

Mineral structures C & D

Updated 092406 by J V Smith

[Ca-aluminosilicate $\text{Ca}_3\text{Ti}(\text{Al},\text{Ti})_2(\text{Si},\text{Al})_3\text{O}_{14}$. Unknown structure, possibly related to *mellilite*.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.]

Ca-armalcolite CaTi_2O_5 . In meteorites: **AE Rubin** 1997 MPS 32 231-47.

cabalzarite $\text{Ca}(\text{Mg},\text{Al},\text{Fe})_2(\text{AsO}_4)_2 \cdot 2(\text{aq},\text{OH})$. *Tsumcorite* group: *lotharmeyerite* subgroup.
Occurrence & structure: **J Brugger & 7 others** 2000 AM 85 1307-14.

[cabrerite = magnesian variety of annabergite.]

cabriite Pd_2SnCu . Orthorhombic superstructure of disordered cubic parent.
Structure of *synthetic*: **check**.

Occurrence: **TL Evstigneeva AD Genkin** 1983 CM 21 481-6;
Pt,Sb-bearing, **GC Wilson JC Rucklidge C Cermignani** 2002 CM 40 473-9.

cacoxenite $\text{Fe}_4(\text{PO}_4)_3(\text{OH})_3 \cdot 12\text{aq}$.

Structure: **PB Moore J Shen** 1983 N 306 356-8 (M749).

Compare with *buttgenbachite*, *connellite*, *kambaldaite* & *szymanskiite*.

[N Rajic & 4 others 2002 *Preparation and characterization of iron(III) phosphate-oxalate using 1,2-diaminopropane as the structure-directing agent*, MMM 55 313-9 (8099).]

cadmium Cd. Distorted hexagonal closest packing. Isostructural with *zinc*.
Structure: **Wells** 4th ed p. 1011.

Atomic displacements: **E Rossmannith** 1978 AC A34 497-500.

XRPD to 174 GPa, stays in hcp: **T Kenichi** 1997 PRB 5170-9 (K936).

[cadmium-dolomite *Synthetic*: MM 32-948.]

cadmoindite CdIn_2S_4 . *Spinel* structure type.

Occurrence & structure (matches *synthetic*): **IVChaplygin & 3 others** 2004 ZVMO 133 (4) 21-7.

cadmoselite CdSe. *Wurtzite* structure type.

Synthetic: **AW Stevenson Z Barnea** 1984 AC B40 530-7.

Occurrence: MM 31 963. Name: MM 32 948.

cadwaladerite $\text{Al}(\text{OH})_2\text{Cl} \cdot 4\text{aq}$.

Structure determination not found.

Occurrence: Dana.

cafarsite $\text{Ca}_8(\text{Ti},\text{Fe},\text{Mn})_{6-7}(\text{AsO}_3)_{12} \cdot 4\text{aq}$.

Structure: **A Edenharter W Nowacki M Weibel** 1977 SMPM 57 1-16 = MA 78-1499.

Occurrence: MM 36 1149.

cafetite $\text{CaTi}_2\text{O}_5 \cdot \text{aq}$.

Structure: SC-XRD, **SV Krivovichev & 4 others** 2003 AM 88 424-9.

Occurrence: **AA Kukharenko VV Kondrat'eva VM Kovyazina** 1959 ZVMO 88 444-53 = AM 45 476.

See *kassite*.

cahnite $\text{Ca}_2\text{B}(\text{AsO}_4)(\text{OH})_4$. Compare with *zircon* structure.

Structure: **CT Prewitt MJ Buerger** 1961 AM 46 1077-85.

Occurrence: MM 21 560.

caichengyunite $\text{Fe}_3\text{Al}_2(\text{SO}_4)_6 \cdot 30\text{aq}$. Not voted by CNMMN.

Occurrence: AM 89 894-7.

CALAVERITE STRUCTURE GROUP OF MONOCLINIC TELLURIDES Includes:

<i>calaverite</i>	AuTe_2
<i>kostovite</i>	AuCuTe_4
<i>sylvanite</i>	AuAgTe_4

Distorted CdI_2 topology.

calaverite AuTe_2 . Dimorphic with orthorhombic *krennerite*.

Average structure, **G Tunell L Pauling** 1952 AC 5 375-81;

F Pertlik 1984 ZK 169 227-36 = MA 86M/4299 (has error);

valence electron distribution theory, **R Caracas X Gonze** 2001 AC B57 633-7 (3448).
 Incommensurate modulation: RT, 100K, **WJ Schutte JL de Boer** 1988 AC B44 486-94 (S1465);
 T & composition dependence, **K Balzuweit & 3 others** 1993 JCG 131 518-32.
 High-P: **K Reithmayer & 3 others** 1993 AC B49 6-11.
¹⁹⁷Au Mössbauer: **J Stanek** 1995 CM 33 185;
FE Wagner JA Sawicki J Friedl 1995 CM 33 187-8.
[calcibeborosilite CaYBeBSi₂O₈(OH)₂.
 Occurrence: **AS Povarrennykh VD Dusmatov** 1970 = **VD Dusmatov NS Samsonova** 1963
 Kristallografiya 677 = MM 54 662. Not approved by IMA.]
calciborite CaB₂O₄.
 2-connected tetrahedral net: Consortium for Theoretical Frameworks 853.
 Structure: early papers on *synthetic*, 1969, 1969, 1970;
DP Shashkin MA Simonov NV Belov 1971 SPD 15 1003-5 (S1301) = MA 71-2694;
A Kirfel 1987 AC B43 333-43.
 Occurrence: MM 31 955.
Synthetic CaAlBO₄, not isostructural: **W Schuckmann** 1968 NJMM 80-6 (S1341);
YuK Egorov-Tismenko MA Simonov NV Belov 1980 SPD 25 226-7 (E293).
calcio-ancylite-Ce (Ca,Sr)Ce(CO₃)₂OH.aq.
 History & new occurrences Greenland & Russia: **IV Pekov OV Petersen AV Voloshin** 1997
 NJMA 171 309-22 (P676);
 Norway: **AO Larsen RA Gault** 2002 NJMM 411-23 (8441).
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
calcio-ancylite-Nd Ca(Nd,Ce)₃(CO₃)₄(OH)₃.aq.
 Occurrence & structure: **P Orlandi M Pasero G Vezzalini** 1990 EJM 2 413 = AM 76 1729.
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
calcioandryobertsite KCaCu₅(AsO₄)₄[As(OH)₂O₂]₂aq.
 Lamellar intergrowth with *andryobertsite* KCdCu₅(AsO₄)₄[As(OH)₂O₂]₂aq.
 Structure: see *andryobertsite*.
 Occurrence & XRPD: **MA Cooper & 3 others** 1999 MR 30 181-6.
calcio-andryobertsite-1M KCaCu₅(AsO₄)₄[AsO₂(OH)₂]₂aq.
 Polytype of *calcio-andryobertsite-2O*.
 Occurrence & SC-XRD structure: **MA Cooper & 3 others** 1999 MR 30 181-6.
calcio-andryobertsite-2O KCaCu₅(AsO₄)₄[AsO₂(OH)₂]₂aq.
 Polytype of *calcio-andryobertsite-1M*.
 Occurrence & SC-XRD structure: **H Sarp R Cerny** 2004 EJM 16 163-9 (10138).
calcioaravaipate PbCa₂Al(F,OH)₉.
 Order-disorder family. Different connectivity to *aravaipate*.
 Structure: SC-XRD, **AR Kampf S Merlino M Pasero** 2003 AM 88 430-5.
 Occurrence: **AR Kampf EE Foord** 1996 MR 27 293-300 = AM 82 207.
calciobetafite e. g. (Ca,Na,Ce,U,Th)₂Zr₂(Ti,Nb,Fe)₄O₁₄ & Ca₂(Ti,Nb)₂(O,OH)₇.
Pyrochlore structure group, *betafite* subgroup.
 Structure: **F Mazzi R Munno** 1983 AM 68 262-76.
 Review: (Ca,REE,Th,U)₂(Nb,Ta,Ti)₂O₇, **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
calcioburbankite Na₃(Ca,REE,Sr)₃(CO₃)₅. *Burbankite* structure group.
 Structure: **YuV Belovitskaya & 4 others** 2001 Kryst 46 1009-13.
 Occurrence: **J Van Velthuizen RA Gault JD Grice** 1995 CM 33 1231-5;
VV Subbotin & 3 others 1999 ZVMO 78-82 (S2179).
calciocatapleite CaZrSi₃O₉.aq. Series with Na analog *catapleite*.
 Occurrence: MM 39 908.
[calciochondrodite Ca₄(SiO₄)₂.Ca(OH)₂. *Chondrodite* structure type.
Synthetic: **EW Buckle HFW Taylor** 1958 AM 43 818-23 (P458).
Synthetic equivalent of *reinhardbraunsite*.
 See *calcium chondrodite* & *chondrodite*.]

calciocopiapite $\text{CaFe}_4(\text{SO}_4)_6(\text{OH})_2$.19aq. *Copiapite* structure group.

Review: **Sabelli**, p. 20.

Occurrence: **MA Kashkai RM Aliev** 1962 AM 47 807.

calcioferrite $\sim(\text{Ca}_{3.3}\text{Fe}_{0.4})(\text{Mg}_{0.8}\text{Fe}_{0.2})(\text{Fe}_{3.3}\text{Al}_{0.7})(\text{PO}_4)_6(\text{OH})_{3.3}$.12.6aq.

Assumed member of *montgomeryite* structure group.

Occurrence: **CW Mead ME Mrose** 1968 USGS Prof Paper 600-D = AM 54 993.

Proposed composition, **PJ Dunn & 3 others** 1983 MR 14 195-7.

calciogadolinite $(\text{Y}, \text{Ca}, \text{RE})_2\text{FeBe}_2\text{Si}_2(\text{O}, \text{OH})_{10}$.

Occurrence: **T Nakai** 1938 Bull Chem Soc Japan 13 591-4 = MA 7-264.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

calciohilairite $\text{CaZrSi}_3\text{O}_9$.3aq. *Hilairite* structure group.

Structure: cation-deficient, SC-XRD, **DYu Pushcharovskii & 5 others** 2002 CrR 47 748-52 (8239).

Occurrence: **RC Boggs** 1988 AM 73 191-4 = MM 54 602.

calciopetersite $\text{CaCu}_6(\text{PO}_4)_2(\text{PO}_3\text{OH})(\text{OH})_6$.3aq. *Mixite* group.

Occurrence & XRD/IR: **J Sejkora & 4 others** 2005 CM 43 1393-400 = AM 91 710.

calciosamarskite Niobate of REE, Y, U, Fe, Ca & Th.

New data & suggested nomenclature: **SL Hanson & 4 others** 1999 MM 63 27-36.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

Occurrence: MM 21 560.]

calcioantite / calcioantalite $\text{CaTa}_4\text{O}_{11}$.

Structure: **NA Yamnova DYu Pushcharovskii AV Voloshin** 1988 SPC 33 498-9.

(*urgursaitite* = Na-bearing calcioantite)

Nb-rich, SC-XRD, **MA Cooper FC Hawthorne P Cerny** 1999 CM 37 1289-4.

Synthetic, isostructural: **M Isobe F Marumo S Iwai M Kimura** 1975 AC B31 908-10.

calciouranoite $(\text{Ca}, \text{Ba}, \text{Pb}, \text{K}, \text{Na})\text{U}_2\text{O}_7$.5aq.

Inadequate description: **VP Rogova & 3 others** 1974 ZVMO 103 103-9 = AM 60 161.

calciovolborthite $\text{CaCu}(\text{VO}_4)(\text{OH})$. *Adelite* structure group. Review (E289).

Structure: **R Basso A Palenzona L Zefiro** 1989 NJMM 300-8.

Relation to *tangeite*: **R Basso L Zefiro** 1994 NJMM 205-8.

calcirtite $\text{CaZr}_3\text{TiO}_9$. Near-*pyrochlore* structure type.

Structure: **YuA Pyatenko ZV Pudovkina** 1961 SPC 6 155-7 (P474).

CALCITE STRUCTURE GROUP Includes:

<i>calcite</i>	CaCO_3
<i>cobaltocalcite</i>	CoCO_3
<i>gaspéite</i>	$(\text{Ni}, \text{Mg}, \text{Fe})\text{CO}_3$
<i>magnesite</i>	MgCO_3
<i>nitronatrite</i>	NaNO_3
<i>otavite</i>	CdCO_3
<i>rhodochrosite</i>	MnCO_3
<i>siderite</i>	FeCO_3
<i>smithsonite</i>	ZnCO_3

Synthetic CrBO_3 , VBO_3 & TiBO_3 : **H Schmid** 1964 AC B17 1080-1.

Synthetic TiBO_3 : **M Huber HJ Deiseroth** 1995 ZK 210 685 (H1030).

calcite CaCO_3 . Calcite structure type.

Structure: early papers to be added;

H Effenberger K Mereiter J Zemann 1981 ZK 156 233-48;

SA Markgraf RJ Reeder 1985 AM 70 590-600;

neutron, 1260K, **MT Dove BM Powell** 1989 PCM 16 503-7;

K Reksten 1990 AM 75 807-12;

HR Wenk H Meisheng T Lindsley W Morres 1991 PCM 17 527-?;

EN Maslen VA Streltsov NR Streltsova 1993 AC B49 636-41;

S-XRD & electron density, **EN Maslen & 3 others** 1995 AC B51 929-39.

Superstructure: PCM 17 527-39 1991; **J Fiquet F Guyot J-P Itié** 1994 AM 79 15-23.
Lattice-dynamic estimated atomic displacements: **T Pilati F Demartin CM Gramaccioli** 1998 AC B54 515-23 (P807).
Raman spectroscopy: **C Biellmann P Gillet** 1992 EJM 4 389-93.
Quasi-harmonic modeling of T vs structural & elastic properties: **A Pavese & 3 others** 1996 PCM 23 89-93 (P613).

Biology

Magnesian calcite in sea urchins, XRPD/HRTEM: **SJ Tsipursky PR Buseck** 1993 AM 78 775-81 (1409).
C & O isotope ratios of recent & historical cement, & kinetics of carbon dioxide absorption by calcium hydroxide: **E Usdowski A Hirschfeld** 2000 NJMM 507-21 (294).
Polymorphism & architectural assembly of Ca carbonates in biologic polymeric matrices: **G Falini & 3 others** 2000 JCS D 3983-7 (684).
Biogenic "amorphous" Ca carbonate, XAS: **Y Levi-Kalishman & 4 others** 2000 JCS D 3977-82 (683).
Mn vs morphology of bacterial Mg-calcite growth: **MT Gonzalez-Munoz & 4 others** 2000 JSR 70 559-64 (1726).
Dissolution by benthic mineralization in deep sea: **F Wenzhoefer & 6 others** 2001 GCA 65 2677-90 (3152).
Coccolith crystallization vs polysaccharide, AFM: **K Henriksen & 3 others** 2004 AM 89 1709-16.

Chemistry in Bulk

Mg-: **J Paquette RJ Reeder** 1990 AM 75 1151-4.
Se substitution mechanism, XAFS: **RJ Reeder & 3 others** 1994 GCA 58 5639-46.
Co/Zn/Pb/Ba trace elements, XAFS: **RJ Reeder GM Lamble PA Northrup** 1999 AM 84 1049-60.
REE coordination, EXAFS: **EJ Elzinga & 6 others** 2002 GCA 66 2875-85 (7831).
Cathodoluminescence vs Mn/Fe: **S Cazenave R Chapoulie G Villeneuve** 2003 MP 78 243-53 (9322).

High Pressure

Anisotropic thermal expansion to 1 GPa & 763 K: **T Wu & 4 others** 1995 AM 80 941-6.
Calcite, 0-1.4 GPa, SC-XRD: **SAT Redfern RJ Angel** 1999 CMP 134 102-6 (R881).
Calcite-II (high-P): structure, **L Merrill W Bassett** 1975 AC B31 343-9.
Calcite-III (high-P): structure, **JR Smyth TJ Ahrens** 1997 GRL 24 1595-8 (S1705);
phase transition, **K Catalli Q Williams** 2005 AM 0 1679-82.
Phase relations to 6 GPa & 2023 K: **K Suito & 8 others** 2001 AM 86 997-1002.
Deformed, Meteor Crater AZ: **JBBurt MC Pope AJ Watkinson** 2005 MPS 40 297-308.

Occurrence, & Chemistry & Physics

Fe/Mn, zoned gangue Mississippi Valley-type deposits, SXRF, cathodoluminescence: **OC Kopp & 3 others** 1990 CG 81 337-47 (K593).
Mn/Sr/Fe of cleats in Illinois Basin coals, SXRF: **A Kolker C Chou** 1994 JG 102 111-6 (K692).
Floating rafts in cave pools, Texas: **PM Taylor HS Chafetz** 2004 J Sedimentary Res 74 328-41 (10264).
In meteorites: **AE Rubin** 1997 MPS 32 231-47;
CV3 chondrite Vigarano: **NM Abreu AJ Brearly** 2005 MPS 40 609-25.
Martian Tataouine, nanobacteria-like: **K Benzerara & 4 others** 2003 PNAS 100 7438-42 (9246).
In dust around evolved stars: **F Kemper & 7 others** 2002 N 415 295-7 (5865).
High-T recrystallization in hydrocarbon source rocks: **E Heydari WJ Wade** 2000 AAPGB 86 1285-303 (7478).
Tufa, Pyramid Lake CA: USGS circular 1267

Surface Chemistry and Physics: Growth.

Sorption selectivity: Cd>Zn~Mn>Co>Ni>>Ba, **JM Zachara CE Cowan CT Resch** 1991 GCA 55 1549-52;
Pb(II)>Cu/Zn(II)>Cd~Fe, **SA El-Korashy** 2003 JMS 38 1709-19 (9021).
AFM of cleavage face in water: **AL Rachlin GS Henderson MC Goh** 1992 AM 77 904-10.
Time-lapse AFM of growth & dissolution, step movement, etch pits: **PE Hillner & 3 others** 1992 G 20 359-62 (H835).
AFM showing poisoning of growth from adsorption of phosphonates & phosphates on growth steps: **AJ Gratz PE Hillner** 1993 JCG 129 784-93(G645).
Step dynamics & spiral growth: **AJ Gratz PE Hillner PK Hansma** 1993 GCA 57 491-5 (G646).
Epitaxial growth of *otavite*, X-ray scattering: **RP Chiarello NC Sturchio** 1994 GCA 58 5633-8;
RP Chiarello & 6 others 1997 GCA 61 1467-74 (C912).
Location of Mn inside & Pb mostly at surface, XR standing wave profile: **Y Qian & 5 others** 1994 S 265 1555-7 (Q5).
Water profile on surface, XR truncation rod study: **RP Chiarello NC Sturchio** 1995 GCA 59 4557-61.
Co(II) sorption on water interface, XPS: **N Xu & 3 others** 1996 GCA 60 2801-15;
XR standing wave: **L Cheng NC Sturchio MJ Bedzyk** 2000 PRB 61 4877- 83 (C1140).
Pb sorption on water interface, XR standing wave, AFM: **NC Sturchio & 11 others** 1997 GCA 61 251-63 (S1721).
Surface structure & morphology: **NH de Leuw SC Parker** 1998 JPC B102 2914-22.
Growth in Mn presence, AFM: **JM Astilleros & 3 others** 2002 GCA 66 3177-89 (8025).
Surface-site specific interaction of aspartate: **HH Tyeng PM Dove** 1997 AM 82 878-87.
Pb adsorption, XR standing-wave/reflectivity: **NC Sturchio & 11 others** 1997GCA 61 251-63 (S2144).
Tetravalent U, XRF & XAS: **NC Sturchio & 4 others** 1998 S 281 971-3 (S2143).

Directed nucleation on crystal-imprinted polymer: **SM D'Souza & 5 others** 1999 N 398 312-6 (D785).
 Stearate monolayer, surface XR reflection: **P Fenter NC Sturchio** 1999 GCA 63 3145-52 (F685).
 Water interface, surface XR reflection: **P Fenter & 5 others** 2000 GCA 64 1221-8 (F688).
 Arsenite adsorption, XR standing wave: **L Cheng & 4 others** 1999 GCA 63 3153-7 (C1139).
 Mn/Zn incorporation, importance of aqueous Cl: **M Temmam J Paquette H Vali** 2000 GCA 64 2417-30 (T650).
 Ba effect on growth, AFM: **JM Astilleros & 3 others** 2000 GCA 64 2965-72 (A930).
 AFM & effect of polycarboxylates on precipitation: **J Rieger J Thieme C Schmidt** 2000 La 16 8300-5 (370).
 Mg as inhibitor in growth, AFM: **KJ Davis PM Dove JJ De Yoreo** 2000 S 290 1134-7 (260).
 Dissolution, effect of Mn & Sr, AFM: **AS Lea & 4 others** 2001 GCA 65 369-79 (1151).
 Inhibition of growth by polycarboxylic acids: **MM Reddy AR Hoch** 2001 JCIS 235 363-70 (1727).
 Uranium (VI) coprecipitated, XAS & luminescence: **RJ Reeder & 7 others** 2001 GCA 65 3491-503 (3449).
 Ni(II) chlorate solution, XPS, TOF-SIMS, AFM: **U Hoffmann SLS Stipp** 2001 GCA 65 4131-9 (3599).
 Dissolution kinetics: **JW Morse RS Arvidson** 2002 ESR 58 51-84 (7645).
 Dissolution vs pH, AFM: **G De Guidici** 2002 AM 88 1279-85.
 Solubility in water-NaCl, 873-1173 K & 6-14 kbar: **RC Newton CE Manning** 2002 AM 87 1401-9.
 Cu/Zn adsorption complexes, EXAFS: **EJ Elzinga RJ Reeder** 2002 GCA 66 3943-54 (8909).
 Dissolution in water, scanning electro-chemical AFM, **CE Jones PR Unwin JV Macpherson** 2003 ChemPhysChem 4 130-46 (8805).
 Variation in dissolution rates: **RS Arvidson & 3 others** 2003 GCA 67 1623-34 (8983).
 Mg vs amorphous calcium carbonate stability: **E Loste & 3 others** 2003 JCG 254 206-18 (9147).
 Solubility, water 6-16 kb 773-1073 K: **NC Caciagli CE Manning** 2003 CMP 146 275-85 (9645).
 Synthesis with copolymers: **P Kjellin M Andersson AEC Palmqvist** 2003 La 19 9196-200 (9593).
 Hg(II) in aqueous solution, AFM/SEM-EDS: **A Godelitsas & 4 others** 2003 MM 67 1193-204.
 Ca-Keggin anion colloid, template for star-shaped: **D Rautary & 2 others** 2003 La 19 10095-9 (9629).
 Etch pit formation during dissolution, saturation state control: **HH Teng** 2004 GCA 68 253-62 (9793).
 Morphology vs Mg incorporation on steps: **KJ Davis & 3 others** 2004 AM 89 714-20.
 Diffusion C & O, 0.1-200 MPa: **TC Labotka & 3 others** 2004 AM 89 799-806.
 Growth modification by acid peptides: **D Vollmer & 3 others** 2004 ChC 1872-3 (10729).
 Growth of *schoepite* on (104): **M Schindler A Putnis** 2004 CM 42 1667-82.
 Growth of uranyl-OH-aq & -carbonates on (104): **M Schindler & 3 others** 2004 CM 42 1683-98.
 Bicarbonate in *synthetic*, NMR: **J Feng & 3 others** 2006 AM 91 957-60.
calcium catapleiite CaZrSi₃O₉.2aq. Analog of *catapleiite*.
 Structure: SC-XRD, **S Merlino & 6 others** 2004 CM 42 1037-45.
 Occurrence: **AM Portnov** 1964 DAN 154 67-9.
[calcium chondrodite Ca₅(SiO₄)₂(OH)₂.
Synthetic: **RM Ganier & 3 others** 1970 SPD 14 946-8 = MA 70-3005;
TP Kuznetsova & 3 others 1980 SPC 25 91-2 (K650) = MA 81-1193.
 Same chemical composition as *calciochondrodite*. [jvs: check whether same structure].
 See *chondrodite*. Probably not a mineral phase at the moment.]
calcium jarosite / calcio-jarosite MM 32 949.
calciumhilgardite-2M(Cc) MM 32 949.
calciumhilgardite-3Tc MM 32 949.
[calcium-langbeinite K₂Ca₂(SO₄)₃.
Synthetic, isotopic with *langbeinite*.
Synthesis: **GW Morey JJ Rowe RO Fournier** 1964 J Inorg Nucl Chem 26 53 = MM 39 909.]
 [calcium-pharmacosiderite (discredited, MR 30 174). Occurrence: MM 39 909.]
calcjarlite Na(Ca,Sr)₃Al₃(F,OH)₁₆. Ca analog of *jarlite*.
 Iso with *jorgensenite* Na₂(Sr,Ba)₁₄Na₂Al₁₂F₆₄(OH,F)₄.
 Structure determination not found.
 Occurrence: MM 39 909; **AD Nozhkin VA Moleva TP Chubkova** 1974 AM 59 873-4.
calclacite CaC₂H₃ClO₂.5aq.
 Structure: **G Giusepetti C Tadini L Ungaretti** 1970 PM 39 145-58.
 Occurrence: MM 28 726;
 on limestone, Delft museum, new XRPD, **JHL Voncken TW Verjroost MM van Tooren**
 2001 NJMM 210-20 (1998).
calcurmolite Ca(UO₂)₃(MoO₄)₃(OH)₂.11aq.
 Structure determination not found.

Occurrence: **OV Federov** 1964 AM 49 1152-3; MM 33 1129-30.
[calcursilite $\text{Ca}_4[(\text{UO}_2)_4(\text{Si}_2\text{O}_5)_5(\text{OH})_6]$.15aq. *Weeksite* mineral group.
Occurrence: ?; **Povarennykh** p. 457.]
calcybeborosilite $\text{CaYBeBSi}_2\text{O}_8(\text{OH})_2$. *Datolite* group.
Structure: **RK Rastsvetaeva & 3 others** 1995 CrR 41 217-21 (R655) = AM 81 1516-7.
Occurrence: MM 39 909.
New data, *calcybeborosilite*-Y: **IV Pekov & 5 others** 2000 Moscow Univ Geol Bull 55 62-70 = AM 86 1537.
Name not approved by CNMN, but might be grandfathered: AM 86 1537.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
calderite $(\text{Mn,Ca})_3(\text{Fe,Al})_2\text{Si}_3\text{O}_{12}$. *Garnet* structure type.
Synthesis: **D Lattard W Schreyer** 1983 CMP 84 199-214;
9 GPa & 1273 K, **T Arit & 4 others** 1998 PCM 26 100-6 (7859).
calderonite $\text{Pb}_2\text{Fe}(\text{VO}_4)_2(\text{OH})$. *Brackebuschite* group.
Occurrence & SC-XRD structure: **G Del Tánago & 3 others** 2003 AM 88 1703-8.
caledonite $\text{Cu}_2\text{Pb}_5(\text{SO}_4)_3\text{CO}_3(\text{OH})_6$. Review: **Sabelli**, p.16; (E289).
Structure: **C Giacobazzo S Menchetti F Scordari** 1973 AC B29 1986-90;
Raman, **RL Frost JT Kloprogge PA Williams** 2003 NJMA 529-42 (10019).
calkinsite-Ce $(\text{Ce,L a})_2(\text{CO}_3)_3$.4aq. Alteration product of *burbankite*.
Structure determination not found.
Occurrence: **WT Pecora JH Kerr** 1953 AM 38 1169-83.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
callaghanite $\text{Cu}_2\text{Mg}_2(\text{CO}_3)(\text{OH})_6$.2aq.
Structure: **G Brunton H Steinfink CW Beck** 1958 AC 11 169-74;
G Brunton 1973 AM 58 551 1973.
Occurrence: MM 30 729. Review: (E289).
calomel HgCl . Analog of *moschelite* Hgl.
Structure: **NJ Calos CHL Kennard RL Davis** 1989 ZK 187 305-7(C694).
calumetite $\text{Cu}(\text{OH,Cl})_2$.2aq. Structure determination not found.
Occurrence: **SA Williams** 1963 AM 48 614-9.
calzirtite $\text{Ca}_2\text{Zr}_5\text{Ti}_2\text{O}_{16}$. Distorted fluorite-CeO₂ type.
Isostructural with *hiärneite* $(\text{Ca,Na,Mn}^{2+})_2(\text{Zr,Mn}^{3+})_5(\text{Sb,Ti,Fe})_2\text{O}_{16}$.
Structure: **YuA Pyatenko ZV Pudovkina** 1961 Krystallografiya 6 196-9;
HJ Rossell 1982 AC B38 593-5;
W Sinclair RA Eggleton GM McLaughlin 1986 AM 71 815-8;
RK Rastsvetaeva & 3 others 1995 CrR 40 746-8 (R603);
ordered domains & new supercell, TEM, **J Lin P Shen** 1996 JSSC 126 177-83 (L802);
ordering in orthorhombic, XRD, **A Callegari F Mazzi L Ungaretti** 1997 NJMM 467-80 (C1025).
[jvs: listed composition from last paper differs from earlier composition $\text{CaZr}_3\text{TiO}_9$ in MM 32 949.]
Occurrence: hyperagpaitic alkaline rocks, **Khomyakov** (1995);
IR, Raman, XRPD: **D Holtstam** 1997 EJM 9 843-8 (H1279);
Nb,Ta-substituted, Jacupiranga: **F Bellatreccia & 4 others** 1999 MM 63 649-60;
metamorphic rocks: **EM Spiridonov VM Gekimiyants IM Kulikova** 1999 DES 366 526-8.
 $[\text{Ca}_2(\text{Zr,Ti})_5(\text{Sb,Mn})_2\text{O}_{16}]$. IMA 96-040 = MR 28 399. Analog of *calzirtite*.]
[camermanite is hexagonal dimorph of *hieratite* K_2SiF_6 ; occurs in salt factories: MM 29 977-8.]
camerolaite / camérolaite $\text{Cu}_4\text{Al}_2[\text{HSbO}_4,\text{SO}_4](\text{OH})_{10}(\text{CO}_3)$.2aq. Compare *cyanotrichite*.
Occurrence: **H Sarp P Perroud** 1991 NJMM 481-6 (S1454) = MM 60 526;
S Cuchet 1995 SMPM 75 283-4.
cameronite $\text{Cu}_7\text{AgTe}_{10}$.
Occurrence: **AC Roberts & 3 others** 1986 CM 24 379-84 = MM 50 742.
camgasite $\text{CaMg}(\text{AsO}_4)(\text{OH})$.5aq.
Occurrence: **P Walenta PJ Dunn** 1989 Aufschluss 40 369 = AM 76 2021.
caminite $5\text{MgSO}_4 \cdot 2\text{Mg}(\text{OH})_2$.aq.
Structure: **RM Haymon M Kastner** 1986 AM 71 819-25.

Complex structural relation with *synthetic* MSHS & MHS: **ME Fleet SN Knipe** 1997 AC B53 358-63 (F534).

campigliaite $\text{Cu}_4\text{Mn}(\text{SO}_4)_2(\text{OH})_6 \cdot 4\text{aq}$. See *devillite* & *serpierite*.

Review: **Sabelli**, p. 24; (E289).

Structure: **C Sabelli** 1982 AM 67 388-93.

Occurrence: **S Menchetti C Sabelli** 1982 AM 67 385-7.

canaphite $\text{CaNa}_2\text{H}_2(\text{PO}_4)_2 \cdot 3\text{aq}$. Pyrophosphate = *synthetic* alpha-.

Structure: **RC Rouse DR Peacor RL Freed** 1988 AM 73 168-71. MM 52 723.

canasite $(\text{Na},\text{K})_6\text{Ca}_5\text{Si}_{12}\text{O}_{30}(\text{OH},\text{F})_4$. May be listed as *kanasite*.

Structure: **MI Chiragov KhS Mamedov NV Belov** 1969 DES 185 96-9 (C716);

VP Golovachev & 3 others 1970 DAN 194 no. 4;

IV Rozhdestvenskaya & 3 others 1988 Mineral Zhurn 10 31-44.

Occurrence: **MD Dorfman & 3 others** 1959 Ann Mineral Mus AN USSR 9 158-66 = MM 32 949.

canasite, F-rich (monoclinic) analog of *canasite*

Occurrence & SC-XRD structure: **RK Rastvetaeva & 3 others** 2003 Dokl Chem 391 177-80 = AM 89 470.

[*frankamenite* $\text{K}_3\text{Na}_3\text{Ca}_5\text{Si}_{12}\text{O}_{30}\text{F}_3\text{OH} \cdot \text{aq}$. F-rich triclinic analog of *canasite*.]

canavesite $\text{Mg}_2\text{CO}_3\text{HBO}_3 \cdot 5\text{aq}$.

Occurrence: **G Ferraris M Franchini-Angela P Orlandi** 1978 CM 16 69.

CANCRINITE MINERAL GROUP OF FELDSPATHOIDS IN THE HEX-ABC POLYTYPIC STRUCTURE GROUP

Includes:

<i>afghanite</i>	$\sim(\text{Na},\text{Ca},\text{K})_8(\text{Al},\text{Si})_{12}\text{O}_{24}(\text{Cl},\text{SO}_4,\text{CO}_3)_{3-4} \cdot \text{aq}$
8-layer-type	
<i>bystrite</i>	
4-layer type	
<i>canocrinite</i>	$\sim\text{Na}_6\text{Ca}_2\text{Al}_6\text{Si}_6\text{O}_{24}(\text{CO}_3)_2$
<i>canocrisilite</i>	$\text{Na}_{7.2}\text{Al}_{4.8}\text{Si}_{7.2}\text{O}_{24}(\text{CO}_3)_{1.2} \cdot 3\text{aq}$
<i>carbonate-canocrinite</i>	$\sim\text{Na}_8\text{Al}_6\text{Si}_6\text{O}_{24}(\text{CO}_3)_2 \cdot 2\text{aq}$
<i>davyne</i>	$\sim(\text{Na},\text{Ca},\text{K})_8\text{Al}_6\text{Si}_6\text{O}_{24}(\text{Cl},\text{SO}_4,\text{CO}_3)_{2-3}$
<i>farneseite</i>	$(\text{Na},\text{K})_{46}\text{Ca}_{10}\text{Al}_{42}\text{Si}_{42}\text{O}_{168}(\text{SO}_4)_{11} \cdot 3\text{aq}$
	ABCABABACBACAC-14-layer type
<i>franzinite</i>	$\sim(\text{Na}_{22}\text{Ca}_{13}\text{K}_5)(\text{Al}_{29}\text{Si}_{31}\text{O}_{120}(\text{SO}_4)_8(\text{CO}_3)_2(\text{OH})_3\text{Cl}) \cdot 4\text{aq}$
10-layer type	
<i>giuseppettite</i>	$\text{Na}_{42}\text{K}_{16}\text{Ca}_6\text{Si}_{48}\text{Al}_{48}\text{O}_{192}(\text{SO}_4)_{10}\text{Cl}_2 \cdot 5\text{aq}$
	ABABABACBABABABC-16-layer type.
<i>hydroxycanocrinite</i>	$\sim\text{Na}_8(\text{Al}_6\text{Si}_6\text{O}_{24}(\text{OH})_2) \cdot 2\text{aq}$
[<i>hydroxyl-canocrinite</i>	synthetic]
[<i>hydroxyl-vishnevite</i>	$\text{Na}_4(\text{AlSiO}_4)_3\text{OH} \cdot \text{aq}$
<i>K-rich vishnevite</i>	
<i>liottite</i>	$\sim(\text{Ca}_{11}\text{Na}_9\text{K}_4)(\text{Al}_{18}\text{Si}_{18})\text{O}_{72}(\text{SO}_4)_4(\text{CO}_3)_2\text{Cl}_3(\text{OH})_4 \cdot 2\text{aq}$
6-layer-type	
<i>microsommitte</i>	$\sim(\text{Na},\text{Ca},\text{K})_{7-8}(\text{Al},\text{Si})_{12}\text{O}_{24}(\text{Cl},\text{SO}_4,\text{CO}_3)_{2-3}$
<i>pitiglianoite</i>	$\sim\text{Na}_6\text{K}_2\text{Si}_6\text{Al}_6\text{O}_{24}(\text{SO}_4) \cdot 2\text{aq}$
<i>quadridavyne</i>	$\sim(\text{Na},\text{K})_6\text{Ca}_2\text{Si}_6\text{Al}_6\text{O}_{24}\text{Cl}_4$
<i>sacrofanite</i>	
	$\sim(\text{Na}_{6.2}\text{Ca}_{1.8}\text{K}_{1.4})(\text{Al}_{5.7}\text{Si}_{6.3})\text{O}_{24}(\text{OH})_{2.7}(\text{SO}_4)_{1.1}(\text{CO}_3)_{0.3}\text{Cl}_{0.2} \cdot 0.3 \text{ aq}$
28-layer type	
<i>tiptopite</i>	$\sim(\text{K}_2\text{Li}_{2.9}\text{Na}_{1.7}\text{Ca}_{0.7})(\text{Be}_6\text{P}_6)\text{O}_{24}(\text{OH})_2 \cdot 1.3\text{aq}$
<i>tounkite</i>	$\sim(\text{Na},\text{Ca},\text{K})_8\text{Al}_6\text{Si}_6\text{O}_{24}(\text{SO}_4)_2\text{Cl} \cdot \text{aq}$
12-layer-type	
<i>vishnevite</i>	$\sim(\text{Na},\text{Ca},\text{K})_8(\text{Al},\text{Si})_{12}\text{O}_{24}(\text{SO}_4,\text{CO}_3,\text{Cl})_{2-4} \cdot n \text{ aq}$
<i>?wenkite</i>	$\sim\text{Ba}_4\text{Ca}_6(\text{Al},\text{Si})_{20}\text{O}_{39}(\text{OH})_2(\text{SO}_4)_3 \cdot n \text{ aq}$

Canocrinite is based on AB stacking of vertex-connected tetrahedra centered on a hexagonal net; IZA-SC code CAN; Consortium for Theoretical Frameworks net 95; gives a hexagonal

cell with a 13 c 2x 2.6 = 5Å.

Some members of the group have more complex stacking with $c = n \times 2.6\text{Å}$;

WL Brown F Cesbron 1973 CRASP D 276 1-4;

R Rinaldi H-R Wenk 1979 AC A35 825-8.

There should be complete Si,Al ordering of the Al_6Si_6 members.

There are also complexities related to the disposition of the stuffing.

Crystal chemistry, review: **L Leoni & 3 others** 1979 RSIMP 35 713-9 = CA 93:189326v.

Crystal chemistry, IR of Cl/SO_4^- : **P Ballirano A Maras PR Buseck** 1996 AM 81 1003-12 (1408).

Thermal expansion: **I Hassan** 1996 MM 60 949-56.

Synthetic $\text{NaAlSiO}_4 \cdot 0.5\text{aq}$: MM 29 984.

Synthesis, hydrothermal: **O Jarchow HH Reese H Saalfeld** 1966 NJMM 289-99.

Synthetic, Na carbonate cancrinite-natrodavynite: polymorphism, **AD Edgar BJ Burley** 1963 CM 7 631-42.

Synthetic Ca- & K-rich: stability fields, **AD Edgar** 1964 CM 8 53-67.

Synthetic sulfate-hydrocancrinite: **R Klaska O Jarchow** 1977 Nw 64 93.

Synthetic NaAl germanate $\text{Na}_8\text{Al}_6\text{Ge}_6\text{O}_{24} \cdot \text{CO}_3 \cdot 2\text{aq}$: **YuA Sokolov & 3 others** 1977 SPD 22 624-5 (S1272).

Synthetic carbonate-, piezoelectric properties of SC: **BN Litvin IB Kobyakov FA Belimenko** 1981 SPC 26 465-7.

Synthetic basic cancrinite: **Yul Smolin & 3 others** 1981 SPC 26 33-5 (S714);

N Bresciani Pahor & 3 others 1982 AC B38 893-5 (P293);

I Hassan HD Grundy 1991 CM 29 377-83.

Synthetic CO_3^- : ND, **A Emiraliev II Yamzin** 1982 SPC 27 27-30 1982 (E301);

piezoelectricity, **IB Kobyakov AA Levin Yul Smolin** 1982 Zh Eksp Teor Fiz 83 1924-9.

Synthetic $\text{NaGdSiO}_4 \cdot 0.2 \text{NaOH}$: **GD Fallon BM Gatehouse** 1982 AC B38 919-20.

Synthetic cancrinite-vishnevite series: **I Hassan HD Grundy** 1984 CM 22 333-40.

Synthetic nitrate-, thiosulfate-, sulfate- & sulfide-: **F Hund** 1984 ZaaC 509 153-.

Synthetic $\text{Na}_8[\text{Al}_6\text{Ge}_6\text{O}_{24}]\text{Ge}(\text{OH})_6 \cdot 2\text{aq}$: **EL Beloneva TG Uvarova LN Dem'yanets** 1986 SPC 31 516-9 (B1436).

Synthetic, ion-exchanged Cu, ESR & echo spectroscopy: **P Raghunathan L Kevan** 1988 Can J Chem 66 1984-8.

Synthetic basic & non-basic cancrinite-natrodavynite: **JC Buhl** 1991 Thermochim Acta 178 19-31.

Synthetic LiCs & LiTi: **P Norby & 4 others** 1991 Z 11 248-53 (N305).

Synthesis in butane-1,3-diol system: **C Liu S Li K Tu R Xu** 1993 JCSOC 1645-6.

Synthetic $(\text{Cs,K})_{0.33}[\text{Na}_{0.18}\text{Fe}_{0.16}\text{aq}](\text{ZnPO}_4)$: **OV Yakubovich OV Karimova OK Mel'nikov** 1994 CrR 39 564-8.

Selenium chain in channel: **Yu A Barnakov & 4 others** 1995 Inorg Mater 31 811-4 (B1389);

AV Kolobov & 3 others 1997 Solid State Comm 103 669-73 = CA 127:337175h;

VV Poborchii M Sato AV Shchukarev 1997 Solid State Comm 103 649-54;

AV Kolobov H Oyanagi VV Poborchii K Tanaka 1999 J Synchrotron Radiat 6 362-3;

EXAFS/XANES showing dimers: **AV Kolobov & 3 others** 1999 PRB 59 9035-43 (182).

Synthetic $\text{Na}_8\text{Al}_6\text{Si}_6\text{O}_{24}\text{S}_2\text{O}_3 \cdot 2\text{aq}$: **G-G Lindner W Massa D Reinen** 1995 JSSC 117 386-91 (L688).

Synthetic $\text{Na}_{4.5}\text{Al}_3.9\text{Si}_8.1\text{O}_{24}\text{Se}_{0.7}$, UV/Vis/Raman: **G Lindner & 5 others** 1996 JSSC 126 50-4 (L774).

Synthetic Fe: **K Latham CD Williams CVA Duke** 1996 Z 17 513-6 (L772).

Synthetic Cs-Li, NMR & XRPD structure: **M Fichtelkord & 5 others** 2001 AM 86 881-8.

$\text{Na}_6\text{Ca}_2\text{Al}_6\text{Si}_6\text{O}_{24}(\text{CO}_3)_2 \cdot [2\text{aq}]$. Many structure determinations, including *synthetics*:

O Jarchow 1965 ZK 122 407-22;

11-repeat carbonate-rich, **FF Foit Jr DR Peacor EW Heinrich** 1973 CM 11 940-51;

HD Grundy I Hassan 1982 CM 20 239-51 (G420);

ND, **VN Kanepit YuZ Nozik** 1985 Gk 1058-62 = CA 103:107793h;

Si-rich, **AP Khomyakov & 4 others** 1991 Vestn Mosk Univ Ser 4 Geol 79-84;

SC-ND, $\text{Na}_8\text{Si}_6\text{Al}_6\text{O}_{24}\text{H}_{0.9}(\text{CO}_3)_{1.4}$, **VN Kanepit EE Rider** 1995 J Struct Chem 36 694-6 (K874);

synthetic, XRPD structure, **K Hackbarth & 4 others** 1999 MMM 30 347-58 (H1416).

Carbonate-rich: superstructure, **I Hassan PR Buseck** 1992 CM 30 49-59;

thermal behavior, **I Hassan** 1996 CM 34 893-900;

XRPD, **P Ballirano & 3 others** 1995 PD 10 173-5 (B1789).

$\text{Na}_6\text{Ca}_{1.5}\text{Al}_6\text{Si}_6\text{O}_{24}(\text{CO}_3)_{1.6} \cdot 1.7\text{aq}$: structure, phase transitions & dehydration with T, **I Hassan SM Antao JB Parise** 2006 AM 91 1117-24.

Carbonate/sulfate, Cameroon: disorder, SC-XRD structure, **P Ballirano A Maras** 2004 EJM 16 135-41 (10135).

Synthetic H-carbonate cancrinite & *sodalite*, SC-XRD structure: **TM Gesing J Buhl** 2000 ZK 215 413-8 (G1207).

Synthetic using 1,3-butanediol, XRPD structure/Na NMR, **A Burton & 3 others** 1999 MMM 30 293-305 (B1924).

Synthetic basic in butanediol-aq: **M Fichtelkord B Posnatzki J Buhl** 2001 ChM 13 1967-75 (2074).

Synthesis in Na-Ca-Al-Si-C-O-aq system: **M Sirbescu DM Jenkins** 1999 AM 84 1850-60.
Synthetic Ga/Ge, SC-XRD structure: **Y Lee & 4 others** 2000 MMM 39 445-55 (215).
Synthetic nitrate-cancrinite, XRPD/MAS-NMR, 100 & 873 K: **M Fechtelkord F Stief J Buhl** 2001 AM 86 165-71.
Synthetic, butanediol-water: **M Fechtelkord B Posnatzki J Buhl** 2003 EJM 15 589-98 (9177).
Synthetic epitaxial growth, cancrinite/sodalite, TEM: **T Okubo & 8 others** 2001 ACIE 40 1069-70.
 Use in spent Bayer liquor: CA 131:10817m, 10818n.
 Potential use as antacid for gastric juice: **CF Linares & 4 others** 2005 MMM 77 215-21 (10914).
cancrisilite $\text{Na}_{7.2}\text{Al}_{4.8}\text{Si}_{7.2}\text{O}_{24}(\text{CO}_3)_{1.2}\cdot 3\text{aq}$. AB-6 structure in *cancrinite* group.
 Structure: **AP Khomyakov & 4 others** 1991 ZVMO 120 80-3 (K663) = MM 60 526-7.
 Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** (1995).
canfieldite $\text{Agg}(\text{Sn},\text{Ge})\text{S}_6$.
 Supposed to form series with *argyrodite*, but crystal symmetry differs.
 Cell dimensions: **N Wang** 1978 NJMM 269-72.
cannizzarite $\sim\text{Pb}_4\text{Bi}_5\text{S}_{11.5}$. Structure: **E Matzat** 1979 AC B35 133-6.
 ED, cannizzarite & isostructural compounds (La/Ce/Pr/Nd)(Ti/Cr/V)S₃: **TB Williams BG Hyde** 1988 AC B44 467-74.
 ED/XRPD, cannizzarite & *bursaite*: **NN Mozgova & 4 others** 1988 NJMA 158 293-309 (M1284).
 Occurrence: MM 21 561.
 Occurrence, Fossa crater, Volcano: **A Garavelli R Laviano F Vurro** 1997 EJM 9 423-32 (G905);
YS Borodaev & 6 others 2000 CM 38 23-34.
Wittite $\text{Pb}_9\text{Bi}_{12}(\text{S},\text{Se})_{27}$ may be Se-substituted *cannizzarite*: **NN Mozgova & 4 others** 1992 MP 46 137-53 (M1244).
cannonite $\text{Bi}_2\text{O}(\text{OH})_2\text{SO}_4$.
 Structure: *synthetic*, **L Golic M Graunar F Lazarni** 1982 AC B38 2881-3.
 Occurrence: **CJ Stanley & 4 others** 1992 MM 56 605-9.
caoxite $\text{Ca}(\text{C}_2\text{O}_4)\cdot 3\text{aq}$.
 Structure: & occurrence, **R Basso & 3 others** 1997 NJMM 84-96 (B1628) = AM 83 185-9;
 matches *synthetic*, **NS Blom JA Kanters WMM Heijnen** 1981 Cryst Struct Comm 10 1283-8,
S Deganello AR Kampf PB Moore 1981 AM 66 859-65.
 Dehydration of *caoxite*, **T Echigo & 4 others** 2005 MM 69 77-88..
 Compare with *whewellite* $\text{CaC}_2\text{O}_4\cdot\text{aq}$ & *weddellite*.
capgarronite $\text{HgAg}(\text{Cl},\text{Br},\text{I})\text{S}$.
 Structure: **B Mason WG Mumme H Sarp** 1992 AM 77 197-200.
cappelenite-Y $\text{Ba}(\text{Y},\text{Ce})_6\text{Si}_3\text{B}_6\text{O}_{24}\text{F}_2$.
 Structure: **J Shen PB Moore** 1984 AM 69 190-5.
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
caracolite $\text{Na}_3\text{Pb}_2(\text{SO}_4)_3\text{Cl}$. *Apatite* type. Review: **Sabelli**, p. 34-5.
 Structure: **W Schneider** 1967 NJMM 284-98 (S1447).
carbaborite $\text{Ca}_2\text{Mg}(\text{CO}_3)_2\text{B}_2(\text{OH})_8\cdot 4\text{aq}$.
 Structure: **Z Ma N Shi J Shen Z Peng** 1981 BM 104 578-81.
 Occurrence: MM 35 1129.
carbocernaite $(\text{Ca},\text{Na})(\text{Sr},\text{Ce},\text{Ba})(\text{CO}_3)_2$. *Burbankite* structure group.
 Structure: **AA Voronkov YuA Pyatenko** 1967 Zh Struct Khim 8 935-?;
S Nicheng M Zhesheng P Zhizhong 1982 Kexue Tongbao 27 76-80.
 Occurrence: MM 32 950;
 in Khibina carbonatite, **AN Zaitsev et al** 1998 MM 62 225-50.
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
carboirite $\text{FeAl}_2\text{GeO}_5(\text{OH})_2$. *Chloritoid* structure type from crystallography.
 Structure determination not found.
 Occurrence: **Z Johan E Oudin P Picot** 1983 TMPM 31 97 = MM 48 571.
Synthetic solid-solution series: **J-Y Julliot M Volfinger J-L Robert** 1987 MP 36 51-69 (J249).
carbokentbrooksite $(\text{Na},\text{void})_{12}(\text{Na},\text{Ce})_3\text{Ca}_6\text{Mn}_3\text{Zr}_3\text{Nb}(\text{Si}_{25}\text{O}_{73})(\text{OH})_3(\text{CO}_3)\cdot\text{aq}$.
Eudialyte group.
 Occurrence & XRPD: **AP Khomyakov & 5 others** 2003 ZVMO 132-5 40-51 (10516).
carbonate-cyanotrichite $(\text{Cu},\text{Zn})_4\text{Al}_2(\text{CO}_3,\text{SO}_4)(\text{OH})_{12}\cdot 2\text{aq}$.
 Review: **Sabelli**, no structure.

XRPD corresponds to *cyanotrichite*.

Occurrence: **EA Ankinovich II Gekht RI Zaitseva** 1963 ZVMO 92 458-63 = AM 49 441-2.

carbonate-fluorapatite $\text{Ca}_5(\text{PO}_4, \text{CO}_3)_3\text{F}$. *Apatite* type.

FTIR & NMR: **P Regnier & 4 others** 1994 AM 79 809-18.

Occurrence: **Dana**.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

carbonate-hydroxylapatite *Apatite* type.

Occurrence: **Dana**.

[carbonate-vishvenite ?Distinct from other members of *cancrinite* group.

Description: MM 54 662.]

caresite-3T $\text{Fe}_4\text{Al}_2(\text{OH})_{12}\text{CO}_3 \cdot 3\text{aq}$. *Hydrotalcite-manasseite* group.

Occurrence & XRPD: **GY Chao RA Gault** 1997 CM 35 1541-9.

carletonite $\text{KNa}_4\text{Ca}_4\text{Si}_8\text{O}_{18}(\text{CO}_3)_4(\text{F}, \text{OH}) \cdot \text{aq}$. Double sheet.

Structure: **GY Chao** 1972 AM 57 765-78.

Occurrence: MM 38 989.

carlfriesite $\text{CaTe}^{4+}_2\text{Te}^{6+}\text{O}_8$.

Structure: **H Effenberger J Zemann H Mayer** 1978 AM 63 847-52.

carlhinzeite $\text{Ca}_2\text{AlF}_7 \cdot \text{aq}$.

Structure determination not found.

Occurrence: **PJ Dunn DR Peacor BD Sturman** 1979 CM 17 103-5.

carlinite Ti_2S .

Synthetic: **JAA Ketelaar EW Gorter** 1939 ZK 101A 367-375;

XPS, **I Grzetic TB Zunic** 1993 PCM 20 286-96.

Occurrence: **AS Radtke FW Dickson** 1975 AM 60 559-65.

[Unnamed mineral, As_3TlTe_2 : **SV Nechaev NJ Cook** 2000 NJMM 557-62 (640).]

carlosruizite $\text{K}_3(\text{Na}, \text{K})_2\text{Na}_3\text{Mg}_5(\text{SeO}_4)_6 \cdot 6\text{aq}$. Isostructural with S analog *fuenzalidaite*.

Structure: **JA Konnert & 3 others** 1994 AM 79 1002-8.

carlosturanite $(\text{Mg}, \text{Fe}, \text{Ti}, \text{Mn})_{21}(\text{Si}, \text{Al})_{12}\text{O}_{28}(\text{OH})_{34} \cdot \text{aq}$.

Structure: **M Mellini G Ferraris R Compagnoni** 1985 AM 70 773-81.

Occurrence: **M Mellini J Zussman** 1986 MM 50 675-9.

HRTEM: IMA Pisa 30-1 1994.

Fe Mössbauer: **A Deriu G Ferraris E Belluso** 1994 PCM 21 222-7 (D48).

carlsbergite CrN .

Structure determination not found, but may be done for synthetic.

Occurrence: **VF Buchwald ERD Scott** 1971 Nature Phys Sci 233 113-4 = AM 57 1311.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

carmichaelite $\text{Ti}_{0.6}\text{Cr}_{0.2}\text{Fe}_{0.1}\text{Mg}_{0.6}\text{O}_{1.5}(\text{OH})_{0.5}$.

Structure contains pentuple edge-sharing octahedra, as in *olivine*, *humite* & *leucophoenicite*, but is unique: **L Wang & 4 others** 2000 AM 85 792-800.

carminite $\text{PbFe}_2(\text{AsO}_4)_2(\text{OH})_2$. Isostructural with *sewardite* $\text{CaFe}_2(\text{AsO}_4)_2(\text{OH})_2$.

Dimorph of *mawbyite*.

Edge-sharing octahedra plus vertex-sharing tetrahedra; check similarity to *brackebuschite*.

Structure: **JJ Finney** 1963 AM 48 1-13;

3 crystals from Sardinia, **F Olmi C Sabelli** 1995 NJMM 553-62 (O301);

Kharisun & 3 others 1996 MM 60 805-11.

carnallite $\text{KMgCl}_3 \cdot 6\text{aq}$.

Structure: **W Fischer** 1973 NJMM 100-9;

EO Schlemper PK Sen Gupta T Zoltai 1985 AM 70 1309-13.

NH_4 -bearing: **MG Siemann** 1994 NJMM 97-100 (S1254).

Synthetic Cl, Br-: MM 28 725.

Synthetic $\text{NH}_4\text{MgCl}_3 \cdot 6\text{aq}$: **X Solans & 4 others** 1983 AC C39 1488-90.

Synthetic (K/NH₄/Rb)(Co/Ni)Br₃·6aq: **S Tepavitcharova & 4 others** 1997 JSSC 129 200-5 (T514).

carnegieite NaAlSiO_4 . Stuffed *cristobalite* structure type; high-low-temperature transition.

Dimorphic with *nepheline*.

Low-, modulated structure: **RL Withers JG Thompson** 1993 AC B49 579-86;

synthetic, XRD, NMR & TEM, **JG Thompson & 4 others** JSSC 104 59-73 (T379).

High-T dynamics, Raman: **P Richet BO Mysen** 1999 GRL 26 2283-6 (R900).

Synthetic defect phases extra Na, Al, Mg and P good ionic conductors (B1362); see *wurtzite* polymorph of $\text{Na}_2\text{MgSiO}_4$.

Synthetic ceramic from LTA zeolite by microwave: **T Ohgushi K Ishimaru S Komarneni** 2001 JACeS 84 321-7 (1254).

Kinetic analysis of crystallization from amorphous Al-silicate: **C Kosanovic & 2 others** 2004 MMM 71 27-32 (10365).

carnevallite Cu_3GaS_4 .

Occurrence: **BH Geier J Otteman** 1970 Mineral Deposita 5 29 = MM 37 956.

CARNOTITE STRUCTURE GROUP

Includes:

carnotite $\text{K}_2(\text{UO}_2)_2(\text{VO}_4)_2 \cdot 3\text{aq}$

margaritasite $(\text{Cs}, \text{K}, \text{H}_3\text{O})_2(\text{UO}_2)_2(\text{VO}_4)_2$ [note: anhydrous]

sengierite $\text{Cu}(\text{UO}_2)_2(\text{VO}_4)_2(\text{OH})_2 \cdot 6\text{aq}$

strelkinite $\text{Na}(\text{UO}_2)(\text{VO}_4) \cdot 3\text{aq}$

jvs: how much water? - needs detailed study and possible expansion of nomenclature.

Synthesis of carnotite & alkali analogs: **PB Barton Jr** 1958 AM 43 799-817.

carnotite $\text{K}_2(\text{UO}_2)_2(\text{VO}_4)_2 \cdot 3\text{aq}$.

Structure: *synthetic anhydrous*, **DE Appleman HT Evans Jr** 1965 AM 50 825-42.

Synthesis: **PB Barton Jr** 1958 AM 43 799-817.

carobbiite KF. *Halite* structure type.

Occurrence: **H Strunz** 1957 AM 42 17.

carpathite $\text{C}_{33}\text{H}_{17}\text{O}$. Occurrence: MM 31 955-6. Distinct from *curtisite*.

CARPHOLITE STRUCTURE GROUP

balipholite $\text{BaMg}_2\text{LiAl}_3\text{Si}_4\text{O}_{12}(\text{OH}, \text{F})_8$

carpholite $\text{K}_x(\text{Mn}_{2-x}\text{Li}_x)\text{Al}_2\text{Si}_2\text{O}_6(\text{OH})_4$

ferrocarpholite $(\text{Fe}, \text{Mg})\text{Al}_2\text{Si}_2\text{O}_6(\text{OH})_4$

magnesiocarpholite $\text{MgAl}_2\text{Si}_2\text{O}_6(\text{OH})_4$

potassic-carpholite $\text{K}(\text{MnLi})\text{Al}_4\text{Si}_4\text{O}_{12}(\text{OH})_4\text{F}_4$

vanadiocarpholite $\text{MnVAI}(\text{Si}_2\text{O}_6)(\text{OH})_4$.

Chain silicate.

carpholite $\text{K}_x(\text{Mn}_{2-x}\text{Li}_x)\text{Al}_2\text{Si}_2\text{O}_6(\text{OH})_4$. Carpholite structure type.

Structure: **IS Naumova EA Pobedinskaya NV Belov** 1975 SPC 19 718-21;

W Lindemann R Wögerbauer P Berger 1979 NJMM 282-7;

S Ghose & 3 others 1989 AM 74 1084-90;

G Ferraris G Ivaldi B Goffé 1992 NJMM 337-47 (F433).

Weathering, TEM: **G Giorgetti I Memmi DR Peacor** 2000 EJM 12 33-44 (G1198).

carphosiderite = hydronium jarosite $\text{H}_3\text{O}[\text{Fe}(\text{OH})_2]_3(\text{SO}_4)_2$.

Synthetic, ND & magnetism (Kagomé antiferromagnet): **AS Wills A Harrison** 1996 JCSF 92 2161-6 (W766).

carraraite $\text{Ca}_3\text{Ge}(\text{OH})_6(\text{SO}_4)_{1.1}(\text{CO}_3)_{0.9} \cdot 12\text{aq}$. *Ettringite-thaumasite* group.

Occurrence & SC-XRD structure: **S Merlino P Orlandi** 2001 AM 86 1293-301.

carrboydite $(\text{Ni}, \text{Cu})_{14}\text{Al}_9(\text{SO}_4, \text{CO}_3)_6(\text{OH})_{43} \cdot 7\text{aq}$? Review: **Sabelli**, p. 21.

Proposed structure: **EH Nickel RM Clarke** 1976 AM 61 366-72. Compare with *hydrotalcite*.

Occurrence: MM 40 905-6.

$[\text{Cu}_{1-x}\text{Al}_x(\text{OH})_2]_n[(\text{SO}_4)_{x/2}\text{aq}]_n$. IMA 96-038 = MR 28 398. Analog of *carrboydite* & *glaucozerinite*.]

carrollite $\text{Cu}(\text{Co}, \text{Ni})_2\text{S}_4$. *Spinel* type (sulfide).

Structure: EXAFS showing only tetrahedral Cu, **J Charnock & 3 others** 1990 AM 75 247-55.

Solid solutions & nomenclature: **T Wagner NJ Cook** 1999 CM 37 545-8.

caryinite $\text{Na}(\text{Ca}, \text{Pb})(\text{Ca}, \text{Mn})(\text{Mn}, \text{Mg})_2(\text{AsO}_4)_3$. As analog of phosphate *alluardite*.

Analog of *arseniopleite* $(\text{Ca}, \text{Na})(\text{Na}, \text{Pb})\text{Mn}(\text{Mn}, \text{Mg}, \text{Fe})_2\text{As}_3\text{O}_{12}$

Structure: **TS Ercit** 1993 MM 57 721-7.

caryopilite $?(\text{Mn}^{2+}, \text{Mg}, \text{Zn})_8(\text{Si}, \text{As})_6\text{O}_{15}(\text{OH})_{12}$.

Modulated 1:1 phyllosilicate: **S Guggenheim RA Eggleton** 1998 CM 36 163-79.
 Occurrence: & structural speculation, **DR Peacor EJ Essene** 1980 AM 65 335-9;
 & relation to *schallerite* & *friedelite*: **PJ Dunn & 3 others** 1981 AM 66 1054-62.

cascandite $\text{CaScSi}_3\text{O}_8(\text{OH})$. *Pyroxenoid*.
 Structure: **M Mellini S Merlino** 1982 AM 67 604-9.
 Intergrowth with *scandiobabingtonite*: **G Raade M Erambert** 1999 NJMM 545-50 (R928).

cassedanneite $\text{Pb}_5(\text{VO}_4)_2(\text{CrO}_4)_2$.aq.
 Analog of *embreyite* $\text{Pb}_5(\text{CrO}_4)_2(\text{PO}_4)_2$.aq.
 Occurrence: **F Cesbron & 3 others** 1988 CRASP 306 125 = AM 73 1493.

cassidyite $\text{Ca}_2(\text{Ni,Mg})(\text{PO}_4)_2$.2aq. *Fairfieldite* type.
 Structure determination not found.
 Occurrence: **JS White Jr EP Henderson B Mason** 1967 AM 52 1190-7.
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.

cassiterite SnO_2 . *Rutile* structure type.
 Structure: **WH Bauer** 1956 AC 9 515-20 1956.
 High-P: transition to *fluorite* type, **L Liu** 1978 S 199 422-5 (L319);
 transition to CaCl_2 type at 12 GPa, $\alpha\text{-PbO}_2$ at >12 GPa, modified *fluorite* at 21 GPa,
J Haines JM Léger 1997 PRB 55 11144-54 (H1230);
 thermoelasticity <30 GPa/1400 K, XRPD, **S Ono & 7 others** 2000 PCM 27 618-22 (317).
 Heat capacity 0-150 K: **VM Gurevich & 5 others** 2004 GI 962-70 (10954).
 -*rutile* solid solution, Mössbauer: **VS Urusov DA Khramov K Langer** 1999 EJM 11 295-8 (U360).
Zirconian-tantalum wadginite exsolution from Mn-Ta-: **M Masau P Cerny R Chapman** 2000 CM 38 685-94.
 OH absorption, NRA, FTIR: **J Maldener F Rauch M Gavranic A Beran** 2001 MP 71 21-9 (1421).
 (110)(4x1) surface structure ion-bombarded annealed 1000 K, LEED: **A Atrei & 3 others** 2001 SuS 475 L223-8 (1323).
 OH defects in natural & *synthetic*: IR, Z Losos A Beran 2004 MP 81 219-34 (10555).
 See *varlamoffite* $\text{Sn}_{1-x}\text{Fe}_x\text{O}_2\text{-x}(\text{OH})_x$, may be isostructural.

castaingite CuMo_2S_5 . XRPD similar to *molybdenite*.
 Occurrence: **A Schüller J Otteman** 1963 NJMA 100 317-21 = AM 50 264.

caswellsilverite NaCrS_2 .
 Occurrence: **A Okada K Keil** 1982 AM 67 132-6.
 Structure determination not found; *synthetic* exists.
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.

catapleite $\text{Na}_2\text{ZrSi}_3\text{O}_9$.2aq. 2-vertex-connected octahedral-tetrahedral net (CTF 1146).
 Isostructural *wadeite*, but not *benitoite*. Series with *calcium catapleite*. Dimorphic *gaidonnayite*.
 Structure: **BK Brunovskii** 1936 Acta Physico Chem USSR 5 863-92 = MA 7-398;
GD Ilyushin & 4 others 1981 SPD 26 808-810 (I111) = MA 83M/0153;
GD Ilyushin LN Dem'yanets 1988 SPC 33 383-7 (I90).

catoptrite see *katoptrite*

cattierite CoS_2 . *Pyrite* structure type.
 Structure: **JL Pratt P Bayliss** 1979 ZK 150 163-7;
 charge density, **E Nowacki D Schwarzenbach T Hahn** 1992 AC B47 650-9 (N376);
 3d Co L-edge X-ray absorption, **JM Charnock & 3 others** 1996 PCM 23 403-8 (C878).
 Occurrence: MM 27 267.

cattiite $\text{Mg}_3(\text{PO}_4)_2$.22aq. Matches *synthetic* polytype 1A2.
 Occurrence & XRPD structure: **SN Britvin & 4 others** 2002 NJMM 160-8 (7087).
Synthetic: **M Catti M Franchini-Angela G Ivaldi** 1981 ZK 155 53-64 (7087).

cavansite $\text{Ca}(\text{VO})(\text{Si}_4\text{O}_{10})$.4aq. Dimorph of *pentagonite*.
 Structure: **HT Evans Jr** 1973 AM 58 412-24;
 dehydrated, **R Rinaldi JJ Pluth JV Smith** 1975 AC B31 1598-602 (R521).
 Occurrence: MM 36 1149-50.
Synthetic $\text{K}_2(\text{VO})(\text{Si}_4\text{O}_{10})$.aq & $\text{Cs}_2(\text{VO})(\text{Si}_4\text{O}_{10})$.3aq, similar structures to *cavansite* &
pentagonite: **X Wang L Liu AJ Jacobson** 2001 AnCh 40 2174-6 (2073).

cavoite CaV_3O_7 .

Occurrence, XRPD = *synthetic*: **R Basso & 3 others** 2003 EJM 15 181-4 (8908).
cavolinite = *quadridavyne* or *davyne*: **J Binon & 3 others** 2004 EJM 16 511-20 (10470).
caysichite-Y $Y_4(Ca_3RE_1)(OH)aq_5[Si_8O_{20}](CO_3)_6.2aq$. Double-crankshaft chain.
Structure: **M Mellini S Merlino** 1978 CM 16 81-8.
Occurrence: MM 39 909.
Review: (different formula) **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
cebaite-Ce $Ba_3Ce_2(CO_3)_5F_2$.
Structure: **FH Li H Hashimoto** 1984 AC B40 454-61;
STEM, MA 85M/3831;
J Shen J Mi 1988 Chin J Geochem 7 378-9 = MA 89M/4116;
Z Yang 1995 NJMM (2) 56-64 (Y148) = AM 81 253.
MM 48 571.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
In Khibina carbonatite: **AN Zaitsev et al.** 1998 MM 62 225-50.
Bayan Obo REE-Nb-F deposit, Mongolia: *bastnaesite?* fluid inclusions, **H Fan & 4 others** IGR 46 638-45 (10467).
Synthetic $Ba_3La_2(CO_3)_5F_2$: **N Mercier M Leblanc** 1993 Eur J Solid State Inorg Chem 30 195-205 = AM 78 1112.
See *huanghoite* & *zhonghuacerite*.
cebollite $Ca_4Al_2Si_3O_{12}(OH)_2$.
Structure determination not found.
Occurrence: **ES Larsen Jr WT Shaller** 1914 J Washington Acad Sci 4 480-2;
kimberlite & zeolitized xenoliths, **FJ Kruger** 1980 MM 43 583-6.
cechite $Pb(Fe,Mg)VO_4OH$. *Descloizite* mineral group.
Conichalcite/descloizite structure type.
Structure: **F Pertlik** 1988 NJMM 34-40 ((P546) = MA 89M/4128).
čejkaite $Na_4(UO_2)(CO_3)_3$.
Occurrence & XRPD structure: **P Ondruš & 4 others** 2003 AM 88 686-93.
celadonite $K(Mg,Fe)(Fe,Al)Si_4O_{10}(OH)_2$. *Mica* structure type: 1M polytype.
Structure: **BB Zvyagin** 1957 SPC 2 388-94;
AP Zhukhlistov & 3 others 1977 SPC 22 284-8;
G Dainyak AS Bukin VA Drits 1984 SPC 29 186-91;
aluminian, **D Slovenec V Majer B Sebecic** 1995 NJMM 363-70.
Structure change, dehydroxylation/rehydration, XRPD: **F Muller & 3 others** 2000 CICIM 48 572-85 (M1861).
celestite / celestine $SrSO_4$. *Barite* structure type.
Structure: **D Garske DR Peacor** 1965 ZK 121 204-10 = MA 17-462;
FC Hawthorne RB Ferguson 1975 CM 13 181-7;
M Miyake I Minato H Morikawa S Iwai 1978 AM 63 506-10;
MA Simonov SI Troyanov MA 87M/5578;
rigid-body character, SD Jacobsen & 3 others 1998 CM 36 1053-60.
High-T oxide-melt differential scanning calorimetry: **J Majzlan A Navrotsky JM Neil** 2002 GCA 66 1839-50 (7338).
celsian $BaAl_2Si_2O_8$. *Feldspar* type. See *Feldspar* database.
Polymorphic with *synthetic* hexagonal phases.
Structure: **RE Newnham HD Megaw** 1960 AC 13 303-12 (N20);
DT Griffen PH Ribbe 1976 AM 61 414-8;
stacking faults, MA 92M/3832.
 α - β transition, time-T XRPD: **A Kremenovic & 3 others** 1997 Solid State Ionics 101-103 611-8.
Occurrence & K substitution: **MC Moro ML Cembranos A Fernandez** 2001 CM 39 1039-51.
In meteorites: AE Rubin 1997 MPS 32 231-47.
Synthetic 'barium-nepheline' = hexacelsian: MM 26 334.
Synthetic Ge: MM 32 958-9.
Synthetic $BaSrFe_4O_8$: (S1266) = MA 76-222.
cementite Fe_3C . = cohenite.
Structure: NJ Petch H Lipson 1940 J Iron Steel Inst 142 95-106 = MA 8-138;
NJ Petch 1944 J Iron Steel Inst 149 143;
4-600 K, NPD, IG Wood & 6 others 2004 JAC 37 82-90 (10242).

[Compare with *roaldite* Fe₄N & *synthetic* Fe₄C: **ZG Pinsker SV Kaverin** 1956 SPC 1 48-53.]

[Almost 200 isostructural compounds.]

[iron carbide Fe_{2.5}C.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.]

cenosite-Y Ca₂(Y_{1.5}REE_{0.5})(Si_{3.9}Al_{0.1})O₁₂CO₃.aq.

Isostructural (?simply name transcription) with *kainosite* Ca₂(Y,Ce)₂(SiO₄)₃CO₃.aq: **G**

Giuseppetti C Tadini M Oddone 1989 NJMM (4) 153-64 (G771).

cerchiarite Ba₂Mn₂Si₃(O,OH,Cl)₁₃.

Occurrence: & SC-XRD of cell geometry & space group: **R Basso & 3 others** 2000 NJMM 373-84 = AM 86 197;

Woods Mine, NSW Australia, **DS Coombs & 3 others** 2004 EJM 16 185-9 (10141).

[cerhomilite Borosilicate of Ca, Be, Fe, Th & REE.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.]

cerianite-Ce (Ce,Th)O₂. *Fluorite* type.

Structure determination not found.

Synthetic, XRPD: **C Frondel U Marvin** 1959 AM 44 882-4.

Occurrence: MM 31 956.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

ceriopyrochlore-Ce (Ce,Ca,Y)₂(Nb,Ta)₂O₆(OH,F). *Pyrochlore* type.

Structure determination not found.

Occurrence: **DD Hogarth** 1977 AM 68 996-1003. MM 42 522.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

[ceriotungstite-Ce CeW₂O₆(OH)₃.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.]

cerite-Ce (Ce,Ca)₉(Mg,Fe)(SiO₄)₆(SiO₃OH)(OH)₃.

Nearly isostructural with *whitlockite*.

Structure: **P Gay** 1957 AM 42 429-32;

PB Moore J Shen 1983 AM 68 996-1003 (M751).

Compare with *ilimaussite*, which has double *c* repeat.

Occurrence, Erzgebirge, Germany: **H Forster** 2000 CM 38 67-79.S

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

cerite-La (La,Ce,Ca)₉(Fe,Ca,Mg)(SiO₃OH)₄(SiO₄)₃(OH)₃.

Nearly isostructural with *whitlockite*.

Occurrence & SC-XRD: **YA Pakhomovsky & 5 others** 2002 CM 40 1177-84.

cerium Ce.

Occurrence, lunar regolith, Crises Sea: **OA Bogatikov & 5 others** 2002 DES 382 83-5 (7553).

cernyite Cu₂(Cd,Zn,Fe)SnS₄. *Stannite* structure type.

Description: **JT Szymanski** 1978 CM 16 147-51.

Solid solution with *kesterite*: **AV Chicagov EuG Osadchii ZV Usyakovskaya** 1986 NJMA 15-22 (C760).

MM 42 522.

cerotungstite (Ce,Nd)W₂O₆(OH)₃.

Should be isostructural with *ytrotungstite*. Compare with *alumotungstite*.

Structure determination not found.

Occurrence: **TG Sahama O Von Knorring M Lehtinen** 1972 AM 57 1558-9;

Bull Geol Soc Finlande 42 223-8 = MM 38 989;

1981 MR 12 81-7.

ceruléite Cu₂Al₇(AsO₄)₄(OH)₁₃.12aq. Structure determination not found.

Occurrence: **K Schmetzer et al.** 1977 AM 62 598-9;

Cornwall, MM 51 738-41.

cerussite PbCO₃. *Aragonite* type.

Structure: **K Sahl** 1974 ZK 139 215-22;

G Chevrier & 5 others 1992 ZK 199 67-74;

Raman, **WN Martens & 3 others** 2004 AM 89 352-8.

Phase transition at high pressure, diamond-anvil cell: **C Lin L Liu** 1997 PCM 24 149-57 (L843).

Industrial PbCO₃.PbO: MM 54 647-9.

cervadonite-(Ce) (Ce,Nd,La)(Fe²⁺,Fe³⁺,Ti,Al)₃SiAs(Si,As)O₁₃.
Occurrence: **T Armbruster & 4 others** 1988 SMPM 68 125-32 = MM 54 662.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

cervantite Sb³⁺Sb⁵⁺O₄. Polymorphic with *clinocervantite*.
Structure, neutron: **G Thornton** 1977 AC B33 1271-3.

cervelleite Ag₄TeS.
Occurrence: **AJ Criddle JE Chisholm CJ Stanley** 1989 EJM 1 371;
PG Spry SE Thieben 1996 MM 60 871-6;
HM Helmy 1999 CM 37 143-58;
& Ag₂Cu₂TeS **NJ Cook CI Ciobanu** 2003 NJMM 321-36 (9501).

cesanite Na₃Ca₂(SO₄)₃OH. *Apatite* structure type. Review: **Sabelli** p.35.
Structure: **S Deganello** 1983 NJMM 305-13;
V Tazzoli 1983 NJMM 305-13;
S Deganello 1984 NJMM 47 522-8;
natural & *synthetic*, SC-XRD, **A Piotrowski & 4 others** 2002 AM 87 715-20.

cesarolite PbH₂Mn₃O₈.
Occurrence: **JE Post** 1994 IMA Pisa p.334;
two phases, including Pb_{0.54}Mn₂O₄ analogous to *chalcophanite*.

cesbronite Cu₅(TeO₃)₂(OH)_{6.2aq}.
Structure determination not found.
Occurrence: **SA Williams** 1974 MM 39 744-6 = AM 64 653.

cesium kupletskite Cs,K)₂Na(Mn,Fe,Li)₇(Ti,Nb)₂Si₈O₂₆(OH)₄F.
Astrophyllite mineral group; series with *kupletskite*.
Structure: see mineral group.
Occurrence: DAN SSSR 197 1394-7 = AM 57 328.

cesplumtantite (Cs,Na)₂(Pb,Sb)₃Ta₈O₂₄.
Structure determination not found.
Occurrence: **AV Volvoshin & 4 others** 1986 Min Zhurn 8 92 = AM 74 50-1.

cesstibtantite (Cs,Na)SbTa₄O₁₂.
Pyrochlore structure group: intermediate between normal & inverse subtypes.
Structure: **TS Ercit P Cerny FC Hawthorne** 1993 MP 48 235-55 (E299).

cetineite ~₂(K,Na)_{3.5}(Sb₂O₃)₃(SbS₃)(OH)₅.
Structure: **C Sabelli I Nakai S Katsura** 1988 AM 73 398-404.
Synthetic Na₃SbSe_{3.3}Sb₂O₃. 0.5Sb(OH)₃: **F Kluger F Pertlik 1985** Monat Chem 116 14-56.
Synthetic Na₆(Sb₁₂O₁₈)(SbSe₃)₂(Na_{1.9}Sb_{0.1})(OH)_{2.3aq4.0} &
Rb₆(Sb₁₂O₁₈)(SbSe₃)₂Sb_{0.2}[(OH)_{0.7aq3.5}]: **X Wang** 1995 ZK 210 693-4 (W723).
Synthetic Na/K-S & Na/K/Rb/Tl/Sr/Ba-Se: **F Liebau X Wang** 1997 EJM Suppl 9-1 223 (L878);
S analog, **F Liebau** 1998 EJM Suppl 10 179 (L953).
Synthetic (Na/K/Rb/Sr/Ba)₆(Sb₁₂O₁₈)(Sb[S/Se]₃)₂(Na/Sb/C)_x(aq/OH/O)_{6-y}: **X Wang F Liebau**
1999 ZK 214 820-34 (W1000).

chabazite ~CaAl₂Si₄O₁₂.6aq. *Zeolite* family.
IZA-SC code CHA. Consortium for Theoretical Frameworks tetrahedral net 83.
Faulted intergrowths *Igmelinite*: **J Plevert RM Kirchner RW Broach** 1999 Proc Int Zeolite Conf 12th 4 2445-52 (9339).
Structure:
early papers are wrong;
correct structure, SCXRD, **LS Dent JV Smith** 1958 N 181 1794-6;
do, **A Alberti & 4 others** 1982 Z 2 303-9 (A383);
hydrated Sr-rich, Azerbaijan, **M Calligaris & 3 others** 1982 AC B38 602-5 (C457);
6 specimens from 4 localities, **F Mazzi E Galli** 1983 NJMM 461-80(M750);
Al ordering from XRD & NMR, **T Takaishi M Kato** 1995 Z 15 689-700 (T449).
Crystal chemistry: **E Passaglia** 1970 AM 55 1278-301.
Optical anomalies vs. Al/Si order: **M Akizuki** 1981 Li14 17-21.
Al,Si ordering, Monte Carlo study: **MC Gordillo CP Herrero** 1996 Chem Phys 211 81-90 .

Ion exchange Pb, NH₄, K, Ca, Mg: **E Torracca P Galli M Pansini C Colella** 1998 MMM 20 119-27 (T583).
Proton sites & ammonia adsorption, quantum-mechanics: **M Brandle & 3 others** 1998 J Chem Phys 109 10379-89.
Energetics of hydration, enthalpy of formation, & cation vs. stability: **S Shim & 3 others** 1999 AM 84 1870-82.
Natural/synthetic, Cu-, dehydrated, photoluminescence: **J Dedecek B Wichterlova P Kubat** 1999 MMM 32 63-74 (D796).
Ca sites & diffusion, calculation: **T Grey & 3 others** 1999 MMM 31 45-9 (G1175).
Proton transfer in hydrated: **IS Afanassyev NK Moroz IA Belitsky** 2000 JPCB 104 6804-8 (A929).
Proton mobility, modeling: **M Sierka J Sauer** 2001 JPC B 105 1603-13 (1729).
Zn position, periodic density function: **LAMM Barbosa RA van Santen J Hafner** 2001 JChS 123 4530-40 (1776).
Natural Ca- & K-, high-T solution calorimetry: **LP Ogorodova & 3 others** 2002 GI 40 466-71(7349).
NH₄exch, XRD/H NMR of arrangement & diffusive mobility: **NK Moroz & others** 2002 J Struct Chem 43 595-600 (8707).

Natural materials related to CHA.

Herschelite is now defined as *chabazite-Ca* by nomenclature commission.

Natural calcic siliceous, John Day Formation: **RA Sheppard AJ Gude 3rd** 1970 USGS Prof Paper 700D 176-80.

Fe-rich, Kola Peninsula pegmatite, 293 & 570K: **EL Belokoneva & 5 others** 1985 SPC 30 507-10 (1131);

IK Butikova YuF Shepelev Yul Smolin 1993 CrR 38 461-3 (B1082).

Natural high-Na chabazite, NMR & XRPD: **KA Thrush SM Kuznicki** 1991 JCSF 87 1031-5 (T543).

Natural authigenic high-Na chabazite in ice-free or weathering horizon of glacial diamictite in

Antarctica: **WE Dickinson RH Grapes** 1997 JSR 67 815-20 (D660).

Chabazite-Na: Kaidun microbreccia meteorite, **M Zolensky A Ivanov** 2003 CEr 63 185-246 (9607).

Synthetic materials related to CHA.

Synthetic complexes/ Hg, HgO, HgCl₂ & CS₂, XRD: **O Weigel E Bezner** 1927 Sitz Gesell Naturwiss Marburg 62 57-111.

Synthetic, isomorphous replacements, stability & sorption capacity: **RM Barrer JW Baynham** 1956 JCS 2892-903;
reactions & stability of ion-exchanged forms, **RM Barrer DA Langley** 1958 JCS 3804-11.

Synthetic hydronium-exchanged: **IR Beattie A Dyer** 1957 JCS 4387-8.

Synthetic dehydrated Ca-exchanged: **JV Smith** 1962 AC 15 835-45.

Synthetic hydrated Ca-exchanged: ambient, **JV Smith F Rinaldi LS Dent Glasser** 1963 AC 16 45-53;
293 & 123K, **JV Smith CR Knowles F Rinaldi** 1964 AC 17 374-84.

Synthetic dehydrated Ca-exchanged with adsorbed Cl₂: **JH Fang JV Smith** 1964 JCS 3749-58.

Physicochemical properties vs crystal structure: **JV Smith** 1964 JCS 3759-70.

Thermodynamics/ thermochemistry of cation exch: **RM Barrer JA Davies LVC Rees** 1969 J Inorg Nucl Chem 31 219-32.

Sorption complexes, Kr & Xe, high P & T: **RM Barrer R Papadopoulos** 1972 PRSL A326 315-30.

Synthetic carbon monoxide-Ca-exchanged: **WJ Mortier JJ Pluth JV Smith** 1977 MRB 12 103-8;

Synthetic dehydrated-Ca-exchanged: **WJ Mortier JJ Pluth JV Smith** 1977 MRB 12 97-102 (M1331);
after CO adsorption, **WJ Mortier JJ Pluth JV Smith** 1977 MRB 12 97-102 (M1332).

Synthetic dehydrated-Na-exchanged: **WJ Mortier JJ Pluth JV Smith** 1977 MRB 12 241-9;

M Calligaris G Nardin L Randaccio 1982 AC B38 602-5.

Synthetic dehydrated H-chabazite pretreated 593K & 873K after steaming: **WJ Mortier & 3 others** 1979 JPC 83 2263-6.

Synthetic Na-, Ca-, Sr-, K-exchanged: **A Alberti & 4 others** 1982 Z 2 303-9 (A383).

Synthetic hydrated Ba- & Cd-exchanged: **M Calligaris G Nardin** 1982 Z 2 200-4 (C492).

Synthetic hydrated K- & Ag-exchanged, **M Calligaris G Nardin L Randaccio** 1983 Z 3 205-8 1983 (C490).

Synthetic ZK-14, EM of defects: **S Cartledge & 2 others** 1983 PCM 9 139-45 (C476).

Synthetic Fe-containing Na,K- & H-, EXAFS/: **Ti Morrison PJ Viccaro GK Shenoy** 1983 ACS Symp Ser 218 319-22.

Synthetic dehydrated fully Ag-exchanged: **M Calligaris A Mezzetti G Nardin L Randaccio** 1984 Z 4 323-8 (223).

Synthetic hydrated & dehydrated partially-Co-exchanged: **M Calligaris G Nardin L Randaccio** 1984 Z 4 251-4 (C499).

Synthetic hydrated K-exchanged ZK-14, XRPD: **S Cartledge EB Keller WM Meier** 1984 Z 4 226-30 (C496).

Solid-state transformation of Na-exchanged- to *sodalite* above 873K: **S Cartledge WM Meier** 1984 Z 4 218-25 (C497).

Synthetic H-loaded & degassed, neutron inelastic scattering: **R Stockmeyer** 1985 Z 5 393-5.

Synthetic deammoniated & dehydroxylated Ca,NH₄-exchanged: **HK Beyer & 4 others** 1985 JCSF 1 81 3049-58 (B780).

Synthetic hydrated & dehydrated partially-Mn-exchanged: **M Calligaris & 3 others** 1985 Z 5 317-9 (C502).

Synthetic hydrated & dehydrated partially-Cs-exchanged: **M Calligaris & 3 others** 1986 Z 6 137-41 (C505).

Synthetic SSZ-13 transformed from cubic P zeolite: **SI Zones RA Van Nordstrand** 1988 Z 8 166-74 (Z53);

SI Zones 1990 JCSF 86 3467-72.

Synthetic hydrated Cu-exchanged: EXAFS spectroscopy, **G Antonioli & 3 others** 1990 JCSD 943-5 (A492).

Synthetic high-Al chabazite, NMR & XRPD: **KA Thrush SM Kuznicki** 1991 JCS 87 1031-5.

Synthetic hydrated & dehydrated Ca-exchanged 523K: **IK Butikova & 2 others** 1993 CrR 38 461-3 (B1082).

XPS of methylene blue incorporated into SAPO-34: **R Hoppe & 4 others** 1993 Z 13 222-8 (206).

Synthetic hydrated Li-exchanged: **IK Butikova YuF Shepelev Yul Smolin** 1994 Krist 39 426-9 (B1163).
Synthetic AIPO, with F, SC-XRD structure: **MM Harding BM Kuriuki** 1994 AC C50 852-4 (H902).
Synthetic random ABC-6 stacking of *babelite*: **R Szostak KP Lillerud** 1994 JCSOC 2357-8 (S1376).
Synthetic ZnAIPO-34, EXAFS & ^{27}Al & ^{31}P MASNMR: **T Novak V Kaucic** 1995 Z 15 708-13;
G González & 4 others 1998 MMM 25 103-8 (G1134).
Synthetic ZnAIPO-UiO-21: SC-XRD structure, **KO Kongshaug H Fjellvag KP Lillerud** 2000 MMM 39 341-50 (3682).
Synthetic CoAIPO₄-44, XRD/EXAFS: **PA Barrett S Gopinathan CRA Catlow JM Thomas** 1995 JPCS 56 1395-405.
Synthesis: 3 ways - no organic amine, in presence of NNN-trimethyladamantane ammonium iodide, recrystallization of Linde Type Y (faujasite type) with ammonium salt, & multinuclear MAS NMR & XRPD: **DE Akporiaye & 3 others** 1996 JPC 100 4148-53 (A695).
Synthesis: Mn aluminophosphate-34 & silicoaluminophosphate-44, ESR, ^{29}Si -MAS-NMR, DTA, TG, IR, UV, **S Ashtekar & 3 others** 1996 JPC 100 3665-70 (A696).
Synthetic HSAPO-34, NPD/IR: **L Smith & 6 others** 1996 S 271 799-802 (S1579).
Synthetic with 6-ring of encapsulated Se: **Yul Smolin & 3 others** 1996 AC A52 Suppl C-402.
Synthetic MgAIPO-34 & 44, MAS-NMR: **S Ashtekar & 3 others** 1996 JCSF 92 2481-6.
Synthetic MeAPO-34, Me = Zn/Mn/Co, EXAFS & NMR: **A Tuel & 4 others** 1996 Microporous Mater 7 271-84.
Synthetic CoAPO-34: **N Rajic & 3 others** 1997 Z 18 115-8 (R708).
Synthetic $[\text{Al}_3\text{P}_3\text{O}_{12}\text{F}][\text{C}_6\text{H}_5\text{NH}].0.15$ aq, SC-XRD, triclinic with pairs of F-bridged Al octahedra: **S Oliver & 3 others** 1997 JMC 7 807-12 (O334).
Synthetic SAPO- & (Zn/Mn/Mg)APO-34 complexes with morpholine & SAPO- & (Zn/Mn/Mg)APO-44 complexes with cyclohexamine, FT-Raman: **S Ashtekar & 3 others** 1997 AnCh 36 876-8 (A751).
Synthetic fluoro-aluminophosphate UT-6, & high-T defluorization to CHA: **S Oliver & 3 others** 1997 JMC 7 807-12.
Synthetic CoAl₂P₂O₈.organic, & CoAl₂P₂O₈.organic.aq, structure: **P Feng X Bu GD Stucky** 1997 N 388 735-40 (F556).
Synthetic CoSAPO-34, XANES/EXAFS for calcination & reduction: **A Moen & 5 others** 1997 JCSF 93 4071-7 (M1582).
Synthetic Co_{0.28}Al_{0.72}PO₄, design of template, EXAFS: **DW Lewis & 5 others** 1997 AnCh 36 2675-7 (L928).
Synthetic MgAPO-34, acidity & Mg ordering: **U Lohse & 5 others** 1997 MiM 12 39-49.
Synthetic Co_{0.28}Al_{0.72}PO₄C₁₀H₂₀N₂: **G Sankar & 8 others** 1998 ChC 117-8 (S1876).
Synthetic D-SSZ-13, neutron PD & IR: **LJ Smith A Davidson AK Cheetham** 1998 Catal Lett 49 143-6.
Synthetic ZnAIPO-47, XRPD of crystallization: **AN Christensen & 3 others** 1998 ChM 10 1688-93 (N488).
Synthetic Co/Al phosphates-amines: **P Feng TE Gier GD Stucky** 1998 MMM 23 221-9 (F629).
Synthetic SAPO-44, NMR, FTIR, etc: **DB Akolekar & 3 others** 1999 Colloids Surf A 146 375-86.
Synthetic AIPO-34 & SAPO-34 using morpholine, FTIR/Raman: **L Marchese & 5 others** 1999 MMM 30 145-53 (M1751).
Synthetic LZ-276,277 faulted ABC-D6R: **GW Skeels & 6 others** 1999 MMM 30 335-40 (S2065).
Synthetic Si-rich, negative thermal expansion, NPD: **DA Woodcock & 5 others** 1999 ChM 11 2508-14 (W982).
Synthetic MnAIPO, XAS: **I Arcon N Rajic A Kodre** 1999 J Synchrotron Rad 6 460-1.
Synthetic Li,Na, NMR, neutron PD: **LJ Smith H Eckert AK Cheetham** 2000 JChS 122 1700-8.
Synthetic AIPO-34, NMR/XRPD structure rehydrated: **A Tuel & 8 others** 2000 JPC B104 5697-705 (T649).
Synthetic HSAPO-34, methylbenzene centers, methanol-olefin catalysis: **W Song & 3 others** 2000 JChS 122 10726-7.
Synthetic acetonitrile, NMR & molecular dynamics: **BL Trout & 3 others** 2000 JPCB 104 11734-7 (679).
Synthetic Al-phosphate, Ni-organic complex, XRPD structure: **A Meden & 4 others** 2001 MMM 47 269074 (3131).
Synthetic Co_{0.5}[Be₃P₃O₁₂][C₃N₂H₁₂].1.5 aq, SC-XRD: **H Zhang & 5 others** 2002 JMC 12 658-62 (6783).
Synthetic (Zn/Fe)APO-34, XANES/EXAFS: **A Ristić & 6 others** 2002 MMM 56 303-15 (7998).
Synthetic SAPO-34, NMR of crystallization: **ØB Vistad & 3 others** 2003 ChM 15 1639-49 (9095).
chabazite-Sr ~(Sr,Ca)Al₂Si₄O₁₂.6aq. *Zeolite* family. IZA-SC code CHA. Consortium for Theoretical Frameworks tetrahedral net 83.
Occurrence & XRPD: **IV Pekov & 4 others** 2000 ZVMO 129 54-8 = AM 86 939.
Natural Sr-rich chabazite: Tavetsch, **M Weibel** 1963 SMPM 43 361-66;
Miyahiro, **K Nakao K Harada A Kato** 1969 MJ 6 69-76;
Bohemia, **J Ulrych R Rychly** 1981 CEr 40 68-71;
Kaiserstuhl, **A Livingstone** 1986 MM 50 348-9.
chabourneite / chabournéite (Ti,Pb)₅(Sb,As)₂₁S₃₄.
Structure determination not found.
Occurrence: **J Mantiene P Picot** 1981 BM 104 10-5;
Z Johann et al 1982 AM 67 621;
AM 86 378.
chadwickite (UO₂)H(AsO₄).
Occurrence & XRPD, matches *synthetic*: **K Walenta** 1999 Aufschluss 49 253-7 = AM 84 1195.

chaidamuite $\text{ZnFe}(\text{SO}_4)\text{OH}\cdot 4\text{aq}$.

Structure: AM 75 1436.

Occurrence: **W Li G Chen Z Peng** 1986 Acta Min Sinica 6 109 = AM 73 1493.

CHALCANTHITE STRUCTURE GROUP Includes:

<i>chalcantinite</i>	$\text{CuSO}_4\cdot 5\text{aq}$
<i>jokokuite</i>	$\text{MnSO}_4\cdot 5\text{aq}$
<i>pentahydrate</i>	$\text{MgSO}_4\cdot 5\text{aq}$
<i>siderotil</i>	$(\text{Fe,Cu})\text{SO}_4\cdot 5\text{aq}$.

Synthetic Cr-, MA 88M/5156.

Important for acid mine-waste.

chalcantinite $\text{CuSO}_4\cdot 5\text{aq}$. Review: **Sabelli** p.16; (E289).

Structure: **DE Bacon NA Curry** 1962 Proc Roy Soc London 266 95-108;

WH Baur JL Rolin 1972 AC B28 1448-55.

-*bonattite* equilibria: **I Chou RR Seal II BS Hemingway** 2001 AM 87 108-14.

chalcoalumite $\text{CuAl}_4(\text{SO}_4)(\text{OH})_{12}\cdot 3\text{aq}$.

Should be isostructural with *mbobomkalite* $(\text{Ni,Cu})\text{Al}_4[(\text{NO}_3)_{1.5}(\text{SO}_4)_{0.25}](\text{OH})_{12}\cdot 3\text{aq}$ & *nickelalumite* $(\text{Ni,Cu})\text{Al}_4[(\text{SO}_4),(\text{NO}_3)_2](\text{OH})_{12}\cdot 3\text{aq}$.

Triclinic cell does not match rhombohedral cell of *alunite*.

Structure determination not found for any phase.

Occurrence: **SA Williams B Khin** 1971 MR 2 126-7.

chalcocite Cu_2S .

Structure: low-alpha & high-beta, **MJ Buerger NW Buerger** 1944 AM 29 55-65;

BJ Wuensch MJ Buerger 1963 MSA Spec Paper 1 164-70 = MA 17-358;

beta-, **R Sadanaga M Ohmasa N Morimoto** 1965 MJJ 4 275-90;

low-, **HT Evans Jr** 1971 Nature Phys Sci 232 69-70 = MA 72-940;

high-, **MJ Buerger B Wuensch** 1977 S 141 276-7;

low-, **HT Evans Jr** 1979 ZK 150 299-320 (E338);

low-, **HT Evans** 1979 S 203 356-8;

beta- 459-608 K, NPD, **RJ Cava F Reidenger BJ Wuensch** 1980 JSSC 31 69-80;

HT Evans 1981 AM 66 807-18.

Tetragonal $\text{Cu}_{1.96}\text{S}$, occurrence: **AH Clark RH Sillitoe** 1971 NJMM 418.

Thermochemistry of $\text{Ag}_2\text{S-Cu}_2\text{S}$ solid solutions: **DE Harlov RO Sack** 1995 GCA 59 4351-65.

Surface oxidation: XAS, **EC Todd DM Sherman** 2003 AM 88 1652-6.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

Roxybite $\sim\text{Cu}_{1.5}\text{Fe}_{0.02}\text{S}$ structure like *low-chalcocite*?: **WG Mumme GJ Sparrow GS Walker** 1988 MM 52 323-30.

Synthetic cubic Cu_9BiS_6 is similar to cubic *high-chalcocite*: MA 82M/3938.

chalcocyanite / chalcokyanite CuSO_4 . Isostructural with *zincosite* ZnSO_4 .

Review: framework structure, (E289).

Structure: early paper; *synthetic*, **CWT Pistorious** 1960 AM 45 744-6;

synthetic, **M Wildner G Giester** 1988 MP 39 201-9 (W686).

Name: MM 29 978.

Synthetic CoSO_4 -alpha: **PC Burns FC Hawthorne** 1993 PD 8 54-6 (B1616).

Synthetic NaCoPO_4 , review isotypic materials: **P Feng X Bu GD Stucky** 1997 JSSC 131160-6.

chalcomenite $\text{CuSeO}_3\cdot 2\text{aq}$. Isostructural with *teinite* (Te).

Dimorphic with *clinochalcomenite*. Review: (E289).

Structure: **G Gattow** 1958 AC 11 377-83 (G4);

T Asai R Kiriya 1073 Bull Chem Soc Japan 46 2395-401;

M Pasero N Perchiatti 1989 NJMM 551-6 (P548);

PD Robinson & 3 others 1992 AM 77 834-8.

chalconatronite $\text{Na}_2\text{Cu}(\text{CO}_3)_2$. Review: (E289).

Structure: **A Mosset J Bonnet J Galy** 1978 ZK 148 165-77 (M1277).

Occurrence: MM 31 956.

CHALCOPHANITE STRUCTURE GROUP Includes:

<i>aurorite</i>	(Mn,Ag,Ca)Mn ₃ O ₇ .3aq
<i>chalcophanite</i>	(Zn,Fe,Mn)Mn ⁴⁺ ₃ O ₇ .3aq
<i>ernienickelite</i>	NiMn ₃ O ₇ .3aq
<i>jianshuiite</i>	(Mg,Mn)Mn ⁴⁺ ₃ O ₇ .3aq

chalcophanite (Zn,Fe,Mn)Mn⁴⁺₃O₇.3aq.

Structure: **JE Post DE Appleman** 1988 AM 73 1401-4.

[Ignore incorrect AC 8 165-72 1955 = MA 13-14.]

Aurorite, *ernienickelite* & *jianshuiite* have similar XRPD, and assumed isostructural.

chalcophyllite Cu₁₈Al₂(AsO₄)₃(SO₄)₃(OH)₂₇.33aq. Review: Sabelli, p.24; (E289).

Structure: **C Sabelli** 1980 ZK 151 129-40.

CHALCOPYRITE STRUCTURE GROUP Includes:

<i>chalcopyrite</i>	CuFeS ₂	
<i>eskebornite</i>	CuFeSe ₂	
<i>gallite</i>	CuGaS ₂	
<i>lenaite</i>	AgFeS ₂	
<i>putoranite</i>	Cu ₁₆₋₁₈ (Fe,Ni) ₁₈₋₁₉ S ₃₂	
<i>roquesite</i>	CuInS ₂	
<i>raguinite</i>	TiFeS ₂	orthorhombic distortion
IMA 95-006	AgInS ₂	

Related to *stannite* structure: both derivatives of *sphalerite*, with *stannite* having all Cu in layers whereas *chalcopyrite* has Cu alternating.

Synthetic AgInS₂, chalcopyrite & orthorhombic types, photoluminescence 8 K: **J Krustol & 4 others** 2000 JAP 88 205-9 (K1247).

Various disordered structures and superstructures occur.

Possible application in thin-film solar cells.

Chalcopyrite-*lenaite* isomorphic series, Yakutia: **VP Samusikov & 2 others** 2000 DES 374 1166-8 (S2232).

Structural interpretation: **P Paufler P Rotsch** 1985 ZK 172 183-90 (P348).

Analog structures: **G Bergerhoff & 3 others** 1999 AC B55 147-56.

K-edge XAS of Zn/Fe/Cu/S in chalcopyrite: **P Saintavit & 5 others** J Phys Colloq 47 411-4.

XANES in Cu(Fe/Ga)S₂ & CuInSe₂ semiconductors: **P Saintavit & 5 others** 1989 Physica B 158 623-4.

Sulfur K- & L-edge XAS, *sphalerite*, chalcopyrite, *stannite*: **D Li & 7 others** 1994 PCM 21 489-99.

Thermal expansion, plasmon energy, bond length of semiconductor II-IV-V and I-III-VI types: **V Kumar BSR Sastry** 2002 JPCS 63 107-22 (3478).

Synthetic AgFeS₂: MA 10-14.

Synthetic Cu(Ga,In)Se₂: SR 56A 58.

Synthetic LiInTe₂: SR 52A 99.

Synthetic CuInSe₂, cleavage, twinning: **ZA Shukri CH Champness** 1997 AC B53 620-30.

Synthetic CuAl(S/Se)₂, phase transitions at high-P, XRPD structure: **RS Kumar & 4 others** 2000 JAICo 312 4-8 (357).

Synthetic AgGaS₂-CdGaS₂-InPS₂, electronic energy: **AA Lavrentiev & 3 others** 2002 J Struct Chem 43 69-79 (7693).

chalcopyrite CuFeS₂.

Structure: **G Donnay & 4 others** 1958 PR 112 1917-23 (D3);

SR Hall JM Stewart 1973 AC B29 579-85 (H385).

Atmospheric/electrochemical surface oxidation: **Q Yin & 3 others** 1995 GCA 59 1091-100 (Y226).

Surface oxidation: REFLE-XAFS, **KER England & 3 others** 1999 MM 63 559-66;

Cu/Fe/O XAS, **EC Todd DM Sherman JA Purton** 2003 GCA 67 2137-46 (9013).

Micro-PIXE of Zn/Ag/Se: **V Moggi-Cecchi & 5 others** 2002 PM 71 101-9 (7537).

Argentopentlandite-mackinawite inclusions, exsolution: MA 02M/2580.

S at fracture surface: **SL Harmer & 3 others** AM 89 1026-32.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

Alteration, depth analysis, XPS, AES & RBS: **G Pratesi C Cipriani** 2000 EJM 12 397-409 (P889).

chalcosiderite CuFe₆(PO₄)(OH)₈.4aq. *Turquoise* structure type.

Structure: **G Giuseppetti F Mazzi C Tadini** 1989 NJMM 227-39 (G772).

chalcostibite CuSbS_2 . Isostructural with *emphlectite*.
 Structure: **W Hoffman** 1933 ZK 84 177-203;
 XRPD & EXAFS of *-emphlectite* series, **MF Razmara & 4 others** 1997 MM 61 79-88;
 SC-XRD refinement, **A Kyono M Kimata** 2005 AM 90 162-5.

chalcothallite $\text{Tl}_2(\text{Cu,Fe})_6\text{SbS}_4$.
 Structure determination not found.
 Occurrence: **EI Semenov & 3 others** 1968 Medd Grønland 181 13-26 = AM 53 1775;
VA Kovalenker & 3 others 1978 DAN SSSR 239 1203-6 = AM 64 658.

challacolloite KPb_2Cl_5 .
 Matches *synthetic*, a known laser.
 Occurrence & XRPD structure: **J Schlüter D Pohl S Britvin** 2005 NJMA 182 95-101

challantite Matches *synthetic* $6\text{Fe}_2(\text{SO}_4)_3 \cdot \text{Fe}_2\text{O}_3 \cdot 63\text{aq}$.
 Occurrence: MM 40 906.

chambersite $\text{Mn}_3\text{B}_7\text{O}_{13}\text{Cl}$. *Boracite* structure type (orthorhombic) from cell data.
 Structure: *synthetic*, **F Kubel O Crottaz** 1996 ZK 211 924 (K895).
 Occurrence: **RM Honea FR Beck** 1962 AM 665-71.

chaméanite $(\text{Cu,Fe})_4\text{As}(\text{Se,S})_4$.
 Structure determination not found.
 Compare *luzonite* & *mgriite*: **Pearson** 369 & 372-3.
 Occurrence: **Z Johan P Picot F Ruhlmann** 1982 TPM 29 151 = AM 67 1074 (J251).

chamosite $(\text{Fe}^{2+}, \text{Mg}, \text{Fe}^{3+})_5\text{Al}(\text{AlSi}_3)\text{O}_{10}(\text{OH}, \text{O})_8$. *Chlorite* group.
 Disordered Ilb-Mg-: **JR Walker DL Bish** 1992 CICIM 40 319-22.
 Heat capacity, DSC: **C Bertoldi & 3 others** 2001 PCM 38 332-6 (2082).
 Compressibility to 9 GPa 293K: **T Theye T Parra C Lathe** 2003 EJM 15 465-8 (9170).
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.
 Ferrian chamosite, IR, decomposition to 1073 K: **JT Kloprogge RL Frost** 2000 CMP 138 59-67.

changbaiite PbNb_2O_6 .
 Structure determination not found.
 Matches *synthetic*; check for structure determination.
 Occurrence: AM 64 242.

changchengite IrBiS .
 XRPD matches synthetic and *mayingite* IrBiTe .
 Occurrence & XRPD: **Z Yu** 1997 Acta Geol Sinica 71 486-90 = AM 83 907.

changoite $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{aq}$. *Blödite* structure type: ? = *zinc-bloedite*.
 Description & XRPD: **J Schlüter K Klaska G Gebhard** 1999 NJMM 97-103 (S2031).
Synthetic, structure: **M Giglio** 1958 AC 11 789-94.

chantalite $\text{CaAl}_2\text{SiO}_4(\text{OH})_4$.
 Structure: **BW Liebich H Sarp E Parthé** 1979 ZK 150 53-63 (L529).
 MM 42 522-3.

chaoite C. Polymorphic with *diamond*, *graphite* & *lonsdaleite*.
 Occurrence: **A El Goresy G Donnay** 1968 S 161 363-4 = AM 54 326; AM 55 1067; AM 68 1251;
 MM 38 989. [jvs: question about validity of characterization: be cautious until resolved.]
Synthesis: **SK Simakov & 6 others** 2004 DES 399A 11289-90 (10895).
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.

chapmanite $\text{Fe}_2\text{Sb}(\text{SiO}_4)_2\text{OH}$. Isostructural with *bismutoferrite*.
 Structure: ED, **AP Zhukhlistov BB Zvyagin** 1977 SPC 22 419-23;
 confirmation by XRPD, **P Ballirano & 4 others** 1998 PD 13 44-9 (B1804).

charlesite $\text{Ca}_6(\text{Al,Si})_2(\text{SO}_4)_2\text{B}(\text{OH})_4(\text{OH}, \text{O})_{12} \cdot 26\text{aq}$. *Ettringite* structure type.
 Review: **Sabelli**, p. 18.
 Structure: **PJ Dunn & 3 others** 1983 AM 68 1033-7.

charoite $\text{K}_2.9\text{Na}_{1.0}(\text{Ca}_{5.6}\text{Ba}_{0.2}\text{Sr}_{0.1})\text{Si}_{14}\text{O}_{35}(\text{OH})_2 \cdot 3\text{aq}$.
 Structure: polysomatic model of *frankamenite*, *miserite*, *apophyllite*, HRTEM: **LV Nikishova IV Rozhdestvenskaya GS Polikanina** 2003 DES 389A 395-8 (8986).
 Polymorphism, ED & ion-exchange: **RL Penn & 3 others** 1995 GSAAP 27 A440.

Occurrence: **VP Rogova et al** 1978 ZVMO 107 94-100 = AM 63 1282.
chatkalite $\text{Cu}_6\text{FeSn}_2\text{S}_8$. *Germanite* structure group.
XRPD almost same as *mawsonite* $\text{Cu}_6\text{Fe}_2\text{SnS}_8$.
Occurrence: **VA Kovalenker et al** 1982 AM 67 621-2.
[**chavesite** (discredited MR 30 174) CaMn phosphate aq, but not analyzed.
Occurrence: **J Murdoch** 1958 AM 43 1154-5.
jvs Supposed to be isostructural with *monetite*, which lacks water, but XRPD does not match.]
chayesite $\text{K}(\text{Mg},\text{Fe})_2[(\text{Mg},\text{Fe})_2\text{Fe}^{3+}\text{Si}_{12}\text{O}_{32}]$. *Osumilite* structure type.
Chayesite-*roedderite* series.
Description: **D Velde & 3 others** 1989 AM 74 1368-73;
E Alietti & 3 others 1994 MM 58 655-62.
chekhovichite $\text{Bi}_2\text{Te}_4\text{O}_{11}$.
Occurrence/SC-XRD structure (= *synthetic*): **EM Spiridonov & 4 others** 1987 Vest Mosk Univ Geol 42 71 = AM 74 140
chelkarite $\text{CaMgB}_2\text{O}_4\text{Cl}_2 \cdot 7\text{aq}$.
Structure determination not found.
Occurrence: **NP Avrova & 3 others** 1971 AM 56 1122.
[**chelyabinskite** From burnt coal dumps. Similar to *thaumasite*.
Not approved by IMA. MM 60 527.]
chenevixite $\text{Cu}_2\text{Fe}_2(\text{AsO}_4)_2(\text{OH})_4 \cdot \text{aq}$.
Fe analog of *luetheite*.
Structure: SC-XRD of zoned crystal: **PC Burns JV Smith IM Steele** 2000 MM 64 25-30..
Occurrence: **Dana**.
chengbolite PtTe_{2-x} , $x \sim 1/3$. Inadequate description. Occurrence: MM 39 909.
In meteorites, $x = 0$: **AE Rubin** 1997 MPS 32 231-47.
chengdeite Ir_3Fe . Ir-dominant analog of *awaruite* & *isoferroplatinum*.
Occurrence: **Z Yu** 1995, Acta Geologica Sinica 69 215-20 = AM 81 516.
chenite $\text{Pb}_4\text{Cu}(\text{SO}_4)_2(\text{OH})_6$.
Structure: **H Hess P Keller H Riffel** 1988 NJMM 259-64 (H991). MM 50 742.
cheralite $(\text{Ca},\text{Ce},\text{Th})(\text{P},\text{Si})\text{O}_4$. *Monazite* type.
Structure: **JJ Finney NN Rao** 1967 AM 52 13-9.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
cheralite-Ce $(\text{Ce},\text{Ca},\text{Th})(\text{P},\text{Si})\text{O}_4$. *Monazite* type.
Structure: **JM Hughes & 3 others** 1995 NJMM 344-50 (H1032).
Occurrence: MM 30 730.
Monazite-cheralite-Ce-brabantite solid solution series, Erzgebirge, Fichtelgebirge, Germany: **H Förster** 1998 AM 83 259-72.
cheremnykhite $\text{Pb}_3\text{Zn}_3\text{TeO}_6(\text{VO}_4)_2$.
Occurrence: **AA Kim NV Zayakina VF Makhotko** 1990 ZVMO 119 50 = MM 60 527.
cherepanovite RhAs. Cell data match *synthetic*.
Structure determination not found.
Occurrence: **NS Rudashevsky & 5 others** 1985 ZVMO 114 464-9 = AM 71 1544.
chernikovite $(\text{H}_3\text{O})(\text{UO}_2)(\text{PO}_4) \cdot 3\text{aq}$. *Meta-autunite* group. Replaces *hydrogen autunite*.
Occurrence: **D Atencio** 1988 MR 19 249 = MM 54 663.
Synthesis, XRPD & IR: **L Van Havebeke R Vochten K Van Springel** 1996 MM 60 759-66.
chernovite YAsO_4 .
Zircon structure type from XRPD, matches synthetic: MA 13-1429.
Solid-solution series with *xenotime*.
Occurrence: **BA Goldin NP Yushkin MV Fishman** 1967 ZVMO 96 699-704 = AM 53 1777
IV Kozyreva IV Shvetsova YaE Yudovich 2003 DES 390 597-600 (9060).
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
chernykhite $(\text{Ba},\text{K})(\text{V},\text{Al})_2(\text{Si},\text{Al})_4\text{O}_{10}(\text{OH})_2$. *Mica* structure type, 2M polytype from cell data.
Structure determination not found.
Occurrence: ZVMO 101 451-8 = AM 58 966.

chervetite $\text{Pb}_2\text{V}_2\text{O}_7$.

Synthetic: **A Kawahara** 1967 BSFMC 90 279-84.

Occurrence: **P Bariand & 3 others** 1963 BSFMC 86 117-20 = AM 48 1416.

[chesofiite $\text{Ca}_9[\text{Si}_2\text{O}_7]_3\cdot\text{CaCl}_2$.

Not allowed as mineral name because occurs in burnt coal waste: AM 82 1038-41.]

chessexite $(\text{Na},\text{K})_4\text{Ca}_2(\text{Mg},\text{Zn})_3\text{Al}_8(\text{SiO}_4)_2(\text{SO}_4)_{10}(\text{OH})_{10}\cdot 40\text{aq}$.

Review: no structure, **Sabelli**.

Occurrence: **H Sarp J Deferne** 1984 SMPM 62 337-41 = AM 69 406.

chesterite $(\text{Mg},\text{Fe})_{17}\text{Si}_{20}\text{O}_{54}(\text{OH})_6$. *Biopyribole* structure family.

Structure determination not found.

Occurrence: **DR Veblen CW Burnham** 1978 AM 63 1000-9.

chestermanite $\text{Mg}_2(\text{Fe},\text{Al},\text{Sb})\text{BO}_5$.

6 Å Zigzag Borate: **MA Cooper FC Hawthorne** 1998 CM 36 1171-93.

Structure: **V Alfredsson & 3 others** 1991 Acta Chem Scand 45 797-804 = MA 93M/1482.

Modular interpretation of oxyborates: **BB Zvyagin GA Siderenko** 1995 AC B51 7-11 (Z87).

Occurrence: **RC Erd EE Foord** 1988 CM 26 911-6.

CHEVKINITE/PERRIERITE MINERAL GROUP

chevkinite-Ce $(\text{Ce},\text{La},\text{Ca},\text{Na},\text{Th})_4(\text{Fe},\text{Mg})_2(\text{Ti},\text{Fe})_3\text{Si}_4\text{O}_{22}$

perrierite $(\text{Ca},\text{Ce},\text{Th})_4(\text{Mg},\text{Fe})_2(\text{Ti},\text{Fe})_3\text{Si}_4\text{O}_{22}$

rengeite $\text{Sr}_4\text{ZrTi}_4\text{Si}_4\text{O}_{22}$

strontio-chevnikite $(\text{Sr},\text{La},\text{Ce},\text{Ca})_4(\text{Fe}^{2+},\text{Fe}^{3+})(\text{Ti},\text{Zr})_4\text{O}_{22}$

Chevnikite-group minerals from East African Rift, EMP analyses: **R Macdonald & 4 others** 2002 MM 66 287-99.

chevkinite-Ce $(\text{Ce},\text{La},\text{Ca},\text{Na},\text{Th})_4(\text{Fe},\text{Mg})_2(\text{Ti},\text{Fe})_3\text{Si}_4\text{O}_{22}$.

Essentially isostructural with *strontiochevkinite* $(\text{Sr},\text{La},\text{Ce},\text{Ca})_4(\text{Fe}^{2+},\text{Fe}^{3+})(\text{Ti},\text{Zr})_4\text{O}_{22}$.

Dimorphic with *perrierite*.

Structure: **CC Peng VR Bun** 1964 Scientia Sinica 13 1539-45;

C Calvo R Faggiani 1974 AM 59 1277-85;

Fe-rich, **Z Yang & 5 others** 2002 EJM 14 969-75 (8346);

Annealed, **E Sokolova & 3 others** 2004 CM 42 1013-25.

Synthesis: AM 52 1094-104; AM 56 307-19.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

Cr-, in Zimbabwe diamond: **MG Kopylova & 5 others** 1997 Russian Geol Geophys = AM 83 403.

Synthetic $\text{La}_4\text{Mn}_5\text{Si}_4\text{O}_{22}$: **C Gueho & 4 others** 1995 ChM 7 486-92 (G745).

Synthetic $\text{Pr}_4\text{V}_5\text{Si}_4\text{O}_{22}$: **J Chen & 4 others** 1995 JSSC 116 211-5 (C761).

Synthetic $\text{Nd}_4\text{V}_5\text{Si}_4\text{O}_{22}$: **J Chen & 4 others** 1995 ACC 52 2125-7 (C857).

chiavennite $\text{CaMnBe}_2\text{Si}_5\text{O}_{13}(\text{OH})_2\cdot 2\text{aq}$. *Zeolite* (s. l.) family; interrupted framework. IZA-SC structure code -CHI. Consortium for Theoretical Frameworks net 981.

Structure: **V Tazzoli & 3 others** 1995 EJM 7 1339-44 (T462).

Probable structural relation with *tvedalite* $(\text{Ca},\text{Mn})_4\text{Be}_3\text{Si}_6\text{O}_{17}(\text{OH})_4\cdot 3\text{aq}$.

childrenite $(\text{Fe},\text{Mn})\text{Al}(\text{PO}_4)(\text{OH})_2\cdot \text{aq}$. Isostructural with *eosphosphite*. Also see *ernstite*.

Structure: **E Giuseppetti C Tadini** 1984 NJMM 263-71 = MA 85M/0189.

chilgardite-(triclinic) $\text{Ca}_2[\text{B}(\text{tetrahedral})_3\text{B}(\text{triangular})_2\text{O}_9]\text{Cl}\cdot \text{aq}$.

Structure: **IM Rumanova ZI Iorsh NV Belov** 1978 SPD 22 460-2 (R468) = MA 79-2129.

chillagite = tungstenian wulfenite $\text{Pb}(\text{Mo},\text{W})\text{O}_4$.

Structure: **IM Rumanova ZI Iorsh NV Belov** 1977 SPD 22 460-2 (R490).

chiluite $\text{Bi}_6\text{Te}_2\text{Mo}_2\text{O}_{21}$.

Occurrence: **X Yong & 5 others** 1989 Acta Min Sinica 9 9-14 = AM 76 666.

chiolite $\text{Na}_5\text{Al}_3\text{F}_{14}$.

Structure: **C Brosset** 1938 ZaaC 238 201-8 = MA 6-232.

chivrolaite $\text{Ca}_4(\text{Ti},\text{Nb})_5(\text{Si}_6\text{O}_{17})_2[(\text{OH},\text{O})_5]_{13-14}\cdot \text{aq}$. Related to *zorite* & *haineaulite*.

Occurrence & SC-XRD structure: **YP Men'shikov & 7 others** 2006 AM 91 922-8.

chkalovite $\text{Na}_2\text{BeSi}_2\text{O}_6$. Stuffed high-*crystalite* type.
 Structure: **MA Simonov YuK Egorov-Tismenko NV Belov** 1976 SPD 20 805-7 (S1284).
 Thermal expansion: **CMB Henderson D Taylor** 1989 MM 53 117-9.
 Occurrence: MM 25 625.
 Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** (1995).
Synthetic Ge-: **YuK Egorov-Tismenko MA Simonov NV Belov** 1976 SPD 21 119-20 (E296).
Synthetic $\text{Na}_4\text{ZnCd}(\text{Si}_2\text{O}_6)_2$: MM 39 932.
Synthetic $\text{Na}_2\text{ZnSi}_2\text{O}_6$: **EL Belokoneva & 3 others** 1970 SPC 14 918-9 (B1125);
MA Simonov EL Belokoneva NV Belov 1981 SPC 25 731-2 (S713);
 substructure of type grown in solid-state, XRPD/ED, **J Grins P Werner Y Kanno** 1997 AChS 51 259-63.

chladniite $\text{Na}_2\text{CaMg}_7(\text{PO}_4)_6$. *Fillowite* structure type.
 Structure: **IM Steele** 1994 Lunar Planet Sci Conf XXV 1337-8 (S1365).
 Occurrence: **TJ McCoy & 4 others** 1994 AM 79 375-80.
 Fe,Mn-bearing, in acapulcoite-lodranite: **C Floss** 1999 AM 84 1354-9.
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.

chloraluminite $\text{AlCl}_3 \cdot 6\text{aq}$.
 Structure: neutron ? **Buchanan ? Harris** 1968 ACB 24 954-?;
 proton NMR, **ZM El Safar W Mulcahy** 1971 ACB 27 1069-70;
 multi-frequency NMR, **SM Nokhrin & 3 others** 2005 CM 43 1581-8.

chlorapatite $\text{Ca}_5(\text{PO}_4)_3\text{Cl}$. *Apatite* structure type.
 Structure: **PE Mackie JC Elliott RA Young** 1972 ACB 28 1840-8;
JM Hughes M Cameron KD Crowley 1989 AM 74 870-6.
 (Ca,Sr)-: **K Sudarsanan RA Young** 1980 ACB 36 1525-30.
 RE-uptake, site preference & degradation of monoclinic structure: **ME Fleet X Liu Y Pan** 2000 AM 85 1437-46.
 Multifrequency EPR of radiation-induced defects in *synthetic*, new center: **SM Nokhrin & 3 others** CM 43 1581-8.
Monazite & *xenotime* inclusions: **DE Harlov H Forster TG Nijland** 2002 AM 87 245-61.
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.

chlorargyrite AgCl . *Halite* type.
 Structure: ?1964 AC 17 1341; **Wells**, p. 349.
 Occurrence: **Dana**.

chlorartinite $\text{Mg}_2(\text{CO}_3)\text{Cl}(\text{OH}) \cdot 3\text{aq}$.
 Same formula, except for Cl for OH, as *artinite*, but triclinic.
 Occurrence & XRD: **LP Vergasova & 3 others** 1998 ZVMO 127 55-9 = MR 30 232 (V363).

chlorbartonite $\text{K}_6\text{Fe}_{24}\text{S}_{26}(\text{Cl},\text{S})$. Analog of *bartonite* with (S,Cl).
 Occurrence and SC-XRD structure: **VN Yakovenchuk & 5 others** 2003 CM 41 503-11

chlorellestadite $\text{Ca}_{10}(\text{SiO}_4)_3(\text{SO}_4)_3\text{Cl}_2$. *Apatite* type.
 Endmember composition, only known pure as *synthetic*.
 Review: **RC Rouse PJ Dunn** 1982 AM 67 90-6.

CHLORITE MINERAL GROUP

Includes:

<i>baileychlore</i>	$[\text{Zn}_{2.5}\text{Fe}_{1.2}\text{Al}_{1.2}\text{Mg}_{0.8}](\text{Si}_{3.5}\text{Al}_{0.5})\text{O}_{10}(\text{OH})_8$
<i>chamosite</i>	$(\text{Fe}^{2+},\text{Mg},\text{Fe}^{3+})_5\text{Al}(\text{AlSi}_3)\text{O}_{10}(\text{OH},\text{O})_8$
<i>borocookeite</i>	$\text{Li}_{1+3x}\text{Al}_{4-x}(\text{BSi}_3)\text{O}_{10}(\text{OH},\text{F})_8$
<i>clinochlore</i>	$(\text{Mg},\text{Fe})_5\text{Al}(\text{AlSi}_3)\text{O}_{10}(\text{OH})_8$
<i>cookeite</i>	$\text{LiAl}_4(\text{AlSi}_3)\text{O}_{10}(\text{OH})_8$
<i>glagolevite</i>	$\text{Na}(\text{Mg},\text{Al})_6[\text{Si}_3\text{AlO}_{10}](\text{OH},\text{O})_8$
<i>gonyerite</i>	$(\text{Mn},\text{Mg})_5\text{Fe}^{3+}(\text{FeSi}_3)\text{O}_{10}(\text{OH})_8$
<i>manandonite</i>	$\text{LiAl}_4(\text{BSi}_3)\text{O}_{10}(\text{OH})_8$
<i>nimite</i>	$(\text{Ni},\text{Mg},\text{Fe})_5\text{Al}(\text{AlSi}_3)\text{O}_{10}(\text{OH})_8$
<i>orthochoamosite</i>	$(\text{Fe}^{2+},\text{Mg},\text{Fe}^{3+})_5\text{Al}(\text{AlSi}_3)\text{O}_{10}(\text{OH},\text{O})_8$
<i>pennantite</i>	$\text{Mn}_5\text{Al}(\text{AlSi}_3)\text{O}_{10}(\text{OH})_8$
<i>[penninite]</i>	$\text{Mg}_{9.8}\text{Al}_{1.6}\text{Fe}_{0.6}(\text{Si}_{6.3}\text{Al}_{1.7})\text{O}_{20}(\text{OH})_{16}$
<i>sudoite</i>	$\text{Mg}_2(\text{Al},\text{Fe})_3(\text{AlSi}_3)\text{O}_{10}(\text{OH})_8$

Structure: Fe-rich monoclinic, **H Steinfink** 1958 AC 11 191-5 (S46A);
 Fe-rich triclinic, **H Steinfink** 1958 AC 11 195-8 (S46B);
SW Bailey BE Brown 1962 AM 47 815-50;
do 1963 AM 48 42-61;
H Shirozo SW Bailey 1965 AM 50 868-85;
 high-P, **RM Hazen LW Finger** 1978 AM 63 293-6;
TL Phillips K Loveless SW Bailey 1980 AM 65 112-22;
 lb interlayer boundary, **DL Bish RF Giese Jr** 1981 AM 66 1216-20;
 neutron, 1-layer monoclinic, **W Joswig H Fuess SA Mason** 1989 CICIM 37 308-16;
 intergrown triclinic & monoclinic IIb, **H Zheng SW Bailey** 1989 CICIM 37 308-16;
 1-layer triclinic, SC-XRD, **W Joswig SW Bailey** 1990 CICIM 38 216-8;
 2 partly dehydrated chromian clinochlores, SC-XRD, **S Guggenheim W Zhan** 1999 AM 84 1415-21;
 Mössbauer & molecular orbital study: **A Lougear & 5 others** 2000 PCM 27 238-69 (L1054).
 Interstratified *serpentine*-chlorites: **JF Banfield SW Bailey WW Barker** 1994 CMP 117 137-50 (B1743);
JF Banfield SW Bailey 1996 AM 81 79-91.
 Mixed layer chlorite/smectite, 20Å repeat: **T Yoneda T Watanabe** 1994 J Clay Sci Soc Japan 34 71-9 = MA 95M/3919.
 Dehydroxylation: **W Zhan S Guggenheim** 1995 CICIM 43 622-9;
 Fe-rich, XRD/DTA/TG/IR, **MD Ruiz Cruz L Moreno Real** 1996 Geol Carpathica-Clays 5 65-71 = MA 98M/3461.
 Chlorite-*berthierine* microstructures, TEM: **H Xu DR Veblen** 1996 CMP 124 291-301 (X18).
 II-b trioctahedral, Barberton greenstone belt: **X Xie GR Byerly RE Ferrell Jr** 1997 CMP 126 275-91 (X18).
 AFM, structural relaxation: **GA Vrdoljak & 3 others** 1994 AM 79 107-12.
 Geochemistry, contamination & octahedral vacancies: **W Jiang DR Peacor PR Buseck** 1994 CICIM 42 593-605 (1410).
 XPS of Al and modeling: **T Ebina & 4 others** 1997 JPCB 101 1125-9 (E395).
 Direct identification of 6 polytypes with semi-random stacking: **T Kogure JF Banfield** 1998 AM 83 925-30.
 Polytypism, stacking disorder, crystal growth & vacancies, HRTEM & SAED: **D Schmidt KJT Livi** 1999 AM 84 160-70.
 Chromium(VI), reduction & sorption by Fe(II)- chlorite, *corrensite* & *montmorillonite* for
 waste-water clean-up: **MF Brigatti & 7 others** 2000 CICIM 48 272-81 (B2013).
Smectite-to-chlorite transformation in hydrothermally altered metabasites: **D Robinson ST
 Schmidt AS de Zamora** 2002 JMG 20 167-74 (3975).
 Weathering of chlorite: in basalt to *corrensite*, *vermiculite*, *kaolinite* & *goethite*, **MF Aspandiar RA
 Eggleton** 2002 CICIM 50 685-98 (8655);
 in saprolite, 699-709.
 Anchizonal *illite* & *chlorite*, diagenesis to metamorphism, TEM, XRPD: **S Shata & 3 others** 2003 AM 88 748-62.
 Equation of state: **AR Pawley SM Clark NJ Chinnery** 2002 AM 87 1172-82.
 Thermodynamics, tschermakite s s in Fe-chlorite: **O Vidal & 2 others** AM 90 347-58;
 experiments, **T Parra & 2 others** AM 90 359-70.
 Cr-clinocllore: high-P reversible transition at 6 GPa, Ia-4 to Ib: **MD Welch WA Crichton** 2005 AM 90 1139-45.
chloritoid (Fe,Mg,Mn)Al₂SiO₅(OH)₂
 Isostructural with *magnesiochloritoid* (Mg) & *ottrelite* (Mn). Triclinic & monoclinic varieties.
 Structure: **GW Brindley FW Harrison** 1952 AC 5 698-9 (B106);
FW Harrison GW Brindley 1957 AC 10 77-82 (H37);
H Steinfink 1958 AC 11 191-5, 195-8;
 monoclinic, **RH Hanscom** 1975 AC B31 780-4;
 triclinic, **R Hanscom** 1980 AM 65 534-9
 natural & *synthetic*, high-P,T, TEM/Mössbauer/UV/XRPD, **M Koch-Muller & 5 others**
 2000 EJM 12 293-314 (K1225);
 high-P IR & thermodynamics, **M Koch-Muller AM Hofmeister Y Fei Z Liu** 2002 AM 87
 609-22.
 Cr,Mg: MM 51 681-7.
 EPMA of 32 grains from Belgium: MA 95M/4635.
chlormagaluminite (Mg,Fe)₄Al₂(OH)₁₂(Cl₂,CO₃)₂.2aq. *Manasseite* structure group.
 Structure determination not found.
 Occurrence: **AA Kashaev et al** 1983 AM 68 849.
chlormanganokalite K₄MnCl₆. Isostructural with *rinneite* K₃NaFeCl₆.
 Structure: **A Bellanca** 1947 PM 16 73-88.
Synthetic K₄CdCl₆: **do** 1951 PM 20 257-63.
chlormagnesite MgCl₂.

CdCl₂ structure type from crystallography: isostructural *lawrencite* FeCl₂ & *scacchite* MnCl₂.
Structure: **Wells** p 350.
chloromenite Cu₉O₂(SeO₃)₄Cl₆.
Occurrence & structure: **L Vergasova & 4 others** 1999 EJM 11 119-23 (V233).
chlorophoenicite (Mn,Mg)₃Zn₂(AsO₄)(OH,O)₆.
Structure: **PB Moore** 1968 AM 53 1110-9.
chlorothionite K₂Cu(SO₄)Cl₂. Review: **Sabelli**, p. 19; (E289). Chain structure.
Structure: **C Giacobazzo E Scandale F Scordari** 1976 ZK 114 226-37.
chloroxiphite Pb₃CuCl₂O₂(OH)₂. Review: (E289).
Structure: **JJ Finney & 3 others** 1977 MM 41 357-61.
Occurrence: Higher Pitts, Somerset, 1x10x30 mm; **PS Burr** 1996 MR 27 245-59.
[chlorspodiosite Ca₂ClPO₄.
Synthetic: **FK Cameron WJ McCaughey** 1911 JPC 15 468 = MM 30 730.
Occurrence in fertilizer: **JR Lehr & 4 others** 1966 *Crystallographic Properties of Fertilizer Compounds*, Tenn Valley Auth Chem Eng Bull 6, 163p (L758).]
choloalite (Pb,Ca)₃(Cu,Sb)₃Te₆O₁₈Cl.
Structure: **JJ Pluth JV Smith P Burns** 1997 done but not published;
SC-XRD, **AE Lam & 3 others** 1999 CM 37 721-9.
Synthesis, no aq, XRPD = isometric: **DW Powell & 4 others** 1994 MM 58 505-8.
Occurrence: with incorrect analysis indicating 1aq: **SA Williams** 1981 MM 44 55-7.
chondrodite Mg₅(SiO₄)₂(F,OH)₂. *Humite* structure family.
Structure related to *pseudosinhalite* Mg₂Al₃O[BO₄]₂OH.
Structure: **GV Gibbs PH Ribbe CP Anderson** 1970 AM 55 1182-94;
SC ND at 295, 100 & 20 K, **A Friedrich & 5 others** 2001 AM 86 981-9
NPD, **AJ Berry M James** 2002 MM 66 441-9.
Hydroxyl: MA 79-142.;
Near-IR, **PSR Prasad LP Sarma** 2004 AM 89 1056-60.
²⁹Si & ¹H NMR: **BL Phillips & 3 others** 1997 PCM 24 179-90.
Thermodynamics & H speciation, IR, Raman: **H Cynn & 3 others** 1996 PCM 23 361-76 (C855).
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** (1995).
Synthesis of hydroxyl-chondrodite: **K Yamamoto S Akimoto** 1977 AJS 277 288-312;
compression, **NL Ross WA Crichton** 2001 AM 86 990-6.
Static compression to 42 GPa: **J Faust E Knittle** 1994 GRL 21 1935-8 (F562).
Raman at high-P: **CC Lin L Liu T Irifune** 1999 PCM 26 226-33 (L983).
SC elastic properties, water in mantle: **SV Sinogeikin JD Bass** 1999 PCM 26 297-303 (S2058).
High-P SC-XRD & NPD: **A Friedrich & 4 others** 2002 AM 87 931-9.
Synthetic fluor-: MM 28 730.
Synthetic Ca₅(SiO₄)₂(OH)₂: **RM Ganiev & 3 others** 1970 SPD 14 946-8 1970;
TP Kuznetsova & 3 others 1980 SPC 25 91-2 (K650).
Synthetic deuterium, time-of-flight ND, O-D . . . O bond geometry: **GA Lager & 3 others** 2001 AM 86 176-80.
Titanium-: **K Fujino Y Takéuchi** 1978 AM 63 535-43.
Synthetic Al₄Co(BO₄)₂O₂: **JJ Capponi M Marezio** 1975 AC B31 2440-3.
Synthetic CaGe-: MA 80-2874.
chrisstanleyite Ag₂Pd₃Se₄. See *oosterboschite* Cu₂Pd₃Se₄.
Analog of *jaguéite* Cu₂Pd₃Se₄.
Structure: **D Topa & 3 others** 2002 IMA Mtg Abstr B30-22.
Occurrence: **WH Paar & 3 others** 1998 MM 62 257-64.
christelite Zn₃Cu₂(SO₄)₂(OH)₆.4aq.
Similar sheets to *ktenasite* (Cu,Zn)_{2.5}(SO₄)(OH)₃, but different H-bonding.
Structure: **G Adwidjaja & 3 others** 1966 ZK 211 518-21 (A715).
Occurrence: **J Schlüter K& 3 others** 1996 NJMM 188-92 (S1612).
christite TIHgAsS₃.
Synthetic: **KL Brown FW Dickson** 1976 ZK 144 367-76 = MA 78-248.

chromatite CaCrO_4 . *Zircon* structure type.
 Synthetic: ? **Clouse** 1932 ZK 83 161-71. MM 42 523.
 Occurrence: MM 33 1131.

chrombismite $\text{Bi}_{16}\text{CrO}_{27}$.
 Occurrence & XRPD: **X Zhou & 4 others** 1996 CM 35 35-8.
 Matches *synthetic*: PDF 37-958.

chromceladonite $\text{KCrMgSi}_4\text{O}_{10}(\text{OH})_2$. *Mica* structure type: 1M polytype.
 Occurrence, XRPD structure: **IV Pekov & 5 others** 2000 ZVMO 129 38-44.

chromdravite $\text{NaMg}_3(\text{Cr,Fe})_6(\text{BO}_3)_3\text{Si}_6\text{O}_{18}(\text{OH})_4$. *Tourmaline* structure type.
 Structure determination not found.
 Occurrence: **EV Rumyantseva** 1984 AM 69 210.

chromferide $\text{Fe}_{1.5}\text{Cr}_{0.5-x}$. Occurrence: MM 50 743.

chromite $(\text{Mg/Fe})\text{Cr}_2\text{O}_4$. *Spinel* structure type.
 Structure: magnetics & cubic/tetragonal transition ~ 100 K, **G Shirane D Cox S Pickard** 1964 J Appl Phys 35 954-5;
RJ Hill JR Craig GV Gibbs 1979 PCM 4 317-39;
YL Chen BF Xu JG Chen YY Ge 1992 PCM 19 255-9;
 detrital Cr-Al-Mg-Fe spinels, Trieste sandstones, **D Lenaz F Princivalle** 1996 NJMM 429-34 (L802).
 Heat capacity (3 anomalies) & thermodynamics 1.5-340 K: **S & 3 others** 2000 AM 85 1686-93.
 High-P Raman to 76 GPa, transition at 14-30 GPa: **Z Wang & 3 others** 2002 JPCS 2057-62.
Synthetic: MgAlFeCr-, SC-XRD/Mössbauer cation distribution, **JS Santos & 2 others** 2005 ACC 61 i27-8.
 In meteorites: **AE Rubin** 1997 MPS 32 231-47;
 large crystals, Saint Aubin iron, **KT Fehr A Carion** 2004 MPS 39 A139-141;
 H-chondrite, activity of *synthetic*, **R Kessel & 3 others** 2004 MPS 39 1287-306;
 V/(Cr + Al) vs oxygen fugacity, **JJ Papike JM Karner CK Shearer** 2004 AM 89 1557-60;
 in marine limestone, asteroid breakup, S Sweden, **B Schmitz T Häggström** 2006 MPS 455-66.

chromium Cr. Body-centered cubic. Isostructural with *iron*.
 Occurrence: **S Yue W Wang S Sun** 1981 Kehue Tonbao 26 959 = MM 48 572;
 in carbonado: **AN Gorshkov & others** 1996 GI 33 59-63 (G850);
 in diamond from Kimberlite Pipe 50, Liaoning, China: **AI Gorshkov & 5 others** 1997 GI 35 695-703 (G929);
 with FeCr, in diamond, lamproite, Argyle, Australia, **AI Gorschkov & 7 others** 2003 GI 41 1143-51 (9787).

chromphyllite $\text{KCr}[\text{AlSiO}](\text{OH},\text{F})$. *Mica* group, dioctahedral.
 Structure: **VG Evsyunin AA Kashaev RK Rastsvetaeva** 1997 CrR 42 571-4 (E409).
 Occurrence, IR, XRPD: **LZ Reznitsky & 6 others** 1997 ZVMO 2 110-9 (R744).

chrysoberyl BeAl_2O_4 . *Olivine* structure type.
 Structure: **EF Farrell JH Fang RE Newnham** 1963 AM 48 804-10 (F46);
R Newnham R Santoro J Pearson C Jansen 1964 AM 49 427-30 (N31);
AP Dudka BK Sevast'yanov VI Simonov 1985 SPC 30 277-9 (D472);
RM Hazen AY Au 1986 PCM 13 69-78;
RM Hazen 1987 PCM 14 13-20 (H623);
RM Hazen LW Finger 1987 PCM 14 426-34 (H697);
 IR, **T Pilati & 4 others** 1993 AC B49 216-22;
 SC-XRD, pure/0.3 % Cr, **MK Rabadanov AP Dudka** 1997 Inorg Mater 33 48-51 (R694);
 location of Cr from SC-XRD, **MK Rabadanov AP Dudka** 1998 CrR 43 991-4 (R864);
 EPR, *alexandrite*, **H Rager A Bakhshandeh-Khiri K Schmetzer** 1998 NJMM 545-57.
 Trace H, polarized FTIR: **P Bauerhansl A Beran** 1997 SMPM 77 131-6 (B1668).
Alexandrite is Cr-bearing chrysoberyl: it is a tunable laser host.
 Cr^{3+} (I) & (II) centers, NMR: **TH Yeom SH Choh** 2001 JAP 90 5946-60 (3790).
Synthetic $\text{Na}_2(\text{Co/Zn})\text{Cl}_4$: MA 78-1519.
Synthetic Co-: valence & coordination of Co, **VP Solntsev & 3 others** 2004 PCM 31 1-11 (10014).

chrysocolla $(\text{Cu,Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4$. naq. Amorphous or microcrystalline?
 Structure: **M-C Van Oosterwyck-Gastuche** 1970 CRASP 271D 1837-40 = MA 71-879.
 XAS, Cu bonding similar to *diopside*: **DA McKeown** 1994 JNCS 180 1-10 (M1199).
 Chemistry and formation: MR 28 52.

chrysotile Family of polytypes, including *clinochrysotile* & *orthochrysotile*.
 Structures and theoretical models: **H Jagodzinski G Kunze** 1954a,b NJMM 95-108,137-50;

EJW Whittaker 1955a,b AC 8 265-71, 571-4 (W32-36);
I Krstanovic S Pavlovic 1964 AM 49 1769-71;
K Toman AJ Frueh Jr 1968 AC A24 374-9;
B Devouard A Baronnet 1995 EJM 7 835-46 (D558);
 Raman of tubular, **JT Kloprogge RL Frost L Rintoul** 1999 PCCP 1 2559-64 (K1158).
 Variation in asbestos fibers, XRD & TEM: **BA Cressy G Cressey RJ Cernik** 1994 CM 32 257-70.
 Dehydration kinetics of asbestos, in situ XRPD: **A Cattaneo AF Gualtieri G Artioli** 2003 PCM 30 177-83.
 Chemical composition & relation with *lizardite*: **DS O'Hanley MD Dyar** 1998 CM 36 727-40.
 Composition gap with *lizardite*, Elba, Italy: **C Viti M Mellini** 1997 EJM 9 585-96 (V273).
Synthetic Co-: **W Noll H Kircher W Sybertz** 1958 Nw 45 489 & 1960 Beitr Min Petr 7 232 = MM 32 951-2.
Synthetic Mg & Ni, hydrothermal 523-723 K, 30-100 MPa: **EN Korytkova & 5 others** 2005 Inorg Mater 41 743-9.
chudobaite (Mg,Zn)₅H₂(AsO₄)₄.10aq.
 See *lindackerite* (Cu,Co,Ni)Cu₄(AsO₄)₂(AsO₃OH)₂.9aq
 Structure: **R Dorner K Weber** 1976 Nw 63 243 (unsatisfactory - MF Fleischer).
 Occurrence: **H Strunz** 1960 NJMM 1 = MM 32 951.
chukhrovite-Ce Ca₃(Ce,Y)Al₂(SO₄)F₁₃.10aq. Review: **Sabelli**, p. 33.
 Structure: **K Walenta** 1979 CE 38 331-9.
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
chukhrovite-Y Ca₃(Y,Ce)Al₂(SO₄)F₁₃.10aq. Review: **Sabelli**, p. 33.
 Structure: **GB Bokiy LI Gorogotskaya** 1965 DAN USSR ESS 163 92-4 = MA 19-180.
 Occurrence: MM 32 951.
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
Synthetic Ca₄AlSi(SO₄)F₁₃: **M Mathew & 3 others** 1981 AM 66 392-7.
churchite (Y,Er,La)PO₄.2aq. Commonly listed as *weinschenkite*.
Gypsum structure group.
 Structure determination not found [jvs: **BeEVERS** 1958 AC 11 is not on churchite.]
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
Synthetic (Y_{1-x}(Gd,Dy,Er)_x)PO₄.2aq, SC-XRD: **M Kohlmann & 4 others** 1994 AC C50 1651-2.
chursinite Hg₃(AsO₄)₂. *Gratonite* structure type.
 Structure matches *synthetic*: **B Kamaner B Kaitner** 1973 AC B29 1666-9 (K849).
Synthetic Hg₃(AsO₄)₂: **A-K Larsson & 3 others** 1993 AC C49 784-6.
Synthetic P-analog: **K Aurivillius BA Nilsson** 1975 ZK 141 1-10.
 Three Hg arsenates, structures not chursinite: **M Weil** 2000 ZN 55 699-706 (W1032).
 Occurrence: MM 50 743.
chvaleticeite (Mn,Mg)SO₄.6aq *Hexahedrite* structure type from cell data.
 Occurrence: **J Pasava & 3 others** 1986 NJMA 121-5 (P560).
chvilevaite Na(Cu,Fe,Zn)₂S₂.
 Based on *wurtzite* type, but with subtle positions for metals that differ from *cubanite*.
 Occurrence: **LN Kaplunnik & 4 others** 1990 SPD 35 6-8 (K632). MM 52 723.
cianciullite Mn(Mg,Mn)₂Zn₂(OH)₁₀.2-4aq.
 Structure: **JD Grice PJ Dunn** 1991 AM 76 1711-4.
 Occurrence: **PJ Dunn & 3 others** 1991 AM 76 1708-10.
cinnabar HgS. Trimorphic with *metacinnabar* & *hypercinnabar*.
 Structure: **KL Aurivillius** 1950 Acta Chem Scand 4 1413-6 = MA 11-418;
P Auvray F Genet 1973 BSFMC 96 218-9;
 Raman, 298 & 77K, **RL Frost WN Martens JT Kloprogge** 2002 NJMM 469-80 (8335).
 High-P polymorph of HgTe/HgSe/CdTe/?ZnTe/Hg_{0.8}Cd_{0.2}Te/Zn_xHg_{1-x}Te/metastable HgO,
 review: **A San-Miguel et al** 1995 PRB 51 8731-6 (S1443).
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.
 Transition, high-P zinc-blende-type polymorph of HgSe & HgTe: **MI McMahon & 3 others** 1996 PRL 77 1781-4 (M1419).
 High-P transition in (Hg,Fe)Se, small changes from Fe-free: **SB Qadri & 5 others** 1992 PRB 46 639-40 (Q19).
 Historical use of *minium* for cinnabar & *red lead*, Raman identification: **Analyst** 124 1323-6 = MA 00M/1134.
ciprianiite Ca₄[(Th,U)REE]₂Al(void)₂(B₄Si₄O₂₂)(OH,F)₂. *Hellandite* group.
 Occurrence & SC-XRD structure: **G Della Ventura & 3 others** 2002 AM 87 739-44.

clairite $(\text{NH}_4)_2\text{Fe}_3(\text{SO}_4)_4(\text{OH})_3 \cdot 3\text{aq}$.

Structure determination not found.

Occurrence: **JEJ Martini** 1986 AM 71 229.

claraite $(\text{Cu,Zn})_3\text{CO}_3(\text{OH})_4 \cdot 4\text{aq}$.

Structure determination not found.

XRPD indexing, triclinic cell: **K Walenta** 1999 = 2003 AM 88 254.

Occurrence: **K Walenta PJ Dunn** 1983 AM 68 471.

claringbullite $\text{Cu}_4(\text{OH})_7\text{Cl}$. Unique edge-sharing octahedral layer structure.

Structural hierarchy of *claringbullite* & Cu oxysalts: **RK Eby FC Hawthorne** 1993 AC B49 28-56.

Structure: **PC Burns MA Cooper FC Hawthorne** 1995 CM 33 633-9 (B1593);

Raman, implication copper corrosion, **RL Frost & 3 others** 2003 NJMM 433-45 (9622).
MM 42 523.

clarkeite ideal endmember $\text{Na}[(\text{UO}_2)\text{O}(\text{OH})]_0 \cdot 1\text{aq}$; substitution by K, Ca, Sr, Y, Th & Pb.

New chemical & structural data, XRPD structure by analogy with $\text{Na}_{1.72}\text{U}_2\text{O}_{6.86}$, CaUO_4 &

$\text{Na}_{0.5}\text{La}_{0.5}\text{UO}_4$: **RJ Finch RC Ewing** 1997 AM 82 607-19.

Occurrence: MM 22 616;

C Frondel 1958 USGS Bull 1064 95-8.

[clathrate hydrates encapsulating methane & other organics

Being considered as storage for hydrogen & methane.

Synthetic I, II & H types need clarification as possible minerals on cold sea bed & tundra: crystal-growth in laboratory, **EA Smelik HE King Jr** 1997 AM 82 88-98. See *craigite*.

Clathrate hydrates: 17 papers AM 89 1153-279 cover SEM, neutron scatter, stability, occurrence, Raman, synthesis, etc. **LJ Florusse & 7 others** 2004 *Stable low-pressure hydrogen clusters stored in a binary clathrate hydrate*, S 306 469-73 (10722).

KA Lokshin & 7 others 2004 *Structure and dynamics of hydrogen molecules in the novel clathrate hydrate by high pressure neutron diffraction*, PRL 93 125503 (10719).]

claudetite As_2O_3 . Dimorphic with *arsenolite*.

Structure: **AJ Frueh** 1951 AM 36 833-50;

F Pertlik 1975 Monat Chem 106 755-62.

claustralite PbSe . *Galena/halite* structure type.

Isostructural with *alabandite*, *altaite*, *galena*, *ninningerite* & *oldhamite*.

Structure: **Y Noda S Ohta S Sato Y Saito** 1983 AC B31 312-7;

thermal parameters 120-298 K, **Y Noda & 6 others** 1987 AC C43 1443-5 (N386).

clay minerals Complex family whose general references are given here.

A Meunier 2005 *Clays*, QE389.625.M48. [Comprehensive monograph on crystal structures;

identification; nucleation and growth; crystal chemistry; thermodynamics & reaction

kinetics; isotopes; microtextures; occurrence in soils, weathered rocks & sediments;

diagenesis; thermal metamorphism & hydrothermal; high-T & -P; extraterrestrial; origin of

life.]

Layered double hydroxides are good anionic exchangers, and potential catalysts, XRD & EXAFS

of *synthetic* ZnCr-Cl & Cu-Cr-Cl types: **H Roussel et al** 2000 JPCB 104 5915-23 (185).

Respiration/dissolution of Fe(III)-bearing clay minerals by bacteria: **JE Kostka & 3 others** 1999 EST 33 3127-33 (K1188).

OH stretching vs first overtone: **S Petit & 3 others** 2004 PCM 31 585-91 (10896).

Clay Materials Used in Construction: **GM Reeves I Sims JC Cripps ed** 2005 Geol Soc Pub, Eng Geol Spec Publ 21.

G Sposito & 5 others 1999 *Surface geochemistry of the clay minerals*, PNAS 96 3358-64.

Cr reduction/sorption by Fe(II)-phyllosilicates, XAS: **MF Brigatti & 7 others** 2000 CICIM 48 272-81 (B2013).

Clays, carbonates, etc, proceedings of conference on mineral diagenesis & reservoir quality: 2000 CIM 35 1-320 (786).

Organophilic bentonite adsorbents for radionuclides, I Adsorption of ionic fission products, II

Hexadecylpyridium complex: **J Bors S Dultz B Riebe** 2000 Appl Clay Sci 16 1-13, **sd jb** 15-29.

Bentonites for pelotherapy, Sardinia mud: **S Cara & 4 others** 2000 Appl Clay Sci 16 117-32.

XPS of surface charge: **WD Johns S Gier** 2001 CIM 36 355-67 (3067).

IR of clay minerals in Athabasca Basin: **G Zhang K Wasyluk Y Pan** 2001 CM 39 1347-63.

Cathodoluminescence & EPR: **J Götze & 4 others** 2002 MP 76 195-212 (8632).

Clay cements in sandstones: **RH Worden S Morad ed** 2003 QE389.625.C517.

clearcreekite $\text{Hg}_3(\text{CO}_3)\text{OH} \cdot 2\text{aq}$. Polymorph of *peterbaylissite*.

Occurrence & XRPD: **AC Roberts & 6 others** 2001 CM 39 779-84.

clerite MnSb_2S_4 . XRPD similar to Mn-rich *berthierite* & synthetic MnSb_2S_4 .
Occurrence: **VV Murzin & 3 others** 1996 ZVMO 3 95-101 (M1447) = AM 82 620-1.

cleusonite $(\text{Pb,Sr})(\text{U}^{4+},\text{U}^{6+})(\text{Fe,Zn})_2(\text{Ti,Fe}^{2+},\text{Fe}^{3+})_{18}(\text{O,OH})_{38}$. *Crichtonite* group.
Occurrence & XRD: **P-A Wülser & 6 others** 2005 EJM 17 933-42 = AM 91 1202.

cliffordite UTe_3O_8 .
Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Synthetic: **R Fischer M Schlatti J Zemann** 1969 Anz Osterreich Akad Wiss 106 93-4 = MA 72-931;
J Galy G Meunier 1971 AC B27 608-16;
F Brandstätter 1981 TMPM 29 1-8 (B1350).
Occurrence: MM 37 956.
Compare *winstanleyite* TiTe_3O_8 .

clinoatacamite $\text{Cu}_2(\text{OH})_3\text{Cl}$. Quadrimorphic with *atacamite*, *botallackite* & *paratacamite*.
Structure: **JD Grice JT Szymanski JL Jambor** 1996 CM 34 73-8.
Occurrence & possible 4th polymorph *paratacamite*: **JL Jambor & 4 others** 1996 CM 34 61-72.

clinobarylite $\text{BaBe}_2\text{Si}_2\text{O}_7$. Orthorhombic 1O polytype of 2O *barylite*.
Structure: SC-XRD, **SV Krivovichev & 4 others** 2004 NJMM 373-84 (10648).
Occurrence: **NV Chukanov & 4 others** 2003 ZVMO 132 27-37; error, monoclinic symmetry.

clinobehoite $\text{Be}(\text{OH})_2$. Monoclinic polymorph of *behoite*.
Structure: **TN Nadezhina & 4 others** 1989
SPD 34 187-9 (N336).
Occurrence: **AV Voloshin & 5 others** 1989 MZh 11 88 = MM 54 663.

clinobirnessite Variety of *birnessite*, single-layer triclinic or double-layer monoclinic.
Occurrence: **AI Gorshov & 4 others** 1992 Lithology & Mineral Resources 27 503 = AM 79 1210.

clinobisvanite BiVO_4 . Distorted *fergusonite* (*scheelite*) structure.
Monoclinic: trimorphic with tetragonal *dreyerite* & orthorhombic *pucherite*.
Structure determination not found.
Occurrence: **O von Knorring et al** 1973 CMP 41 325-31;
PJ Bridge MW Pryce 1974 MM 39 847-9;
EE Foord 1996 MM 60 387-8;
supergene pseudomorph after *dreyerite*, **JB Collier IR Plimer** 2002 NJMM 401-10.

clinocervantite Sb_2O_4 -beta. Monoclinic polymorph of *cervantite*.
Occurrence & structure: **R Basso & 3 others** 1999 EJM 11 95-100.

clinochalcomenite $\text{CuSeO}_3 \cdot 2\text{aq}$. Dimorphous with *chalcomenite*. Isostructural with *ahlfeldite* (Ni), *cobaltomenite* (Co) & various synthetics including $\text{ZnSeO}_3 \cdot \text{aq}$.
Structure: **K Lo Z Chen Z Ma** 1984 Kexue Tongbao 29 352-5.
Occurrence: MM 43 1059.

clinocllore $(\text{Mg,Fe})_5\text{Al}(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_8$.
Chlorite mineral/structure group; series with *chamosite*.
Monoclinic ferroan, structure: **AC Rule SW Bailey** 1987 CICIM 35 129-38 (R394);
synthetic, NMR, **DM Welch J Barras J Klinowski** 1995 AM 80 441-7.
Triclinic IIb-4 polytype, SC-XRD structure: **JR Smyth & 4 others** 1997 CICIM 45 544-50 (S1828).
Heat capacity, DSC: **C Bertoldi & 3 others** 2001 PCM 38 332-6 (2082).
[*Penninite* $\text{Mg}_{9.8}\text{Al}_{1.6}\text{Fe}_{0.6}(\text{Si}_{6.3}\text{Al}_{1.7})\text{O}_{20}(\text{OH})_{16}$] is 1-layer triclinic - IIb-4 stacking type.
Structure: **W Joswig & 4 others** 1980 AM 65 349-52.]
High-P: to 6.5 GPa, neutron PD structure, H bond, **MD Welch WG Marshall** 2001 AM 86 1380-6;
<27 GPa, XRPD, transition, **MD Welch AK Kleppe AP Jephcoat** 2004 AM 89 1337-40.
Compressibility to 8 GPa, XRPD: **MD Welch WA Crichton** 2002 EJM 14 561-5 (7673).
Compressibility to 9 GPa at 293K: **T Theye T Parra C Lathe** 2003 EJM 15 465-8 (9170).
H-bonding to 26 GPa, Raman of *synthetic*: **AK Kleppe AP Jephcoat MD Welch** 2003 AM 88 565-73.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

clinochrysotile / clino-chrysotile $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$. *Kaolinite-serpentine* structure group.
Polymorphic with *antigorite*, *orthochrysotile* & *parachrysotile*.
Structure determination not found.

Occurrence: **EJW Whittaker** 1951 AC 4 187 = MM 30 730.

clinoclase $\text{Cu}_3\text{AsO}_4(\text{OH})_3$. Polymorph of *gilmarite*. Review: (E289).

Structure: **S Ghose M Fehlmann M Sundaralingam** 1965 AC 18 777-87 1965;
RK Eby FC Hawthorne 1990 AC C46 2291-4 1990 (E352).

IR & Raman: OH vibration & dehydration, **WN Martens & 3 others** 2003 AM 88 501-8.
 $[\text{Cu}_3\text{AsO}_4(\text{OH})_3]$. IMA 96-017 = MR 28 398. Triclinic polymorph of *clinoclase*.]

clinoenstatite MgSiO_3 . *Pyroxene* type, endmember composition, monoclinic subtype.
Trimorphic with orthorhombic *enstatite* & synthetic *protoenstatite*.

Structure: **N Morimoto DE Appleman** 1960 ZK 114 120-47.

Plane-wave pseudopotential model of high-P changes: **W Duan & 3 others** 2001 AM 86 762-8.
Molecular dynamics simulation of phase transition: PCM 28 591-9 (3443).

Synthetic $\text{CaZnSi}_2\text{O}_6$ & $\text{CaZnGe}_2\text{O}_6$: XRD structural comparison, **GJ Redhnmmer G Roth** 2005 ACC .

Occurrence: garnet pyroxenite, Dabie-Sulu, China, **RY Chang & 3 others** 2002 AM 87 867-74.

clinoeulite Monoclinic dimorph of *eulite*, a *pyroxene*. MM 42 523.

clinoferrosilite *Pyroxene* type, endmember composition, monoclinic subtype.
Dimorp of orthorhombic *ferrosilite*.

Structure, high-: **S Sueno M Kimata CT Prewitt** 1984 AM 9 264-9;
high-P, **DA High-Jones AB Woodland RJ Angel** 1994 AM 1032-41;
high-P crystal-field spectra, **NL Ross JR Sowerby** 1999 EJM 11 791-801.

clinohedrite $\text{CaZnSiO}_3\text{OH}$. 2,3-vertex-connected tetrahedral net.
Some structural resemblance to *gerstmannite* & *hodgkinsonite*.

Structure: **AV Nikitin NV Belov** 1964 DES 148 118-20
CC Venetopoulos PJ Rentzeperis 1976 ZK 144 377-92;
MA Simonov & 3 others 1977 SPD 22 614-6 (S1340);
MA Simonov YuK Egorov-Tismenko NV Belov 1978 SPD 23 113-4 (S1344).

clinohumite $(\text{Mg,Fe})_9(\text{SiO}_4)_4(\text{F,OH})_2$. *Humite* structure family.
Isostructural with (Mn,Mg) *sonolite*.

Structure: **K Robinson GV Gibbs PH Ribbe** 1973 AM 58 43-9 1973;
SC-ND, 295, 100 & 20 K, **A Friedrich & 5 others** 2001 AM 86 981-9.

Hydroxyl-clinohumite, *synthesis*: **K Yamamoto S Akimoto** 1977 AJS 277 288-312;
Raman, 0-37 GPa & 81-873 K, **C Lin & 3 others** 2000 PCM 27 320-31;
compression, **NL Ross WA Crichton** 2001 AM 86 990-6.

Titanian: **V Kocman J Rucklidge** 1973 CM 12 39-45;
K Fujino Y Takéuchi 1978 AM 63 535-43.

Sound velocity: **TL Beckman Fritzel JD Bass** 1997 GRL 24 1023-6 (B1586).

Stability: **A Pawley** 2000 CMP 138 284-91 (P874).

clinojimthompsonite $(\text{Mg,Fe})_5\text{Si}_6\text{O}_{16}(\text{OH})_2$. Dimorphic with *jimthompsonite*.
Structure determination not found for mineral, but done for synthetic analogs.

Occurrence & EM: **DR Veblen CW Burnham** 1978 AM 63 1000-9.

Ca- analog: unnamed mineral, inclusion in fibrous phase: **J Akai** 1982 CMP 80 117-3;
EM, **H Konishi J Akai K Kurokawa** 1993 J Geol Soc Japan 99 679-82 = MA 96M/2066.

Synthetic ion-exchanged $[\text{Ca}_{0.6}\text{void}_{1.4}][\text{Ca}_{1.4}\text{void}_{0.6}]\text{Mg}_8\text{Si}_{12}\text{O}_{32}(\text{OH})_4$: **J Akai M Saito** 1985 BM 108 21-8 (A660).

Synthetic $\text{Na}_2\text{Mg}_4\text{Si}_6\text{O}_{16}(\text{OH})_2$: structure, **H Tateyama S Shimoda T Sudo** 1978 CMP 66 149-56.

Synthetic $\text{NaMg}_4\text{Si}_6\text{O}_{15}(\text{OH})_3$: **VA Drits & 4 others** 1974 SPC 19 737-41;
VA Drits YI Goncharov VA Khadzhi 1976 Izv Akad Nauk Ser Geol 7 32-41.

clinohydroxylapatite $(\text{Ca,Na})_5[(\text{P,S})\text{O}_4]_3(\text{OH,Cl})$.
Monoclinic variety of *hydroxylapatite*.

Occurrence & distinctive XRPD: **AR Chakhmouradian L Medici** 2006 EJM 18 105-12 = AM 91 1453.

clinokurchatovite $\text{Ca}(\text{Mg,Fe,Mn})\text{B}_2\text{O}_5$.
Dimorphic with *kurchatovite* : see for structure references. MM 48 572.

clinomimetite $\text{Pb}_5(\text{AsO}_4)_3\text{Cl}$. *Apatite* structure group.
Monoclinic inversion product of *mimetite* above ~390K.

Structure: **Y Dai JM Hughes PB Moore** 1991 CM 29 369-76.
Occurrence: **Y Dai** 1993 MR 24 307-10.

clinophosinaite $\text{Na}_3\text{CaPSiO}_7$.

Phosinaite is orthorhombic analog Ce substitution for Ca: **VM Krutik & 4 others** 1982 SPC 26 679-82 (K646).

Structure: **VM Krutik & 4 others** 1980 SPC 25 138-42 (K649).

Occurrence: **AP Khomyakov et al** 1982 AM 67 414;

hyperagpaitic alkaline rocks (revised formula): **Khomyakov** (1995).

clinoptilolite $(\text{Na,K})_6(\text{Al}_6\text{Si}_3\text{O}_{72})\cdot 20\text{aq}$. *Zeolite* mineral family; HEU structure topology.

Consortium for Theoretical Frameworks net 602.

Structure: **A Alberti** 1972 TMPM 18 129-46;

2 specimens, **A Alberti** 1975 TMPM 22 25-37 (A269);

K Koyama Y Takéuchi 1977 ZK 145 216-39;

T Armbruster 1978 AM 78 260-4;

proton NMR, **J Gallier M Gaspard G Martin** 1981 J Chim Phys Phys-Chim Biol 78 757-69;

623 K, **Y Kudoh Y Takéuchi** 1983 MJ 11 392-406 (K400);

Mg-Na-rich natural, **O Petrov T Karamaneva G Kirov** 1984 Dokl Bolg Akad Nauk 37 785-8 = CA 102:28595w;

Mg-rich, **K Sugiyama Y Takéuchi** 1986 Stud Surf Sci Catal 28 449-56;

dehydration, B-phase, **DL Bish** 1990 EJM 2 771-7;

stepwise dehydration of *heulandite*-, **T Armbruster ME Gunter** 1991 AM 76 1872-83;

dehydration of Na-poor, Ca,K,Mg-rich at 100K, **T Armbruster** 1993 AM 78 260-4;

natural & Cs-exchanged, **JR Smyth AT Spaid DL Bish** 1990 AM 75 522-8;

XRPD/IR/Raman, heated, **J Hanuza A Miecznikowski** 1996 Pol J Chem 70 259-64 = CA 124:327433q;

Al distribution, periodic lattice simulation, **AR Ruiz-Salvador & 5 others** 1998 JPCB 102 8417-25 (R855);

-*heulandite* polymorphism, computer simulation: **do & 6 others** 2000 PCCP 2 1803-13 (R934);

2 epiclastic, high Mg/low K, XRPD struct: **P Cappelletti A Langella G Cruciani** 1999 EJM 11 1051-60 (C1137);

cation exchange/dehydration/calcination, in situ XRPD, **M Johnson & 8 others** 2003 JPCB 107 942-51 (9110).

NMR: **RL Ward H McKague** 1994 JPC 98 1232-7;

hydrated Li/Na/K/Cs/ NH_4 /Mg/Ca/Sr/Ba, **SP Gabuda & 4 others** 1996 Zh Strukt Khim 37 891-900;

proton-, **S Nagyova** 1997 Acta Phys Slovaca 47 441-8 = CA 128:14946m;

accumulation of acid sites during repeated dehydration, **NK Moroz & 3 others** 2003 PCM 30 243-7 (9238).

Dealuminated: **F Grejtak J Krajcovic P Komadel** 1994 Geol Carpathica-Clays 45 99-102 = MA 95M/4676.

Equilibrium in clinoptilolite-water system: **WJ Carey DL Bish** 1996 AM 81 952-62.

Altered silicic vitric tuffs with hydrothermal reactions: **P Münch J Duplay J-J Cocheme** 1996 CICIM 44 49-67 (M1380).

Environmental applications for toxic Pd/Cs/Cd/Sr/Cu/Co: **T Wieser** 1993 Prace Mineralogiczne 84 57-60 = MA 95M/4193.

Solubility & stability in aqueous solution: **RT Wilkin HL Barnes** 1998 AM 83 746-61;

calcic, **LG Benning RT Wilkin HL Barnes** 2000 AM 85 495-508.

Tapping-mode AFM & high-resolution thermogravimetry: CA 127:55149b.

Optimization of clay liners in waste deposits: **MW Upmeier KA Czurda** 1997 Stud Surf Sci Catal 105B 1633-9.

Kinetics of ammonium adsorption/desorption: **M Kithome & 3 others** 1998 SSSAJ 62 622-9.

Enhanced N removal in septic tank leachfield: **HS Tang AP Kruzic SL Mentser** 1998 = CA 130:342340z.

Sorption kinetics of hexadecyltrimethylammonium: **Z Li** 1999 La 15 6438-45.

-rich rock, Na/Cs/Sr exchange: **R Woods ME Gunter** 2001 AM 86 424-30, 431-7.

Thermochemistry, natural & Na/NaK/K/Ca-exchanged: **S Yang A Navrotsky R Wilkin** 2001 AM 86 438-47.

Thermal behavior vs. chemistry: **KP Kitsopoulos** 2001 CICIM 49 236-43.

Dissolution, AFM: **BR Bickmore & 4 others** 2001 AM 86 411-23.

NH_4 -exchanged natural: XRD & H NMR of arrangement & diffusive mobility, **NK Moroz & 3**

others 2002 J Struct Chem 43 595-600 (8707);

dehydration/dealumination: **B Tomazovic T Ceranic G Sijaric** 1996 Z 16 301-8 & 309-12 (T466).

Cationic surfactants, sorption vs hydrocarbon chain length: **B Ersoy MS Celik** 2003 CICIM 51 172-80.

Occurrence: Sardinia pyroclastics (G1165);

barium-rich in Japan Sea (N508).

Synthesis without seeds: **CD Williams** 1997 ChC 2113-4 (W859).

[*Potassium clinoptilolite*, occurrence: MM 39 924.]

Ba-exchanged: **O Petrov L Filizova G Kirov** 1985 Dokl Bulg Akad Nauk 38 603-6 = CA 103:90562g.

Cs-exchanged: **do** 1991 Dokl Bulg Akad Nauk 44 77-80 = MA 93M/3985.

Na/K/Cs/NH₄/Ca/Mg/Ba-exchanged, thermal stability: **A Arcoya & 4 others** 1996 MiMa 7 1-13.

$\text{Cr}^{5+}/\text{Cu}^{2+}$ -exchanged natural, EPR: **F Koksai F Uzun K Ibrahim** 1996 ZN 51A 242-4.

Synthetic K,Na-: **S Satokawa K Itabashi** 1997 MiMa 8 49-55.

Synthetic series with *heulandite*, unit-cell dimensions, IR and thermal properties: **D Zhao & 6 others** 1998 MMM 21 371-9 (Z174).

Na-free, high-Si from Middle Volga: **TZ Lygina & 3 others** 1998 ZVMO 108-10 (L1040).
Na- & K-exchanged, thermodynamics of hydration to 573 K: **RT Wilkin HL Barnes** 1999 PCM 26 468-76 (W966).
Synthetic Ni-exchanged, ESR & echo modulation: **H Choo & 3 others** 1999 JPCB 103 6193-9 (C1112).
Kinetics, Pb uptake: **VJ Inglezakis & 3 others** 1999 JCIS 215 54-7.
Cu adsorption: **VO Vasylechko & 5 others** 1999 Adsorpt Sci Technol 17 125-34 (9337).
Sorption kinetics of hexadecyltrimethylammonium on natural: **Z Li** 1999 La 15 6438-45 (9336).
Ba-rich, authigenic in Japan Sea sediments: **TH Nahr G Bohrmann** 1999 CG 158 227-44.
Composition, from volcanic glass during burial diagenesis: **S Ojihara** 2000 CICIM 48 106-10 (O417).
Ion-exchanged NH₄/Cu/Zn/Cd/Pb, Sardinia clinoptilolite: **A Langella & 5 others** 2000 MMM 37 337-43 (L1059).
Synthetic (Na/K/H/Li/Ni/Co/Cu), EPR & diffuse reflectance spectroscopy of photoionization of adsorbed N-alkylphenothiazine: **RM Krishna & 4 others** 2000 PCCP 2 3335-9 (K1250).
Glucose binding to Fe-bearing: **B Concepcion-Rosabal & 2 others** 2000 MMM 38 161-6 (252).
Carbonate ions, role vs Ni(II)-NH₄ exchange: **I Rodriguez-Iznaga & 2 others** 2000 MMM 41 129-36 (460).
Base-exchanged natural as Knoevenagel catalyst: **CF Linares & 5 others** 2000 MMM 41 69-77 (458).
Absorption kinetics CO₂/O₂/N₂/CH₄ in cation-exchanged: **G Aguilar-Armenta & 7 others** 2000 JPCB 105 1313-9.
Arsenate-arsenite uptake by tuffs: **MP Elizale-Gonzalez & 3 others** 2001 MMM 46 277-86 (2307).
Cu adsorption: & Si/Al/Ca/Mg/Na release, **M Doula A Ioannou A Dimirkou** 2002 JCIS 245 237-50 (5438);
effect of Cl/NO₃/SO₄ anion, **MK Doula A Ioannou** 2003 MMM 58 115-30 (8781).
Ion exchange of Pb/Cr/Cu/Fe on natural: **VJ Inglezakis & 2 others** 2002 WR 36 2784-92 (7633).
Electrokinetics with mono- & multivalent electrolytes: **B Ersoy MS Celik** 2002 MMM 55 305-12 (8095).
Natural as exchanger of Ni(II)/ammonium in waste management: **MMM** 53 71-80 (7790).
Thermal behavior, natural/cation exchanged, Sardinia: **A Langella & 4 others** 2003 CICIM 51 625-33.
Synthetic CaZnGe₂O₆ & CaZnSi₂O₆: XRD structure, **GJ Redhammer G Roth** 2005 ACC 61 i20-2.

clinopyroxene *Pyroxene* structure family; general name for monoclinic subgroup.
See pyroxene for main references.

Crystal chemical study of cpx from plagioclase peridotites: **P Nimmis** 1995 MP 53 49-61.
SC-XRD structure: Alicudi, Aeolian arc: **S Nazzareni & 3 others** 1998 EJM 10 291-300 (N486);
26 Lipari volcanic: **D Pasqual G Molin PF Zanazzi GM Crisci** 1998 CM 36 97-105;
5 on Di-E n join. **M Tribaudino & 2 others** CM 2005 1411-21.
High-T crystal chemistry of CaMgSi₂O₆-CaAl₂SiO₆: **M Tribaudino** 1996 EJM 8 273-9 (T481).
Intersite Mg/Fe partitioning in high-P Ca-free: **AB Woodland C McCammon RJ Angel** 1997 AM 82 923-30.
High-P phase transition: **T Arlt & 4 others** 1998 AM 83 1176-81;
effect of iron, **NL Ross B Reynard** 1999 EJM 11 585-9 (R897).
C2/c-P2₁/c transition in Li(Cr/Ga/Fe/V/Sc/In): **GJ Redhammer G Roth** 2004 ZK 219 685-605 (10955).
Johannsenite-hedenbergite solid solution, SC-XRD structure: **GC Capitani M Mellini** 2000 EJM 12 1215-27 (297).
Ultrahigh K: *synthesis*, high P, **LT Chudinovskikh & 3 others** 2001 DES 381 956-9 (3596);
occurrence, microdiamond mine, Kazakhstan, **L Bindi & 4 others** 2003 AM 88 464-8.
K-bearing, composition/phase equilibria 7 GPa: **OG Safonov YuA Litvin LL Perchuk** 2002 DES 382 91-5 (7555).
Synthetic K-rich: SC-XRD structure & compressibility to 10 GPa at 298 K: **L Bindi & 7 others** 2006 AM 91 802-8.
High-T P/C phase change in Fe-free Ca-rich: **M Tribaudino & 3 others** PCM 30 529-35.
Synthetic K-rich: SC-XRD. **L Bindi & 4 others** 2002 EJM 14 929-34 (8350).
Synthetic Ca(Co/Ni)Si₂O₆, magnetic properties, NPD 2K: **G Durand & 4 others** 1996 JSSC 124 374-80 (D593).
Synthetic En-Fs join; TEM/XRPD/Mössbauer: **RJ Angel & 2 others** 1998 PCM 25 249-58 (A817);
SG Eeckhout & 3 others 2000 AM 85 943-52;
10 samples, IR, **T Boffa Ballaran MA Carpenter NL Ross** 2001 MM 65 339-50;
magnetics, **SG Eeckhout & 6 others** 2001 AM 86 957-64.
Synthetic, structure: **M Okui H Sawada F Marumo** 1998 PCM 25 318-22 (O383).
Synthetic CaMgSi₂O₆-Mg₂Si₂O₆, TEM: **M Tribaudino** 2000 AM 85 707-15.
Eclogite geobarometer: **SK Simanov LA Taylor** 2000 IGR 42 534-44 (S2180).
In eclogite, Kazakhstan, IR, 3 OH bands: **I Katayama S Nakashima** 2003 AM 88 229-34.
OH in omphacite from Siberian upper mantle: **M Koch-Müller & 2 others** 2004 AM 89 921-31.
Kosmochlor-diopside, incommensurate polymorph: **S Sakamoto & 2 others** 2003 AM 88 1605-7.
Relics of high-T in Di-CaTs, skarns, Rumania: **M Pascal & 3 others** 2005 CM 43 857-82.
Synthetic hedenbergite-aegirine: XRPD structure, **GJ Redhammer et al** 2000 EJM 12 105-20 (R937);
SC-XRD structure, Mössbauer, **GJ Redhammer & 4 others** 2006 AM 91 1271-92.

Synthetic FeGeO₃, SC-XRD to 8 GPa: **T Hattori & 4 others** 2000 AM 85 1485-91;
transformations to 638 K, **T Hattori & 3 others** 2001 PCM 28 377-87 (2924).
Synthetic diopside-enstatite, compressibility, XRPD: **M Tribaudino & 3 others** 2000 PCM 27 656-64 (321).
Synthetic Ca_{0.5}Mg_{1.5}Si₂O₆, transition ~4 GPa: **M Tribaudino & 3 others** 2001 AM 86 807-13.
Synthetic analogs of Fe-cpx in meteoritic chondrules, TEM: **S Weinbruch & 2 others** 2001 MPS 36 1237-48.
Synthetic diopside-Ca-tschermakite, ²⁹Si MAS-NMR: **RL Flemming RW Luth** 2002 AM 87 25-36.
Synthetic Ca(Fe_{0.5}Zn_{0.5})Si₂O₆, SC-XRD structure: **M Heuer A Huber G Bromiley** 2002 ZK 217 465-6 (8686).
Synthetic Ca(Fe_{0.2}Zn_{0.8})Si₂O₆, SC-XRD structure: **M Heuer A Huber GJ Redhammer** 2002 ZK 217 467-8 (8687).
Synthetic diopside-leucite, 7 GPa, phase relations: **OG Safonov & 4 others** 2003 CMP 146 120-33 (9603).
Fe-free: exsolution/coarsening during isothermal annealing: **S Weinbruch V Styrsa WF Müller** GCA 67 5071-82.
Synthetic hedenbergite-peteddunnite, XRPD/Mossbauer: **AL Huber & 5 others** 2004 PCM 31 67-79 (10119).
Fe partitioning with basaltic melt vs O fugacity: **MC McCanta & 3 others** 2004 AM 89 1685-93.
Megacrysts from Enmelen melanephelinitic volcanoes, Russia: **VV Akinin & 3 others** 2005 CMP 150 85-101.
Size distribution exsolution lammella, En₄₅Di₅₅, 1373-1573 K 1 hr– 3 weeks: **S Weinbruch & 2 others** 2006 AM 91 553-9.

clinosaflorite (Co,Fe,Ni)As₂. Dimorphic with *safflorite*.

Löllingite structure subgroup of *marcasite* supergroup.

Appears to be merely a slight geometrical distortion of the orthorhombic compressed-*marcasite* structure type of *safflorite*.

Structure determination not found.

Occurrence: **D Radcliffe LG Berry** 1971 CM 10 877-81.

clinostrengite [= metastrengite & phosphosiderite] FePO₄.2aq.

Monoclinic dimorph of *strengite*: MM 29 978. *Clinovariscite* structure group.

Structure: **J Borensztajn** 1965 CRASP 261 376-8;

J Borensztajn 1966 BSFMC 89 428-38;

PB Moore 1966 AM 51 168-76.

clinotobermorite ~Ca₅Si₆(O,OH)₁₈.4-5aq. *Tobermorite* family.

Substructure, SC-XRD: **C Hoffman T Armbruster** 1997 ZK 212 854-73 (H1313).

Structural disorder: **C Henmi I Kusachi** 1992 MM 56 353-8.

Polytypes, 4 SC-XRD structures & order-disorder: **S Merlino E Bonaccorsi T Armbruster** 2000 EJM 12 411-29 (M1807).

Description: AM 78 672.

clinotyrolite Ca₂Cu₉[(As,S)O₄]₄(O,OH)₁₀.10aq.

Probably monoclinic polytype of orthorhombic *tyrolite*.

Structure determination not found.

Occurrence: MM 43 1059. **Check PDF 33-273 for reference.**

clino-ungemachite ?~K₃Na₉Fe(SO₄)₆(OH)₃.9aq.

Monoclinic relative of *ungemachite*.

Review: **Sabelli**, no structure.

Occurrence: MM 24 606; **Dana**.

CLINOVARISCITE STRUCTURE GROUP Includes:

clinostrengite FePO₄.2aq

clinovariscite AlPO₄.2aq

kolbeckite ScPO₄.2aq

Neglect of aqua ligands leaves tetrahedral net type 3 of Consortium for Theoretical Frameworks;
this net also occurs in *svyatoslavite* CaAl₂Si₂O₈.

Compare with *variscite* structure group based on net 5.

clinovariscite AlPO₄.2aq. *Clinovariscite* structure group.

Structure: **J Borensztajn** 1965 CRASP 261 376-8;

J Borensztajn 1966 BSFMC 89 428-38;

R Kniep D Mootz 1973 AC B29 2292-4.

Also known as *metavariscite*.

Occurrence: **JR Lehr & 4 others** 1966 *Crystallographic Properties of Fertilizer Compounds*, Tenn
Valley Auth Chem Eng Bull 6, 163p (L758).

clinozoisite Ca₂Al₃(SiO₄)₃(OH). *Epidote* structure type.

Structure: **WA Dollase** 1968 AM 53 1882-98 (D119).

Thermal expansion to 1173 K: **AR Pawley SAT Redfern TJB Holland** 1996 AM 81 335-40.

Compressibility to 5 GPa, SC-XRD in diamond cell: **P Comodi PF Zanazzi** 1997 AM 82 61-8.

OH vs P to 36 GPa, IR: **SE Bradbury Q Williams** 2003 AM 88 1460-70.

Calorimetry: **EA Smelik G Franz A Navrotsky** 2000 AM 86 80-91.

clintonite $\text{Ca}(\text{Mg},\text{Al})_3(\text{Al}_3\text{Si})\text{O}_{10}(\text{OH})_2$. *Mica* structure family.

Structure: (*xanthophyllite*) **Y Takéuchi R Sadanaga** 1959 AC 12 945-6;

Y Takéuchi R Sadanaga 1966 MJJ 4 424-37;

neutron, **W Joswig G Amthauer Y Takéuchi** 1986 AM 71 1194-7;

JA McKinney CI Mora SW Bailey 1988 AM 73 365-75 (M905);

Si/Al NMR & ionic repulsion, **J Sanz CP Herrero J Robert** 2003 JPCB 107 8337-42 (9225).

SC-XRD of six 1M specimens from skarns, **E Alietti F Brigatti L Poppi** 1997 AM 82 936-45.

Occurrence: Crestmore, CA, **C Forrester** 2004 MR 35 325-30.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

Cl-tyretekite $\text{Ca}_2\text{B}_5\text{O}_8\text{Cl}(\text{OH})_2$. Trimorphic with *hilgardite* & *parahilgardite*.

Structure determination not found.

Occurrence: AM 63 598.

Questionable: MM 42 523.

coalingite $\text{Mg}_{10}\text{Fe}_2(\text{CO}_3)(\text{OH})_{24.2\text{aq}}$.

Structure: **J Pastor-Rodriguez HFW Taylor** 1971 MM 38 286-94.

Occurrence: MM 35 1131.

General review: **HFW Taylor** 1973 MM 39 377-**nn** (T186).

cobaltarthurite $\text{CoFe}_2(\text{AsO}_4)_2(\text{OH})_2.4\text{aq}$. *Arthurite* structure group.

Structure: XRPD, **M Raudsepp E Pani** 2002 CM 40 733-7;

H atoms, **AR Kampf** 2005 CM 43 1387-91 = AM 91 714.

Occurrence: **JL Jambor & 3 others** 2002 CM 40 725-32.

cobaltaustinite $\text{CaCoAsO}_4(\text{OH})$. Analog of *austinite*. *Adelite* structure group.

Occurrence: **EH Nickel WD Birch** 1988 Austral Min 3 53-57 (N411) = AM 74 501.

COBALTITE STRUCTURE GROUP Includes:

cobaltite CoAs

gersdorffite NiAs

hollingworthite RuAs

irarsite IrAs

platarsite PtAs

tolovskite IrSb

ullmannite NiSb

willyamite CoSb.

Survey: **P Bayliss** 1982 AM 67 1048-57; **do** 1986 CM 24 27-33.

Synthetic PtGeSe: MA 74-1928.

Synthetic [Rh/Ir/Pd/Pt]AsS: **F Hulliger** 1963 N 198 382-3;

F Hulliger E Mooser 1965 JPCS 26 429-31.

[*Synthetic* $\text{Pb}_{0.7}(\text{Hg},\text{Co})_{0.4}\text{Sr}_{1.9}\text{O}_3\text{Co}_{1.8}\text{O}_{3.6}$, structure/XRPD/TEM: **D Pelloquin & 7 others**

2002 ChM 14 3100-5 (7720). A misfit cobaltite.]

cobaltite CoAsS.

Ordered & disordered: **RF Giese Jr PF Kerr** 1965 AM 50 1002-14;

ME Fleet PC Burns 1990 CM 28 719-23 (F529).

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

Synthetic substitutions: **P Bayliss** 1969 AM 54 426-30.

Unnamed dimorph with *marcasite* structure: AM 49 818 = DAN SSSR 153 1420-3.

cobaltkieserite $\text{CoSO}_4.\text{aq}$. *Kieserite* mineral group.

Occurrence & XRPD: **D Holtstam** 2002 GFF 124 117-9 (7976).

cobaltkoritnigite $(\text{Co},\text{Zn})\text{AsO}_3(\text{OH}).\text{aq}$.

Should be isostructural with Zn-rich analog *koritnigite*.

[New $\text{CoHAsO}_4.\text{aq}$ = *synthetic*: Pisa IMA Mtg 307-8;

F Zettler & 3 others 1979 ZaaC 454 134-44.]

cobaltneustädtelite $\sim\text{Bi}_2\text{Fe}(\text{Co},\text{Fe})(\text{OH})_2.5\text{O}_{1.5}(\text{AsO}_4)_2$.

Isostructural with *medenbachite* & *neustädteite*.

Occurrence & SC-XRD structure: **H Bernhardt & 2 others** 2001 Mitt Österreich Mineral Gesell 146 157-9;

W Krause & 3 others 2002 AM 87 726-38.

cobaltolotharmeyerite $\text{Ca}(\text{Co,Fe,Ni})_2(\text{AsO}_4)_2(\text{OH, aq})_2$. *Tsumcorite* group.

Occurrence & SC-XRD structure: **W Krause & 3 others** 1998 NJMM 505-17 (K1204).

cobaltocalcite CoCO_3 . *Calcite* structure type.

Synthetic CoCO_3 , structure: **F Pertlik** 1986 ACC 42 4-5 (P569).

Name replaces *sphaerocobaltite*: MM 29 979.

cobaltomenite $\text{CoSeO}_3 \cdot 2\text{aq}$. Isostructural *ahlfeldite/clinochalcomenite* & various *synthetics*.

Structure: **M Wildner** 1990 NJMM 353-62 (W633).

cobalt pentlandite $(\text{Co,Fe,Ni})_9\text{S}_8$. Isostructural with *pentlandite*.

Structure determination not found.

Occurrence: **O Kouvo M Huhma Y Vuorelainen** 1959 AM 44 897-900;

EF Stumpfl AM Clark 1965 AM 50 2107-8;

MA 96M/4574.

cobalttsumcorite $\text{Pb}(\text{Co,Fe})_2(\text{AsO}_4)_2 \cdot (\text{aq}/\text{OH})_2$. *Tsumcorite* group.

Occurrence & structure: **W Krause & 3 others** 2001 NJMM 558-76 (6132).

cobalt-zippeite $\text{Co}_2(\text{UO}_2)_6(\text{SO}_4)_3(\text{OH})_{10} \cdot 16\text{aq}$. Structure determination not found.

Occurrence: **C Frondel et al** 1976 CM 14 429-36.

coccinite HgI_2 .

Description & crystallography (XRPD matches *synthetic*): **T Witzke** 1997 NJMM 505-10 (W880).

cochromite $(\text{Co,Ni,Fe})(\text{Cr,Al})_2\text{O}_4$. *Spinel* structure type.

Structure determination not found.

Occurrence: **SA DeWaal** 1980 AM 65 811.

Co-rich spinel: MM 58 247-56.

$(\text{Co,Mg,Fe})(\text{Al,Cr})_2\text{O}_3$: AM 80 187.

[COCONINOITE MINERAL SUBGROUP Includes:

coconinoite $?\text{Fe}_2\text{Al}_2(\text{UO}_2)_2(\text{PO}_4)_4(\text{SO}_4)(\text{OH})_2 \cdot 20\text{aq}$

furongite $\text{Al}_2(\text{UO}_2)(\text{PO}_4)_2(\text{OH})_2 \cdot 8\text{aq}$

moreauite $\text{Al}_3(\text{UO}_2)(\text{PO}_4)_3(\text{OH})_2 \cdot 13\text{aq}$

xiangjiangite $(\text{Fe,Al})(\text{UO}_2)_4(\text{PO}_4)_2(\text{SO}_4)_2(\text{OH}) \cdot 22\text{aq}$

General mineral properties: **LN Belova et al** 1994 IMA Pisa 36-7.

Placed in *phosphuranylite* mineral group for convenience.]

coconinoite $?\text{Fe}_2\text{Al}_2(\text{UO}_2)_2(\text{PO}_4)_4(\text{SO}_4)(\text{OH})_2 \cdot 20\text{aq}$.

Phosphuranylite mineral group; beware of problems.

Structure determination not found.

Occurrence: **EJ Young AD Weeks R Meyrowitz** 1966 AM 651-63;

LN Belova et al DAN 329 772-5.

[coeruleolactite $(\text{Ca,Cu})\text{Al}_6(\text{PO}_4)_4(\text{OH})_8 \cdot 4-5\text{aq}$. *Turquoise* group.

Structure determination not found.

Occurrence: **Dana**; AM 43 1224.

Existence doubtful: **EE Foord JE Taggart Jr** 1998 MM 62 93-111.]

coesite SiO_2 . Consortium for Theoretical Frameworks tetrahedral net 598.

Structure: **T Zoltai MJ Buerger** 1959 ZK 111 129-41;

GV Gibbs CT Prewitt KJ Baldwin 1977 ZK 145 108-23 (G372);

L Levien CT Prewitt 1981 AM 66 324-33;

neutron at 15 & 287 K, **JR Smyth & 3 others** 1987 JPC 91 988-92;

electron density to 17 GPa, **GV Gibbs & 4 others** 2000 JPCB 104 10534-42 (354);

electron density, theory/experiment, **GV Gibbs & 5 others** 2003 JPCB 107 12996-3006.

Raman spectra at 105-875 K: **L Liu TP Mernagh WO Hibberson** 1997 PCM 24 396-402 (L835).

OH: solubility, FTIR of samples grown 1473 K 5-10 GPa, **JL Mosenfelder** 2000 PCM 27 610- (316);

incorporation > 5 GPa 1373 K, **M Koch-Mueller & 3 others** 200 PCM 28 693-705 (3827);

natural/*synthetic*, **do & 6 others** 2003 AM 88 1436-45;

vs kinetics of *quartz* transition, **C Lathe & 6 others** 2005 AM 90 36-43..

Anomalous compression/equation of state: **RJ Angel JL Mosenfelder CSJ Shaw** 2001 PEPI124 71-9 (2075).

Compression mechanisms, SC-XRD structure to 9 GPa: **RJ Angel CSJ Shaw GV Gibbs** PCM 30 167-76 (9127).

Occurrence: MM 30 731;

Himalaya, implications for India-Asia collision, **PJ O'Brien & 4 others** 2001 G 29 435-8 (1600);

Erzgebirge, eclogite, **H Massonne** 2001 EJM 13 565-70 (2072);

exsolution in titanite, Kazakhstan, **Y Ogasawa K Fukasawa S Maruyama** 2002 AM 87 454-61;

Antarctica, **B Ghiribelli M Frezzotti R Palmeri** 2002 EJM 14 355-60 (7129);

TEM of inclusions in Dora Maira pyrope quartzite, **F Langenhorst J Poirier** 2002 EPSL 203 793-803 (8024);

inclusions in garnet of eclogite, Ladakh, India, **HK Sachan & 6 others** 2004 EJM 16 235-40 (10108);

preservation, importance of fluid infiltration, **JL Mosenfelder & 3 others** 2005 AM 90 779-89.

coffinite $U(SiO_4)_{1-x}(OH)_4x$. Essentially *zircon* structure type.

Structure: **C Keller** 1963 Nucleonik 5 41-8;

VT Dubinchuk IS Naumova GA Sidorenko 1981 Mineral Zh 3 81-5 = MA 82M/2411.

REE-substituted: **PL Hansley JJ Fitzpatrick** 1989 AM 74 263-70.

Occurrence: **LR Stüff TW Stern AM Sherwood** 1956 AM 41 675-88.

Phosphatian: **J Janeczek** 1996 MM 60 665-9.

Synthetic $USiO_4$: **LH Fuchs E Gebert** 1958 AM 43 243-8;

LH Fuchs HR Hoekstra 1959 AM 44 1057-63.

cohenite = cementite (metallurgical name) $(Fe,Ni,Co)_3C$.

Related carbides, borides & silicides: **B Aronsson S Rundqvist** 1962 AC 15 878-87 (A664).

Structure: cementite, **H Lipson NJ Petch** 1940 J Iron Steel Institute 142 95-106 = MA 8-138;

WH Hume-Rothery GV Raynor AT Little 1942 J Iron Steel Institute 145 143-9 = MA 9-41;

AI Gardin 1963 SPD 7 872-4 = MA 16-246;

neutron, **BG Lyashchenko LM Sorokin** 1963 (L592);

EJ Fasiska GA Jeffery 1965 AC 19 463-71 (F470).

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

colemanite $CaB_3O_4(OH)_3.aq$. 3-ring, triangle & 2 tetrahedra, chain type.

Similar to anhydrous *jarandolite* $CaB_3O_4(OH)_3.aq$.

Structure: **CL Christ JR Clark HT Evans Jr** 1958 AC 11 761-70;

JR Clark DE Appleman CL Christ 1964 J Inorg Nucl Chem 26 73-95;

PC Burns FC Hawthorne 1993 CM 31 297-304 (B1608);

boron K-edge XANES, **ME Fleet S Muthupari** 2000 AM 85 1009-21.

collinsite $Ca_2(Mg,Fe,Ni)(PO_4)_2.2aq$. *Fairfieldite* structure type.

Structure: **PD Brotherton & 3 others** 1974 Australian J Chem 27 653-6 = MA 75-1944.

Occurrence: MM 21 561-2;

Kovdor Complex, Sr substitution, IR, **RP Liferovich** 2001 CM 39 1081-94.

Natural $(Ca,Sr)_2Mg(PO_4)_2.2aq$, 21 wt % SrO: XRPD structure, **OV Yakubovich & 4 others** 2003 CrR 48 226-32 (8932).

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

coloradoite HgTe. *Sphalerite* structure type.

Structure: **de Jong** 1926 ZK 63 466-*nnn*.

Occurrence, Romania: MA 95M/3315.

COLUMBITE STRUCTURE FAMILY Includes:

<i>bismutocolumbite</i>	$Bi(Nb,Ta)O_4$
	jvs: placed here because of name but structural evidence not seen.]
<i>euxenite</i>	$(Y,Ca,Ce,U,Th)(Nb,Ta,Ti)_2O_6$
<i>ferrocolumbite</i>	$(Fe,Mn)(Nb,Ta)_2O_6$
<i>ferrotantalite</i>	$(Fe,Mn)(Ta,Nb)_2O_6$
<i>fersmite</i>	$(Ca,Ce,Na)(Nb,Ti,Fe,Al)_2O_6$
<i>magnesiocolumbite</i>	$(Mg,Fe,Mn)(Nb,Ta)_2O_6$
<i>magnesiotantalite</i>	$(Mg,Fe)(Ta,Nb)_2O_6$
<i>manganocolumbite</i>	$(Mn,Fe)(Nb,Ta)_2O_6$
<i>polycrase</i>	$(Y,Ca,Ce,U,Th)(Ti,Nb,Ta)_2O_6$
<i>uranopolycrase</i>	$(U,Y)(Ti,Nb)_2O_6$

[*ytthrocrasite* (Y,Th,Ca,U)(Ti,Fe)₂(O,OH)₆]

Columbite is general name for three of the above minerals.

Based on alpha-PbO₂ structure type represented by *scrutinyite*.

Structure: **M Wenger Th Armbruster CA Geiger** 1991 AM 76 1897-90.

Synthetic FeNb₂O₆: **K Edström JO Thomas GC Farrington** 1991 AC B47 210-6 (E345);

JH Sturdivant 1930 ZK 75 88-108.

Synthetic MgNb₂O₆, neutron PD: **S Pagola & 3 others** 1997 JSSC 134 76-84 (P759)

[*Synthetic* ZrTiO₄, similar structure to ferrocolumbite, XRD/XAS: **J Xu & 3 others** 2000 ChM12 3347-55 (365).]

Structural relations, α-PbO₂/wolframite/columbite FeNb₂O₆: **F Laves G Bayer A Panages** 1963 SMPM 43 217-34.

Magnetic structure FeNb₂O₆: **H Weitzel** 1971 ZaaC 380 119-27.

(Fe/Ni/Co/Mn)Nb₂O₆, MnTa₂O₆, NPD: **H Weitzel** 1976 ZK 144 238-58 (W716).

Synthetic (Fe/Fe_{0.5}Mn_{0.5}/Mn)Nb₂O₆ & (Mn/Mn_{0.65}Fe_{0.35})Ta₂O₆, **MA Wise & 2 others** 1985 NJMM 372-8 (W708).

Fe/Mn(Nb,Ta), SC-XRD struct 573/873 K, thermal expansion 298-1173: **SC Tarantino & 3 others** 2003 PCM 30 590-8.

Synthetic (Fe,Mn)Nb₂O₆: XRPD structure, EPR & magnetics, **C Tealdi & 5 others** 2004 PCCP 10 1039-43 (10702).

Manganocolumbite-ferrocolumbite solid solution: mixing & ordering, SC-XRD, **SC Tarantino M Zena** 2005 AM 90 1301-7.

colusite Cu₁₃V(As,Sn,Sb)₃S₁₆. *Germanite* structure group.

See *arsenosulvanite*.

See *stibiocolusite* & *germanocolusite* that have lower symmetry than *colusite*.

Isostructural with cubic Sn analog *nekrasovite*.

Structure: **J Murdoch** 1953 AM 38 794-801;

PN Dangel BJ Wuensch 1970 AM 55 1787-91;

PG Spry & 4 others 1994 AM 79 750-62 (1411);

SC-XRD, **OV Frank-Kamenetskaya & 2 others** 2002 J Struct Chem 43 89-100 (7694).

Occurrence: MM 23 627-8;

Ge-bearing, Waterloo, Australia: **T Wagner T Monecke** 2005 CM 43 655-69.

comancheite Hg₁₃(Cl,Br)₈O₉.

Structure determination not found.

Occurrence: **AC Roberts HG Ansell PJ Dunn** 1981 CM 19 393-6 (R524).

combeite Na₂Ca₂Si₃O₉. *Lovozerite* structure group.

Structure: **RX Fischer E Tillmans** 1983 NJMM 49-59 (F392);

synthetic, **H Ohsato Y Takéuchi I Maki** 1986 AC C42 934-7;

high/low transition, **RX Fischer E Tillmans** 1987 AC C43 1852-4;

H Ohsato I Maki Y Takéuchi 1985 AC C41 1575-7;

synthetic, **H Ohsato Y Takéuchi I Maki** 1990 AC B46 125-31.

Occurrence: MM 31 956.

System Na₂SiO₃-CaSiO₃: **GK Moir FP Glasser** 1974 Phys Chem Glasses 15 6-11 (M1173).

System Na₂SiO₃-CaSiO₃-SiO₂: **GW Morey NL Bowen** 1926 J Soc Glass Tech 9 226-64 (M1174).

comblainite ~($\text{Ni}^{2+}_x\text{Co}^{3+}_{1-x}$)(OH)₂(CO₃)_{0.5-x/2.y} aq. *Hydrotalcite/pyroaurite* group.

Structure determination not found.

Occurrence: **P Piret M Deliens** 1980 BM 103 113-7.

compreignacite K₂(UO₂)₆O₄(OH)_{6.8}aq. *Becquerelite* structure group.

Structure: partly correct, **MM Granger J Protas** 1965 BSFMC 88 211-3 (G713);

P Burns 1998 CM 36 1061-7.

Synthetic Cs-analog: but not isostructural, SC-XRD: **FC Hill PC Burns** 1999 CM 37 1283-8.

Cs-exchanged, topologically isostructural, **PWO Hoskin PC Burns** 2003 MM 67 689-96.

Occurrence: MM 35 1131.

congolite (Fe,Mg,Mn)₃B₇O₁₃Cl. *Boracite* structure group.

Rhombohedral dimorph of *ericaite*.

Natural "*trigonal ericaite*" appears to be congolite (jvs): **E Dowty JR Clark** 1972 Solid State Comm 10 543-8 (D188).

Occurrence: MM 38 990.

Synthetic Fe₃B₇O₁₃Cl: **M-E Mendoza-Alvarez & 3 others** 1985 AC C41 1551-2.

Phase transition in *boracite-trembathite*-congolite: **PC Burns MA Carpenter** 1996 CM 34 881-92.

CONICALCITE/DESCLOIZITE STRUCTURE GROUP

Includes the *adelite* & *descloizite* mineral groups.

conichalcite $\text{CaCuAsO}_4\text{OH}$. *Conichalcite/descloizite* structure group. *Adelite* mineral group. Review (E289).

Structure: **MM Qurashi WH Barnes** 1963 CM 7 561-77 (Q6)

SEM/FTIR/Raman/electronic reflection: **BJ Reddy RL Frost WN Martens** 2005 MM 69 155-68.

connellite $\sim\text{Cu}_{19}\text{Cl}_4(\text{SO}_4)(\text{OH})_{32}\cdot 3\text{aq}$ Isostructural with *buttgenbachite*.

Edge-vertex-connected octahedral framework. Review: **Sabelli** p. 35.

Structure: **WJ McLean JW Anthony** 1972 AM 57 426-38.

Synthetic $\text{Cu}_{37}\text{Cl}_8(\text{SO}_4)_2(\text{OH})_{62}\cdot 8\text{aq}$: MM 54 425-30.

Compare with *buttgenbachite*, *cacoxenite*, *kambaldaite* & *szymanskiite*.

cookeite $\text{LiAl}_4(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_8$. *Chlorite* structural group.

Structure: **ZV Vrublevskaia & 3 others** 1960 AM 60 1041-6;

2-layer 'r'-laa, **H Zheng SW Bailey** 1997 AM 82 1007-13.

Polymorphs from pegmatites & metamorphics, SAED/HRTEM: **M Jullien A Baronnet B Goffé** 1996 AM 81 67-78.

Metamorphic, metapelites Morocco/Spain, electron/ ion microprobes/TEM: **B Goffé & 3 others** 1996 EJM 8 335-48.

Lunijianlaite, regular alternation with *pyrophyllite*: **Y Kong X Peng D Tian** 1990 Acta Mineralogica Sinica 10 289-98.

Polytypism, low-grade metapelites, Spain: **MP Mata & 2 others** 2004 AM 89 1510-5.

coombsite $\text{KMn}_{13}(\text{Si,Al})_{18}\text{O}_{42}(\text{OH})_{14}$. Mn analog of *zussmanite*.

Occurrence: **T Sameshima Y Kawachi** 1991 New Zealand J Geol Geophys 34 329 = AM 77 671.

COOPERITE MINERAL GROUP Includes:

braggite (Pt,Pd,Ni)S

cooperite PtS

vysotskite (Pd,Ni)S

[Braggite & cooperite are dimorphic with superstructure relationship.]

cooperite (Pt,Pd)S. Dimorphic with *braggite*. Cooperite mineral group.

Structure: **R Gramlich-Meier WM Meier** 1982 JSSC 44 41-9.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

Occurrence: MM 22 618.

coparsite $\text{Cu}_4\text{O}_2[(\text{As,V})\text{O}_4]\text{Cl}$.

Incomplete description & SC-XRD structure: **GL Starova & 2 others** 1998 ZK 213 650-53 = AM 84 1685.

Description: **LP Vergasova & 4 others** 1999 CM 37 911-4.

COIAPITE STRUCTURE GROUP Includes:

aluminocopiapite $\text{AlFe}^{3+}_4(\text{SO}_4)_6\text{O}(\text{OH})\cdot 20\text{aq}$

calcicocopiapite $\text{CaFe}^{3+}_4(\text{SO}_4)_6(\text{OH})_2\cdot 19\text{aq}$

copiapite $(\text{Fe,Mg})\text{Fe}^{3+}_4(\text{SO}_4)_6(\text{OH})_2\cdot 20\text{aq}$

cuprocopiapite $\text{CuFe}^{3+}_4(\text{SO}_4)_6(\text{OH})_2\cdot 20\text{aq}$

ferricocopiapite $\text{Fe}^{3+}\text{Fe}^{3+}_4(\text{SO}_4)_6\text{O}(\text{OH})\cdot 20\text{aq}$

magnesiocopiapite $\text{Mg}^{3+}_4(\text{SO}_4)_6(\text{OH})_2\cdot 20\text{aq}$

zincocopiapite $\text{ZnFe}^{3+}_4(\text{SO}_4)_6(\text{OH})_2\cdot 18\text{aq}$

[jvs: I am sceptical of trivalent Mg.]

Cell dimensions of Mg/Al/Ni-: **D Atencio FMS Carvalho** 1994 IMA Pisa p. 21.

copiapite $(\text{Fe,Mg})\text{Fe}^{3+}_4(\text{SO}_4)_6(\text{OH})_2\cdot 20\text{aq}$. *Copiapite* group.

Review: **Sabelli** p. 20.

Description: **P Süsse** 1970 NJMM 268-77;

magnesian, **P Süsse** 1972 ZK 135 34-55;

ferrian, **L Fanfani & 3 others** 1973 AM 58 314-22;

EL Zodrow 1980 AM 65 961-7;

P Bayliss D Atencio 1985 CM 23 53-6.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

COPPER STRUCTURE GROUP Includes:

aluminum Al

copper Cu

[cuproauride] Cu_3Au_2 jvs: ?]

<i>electrum</i>	(Ag,Au)
<i>gold</i>	Au
<i>iridium</i>	Ir
<i>iron-gamma</i>	Fe
<i>lead</i>	Pb
<i>nickel</i>	Ni
<i>palladium</i>	Pd
<i>platinum</i>	Pt
<i>rhodium</i>	(Rh,Pt)
<i>silver</i>	Ag
<i>[yixunite]</i>	(Pt,In) Might merely be indian platinum solid solution.]
<i>zhanghengite</i>	CuZn. Matches synthetic alloy.

Cubic closest packing of spheres = face-centered cubic.

Native metals & alloys in kimberlite pipe aureoles, Arkhangelsk: Au, Fe, Ni, W, Fe-Cr, Fe-Ni, Fe-Ni-Cu, Fe-Ni-Cr, Ni-Cr-Fe-W-Mo, Fe-Mn-Si, Cu-Ni, Cu-Ni-Sn(Fe), Cu-Sn, Cu-Zn, Cu-Zn-Sn, Cu-Zn-Ni, Cu-Al, Cu, Sn, Zn, Pb, Pb-Sb, Pb-Cu-Zn, **AB Makeev & 4 others** 2002 DES 365A 714-7 (8021).

Microparticles of (Cu,Au,Ag)₄Zn/Ag/Au/AuS/CdS/MoS₂/Pb/Re/RhI₃/Sb/Sn from Mare

Fecundidatis: **OA Bogatkov & 6 others** 2004 DES 395A 448-52 (10400).

[*zincopperite* Cu₇Zn₄. jvs?, MA 03M/3142.]

copper Cu. Copper structure group.

Atomic displacements: **CJ Martin DA O'Connor** 1978 AC A34 500-5.

Charge density: **JR Schneider NK Hansen H Kretschmer** 1981 AC A37 711-22.

Brass-alpha is Cu_{1.0-0.9}Zn_{0-0.1}.

Alloying of Sn on 111, formation kinetics of islands, LEED & AFM: **AK Schmid NC Bartelt RQ Hwang** 2000 S 290 1561-4 (370).

X-ray reflectivity of 110 surface: **G Helgesen & 4 others** 1993 PRB 48 15320-3.

XRF microscopy of intracell topography: 2005 PNAS 102 1179-84.

Inclusions in *illite*, TEM: **JH Ahn H Xu PR Buseck** 1997 CICIM 45 295-7 (1407).

Inclusions in *olivine* phenocrysts of picrite lava: **Z Zhang & 3 others** 2006 AM 91 1178-83.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

coquandite Sb₆O₈(SO₄).aq.

Partial crystal structure: **C Sabelli P Orlandi G Vezzalini** 1992 MM 56 599-603.

coquimbite Fe₂(SO₄)₃.9aq.

Structure: **JH Fang PD Robinson** 1970 AM 55 1534-50 (F359);

synthetic, **G Giester R Miletich** 1994 IMA Pisa p. 145.

Occurrence in meteorites: **AE Rubin** 1997 MPS 32 733-4.

Synthetic Se analog: structure, thermal decomposition, **G Giester R Miletich** 1995 NJMM 211-23.

corderoite Hg₃S₂Cl₂-gamma. Dimorphic with *lavrentievite*.

Structure: **H Puff J Küster** 1962 Nw 49 299;

KL Aurivillius 1967 Arkiv Kemi 26 497-505;

synthetic, **AJ Frueh** 1968 AC B24 156-7;

synthetic, **S Durovic** 1968 AC B24 1661-70.

MM 40 906.

[Hg₃S₂Cl₂. IMA 96-026. Orthorhombic polymorph of *corderoite*.]

cordierite (Mg,Fe)₂Al₄Si₅O₁₈.

Isotypic with *beryl* except for ordering. Ordered orthorhombic polymorph.

Indialite is hexagonal disordered polymorph. Fe-rich analog is *sekaninaite*.

Industrial use in ceramics and catalyst supports.

Structure: Ar & water positions, **JV Smith W Schreyer** 1962 MM 33 226-36;

proton NMR, **X Paré P Ducros** 1964 BSFMC 87 429-33;

GV Gibbs 1966 AM 51 1068-87 (G103);

hydrous low-, **JP Cohen FK Ross GV Gibbs** 1977 AM 62 667-78;

optical/IR/Mössbauer/XRD, **DS Goldman GR Rossman WA Dollase** 1977 AM 62 1144-57;

orientation of channel water & CO₂, **T Armbruster FD Bloss** 1982 AM 67 284-91;
proton NMR, **DG Carson GR Rossman RW Vaughan** 1982 PCM 8 14-9;
Ar, N₂ & CO₂, **T Armbruster** 1985b PCM 12 233-45;
Fe-rich low- from volcanic rocks, **T Armbruster** 1985c CMP 91 180-7;
²⁹Si MAS NMR *synthetics* & ordering models, **A Putnis CA Fyfe GC Gobbi** 1985 PCM 12 211-6;
A Putnis RJ Angel 1985 PCM 12 217-22;
Li,Na,Be- at 100-550K, **T Armbruster** 1986 ZK 174 205-17 (A319);
MF Hochella Jr GE Brown Jr 1986 JACeS 69 13-8 (H689);
Landau theory of ordering, **E Salje** 1987 PCM 14 455-60;
Al,Si ordering from XRD & NMR, **A Putnis & 4 others** 1987 PCM 14 446-54;
IR of *synthetic* CO₂-Mg-, **N LeBreton** 1989 CMP 103 387-96;
P Daniels 1990 ZK 190 271-6;
Raman, **WCK Poon A Putnis E Salje** 1990 J Phys Condens Matter 2 6361-72;
TEM of modulations in Eifel volcanic, **WF Müller W Schreyer** 1991 EJM 3 915-31;
P Daniels 1992 AM 77 407-11;
P Daniels H Gies 1992 PCM 18 383-8;
quasi-elastic neutron scattering, **B Winkler G Coddens B Hennion** 1994 AM 79 801-8;
Al,Si distribution from NMR, **MT Dove V Heine** 1996 AM 81 39-44;
Bragg-Williams model for ordering T, **MT Dove & 3 others** 1996 AM 81 349-62;
inelastic neutron scattering/dynamics molecular water: **B Winkler B Hennion** 1994 PCM 21 539-45;
crystal field transitions, neutron inelastic scattering, **B Winkler & 4 others** 1997 PCM 25 79-82 (1326);
aliphatic hydrocarbons, polarized IR, **VM Khomenko K Langer** 1999 AM 84 1181-5;
Fe coord., **CA Geiger T Armbruster V Khomenko S Quartieri** 2000 AM 85 1255-64;
role of carbon dioxide and water, **BA Kolesov CA Geiger** 2000 AM 85 1265-74;
FeMg-series, natural/heated, SC-XRD/Mössbauer, **T Malcherek & 5 others** 2000 AM 86 66-79;
Fe(III), EPR, IR, XRD, TEM, **CA Geiger H Rager M Czank** 2000 CMP 140 344-52;
optical spectra, **MN Taran GR Rossman** 2001 AM 86 973-80;
Fe sites, **VM Khomenko K Langer CA Geiger** 2001 CMP 141 381-96 (2922);
IR/electronic absorption vs Mg/Fe, energetics: **CA Geiger M Grams** 2003 CMP 145 752-64 (9570).
Thermal expansion: **ME Milberg HD Blair** 1977 JACeS 60 372-3;
JL Schlenker & 4 others 1977 PCM 1 243-55.
High-T: crystal chemistry, **MF Hochella Jr & 3 others** 1979 AM 64 337-51;
JH Wallace H-R Wenk 1980 AM 65 96-111 (W413);
behavior of water & CO₂, **RD Aines GR Rossman** 1984 AM 69 319-27;
"early partial melting", **GC Capitani & 3 others** 2002 EJM 14 879-90 (8333).
High-P: phase transition, **PW Mirwald** 1982 AM 67 277-83;
J Koepke H Schulz 1986 PCM 1986 PCM 13 165-73.
Thermodynamic model: **RG Berman LYa Aranovich** 1996 CMP 126 1-24 (B1572).
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
Natural Na,Be-substituted: **W Schreyer CE Gordillo G Werding** 1979 CMP 70 421-8.
Natural CO₂-: **P Povondra J Stankova J Stanek** 1993 Acta Univ Carolinae Geol 331-49.
Water distribution with granite: **SL Harvey DP Carrington** 2001 JP 42 1595-620 (3041).
Experimental partitioning Be/Cs/Li/B/F/P vs felsic melt: **JM Evensen D London** 2003 CMP 144 739-57.
Synthetic K-bearing high-: **YH Kim & 3 others** 1984 MRB 19 209-17;
XRPD & IR, **SAT Redfern & 3 others** 1989 AM 74 1293-9;
symmetry, **P Daniels** 1990 ZK 190 271-6;
symmetry, **P Daniels** 1992 AM 77 407-11;
MAS-NMR ²⁹Si, **P Daniels H Gies** 1992 PCM 18 383-8;
electron-optical & XRPD *synthetic* & natural K-bearing, **P Daniels & 3 others** 1992 CMP 111 484-92.
EMPA reference sample: **C Bertoldi & 9 others** 2006 AM 91 187.
Synthetic Mg-: anhydrous, **PW Mirwald** 1981 PCM 7 268-70;
optics, **T Armbruster FD Bloss** 1981 CMP 77 332-6;
pseudo-hexagonal, **T Armbruster** 1985a NJMM 6 255-67 (A630);
Raman, Al-Si order, **P MacMillan A Putnis MA Carpenter** 1984 PCM 10 256-60;
undoped & K-doped, hexagonal-orthorhombic transition vs. ordering induced by thermal

annealing, **P Daniels & 3 others** 1994 EJM 6 323-35;
 with alkanes, high T & P, IR: **TA Bulbuk GY Shvedenkov GG Lepezin** 2002 PCM 29 140-54 (7294).
Synthetic K-: breakdown to *phlogopite* & *Mg-cordierite*: **AV Ganesh & 3 others** 2004 CuS 87 104-8 (10536).
Synthetic Mn-: MM 28 733.
Synthetic high cordierite & Mn, Ga, Ge solid solutions: **H Ikawa & 5 others** 1986 69 492-8.
Synthesis of Fe, Mn, Co, Na, Be, K, Cs, aq, CO₂-cordierites: **W Schreyer** 1985 BM 108 273-91.
Synthetic Mg₂Al₂BeSi₆O₁₈: **A Hölscher W Schreyer** 1989 EJM 1 21-37(H745).
Synthetic Fe-bearing, IR of water: **C Boberski W Schreyer** 1990 EJM 2 565-84.
Synthetic K/Cs-substituted, NPD: **P Thomas & 3 others** 1991 Eur J Solid State Inorg Chem 28 1011-20.
Synthetic zeolite conversion with ZnO enhancement, EXAFS/XRD: **G Sankar & 8 others** 1993 JPC 97 9550-4 (S1385).
Synthetic Cu-doped: **P Thomas I Gonby D Mercurio T Merle D Frit** 1995 MRB 30 141-8.
Synthetic Co-/Mn-, structure, lattice dynamics/magnetism: **K Knorr M Meschke B Winkler** 1999 PCM 26 521-9 (K1170).
Synthetic Mg & Fe, heat capacity: **CA Geiger H Voigtlander** 2000 CMP 138 46-50 (G1183).
Synthetic -anorthite, crystallization/sintering, ceramic: **MR Boudcicha & 3 others** 2001 JMSL 20 215-7 (1728).
Synthetic NaCaBe-: SC-XRD structure, **OV Yakubovich & 4 others** 2004 CrR 49 955-63 (10957)

cordylite-Ce (Na_{1-x}Ca_{x/2})Ba(Ce,etc)₂(CO₃)₄F. *Parasite* structure group.
 New composition & structure: **G Giester & 6 others** 1998 AM 83 178-84.
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
 In Khibina carbonatite: **AN Zaitsev et al** 1998 MM 62 225-50
baiyuneboite-(Ce) is cordylite-Ce: AM 75 240-6;
 structure, **P Fu Y Gong M Shao J Qian** 1987 Acta Mineral Sinica 7 298-304.
 History: **J Zemmann** 2002 NJMM 255-64 (7551).

corkite PbFe₃(SO₄)(PO₄)(OH). *Beudantite* structure group. **Sabelli**, p. 25.
 Structure: **G Giuseppetti C Tadini** 1987 NJMM 19 71-81 (G798).
cornetite Cu₃(PO₄)(OH)₃. Framework type. Review: (E289).
 Structure: **RK Eby FC Hawthorne** 1989 MP 40 127-36.
 IR & Raman: **W Martens RL Frost** 2003 AM 88 37-46.
 Occurrence: MM 31 956-7.

cornubite Cu₅(AsO₄)₂(OH)₄. Dimorph of *cornwallite*. Review (E289).
 Structure: **N Sieber & 3 others** 1984 FM 62-1 231-3;
E Tillmanns W Hofmeister K Petitjean 1985 Bull Geol Soc Finland 57 119-27.
 IR & Raman: OH vibration & dehydration, **WN Martens & 3 others** 2003 AM 88 501-8.
 Occurrence with *cornwallite*, Bulgaria: **J Minceva-Stefanova** 1993 C R Acad Bulg Sci 46 65-8 = MA 95M/4714.

cornwallite Cu₅(AsO₄)₂(OH)₄. Dimorph of *cornubite*. Isostructural with *pseudomalachite*.
 Structure: SC-XRD, **T Arlt T Armbruster** 1999 NJMM 468-80 (A816).
 IR & Raman: OH vibration & dehydration, **WN Martens & 3 others** 2003 AM 88 501-8.
 Occurrence: **LG Berry** 1951 AM 36 484-503.

coronadite PbMn₈O₁₆.0-1.5aq.
Cryptomelane structure group; *manganomelane* mineral group: see *hollandite*.
 Structure: **JE Post DL Bish** 1989 AM 74 913-7;
 XRPD, I2/m, **JE Post** 1994 IMA Pisa 334.

corrensite *Chlorite-vermiculite/smectite* intergrowth.
 Distinct thermodynamic phase from EMPA/XRD/SEM/HRTEM/AEM: **D Beaufort & 3 others** 1997 AM 82 109-24.
 Occurrence: AM 40 137;
 Wyoming, **PC Ryan S Hillier** 2002 AM 87 1607-15
 Chromium(VI), reduction/sorption by Fe(II)- *chlorite/corrensite/montmorillonite* for waste-water
 clean-up: **MF Brigatti & 7 others** 2000 CICIM 48 272-81 (B2013).

corundum Al₂O₃-alpha. *Hematite* structure type.
Corundum-hematite solid solution, thermodynamics & crystal chemistry, & FeAlO₃ phase : **J
 Majzlan A Navrotsky BJ Evans** 2002 PCM 29 515-26 (8208).
 [Nanocrystalline -gamma is typical *synthetic* product at low T.]
 [Polymorphic with synthetic phases: cubic, *gamma*, *delta*, *nu*, *sigma*, *theta*; hexagonal, *chi*.
 Delta is a modulated sigma: **SV Tsybulya GN Kryukova** 2003 PD 18 309-11 (9677).]
 Cation motifs in corundum, *spinel* & *amesite* homologous classes: **NI Smirnova** 2003 CrR 48 171-9 (8935).
 Structure: **L Pauling SB Hendricks** 1925 JACS 47 781-90;

RE Newnham YM DeHaan 1962 ZK 117 235-7 (N19);
J Lewis D Schwarzenbach HD Flack 1982 AC A38 733-9;
P Thompson DE Cox JB Hastings 1987 JAC 20 79-85;
A Kirfel K Eichhorn 1990 AC A46 271-84 (K863);
EN Maslen & 4 others 1993 AC B49 973-80 (M1531).
 General crystal-chemical theory: **DM Griaquinta H Czurloye** 1994 ChM 6 365-72 (G672).
 Surface energies of alpha- & gamma-: **JM McHale & 3 others** 1997 S 277 788-91 (1326).
 Thermal expansion, 300-3000 K: **G Fiquet P Richet G Montagnac** 1999 PCM 27 103-11(F683).
 Quantum-mechanics predicting transformation at 78 GPa to Rh₂O₃ type & 223 GPa to Pbnm-
perovskite: **KT Thomson RM Wentcovitch MST Bukowinski** 1996 S 274 1880-2.
 Shock transition at 79 GPa: **T Mashimo & 5 others** 2000 GRL 27 2021-4 (M1821).
 Al XANES of natural & *synthetics*: **A Mottana & 5 others** 1998 JAC 31 890-8 (M1695).
 Surface properties & catalysis
 CoMoS/gamma alumina catalyst, Mo EXAFS: **M Boudart et al** 1985 S 228 717-9 (B1184).
 Surface relaxation, theory: **I Manassidis A De Vita MJ Gillan** 1993 Surf Sci Lett 285 L517-21 (M1060).
 Hydroxyl, EELS: **V Constet J Jupille** 1994 SuS 307-9 1161-5 (C698).
 Co-oxide, polarized total-reflection fluorescence EXAFS: **M Shirai & 4 others** 1994 JCa 145 159-65.
 Outer-sphere Pb(II) adsorption, grazing-angle XAFS: **JR Bargar & 3 others** 1996 GCA 60 3541-7 (B1658).
 Water vapor, XPS: **P Liu & 4 others** 1998 SuS 417 53-65 (L998).
 Sorption of Co, grazing-incidence XAFS: **CSN Towle & 3 others** 1999 JCIS 217 312-21(250).
 Hydrated 0001 surface, truncation rod diffraction: **PJ Eng & 6 others** 2000 S 288 1029-33.
 Depletion/regeneration of dissolution sites at water interface: **SD Samson & 2 others** 2000 GCA 64 3471-84 (S2219).
 Arsenite/arsenate sorption on gamma, XAS: **Y Arai EJ Elzinga DL Sparks** 2001 JCIS 235 80-8.
 Water interface, zero charge, AFM/Second Harmonic Generation: **AG Stack & 2 others** 2001 GCA 65 3055-63 (3012).
 Dynamic SFM of high-T phase: **C Barth M Reichling** 2001 N 414 54-7 (3466).
 Grazing-incidence XAFS, aqueous Zn(II) sorption: **TP Trainor & 4 others** 2001 JCIS 244 239-44 (5441).
 Crystal truncation rod diffraction: **TP Trainor & 4 others** 2002 SuS 496 238-50 (4349).
 Grazing-incidence XRD of ruby (0001): **I Vilfan & 3 others** 2002 SuS 505 L215-21 (7267).
 Co on hydroxylated (0001): **SA Chambers & 3 others** 2002 S 297 827-31 (7730).
Ruby & sapphire are gem varieties of corundum carrying Cr(III), Fe(III) etc:
 H-P structure to 4.6 GPa, **LW Finger RM Hazen** 1978 JAP 49 5823-6 (F214);
 ruby, SC-XRD, **VG Tsirelson & 4 others** 1985 Physics stat solidii A87 425-33;
 XRPD, Al position, **B Estifanos & 4 others** 1997 Norsk Geol Tidsskrift 77 119-22 (E401);
 compression moduli to 8 GPa, **K Langer MN Taran AN Platonov** 1997 PCM 24 109-14;
 texture & element partition in trapische, **I Sunagawa H Bernhardt K Schmetzer** 1999
 JCG 206 322-30 (S2103);
 Al XANES of sapphire, **JM Chen & 3 others** 1993 PRB 48 10047-51;
 ruby inclusion in *clinopyroxene*, Thailand, **C Sutthirat & 4 others** 2001 MM 65 277-95;
 "trapische" ruby, Burma, trace elements/cathodoluminesce, **V Garnier & 4 others** 2002 MP 76 179-93 (8627);
 structural/electronic relaxation at Cr & Fe, XR linear dichroism: **E Gaudry & 5 others** 2003 PRB 094108 (8939);
 flux *synthesis* of ruby bipyramids, **S Oshi & 2 others** 2004 JChS 126 4768-9 (10225);
 Cm(III) adsorption on sapphire, **Th Rabung & 4 others** 2004 JPCB 108 17160-5 (10853)
 Ruby-marble, N Vietnam, **V Garnier & 6 others** 2005 CM 43 1315-39..
 Inclusions in corundum macrocrysts from basalts: **J Guo SY O'Reilly WL Griffin** 1996 CMP 122 368-86 (G833).
 Grain boundary strengthening by REE: **JP Buban & 6 others** 2006 S 311 212-5.
 In meteorites: **AE Ruben** 1997 MPS 32 231-47;
 carbonaceous chondrites: **A Greshake & 3 others** 1996 S 272 1316-8 (G853).
 Polymorphism, presolar Al₂O₃ grains from giant branch stars: **RM Stroud & 2 others** 2004 S 305 1455-7 (10599).
Synthetic high-P rare-earth varieties: **CT Prewitt & 3 others** 1969 IC 8 1985-93 (P652).
Synthetic Sn/Ti-doped: **FJ Berry & 4 others** 1997 JSSC 130 272-6 (B1647).
corvusite V⁴⁺V⁵⁺₆O₁₇.n aq. Vanadium bronze structure group; *straczekite* subtype.
 Structure: review, **HT Evans Jr JM Hughes** 1990 AM 75 508-21;
HT Evans Jr JE Post DR Ross JA Nelen 1994 CM 32 339-51.
 Occurrence: MM 23 628.
cosalite Pb₂Bi₂S₅.
 Structure: **G Weitz E Hellner** 1960 ZK 113 385-402;
T Srikrishnan W Nowacki 1974 ZK 140 114-36 (S465);

anomalous scattering, **R Wulf** 1995 MP 52 187-96 (W674);
 review, **A Skowron ID Brown** 1994 AC B50 524-38 (S1374);
 HRTEM, structural & chemical modulations, **A Pring B Etschmann** 2002 MM 66 451-8.
 Isostructural $\text{Pb}_2\text{Sb}_2\text{Se}_5$, **A Skowron ID Brown** 1990 ACC46 2287-91 (S1468).

coskrenite-Ce $(\text{Ce,Nd,La})_2(\text{SO}_4)_2(\text{C}_2\text{O}_4) \cdot 8\text{aq}$.
 Occurrence & SC-XRD structure: **DR Peacor RC Rouse EJ Essene RJ Laup** 1999 AM 1453-62.

costibite CoSbS .
Marcasite structure type from uncompressed axial ratios, but structure determination not found:
 should be ordered with lower space group.
 [jvs: *löllingite* subgroup of *marcasite* supergroup has compressed *c*-axis.]
 Occurrence: **LJ Cabri DC Harris JM Stewart** 1970 AM 55 10-7.

cotunnite PbCl_2 .
 Structure: **Z Yu LE Nozik LA Fykin** 1976 SPC 21 38-40 (C709);
J Haines JM Léger A Atouf 1995 JACeS 78 445-8 (H950);
 High-P, ZrO_2 structure type: MA 80-1609.
Synthetic Sn(II)I_2 : MA 73-3491.
Synthetic SnClF : MA 78-263.
Synthetic LiNaSe : 1989 J Less-Common Metals 156 43-7 = SR 56A 52.
Synthetic NaLiTe , KNaTe & KNaSe : 1989 Z N 44B 1602-4 = SR 56A 56.
Synthetic HfO_2 & ZrO_2 , neutron PD, **J Haines & 6 others** 1997 JACeS 80 1910-4 (H1179);
 lattice dynamics, **AP Mirgorodsky PE Quintard** 1999 JACeS 82 3121-4 (M1780).
 Non-isostructural PbF_2 , high-T fluorite & low-T unknown: MA 11-208.
 Transition at 7-16 GPa to monoclinic structure with 4% higher density & 10-coordination for
 PbCl_2 , BaCl_2 , BaBr_2 & SnCl_2 : **JM Léger J Haines A Atouf** 1995 PRB 3902-5 (L684).
Fluorite-type BaF_2 *frankdicksonite* to cotunnite type 3 GPa: **JM Leger & 4 others** 1995 PRB 52 13247-56 (L701).
 To high-P post-cotunnite phase at 5-15 GPa of Ba(Cl/Br/I)_2 : **JM Leger J Haines A Atouf** 1995 JAC 28 416-23 (L691).
 >400 oxides have *cotunnite* connectivity, high-P stability: **JK Dewhurst JE Lowther** 2001 PRB 64 014104 1-7 (1997).

coulsonite FeV_2O_4 . *Spinel* structure type but structure determination not found.
 Occurrence: MM 24 607;
AS Radtke 1962 AM 47 1284-91.
 IMA 94-034: $\text{Mg(V,Cr)}_2\text{O}_4$.
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.

cousinite $\text{MgU}_2\text{Mo}_2\text{O}_{13} \cdot 6\text{aq}$. Mineral status uncertain.
 Occurrence: **JF Vaes** 1959 AM 44 910.

coutinhoite $\text{Th}_x\text{Ba}_{1-2x}\text{aqy}(\text{UO}_2)_2\text{Si}_5\text{O}_{13} \cdot \text{aq}$.
 Structure: probably like *weeksite*, **D Atencio FMS Carvalho Pa matioli** 2004 AM 89 721-4.
 Occurrence: do.

covellite / covelline CuS . Isostructural with Se analog *klockmanite*.
 Structure: **LG Berry** 1954 AM 39 504-9;
NV Belov EA Pobedinskaya 1969 SPC 13 843-7 (B1127);
R Kalbskopf F Pertlik J Zemann 1975 TMPM 22 242-9;
HT Evans Jr JA Konnert 1976 AM 61 996-1000;
HT Evans Jr 1981 AM 66 807-18;
H Fjellvåg & 5 others 1988 ZK 184 111-21 (F381);
 NQR of Cu, **VN Ashkin & 4 others** 1994 ZVMO 12359-63 = MA 95M/4023.
 Hexagonal-orthorhombic transition, Cu(S,Se) series: **H Nozaki & 3 others** 1995 JSSC 118 176-9 (N388).
 Electrochemical oxidation, alkaline solution, XPS: **Q Yin & 3 others** 1994 JCIS 166 133-42 (Y199).
 High-pressure: **Y Takéuchi Y Kudoh G Sato** 1985 ZK 173 119-28.
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.

cowlesite $\text{CaAl}_2\text{Si}_3\text{O}_{10} \cdot 5-6\text{aq}$.
 Zeolite: structure unsolved: crystallographic data, **G Vezzalini & 3 others** 1992 MM 56 575-9.
 Occurrence: **WS Wise RW Tschernich** 1975 AM 60 951-6
 Australia, MA 02M/4798.

coyoteite $\text{NaFe}_3\text{S}_5 \cdot 2\text{aq}$.

Structure determination not found.

Occurrence: **WS Wise RW Tschernich** 1975 AM 60 951-6.

[craigite] Clathrate compounds in deep ice.

Occurrence: **SL Miller** 1970 S 165 489 = MM 38 990.]

CRANDALLITE STRUCTURE GROUP

	Includes:
<i>arsenocrandallite</i>	$(Ca,Sr)Al_3[(As,P)O_4]_2(OH)_5.aq$
<i>arsenoflorencite (Ce/La/Nd)</i>	$(Ce/La/Nd)Al_3(AsO_4)_2(OH)_6$
<i>arsenogorceixite</i>	$BaAl_3H(AsO_4)_2(OH)_6$
<i>arsenogoyazite</i>	$?SrAl_3(AsO_4)_2(OH)_5.aq$
<i>benauite</i>	$HSrFe_3(PO_4)_2(OH)_6$
	also S-rich relative with P/S ~ 2
<i>crandallite</i>	$CaAl_3(PO_4)_2(OH)_5.aq$
<i>dussertite</i>	$BaFe_3(AsO_4)_2(OH)_5$
<i>eylettersite</i>	$(Th,Pb)_{1-x}Al_3(P/SiO_4)_2(OH)_6$
<i>florencite</i>	$CeAl_3(PO_4)_2(OH)_6$
<i>florencite-(La)</i>	$(La,Ce)Al_3(PO_4)_2(OH)_6$
<i>florencite-(Nd)</i>	$(Nd,Ce)Al_3(PO_4)_2(OH)_6$
<i>gorceixite</i>	$BaAl_3(PO_4)(PO_3OH)(OH)_6$
<i>goyazite</i>	$SrAl_3(PO_4)_2(OH)_5.aq$
<i>graulichite-Ce</i>	$CeFe^{3+}_3(AsO_4)_2(OH)_6$
<i>hinsdalite</i>	$PbAl_3((P,S)O_4)_2(OH,aq)_6$
<i>lusungite</i>	$(Sr,Pb)Fe_3(PO_4)_2(OH)_5.aq$
<i>philipsbornite</i>	$PbAl_3H(AsO_4)_2(OH)_6$
<i>plumbogummite</i>	$PbAl_3(PO_4)_2(OH,aq)_6$
<i>springcreekite</i>	$BaV_3(PO_4)_2(OH,aq)_6$
<i>[viséite]</i>	Si-rich-defective crandallite $(Ca,Sr,Ba)Al_3(P/SiO_4)_2(OH)_{n.m} aq]$
<i>waylandite</i>	$(Bi,Ca)Al_3(P/SiO_4)_2(OH)_6$
<i>zaireite</i>	$Bi(Fe,Al)_3(PO_4)_2(OH)_6$

Nomenclature of *alunite* supergroup that includes *alunite*, *beudantite* and crandallite groups: **JL**

Jambor 1999 CM 37 1323-42. [*jvs: confusing nomenclature, read in detail!*]

Waylandite has unnamed As analog.

Thorium in crandallite minerals: **LE Mordberg** 2004 MM 68 489-97.

Early diagenesis of *woodhouseite* & *crandallite* in sandstones: **G Pe-Piper LM Dolansky** 2005 AM 90 1434-41.

crandallite $CaAl_3(PO_4)_2(OH)_5.aq$. Crandallite structure group.

Structure: **UM Cowgill GE Hutchinson O Joensuu** 1963 AM 48 1144-63;

AM Blount 1974 AM 59 41-7 (B1410).

-*woodhouseite* series: *synthesis*, thermodynamics, **RG Schwab & 3 others** 2004 NJMA 385-409 (10730).

Relation to hexagonal tungsten bronze: **M Goreaud B Raveau** 1980 AM 65 953-6.

Occurrence in marine sandstones: **B Rasmussen** 1996 AJS 296 601-32 (R677).

Precipitation in Stone Age bone: **L Quattropani L Charlet H de Lumley M Menu** 1999 MM 63 801-12.

crawfordite $Na_3Sr(PO_4)(CO_3)$. Compare with *bradleyite*, *bonshtedtite* & *sidorenkite*.

Structure determination not found.

Occurrence: **AP Khomyakov LI Polezhaeva EV Sokolova** 1994 ZVMO 123 107-11.

Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** (1995).

creaseyite $Cu_2Pb_2(Fe,Al)_2Si_5O_{17}.6aq$.

Structure determination not found.

Occurrence: **SA Williams RA Bideaux** 1975 MM 40 227-31.

crednerite $MnCuO_2$.

Structure: **ID Kondrashev** 1959 SPC 3 703-6 = MA 15-26;

J Töpfer & 4 others 1995 ZK 210 184-7 = MA 95M/4018.
Synthetic SrHgO₂: **YD Kondrashev** 1958 Krist 3 696-700.
creedite Ca₃Al₂(SO₄)F₈(OH)₂.2aq. Review: **Sabelli**, p. 28.
Structure: **SV Borisov & 3 others** 1965 DAN USSR ES 155 129-31 = MA 18-87;
G Giuseppetti C Tadini 1983 NJMM 69-78.
Enthalpy of formation: **IA Kiseleva & 3 others** 2002 GI 40 1026-30 (8344).
crerarite (Pt,Pb)Bi₃(S,Se)_{4-x}.
Halite overall structure type with complex cation assignment.
Structure: **NJ Cook & 4 others** 1994 NJMM 567-75 (C753).
CRICHTONITE STRUCTURE GROUP Includes:

<i>cleusonite</i>	(Pb,Sr)(U ⁴⁺ ,U ⁶⁺)(Fe,Zn) ₂ (Ti,Fe ²⁺ ,Fe ³⁺) ₁₈ (O,OH) ₃₈
<i>crichtonite</i>	(Sr,La,Ce,Y)(Ti,Fe,Mn) ₂₁ O ₃₈
<i>davidite-Ce</i>	?(Ce,etc)(Y,U,Fe)(Ti,Fe) ₂₀ (O,OH) ₃₈
<i>davidite-La</i>	(La,Ce)(Y,U,Fe)(Ti,Fe) ₂₀ (O,OH) ₃₈
<i>davidite-Y</i>	?(Y,etc)(Y,U,Fe)(Ti,Fe) ₂₀ (O,OH) ₃₈
<i>dessautite</i>	(Sr,Pb)(Y,U)(Ti,Fe ³⁺) ₂₀ O ₃₈
<i>gramaccioliite-Y</i>	(Pb,Sr)(Y,Mn)(Ti,Fe) ₁₈ Fe ₂ O ₃₈ .
<i>landauite</i>	NaMnZn ₂ (Y,Fe) ₆ Ti ₁₂ O ₃₈
<i>lindsleyite</i>	(Ba,Sr)(Ti,Cr,Fe,Mg,Zr) ₂₁ O ₃₈
<i>lovingite</i>	(Ca,Ce)(Ti,Fe,Cr,Mg) ₂₁ O ₃₈
<i>mathiasite</i>	(K,Ca,Sr)(Ti,Cr,Fe,Mg) ₂₁ O ₃₈
<i>senaite</i>	Pb(Ti,Fe,Mn) ₂₁ O ₃₈

Split of davidite into -Ce, -La & -Y: **P Orlandi & 3 others** 1997 AM 82 807-11.
Synthetic (Ca/Sr)₂Zn₄Ti₁₅O₃₆, Ca₂Co₄Ti₁₅O₃₆ & NaAlZn₄Ti₁₅O₃₆: MA 82M/0172.
Composition ranges: **RG Platt RH Mitchell** 1996 MM 60 403-13.
crichtonite (Sr,La,Ce,Y)(Ti,Fe,Mn)₂₁O₃₈.
Structure: **IE Grey DJ Lloyd JS White Jr** 1976 AM 61 1203-12.
Review: (Sr,La,Ce,Y)(Ti,Fe,Mn)₂₁O₃₆, **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
criddleite TlAg₂Au₃Sb₁₀S₁₀.
Occurrence, crystallography & *synthesis*: **DC Harris & 3 others** 1988 MM 52 691-7.
crystalite SiO₂. One of many structural varieties of natural & *synthetic* silicas.
Consortium for Theoretical Frameworks tetrahedral net 1.
Review of related structures: **JG Thompson & 3 others** 1998 JSSC 141 29-49 (T601).
Structure: **WA Dollase** 1965 ZK 121 369-77 (D70);
high-low inversion, **DR Peacor** 1973 ZK 138 274-98 (P345);
DM Hatch S Ghose 1973 PCM 17 554-62;
AF Wright AJ Leadbetter 1975 Phil Mag 31 1391-401 (1391);
high, **AJ Leadbetter TW Smith AF Wright** 1973 N 244 125-6;
alpha-beta transition in SiO₂ & AlPO₄, **AJ Leadbetter AF Wright** 1976 Phil Mag 33 105-12 (L411);
alpha-beta transition, SiO₂/AlPO₄/GaPO₄, **LH Cohen W Klement Jr** 1979 Phil Mag 39 399-409;
neutron, **JJ Pluth JV Smith J Faber Jr** 1985 JAP 57 1045-9 (P346);
A Yeganeh-Haeri DJ Weidner JB Parise 1992 S 257 650-2 (Y149);
high-P to 4.4 GPa, **DC Palmer LW Finger** 1993 AM 79 1-8;
NMR spectroscopy to 770 K, **BL Phillips & 3 others** 1993 PCM 20 341-52;
RT Downs DC Palmer 1994 AM 79 9-14;
atomic relaxation theory, **F Liu et al** 1993 PRL 70 2750-3 (L545);
Raman of high-P transitions, **DC Palmer RJ Hemley CT Prewitt** 1994 PCM 21 481-8;
compressional phase change, **JB Parise & 4 others** 1994 JAP 75 1361-7 (P692);
thermal expansion to 1573K, **IP Swainson MT Dove** 1995 PCM 22 61-5;
E Bourova P Richet 1998 GRL 25 2333-6 (B1835);
TEM, **RL Withers JG Thompson TR Welberry** 1989 PCM 16 517-23;
laser Brillouin spectr/negative Poisson ratio, **A Yeganeh-Haeri DJ Weidner JB Parise** 1992 S 257 650-2;

Si-O & orientational disorder from neutron total scattering, **MT Dove** 1997 PCM 24 311-7 (D645);
high-T dynamics, Raman: **P Richet BO Mysen** 1999 GRL 26 2283-6 (R900);
high-P phase II, neutron PD structure, **MT Dove & 6 others** 2000 MM 64 569-76;
surface dehydroxylation/silanization, molecular dynamics, **S Iarlori & 4 others** 2001 JPCB 2001 8007-13;
high-P to 61 non-hydrostatic GPa, Raman/XRPD, **VB Prokopenko & 3 others** 2001 JAICo 327 87-95 (3153);
IR/Raman, α - β transition, **IP Swainson mT Dove DC Palmer** 2003 PCM 30 353-65 (9243).
Direct transition to α -PbO₂, > 80 GPa: **NA Dubrovinskaia & 5 others** 2001 EJM 13 479-83 (2071).
In meteorites: **AE Rubin** 1997 MPS 32 231-47;
Tatahouine achondrite: **K Benzerara & 4 others** 2002 AM 87 1250-6;
shocked, & quartz, basaltic shergottite, Mars, **H Leroux P Cordier** 2006 MPS 41 913-23.
Piezoelectricity of quartz/cristobalite airborne dust re adverse health: **BJ Williamson & 2 others** 2001 AEI 35 3539-42.
Synthetic III-V analogs, (Al/Ga/B)PO₄ & BaSO₄, **K Kosten H Arnold** 1980 ZK 152 119-33 (1392).
Synthetic AlPO₄, alpha-beta transition: **DM Hatch S Ghose JL Bjorkstam** 1994 PCM 21 67-77;
Structure at 298-473 K, **HA Graetsch** 2003 NJMM 289-301 (10010).
Synthetic RbLiMoO₄: **AI Kruglik RF Klevtsova KS Aleksandrov** 1983 SPD 28 607-9 (K631).
Synthetic CsLiMoO₄: **RF Klevtsova PV Klevtsov KS Aleksandrov** 1980 SPD 25 966-8 (K626);
AI Kruglik RF Kletsova KS Aleksandrov 1983 SPD 28 607-9 (K626);
V Petricek & 4 others 1987 SPD 32 179-80 (P466).
Synthetic CsLiWO₄: **V Petricek & 4 others** 1987 SPD 32 179-80.
Synthetic Na₂BeSiO₄ orthorhombic polymorph stuffed cristobalite type:
S Fröstang J Grins D Louër P-E Werner 1988 Solid State Ionics 31 131;
B Maksimov & 5 others 1990 JSSC 86 64-74.
Synthetic Na_{1.8}Be_{0.9}Si_{1.1}O₄: 1990 Solid State Ionics 44 51-4 = SR 57A 300.
Synthetic Na₂MgSiO₄, Na_{1.7}Mg_{0.8}Al_{0.15}Si_{1.1}O₄ & Na_{1.8}Mg_{0.9}Si_{1.1}O₄, modulation wave: **RL Withers & 4 others** 1997 AC B53 203-20 (W793).
Synthetic members NaAlO₂-NaAlSiO₄ system, XRD & EM: **JG Thompson A Melnitchenko SR Palethorpe RL Withers** 1997 JSSC 131 24-37 (T524);
2 tetragonal & 2 orthorhombic types, **JG Thompson RL Withers A Melnitchenko SR Palethorpe** 1998 AC B54 531-46 (T595);
commensurate modulated cubic type, **RLW JGT AM SRP** 1998 AC B54 547-57 (W936).
Synthetic in KAlO₂-KAlSiO₄, XRD: **SLG Husheer JG Thompson A Melnitchenko** 1999 JSSC 147 624-30 (H1456).
Synthetic K₂ZnGeO₄, α & β , NPD: **C Colbeau-Justin & 4 others** 1997 JSSC134 59-66 (C1019).
Stuffed K₂(Mg/Zn/Co/Cd)SiO₄, transformations: **WA Dollase** PCM 25 389-92 (D727).
Synthetic BaBeSiO₄, XRPD structure: **SE Dann MT Weller** 1998 MRB 33 683-91 (D725).
Synthetic LiZnPO₄, SC-XRD structure: **X Bu TE Gier GD Stucky** 1998 JSSC 138 126-30.
Synthetic Cd cyanide with cristobalite connectivity: **T Kitazawa** 1998 JMC 8 671-4 (K1080).
Synthetic K₂(Mg/Cd)GeO₄, revised: **C Colbeau-Justin & 3 others** 1997 PD 12 138-40 (C1128).
Synthetic GaPO₄, high-T transitions, XRPD: **R Barz J Schneider P Gille** 1999 ZK 214 845-9 (B1985).
Synthetic (Si_{0.9}Ge_{0.1}O₂), defects & transition to *tridymite*, TEM: **H Lemmens & 3 others** 2000 PCM 27 386-97 (L1061).
Synthetic Ca-Al doped, shear stress vs. phase transformation: **SJ Lee SH Lee** 2001 JMSL 20 135-7 (1410).
Synthetic PON, **JM Leger & 8 others** 2001 PCM 28 388-98 (2925).
Synthetic BPO₄: SC-XRD structure, **H Schmidt & 9 others** 2004 ZaaC 630 655-62 (10258).
Synthetic (Rb/Cs)₅[Fe₃O₆]: **G Frisch C Rohr** 2004 ZN 59b 771-81 (10728).
crocoite PbCrO₄. *Monazite* structure type.
Monoclinic dimorph with transition to orthorhombic *barite* structure at 1068 K..
Structure: **I Naray-Szabo G Argay** 1964 Acta Chim Acad Sci Hungary 40 283-8;
S Quareni R De Pieri 1965 AC 19 287-9 (Q8);
synthetic, **H Effenberger F Pertlik** 1986 ZK 176 75-83;
NPD, thermal expansion tensor 4-290 K, **KS Knight** 1996 MM 60 963-72.
Orthorhombic *barite* phase: *synthetic*, **G Collotti L Conti M Zocchi** 1959 AC 12 416;
natural 1073 K, NPD structure, **KS Knight** 2000 MM 64 291-300.
cronstedtite Fe₂²⁺Fe³⁺(Si,Fe³⁺)O₅(OH)₄. *Kaolinite-serpentine* structure group.
Structure: **R Steadman PM Nuttall** 1963 AC 16-8;

do 1964 AC 17 404-6;
 2H₂ polytype, **CA Geiger & 3 others** 1983 CICIM 31 97-108 (G444);
 3T polytype, **L Smrcok & 3 others** 1994 CICIM 42 544-51 (S1379);
 electronic structure, model calculation, **L Benco L Smrcok** 1995 CICIM 43 8-13;
 1T polytype, SC-XRD, **J Hybler & 3 others** 2000 CICIM 48 331-8 (H1473);
 HR-TEM of polytypes, **T Kogure J Hybler S Durovic** 2001 CICIM 49 310-7 (2918);
 2H₂ polytype, **J Hybler & 3 others** 2002 CICIM 50 601-13 (8338);
 1T, parallel intergrowth, **S Đurovic & 2 others** 2004 CICIM 52 613-21 (10746).
 Occurrence: CM chondrites, TEM & Fe oxidation, **TJ Zega LAJ Garvie PR Buseck** 2003 AM 88 1169-72.

cronusite Ca_{0.2}CrS₂.2aq.
 Occurrence: Norton enstatite achondrite, **SN Britvin & 5 others** 2001 ZVMO 3 29-35.

crookesite (Cu,Tl,Ag)₂Se.
 Structure determination not found.
 See *sabatierite*.
 Occurrence: **Dana; JW Early** 1950 AM 35 337-64.
Synthetic TICu₇Se₄ & NH₄Cu₇Se₄, structure: **Z Johan** 1987 CRASP 304 II 1121-4.
Synthetic Cu-deficient NH₄Cu₇Se₄: **RA Berger** 1987 ZK 181 241-9.

cryolite Na₃AlF₆. Monoclinic at low T; inverts to cubic at high T.
 Same overall topology as cubic *elpasolite*, but with differences in cation positions and geometry.
 Phase transitions & molar volume change: **B Lavina & 3 others** 2006 AM 91 104-10.
 Structure: **EG Steward HP Rooksby** 1953 AC 6 49-52, also NH₄ & K analogs;
FC Hawthorne RB Ferguson 1975 CM 13 377-82.
Synthetic NH₄⁻: cubic, MM 28 723.
Synthetic (Li/Na/K/Rb/Cs/Ag/Tl/NH₄)FeF₆: MA 71-124.
Synthetic K₃AlF₆: MM 28 736; cubic, MA 10-208.
Synthetic Fe: (M1128).
Synthetic Cs₂NaCr(CN)₆ & (Rb/Cs)₂(Na/K/Rb/NH)(Cr/Mn/Fe/Co)(CN)₆, SC-XRD structure: **S Peschel & 3 others** 2000 ZaaC 626 1561-6 (P885).

cryolithionite Na₃Li₃Al₂F₁₂. Garnet structure type.
 Structure: **S Geller** 1971 AM 56 18-23;
OV Yakubovich VS Urusov 1997 Phys-Doklady 42 474-8 (Y217).
Synthetic Na₃Li₃(Ga/In/Sc/Ti/V/Cr/Mn/Fe/Co/Rh/Ni)₂F₁₂: **D Babel A Tressaud** 1985, *Crystal structure of fluorides*, in *Inorganic Solid Fluorides*, Academic pt 3, 77-203.

cryptohalite (NH₄)₂SiF₆. Antifluorite structure type. Isostructural with *hieratite*.
 Structure: **V Vainshtein MM Stasova** 1957 SPC 1 241-8.

cryptomelane K(Mn⁴⁺,Mn²⁺)₈O₁₆.
Hollandite structure group; *manganomelane* mineral group.
 Structure: **JE Post RB Van Dreele PR Buseck** 1982 AC B38 1056-65;
synthetic, EPR: **MV Ananth K Dakshinamurthi** 1997 JMC 7 517-20 (A739).
 O-deficient product from microwave heating: **Q Zhang SL Suib** 1999 ChM 11 1306-11 (Z196).
 Sr-rich, occurrence in *braunite* ores: **R Cabella G Lucchetti P Marescotti** 1995 NJMM 395-407.
 Some *octahedral molecular sieves* (OMS) are based on the cryptomelane topology:
 sol-gel *synthesis* of OMS-2, **N Duan SL Suib C O'Young** 1995 JCSCC 1367-8 (D552);
 lattice oxygen mobility & stability of Ni & Cu types, **Y Yin & 3 others** 1995 IC 34 4187-93;
 cupric ion vs structure and reactivity, **E Nicolas-Tolentino & 4 others** 1999 ChM 11 1733-41 (N510);
 Cu/Zn/Ni/Co/Al/Mg-doped, **X Chen & 3 others** 2002 ChM 14 946-8;
 alkali & ammonium templates, **J Liu & 4 others** 2003 JPSB 107 9185-94 (9329);
 high-valence substitution, **M Polverejan JC Villegas SL Suib** 2004 JChS 126 7774-5 (10412).
 Occurrence: MM 26 336.
 (Sr,Ba,K)Mn₈O₁₆: IMA 95-005.

cualstibite Cu₆Al₃(SbO₄)₃(OH)₁₂.10aq.
 Structure determination not found.
 Occurrence: **K Walenta** 1985 AM 70 1329.

cubanite CuFe_2S_3 . Dimorphic with cubic *isocubanite*.

Structure: **MJ Buerger** 1947 AM 32 415-25;

LV Azaroff MJ Buerger 1955 AM 40 213-25;

ME Fleet 1970 ZK 132 276-87;

JT Szymanskii 1974 ZK 140 218-39;

quenched high-, **T Mizota K Kato** 1983 MJJ 11 213-21;

C McCammon & 3 others 1992 AM 77 937-44;

high-Fbar43m near-*sphalerite* = *isocubanite*, heated natural, **JT Szymanskii** 1974 ZK 140 240-8;

high-pressure, *niccolite* structure, **CA McCammon** 1995 AM 80 1-8.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

cuboargyrite AgSbS_2 .

Occurrence, XRPD matches *synthetic*: PDF 17-456, **K Walenta** 1998 Lapis 23 21-3 = AM 84 1196.

cumengéite $\text{Pb}_{21}\text{Cu}_{20}\text{Cl}_{42}(\text{OH})_{40}\cdot 6\text{aq}$.

Structure: **FC Hawthorne LA Groat** 1986 MM 50 157-62.

Occurrence & corrected structure: **G Cruciani & 3 others** 2005 MM 69 1037-45 = AM 91 1208.

cumingtonite $(\text{Mg,Fe})_7\text{Si}_8\text{O}_{22}(\text{OH})_2$. *Amphibole* structure group; monoclinic subtype.

Two types with space group $C2/m$ & $P2_1/m$.

Structure: **S Ghose** 1961 AC 14 622-7 ($G22$);

KF Fischer 1966 AM 51 814-8 ($F77$);

JJ Papike M Ross JR Clark 1969 Mineral Soc Amer Spec Paper 2 117-37;

transition ~ 318 K, **CT Prewitt JJ Papike M Ross** 1970 EPSL 8 448-50;

transition ~ 373 K, **S Sueno & 3 others** 1972 JGR 77 5767-77;

H Yang MM Hirschmann 1995 AM 80 916-22;

Mn-, **S Ghose Y Hexiong** 1989 AM 74 1091-6;

24 heated/6 natural ferromagnesian clinoamphiboles, **M Hirschmann BW Evans H Yang** 1994 AM 79 862-77;

$P2_1/m$ at 140 K, **H Yang JR Smyth** 1996 AM 81 363-8;

exsolved hornblende lamellae, TEM, **U Klein TG Sharp JC Schumacher** 1997 AM 82 1079-90;

optics & Fe-Mg order-disorder, **BW Evans O Medenbach** 1997 EJM 9 993-1003 E423;

Mn, Mg disorder 323-973 K, neutron, **JJ Reece & 3 others** 2000 MM 64 255-66;

Mössbauer, phase transition, **TB Ballaran CA McCammon MA Carpenter** 2002 AM 87 1490-3;

IR, phase transition, **TB Ballaran MA Carpenter MC Domeneghetti** 2004 AM 89 1717-27;

high-T IR & SC-XRD to ~ 8 GPa: **H Yang & 5 others** 1998 AM 83 288-99.

cupalite $(\text{Cu,Zn})\text{Al}$. Occurrence & crystallography: •MM 50 743-4.

cuprite Cu_2O .

Structure: **B Borie** 1974 AC A30 337-41;

A Kirfel K Eichhorn 1990 AC A46 271-84;

charge density, **R Restori D Schwarzenbach** 1986 AC B42 201-8;

SC-XRD multipole refinement, **T Lippmann JR Schneider** 2000 JAC 33 156-67 (L1051), AC A56 575-84 (130).

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

Synthetic isostructural Ag_2O : **B Borie** 1974 AC A30 337-41.

Synthetic isostructural Pd_2O & Pt_2O : 1989 J Less-Common Metals 147 59 = SR 56A 271.

Synthetic Cu_{64}O : **R Guan H Hashimoto KH Kuo** 1985 AC B41 219-25.

Iodine sorption vs. pH: **G Lefevre & 3 others** 2000 La 16 4519-27 (L1060).

cuproadamite

Orthorhombic Cu-rich *adamite* (note: *olivenite* is monoclinic): **RSW Braithwaite** 1983 MM 47 51-7; MM 52 552-3.

cuproartinite $(\text{Cu,Mg})_2\text{CO}_3(\text{OH})_2\cdot 3\text{aq}$. Compare with Mg analog *artinite*.

Occurrence: **SG Oswald WW Crook III** 1979 AM 64 886-9.

CUPROBISMUTITE HOMOLOGOUS SERIES

cuprobismutite

hodrushite

kupčikite

paděraite

Structures & chemistry: **D Topa & 2 others** 2003 CM 41 1481-501.

Cuprobismutite-*paděraite* intergrowths: HRTEM, **CL Ciobanu A Pring NJ Cook** 2004 MM 68 279-300

cuprobismutite $\text{Cu}_{10}\text{Bi}_4\text{S}_{23}$.
 Related to *hodrushite*, *kupčikite*, *paděraite* & $\text{Cu}_4\text{Bi}_5\text{S}_{10}$ (MA 76-236), $\text{Cu}_4\text{Bi}_4\text{S}_9$; review,
E Makovicky I Søtofte S Karup-Møller 2002 ZK 217 597-604 (8703).
 Structure: **T Ozawa W Nowacki** 1975 NJMM (2) 99-100 (O123);
do 1975 ZK 142 161-70 (O134);
D Topa & 2 others 2003 CM 41 1481-501.
 Occurrence with *hodrushite* & *paděraite*: **NJ Cook CL Ciobanu** 2003 CM 41 441-56.

cuprocopiapite $\text{CuFe}^{3+}_4(\text{SO}_4)_6(\text{OH})_2 \cdot 20\text{aq}$.
Copiapite structure group: **MC Bandy** 1938 AM 23 737. Review: **Sabelli** p.20; (E289).
 Structure determination not found.

cuprohydromagnesite $(\text{Cu},\text{Mg})_5(\text{CO}_3)_4(\text{OH})_2 \cdot 4\text{aq}$.
 Compare Mg analog *hydromagnesite* & *widgiemoolthalite* $(\text{Ni},\text{Mg})_5(\text{CO}_3)_4(\text{OH})_2 \cdot 4-5\text{aq}$.
 Occurrence: **SG Oswald WW Crook III** 1979 AM 64 886-9.

cuproiridsite CuIr_2S_4 .
 Isostructural series with *cuprorhodsite*, *ferrorhodsite* & *malanite*.
 Occurrence: **NS Rudashevskii et al** 1985 ZVMO 114 187-95 = AM 71 1277.
 Charge compensation in Cu-Fe-PGE thiospinels, Penikat: **AV Barkov & 3 others** 2000 AM 85 694-9.
Synthetic $\text{Cu}(\text{Co}/\text{Rh}/\text{Ir})_2\text{S}_4$, electronic bands: **T Oda & 3 others** 1995 J Phys-Cond Matter 7 4433-45.
Synthetic, metal-insulator transition: **J Matsuno & 7 others** 1997 PRB 55 R15979-82.
Synthetic S,Se solid solution, metal-insulator transition: **S Nagata & 6 others** 1998 PRB 58 6844-54.

cupromontmorillonite
 Occurrence: MM 30 731, correction of 19th list.

cupropavonite $\text{AgPbCu}_2\text{Bi}_5\text{S}_{10}$.
 [jvs: probable member of *pavonite* homologous series.]
 Occurrence: **S Karup-Møller E Makovicky** 1979 BM 102 351-67 (K689) = AM 65 206.

cuprorhodsite CuRh_2S_4 . Isostructural series with *cuproiridsite*, *ferrorhodsite* & *malanite*.
 Occurrence: **NS Rudashevskii et al** 1985 ZVMO 114 187-95 = AM 71 1277.
 Charge compensation, Cu-Fe-PGE thiospinels, Penikat: **AV Barkov & 3 others** 2000 AM 85 694-9.
Synthetic $\text{Cu}(\text{Co}/\text{Rh}/\text{Ir})_2\text{S}_4$, electronic bands: **T Oda & 3 others** 1995 J Phys-Condensed Matter 7 4433-45.

cuprorivaite $\text{CaCuSi}_4\text{O}_{10}$. *Gillespite* structure group. = Egyptian blue.
 Structure: **A Pabst** 1959 AC 12 733-9 (P453);
 NPD, **BC Chakoumakos JA Fernandez-Baca LA Boatner** 1993 JSSC 103 105-13.
 Review: (E289).
 Occurrence: MM 25 626.
Synthetic $\text{CaCuSi}_4\text{O}_{10}$: **W Bensch M Schur** 1995 ZK 210 530 (B141 4).

[cuproscheelite CuWO_4 .
 Name used in materials science for *synthetic* member of *wolframite* structure group.
 Structure: **L Kihlberg E Gebert** 1970 AC B26 1020-5;
S Klein H Weitzel 1975 JACr 8 54-9; antiferromagnetic structure,
JB Forsyth C Wilkinson AI Zvyagin 1991 J Phys-Condensed Matter 3 8433-40.
 Phase transition with *sanmartinite* ZnWO_4 : XRPD structure, **SAT Redfern & 3 others** 1995 EJM
 7 1019-28 (R599).
 Solid solution *sanmartinite*-cuproscheelite:
 Cu 2p absorption spectroscopy, **PF Schofield & 3 others** 1993 PCM 20 375-81;
 EXAFS, **PF Schofield et al** 1994 MM 58 185-99;
 XRPD, **PF Schofield & 3 others** 1997 AC B53 102-12 (S676).
 Mineral description, proposed discreditation: **RH Sillitoe AH Clark AES Mayer** 1970 AM 55 1345-52.]

cuprosklodowskite $\text{Cu}(\text{UO}_2)_2(\text{SiO}_4)_2 \cdot 4\text{aq}$. Sheet structure.
 Review: (E289); **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
 Structure: **J Piret-Meunier M Van Meerssche** 1963 Bull Classe Sci Acad Roy Belgique 49 181-91 = MA 17-258;
A Rosenzweig RR Ryan 1975 AM 60 448-53.
 Occurrence: MM 23 628.

cuprospinel $(\text{Cu},\text{Mg})\text{Fe}_2\text{O}_4$. *Spinel* structure type.
 Structure determination not found.

Occurrence: **EH Nickel** 1973 CM 11 1003-7.
cuprostibite $\text{Cu}_2(\text{Sb,Tl})$.
XRPD matches *synthetic*: ? **Westgren et al** 1929 Z Phys Chem B 3 6-? jvs: check composition.
Occurrence: MM 37 956.
cuprotungstite $\text{Cu}_3(\text{WO}_4)_2(\text{OH})_2$.
Occurrence: **RS Cannon Jr FS Grimaldi** 1953 AM 38 903-11;
K Walenta 1979 MM 43 448-50; AM 75 713.
[cuprovudyavrite Silicate of Cu, Ti & REE.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.]
curetonite $\text{Ba}(\text{Al,Ti})(\text{PO}_4)(\text{OH},\text{O})\text{F}$.
Structure: **M Cooper FC Hawthorne** 1994 AM 79 545-9.
Occurrence: MM 43 1059.
curiéinite $\text{Pb}(\text{UO}_2)_2(\text{VO}_4)_2.5\text{aq}$. Isostructural with *francevillite*.
Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Occurrence: MM 37 956.
Structure of *synthetic*: **J Boréne F Cesbron** 1971 BSFMC 94 8-14 (B1179).
Synthetic $\text{Ni}(\text{UO}_2)_2(\text{VO}_4)_2.4\text{aq}$: **J Boréne F Cesbron** 1970 BSFMC 93 426-32.
curite $\text{Pb}_{3+x}(\text{UO}_2)_4\text{O}_{4+x}(\text{OH})_{3-x}.2\text{aq}$.
Review: **V Baran M Unzeitig** 1991 NJMM 63-75 (B1358);
PC Burns ML Miller RC Ewing 1996 CM 34 845-80;
PC Burns R Finch 1999 Rev Mineral 38.
Structure: **K Mereiter** 1979 TPM 26 279-92;
natural, **JC Taylor WI Stuart IA Mumme** 1981 J Inorg Nucl Chem 43 2419-23;
14 natural and 1 *synthetic*, SC-XRD, **Y Li PC Burns** 2000 CM 38 727-35.
Synthetic $[\text{Pb}_{6.6}(\text{aq},\text{OH})_4][(\text{UO}_2)_8(\text{OH})_6]_2$: **K Mereiter** 1979 TPM 26 279-92 (M1260).
Synthetic Sr analog, SC-XRD structure: **PC Burns FC Hill** 2000 CM 38 175-81.
[curtisite Complex mixture of polycyclic aromatic hydrocarbons:
M Blumer 1975 CG 16 245-56;
H Strunz B Contag 1965 NJMM 1 19-25.
Occurrence: MM 21 562.
Different compounds occur in *idrialite* & *pendletonite*.
Carpathite $\text{C}_{33}\text{H}_{17}\text{O}$ is distinct from *curtisite*: occurrence: MM 31 955-6.]
cuspidine $\text{Ca}_4\text{Si}_2\text{O}_7(\text{F},\text{OH})_2$. *Wöhlerite/lâvenite* supergroup, *lâvenite* structure group.
Not isostructural with *wöhlerite*. Near-isostructural with *janhaugite* (double *c*), *lâvenite* & *niocalite*.
Review of *cuspidine/lâvenite* structure group: **S Merlino N Perchiazzi** 1988 CM 26 933-43.
Structure: **RF Smirnova IM Rumanova** 1955 ZVMO 84 959-69 (S34);
S Saburi & 4 others 1977 MJ 8 286-98.
Occurrence: hyperagpaitic alkaline rocks, **Khomyakov** (1995);
after *melillite*, Bushveld Complex, **IS Buick & 3 others** 2000 S African J Geology 103 249-54 (2077).
Synthetic $\text{NaCa}_2\text{LuSi}_2\text{O}_7\text{F}_2$: **ME Fleet Y Pan** 1995 CM 33 879-84.
Synthetic $\text{Na}_2\text{Ca}_2\text{P}_2\text{O}_7\text{F}_2$: **A Piotrowski V Kahlenberg RX Fischer** 2000 AM 85 1534-9.
cuzticitic $\text{Fe}^{2+}_2\text{TeO}_6.3\text{aq}$.
Structure determination not found.
Occurrence: **SA Williams** 1982 MM 46 257-9 = AM 68 471.
cyanochroite $\text{K}_2\text{Cu}(\text{SO}_4)_2.6\text{aq}$. *Picromerite* structure group. Review: (E289); **Sabelli** p.31.
Structure: **DJ Robinson CHL Kennard** 1972 Cryst Struct Comm 1 185-8;
M Carapezza L Riva di Sanseverino 1986 Min Petr Acta 14 23-37 = MA 72-1845.
cyanophyllite $\text{Cu}_5\text{Al}_2(\text{SbO}_4)_3(\text{OH})_7.9\text{aq}$.
Structure determination not found.
Occurrence: **K Walenta** 1981 AM 66 1274.
cyanotrichite $\text{Cu}_4\text{Al}_2(\text{SO}_4)(\text{OH})_{12}.2\text{aq}$.
Review: **Sabelli**. Compare *camerolaitite*.
Structure determination not found.

Raman vs OH: **RL Frost & 4 others** 2004 AM 89 1130-7.

Occurrence: **Dana**.

[cyclo wollastonite *Pyroxenoid* mineral group.]

CYLINDRITE STRUCTURE GROUP Includes:

<i>cylindrite</i>	$Pb_3Sn_4FeSb_2S_{14}$
<i>franckeite</i>	$Pb_5Sn_3Sb_2S_{14}$
<i>incaite</i>	$Fe(Pb,Ag)_4Sn_4Sb_2S_{15}$
<i>levy claudite</i>	$Pb_8Sn_7Cu_3(Bi,Sb)_3S_{28}$
<i>potosiite</i>	$Pb_{48}Sn_{18}Fe_7Sb_{16}S_{115}$

Complex layer structures with stacking differences & non-commensurate relations.

cylindrite $Pb_3Sn_4FeSb_2S_{14}$. *Cylindrite* mineral group.

Complex layer structure not easy to define in detail.

X-ray study: **E Makovicky** 1976 NJMA 126 304-26.

TEM & model images; **TB Williams BG Hyde** 1988 AC B44 467-4;

do 1988 PCM 15 521-44;

S Wang KH Kuo 1991 AC A47 381-92 (W696);

S Wang PR Buseck 1992 AM 77 758-64.

cymrite $BaAl_2Si_2(O,OH)_8.aq.$

Structure: **AA Kashaev** 1967 DAN USSR ES 169 114-6 = MA 69-2896;

VA Drits AA Kashaev 1969 SPC 13 700-4 (D476) = MA 69-2897;

VA Drits AA Kashaev GV Sokolova 1975 SPC 20 171-5 (D473);

NB Bolotina & 3 others 1991 SPC 36 190-4.

New occurrence & stability: **LC Hsu** 1994 CMP 118 314-20.

cyrilovite $NaFe_3(PO_4)_2(OH)_4.2aq.$ Isostructural with *millisite* & *wardite*.

Structure: **D Cozzupoli & 3 others** 1987 MP 37 1-14 (C712) = MA 88M/1837;

MA Cooper F Hawthorne P Cerny 2000J Czech Geol Soc 45 95-100.

Occurrence: MM 30 731.

dachiardite $\sim(Ca,Na_2K_2)_5Al_{10}Si_38O_{96}.25aq.$ *Zeolite* family.

Disordered variant *svetlozarite*.

IZA-SC structure code DAC. Consortium for Theoretical Frameworks net 248.

Structure: **G Gottardi WM Meier** 1963 ZK 119 53-64 (G451);

acentric domains simulating centric structure, **G Vezzalini** 1984 ZK 166 63-71 (V113);

S Quartieri G Vezzalini A Alberto 1990 EJM 2 187-93.

New topology, CTF net 620, intergrown with dachiardite: **S Quartieri G Vezzalini A Alberti** 1990 EJM 2 187-93 (Q3).

dachiardite-Na $(Na_2,Ca,K)_4-5(Si,Al)_{48}O_{96}.25-27aq.$ Part of *dachiardite*.

Occurrence: **A Alberti** 1975 CMP 49 63-6;

T Yoshimura S Wakabayashi 1977 Sci Repts Niigata Univ Ser E Geol no. 4 49-64 = AM 64 244;

M Bonardi & 3 others 1981 CM 19 285-9.

dadsonite $Pb_{23}Sb_{25}S_{60}Cl.$

Review of homologous & other phases in Pb-Sb-S-Cl system: **Y Moëlo** 1979 CM 17 595-600;

VV Kostov J Macicek 1995 EJM 7 1007-18 (K789).

Structure: **E Makovicky WG Mumme** 1984 AC A40 Suppl C246;

review, **E Makovicky** 1993 EJM 5 545-91.

Occurrence: **J Jambor** 1969 MM 37 437-41.

Synthetic homologous $Pb_{12.6}Sb_{11.4}S_{28.3}Cl_{2.6}$: **VV Kostov J Macicek** 1995 EJM 7 1007-18.

[dakeite $3CaCO_3.Na_2SO_4.UO_3.10aq.$

Occurrence: MM 24 608.]

dalyite $K_2ZrSi_6O_{15}$. Compare with *davanite* possible isostructural Ti analog.

Compare with *armstrongite* & *sazhinite* that have different cell symmetry.

Structure: **SG Fleet** 1965 ZK 121 349-68 (F67).

Occurrence: MM 29 979.

Synthetic isostructural $K_2TiSi_6O_{15}$: **W Gebert O Medenbach OW Flörke** 1983 TMPM 31 69-79 (G763).

damaraite $\text{Pb}_3\text{O}_2(\text{OH})\text{Cl}$.
 Structure: *synthetic*, **SV Krivovichev PC Burns** 2001 EJM 13 801-9 (3463);
P Keller F Lissner T Schleid 2001 NJMM 326-36 (2308).
Synthetic Br-analog, SC-XRD structure: **SV Krivovichev PC Burns** 2001 Solid State Sciences 3 455-9.
 Occurrence: **AJ Criddle & 3 others** 1990 MM 54 593-8 (C744).

damiaoite PtIn_2 .
 Occurrence & XRPD: **Z Yu** 1997 AM 83 652-6.

danalite $(\text{Fe},\text{Mn},\text{Zn})_4\text{Be}_3(\text{SiO}_4)_3\text{S}$. *Helvite* mineral group. *Sodalite* structure type.
 Structure: **I Hassan HD Grundy** 1985 AM 70 186-92;
 SC-XRD, **P Nimis G Molin D Visona** 1994 MM 60 375-9;
 XRPD to 1312 K, **SM Antao I Hassan JB Parise** 2003 CM 41 1413-22.

danbaite CuZn_2 . Should be same structure as *synthetic*: **check**.
 Occurrence: AM 69 566.

danburite $\text{CaB}_2\text{Si}_2\text{O}_8$. Analog of *maleevite* & *pekovite*.
Paracelsian topology; pairs of B and Si tetrahedra instead of Al and Si alternation in *paracelsian*.
 Structure: **C Dunbar F Machatschi** 1930 ZK 76 133-46;
G Johansson 1959 AC 12 522-5;
VV Bakakin VB Kravchenko NV Belov 1960 DAN SSSR ES 129 1155-8 = MA 16-26;
MW Phillips PH Ribbe GV Gibbs 1974 AM 59 79-85;
K Sugiyama Y Takéuchi 1985 ZK 173 293-304;
 boron K-edge XANES, **ME Fleet S Muthupari** 2000 AM 85 1009-21.
Synthetic KBSi_3O_8 : **M Kimata** 1993 MM 57 157-64.

danielsite $(\text{Cu},\text{Ag})_{14}\text{HgS}_8$.
 Probably superstructure of *balkanite*.
 XRPD only: AM 72 401-3. MM 52 723.

[d'ansite $\text{Na}_{21}\text{Mg}(\text{SO}_4)\text{Cl}_3$. Review: **Sabelli** p. 35.
Synthesis: MM 32 952; **H Burzlaff E Hellner** 1961 Z f Elektrochemie 65 565-71 (B1373).
 Zn analog: **H Burzlaff H-H Grube** 1980 ZK 152 83-93 (B1360).]

daomanite CuPtAsS_2 . Structure determination not found.
 Occurrence: AM 61 184;
Z Yu 2001 Acta Geol Sinica 75 396-9 = MA 02M/0824.

daqingshanite-Ce $(\text{Sr},\text{Ca},\text{Ba})_3(\text{Ce},\text{La},\text{Nd})(\text{PO}_4)(\text{CO}_3)_{3-x}(\text{OH},\text{F})_y$.
 Isostructural with *huntite*.
 Structure: **L Ximen Z Peng** 1985 Geochemistry 4 89-96 = MA 86M/2941;
L Ximen Z Peng 1985 Acta Mineralogica Sinica 52 109-14 = MA 86M/1443;
 (Ce), **JM Hughes N Yunxiang** 1994 MM 58 493-6.
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

darapiosite / darapiozite $(\text{K},\text{Na})_3\text{Li}(\text{Mn},\text{Zn})_2\text{ZrSi}_{12}\text{O}_{30}$. *Osumilite* structure type.
 Structure: SC-XRD & IR, **G Ferraris & 3 others** 1999 CM 37 769-74.
 XRPD: **EI Semenov & 3 others** 1975 ZVMO 104 583-5.

darapskite $\text{Na}_3(\text{NO}_3)(\text{SO}_4)\cdot\text{aq}$. Review: **Sabelli** p. 28.
 Structure: **C Sabelli** 1967 Atti Accad Naz Lincei R Cl Sci Fis Mat Nat 42 874-87 = MA 69-181;
GE Eriksen ME Mrose 1970 AM 55 1500-17.

dashkesanite $\text{K}_{0.6}\text{Na}_{0.4}(\text{Ca}_{1.95}\text{Mn}_{0.05})(\text{Fe}_{0.8}^{2+}\text{Mg}_{0.8})_2$
 $(\text{Fe}_{0.35}^{3+}\text{Fe}_{0.5}^{2+}\text{Mg}_{0.15})_2\text{Fe}^{2+}(\text{Si}_{2.9}\text{Al}_{1.1})(\text{Si}_{3.4}\text{Al}_{0.6})\text{O}_{22}\text{Cl}_{1.4}(\text{OH},\text{F})_{0.6}$.
Amphibole structure type.
 Structure: **RK Rastsvetaeva & 3 others** 1996 CrR 41 58-62 (R619) (P616).
 Occurrence & description: MM 24 608; AM 84 1688.

dashkovaite $\text{Mg}(\text{HCO}_3)_2\cdot 2\text{aq}$.
 Occurrence, XRPD matches *synthetic*: **NV Chukanov & 3 others** 2000 ZVMO 129 49-53 = AM 86 1534.

DATOLITE-GADOLINITE-HERDERITE STRUCTURE GROUP Includes:
 boron subgroup
 beryllium subgroup

<i>bakerite</i>	$\text{Ca}_4\text{B}_5\text{Si}_3\text{O}_{15}(\text{OH})_5$	
<i>bergslagite</i>		$\text{CaBeAsO}_4(\text{OH})$
<i>alcioadolinite</i>		$(\text{Ca},\text{RE})_2\text{FeBe}_2\text{Si}_2(\text{O},\text{OH})_{10}$
<i>calcybeborosilite</i>		$\text{CaYBeBSi}_2\text{O}_8(\text{OH})_2$
<i>datolite</i>	$\text{CaBSiO}_4(\text{OH})$	
<i>euclase</i>		$\text{BeAlSiO}_4(\text{OH})$
<i>gadolinite</i>		general name for $\text{RE}_2\text{Fe}^{2+}\text{Be}_2\text{Si}_2\text{O}_{10}$
<i>gadolinite-Ce</i>		$(\text{Ce},\text{La},\text{Nd},\text{Y})_2\text{FeBe}_2\text{Si}_2\text{O}_{10}$
<i>gadolinite-Y</i>		$\text{Y}_2\text{FeBe}_2\text{Si}_2\text{O}_{10}$
<i>herderite</i>		$\text{CaBe}(\text{PO}_4)(\text{F},\text{OH})$
<i>hingganite-Ce</i>		$\text{CeBeSiO}_4(\text{OH})$
<i>hingganite-Y</i>		$(\text{Y},\text{Yb},\text{Er})\text{BeSiO}_4(\text{OH})$
<i>hingganite-Yb</i>		$(\text{Yb},\text{Y})\text{BeSiO}_4(\text{OH})$
<i>homilite</i>	$\text{Ca}_2(\text{Fe},\text{Mg})\text{B}_2\text{Si}_2\text{O}_{10}$	
<i>hydroxylherderite</i>		$\text{CaBe}(\text{PO}_4)(\text{OH})$
<i>minasgeraisite</i>		$\text{CaY}_2\text{Be}_2\text{Si}_2\text{O}_{10}$
<i>väyrynenite</i>		$\text{MnBePO}_4(\text{OH},\text{F})$

[*xinganite* is misspelt *hingganite*-(Y).]

datolite $\text{CaBSiO}_4(\text{OH})$. *Gadolinite* structure type.

Structure: **T Ito H Mori** 1951 AC 6 24-32;

Y Sugitani M Watanabe K Nagashima 1972 AC B28 326-7;

FF Foit MW Phillips GV Gibbs 1973 AM 58 909-14;

boron K-edge XANES, **ME Fleet S Muthupari** 2000 AM 85 1009-21.

daubréeite $\text{BiO}(\text{OH},\text{Cl})$. OH end-member of *bismoclite* from cell data. *Matlockite* structure type.

Occurrence: **Dana**.

daubréelite FeCr_2S_4 . *Spinel* structure type; *linnaeite* family.

Structure: **D Lundqvist** 1943 Ark Kemi Min Geol 17B no. 12 1-4 = MA 9-97.

In meteorites: **AE Rubin** 1997 MPS 32 231-47.

davanite $\text{K}_2\text{TiSi}_6\text{O}_{15}$. Ti analog of *dalyite*.

Occurrence: **KA Lazebnik YuD Lazebnik VF Makhotko** 1984 ZVMO 113 95;

G Raade 1987 AM 72 1014-5.

Synthetic: **W Gebert O Medenbach OW Flörke** 1983 TMPM 31 69-79.

dauidite-Ce $(\text{Ce},\text{La})(\text{Y},\text{U},\text{Fe})(\text{Ti},\text{Fe})_{20}(\text{O},\text{OH})_{38}$. *Crichtonite* structure type.

Structure: **BM Gatehouse IE Grey PR Kelly** 1979 AM 64 1010-7.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

dauidite-La $(\text{La},\text{Ce})(\text{Y},\text{U},\text{Fe})(\text{Ti},\text{Fe})_{20}(\text{O},\text{OH})_{38}$. *Crichtonite* structure type.

Structure: **BM Gatehouse IE Grey PR Kelly** 1979 AM 64 1010-7.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

Synthetic LaTiGaO , structure & XRPD: **A Meden D Kolar S Skapin** 1999 PD 14 36-41 (M1717).

davisonite $\text{Ca}_3\text{Al}(\text{PO}_4)_2(\text{OH})_3\cdot\text{aq}?$.

Occurrence: **Dana** 2 939-40. Name: MM 29 979.

davreuxite $\text{MnAl}_6\text{Si}_4\text{O}_{17}(\text{OH})_2$.

Structure: **K Sahl PG Jones GM Sheldrick** 1983 AM 69 783-87.

davyne $(\text{Na},\text{Ca},\text{K})_8\text{Al}_6\text{Si}_6\text{O}_{24}(\text{Cl},\text{SO}_4,\text{CO}_3)_{2-3}$. *Cancrinite* structure type.

Review: **Sabelli** p. 40-1.

Structure: **P Bariand F Cesbron R Giraud** 1968 BSFMC 91 34-42;

E Bonaccorsi S Merlino M Pasero 1990 NJMM 3 97-112 (B970);

I Hassan HD Grundy 1990 CM 28 341-9;

XRPD, **P Ballirano A Maras PR Buseck AM Yates** 1997 PD 12 9-102 (B1959);

carbonate, SC-XRD, **P Ballirano E Bonaccorsi S Merlino** 1998 CM 36 1285-92.

dawsonite $\text{NaAl}(\text{CO}_3)(\text{OH})_2$.
 Structure: **AJ Frueh Jr JP Golightly** 1967 CM 9 51-6;
E Corrazza C Sabelli S Vannucci 1977 NJMM 381-97;
TLT Trinh EA Pobedinskaya AP Khomyakov 1987 Vest Mosk univ Ser. 4 Geol 1 74-7.
 Occurrence: in hyperagpaitic alkaline rocks, **Khomyakov** (1995);
 fluid inclusion in *quartz*, MC Sirbescu PL Nabelek 2003 AM 88 1055-60.
Synthetic (Na/K/NH₄): **X Zhang & 4 others** 2004 JSSC 177 840-55 (10105).
dayingite $\text{Cu}(\text{Co,Pt})_2\text{S}_4$. Very close to *carrollite* $\text{Cu}(\text{Co,Ni})_2\text{S}_4$.
Spinel structure type, *polydymite* family, from cell data.
 Structure determination not found.
 Occurrence: AM 61 184 = MM 40 906.
 = *Co-rich malanite*: AM 67 1081-2, AM 82 821.

deanesmithite $\text{Hg}^+\text{Hg}^{2+}_3\text{Cr}^{6+}\text{O}_5\text{S}_2$.
 Occurrence & structure summary: **AC Roberts & 4 others** 1993 CM 31 787-93.

[debaosite $\text{Cu}_{10}(\text{AsO}_4)_2(\text{SO}_4)(\text{CO}_3)(\text{OH})_{10.5}\text{aq}$.
 Not approved IMA; status uncertain = MM 60 528.]

decrespignyite-Y $(\text{Y,RE})_4\text{Cu}(\text{CO}_3)_4\text{Cl}(\text{OH})_5.2\text{aq}$. No structure.
 Occurrence & XRPD: **K Wallwork & 3 others** 2002 MM 66 181-8.

deerite $(\text{Fe,Mn})_6(\text{Fe,Al})_3\text{Si}_6\text{O}_{20}(\text{OH})_5$. Edge-sharing octahedra.
 Structure: **ME Fleet** 1977 AM 62 990-8 (F357).
 Occurrence: MM 35 1132.
Alumino-deerite $\sim\text{Fe}_6\text{Al}_3\text{Si}_6\text{O}_{20}(\text{OH})_5$, *synthetic* endmember: MM 43 1057.

defernite $\text{Ca}_6(\text{CO}_3)_{2-x}(\text{SiO}_4)_x(\text{OH})_7(\text{Cl,OH})_{1-2x}$, $x \sim 0.5$.
 Composition revised: **BW Liebich H Sarp** 1985 SMPM 65 153-8.
 Near isostructural with *holdawayite*.
 Structure: **DR Peacor & 4 others** 1988 AM 73 888-93;
 SC-XRD, 100K, SiO_4 substitution mechanism, **T Armbruster P Yang W Lieblich** 1996 AM 81 625-31.

[dehrite $?7\text{CaO} \cdot (\text{Na/K})_2\text{O} \cdot 2\text{P}_2\text{O}_5 \cdot \text{aq}$.
 Occurrence: MM 22 618.]

delafossite CuFeO_2 . 3R-polytype is isostructural with *mccconnellite*.
 Mössbauer: **AH Muir H Wiedersich** 1967 JPCS 28 65-71.
 2H-polytype: **H Effenberger** 1991 AC C47 2644-6.
 XRPD to 10GPa: **TR Zhao & 4 others** 1997 MRB 32 151-7 (Z124).
 Distribution of M-M distances: **R Isea A Ramos-Gallardo** 1998 AC B54 35-40 (I228).
Synthetic BaHgO_2 : **SN Putilin SM Karzakov M Marezio** 1994 JSSC 109 406-?
Synthetic CuAlO_2 , p- electric conduction: **H Kawazoe M & 5 others** 1997 N 389 939-42 (K1016);
 XRPD, TEM: **G Van Tenderloo & 4 others** 2001 JSSC 156 428-36 (1319);
 defects vs hydrothermal & standard syntheses, **BJ Ingram & 6 others** 2004 ChM 16 5616-22 (10977).
Synthetic $\text{In}(\text{Fe,Ti})\text{O}$ compounds: **F Brown N Kimizuka** 2001 JSSC 157 13-22 (1730).
Synthetic CuGaO , high-P: **J Pellicer-Porres & 11 others** 2004 PRB 69 024109 (10070).

DELHAYELITE STRUCTURE GROUP Includes:

<i>delhayelite</i>	$(\text{Na,K})_{10}\text{Ca}_5\text{Al}_6\text{Si}_{32}\text{O}_{80}(\text{Cl}_2,\text{F}_2,\text{SO}_4)_3.18\text{aq}$
<i>hydrodelhayelite</i>	$\text{KCa}_2(\text{Si}_7\text{Al})\text{O}_{17}(\text{OH})_2.6\text{aq}$
<i>macdonaldite</i>	$\text{BaCa}_4\text{Si}_{16}\text{O}_{36}(\text{OH})_2.10\text{aq}$
<i>mountainite</i>	$(\text{Ca,Na}_2,\text{K}_2)_2\text{Si}_4\text{O}_{10}.3\text{aq}$
<i>rhodesite</i>	$(\text{Ca,Na}_2,\text{K}_2)_8\text{Si}_{16}\text{O}_{40}.11\text{aq}$

Review: **MI Chiragov MG Dorfman** 1981 DAN USSR ES 260 134-7 (C717).

delhayelite $(\text{Na,K})_{10}\text{Ca}_5\text{Al}_6\text{Si}_{32}\text{O}_{80}(\text{Cl}_2,\text{F}_2,\text{SO}_4)_3.18\text{aq}$.
 Structure: **E Cannillo G Rossi L Ungaretti** 1969 RSIMP 26 3-15 (C210).
 Uncertain composition & review of occurrences: **JB Dawson PG Hill** 1998 MM 62 179-96.
 Occurrence: Oldoinyo Lengai, MM 32 953;

deliensite $\text{Fe}(\text{UO}_2)_2(\text{SO}_4)_2(\text{OH})_2.3\text{aq}$.

Occurrence, SC- & P-XRD, FTIR: **R Vochten N Blaton O Peeters** 1997 CM 35 1021-5.
delindeite $(\text{Na,K,void})_3\text{Ba}_2(\text{Ti,Fe})\text{Ti}_2(\text{O,OH})_4\text{Si}_4\text{O}_{14}(\text{aq,OH})_2$.
Bafersitite mero-plesiotype structure series.
Structure: SC-XRD, **G Ferraris & 4 others** 2001 CM 39 1306-11.
Occurrence: Magnet Cove, $\sim(\text{Na,K})_{2.7}(\text{Ba,Ca})_4(\text{Ti,Fe,Al})_6\text{Si}_8\text{O}_{26}(\text{OH})_{14}$, **DE Appleman & 4 others** 1987 MM 51 417-25.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** (1995).
dellaite $\text{Ca}_6\text{Si}_3\text{O}_{11}(\text{OH})_2$.
Synthetic: **RM Ganiev VV Ilyukhin NV Belov** 1970 SPD 15 85-?;
AN Safronov & 3 others 1981 SPD 26 129-30 (S1299).
Occurrence: **SO Agrell** 1965 MM 34 1-15.
dellaventuraite $\text{NaNa}_2(\text{MgMn}_2\text{TiLi})\text{Si}_8\text{O}_{22}\text{O}_2$. Amphibole.
Occurrence & SC-XRD structure: **KT Tait & 4 others** 2005 AM 90 304-9.
deloneite-Ce $\text{NaCa}_2\text{SrCe}(\text{PO}_4)_3\text{F}$. *Apatite* structure type. Isotype of *belovite*.
Occurrence/crystallography: **AP Khomyakov & 3 others** 1996 ZVMO 5 83-94 (K898).
Structure: **RK Rastsvetaeva AP Khomyakov** 1996 DAN 349 354-7.
R-apatite: new mineral, $\text{Ca}_{3.2}(\text{Sr}_{1.2}\text{Na}_{0.3}\text{Ce}_{0.3})(\text{PO}_4)_3\text{F}$, SC-XRD structure, **RK Rastsvetaeva AP Khomyakov** 1996 CrR 41 789-92 (R724).
deloryite $\text{Cu}_4(\text{UO}_2)(\text{MoO}_4)_2(\text{OH})_6$.
Structure: *synthetic*, **R Tali VV Tabachenko LM Kovba** 1993 Neog Khim 38 1450-2;
natural, different description, **DYu Pushcharovsky RK Rastsvetaeva H Sarp** 1996 JAICo 239 23-6 (P630).
Structure relation with *derriksite*.
Occurrence: **H Sarp PJ Chiappero** 1992 NJMM 58-64 (S1455).
delrioite $\text{CaSrV}_2\text{O}_6(\text{OH})_2.3\text{aq}$.
Structure determination not found.
Intergrown *metadelrioite* $\text{CaSrV}_2\text{O}_6(\text{OH})_2$, SC-XRD parallel fibers: **ML Smith** 1970 AM 55 185-200.
Occurrence: MM 32 953.
[delta-alumina] Al_2O_3 .
Synthetic: modulated variant of sigma-: **H Saalfeld W Guse** 1991 NJMA 163 159-67 (S1467).
[deltaite] $8\text{CaO}.5\text{Al}_2\text{O}_3.4\text{P}_2\text{O}_5.14\text{aq}$.
Occurrence: MM 22 618.]
delvauxite $(\text{Ca,Mg})(\text{Fe,Al})_3(\text{PO}_4,\text{SO}_4,\text{CO}_3)_2(\text{OH})_{8.4-6\text{aq}}$. Amorphous.
Probably equals *borickyite* & *foucherite*: (C756).
demesmaekerite $\text{Pb}_2\text{Cu}_5(\text{UO}_2)_2(\text{SeO}_3)_6(\text{OH})_6.2\text{aq}$.
Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Structure: **D Ginderow F Cesbron** 1983 AC C39 824-7.
Occurrence: MM 35 1132.
denisovite $(\text{K,Na})\text{Ca}_2\text{Si}_3\text{O}_8(\text{F,OH})$. ?K-analog of *pectolite*.
Structure determination not found.
Occurrence: **YuP Menshikov** 1984 ZVMO 113 607-12 = AM 70 1329.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** (1995).
denningite $(\text{Mn,Ca,Zn})\text{Te}_2\text{O}_5$.
Structure: **EV Walitzi** 1965 TPM 10 241-55 (W112).
Occurrence: MM 33 1131.
Synthetic $\text{MnCu}(\text{Te}_2\text{O}_5)$: **R Miletich** 1991 Ost Akad Wiss Math etc. 128 31-4 = MA 94M/2947;
R Miletich 1993 MP 48 129-45 = MA 94M/1598.
[dennisonite] $6\text{CaO}. \text{Al}_2\text{O}_3. 2\text{P}_2\text{O}_5. 5\text{aq}$.
Occurrence: MM 22 618.]
DERBYLITE MINERAL GROUP

<i>derbylite</i>	$\text{Fe}_4\text{Ti}_3\text{SbO}_{13}(\text{OH})$
<i>graeserite</i>	$\text{Fe}_4\text{Ti}_3\text{AsO}_{13}(\text{OH})$
<i>hemloite</i>	$(\text{Ti,V,Fe,Al})_{12}(\text{As,Sb})_2\text{O}_{23}(\text{OH})$.
<i>tomichite</i>	$(\text{V,Fe})_4\text{Ti}_3\text{AsO}_{13}\text{OH}$

derbylite $\text{Fe}_4\text{Ti}_3\text{SbO}_{13}(\text{OH})$.
Essentially isostructural with *tomichite* $(\text{V},\text{Fe})_4\text{Ti}_3\text{AsO}_{13}\text{OH}$.
Structure: **PB Moore T Araki** 1976 NJMA 126 292-303 (M566).

derriksite $\text{Cu}_4(\text{UO}_2)(\text{SeO}_3)_2(\text{OH})_6\text{.aq}$.
Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Structure: **D Ginderow F Cesbron** 1983 AC C39 1605-7.
Possible structural relation with *deloryite*.
Occurrence: MM 38 990.

dervillite Ag_2AsS_2 .
Structure determination not found.
Occurrence: **H Bari** 1941 Pierres et Terre 23-24 62-7 = AM 68 1041.

desautelsite $\text{Mg}_6\text{Mn}_2(\text{CO}_3)(\text{OH})_{16}\text{.4aq}$. *Hydrotalcite/pyroaurite* structure group.
Structure determination not found.
Occurrence: **PJ Dunn DR Peacor TD Palmer** 1979 AM 64 127-30;
MA 96M/2136; MA 97M/1999.

DESCLOIZITE MINERAL GROUP OF LEAD VANADATES *Conichalcite/descloizite*
structure group. Includes:

<i>cechite</i>	$\text{Pb}(\text{Fe},\text{Mn})\text{VO}_4\text{OH}$
<i>descloizite</i>	$\text{Pb}(\text{Zn},\text{Cu})\text{VO}_4\text{OH}$
<i>mottramite</i>	$\text{Pb}(\text{Cu},\text{Zn})\text{VO}_4\text{OH}$
<i>pyrobelonite</i>	PbMnVO_4OH
<i>tangeite</i>	$\text{CaCuVO}_4(\text{OH})$

tangeite replaces *calciovolborthite*.
See **ADELITE** for isostructural arsenates and two silicates.

descloizite $\text{Pb}(\text{Zn},\text{Cu})\text{VO}_4\text{OH}$. *Conichalcite/descloizite* structure type.
Descloizite mineral group.
Structure: **HG Bachmann** 1953 AC 6 102 & NJMM 193-208;
MM Qurashi WH Barnes 1963 CM 7 561-77;
do 1964 CM 8 23-39;
FC Hawthorne R Faggiani 1979 AC B35 717-20.

despujolsite $\text{Ca}_3\text{Mn}(\text{SO}_4)_2(\text{OH})_6\text{.3aq}$.
Isostructural with *fleischerite*, *schaurteite* & $\text{Ca}_3\text{Ge}(\text{SO}_4)_2(\text{OH})_6\text{.3aq}$. Review: **Sabelli** p. 33.
Structure: **C Gaudfroy & 3 others** 1968 BSFMC 91 43-50.

dessautite $(\text{Sr},\text{Pb})(\text{Y},\text{U})(\text{Ti},\text{Fe}^{3+})_{20}\text{O}_{38}$. *Crichtonite* mineral group.
Structure: **P Orlandi & 3 others** 1997 AM 82 807-11.

destinezite $\text{Fe}_2(\text{PO}_4)(\text{SO}_4)(\text{OH})_6\text{.aq}$. Cf. amorphous *diadochite*.
Structure: **DR Peacor & 3 others** 1999 CICIM 47 1-11 (P826).

devilline / devillite $\text{CaCu}_4(\text{SO}_4)_2(\text{OH})_6\text{.3aq}$. Corrugated layer structure.
Ca-analog of *lautenthalite* $\text{PbCu}_4(\text{SO}_4)_2(\text{OH})_6\text{.3aq}$. See *campigliaite*, *ktenasite* & *serpierite*.
Review: **Sabelli** p. 24; (E289).
Structure: **C Sabelli PF Zanazzi** 1972 AC B28 1182-9.
Raman vs OH: **RL Frost & 4 others** 2004 AM 89 1130-7.

[devitrite $\text{Na}_2\text{Ca}_3\text{Si}_6\text{O}_{16}$.
Structure: **M Ihara & 5 others** 1984 *The crystal structure of devitrite (disodium tricalcium hexasilicate, Na₂Ca₃Si₆O₁₆)*, Yogyo Kyokai Shi 92 373-8.
Occurrence in commercial devitrified glass: MM 23 628.]

dewindtite $\text{Pb}_3[\text{H}(\text{UO}_2)_3\text{O}_2(\text{PO}_4)_2]_2\text{.12aq}$.
Phosphuranylite mineral group; geometrical isomer uudduuS; beware of problems.
Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Structure: **P Piret J Piret-Meunier M Deliens** 1990 EJM 2 399-405.
Supposed isostructural with but chemically different from *renardite*: **V Ross** 1956 AM 41 915-26.

diabolite / diaboelite / diabolite $\text{Pb}_2\text{CuCl}_2(\text{OH})_4$. Defect *perovskite* structure type.

Structure: **A Byström K-A Wilhemi** 1950 Arkiv Kemi 2 397-404 = MA 11-237;
RC Rouse 1971 ZK 134 69-80 = MA 72-1866;
MA Cooper FC Hawthorne 1995 CM 33 1125-9.

diadochite $\text{Fe}_2(\text{PO}_4)(\text{SO}_4)(\text{OH}) \cdot 5\text{aq}$.

Review; **Sabelli**; ?amorphous, no structure determination.

Occurrence: **Dana**.

[destinezite $\text{Fe}_2(\text{PO}_4)(\text{SO}_4)(\text{OH}) \cdot 6\text{aq}$. Cf. amorphous *diadochite*.

Structure: **DR Peacor & 3 others** 1999 CICIM 47 1-11 (P826).]

diamond C. Isostructural with *silicon* & *grey tin*.

Polymorphic with *chaoite*, *graphite*, *lonsdaleite* & unnamed cubic 14.7 Å phase at Popigai impact crater [**A El Goresy & 8 others** 335 CRG 335 889-98 (9808)].

See special issue of Elements 1 (2) 2005 for reviews of inclusions, origin, carbonado & framesite, microdiamonds in metamorphic rocks, meteoritic microdiamonds, changing color of gems, and growing better diamonds.

Diamond is the hardest known material, and an excellent thermal conductor. It is refractory when protected from oxygen. Diamond is thermodynamically stable only at high pressure.

Geologically, it occurs in xenoliths from the earth's mantle, and it carries various high-P minerals as inclusions. Collision-induced shock pressure has converted *graphite* into diamond in certain meteorites and Earth rocks. Diamond occurs in various metamorphic rocks where its history is still uncertain. It is shaped and polished as a gem.

As an industrial abrasive, diamonds of poor quality are best. Diamond has been synthesized by vapor processes that can coat cutting tools.

C Owers 2000 *Industrial diamond: applications, economics and a view to the future*, Industr Diamond Review 60 176-81.

[*Cyclohexamantane* $\text{C}_{26}\text{H}_{30}$ occurs in petroleum, and is described as a small diamond molecule capped with H: **JE Dahl & 7 others** 1999 N 399 54-6, news & views 15-6 (9074); **JEP Dahl & 12 others** 2003 AnCh 42 2040-4 (9022); **H Hopf** 2003 ACIE 42 2000-2 (9005).

C_{14} - C_{15} diamantane in crystalline basement: **GN Gordadze GV Rusinova** 2004 GI 42 1086-90 (10880).]

E Edward 2002 *Diamond Deposits: Origin, Exploration, and History of Discovery*, TN990.E75.

M Power & 2 others 2004 *Geophysical methods for kimberlite exploration in northern Canada*, LE 1124-9 (10803).

MN Ducea & 3 others 2005 *Subducted carbonates, metasomatism of mantle wedges, and possible connection to diamond formation; An example from California*, AM 90 864-70.

Structural properties: bulk

Electron density: neutron PD, **PF Price EN Maslen FH Moore** 1978 AC A34 171-2;

PF Price EN Maslen 1978 AC A34 173-83.

MA Spackman 1991 AC A47 420-7.

synchrotron XRD: **CA Boeyens & 3 others** 1999 ZK 214 351-2 (B1946).

Famous Diamonds: **I Balfour** 1997, TS 753.B18.

Optical Properties of Diamond: **AM Zaitsev** 2001 Springer, QE393.Z35.

Nitrogen & other impurities, IR: **FV Kaminsky GK Khachatryan** 2001 CM 39 1733-46.

Superconductivity, *synthetic* high-P, B-doped, >4 K: **EA Ekimov & 6 others** 2004 N 542-5 (10161).

Black, Siberia, SEM/TEM, *magnetite* inclusions: **SV Titkov & 4 others** 2003 GG 200-9 (9606).

Raman: effect of B impurity, **AN Utyukh & 2 others** 2004 IMA 40 926-31 (10706).

3D-H microscopy: **P Reichart & 5 others** 2004 S 306 1537-40 (10318).

Neutron irradiation vs phase transition: **IKh Abdukadyrova** 2004 IMA 40 1186-90 (10868).

Luminescence/absorption of natural & synthetic: **J Lindblom & 3 others** 2005 AM 90 428-40.

Raman mapping of growth zoning & strain: **L Nasdala & 3 others** 2005 AM 90 745-8.

Shock compressing to a conducting fluid at 600-1000 GPa: **DK Bradley & 6 others** 2004 PRL 93 195506 (10958).

Structural properties: surface

Diamond nucleation by H condensation on *graphite* edges: **WRL Lambrecht & 5 others** 1993 N 364 607-10 (8885).

Diamond coating of titanium alloys: **MD Drory JW Hutchinson** 1994 S 263 1753-5 (8883).

Growth, atomic hydrogen & methyl radicals: **SS Lee & 3 others** 1994 S 263 1596-8 (8884).

Structure & morphology of polished-, XRD, interpretation of truncation rods in terms of terminal H & OH: **WJ Huisman & 6 others** 1997 SuS 387 342-53 (H1263).

Surface termination by H and O: **DP Malta JB Posthill TP Humphreys RJ Markunas** 1997 USA Microscopy & Analysis Jan 7-9 (M1443).

H adsorption: **T Aizawa T Ando** 1996 J Cryst Soc Japan 38 160-6 = MA 98M/1490.

Canada, 538 kimberlites & growing production: **BA Kjarsgaard AA Levinson** 2002 GG Fall 208-38 (9075).
Venetia kimberlite, S. Africa: IR of N-bearing, implications for craton-margin: **KS Viljoen** 2002 CMP 144 98-108 (8343).
Ferropericlase/enstatite incl suggested as disproportionate product of *ferromagnesite*: **L Liu** 2002 CMP 144 16-21 (8342).
Inspinel/garnet spinel/garnet in gt websterite, w. Norway: **HLM van Roermund & 3 others** 2002 G 30 959-62 (8277).
~600 crystals, W Russia kimberlites, IR, H/N content: **GK Khachatryan FV Kaminsky** 2003 CM 41 171-84.
~2300 gems, Yakutia, *chromite, garnet* inclusions, non-syngenetic: **LA Taylor & 4 others** 2003 AM 88 912-28.
Guaniamo, *coesite* incl, O isotope link with altered sea-floor basalts: **DJ Schulze & 4 others** 2003 423 68-70 (8948).
Nanocrystals, gt-pyroxenite xenolith, Hawaii: **R Wirth A Rocholl** 2003 EPSL 211 357-69 (9072).
Oriented *graphite* inclusions, Ekati mine, Canada: **J Glinnemann K Kusaka JW Harris** 2003 ZK 218 733-9 (9676).
Lamproites, Argyle, W Australia, native Fe & Cr, FeCr & CuZn alloys, etc: **AI Gorshkov & 7 others** 2003 GI 41 1143-51.
Multi-stage metasomatism, eclogite xenos, Udachnaya kimberlite, Yakutia: **KC Misra & 3 others** 2004 CMP 146 696-714.
Peridotite inclusions, Orapa/Jwaneng kimberlites, Kalahari Craton: **T Stachel & 3 others** 2004 CMP 147 32-47 (10117).
Carbonatitic melt inclusions in cuboids, Udachnaya kimberlite: **DA Zedgenisov & 3 others** 2004 MM 68 61-74.
LA Taylor M Anand 2004 *Diamonds: time capsules from the Siberian mantle*, Chem Erde 64 1-74 (10310).
R Tappert & 4 others 2005 *Mineral inclusions in diamonds from the Panda kimberlite, Slave Province, Canada*, EJM 17 423-40. [*Ferropericlase* from lower mantle; with *Mg-Al spinel/ol/pure silica*. Peridotitic *garnet/ol/pyroxene*.]
Y Fedortchouk D Canil JA Carlson 2005 *Dissolution forms in Lac de Gras diamonds and their relationship to the temperature and redox state of kimberlite magma*, CMP 150 54-69.
Microdiamonds: classification & tectonic significance for Dabie & S-Lu, China: **S Xu & 4 others** 2005 MM 69 509-20.
Fibrous, Yakutia/Congo/Canada: IR, H- defects, water inclusions, **DA Zedgenisov & 3 others** 2006 MM 70 219-29.

Non-mantle occurrences

Carbonado, proposed origin from impact on early crust, **JV Smith JB Dawson** 1985 G 13 342-3;
microstructure: **S De & 4 others** 1998 EPSL 164 421-33 (D770);
cathodoluminescence: **CW Magee WR Taylor** 1999 Proc VII Int Kimberlite Conf 529-32;
magnetic properties of associated minerals, **G Kletetschka & 3 others** 2000 EPSL 181 279-90 (184);
chemical heterogeneity, **S De & 3 others** 2001 EPSL 185 315-30 (1334);
native Fe, Cr & Ni, rutile, sphalerite, pentlandite, zircon, **SV Titkov & 6 others** 2001 GI 39 228-36 (1410);
Brazil, *quartz/rutile/clay inclusions*, Pb-Pb dating, **Y Sano** 2002 PR 113 155-68 (3897);
EPR & photoluminescence, **VA Nadolny & 6 others** 2003 AM 88 11-7;
cathodoluminescence, **G Pratesi & 4 others** 2003 AM 88 1778-87
Brazil, -diamond aggregate, **AB Makeyev & 5 others** 2003 DES 393A 9 1251-5.
Polycrystal bort, Shengli kimberlite, China, inclusions of *iron, Fe-Cr, gersdorffite, siegenite*: **AI Gorshkov & 5 others** 2000 GI 38 698-705.
Microdiamonds, Saxony gneiss, micro-Raman: **L Nasdala H Massone** 2000 EJM 12 498 (N524).
Metamorphic, Kazakhstan gneiss: **LF Dobrzhinetskaya & 3 others** 2001 G 29 263-6 (1323).
Diamond/graphite in gneiss, Ries Crater, Germany: **A El Goresy & 5 others** 2001 AM 86 611-21.
Impact origin for ~3.5 Ga diamonds with eclogitic & meteoritic inclusions: **VN Anfilogov** 2001 DES 377 219-20 (1725).
Microdiamond daughter crystals precipitated from supercritical CO₂ + silicate fluids in *garnet*,
Erzgebirge, Germany: **B Stoeckert & 3 others** 2001 G 29 391-4 (1599).
Microdiamonds, *garnet/zircon*, Kazakhstan: TEM, many inclusion types including Th_xO_y, **LF Dobrzhinetskaya & 4 others** JMG 21 425-37 (9073).
Microdiamonds in *garnet*, Kokchetav gneiss: **S Hwang P Shen T Yui H Chu** 2003 EJM 15 503-11 (9174);
H Ishida & 3 others 2003 JMG 21 515-22.
CJ O'Neill L Moresi 2003 *How long can diamonds remain stable in the continental lithosphere?* EPSL 213 43-52 (9259).
BC Bostick & 5 others 2003 *Low-temperature microdiamond aggregates in the Maksyutov Metamorphic Complex, South Ural Mountains, Russia*, AM 88 1709-17.
NV Sobolev & 9 others 2003 *US-Russian Civilian Research and Development Fund Project: An origin of microdiamonds in metamorphic rocks of the Kokchetav Massif*, Ep 26 290-4 (9798).
AA Valter & 3 others 2003 *Structural and morphological evidence of the impact-induced development of diamond after graphite in the Novo-Urei meteorite*, GI 41 939-46 (9617).
MN Taran VM Kvasnytsya K Langer 2004 *On unusual deep-violet microcrystals of diamond from placers of Ukraine*, EJM 16 241-5 (10309).
Y Ding DR Veblen 2004 *Impactite from Henbury, Australia*, AM 89 961-8. [*Magnetite, quartz, hercynite, fayalite*.]
VS Shatsky & 4 others 2005 *Diamond formation in UHP dolomite marbles and garnet-pyroxene rocks of the Kokchetav Massif, northern Kazakhstan: natural and experimental evidence*, IGR 47 999-1010.

In meteorites: **AE Rubin** 1997 MPS 32 231-47;
presolar, HRTEM of meteoritic & terrestrial nano-: **TL Daulton & 4 others** 1996 GCA 60 4853-72 (1412);
IR of interstellar nano-, **HGM Hill & 3 others** 1997 MPS 32 713-8;
presolar history of trace gases, **AP Koscheev & 3 others** 2001 N 412 615-7 (2927);
?nanodiamond in early Solar System, **ZR Dai & 5 others** 2002 N 418 157-9 (7430).

Synthesis

- Epitaxial growth on *sapphire*: **M Yoshimoto & 7 others** 1999 N 399 340-2.
Thermal activation of *graphite*: **AV Palichenko & 4 others** 1999 N 402 162-4 (P854).
From carbonate/carbonatitic fluid: **YuN Pal'yanov & 4 others** 1999 N 400 417-8 (P859);
M Akaishi S Yamaoka 2000 JCG 209 999-1003 (A918);
AG Sokol & 5 others 2000 EJM 12 367-75 (S2148);
AG Sokol & 4 others 2001 EJM 13 893-900 (3445);
M Arima Y Kozai M Akaishi 2002 G 30 691-4 (7800).
From metal-carbon system: Fe-Ni-C, **VI Solozhenko & 4 others** 2002 JPC B 106 6634-7 (7451);
Fe-Ni-C-O, **II Kedorov AA Chepurov JM Dereppe** 2002 GcJ 36 247-53 (7683).
From sulfide-carbon system: **YuA Litvin & 3 others** 2002 DES 382 40-3 (7552).
Review: **AS Barnard** 2000 *The Diamond Formula*, TP873.5.B37.
Conversion of SiC: **Y Gogotsi & 3 others** 2001 N 411 283-6 (2083).
From carbon dioxide fluid: **S Yamaoka & 3 others** 2002 JCG 234 5-8 (3464).
Using Fe₃C: **L Yin & 5 others** 2002 JCG 234 1-4 (3465).
Magnesite/coesite/enstatite interaction: **YN Pal'yanov & 4 others** 2002 AM 87 1009-13.
Molten carbonate-silicate rock, 5.5-7.5 GPa, >1773 K: **YuA Litvin AV Spivak YuA Matseev** 2003 GI 41 109-8.
Fe/Ni impurities, XRF tomography/XANES: **Y Meng & 3 others** 2003 AM 88 1555-9.
Reduction of Mc carbonate with Na metal: **Z Lou & 4 others** 2003 AnCh 42 4501-3 (9579).
From C-pentlandite melt at mantle PT: **YuN Pal'yanov & 3 others** 2003 DES 392 1026-9 (9406).
From carbonate-silicate rock, Uzbekistan, 4-7 GPa 1473-1973 K: **AV Bobrov & 2 others** 2004 GI 42 39-48 (9893).
Apollo Diamond Inc, gem quality, CVD method: **W Wang & 5 others** 2003 GG 39 268-83.
Synthetic sintered vs carbonado: **S De & 3 others** 2004 AM 89 439-46.
Synthetic reduction of CO₂ by K/Li: **Z Lou & 4 others** 2004 JPCB 108 4239-41 (10142).
Synthesis at 6 GPa 1473 & 1693 K: C-O-H fluid vs time, **AG Sokol & 3 others** 2004 GI 42 830-8 (10707).
B impurity vs Raman: **AN Utyuzh & 2 others** 2004 IMA 40 926-31 (10706).
Skeletal: **LF Dobrzhinetskaya & 2 others** 2004 G 32 869-72 (10804).
Effect of SiC: **VP Shipilo & 4 others** 2004 IMA 40 1156-60 (10881).
Mantle P-T with carbonate fluids: analytical review, **AG Sokol YuN Pal'yanov** 2004 GI 42 1018-32 (10882).
Characteristics of high-P,T synthetic diamonds: **JE Shigley & 2 others** 2004 GG 40 303-13.
Shock, graphite gneiss: **T Kenkmann U Hornemann D Stöfler** 2005 MPS 1299-310.
- Synthetic analogs
Synthetic Borazone, BN, SC-XRD structure: **K Eichhorn & 3 others** 1991 AC B47 843-8 (E306).
Shock *synthesis*, cubic BC₂N: **T Komatsu M & 3 others** 1996 JMC 6 1799-803 (K879).
Calculated strength of BC₂N: **Y Zhang & 2 others** 2004 PRL 195504 (10959).
- diaoyudaoite** NaAl₁₁O₁₇.
Matches *synthetic* sodium beta-alumina: **CR Peters & 3 others** 1971 AC B27 1826-34 (P515).
Occurrence: **S Shen & 5 others** 1986 Acta Min Sinica 6 224.
Synthetic Na_{1+x}Al₁₁O_{17+x/2}: **K Edström JO Thomas GC Farrington** 1991 ACB 47 210-6 (E345).
- diaphorite** Ag₃Pb₂Sb₃S₈. Derivative of *galena*.
Structural relations between *diaphorite*, *freieslebenite*, *marrite* & *sicherite*: **P Berlepsch E Makovicky T Armbruster** 2002 NJMA 178 75-91 (8796).
Structure: too simple, **E Hellner** 1958 ZK 110 169-74;
cation order, polytypism: **T Armbruster & 3 others** EJM 15 137-40.
- DIASPORE STRUCTURE GROUP** Includes:
- | | |
|------------------------|--|
| <i>bracewellite</i> | CrO(OH) |
| <i>diaspore</i> | AlO(OH) |
| <i>goethite</i> | FeO(OH) |
| <i>groutite</i> | MnO(OH) |
| <i>montroseite</i> | (V,Fe)O(OH) |
| <i>paramontroseite</i> | VO ₂ loss of hydrogen from <i>montroseite</i> |
- Synthetic* alpha-GaOOD, ND: **MF Pye JJ Birtill PG Dickens** 1977 AC B33 3224-6.
diaspore (Al,Fe)O(OH). *Diaspore* structure type.
Structure: **WR Busing HA Levy** 1958 AC 11 798-803 (B216);
RJ Hill 1979 PCM 5 179-200.
Thermal expansion to 573K: **AR Pawley SAT Redfern TJB Holland** 1996 AM 81 335-40.

Polarized EXAFS, epitaxial growth of *hematite*-like clusters in natural Fe-: **JL Hazemann & 3 others** 1992 PCM 19 25-38 (H802).

Comparison of cation array in Al oxides, hydroxides and oxyhydroxides: **A Ramos-Gallardo A Vegas** 1996 ZK 211 299-303 (R665).

Dehydration to *corundum* and water, TEM: **L Loeffler W Mader** 2001 AM 86 293-303.

Stabilization of Mn(II): **U Halenius** 2001 NJMM 81-96 (1224).

Thermal decomposition, IR: **JT Klopogge HD Ruan RL Frost** 2000 JMS 37 1121-9 (7252).

Theermoluminescence: **V Correcher & 2 others** 2003 GRL 30 18028 (9601).

[*Tanatarite* is supposed to be monoclinic dimorph: MM 21 577.]

dickinsonite (K,Ba)(Na,Ca)₅(Mn,Fe,Mg)₁₄Al(PO₄)₁₂(OH,F)₂.

Isostructural with *arrojadite* KNa₄CaMn₄Fe₁₀Al(PO₄)₁₂(OH,F)₂ & *sigismundite* Na₃(Ba,K,Pb)(Ca,Sr)(Fe,Mg,Mn)₁₄Al(PO₄)₁₂(OH)₂.

Possible relation with *panethite*. 2,3-connected octahedral-tetrahedral net.

Structure: **PB Moore & 4 others** 1981 AM 66 1034-49.

dickite Al₂Si₂O₅(OH)₄. *Kaolinite-serpentine* mineral group. Polymorphic with *halloysite*, *kaolinite* & *nacrite*.

Structure: **RE Newnham GW Brindley** 1956 AC 9 759-64;
RE Newnham 1961 MM 32 683-704;
JM Adams AW Hewat 1981 CICIM 29 316-9;
IV Rozhdestvenskaya & 3 others 1982 Mineral Zh 4 52-8 = MA 83M/0162;
W Joswig VA Drits 1986 NJMM 19-22;
Fourier transform Raman, **RL Frost** 1995 CICIM 43 191-5;
RL Frost et al 1998 Analyst 123 611-6;
SC-Raman, **CT Johnston & 4 others** 1998 AM 83 75-84;
polarized Raman & IR, **S Shoval & 4 others** 2001 CICIM 49 347-54 (2919).

Stacking defects/long-period polytypes in kaolin minerals, hydrothermal deposit: **T Kogure A Inoue** 2005 EJM 17 465-73.

OH: deformation, **RL Frost** 1998 CICIM 46 280-9 (F617);
molecular dynamics, **L Benco & 3 others** 2001 AM 86 1057-65.

P-controlled polytypism: **P Dera & 3 others** 2003 AM 88 1428-35.

H, diffusion & solubility: **S Hercule J Ingrin** 1999 AM 84 1577-87.

Cr-incorporation, EPR: **E Balan & 3 others** 2002 PCM 29 273-9 (7759).

Thermochemistry showing less stable than *kaolinite*: **C Fialips & 3 others** 2003 AM 88 837-45.

Occurrence: MM 22 618-9;
Highland Boundary Fault, **J Parnell M Baron A Boyce** 2000 JGSL 157 635-40 (P872);
N Australia, **P Patrier & 3 others** 2003 CICIM 51 102-16 (8610).

Metadickite: MA 83M/0160.

dickthomssenite Mg(V₂O₆).7aq.

Occurrence & SC-XRD structure: **JM Hughes & 8 others** 2001 CM 39 1691-700.

[dienerite Ni₃As. Probably *Ni-skutterudite*: MM 65 685-7.

Occurrence: MM 21 562; **Dana**.]

dietrichite (Zn,Fe,Mn)Al₂(SO₄)₄.22aq. *Halotrichite* structure type. Review: **Sabelli** p.11.

Structure: XRPD, **P Ballirano & 2 others** 2003 EJM 15 1043-9 (10075).

dietzeite Ca₂(IO₃)₂(CrO₄).aq.

Structure: **PC Burns FC Hawthorne** 1993 CM 31 313-9 (B1610).

digenite Cu₉S₅.

Phase transition from low digenite to 1a-solid-solution at 355 K, revised phase diagram of series with *bornite*, NPD: **BA Grguric RJ Harrison A Putnis** 2000 MM 64 213-31.

Structure: **G Donnay JDH Donnay G Kullerud** 1958 AM 43 228-42 (D7);
3 polymorphs, *synthetic*, **N Morimoto G Kullerud** 1963 AM 48 110-23 (M117);
N Morimoto A Gyobu 1971 AM 56 1889-909;
L Pierce PR Buseck 1978 AM 63 1-16;
high-T, **GB Gasymov & 4 others** 1978 SPD 23 218-9 (G685);
MA Gesalov & 4 others 1979 SPC 24 700-3;
293 to 773 K, **G Will E Hinze ARM Abdelrahman** 2002 EJM 14 591-8 (7675).

Occurrence in meteorites: **AE Rubin** 1997 MPS 32 733-4.
dimorphite As_4S_3 -II. Polymorphs I (alpha) & II: MA 74-954.
Synthetic-I: **J Whitfield** 1970 J Chem Soc A 1800-3.
dinite $C_{20}H_{36}$. Structure: AM 77 674.
diomignite $Li_2B_4O_7$.
2 interlocking nets. 1 tetrahedon & 1 triangle linked into CTF net 1059.
Structure, *synthetic*: **J Krogh-Moe** 1968 AC B24 179-81;
M Natarajan R Faggiani ID Brown 1979 Cryst Struct Commun 8 367-70.
Occurrence: **D London ME Zolensky E Roedder** 1987 CM 25 173-80.
diopside $CaMgSi_2O_6$. *Pyroxene* structure type, monoclinic subgroup.
Structure: early papers not listed;
LW Finger Y Ohashi 1976 AM 61 303-10 (F200);
L Levien CT Prewitt 1981 AM 66 315-23;
high T & P, **RM Hazen LW Finger** 1981 CIWYB 80 373-6;
20 structures, MA 90M/3898;
P Benna G Chiari E Bruno 1987 MP 36 71-84 (B1346);
S Carbonin & 4 others 1989 MP 41 1-10 (C763);
TEM of shocked, **H Leroux JC Doukhan F Langenhorst** 1994 PCM 20 521-30;
K-richest Cr-diopside, effect of K on average structure, **GE Harlow** 1996 AM 81 632-8;
lattice-dynamics model, **T Pilati F Demartin CM Gramaccioli** 1996 AM 81 811-21;
crystal field spectra of trivalent Mn, **U Hälenius H Skogby** 1996 EJM 8 1231-40 (H1146);
cell data to 10 GPa, **L Zhang H Ahsbahs SS Hafner A Kutoglu** 1997 AM 82 245-58;
ferrian-aluminian, SC-XRD, anomalous dispersion for Fe(III): **M Okui & 4 others** 1997 MJJ 19 163-72 (O377);
SC-ND at 10 K, **M Prencipe M & 4 others** 2000 CM 38 183-9;
Fe Mössbauer, 4-800 K, **E De Grave SG Eeckhout** 2003 AM 88 1145-52.
High-P phase change to 34 GPa: **Y Kim LC Ming MH Manghnani** 1994 PEPI 83 67-79 (K979).
High-T Raman/quasi-harmonic lattice dynamics: **V Swamy LS Dubrovinsky M Matsui** 1997 PCM 24 440-6 (S1735).
High-T XRPD/Raman, phase change, **P Richet BO Mysen J Ingrin** 1998 PCM 25 404-14 (R836);
A Chopelas G Serghiou 2002 PCM 29 403-8 (7811).
Mg XANES: **D Cabaret & 3 others** 1998 AM 83 300-4.
REE diffusion: **JA Van Orman TL Grove N Shimizu** 2001 CMP 141 687-703 (3450).
O diffusion: **J Ingrin L Pacaud O Jaoul** 2001 EPSL 192 347-61 (3460).
OH vs O isotope diffusion, IR: **EA Johnson & 3 others** 2002 AM 87 899-908.
High-T diffusion of H, anisotropy: **SC Woods S Mackwell D Dyar** 2000 AM 85 480-7.
Creep: **A Dimanov & 4 others** JGRB 108 ECV 15-1 (8924).
Subsilicic ferrian aluminian, Chelyabinsk coal basin, SC-XRD: **YK Kabalov & 4 others** 1997 EJM 9 617-21 (K925).
Cr-diopside: H solubility & speciation, **GD Bromley & 4 others** 2004 AM 89 941-9.
K-bearing kosmochloric, Osayama serpentinite mélange, Japan: **T Tsujimori JG Liou** 2005 AM 90 1629-35.
In meteorites: **AE Rubin** 1997 MPS 32 231-47;
EL6 chondrite, **C Floss & 3 others** 2002 GCA 67 543-55 (8549).
Synthetic Mg-Ni series, MA 91M/3904;
Di₈₀En₂₀, low to high T, MA 91M/2595.
Synthetic NaFeGe₂O₆: MA 69-1974.
Synthetic Ca-Sr, XRPD & IR: **M Gottschalk J Najorka M Andrut** 1998 PCM 25 415-28 (G1110).
Synthetic ferri-Tschermak molecule, Mössbauer & XRPD: **GJ Redhammer** 1998 EJM 10 439-52 (R837).
Synthetic, high-T O diffusion: **L Pacaud J Ingrin O Jaoul** 1999 MM 63 673-86.
Synthetic Ti(3⁺,4⁺)-B-Na: SC-XRD structure: **S Nazzareni & 3 others** 2004 EJM 16 443-9 (10494).
diopstase $CuSiO_2(OH)_2$. Review (E289); sheet structure.
Structure: **HG Heide & 3 others** 1955 AC 8 425-30;
PH Ribbe GV Gibbs MM Hamil 1977 AM 62 807-11;
NV Belov & 3 others 1978 SPD 23 215-7 (B1109);
dehydrated, **KH Breuer W Eysel R Müller** 1989 ZK 187 15-23 (B1100);
vibrational analysis, **DA McKeown CC Kim MI Bell** 1995 PCM 22 137-44;
charge-density & antiferromagnetism, **EL Belokoneva & 3 others** 2002 PCM 29 430-8 (7814).
Synthetic Pb₃Ge₃O₉.aq, similar 6-rings: **HH Otto H-J Brandt** 1996 EJM 8 301-10 (O315).

Synthetic $\text{Cu}_3\text{Ge}_3\text{O}_9 \cdot 3\text{aq}$, structure: **H-J Brandt HH Otto** 1997 ZK 212 34-40 (B1565).
 CuSiO_3 , metastable decomposition product: **HH Otto M Meibohm** 1999 ZK 214 558-65 (O404).
dissakisite-Ce $\text{Ca}_{1.0}(\text{Ce}_{0.6}\text{La}_{0.3}\text{Nd}_{0.1})\text{Mg}_{0.9}\text{Ti}_{0.1}\text{Al}_{1.9}\text{Si}_{2.9}\text{O}_{12}(\text{OH})$.
Epidote structure type.
Structure: **RC Rouse DR Peacor** 1993 CM 31 153-7.
Occurrence: *talc-chlorite*, Trimouns, Pyrenees, **P de Parseval F Fontan T Aigouy** 1997 CRASP 324 IIa 625-30;
chromian-, in garnet lherzolite, China, **J Yang M Enami** 2003 AM 88 604-10.
Review: (different formula) **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
dissakisite-La $\text{CaLaMgAl}_2\text{Si}_3\text{O}_{12}(\text{OH})$.
Epidote structure type.
Occurrence & XRPD structure: **S Tumiati & 5 others** 2005 AM 90 1177-85.
Structure: SC-XRD & Mössbauer, **B Lavina & 3 others** 2006 AM 91 104-10.
dittmarite $(\text{NH}_4)\text{Mg}(\text{PO}_4) \cdot \text{aq}$. Layer structure with Mn/Fe/Ni/Co isotypes.
Structure: *synthetic*, XRPD, **KO Kongshaug H Fjellvag KP Lillerud** 2000 JMC 10 1915-20 (3631);
[also organically templated UiO-24-EN & UiO-24-DAB with same layers propped apart].
Synthetic Mn/Fe/Ni/Co: **D Tranqui & 3 others** 1968 BSFMC 91 10-7.
Synthetic $(\text{NH}_4)\text{Mn}(\text{AsO}_4) \cdot \text{aq}$ analog, XRPD/magnetism: **JL Mesa & 5 others** 1999 MRB 34 1545-6 (M1787).
Occurrence: **ME Mrose** 1971 USGS Prof Paper 750-A 115 = AM 57 1316.
diversilite-Ce $\text{Na}_2(\text{Ba},\text{K})_6\text{Ce}_2\text{FeTi}_3[\text{Si}_3\text{O}_9]_3(\text{SiO}_3\text{OH})_3(\text{OH},\text{aq})_9$. Similar to *ilimaussite-Ce*.
Structure: revised, **SV Krivovichev YN Yakovenchuk** 2005 ZVMO 134(1) 113-7 = AM 91 715.
Occurrence: **AP Khomyakov & 3 others** 2003 ZVMO 132-5 34-9 (10515).
dixenite $\text{CuMn}_{14}\text{Fe}(\text{As}^{3+}\text{O}_3)_5(\text{SiO}_4)_2(\text{As}^{5+}\text{O}_4)(\text{OH})_6$. *Mcgovernite* group.
Structure: **T Araki PB Moore** 1981 AM 66 1263-73 (A331).
[dixeyite] $?\text{Al}_2\text{O}_3 \cdot 4-5\text{SiO}_2 \cdot 3-4\text{aq}$.
Occurrence: MM 32 953.]
[djalmaite] Ta analog of *betafite*.
Occurrence: MM 26 336.]
djerfisherite $\text{K}_6\text{Na}(\text{Fe},\text{Cu},\text{Ni})_{24}\text{S}_{26}\text{Cl}$. ~Superstructure of *sphalerite*.
Djerfisherite group, see *bartonite*, *owensite* & *thalfenisite*.
Structure: **MT Dmitrieva VV Ilyukhin** 1976 SPD 20 469-70 (D470);
MT Dmitrieva VV Ilyukhin GB Bokii 1980 SPC 24 683-5.
Occurrence: MM 36 1150;
DB Clarke & 3 others 1994 CM 32 815-23;
MM 63 433-8.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
Synthetic $\text{K}_6\text{LiFe}_{24}\text{S}_{26}\text{Cl}$: **BS Tani** 1977 AM 62 819-23.
Synthetic $\text{Ba}_6\text{Cu}_{12}\text{Fe}_{13}\text{S}_{27}$: **J Llanos C & 4 others** 1997 JSSC 128 62-5 (L833).
djurleite $\text{Cu}_{31}\text{S}_{16}$.
Structure: **HT Evans Jr** 1979 S 203 3356-8;
do 1979 ZK 150 299-320 (E338);
do 1981 AM 66 807-18;
geometry & twinning, **H Takeda JDH Donnay DE Appleman** 1967 ZK 125 414-22.
Intergrowths with *digenite* & *chalcocite*: **M Posfai PR Buseck** 1994 AM 79 308-15 (1421).
Occurrence: MM 33 1131-2.
Roxbyite $\sim\text{Cu}_{1.5}\text{Fe}_{0.02}\text{S}$, structure possibly related to djurleite, occurrence & crystallography:
WG Mumme GJ Sparrow GS Walker 1988 MM 52 323-30.
Synthetic Cu-S phases: **T Ohtani & 3 others** 1995 MRB 30 1495-504 (O316).
dmisteinbergite $\text{CaAl}_2\text{Si}_2\text{O}_8$.
Trimorphic with *anorthite* & orthorhombic phase (*svyatoslavite*).
Synthetic phase denoted "*hexagonal anorthite*".
Occurrence: **BV Chesnokov & 4 others** 1990 ZVMO 43-6 (C713) = AM 77 446-7.
Synthetic, structure: **Y Takéuchi G Donnay** 1959 AC 12 405-70.
Synthetic "dehydrated-hexagonal-scholzite" is isostructural.

Breakdown of Ca-exchanged LTA zeolite to amorphous intermediate 1073-1173K, then to dmisteinbergite & partly disordered & ordered *anorthite*, XRPD refinement of dmisteinbergite: **R Dimitrijevic V Dondur A Kremenovic** 1996 Z 16 294-300 (D586).

dolerophane / dolerophanite $\text{Cu}_2(\text{SO}_4)\text{O}$. Review: **Sabelli** p.33; (E289).

Structure: **E Flügel-Kahler** 1963 AC 16 1009-14;

WJ McLean JW Anthony 1970 AM 55 1103-14;

H Effenberger 1985 Monat Chem 116 927-31;
MA 90M/1457.

dollaseite-Ce $\text{CaCeMg}_2\text{AlSi}_3\text{O}_{11}(\text{OH})\text{F}$.

Structure: **DR Peacor PJ Dunn** 1988 AM 73 838-42.

Mn-rich: AM 77 451.

Review: (different formula) **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

DOLOMITE STRUCTURE GROUP

Carbonates include:

ankerite $\text{Ca}(\text{Fe},\text{Mg})(\text{CO}_3)_2$

dolomite $\text{CaMg}(\text{CO}_3)_2$

kutnohorite $\text{Ca}(\text{Mn},\text{Mg},\text{Fe})(\text{CO}_3)_2$

minrecordite $\text{CaZn}(\text{CO}_3)_2$

norsethite $\text{BaMg}(\text{CO}_3)_2$

Isostructural with the borates:

nordenskiöldine $\text{CaSn}(\text{BO}_3)_2$

tusionite $\text{MnSn}(\text{BO}_3)_2$

Synthetic $\text{BaZr}(\text{BO}_3)_2$: **V Hornebecq & 3 others** 2002 MRB 37 2165-78 (8327).

dolomite $\text{CaMg}(\text{CO}_3)_2$.

Structure: early papers;

H Steinfink FJ Sans 1959 AM 44 679-82, O should be at 0.2474;

E Kahler 1962 Nw 49 298;

A Beran J Zemann 1977 TMPM 24 279-86;

PL Althoff 1977 AM 62 772-83;

RJ Reeder H-R Wenk 1979 GRL 6 77-80;

H Effenberger A Kirfel G Will 1983 TMPM 31 151-64 (E331);

RJ Reeder 1983 ReM 11 1-47;

RJ Reeder H-R Wenk 1983 AM 68 769-76;

modulated, **G Van Tenderloo H-R Wenk R Gronsky** 1985 PCM 12 333-41;

RJ Reeder SA Markgraf 1986 AM 71 795-804;

high-P, **NL Ross RJ Reeder** 1992 AM 77 412-21;

H-R Wenk H Meisheng S Frisia 1993 AM 78 769-74;

G Fiquet F Guyot J-P Itié 1994 AM 79 15-23; MA 78-1516;

XRPD at high P & T, **I Martinez J Zhang RJ Reeder** 1996 AM 81 611-24

incommensurate c-domain superstructure, **KA Schubel DC Elbert DR Veblen** 2000 AM 85 858-62;
298-1466 K at 3 GPa, cation disorder, **SM Antao & 4 others** 2004 AM 89 1142-7.

Anisotropic thermal expansion to 1 GPa 763 K: **T Wu & 4 others** 1995 AM 80 941-6

Raman to 25 GPa: **C Biellman P Gillet** 1992 EJM 4 389-93.

Black matrix breccias, Irish Zn-Pb ore, cathodoluminescence, inclusions: **JJ Wilkinson G Earls** 2000 MM 64 1017-36.

Cathodoluminescence, diagenetic & hydrothermal: **Sed Geol** 140 191-9 (2081).

Slip & dislocation behavior: **DJ Barber H Wenk** 2001 EJM 13 1221-43 (2080).

Synthesis & geochemical implications: **E Usdowski** 1994 Spec Publ Int Assoc Sedimentology 21 345-60 = MA 95M/4311.

Ankerite- join, synthesis/characterization/energetics: **L Chai A Navrotsky** 1996 AM 81 1141-7.

Dissolution kinetics: **OS Pokrovsky J Schott** 2001 AJS 301 597-626 (3600);

JW Morse RS Arvidson 2002 ESR 58 51-84 (7645);

& growth kinetics, water interface, SEM, **X Hu DA Grossie SR Higgins** 2005 AM 90 963-8.

Heat to *aragonite* + *magnesite* at 900-1300 K: **M Shirasaka & 4 others** 2002 AM 87 922-30.

Loss of Mn during heating, EPR: AM 89 785-9.

Occurrence, evolution & economics: **J Warren** 2000 ESR 52 1-81 (776).

Mg-aq interaction, growth inhibitor, molecular modeling: **NH de Leeuw SC Parker** 2001 PCCP 3 3217-21 (2964).

Impurities & nonstoichiometry, modeling: **K Wright RT Cygan B Slater** 2002 GCA 66 2541-6 (7668).
 Dolomitization: role of sulfide oxidation in hypersaline lagoons, Brazil: **NF Moreira & 4 others** 2004 G 32 701-4 (10553).
 Excess Ca-: XRPD/EM/EMP show 2 types of complex interlayering, **VA Drits & 3 others** 2005 CM 43 1285-90.
 Occurrence, marine dolomite: **F Tateo & 3 others** 2001 EJM 13 727-41 (3462).
 Hydrothermal: **HG Machel J Lonnee** 2002 SG 152 163-71 (8023).
 Paramagnetic radicals as indicator of geological events: **RWA Franco F Pelegrini AM Rossi** 2003 PCM 30 39-43.
HD Holland H Zimmermann 2003 *The dolomite problem revisited*, *Frontiers in Geochemistry: Global Inorganic Geochemistry*, 1, 106-24.
 Dolomitic carbonatite volcanism, Limagne Basin, France: **K Bailey & 4 others** 2006 MM 70 231-56.
 In meteorites: **AE Rubin** 1997 MPS 32 231-47.
 In dust around evolved stars: **F Kemper & 7 others** 2002 N 415 295-7 (5865).
doloresite $\text{HgV}_6\text{O}_{16}$. Double-octahedral-edge-connected chains linked to single octahedral chains. Compare with *haggite*.
 Structure: **HT Evans Jr ME Mrose** 1960 AM 45 1144-66;
HT Evans Jr ME Mrose 1958 AC 11 56-8 (E348).
 Occurrence: MM 31 957.
domeykite Cu_3As -alpha.
 Structure: **JE Iglesias W Nowacki** 1977 ZK 145 334-45 (I127);
 NQR, **BB Begaev & 4 others** 2002 ZVMO 5 54-60.
 Distinct from *koutekite* Cu_2As .
[donathite $(\text{Fe}_{1.5}\text{Cr}_{1.3}\text{Mg}_{0.2})\text{O}_4$. *Spinel* structure type. Tetragonal variant of *chromite*.
 Occurrence: MM 37 957.
 Discredited mixture cubic & tetragonal spinels, XRPD/SEM/TEM: **PC Burns & 4 others** 1997 NJMM 163-74 (B1622).]
donharrisite $\text{Ni}_8\text{Hg}_3\text{S}_9$.
 Structure determination not found.
 Occurrence: **WH Paar & 4 others** 1989 CM 27 257-62.
donnayite-Y $\text{NaSr}_3\text{CaY}(\text{CO}_3)_6 \cdot 3\text{aq}$ & $(\text{Na}, \text{Ce}, \text{REE})\text{Sr}(\text{CO}_3)_2 \cdot \text{aq}$.
 May be necessary to subdivide into minerals with defined composition ranges.
Mckelveyite structure group.
 Structure, Khibina donnayite & M5 (disordered Na/REE): **TLT Trinh & 3 others** 1992 Vest Mosk univ Ser 4 Geol 5 69-78.
 Occurrence: **GV Chao PR Mainwaring J Baker** 1978 CM 16 335-40;
 Khibina carbonatite, **AN Zaitsev et al** 1998 MM 62 225-50;
 hyperagpaitic alkaline rocks, **Khomyakov** 1995.
 Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
donpeacorite $(\text{Mn}, \text{Mg})\text{MgSi}_2\text{O}_6$. *Pyroxene* structure type; orthorhombic subtype.
 Structure: **EU Petersen LM Anovitz EJ Essene** 1984 AM 69 472-80.
 Mn/Mg intra-crystalline exchange: **M Stimpfl** 2005 AM 90 155-61.
 Occurrence in meteorites: **AE Rubin** 1997 MPS 32 733-4.
dorallcharite $\text{Ti}_{0.8}\text{K}_{0.2}\text{Fe}_3(\text{SO}_4)_2(\text{OH})_6$. *Jarosite-alunite* family.
 Structure determination not found.
 Occurrence: **TB Zunic & 3 others** 1994 EJM 6 255-6 (Z76).
dorfmanite $\text{Na}_2\text{H}(\text{PO}_4)_2 \cdot 2\text{aq}$.
 Structure determination not found.
 Occurrence: **Yu Kupustin et al** 1980 ZVMO 109 211-6 = AM 6 217-8.
[dorite
G Ritvo GN White JB Dixon 2003 *A new iron sulfide precipitated from saline solution*, SSSAJ 67 1303-8.]
dorrite $\text{Ca}_2(\text{Mg}_2\text{Fe}_4)(\text{Al}_4\text{Si}_2)\text{O}_{20}$. *Aenigmatite* structure type.
 Occurrence: **MA Cosca RC Rouse EJ Essene** 1988 AM 73 1440-8.
Synthetic: structure, Fe-rich, **WG Mumme** 1988 NJMM 359-66.
dosulite Mn silicate. aq.
 Supposed to be amorphous, but XRPD given! AM 55 1070.
douglasite $\text{K}_2\text{FeCl}_4 \cdot 2\text{aq}$.
 Structure determination not found.
 Occurrence: **Dana**.
downeyite SeO_2 .

Structure: **JD McCullough** 1937 JChS 59 789-94.
Occurrence: MM 42 523.

doyleite $\text{Al}(\text{OH})_3$. Polymorphic with *bayerite*, *gibbsite* & *nordstrandite*.
Structure: **GV Chao J Baker AP Sabina AC Roberts** 1985 CM 23 21-8;
SC-XRD, laser Raman & AFM, **GR Clark KA Rodgers GS Henderson** 1998 ZK 213 96-100 (C433).

dozyite $\sim(\text{Mg}_7\text{Al}_2)(\text{Si}_4\text{Al}_2)\text{O}_{15}(\text{OH})_{12}$. 1:1 *serpentine-chlorite* structure.
Structure: **SW Bailey & 3 others** 1995 AM 80 65-77.

dravite $\text{NaMg}_3\text{Al}_6(\text{BO}_3)_3\text{Si}_6\text{O}_{18}(\text{OH},\text{F})_4$. *Tourmaline* structure type.
Structure: **FF Foit Jr PE Rosenberg** 1979 AM 64 788-98;
FC Hawthorne DJ Macdonald PC Burns 1993 AM 78 265-70;
Carinthia, Austria, natural, SC-XRD, **F Pertlik & 4 others** 2003 NJMM 277-88
Syros, Greece, SC-XRD, Mössbauer, **HR Marschall & 3 others** 2004 EJM 16 817-23 (10831).
Synthesis, hydrothermal: **G von Goerne G Franz R Wirth** 1999 EJM 11 1061-77 (V361).

dresserite $\text{Ba}_2\text{Al}_4(\text{CO}_3)_4(\text{OH})_8$.3aq. *Dundasite* structure group.
Structure determination not found.
Occurrence: **JL Jambor DG Fong AP Sabina** 1969 CM 10 84-9.

dreyerite BiVO_4 . *Zircon* structure type. Trimorphic with *clinobisvanite* & *pucherite*.
Occurrence: MM 43 1060;
& structure, **G Dreyer E Tillmanns** 1981 NJMM 151-4 = AM 67 62.

drugmanite $\text{Pb}_2(\text{Fe},\text{Al})(\text{PO}_4)_2(\text{OH})$.aq. *Gadolinite* structure group.
Structure: **GSD King L Sengier-Roberts** 1988 BM 111 431-7.

drysdallite $\text{Mo}(\text{Se},\text{S})_2$. Isostructural with *molybdenite* from XRPD.
Structure determination not found.
Occurrence: **F Cech M Rieder S Vrana** 1973 NJMM 433-42.
Synthesis, non-stoichiometry/polytypism: **H Naruke & 3 others** 1996 MRB 31 647-55 (N406).

dufrenite $\text{Fe}^{2+}\text{Fe}^{3+}_4(\text{PO}_4)_3(\text{OH})_5$.2aq.
Isostructural with *burangaitite*; & *natrodufrenite* based on XRPD.
Structure: **PB Moore** 1970 AM 55 135-69.
?*cardosonite*: MM 31 955.
Compare with *andrewsite* & *laubmannite*.

dufrenoyite $\text{Pb}_2\text{As}_2\text{S}_5$. *Sartorite* group.
Structure: **F Marumo W Nowacki** 1967 ZK 124 409-19;
B Ribar C Nicca W Nowacki 1969 ZK 130 15-40 (R218).
Check with *sollyite* $\text{Pb}_3\text{As}_4\text{S}_9$.

duftite $\text{PbCuAsO}_4\text{OH}$. *Conichalcite/descloizite* structure type. *Descloizite* mineral group.
Structure: **H Effenberger F Pertlik** 1988 ZK 185 610.
Occurrence: MM 32 953.

dugganite $\text{Pb}_3\text{Zn}_3(\text{TeO}_6)(\text{AsO}_4)(\text{OH})_3$.
See *kuksite* & *remnykhite* which are analogous phosphate and vanadate.
Structure: **AE Lam LE Groat TS Ercit** 1998 CM 36 823-30.
Occurrence: **SA Williams** 1978 AM 63 1016-9.
V,Si variety: AM 76 1440.

duhamelite $\text{Cu}_4\text{Pb}_2\text{Bi}(\text{VO}_4)_4(\text{OH})_3$.8aq.
Structure determination not found.
Occurrence: **SA Williams** 1981 MM 44 151-2.

dukeite $\text{Bi}_{24}\text{Cr}_8\text{O}_{57}(\text{OH})_6$.3aq.
Occurrence & structure, SC-XRD: **PC Burns & 4 others** 2000 AM 85 1822-7.

dumontite $\text{Pb}_2(\text{UO}_2)_3\text{O}_2(\text{PO}_4)_2$.5aq.
Phosphuranylite mineral group; geometrical isomer udududS; beware of problems.
Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Structure: **J Piret-Meunier A Léonard M Van Meerssche** 1962 Bull acad roy Belgique, Sci, ser 5, 48 751-60;
P Piret J Piret-Meunier 1988 BM 111 439-42.
Synthesis: **V Ross** 1956 AM 41 917-26.

dumortierite $(\text{Al},\text{Fe})\text{Al}_6(\text{BO}_3)\text{Si}_3\text{O}_{16}(\text{O},\text{OH})_2$.

Isostructural with *magnesiodumortierite* from cell data.

Structure: **NI Golovastikov** 1965 SPD 10 493-5;

PB Moore T Araki 1978 NJMA 132 231-41 (M609);

VD Alexander DT Griffen TJ Martin 1986 AM 71 786-94.

$\text{Ti}_{0.2}$ -dumortierite, XRPD, cell: **GJ Beukes & 5 others** 1987 NJMA 157 303-18 (B1359)

SC-XRD & FTIR, chemistry, **Y Fuchs & 5 others** 2005 EJM 17 173-83 (11025).

Fe-Ti charge transfer: **AN Platonov & 4 others** 2000 EJM 12 52-8 (P886).

Occurrence: clay deposit, Korea, IR, **CO Choo Y Kim** 2003 MM 67 799-806.

Inclusions in rose quartz: **C Ma JS Goreva GR Rossman** 2002 AM 87 269-70.

Synthetic $\text{Ni}_{12+x}\text{H}_{6-2x}(\text{AsO}_4)_8(\text{OH})_6$, x 1.16-1.33: **MD Marcos & 4 others** 1995 JMC 5 917-25 (M1289).

Synthetic $(\text{Co}/\text{Ni})_{12}(\text{OH})_2(\text{SeO}_3)_8(\text{OH})_6$: **P Amorós & 4 others** 1996 JSSC 126 169-76 (A726).

DUNDASITE STRUCTURE GROUP Includes:

dresserite $\text{BaAl}_2(\text{CO}_3)_4(\text{OH})_{4.1.5\text{aq}}$

dundasite $\text{PbAl}_2(\text{CO}_3)_2(\text{OH})_{4.\text{aq}}$

petterdite $\text{PbCr}_2(\text{CO}_3)_2(\text{OH})_{4.\text{aq}}$

strontiodresserite $(\text{Sr},\text{Ca})\text{Al}_2(\text{CO}_3)_2(\text{OH})_{4.\text{aq}}$

dundasite $\text{PbAl}_2(\text{CO}_3)_2(\text{OH})_{4.\text{aq}}$. Dundasite structure group.

Structure: **G Cocco & 3 others** 1972 MM 38 564-9.

Cr analog = IMA 99-034: CM 38 248.

dunhamite $?\text{PbTeO}_3$.

Structure of *synthetic* PbTeO_3 : **P Sciau J Lapasset J Moret** 1986 AC C42 1688-90 (S1503).

Inadequate characterization: MM 28 728.

durangite $\text{NaAlAsO}_4\text{F}$. *Titanite* structure type.

Structure: **P Kokkoros** 1938 ZK 99 38-49.

duranusite As_4S .

Structure determination not found.

Occurrence, Duranus, France: **Z Johan et al** 1975 BSFMC 96 131-4.

Realgar alteration, Argentina: **F Marquez-Zavalia JR Craig TN Solberg** 1999 CM 37 1255-9.

dusmatovite $\text{K}_{1.4}\text{Na}_{0.6}(\text{Mn},\text{Zr},\text{Y})_2(\text{Zn},\text{Li})_3[\text{Si}_{12}\text{O}_{30}]$. *Milarite* structure group.

Structure: **EV Sokolova LA Pautov** 1995 Physics Doklady 40 503-6 (S1545).

Occurrence: **LA Pautov & 3 others** 1996 Vestnik Moscow Univ

Ser 4 Geol 2 54-60.

dussertite $\text{Ba}(\text{Fe},\text{Sb})_3(\text{AsO}_4)_2(\text{OH},\text{aq})_6$. *Crandallite* structure type.

Structure: antimonian, **U Kolitsch LA Pautov & 3 others** 1999 MM 63 17-26.

Occurrence: **Dana**.

duttonite $\text{VO}(\text{OH})_2$.

Structure: **HT Evans Jr ME Mrose** 1958 AC 11 56-8 (E308).

Occurrence: MM 31 957.

[*paraduttonite* $\sim\text{V}_2\text{O}_5.\text{aq}$. Oxidation product of *duttonite*.

Occurrence: MM 33 1147.]

dwornikite $(\text{Ni},\text{Fe})\text{SO}_4.\text{aq}$. *Kieserite* structure type.

Structure: **HR Oswald** 1965 Helv Chim Acta 48 590-600;

C Milton HT Evans Jr RG Johnson 1982 MM 46 351-5.

Occurrence: MM 46 518.

dypingite $\text{Mg}_5(\text{CO}_3)_4(\text{OH})_{2.5\text{aq}}$. *Lansfordite* mineral group of hydrous carbonates.

Structure determination not found.

Occurrence: **G Raade** 1970 AM 55 1457-65.

[dysanalyte $(\text{Ca},\text{Ce},\text{Na})(\text{Ti},\text{Nb},\text{Ta})\text{O}_3$.

Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.]

dyscrasite Ag_3Sb . *Allargentum* may be disordered dyscrasite.

Compare *paraschachnerite*.

Structure: **JD Scott** 197 CM 14 139-42.

Composition ranges, natural, Ag-Sb system: **C Cipriani M Corazza G Mazzetti** 1996 EJM 8 1347-50 (C882).

dzhallindite / dzhallindite In(OH)_3 . Possibly isostructural with *söhngeite* Ga(OH)_3 .

Synthetic, structure: **R Roy MW Schafer** 1954 JPC 58 372-5 (R545).

Occurrence: **AD Genkin IV Murav'eva** 1963 ZVMO 92 445-7 = AM 49 439-40.

dzharkenite FeSe_2 . Structural analog of *pyrite* FeS_2 . Dimorph of *ferroselite*.

Occurrence & crystallography: **YuV Yashunsky LA Pautov & 3 others** 1995 ZVMO 124 85-90.

dzhezkazganite Rhenium-copper mineral: insufficient data AM 48 209 = (P530). Appears to be amorphous. Summary of rhenium minerals: (P522).

[dzhimboite incorrect transcription for *jimboite*.]