Thermo-Calc Software

IRSN NUCLEA-19 Nuclear Alloys-Oxides Database (NUCL19)

Technical Information

Available Starting with Thermo-Calc Version 2021a

Document created 11/16/2020

About the IRSN NUCLEA-19 Nuclear Alloys-Oxides Database (NUCL19)

NUCL: IRSN NUCLEA-Nuclear Alloys-Oxides Database Revision History

NUCL19 is a thermodynamic and properties database owned by IRSN that can be applied to study fundamental scientific issues and efficiently investigate practical engineering problems in both the In-Vessel and Ex-Vessel nuclear reactor circumstances. It effectively enables you to calculate the thermochemical equilibrium states at any step of an eventually-severe accident, and to utilize the calculation results for improving the predictions and treatments of thermo-hydraulic or other accidents, enhancing the design and engineering of modern and safety-prioritized nuclear reactors and assisting in the assessment and processing of nuclear fuel and waste managements.

The database contains critically-assessed and internally-consistent thermodynamic data for the entire field from metal to oxide domains within an 18-element framework, +H and +Ar, which are only for the gaseous phase and for hydrides and hydrous oxides/silicates.

Included Elements (18+2)

Ag	Al	Ar	B	Ba	C	Ca	Cr	Fe	H
In	La	Mg	Ni	O	Ru	Si	Sr	U	Zr

Included Phases and Assessed Systems

See the *Overview of NUCLEA-19* pages at the end of this PDF that have details such as atoms, stoichiometric condensed phases, condensed solutions, gas, and the assessed binary, ternary, and quaternary systems.

Available Solution and Stoichiometric Phases

Condensed solution phases: *(solids/liquid phases)*	65 phases
Condensed stoichiometric phases: *(solid/liquid substances)*	510 phases
Gaseous mixture phase: *(ideal gaseous mixture)*	209 gaseous species

The hydrogen element (H) being as a major component is added into the system, while its dissolution in condensed solid and liquid solution phases has not been taken into account yet. The Ar component is only present in the gaseous mixture phase. Included condensed stoichiometric phases (pure substances) are widely ranged: intermediate metallic compounds, oxides and hydroxides, silicates and hydrous silicates, hydrides, carbides and carbonates, borides and borates, and some simple inorganic/organic substances.

Available Assessments and Evaluations

Binary subsystems: *(metallic alloys, carbides, borides, oxides)*	153
Ternary subsystems: *(metallic alloys, carbides, borides, oxides, silicates)*	105
Quaternary subsystems: *(oxides, silicates, borates)*	16

For many other ternary, quaternary and higher-order subsystems, the analytical descriptions of lower-order constituent subsystems are effectively combined and used (through appropriate extrapolations) to predict multicomponent systems, especially for compositions and temperatures which have not been experimentally evaluated. Depending on the complexity of multicomponent systems, such an analytical prediction is more or less accurate.

Limits

As in the spirit of the CALPHAD method, predictions can be made for multicomponent systems by extrapolation into multicomponent space of data critically evaluated and assessed based on binary, ternary and in some cases higher order systems. However, critical calculations must always be verified by equilibrium experimental data; it is the user's responsibility to verify the calculations but Thermo-Calc Software AB is interested to know about any significant deviations in order to improve any future release.

Additional Resources

This document is available on our website on the Nuclear Materials Databases page, where you can also link to many other resources. Alternatively, when in Thermo-Calc, press F1 to search the online help for more information.

NUCL: IRSN NUCLEA-Nuclear Alloys-Oxides Database Revision History

Current Database Version

Database name (acronym):	**IRSN NUCLEA-19 Nuclear Alloys-Oxides Database (NUCL19)**
Database owner:	**IRSN**
Database version:	**19**

Changes in the Most Recent Database Release

NUCL15 (NUCLEA-15) to NUCL19 (NUCLEA-19)

IRSN NUCLEA-Nuclear Alloys-Oxides Database (NUCL19)

Software release version: 2021a (January 2021)

Binary Systems

- Ag-Mg: The lattice-stability of Mg (FCC_A1) available in the Unary 5.0 SGTE database taken into account.
- Ag-Zr: Change of the decomposition nature of AG1ZR1 and AG1ZR2, to congruent and peritectic respectively
- Al-Fe: Sundman et al., Acta Materialia, 57(10):2896–2908, 2009.
- Al-Mg: Liang et al. Z. Metallkde., 89(8):536–540, 1998.
- B-Cr: Revision of the thermodynamic properties of the stoichiometric phases.
- B-Ni: Sun et al., International Journal of Materials Research, 100:59–67, 2009.
- B-Si: The lattice-stability of metastable B(dia_A4) available in the Unary 5.0 SGTE database taken into account
- Ba-Mg: Error correction
- Ba-Si: Three additional stoichiometric phases, BA2SI1, BA5SI3, BA1SI1, BA3SI4.
- Ca-La: FCC_A1 is not more stable above 1500 K.
- Cr-Ru: The lattice-stability of Ru(BCC_A2) available in the Unary 5.0 SGTE database taken into account
- Cr-Zr: Yang et al. Journal of Nuclear Materials, 441(1-3):190–202, 2013.
- Fe-Ni: Introduction of the $FeNi_3$ phase as a stoichiometric phase.

- Fe-Ru: The lattice-stability of Ru(BCC_A2) available in the Unary 5.0 SGTE database taken into account
- Fe-Si: Y. Yuan et al. Calphad, 44:54–61, 2014.
- Fe-U: The lattice-stabilities of Fe(ORT_A20) and Fe(TET) available in the Unary 5.0 SGTE database taken into account
- In-Mg: The lattice-stabilities of Mg(FCC_A1) and In(FCC_A1) available in the Unary 5.0 SGTE database taken into account.
- In-O: Improvement of the modeling of solubility of oxygen in indium liquid
- La-Mg: F. Zhang, Journal of Alloys and Compounds, 663:279–288, 2016.
- La-U: Improvement of liquid thermodynamic properties
- La-Zr: N. Mattern et al. Calphad, 52:8–20, 2016.
- Mg-U: The lattice-stability of U (hcp_A3) available in the Unary 5.0 SGTE database taken into account.
- Mg-Zr: R. Arroyave et al., Calphad, 29(3):230–238, 2005.
- Ni-U: The lattice-stability of U (FCC_A2) available in the Unary 5.0 SGTE database taken into account
- Ru-U: The lattice-stability of Ru (BCC_A2) and U (hcp_A3) available in the Unary 5.0 SGTE database taken into account. The Ru3U compound is now modeled as a solution phase, CxRU3U1 (SS).
- Si-Sr: Li et al. System. Calphad, 35(4):594–600, 2011.

Pseudo-binary Systems

Al-Ba-O Al_2O_3-BaO

- Introducing two new stoichiometric compounds in the BaO-rich region, AL2BA4O7(S), and AL2BA7O10(S)

Al-La-O Al_2O_3-La_2O_3

- Improvement of $AlLaO_3$ thermodynamic properties.

Al-O-Sr Al_2O_3-SrO

- $Al1_2SrO_{19}$ melts congruently whereas its decomposition was previously considered to be peritectic.

Ba-O-Si BaO-SiO_2

- Additional compound in the BaO-rich part, BA3O5SI1(S).

Ca-O-Sr CaO-SrO

- Improvement with consideration of new experimental data.

Ca-O-Zr CaO-ZrO_2

- Description of the solubility of CaO in the ZrO_2 tetragonal phase, and the solubility of ZrO_2 in the CaO FCC_B1.

In-O-Zr In_2O_3-ZrO_2

- Improvement of the modeling in the zirconia-rich region.

La-O-U La_2O_3-UO_2

- Improvement of the oxygen potential above the solid solution FCC_C1.

La-O-Si La_2O_3-SiO_2

- Improvement of the thermodynamic properties of $La_2Si_2O_7$

O-Si-Sr SiO_2-SrO

- Improvement with consideration of new experimental data.

O-Si-Zr SiO_2-ZrO_2

- Improvement of the description of the $ZrSiO_4$ compound (thermodynamic properties and decomposition temperature)

Ternary Systems

- C-O-Zr: Improvement with consideration of new experimental data.
- Cr-O-Zr: Modeling of the ternary system in the metallic-oxidic part.
- Reassessment of the Fe-O-U, Fe-O-Zr, and O-U-Zr systems.

Pseudo-ternary Systems

Ca-O-Si-Zr: Modeling of the CaO-SiO_2-ZrO_2 pseudo-ternary system

Previous Releases

NUCL10 (NUCLEA-10) to NUCL15 (NUCLEA-15)

IRSN NUCLEA- Nuclear Alloys-Oxides Database (NUCL15_4)

Software release version: 2017a (March 2017)

Binary Systems

The description of some binary systems are improved:

- Ag-Al: improved limits of the FCC_A1+HCP_A3 biphasic domain.
- Ag-B: added LIQUID miscibility gap.
- Al-In: improved limits of the LIQUID miscibility gap.
- Al-Zr: added Al3Zr4(S) and improved modeling of the stoichiometric condensed phases.
- B-C: BETA_B decomposition changed to peritectic.
- C-U: C3U2(S) made unstable at low temperature.
- Cr-La: improved modeling of LIQUID.
- Cr-O: improved modeling of LIQUID.
- In–Zr: added In1Zr1(S), In2Zr1(S), In1Zr2(S); In3Zr1(S) decomposition changed to peritectic.
- La -Ni: added La5Ni19(S).

Ternary Systems

The description of some ternary systems are improved:

- Al-O-Fe: Al_2FeO_4 decomposition changed to peritectic in AlO1.5-FeO; SPINEL domain extended in AlO1.5-FeO1.5.
- Ca-Cr-O: added assessment of CaO-CrO-Cr_2O_3 for oxygen partial pressures ranging from equilibrium with metallic chromium to PO2 = 10−3 atm.
- Cr-O-Si: added assessment of CrO-Cr_2O_3-SiO_2 for oxygen partial pressures ranging from equilibrium with metallic chromium to PO_2 = 0.21 atm.
- Ni-O-Si: improved limits of the LIQUID miscibility gap in NiO-SiO_2; improved modeling of Ni2O4Si1(S).

Quaternary Systems

The description of some quaternary systems are improved:

- Al-Ca–Fe-O: added assessments of Al_2O_3-CaO-Fe_2O_3 and Al_2O_3-CaO-FeO.
- Al-Fe-O-Si: added assessments of Al_2O_3-Fe_2O_3-SiO_2 and Al_2O_3-FeO-SiO_2.
- Ca-Cr-O-Si: improved assessment of CaO-CrO-Cr_2O_3 for reducing conditions and for oxidizing conditions at low CaO-content; added $Ca_3Cr_2O_{12}Si_3$ (Uvarovite), $Ca_5Cr_5O_{50}Si_{20}$ (Gillespite).

IRSN NUCLEA-19 Nuclear Alloys-Oxides Database (NUCL19)

Overview Including Phase and System Information

Available Starting with Thermo-Calc Version 2021a

Document created 11/13/2020

Contents

Overview of NUCLEA-19

October 09, 2020

1 General Description

1.1 Atoms

18 + 2 atoms

U, O, Zr	fuel element
Ag, In, B, C	control rod
Fe, Cr, Ni	vessel and internal structure
Si, Mg, Al, Ca	concrete
Ba, La, Ru, Sr	fission products
Ar, H	gas

1.2 Stoichiometric Condensed Phases

LatSubSol name	TDB name
AG1BA1(S)	**AG1BA1**
AG2BA1(S)	**AG2BA1**
AG2BA3(S)	**AG2BA3**
AG5BA1(S)	**AG5BA1**
AG2C1O3(S)	**AG2C1O3**
AG1CA1(S)	**AG1CA1**
AG1CA3(S)	**AG1CA3**
AG2CA1(S)	**AG2CA1**
AG3CA5(S)	**AG3CA5**
AG7CA2(S)	**AG7CA2**
AG9CA2(S)	**AG9CA2**
AG2CR1O4(S)	**AG2CR1O4**
AG1IN2(S)	**AG1IN2**
AG2IN1(S)	**AG2IN1**
AG3IN1(S)	**AG3IN1**
AG1LA1(S)	**AG1LA1**
AG2LA1(S)	**AG2LA1**
AG5LA1(S)	**AG5LA1**
AG46LA14(S)	**AG46LA14**
AG1MG3(S)	**AG1MG3**
AG3MG1(S)	**AG3MG1**
AG2O1(S)	**AG2O1**
AG1SR1(S)	**AG1SR1**
AG2SR1(S)	**AG2SR1**
AG2SR3(S)	**AG2SR3**
AG4SR1(S)	**AG4SR1**
AG5SR1(S)	**AG5SR1**
AG1ZR1(S)	**AG1ZR1**
AG1ZR2(S)	**AG1ZR2**
AL1B2(S)	**AL1B2**

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LatSubSol name	TDB name
AL1B10(S)	AL1B10
AL1B12(S)	AL1B12
AL4B2O9(S)	AL4B2O9
AL4BA1(S)	AL4BA1
AL5BA4(S)	AL5BA4
AL13BA7(S)	AL13BA7
AL2BA1O4(S)	AL2BA1O4
AL2BA3O6(S)	AL2BA3O6
AL2BA4O7(S)	AL2BA4O7
AL2BA7O10(S)	AL2BA7O10
AL12BA1O19(S)	AL12BA1O19
AL4C3(S)	AL4C3
AL4C4SI1(S)	AL4C4SI1
AL8C7SI1(S)	AL8C7SI1
AL1CA1(S)	AL1CA1
AL2CA1(S)	AL2CA1
AL3CA8(S)	AL3CA8
AL4CA1(S)	AL4CA1
AL2CA3H12O12(S)	AL2CA3H12O12
AL2CA4H26O20(S)	AL2CA4H26O20
AL2CA1H4O10SI2(S)	AL2CA1H4O10SI2
AL4CA3MG1O10(S)	AL4CA3MG1O10
AL16CA1MG2O27(S)	AL16CA1MG2O27
AL28CA2MG2O46(S)	AL28CA2MG2O46
AL14CA12O33(S)	AL14CA12O33
AL2CA1O8SI2(ANORTHITE)	AL2CA1O8SI2
AL2CA2O7SI1(MELILITE)	AL2CA2O7SI1
AL2CA1SI2(S)	AL2CA1SI2
AL1CR2(S)	AL1CR2
AL4CR1(S)	AL4CR1
AL8CR5(S)	AL8CR5
AL9CR4(S)	AL9CR4
AL13CR2(S)	AL13CR2
AL2FE1(S)	AL2FE1
AL5FE2(S)	AL5FE2
AL1FE1O3(S)	AL1FE1O3
AL2FE3O12SI3(ALMANDINE)	AL2FE3O12SI3
AL4FE2O18SI5(FERROCORDIERITE)	AL4FE2O18SI5
AL1H3(S)	AL1H3
AL1H3O3(S)A	AL1H3O3
AL2H2O4(S)B	AL2H2O4_1
AL2H2O4(S)D	AL2H2O4_2
AL2H6O6(S)	AL2H6O6
AL2H4O9SI2(S)D	AL2H4O9SI2_1
AL2H4O9SI2(S)H	AL2H4O9SI2_2
AL2H4O9SI2(S)K	AL2H4O9SI2_3
AL1LA1(S)	AL1LA1

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LatSubSol name	TDB name
AL1LA3(S)	AL1LA3
AL2LA1(S)	AL2LA1
AL3LA1(S)	AL3LA1
AL11LA3(S)	AL11LA3
AL24LA10(S)	AL24LA10
AL1LA1O3(S)	AL1LA1O3
AL11LA1O18(S)	AL11LA1O18
AL30MG23(S)	AL30MG23
AL140MG89(B-AL3MG2)	AL140MG89
AL4MG2O18SI5(CORDIERITE)	AL4MG2O18SI5
AL18MG7O40SI3(SAPHIRINE)	AL18MG7O40SI3
AL1NI3(S)	AL1NI3
AL3NI1(S)	AL3NI1
AL3NI2(S)	AL3NI2
AL2O4SR1(H_T)	AL2O4SR1_1
AL2O4SR1(L_T)	AL2O4SR1_2
AL2O6SR3(S)	AL2O6SR3
AL4O7SR1(S)	AL4O7SR1
AL6O23SR14(LT)	AL6O23SR14_1
AL6O23SR14(HT)	AL6O23SR14_2
AL12O19SR1(S)	AL12O19SR1
AL1RU1(S)	AL1RU1
AL2RU1(S)	AL2RU1
AL3RU2(S)	AL3RU2
AL6RU1(S)	AL6RU1
AL13RU4(S)	AL13RU4
AL1SR1(S)	AL1SR1
AL2SR1(S)	AL2SR1
AL4SR1(S)	AL4SR1
AL2U1(S)	AL2U1
AL3U1(S)	AL3U1
AL4U0.9(S)	AL4U09
AL1ZR1(S)	AL1ZR1
AL1ZR2(S)	AL1ZR2
AL1ZR3(S)	AL1ZR3
AL2ZR1(S)	AL2ZR1
AL2ZR3(S)	AL2ZR3
AL3ZR1(S)	AL3ZR1
AL3ZR2(S)	AL3ZR2
AL3ZR4(S)	AL3ZR4
AL3ZR5(S)	AL3ZR5
AL4ZR5(S)	AL4ZR5
B6BA1(S)	B6BA1
B2BA1O4(S)	B2BA1O4
B2BA3O6(S)	B2BA3O6
B4BA1O7(S)	B4BA1O7
B8BA1O13(S)	B8BA1O13

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LatSubSol name	TDB name
B1C1U1(S)	B1C1U1
B2C1U1(S)	B2C1U1
B2C7U5(S)	B2C7U5
B6CA1(S)	B6CA1
B2CA1O4(S)	B2CA1O4
B2CA2O5(S)	B2CA2O5
B2CA3O6(S)	B2CA3O6
B4CA1O7(S)	B4CA1O7
B2CA1O8SI2(S)	B2CA1O8SI2
B2CA5O10SI1(S)	B2CA5O10SI1
B1CR1(S)	B1CR1
B1CR2(S)	B1CR2
B2CR1(S)	B2CR1
B3CR5(S)	B3CR5
B4CR1(S)	B4CR1
B4CR3(S)	B4CR3
B1FE1(S)	B1FE1
B1FE2(S)	B1FE2
B1FE1O3(S)	B1FE1O3
B1FE3O6(S)	B1FE3O6
B2FE1O4(S)	B2FE1O4
B2FE2O5(S)	B2FE2O5
B2FE3O6(S)	B2FE3O6
B2FE3U1(S)	B2FE3U1
B4FE1U1(S)	B4FE1U1
B5H9(L)	B5H9
B10H14(C)	B10H14
B1H1O2(C)	B1H1O2
B1H3O3(S)	B1H3O3
B2H4O4(S)	B2H4O4
B3H3O3(S)	B3H3O3
B2IN2O6(S)	B2IN2O6
B4LA1(S)	B4LA1
B6LA1(S)	B6LA1
B9LA1(S)	B9LA1
B2LA2O6(S)	B2LA2O6
B2LA6O12(S)	B2LA6O12
B6LA2O12(S)	B6LA2O12
B2MG1(S)	B2MG1
B4MG1(S)	B4MG1
B7MG1(S)	B7MG1
B2MG2O5(S)	B2MG2O5
B2MG3O6(S)	B2MG3O6
B4MG1O7(S)	B4MG1O7
B0.414NI0.586(S)	B0414NI0586
B0.436NI0.564(S)	B0436NI0564
B1NI1(S)	B1NI1

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LatSubSol name	TDB name
B1NI2(S)	B1NI2
B1NI3(S)	B1NI3
B2NI2O5(S)	B2NI2O5
B2NI3O6(S)	B2NI3O6
B1O1.5(S)	B1O15
B2O4SR1(S)	B2O4SR1
B2O5SR2(S)	B2O5SR2
B2O6SR3(S)	B2O6SR3
B4O7SR1(S)	B4O7SR1
B6O10SR1(S)	B6O10SR1
B1RU1(S)	B1RU1
B2RU1(S)	B2RU1
B3RU2(S)	B3RU2
B3RU7(S)	B3RU7
B3SI1(S)	B3SI1
B6SI1(S)	B6SI1
B14SI1(S)	B14SI1
B6SR1(S)	B6SR1
B2U1(S)	B2U1
B4U1(S)	B4U1
B12U1(S)	B12U1
B1ZR1(S)	B1ZR1
B2ZR1(S)	B2ZR1
B4ZR3(S)	B4ZR3
B12ZR1(S)	B12ZR1
BA1C2(S)	BA1C2
BA1C1O3(C)	BA1C1O3
BA1CR1O4(S)	BA1CR1O4
BA1CR2O4(S)	BA1CR2O4
BA3CR2O6(S)	BA3CR2O6
BA1FE2O4(S)	BA1FE2O4
BA1FE12O19(S)	BA1FE12O19
BA2FE2O5(S)	BA2FE2O5
BA2FE6O11(S)	BA2FE6O11
BA7FE4O13(S)	BA7FE4O13
BA1H2(C)	BA1H2
BA1H2O2(C)	BA1H2O2
BA1IN1(S)	BA1IN1
BA1IN2(S)	BA1IN2
BA1IN4(S)	BA1IN4
BA5IN2(S)	BA5IN2
BA5IN3(S)	BA5IN3
BA13IN1(S)	BA13IN1
BA1IN2O4(S)	BA1IN2O4
BA2IN2O5(S)	BA2IN2O5
BA3IN2O6(S)	BA3IN2O6
BA4IN6O13(S)	BA4IN6O13

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LatSubSol name	TDB name
BA5IN2O8(S)	BA5IN2O8
BA1LA2O4(S)	BA1LA2O4
BA1MG2(S)	BA1MG2
BA2MG17(S)	BA2MG17
BA6MG23(S)	BA6MG23
BA1NI1O2(S)	BA1NI1O2
BA3NI1O4(S)	BA3NI1O4
BA1O2(S)	BA1O2
BA1O3SI1(S)	BA1O3SI1
BA1O5SI2(S)	BA1O5SI2
BA2O4SI1(S)	BA2O4SI1
BA2O8SI3(S)	BA2O8SI3
BA3O5SI1(S)	BA3O5SI1
BA3O13SI5(S)	BA3O13SI5
BA5O21SI8(S)	BA5O21SI8
BA1O4U1(S)	BA1O4U1
BA1SI1(S)	BA1SI1
BA1SI2(S)	BA1SI2
BA2SI1(S)	BA2SI1
BA3SI4(S)	BA3SI4
BA5SI3(S)	BA5SI3
C1(GRA_HEX_A9)	C
C2CA1(S)	C2CA1
C2CA1MG1O6(S)	C2CA1MG1O6
C1CA1O3(C)	C1CA1O3
C2CR3(M3C2)(C-CR-FE-NI)	C2CR3
C6CR1O6(S)	C6CR1O6
C1FE1O3(S)	C1FE1O3
C5FE1O5(L)	C5FE1O5
C1H4(L)	C1H4
C2H6(L)	C2H6
C3H6(L)	C3H6
C3H8(L)	C3H8
C1H2O2(L)	C1H2O2
C1H4O1(L)	C1H4O1
C2H4O2(L)	C2H4O2
C2H6O1(L)	C2H6O1
C2H6O2(L)	C2H6O2
C3H6O1(L)	C3H6O1
C3H6O2(L)	C3H6O2
C3H8O1(L)	C3H8O1
C3H8O3(L)	C3H8O3
C2LA1(LT)	C2LA1
C2MG1(S)	C2MG1
C3MG2(S)	C3MG2
C1MG1O3(C)	C1MG1O3
C1NI1O3(S)	C1NI1O3

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LatSubSol name	TDB name
C4NI1O4(L)	C4NI1O4
C1O3SR1(C)	C1O3SR1
C1O5U1(S)	C1O5U1
C2RU1U2(S)	C2RU1U2
C1SI1(S)	C1SI1
C2SI2U3(T1)	C2SI2U3
C3SI16U20(T2)	C3SI16U20
C2SR1(S)	C2SR1
C3U2(S)	C3U2
CA1CR1O4(S)	CA1CR1O4
CA1CR2O4(HT)	CA1CR2O4_1
CA1CR2O4(BT)	CA1CR2O4_2
CA2CR13O20(X)	CA2CR13O20
CA3CR2O12SI3(UVAROVITE)	CA3CR2O12SI3
CA5CR5O50SI20(GILLESPITE)	CA5CR5O50SI20
CA1FE3O5(S)(CWF)	CA1FE3O5
CA1FE4O7(S)	CA1FE4O7
CA1FE5O7(S)(CW3F)	CA1FE5O7
CA1FE1O6SI2(hedenbergite)	CA1FE1O6SI2
CA1H2(C)	CA1H2
CA2H2MG5O24SI8(S)	CA2H2MG5O24SI8
CA1H2O2(S)	CA1H2O2
CA1H4O7SI2(S)	CA1H4O7SI2
CA2H2.333O5.166SI1(S)	CA2H2333O5166SI1
CA2H5O10.5SI3(S)	CA2H5O105SI3
CA3H6O10SI2(S)	CA3H6O10SI2
CA4H3O11.5SI3(S)	CA4H3O115SI3
CA5H6O20SI6(S)	CA5H6O20SI6
CA5H11O22.5SI6(S)	CA5H11O225SI6
CA5H21O27.5SI6(S)	CA5H21O275SI6
CA6H2O19SI6(S)	CA6H2O19SI6
CA1IN1(S)	CA1IN1
CA1IN2(S)	CA1IN2
CA3IN1(S)	CA3IN1
CA1MG2(S)	CA1MG2
CA2MG1O7SI2(AKERMANITE)	CA2MG1O7SI2
CA3MG1O8SI2(S)(MERWINITE)	CA3MG1O8SI2
CA1NI2(S)	CA1NI2
CA1NI3(S)	CA1NI3
CA1NI5(S)	CA1NI5
CA2NI7(S)	CA2NI7
CA1O2(S)	CA1O2
CA1O3SI1(PSEUDOWOL)(ASS1)	CA1O3SI1
CA2O4SI1(LARNITE)(ASS1)	CA2O4SI1
CA3O5SI1(HATRURITE)(ASS1)	CA3O5SI1
CA3O7SI2(RANKINITE)(ASS1)	CA3O7SI2
CA2O12SI4ZR1(S)	CA2O12SI4ZR1

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LatSubSol name	TDB name
CA3O9SI2ZR1(S)	CA3O9SI2ZR1
CA1O4U1(S)	CA1O4U1
CA1O3ZR1(S)	CA1O3ZR1
CA1SI1(S)	CA1SI1
CA1SI2(S)	CA1SI2
CA2SI1(S)	CA2SI1
CR1LA1O3(S)	CR1LA1O3
CR1O2(S)	CR1O2
CR1O3(C)	CR1O3
CR5O12(S)	CR5O12
CR8O21(S)	CR8O21
CR3O1ZR3(S)	CR3O1ZR3
CR2RU1(S)	CR2RU1
CR3RU1(S)	CR3RU1
CR1SI1(S)(2)	CR1SI1
CR1SI2(S)(2)	CR1SI2
CR3SI1(S)(2)	CR3SI1
CR5SI3(S)(2)	CR5SI3
FE1H1O2(S)	FE1H1O2
FE1H2O2(S)	FE1H2O2
FE1H3O3(S)	FE1H3O3
FE2H2O4(S)	FE2H2O4
FE1LA1O3(S)	FE1LA1O3
FE12LA1O19.5(S)	FE12LA1O195
FE1NI3(S)	FE1NI3
FE2O5SR2(S)	FE2O5SR2
FE2O6SR3(S)	FE2O6SR3
FE10O22SR7(S)	FE10O22SR7
FE12O19SR1(S)	FE12O19SR1
FE1O4U1(S)	FE1O4U1
FE1SI1(S)	FE1SI1
FE1SI2(S)	FE1SI2
FE2SI1(S)	FE2SI1
FE3SI7(S)	FE3SI7
FE5SI3(S)	FE5SI3
FE1U6(S)	FE1U6
FE4U3ZR5(e)	FE4U3ZR5
FE6U71ZR23(l)	FE6U71ZR23
FE50U18ZR32(k)	FE50U18ZR32
FE1ZR2(S)	FE1ZR2
FE1ZR3(S)	FE1ZR3
FE735ZR265(S)	FE735ZR265
H2LA1(S)	H2LA1
H3LA1O3(S)	H3LA1O3
H2MG1(S)	H2MG1
H2MG1O2(S)	H2MG1O2
H2MG3O12SI4(S)	H2MG3O12SI4

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LatSubSol name	TDB name
H2MG7O24SI8(S)	**H2MG7O24SI8**
H4MG3O9SI2(S)	**H4MG3O9SI2**
H2O1(L)	**H2O1**
H2O2SR1(C)	**H2O2SR1**
H2O4U1(S)	**H2O4U1**
H4O5U1(S)	**H4O5U1**
H6SI2(S)	**H6SI2**
H2SR1(C)	**H2SR1**
H3U1(S)	**H3U1**
H2ZR1(S)	**H2ZR1**
IN1LA1(S)	**IN1LA1**
IN1LA2(S)	**IN1LA2**
IN1LA3(S)	**IN1LA3**
IN2LA1(S)	**IN2LA1**
IN3LA1(S)	**IN3LA1**
IN5LA3(S)	**IN5LA3**
IN1MG2(S)	**IN1MG2**
IN1MG3(S)	**IN1MG3**
IN2MG5(S)	**IN2MG5**
IN7MG3(S)	**IN7MG3**
IN1NI1(S)	**IN1NI1**
IN1NI2(S)	**IN1NI2**
IN1NI3(S)	**IN1NI3**
IN3NI2(S)	**IN3NI2**
IN7NI3(S)	**IN7NI3**
IN42NI58(S)	**IN42NI58**
IN2O3(S)	**IN2O3**
IN2O4SR1(S)	**IN2O4SR1**
IN1SR1(S)	**IN1SR1**
IN1SR3(S)	**IN1SR3**
IN2SR1(S)	**IN2SR1**
IN2SR3(S)	**IN2SR3**
IN3SR1(S)	**IN3SR1**
IN3SR2(S)	**IN3SR2**
IN5SR1(S)	**IN5SR1**
IN5SR2(S)	**IN5SR2**
IN3U1(S)	**IN3U1**
IN1ZR1(S)	**IN1ZR1**
IN1ZR2(S)	**IN1ZR2**
IN1ZR3(S)	**IN1ZR3**
IN2ZR1(S)	**IN2ZR1**
IN3ZR1(S)	**IN3ZR1**
LA1MG1(S)	**LA1MG1**
LA1MG2(S)	**LA1MG2**
LA1MG12(S)	**LA1MG12**
LA2MG17(S)	**LA2MG17**
LA5MG41(S)	**LA5MG41**

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LatSubSol name	TDB name
LA1NI1(S)	LA1NI1
LA1NI3(S)	LA1NI3
LA1NI5(S)	LA1NI5
LA2NI3(S)	LA2NI3
LA2NI7(S)	LA2NI7
LA3NI1(S)	LA3NI1
LA5NI19(S)	LA5NI19
LA7NI3(S)	LA7NI3
LA7NI16(S)	LA7NI16
LA2O5SI1(S)	LA2O5SI1
LA2O7SI2(S)	LA2O7SI2
LA4O12SI3(S)	LA4O12SI3
LA4O7SR1(S)	LA4O7SR1
LA4O9SR3(S)	LA4O9SR3
LA2O5ZR1(S)	LA2O5ZR1
LA2O7ZR2(S)	LA2O7ZR2
LA1RU2(S)	LA1RU2
LA3RU1(S)	LA3RU1
LA5RU2(S)	LA5RU2
LA5RU3(S)	LA5RU3
LA7RU3(S)	LA7RU3
LA1SI1(S)	LA1SI1
LA1SI2(S)	LA1SI2
LA3SI2(S)	LA3SI2
MG1NI2(S)	MG1NI2
MG2NI1(S)	MG2NI1
MG1O3SI1(CLINOENSTATITE)	MG1O3SI1_1
MG1O3SI1(ENSTATITE)	MG1O3SI1_2
MG1O3SI1(PROENSTATITE)	MG1O3SI1_3
MG1O4U1(S)	MG1O4U1
MG2SI1(S)	MG2SI1
MG2SR1(S)	MG2SR1
MG17SR2(S)	MG17SR2
MG23SR6(S)	MG23SR6
MG38SR9(S)	MG38SR9
NI2O4SI1(S)	NI2O4SI1
NI1SI1(S)	NI1SI1
NI2SI1(S)	NI2SI1
NI3SI1(HIGH_T)	NI3SI1_1
NI3SI1(MEDIUM_T)	NI3SI1_2
NI3SI2(S)	NI3SI2
NI29SI9(LOW_T)	NI29SI9
NI31SI12(S)	NI31SI12
NI35SI65(S)	NI35SI65
NI1SR1(S)	NI1SR1
NI1U6(S)	NI1U6
NI2U1(S)	NI2U1

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LatSubSol name	TDB name
NI5U1(S)	NI5U1
NI7U5(S)	NI7U5
NI9U7(S)	NI9U7
NI77U23(S)	NI77U23
NI78U22(S)	NI78U22
NI1ZR1(S)	NI1ZR1
NI1ZR2(S)	NI1ZR2
NI3ZR1(S)	NI3ZR1
NI5ZR1(S)	NI5ZR1
NI7ZR2(S)	NI7ZR2
NI11ZR9(S)	NI11ZR9
NI21ZR8(S)	NI21ZR8
NI575ZR425(S)	NI575ZR425
O2RU1(S)	O2RU1
O2SI1(CRISTOBALITE)	O2SI1_1
O2SI1(H_T_QUARTZ)	O2SI1_2
O2SI1(L_T_QUARTZ)	O2SI1_3
O2SI1(TRIDYMITE)	O2SI1_4
O3SI1SR1(S)	O3SI1SR1
O4SI1SR2(S)	O4SI1SR2
O5SI1SR3(S)	O5SI1SR3
O2SR1(S)	O2SR1
O4SR2ZR1(S)	O4SR2ZR1
O7SR3ZR2(S)	O7SR3ZR2
O3U1(S)	O3U1
O8U3(S)	O8U3
O9U4(S)	O9U4
O2ZR1(MONOCLINIC)	O2ZR1
RU1SI1(S)	RU1SI1
RU2SI1(S)	RU2SI1
RU2SI3(S)	RU2SI3
RU4SI3(S)	RU4SI3
RU5SI3(S)	RU5SI3
RU1U2(S)	RU1U2
RU4U3(S)	RU4U3
RU5U3(S)	RU5U3
RU48U52(S-L)	RU48U52_1
RU48U52(S-H)	RU48U52_2
RU1ZR1(S)	RU1ZR1
RU2ZR1(S)	RU2ZR1
SI1SR1(S)	SI1SR1
SI1SR2(S)	SI1SR2
SI2SR1(S-A)	SI2SR1
SI3SR5(S)	SI3SR5
SI1U3(HIGH_T)	SI1U3_1
SI1U3(LOW_T)	SI1U3_2
SI1.88U1(S)	SI188U1

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LatSubSol name	TDB name
SI3U1(S)	**SI3U1**
SI5U3(S)	**SI5U3**
SI511U489(S)	**SI511U489**
SI1ZR1(S)	**SI1ZR1**
SI1ZR2(S)	**SI1ZR2**
SI1ZR3(S)	**SI1ZR3**
SI2ZR1(S)	**SI2ZR1**
SI2ZR3(S)	**SI2ZR3**
SI3ZR5(S)	**SI3ZR5**
SI4ZR5(S)	**SI4ZR5**

1.3 Condensed Solutions

LatSubSol name	mult	atoms	TDB name
AL12MG17	1	Al, Mg	**AL12MG17**
AL13FE4	1	Al, Fe	**AL13FE4**
AL8FE5	1	Al, Fe	**AL8FE5**
ALPHA(C2S)	1	Ca, O, Si, Mg	**ALPHAC2S**
ALPHA2(C2S)	1	Ca, O, Si, Mg	**ALPHA2C2S**
B4C1	1	B, C	**B4C1**
BCC_A2(1)	2	Al, C, Cr, Fe, In, La, Mg, Ni, Ru, Si, U, Zr	**BCCA21**
BCC_A2(2)	2	Ag, C, Al, Cr, Fe, In, Ni, Ru, Si, U, Zr, O	**BCCA22**
BCC_A2(3)	1	Ba, Ca, Sr	**BCCA23**
BCC_A2(4)	1	Ag, C, Ca, In, La, Mg	**BCCA24**
BCC_A2(5)	1	In, Ni	**BCCA25**
BCC_A2(6)	1	Ag, Al, In, Mg	**BCCA26**
BCT	1	C, U, O	**BCT**
BETA_B	1	B, C, Si	**BETAB**
C2F	1	Al, Ca, O, Fe	**C2F**
C2LA(1+x)(HT)	1	C, La	**C2LA1xHT**
C3A	1	Al, Ca, O, Fe	**C3A**
C3LA(2+x)	1	C, La	**C3LA2x**
CA	2	Al, Ca, O, Fe	**CAsto**
CA2	1	Al, Ca, O, Fe	**CA2sto**
CA6	1	Al, Ca, O, Fe	**CA6sto**
CC	1	Ba, O, Ca, La, Sr, Zr	**CC**
CR-ZR(LAVES-C14)	1	Cr, Zr	**CRZRLAVESC14**
CUB_A13	1	Ag, Al	**CUBA13**
CW2S_OLIVINE	2	Ca, O, Si, Fe, Mg	**CW2SOLIVINE**
CWS_WOLLASTONITE	2	Ca, O, Si, Fe, Mg	**CWSWOLLASTONITE**
CxRU3U1(SS)	1	C, Ru, U	**CxRU3U1SS**
DELTA	1	U, Zr	**DELTA**
DHCP	1	La, Mg	**DHCP**
DIA_A4	1	B, Ru, Si, Sr	**DIAA4**
DIOPSIDE	1	Ca, Mg, O, Si	**DIOPSIDE**

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LatSubSol name	mult	atoms	TDB name
FCC_A1(1)	1	Ag, C, Al, Cr, Fe, In, Ni, Ru, Si, U, Zr	**FCCA11**
FCC_A1(2)	1	Ag, Al, In, Mg	**FCCA12**
FCC_A1(3)	1	Ba, Ca, La, Sr	**FCCA13**
FCC_A1(4)	1	Ag, C, Ba, Ca, In, La, Mg	**FCCA14**
FCC_B1(1)	1	Ca, O, Fe, Mg, Ni, Sr	**FCCB11**
FCC_B1(2)	1	Al, O, Ca, Cr, Fe, Mg, Ni, Si	**FCCB12**
FCC_B1(3)	2	Ba, O, Ca, Fe, Mg, Ni, Sr, Zr	**FCCB13**
FCC_B1(4)	2	C, U, Zr, O	**FCCB14**
FCC_C1	2	Ba, O, Ca, Cr, Fe, In, La, Mg, Sr, U, Zr	**FCCC1**
FCC_L10,BETA'	1	In, Mg	**FCCL10BETA**
FCC_L12,BETA"	1	In, Mg	**FCCL12BETA**
HCP_A3(1)	2	Ag, C, Al, Cr, Fe, In, La, Mg, Ni, Ru, U, Zr, O	**HCPA31**
HCP_A3(2)	1	Ag, Al, In	**HCPA32**
HCP_A3(3)	1	In, Ni	**HCPA33**
LAMG3	1	La, Mg	**LAMG3**
LAVES	2	Cr, Fe, U, Zr	**LAVES**
LIQUID	3	Ag, Al, O, Si, Ca, B, Ba, La, Sr, C, Cr, Fe, In, Mg, Ni, U, Zr, Ru	**LIQUID**
M23C6(1)	1	C, Cr, Fe, Ni	**M23C61**
M23C6(2)	1	B, Fe, C	**M23C62**
M3C1	1	B, Cr, Fe, Ni, C	**M3C1**
M7C3	1	C, Cr, Fe, Ni	**M7C3**
MULLITE	1	Al, B, O, Si	**MULLITE**
ORT_A20	1	Fe, Si, U, Zr	**ORTA20**
PEROVSKITE	1	Ba, O, U, Zr, Sr	**PEROVSKITE**
RHO	2	Al, O, Cr, Fe, Zr	**RHO**
SI2SR-B	1	Si, Sr	**SI2SRB**
SI2U3(SS)	1	C, Si, U	**SI2U3SS**
SIGMA	1	Cr, Fe, Ni	**SIGMA**
SPINEL	1	Al, Fe, O, Mg, Ni, Cr	**SPINEL**
T(SS)	1	Al, Ca, O, Fe	**TSS**
TCHERNOBYLITE	1	O, Si, U, Zr	**TCHERNOBYLITE**
TET(METAL)	1	Al, Cr, Fe, Ru, Si, U, Zr	**TETMETAL**
TET(OXIDE)	1	Ba, O, Ca, Cr, Fe, In, La, Mg, U, Zr	**TETOXIDE**
TET_A6	1	In, Mg	**TETA6**

1.4 Gas

LatSubSol name	TDB name
AG1(G)	AG
AG2(G)	AG2
AG1O1(G)	AG1O1
AL1(G)	AL
AL2(G)	AL2
AL1B1O2(G)	AL1B1O2
AL1C1(G)	AL1C1
AL1C2(G)	AL1C2
AL2C2(G)	AL2C2
AL1H1(G)	AL1H1
AL1H2(G)	AL1H2
AL1H3(G)	AL1H3
AL1H1O1(G)1	AL1H1O1_1
AL1H1O1(G)2	AL1H1O1_2
AL1H1O2(G)	AL1H1O2
AL1H2O2(G)	AL1H2O2
AL1O1(G)	AL1O1
AL1O2(G)	AL1O2
AL2O1(G)	AL2O1
AL2O2(G)	AL2O2
AL2O3(G)	AL2O3
AR1(G)	AR
B1(G)	B
B2(G)	B2
B1BA1O2(G)	B1BA1O2
B1C1(G)	B1C1
B1C2(G)	B1C2
B2C1(G)	B2C1
B1H1(G)	B1H1
B1H2(G)	B1H2
B1H3(G)	B1H3
B2H6(G)	B2H6
B5H9(G)	B5H9
B10H14(G)	B10H14
B1H1O1(G)1	B1H1O1_1
B1H1O1(G)2	B1H1O1_2
B1H1O2(G)	B1H1O2
B1H2O1(G)	B1H2O1
B1H2O2(G)	B1H2O2
B1H3O1(G)	B1H3O1
B1H3O2(G)	B1H3O2
B1H3O3(G)	B1H3O3
B2H4O4(G)	B2H4O4
B3H3O3(G)	B3H3O3
B3H3O6(G)	B3H3O6

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LatSubSol name	TDB name
B1O1 (G)	B1O1
B1O2 (G)	B1O2
B2O1 (G)	B2O1
B2O2 (G)	B2O2
B2O3 (G)	B2O3
B1O2SR1 (G)	B1O2SR1
BA1 (G)	BA
BA1H1 (G)	BA1H1
BA1H1O1 (G)	BA1H1O1
BA1H2O2 (G)	BA1H2O2
BA1O1 (G)	BA1O1
BA2O1 (G)	BA2O1
C1 (G)	C
C2 (G)	C2
C3 (G)	C3
C4 (G)	C4
C5 (G)	C5
C6CR1O6 (G)	C6CR1O6
C5FE1O5 (G)	C5FE1O5
C1H1 (G)	C1H1
C1H2 (G)	C1H2
C1H3 (G)	C1H3
C1H4 (G)	C1H4
C2H1 (G)	C2H1
C2H2 (G)	C2H2
C2H3 (G)	C2H3
C2H4 (G)	C2H4
C2H5 (G)	C2H5
C2H6 (G)	C2H6
C3H4 (G) 1	C3H4_1
C3H4 (G) 2	C3H4_2
C3H4 (G) 3	C3H4_3
C3H6 (G) 1	C3H6_1
C3H6 (G) 2	C3H6_2
C3H7 (G) 1	C3H7_1
C3H7 (G) 2	C3H7_2
C3H8 (G)	C3H8
C1H1O1 (G)	C1H1O1
C1H1O2 (G)	C1H1O2
C1H2O1 (G)	C1H2O1
C1H2O2 (G) C	C1H2O2_1
C1H2O2 (G) T	C1H2O2_2
C1H3O1 (G) 1	C1H3O1_1
C1H3O1 (G) 2	C1H3O1_2
C1H4O1 (G)	C1H4O1
C2H2O1 (G)	C2H2O1
C2H2O2 (G)	C2H2O2

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LatSubSol name	TDB name
C2H4O1(G)1	C2H4O1_1
C2H4O1(G)2	C2H4O1_2
C2H4O2(G)1	C2H4O2_1
C2H4O2(G)2	C2H4O2_2
C2H4O4(G)	C2H4O4
C2H6O1(G)1	C2H6O1_1
C2H6O1(G)2	C2H6O1_2
C2H6O2(G)	C2H6O2
C3H4O1(G)1	C3H4O1_1
C3H4O1(G)2	C3H4O1_2
C3H4O1(G)3	C3H4O1_3
C3H4O2(G)1	C3H4O2_1
C3H4O2(G)2	C3H4O2_2
C3H4O3(G)	C3H4O3
C3H6O1(G)1	C3H6O1_1
C3H6O1(G)2	C3H6O1_2
C3H6O1(G)3	C3H6O1_3
C3H6O1(G)4	C3H6O1_4
C3H6O1(G)5	C3H6O1_5
C3H6O2(G)	C3H6O2
C3H6O3(G)	C3H6O3
C3H8O1(G)1	C3H8O1_1
C3H8O1(G)2	C3H8O1_2
C3H8O1(G)3	C3H8O1_3
C2H6O1SI1(G)	C2H6O1SI1
C2H8SI1(G)	C2H8SI1
C4NI1O4(G)	C4NI1O4
C1O1(G)	C1O1
C1O2(G)	C1O2
C2O1(G)	C2O1
C3O2(G)	C3O2
C1SI1(G)	C1SI1
C1SI2(G)	C1SI2
C1SI3(G)	C1SI3
C1SI4(G)	C1SI4
C2SI1(G)	C2SI1
C2SI2(G)	C2SI2
C2SI3(G)	C2SI3
CA1(G)	CA
CA2(G)	CA2
CA1H1(G)	CA1H1
CA1H1O1(G)	CA1H1O1
CA1H2O2(G)	CA1H2O2
CA1O1(G)	CA1O1
CR1(G)	CR
CR2(G)	CR2
CR1O1(G)	CR1O1

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LatSubSol name	TDB name
CR1O2(G)	CR1O2
CR1O3(G)	CR1O3
FE1(G)	FE
FE2(G)	FE2
FE1H2O2(G)	FE1H2O2
FE1O1(G)	FE1O1
H1(G)	H
H2(G)	H2
H1IN1(G)	H1IN1
H1IN1O1(G)	H1IN1O1
H1MG1(G)	H1MG1
H1MG1O1(G)	H1MG1O1
H2MG1O2(G)	H2MG1O2
H1NI1(G)	H1NI1
H2NI1O2(G)	H2NI1O2
H1O1(G)	H1O1
H1O2(G)	H1O2
H2O1(G)	H2O1
H2O2(G)	H2O2
H1O1RU1(G)	H1O1RU1
H2O2RU1(G)	H2O2RU1
H2O3SI1(G)	H2O3SI1
H4O4SI1(G)	H4O4SI1
H1O1SR1(G)	H1O1SR1
H2O2SR1(G)	H2O2SR1
H1SI1(G)	H1SI1
H2SI1(G)	H2SI1
H3SI1(G)	H3SI1
H4SI1(G)	H4SI1
H6SI2(G)	H6SI2
H1SR1(G)	H1SR1
H1ZR1(G)	H1ZR1
IN1(G)	IN
IN2(G)	IN2
IN1O1(G)	IN1O1
IN2O1(G)	IN2O1
LA1(G)	LA
LA1O1(G)	LA1O1
LA2O1(G)	LA2O1
LA2O2(G)	LA2O2
MG1(G)	MG
MG2(G)	MG2
MG1O1(G)	MG1O1
NI1(G)	NI
NI1O1(G)	NI1O1
O1(G)	O
O2(G)	O2

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LatSubSol name	TDB name
O3(G)	**O3**
O1RU1(G)	**O1RU1**
O2RU1(G)	**O2RU1**
O3RU1(G)	**O3RU1**
O4RU1(G)	**O4RU1**
O1SI1(G)	**O1SI1**
O2SI1(G)	**O2SI1**
O2SI2(G)	**O2SI2**
O1SR1(G)	**O1SR1**
O1U1(G)	**O1U1**
O2U1(G)	**O2U1**
O3U1(G)	**O3U1**
O1ZR1(G)	**O1ZR1**
O2ZR1(G)	**O2ZR1**
RU1(G)	**RU**
SI1(G)	**SI**
SI2(G)	**SI2**
SI3(G)	**SI3**
SR1(G)	**SR**
SR2(G)	**SR2**
U1(G)	**U**
ZR1(G)	**ZR**
ZR2(G)	**ZR2**

2 Assessed Systems

2.1 Binary Systems

assessed binary systems								
Ag – Al	Ag – B	Ag – Ba	Ag – C	Ag – Ca	Ag – Cr	Ag – Fe	Ag – In	Ag – La
Ag – Mg	Ag – Ni	Ag – O	Ag – Ru	Ag – Si	Ag – Sr	Ag – U	Ag – Zr	Al – B
Al – Ba	Al – C	Al – Ca	Al – Cr	Al – Fe	Al – In	Al – La	Al – Mg	Al – Ni
Al – O	Al – Ru	Al – Si	Al – Sr	Al – U	Al – Zr	B – Ba	B – C	B – Ca
B – Cr	B – Fe	B – In	B – La	B – Mg	B – Ni	B – O	B – Ru	B – Si
B – Sr	B – U	B – Zr	Ba – C	Ba – Ca	Ba – Cr	Ba – Fe	Ba – In	Ba – La
Ba – Mg	Ba – Ni	Ba – O	Ba – Ru	Ba – Si	Ba – Sr	Ba – U	Ba – Zr	C – Ca
C – Cr	C – Fe	C – In	C – La	C – Mg	C – Ni	C – O	C – Ru	C – Si
C – Sr	C – U	C – Zr	Ca – Cr	Ca – Fe	Ca – In	Ca – La	Ca – Mg	Ca – Ni
Ca – O	Ca – Ru	Ca – Si	Ca – Sr	Ca – U	Ca – Zr	Cr – Fe	Cr – In	Cr – La
Cr – Mg	Cr – Ni	Cr – O	Cr – Si	Cr – Ru	Cr – Sr	Cr – U	Cr – Zr	Fe – In
Fe – La	Fe – Mg	Fe – Ni	Fe – O	Fe – Ru	Fe – Si	Fe – Sr	Fe – U	Fe – Zr
In – La	In – Mg	In – Ni	In – O	In – Ru	In – Si	In – Sr	In – U	In – Zr
La – Mg	La – Ni	La – O	La – Ru	La – Si	La – Sr	La – U	La – Zr	Mg – Ni
Mg – O	Mg – Ru	Mg – Si	Mg – Sr	Mg – U	Mg – Zr	Ni – O	Ni – Ru	Ni – Si
Ni – Sr	Ni – U	Ni – Zr	O – Ru	O – Si	O – Sr	O – U	O – Zr	Ru – Si
Ru – Sr	Ru – U	Ru – Zr	Si – Sr	Si – U	Si – Zr	Sr – U	Sr – Zr	U – Zr

2.2 Ternary Systems

system	assessed sub-systems
Al – B – O	$Al_2O_3 - B_2O_3$
Al – Ba – O	$Al_2O_3 - BaO$
Al – Ca – O	$Al_2O_3 - CaO$
Al – Cr – O	$Al_2O_3 - Cr_2O_3$
Al – Fe – O	$Al_2O_3 - FeO - Fe_2O_3$
Al – In – O	$Al_2O_3 - In_2O_3$
Al – La – O	$Al_2O_3 - La_2O_3$
Al – Mg – O	$Al_2O_3 - MgO$
Al – Ni – O	$Al_2O_3 - NiO$
Al – O – Si	$Al_2O_3 - SiO_2$
Al – O – Sr	$Al_2O_3 - SrO$
Al – O – U	$Al_2O_3 - UO_2$
Al – O – Zr	$Al_2O_3 - ZrO_2$
B – Ba – O	$B_2O_3 - BaO$
B – C – Fe	full
B – C – U	full
B – C – Zr	full
B – Ca – O	$B_2O_3 - CaO$
B – Cr – O	$B_2O_3 - Cr_2O_3$
B – Fe – O	$B_2O_3 - FeO - Fe_2O_3$
B – Fe – U	full
B – Fe – Zr	full
B – In – O	$B_2O_3 - In_2O_3$
B – La – O	$B_2O_3 - La_2O_3$
B – Mg – O	$B_2O_3 - MgO$
B – Ni – O	$B_2O_3 - NiO$
B – O – Si	$B_2O_3 - SiO_2$
B – O – Sr	$B_2O_3 - SrO$
B – O – U	$B_2O_3 - UO_2$
B – O – Zr	$B_2O_3 - ZrO_2$
Ba – Ca – O	$BaO - CaO$
Ba – Cr – O	$BaO - Cr_2O_3$
Ba – Fe – O	$BaO - FeO$ $BaO - Fe_2O_3$
Ba – In – O	$BaO - In_2O_3$
Ba – La – O	$BaO - La_2O_3$
Ba – Mg – O	$BaO - MgO$
Ba – Ni – O	$BaO - NiO$
Ba – O – Si	$BaO - SiO_2$
Ba – O – Sr	$BaO - SrO$
Ba – O – U	$BaO - UO_2$
Ba – O – Zr	$BaO - ZrO_2$
C – Cr – Fe	full
C – Cr – Ni	full
C – Fe – Ni	full
C – O – U	full
C – O – Zr	full
C – U – Zr	full

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system	assessed sub-systems
Ca – Cr – O	$CaO - CrO - Cr_2O_3$
Ca – Fe – O	$CaO - FeO - Fe_2O_3$
Ca – In – O	$CaO - In_2O_3$
Ca – La – O	$CaO - La_2O_3$
Ca – Mg – O	$CaO - MgO$
Ca – Ni – O	$CaO - NiO$
Ca – O – Si	$CaO - SiO_2$
Ca – O – Sr	$CaO - SrO$
Ca – O – U	$CaO - UO_2$
Ca – O – Zr	$CaO - ZrO_2$
Cr – Fe – O	full
Cr – Fe – Ni	full
Cr – Fe – Zr	full
Cr – In – O	$Cr_2O_3 - In_2O_3$
Cr – La – O	$Cr_2O_3 - La_2O_3$
Cr – Mg – O	$Cr_2O_3 - MgO$
Cr – Ni – O	full
Cr – O – Si	$CrO - Cr_2O_3 - SiO_2$
Cr – O – Sr	$Cr_2O_3 - SrO$
Cr – O – U	$Cr_2O_3 - UO_2$
Cr – O – Zr	full
Fe – In – O	$FeO - In_2O_3$ $Fe_2O_3 - In_2O_3$
Fe – La – O	$FeO - La_2O_3$ $Fe_2O_3 - La_2O_3$
Fe – Mg – O	$FeO - MgO$ $Fe_2O_3 - MgO$
Fe – Ni – O	full
Fe – O – Si	$FeO - Fe_2O_3 - SiO_2$
Fe – O – Sr	$FeO - SrO$ $Fe_2O_3 - SrO$
Fe – O – U	full
Fe – O – Zr	full
Fe – U – Zr	full
In – La – O	$In_2O_3 - La_2O_3$
In – Mg – O	$In_2O_3 - MgO$
In – Ni – O	$In_2O_3 - NiO$
In – O – Si	$In_2O_3 - SiO_2$
In – O – Sr	$In_2O_3 - SrO$
In – O – U	$In_2O_3 - UO_2$
In – O – Zr	$In_2O_3 - ZrO_2$
La – Mg – O	$La_2O_3 - MgO$
La – Ni – O	$La_2O_3 - NiO$
La – O – Si	$La_2O_3 - SiO_2$
La – O – Sr	$La_2O_3 - SrO$
La – O – U	$La_2O_3 - UO_2$
La – O – Zr	$La_2O_3 - ZrO_2$
Mg – Ni – O	$MgO - NiO$
Mg – O – Si	$MgO - SiO_2$
Mg – O – Sr	$MgO - SrO$
Mg – O – U	$MgO - UO_2$
Mg – O – Zr	$MgO - ZrO_2$

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system	assessed sub-systems
Ni – O – Si	$NiO - SiO_2$
Ni – O – Sr	$NiO - SrO$
Ni – O – U	$NiO - UO_2$
Ni – O – Zr	$NiO - ZrO_2$
O – Si – Sr	$SrO - SiO_2$
O – Si – U	$SiO_2 - UO_2$
O – Si – Zr	$SiO_2 - ZrO_2$
O – Sr – U	$SrO - UO_2$
O – Sr – Zr	$SrO - ZrO_2$
O – U – Zr	full

2.3 Quaternary Systems

system	assessed sub-systems
Al – B – Ca – O	$Al_2O_3 - B_2O_3 - CaO$
Al – B – O – Si	$Al_2O_3 - B_2O_3 - SiO_2$
Al – B – O – Mg	$Al_2O_3 - B_2O_3 - MgO$
Al – Ca – Fe – O	$Al_2O_3 - CaO - FeO - Fe_2O_3$
Al – Ca – O – Si	$Al_2O_3 - CaO - SiO_2$
Al – Fe – O – Si	$Al_2O_3 - FeO - Fe_2O_3 - SiO_2$
Al – O – Si – U	$Al_2O_3 - SiO_2 - UO_2$
Al – O – Si – Zr	$Al_2O_3 - SiO_2 - ZrO_2$
Al – O – U – Ar	$Al_2O_3 - UO_2 - ZrO_2$
B – Ca – Mg – O	$B_2O_3 - CaO - MgO$
B – Ca – O – Si	$B_2O_3 - CaO - SiO_2$
B – Mg – O – Si	$B_2O_3 - MgO - SiO_2$
Ca – Cr – O – Si	$CaO - CrO - Cr_2O_3 - SiO_2$
Ca – Fe – O – Si	$CaO - FeO - Fe_2O_3 - SiO_2$
Ca – O – Si – Zr	$CaO - SiO_2 - ZrO_2$
O – Si – U – Zr	$SiO_2 - UO_2 - ZrO_2$