overgrown by titanite with ilmenite as outermost rim.

MINERAL		Foliation		Open folds	
PHENGITE	- - - -	—		—	
QUARTZ		- - - -			
GARNET	- - - -	- - - -	- - - -		
GLAUCOPHANE	- - - -	- - - -			
ALLANITE	- - - -	- - - -			
CHLORITE			- - - -	—	- - - -

RUTILE	-----	-----			
TITANITE			-----	-----	
ALBITE					-----

Table S3: Metamorphic evolution of sample FG12157.

S1.4 IC - FG1347 Chloritoid, garnet and rutile micaschist (Liévanere, Aosta Valley).

Mode: quartz ~ 35%, micas (mostly phengite with minor paragonite) ~25%, chloritoid ~15% garnet ~15%, remaining ~10% epidote, chlorite, rutile, opaques and zircon.

- 5 The main foliation is marked by phengite, paragonite, chloritoid, allanite and rutile and wraps around large garnet porphyroblasts. In the field is visible a strong stretching lineation marked by the chloritoid. The chloritoid is present in two generations: the first marking the main foliation, the younger of which is poikiloblastic and includes the main foliation. The garnet (from ca. 100 µm to several mm in size) has a pre-Alpine core and several Alpine rims. Pre-Alpine monazites (100-200 µm) are preserved at the core of allanite and are partially overgrown by allanite and apatite symplectites. Allanite is
10 rimmed by clinzoisite. Chlorite grows at the expense of the garnet rim and along brittle fractures.

MINERAL	Pre	Foliation	Post
QUARTZ		---	
WHITE MICAS	---	---	
CHLORITOID		1 st generation ---	2 nd generation ---
GARNET	---	---	
RUTILE		---	
EPIDOTE		Allanite ---	Clinzoisite -----

Table S4: Metamorphic evolution of sample FG1347.

S1.5 IC - FG1249 Garnet, epidote and rutile micaschist (Faye, Lys Valley).

Mode: quartz ~ 40%, micas (2/3 phengite, 1/3 paragonite) ~40%, garnet ~15%, remaining ~5% epidote, chlorite, albite, rutile, glaucophane, zircon and opaques.

- 15 The foliation is marked by the preferred orientation of phengite, paragonite, allanite, rutile and wraps around garnet porphyrocrysts. Allanite is present in two generations and is rimmed by epidote; it rarely preserves monazite (probably pre-Alpine) at the core. The garnet (from ca. 100 µm to several mm in size) shows pre-Alpine core and several Alpine rims.

Rare glaucophane is partially overgrown by albite and green amphibole. Chlorite and albite occur marking the greenschist retrogression.

MINERAL	Pre	Foliation	Post
WHITE MICAS	—	—	
QUARTZ		—	
GARNET	—		
EPIDOTE		Allanite	Epidote
RUTILE	- - - -	—	
ALBITE			—
GLAUCOPHANE	- - - -		

Table S5: Metamorphic evolution of sample FG1249.

S1.6 EC - FG1420 Garnet orthogneiss (Mont Crabun, Nantey Valley, Aosta Valley).

- 5 Mode: quartz ~ 35%, phengite ~35%, albite ~15%; garnet ~5%, remaining ~10% chlorite, epidote, K-feldspar, biotite, titanite, zircon, opaques and apatite.

This sample shows a millimetric foliation marked by phengite and chlorite.

The garnet has a grain size up to one centimetre and a red colour in the outcrop. It overgrows a foliation marked by quartz, epidote and titanite, discordant with the main foliation, and shows magmatic allanite as inclusions. The garnet crystals are wrapped by the main foliation; in the pressure shadows crystallize quartz, chlorite and phengite.

- 10 Alpine allanite has a grain size up to 100 µm and is rimmed by epidote. Rare monazite of few microns is visible at the core of the Alpine allanite.

MINERAL			Pre	Main foliation	Post
PHENGITE			—	—	
QUARTZ		—		—	
GARNET			—		
EPIDOTE	Magm Aln —	Ep —	Met Aln - - - -	Ep - - - -	Ep —
CHLORITE				—	—
ALBITE			- - - -	—	—
TITANITE		—	- - - -	- - - -	- - - -

Table S6 Metamorphic evolution of sample FG1420.**S1.7 EC -FG12107 Leucogneiss (summit of Mt Crabun, Aosta Valley).**

Mode: albite ~ 40%, phengite ~30%, quartz ~20%; remaining ~10% epidote, chlorite, actinolite, titanite, zircon and sulphides.

- 5 The foliation is marked by albite, phengite and chlorite.

Alpine allanite has a grain size up to one hundred microns and is rimmed by epidote.

MINERAL	Pre	Main foliation	Post
ALBITE		—	
PHENGITE	—	—	
QUARTZ		—	
EPIDOTE	Met Aln - - - -	Ep - - - -	Ep —
CHLORITE		—	—
ACTINOLITE		- - - -	- - - -
TITANITE	- - - -	- - - -	- - - -

Table S7 Metamorphic evolution of sample FG12107.

COMPLEX	SAMPLE	UTM ED 1950, 32N X/Y (m)	
IC	FG1324	409039	5045383
IC	FG1315	408514	5051580
IC	FG12157	409683	5054033
IC	FG1247	406318	5052474
IC	FG1249	406637	5053931
EC	FG1420	405188	5057108
EC	FG12107	405452	5057561

Table S8 Location of the studied samples.

- 10 **S2 Compositional maps for the garnet end-members of sample FG1420**

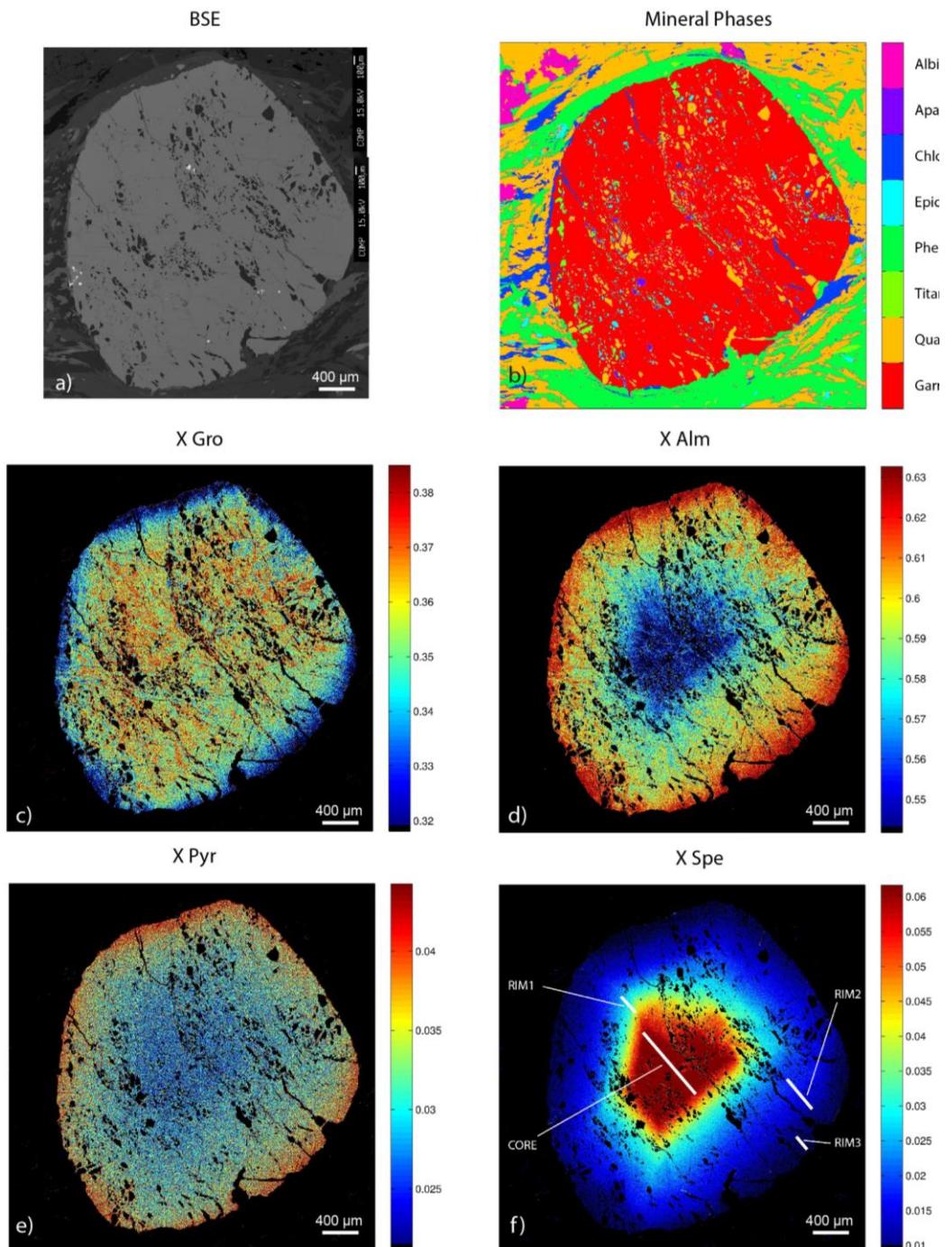


Figure S1: Millimetric garnet in sample FG1420. a) BSE picture. b) Mineral phases X-ray map. c) d), e) and f) Standardized X-ray map for the X_{Grs} , X_{Alm} , X_{Pyr} and X_{Spe} maps respectively. Note the garnet zoning reflects continuous growth well visible from X_{Spe} .

S3 Mineral compositions

In the Excel document (S3 Mineral compositions) tables are reported the mineral compositions of the main phases and compared with the modeled compositions. Furthermore, in the tables are also provided the predicted assemblages for the different stages as well as the bulk compositions used.

5 S4 Thermodynamic database

In the Excel document (S4 Thermodynamic database) is available the thermodynamic database used for the computation of the *Isochemical phase diagrams*

S5 Chlorite and white mica multi-equilibrium

Chl-Phg-Qtz equilibria used for modeling:

- 4 Clinochlore + 4 Daphnite - 5 Fe-Amesite + 5 Mg-Amesite
- 14 alpha-Quartz - 4 Daphnite + 5 Fe-Amesite + 3 Mg-Amesite - 6 Sudoite + 8 WATER
- 10 Mg-Celadonite + 15 alpha-Quartz - 2 Daphnite + 10 Fe-Celadonite + 2 Mg-Amesite - 4 Pyrophyllite + Sudoite
- 75 alpha-Quartz - 2 Clinochlore + 2 Daphnite - 10 Fe-Celadonite + 10 Muscovite - 20 Pyrophyllite + 5 Sudoite
- 5 Mg-Celadonite + Clinochlore + 4 Daphnite - 5 Fe-Amesite + 5 Muscovite
- 2 Fe-Amesite - 8 Fe-Celadonite + 13 Mg-Amesite + 8 Muscovite + 14 Pyrophyllite - 26 Sudoite + 30 WATER

10 S6 Modelling methods used for each sample

SAMPLE	Method used				
	GrtMod	Garnet isopleths (Theriak)	Si apfu in Phe (Theriak)	X _{Mg} in Phe (Theriak)	Chl-Wm multiequilibria
FG1324		X	X	X	
FG1315	X		X	X	X
FG12157	X		X	X	X
FG1247	X		X	X	X
FG1249	X		X	X	
FG1420	X		X	X	X

Table S9: Summary of the modelling method used for each sample.

S7 XRF analyses of major elements

MAJOR ELEMENTS wt - %	Internal Complex					External Complex	
	FG1324	FG1315	FG1347	FG12157	FG1249	FG1420	FG12107
SiO ₂	67.18	64.09	58.47	60.36	58.82	60.44	73.65
TiO ₂	0.69	0.95	1.12	1.03	1.03	0.71	0.04
Al ₂ O ₃	14.36	17.12	20.39	16.51	18.87	19.04	14.94
Fe ₂ O ₃	5.8	7.78	9.94	8.84	9.58	6.13	0.69
MnO	0.08	0.08	0.08	0.1	0.23	0.11	0.01

MgO	2.58	2.34	2.85	3.29	2.76	2.13	0.24
CaO	1.93	0.72	0.39	2.09	1.6	2.1	0.37
Na2O	2.8	1.05	0.54	1.19	0.88	1.73	7.14
K2O	2.71	3.13	3.26	3.57	3.94	4.6	1.41
P2O5	0.18	0.1	0.1	0.14	0.13	0.21	0.1
LOI	1.36	2.06	2.44	2.01	1.58	2.73	0.67
Cr2O3	0.01	0.01	0.02	0.02	0.02	0	0
NiO	0	0.01	0.01	0.01	0.01	0	0
Sum	99.69	99.43	99.6	99.15	99.44	99.94	99.25

Table S10: XRF analyses of major elements of the studied samples

S8 GRTMOD results

S8.1 FG1315

STAGE 1/4

5

*** New computation (see details below)

PARAMETERS -----

	Alm	Gro	Pyr	Spe
10 FIT:	0.685	0.037	0.279	0.000
WEIGHT:	4430	420	1240	90

*** OPTIMIZATION 1

15

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	600	600	800	800	0	0	0	0	0	0
P:	8000	16000	8000	16000	0	0	0	0	0	0

20

LIMITS -----

	MIN	MAX
V1:	2.000	40.000

25

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 600 & P0 = 8000

30

... OPTIMIZATION COMPLETED (91 s)...

SI(1.0666)AL(0.33582)FE(0.097286)MN(0)MG(0.058065)CA(0.012839)NA(0.033882)TI(0.0122)K(0.066454)H(1)O(?)O(
0) * FG13-15

TC = 751.4749 & P = 8234.707

5 Composition of GARNET: Alm(0.68451) # Gro(0.03653) # Pyr(0.27896) # Spe(0)

Volume fraction of GARNET = 13.9441 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0288/2.7165 (in g/ccm)

Residue = 4.3869e-05

10

--> SOLUTION (residue is lower than STOL [0.05])

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[1] ##

15

TC0 = 600 & P0 = 16000

... OPTIMIZATION COMPLETED (168 s)...

20

SI(1.0666)AL(0.33582)FE(0.097286)MN(0)MG(0.058065)CA(0.012839)NA(0.033882)TI(0.0122)K(0.066454)H(1)O(?)O(
0) * FG13-15

TC = 841.308 & P = 12277.9744

Composition of GARNET: Alm(0.626) # Gro(0.042072) # Pyr(0.33193) # Spe(0)

25

Volume fraction of GARNET = 17.6388 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9833/2.7137 (in g/ccm)

Residue = 0.079171

30

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 800 & P0 = 8000

... OPTIMIZATION COMPLETED (52 s)...

SI(1.0666)AL(0.33582)FE(0.097286)MN(0)MG(0.058065)CA(0.012839)NA(0.033882)TI(0.0122)K(0.066454)H(1)O(?)O(

5 0) * FG13-15

TC = 751.2221 & P = 8235.3091

Composition of GARNET: Alm(0.68441) # Gro(0.036561) # Pyr(0.27903) # Spe(0)

Volume fraction of GARNET = 13.9517 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

10 Density of GARNET/MATRIX = 4.0288/2.7166 (in g/ccm)

Residue = 0.00016974

--> SOLUTION (residue is lower than STOL [0.05])

15

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 800 & P0 = 16000

20 ... OPTIMIZATION COMPLETED (103 s)...

SI(1.0666)AL(0.33582)FE(0.097286)MN(0)MG(0.058065)CA(0.012839)NA(0.033882)TI(0.0122)K(0.066454)H(1)O(?)O(

0) * FG13-15

25 TC = 844.6368 & P = 12366.6987

Composition of GARNET: Alm(0.62599) # Gro(0.042133) # Pyr(0.33187) # Spe(0)

Volume fraction of GARNET = 17.641 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9831/2.714 (in g/ccm)

30 Residue = 0.079139

>> STAGE[1] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.0666)AL(0.33582)FE(0.097286)MN(0)MG(0.058065)CA(0.012839)NA(0.033882)TI(0.0122)K(0.066454)H(1)O(?)O(0)
0) * FG13-15
T = 751.4749 & P = 8234.707
Res = 4.3869e-05

5

--> Loop [1] - (8)

--> Loop [2] - (2)

--> Loop [3] - (2)

--> Loop [4] - (2)

10 --> Loop [5] - (2)

--> Loop [6] - (2)

--> Loop [7] - (2)

--> Loop [8] - (2)

--> Loop [9] - (1)

15 --> Loop [10] - (1)

--> Loop [11] - (1)

--> Loop [12] - (1)

--> Loop [13] - (0)

20

Garn Volume = 13.9441 +/- 0.94294 vol-%

STAGE 2/4

25

*** New computation (see details below)

PARAMETERS -----

	Alm	Gro	Pyr	Spe
--	-----	-----	-----	-----

30 FIT: 0.607 0.187 0.206 0.000

WEIGHT: 3800 2520 940 65

==> GO FAST MODE (OPTI = 2 # OPTPP: 650 - 15000)

*** OPTIMIZATION 2

5 INPUT VARIABLES -----
1 2 3 4 5 6 7 8 9 10
TC: 650 0 0 0 0 0 0 0 0 0
P: 15000 0 0 0 0 0 0 0 0 0
X1: 10.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

10 LIMITS -----
MIN MAX
V1: 10.000 10.500
V2: 1.000 99.000

15

>> RUN 1/1 ## OPTIMIZATION 2 ## STAGE[2] ##

TC0 = 650 & P0 = 15000
20 X0-1 = 10.25

... OPTIMIZATION COMPLETED (50 s)...

25 SI(1.141)AL(0.32202)FE(0.039565)MN(0)MG(0.037668)CA(0.011056)NA(0.039624)TI(0.014246)K(0.077681)H(1)O(?)O
(0) * FG13-15
TC = 649.0793 & P = 15249.0795
X-1 = 10.2558

30 Composition of GARNET: Alm(0.60727) # Gro(0.18631) # Pyr(0.20642) # Spe(0)
Volume fraction of GARNET = 5.5414 (in vol-% of the system)
Subsystem volume fraction = 89.7442 (in vol-% of the system)
Density of GARNET/MATRIX = 3.9931/2.7885 (in g/ccm)
Residue = 0.00086729

--> SOLUTION (residue is lower than STOL [0.05])

5 >> STAGE[2] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.141)AL(0.32202)FE(0.039565)MN(0)MG(0.037668)CA(0.011056)NA(0.039624)TI(0.014246)K(0.077681)H(1)O(?)O
(0) * FG13-15

T = 649.0793 & P = 15249.0795

10 X-1 = 10.2558

Res = 0.00086729

--> Loop [1] - (5)

--> Loop [2] - (2)

15 --> Loop [3] - (1)

--> Loop [4] - (1)

--> Loop [5] - (1)

--> Loop [6] - (1)

--> Loop [7] - (1)

20 --> Loop [8] - (1)

--> Loop [9] - (1)

--> Loop [10] - (0)

25 Garn Volume = 5.5414 +/- 0.21724 vol-%

STAGE 3/4

*** New computation (see details below)

30

PARAMETERS -----

	Alm	Gro	Pyr	Spe
--	-----	-----	-----	-----

FIT:	0.647	0.115	0.238	0.000
------	-------	-------	-------	-------

WEIGHT:	4200	1670	1030	75
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==> GO FAST MODE (OPTI = 2 # OPTP: 650 - 19000)

5

*** OPTIMIZATION 2

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
10	TC:	650	0	0	0	0	0	0	0	0
	P:	19000	0	0	0	0	0	0	0	0
	X1:	7.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	X2:	2.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

15 LIMITS -----

	MIN	MAX
	V1: 7.900	8.000
	V2: 2.900	3.000
	V3: 1.000	99.000

20

>> RUN 1/1 ## OPTIMIZATION 2 ## STAGE[3] ##

TC0 = 650 & P0 = 19000

25 X0-1 = 7.95

X0-2 = 2.95

... OPTIMIZATION COMPLETED (80 s)...

30

SI(1.1997)AL(0.33842)FE(0.043621)MN(0)MG(0.041576)CA(0.0074192)NA(0.041674)TI(0.014983)K(0.081709)H(1)O(?)
O(0) * FG13-15

TC = 649.9722 & P = 19030.6611

X-1 = 7.9614

X-2 = 2.9519

Composition of GARNET: Alm(0.64732) # Gro(0.11516) # Pyr(0.23752) # Spe(0)

Volume fraction of GARNET = 5.6115 (in vol-% of the system)

5 Subsystem volume fraction = 89.0867 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0335/2.8163 (in g/ccm)

Residue = 1.9486e-05

--> SOLUTION (residue is lower than STOL [0.05])

10

>> STAGE[3] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.1997)AL(0.33842)FE(0.043621)MN(0)MG(0.041576)CA(0.0074192)NA(0.041674)TI(0.014983)K(0.081709)H(1)O(?)

15)O(0) * FG13-15

T = 649.9722 & P = 19030.6611

X-1 = 7.9614

X-2 = 2.9519

Res = 1.9486e-05

20

--> Loop [1] - (8)

--> Loop [2] - (8)

--> Loop [3] - (8)

--> Loop [4] - (8)

25 --> Loop [5] - (2)

--> Loop [6] - (2)

--> Loop [7] - (2)

--> Loop [8] - (1)

--> Loop [9] - (1)

30 --> Loop [10] - (1)

--> Loop [11] - (1)

--> Loop [12] - (1)

--> Loop [13] - (1)

--> Loop [14] - (1)

--> Loop [15] - (0)

Garn Volume = 5.6115 +/- 0.089461 vol-%

5

STAGE 4/4

*** New computation (see details below)

10

PARAMETERS -----

	Alm	Gro	Pyr	Spe
FIT:	0.698	0.058	0.244	0.000
WEIGHT:	4450	820	1170	50

15

20

*** OPTIMIZATION 2

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	650	0	0	0	0	0	0	0	0	0
P:	18000	0	0	0	0	0	0	0	0	0
X1:	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X2:	2.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X3:	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

30

LIMITS -----

	MIN	MAX
V1:	3.000	4.000
V2:	2.000	2.500
V3:	2.000	3.000

V4: 1.000 99.000

>> RUN 1/1 ## OPTIMIZATION 2 ## STAGE[4] ##

5

TC0 = 650 & P0 = 18000

X0-1 = 3.5

X0-2 = 2.25

X0-3 = 2.5

10

... OPTIMIZATION COMPLETED (185 s)...

SI(1.2007)AL(0.35037)FE(0.064528)MN(0)MG(0.050027)CA(0.0068852)NA(0.040645)TI(0.01462)K(0.079631)H(1)O(?)

15 O(0) * FG13-15

TC = 669.7767 & P = 18016.5718

X-1 = 3.0049

X-2 = 2.5

X-3 = 2.5002

20 ----

Composition of GARNET: Alm(0.6667) # Gro(0.074809) # Pyr(0.25849) # Spe(0)

Volume fraction of GARNET = 8.6335 (in vol-% of the system)

Subsystem volume fraction = 91.9949 (in vol-% of the system)

Density of GARNET/MATRIX = 4.045/2.8084 (in g/ccm)

25 Residue = 0.037977

--> SOLUTION (residue is lower than STOL [0.05])

30 >> STAGE[4] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.2007)AL(0.35037)FE(0.064528)MN(0)MG(0.050027)CA(0.0068852)NA(0.040645)TI(0.01462)K(0.079631)H(1)O(?)

O(0) * FG13-15

T = 669.7767 & P = 18016.5718

X-1 = 3.0049

X-2 = 2.5

X-3 = 2.5002

Res = 0.037977

5

--> Loop [1] - (8)

--> Loop [2] - (8)

--> Loop [3] - (7)

--> Loop [4] - (6)

10 --> Loop [5] - (6)

--> Loop [6] - (6)

--> Loop [7] - (5)

--> Loop [8] - (5)

--> Loop [9] - (5)

15 --> Loop [10] - (5)

--> Loop [11] - (5)

--> Loop [12] - (5)

--> Loop [13] - (5)

--> Loop [14] - (5)

20 --> Loop [15] - (5)

--> Loop [16] - (3)

--> Loop [17] - (3)

--> Loop [18] - (3)

--> Loop [19] - (2)

25 --> Loop [20] - (2)

--> Loop [21] - (2)

--> Loop [22] - (1)

--> Loop [23] - (1)

--> Loop [24] - (1)

30 --> Loop [25] - (1)

--> Loop [26] - (1)

--> Loop [27] - (1)

--> Loop [28] - (1)

--> Loop [29] - (1)

--> Loop [30] - (1)
--> Loop [31] - (1)
--> Loop [32] - (1)
--> Loop [33] - (1)
5 --> Loop [34] - (1)
 --> Loop [35] - (1)
 --> Loop [36] - (1)
 --> Loop [37] - (1)
 --> Loop [38] - (0)

10

Garn Volume = 8.6335 +/- 0.57618 vol-%

15

| FINAL RESULTS |

20

-> GARNET RESORPTION (vol-%)

	Grt1	Grt2	Grt3	Grt4	Total
Stage 1	0.000	0.000	0.000	0.000	0.000
Stage 2	3.688	0.000	0.000	0.000	3.688
Stage 4	4.956	0.452	3.111	0.000	8.520

-> VOLUME OF GARNET (vol-%)

	Grt1	Grt2	Grt3	Grt4	Total
30 Stage 1 13.944 0.000 0.000 0.000 13.944					
Stage 2	10.256	5.541	0.000	0.000	15.797
Stage 3	7.961	2.952	5.612	0.000	16.525
Stage 4	3.005	2.500	2.500	8.634	16.639

-> NEWLY GROWN GARNET (vol-%)

	Grt1	Grt2	Grt3	Grt4	Total
Stage 1	13.944	0.000	0.000	0.000	13.944
Stage 2	0.000	5.541	0.000	0.000	5.541
5 Stage 3	0.000	0.000	5.612	0.000	5.612
Stage 4	0.000	0.000	0.000	8.634	8.634

-> ROCK DENSITY (g/ccm)

	Density
10 Stage 1	2.900
Stage 2	2.982
Stage 3	3.016
Stage 4	3.012

15

S8.2 FG12 157

STAGE 1/3

5

*** New computation (see details below)

PARAMETERS -----

	Alm	Gro	Pyr	Spe
10 FIT:	0.703	0.040	0.257	0.000
WEIGHT:	3750	420	1270	18

***** OPTIMIZATION 1**

15

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	600	600	800	800	0	0	0	0	0	0
P:	8000	16000	8000	16000	0	0	0	0	0	0

20

LIMITS -----

	MIN	MAX
V1:	4.000	40.000

25

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 600 & P0 = 8000

30

... OPTIMIZATION COMPLETED (69 s)...

SI(1.0045)AL(0.32385)FE(0.11065)MN(0)MG(0.081638)CA(0.037268)NA(0.038399)TI(0.013228)K(0.075796)H(1)O(?)O
(0) * FG12-157

TC = 851.0042 & P = 6030.8838

5 Composition of GARNET: Alm(0.68719) # Gro(0.0528) # Pyr(0.26001) # Spe(0)

Volume fraction of GARNET = 10.5029 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0135/2.6347 (in g/ccm)

Residue = 0.020631

10

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 600 & P0 = 16000

15

... OPTIMIZATION COMPLETED (106 s)...

SI(1.0045)AL(0.32385)FE(0.11065)MN(0)MG(0.081638)CA(0.037268)NA(0.038399)TI(0.013228)K(0.075796)H(1)O(?)O

20 (0) * FG12-157

TC = 674.5178 & P = 17494.4874

Composition of GARNET: Alm(0.62343) # Gro(0.11082) # Pyr(0.26575) # Spe(0)

Volume fraction of GARNET = 19.8226 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

25 Density of GARNET/MATRIX = 4.0096/2.8739 (in g/ccm)

Residue = 0.10696

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[1] ##

30

TC0 = 800 & P0 = 8000

... OPTIMIZATION COMPLETED (75 s)...

SI(1.0045)AL(0.32385)FE(0.11065)MN(0)MG(0.081638)CA(0.037268)NA(0.038399)TI(0.013228)K(0.075796)H(1)O(?)O
(0) * FG12-157

TC = 899.9797 & P = 6141.6123

5 Composition of GARNET: Alm(0.69316) # Gro(0.050473) # Pyr(0.25636) # Spe(0)

Volume fraction of GARNET = 7.1092 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0124/2.6775 (in g/ccm)

Residue = 0.014518

10

--> SOLUTION (residue is lower than STOL [0.02])

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[1] ##

15

TC0 = 800 & P0 = 16000

... OPTIMIZATION COMPLETED (90 s)...

20

SI(1.0045)AL(0.32385)FE(0.11065)MN(0)MG(0.081638)CA(0.037268)NA(0.038399)TI(0.013228)K(0.075796)H(1)O(?)O

(0) * FG12-157

TC = 899.555 & P = 6173.7573

Composition of GARNET: Alm(0.69057) # Gro(0.050494) # Pyr(0.25894) # Spe(0)

25

Volume fraction of GARNET = 7.3815 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0106/2.6758 (in g/ccm)

Residue = 0.016456

30

--> SOLUTION (residue is lower than STOL [0.02])

>> STAGE[1] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.0045)AL(0.32385)FE(0.11065)MN(0)MG(0.081638)CA(0.037268)NA(0.038399)TI(0.013228)K(0.075796)H(1)O(?)O
(0) * FG12-157

T = 899.9797 & P = 6141.6123

Res = 0.014518

5

--> Loop [1] - (5)

--> Loop [2] - (3)

--> Loop [3] - (1)

--> Loop [4] - (1)

10

--> Loop [5] - (1)

--> Loop [6] - (1)

--> Loop [7] - (1)

--> Loop [8] - (1)

--> Loop [9] - (0)

15

Garn Volume = 7.1092 +/- 2.3824 vol-%

STAGE 2/3

20

*** New computation (see details below)

PARAMETERS -----

Alm Gro Pyr Spe

25 FIT: 0.642 0.158 0.200 0.000

WEIGHT: 3280 1820 980 10

==> GO FAST MODE (OPTI = 2 # OPTP: 650 - 16000)

30

*** OPTIMIZATION 2

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	650	0	0	0	0	0	0	0	0	0
P:	16000	0	0	0	0	0	0	0	0	0
X1:	5.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5

LIMITS -----

	MIN	MAX
V1:	4.000	7.109
V2:	3.000	99.000

10

>> RUN 1/1 ## OPTIMIZATION 2 ## STAGE[2] ##

TC0 = 650 & P0 = 16000

15

X0-1 = 5.5546

... OPTIMIZATION COMPLETED (82 s)...

20 SI(1.0381)AL(0.3157)FE(0.08112)MN(0)MG(0.074582)CA(0.038422)NA(0.041752)TI(0.014351)K(0.082684)H(1)O(?)O(0)
0) * FG12-157

TC = 649.4117 & P = 16067.5674

X-1 = 5.7325

25 Composition of GARNET: Alm(0.64172) # Gro(0.1582) # Pyr(0.20008) # Spe(0)
Volume fraction of GARNET = 10.8101 (in vol-% of the system)
Subsystem volume fraction = 94.2675 (in vol-% of the system)
Density of GARNET/MATRIX = 4.0214/2.8581 (in g/ccm)
Residue = 6.8726e-06

30

--> SOLUTION (residue is lower than STOL [0.02])

>> STAGE[2] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.0381)AL(0.3157)FE(0.08112)MN(0)MG(0.074582)CA(0.038422)NA(0.041752)TI(0.014351)K(0.082684)H(1)O(?)O(

0) * FG12-157

T = 649.4117 & P = 16067.5674

5 X-1 = 5.7325

Res = 6.8726e-06

--> Loop [1] - (5)

--> Loop [2] - (3)

10 --> Loop [3] - (2)

--> Loop [4] - (0)

Garn Volume = 10.8101 +/- 0.65117 vol-%

15 ##### STAGE 3/3 #####

*** New computation (see details below)

PARAMETERS -----

20 Alm Gro Pyr Spe

FIT: 0.595 0.238 0.167 0.000

WEIGHT: 3000 2920 720 8

25 *** OPTIMIZATION 1

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
--	---	---	---	---	---	---	---	---	---	----

TC: 600 600 800 800 0 0 0 0 0 0

30 P: 8000 16000 8000 16000 0 0 0 0 0 0

LIMITS -----

	MIN	MAX
--	-----	-----

V1: 4.000 5.733

V2: 3.000 10.810

V3: 4.000 99.000

ADJUSTEMENTS -----

5 VOL (%)

GRT-1: 5.733

GRT-2: 10.810

10 >> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[3] ##

TC0 = 600 & P0 = 8000

... OPTIMIZATION COMPLETED (7 s)...

15

TC = 600 & P = 8000

Volume fraction of GARNET = 0 (in vol-% of the system)

Subsystem volume fraction = 83.4574 (in vol-% of the system)

20 Density of GARNET/MATRIX = 0/2.7514 (in g/ccm)

Residue = 1000000000000000000000000

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[3] ##

25

TC0 = 600 & P0 = 16000

... OPTIMIZATION COMPLETED (40 s)...

30

TC = 600 & P = 16000

Volume fraction of GARNET = 0.76372 (in vol-% of the system)

Subsystem volume fraction = 83.4574 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0532/2.8706 (in g/ccm)

Residue = 100000000000000000000000

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[3] ##

5

TC0 = 800 & P0 = 8000

... OPTIMIZATION COMPLETED (7 s)...

10

TC = 800 & P = 8000

Volume fraction of GARNET = 0 (in vol-% of the system)

Subsystem volume fraction = 83.4574 (in vol-% of the system)

Density of GARNET/MATRIX = 0/2.6916 (in g/ccm)

15

Residue = 100000000000000000000000

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[3] ##

20

TC0 = 800 & P0 = 16000

... OPTIMIZATION COMPLETED (88 s)...

25

SI(1.1866)AL(0.32552)FE(0.036522)MN(0)MG(0.072833)CA(0.030967)NA(0.051572)TI(0.017672)K(0.10261)H(1)O(?)O

(0) * FG12-157

TC = 753.5268 & P = 15695.1843

Composition of GARNET: Alm(0.49993) # Gro(0.23025) # Pyr(0.26981) # Spe(0)

Volume fraction of GARNET = 4.0001 (in vol-% of the system)

30

Subsystem volume fraction = 83.4574 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9017/2.7801 (in g/ccm)

Residue = 0.1403

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

...

==> SOLUTION (1) is selected for OPTIMIZATION 2

5

*** OPTIMIZATION 2

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
10 TC:	754	754	754	0	0	0	0	0	0	0
P:	15695	15695	15695	0	0	0	0	0	0	0
X1:	5.73	4.00	4.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X2:	10.81	3.00	6.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00

15 LIMITS -----

MIN MAX

V1:	4.000	5.733
V2:	3.000	10.810
V3:	4.000	99.000

20

>> RUN 1/3 ## OPTIMIZATION 2 ## STAGE[3] ##

TC0 = 753.5268 & P0 = 15695.1843

25 X0-1 = 5.7325

X0-2 = 10.81

... OPTIMIZATION COMPLETED (70 s)...

30

SI(1.1866)AL(0.32552)FE(0.036522)MN(0)MG(0.072833)CA(0.030967)NA(0.051572)TI(0.017672)K(0.10261)H(1)O(?)O
(0) * FG12-157

TC = 753.5268 & P = 15695.1843

X-1 = 5.7325

X-2 = 10.81

Composition of GARNET: Alm(0.49993) # Gro(0.23025) # Pyr(0.26981) # Spe(0)

Volume fraction of GARNET = 4.0001 (in vol-% of the system)

5 Subsystem volume fraction = 83.4574 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9017/2.7801 (in g/ccm)

Residue = 0.1403

10 >> RUN 2/3 ## OPTIMIZATION 2 ## STAGE[3] ##

TC0 = 753.5268 & P0 = 15695.1843

X0-1 = 4

X0-2 = 3

15

... OPTIMIZATION COMPLETED (104 s)...

SI(1.0814)AL(0.32411)FE(0.077852)MN(0)MG(0.076966)CA(0.036195)NA(0.044012)TI(0.015121)K(0.087223)H(1)O(?)

20 O(0) * FG12-157

TC = 644.9681 & P = 14011.2544

X-1 = 4.2544

X-2 = 3.4846

25 Composition of GARNET: Alm(0.59485) # Gro(0.23835) # Pyr(0.1668) # Spe(0)

Volume fraction of GARNET = 10.5829 (in vol-% of the system)

Subsystem volume fraction = 92.2611 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9803/2.7853 (in g/ccm)

Residue = 2.3182e-05

30

--> SOLUTION (residue is lower than STOL [0.02])

>> RUN 3/3 ## OPTIMIZATION 2 ## STAGE[3] ##

TC0 = 753.5268 & P0 = 15695.1843

X0-1 = 4.8663

X0-2 = 6.905

5

... OPTIMIZATION COMPLETED (94 s)...

SI(1.1282)AL(0.32452)FE(0.058889)MN(0)MG(0.074792)CA(0.034369)NA(0.047394)TI(0.016262)K(0.094108)H(1)O(?)

10 O(0) * FG12-157

TC = 645.0055 & P = 14012.9406

X-1 = 5.4197

X-2 = 6.4712

15 Composition of GARNET: Alm(0.59483) # Gro(0.23831) # Pyr(0.16686) # Spe(0)

Volume fraction of GARNET = 6.4999 (in vol-% of the system)

Subsystem volume fraction = 88.1091 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9803/2.7942 (in g/ccm)

Residue = 6.0703e-05

20

--> SOLUTION (residue is lower than STOL [0.02])

>> STAGE[3] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

25

SI(1.0814)AL(0.32411)FE(0.077852)MN(0)MG(0.076966)CA(0.036195)NA(0.044012)TI(0.015121)K(0.087223)H(1)O(?)

O(0) * FG12-157

T = 644.9681 & P = 14011.2544

X-1 = 4.2544

30 X-2 = 3.4846

Res = 2.3182e-05

--> Loop [1] - (8)

--> Loop [2] - (5)

--> Loop [3] - (1)
--> Loop [4] - (1)
--> Loop [5] - (1)
--> Loop [6] - (1)
5 --> Loop [7] - (1)
 --> Loop [8] - (1)
 --> Loop [9] - (1)
 --> Loop [10] - (1)
 --> Loop [11] - (1)
10 --> Loop [12] - (0)

Garn Volume = 10.5829 +/- 0.44435 vol-%

15

| FINAL RESULTS |

20

-> GARNET RESORPTION (vol-%)

	Grt1	Grt2	Grt3	Total
Stage 1	0.000	0.000	0.000	0.000
Stage 2	1.377	0.000	0.000	1.377
25 Stage 3	1.478	7.325	0.000	8.804

-> VOLUME OF GARNET (vol-%)

	Grt1	Grt2	Grt3	Total
Stage 1	7.109	0.000	0.000	7.109
30 Stage 2	5.733	10.810	0.000	16.543
Stage 3	4.254	3.485	10.583	18.322

-> NEWLY GROWN GARNET (vol-%)

Grt1 Grt2 Grt3 Total

Stage 1	7.109	0.000	0.000	7.109
Stage 2	0.000	10.810	0.000	10.810
Stage 3	0.000	0.000	10.583	10.583

5 -> ROCK DENSITY (g/ccm)

Density

Stage 1	2.772
Stage 2	3.050
Stage 3	3.007

10

S8.3 FG1347

5

STAGE 1/4

*** New computation (see details below)

10 PARAMETERS -----

	Alm	Gro	Pyr	Spe
FIT:	0.691	0.032	0.277	0.000
WEIGHT:	2750	300	750	40

15

*** OPTIMIZATION 1

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	600	600	800	800	0	0	0	0	0	0
P:	8000	16000	8000	16000	0	0	0	0	0	0

LIMITS -----

	MIN	MAX
V1:	4.000	40.000

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[1] ##

30 TC0 = 600 & P0 = 8000

... OPTIMIZATION COMPLETED (83 s)...

SI(0.97304)AL(0.39996)FE(0.12443)MN(0)MG(0.07072)CA(0.0069544)NA(0.017425)TI(0.014384)K(0.069214)H(1)O(?)
O(0) * FG13-47

TC = 705.0263 & P = 8003.5795

5 Composition of GARNET: Alm(0.69151) # Gro(0.032246) # Pyr(0.27624) # Spe(0)

Volume fraction of GARNET = 18.252 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0391/2.7883 (in g/ccm)

Residue = 0.0011576

10

--> SOLUTION (residue is lower than STOL [0.05])

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[1] ##

15

TC0 = 600 & P0 = 16000

... OPTIMIZATION COMPLETED (87 s)...

20

SI(0.97304)AL(0.39996)FE(0.12443)MN(0)MG(0.07072)CA(0.0069544)NA(0.017425)TI(0.014384)K(0.069214)H(1)O(?)
O(0) * FG13-47

TC = 601.162 & P = 19995.8322

Composition of GARNET: Alm(0.67695) # Gro(0.039309) # Pyr(0.28374) # Spe(0)

25

Volume fraction of GARNET = 21.9181 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0662/2.884 (in g/ccm)

Residue = 0.01684

30

--> SOLUTION (residue is lower than STOL [0.05])

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 800 & P0 = 8000

... OPTIMIZATION COMPLETED (38 s)...

5

SI(0.97304)AL(0.39996)FE(0.12443)MN(0)MG(0.07072)CA(0.0069544)NA(0.017425)TI(0.014384)K(0.069214)H(1)O(?)
O(0) * FG13-47

TC = 776.9141 & P = 8144.5313

Composition of GARNET: Alm(0.69899) # Gro(0.031917) # Pyr(0.26909) # Spe(0)

10 Volume fraction of GARNET = 17.6632 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0367/2.754 (in g/ccm)

Residue = 0.011508

15 --> SOLUTION (residue is lower than STOL [0.05])

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[1] ##

20 TC0 = 800 & P0 = 16000

... OPTIMIZATION COMPLETED (80 s)...

25 SI(0.97304)AL(0.39996)FE(0.12443)MN(0)MG(0.07072)CA(0.0069544)NA(0.017425)TI(0.014384)K(0.069214)H(1)O(?)
O(0) * FG13-47

TC = 601.039 & P = 19991.5756

Composition of GARNET: Alm(0.67695) # Gro(0.039309) # Pyr(0.28374) # Spe(0)

Volume fraction of GARNET = 21.918 (in vol-% of the system)

30 Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0662/2.884 (in g/ccm)

Residue = 0.01684

--> SOLUTION (residue is lower than STOL [0.05])

>> STAGE[1] ## AUTO-REFINEMENT - SOLUTION (1/3 - Optimization: 1)

5 SI(0.97304)AL(0.39996)FE(0.12443)MN(0)MG(0.07072)CA(0.0069544)NA(0.017425)TI(0.014384)K(0.069214)H(1)O(?)
O(0) * FG13-47
T = 705.0263 & P = 8003.5795
Res = 0.0011576

10 --> Loop [1] - (8)

--> Loop [2] - (5)

--> Loop [3] - (3)

--> Loop [4] - (2)

--> Loop [5] - (2)

15 --> Loop [6] - (2)

--> Loop [7] - (2)

--> Loop [8] - (2)

--> Loop [9] - (0)

20

Garn Volume = 18.252 +/- 2.3052 vol-%

>> STAGE[1] ## AUTO-REFINEMENT - SOLUTION (2/3 - Optimization: 2)

25 SI(0.97304)AL(0.39996)FE(0.12443)MN(0)MG(0.07072)CA(0.0069544)NA(0.017425)TI(0.014384)K(0.069214)H(1)O(?)
O(0) * FG13-47

T = 601.162 & P = 19995.8322

Res = 0.01684

30

--> Loop [1] - (3)

--> Loop [2] - (3)

--> Loop [3] - (3)

--> Loop [4] - (3)

```
--> Loop [5] - (3)
--> Loop [6] - (3)
--> Loop [7] - (3)
--> Loop [8] - (3)
5   --> Loop [9] - (3)
    --> Loop [10] - (2)
    --> Loop [11] - (2)
    --> Loop [12] - (2)
    --> Loop [13] - (2)
10  --> Loop [14] - (2)
    --> Loop [15] - (2)
    --> Loop [16] - (2)
    --> Loop [17] - (1)
    --> Loop [18] - (1)
15  --> Loop [19] - (0)
```

Garn Volume = 21.9181 +/- 3.3808 vol-%

```
20
>> STAGE[1] ## AUTO-REFINEMENT - SOLUTION (3/3 - Optimization: 3)

SI(0.97304)AL(0.39996)FE(0.12443)MN(0)MG(0.07072)CA(0.0069544)NA(0.017425)TI(0.014384)K(0.069214)H(1)O(?)
O(0) * FG13-47
25  T = 776.9141 & P = 8144.5313
    Res = 0.011508

    --> Loop [1] - (8)
    --> Loop [2] - (7)
30  --> Loop [3] - (7)
    --> Loop [4] - (4)
    --> Loop [5] - (3)
    --> Loop [6] - (1)
    --> Loop [7] - (1)
```

--> Loop [8] - (1)
--> Loop [9] - (1)
--> Loop [10] - (1)
--> Loop [11] - (1)
5 --> Loop [12] - (1)
 --> Loop [13] - (1)
 --> Loop [14] - (1)
 --> Loop [15] - (1)
 --> Loop [16] - (1)
10 --> Loop [17] - (1)
 --> Loop [18] - (1)
 --> Loop [19] - (1)
 --> Loop [20] - (0)

15

Garn Volume = 17.6632 +/- 2.8008 vol-%

STAGE 2/4

20 *** New computation (see details below)

PARAMETERS -----

Alm Gro Pyr Spe

FIT: 0.663 0.111 0.226 0.000

25 WEIGHT: 2600 1050 550 50

*** OPTIMIZATION 1

30 INPUT VARIABLES -----

1 2 3 4 5 6 7 8 9 10

TC: 600 600 800 800 0 0 0 0 0

P: 8000 16000 8000 16000 0 0 0 0 0

5 LIMITS -----

	MIN	MAX
V1:	4.000	17.663
V2:	1.000	99.000

5

10 ADJUSTEMENTS -----

	VOL (%)
GRT-1:	17.663

10

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 600 & P0 = 8000

15

... OPTIMIZATION COMPLETED (14 s)...

TC = 600 & P = 8000

Volume fraction of GARNET = 0.6232 (in vol-% of the system)

20

Subsystem volume fraction = 82.3368 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0183/2.79 (in g/ccm)

Residue = 1000000000000000000000000

25

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 600 & P0 = 16000

... OPTIMIZATION COMPLETED (84 s)...

30

SI(1.0817)AL(0.39466)FE(0.026614)MN(0)MG(0.038027)CA(0.0027491)NA(0.022904)TI(0.018826)K(0.090912)H(1)O(?)
O(0) * FG13-47

TC = 590.6289 & P = 19998.6217

Composition of GARNET: Alm(0.64585) # Gro(0.12541) # Pyr(0.22874) # Spe(0)

Volume fraction of GARNET = 2.0954 (in vol-% of the system)

Subsystem volume fraction = 82.3368 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0408/2.8889 (in g/ccm)

5 Residue = 0.022388

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

10 >> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 800 & P0 = 8000

... OPTIMIZATION COMPLETED (82 s)...

15

SI(1.0817)AL(0.39466)FE(0.026614)MN(0)MG(0.038027)CA(0.0027491)NA(0.022904)TI(0.018826)K(0.090912)H(1)O(?)
O(0) * FG13-47

TC = 806.4223 & P = 9045.2645

20 Composition of GARNET: Alm(0.63587) # Gro(0.04907) # Pyr(0.31506) # Spe(0)

Volume fraction of GARNET = 1.0444 (in vol-% of the system)

Subsystem volume fraction = 82.3368 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9873/2.7417 (in g/ccm)

Residue = 0.11243

25

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[2] ##

30

TC0 = 800 & P0 = 16000

... OPTIMIZATION COMPLETED (66 s)...

SI(1.0817)AL(0.39466)FE(0.026614)MN(0)MG(0.038027)CA(0.0027491)NA(0.022904)TI(0.018826)K(0.090912)H(1)O(?)
O(0) * FG13-47

TC = 590.8106 & P = 19986.4189

5 Composition of GARNET: Alm(0.64577) # Gro(0.1246) # Pyr(0.22963) # Spe(0)

Volume fraction of GARNET = 2.1089 (in vol-% of the system)

Subsystem volume fraction = 82.3368 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0407/2.8887 (in g/ccm)

Residue = 0.022101

10

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

...

==> SOLUTION (3) is selected for OPTIMIZATION 2

15

*** OPTIMIZATION 2

INPUT VARIABLES -----

20 1 2 3 4 5 6 7 8 9 10
TC: 591 591 591 0 0 0 0 0 0 0
P: 19986 19986 19986 0 0 0 0 0 0 0
X1: 17.66 4.00 10.83 0.00 0.00 0.00 0.00 0.00 0.00 0.00

25 LIMITS -----

 MIN MAX

V1: 4.000 17.663

V2: 1.000 99.000

30

>> RUN 1/3 ## OPTIMIZATION 2 ## STAGE[2] ##

TC0 = 590.8106 & P0 = 19986.4189

X0-1 = 17.6632

... OPTIMIZATION COMPLETED (16 s)...

5 SI(1.0817)AL(0.39466)FE(0.026614)MN(0)MG(0.038027)CA(0.0027491)NA(0.022904)TI(0.018826)K(0.090912)H(1)O(?)
O(0) * FG13-47

TC = 590.8106 & P = 19986.4189

X-1 = 17.6632

10 Composition of GARNET: Alm(0.64577) # Gro(0.1246) # Pyr(0.22963) # Spe(0)

Volume fraction of GARNET = 2.1089 (in vol-% of the system)

Subsystem volume fraction = 82.3368 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0407/2.8887 (in g/ccm)

Residue = 0.022101

15

--> SOLUTION (residue is lower than STOL [0.05])

>> RUN 2/3 ## OPTIMIZATION 2 ## STAGE[2] ##

20

TC0 = 590.8106 & P0 = 19986.4189

X0-1 = 4

... OPTIMIZATION COMPLETED (171 s)...

25

SI(1.0522)AL(0.3961)FE(0.053224)MN(0)MG(0.046921)CA(0.0038932)NA(0.021413)TI(0.017617)K(0.085009)H(1)O(?)
O(0) * FG13-47

TC = 595.021 & P = 14884.0748

30 X-1 = 13.5069

Composition of GARNET: Alm(0.66302) # Gro(0.11144) # Pyr(0.22554) # Spe(0)

Volume fraction of GARNET = 3.4736 (in vol-% of the system)

Subsystem volume fraction = 86.4931 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0423/2.8583 (in g/ccm)

Residue = 1.9218e-05

--> SOLUTION (residue is lower than STOL [0.05])

5

>> RUN 3/3 ## OPTIMIZATION 2 ## STAGE[2] ##

TC0 = 590.8106 & P0 = 19986.4189

10 X0-1 = 10.8316

... OPTIMIZATION COMPLETED (113 s)...

15 SI(1.0701)AL(0.39522)FE(0.037098)MN(0)MG(0.041531)CA(0.0031998)NA(0.022317)TI(0.01835)K(0.088586)H(1)O(?)
O(0) * FG13-47

TC = 592.6305 & P = 19088.5935

X-1 = 16.0743

20 Composition of GARNET: Alm(0.66303) # Gro(0.11141) # Pyr(0.22556) # Spe(0)

Volume fraction of GARNET = 2.7956 (in vol-% of the system)

Subsystem volume fraction = 83.9257 (in vol-% of the system)

Density of GARNET/MATRIX = 4.052/2.8847 (in g/ccm)

Residue = 3.1559e-05

25

--> SOLUTION (residue is lower than STOL [0.05])

>> STAGE[2] ## AUTO-REFINEMENT - SOLUTION (1/3 - Optimization: 1)

30

SI(1.0817)AL(0.39466)FE(0.026614)MN(0)MG(0.038027)CA(0.0027491)NA(0.022904)TI(0.018826)K(0.090912)H(1)O(?)
O(0) * FG13-47

T = 590.8106 & P = 19986.4189

X-1 = 17.6632

Res = 0.022101

--> Loop [1] - (1)
--> Loop [2] - (1)
5 --> Loop [3] - (1)
--> Loop [4] - (1)
--> Loop [5] - (1)
--> Loop [6] - (1)
--> Loop [7] - (0)

10

Garn Volume = 2.1089 +/- 0.13773 vol-%

15 >> STAGE[2] ## AUTO-REFINEMENT - SOLUTION (2/3 - Optimization: 2)

SI(1.0522)AL(0.3961)FE(0.053224)MN(0)MG(0.046921)CA(0.0038932)NA(0.021413)TI(0.017617)K(0.085009)H(1)O(?)

O(0) * FG13-47

T = 595.021 & P = 14884.0748

20 X-1 = 13.5069

Res = 1.9218e-05

--> Loop [1] - (5)
--> Loop [2] - (2)
25 --> Loop [3] - (2)
--> Loop [4] - (2)
--> Loop [5] - (2)
--> Loop [6] - (2)
--> Loop [7] - (2)
30 --> Loop [8] - (2)
--> Loop [9] - (2)
--> Loop [10] - (2)
--> Loop [11] - (2)
--> Loop [12] - (2)

--> Loop [13] - (1)
--> Loop [14] - (1)
--> Loop [15] - (1)
--> Loop [16] - (1)
5 --> Loop [17] - (1)
--> Loop [18] - (0)

Garn Volume = 3.4736 +/- 0.33789 vol-%

10

>> STAGE[2] ## AUTO-REFINEMENT - SOLUTION (3/3 - Optimization: 3)

SI(1.0701)AL(0.39522)FE(0.037098)MN(0)MG(0.041531)CA(0.0031998)NA(0.022317)TI(0.01835)K(0.088586)H(1)O(?)

15 O(0) * FG13-47

T = 592.6305 & P = 19088.5935

X-1 = 16.0743

Res = 3.1559e-05

20 --> Loop [1] - (2)
--> Loop [2] - (2)
--> Loop [3] - (2)
--> Loop [4] - (2)
--> Loop [5] - (2)

25 --> Loop [6] - (1)
--> Loop [7] - (1)
--> Loop [8] - (0)

30 Garn Volume = 2.7956 +/- 0.41006 vol-%

STAGE 3/4

*** New computation (see details below)

PARAMETERS -----

Alm Gro Pyr Spe

FIT: 0.681 0.059 0.260 0.000

5 WEIGHT: 2630 630 700 50

*** OPTIMIZATION 1

10 INPUT VARIABLES -----

1 2 3 4 5 6 7 8 9 10

TC: 600 600 800 800 0 0 0 0 0

P: 8000 16000 8000 16000 0 0 0 0 0

15 LIMITS -----

MIN MAX

V1: 4.000 16.074

V2: 1.000 2.796

V3: 1.000 99.000

20

ADJUSTEMENTS -----

VOL (%)

GRT-1: 16.074

GRT-2: 2.796

25

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[3] ##

TC0 = 600 & P0 = 8000

30

... OPTIMIZATION COMPLETED (22 s)...

TC = 600 & P = 8000

Volume fraction of GARNET = 0.54416 (in vol-% of the system)

Subsystem volume fraction = 81.1301 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0226/2.7877 (in g/ccm)

Residue = 100000000000000000000000

5

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[3] ##

TC0 = 600 & P0 = 16000

10

... OPTIMIZATION COMPLETED (120 s)...

15

SI(1.1682)AL(0.42663)FE(0.030306)MN(0)MG(0.042696)CA(0.00097975)NA(0.024707)TI(0.020308)K(0.098067)H(1)O(?)O(0) * FG13-47

TC = 619.4268 & P = 11010.0781

Composition of GARNET: Alm(0.65198) # Gro(0.077232) # Pyr(0.27079) # Spe(0)

Volume fraction of GARNET = 1.0686 (in vol-% of the system)

Subsystem volume fraction = 81.1301 (in vol-% of the system)

20

Density of GARNET/MATRIX = 4.0238/2.8114 (in g/ccm)

Residue = 0.035499

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

25

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[3] ##

TC0 = 800 & P0 = 8000

30

... OPTIMIZATION COMPLETED (48 s)...

SI(1.1682)AL(0.42663)FE(0.030306)MN(0)MG(0.042696)CA(0.00097975)NA(0.024707)TI(0.020308)K(0.098067)H(1)O(?)O(0) * FG13-47

TC = 839.9219 & P = 7994.1406

Composition of GARNET: Alm(0.63617) # Gro(0.013768) # Pyr(0.35007) # Spe(0)

Volume fraction of GARNET = 1.001 (in vol-% of the system)

Subsystem volume fraction = 81.1301 (in vol-% of the system)

5 Density of GARNET/MATRIX = 3.9828/2.7393 (in g/ccm)

Residue = 0.11045

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

10

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[3] ##

TC0 = 800 & P0 = 16000

15

... OPTIMIZATION COMPLETED (101 s)...

SI(1.1682)AL(0.42663)FE(0.030306)MN(0)MG(0.042696)CA(0.00097975)NA(0.024707)TI(0.020308)K(0.098067)H(1)O(?)O(0) * FG13-47

20 TC = 599.4087 & P = 18963.2648

Composition of GARNET: Alm(0.68067) # Gro(0.059484) # Pyr(0.25985) # Spe(0)

Volume fraction of GARNET = 1.4178 (in vol-% of the system)

Subsystem volume fraction = 81.1301 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0661/2.8832 (in g/ccm)

25 Residue = 7.5372e-05

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

...

30 ==> SOLUTION (3) is selected for OPTIMIZATION 2

*** OPTIMIZATION 2

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	599	599	599	0	0	0	0	0	0	0
P:	18963	18963	18963	0	0	0	0	0	0	0
5 X1:	16.07	4.00	10.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X2:	2.80	1.00	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00

LIMITS -----

	MIN	MAX
--	-----	-----

10 V1:	4.000	16.074
V2:	1.000	2.796
V3:	1.000	99.000

15 >> RUN 1/3 ## OPTIMIZATION 2 ## STAGE[3] ##

TC0 = 599.4087 & P0 = 18963.2648

X0-1 = 16.0743

X0-2 = 2.7956

20 ... OPTIMIZATION COMPLETED (53 s)...

25 SI(1.1682)AL(0.42663)FE(0.030306)MN(0)MG(0.042696)CA(0.00097975)NA(0.024707)TI(0.020308)K(0.098067)H(1)O(?)O(0) * FG13-47

TC = 599.4087 & P = 18967.8945

X-1 = 16.0743

X-2 = 2.7956

30 Composition of GARNET: Alm(0.68069) # Gro(0.059412) # Pyr(0.2599) # Spe(0)

Volume fraction of GARNET = 1.4196 (in vol-% of the system)

Subsystem volume fraction = 81.1301 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0662/2.8833 (in g/ccm)

Residue = 1.5605e-05

--> SOLUTION (residue is lower than STOL [0.05])

5 >> RUN 2/3 ## OPTIMIZATION 2 ## STAGE[3] ##

TC0 = 599.4087 & P0 = 18963.2648

X0-1 = 4

X0-2 = 1

10

... OPTIMIZATION COMPLETED (231 s)...

SI(1.0441)AL(0.41048)FE(0.091914)MN(0)MG(0.061146)CA(0.0048778)NA(0.020022)TI(0.016497)K(0.079505)H(1)O(?)

15)O(0) * FG13-47

TC = 603.4396 & P = 16235.2343

X-1 = 6.6293

X-2 = 1.0084

20 Composition of GARNET: Alm(0.68734) # Gro(0.052259) # Pyr(0.26041) # Spe(0)

Volume fraction of GARNET = 9.8518 (in vol-% of the system)

Subsystem volume fraction = 92.3623 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0649/2.8693 (in g/ccm)

Residue = 0.0097853

25

--> SOLUTION (residue is lower than STOL [0.05])

>> RUN 3/3 ## OPTIMIZATION 2 ## STAGE[3] ##

30

TC0 = 599.4087 & P0 = 18963.2648

X0-1 = 10.0372

X0-2 = 1.8978

... OPTIMIZATION COMPLETED (140 s)...

SI(1.1138)AL(0.41947)FE(0.056971)MN(0)MG(0.050408)CA(0.003162)NA(0.022659)TI(0.018642)K(0.089954)H(1)O(?)
5 O(0) * FG13-47
TC = 601.0983 & P = 17929.5727
X-1 = 12.8969
X-2 = 1.3604

10 Composition of GARNET: Alm(0.68069) # Gro(0.059427) # Pyr(0.25989) # Spe(0)
Volume fraction of GARNET = 5.0057 (in vol-% of the system)
Subsystem volume fraction = 85.7427 (in vol-% of the system)
Density of GARNET/MATRIX = 4.0636/2.8765 (in g/ccm)
Residue = 5.5221e-06
15 --> SOLUTION (residue is lower than STOL [0.05])

>> STAGE[3] ## AUTO-REFINEMENT - SOLUTION (1/3 - Optimization: 1)

20 SI(1.1682)AL(0.42663)FE(0.030306)MN(0)MG(0.042696)CA(0.00097975)NA(0.024707)TI(0.020308)K(0.098067)H(1)O(?)
O(0) * FG13-47
T = 599.4087 & P = 18967.8945
X-1 = 16.0743
25 X-2 = 2.7956
Res = 1.5605e-05

--> Loop [1] - (2)
--> Loop [2] - (2)
30 --> Loop [3] - (2)
--> Loop [4] - (2)
--> Loop [5] - (1)
--> Loop [6] - (1)
--> Loop [7] - (1)

--> Loop [8] - (0)

Garn Volume = 1.4196 +/- 0.38169 vol-%

5

>> STAGE[3] ## AUTO-REFINEMENT - SOLUTION (2/3 - Optimization: 2)

SI(1.0441)AL(0.41048)FE(0.091914)MN(0)MG(0.061146)CA(0.0048778)NA(0.020022)TI(0.016497)K(0.079505)H(1)O(?)

10)O(0) * FG13-47

T = 603.4396 & P = 16235.2343

X-1 = 6.6293

X-2 = 1.0084

Res = 0.0097853

15

--> Loop [1] - (4)

--> Loop [2] - (2)

--> Loop [3] - (2)

--> Loop [4] - (2)

20 --> Loop [5] - (2)

--> Loop [6] - (2)

--> Loop [7] - (2)

--> Loop [8] - (2)

--> Loop [9] - (2)

25 --> Loop [10] - (2)

--> Loop [11] - (2)

--> Loop [12] - (2)

--> Loop [13] - (2)

--> Loop [14] - (2)

30 --> Loop [15] - (2)

--> Loop [16] - (2)

--> Loop [17] - (2)

--> Loop [18] - (1)

--> Loop [19] - (1)

```
--> Loop [20] - (1)
--> Loop [21] - (1)
--> Loop [22] - (1)
--> Loop [23] - (1)
5   --> Loop [24] - (1)
--> Loop [25] - (1)
--> Loop [26] - (1)
--> Loop [27] - (1)
--> Loop [28] - (1)
10  --> Loop [29] - (0)
```

Garn Volume = 9.8518 +/- 1.4243 vol-%

15

```
>> STAGE[3] ## AUTO-REFINEMENT - SOLUTION (3/3 - Optimization: 3)
```

```
SI(1.1138)AL(0.41947)FE(0.056971)MN(0)MG(0.050408)CA(0.003162)NA(0.022659)TI(0.018642)K(0.089954)H(1)O(?)
O(0) * FG13-47
```

```
20  T = 601.0983 & P = 17929.5727
X-1 = 12.8969
X-2 = 1.3604
Res = 5.5221e-06
```

```
25  --> Loop [1] - (2)
--> Loop [2] - (2)
--> Loop [3] - (2)
--> Loop [4] - (2)
--> Loop [5] - (2)
30  --> Loop [6] - (2)
--> Loop [7] - (2)
--> Loop [8] - (2)
--> Loop [9] - (1)
--> Loop [10] - (0)
```

Garn Volume = 5.0057 +/- 1.005 vol-%

5 ##### STAGE 4/4 #####

*** New computation (see details below)

PARAMETERS -----

10 Alm Gro Pyr Spe

FIT: 0.700 0.042 0.258 0.000

WEIGHT: 2680 400 700 50

15 *** OPTIMIZATION 1

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
--	---	---	---	---	---	---	---	---	---	----

TC: 600 600 800 800 0 0 0 0 0 0

20 P: 8000 16000 8000 16000 0 0 0 0 0 0

LIMITS -----

	MIN	MAX
--	-----	-----

V1: 4.000 12.897

25 V2: 1.000 1.360

V3: 1.000 5.006

V4: 1.000 99.000

ADJUSTEMENTS -----

30 VOL (%)

GRT-1: 12.897

GRT-2: 1.360

GRT-3: 5.006

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[4] ##

TC0 = 600 & P0 = 8000

5

... OPTIMIZATION COMPLETED (19 s)...

TC = 600 & P = 8000

10 Volume fraction of GARNET = 0.58487 (in vol-% of the system)
Subsystem volume fraction = 80.737 (in vol-% of the system)
Density of GARNET/MATRIX = 4.0279/2.8013 (in g/ccm)
Residue = 1000000000000000000000000

15

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[4] ##

TC0 = 600 & P0 = 16000

20 ... OPTIMIZATION COMPLETED (64 s)...

SI(1.2715)AL(0.46684)FE(0.037634)MN(0)MG(0.048238)CA(0.0010956)NA(0.026763)TI(0.022001)K(0.10623)H(1)O(?)
O(0) * FG13-47

25 TC = 598.2604 & P = 19990.3279
Composition of GARNET: Alm(0.69531) # Gro(0.043477) # Pyr(0.26122) # Spe(0)
Volume fraction of GARNET = 1.9832 (in vol-% of the system)
Subsystem volume fraction = 80.737 (in vol-% of the system)
Density of GARNET/MATRIX = 4.0802/2.8913 (in g/ccm)
30 Residue = 0.0055315

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[4] ##

TC0 = 800 & P0 = 8000

5 ... OPTIMIZATION COMPLETED (95 s)...

SI(1.2715)AL(0.46684)FE(0.037634)MN(0)MG(0.048238)CA(0.0010956)NA(0.026763)TI(0.022001)K(0.10623)H(1)O(?)
O(0) * FG13-47

10 TC = 796.6492 & P = 8772.2936

Composition of GARNET: Alm(0.68058) # Gro(0.020115) # Pyr(0.2993) # Spe(0)

Volume fraction of GARNET = 1.0104 (in vol-% of the system)

Subsystem volume fraction = 80.737 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0226/2.7487 (in g/ccm)

15 Residue = 0.050095

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

20 >> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[4] ##

TC0 = 800 & P0 = 16000

... OPTIMIZATION COMPLETED (74 s)...

25

SI(1.2715)AL(0.46684)FE(0.037634)MN(0)MG(0.048238)CA(0.0010956)NA(0.026763)TI(0.022001)K(0.10623)H(1)O(?)
O(0) * FG13-47

TC = 598.2613 & P = 19993.0603

30 Composition of GARNET: Alm(0.69528) # Gro(0.043435) # Pyr(0.26128) # Spe(0)

Volume fraction of GARNET = 1.9851 (in vol-% of the system)

Subsystem volume fraction = 80.737 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0802/2.8913 (in g/ccm)

Residue = 0.005576

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

...

5 ==> SOLUTION (1) is selected for OPTIMIZATION 2

*** OPTIMIZATION 2

10 INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	598	598	598	0	0	0	0	0	0	0
P:	19990	19990	19990	0	0	0	0	0	0	0
X1:	12.90	4.00	8.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15 X2:	1.36	1.00	1.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X3:	5.01	1.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

LIMITS -----

MIN MAX

20 V1:	4.000	12.897
V2:	1.000	1.360
V3:	1.000	5.006
V4:	1.000	99.000

25 -----

>> RUN 1/3 ## OPTIMIZATION 2 ## STAGE[4] ##

TC0 = 598.2604 & P0 = 19990.3279

X0-1 = 12.8969

30 X0-2 = 1.3604

X0-3 = 5.0057

... OPTIMIZATION COMPLETED (45 s)...

SI(1.2715)AL(0.46684)FE(0.037634)MN(0)MG(0.048238)CA(0.0010956)NA(0.026763)TI(0.022001)K(0.10623)H(1)O(?)O(0) * FG13-47

TC = 598.2604 & P = 19996.1844

5 X-1 = 12.8969

X-2 = 1.3604

X-3 = 5.0057

Composition of GARNET: Alm(0.69531) # Gro(0.043397) # Pyr(0.26129) # Spe(0)

10 Volume fraction of GARNET = 1.9869 (in vol-% of the system)

Subsystem volume fraction = 80.737 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0803/2.8913 (in g/ccm)

Residue = 0.0055477

15 --> SOLUTION (residue is lower than STOL [0.05])

>> RUN 2/3 ## OPTIMIZATION 2 ## STAGE[4] ##

20 TC0 = 598.2604 & P0 = 19990.3279

X0-1 = 4

X0-2 = 1

X0-3 = 1

25 ... OPTIMIZATION COMPLETED (199 s)...

SI(1.0666)AL(0.4217)FE(0.099165)MN(0)MG(0.064623)CA(0.0047333)NA(0.020294)TI(0.016725)K(0.08059)H(1)O(?)O(0) * FG13-47

30 TC = 598.0707 & P = 19967.2379

X-1 = 4.3784

X-2 = 1.1986

X-3 = 1.2956

Composition of GARNET: Alm(0.69978) # Gro(0.0418) # Pyr(0.25842) # Spe(0)
Volume fraction of GARNET = 11.9242 (in vol-% of the system)
Subsystem volume fraction = 93.1275 (in vol-% of the system)
Density of GARNET/MATRIX = 4.0837/2.8939 (in g/ccm)
5 Residue = 3.8961e-06

--> SOLUTION (residue is lower than STOL [0.05])

10 >> RUN 3/3 ## OPTIMIZATION 2 ## STAGE[4] ##

TC0 = 598.2604 & P0 = 19990.3279
X0-1 = 8.4484
X0-2 = 1.1802
15 X0-3 = 3.0028

... OPTIMIZATION COMPLETED (145 s)...

20 SI(1.1531)AL(0.44125)FE(0.07426)MN(0)MG(0.058115)CA(0.0032053)NA(0.022993)TI(0.018926)K(0.091286)H(1)O(?)
O(0) * FG13-47

TC = 598.0286 & P = 19987.4322
X-1 = 8.13
X-2 = 1.2493
25 X-3 = 3.1027

Composition of GARNET: Alm(0.69978) # Gro(0.041797) # Pyr(0.25842) # Spe(0)

Volume fraction of GARNET = 7.1014 (in vol-% of the system)
Subsystem volume fraction = 87.518 (in vol-% of the system)
30 Density of GARNET/MATRIX = 4.0837/2.893 (in g/ccm)
Residue = 5.664e-06

--> SOLUTION (residue is lower than STOL [0.05])

>> STAGE[4] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.2715)AL(0.46684)FE(0.037634)MN(0)MG(0.048238)CA(0.0010956)NA(0.026763)TI(0.022001)K(0.10623)H(1)O(?)

5 O(0) * FG13-47
T = 598.2604 & P = 19996.1844
X-1 = 12.8969
X-2 = 1.3604
X-3 = 5.0057
10 Res = 0.0055477

--> Loop [1] - (1)
--> Loop [2] - (1)
--> Loop [3] - (1)
15 --> Loop [4] - (1)
--> Loop [5] - (1)
--> Loop [6] - (1)
--> Loop [7] - (1)
--> Loop [8] - (0)

20

Garn Volume = 1.9869 +/- 0.26835 vol-%

25

| FINAL RESULTS |

30 -> GARNET RESORPTION (vol-%)

	Grt1	Grt2	Grt3	Grt4	Total
Stage 1	0.000	0.000	0.000	0.000	0.000
Stage 2	1.589	0.000	0.000	0.000	1.589

Stage 3	3.177	1.435	0.000	0.000	4.613
Stage 4	0.000	0.000	0.000	0.000	0.000

-> VOLUME OF GARNET (vol-%)

5		Grt1	Grt2	Grt3	Grt4	Total
	Stage 1	17.663	0.000	0.000	0.000	17.663
	Stage 2	16.074	2.796	0.000	0.000	18.870
	Stage 3	12.897	1.360	5.006	0.000	19.263
	Stage 4	12.897	1.360	5.006	1.987	21.250

10

-> NEWLY GROWN GARNET (vol-%)

		Grt1	Grt2	Grt3	Grt4	Total
	Stage 1	17.663	0.000	0.000	0.000	17.663
	Stage 2	0.000	2.796	0.000	0.000	2.796
15	Stage 3	0.000	0.000	5.006	0.000	5.006
	Stage 4	0.000	0.000	0.000	1.987	1.987

-> ROCK DENSITY (g/ccm)

		Density
20	Stage 1	2.981
	Stage 2	3.103
	Stage 3	3.102
	Stage 4	3.137

25

S8.4 FG1249

STAGE 1/3

5 *** New computation (see details below)

PARAMETERS -----

	Alm	Gro	Pyr	Spe
--	-----	-----	-----	-----

FIT:	0.719	0.049	0.180	0.051
------	-------	-------	-------	-------

10 WEIGHT: 200 210 370 170

***** OPTIMIZATION 1****15 INPUT VARIABLES -----**

	1	2	3	4	5	6	7	8	9	10
--	---	---	---	---	---	---	---	---	---	----

TC:	600	600	800	800	0	0	0	0	0	0
-----	-----	-----	-----	-----	---	---	---	---	---	---

P:	8000	16000	8000	16000	0	0	0	0	0	0
----	------	-------	------	-------	---	---	---	---	---	---

20 LIMITS -----

	MIN	MAX
--	-----	-----

V1:	4.000	40.000
-----	-------	--------

25 >> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 600 & P0 = 8000

... OPTIMIZATION COMPLETED (93 s)...

30

SI(0.97887)AL(0.37015)FE(0.11983)MN(0.0032422)MG(0.068486)CA(0.028531)NA(0.028396)TI(0.013228)K(0.083652)
H(1)O(?)O(0) * FG12-49

TC = 725.5422 & P = 5978.289
Composition of GARNET: Alm(0.71673) # Gro(0.060213) # Pyr(0.18581) # Spe(0.037254)
Volume fraction of GARNET = 9.9935 (in vol-% of the system)
Subsystem volume fraction = 100 (in vol-% of the system)
5 Density of GARNET/MATRIX = 4.0772/2.7606 (in g/ccm)
Residue = 0.018462

--> SOLUTION (residue is lower than STOL [0.04])

10

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 600 & P0 = 16000

15

... OPTIMIZATION COMPLETED (124 s)...

20

SI(0.97887)AL(0.37015)FE(0.11983)MN(0.0032422)MG(0.068486)CA(0.028531)NA(0.028396)TI(0.013228)K(0.083652)
H(1)O(?)O(0) * FG12-49

25

TC = 650.4458 & P = 16852.6554

Composition of GARNET: Alm(0.63782) # Gro(0.12914) # Pyr(0.21452) # Spe(0.018519)

Volume fraction of GARNET = 21.3615 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0347/2.8347 (in g/ccm)

30

Residue = 0.12341

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[1] ##

35

TC0 = 800 & P0 = 8000

... OPTIMIZATION COMPLETED (130 s)...

SI(0.97887)AL(0.37015)FE(0.11983)MN(0.0032422)MG(0.068486)CA(0.028531)NA(0.028396)TI(0.013228)K(0.083652)
H(1)O(?)O(0) * FG12-49

TC = 717.0163 & P = 5682.2602

5 Composition of GARNET: Alm(0.72472) # Gro(0.059205) # Pyr(0.17564) # Spe(0.040435)

Volume fraction of GARNET = 9.1899 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0859/2.7655 (in g/ccm)

Residue = 0.016069

10

--> SOLUTION (residue is lower than STOL [0.04])

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[1] ##

15

TC0 = 800 & P0 = 16000

... OPTIMIZATION COMPLETED (161 s)...

20

SI(0.97887)AL(0.37015)FE(0.11983)MN(0.0032422)MG(0.068486)CA(0.028531)NA(0.028396)TI(0.013228)K(0.083652)
H(1)O(?)O(0) * FG12-49

TC = 716.6699 & P = 5669.1746

Composition of GARNET: Alm(0.72505) # Gro(0.059157) # Pyr(0.17521) # Spe(0.04059)

25

Volume fraction of GARNET = 9.1539 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0863/2.7658 (in g/ccm)

Residue = 0.016188

30

--> SOLUTION (residue is lower than STOL [0.04])

>> STAGE[1] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(0.97887)AL(0.37015)FE(0.11983)MN(0.0032422)MG(0.068486)CA(0.028531)NA(0.028396)TI(0.013228)K(0.083652)
H(1)O(?)O(0) * FG12-49
T = 725.5422 & P = 5978.289
Res = 0.018462

5

--> Loop [1] - (8)

--> Loop [2] - (8)

--> Loop [3] - (5)

--> Loop [4] - (4)

10

--> Loop [5] - (4)

--> Loop [6] - (2)

--> Loop [7] - (2)

--> Loop [8] - (2)

--> Loop [9] - (2)

15

--> Loop [10] - (2)

--> Loop [11] - (2)

--> Loop [12] - (1)

--> Loop [13] - (1)

--> Loop [14] - (0)

20

Garn Volume = 9.9935 +/- 1.6947 vol-%

STAGE 2/3

25

*** New computation (see details below)

PARAMETERS -----

	Alm	Gro	Pyr	Spe
--	-----	-----	-----	-----

FIT:	0.756	0.092	0.152	0.000
------	-------	-------	-------	-------

30

WEIGHT:	200	500	340	22
---------	-----	-----	-----	----

*** OPTIMIZATION 1

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	600	600	800	800	0	0	0	0	0	0
P:	8000	16000	8000	16000	0	0	0	0	0	0

5

LIMITS -----

	MIN	MAX
V1:	8.000	9.990
V2:	2.000	99.000

10

ADJUSTEMENTS -----

VOL (%)
GRT-1: 9.990

15

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 600 & P0 = 8000

20

... OPTIMIZATION COMPLETED (82 s)...

SI(1.0386)AL(0.36384)FE(0.064051)MN(0)MG(0.060799)CA(0.028034)NA(0.032787)TI(0.015291)K(0.09733)H(1)O(?)O
(0) * FG12-49

25

TC = 618.5989 & P = 6606.1645

Composition of GARNET: Alm(0.71506) # Gro(0.11509) # Pyr(0.16984) # Spe(0)

Volume fraction of GARNET = 3.7196 (in vol-% of the system)

Subsystem volume fraction = 90.01 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0599/2.7652 (in g/ccm)

30

Residue = 0.049762

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 600 & P0 = 16000

5 ... OPTIMIZATION COMPLETED (69 s)...

SI(1.0386)AL(0.36384)FE(0.064051)MN(0)MG(0.060799)CA(0.028034)NA(0.032787)TI(0.015291)K(0.09733)H(1)O(?)O
(0) * FG12-49

10 TC = 543.8563 & P = 15239.9585

Composition of GARNET: Alm(0.66794) # Gro(0.21348) # Pyr(0.11858) # Spe(0)

Volume fraction of GARNET = 8.3889 (in vol-% of the system)

Subsystem volume fraction = 90.01 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0492/2.8351 (in g/ccm)

15 Residue = 0.15309

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

20 >> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 800 & P0 = 8000

... OPTIMIZATION COMPLETED (75 s)...

25

SI(1.0386)AL(0.36384)FE(0.064051)MN(0)MG(0.060799)CA(0.028034)NA(0.032787)TI(0.015291)K(0.09733)H(1)O(?)O
(0) * FG12-49

TC = 618.9824 & P = 6607.3634

30 Composition of GARNET: Alm(0.71508) # Gro(0.1148) # Pyr(0.17012) # Spe(0)

Volume fraction of GARNET = 3.7458 (in vol-% of the system)

Subsystem volume fraction = 90.01 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0599/2.7649 (in g/ccm)

Residue = 0.04972

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

5 >> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 800 & P0 = 16000

... OPTIMIZATION COMPLETED (146 s)...

10

SI(1.0386)AL(0.36384)FE(0.064051)MN(0)MG(0.060799)CA(0.028034)NA(0.032787)TI(0.015291)K(0.09733)H(1)O(?)O
(0) * FG12-49

TC = 666.8118 & P = 6605.5321

15 Composition of GARNET: Alm(0.71182) # Gro(0.083985) # Pyr(0.20419) # Spe(0)

Volume fraction of GARNET = 2.6922 (in vol-% of the system)

Subsystem volume fraction = 90.01 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0534/2.767 (in g/ccm)

Residue = 0.068717

20

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

...

==> SOLUTION (3) is selected for OPTIMIZATION 2

25

*** OPTIMIZATION 2

INPUT VARIABLES -----

30	1	2	3	4	5	6	7	8	9	10
TC:	619	619	619	0	0	0	0	0	0	0
P:	6607	6607	6607	0	0	0	0	0	0	0
X1:	9.99	8.00	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

LIMITS -----

	MIN	MAX
V1:	8.000	9.990
V2:	2.000	99.000

5

>> RUN 1/3 ## OPTIMIZATION 2 ## STAGE[2] ##

TC0 = 618.9824 & P0 = 6607.3634

10 X0-1 = 9.99

... OPTIMIZATION COMPLETED (82 s)...

15 SI(1.0384)AL(0.36387)FE(0.064262)MN(0)MG(0.060828)CA(0.028036)NA(0.03277)TI(0.015283)K(0.097278)H(1)O(?)O
(0) * FG12-49

TC = 619.6975 & P = 6608.7438

X-1 = 9.956

20 Composition of GARNET: Alm(0.71513) # Gro(0.11425) # Pyr(0.17062) # Spe(0)

Volume fraction of GARNET = 3.778 (in vol-% of the system)

Subsystem volume fraction = 90.044 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0599/2.7649 (in g/ccm)

Residue = 0.049615

25

>> RUN 2/3 ## OPTIMIZATION 2 ## STAGE[2] ##

TC0 = 618.9824 & P0 = 6607.3634

30 X0-1 = 8

... OPTIMIZATION COMPLETED (88 s)...

SI(1.0257)AL(0.36521)FE(0.076111)MN(0)MG(0.062461)CA(0.028141)NA(0.031837)TI(0.014845)K(0.094372)H(1)O(?)
O(0) * FG12-49

TC = 615.5286 & P = 6116.326

5 X-1 = 8.003

Composition of GARNET: Alm(0.73657) # Gro(0.10603) # Pyr(0.1574) # Spe(0)

Volume fraction of GARNET = 2.0024 (in vol-% of the system)

Subsystem volume fraction = 91.997 (in vol-% of the system)

10 Density of GARNET/MATRIX = 4.0757/2.7971 (in g/ccm)

Residue = 0.024006

--> SOLUTION (residue is lower than STOL [0.04])

15 _____

>> RUN 3/3 ## OPTIMIZATION 2 ## STAGE[2] ##

TC0 = 618.9824 & P0 = 6607.3634

X0-1 = 8.995

20 ... OPTIMIZATION COMPLETED (94 s)...

SI(1.026)AL(0.36517)FE(0.075797)MN(0)MG(0.062417)CA(0.028138)NA(0.031862)TI(0.014857)K(0.09445)H(1)O(?)O(

25 0) * FG12-49

TC = 618.3961 & P = 6620.7806

X-1 = 8.0559

Composition of GARNET: Alm(0.71547) # Gro(0.11448) # Pyr(0.17005) # Spe(0)

30 Volume fraction of GARNET = 5.676 (in vol-% of the system)

Subsystem volume fraction = 91.9441 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0603/2.7665 (in g/ccm)

Residue = 0.049234

```
>> STAGE[2] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.0257)AL(0.36521)FE(0.076111)MN(0)MG(0.062461)CA(0.028141)NA(0.031837)TI(0.014845)K(0.094372)H(1)O(?)  
5   O(0) * FG12-49  
T = 615.5286 & P = 6116.326  
X-1 = 8.003  
Res = 0.024006

10  --> Loop [1] - (8)  
    --> Loop [2] - (7)  
    --> Loop [3] - (5)  
    --> Loop [4] - (5)  
    --> Loop [5] - (4)  
15  --> Loop [6] - (4)  
    --> Loop [7] - (2)  
    --> Loop [8] - (0)

20  Garn Volume = 2.0024 +/- 1.3661 vol-%

##### STAGE 3/3 #####
*** New computation (see details below)
25  PARAMETERS -----
      Alm    Gro    Pyr    Spe
FIT:  0.624  0.176  0.200  0.000
WEIGHT:     160     1400    420      35
30

==> GO FAST MODE (OPTI = 2 # OPTP: 650 - 16000)
```

*** OPTIMIZATION 2

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
5 TC:	650	0	0	0	0	0	0	0	0	0
P:	16000	0	0	0	0	0	0	0	0	0
X1:	7.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X2:	1.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

10 LIMITS -----

	MIN	MAX
V1:	7.000	8.000
V2:	1.900	2.000
V3:	1.000	99.000

15

>> RUN 1/1 ## OPTIMIZATION 2 ## STAGE[3] ##

TC0 = 650 & P0 = 16000

20 X0-1 = 7.5

X0-2 = 1.95

... OPTIMIZATION COMPLETED (94 s)...

25

SI(1.0832)AL(0.38097)FE(0.070374)MN(0)MG(0.064734)CA(0.0286)NA(0.034019)TI(0.015824)K(0.10094)H(1)O(?)O(0)

) * FG12-49

TC = 614.2473 & P = 16347.149

X-1 = 7.7974

30 X-2 = 1.9558

Composition of GARNET: Alm(0.62385) # Gro(0.17604) # Pyr(0.20011) # Spe(0)

Volume fraction of GARNET = 9.9493 (in vol-% of the system)

Subsystem volume fraction = 90.2468 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0121/2.835 (in g/ccm)

Residue = 3.379e-05

--> SOLUTION (residue is lower than STOL [0.04])

5

>> STAGE[3] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.0832)AL(0.38097)FE(0.070374)MN(0)MG(0.064734)CA(0.0286)NA(0.034019)TI(0.015824)K(0.10094)H(1)O(?)O(0)

10) * FG12-49

T = 614.2473 & P = 16347.149

X-1 = 7.7974

X-2 = 1.9558

Res = 3.379e-05

15

--> Loop [1] - (8)

--> Loop [2] - (6)

--> Loop [3] - (4)

--> Loop [4] - (1)

20 --> Loop [5] - (0)

Garn Volume = 9.9493 +/- 0.2293 vol-%

25

STAGE 4/4

*** New computation (see details below)

30

PARAMETERS -----

	Alm	Gro	Pyr	Spe
--	-----	-----	-----	-----

FIT:	0.583	0.231	0.186	0.000
------	-------	-------	-------	-------

WEIGHT:	160	1400	420	35
---------	-----	------	-----	----

*** OPTIMIZATION 1

5 INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	600	600	800	800	0	0	0	0	0	0
P:	8000	16000	8000	16000	0	0	0	0	0	0

10 LIMITS -----

MIN MAX

V1: 7.780 7.790

V2: 1.850 1.900

V3: 3.000 9.000

15 V4: 1.000 99.000

ADJUSTEMENTS -----

VOL (%)

GRT-1: 7.790

20 GRT-2: 1.900

GRT-3: 9.000

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[4] ##

25

TC0 = 600 & P0 = 8000

... OPTIMIZATION COMPLETED (109 s)...

30

SI(1.2916)AL(0.42932)FE(0.038446)MN(0)MG(0.065287)CA(0.02088)NA(0.042853)TI(0.019578)K(0.12788)H(1)O(?)O(0)
0) * FG12-49

TC = 657.3779 & P = 11272.8762

Composition of GARNET: Alm(0.59069) # Gro(0.18782) # Pyr(0.22149) # Spe(0)

Volume fraction of GARNET = 2.8709 (in vol-% of the system)

Subsystem volume fraction = 81.31 (in vol-% of the system)

Density of GARNET/MATRIX = 3.971/2.7711 (in g/ccm)

Residue = 0.056101

5

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[4] ##

10

TC0 = 600 & P0 = 16000

... OPTIMIZATION COMPLETED (73 s)...

15

SI(1.2916)AL(0.42932)FE(0.038446)MN(0)MG(0.065287)CA(0.02088)NA(0.042853)TI(0.019578)K(0.12788)H(1)O(?)O(

0) * FG12-49

TC = 661.6837 & P = 15604.4678

Composition of GARNET: Alm(0.58713) # Gro(0.1922) # Pyr(0.22067) # Spe(0)

20

Volume fraction of GARNET = 4.0509 (in vol-% of the system)

Subsystem volume fraction = 81.31 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9774/2.8017 (in g/ccm)

Residue = 0.05187

25

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[4] ##

30

TC0 = 800 & P0 = 8000

... OPTIMIZATION COMPLETED (9 s)...

TC = 800 & P = 8000

Volume fraction of GARNET = 0 (in vol-% of the system)

Subsystem volume fraction = 81.31 (in vol-% of the system)

Density of GARNET/MATRIX = 0/2.7168 (in g/ccm)

5 Residue = 1000000000000000000000000

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[4] ##

10 TC0 = 800 & P0 = 16000

... OPTIMIZATION COMPLETED (124 s)...

15 SI(1.2916)AL(0.42932)FE(0.038446)MN(0)MG(0.065287)CA(0.02088)NA(0.042853)TI(0.019578)K(0.12788)H(1)O(?)O(0)
0) * FG12-49

TC = 657.4094 & P = 11291.7221

Composition of GARNET: Alm(0.59072) # Gro(0.18784) # Pyr(0.22145) # Spe(0)

Volume fraction of GARNET = 2.8782 (in vol-% of the system)

20 Subsystem volume fraction = 81.31 (in vol-% of the system)

Density of GARNET/MATRIX = 3.971/2.7713 (in g/ccm)

Residue = 0.056067

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

25

...

==> SOLUTION (2) is selected for OPTIMIZATION 2

30 *** OPTIMIZATION 2

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	662	662	662	0	0	0	0	0	0	0

P: 15604 15604 15604 0 0 0 0 0 0 0
X1: 7.79 7.78 7.79 0.00 0.00 0.00 0.00 0.00 0.00 0.00
X2: 1.90 1.85 1.88 0.00 0.00 0.00 0.00 0.00 0.00 0.00
X3: 9.00 3.00 6.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

5

LIMITS -----

	MIN	MAX
V1:	7.780	7.790
V2:	1.850	1.900
V3:	3.000	9.000
V4:	1.000	99.000

10

>> RUN 1/3 ## OPTIMIZATION 2 ## STAGE[4] ##

15

TC0 = 661.6837 & P0 = 15604.4678

X0-1 = 7.79

X0-2 = 1.9

X0-3 = 9

20

... OPTIMIZATION COMPLETED (65 s)...

25

SI(1.2916)AL(0.42932)FE(0.038446)MN(0)MG(0.065287)CA(0.02088)NA(0.042853)TI(0.019578)K(0.12788)H(1)O(?)O(0)
0) * FG12-49

TC = 661.6837 & P = 15607.325

X-1 = 7.79

X-2 = 1.9

X-3 = 9

30

Composition of GARNET: Alm(0.58712) # Gro(0.19228) # Pyr(0.2206) # Spe(0)

Volume fraction of GARNET = 4.0509 (in vol-% of the system)

Subsystem volume fraction = 81.31 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9773/2.8017 (in g/ccm)

Residue = 0.051761

--> SOLUTION (residue is lower than STOL [0.07])

5

>> RUN 2/3 ## OPTIMIZATION 2 ## STAGE[4] ##

TC0 = 661.6837 & P0 = 15604.4678

X0-1 = 7.78

10

X0-2 = 1.85

X0-3 = 3

... OPTIMIZATION COMPLETED (77 s)...

15

SI(1.1775)AL(0.40651)FE(0.06276)MN(0)MG(0.066689)CA(0.026901)NA(0.037678)TI(0.017413)K(0.11202)H(1)O(?)O(

0) * FG12-49

TC = 661.501 & P = 15620.4004

X-1 = 7.7833

20

X-2 = 1.8951

X-3 = 3.0741

Composition of GARNET: Alm(0.5881) # Gro(0.19039) # Pyr(0.22151) # Spe(0)

Volume fraction of GARNET = 8.5979 (in vol-% of the system)

25

Subsystem volume fraction = 87.2476 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9782/2.8004 (in g/ccm)

Residue = 0.053863

--> SOLUTION (residue is lower than STOL [0.07])

30

>> RUN 3/3 ## OPTIMIZATION 2 ## STAGE[4] ##

TC0 = 661.6837 & P0 = 15604.4678

X0-1 = 7.785

X0-2 = 1.875

X0-3 = 6

5 ... OPTIMIZATION COMPLETED (47 s)...

SI(1.2357)AL(0.41807)FE(0.050172)MN(0)MG(0.065929)CA(0.023778)NA(0.04033)TI(0.018521)K(0.12015)H(1)O(?)O(

0) * FG12-49

10 TC = 661.6837 & P = 15616.6588

X-1 = 7.785

X-2 = 1.897

X-3 = 6.225

15 Composition of GARNET: Alm(0.58752) # Gro(0.19122) # Pyr(0.22126) # Spe(0)

Volume fraction of GARNET = 6.0882 (in vol-% of the system)

Subsystem volume fraction = 84.093 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9777/2.8011 (in g/ccm)

Residue = 0.053027

20

--> SOLUTION (residue is lower than STOL [0.07])

>> STAGE[4] ## AUTO-REFINEMENT - SOLUTION (1/2 - Optimization: 1)

25

SI(1.2916)AL(0.42932)FE(0.038446)MN(0)MG(0.065287)CA(0.02088)NA(0.042853)TI(0.019578)K(0.12788)H(1)O(?)O(

0) * FG12-49

T = 661.6837 & P = 15607.325

X-1 = 7.79

30 X-2 = 1.9

X-3 = 9

Res = 0.051761

--> Loop [1] - (6)

--> Loop [2] - (4)
--> Loop [3] - (2)
--> Loop [4] - (2)
--> Loop [5] - (2)

5 --> Loop [6] - (2)
 --> Loop [7] - (2)
 --> Loop [8] - (2)
 --> Loop [9] - (2)
 --> Loop [10] - (2)

10 --> Loop [11] - (2)
 --> Loop [12] - (1)
 --> Loop [13] - (0)

15 Garn Volume = 4.0509 +/- 1.1851 vol-%

>> STAGE[4] ## AUTO-REFINEMENT - SOLUTION (2/2 - Optimization: 2)

20 SI(1.1775)AL(0.40651)FE(0.06276)MN(0)MG(0.066689)CA(0.026901)NA(0.037678)TI(0.017413)K(0.11202)H(1)O(?)O(0)
 * FG12-49
 T = 661.501 & P = 15620.4004
 X-1 = 7.7833
 X-2 = 1.8951

25 X-3 = 3.0741
 Res = 0.053863

--> Loop [1] - (7)
--> Loop [2] - (4)

30 --> Loop [3] - (3)
 --> Loop [4] - (3)
 --> Loop [5] - (2)
 --> Loop [6] - (2)
 --> Loop [7] - (2)

--> Loop [8] - (2)

--> Loop [9] - (2)

--> Loop [10] - (2)

--> Loop [11] - (2)

5 --> Loop [12] - (1)

--> Loop [13] - (0)

Garn Volume = 8.5979 +/- 1.5682 vol-%

10

15 | FINAL RESULTS |

-> GARNET RESORPTION (vol-%)

		Grt1	Grt2	Grt3	Grt4	Total
20	Stage 1	0.000	0.000	0.000	0.000	0.000
	Stage 2	1.990	0.000	0.000	0.000	1.990
	Stage 3	0.206	0.047	0.000	0.000	0.252
	Stage 4	0.014	0.061	6.875	0.000	6.950

25 -> VOLUME OF GARNET (vol-%)

		Grt1	Grt2	Grt3	Grt4	Total
30	Stage 1	9.993	0.000	0.000	0.000	9.993
	Stage 2	8.003	2.002	0.000	0.000	10.005
	Stage 3	7.797	1.956	9.949	0.000	19.703
	Stage 4	7.783	1.895	3.074	8.598	21.350

-> NEWLY GROWN GARNET (vol-%)

		Grt1	Grt2	Grt3	Grt4	Total
	Stage 1	9.993	0.000	0.000	0.000	9.993

Stage 2	0.000	2.002	0.000	0.000	2.002
Stage 3	0.000	0.000	9.949	0.000	9.949
Stage 4	0.000	0.000	0.000	8.598	8.598

5 -> ROCK DENSITY (g/ccm)

Density

Stage 1	2.892
---------	-------

Stage 2	2.925
---------	-------

Stage 3	3.073
---------	-------

10 Stage 4	3.062
------------	-------

S8.5 FG1420

STAGE 1/4

5 *** New computation (see details below)

PARAMETERS -----

Alm	Gro	Pyr	Spe
-----	-----	-----	-----

FIT:	0.539	0.358	0.023	0.080
------	-------	-------	-------	-------

10 WEIGHT: 1380 1850 70 230

***** OPTIMIZATION 1****15 INPUT VARIABLES -----**

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

TC:	525	525	775	775	0	0	0	0	0
-----	-----	-----	-----	-----	---	---	---	---	---

P:	8000	16000	8000	16000	0	0	0	0	0
----	------	-------	------	-------	---	---	---	---	---

20 LIMITS -----

MIN	MAX
-----	-----

V1:	0.000	40.000
-----	-------	--------

25 >> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 525 & P0 = 8000

... OPTIMIZATION COMPLETED (155 s)...

30

SI(1.0058)AL(0.37348)FE(0.076688)MN(0.0015506)MG(0.052854)CA(0.037447)NA(0.055824)TI(0.0091182)K(0.097665)
H(1)O(?)O(0) * FG14-20

TC = 486.1073 & P = 5795.2668
Composition of GARNET: Alm(0.52405) # Gro(0.34499) # Pyr(0.034969) # Spe(0.095996)
Volume fraction of GARNET = 1.8272 (in vol-% of the system)
Subsystem volume fraction = 100 (in vol-% of the system)
5 Density of GARNET/MATRIX = 3.994/2.784 (in g/ccm)
Residue = 0.028182

--> SOLUTION (residue is lower than STOL [0.05])

10

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 525 & P0 = 16000

15

... OPTIMIZATION COMPLETED (106 s)...

20

SI(1.0058)AL(0.37348)FE(0.076688)MN(0.0015506)MG(0.052854)CA(0.037447)NA(0.055824)TI(0.0091182)K(0.097665)
H(1)O(?)O(0) * FG14-20

TC = 454.6997 & P = 16133.2122

Composition of GARNET: Alm(0.62229) # Gro(0.24582) # Pyr(0.035216) # Spe(0.096672)

Volume fraction of GARNET = 1.8653 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0965/2.9281 (in g/ccm)

25

Residue = 0.14168

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[1] ##

30

TC0 = 775 & P0 = 8000

... OPTIMIZATION COMPLETED (120 s)...

SI(1.0058)AL(0.37348)FE(0.076688)MN(0.0015506)MG(0.052854)CA(0.037447)NA(0.055824)TI(0.0091182)K(0.097665)
5)H(1)O(?)O(0) * FG14-20

TC = 487.618 & P = 9648.7371

5 Composition of GARNET: Alm(0.58686) # Gro(0.2778) # Pyr(0.035808) # Spe(0.099532)

Volume fraction of GARNET = 1.8007 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0531/2.8743 (in g/ccm)

Residue = 0.096699

10

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[1] ##

TC0 = 775 & P0 = 16000

15

... OPTIMIZATION COMPLETED (139 s)...

SI(1.0058)AL(0.37348)FE(0.076688)MN(0.0015506)MG(0.052854)CA(0.037447)NA(0.055824)TI(0.0091182)K(0.097665)
20)H(1)O(?)O(0) * FG14-20

TC = 455.4224 & P = 16136.7471

Composition of GARNET: Alm(0.62493) # Gro(0.24655) # Pyr(0.035547) # Spe(0.092974)

Volume fraction of GARNET = 1.9402 (in vol-% of the system)

Subsystem volume fraction = 100 (in vol-% of the system)

25 Density of GARNET/MATRIX = 4.0957/2.9276 (in g/ccm)

Residue = 0.14232

>> STAGE[1] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

30

SI(1.0058)AL(0.37348)FE(0.076688)MN(0.0015506)MG(0.052854)CA(0.037447)NA(0.055824)TI(0.0091182)K(0.097665)
35)H(1)O(?)O(0) * FG14-20

T = 486.1073 & P = 5795.2668

Res = 0.028182

--> Loop [1] - (4)

--> Loop [2] - (1)

--> Loop [3] - (1)

5 --> Loop [4] - (1)

--> Loop [5] - (1)

--> Loop [6] - (0)

10 Garn Volume = 1.8272 +/- 0.26128 vol-%

STAGE 2/4

15

*** New computation (see details below)

PARAMETERS -----

Alm Gro Pyr Spe

20 FIT: 0.567 0.365 0.025 0.043

WEIGHT: 1450 1850 75 90

*** OPTIMIZATION 1

25

INPUT VARIABLES -----

1 2 3 4 5 6 7 8 9 10

TC: 525 525 775 775 0 0 0 0 0

P: 8000 16000 8000 16000 0 0 0 0 0

30

LIMITS -----

MIN MAX

V1: 1.790 1.827

V2: 1.000 99.000

ADJUSTEMENTS -----

VOL (%)

GRT-1: 1.827

5

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 525 & P0 = 8000

10

... OPTIMIZATION COMPLETED (249 s)...

SI(1.0157)AL(0.37243)FE(0.069824)MN(0.00026715)MG(0.053887)CA(0.032519)NA(0.057315)TI(0.0093288)K(0.10027

15)H(1)O(?)O(0) * FG14-20

TC = 503.4339 & P = 6692.8139

Composition of GARNET: Alm(0.59254) # Gro(0.33451) # Pyr(0.043483) # Spe(0.029467)

Volume fraction of GARNET = 1.0026 (in vol-% of the system)

Subsystem volume fraction = 98.1728 (in vol-% of the system)

20 Density of GARNET/MATRIX = 3.9966/2.7847 (in g/ccm)

Residue = 0.045691

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

25

>> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 525 & P0 = 16000

30

... OPTIMIZATION COMPLETED (129 s)...

SI(1.0157)AL(0.37243)FE(0.069824)MN(0.00026715)MG(0.053887)CA(0.032519)NA(0.057315)TI(0.0093288)K(0.10027

)H(1)O(?)O(0) * FG14-20

TC = 468.6608 & P = 16481.0852
Composition of GARNET: Alm(0.68895) # Gro(0.23899) # Pyr(0.041902) # Spe(0.030156)
Volume fraction of GARNET = 1.0069 (in vol-% of the system)
Subsystem volume fraction = 98.1728 (in vol-% of the system)
5 Density of GARNET/MATRIX = 4.0971/2.9229 (in g/ccm)
Residue = 0.17629

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

10

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 775 & P0 = 8000

15

... OPTIMIZATION COMPLETED (331 s)...

20

SI(1.0157)AL(0.37243)FE(0.069824)MN(0.00026715)MG(0.053887)CA(0.032519)NA(0.057315)TI(0.0093288)K(0.10027)
H(1)O(?)O(0) * FG14-20

TC = 504.2653 & P = 8569.1904

Composition of GARNET: Alm(0.62649) # Gro(0.30029) # Pyr(0.043283) # Spe(0.029939)

Volume fraction of GARNET = 1.0041 (in vol-% of the system)

Subsystem volume fraction = 98.1728 (in vol-% of the system)

Density of GARNET/MATRIX = 4.027/2.8475 (in g/ccm)

25

Residue = 0.090409

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

30

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[2] ##

TC0 = 775 & P0 = 16000

... OPTIMIZATION COMPLETED (203 s)...

SI(1.0157)AL(0.37243)FE(0.069824)MN(0.00026715)MG(0.053887)CA(0.032519)NA(0.057315)TI(0.0093288)K(0.10027)
H(1)O(?)O(0) * FG14-20

5 TC = 466.1509 & P = 16639.1912

Composition of GARNET: Alm(0.68563) # Gro(0.24334) # Pyr(0.041262) # Spe(0.029776)

Volume fraction of GARNET = 1.0203 (in vol-% of the system)

Subsystem volume fraction = 98.1728 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0949/2.9238 (in g/ccm)

10 Residue = 0.17086

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

...

15 ==> SOLUTION (1) is selected for OPTIMIZATION 2

*** OPTIMIZATION 2

20 INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	503	503	503	0	0	0	0	0	0	0
P:	6693	6693	6693	0	0	0	0	0	0	0
X1:	1.83	1.79	1.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00

25

LIMITS -----

	MIN	MAX
V1:	1.790	1.827
V2:	1.000	99.000

30

>> RUN 1/3 ## OPTIMIZATION 2 ## STAGE[2] ##

TC0 = 503.4339 & P0 = 6692.8139

X0-1 = 1.8272

... OPTIMIZATION COMPLETED (155 s)...

5

SI(1.0155)AL(0.37245)FE(0.069965)MN(0.00029352)MG(0.053866)CA(0.03262)NA(0.057284)TI(0.0093244)K(0.10022)

H(1)O(?)O(0) * FG14-20

TC = 502.9372 & P = 6662.0478

X-1 = 1.7903

10

Composition of GARNET: Alm(0.59037) # Gro(0.33432) # Pyr(0.043222) # Spe(0.032089)

Volume fraction of GARNET = 1.0141 (in vol-% of the system)

Subsystem volume fraction = 98.2097 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9969/2.7846 (in g/ccm)

15

Residue = 0.043801

--> SOLUTION (residue is lower than STOL [0.05])

20

>> RUN 2/3 ## OPTIMIZATION 2 ## STAGE[2] ##

TC0 = 503.4339 & P0 = 6692.8139

X0-1 = 1.79

25

... OPTIMIZATION COMPLETED (166 s)...

SI(1.0155)AL(0.37245)FE(0.069959)MN(0.0002925)MG(0.053867)CA(0.032616)NA(0.057286)TI(0.0093246)K(0.10022)

H(1)O(?)O(0) * FG14-20

30

TC = 502.7765 & P = 6655.1159

X-1 = 1.7917

Composition of GARNET: Alm(0.5898) # Gro(0.33462) # Pyr(0.043156) # Spe(0.032422)

Volume fraction of GARNET = 1.0002 (in vol-% of the system)

Subsystem volume fraction = 98.2083 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9967/2.7846 (in g/ccm)

Residue = 0.04317

5 --> SOLUTION (residue is lower than STOL [0.05])

>> RUN 3/3 ## OPTIMIZATION 2 ## STAGE[2] ##

10 TC0 = 503.4339 & P0 = 6692.8139

X0-1 = 1.8086

... OPTIMIZATION COMPLETED (180 s)...

15

SI(1.0156)AL(0.37244)FE(0.069895)MN(0.0002805)MG(0.053876)CA(0.03257)NA(0.057299)TI(0.0093266)K(0.10025)H

(1)O(?)O(0) * FG14-20

TC = 503.0945 & P = 6681.4242

X-1 = 1.8085

20 ----

Composition of GARNET: Alm(0.59107) # Gro(0.33459) # Pyr(0.043301) # Spe(0.031039)

Volume fraction of GARNET = 1.002 (in vol-% of the system)

Subsystem volume fraction = 98.1915 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9967/2.7848 (in g/ccm)

25 Residue = 0.044306

--> SOLUTION (residue is lower than STOL [0.05])

30 >> STAGE[2] ## AUTO-REFINEMENT - SOLUTION (1/1 - Optimization: 1)

SI(1.0155)AL(0.37245)FE(0.069965)MN(0.00029352)MG(0.053866)CA(0.03262)NA(0.057284)TI(0.0093244)K(0.10022)

H(1)O(?)O(0) * FG14-20

T = 502.9372 & P = 6662.0478

X-1 = 1.7903

Res = 0.043801

--> Loop [1] - (5)
5 --> Loop [2] - (3)
 --> Loop [3] - (1)
 --> Loop [4] - (1)
 --> Loop [5] - (1)
 --> Loop [6] - (1)
10 --> Loop [7] - (1)
 --> Loop [8] - (1)
 --> Loop [9] - (1)
 --> Loop [10] - (0)

15

STAGE 3/4

*** New computation (see details below)

20 PARAMETERS -----

	Alm	Gro	Pyr	Spe
FIT:	0.600	0.354	0.029	0.017
WEIGHT:	1550	1850	90	50

25

*** OPTIMIZATION 1

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
30 TC:	525	525	775	775	0	0	0	0	0	0
P:	8000	16000	8000	16000	0	0	0	0	0	0

LIMITS -----

MIN MAX

V1: 1.790 1.790
V2: 1.000 1.014
V3: 1.000 99.000

5 ADJUSTEMENTS -----

VOL (%)

GRT-1: 1.790
GRT-2: 1.014

10

>> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[3] ##

TC0 = 525 & P0 = 8000

15 ... OPTIMIZATION COMPLETED (65 s)...

SI(1.0338)AL(0.37643)FE(0.066664)MN(0)MG(0.055094)CA(0.030165)NA(0.058833)TI(0.0095587)K(0.10293)H(1)O(?)
O(0) * FG14-20

20 TC = 512.7394 & P = 7338.0934

Composition of GARNET: Alm(0.62268) # Gro(0.32762) # Pyr(0.049695) # Spe(0)

Volume fraction of GARNET = 1.0103 (in vol-% of the system)

Subsystem volume fraction = 97.1956 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9981/2.785 (in g/ccm)

25 Residue = 0.044349

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

30 >> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[3] ##

TC0 = 525 & P0 = 16000

... OPTIMIZATION COMPLETED (99 s)...

SI(1.0338)AL(0.37643)FE(0.066664)MN(0)MG(0.055094)CA(0.030165)NA(0.058833)TI(0.0095587)K(0.10293)H(1)O(?)
O(0) * FG14-20

5 TC = 472.6356 & P = 17211.3332

Composition of GARNET: Alm(0.72186) # Gro(0.2313) # Pyr(0.046837) # Spe(0)

Volume fraction of GARNET = 1.0012 (in vol-% of the system)

Subsystem volume fraction = 97.1956 (in vol-% of the system)

Density of GARNET/MATRIX = 4.1012/2.9217 (in g/ccm)

10 Residue = 0.17514

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

15 >> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[3] ##

TC0 = 775 & P0 = 8000

... OPTIMIZATION COMPLETED (120 s)...

20

SI(1.0338)AL(0.37643)FE(0.066664)MN(0)MG(0.055094)CA(0.030165)NA(0.058833)TI(0.0095587)K(0.10293)H(1)O(?)
O(0) * FG14-20

TC = 512.9194 & P = 8618.9218

25 Composition of GARNET: Alm(0.64734) # Gro(0.30349) # Pyr(0.049168) # Spe(0)

Volume fraction of GARNET = 1.0091 (in vol-% of the system)

Subsystem volume fraction = 97.1956 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0198/2.8343 (in g/ccm)

Residue = 0.074549

30

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[3] ##

TC0 = 775 & P0 = 16000

... OPTIMIZATION COMPLETED (85 s)...

5

SI(1.0338)AL(0.37643)FE(0.066664)MN(0)MG(0.055094)CA(0.030165)NA(0.058833)TI(0.0095587)K(0.10293)H(1)O(?)
O(0) * FG14-20

TC = 472.3746 & P = 17233.7084

10 Composition of GARNET: Alm(0.7215) # Gro(0.23163) # Pyr(0.046873) # Spe(0)

Volume fraction of GARNET = 1.0148 (in vol-% of the system)

Subsystem volume fraction = 97.1956 (in vol-% of the system)

Density of GARNET/MATRIX = 4.101/2.9218 (in g/ccm)

Residue = 0.17466

15

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

...

==> SOLUTION (1) is selected for OPTIMIZATION 2

20

*** OPTIMIZATION 2

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
25 TC:	513	513	513	0	0	0	0	0	0	0
P:	7338	7338	7338	0	0	0	0	0	0	0
X1:	1.79	1.79	1.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X2:	1.01	1.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

30

LIMITS -----

	MIN	MAX
V1:	1.790	1.790
V2:	1.000	1.014

V3: 1.000 99.000

>> RUN 1/3 ## OPTIMIZATION 2 ## STAGE[3] ##

5

TC0 = 512.7394 & P0 = 7338.0934

X0-1 = 1.7903

X0-2 = 1.0141

10 ... OPTIMIZATION COMPLETED (42 s)...

SI(1.0338)AL(0.37643)FE(0.066664)MN(0)MG(0.055094)CA(0.030165)NA(0.058833)TI(0.0095587)K(0.10293)H(1)O(?)

O(0) * FG14-20

15 TC = 512.7394 & P = 7340.8703

X-1 = 1.7903

X-2 = 1.0141

Composition of GARNET: Alm(0.62274) # Gro(0.3276) # Pyr(0.049656) # Spe(0)

20 Volume fraction of GARNET = 1.0068 (in vol-% of the system)

Subsystem volume fraction = 97.1956 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9982/2.7851 (in g/ccm)

Residue = 0.044374

25 --> SOLUTION (residue is lower than STOL [0.05])

>> RUN 2/3 ## OPTIMIZATION 2 ## STAGE[3] ##

30 TC0 = 512.7394 & P0 = 7338.0934

X0-1 = 1.79

X0-2 = 1

... OPTIMIZATION COMPLETED (34 s)...

SI(1.0337)AL(0.37642)FE(0.066696)MN(0)MG(0.055087)CA(0.030187)NA(0.058824)TI(0.0095574)K(0.10291)H(1)O(?)
O(0) * FG14-20

5 TC = 512.7394 & P = 7338.0934

X-1 = 1.79

X-2 = 1.0061

Composition of GARNET: Alm(0.62271) # Gro(0.32763) # Pyr(0.04966) # Spe(0)

10 Volume fraction of GARNET = 1.0178 (in vol-% of the system)

Subsystem volume fraction = 97.2039 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9981/2.785 (in g/ccm)

Residue = 0.044345

15 --> SOLUTION (residue is lower than STOL [0.05])

>> RUN 3/3 ## OPTIMIZATION 2 ## STAGE[3] ##

20 TC0 = 512.7394 & P0 = 7338.0934

X0-1 = 1.7902

X0-2 = 1.0071

... OPTIMIZATION COMPLETED (33 s)...

25

SI(1.0337)AL(0.37642)FE(0.066689)MN(0)MG(0.055089)CA(0.030182)NA(0.058826)TI(0.0095577)K(0.10292)H(1)O(?)
O(0) * FG14-20

TC = 512.7394 & P = 7343.8263

30 X-1 = 1.7902

X-2 = 1.0078

Composition of GARNET: Alm(0.6228) # Gro(0.32754) # Pyr(0.049657) # Spe(0)

Volume fraction of GARNET = 1.0091 (in vol-% of the system)

Subsystem volume fraction = 97.202 (in vol-% of the system)

Density of GARNET/MATRIX = 3.9982/2.7852 (in g/ccm)

Residue = 0.04444

5 --> SOLUTION (residue is lower than STOL [0.05])

>> STAGE[3] ## AUTO-REFINEMENT - SOLUTION (1/3 - Optimization: 1)

10 SI(1.0338)AL(0.37643)FE(0.066664)MN(0)MG(0.055094)CA(0.030165)NA(0.058833)TI(0.0095587)K(0.10293)H(1)O(?)

O(0) * FG14-20

T = 512.7394 & P = 7340.8703

X-1 = 1.7903

X-2 = 1.0141

15 Res = 0.044374

--> Loop [1] - (2)

--> Loop [2] - (2)

--> Loop [3] - (1)

20 --> Loop [4] - (1)

--> Loop [5] - (1)

--> Loop [6] - (0)

25 Garn Volume = 1.0068 +/- 0.3636 vol-%

>> STAGE[3] ## AUTO-REFINEMENT - SOLUTION (2/3 - Optimization: 2)

30 SI(1.0337)AL(0.37642)FE(0.066696)MN(0)MG(0.055087)CA(0.030187)NA(0.058824)TI(0.0095574)K(0.10291)H(1)O(?)

O(0) * FG14-20

T = 512.7394 & P = 7338.0934

X-1 = 1.79

X-2 = 1.0061

Res = 0.044345

--> Loop [1] - (2)
--> Loop [2] - (2)
5 --> Loop [3] - (1)
 --> Loop [4] - (1)
 --> Loop [5] - (1)
 --> Loop [6] - (0)

10

Garn Volume = 1.0178 +/- 0.36672 vol-%

>> STAGE[3] ## AUTO-REFINEMENT - SOLUTION (3/3 - Optimization: 3)

15

SI(1.0337)AL(0.37642)FE(0.066689)MN(0)MG(0.055089)CA(0.030182)NA(0.058826)TI(0.0095577)K(0.10292)H(1)O(?)

O(0) * FG14-20

T = 512.7394 & P = 7343.8263

X-1 = 1.7902

20 X-2 = 1.0078

Res = 0.04444

--> Loop [1] - (2)
--> Loop [2] - (2)
25 --> Loop [3] - (1)
 --> Loop [4] - (1)
 --> Loop [5] - (1)
 --> Loop [6] - (0)

30

Garn Volume = 1.0091 +/- 0.36043 vol-%

STAGE 4/4

*** New computation (see details below)

PARAMETERS -----

	Alm	Gro	Pyr	Spe
5 FIT:	0.632	0.323	0.037	0.008
WEIGHT:	1600	1750	105	25

*** OPTIMIZATION 1

10

INPUT VARIABLES -----

	1	2	3	4	5	6	7	8	9	10
TC:	525	525	775	775	0	0	0	0	0	0
P:	8000	16000	8000	16000	0	0	0	0	0	0

15

LIMITS -----

	MIN	MAX
V1:	1.790	1.790
V2:	1.000	1.014
20 V3:	1.000	1.007
V4:	1.000	99.000

ADJUSTEMENTS -----

VOL (%)

25 GRT-1:	1.790
GRT-2:	1.014
GRT-3:	1.007

30 >> RUN 1/4 ## OPTIMIZATION 1 ## STAGE[4] ##

TC0 = 525 & P0 = 8000

... OPTIMIZATION COMPLETED (58 s)...

SI(1.0618)AL(0.38397)FE(0.063646)MN(0)MG(0.056806)CA(0.028057)NA(0.06094)TI(0.009883)K(0.10661)H(1)O(?)O(0)
0) * FG14-20

5 TC = 517.0817 & P = 8079.5685

Composition of GARNET: Alm(0.62655) # Gro(0.31871) # Pyr(0.054739) # Spe(0)

Volume fraction of GARNET = 1.0132 (in vol-% of the system)

Subsystem volume fraction = 96.1888 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0024/2.7885 (in g/ccm)

10 Residue = 0.020507

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

15 >> RUN 2/4 ## OPTIMIZATION 1 ## STAGE[4] ##

TC0 = 525 & P0 = 16000

... OPTIMIZATION COMPLETED (107 s)...

20

SI(1.0618)AL(0.38397)FE(0.063646)MN(0)MG(0.056806)CA(0.028057)NA(0.06094)TI(0.009883)K(0.10661)H(1)O(?)O(0)
0) * FG14-20

TC = 474.3016 & P = 17690.1038

25 Composition of GARNET: Alm(0.7268) # Gro(0.22189) # Pyr(0.051304) # Spe(0)

Volume fraction of GARNET = 1.0187 (in vol-% of the system)

Subsystem volume fraction = 96.1888 (in vol-% of the system)

Density of GARNET/MATRIX = 4.1061/2.9194 (in g/ccm)

Residue = 0.13975

30

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

>> RUN 3/4 ## OPTIMIZATION 1 ## STAGE[4] ##

TC0 = 775 & P0 = 8000

... OPTIMIZATION COMPLETED (114 s)...

5

SI(1.0618)AL(0.38397)FE(0.063646)MN(0)MG(0.056806)CA(0.028057)NA(0.06094)TI(0.009883)K(0.10661)H(1)O(?)O(0)
0) * FG14-20

TC = 518.5506 & P = 8811.4089

10 Composition of GARNET: Alm(0.6414) # Gro(0.30482) # Pyr(0.053774) # Spe(0)

Volume fraction of GARNET = 1.0118 (in vol-% of the system)

Subsystem volume fraction = 96.1888 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0152/2.824 (in g/ccm)

Residue = 0.027694

15

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

>> RUN 4/4 ## OPTIMIZATION 1 ## STAGE[4] ##

20

TC0 = 775 & P0 = 16000

... OPTIMIZATION COMPLETED (105 s)...

25

SI(1.0618)AL(0.38397)FE(0.063646)MN(0)MG(0.056806)CA(0.028057)NA(0.06094)TI(0.009883)K(0.10661)H(1)O(?)O(0)
0) * FG14-20

TC = 474.4693 & P = 17667.9321

Composition of GARNET: Alm(0.7269) # Gro(0.22174) # Pyr(0.051354) # Spe(0)

30 Volume fraction of GARNET = 1.0007 (in vol-% of the system)

Subsystem volume fraction = 96.1888 (in vol-% of the system)

Density of GARNET/MATRIX = 4.1061/2.9193 (in g/ccm)

Residue = 0.13993

--> TEMPORARY SOLUTION (to be used as input for optimization 2)

...

==> SOLUTION (1) is selected for OPTIMIZATION 2

5

*** OPTIMIZATION 2

INPUT VARIABLES -----

10	1	2	3	4	5	6	7	8	9	10
TC:	517	517	517	0	0	0	0	0	0	0
P:	8080	8080	8080	0	0	0	0	0	0	0
X1:	1.79	1.79	1.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X2:	1.01	1.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	X3:	1.01	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00

LIMITS -----

	MIN	MAX
V1:	1.790	1.790
20 V2:	1.000	1.014
V3:	1.000	1.007
V4:	1.000	99.000

25 >> RUN 1/3 ## OPTIMIZATION 2 ## STAGE[4] ##

TC0 = 517.0817 & P0 = 8079.5685

X0-1 = 1.7903

X0-2 = 1.0141

30 X0-3 = 1.0068

... OPTIMIZATION COMPLETED (33 s)...

SI(1.0618)AL(0.38397)FE(0.063646)MN(0)MG(0.056806)CA(0.028057)NA(0.06094)TI(0.009883)K(0.10661)H(1)O(?)O(

0) * FG14-20

TC = 517.0817 & P = 8089.0367

5 X-1 = 1.7903

X-2 = 1.0141

X-3 = 1.0068

Composition of GARNET: Alm(0.62676) # Gro(0.31854) # Pyr(0.054705) # Spe(0)

10 Volume fraction of GARNET = 1.0062 (in vol-% of the system)

Subsystem volume fraction = 96.1888 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0026/2.7887 (in g/ccm)

Residue = 0.020464

15 --> SOLUTION (residue is lower than STOL [0.05])

>> RUN 2/3 ## OPTIMIZATION 2 ## STAGE[4] ##

20 TC0 = 517.0817 & P0 = 8079.5685

X0-1 = 1.79

X0-2 = 1

X0-3 = 1

25 ... OPTIMIZATION COMPLETED (32 s)...

SI(1.0616)AL(0.38393)FE(0.063693)MN(0)MG(0.056793)CA(0.028089)NA(0.060922)TI(0.0098803)K(0.10658)H(1)O(?)

O(0) * FG14-20

30 TC = 517.0817 & P = 8085.8806

X-1 = 1.79

X-2 = 1.0086

X-3 = 1

Composition of GARNET: Alm(0.6267) # Gro(0.31859) # Pyr(0.05471) # Spe(0)

Volume fraction of GARNET = 1.0198 (in vol-% of the system)

Subsystem volume fraction = 96.2014 (in vol-% of the system)

Density of GARNET/MATRIX = 4.0025/2.7886 (in g/ccm)

5 Residue = 0.020471

--> SOLUTION (residue is lower than STOL [0.05])

10 >> RUN 3/3 ## OPTIMIZATION 2 ## STAGE[4] ##

TC0 = 517.0817 & P0 = 8079.5685

X0-1 = 1.7902

X0-2 = 1.0071

15 X0-3 = 1.0034

... OPTIMIZATION COMPLETED (35 s)...

20 SI(1.0617)AL(0.38396)FE(0.063665)MN(0)MG(0.056801)CA(0.02807)NA(0.060933)TI(0.0098819)K(0.1066)H(1)O(?)O(0)
0) * FG14-20

TC = 517.0817 & P = 8079.5685

X-1 = 1.7902

X-2 = 1.0126

25 X-3 = 1.0034

Composition of GARNET: Alm(0.62658) # Gro(0.3187) # Pyr(0.054714) # Spe(0)

Volume fraction of GARNET = 1.0178 (in vol-% of the system)

Subsystem volume fraction = 96.1939 (in vol-% of the system)

30 Density of GARNET/MATRIX = 4.0024/2.7885 (in g/ccm)

Residue = 0.020479

--> SOLUTION (residue is lower than STOL [0.05])

```
>> STAGE[4] ## AUTO-REFINEMENT - SOLUTION (1/3 - Optimization: 1)

SI(1.0618)AL(0.38397)FE(0.063646)MN(0)MG(0.056806)CA(0.028057)NA(0.06094)TI(0.009883)K(0.10661)H(1)O(?)O(
5   0) * FG14-20
T = 517.0817 & P = 8089.0367
X-1 = 1.7903
X-2 = 1.0141
X-3 = 1.0068
10 Res = 0.020464

--> Loop [1] - (5)
--> Loop [2] - (2)
--> Loop [3] - (2)
15 --> Loop [4] - (2)
--> Loop [5] - (2)
--> Loop [6] - (2)
--> Loop [7] - (1)
--> Loop [8] - (0)
20

Garn Volume = 1.0062 +/- 0.93022 vol-%



---


25 >> STAGE[4] ## AUTO-REFINEMENT - SOLUTION (2/3 - Optimization: 2)

SI(1.0616)AL(0.38393)FE(0.063693)MN(0)MG(0.056793)CA(0.028089)NA(0.060922)TI(0.0098803)K(0.10658)H(1)O(?)O(
O(0) * FG14-20
T = 517.0817 & P = 8085.8806
30 X-1 = 1.79
X-2 = 1.0086
X-3 = 1
Res = 0.020471
```

--> Loop [1] - (5)

--> Loop [2] - (2)

--> Loop [3] - (2)

--> Loop [4] - (2)

5 --> Loop [5] - (2)

--> Loop [6] - (2)

--> Loop [7] - (1)

--> Loop [8] - (0)

10

Garn Volume = 1.0198 +/- 0.92985 vol-%

>> STAGE[4] ## AUTO-REFINEMENT - SOLUTION (3/3 - Optimization: 3)

15

SI(1.0617)AL(0.38396)FE(0.063665)MN(0)MG(0.056801)CA(0.02807)NA(0.060933)TI(0.0098819)K(0.1066)H(1)O(?)O(

0) * FG14-20

T = 517.0817 & P = 8079.5685

X-1 = 1.7902

20 X-2 = 1.0126

X-3 = 1.0034

Res = 0.020479

--> Loop [1] - (5)

25 --> Loop [2] - (2)

--> Loop [3] - (2)

--> Loop [4] - (2)

--> Loop [5] - (2)

--> Loop [6] - (2)

30 --> Loop [7] - (1)

--> Loop [8] - (0)

Garn Volume = 1.0178 +/- 0.89535 vol-%

5

| FINAL RESULTS |

-> GARNET RESORPTION (vol-%)

10		Grt1	Grt2	Grt3	Grt4	Total
	Stage 1	0.000	0.000	0.000	0.000	0.000
	Stage 2	0.037	0.000	0.000	0.000	0.037
	Stage 3	0.000	0.000	0.000	0.000	0.000
	Stage 4	0.000	0.000	0.000	0.000	0.000

15

-> VOLUME OF GARNET (vol-%)

		Grt1	Grt2	Grt3	Grt4	Total
	Stage 1	1.827	0.000	0.000	0.000	1.827
	Stage 2	1.790	1.014	0.000	0.000	2.804
20	Stage 3	1.790	1.014	1.007	0.000	3.811
	Stage 4	1.790	1.014	1.007	1.006	4.817

-> NEWLY GROWN GARNET (vol-%)

25		Grt1	Grt2	Grt3	Grt4	Total
	Stage 1	1.827	0.000	0.000	0.000	1.827
	Stage 2	0.000	1.014	0.000	0.000	1.014
	Stage 3	0.000	0.000	1.007	0.000	1.007
	Stage 4	0.000	0.000	0.000	1.006	1.006

30 -> ROCK DENSITY (g/ccm)

Density

Stage 1	2.806
Stage 2	2.819
Stage 3	2.831

S9 Zircon ages

- 5 The errors are given as 2 Standard Error for individual dates, as 95% confidence level for weighted mean ages (Excel document S9 Zircon age).