Mineral structures S&T

Updated to 092106 by J V Smith

sabatierite ?$TlCu_6Se_4$. Structure determination not found.
Crystallography, composition, XRPD vs *synthetic* $TlCu_4S_3$: **RA Berger** 1987 ZK 181 241-9 = AM 74 1404.
Occurrence: **Z Johan M Kvacek P Picot** 1978 BM 101 557-60.
sabelliite $(Cu,Zn)_2Zn(As,Sb)O_4(OH)_3$.
Structure: **F Olmi C Sabelli R Trosti-Ferroni** 1995 EJM 7 1331-7 (O307).
Occurrence: **F Olmi A Santucci R Trosti-Ferroni** 1995 EJM 7 1325-30 (O305).
sabieite $(NH_4)Fe(SO_4)_2$. Analog of *godovikovite* $NH_4(Al,Fe)(SO_4)_2$.
Structure determination not found.
Occurrence: **JEJ Martini** 1983 Ann Geol Surv S Africa 17 29-34 = AM 71 229;
EP Shcherbakova LF Bazhenova BV Chesnokov 1988 ZVMO 117 208.
Hydrates to *lonecreekite* with 10aq.
sabinaite ~$Na_4Zr_2TiO_4(CO_3)_4$.
Structure: **AM McDonald** 1996 CM 34 811-5.
Occurrence & crystallography: **JL Jambor BD Sturman GC Weatherly** 1980 CM 18 25-9;
GY Chao X Jienang 1985 CM 23 17-9.
sabugalite $HAl(UO_2)_4(PO_4)_4.16aq$. *Autunite* structure group.
Structure determination not found.
Occurrence: **C Frondel** 1958 USGS Bull 1064 196-200 = MM 29 993.
Synthesis & XRPD: **GB Magin Jr GJ Jansen B Levin** 1959 AM 44 419-22.
sacrofanite
~$(Na_{6.2}Ca_{1.8}K_{1.4})(Al_{5.7}Si_{6.3})O_{24}(OH)_{2.7}(SO_4)_{1.1}(CO_3)_{0.3}Cl_{0.2}.0.3$ aq.
Cancrinite structure group; presumably 28-repeat.
Occurrence/crystallography: **F Burragato GC Parodi PF Zanazzi** 1980-1981 NJMA 140 102-10.
XRPD: **P Ballirano & 4 others** 1995 PD 10 13-9 (B1788).
sadanagaite $(K,Na)Ca_2(Fe,Mg,Al,Fe)_5(Si,Al)_8O_{22}(OH)_2$.
Amphibole structure group; monoclinic subtype.
Structure determination not found.
Occurrence: **H Shimazaki M Bunno T Ozawa** 1984 AM 69 465-71;
T Sawaki 1989 MM 53 99-106;
Nikandrov YuS Kobyashev PM Valizer 2001 ZVMO 1 95-8.
saddlebackite $Pb_2Bi_2Te_2S_3$.
Occurrence & hexagonal ED pattern: **RM Clarke** 1997 Australian J Mineral 3 119-24 = AM 83 1118.
safflorite $(Co,Fe)As_2$. *Löllingite* structure subgroup in *marcasite* supergroup.
Structure: **EH Roseboom** 1963 AM 48 271-99;
synthetic, **R Darmon M Winterbergen** 1966 BSFMC 89 213-5.
Clinosafflorite is slightly monoclinic, but otherwise similar to orthorhombic safflorite.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
sahamalite-Ce $(Mg,Fe)(Ce,La,Nd)_2(CO_3)_4$.
Structure: **F Pertlik A Preisinger** 1983 TMPM 31 39-46 (P452).
Occurrence: MM 30 746.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
sahlinite $Pb_{14}(AsO_4)_2O_9Cl_4$. Isostructural with V analog *kombatite.*
Derivative of *litharge* PbO type.
Structure: SC-XRD, **E Bonaccorsi M Pasero** 2003 MM 67 15-21.
Occurrence & crystallography: **RC Rouse PJ Dunn** 1985 NJMM 127-31 (R579).
Description: MM 24 622.
sailaufite $(Ca,Na,void)_2Mn_3O_2(AsO_4)_2(CO_3).3aq$.
Related to *mitridatite* group & *pararobertsite*.

Occurrence & SC-XRD structure: **M Wildner & 3 others** 2003 15 555-64 (9176).
sainfeldite $Ca_5(AsO_4)_2(AsO_3OH]_2.4aq$.
Isostructural *villyaellenite* $(Mn,Ca)_5(AsO_3OH)_2(AsO_4)_2.4aq$ & *hureaulite* $Mn_5(PO_4)_2[PO_3OH]_2.4aq$.
Structure: **G Ferraris F Abbona** 1972 BSFMC 95 33-41.
Occurrence: MM 35 1151.
sakhaite $Ca_{12}Mg(BO_3)_7(CO_3)_4Cl(OH)_2.aq$. Compare with *harkerite*.
Structure: *synthetic*, **AV Chichagov MA Simonov NV Belov** 1975 SPD 19 559-61 (C705);
OV Yakubovich & 3 others 1978 SPD 23 225-6.
Harkerite- series, Siberia: **SV Malinko NV Chukanov AE Lisitsyn** 1999 ZVMO 96-9 (M1832).
Occurrence: MM 35 1151.
Sakhaite-like mineral unnamed until further data: **PJ Dunn & 4 others** 1990 MM 54 105-8.
sakharovaite $(Pb,Fe)(Sb,Bi)_2S_4$.
Incomplete data. AM 41 814 & 45 1134.
sakuraiite ~(Cu,Zn,Fe,Ag,In,Sn)S. [jvs: defect *sphalerite* structure type?].
Occurrence & crystallography: **A Kato** MM 37 963-4;
SA Kissin DR Owens 1986 CM 24 679-83;
M Shimizu A Kato T Shiozawa 1986 CM 24 405-9;
conflict in preceding data, AM 73 934.
sal-ammoniac / salammoniac NH_4Cl. CsCl structure type.
Structure: ND, **K Kurki-Suonio & 3 others** 1976 AC A32 110-5.
Occurrence: MA 96M/4581.
saléeite / saleeite / saleite $Mg(UO_2)_2(PO_4)_2.10aq$. *Autunite* structure group.
Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Structure: **SA Miller JC Taylor** 1986 ZK 177 247-53.
Occurrence: MM 23 637; MM 25 643.
Ferrous-: **R Vochten K Van Springel** 1996 MM 60 647-51.
TEM, SEM & BSE images of saléeite formed during oxidation: **T Murakami & 3 others** 1997 AM 82 888-99.
salesite $Cu(IO_3)OH$. Review: (E289).
Structure: **S Ghose** 1962 AC 15 1105-9 (G53) = MA 16-251.
Occurrence: MM 25 643.
$[Cu(IO_3)_2.aq$: **S Ghose C Wan** 1978 AM 63 172-9.]
saliotite $Na_{0.5}Li_{0.5}Al_3[Si_3Al]O_{10}(OH)_5$. Interstratified 1:1 *cookeite/paragonite*.
Structure: **B Goffé A Baronnet G Morin** 1994 EJM 6 897-911 (G729).
salzburgite $Pb_{0.4}Cu_{0.4}Bi_{1.6}S_3$
45 Å member of *bismuthinite-aikinite* series, stuffed *stibnite*.
Compare *paarite* with different superstructure.
Occurrence & structure: SC-XRD,
D Topa E Makovicky T Balic-Zunic 2005 CM 43 909-17 = AM 91 218.
samarskite-Y $(Y,Ce,U,Fe)_3(Nb,Ta,Ti)_5O_{16}$. Alpha-$PbO_2$ structure type (*scrutinyite*).
Polymorphism & structural relations with other minerals: **Y Sugitani Y Suzuki K Nagashima** 1985 AM 70 856-66.
Structure: **AI Komkov** 1965 DAN 160 127-9;
L Keller CNJ Warner 1983 AM 68 459-65;
JK Warner RC Ewing 1993 AM 78 419-24.
New data, *ishikawaite* & *"calciosamarskite"*: **SL Hanson WB Simmons AU Falster** 1996 GAC-MAC Mtg P-4.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
samfowlerite $Ca_{14}Mn_3Zn_2(Zn,Be)_2Be_6(SiO_4)_6(Si_2O_7)_4(OH,F)_6$.
Structure: **RC Rouse & 5 others** 1994 CM 32 43-53.
sampleite $NaCaCu_5(PO_4)_5Cl.5aq$.
From crystallography isostructural with As analog $NaCaCu_5(AsO_4)_4Cl.4$-$5aq$ & Pb analog *zdenekite* $NaPCu_5(AsO_4)4Cl.5aq$.
Structure determination not found.
Occurrence: MM 26 341; **Dana**.

samsonite $Ag_4MnSb_2S_6$.
Structure: **A Edenharter W Nowack**i 1974 ZK 140 87-99 (E152).
samuelsonite $(Ca,Ba)Fe_2Mn_2Ca_8Al_2(PO_4)_{10}(OH)_2$. Related to *apatite* structure.
Structure: **PB Moore T Araki** 1977 AM 62 229-45.
Occurrence: MM 40 913.
sanbornite $BaSi_2O_5$.
Structure: **RM Douglass** 1958 AM 43 517-36 (D6);
K-F Hesse F Liebau 1980 ZK 153 33-41 (H981).
High-T: **H Katscher G Bissert F Liebau** 1973 ZK 137 146-58.
Occurrence: MM 23 637.
Homologous series: AM 43 517-36.
Synthetic phases II & III of $BaGe_2O_5$: **M Ozima** 1985 AC C41 1003-7 (O285).
sanderite $MgSO_4.2aq$.
Occurrence: **W Berdesinski** 1952 NJMM 28.
Hydration product of monohydrate *kieserite*.
saneroite $Na_{2.3}(Mn^{2+,3+})_{10}(Si_{11},V_1)O_{34}(OH)_4$.
Five-tetrahedra chain with sixth tetrahedron as an appendix; octahedral band and Na polyhedra form layer.
Structure: **R Basso A Della Giusta** 1980 NJMA 138 333-42 (B1626).
Occurrence: MM 46 525.
sanidine $(K,Na)AlSi_3O_8$. *Feldspar* structure group (see data base).
Synthetic $KGaSi_3O_8$, structure: **M Kimata S Saito M Shimizu** 1995 EJM 7 287-93.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
sanjuanite $Al_2(PO_4)(SO_4)(OH).9aq$. Review: **Sabelli** , no structure.
XRPD: **H de Bruijn & 3 others** 1989 MM 53 385-6.
Occurrence: **MEJ de Abeledo & 3 others** 1968 AM 53 1-8.
sanmartinite $(Zn,Fe,Ca,Mn)WO_4$. *Wolframite* structure group.
Based on alpha-PbO_2 (*scrutinyite*) connectivity.
Used in scintillation detectors, photoanodes & masers.
Structure: *synthetic*, **OS Filipenko EA Pobedimskaya NV Belov** 1968 SPC 13 127-9 (low accuracy);
NPD, **PF Schofield KS Knight G Cressey** 1996 JMS 31 2873-7 (S1602).
Occurrence: MM 28 737.
Solid solution with *cuproscheelite* $CuWO_4$, Cu 2p absorption spectroscopy:
PF Schofield & 3 others 1993 PCM 20 375-81;
XRPD, **do** 1997 AC B53 102-12 (S676).
phase transition, XRPD structure **SAT Redfern & 3 others** 1995 EJM 7 1019-28 (R599).
santabarbaraite $Fe_3(PO_4)_2(OH)_3.5aq$. Amorphous.
Occurrence, EXAFS & XANES: **G Pratesi & 3 others** 2003 EJM 15 185-92 (8907).
santaclaraite $CaMn_4Si_5O_{14}(OH)_2.aq$. *Pyroxenoid* structure group.
Structure: **Y Ohashi LW Finger** 1981 AM 66 154-68.
Occurrence: MM 48 581.
santafeite $(Na,Ca,Sr)_3(Mn,Fe)_2Mn_4(VO_4)_4(OH)_5.2aq$.
Structure: **PJ Dunn DR Peacor** 1986 MM 50 299-300.
Occurrence: MM 31 971.
santanaite $Pb_{11}CrO_{16}$.
Structure determination not found.
Occurrence & crystallography: **A Mücke** 1973 NJMM 455-8.
santite $KB_5O_6(OH)_4.2aq$.
Matches *synthetic*: **WR Cook H Jaffe** 1957 AC 10 705-7 (C800).
Compare with *lardellerite*.
Occurrence & crystallography: **S Merlino F Sartori** 1970 CMP 27 159-65 = AM 56 636.
saponite $(Ca,Na_2)_{0.17}(Mg,Fe)_3(Si,Al)_4O_{10}(OH)_2.4\ aq$. *Smectite* group.

Structure determination not found
HRTEM, saponite-to-*chlorite* via *corrensite*: **T Murakami T Sato A Inoue** 1999 AM 84 1080-7.
IR, dehydroxylation: **JT Kloprogge RL Frost** 2001 NJMM 446-63 (3611).
IR/Raman, Na/K-, OH stretching: **M Pelletier & 5 others** 2003 AM 88 1801-8.
Synthesis & thermal stability: **RJMJ Vogels & 2 others** 2005 AM 90 931-44, **& 3 others** 955-53.
Al-pillaring: **MA Vicente J Lambert** 2003 ClClM 51 168-71.
In Emet colemanite mines, Turkey: **M Colak C Helvaci M Maggetti** 2000 ClClM 48 409-23 (C1161).
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
Sobotkite $(Ca_{0.13}K_{0.01})(Mg_{1.91}Al_{0.95})(Si_{3.06}Al_{0.94})O_{10}(OH)_2$ might be *aluminian saponite*.
Griffithite is a trioctahedral *smectite* with dioctahedral domains; **P Komadel & 3 others** 2000 CIM 35 625-34 (K1251).
XPS of Al & model: **T Ebina & 4 others** 1997 JPC B 101 1125-9 (E395).
Synthetic Al & Si/Ti pillared: **PB Malla S Komarneni** 1993 ClClM 41 472-83 (M461).
Synthetic Ti-pillared: **F Kooli J Bovey W Jones** 1997 JMC 7 153-8 (K884).
Synthetic Zr-oligomer pillaring: **R Toranzo & 4 others** 1998 MMM 24 173-88 (T598).
Synthetic Co/Cr/Cu-substituted: **M Sychev** 1999 12th IZC 1261-8.
Intercalation of cationic dyes: **M Iwasaki et al** 2000 ClClM 48 392-9 (I256).
Synthetic Mg/Ni-: **R Prihod'ko & 6 others** 2004 MMM 69 49-63 (10238).
Synthetic Na-, hydration/swelling vs layer charge: **LJ Michot & 4 others** 2005 AM 90 166-72.

sapphirine $(Mg,Al)_4(Al,Si)_3O_{10}$.

Relation to *spinel*, *clinopyroxene* & beta-gallia structures: **J Barbier BG Hyde** 1988 AC B44 373-7 (B1365).
Related to *khmaralite* ~$Mg_{5.5}Al_{14.3}Fe_2Si_{4.8}Be_{1.5}O_{40}$.
Structure & chemistry: **PB Moore** 1968 N 218 81-2;
PB Moore 1969 AM 54 31-49 (M256);
1Tc polytype, **S Merlino** 1980 ZK 151 91-100 (M777);
JB Higgins PH Ribbe RK Herd 1979 CMP 68 349-56;
JB Higgins PH Ribbe 1979 CMP 68 357-68;
J Barbier BG Hyde 1988 AC B44 373-7;
electronic absorption spectra, **K Langer & 3 others** 1994 PCM 21 29-35;
synthetic Mg-Ga-Ge, SC-XRD, **J Barbier** 1998 EJM 10 1283-93 (B1888).
Antarctica, close to ideal endmember $Mg_2Al_4SiO_{10}$, 1Tc polytype: **SL Harley AG Christy** 1995 EJM 7 637-53 (H1018).
Synthetic Be: structure, **AG Christy & 4 others** 2002 AM 87 1104-12;
vs natural Be- & khmaralite, Be vs P/T Fe/Mg, **AG Christy ES Grew** 2004 AM 89 327-38.
Occurrence: N. Quebec: **S Cadéron & 3 others** 2005 CM 43 463-78.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

sarabauite $CaSb_{10}O_{10}S_6$.

Structure: **I Nakai & 3 others** 1978 ACB 34 3569-72.
Occurrence: MM 42 529.

sarcolite $(Ca,Na)_9Al_4Si_6O_{26}F$. CTF net 975.

Structure: **G Giuseppetti F Mazzi C Tadini** 1977 TMPM 24 1-21 (G365);
do 1987 NJMM 521-7.

sarcopside $(Fe,Mn,Mg)_3(PO_4)_2$. *Olivine* structure type.

Structure: **PB Moore** 1972 AM 57 24-35 (M1152);
synthetic, **T Ericsson AC Nord G Åberg** 1986 AM 71 136-41.
Natural $(Fe_{3.2}Mg_{1.4}Mn_{1.4})(P_{4.1}Al_{0.1})O_{16.6}$: **R Zhang** 1995 J Mineral Petrol China 15 6-10 = MA 95M/0922.
In meteorites: **AE Rubin** 1997 MPS 32 231-47;
13 phosphates in IIIAB irons, **EJ Olsen & 5 others** 1999 MPS 34 285-300 (210).
Synthetic $(Fe,Zn)_3(PO_4)_2$: **YuK Kabalov & 4 others** 1973 SPD 18 362-3 (K629).
Synthetic $Ni_{0.75}Zn_{0.25}$: ND, **AG Nord** 1982 NJMM 422-32.
Synthetic $NiFe_2(PO_4)_2$: resonant XR- & NPD, **JK Warner AK Cheetham DE Cox** 1995 JACr 28 494-502 (W726);
Isotope substitution & NPD, **PF Henry MT Weller CC Wilson** 2003 JACr 36 1361-7 (1361).

sarkinite $Mn_2(AsO_4)(OH)$. *Triploidite* structure group. Dimorph of *eveite*.

Structure: **A Dal Negro G Giuseppetti JM Martin Pozas** 1974 TMPM 21 246-60 (D251);
Mn valency & color, **U Hålenius E Westlund** 1998 MM 62 113-9.

sarmientite $Fe_2(AsO_4)(SO_4)OH.5aq$. Review: **Sabelli**, no structure.

Structure determination not found.

Occurrence: MM 26 241;
MEJ de Abeledo MAR de Benyacar 1968 AM 53 2077-82.

SARTORITE MINERAL GROUP OF LEAD ARSENIDE SULFIDES

baumhauerite	$Pb_3As_4S_9$
dufrenoysite	$Pb_2As_2S_5$
livingeite	$Pb_9As_{13}S_{28}$
rathite I	$Pb_9As_{13}S_{28}$
rathite II, III, & IV?	
sartorite	variable near $PbAs_2S_4$
sollyite	$Pb_3As_4S_9$

Crystal chemistry of sartorite group, HRTEM: **A Pring** 2001 SMPM 81 69-87 (2146).
Crystal chemistry of sartorite homologs & related sulfosalts: **P Berlepsch E Makovicky T Balic-Zunic** 2001 NJMA 176 45-66 (1194).
Synthetic sartorite-II, double-b: **H Rösch E Hellner** 1959 Nw 46 72 = MM 39 926.

sartorite $PbAs_2S_4$.

Structure: **Y Iitaka W Nowacki** 1961 AC 14 1291-2;
T Ozawa Y Takéuchi 1993 MJ 16 358-70;
A Pring T Williams R Withers 1993 AM 78 619-26;
9-fold superstructure, SC-XRD, **P Berlepsch & 3 others** 2003 AM 88 450-61..

saryarkite-Y / saryarkite $Ca(Y,Th)Al_5(SiO_4)_2(P/SO_4)_2(OH)_7.6aq$.

XRPD similar to *rhabdophane*, but mismatch with chemistry & proposed cell.
Structure determination not found.
Occurrence: **OF Krol & 3 others** 1964 ZVMO 93 147-55 = AM 49 1775-6.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

sasaite $(Al,Fe)_6[(PO_4),(SO_4)]_5(OH)_3.\sim 35aq$.

Review: **Sabelli**, no structure.
Structure determination not found.
Occurrence: **JEJ Martini** 1978 MM 42 401-4.

sassolite H_3BO_3.

Structure: **WH Zachariasen** 1954 AC 7 305-10;
M Gajhede S Larsen S Rettrup 1986 AC B42 545-52.
Occurrence in fertilizers: **JR Lehr & 4 others** 1966 *Crystallographic Properties of Fertilizer Compounds*, Tenn Valley Auth Chem Eng Bull 6, 163p (L758).
In fluid inclusions of granite, laser Raman: **R Thomas** 2002 AM 87 56-68.
In *synthetic* granite pegmatite: **IV Veksler R Thomas C Schmidt** 2002 AM 87 775-9.

satimolite $KNa_2Al_4B_6O_{15}Cl_3.13aq$.

Structure determination not found.
Occurrence: AM 55 1069-70.

satpaevite $Al_{12}V^{2+}{}_2V^{5+}{}_6O_{37}.30aq$.

Structure determination not found.
Occurrence: **EA Ankinovich** 1959 ZVMO 88 157-64 = AM 44 1325-6.

satterlyite $(Fe,Mg)_{12}(PO_3OH)(PO_4)_5(OH,O)_6$. Dimorphic with *wolfeite*.

Analog of *holtedahlite* $Mg_2(PO_4)(OH)$.
Structure: **U Kolitsch M Andrut G Giester** 2002 EJM 14 127-33 (6140).
Occurrence: **JA Mandarino BD Sturman MI Corlett** 1978 CM 16 411-3.

sauconite $Na_{0.33}Zn_3(Si,Al)_4O_{10}(OH)_2.4aq$. *Smectite* structure group. See *zincsilite*.

Structure determination not found.
Occurrence: **CS Ross** 1946 AM 31 411-24.
[Also used for *synthetic* $Zn(OH)_2$: MM 31 971.]
Heterogeneous catalyst for adding primary alcohol to alkyne & allene: **K Breuer & 5 others** 1999 AnCh 38 1401-5.

sayrite $Pb_2(UO_2)_5O_6(OH)_2.4aq$.

Review: **V Baran M Unzeitig** 1991 NJMM 63-75 (B1358);
PC Burns ML Miller RC Ewing 1996 CM 34 845-80.

Structure: **P Piret & 3 others** 1983 BM 106 299-304.
Occurrence: MM 48 582.

sazhinite-Ce $Na_2CeSi_6O_{14}(OH).\sim 5aq$. Compare with *armstrongite* & *dalyite*.

Structure: **NG Shumyatskaya AA Voronkov YuA Pyatenko** 1981 SPC 25 419-23 (S1333).
Occurrence: MM 39 926.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.
Synthetic $NaNdSi_6O_{13}(OH)_2$ .n aq: **OG Karpov & 4 others** 1977 SPD 22 464-5 (K622).
Synthetic $K_3NdSi_6O_{15}$, not isostructural, but related: **SM Haile BJ Wuensch** 2000 ACB 56 349-62 (H1484).
Synthetic $K_3NdSi_6O_{15}.2aq$, not isostructural, but related: **do** 2000 AC B56 335-48 (H1483).

sazykinaite-Y $Na_5YZrSi_6O_{18}.6aq$. *Hilairite* structure group.

Structure determination not found, though diagram given: occurrence & crystallography, **AP Khomyakhov GN Necheljustov RK Rastsvetaeva** 1993 ZVMO 122 76-82 (K659A).
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.
Unnamed mineral M67 is Ti,Nb variant.

sborgite $NaB_5O_6(OH)_4.3aq$.

Structure: **S Merlino F Sartori** 1972 AC B78 3559-67.
Occurrence: MM 31 971.

scacchite $MnCl_2$. $CdCl_2$ structure type.

Isostructural with Mg analog *chlormagnesite* . $MgCl_2$ & Fe,Ni analog *lawrencite* $(Fe,Ni)Cl_2$.
Structure determination not found; *synthetic* **Wells** p 350.
Occurrence: **Dana**.

scainiite $Pb_{14}Sb_{30}S_{54}O_5$. Related to *pellouxite*.

Occurrence and structural description: **P Orlandi & 3 others** 1999 EJM 11 949-54 (O412).

scandiobabingtonite $\sim Ca_2(Fe,Mn)^{2+}ScSi_5O_{14}(OH)$. Iso with babingtonite.

Occurrence at Baveno, & structure: **P Orlandi M Pasero G Vezzalini** 1998 AM 83 1330-4.
Intergrowth with scandiobabingtonite: **G Raade M Erambert** 1999 NJMM 545-50 (R928).

SCAPOLITE Name of mineral group. Includes:

marialite $Na_4Al_3Si_9O_{24}Cl$.
Structure: **JJ Papike T Zoltai** 1965 AM 50 641-55.

meionite $Ca_4Al_6Si_6O_{24}CO_3$.
Structure: **SB Lin BJ Burley** 1973 ACB 29 2024-6;

synthetic
BG Aitken HT Evans Jr JA Konnert 1984 NJMA 149 309-24 (A382).

silvialite $Ca_4Al_6Si_6O_{24}SO_4$.

Occurrence & structure: **DK Teertstra M & 3 others** 1999 MM 63 321-9.
Nomenclature: **P Bayliss** 1987 MM 51 176 = AM 73 198.
Substitutional mechanisms/end-member formulae: **DK Teertstra BL Sherriff** 1997 CG 136 233-60 (T512).

[mizzonite] Varietal name only. Intermediate member of *scapolite* group.
Structure: **JJ Papike NC Stephenson** 1966 AM 51 1014-27 (P72).

[wernerite] Old name for scapolite; not used now.
$Na_{3.3}K_{0.5}Ca_{4.2}Al_{8.7}Si_{15}O_{48}Cl_{0.7}(SO_4)_{0.4}(CO_3)_{0.9}$.
Structure: **SB Lin BJ Burley** 1974 TMPM 21 196-215;
SB Lin BJ Burley 1975 AC B31 1806-14.

Na,Cl-rich scapolite
Structure: **SB Lin BJ Burley** 1973 AC B29 1272-8.

Scapolite crystal chemistry: **BW Evans DM Shaw DR Haughton** 1969 CMP 24 293-305;
SB Lin 1975 Acta Geol Taiwanica no. 18 36-48;
L Levien JJ Papike 1976 AM 61 864-77.
Antiphase domains: **PP Phakey S Ghose** 1972 Nature Phys Sci 238 78-80.
Synthetic high-pressure nitrate scapolite: **JR Goldsmith RC Newton PB Moore** 1974 AM 59 768-74.
Topologic control on Al/Si distribution: **WE Klee** 1974 ZK 140 154-62, 163-8.
Yellow luminescence of S_2: **RP Burgner BE Scheetz WB White** 1978 PCM 2 317-24.
Enumeration of 4-connected nets containing *bru* unit: **A Alberti** 1979 AM 64 1188-93.

Sulfate disorder: **RC Peterson G Donnay Y LePage** 1979 CM 17 53-61.
Thermal behavior: TGA, DTA, MS, XRPD, **G Graziani S Lucchesi** 1982 AM 67 1229-41;
SM Antao I Hassan 2002 CM 40 1395-402.
Al/Si ordering vs metamorphic grade, TEM: **WH Oterdoom H-R Wenk** 1983 CMP 83 330-41.
^{29}Si MAS-NMR, 15 natural scapolites 21-91% meionite: **BL Sherriff HD Grundy JS Hartman** 1987 CM 25 717-30.
HRTEM, binary solid solution between marialite & meionite: **I Hassan PR Buseck** 1988 AM 73 119-34.
P vs structure geometry & volatiles: **P Comodi M Mellini PF Zanazzi** 1990 EJM 2 195-202.
Phase equilibria, calcic scapolite, XRD & Al/Si order: **DP Moecher EJ Essene** 1990 JP 31 997-1024.
Synthetic Mg-Al, SC-XRD: **S Lucchesi A Della Giusta** 1994 ZK 209 714-9.
Cell dimensions of *marialite-meionite* series: **DK Teertstra BL Sherriff** 1996 AM 81 169-80.
^{29}Si/^{27}Al MAS-NMR & XRPD of intermediate: **BL Sherriff & 6 others** 1998 CM 36 1267-83.
Br substituted natural *marialite & meionite*, EMPA: **Y Pan P Dong** 2003 CM 41 529-40.
I/P phase transition: ED of domains, **Y Seto & 3 others** 2004 AM 89 257-65.
Chemical composition, role of S & K: **AA Zolotarev TG Petrov SV Moshkin** 2003 ZVMO 132-6 63-84 (10521).

scarbroite $Al_5(CO_3)(OH)_{13}.5aq.$

Structure: **GW Brindley** 1980 MM 43 615-8.

scawtite $Ca_7Si_6O_{18}(CO_3).2aq.$

Structure: **JJ Pluth JV Smith** 1973 AC B29 73-80;
L Zhang P Fu H Yang K Yu Z Zhou 1992 Chinese Sci Bull 37 930-4;
SC-XRD, **JD Grice** 2005 CM 43 1489-500.
Occurrence: MM 22 627.

schachnerite $Ag_{1.1}Hg_{0.9}$-beta. [alpha- is *mercurian silver* with ccp.]

Structure type is flattened distorted hexagonal closest packing of spheres with cation disorder similar to *allargentum* $Ag_{1-x}Sb_x$ & *weishanite* (Au,Ag,Hg): contrast with *osmium* & other true metals with hcp.
Occurrence and crystallography: **E Seeliger A Mücke** 1972 NJMA 117 1-18.
[*paraschachnerite* is orthorhombic $Ag_{1.2}Hg_{0.8}$, similar to *algodonite* & *dyscrasite*.]
[*moschellandsbergite* Ag_2Hg_3 is cubic.]
[jvs: when have time check all these structures and establish the structure groups.]

schafarzikite $FeSb_2O_4$. *Trippkeite* structure group. See also *apuanite* & *versiliaite*.

Structure: **J Zemann** 1951 TMPM 2 166-75;
R Fischer F Pertlik 1975 TMPM 22 236-41.

schäferite $NaCa_2Mg_2(VO)_3$. *Garnet* structure.

Occurrence & SC-XRD structure: **W Krause G Blass H Effenberger** NJMM 123-34 (K1141).

schairerite $Na_2(SO_4)_7F_6Cl$. Review: **Sabelli** p. 31. Compare with *sulphohalite*.

Structure: **L Fanfani & 4 others** 1975 MM 40 131-9.
Occurrence: MM 22 627.

schallerite $Mn_8Si_6O_{15}(OH)_7[As_3O_6(OH)_3]$.

Friedelite structure group; trigonal subtype with superstructure.
Occurrence/crystallography: **PJ Dunn & 3 others** 1981 AM 66 1054-62.
Structure: **T Kato I Watanabe** 1992 J Fac Liberal Arts, Yamaguchi Univ 26 51-63 = MJJ 1995 246 = MA 95M/4004.

schapbachite AgBiS2.

Occurrence: Black Forest, Germany, **K Walenta & 2others** 2004 NJMM 425-32 (107350.

schaureteïte / schaureteite $Ca_3Ge(SO_4)_2(OH)_6.3aq.$

Essentially isostructural with Mn analog *despujolsite* and Pb analog *fleischerite*.
Review: **Sabelli** p. 34.
Structure determination not found.
Occurrence: **H Strunz C Tennyson** 1968 = AM 53 507.

SCHEELITE STRUCTURE GROUP Includes:

clinobisvanite	$BiVO_4$
fergusonite	$(Y,Er,Ce,Fe)(Nb,Ta,Ti)O_4$
fergusonite-beta-Nb	$(Nd,Ce)NbO_4$
formanite	$Y(Ta,Nb)O_4$

paraniite-Y	$Ca_2Y(AsO_4)(WO_4)_2$
powellite	$Ca(Mo,W)O_4$
reidite	$ZnSiO_4$
scheelite	$CaWO_4$
stolzite	$PbWO_4$
tetrarooseveltite	$BiAsO_4$-beta
wulfenite	$PbMoO_4$

Crystallographic twin operations relating *anhydrite* to *zircon*, scheelite, etc: (N373).
Crystal chemistry of complex Nb & Ta oxides: **J Graham MR Thornber** 1974 AM 59 1026-39.
Synthetic $SrMoO_4$: **YuK Egorov-Tismenko MA Simonov NV Belov** 1967 SPC 12 436-7.
Ordered cation vacancies: *synthetic* $La_2(MoO_4)_3$, **W Jeitschko** 1973 ACB 29 2074-81;
synthetic $Bi_2(MoO_4)_3$, **AF Van den Elzen GD Rieck** 1973 ACB 29 2433-6;
High-P $ZrSiO_4$: **L-G Liu** 1979 EPSL 44 390-6;
K Kusaba & 3 others 1985 EPSL 73 433-9.
Synthetic $ErVO_4$-II (high-P): **K-J Range H Meister** 1990 ACC 46 1093-4 (R572).
High-pressure $CeVO_4$-III: 1990 ZN 45B 598-602.
Synthetic $Na_{0.5-x}(Bi/Ce/La)_{0.5+x/3}MoO_4$: **RG Teller** 1992 AC C48 2101-4 (T435).
Synthetic $Ag(Eu/Gd/Tb)Mo_2O_8$: **F Shi J Meng Y Ren** 1996 JSSC 121 236-9 (S1550).
Synthesis of $CeVO_4$-I(*wakefieldite* structure) at ambient P, & -II (*monazite*) & -III (scheelite) at high P, structure of I & II: **K Range H Meister U Klement** 1990 ZN 45b 598-602 (R617).
Polymorphism of $NdTaO_4$: **YuA Titov & 4 others** 1997 Inorg Mater 33 60-3 (T501).
Synthetic $(Li/Na/K/Cs)Cr(MoO_4)_2$, spectroscopy/magnetics: **J Hanuza & 5 others** 1999 JSSC 148 468-78 (H1450).
Synthetic $Li(Y/Nd)(MoO_4)_2$, SC-XRD structure: **U Kolitsch** 2001 ZK 216 449-54 (3586).

scheelite $CaWO_4$. *Scheelite* structure type.
Synthetic: **L Vegard** 1926 Phil Mag 1 1151;
LG Sillén AL Nylander Arkiv Kemi Mineral Geol 17A = MA 9-44;
BC Frazer I Almodovar 1964 J Chem Phys 40 504-6 (K773);
RM Hazen LW Finger JWE Mariathasan 1985 JPCS 46 253-63 (H613).
Raman, scheelite, *wolframite* & *wulfenite*: **JT Kloprogge RL Frost** 1999 NJMM 193-211(K1165).
Atom mechanism vs P, *-fergusonite/wolframite* transitions: **D Erraandonea & 3 others** 2004 JSSC 177 1087-97 (10239).
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

schertelite $(NH_4)_2MgH_2(PO_4)_2.4aq$. Compare with *hannayite* & *struvite*.
Structure: **AA Khan WH Baur** 1972 AC B28 683-93.
Occurrence in fertilizers: **JR Lehr & 4 others** 1966 *Crystallographic Properties of Fertilizer Compounds*, Tenn Valley Auth Chem Eng Bull 6, 163p (L758).

scheteligite $(Ca,Fe,Mn,Sb,Bi,Y)_2(Ti,Ta,Nb,W)_2O(O,OH)_7$.
No crystallographic data.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

scheuchzerite $Na(Mn,Mg)_9[VSi_9O_{28}(OH)](OH)_3$. Unique single-chain silicate.
Occurrence & SC-XRD structure: **J Brugger & 4 others** 2006 AM 91 937-43.

schiavinatoite $(Nb,Ta)BO_4$. *Zircon* structure type.
Occurrence & SC-XRD structure: **F Demartin & 3 others** 2001 EJM 13 159-65 (1672).

schieffelinite $Pb(Te,S)O_4.aq$.
Structure determination not found.
Occurrence: **SA Williams** 1980 MM 43 771-3.

schirmerite $Ag_3Pb_6Bi_7S_{18}$. *Lillianite* homologous series, subtype 4,7r (r = random).
Occurrence: **S Karup-Møller** 1973 CM 11 592-57;
E Makovicky S Karup-Møller 1977 NJMA 131 56-82.

schlemaite $(Cu,void)_6(Pb,Bi)Se_4$
Occurrence & SC-XRD structure: **H Forster & 7 others** 2003 CM 41 1433-44.

schlossmacherite $(H_3O,Ca)Al_3(S/AsO_4)_2(OH)_6$. *Alunite* group. Review: **Sabelli** p.26.

Structure: **K Schmetzer J Ottemann H Bank** 1980 NJMM 215-22.

schmiederite / schmeiderite $Pb_2Cu_2(OH)_4(SeO_3)(SeO_4)$.

Structure closely related to sulfate *linarite*. Review: (E289).
Structure: **H Effenberger** 1988 MP 36 3-12 (E328).
Occurrence: MM 33 1149.

schmitterite UO_2TeO_3. Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.

Structure: *synthetic*, **G Meunier J Galy** 1973 AC B29 1251-5.
Occurrence: MM 38 998.

schneebergite $BiCo_2(AsO_4)_2OH.aq$. *Tsumcorite* structure type.
Occurrence & SC-XRD structure: **W Krause & 3 others** 2001 EJM 14 115-26 (6139).

schneiderhöhnite = schneiderhoehnite $Fe^{2+}Fe^{3+}{}_3As_5O_{13}$.

Structure: **FC Hawthorne** 1985 CM 23 675-9.
Occurrence: MM 39 926.

schoderite $Al_2(PO_4)(VO_4).8aq$.

Structure determination not found.
Occurrence & crystallography: MM 32 979;
DM Hausen 1962 AM 47 637-48;
A Pabst 1979 AM 64 713-20.
[*metaschoderite* has 6aq.]

SCHOENFLIESITE/STOTTITE STRUCTURE GROUP Includes:

bernalite	$(Fe,etc)(OH)_3$	Immm
burtite	$CaSn(OH)_6$	R3
dzhalindite	$In(OH)_3$	cubic
jeanbandyite	$(Fe,Mn)Sn(OH)_6$	$P4_2/n$
mopungite	$NaSb(OH)_6$	$P4_2/n$
mushistonite	$(Cu,Zn,Fe)Sn(OH)_6$	Pn3m
natanite	$FeSn(OH)_6$	Pn3m
schoenfliesite	$MgSn(OH)_6$	Pn3m
stottite	$FeGe(OH)_6$	$P4_2/n$
söhngeïte	$Ga(OH)_3$	Im3
vismirnovite	$ZnSn(OH)_6$	Pn3m
tetrawickmanite	$MnSn(OH)_6$	$P4_2/n$
wickmanite	$(Mn,Ca)Sn(OH)_6$	Pn3m
zinc-stottite	$ZnFeGe_2(OH)_{12}$	tetragonal

All are based on ReO_3 structure type with varying degrees of distortion and chemical substitution.
Occurrence/review minerals in stottite group: **AR Kampf** 1982 MR 13 235-9 = AM 68 471-2.
[May be iso Sb & Ge componds: check.]

schoenfliesite $MgSn(OH)_6$. Schoenfliesite structure group.

XRPD matches *synthetic*.
Structure: NPD, **LC Basciano & 3 others** 1998 CM 36 1203-10.
Occurrence: **GT Faust WT Schaller** 1971 ZK 134 116-41.

schoepite $(UO_2)_8O_2(OH)_{12}.12aq$.

Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Three phases I (fully hydrated, n = 2), II (2-1), III (~1).
Structure of above composition: **RJ Finch & 3 others** 1996 CM 34 1071-88.
XRPD: **RJ Finch & 3 others** 1997 PD 12 230-8 (F680).
Crystallographic relations among schoepite, metaschoepite & dehydrated schoepite: **RJ Finch FC Hawthorne RC Ewing** 1998 CM 36 831-45.
Phase transformations & crystal chemistry, proposed structures: **CL Christ** 1965 AM 50 235-9.
Transformation from *synthetic* U_3O_8: **R Vochten E De Grave H Lauwers** 1990 MP 41 247-55 (V226).
Occurrence: **CL Christ JR Clark** 1960 AM 45 1026-61.

= *epiianthinite*: MM 28 728.
Synthetic $UO_2(OH)_2$: **RB Roof Jr DT Cromer AC Larson** 1964 AC 17 701-5.

schöllhornite $Na_{0.3}CrS_2.aq.$

Occurs in Norton County enstatite chondrite as dihydrate which lost aqua in museum.
Structure not determined, but is layered related to *synthetics*: **R Schöllborn R Arndt A Kubny** 1979 ZaaC 251 376-95.
Occurrence & crystallography: **A Okada & 3 others** 1985 AM 70 638-43.

scholzite $CaZn_2(PO_4)_2.2aq.$ Dimorphic with *parascholzite*.

Orthorhombic $Pbc2_1$ structure: **K Taxer** 1975 AM 60 1019-22.

Occurrence: MM 29 993.
Polytypic theory: **K Taxer** 1992 ZK 198 239-55.
Also: MA 70-2128, 73-3502, 74-3450.
Dehydration to monohydrate and mixture of three anhydates: **R Czaya** 1972 AC B28 322-3 (C776); the beta hexagonal anhydrate is isostructural with hexagonal $Ca/BaAl_2Si_2O_8$.

schomiokite-Y $Na_3Y(CO_3)_3.3aq.$

Compare with *kamphaugite-(Y)*, *kimuraite*, *lokkaite* & *tengerite*.
Structure: **DYu Pushcharovsky RK Rastsvetn[a]eva IV Pekov** 1996 AC A52 Suppl C-339.
Occurrence: **AP Khomyakov NG Shumyatskaya LI Polezhaeva** 1992 ZVMO 129-32 (K671A).

schoonerite $ZnMnFe^{2+}_2Fe^{3+}(PO_4)_3(OH)_2.9aq.$

Structure: **AR Kampf** 1977 AM 62 250-5.
Occurrence: MM 42 529.

schorl $\sim NaFe_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$. *Tourmaline* structure type.

Structure: **S Fortier G Donnay** 1975 CM 13 173-7;
alkali-deficient, **FF Foit Jr** 1989 AM 74 422-31;
Al-rich overgrown with B-rich *olenite*, **A Ertl JM Hughes** 2002 MP 75 69-78 (7278).

schorlomite $CaTi_2Fe_2SiO_{12}$. *Garnet* structure type.

ND & Mössbauer of *synthetic* Ti-rich garnet, **HP Weber D Virgo FE Huggins** 1975 Carnegie Inst Washington Yr Bk 74 575-9;
Y Bi B Mu Z Zhang M Shao 1983 Acta Mineral Sinica 4 265-70;
oxygen position disorder, **RC Peterson AJ Locock RW Luth** 1995 CM 33 627-31;
spectroscopy of Fe & Ti, **A Locock & 4 others** 1995 AM 80 27-38.
Crystal chemistry/formula/inter-species boundaries: **AR Chakhmouradian CA McCammon** 2005 PCM 32 277-89.

schreibersite $(Fe,Ni)_3P$. Ni analog is called *nickel phosphide*.

Structure: **F-D Doenitz** 1970 ZK 131 222-36;
Vicenice iron, XRPD, **R Skala J Fryda** 1996 Lunar Planet Sci XXVII 1211-2 & Meteoritics 31 Suppl A131-2;
Ni partition, Odessa, SC-XRD, **rs I Cisarova** 2000 MPS 35 A149;
Tocopilla, XRPD, **rs ic** 2003 MPS 38 Suppl A42.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

schreyerite $V_2Ti_3O_9$. Forms (incomplete?) series with *olkhonskite* $(Cr,V)_2Ti_3O_9$.

Dimorphic with *kyzylkumite* .
Intergrown with *rutile*.
Subtracted XRPD corresponds to Andersson-type shear structure derived from parent alpha-PbO_2 (*scrutinyite*) in *synthetic* materials.
Occurrence and XRPD: **O Medenbach K Schmetzer** 1976 Nw 63 293-4 = AM 62 395;
O Medenbach K Schmetzer 1978 AM 63 1182-6
New occurrence Lake Baikal & SC-XRD structure: **N Döbelin & 4 others** 2006 AM 91 196-203.

schröckingerite $NaCa_3(UO_2)(SO_4)(CO_3)_3F.10aq.$

Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Structure: **K Mereiter** 1986 TMPM 35 1-18 (M1253).
[*Synthetic* $Na_4(UO_2)(CO_3)_3$, structure: **Y Li SV Krivovichev PC Burns** 2001 MM 65 297-304.]

schubnelite $FeVO_4aq.$ *Vanadium bronze* structure group; *other* subgroup.

Isostructural with (Mg/Mn)(Mo/W) *synthetics*: **M Amberg & 3 others** 1988 JSSC 77 162-9;
A Clearfield A Moini PR Rudolf 1985 IC 24 4606-9.

Structure: **M Schindler FC Hawthorne** 1999 AM 84 665-8.
Review: **HT Evans Jr JM Hughes** 1990 AM 75 508-21.
Occurrence: **F Cesbron** 1970 BSFMC 93 470-5.

schuetteite $Hg_3(SO_4)O_2$.

Structure determination not found.
XRPD matches *synthetic*.
Occurrence: **EH Bailey & 3 others** 1959 AM 44 1026-38.
[*Synthetic* (Hg/Cd)SO_4: structures, **K Aurivillius C Stålhandske** 1980 ZK 153 121-9 (A611).

schuilingite-Nd $PbCu(Nd,Gd,Sm,Y)(CO_3)_3OH.1aq$.

Structure: SC-XRD, **M Schindler FC Hawthorne** 1999 CM 37 1463-70.
Occurrence & crystallography: MM 28 738;
C Guillemin R Pierrot 1957 BSFMC 80 549-51;
H Sarp J Bertrand J Deferne 1983 SMPM 63 1-6.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

schulenbergite $(Cu,Zn)_7(SO_4,CO_3)_2(OH)_{10}.3aq$.

Structure determination not found.
Complex superstructure: **WG Mumme H Sarp PJ Chiappero** 1994 Arch Sci Geneve 47 117-24 = AM 80 849-50.
Occurrence: MM 48 582.
Synthetic Zn analog: **A Livingstone B Jackson PJ Davidson** 1992 MM 56 215-9.

schultenite $PbHAsO_4$. Paraelectric/ ferroelectric transition at 313K.

Structure: **H Effenberger F Pertlik** 1986 TMPM 35 157-66 (E330), also $PbHPO_4$;
CC Wilson PJ Cox NS Stewart 1991 J Cryst Spectr Res 21 589-93;
ND, 125-324 K, **CC Wilson** 1994 MM 58 629-34.
Occurrence: MM 21 576.
Synthetic $PbHPO_4$: MM 32 976.

schumacherite $Bi_3(V,etc.O_4)_2O(OH)$.

Isotypic with *petitjeanite* $Bi_3(PO_4)_2O(OH)$ & *preisingerite* $Bi_3(AsO_4)_2O(OH)$ from XRPD.
Structure determination not found.
Occurrence & crystallography: **K Walenta & 3 others** 1983 TMPM 31 165-73.

schwartzembergite $Pb_5IO_6H_2Cl_3$.

Structure: SC-XRD, **MD Welch & 3 others** 2001 CM 39 785-95.
Occurrence & new formula: **A Mücke** 1969 German abstract = AM 55 1814.

[**schwazite** $Cu_6(Cu_{4.6}Hg_{1.4})Sb_{3.3}As_{0.7}S_{12}S$.

Can be described as mercurian *tetrahedrite*.
Structure: **R Kalbskopf** 1971 TMPM 16 173-5;
LN Kaplunnik EA Pobedimskaya NV Belov 1980 SPD 25 506-7 (K627);
occurrence & SC-XRD, **L Karanović & 4 others** 2003 NJMM 503-20.]

schwertmannite $\sim Fe_8O_8(OH)_6(SO_4).n\ aq$

Composition varies with pH & sulfate concentration. Related to *akaganéite*.
Structure: TEM, *synthetic*, **M Loan & 3 others** 2004 AM 89 1735-42.
Occurrence: **JM Bigham L Carlson E Murad** 1994 MM 58 641-8;
U Schwertmann JM Bigham E Murad 1995 EJM 7 547-52 (S1448);
JM Bigham & 4 others 1996 GCA 60 2111-21;
CW Childs K Inoue C Mizota 1998 ChG 144 81-6 (C1030);
steam condensate, Taupo, New Zealand: **KA Rodgers & 4 others** 2000 MM 64 125-42.
Synthetic, IR: **RJ Barham** 1997 JMR 12 2751-8 (B1773).
Solubility: **J Yu M Park J Kim** 2002 GJ 36 119-32 (7277).
Arsenate sorption: **K Fukushi & 4 others** 2004 AM 89 1728-37.
Transition to *goethite* vs pH at 296 K: **U Schwertmann L Carlson** 2005 ClM 40 63-6.

sclarite $(Zn,Mg,Mn)_4Zn_3(CO_3)_2(OH)_{10}$. Isostructural with Mn,Zn analog *loseyite*.

Structure: **JD Grice PJ Dunn** 1989 AM 74 1355-9.

scleroclase $PbAs_2S_4$.

Structure: **Y Iitaka W Nowacki** 1961 AC 14 1291-2 (I11).

scolecite $CaAl_2Si_3O_{10}.3aq$. *Natrolite* structure type.

Structure: proton NMR, **LV Ivleva SP Garuda** 1972 SPC 16 713-4 (I99);
L Fälth S Hansen 1979 AC B35 1877-80 (F213);
SC-N&XRD, **JV Smith & 3 others** 1984 Proc 6th Int Zeolite Conf 842-50 (S1511);
SC-ND, **Å Kvick K Ståhl JV Smith** 1985 ZK 171 141-54;
W Joswig H Bartl H Fuess 1984 ZK 170 220-3 (J260;
refinement of high-order diffraction intensities, internal & external vibration amplitudes, **E Stuckenschmidt & 3 others** 1997 PCM 24 403-10 (S1736);
electron density & bond topochemistry, **S Kuntzinger & 3 others** 1998 ACB 54 819-33;
Al & Si, MAS-NMR, **PS Neuhof & 4 others** 2002 AM 87 1307-20;
Raman & IR of water in channels, **BA Koselov CA Geiger** 2006 AM 91 1039-48.

Real-time XRPD: of dehydration, **K Ståhl J Hanson** 1994 JACr 27 543-50;
dehydration/rehydration, **K Ståhl R Thomasson** 1994 Z 14 12-7 (S1238);

High P: phase changes & amorphization, **P Gillet J Malézieux J Itié** 1996 AM 81 651-7;
do, XRPD & Raman, **JM Malezieux P Gillet JP Itié** 1996 J Phys IV C4/561-9;
phase changes, Raman, **IS Bazhan OV Kholdeev BA Fursenko** 1999 DES 364 71-2 (B1920);
<5 GPa, SC-XRD, **P Comodi GD Gatta PF Zanazzi** 2002 EJM 14 567-74 (7672);
deformation, **P Ballone & 3 others** 2002 AM 87 1194-206.

scorodite $FeAsO_4.2aq$. *Variscite* structure group.

Structure: **R Kiriyama K Sakurai** 1949 X-rays, Osaka 5 85-8 = MA 11-241;
K Kitayama R Kiriyama Y Baba 1975 AC B31 322-4 (K561);
FC Hawthorne 1976 AC B32 2891-2 (9292).

Mn-, Urals: **IV Kozyreva IV Shvetsova MP Ketris** 2001 DES 376 12-6 (1339).

scorzalite $(Fe,Mg)Al_2(PO_4)_2(OH)_2$. *Lazulite* structure group.

Structure: **ML Lindberg CL Christ** 1959 AC 12 695.

Structure: MM 28 738.

Stability field: **P Schmid-Beurmann G Morteani L Cemic** 1997 MP 61 211-22 (S1880).

scotlandite $PbSO_3$. Isostructural with *molydomenite* $PbSeO_3$ & synthetic $KClO_3$.

Structure: **F Pertlik J Zemann** 1985 TMPM 34 289-95 (P538);
XR/ND, **A Nørlund Christensen AW Hewat** 1990 Acta Chem Scand 44 688-91(N364).

Occurrence: MM 48 582.

SCRUTINYITE STRUCTURE GROUP

Alpha-PbO_2 structure type. Many subtle details involving cation order & superstructures.

Various oxides convert to this structure type at high P.

Columbite sub-group

[bismutocolumbite	$Bi(Nb,Ta)O_4$
euxenite	$(Y,Ca,Ce,U,Th)(Nb,Ta,Ti)_2O_6$
ferrocolumbite	$(Fe,Mn)(Nb,Ta)_2O_6$
fersmite	$(Ca,Ce,Na)(Nb,Ti,Fe,Al)_2O_6$
magnesiocolumbite	$(Mg,Fe,Mn)(Nb,Ta)_2O_6$
manganocolumbite	$(Mn,Fe)(Nb,Ta)_2O_6$
polycrase	$(Y,Ca,Ce,U,Th)(Ti,Nb,Ta)_2O_6$
uranopolycrase	$(U,Y)(Ti,Nb)_2O_6$
[*yttrocrasite*	$(Y,Th,Ca,U)(Ti,Fe)_2(O,OH)_6$]

huebnerite	$MnWO_4$
ixiolite	$(Ta_{0.4}Mn_{0.3}Nb_{0.2},Ti,Sn,Fe)O_2$
manganotantalite	$Mn(Ta_{0.6}Nb_{0.4})_2O_6$
qitianlingite	$(Fe_{1.3}Mn_{0.6}Nb_{0.1})(Nb_{1.5}Ta_{0.4}Ti_{0.1})(W_{0.9}Nb_{0.1})O_{10}$
samarskite **-*Y***	$(Y,Ce,U,Fe)_3(Nb,Ta,Ti)_5O_{16}$.
scrutinyite	PbO_2
srilankite	$ZrTi_2O_6$
tantalite	$(Mn,Fe)(Ta,Nb)_2O_6$

tungstenixiolite $Fe_{1.0}Mn_{0.5}Nb_{0.5})(Nb_{0.9}W_{0.8}Ta0.2Ti_{0.1})O_8$
wodginite $Mn(Sn_{0.6}Ta_{0.2}Ti_{o.1}Fe_{0.1})(Ta_{0.9}Nb_{0.1})O_8$.
Titano-, ferro-, & lithio- variants

Wolframite sub-group
[cuproscheelite $CuWO_4$mineral species questioned]
ferberite $FeWO_4$
huebnerite $MnWO_4$
sanmartinite $(Zn,Fe,Ca,Mn)WO_4$
wolframite $(Fe,Mn)WO_4$
wolframoixiolite $(Fe,Mn,Nb)_2(Nb,W,Ta)_2O_8$

Summary, **NA Yamnova DYu Pushcharovskii AV Volshin** 1995 CrR 40 428-33 (Y158).
Crystal chemistry of complex Nb & Ta oxides: **J Graham MR Thornber** 1974 AM 59 1026-39.
Synthetic TiO_2-II: synthesized 4 GPa & 723 K, **PY Simons F Dachille** 1967 AC 23 334-6;
high-P *rutile* to *baddeleyite* & *scrutinyite* types: **L Gerward JS Olsen** 1997 JACr 30 259-64 (G914).
Synthetic $FeNbO_4$: 1989 MRB 24 523-7 = SR 56A 142.
Synthetic Fe_2N-xi: **D Rechenbach H Jacobs** 1996 JAlCo 235 15-22 (R663).
Synthetic GeO_2: **VB Prakapenka & 7 others** 2003 PRB 67 132101(4).
High-P phase of silica, Mars meteorite Shergotty: **P Dera & 3 others** 2002 AM 87 1018-23.

scrutinyite PbO_2. *Scrutinyite* structure group.
Structure: *synthetic*, **Al Zaslavskii SS Tolkachev** 1952 Zhurn Fiz Khim 1952 26 743-52 = SR 16 224-5;
F Laves G Bayer A Panagos 1963 SMPM 43 217-34.
Occurrence: **JE Taggart Jr & 3 others** 1988 CM 26 905-10;
I Ya Nekrasov 1994 DAN 324 150-3 (N352) = MM 54 669.

seamanite $Mn_3(PO_4)B(OH)_6$.
Structure: **EN Kurkatova VG Rau IM Rumanova** 1971 SPD 16 272-4;
PB Moore S Ghose 1971 AM 56 1527-38 (M1154)
H-bonding, **DMC Huminicki FC Hawthorne** 2002 CM 40 923-8.
Occurrence: MM 22 627.

searlesite $NaBSi_2O_5(OH)_2$.
Structure: **VB Kravchenko GB Bokiy** 1964 SPC 9 143-8 (K639);
S Ghose C Wan 1976 AM 61 123-9;
NMR, & of *magadiite/kenyaite* mixtures, **CA Fyfe J Skibsted W Schwieger** 2001 IC 40 5906-12 (3511).
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

sederholmite NiSe-beta. *Niccolite* structure group.
XRPD matches *synthetic*.
Occurrence/crystallogr: **V Vuorelainen A Huhma A Häkli** 1964 CRGF 36 113-25 = AM 50 519.

sedovite $U(MoO_4)_2$.
Structure determination not found.
Occurrence: **KV Skvortsova GA Sidorenko** 1965 ZVMO 94 548-54 = AM 51 530.

seeligerite $Pb_3(IO_3)Cl_3O$. XRPD from synthetic.
Structure: **P Burns** 1999.
Occurrence: **A Mücke** 1971 NJMM 210-7.

seelite $Mg[(UO_2)(AsO_3)_{0.7}(AsO_4)_{1.3}]_2.7aq$.
Suggested that isostructural with *ranunculite*, but cell data differ.
Structure: **P Piret J Piret-Meunier** 1994 EJM 6 673-7.
Occurrence: **P Bariand & 5 others** 1993 MR 24 463-7 = MM 60 681;
K Walenta 1996 Chem Erde 56 273-80 (W767).

segelerite $CaMgFe(PO_4)_2(OH).4aq$. *Overite* structure group.
Structure: **PB Moore T Araki** 1977 AM 62 692-702.
Occurrence: MM 39 926.

segnitite $PbFe_3H(AsO_4)_2(OH)_6$. *Beudantite* structure group.
Discredited *lusungite* would have become the P analog.

Structure determination not found.
Occurrence: **WD Birch A Pring BM Gatehouse** 1992 AM 77 656-9.

seidite-Ce $Na_4(Ce,Sr)_2Ti(OH)_2(Si_8O_{18})(O,OH,F)_4.5aq$. *Rhodesite* group. Zeolitic properties. Octahedral-tetrahedral net.
Structure: XRPD & SAED, **G Ferraris & 4 others** 2003 CM 41 1183-92.
Occurrence: **AP Khomyakov & 5 others** 1998 ZVMO 127 94-100 (K1218).

SEIDOZERITE STRUCTURE GROUP Includes:

bafertisite	$Ba(Fe,Mn)_2TiSi_2O_7(O,OH)_2$
barytolamprophyllite	$(Na,K)_2(Ba,Ca,Sr)_2(Ti,Fe)_3(SiO_4)_4(O,OH)_2$
ericssonite	$BaMn_2FeOSi_2O_7OH$
?götzenite	$(Ca,Na)_7(Ti,Al)_2Si_4O_{15}(F,OH)_3$?
grenmarite	$(Zr,Mn)_2(Zr,Ti)(Mn,Na)(Na,Ca)_4(Si_2O_7)_2(O,F)_4$
lamprophyllite	$Na_2(Sr,Ba)_2Ti_3(SiO_4)_4(OH,F)_2$
nabalamprophyllite	$(Na,Ba)Na_3Ba\{Ti[Ti_2O_2Si_4O_{14}\}(OH,F)_2$
orthoericssonite	$BaMn_2FeOSi_2O_7OH$
?rinkolite	$Na_2Ca_4CeTi[Si_2O_7]_2OF_3$
seidozerite	$(Na,Ca)_2(Zr,Ti,Mn)_2Si_2O_7(O,F)_2$
unnamed	$BaMn_2TiO[Si_2O_7](OH)_2$

Homologous structure relation with *nacaphite* $Na_2Ca(PO_4)F$.

seidozerite $(Na,Ca)_2(Zr,Ti,Mn)_2Si_2O_7(O,F)_2$. *Seidozerite* structure group.
Structure: **VI Simonov NV Belov** 1960 SPC 4 146-57;
Ca-rich, **SM Skszat VI Simonov** 1966 SPC 10 505-8 (S1311);
SC-XRD, **DYu Pushcharovsky & 5 others** 2002 CrR 232-6 (7082).
Occurrence: MM 32 979.

seinäjokite $(Fe,Ni)(Sb,As)_2$. *Löllingite* structure subgroup in *marcasite* supergroup.
Structure determination of mineral not found.
Synthetic $FeSb_2$, structure: **H Holseth A Kjekshus** 1969 Acta Chem Scand 23 3043-50 (H1040).
Occurrence: **EM Spiridonov & 4 others** 1994 ZVMO 123 65-77.

sekaninaite $(Fe,Mg)_2Al_4Si_5O_{18}$. Isostructural with Mg analog *cordierite*.
Structure determination not found.
Occurrence: Czech paper = AM 62 395;
Erzgerbirge, **B Gottesmann H Förster** 2004 EJM 16 483-91 (10477).

selenium Se. Alpha-monoclinic polymorph isostructural with *tellurium*.
Tetradymite mineral/structure group, Te subgroup: **P Bayliss** 1991 AM 76 257-65.
Trigonal polymorph: **AJ Bradley** 1924 Phil Mag 48 477;
P Cherin P Unger 1967 IC 6 1589-91 (C775).
Synthetic alpha-monoclinic: **P Cherin P Unger** 1972 AC B28 313-7.
Second monoclinic (beta): [wrong **RD Burbank** 1951 AC 4 140];
RE Marsh L Pauling JD McCullough 1953 AC 6 71-5 (M1316).

selenojalpaite Ag_3CuSe_2. Similar but perhaps not identical structure with *jalpaite.*
Occurrence & XRD: **L Bindi G Pratesi** 2005 CM 43 1373-7 = AM 91 713-4.

selenostephanite $Ag_5Sb(Se,S)_4$. Isostructural with S analog *stephanite*.
Structure determination not found.
Occurrence & crystallography: **MM Botova & 2 others** 1985 ZVMO 114 627-30 = AM 72 225.

[selen-tellurium Discredited: **P Bayliss** 1991 AM 76 257-65.]

seligmannite $CuPbAsS_3$. *Bournonite* structure group.
Structure: **E Hellner G Leineweber** 1956 ZK 107 149-54;
A Edenharter W Nowacki Y Takéuchi 1970 ZK 131 397-417 (E114);
Y Takéuchi N Haga 1970 ZK 130 254-60 (T147);
VV Bakakin AA Godovikov 1980 SPD 25 145-6 (B1113).

sellaite MgF_2. *Rutile* structure group.
Structure: **WH Baur** 1976 AC B32 2200-4;

G Vidal-Valat & 3 others 1979 AC B35 1584-90;
L Pauling 1980 AC B36 761-2 = MA 80-2900.

P-driven changes in (Ni/Mg/Co/Zn/Fe/Mn)F_2: **LC Ming & 3 others** 1980 PEPI 23 276-85 (M694).

selwynite $NaK(Be,Al)Zr_2(PO_4)_4.2aq$. Isostructural with *gainesite* & *mccrillisite*.

Occurrence & XRPD: **WD Birch A Pring EE Foord** 1995 CM 33 55-8.

semenovite $(Ca,Ce,La,Na)_{10\text{-}12}(Fe,Mn)(Si,Be)_{20}(O,OH,F)_{48}$.

Structure: **F Mazzi & 4 others** 1979 AM 64 202-10.

Occurrence: MM 39 926.

Review: (different formula), **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

semseyite $Pb_9Sb_8S_{21}$. *Plagionite* homologous series, n = 3: see group review.

Structure determination not found.

Occurrence: **Dana**; (W786).

Available crystals: MR 28 137.

senaite $Pb(Ti,Fe,Mn)_{21}O_{38}$. *Crichtonite* structure group.

Structure: **IE Grey DJ Lloyd** 1976 AC B32 1509-13;
IE Grey DJ Lloyd JS White Jr 1976 AM 61 1203-12;
U-rich, **KT Armbruster M Kunz** 1990 EJM 2 163-70.

Occurrence, Alpine fissure, Sr-rich: **WF Oberholzer S Graeser E Reusser** 1997 SMPM 77 233-6 (O340).

senandorite = *andorite VI*. *Lillianite* homologous series.

senarmontite Sb_2O_3. Dimorphic with *valentinite*.

Structure: **C Svensson** 1975 AC B31 2016-8.

Gudmundite-antimony mineralization, Quebec ophiolite, late hypogene, *kermesite*, senarmontite, *valentinite*: **C Normand M Gauthier M Jebrak** 1996 EcG 91 149-63 (N408).

senegalite $Al_2(PO_4)(OH)_3.aq$.

Structure: **TD Keegan T Araki PB Moore** 1979 AM 64 1243-7 (K555).

Occurrence: MM 40 913.

sengierite $Cu(UO_2)_2(VO_4)_2(OH)_2.6aq$.

Review: (E289); **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.

Compare with *carnotite* K & *strelkinite* Na.

Structure: **P Piret J-P Declercq D Wauters-Stoop** 1980 BM 103 176-8.

Occurrence; MM 28 738.

sepiolite $\sim Mg_4Si_6O_{15}(OH)_2.6aq$. Analog of Ni *falcondoite*.

Revised composition (& palygorskite): **E Galan MI Carretero** 1999 ClCIM 47 399-409 (G1179).

Structure: **B Nagy WF Bradley** 1955 AM 40 885-92;
K Brauner A Preisinger 1956 TMPM 6 120-40 (B1569);
M Rautureau C Tchoubar 1976 ClCIM 24 43-9 (R695).

Adsorption of monovalent organic cations: **G Rytwo & 6 others** 1998 ClCIM 46 340-8 (R840).

Decolorization of sugar juice: **HI Unal B Erdogan** 1998 ACS 12 419-29.

High adsorption heavy metals from waste water, Cd>Cu>Zn>Ni: **AG Sanchez & 2 others** 1999 CIM 34 469-77.

Adsorption/desorption of water in ambient air 373-773 K: **F Caturla et al** 1999 ACS 15 367-80.

Acid treatment, MAS-NMR, SAXS: **I Dekany & 3 others** 1999 ACS 14 141-60.

Pt/sepiolite catalysts, MAS-NMR: **MA Aramendia & 6 others** 2000 JCIS 227 469-75 (7050).

Partial dehydration, MAS-NMR: **MR Weir & 3 others** 2002 ClCIM 50 240-7 (7143).

Adsorption of nitrogen, carbon dioxide, ammonia & aq: **M Molina-Sabio & 3 others** 2001 MMM 47 389-96 (3126).

Clay/carbon composite, folding T, SAXS: **G Sandi & 3 others** 2002 ChM 14 739-42 (6214).

Pyridine derivatives, adsorption: **E Sabah MS Celik** 2002 JCIS 251 33-8 (7764).

[*Fe-sepiolite* = *gunnbjarnite* : occurrence, MM 29 983;
Lovozero, **VN Chukanova & 3 others** 2002 GI 40 1225-9 (8750).

[*Mn-sepiolite* $\sim Mn_4Fe_4Si_{12}O_{30}(OH)_6.8aq$. Sepiolite type.

Occurrence: MM 39 921.]

Palygorskite- series, growth from solution, thermodynamics: **R Birsoy** 2002 ClCIM 50 736-45.

serandite $NaMn_2Si_3O_8OH$. *Pyroxenoid* structure group. Isostructural with *pectolite*.

Structure: **Y Takéuchi Y Kudoh T Yamanaka** 1976 AM 61 229-37;
bustamite, *wollastonite* & *pectolite-schizolite*-serandite series, **Y Ohashi LW Finger** 1978 AM 63 274-88;

SC-XR & ND, double proton positions, **SD Jacobsen & 3 others** 2000 AM 85 745-52.
SC-IR of H bonds: **VMF Hammer E Libowitsky GR Rossman** 1998 AM 83 569-76.
Occurrence: MM 22 627.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** (1995).
Synthetic aluminated, ethanol conversion: **V Gruver A Sun JJ Fripiat** 1995 Catal Lett 34 359-64.

serendibite $(Ca,Na)_2(Mg,Al,Fe)6\ (Si,Al,B)_6\ O_{20}$. *Aenigmatite* structure type.

Structure: **M Buerger V Venkatakrishnan** 1974 PNAS 71 4348-51;
MP Machin P Süsse 1974 NJMM 435-41 (M138);
DG Van Derveer & 3 others 1993 AM 78 195-203.
From Russian skarns: MA 96M/2061.

sergeevite $Ca_2Mg_{11}(CO_3)_{13}.10aq$.

Occurrence: MM 43 1067.

sericite Field term for certain fine-grained micas.

Dehydroxylated 2M, structural comparison with unheated, relation to mixed-layer with *smectite*:
K Tomita K Shiraki M Kawano 1998 Clay Sci 10 423-41 = MA 00M/0133.
Dehydration & CO_2 incorporation in annealed, IR: **M Zhang & 4 others** 2005 AM 90 173-80.

serpentine $(Mg,Fe,Ni)Si_2O_5(OH)_4$. Includes *antigorite, chrysotile & lizardite*.

Easily distinguished by FT-Raman: **C Rinaudo D Gastaldi E Belluso** 2003 CM 41 883-90.
Member of *kaolinite*-serpentine group. Many subtle distinctions.
Review of structures: **FJ Wicks EJW Whittaker** 1975 CM 13 227-43.
IR, structure vs cations: **J Bishop E Murad MD Dyar** 2002 CIM 37 617-28.
Cation size vs curvature, HRTEM-AEM: **R Perbost M Amouric J Olives** 2003 CICIM 51 430-8 (9268).
Microbeam X-ray diffraction: **FJ Wicks J Zussman** 1975 CM 13 244-58.
6-layer-: structure, **SH Hall & 3 others** 1976 CM 14 314-21(H457).
Polygonal: structure, **A Baronnet M Mellini B Devonard** 1994 PCM 21 330-43;
model of 30-sector from TEM & SAED, **I Dódony** 1997 PCM 24 39-49 (D623);
TEM of microstructure relation resulting from recrystallization of *chrysotile* to polygonal serpentine & *lizardite* : **C Viti M Mellini** 1997 EJM 9 585-96 (V273);
TEM of *synthetic*, **B Devouard & 3 others** 1997 EJM 9 539-46 (D647)
HRTEM/SAED of 15- & 30-sector, **A Baronnet B Devouard** 2005 CM 43 513-42.
Amorphization 14-27 GPa 473-573 K: **T Irifune & 5 others** 1996 S 272 1468-70 (I143).
Regular interstratified serpentine-*chlorite* minerals: **JF Banfield SW Bailey** 1996 AM 81 79-91.
Derivation/identification of nonstandard polytypes: **SW Bailey JF Banfield** 1995 AM 801104-15.
Complex polytypism: **JF Banfield & 3 others** 1995 AM 80 1116-31.
Diffuse reflectance: **WM Calvin TVV King** 1997 MPS 32 693-701.
High-P Raman to10GPa: **A Auzende & 4 others** 2004 PCM 31 269-7 (10539).
Origin & diagenesis in Tuscaloosa Formation, US Gulf Coast, XRPD: **PC Ryan RC Reynolds Jr** 1996 AM 81 213-25.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
Serpentinites: **DS O'Hanley** 1996, *Records of Tectonic and Petrological History*, Oxford U P;
Cuba, TEM, EJM 14 905-14 (8332).
H-rich fluids, **NH Sleep & 4 others** 2004 PNAS 101 12818-23 (10675).
Serpentinized peridotite: non-topotactic *olivine*, HRTEM/AEM, **C Rumori M Mellini C Viti** 2004 EJM 16 731-41 (10844).
XRPD reference patterns, inaccuracies: **FJ Wicks** 2000 PD 15 42-50 (W1003).

serpierite $Ca(Cu,Zn)_4(SO_4)_2(OH)_6.3aq$. Composite layer structure.

See *campligianite*, *devillite* & *ktenasite*. Review: **Sabelli** p. 24: (E289).
Structure: **C Sabelli PF Zanazzi** 1972 AC B28 1214-21.
Raman vs OH: **RL Frost & 4 others** 2004 AM 89 1130-7.
Occurrence: MM 54 669.

serrabrancaite $MnPO_4.aq$. *Kieserite* structure type.

Structure: *synthetic*, XRPD, **P Lightfoot AK Cheetham AW Sleight** 1987 IC 26 3544-7.
Occurrence & description, XRPD matches *synthetic*: **T Witke & 4 others** 2000 AM 85 847-9.

sewardite $CaFe_2(AsO_4)_2(OH)_2$. *Carminite* structure type.

Occurrence & structure: **AC Roberts & 4 others** 2002 CM 40 1191-8.

shabaite-Nd $Ca(Nd,Sm,Y)_2(UO_2)(CO_3)_4(OH)_6.6aq$.

Structure determination not found.

Occurrence: **M Deliens P Piret** 1989 EJM 1 85-8.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
shabynite $Mg_3(BO_3)(Cl,OH)_2(OH)_5.4aq$.
Structure determination not found.
Occurrence: **NN Pertsev & 5 others** 1980 ZVMO 109 569-73 = AM 66 1101.
shadlunite $(Pb_{0.7}Cd_{0.2})Fe,Cu)_8S_8$. *Pentlandite* structure group from XRPD.
Series with *manganese-shadlunite* $(Mn,Pb,Cd)(Cu,Fe)_8S_8$.
Occurrence: **TL Evstigneeva & 4 others** 1973 ZVMO 102 63-74 = AM 58 1114.
[*Mn-shadlunite* Mn replaces Pb in *shadlunite*. Occurrence: MM 39 921.]
shafranovskite $K_2Na_3(Mn,Fe,Na)_4Si_9(O,OH)_{27}(OH)_2.naq$.
Structure: SC-XRD, **SV Krivovichev & 5 others** 2004 AM 89 1816-21.
Occurrence & ED: **AP Khomyakov & 4 others** 1982 ZVMO 111 475-80.
Occurrence: MM 48 582.
Mineral M20 is Fe-rich analog. Its alteration product is M21.
See unnamed section for M22, M23, M24, M25, & M66.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.
shakhovite $Hg_4SbO_3(OH)_3$.
Structure: **E Tillmanns R Krupp K Abraham** 1982 TMPM 30 227-35 (T431);
NA Pal'chik & 4 others 1984 SPD 23 694-6 (P460) = MA 89M/4123.
Occurrence: MM 46 525.
shandite $Ni_3Pb_2S_2$. Bi analog *parkerite* has derivative structure.
Structure: *synthetic*, **MA Peacock J McAndrew** 1950 AM 35 425-39;
XRPD, rhombohedral, **WS Brower HS Parker RS Roth** 1974 AM 59 296-301.
Occurrence: MM 29 993-4.
Synthetic $Ni_3Sn_2S_2$: & structure review, **A Michelet G Collin** 1976 J Less-Common Metals 45 185-91 (M1334);
revision, **A Clauss M Warasteh K Weber** 1978 NJMM 256-68;
SC-XRD, **K-J Range F Rau M Zabel H Paulus** 1997 ZK 212 50 (R706).
Synthetic $M_3M'_2X_2$: **M Zabel S Wandiger K-J Range** 1979 ZN 34b 238-41.
Synthetic $Ni_3Pb_2Se_2$, $Ni_3(Sn/In/Tl)_2S_2$: **A Clauss M Warasteh K Weber** 1978 NJMM 256-68 (C835).
Synthetic $Ni_3Pb_2Se_2$, structure: **K-J Range H Paulus F Rau M Zabel** 1997 ZK 212 136 (R709).
shannonite Pb_2OCO_3.
Structure, SC-XRD: **SV Krivovichev** PC Burns 2000 MM 64 1063-8 .
Occurrence: **AC Roberts & 6 others** 1995 MM 59 305-10.
Early history: **LM Juckes** 1999 Min Soc Bull 124 3-5.
sharpite $Ca(UO_2)_6(CO_3)_5(OH)_4.6aq$.
Structure determination not found.
Occurrence: MM 25 644; **C Frondel** 1958 USGS Bull 1064 106-8.
shattuckite $Cu_5(SiO_3)_4(OH)_2$. Review: (E289), framework, cf. *plancheite*.
Structure: **M Le Bihan** 1967 BSFMC 90 3-7;
A Kawahara 1976 MJJ 8 193-9;
HT Evans Jr ME Mrose 1977 AM 62 491-502, correction 63 1266.
shcherbakovite $K_2NaTi_2O(OH)Si_4O_{12}$.
Isostructural with *batisite*, $Na_2BaTi_2(Si_2O_7)_2$ & *noonkanbahite* $\sim KNaBaTi_2Si_4O_{14}$.
Structure: SC-XRD, **YA Uvarova & 4 others** 2003 CM 41 1193-201.
Occurrence & crystallography: **EM Es'kova ME Kazakova** 1954 DAN 99 837-41 = AM 40 788;
SM Kravchenko EV Vlasova NG Pinevich 1960 DAN 133 657-60 = AM 45 1317;
RH Mitchell 1990 MM 54 645-6.
shcherbinaite V_2O_5. *Vanadium bronze* structure group; *other* subgroup.
Review: **HT Evans Jr JM Hughes** 1990 AM 75 508-21.
Structure: **A Byström K-A Wilhelmi O Brotzen** 1950 Acta Chem Scand 4 1119-30;
= *synthetic*, **R Enjalbert J Galy** 1986 AC C42 1467-9;
JM Hughes LW Finger 1983 AM 68 1220-2.
Occurrence: MM 39 926.

sheldrickite $NaCa_3(CO_3)_2F_3.aq.$

Occurrence & structure: **JD Grice RA Gault J van Velthuizen** 1997 CM 35 181-7.

[**shentulite** ~(Th,Fe,Ca,Ce)[(Si/P/As)O_4,CO_3OH]. No structure.

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

sherwoodite $Ca_9Al_2V^{5+}_{24}V^{4+}_4O_{80}.56aq.$ Heteropoly complex.

Structure: **HT Evans Jr JA Konnert** 1978 AM 63 563-8.

Occurrence: MM 32 980.

shibkovite $K(Ca,Mn,Na)_2(K_{2-x}void_x)_2Zn_3Si_{12}O_{30}$. *Milarite* group.

Structure: **EV Sokolova VB Rybakov LA Pautov** 1999 DES 369A 1288-90 (S2128) .

Occurrence & XRPD: **LA Pautov AA Agakhanov EV Sokolova** 1998 ZVMO 127 89-94 (P863).

shigaite $Mn_7Al_4(SO_4)_2(OH)_{22}.8aq.$ Structural analog of *motukoreaite* & *nikischerite*.

Structure: **MA Cooper FC Hawthorne** 1996 CM 34 91-7.

Occurrence: **DR Peacor & 3 others** 1985 NJMM 253-7 (P562).

shirokshinite $K(NaMg_2)Si_4O_{10}F_2$. *Mica* group.

Occurrence & SC-XRD structure: **IV Pekov & 5 others** 2003 EJM 15 447-54.

shkatulkalite $Na_{10}(Mn,Ca,Sr)Ti_3Nb_3(Si_2O_7)_6(OH)_2F.12aq.$ See *murmanite*.

Occurrence & crystallography: **YuP Menshikov & 3 others** 1996 ZVMO 125 120-6 (M1448).

shomiokite-Y $Na_3(Y,REE)(CO_3)_3.3aq.$

Structure: **JD Grice** 1996 CM 34 649-55;
RK Rastsvetaeva DYu Pushcharovsky IV Pekov 1996 EJM 8 1249-55 (R704).

Definition: **AP Khomyakov NG Shumyatskaya LT Polezhaeva** 1992 ZVMO 121 129-32.

Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

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

shortite $Na_2Ca_2(CO_3)_3$.

Structure: **FE Wickman** 1949 Ark Mineral Geol 1 91-101 = MA 11-100.

Raman: **AN Zaitsev AR Chakhmouradian** 2002 CM 40 103-20.

Occurrence: MM 25 644.

Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

shuangfengite $IrTe_2$. Isostructural with *synthetic* $PtTe_2$.

Occurrence & crystallography: **Z Yu** 1994 Acta Mineral Sinica 14 322-6 = MR 27 120.

[*Platinoshuanfengite* (actually Pt-rich): AM 84 198.]

shubnikovite $Ca_2Cu_8(AsO_4)_6ClOH.7aq?$

Structure determination not found.

Occurrence: **EI Nefedov** 1953 ZVMO 82 311-7 = AM 40 552.

Occurrence: MM 30 746.

shuiskite $Ca_2(Mg,Al,Fe)(Cr,Al)_2(Si,Al)O_4(Si_2O_7)(OH)_2.aq.$

Pumpellyite structure group from cell data.

Occurrence: **OK Ivanov & 3 others** 1981 ZVMO 110 508-12.

sibirskite $CaHBO_3$. Compare with *korzhinskite* $CaB_2O_4.0.5aq.$

XRPD matches *synthetic*: **H-A Lehmann A Zielfelder G Herzog** 1958 ZaaC 296B 202-3.

[jvs: check for structure of *synthetic*.]

Occurrence: **NN Vasilkova** 1962 ZVMO 91 455-64;
& crystallography, XRPD, ED, = *synthetic*: **SV Malinko VT Dubinchuk** 1996 ZVMO 4 60-70 (M1446).

[$Ca_2B_2O_5.aq.$ IMA 96-051. See *sibirskite*.]

sicherite $TlAg_2(As,Sb)_3S_6$.

Structural relations between *diaphorite, freieslebenite, marrite & sicherite*: **P Berlepsch E Makovicky T Armbruster** 2002 NJMA 178 75-91 (8796).

Occurrence & SC-XRD structure: **S Graeser & 3 others** 2001 AM 86 1087-93.

sicklerite $Li(Mn,Fe)PO_4$. *Olivine* structure type from cell data.

[*Manganese-sicklerite*, occurrence: MM 26 339.]

siderazot Fe_5N_2.

siderite $FeCO_3$. *Calcite* structure group.

Structure: **H Effenberger K Mereiter J Zemann** 1981 ZK 156 233-43.

Siderite-*magnesite* solid solution, FTIR: **ME Böttcher P-L Gehlken** 1995 NJMA 169 81-95.
Thermoelasticity: **J Zhang & 3 others** 1998 AM 83 280-7.
Stability at 5-12 kbar & 753-823 K: **AM Koziol** 2004 AM 89 294-300.
Occurrence with *green rust* in bacterially-reduced anoxic sediments of Seine estuary, France, Mössbauer & microRaman, comparison with *synthetics*: **A Boughriet & 3 others** 1997 JCSF 93 3209-15 (B1672).
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
Hydrothermal decomposition to *magnetite*/organics, application Mars & early Earth: **TM McCollom** 2003 GCA 67 311-7.

sideronatrite $Na_2Fe(SO_4)_2(OH).3aq$. Review: **Sabelli** p.15.
Contains $M(TO_4)_2$ chain in *labuntsovite*, *metasideronatrite*, *nenadkevichite*, *tancoite* & *yftisite*.
Structure: **F Cesbron** 1964 BSFMC 87 125-43;
F Scordari 1981 TMPM 28 315-9 (S145).
In coastal sea-spray, conversion to *metasideronatrite* $Na_2Fe(SO_4)_2(OH).aq$: **LAJ Garvie** 1999 MM 63 757-9.

siderophyllite $KFe_2AlAl_2Si_2O_{10}(F,OH)$. *Mica* structure group.
Structure determination not found.
Occurrence: **Deer Howie Zussman** 3 60.

siderotil $(Fe,Cu)SO_4.5aq$. Review: **Sabelli** p. 16-7.
Isostructural with *chalcanthite.*
Structure: **JL Jambor RJ Traill** 1963 CM 7 751-63;
revised with 5aq, SC-XRD, **RC Peterson PL Roeder Y Zhang** 2003 CM 41 671-6.
Distinct from *rozenite* 4aq: **P Bayliss** 1987 MM 51 176.

sidorenkite $Na_3Mn(PO_4)(CO_3)$.
Isostructural with Fe analog *bonshtedtite* & Mg analog *bradleyite*.
Structure: **TA Kurov & 3 others** 1980 MZh 2 65-70 = MA 81-3827.
Raman: **AN Zaitsev AR Chakhmouradian** 2002 CM 40 103-20.
Occurrence: MM 43 1067.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

sidpietersite $Pb_4(SO_3S)O_2(OH)_2$.
Structure: **MA Cooper FC Hawthorne P Cerny** 1999 CM 37 1275-82.
Occurrence: **AC Roberts & 6 others** 1999 CM 37 1269-73.

sidwillite $MoO_3.2aq$.
Structure: **F Cesbron D Ginderow** 1986 BM 108 813.

[siegenite = Ni-cobaltpolydymite $(Co,Ni)_3S_4$. *Spinel* structure group; *linnaeite* subgroup.
[jvs: look for structure of *synthetic*.] Structure determination not found.
Occurrence: **Dana**;
Wales, MM 60 978-82.]

sieleckiite $Cu_3Al_4(PO_4)_2(OH)_{12}.2aq$.
Structure determination not found.
Occurrence: **WD Birch A Pring** 1988 MM 52 515-8.

sigismundite $Na_3(Ba,K,Pb)(Ca,Sr)(Fe,Mg,Mn)_{14}Al(PO_4)_{12}(OH)_2$.
Isostructural *arrojadite* $KNa_4CaMn_4Fe_{10}Al(PO_4)_{12}(OH,F)_2$ & *dickinsonite*
$(K,Ba)(Na,Ca)_5(Mn,Fe,Mg)_{14}Al(PO_4)_{12}(OH,F)_2$.
Possible relation with *panethite*. 2,3-connected octa-tetra net.
Occurrence & structure: **F DeMartin & 3 others** 1996 CM 34 827-34.

sigloite $Fe^{3+}Al_2(PO_4)_2(OH)_3.7aq$. *Paravauxite* structure group.
Structure: **FC Hawthorne** 1988 MP 38 201-11 (H971) = MA 89M/0264.
Occurrence: MM 33 1150.

sigma-alumina Al_2O_3. *Spinel* structure type with defects.
Structure: **W Guse H Saalfeld** 1990 NJMM 217-26.
Delta- is a modulated variant of sigma-: **H Saalfeld W Guse** 1991 NJMA 163 159-67 (S1457).

silhydrite $Si_3O_6.aq$.
Occurrence: **AJ Gude III RA Sheppard** 1972 AM 57 1053;
K Beneke G Lagaly 1977 CIM 12 363-5;

soda lake in Bolivian Altiplano: **A Abdelouas & 4 others** 1995 CIM 30 77-82.

silicon Si. *Diamond* structure type.

Atomic displacements: **PF Price EN Maslen SL Mair** 1978 AC A34 183-93.

Occurrence: MM 60 682;

Kudriavy volcano: **MA Korzhinsky & 3 others** 1995 N 375 544.

with *moissanite*, *Fe-Ti silicides* & *sinoite*, Yakutia kimberlites: **EA Mathez & 3 others** 1995 GCA 59 781-91.

silicocarnotite $Ca_5(PO_4)_2(SiO_4)_3$. Hybrid *glaserite* (*aphthitalite)-apatite* structure.

Isotypic with S analog *ternesite*.

Structure: *synthetic*, **B Dickens WE Brown** 1971 TMPM 16 1-27 (D532).

Occurs in Thomas slag from steel industry.

Review of silicophosphates, including silicocarnotite & *nagelschmidtite*, & importance for fertilizers: **BI Lazoryak VN Golubev RG Aziev** 1989 SPC 33 659-64 (L585).

Synthetic $Ca_5(PO_4)_2((Ge/Si)O_4)_3$: **G Engel U Fischer** 1985 ZK 173 101-11.

Synthetic $Ca_3(Sm/Eu/Gd/Dy/Er/Yb/Lu/Y)(SiO_4)_3$, $Ca_3(Sm/Eu/GdTb)_2(GeO_4)_3$, $(Ca/Cd)_5(PO_4)_2(SiO_4)$ $)_3$ & complex types: **G Engel K Cee** 1995 ZaaC 621 1803-7.

Synthetic $Ca_3Y_2(SiO_4)_3$, SC-XRD structure: **H Yamane T Nagasawa M Shimada T Endo** 1997 ACC 53 1367-9 (Y218).

silinaite $NaLiSi_2O_5.2aq$.

Structure: **JD Grice** 1991 CM 29 363-7.

IR & Raman: **Y Huang Z Jiang W Schwieger** 1999 Can J Chem 77 495-501.

Occurrence: MM 60 682.

Synthesis & XRPD: (B1311).

sillénite / sillenite $Bi_{12}SiO_{20}$.

Structure: **SC Abrahams PB Jamieson JL Bernstein** 1967 J Chem Phys 47 4034-41;

SC Abrahams JL Bernstein C Svensson 1979 J Chem Phys 71 788-92.

Occurrence & synthesis: MM 27 274. 40 *synthetic* analogs.

General structural models & mechanisms of atomic substitution:

DC Craig NS Stevenson 1975 JSSC 15 1-8;

SF Radaev VI Simonov 1992 Kr 37 914-41.

Synthetic $Bi_{24}(VO_4)(BiO_4)O_{32}$ & $Bi_{24}[GaO_2(OH)_2]_2O_{32}$: 1989 Izv Akad Nauk SSSR Neorg Mater 25 1715-8.

Synthetic $Bi_{12}(FeP)O_{20}$: **SF Radaev & 5 others** 1989 DAN 307 1381-4.

Synthetic $Bi_{12}(B_{0.5}Fe_{0.5})O_{19.5}$ & $Bi_{12}(B_{0.67}Fe_{0.33})O_{19.3}$: 1990 SPC 35 663-6 = SR 57A 164.

Synthetic $Bi_{12}(Bi_{0.75}V_{0.25})O_{20}$: 1990 JSSC 86 59-63 = SR 57A 164.

Synthetic $Bi_{12}(Bi_{0.5}Fe_{0.5})O_{19.5}$ & $Bi_{12}(Bi_{0.67}Zn_{0.33})O_{19.3}$: **SF Radaev LA Muradyan VI Simonov** 1991 AC B47 1-6 (R553); important earlier references.

Synthetic gamma-Bi_2O_3: **SF Radaev VI Simonov YuF Kargin** 1992 AC B48 604-9 (R566).

Synthetic $Bi_{24}(As,Ge,P,Si,V)_2O_{40}$: **HS Horowitz & 4 others** 1989 Solid State Ionics 32 687-90.

Synthetic $Bi_{12}(Ge/Si)O_{20}$: XPS, **R Goplaakrishnan CS Gopinath P Rawasamy** 1996 Cryst Res Technol 31 249-54.

Synthetic $Bi_{24}B_2O_{39}$, structure: **YuF Kargin AV Egorysheva** 1998 Inorg Mater 34 714-8 (K1092).

sillimanite Al_2SiO_5. Trimorphic with *andalusite* & *kyanite*.

Structure: **CW Burnham** 1963 ZK 118 127-48 (B168);

ND, **LW Finger E Prince** 1972 Carnegie Inst Washington Year Book 71 496-500;

JK Winter S Ghose 1979 AM 64 573-86;

RC Peterson RK McMullan 1986 AM 71 742-5;

DL Bish CW Burnham 1992 AM 77 374-9;

JF Stebbins CW Burnham DL Bish 1993 AM 78 461-4;

Bragg-Williams model for ordering T, **MT Dove & 3 others** 1996 AM 81 349-62.

Lattice-dynamics model: **T Pilati F Demartin CM Gramaccioli** 1997 AC B53 82-94 (P662).

Cr substitution & interpretation of spectroscopy: MA 96M/1531.

Defects, computer simulation: **L Wondraczek & 5 others** 2002 PCM 29 341-5 (7680).

silver Ag. Cubic closest packing = face centered cubic. *Copper* structure group.

Electrum is Ag,Au.

Composition ranges of natural specimens in Ag-Sb: **C Cipriani M Corazza G Mazzetti** 1996 EJM 8 1347-50 (C882).

Clean & Cs-covered (001), surface XRD: **HL Meyerheim & 3 others** 1997 ZK 212 327-33 (1385).

silver-palladium ~AgPd.

silver-rhodostannite $AgCuFeSn_3S_8$.
Related to *rhodostannite* $Cu_2FeSn_3S_8$ and *toyohaite* $Ag_2FeSn_3S_8$.
Disordered *spinel* structure type. Not submitted to IMA.
Occurrence: MM 50 757.
silvialite $Ca_4Al_6Si_6O_{24}SO_4$. *Scapolite* group.
Occurrence/structure: **DK Teertstra & 3 others** 1999 MM 63 321-9.
simanite $Mn_3PO_4IBO_3.3aq$
simferite $\sim Li_{0.5}(Mg_{0.5}Fe^{3+}_{0.3}Mn^{3+}_{0.2})(PO_4)$.
Triphylite structure subgroup of phosphates in *olivine* structure group, but with Li half-occupancy.
Structure: **OV Yakubovich VV Bairakov MA Simonov** 1989 SPD 34 669-71 (Y125).
Mineral data: MA 78 452;
VV Bayrakov & 4 others 2005 M Zh 2 112-20 = AM 91 205.
simmonsite NaLiAlF.
Occurrence & XRD: unsolved structure, *perovskite* derivative? **EE Foord & 7 others** 1999 AM 84 769-72;
Synthetic, XRPD, **KC Ross RH Mitchell AR Chakhmouradian** 2003 JSSC 172 95-101.
simonellite $C_{19}H_{24}$.
Matches organic: 1,1-dimethyl-7-isopropyl-1,2,3,4 tetrahydro-phenanthrene.
simonite $TlHgAs_3S_6$.
Structure: **P Engel & 3 others** 1982 ZK 161 159-66.
Occurrence: MM 48 582.
simonkolleite $Zn_5(OH)_8Cl_2.aq$.
Structure: *synthetic,* **W Lotmar** 1946 Helv Chim Acta 29 14-21;
W Nowacki JN Silverman 1961 ZK 115 21-51;
R Allman 1968 ZK 126 417-26;
natural, **FC Hawthorne E Sokolova** 2002 CM 939-46.
Occurrence: (S1484) = MM 50 757.
simplotite $CaV_4O_9.5aq$.
Structure determination not found.
Occurrence: **ME Thompson CH Roach R Meyrowitz** 1958 AM 43 16-24.
simpsonite $Al_4(Ta,Nb)_3O_{13}(OH,F)$. Topotactic with *alumotantite*.
Structure: **SV Borisov NV Belov** 1962 DAN 147 147-50 = MA 17-561;
review, **J Graham MR Thornber** 1974 AM 59 1026-39;
TS Ercit P Cerny FC Hawthorne 1992 CM 30 663-71.
Occurrence: MM 25 644.
Crystal chemistry of complex Nb & Ta oxides: **J Graham MR Thornber** 1974 AM 59 1026-39.
sincosite $Ca(VO)_2(PO_4)_2.5aq$.
Triclinic polymorph: **H Yang W Lee S Wang K Lii** 1992 IC 31 743-**?**
Synthesis: **WA Franke & 3 others** 1997 ZVMO 126 85-6.
sinhalite $MgAlBO_4$. *Olivine* structure type.
Structure: **JH Fang RE Newnham** 1965 MM 35 196-9;
CL Hayward RJ Angel NL Ross 1994 EJM 6 313-21.
Occurrence: MM 29 994.
Trace H from polarized FTIR: **P Bauerhansl A Beran** 1997 SMPM 77 131-6 (B1668).
Synthetic "pseudosinhalite", natural equivalent submitted as new mineral: **W Schreyer O Medenbach S Burchard NN Pertsev** 1997 EJM Suppl 9-1 319 (S1781).
sinjarite $CaCl_2.2aq$.
sinkankasite $Mn(aq)_4[Al(PO_3OH)_2OH]aq_2$. *Tancoite* chain.
Structure: **PC Burns FC Hawthorne** 1995 AM 80 620-7 (B1621).
Occurrence: MM 48 582.
sinnerite $Cu_6As_4S_9$. Derivative of *sphalerite/tetrahedrite* structure type.
Structure: **F Marumo W Nowacki** 1964 SMPM 44 439-54;
E Makovicky BJ Skinner 1972 AM 57 824-34; 1975 AM 60 998-1012.
sinoite Si_2N_2O. Matches *synthetic*.

Structure: **I Idrestedt C Brosset** 1964 Acta Chem Scand 18 1879-86 (I23).
Occurrence: MM 35 1153.
Occurrence Yakutia kimberlites with *moissanite*, *Fe-Ti silicides* & *silicon*: **EA Mathez & 3 others** 1995 GCA 59 781-91.
In meteorites: **AE Rubin** 1997 MPS 32 231-47;
in EL4 chondrite, **AE Rubin** 1997 AM 82 1001-6.

sitinakite $KNa_2Ti_4Si_2O_{13}OH.4aq$.

Complex edge-vertex connected octahedral-tetrahedral framework.
Structure: **EV Sokolova & 4 others** 1989 SPD 34 583-5 (S1295).
Occurrence: MM 60 682.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.
Synthetic Ge/Si sitinakite/*pharmacosiderite* intergrowth: **RL Bedard** US Patent 5,935,552.
Synthetic $Na_3NbTi_3Si_2O_{14}.4aq$: **A Tripathi & 3 others** 2003 JSSC 175 72-83 (9546).
Sitinakite analogs are being tested for selective adsorption of Cs & Sr from nuclear waste.

sjögrenite $Mg_6Fe^3_2(CO_3)(OH)_{14}.5aq$. *Manasseite* structure group.

Structure: **R Allman H Lhose** 1966 NJMM 6 161-81;
L Ingram HFW Taylor 1967 MM 36 465-79.
Occurrence: MM 26 341; MM 27 274.

skaergaardite PdCu. CsCl structure type.

Occurrence & XRPD structure: **NS Rudashevsky & 6 others** 2004 MM 68 615-32.

skinnerite Cu_3SbS_3.

Polymorphism: **HJ Whitfield** 1980 Solid State Comm 33 747-8.
Structure order in $Cu_3(Sb/Bi)S_3$ polymorphs: **E Makovicky** 1994 NJMA 168 185-212 (M211).
Low-T polymorph in $P2_1/c$: **E Makovicky T Balic-Zunic** 1995 CM 33 655-63.
Occurrence: MM 40 913.
Similar to but different from *wittichenite* Cu_3BiS_3.

skippenite Bi_2Se_2Te. *Tetradymite* structure group; *tetradymite* subgroup.

Review: **P Bayliss** 1991 AM 76 257-65.
Structure: SC-XRD, **L Bindi Cipriani** 2004 CM 42 835-40.
Synthetic: **S Nakajima** 1963 J Phys Chem Solids 24 479-85.
Occurrence: MM 52 730.
New data: **EM Spiridonov & 3 others** 1996 DAN 345-8 132-6 (S1628).

sklodowskite $Mg[(UO_2)(SiO_3OH)_2]_2.6aq$.

Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Structure: **RR Ryan A Rosenzweig** 1977 Cryst Struct Comm 6 611-5.

skutterudite (Co,Ni)As_3. Isostructural with *kieftite* $CoSb_3$. Distortion of ReO_3 structure type.

Structure: **A Kjekshus T Rakke** 1974 Acta Chem Scand A28 99-103;
N Mandel J Donohue 1971 AC B27 2288-9.
Structure family (Co/Ni/Rh/Pd)(P/As/Sb)$_3$: refs in (P622).
Localized vibration modes: **V Keppens & 9 others** 1998 N 395 876-8 (K1114).
Photon-glass-electron thermoelectric energy conversion: **GS Nolas DT Morelli TM Tritt** 1999 Ann Rev Mater Sci 29 89-116 (N521).
Synthetic Rh/$IrAs_2$: **RD Heyding LD Calvert** 1961 Can J Chem 39 955-7 (H1041).
Synthetic (La/Ce/Pr/Nd/Eu)(Fe/Ru/Os)$(P/As/Sb)_{12}$ thermoelectrics: **BC Sales D Mandrus RK Williams** 1996 S 272 1325-8 (S1590).
Synthetic $CoGe_{1.5}(S/Se)_{1.5}$, P&SC-XRD of twins: **M Partik C Kringe HD Lutz** 1996 ZK 211 304-12 (P622).
Synthetic $FeSb_3$ & $(La/Hf/Y)_{1-x}Fe_4Sb_{12}$: **MD Hornbostel & 3 others** 1997 JAChS 119 2665-8 (H1154).
Synthetic $LaFe_4P_{12}$: **MD Hornbostel & 3 others** 1997 IC 36 4270-4 (H1219).
Synthetic ((Co/Ir/Rh)(B/P/Sb), structural & electrical properties: **L Chapon & 2 others** 1999 JAlCo 282 58-63 (C1088).
Synthetic $La_{1-x}Ce_xRu_4P_{12}/CeOs_4P_{12}$: **I Shirotani & 4 others** 1999 JSSC 142 146-51 (S2009).
Synthetic $Tl_{0.5-0.8}Co_{3-4}Fe_{0-1}Sb_{11-12}Sn_{0-1}$, phonon glass & Einstein oscillators: **RP Hermann & 6 others** 2003 PRL 90 133505 (8942).
Synthetic p-$Ba_yFe_xCo_{4-x}Sb_{12}$, thermoelectrics: **XF Tang & 4 others** 2002 JMR 17 2953 (9133).
Synthetic $(Ce/Eu/Yb)(Fe/Ru)_4(P/Sb)_{12}$: EXAFS of rattling of Ce/Eu/Yb, **D Cao & 5 others** 2004 PRB 70 094109 (10970).

slavikite $NaMg_2Fe_5(SO_4)_7(OH)_6.33aq$. Review: **Sabelli** p. 23.
Structure: **P Süsse** 1973 NJMM 93-5; 1975 NJMM 27-40.
Occurrence: MM 21 575.
Occurrence in meteorites: **AE Rubin** 1997 MPS 32 733-4.
slavyanskite $CaAl_2O_4.8.5aq$.
Occurrence: MM 42 529.
slawsonite $(Sr,Ca)Al_2Si_2O_8$. *Paracelsian* structure type (not *feldspar*).
Structure: monoclinic, **DT Griffen PH Ribbe GV Gibbs** 1977 AM 62 31-5;
triclinic, **T Tagai & 4 others** 1995 ZK 210 741-5 (T453).
SMECTITE MINERAL/STRUCTURE GROUP Includes

aliettite	1:1 regular interstratified *talc*/trioctahedral *smectite*
beidellite	$\sim(Na)_{0.3}Al_2(Al,Si)_4O_{10}(OH)_2.n$ aq
ferrosaponite	$Ca_{0.3}(Fe,Mg)_3(Si,Al)_4O_{10}(OH)_2.4aq$
hectorite	$Na_{0.3}(Mg,Li)_3Si_4O_{10}(F,OH)_2$
montmorillonite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2$. n aq
nontronite	$Na_{0.33}Fe_2(Si,Al)_4O_{10}(OH)_2.n$ aq
saponite	$(Ca,Na_2)_{0.17}(Mg,Fe)_3(Si,Al)_4O_{10}(OH)_2.4$ aq
sauconite	$Na_{0.33}Zn_3(Si,Al)_4O_{10}(OH)_2.4$ aq
sobotskite	$(Ca_{0.13}\ K_{0.01})(Mg_{1.91}Al_{0.95})(Si_{3.06}Al_{0.94})O_{10}(OH)_2$
stevensite	$Mg_3Si_4O_{10}(OH)_2$
swinefordite	$(Ca,Na)_{0.33}(Al,Li,Mg)_2(Si,Al)_4\ (OH,F)_2.2$ aq
yakhontovite	$Ca_{0.2}(Fe_{0.8}Cu_{0.8}Mg_{0.7})Si_4O_{10}(OH)_2$

IR, structure vs cations: **J Bishop E Murad MD Dyar** 2002 CIM 37 617-28.
IR, dioctahedral smectites, OH vs Fe/Al/Mg: **J Bishop & 3 others** CIM 37 607-16;
OH region, **BB Zviagina & 3 others** 2004 CICIM 52 399-410.
IR, reduced & reoxidized ferruginous: **C Fialips & 3 others** CICIM 50 455-69.
In-situ dissolution under alkaline conditon at RT: AFM, **Y Kuwahara** 2006 AM 91 1142-9.
Ferruginous smectite, IR, OH stretching: **J Majedova P Komadel B Cicel** 1994 CIM 29 319-26.
Palagonite, Mid-Atlantic Ridge: **Z Zhou & 3 others** 1992 CM 30 75-81.
[mixed layer chlorite/smectite 20Å: **T Yoneda T Watanabe** 1994 J Clay Science Soc Japan 34 71-9 = MA 95M/3919.]
[brinrobertsite $(Na_{0.2}K_{0.1}Ca_{0.1})(Al_{3.8}Mg_{0.1}Fe_{0.1})(Si_{7.8}Al_{0.2})O_{20}(OH)_4.3.5aq$.
Ordered, mixed-layer, dioctahedral pyrophyllite-smectite.]
Montmorillonite-water-Na system: T change, SAXS, **CH Pons & 2 others** 1981CIM 16 23-42;
Na/Ca, SAXS/TEM, **H Ben Rhaïem & 2 others** 1987 Proc Int Clay Conf 292-7 (B1744).
Illite/smectite: interlayer order, **SP Altaner CM Bethke** 1988 AM 73 766-74;
in Paleozoic K-bentonites, XRPD interpreted by computer modeling, rotational disorder, **DK McCarty RC Reynolds Jr** 1995 CICIM 43 271-84 (M1320);
structural transformations, hydrothermal, **VA Drits AL Salyn V Sucha** 1996 CICIM 44 181-90 (D588);
McEwan crystallite, dominant $2M_1$ polytype, **H Dong DR Peacor** 1996 CICIM 44 257-75;
synthesis, TEM/XRPD, *Fe-lizardite*, **A Drief & 3 others** 2002 CICIM 50 746-56 (8658).
Synthesis: single crystals several tens of µm: **H Yamada** 1993 J Japan Assoc Crystal Growth 20 230-5 = MA 95M/4260;
review: **JT Kloprogge S Komarneni JE Amonette** 1999 CICIM 47 529-54 (K1198).
XPS of Al & model: **T Ebina & 4 others** 1997 JPCB 101 1125-9 (E395).
Phase relations among smectite, R1 *illite*-smectite & *illite*: **H Dong DR Peacor RL Freed** 1997 AM 82 379-91.
Transformation at 353/573 K in presence of Fe ovides: **D Guillaume & 8 others** 2004 CIM 39 17-34 (10322).
Surfactant assembly of open framework silica in galleries of smectite: **A Galarneau & 2 others** 1997 ChC 1661-2 (G922).
Transformation mechanisms/ interstratification smectite to *kaolinite*, HRTEM: **M Amouric J Olives** 1998 CICIM 46 521-7.
Coherent TEM/XRD description of mixed-layer *illite*/smectite: **GD Guthrie Jr RC Reynolds Jr** 1998 CM 36 1421-34.
n-alkylammonium exchange in 2:1 clay minerals: **SK Sears R Hesse H Vali** 1998 CM 36 1485 506.
Ga-polyethyleneoxide pillared smectite: **E Montarges LJ Michot P Ildefonse** 1999 MMM 28 83-101 (M1716).
Rheology of smectite-laden emulsions: **G Lagaly M Reese S Abend** 1999 Appl Clay Sci 14 279-98 = MA 00M/0127.
K-smectite, dissolution-crystallization: **R Mosser-Ruck & 3 others** 1999 CIM 34 275-90 (2709).
Fe oxidation/organic cations vs dehydration: **JW Stucki & 4 others** 2000 CICIM 48 290-8.
Glycine sorption on Na/Ca/Cu-: **E Benincasa & 4 others** 2000 CIM 35 635-41 (B2020).
Chemistry of smectites in clastic sediments & transformation to illite: **A Drief F Nieto** 2000 CIM 35 665-78 (D814).
Al-pillared modified by Ce/La, enhanced thermal stability: **JL Valverde & 3 others** 2000 CICIM 48 424-32 (V368).

Magnetics of oxidized & reduced: **R Schuette BA Goodman JW Stucki** 2000 PCM 27 251-7 (S2190).
Fe (III) to (II) reduction, model: **VA Drits A Manceau** 2000 ClCIM 48 185-95 (D815).
Li-saturated, short-range order: **MD Alba and 3 others** 2001 AM 86 124-31;
IR, **J Madejova & 3 others** 2000 CIM 35 739-51, 753-61 (447).
HR-TEM illite-smectite distinguishes detrital vs authigenic: **P Uhlik & 3 others** 2000 CIM 35 781-9 (451).
Stability in acid salt solution & fate of Eu/Th/U: **A Bauer & 3 others** 2001 CIM 36 93-104.
Retention of OH-Al complexes by dioctahedral: **C Volzone LB Garrido** 2001 CIM 36 115-24.
Ti-pillared, influence of Ti precursor: **MA Vicente & 4 others** 2001 CIM 36 125-38.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
Illitization in K-rich solution: **R Mosser-Ruck & 3 others** 2001 EJM 13 829-40 (3614).
Adsorption mechanism subst nitrobenzenes: **SA Boyd & 3 others** 2001 EST 35 4227-34 (3615).
-to-*chlorite*, hydrothermally altered metabasites: **D Robinson ST Schmidt AS de Zamora** 2002 JMG 20 167-74 (3975).
-to-*illite*, hydrothermally altered rhyolitic hyaloclastite, TEM: **B Bauluz & 2 others** 2002 ClCIM 50 157-73 (7137).
Growth in rhyolitic obsidian, SEM-TEM-AFM: **S Fiore & 3 others** 2001 CIM 36 495-500 (3990).
Hexadecyl-trimethylammonium-exchanged, TEM: **SY Lee SJ Kim** 2002 CIM 37 465-72.
Synthetic Zn-*sauconite* & -*hectorite*: **S Higashi & 2 others** 2002 ClCIM 50 299-305 (7460).
Cs-exchanged, wet-dry cycles: **J Cuadros** 2002 CIM 37 473-86.
Synthetic (Na/K/Rb/Cs)MgLiSiO-fluoro, SC-XRD structure of Cs: **J Breu W Seidl A Stoll** 2003 ZaaC 629 5503-15 (8593).
Synthetic Fe-dioctahedral, XAS: **D Vantelon & 5 others** 2003 PM 30 44-53.
Intercalation & surface modified non-ionic surfactants: **Y Deng JB Dixon GN White** 2003 ClCIM 51 150-61.
Hexadecyltrimethylammonium: -exchanged, dehydration, **SY Lee SJ Kim** 2003 CIM 38 225-32;
expansion, **SY Lee SJ Kim** 2002 ClCIM 50 435-45.
Use as nanomaterials: **RA Schoonheydt** 2002 ClCIM 50 411-20.
8-hydroxyquinoline intercalation: **N Khaorapapong K Kuroda M Ogawa** 2002 ClCIM 50 428-34.
Dehydration model in shallow sedimentary basin: **C Liu W Lin** 2005 ClCIM 53 55-70.
Alteration induced by hydrolytic exchange: **S Ramirez D Righi S Petit** 2005 CIM 40 15-24.
Crystal chemistry of ferric from weathered Ni ore: IR/EXAFS, **A Gaudin & 6 others** 2004 CIM 39 453-7 (10911).
Preparation & properties of reduced-charge: **P Komadel & 2 others** 2005 ClCIM 53 313-34.
Cation exchange & pillaring by aqueous Fe nitrate: **H Dramé** 2005 ClCIM 53 335-47.
Alteration of basic pyroclastic rocks, Cyprus: **GE Christidis** 2006 AM 91 685-701.

smirnite Bi_2TeO_5. XRPD matches *synthetic* [jvs: check for structure].
Occurrence: **EM Spiridonov & 7 others** 1984 DAN 278 199-202 = AM 70 876-7.

[smirnovkite $(Th,Ce,Ca)(P,Si,Al)(O,F,OH)_5$.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.]

smithite $AgAsS_2$. Dimorphic with *trechmannite*.
Structure: **E Hellner H Burzslaff** 1964 Nw 51 35-6.

smithsonite $ZnCO_3$. *Calcite* structure type.
Structure: **H Effenberger K Mereiter J Zemann** 1981 ZK 156 233-43.
Cathodoluminescence vs Mn: **T Götte DK Richter** 2004 MM 68 199-208.
Synthetic rhodochrosite-smithsonite series, XRPD & IR: **ME Böttcher** 1995 MM 59 481-8.

smolianinovite $(Co,Ni,Mg,Ca)_3(Fe,Al)_2(AsO_4)_4OH.11aq$.
Structure determination not found.
Occurrence: **LK Yakhontova** 1956 DAN 109 849-50 = AM 42 307-8;
LK Yakhontova & 3 others 1973 = AM 59 1141;
LK Smith KN Han F Lawson 1977 MM 41 385-8;
Mt Isa, MA 96M/4948.

smrkovecite $Bi_2O(OH)(PO_4)$. Cell data match *atelestite* $Bi_2O(OH)(AsO_4)$.
Mineralogy & XRPD: **T Ridkosil J Sejkora V Sreein** 1996 NJMM 97-102 (R653) -4.

smythite $\sim(Fe,Ni)_9S_{11}$.
Structure: low accuracy, **RC Erd HT Evans Jr DH Richter** 1957 AM 42 309-33.
Redefined: **LA Taylor KL Williams** 1972 AM 57 1571-7.
Phase relations with *mackinawite* & *greigite*: **RE Krupp** 1994 EJM 6 265-78.
Formation processes in Nature: **Y Furukawa HL Barnes** 1996 GCA 60 3581-91.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

sobolevite $Na_5(Na_4Ca_2)Ti_2[Si_2O_7][PO_4]_3O_2F_2$.
Murmanite-lomonosovite structure group.

Structure: **EK Sobolova YuK Egorov-Tismenko AP Khomyakov** 1988 SPD 33 711-4 (S1290);
E Sokolova & 2 others 2005 CM 43 1527-44.
Occurrence: MM 48 582.
sobolevskite PdBi. *Niccolite* structure group.
Structure: mixture of two polymorphs, **P Bayliss** 1990 CM 28 751-5.
Occurrence: MM 40 914.
New Sb- & Te- varieties: **ND Tolstykh & 3 others** 1997 DAN ESS 357 1145-8.
Pb-bearing varieties: **NJ Cook CL Ciobanu RKW Merkle** 2002 CM 40 329-40.
sobotkite $(Ca_{0.13}K_{0.01})(Mg_{1.91}Al_{0.95})(Si_{3.06}Al_{0.94})O_{10}(OH)_2$.
Trioctahedral member of *smectite* structure group.
Might be regarded as merely *aluminian saponite*.
Occurrence: **C Haranczyk K Prchazka** 1976 Prace Muzeum Ziemi 22 3-64 = AM 61 177.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

SODALITE STRUCTURE GROUP Includes:

beryllosodalite	~$Na_4BeAlSi_4O_{12}Cl$
bicchulite	$Ca_2[Al_2SiO_6](OH)_2$
danalite	$(Fe,Mn,Zn)_4Be_3(SiO_4)_3S$
hauyne	$(Na,Ca)_{4-8}Al_6Si_6O_{24}(SO_4,Cl)_{1-2}$
helvite	$Mn_4Be_3(SiO_4)_3S$
hydroxysodalite	$Na_4Al_3Si_3O_{12}OH$
kamaishilite	$Ca_2Al_2SiO_6(OH)_2$
nosean	$Na_8Al_6Si_6O_{24}SO_4$
sodalite	$Na_4Al_3Si_3O_{12}Cl$
tsaregorodtsevite	$N(CH_3)_4[Si_2(Si_{0.5}Al_{0.5})O_6]$
tugtupite	$Na_4BeAlSi_4O_{12}Cl$

Thermal analysis, *danalite, helvite, sodalite & tugtupite*: **SM Antao I Hassan** 2002 CM 40 121-36.
Topology of sodalite & *tetrahedrite* structures: **E Koch E Hellner** 1981 ZK 154 95-114 (K744).
Br substituted natural *sodalite*, EMPA: **Y Pan P Dong** 2003 CM 41 529-40.
Color & chemical zoning, Mt Vulture lava, Italy: **A Di Muro & 2 others** 2004 MM 68 591-614.
Synthetic Ge-: MM 32 958-9.
Synthetic $Zn_4OB_6O_{12}$: **OS Bondareva & 3 others** 1979 SPD 23 529-30 (B1111).
Synthetic $H(P/As/Sb)F_6$.4.6aq.HF-beta: incorrect assignation of 5aq, **M Wiebcke D Mootz** 1986 ZK 177 291-9 (W758); correction, **D Mootz D Stäben** 1992 ZN 476 263-74 (M1387).
Synthetic $Na_3[AlSiO_4]_3.4D_2O$, ND: **J Felsche S Luger P Fischer** 1987 AC C43 809-11 (F452).
Hydroxysodalite: ND, **A Emiraliev Il Yamzin** 1978 SPC 23 27-9;
ND, **S Luger J Felsche P Fischer** 1987 AC C43 1-3 (L671);
synthesis, MAS-NMR/XRD/DTA-DTG, **C Mundus & 2 others** 1996 EJM 8 231-9 (M1390).
Synthetic $Na_4(Al_3Ge_3O_{12})(Cl/Br/I)$: 1989 AC C45 843-7.
Synthetic $Na_8[AlSiO_4]_6(NO_2)_2$: **P Sieger & 3 others** 1991 AC C47 498-501 (S1472);
anomalous thermal expansion, **CH Rüscher TM Gesing J Buhl** 2003 ZK 218 332-44..
Synthetic $Li_8Be_6P_6O_{24}Br_2$: **TE Gier WTA Harrison GD Stucky** 1991 AnCh 30 1169-71.
Synthetic $(C_3H_6O_2)_2(Si_6O_{12})_2$: **G van de Goor P Behrens J Felsche** 1994 MiMa 2 493-500;
NPD, room T & 1.3 GPa, **K Fütterer & 4 other** 1994 ZK 209 517-23.
Synthetic $(Fe/Co/Ni)_{6+y/2-x}H_{2x}[P_{12}N_{24}](Cl/Br/I)_y$: **W Schnick & 3 others** 1995 ZaaC 621 987-92 (S1470).
Synthetic $(Na/Li/K)_8[AlSiO_4]_6[(Cl/Br/I)O_3]_x(OH)_{2-x}$: **PJ Mead MT Weller** 1995 Z 15 561-8.
Synthetic $(Fe/Co/Ni)_{6+y/2-x}H_{2x}[P_{12}N_{24}]Z_y$: **W Schnick & 4 others** 1995 ZaaC 621 987-92.
Synthetic $Ca_4Al_6O_{16}S$: **NJ Calos & 3 others** 1995 JSSC 119 1-7 (C795).
Synthetic interrupted & expanded sodalites, piperazine.$Zn_2PO_4(H_2PO_4)_2$ & piperazine $[Zn.aq.Zn(PO_4)(HPO_4)]_2.aq$: **P Feng X Bu GD Stucky** 1995 AnCh 34 1745-7.
Synthetic $Sr_8Al_{12}O_{24}(CrO_4)_2$, high-P N & XRD to 7 GPa:
R Melzer & 3 others 1995 Cryst Res Technol 30 767-73;

intermediate, XRPD structure 297K: **DM Többens W Depmeier** 2001 ZK 216 611-5.

Synthetic Si/Al infinity to 1, XRPD, MAS-NMR, DTA: **M Sato & 3 others** 1995 Chem Lett 1033-4.

Synthetic $(C_2H_7NO)_2(Si_6O_{12})_2$ & $(C_2H_8N_2)_2(Si_6O_{12})_2$: **CM Braunbarth & 4 others** 1996 Z 16 207-17 (B1454).

Synthetic $Cd_8[BeSiO_4]_6(S/Se/Te)_2$: **SE Dann MT Weller** 1996 IC 35 555-8 (D568).

Synthetic Na-loaded: **G Engelhardt & 5 others** 1996 ChC 729-30 (E380).

Synthetic Mg-aluminophosphate type 20: structure NPD, **S Han & 3 others** 1990 EJM 2 787-98; **S Prasad JF Haw** 1996 ChM 8 861-4 (P602).

Synthetic, isomorphous substitution Si by Al, ethylene glycol: **MA Camblor & 2 other** 1996 ChC 425-6 (C834).

Synthetic zincophosphate from micelle growth: **KSN Reddy & 5 others** 1996 JPC 100 9870-80.

Synthetic $Ca_4[Al_6O_{12}](CrO_4)$: TEM tetragonal/orthorhombic superstructures, **I Hassan** 1996 EJM 8 477-86 (H1104), **do** 1996 CM 34 1031-8, **do** 1996 ZK 211 228-33 (H1086); twinning, **do** 1996 MM 60 617-22;
phase transitions & high-T structure evolution of cubic, **SM Antao I Hassan JB Parise** 2004 CM 42 1047-56.

Synthetic $Na_4Si_3Al_3O_{12}Cl$, ND to 1200K: **RK McMullan & 3 others** 1996 ACB 52 616-27.

Synthetic $Sr_4[AlO_2]_6(TeO_3)$ & reduced product $Sr_4[AlO_2]_6Te$, XRPD, EXAFS, IR & MAS-NMR: **SA Dann MT Weller** 1996 JMC 6 1717-21 (D596).

Synthetic $Zn_8[P_{12}N_{24}](O/S/Se/Te)_2$: **F Wester W Schnick** 1996 ZaaC 622 1281-6 (W774).

Synthetic $Na_4Si_3Al_3O_{12}Cl$, structure & ionic mobility at 295 to 1200 K by ND: (M1418).

Synthetic $Ca_8Al_{12}O_{24}(CrO_4)_2$, NPD 700 K: **R Melzer W Depmeier** 1996 Cryst Res Technol 31 459-67.

Synthetic $Ga_8(Ga_2SiO_6)_4(OH)_8$, EXAFS: **MJ Pack SE Dann MT Weller** 1996 ChC 1347-8.

Synthetic $(Ca_{1-x}Sr_x)_8[Al_{12}O_{24}](WO_4)_2$, phase transitions: **X Hu & 3 others** 1996 ZK 211 679-88 (H1141).

Synthetic $Na_8Mg_3Si_9O_{24}(OH)_2$ & $Na_8Mg_3Si_9O_{24}(OH,Cl)_2$, XRPD & NMR: **JG Thompson & 4 others** 1996 JMC 6 1933-7 (T500).

Synthetic $Zn_8(O/S/Se)[BO_2]_{12}$ & $[Cd_yZn_{1-y}]_8(S/Se/Te)[BeSi_xGe_{1-x}O_4]_6$: **KL Moran & 7 others** 1996 ChM 8 1930-43.

Synthetic $Na_8[AlSiO_4]_6(IO_3)_{2-x}(OH,aq)_x$: **J Buhl** 1996 Thermochim Acta 286 251-62 = CA 125:315028u.

Synthetic $Ca_8Al_{12}O_{24}(CrO_4)_2$, TEM of phase changes during heating in electron beam: **I Hassan** 1996 AM 81 1375-9; **do** 1996 Kuwait J Sci Eng 23 267-303.

Synthetic, encapsulated glycol: **SB Hong MA Camblor ME Davis** 1997 JAChS 119 761-70 (H1143).

Synthetic $Zn_6P_{12}N_{24}$(O/S/Se/Te), for H encapsulation: **J Weitkamp & 4 others** 1997 AdM 9 247-8 (W789).

Synthetic $Ca_8Al_{12}O_{24}(MoO_4)_2$, high-T: **S van Smaalen & 3 others** 1997 JSSC 129 130-43 (V268).

Synthetic $(Nd/Sm)_4Al_{12}O_{24}(Pb_4O_4)_2$: **J Werner H Müller-Buschbaum** 1997 ZN 52b 449-52 (W798).

Synthetic silicosodalite to 3 GPa, SCXRD: **O Oeckler & 3 others** 1997 EJM Suppl 9-1 273 (O345).

Synthetic $(Al/Ga)Co_2P_3O_{12}$, structure: **P Feng X Bu GD Stucky** 1997 N 388 735-40 (F556).

Synthetic $Na_8Al_6Si_6O_{24}Cl_2$, refined structure: **R Wartchow** 1997 ZK 212 80.

Synthetic nitrate enclathrated in organic solvents: **M Fechtelkord B Posnatzki J Buhl** 1997 Z 19 334-42.

Synthetic Ge-Br: **LN Dem'yanets** 1997 Kr 42 1130-2.

Heated *lazurite*, sulfide sodalite, SC-XRD: **RK Rastsvetaeva & 3 others** 1997 DAN 356 773-6.

Synthetic NaZnAl phosphate: **H Fuda & 3 others** 1998 Bull Chem Soc Japan 71 299-303.

Synthetic Ga/Ge, XRPD, IR, MAS-NMR, **GM Johnson MT Weller** 1997 Stud Surf Sci Catal 105A 269-75.

Synthetic P/As-based, template control: **X Bu & 3 others** 1998 MMM 20 371-9 (B1835).

Zn-exchange, XRPD, EXAFS, MAS-NMR: **L Khouchaf & 4 others** 1998 MMM 20 27-37 (K1092).

Synthetic P oxonitrido: **N Stock E Irran W Schnick** 1998 CEJ 4 1822 (S1994).

Synthetic AlP-dimethylformamide: **L Vidal JL Paillaud Z Gabelica** 1998 MMM 24 189-97 (V232).

Synthetic $Na_8[AlGeO_4]_6(NO_2)_2$: **S Bachmann J Buhl** 1999 MMM 28 35-47 (B1902).

Synthetic $Na_8(AlSiO_4)_6(CO_3)_X(HCOO)_{2-2X}{}^{aq}{}_{4X}$, XRPD & FTIR: **M Fechtelkord** 1999 MMM 28 335-51 (F653).

Synthetic LiGaSi & AlGe halide-, NPD structure: **GM Johnson MT Weller** 1999 IC 38 2442-50.

Synthetic Tl /Ag, XRPD, IR, MAS-NMR: **SE Latturner & 4 others** 1999 JPCB 103 7135-44.

Synthetic halogen- in ceramics, XRD & EM: **M Valdek A Paat** 1999 Proc Est Acad Sci 5 71-86.

Synthetic (Na/Ag/Tl)AlSi, XRPD: **BB Iversen S Latturner G Stucky** 1999 ChM 11 2912-8 (I254).

Na-doped Na-, magnetic coupling between F centers & hyperfine interactions with framework atoms: **R Windiks J Sauer** 1999 PCCP 1 4505-13 (W986).

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

Synthetic (Al/Si/Ga)(Be/Al/Si/Ge), MAS-NMR: **GM Johnson & 3 others** 2000 JPCB 104 1454-63 (J365).

Synthetic Al/Ga,Si/Ge,Cl/Br/I/chlorate/bromate/acetato/manganate,S/Se,CN, XR/NPD, Raman, IR, MAS-NMR: **GM Johnson PJ Mead MT Weller** 2000 MMM 38 445-60 (193).

Use in spent Bayer liquor: CA 131:10817m, 10818n.
Glass-bonded sodalite for nuclear waste, Ce/U/Pu behavior: **LR Morss & 3 others** 2000 JAICo 303-304 42-8 (M1833).
Chalcogen color centers in *ultramarine*-type solids including lapis lazuli: **D Reinen G Lindner** 1999 CSR 28 75-84 (R931).
Synthetic pyrrolidine & ethylamine silica, XRD, NMR, IR: **U Werthmann B Marler H Gies** 2000 MMM 39 549-62 (219).
Synthetic silica, tilt mechanism vs T: **K Knorr B Winkler V Milman** 2001 ZK 216 495-500 (3618).
Synthetic epitaxial growth, cancrinite/*sodalite*, TEM: **T Okubo & 8 others** 2001 ACIE 40 1069-70.
Synthetic Zn-borate-*ultramarine*, SC-XRD structure: **YuK Gubina EL Belokoneva** 2001 DES 377 172-4 (1761).
Synthetic Zn-phosphate, spontaneous crystallization by grinding: **S Kowalak & 2 others** 2001 ChC 575-6 (1432).
Synthetic AlPO, NMR & XRD: **M Roux & 5 others 2001** JPCB 105 9083-92 (3152).
Synthetic Sr-chromate-aluminate, low-T phase, N/XRD struct: **DM Toebbnes W Depmeier** 2001 ZK 216 586-90 (4019).
Synthetic Br-basic/hydro/dry, XRPD & MAS-NMR: **H Trill H Eckert VI Srdanov** 2002 JAChS 124 8361-70 (7505).
Synthetic piperazinium zincophosphates, 2 interrupted SOD nets, H-bonding: **M Wiebcke** 2002 MMM 54 331-9 (7801).
Synthetic Cl/Br, Cl/I, Br/I, XRPD structure & NMR: **H Trill H Eckert VI Srdanov** 2003 JPCB 107 8779-88 (9278).
Synthetic NaAlSi-cyanide, XRPD: **TM Gesing J Buhl** 2003 ZK NCS 218 275 (9530).
Synthetic NaAlSi-cyanate, XRPD: **J Buhl & 3 others** 2003 MMM 65 145-53 (9667.
Synthetic Li/Na/K/Mg/Ca/Sr-hydrosodalite: XRPD struct/DSC/TGA: **E Kendrick S Dann** 2004 JSSC 177 1513-9 (10231).
Synthetic $Na_8[AlSiO_4]_6(BH_4)_2$: XRD structure, IR/NMR, **J Buhl TM Gesing CH Rüscher** 2005 MMM 80 57-63 (11031).

sodalite $Na_4Al_3Si_3O_{12}Cl$

Structure: **L Pauling** 1930 ZK 74 213-25 (P624);
XRPD, 301-1255 K, **I Hassan SM Antao JB Parise** 2004 AM 89 359-64.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
Natural crystal, diamond cell, possible phase transition 3GPa, amorphization 7.3 GPa: **S Werner S Barth R Jordan H Schulz** 1996 ZK 211 158-62 (W754).

soddyite $(UO_2)_2SiO_4.2aq$. Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.

Structure: **EL Belokoneva & 5 others** 1979 SPC 24 315-7 (B1112);
synthetic, ND, **YuZ Novick LM Kuznetsov** 1990 SPC 36 921-2;
F Demartin CM Gramaccioli T Pilati 1992 AC C48 1-4 (D495).
Crystal chemistry: **FV Stohl DK Smith** 1981 AM 66 610-25.
Occurrence: MM 21 577.
Synthesis & XRPD: **R Vochten & 3 others** 1995 NJMM 470-80 (V238.

sodicanthophyllite $Na(Mg,Fe)_7(AlSi_7)O_{22}(OH)_2$. *Amphibole* structure group.

Structure determination not found.
Definition: **BE Leake** 1978 AM 63 1023-52.

sodic-ferripedrizite $NaLiNaFe_2Mg_2LiSi_8O_{22}(OH)_2$. *Amphibole* structure group.

Occurrence & SC-XRD: **R Oberti et al** 2000 AM 85 578-85.

sodic-ferri-ferropedrizite $NaLi_2Fe_2Mg_2LiSi_8O_{22}(OH)_2$. *Amphibole* structure group.

Occurrence & SC-XRD: **R Oberti et al** 2003 CM 41 1345-54.

sodium alum $NaAl(SO_4)_2.12aq$. *Alum* structure group. Review; **Sabelli** p. 9.

Structure: **DT Cromer MJ Kay AC Larson** 1967 AC 22 182-7.

sodium autunite $Na(UO_2)(PO_4).4aq$. *Autunite* structure group.

sodium betpakdalite $(Na,Ca)_3Fe_2(As_2O_4)(MoO_4)_6.15aq$.

Related to *betpakdalite* & *melkovite*.
Occurrence & crystallography: **KV Skvortsova & 5 others** 1971 ZVMO 100 603-11.

sodium boltwoodite $(H_3O)(Na,K)(UO_2)SiO_4.aq$.

May be related structurally to K analog but change of symmetry would imply distortion.
Structure determination not found.
Occurrence & crystallography: **AN Chernikov DP Shaskin IN Gavrilova** 1975 DAN SSSR 221 195-7 = AM 61 1054-5.

sodium-gedrite $Na(Mg,Fe)_6Al(Al_2Si_6)O_{22}(OH)_2$. *Amphibole* structure group.

Structure determination not found.
Definition: **BE Leake** 1978 AM 63 1023-52.
Occurrence: MM 42 529.

[sodium-melilite $NaCaAlSi_2O_7$. *Melilite* endmember.

Synthetic : MM 30 747; MM 42 529.
Hypothetical $Na_2Si_3O_7$: MA 12-197.]

[sodium-nepheline $NaAlSiO_4$. *Nepheline* endmember.

Synthetic.

Cell dimensions indicate occurs at Monte Somma, MM 31 972.]

sodium pharmacosiderite / sodium-pharmacosiderite
$Na_2Fe_4(AsO_4)_3(OH)_5.7aq$. *Pharmacosiderite* structure type.

XRPD: **DR Peacor PJ Dunn** 1985 MR 16 121-4 = AM 71 230.

sodium phlogopite / sodium-phlogopite $(Na,K)Mg_3AlSi_3O_{10}(OH)_2$.

Mica structure group.
Structure determination not found.
Occurrence: **W Schreyer K Abraham H Kulke** 1981 AM 66 639;
in meteorites: **AE Rubin** 1997 MPS 32 231-47.

[sodium uranospinite $(Na_2,Ca)(UO_2)_2(AsO_4)_2.5aq$.

Meta-autunite structure group from crystallography.
Structure determination not found.
Occurrence: **EV Kopchenova KV Skvortsova** 1957 DAN 114 634-6 = AM 43 383-4. Renamed *meta-sodium-uranospinite*: MM 35 1144.]

sodium zippeite $Na_4(UO_2)_6(SO_4)_3(OH)_{10}.4aq$. Review: **Sabelli**.

Structure determination not found.
Occurrence: **C Frondel J Ito AM Weeks** 1976 CM 14 429-36;
NJ Elton JJ Hooper 1993 MM 57 352-4.

sogdianite $(K,Na)_2Li_2(Li,Fe,Al)_2ZrSi_{12}O_{30}$. *Osumilite* structure group.

Structure: **VV Bakakin VP Balkin LP Solov'eva** 1975 SPC 19 460-2 (B1140);
crystal chemistry & SC-XRD, **MA Cooper FC Hawthorne ES Grew** 1999 AM 84 764-8;
do of end-member, **EV Sokolova FC Hawthorne LA Pautov** 2000 CM 38 853-9.
Occurrence: MM 37 964.

söhngeïte $Ga(OH)_3$.

Probably isostructural with *bernalite* $Fe(OH)_3$ & *dzalindite* $In(OH)_3$ from crystallography.
Structure determination not found.
Occurrence: **H Strunz** 1965 Nw 52 493 = AM 51 1815.

solanite = suolunite $Ca_2Si_2O_7.aq$.

Occurrence: MM 35 1153.

solongoite $Ca_2B_3O_4(OH)_4Cl$.

Structure: **NA Yamnova YuK Egorov-Tismenko MA Simonov** 1974 SPD 19 326-7 (Y105);
NA Yamnova MA Simonov NV Belov 1977 SPC 22 356-7.
Occurrence: MM 39 927.

sollyite $Pb_3As_4S_9$. Occurrence: MM 29 994. *Sartorite group.*

[jvs: ?relation to *dufrenoysite*.]

sonolite $(Mn,Mg)_9(SiO_4)_4(OH,F)_2$. *Humite* structure family.

Isostructural with *clinohumite*. Dimorphic with (Mg,Fe) *jerrygibbsite*.
Structure: **T Kato Y Ito N Hashimoto** 1989 NJMM 410-30 (K740);
Mg-rich & Mn-rich, **JD Grice PJ Dunn** 1994 MM 58 333-6.
Occurrence: MM 33 1150.

sonoraite $FeTeO_3OH.aq$.

Structure: **G Donnay JM Stewart H Preston** 1970 TMPM 14 27-44 (D534).
Occurrence: MM 37 964.

sopcheite $Ag_4Pd_3Te_4$.

Structure determination not found.
Occurrence: **DA Orsoev SA Rezhenova AN Bodanova** 1982 ZVMO 111 114-7;
GR Dunning JHG Laflamme AJ Criddle 1984 CM 22 233-7.

sophiite $Zn_2SeO_3Cl_2$.

Structure determination not found.
Occurrence: **LP Versagova & 3 others** 1989 ZVMO 118 65.

sorbyite $Pb_{19}(Sb,As)_{20}S_{49}$.

Structure determination not found.
Occurrence: **JL Jambor** 1967 CM 9 191-213 (J235).

sørensenite $Na_4SnBe_2Si_6O_{16}(OH)_4$.
Structure: **NV Maksimova VV Ilyukhin NV Belov** 1974 SPD 18 681-2 (M1112);
J Metcalf-Johansen RG Hazell 1976 AC B32 2553-6 (M1177).
Occurrence: MM 36 158-9.
sorosite Cu(Sn,Sb). Cell dimensions from XRPD consistent with *nickeline* structure type.
Occurrence & XRPD: **AY Barkov & 4 others** 1998 AM 83 901-6.
sosedkoite $(K,Na)_5Al_2(Ta,Nb,Sb)_{22}O_{60}$.
Structure determination not found; XRPD indexes on cell analogous to synthetic $K_3Li_2Ta_5O_{15}$
[M Fleischer sceptical; jvs check literature for structure.]
Occurrence: **AV Voloshin YuP Mel'nikov YaA Pakhomovskii** 1982 DAN 264 442-5.
soucekite $CuPbBi(S,Se)_3$. *Bournonite* structure group.
Structure determination not found.
Occurrence: **F Cech I Vavrin** 1979 NJMM 289-95.
souzalite $(Mg,Fe)_3(Al,Fe)_4(PO_4)_4(OH)_6.2aq$. Series with *gormanite.*
Structure: idea, **PB Moore** 1970 AM 55 135-69;
XRPD, **A Le Bail PW Stephens F Hubert** 2003 EJM 15 719-23 (10228).
Occurrence: MM 28 739;
BD Sturman & 3 others 1981 CM 19 381-7.
spadaite $?MgSiO_2(OH)_2.aq$.
Structure determination not found.
Occurrence: **WT Schaller TB Nolan** 1931 AM 16 231-6.
spangolite $Cu_6Al(SO_4)(OH)_{12}Cl.3aq$. Review: (E289).
Structure: **S Merlino & 3 others** 1992 NJMM 349-57 (M1275);
FC Hawthorne M Kimata RK Eby 1993 AM 78 649-52.
spencerite $Zn_4(PO_4)_2(OH)_2.3aq$.
Structure: **L Fanfani A Nunzi PF Zanazzi** 1972 MM 38 687-92.
spencite $\sim(Ca,Fe)_2Y_3B_3(Si,Al)_5(O,OH)_{20}$. Metamict.
Occurrence: MM 32 981.
sperrylite $PtAs_2$. *Pyrite* structure group.
Structure determination not found.
Occurrence: **Dana**; **RI Gait** 1982 MR 13 159-60.
Se-bearing, Western Sayan: **N Tolstykh A Krivenko L Pospelova** 1997 EJM 9 457-65 (T517).
Synthesis: **RD Heyding LD Calvert** 1961 Can J Chem 39 955-7 (H1041).
Hydrothermal *synthesis* & characterization: **VI Tikhomirova AV Chichagov** 2000 DES 373A 974-6 (180).
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
spertiniite $Cu(OH)_2$.
Structure: **HR Oswald & 3 others** 1990 AC C46 2279-84 (O280). Occurrence: MM 46 526.
spessartine $Mn_3Al_2Si_3O_{12}$. *Garnet* structure type.
Structure: **GA Novak GV Gibbs** 1971 AM 56 791-825;
JR Smyth & 4 others 1990 AM 75 314-8;
SC-XRD at 100, 293 & 525 K & IR, **CA Geiger T Armbruster** 1997 AM 82 740-7;
100 – 600 K, **U Dodehorst CA Geiger T Armsbruster** 2002 AM 87 542-9;
atomic displacements, **CM Grammaccioli T Pilati F Demartin** 2002 ACB 58 965-9.
SC-XRD, hydrostatic compression to 15 GPa: **L Zhang & 3 others** 1999 PCM 27 52-8 (Z217).
Cell dimension to 25 GPa, XRPD: **V Diella & 3 others** 2004 AM 89 371-6.
Mössbauer & FTIR of Fe/OH: **SG Eeckhout & 5 others** 2002 AM 87 1297-306.
sphaerobertrandite $Be_3SiO_4(OH)_2$.
Occurrence & XRD structure: **IV Pekov & 11 others** 2003 EJM 15 157-66 (8910).
sphaerobismoite $(Bi_{0.96}As_{0.04})_2O_3$. Polymorph of *bismite*.
Occurrence & tetragonal cell: **K Walenta** 1995 Aufschluss 46 245-8 = AM 81 1514-5.
[jvs: cell dimensions do not match those for the *synthetic* high-T beta.]
SPHALERITE STRUCTURE GROUP Includes:

marshite	CuI
miersite	(Ag,Cu)I

nantokite CuCl
sakuraiite (Cu,etc)S
sphalerite ZnS

Review of ordering of metal atoms: **J Hauck K Mika** 1998 JSSC 138 334-41 (W912).
Acicular Ag,Sb,Cu-enriched, British Columbia: **G Beaudoin** 2001 CM 38 1387-98.
Synthetic $CoGa_2S_4$-alpha (ordered tetragonal) & -beta (disordered cubic): **E Agostinelli L Gastaldi S Viticoli** 1985 JPCS 46 1345-9.
Synthetic GaP, ZnS, ZnSe & ZnTe, anharmonic thermal vibrations from high-T XRD: **MKh Rabadanov AA Loshmanov YuV Shaldin** 1997 CrR 42 592-602 (R736).

sphalerite ZnS. Sphalerite structure type.
Simulation of structure and stability of surface: **K Wright & 3 others** 1998 AM 83 141-6.
Growth in biofilms of sulfate-reducing bacteria: **M Labrenz & 12 others** 2000 S 290 1744-7 (371).
Interaction with *Bacillus polymyxa*, application to leaner ore mining: **D Santhiya S Subramanian KA Natarajan** 2001 JCIS 235 289-97, 298-309 (1637);
surface studies, **do** 2002 JCIS 256 237-48.
Oxidative dissolution, surface microsc: **G de Giudici M Voltolini M Moret** 2002 EJM 14 757-62.
Pyrrhotite inclusions: **TR Pradeep Kumar GN Jadhav** 2003 CuS 84 501-3.
Crystal chemistry of Fe-bearing: **P Lepetit & 3 others** 2003 PCM 30 185-91 (9233).
Stacking faults & twin boundaries, Kosovo: **V Šrot & 4 others** 2003 AM 88 1809-16.
Mn distribution, EPR: **GP Bernardini & 4 others** 2004 PCM 31 80-4 (10120).
Composition zoning: **F Di Benedetto & 4 others** 2005 AM 90 1384-92.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

spheniscidite $(NH_4,K)(Fe,Al)_2(PO_4)_2OH.2aq$. *Leucophosphite* structure group.
Synthetic, structure: **M Cavellec D Riou G Ferey** 1994 AC C50 1379-81 (C725).
Occurrence: MM 50 758.
Hydrothermal *synthesis* with urea: **C Trobajo et al** 2000 JCSD 767-90 (T638).

SPINEL STRUCTURE GROUP Includes:

chromite	$MgCr_2O_4$
filipstadite	$(Mn,Mg)_2(Sb^{5+}_{0.5}Fe^{3+}_{0.5})O_4$
franklinite	$(Zn,Mn,Fe)(Fe^{3+},Mn^{3+})_2O_4$
gahnite	$ZnAl_2O_4$
magnesiocoulsonite	MgV_2O_4
magnetite	$FeFe_2O_4$
qandilite	Mg_2TiO_4
greigite	$(Fe^{2+},Fe^{3+})_3S_4$
pleonaste	$(Mg,Fe)Al_2O_4$
hodostannite	$Cu_2FeSn_3S_8$
ringwoodite	$(Mg,Fe)_2SiO_4$
silver-rhodostannite	$AgCuFeSn_3S_8$
spinel	$MgAl_2O_4$
tegengrenite	$(Mg,Mn,Zn)_2(Sb,Mn,Si,Ti,Al,Fe)O_4$.
toyohaite	$Ag_2FeSn_3S_8$
ulvöspinel	Fe_2TiO_4
zincochromite	$ZnCr_2O_4$

Many others to be added.
Three natural, XRD & Mössbauer: **S Carbonin U Russo AD Giusta** 1996 MM 60 355-68.
Natural Zn,Mn-ferrite: **JR Marcano & 3 others** 1996 MRB 1 1587-92.
Phase transitions: **C Haas** 1965 PCM 26 1225-32;
Y Billet I Morgenstern-Badarau A Michel 1967 BSFMC 90 8-19;
VM Talanov 1990 Physica Status Solidi B162 61-73.
Curie T, magnetic susceptibility/cation ordering $(Fe_3O_4)_x(MgAl_2O_4)_{1-x}$, **RJ Harrison A Putnis** 1996 AM 81 375-84.
T dependence of disorder in Balmuccia spinel: **A Della Giusta S Carbonin G Ottonello** 1996 MM 60 603-16.

Mg-Al spinel from Sacrofano: **S Lucchesi A Della Giusta** 1997 MP 59 91-9 (L831).
Distribution of M-M distances: **R Isea A Ramos-Gallardo** 1998 AC B54 35-40 (I228).
21spinels from xenoliths Alban Hills: **S Lucchesi M Amoriello A Della Giusta** 1998 EJM 10 473-82 (L936).
Non-convergent cation ordering, magnetite-spinel series,ND: **RJ Harrison & 3 others** 1999 AM 84 555-63.
Cation ordering & T for Mg-Al-rich spinels from skarn, **F Princivalle & 3 others** 1999 MM 63 257-62.
Cation partition with P, NPD: **A Pavese G Artioli S Hull** 1999 AM 84 905-12.
Two detrital Cr-spinels, SC-XRD: **S Carbonin & 3 others** 1999 NJMM 359-71 (C1123).
Chemistry of magmatic spinel, relation *olivine* & melt*:* **VS Kamenetsky AJ Crawford S Meffre** 2001 JP 42 655-71 (1607).
Optical spectra for ferrous Fe: **GR Rossman MN Taran** 2001 AM 86 896-903.
Thermal conductivity, vibrational spectroscopy, theory: **AM Hofmeister** AM 86 1188-209.
Cation distribution, model: **B Lavina G Salviula A Della Giusta** 2002 PCM 29 10-8 (7285).
Cr, Fe(III)-spinels, Mössbauer: **JC Waerenborgh & 3 others** 2002 EJM 14 437-46 (7135).
Fe/Mg diffusion in aluminous-: **H Liermann J Ganguly** 2002 GCA 66 2903-13 (7833).
Magnetite & *synthetic* (Mg/Co/Ni/Zn), XR magnetic circular dichroism vs cation site occupancy: **RAD Pattrick & 5 others** 2002 EJM 14 1095-102.
In situ heating, SC-XRD: **S Carbonin & 3 others** 2002 PCM 29 503-14.
Structure modeling/cation partition, high T/P: **B Lavina & 2 others** 2004 PCM 31 45-51 (10017).
Magnetic susceptibility vs T, Fe-Si-oxides: **A Kontny & 2 others** 2004 PCM 31 28-40 (10016).
Cr-, Albania ophiolite: cation vacancy, **F Bosi & 3 others** 2004 AM 89 1367-73.
Cr-, Murray Basin, Australia: **M Pownceby** 2005 MM 69 191-204.
Cr-, heavy-mineral sands, southeast Africa: **M Pownceby P Bourne** 2006 MM 70 51-64.
Cr-, ferric/ferrous & oxidation state: **M Quintiliani & 2 others** 2006 AM 91 907-16.
Natural ferrites: cation site occupancy, XAS/ magnetic circular dichroism, **CI Pearce & 4 others** 2006 AM 91 880-93.
In meteorites: **AE Rubin** 1997 MPS 32 231-47;
Umbarger L6 chondrite, Fe_2SiO_4, **Z Xie N Tomioka** TG Sharp 2002 AM 87 1257-60;
B1 Ca-Al-rich inclusions, **HH Connolly Jr DS Burnett KD McKeegan** 2003 MPS 38 225-41;
Murray/Murchison carbonaceous chondrites, presolar, **E Zinner & 6 others** GCA 67 5083-96.
Synthetic Co_2SiO_4: **N Morimoto & 3 others** 1974 AM 59 475-95.
Synthetic $Zn(Co,Ni)GeO_4$, order-disorder: **J Preudomme P Tarte** 1980 JSSC 35 272-7.
Synthetic $CaFe_2O_4$-Fe_3O_4, Ca in tetrahedral site: 1989 JSSC 78 154 = SR 56A 271.
Synthetic $LiMn_2O_4$, Jahn-Teller transition ~ 280K: **A Yamada M Tanaka** 1995 MRB 30 715-21;
Verwey transition & magnetism, **Y Shimakawa T Numata J Tabuchi** 1997 JSSC 131 138-43 (S1724);
NMR & FTIR of cathode prepared by tartaric acid gel, **YM Hon & 3 others** 2001 JSSC 160 368-76 (3398).
Synthetic $ZnGa_2O_4$: **M Wendschuh-Josties & 3 others** (1995) NJMM 273-80 (W719).
Synthetic $Mg_7Ga_2GeO_{12}$, Omega- phase intermediate *olivine* & spinel structures: **J Barbier BG Hyde** 1987 ACB 43 34-40 (B1364).
Synthetic Zn_2TiO_4: phase transition 833 K high-T cubic to low-T tetragonal, **Y Billet I & 2 others** 1967 BSFMC 90 8-19;
^{17}O NMR & XRPD, **RL Millard RC Peterson BK Hunter** 1995 AM 80 885-96.
Synthetic $MgCr_xAl_{2-x}O_4$: **NV Chezhina IV Galanova** 1994 Russian J Inorg Chem 39 555-7 .
Synthetic $MgCr_2O_4$, electron density: **H Sawada** 1996 MRB 31 361-6 (S1574).
Synthetic $MgGa_2O_4$, electron density: **do** 1996 MRBI 31 367-71 (S1575).
Synthetic (Mn/Fe/Ni)(Fe/Cr)O_4, cell dimensions: **GC Allen KR Hallam JA Jutson** 1995 PD 10 214-20.
Synthetic $Zn_{1-x}Fe_xAl_2O_4$, XRPD: MA 96M/1556.
Synthetic $ZnAl_2O_4$: on alumina in catalytic system, XAS/XRD/TEM: **R Revel & 4 others** 2000 JPCB 104 9828-35;
nanocrystalline synthesis, **S Mathus & 9 others** 2001 JACeS 84 1921-8 (3010).
Synthetic Fe_2SiO_4-gamma: PVT to 673 K, **TG Plymate JH Stout** 1994 PCM 21 413-20.
Synthetic Mg_2SiO_4-gamma: PVT to 30 GPa & 700K, **Y Meng & 4 others** 1994 PCM 21 407-12.
Synthetic Ni_2SiO_4-gamma, diffuse reflectance: **S Rossano L Galoisy G Gwamnesia** 1996 EJM 8 471-5 (R666).
Synthetic $Mg_{2-x}Ti_{1+x}O_4$, electrical & magnetic properties: **H Hohl C Kloc E Bucher** 1996 JSSC 125 216-23 (H1117).
Synthetic $LiAl_5O_8$ & $Li_2Al_4O_7$: **M Kriens & 5 others** 1996 NJMM 344-50 (K881).
Synthetic $NiMn_2O_{4+x}$, WAXS: **C Laberty et al** 1997 JSSC 129 271-6 (L832).
Synthetic $Li_4Mn_5O_{12}$, N & XRD: **T Takada & 3 others** 1997 JSSC 130 74-80 (T518).
Synthetic $Ni_{1+x}Fe_{2-2x/3}O_4$, N & XRPD: **MC Blesa & 3 others** 1997 JSSC 129 123-9 (B1588).

Synthetic $CuCr_2O_4$ & $CuRh_2O_4$, XRPD: **WA Dollase HSC O'Neill** 1997 AC C53 657-9 (D643).

Synthetic $LiNiVO_4$: **SRS Prabaharan & 3 others** 1997 JMC 7 1791-6 (P721).

Synthetic $LiTi_2O_4$, spinel to *ramsdellite* 1148-1198 K, ND: **RKB Gover JTS Irvine AA Finch** 1997 JSSC 132 382-8.

Compressibility of calcium-ferrite type <9 GPa: **M Yutani T Yagi H Yusa T Irifune** 1997 PCM 24 340-4 (Y203).

Synthetic spinelloid, $Fe_{2.57}Si_{0.43}O_4$, structure: **RJ Angel AB Woodland** 1998 EJM 10 607-11.

Synthetic $(Mg_{0.70}Fe_{0.23})Al_{1.97}O_4$, NPD: **A Pavese & 3 others** 1999 PCM 26 242-50 (P838);
reevaluation, **JA Foley SE Wright JM Hughes** 2001 28 143-9 (1630).

Synthetic $Mg(Ga,Ge)O_4$, beta $Mg_3Ga_2GeO_8$, NPD structure: **RL Millard & 2 others** 2000 PCM 27 179-93 (M1831).

Synthetic $ZnMn_2O_4$, high-P phase transition, XRPD: **S Asbrink et al** 1999 PRB 60-5 (A914).

Synthetic $NiAl_2O_4$, 111 systematic row CBED: **Y Tabira RL Withers** 1999 PCM 27 112-8 (T634).

Synthetic $LiMn_2O_4$, phase transition: XRPD, **G Rousse et al** 1999 ChM 11 3629-35 (R929);
SC-XRD, **J Akimoto Y Takahashi Y Gotoh S Mizuta** 2000 ChM 12 3246-8 (364).

Synthetic $CoAl_2O_4$, sol-/citrate-gel, XRPD/FTIR/UV-VIS/SEM/TGA/DTA, **M Zayat D Levy** 2000 ChM 12 2763-9 (Z233).

Synthetic $Zn_{0.97}Fe_{2.02}O_4$, 300-1600 K, ND: **A Pavese D Levy A Hoser** 2000 AM 85 1497-502.

Synthetic $CdCr_2(S/Se)_4$, electronic band structure: **N Shanthi P Mahadevan DD Sarma** 2000 JSSC 155 198-205 (673).

Synthetic (Mg/Fe/Ni/Co)-silicate high P, IR/shear moduli: **AM Hofmeister HK Mao** AM 86 622-39.

Synthetic Fe_2SiO_4-Fe_3O_4: magnetics, **T Yamanaka M Okita** 2001 PCM 28 102-9 (1639);
electric conductivity, **T Yamanaka H Shimazu K Ota** 2001 PCM 28 110-8 (1638).

Synthetic $(Mg,Zn)(Al,Fe)_2O_4$, SC-XRD & Mössbauer: **GB Andreozzi & 3 others** 2001 EJM 13 391-402 (2147).

Synthetic $CuIr_2S_4$, SC-XRD below metal-insulator transition: **PG Radaelli & 9 others** 2002 N 416 155-8 (7049).

Synthetic Fe(III,II)-bearing, optical absorption: **U Halenius H Skogby CB Andreozzi** 2002 PCM 29 319-30 (7646).

Synthetic $(Tl_xFe_{1-x})_{3-\delta}O_4$: non-stoichiometry & point defects, **S Aggarwal R Dieckmann** 2002 PCM 29 695-796 (8546).

Synthetic $NiCr_2O_4$: review of use as industrial catalyst, gas sensor & high-T oxidation product of Ni-alloys, low-T calorimetry: **S Klemme JC van Miltenburg** 2002 PCM 29 663-7 (8581).

Synthetic spinel-hercynite solid solution: FTIR, **H Skögby U Halenius** 2003 AM 88 489-92.

Synthetic $CoCr_2O_4$ –Co_3O_4 solid solution: XRPD structure, **HSC O'Neill** 2003 MM 67 547-54.

Synthetic CoFeO: high-P XRD & Raman: **Z Wang & 7 others** 2003 PRB 68 094101 (9556).

Synthetic $MgFe_2O_4$: equation of state, XRPD, **D Levy & 5 others** 2004 PCM 31 122-9 (10124);
cation ordering, XRPD to 1255 K, **SM Antao I Hassan JB Parise** 200 5AM 90 219-28;
cation distribution, 0-2 GPa873-1473 K: **R Kagi & 3 others** 2995 AM 9- 708-17.

Synthetic $Mg(Al,Fe)_2O_4$: SC-XRD, cation distribution, **A Nakatsuka & 4 others** 2004 PCM 31 278-87 (10540).

Synthetic $MgCr_2O_4$-$FeCr_2O_4$,SC-XRD structure/Mössbauer/IR: **D Lenaz & 3 others** 2004 PCM 31-633-42 (10902).

Synthetic $CoCo_xAl_{2-x}O_4$: via EDTA chelate, **C Wang & 3 others** 2004 JMS 39 6191-201 (10968).

Synthetic $CuAl_2O_4$: cation distribution vs T, **HStC O'Neill & 3 others** 2005 EJM 17 581-6.

Complex high-pressure behavior: **T Irifune M Fujino E Ohtani** 1991 N 349 409-11(I219);
to MgO & Al_2O_3 <25 GPa & $CaFe_2O_4$ type < 38 GPa: **T Irifune & 4 others** 2002 PCM 29 645-54 (8579).

EoS to: 65 GPa, **MB Kruger & 3 others** 1997 PRB 1-3 (B1641);
30 GPa, **D Levy A Pavese M Hanfland** 2003 AM 88 93-8.

Cations: mixing at high-T, ^{27}Al-NMR, **H Maekawa & 3 others** 1997 AM 82 1125-32;
ordering, SC-XRD, quenched, **GB Andreozzi & 3 others** 2000 AM 85 1164-71;
& vacancy distribution, NPD, **A Pavese G Artioli A Hoser** 2000 ZK 215 406-12 (P894);
kinetics, **GB Andreozzi F Princivalle** 2002 AM 87 838-44;
disorder, to 1600 K 3 GPa, NPD, **F Méducin & 6 others** 2004 AM 89 981-6.

Thermodynamics/kinetics cation ordering <1873 K:
ND, **SAT Redfern & 3 others** 1999 AM 84 299-310;
theory, **MC Warren MT Dove SAT Redfern** 2000 MM 64 311-7.

Thermal expansion: 300-3000 K, **G Fiquet P Richet G Montagnac** 1999 PCM 27 103-11(F683);
SC-XRD, 298-1223 K, **S Carbonin & 3 others** 2002 PCM 29 503-14 (8207).

Harmonic & anharmonic properties: **I Suzuki I Ohno OL Anderson** 2000 AM 85 304-11.

Gahnite sound velocity/elasticity to 9 GPa & implications for spinel-elasticity systematics: **HJ Richmannn SD Jacobsen** 2006 AM 91 1049-54.

Unmixed in chromitite, peridotite complex, Japan: **A Tamura S Arai** 2005 AM 90 473-80.

Cr-spinel , detrital se Alps & outer Dinarides: **D Lenaz F Princivalle** 2005 CM 43 1305-14.
Fore-arc peridotite, Najahima Seamount: **H Okamura S Arai Y Kim** 2006 MM 15-26.

spionkopite $Cu_{39}S_{28}$.

Structure determination not found.
Occurrence: **RJ Goble** 1980 CM 18 511-8;
Vielsam, Belgium, **F Hatert** 2005 CM 43 25-35.

spiroffite $(Mn,Zn)_2Te_3O_8$. Iso *zincospiroffite* $Zn_2Te_3O_8$.

Structure: *synthetic*, **K Hanke** 1966 Nw 53 273;
natural, **MA Cooper FC Hawthorne** 1996 CM 34 821-6.
Occurrence: MM 33 1150.
Synthetic Mn/Co/Ni/Cu/Zn, XRPD, SC-XRD structure, antiferromagnetism: **CR Feger GL Schimek JW Kolis** 1999 JSSC 143 246-53 (F645).

spodumene $LiAlSi_2O_6$. *Pyroxene* structure group, monoclinic subgroup.

Structure: **S Kuntzinger** 1999 AC B55 867-81(K1209);
SC-ND at 54 K, **M Tribaudino & 3 others** 2003 CM 41 521-7.
Synthetic Fe,Mg-bearing: high-T XRD structure across phase transition, **F Camara G Iezzi R Oberti** 2003 PCM 30 20-30;
high-P XRD/Raman, **GD Gatta TB Ballaran G Iezzi** 2005 PCM 32 132-9.

Synthetic $LiGaSi_2O_6$, structure & ^{69}Ga-NMR: **A Sato T Osawa H Ohashi** 1994 AC C50 487-8;

Synthetic $LiScSi_2O_6/ZnSiO_3$, displacive transition: **T Arlt RJ Angel** 2000 PCM 27 719-31 (948).

spriggite $Pb_3(UO_2)_6O_8(OH)_2.3aq$.

Occurrence: **J Brugger et al** 2003 Australian J Mineral 9 15;
& structure, **do & 5 others** 2004 AM 89 339-47.

springcreekite $BaV_3(PO_4)_2(OH,aq)_6$. *Crandallite* group.

Occurrence & structure: **U Kolitsch & 3 others** 1999 NJMM 529-44 (K1215).

spurrite $Ca_5(SiO_4)_2(CO_3)$. Dimorphic with *paraspurrite*.

Structure: **JV Smith & 3 others** 1960 AC 13 454-8 (S59);
RF Klevtsova NV Belov 1961 SPC 5 659-67 (K41) = MA 15-264;
SC-XRD, **JD Grice** 2005 CM 43 1489-500.

[squawcreekite $Fe^{3+}SbO_4$.

Replaced by *tripuhyite*. But see: 2003 NJMM 407-20.]

srebrodol'skite $Ca_2Fe_2O_5$. *Brownmillerite* structure group. See AM 91 223.

2-connected octa-tetra net: Consortium for Theoretical Frameworks net 1098.
Structure determination not found.
Occurrence: **BV Chesnokov LF Bazhenova** 1985 ZVMO 114 195-9.

srilankite $ZrTi_2O_6$. *Scrutinyite* structure group.

Alpha-PbO_2 structure type: **A Willgallis H Hartl** 1983 ZK 164 59.

High-P stability in ZrO_2-TiO_2: **U Troitzsch DJ Ellis** 2004 EJM 16 577-84 (10625).

Occurrence: MM 48 583;
Oceanic peridotite, **T Morishita & 4 others** 2004 AM 89 759-66.
Synthesis of $(Zr,Ti)O_2$ series: **A Willgallis R Brauer J-C Buhl** 1987 NJMM 129-35 (W707).
[jvs Is there a superstructure at the 1:2 ratio?]

stalderite $(Tl,Cu)(Zn,Fe,Hg)AsS_3$. Isotypic with *routhierite* $(Tl,Cu,Ag)(Hg,Zn)(As,Sb)S_3$.

Mineralogy & crystal structure: **S Graeser & 3 others** 1995 SMPM 75 337-45 (G847).

stanekite $Fe^{3+}(Mn,Fe^{2+},Mg)(PO_4)O$. Triploidite structure group.

Occurrence & XRD: **P Keller & 4 others** 1997 EJM 9 475-82 (K923).
Does not match *synthetic* FeP_2O_5: **A Modaressi** 1981 JSSC 40 301-11.

stanfieldite $Ca_4(Mg,Fe,Mn)_5(PO_4)_6$.

Structure: abstract, **JJ Pluth & 3 others** 1996 AC A52 Suppl C-14.
Occurrence: **LF Fuchs** 1967 S 158 190 = MM 36 1159.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

stanleyite $VOSO_4.6aq$.

Occurrence & crystallography: **A Livingstone** 1982 MM 45 163.

STANNITE STRUCTURE GROUP Includes:

barquillite	$Cu(Cd,Fe)GeS$
briartite	$Cu_2(Zn,Fe)GeS_4$
cernyite	$Cu_2(Cd,Zn,Fe)SnS_4$
famatinite	Cu_3SbS_4
ferrokesterite	Cu_2FeSnS_4
hemusite	Cu_6SnMoS_8
hocartite	Ag_2FeSnS_4
isostannite	Cu_2FeSnS_4
këserite	$Cu_2(Zn,Fe)SnS_4$
kiddcreekite	Cu_6SnWS_8
kuramite	Cu_3SnS_4
luzonite	Cu_3AsS_4
permingeaite	$Cu_3(Sb,As)Se_4$
pirquitasite	Ag_2ZnSnS_4
stannite	Cu_2FeSnS_4
stannoidite	$Cu_8(Fe,Zn)_3Sn_2S_{12}$ superstructure
(velikite)	$(Cu,Hg)_{11}Sn_4S_{16}$

Related to *chalcopyrite* structure: both derivatives of *sphalerite*, with *stannite* having all Cu in layers whereas *chalcopyrite* has Cu alternating. Probably detailed study will reveal complications.

Stannite-këserite synthetic series: SC-XRD structure, **P Bonazzi & 3 others** 2003 CM 639-47.

[Cu_2HgSnS_4. IMA 96-052. Analog of *stannite*.]

stannite Cu_2FeSnS_4. Low-temperature tetragonal polymorph.

Stannite structure group. Dimorphic with *ferrokesterite.*

Structure: **SR Hall JT Szymanski JM Stewart** 1978 CM 16 131-7;
antiferromagnetic transition, *synthetic*, **A Caneschi & 3 others** 2004 PCM 31 190-6..

Isostannite is the cubic high-temperature polymorph of *stannite*: MM 31 962.

EPR & SQUID magnetometry: **GP Bernardini et al** 2000 PCM 27 453-61 (B2022).

Synthetic Mn analog & Cu_2SnS_3-ZnS-MnS phase relations 1093 & 973 K: **EG Osadchii** 1996 NJMM 201-11 (O320).

stannoidite $Cu_8(Fe,Zn)_3Sn_2S_{12}$. Superstructure of *stannite*.

Structure: **Y Kudoh Y Takeuchi** 1976 ZK 144 145-60 = MA 78-245.

Occurrence: MM 37 964.

stannomicrolite $(Sn,Mn,Fe)_2(Ta,Sn,Nb,Ti)_2(O_{6.6}OH_{0.6})$.

Pyrochlore structure type.

No detailed structure determination.

Composition: **TS Ercit P Cerny J Siivola** 1987 NJMM 249-52 (E361).

Occurrence: MM 42 529.

jvs: compare with *sukulaite* ?$Sn_2Ta_2O_7$: **A Vorma J Siivola** 1967 Bull Comm Geol Finlande 229 173 = MM 37 965.

stannopalladinite $(Pd,Cu)_3Sn_2$.

[staringite = cassiterite + tellurium $Fe_{0.5}Sn_{4.5}TaO_{12}$.

Possibly in *trirutile* structure group.

Occurrence: MM 37 964.]

starkeyite $MgSO_4.4aq$. *Rozenite* structure group. Review: **Sabelli** p. 12.

Structure: **WH Baur** 1962 AC 15 815-26 & 1964 17 863.

Occurrence: MM 31 972-3.

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

staurolite $\sim(Fe,Mg,Zn)_2Al_9(Si,Al)_4O_{22}(OH)_2$. Staurolite structure type.

See *magnesiostaurolite & zincostaurolite*.

Structure: **K Hanisch ?** NJMM 362-6;

JV Smith 1968 AM 53 1139-55 (S909);
ND, **Y Takéuchi N Aikawa T Yamamoto** 1972 ZK 136 1-22 (T312);
ND 100K, **T Tagai W Joswig** 1985 NJMM 97-107 (T311);
Co-bearing, **KN Bringhurst DT Griffen** 1986 AM 71 1466-72;
ND, **K Ståhl Å Kvick JV Smith** 1988 JSSC 73 362-80;
K Ståhl J-P Legros 1990 AC B46 292-301;
HR Wenk & 3 others 1992 AC A48 700-16;
crystal-chemical perspective, **MJ Holdaway & 5 others** 1991 AM 76 1910-9;
XAS, Fe/Mn/Zn/Ti, **CMB Henderson & 3 others** 1993 AM 78 477-85;
FC Hawthorne & 4 others 1993abc CM 31 551-82, 583-95, 597-616 (H859,860,861);
redox, **F Caucia & 4 others** 1994 CM 32 477-89;
polarized IR, **N Aikawa K Shinoda** MJJ 17 118-31;
H-rich, **FC Hawthorne & 4 others** 1994 CM 32 491-5;
polarized FTIR, **M Koch-Müller K Langer A Beran** 1995 PCM 22 108-14 ;
Zn-rich, SC-XRD, **R Oberti** 1996 CM 34 1051-7;
EXAFS, Fe, Co, Zn & Mg-, **CMB Henderson & 3 others** 1997 MM 61 613-25;
synthetic Fe-,Mg-, XRPD, **M Koch-Müller & 3 others**1998 EJM 10 453-60 (K1084);
IR of OH, **M Koch-Müller K Langer** 1998 EJM 10 1267-73 (K1130);
synthetic Fe,Mg,Zn-, Mössbauer, **M Koch-Müller & 2 others** 1999 PCM 26 312-21.
Isothermal compression: **P Comodi & 3 others** 2002 AM 87 1164-71.
Optical spectra for Fe(II): **GR Rossman MN Taran** 2001 AM 86 896-903.
Cr/Fe(III) vs Mg-Al order/disorder: **F Martignago A Dal Negro S Carbonin** 2003 PCM 30 401-8 (9333).
Synthetic in Mg-Fe-Al-Si-O-H system: **D Lattard W Bubunik** 1995 EJM 7 931-47 (L696).
Synthesis in Mg-Al-Si-aq system 2 to 5 GPa: **T Fockenberg** 1995 EJM 7 1373-80 (F479).
Synthesis in melting of metapelite: **A García-Casco & 5 others** 2003 JP 44 1727-57 (9399).
Mg-, enthalpy: **K Grevel & 3 others** 2002 AM 87 397-404.
Occurrence: Dokolwayo kimberlite, Swaziland, many types of inclusions, including staurolite & *albite*: **LRM Daniels JJ Gurney** 1999 Proc VII Int Kimberlite Conf 134-42;
Central Swiss Alps eclogite, domain evolution, **FM Brouwer M Engi** 2005 CM 43 105-28.

steacyite $K(Na,Ca)_2ThSi_8O_{20}$.

Compare with *arapovite*, *ekanite*, *iraqite* & *turkestanite* $(K_{0.53}void_{0.47})(Ca,Na)_2Th[Si_8O_{20}]$.
Structure: **P Richard G Perrault** 1972 AC B28 1994-9.
Occurrence & composition: MM 46 526;
GC Parodi G Della Ventura 1987 NJMM 233-9 (P558).

steenstrupine-Ce $Na_{14}Ce_6Mn^{2+}Mn^{3+}Fe^{2+}_2(Zr,Th)(Si_6O_{18})_2(PO_4)_7.3aq$.

Structure: **PB Moore J Shen** 1983 TMPM 31 47-67 (M741).
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
Occurrence in hyperagpaitic alkaline rocks (revised formula for amorphous): **Khomyakov** 1995;
zoning, Ilimaussaq, **AP Khomyakov H Sørensen** 2001 GGUB 190 109-18 (8689.

steigerite $AlVO_4.\sim3aq$. Amorphous.

Occurrence: MM 24 623-4.

stellerite $CaAl_2Si_7O_{18}.7aq$. *Zeolite* mineral group.

Structure: **E Galli A Alberti** 1975 BSFMC 98 11-8 (G363);
ND, **SA Miller JC Taylor** 1985 Z 5 7-10;
Na-, **E Passaglia M Sacerdoti** 1982 BM 108 338-42.
Thermochemistry: **IA Kiseleva & 3 others** 2001 GI 39 170-6 (1337).
Dehydration kinetics vs T-O-T bridge breaking: XRPD, **R Arletti & 2 others** 2006 AM 91 628-34.

stenhuggarite $CaFe(AsO_2)(AsSbO_5)$.

Structure: **A Coda & 3 others** 1977 AC B33 1807-11.
Occurrence: MM 37 964.

stenonite $Sr_2Al(CO_3)F_5$.

Structure, classification of aluminofluoride minerals: **FC Hawthorne** 1984 CM 22 245-51 (H599).
Occurrence: MM 33 1151

stepanovite $NaMgFe(C_2O_4)_3.8-9aq$. Compare with Al compound *zhemchuzhnikovite*.

Occurrence: MM 30 747.

stephanite Ag_5SbS_4.

Structure: **B Ribar W Nowacki** 1970 AC B26 202-7 (R174);
AA Petrunina & 3 others 1970 SPD 14 833-5 (P475).

stercorite = microcosmic salt $Na(NH_4)H(PO_4).4aq$.

Structure: **G Ferraris M Franchini-Angela** 1974 AC B30 504-11.

sterlinghillite $Mn_3(AsO_4)_2.4aq$.

Structure determination not found.
Occurrence: NJ, **PJ Dunn** 1981 = AM 66 182;
Japan, 3aq, **S Matsubara & 3 others** 2000 = AM 86 770.

sternbergite $AgFe_2S_3$. Dimorphic with *argentopyrite*.

Structure: **F Pertlik** 1987 NJMM 458-64 (P559).

sterryite $Ag_2Pb_{10}(Sb,As)_{12}S_{29}$.

Structure determination not found.
Occurrence: **JL Jambor** 1967 CM 9 191-213 (J235).

stetefeldtite $Ag_2Sb_2(O,OH)_7$. *Stibiconite* structure group.

Structure determination not found.
Occurrence: **B Mason CJ Vitaliano** 1953 MM 30 100-12.

stevensite $Mg_3Si_4O_{10}(OH)_2$. *Smectite* structure group.

Structure: **GW Brindley** 1955 AM 40 239-47 (B96).
Synthetic Zn analog: **F Lhommédé & 3 others** 1996 CRASP 322 IIa 827-30 (L760).
Synthesis from *hydromagnesite* & Na silicate: **N Takahashi & 4 others** 1997 MiMa 9 35-42.

stewartite $MnFe_2(PO_4)_2(OH)_2.8aq$. Trimorphic with *laueite* & *strunzite*.

Iso with *kastningite* $(Mn,Fe,Al)Al_2(PO_4)_2(OH)_2.8aq$.

Structure: **PB Moore** 1975 NJMA 123 148-59 (M1178);
PB Moore T Araki 1975 AM 59 1272-62.

stibarsen SbAs. *Tetradymite* mineral-structure group; arsenic sub-group.

Structure: **P Bayliss** 1991 AM 76 257-65.
Occurrence: MM 26 342.
Synthetic: MM 29 996.

STIBICONITE MINERAL GROUP Includes

bindheimite	$Pb_2Sb_2O_6(O,OH)$
bismutostibiconite	$Bi(Sb,Fe)_2O_7$
jixianite	$Pb(W,Fe)_2(O,OH)_7$
[lewisite	$(Ca,Fe,Na)_2(Sb,Ti)_2O_7$ unnecessary name?]
partzite	$?Cu_2Sb_2(O,OH)_7$
romeite	$(Ca,Fe,Mn,Na)_2(Sb,Ti)_2 O_6(O,OH,F)$
stetefeldtite	$Ag_2Sb_2(O,OH)_7$
stibiconite	$Sb^{3+}Sb^{5+}{}_2O_6OH$

Part of *pyrochlore* structure group.

stibiconite $Sb^{3+}Sb^{5+}{}_2O_6OH$. *Pyrochlore* structure group.

Structure determination not found.
Mössbauer spectroscopy: AM 79 574.
Occurrence: **CJ Vitaliano BJ Mason** 1952 AM 37 982-99.

stibiobetafite $(Ca,Sb)_2(Y,Nb,Ta)_2(O,OH)_7$. *Pyrochlore* structure group.

Structure determination not found.
Occurrence: **P Cerny & 3 others** 1979 CM 17 583-8.

stibiocolumbite $SbNbO_4$. Isostructural series with Ta analog *stibiotantalite*.

Structure: **NV Zubkova & 9 others** 2002 NJMM 145-59 (7090).
Occurrence: **Dana**.

stibiocolusite $Cu_{13}V(Sb,Sn,As)_3S_{16}$. *Germanite* structure group.

Structure determination not found.

Occurrence: **EM Spiridonov AS Badalov VV Kovachev** 1992 DES 324 145-9.

stibiomicrolite

stibiopalladinite $Pd_{5+x}(Sb,As)_{2-x}$. Related to *isomertieite*, *mertieite-I* & *mertieite-II*.

Structure: **P Bayliss** 1990 CM 28 751-5.

Occurrence & crystallography: **GA Desborough JJ Finney BF Leonard** 1973 AM 58 1-10;
LJ Cabri TT Chen 1976 AM 61 1249-54.

Occurrence: MM 22 628;
ND Tolstykh & 4 others 2000 EJM 12 431-40 (T641).

Phase relations in Pd-Pt-Sb: **W Kim GY Chao** 1996 NJMM 351-64 (K886).

stibiotantalite $Sb(Ta,Nb)O_4$.

Isostructural with Bi analog *bismutotantalite* & Nb analog *stibiocolumbite*.

Structure: **NF Karyakina & 4 others 1973** SPC 17 766-7;
ferroelectric transition, **TS Ercit EE Foord** 1995 GAC/MAC Mtg 14.

Crystal chemistry of complex Nb & Ta oxides: **J Graham MR Thornber** 1974 AM 59 1026-39.

Synthesis: **RS Roth JL Waring** 1963 AM 48 1348-56.

Review: MA 75-882.

Synthetic Sb_2O_4: **K Dihlstrom** 1938 Z aaC 239 57-64.

stibivanite Sb_2VO_5.

Structure: polytypism, **S Merlino & 4 others** 1989 CM 27 625-32;
JT Szymanski 1980 CM18 333-7.

Occurrence: MM 46 526.

STIBNITE STRUCTURE GROUP Includes:

aikinite	$PbCuBiS_3$
antimonselite	$\sim Sb_2Se_3$
bismuthinite	Bi_2S_3
guanajuatite	$Bi_2(Se,S)_3$
paarite	$Pb_{0.4}Cu_{0.4}Bi_{1.6}S_3$
salzburgite	$Pb_{0.4}Cu_{0.4}Bi_{1.6}S_3$
stibnite	Sb_2S_3

[jvs: check whether aikinite is stuffed.]

Structural relation to K_2CuCl_2 structure type: **CB Shoemaker** 1973 ZK 137 225-39.

stibnite Sb_2S_3. Stibnite structure group.

Structure: **S Scavnicar** 1960 ZK 114 85-97;
P Bayliss W Nowacki 1972 ZK 135 308-15;
NV Belov YuG Zagal'skaya EA Pobedimskaya 1973 SPD 18 214-5 (B1119);
DD McKee JT McMullan 1976 ZK 142 447-9;
XPS, **I Grzetic TB Zunic** 1993 PC M 20 286-96;
review, **A Skowron ID Brown** 1994 AC B50 524-38 (S1374)
230, 173 & 128 K, SC-XRD, **A Kyono & 4 others** 2002 PCM 29 254-60 (7757);
0-10 GPa, XRD & equation of state, **LF Lundegaard & 3 others** 2003 PCM 30 463-8 (9576);
monoclinic below 290 K, XRPD, **S Kuze & 4 others** 2004 AM 89 1022-5.

Low-T heat capacity: **VM Gurevich & 5 others** 2002 GI 40 164-76 (7439).

Microstructures vs fault movement: **J Bellot & 3 others** 2004 MD 39 576-82 (10969).

Occurrence: H4/5 chondrite, Thuathe, Lesotho, **H de Bruijn & 2 others** 2004 NJMM 357-60 (10646).

Synthesis of bundles of rods: **C An & 3 others** 2003 IC 42 8081-6 (9528).

stichtite $Mg_6Cr_2(CO_3)(OH)_{16}.4aq$. *Hydrotalcite/pyroaurite* structure group.

Dimorphic with *barbertonite*.

Structure review: **HFW Taylor** 1973 MM 39 377-89.

In chromite-bearing serpentinites: **LD Ashwal B Cairncross** 1997 CMP 127 75-86 (A740).

Local ordering of Cr: **HCB Hansen CB Koch** 1996 CIM 31 53-61.

Occurrence in Orissa, India & thermal transition: **SK Mondal TK Baidya** 1996 MM 60 836-40.

Synthesis & incorporated oxalate/ferricyanide: **AS Prakash & 2 others** 2000 MRB 35 2189-97 (1760).

stilbite $NaCa_2Al_5Si_{13}O_{36}.14aq$. *Zeolite* mineral group.

IZA-SC code STI. CTF tetrahedral net 603.

Structure: **E Galli G Gottardi** 1966 Mineral Petrogr Acta 12 1-10;
M Slaughter 1970 AM 55 387-97 (S405);
E Galli 1971 AC B27 833-41 (G257);
A Alberti 1973 TMPM 19 173-84;
type B, **A Alberti R Rinaldi G Vezzalini** 1978 PCM 2 365-75 (A300);
dehydration dynamics, XRPD, **G Cruciani & 4 others** 1997 AM 82 729-39;
dehydration in situ FTIR: **PSR Prasad & 2 others** 2005 AM 90 1636-40.
Enumeration of 4-connected nets containing *bru* unit: **A Alberti** 1979 AM 64 1188-93.
Reactive Al-O-Al, triple-quantum O^{17} NMR: **JF Stebbins & 3 others** 1999 AM 84 1680-4.
Thermochemistry: **IA Kiseleva & 3 others** 2001 GI 39 170-6 (1337);
do AM 85 448-55.
Ultrastabilization of natural: **X Cheng & 5 others** 2005 MMM 83 233-43.
Occurrrence: China, XRPD/TG/DTG/DTA/FTIR/MAS-NMR: **J Li J Qiu Y Sun Y Long** 2000 MMM 37 365-78 (L1063);
in meteorites: **AE Rubin** 1997 MPS 32 733-4.

stilleite ZnSe. *Sphalerite* structure type.
Structure: **GY McIntyre G Moss Z Barnea** 1980 AC A36 482-90.
Occurrence: MM 31 973.
Synthetic, anharmonic disorder at high T: **M Kh Rabadanov** 1995 CrR 40 460-5.

stillwaterite Pd_8As_3. Structure determination not found.
Occurrence: **LJ Cabri et al** 1975 CM 13 321-35.

stillwellite-Ce (Ce,La,Ca)$BSiO_5$. Polyhedral cluster.
Structure: **AA Voronkov NG Batalieva YuA Pyatenko** 1965 SPC 9 461-2 (V201);
$CeBSiO_5$, **AA Voronkov YuA Pyatenko** 1967 SPC 12 214-20 (V199);
A Callegari & 3 others 1992 NJMM 49-57 (C757);
PC Burns & 4 others 1993 CM 31 147-52 (B1623).
Occurrence: MM 31 973.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
La-: **VR Samygnina & 3 others** 1993 Kr 38 61-5.
Synthetic $LnBGeO_5$: **A Rulmont P Tarte** 1988 JSSC 75 244-50; SR 57A 244.
Synthetic (La/Pr)$BSiO_5$: **SYu Stefanovich & 6 others** 1995 Inorg Mater 31 756-9 (S1488);
Y Ono K Takayama T Kajitana 1996 J Phys Soc Japan 1996 65 3224-8 = CA 125:312842u;
EL Belokoneva & 3 others 1996 Zh Neorg Khim 41 1097-101 = CA 125:312862a.
Synthetic $PbBAsO_5$: **C Park K Bluhm** 1996 ZN 51b 313-8 (P620).
Synthetic $BaBAsO_5$: **do** 722-6 (P637).
Synthetic $LaBSiO_5$, SC-XRD: **L Chi H Chen H Zhuang J Huang** 1997 JAlCo 252 L12-5.
Synthetic $La_3BSi_2O_{10}$, SC-XRD: **EV Shvanskii & 3 others** 2000 JSSC 154-6 (76).
Stillwellite materials have nonlinear optics & are piezoelectric; potential of Nd-substituted ones as industrial lasers.

STILPNOMELANE STRUCTURE GROUP Includes:

franklinphilite	$K_2Mn_{24}(Si,Al)_{36}(O,OH)_{108}.$~6aq
lennilenapeite	$K_{6-7}(Mg,Mn,Fe,Zn)_{48}(Si,Al)_{72}(O,OH)_{216}.16aq$
stilpnomelane	$K(Fe,Al)_{10}Si_{12}O_{30}(OH)_2$

Probably a host of subtle variants involving chemical substitutions & stacking changes of the basic layer structure.

stilpnomelane $K(Fe,Al)_{10}Si_{12}O_{30}(OH)_2$. Stilpnomelane structure group.
Structure: subcell, **RA Eggleton SW Bailey** 1965 Clays & Clay Minerals, Proc 13th National Conf 49-63 (E40);
RA Eggleton 1970 N 225 625-6;
do 1972 MM 38 693-711.

stishovite SiO_2. *Rutile* structure type. One of many polymorphs of silica; stable at high pressure.
Structure: **SM Stishov NV Belov** 1964 DAN USSR ES 143 146-8 = MA 17-140;
W Baur AA Khan 1971 AC B27 2133-9;
W Sinclair AE Ringwood 1978 N 714-5 (S1508);
RJ Hill MD Newton GV Gibbs 1983 JSSC 47 185-200 (H583);

N Ross & 3 others 1990 AM 75 739-47;
electron density, **A Kirfel & 4 others** 2001 AC A57 663-77 (3617);
charge density <30 GPa, **T Yamanaka T Fukuda J Tsuchiya** 2002 PCM 29 633-41 (8455).
Raman spectra at 105-875 K: **L Liu TP Mernagh WO Hibberson** 1997 PCM 24 396-402 (L835).
Model for H-docking sites & defects: **GV Gibbs DF Cox NL Ross** 2004 PCM 31 232-9 (10323).
Occurrence: MM 33 1151;
Muonionalusta IVA iron meteorite, **D Holtstam & 3 others** 2003 MPS 1579-83.
Distortion to $CaCl_2$-type at high P: **KJ Kingma & 3 others** 1995 N 374 243-5 (K712);
Landau free energy, **MA Carpenter RJ Hemley H Mao** 2000 JGR 105 10807-16 (C1143);
P-induced Landau transition, **D Andrault & 3 others** 2000 ESRF Newsletter October 19-20;
strength & elasticity to 60 GPa, **SR Shieh TR Duffy B Li** 2002 PRL 89 255507(4).
equation-of-state to 130 GPa, XRD: **D Andrault & 3 others** 2003 AM 88 301-7.
Synthetic Al,H-, & pure-silica, structure: **JR Smyth RY Swope AR Pawley** 1995 AM 80 454-6;
equation of state to 40 GPa at 300 K, **S Ono & 5 others** 2002 AM 87 1486-9.
Synthetic Ge at high P, transition from rutile structure to $CaCl_2$: **J Haines & 3 others** 2000 PCM 27 575-82 (H1492).

stistaite SnSb.
XRPD matches synthetic.
Occurrence: MM 38 999.

stoiberite $Cu_5V_2O_{10}$. Review: (E289).
Structure: **RD Shannon C Calvo** 1973 AC B29 1338-45.
Occurrence: MM 43 1067.

stokesite $CaSnSi_3O_9.2aq$.
Structure: **A Vorma** 1963 MM 33 615-7.

stolzite $PbWO_4$-I. *Scheelite* structure group.
Trimorphic with *raspite*-II & high-P phase III.
Structure: **GF Plakhov & 3 others** 1971 SPC 15 928-9 (P473);
K Xu J Xue Y Ding G Lu 1994 Acta Geol Sinica 68 287-92 = MA 95M/1408;
Czochralski *synthesis* & SC-XRD, **JM Moreau & 3 others** 1996 JAlCo 238 46-8.
Synthetic $Pb_7W_8O_{32-x}$, defect superstructure: **do**.

stoppaniite $(Fe,Al,Mg)_4[Be_6Si_{12}O_{36}].(Na,void).2$ aq. *Beryl* group.
Occurrence & XRPD: **G Ferraris M Prencipe P Rossi** 1998 EJM 10 491-6;
J Della Ventura et al 2000 EJM 12 121-7 (D800).

s**tornesite-Y** $(Y,Ca)voidNa_6(Ca,Na)_8(Mg,Fe)_{43}(PO_4)_{36}$. *Fillowite* group.
Occurrence & structure: **ES Grew & 4 others** 2006 AM 91 1412-24.

STOTTITE MINERAL GROUP Includes:

[bernalite	$(Fe,etc)Sn(OH)_3$	possible member]
jeanbandyite	$FeSn(OH)_6$	
natanite	$FeSn(OH)_6$	
stottite	$FeGe(OH)_6$	
tetrawickmanite	$MnSn(OH)_6$	

Stottite minerals have tetragonal pseudocubic symmetry & belong to the *schoenfliesite*/stottite structure group based on the ReO_3 structure type.
Occurrence & review of related minerals in stottite group: **JS White JA Nelen** 1973 MR 4 24-30;
AR Kampf 1982 MR 13 235-9.
(Fe,Zn)- = *zincian stottite*: AM 56 1488.

stottite $FeGe(OH)_6$. Stottite structure group.
Structure: **H Strunz M Giglio** 1960 AC 14 205-8 (S1533);
CR Ross II LR Bernstein GA Waychunas 1988 AM 73 657-61;
compressibility <8 GPa, SC-XRD, **NL Ross TD Chaplin MD Welch** 2002 AM 87 1410-4.
Occurrence: MM 32 982.

straczekite $(Ca,K,Ba)_2V_8O_{20}.3aq$. *Vanadium bronze* structure group; *straczekite* subgroup.
Review: **HT Evans Jr JM Hughes** 1990 AM 75 508-21.
Structure: *synthetic*, **A Kutoglu** 1983 ZK 162 263-72.

Occurrence & crystallography: **HT Evans Jr & 3 others** 1984 MM 48 289-93.

strakhovite $NaBa_3(Mn^{2+,3+})_4[Si_4O_{10}(OH)_2][Si_2O_7]O_2F.aq$.

Structure contains MnO_5 tetragonal pyramid, $MnO_4(OH)F$ octahedron, Si_2O_7 ditetrahedron, $Si_4O_{10}(OH)_2$ ring, two 8-vertex BaO_8 polyhedra, NaO_5, aqua.

Structure: **NA Yamnova & 4 others** 1992 SPC 37 174-7 (Y191).

Occurrence: **VV Kalinin & 4 others** 1994 ZVMO 123 96-105 = AM 81 252; also 1993 AM 78 675-6; MR 27 306.

stranskiite $Zn_2Cu(AsO_4)_2$. Review: (E289).

Structure: **K Plieth G Sänger** 1967 ZK 124 91-100; **C Calvo KY Leung** 1969 ZK 130 231-3; **P Keller H Hess PJ Dunn** 1979 TMPM 26 167-74 (K737). Occurrence: MM 32 982.

Synthetic $Cu_3(PO_4)_2$: MA 79-213.

strashimirite $Cu_8(AsO_4)_4(OH)_4.5aq$.

Structure determination not found.

Occurrence & crystallography: **I Mincheva-Stefanova** 1969 ZVMO 97 470-7 = AM 54 1221; **B Golebiowska** 1999 Mineralogia Polonica 30 3-11.

strätlingite = 'gehlenite hydrate' $Ca_2Al_2SiO_7.8aq$.

Structural polytype of *vertumnite*, but somewhat different composition.

Structure: **R Rinaldi M Sacerdoti E Passaglia** 1990 EJM 2 841-9.

MAS-NMR: **S Kwan J LaRosa MW Grutzeck** 1995 JACeS 78 1921-6 (K772).

Occurrence: MM 40 914.

strelkinite $Na(UO_2)(VO_4).3aq$.

Compare with K relative *carnotite* and Cu relative *sengierite*.

Structure determination not found.

Occurrence & crystallography: **MA Alekseeva et al** 1974 ZVMO 103 576-80 = AM 60 488-9.

strengite $FePO_4.2aq$. *Variscite* structure group.

Structure determination not found.

Occurrence & crystallography: **Dana**; PDF 33-667.

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

stringhamite $CuCaSiO_4.aq$. Review: (E289).

Structure: **FC Hawthorne** 1985 TMPM 34 15-24.

Occurrence: MM 40 914.

stromeyerite AgCuS.

Structure: **AJ Frueh** 1956 ZK 106 299-307; **HT Evans** Jr 1981 AM 66 807-18; **CL Baker FJ Lincoln AWS Johnson** 1991 AC B47 891-9 (B1369).

stronalsite $Na_2SrAl_4Si_4O_{16}$. Isostructural with Ba analog *banalsite*.

Structure determination not found.

Occurrence & crystallography: **H Hoi & 4others** 1987 MJJ 13 368 = MM 52 730.

Occurrence: MA 96M/4544.

strontianite $SrCO_3$. *Aragonite* structure group.

Structure: **JPR de Villiers** 1971 AM 56 758-67; ND, **D Jarosch G Heger** 1988 BM 139-42.

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

Dissolution up to 4 GPa & 523 K: **C Sanchez-Valle & 5 others** 2003 AM 88 978-85.

Strontianite-*witherite* solid solution, FTIR: **ME Böttcher & 3 others** 1997 EJM 9 519-28 (B1646).

strontiapatite $(Sr,Ca)_5(PO_4)_3(OH,F)$. *Apatite* group. Occurrence: MM 39 927.

strontian-apatite *Apatite* group. Occurrence: MM 30 747.

strontioborite $SrB_8O_{11}(OH)_4$.

Structure: **AA Brovkin NV Zayakina VS Brovkina** 1975 SPC 20 563-6 (B1142).

strontiochevnikite / strontio-chevnikite $(Sr,La,Ce,Ca)_4(Fe^{2+},Fe^{3})_2(Ti,Zr)_4O_{22}$.

Essentially isostructural with Ca-rich analog *chevnikite*.
Structure determination not found.
Occurrence & crystallography: **SE Haggerty AN Mariano** 1983 CMP 84 365-81.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

strontiodresserite $(Sr,Ca)Al_2(CO_3)_2(OH)_4.aq$. Isostructural with Ba analog *dresserite*.
Structure determination not found.
Occurrence & crystallography: **JL Jambor et al** 1977 CM 15 405-7.

strontioginorite $(Sr,Ca)_2B_{14}O_{20}(OH)_6.5aq$.
Essentially isostructural with Ca analog *ginorite*. Compare with *strontium ginorite*.
Structure: **JA Konnert JR Clark CL Christ** 1970 AM 55 1911-31;
SC-XRD, **JD Grice** 2005 CM 43 1019-26.
Occurrence: MM 32 982.

strontiohilgardite-1Tc $(Ca,Sr)_2B_5O_8(OH)_2Cl$. Polytype of *parahilgardite*.
Occurrence: MM 32 982.

strontiojoaquinite $Sr_2Ba_2(Na,Fe)_2Ti_2Si_8O_{24}(O,OH)_2.aq$.
Joaquinite structure group; monoclinic subtype from crystallography.
Structure determination not found.
Occurrence & crystallography: **WS Wise** 1982 AM 67 809-16.

strontiomelane $SrMn(IV)_6Mn(III)_2O_{16}$. *Cryptomelane* group.
Occurrence & XRPD: **N Meisser & 3 others** 1999 CM 37 673-8.

strontio-orthojoaquinite $Na(Ba,Sr)_4Fe^{3+}Ti_2Si_8O_{24}(OH)_4$.
Joaquinite structure group; orthorhombic subtype. MM 48 583.
Structure: **T Kato T Mizota** 1990 J Fac Liberal Arts Yamaguchi University 24 23-32 = MA 95M/1383.

strontiopiemontite $CaSr(Al,Mn,Fe)_3Si_3O_{11}O(OH)$. *Epidote* structure group.
Occurrence: **P Bonazzi S Menchetti AA Palenzona** 1990 EJM 2 519.

strontiopyrochlore $(Sr,Ce,Ca)_{0.66}(Nb,Fe)_2(O,OH)_7$. *Pyrochlore* structure group.
Occurrence: **AV Lapin & 3 others** 1986 DAN 290 1212.

strontiowhitlockite $Sr_9Mg(PO_3OH)(PO_4)_6$-beta.
Isostructural with beta-$Ca_3(PO_4)_2$ which belongs to the*whitlockite* family, but is not isostructural with *whitlockite* itself.
Structure: *synthetic* beta-$(Sr_{2.6}Mg_{0.4})_3(PO_4)_2$, **SN Britvin & 3 others** 1991 CM 29 87-93.
Occurrence: MM 60 682.

[strontium äkermanite $MgSr_2Si_2O_7$. Isostructural with *äkermanite* in *melilite* group.
Synthetic: MM 48 583.]

strontium-apatite $(Sr,Ca)_5(PO_4)_3(OH,F)$. *Apatite* structure type.
Structure determination not found.
Occurrence: **AS Efimov SM Kravchenko ZV Vasil'eva** 1962 DAN 142 439-42 = AM 47 808;
AR Chakhmouradian EP Reguir RH Mitchell 2002 CM 40 121-36.

strontium ginorite $Sr_2B_{14}O_{23}.8aq$. Analog of *ginorite* $Ca_2B_{14}O_{23}.8aq$.
Compare with *strontioginorite*. Definition: MM 32 982.

strunzite $MnFe_2(PO_4)_2(OH)_2.8aq$. Trimorphic with *laueite* & *stewartite*.
Structure: **L Fanfani & 3 others** 1978 TMPM 25 77-87 (F430).
Occurrence: MM 31 973.

strüverite $(Ti,Ta,Nb,Sn,Fe)O_2$. *Rutile* structure type. Isostructural with *ilmenorutile*.
Structure determination not found.
Occurrence: **BH Flinter** 1964 AM 49 792-4. [jvs: consider using the name rutile-(tantaloan, etc.]

struvite $NH_4MgPO_4.6aq$.
Analogs with n aq, structure of $CaKAsO_4.8aq$: **B Dickens WE Brown** 1972 AC B28 3056-65.
Compare with *hannayite* & *schertelite*.
Structure: **A Whitaker JW Jeffery** 1970 AC B26 1429-40, 1440-4;
correct polarity, *synthetic*, **F Abbona M Calleri G Ivaldi** 1984 AC B40 223-7;

ND, **G Ferraris H Fuess W Joswig** 1986 AC B42 253-8 (F436).
As analog: **G Ferraris M Franchini-Angela** 1973 AC B29 859-63.
Occurrence in fertilizers: **JR Lehr and 4 others** 1966 *Crystallographic Properties of Fertilizer Compounds*, Tenn Valley Auth Chem Eng Bull 6, 163p (L758).
Synthetic $MgKPO_4.6aq$: **M Mathew LW Schroeder** 1979 AC B35 11-3.
Synthetic $Mg_2KH(As/P)_2.15aq$, & other struvite-related materials: **S Takagi M Mathew WE Brown** 1982 AC B38 44-50.
Synthetic $NaMgPO_4.7aq$: **M Mathew & 3 others** 1982 AC B38 40-4.
Synthetic $NH_4CaPO_4.7aq$: **S Takagi M Mathew WE Brown** 1984 AC C40 1111-3 (T437).
Forms scales in anaerobic sludge digesters, reduced by dosing with ferric chloride, also get *vivianite*: **D Mamais & 4 others** 1994 WER 66 912-8 (M1183).
studenitsite / studenicite $NaCa_2B_9O_{14}(OH)_4.2aq$.
Occurrence & structure: **SV Malinko & 7others** 1995 ZVMO 124 57-64 = AM 81 1284.
Structure: **NA Yamnova & 4 others** Kr 38 71.
studtite $[(UO_2)(O_2).2aq].2aq$. Compare with *metastudtite*.
Structure: cell dimensions, **PC Debets** 1983 J Inorg Nucl Chem 25 727-30; **PC Burns K Hughes** AM 88 1165-8.
Occurrence: MM 28 738; **K Walenta** 1974 AM 59 166-71.
XRPD, thermal analysis/IR of natural & *synthetic*: **J Cejka J Sejkora M Deliens** 1996 NJMM 125-34 (C836).
stumpflite Pt(Sb,Bi). *Niccolite* structure group.
Structure determination not found.
Occurrence: **Z Johan P Picot** 1974 BSFMC 95 610-3.
Phase relations in Pd-Pt-Sb: **W Kim GY Chao** 1996 NJMM 351-64 (K886).
sturmanite $Ca_6(Fe,Al,Mn)_2(SO_4)_{2.5}[B(OH)_4](OH)_{12}.25aq$. *Ettringite* structure group.
Review: **Sabelli** p.18.
Structure: SC-XRD, **DY Puschcharovsky & 6 others** 2004 CM 42 723-9.
DTA, TG & XRPD: **SM Antao MJ Duane I Hassan** 2002 CM 40 1403-9.
Occurrence: **DL Peacor PJ Dunn M Duggan** 1983 CM 21 705-9.
stützite $\sim Ag_{5-x}Te_3$. Compare with *empressite*.
Structure: **RM Imamov ZG Pinsker** 1966 SPC 11 182-8; *synthetic*, **J Peters O Conrad B Bremer B Krebs** 1996 ZaaC 1823-32 (P651).
suanite $Mg_2B_2O_5$.
Structure: **Y Takéuchi** 1952 AC 5 574-81.
Occurrence: MM 30 747.
sudburyite (Pd,Ni)Sb. *Niccolite* structure group.
Occurrence: **LJ Cabri JHG LaFlamme** 1974 CM 12 275-9; **ND Tolstykh & 4 others** 2000 EJM 12 431-40 (T641).
Phase relations in Pd-Pt-Sb: **W Kim GY Chao** 1996 NJMM 351-64 (K886).
sudoite $Mg_2(Al,Fe)_3Si_3AlO_{10}(OH)_8$. *Chlorite* structure group.
Structure: **C Lin SW Bailey** 1985 ClCIM 33 410-4 (L386).
Occurrence: MM 33 1151; **A Anceau** 1996 EJM 8 493-505.
sudovikovite $PtSe_2$. Trigonal CdI_2 structure type.
Occurrence, XRPD matches *synthetic*: **YuS Polekhovskii IP & 5 others** 1997 DAN 354 1 82-5 (P739) = AM 83 1118.
suessite Fe_3Si.
Structure: **K Keil JL Berkley** 1982 AM 67 126-31.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
sugilite $KNa_2(Fe,Mn,Al)_2Li_3Si_{12}O_{30}$. *Osumilite* structure group.
Structure: **T Kato T Miura N Murakami** 1976 MJJ 8 184-92; **T Armbruster R Oberhänsli** 1988 AM 73 595-600.
Occurrence: MM 42 530.
sukulaite $?Sn_2Ta_2O_7$. ?isostructural with *microlite*.
Occurrence: **A Vorma J Siivola** 1967 Bull Comm Geol Finlande 229 173 = MM 37 965.
jvs: compare with *stannomicrolite*.
sulfoborite $Mg_3B_2(SO_4)(OH)_9F$.
Structure: **RF Giese Jr G Penna** 1983 AM 68 255-61.

sulfur S-alpha-orthorhombic. Trimorphic with S-beta *garibaldite* & S-gamma *rosickyite*.
Structure: early papers; **GS Pawley R Rinaldi** 1972 AC B28 3605-9;
SJ Rettig J Trotter 1987 AC C43 2260-2.
High-P: I to II to III, **Y Akahama M Kobayashi H Kawamura** 1993 PRB 6862-4 (A769);
ortho to monoclinic ~5 GPa & amorphous phase ~25 GPa: **H Luo AL Ruoff** 1993 PRB 48 569-72 (L873);
superconductivity 10-17 K, **VV Struzhkin & 3 others** 1997 N 390 382-4 (S1848);
helical at 3 GPa & 673 K, **WA Crichton GBM Vaughan M Mezouar** 2001 ZK 216 417-9 (3616).
Occurrence: reduced *gypsum* evaporite: **J Alonso-Azcarate & 2 others** 2001 CG 174 389-402 (1401);
Perticara Mine: **A Guastoni F Pezzotta** 2002 MR 33 305-18;
meteorites, **AE Rubin** 1997 MPS 32 231-47.
Synthetic fibrous S_4: **F Tuinstra** 1966 AC 20 341-9; MA 71-1764, 1765.

sulphohalite = sulfohalite $Na_6(SO_4)_2FCl$. Review: **Sabelli** p. 31.
Structure: **A Pabst** 1934 ZK 89 514-7;
L Fanfani & 4 others 1975 MM 40 131-9.

sulphotsumoite Bi_3Te_2S.
Tetradymite mineral/structure group, *tsumoite* subgroup: **P Bayliss** 1991 AM 76 257-65.
Occurrence: MM 46 526.

sulunite AM 45 478.

sulvanite Cu_3VS_4. *Sphalerite* structure type.
Isostructural series with As analog *arsenosulvanite*.
Structure: **FJ Trojer** 1966 AM 51 890-4.

sundiusite $Pb_{10}(SO_4)Cl_2O_8$. Review: **Sabelli**, no structure.
Structure determination not found.
Occurrence: **PJ Dunn RC Rouse** 1980 AM 65 506-8.

suolunite = solanite $Ca_2Si_2O_5(OH)_2.aq$.
Structure: **X-ray Lab**, MA 75-871;
N Shi L Liao 1993 AC A49 Suppl p. 264 (abstr only).

suredaite $PbSnS_3$. NH_4CdCl_3 structure type.
Occurrence & structure, XRPD: **WH Paar & 6 others** 2000 AM 85 1066-75;
Matches *synthetic*.
Many isostructural *synthetic* sulfides & selenides.

surinamite $(Mg,Fe)_3Al_4BeSi_3O_{16}$.
Structure: **PB Moore T Araki** 1983 AM 68 804-10.
Occurrence: **de Roever et al** 1976 AM 61 193-9;
South Harris, review of other occurrences, **S Baba et al** 2000 AM 85 1474-84.
Synthesis: **A Holscher W Schreyer** 1989 EJM 4 193-207.
Synthetic $Mg_4(Al/Ga)_4Ge_3O_{16}$, XRPD & TEM: **J Barbier** 1996 PCM 23 151-6 (B1489);
SC-XRD structure, **do** 1998 EJM 10 1283-93 (B1888).

surite $\sim Pb(Pb,Ca)(Al,Fe,Mg)_2(Si,Al)_4O_{10}(CO_3)_2(OH)_2$.
Complex layer structure represented ~ by 2:1 dioctahedral *smectite* interlayered with*hydrocerussite*.
Iso with *ferrisurite* & closely related to *niksergievite*
$[Ba_{1.33}Ca_{0.67}Al(CO_3)(OH)_4][Al_2(AlSi_3O_{10})(OH)_2].naq$.
Structure: **M Uehara A Yamazaki S Tsutsumi** 1997 AM 82 416-22;
Fe & cation order, **J Barbier & 4 others** 2002 AM 87 501-13.
Occurrence: **K Hayase & 6 others** 1978 AM 63 1175-81.

surkhobite $(Ca,Na)_{1.3}(Ba,K)_{1.2}(Fe,Mn)_4(Ti,Zr,Nb)_2Si_4O_{16}(F,OH)_3$. Titanosilicate mica family. Analog of *perraultite*.
Occurrence/SC-XRD structure: **EM Eskova & 4 others** 2003 ZVMO 2 60-7;
KA Rozenberg & 2 others 2003 CrR 48 384-9 (9100).

sursassite $Mn_2Al_3(SiO_4)(Si_2O_7)(OH)_3$.
Structure: **M Mellini S Merlino M Pasero** 1984 PCM 10 99-105 (M775).
Occurrence: MM 21 577.

Synthetic $Mg_4(MgAl)Al_4(Si_6O_{21})(OH)_7$, near-analog of sursassite, but not *pumpellyite*, high-P:
XRPD structure, **M Gottschalk & 6 others** 2000 EJM 12 935-45 (235);
thermodynamics, **K Grevel & 4 others** 2001 PCM 28 475-87 (2934).
Synthetic Fe,Mg solid solution, 4-5 GPa, 873-923 K, XRPD: **B Wunder M Gottschalk** 2002 EJM 14 575-80 (7674).

susannite $Pb_4(SO_4)(CO_3)_2(OH)_2$. Trimorphic with *leadhillite* & *macphersonite*.

High-T reversible transition with leadhillite: HT-XRPD: **L Bindi S Menchetti** 2005 AM 90 1641-7.
Structure: SC-XRD, **IM Steele JJ Pluth A Livingstone** 1999 EJM 11 493-9 (S2039);
Raman, **RL Frost JT Kloprogge PA Williams** 2003 NJMA 529-42 (10019).
Occurrence: **ME Mrose RP Christian** 1969 CM 10 141.

sussexite $MnBO_2(OH)$. Isostructural series with Mg analog *szaibelyite*.

Structure: **C Hoffman T Armbruster** 1995 SMPM 75 123-33 (H970) = AM 81 1017.

suzukiite $(Ba,Sr)VSi_2O_7$. Isostructural with Sr analog *haradaite*.

Structure determination not found.
Occurrence: **S Matsubara A Kato S Yui** 1982 MiJ 11 15-20 = AM 68 282.

svabite $Ca_5(AsO_4)_3(F,Cl,OH)$. *Apatite* structure type.

Structure: **P Goodman & 4 others** 1996 AC A52 Suppl C-314;
M Wildner G Giester MA Götzinger 1997 EJM Suppl 9-1 388 (W821).
Occurrence: **Dana**.

svanbergite $SrAl_3(PO_4)(SO_4)(OH)_6$. *Beudantite* structure group.

Isostructural with As analog *kemmlitzite*. Review: **Sabelli** p.25.
Structure: **T Kato Y Miura** 1977 MJJ 8 419-30.

sveite $KAl_7(NO_3)_4Cl_2(OH)_{16}.8aq$.

Occurrence: **JEJ Martini** 1980 Trans Geol Soc S Africa 83 239 = MM 48 583.

sverigeite $Na(Mn,Mg)_2Sn[Be_2Si_3O_{12}OH]$. Chain structure type.

Structure: **RC Rouse DR Peacor GW Metz** 1989 AM 74 1343-50.

[svetlozarite $(Ca,K_2,Na_2)Al_2(Si,Al)_{12}O_{28}.6aq$.
Multiply-twinned heavily faulted *dachiardite*: structure, **LR Gellens GD Price JV Smith** 1982 MM 45 157-61.
Occurrence: **MN Maleyev** 1976 IGR 19 993-6.]

svyatoslavite $CaAl_2Si_2O_8$. Polymorphic with *anorthite* & *dmisteinbergite*.

Probably monoclinic pseudo-orthorhombic matching *synthetic* phase, originally described as orthorhombic: structure, **Y Takéuchi N Haga J Ito** 1973 ZK 137 380-98.
Based on tetrahedral net type 3 of the Consortium for Theoretical Frameworks. [This net also accounts for the non-aqua connectivity of the *metavariscite* structure group.]
Occurrence: **BV Chesnokov & 5 others** 1989 ZVMO 118 111-4 (C715).

[svyagintsevite $(Pd,Pt)_3(Pb,Sn)$. XRD matches *synthetic* Pd_3Pb & Pd_3Sn.

jvs: structure not in Pearson & Wells; fcc structure would indicate that merely a substituted *palladium*; however, if symmetry were primitive cubic, and composition definitely 3:1, should be isostructural with Cu_3Au; check for *synthetic*.

Occurrence: **AD Genkin IV Murav'eva NV Troneva** 1966 Geol Rud Mes 8 94-100 = AM 52 299.]

svyazhinite $(Mg,Mn,Ca)(Al,Fe)(SO_4)_2$ F.14aq.

Cell dimensions match *aubertite* $CuAl(SO_4)_2Cl.14aq$.

Occurrence & crystallography: **BV Chesnokov & 4 others** 1984 ZVMO 113 347-51 = AM 70 877.

swaknoite $(NH_4)_2Ca(HPO_4)_2.aq$. Dimorph of monoclinic *mundrabillaite*.

Structure determination not found [jvs: check for *synthetic*.]
Occurrence & crystallography: **JEJ Martini** 1992 Bull South African Speleo Assoc 32 72-4 = AM 78 1110.

swamboite $UH_6(UO_2SiO_4)_6.30aq$. Pseudocell consistent with *uranophane*.

Structure determination not found.
Occurrence & crystallography: **M Deliens P Piret** 1981 CM 19 553-7.

swartzite $CaMg[UO_2(CO_3)_3].12$ aq.

Structure somewhat transitional between the island *bayleyite* and the layer *liebigite*.
Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Structure: **K Mereiter** 1986 NJMM 481-92 (M1301).
Occurrence: MM 28 738.

Synthetic: **K Mereiter & 3 others** 1988 ZK 185 633;
FTIR & fluorescence, **S Amayri & 4 others** 2004 CM 42 953-62.

swedenborgite $NaBe_4SbO_7$.

Structure: **K Aminoff** 1933 Svenske Vetensk Handl 11 1-13;
L Pauling HP Klug AN Winchell 1935 AM 20 492-501;
SC-XRD, **DMC Huminicki FC Hawthorne** 2001 CM 39 153-8.

[*Synthetic* $Na_{10}Be_4Si_4O_{17}$ also has four BeO_4 tetrahedra sharing a vertex: **L Eriksson S Frostang J Grins** 1990 AC B46 736-9 (E264).]

sweetite $Zn(OH)_2$. Trimorphic with *ashoverite* & *wülfingite*.

Structure determination not found; no *synthetic* equivalent found.
Occurrence & crystallography: **AM Clark & 3 others** 1984 MM 48 267-9.

swinefordite $(Ca,Na)_{0.33}(Al,Li,Mg)_2(Si,Al)_4\ (OH,F)_2.2aq$. *Smectite* structure group.

Structure determination not found.
Occurrence & crystallography: **P Tien PB Leavens JA Nelen** 1975 AM 60 540-7.

switzerite $(Mn,Fe)_3(PO_4)_2.7aq$.

Structure: **L Fanfani PF Zanazzi** 1979 TMPM 26 255-69 (F431);
PF Zanazzi PB Leavens JS White Jr 1986 AM 71 1224-8.
Occurrence: MM 36 1159.

sylvanite $AuAgTe_4$. *Calaverite* structure group.

Structure: **G Tunell** 1941 AM 26 457-7;
G Tunell L Pauling 1952 AC 5 375-81;
F Pertlik 1984 TMPM 33 203-12 (P541).

sylvite KCl. *Halite* structure type.

Structure: early papers;
ND, **MJ Cooper KD Rouse** 1973 ACA 29 514-20, correction 32 171;
atomic displacements & electron density, **CJ Martin DA O'Connor** 1978 ACA 34 505-12;
do, **G Böbel P Cortona C Sommers FG Fumi** 1983 ACA 39 400-7;
do, 1989 ACA 45 112.

Microcrysts, natrocabonatite, Oldoniyo Lengai, Tanzania: **RH Mitchell** 2006 70 103-14.

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

symesite $Pb_{10}(SO_4)O_7Cl_4.aq$. *Nadorite* family of Pb-sheet minerals.

Occurrence, TEM & XRD: **MD Welch & 3 others** 2000 AM 85 1526-33.

symplesite $Fe_3(AsO_4)_2.8aq$. *Metavivianite* structure group?

Dimorphic with *parasympesite*.
Structure determination not found.
Occurrence: **Dana**.

synadelphite $(Mn,Mg,Ca,Pb)_9(AsO_3)(AsO_4)_2(OH)_9.2aq$.

Complex structure with edge-shared trigonal pyramids & octahedra.
Structure: **PB Moore** 1970 AM 55 2023-37 (M1159).

synchysite-Ce $Ca(Ce,La)(CO_3)_2F$. *Parisite* mineral group.

Structural series with *bastnaesite*. See *parisite* & *roentgenite*.
Structure: **L Wang & 4 others** 1994 CM 32 865-71;
TEM, IMA Mtg Pisa p. 451.
Polytypism (3R & 6R) & microtwins, TEM: AM 83 910.
With *parisite-Ce* in *talc-chlorite*, Trimouns, French Pyrenees: **P de Parseval F Fontan T Aigouy** 1997 CRASP 324 IIa 625-30 (D639).
Occurrence of solid solution with -Y: **H Foerster** 2001 MP 72 259-80 (2935).
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

synchysite-Nd $Ca(Nd,Y,Gd)(CO_3)_2F$. *Parisite* mineral group.

Synchisite structure type from XRPD: PDF 35-589.
Occurrence: **Z Maksimovic G Panto** 1978 = AM 64 658. MM 48 583.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

synchysite-Y = doverite $Ca(Y,Ce)(CO_3)_2F$. *Parisite* mineral group.

Synchisite structure type.
Structure: **L Wang K Zhou** 1995 Acta Petrol Mineral 14 336-44.
Occurrence & XRPD: MM 31 957;
AA Levinson RA Borup 1962 AM 47 337-43.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
syngenite $K_2Ca(SO_4)_2.aq$. Isostructural with NH_4 analog *koktaite*.
Review: **Sabelli** p. 29.
Structure: **E Corazza C Sabelli** 1967 ZK 124 398-408;
GB Bokij NA Pal'chik MYu Antipin SPC 23 141-3;
LI Gorogotskaya 1985 DAN USSR ES 157 67-9.
Occurrence in fertilizers: **JR Lehr & 4 others** 1966 *Crystallographic Properties of Fertilizer Compounds*, Tenn Valley Auth Chem Eng Bull 6, 163p (L758).
szaibelyite $MgBO_2OH$. Isostructural series with Mn analog *sussexite*.
Structure: **C Peng C Wu P Chang** 1963 Sci Sinica 12 176 1-4;
Y Takéuchi Y Kudoh 1975 AM 60 273-9;
TEM & Rietveld XRPD, **I Dodony GA Lovas** 1994 IMA Mtg Pisa 99;
boron K-edge XANES, **ME Fleet S Muthupari** 2000 AM 85 1009-21.
Type locality, new data: **S Marincea** 2001 CM 39 111-27.
Synthesis & stability: **B Pöter W Schreyer** 1997 EJM Suppl 9-1 284 (P719).
szenicsite $Cu_3(MoO_4)(OH)_4$. Close relation with *antlerite* $Cu_3(SO_4)(OH)_4$.
Structure, SC-XRD: **PC Burns** 1998 MM 62 461-9 (B1889);
J Stolz T Armbruster 1998 NJMM 278-88 (S1963).
Occurrence & XRPD: **CA Francis LC Pitman DE Lange** 1994 MR 25 76;
do, 1996 28 387-94.
szmikite $MnSO_4.aq$. *Kieserite* structure type.
Structure: *synthetic*, **M Wildner G Giester** 1991 NJMM 296-306.
szomolnokite $FeSO_4.aq$. *Kieserite* structure type.
Structure: *synthetic*, **M Wildner G Giester** 1991 NJMM 296-306.
Occurrence in meteorites: **AE Rubin** 1997 MPS 32 733-4.
[sztrobayite Bi_3TeS_2.
Occurrence: **B Nagy** 1983 Földtani Közlöny 113 247 = MM 52 730-1. Not approved by IMA.]
szymanskiite $Hg_{16}(Ni,Mg)_6(CO_3)_{12}(OH)_{12}(H_3O)_8.3aq$.
Structure: **JT Szymanski AC Roberts** 1990 CM 28 709-18.
Compare with *buttgenbachite-connellite*, *cacoxenite* &*kambaldaite.*

TAAFFEITE MINERAL GROUP
Defined as having *spinel* & modified *nolanite* modules, & Be in tetrahedral site near H position:
T Armbruster 2002 EJM 14 389-95 (7149).

ferrotaaffeite-6N'2S	$(Be,Zn,Mg)FeAl_4O_8$	*pehrmanite* renamed
magnesiotaaffeite-2N'2S	$Mg_3BeAl_8O_{16}$	*taaffeite* renamed
magnesiotaaffeite-6N'3S	$(Mg,Fe,Zn)_2Al_6BeO_{12}$	*musgravite* renamed

tacharanite $\sim Ca_{12}Al_2Si_{18}O_{51}.18aq$. Compare with *tobermorite*.
Structure determination not found.
XRPD & fiber rotation: **G Cliff & 3 others** 1975 MM 40 113-26.
Occurrence: MM 32 983.
tachhydrite = **tachyhydrite** $CaMg_2Cl_6.12aq$.
Structure: **JR Clark HT Evans Jr RC Erd** 1980 AC B36 2736-9;
A Leclaire MM Borel JC Monier 1980 AC B36 2734-5.
tadzhikite-Ce $Ca_4Ce_2Ti[(B_4Si_4O_{22})(OH)_2$. *Hellandite* structure group.
Re-definition, nomenclature & crystal chemistry: **R Oberti & 4 others** 2002 AM 87 745-52.
Structure: **NM Chernitsova ZV Pudovkina YuA Pyatenko** 1982 SPD 27 367-8 (C706);
FC Hawthorne MA Cooper MC Taylor 1998 CM 36 817-22.
Occurrence: MM 38 999.

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

taeniolite $KLiMg_2Si_4O_{10}F_2$. *Mica* structure group; one-layer monoclinic subtype.

Structure: **H Toraya & 3 others** 1977 ZK 146 73-83.

taenite $Fe_{1-x}Ni_x$-gamma.

Iron-nickel alloy in iron meteorites, commonly with x ~ 0.3. Isostructural with *iron-gamma*.
Structure: **JK Albertsen GB Jensen JM Knudsen** 1978 N 273 453-4.
Cooling experiments: **RJ Reisener JI Goldstein** 2003 MPS 38 1669-78.
In meteorites: **AE Rubin** 1997 MPS 32 231-47;
C Yang DB Williams JI Goldstein 1997 GCA 61 2943-56 (Y204);
zoned/unzoned in H/L/LL chondrites, **RJ Reisener JI Goldstein** 2003 MPS 1679-96.
Tetrataenite FeNi is a superstructure.
Antitaenite is proposed low-spin phase with ~25-30% Ni.
Magnetism: **DG Rancourt RB Scorzelli** 1995 J Magnetism Magnetic Materials 150 30-6 = AM 81 766.
Manganoan ($Fe_{1-x}Mn_x$): **ME Generalov GF Tananaeva SF Glavatskikh** 1995 DAN 34 511-5.

taikanite $BaSr_2Mn_2O_2Si_4O_{12}$. Chain structure.

Structure: **NA Yamnova & 3 others** 1992 SPC 37 319-21 (Y109);
T Armbruster R Oberhänsli M Kunz 1993 AM 78 1088-95.
Occurrence: MM 50 758.
Crystal chemistry & polarized UV/visible: **B Velickov K Langer** 1997 EJM Suppl 9-1 371 (V281).

taimyrite $\sim(Pd,Cu,Pt)_3Sn$.

Occurrence & XRPD: **VD Begizov EN Zav'yalov EG Palov** 1982 ZVMO 111 78-83.
Taimyrite-*tatyanaite* series, Noril'sk, Siberia: **AY Barkov & 3 others** 2000 CM 38 599-609.
Pt-dominant analogue: IMA 95-049.
Occurrence & composition variations: **NJ Cook CL Ciobanu RKW Merkle** 2002 CM 40 329-40.

[takanelite Occurrence: MM 38 999.
?Relation with *birnessite* & *rancieite*, **SJ Kim** 1980 J Geol Soc Korea 16 105-13 = AM 69 814.]

takedaite $Ca_3B_2O_6$.

Structure, *synthetic*: **UL Schäfer** 1968 NJMM 75-80;
J Majling & 4 others 1974 MRB 9 1379-82;
A Vegas FH Cano S Garcia-Blanco 1975 AC B311416-9;
A Vegas 1985 AC C41 1689-90.
Occurrence: **I Kusachi C Henmi S Kobayashi** 1995 MM 59 545-8. MR 27 306.

takéuchiite $(Mg,Mn)_2(Mn,Fe)BO_3O_2$.

6 Å Zigzag Borate: **MA Cooper FC Hawthorne** 1998 CM 36 1171-93.
6t6t polytype of *pinakiolite* structure group.
Structure: **R Norrestam J Bovin** 1987 ZK 181 135-50;
R Norrestam S Dahl J Bovin 1989 ZK 187 201-11;
defects, **J Bovin M O'Keeffe MA O'Keeffe** 1981 AC A37 28-35;
ED, **do** 1981 AC A37 42-6.
Modular interpretation of oxyborates: **BB Zvyagin GA Siderenko** 1995 AC B51 7-11 (Z87).
Occurrence: MM 46 527.

takovite $Ni_6Al_2(CO_3)(OH)_{16}.4aq$. *Hydrotalcite/pyroaurite* structure group.

Structure review: **HFW Taylor** 1973 MM 39 377-89 (T186).
Synthesis: **MK Titulaer JBH Jansen JW Geus** 1994 ClClM 42 249-58.
Occurrence: MM 32 983; **DL Bish GW Brindley** 1977 AM 62 458-64;
in Ni-contaminated soil: C&EN May 5 1997 59 (S1683).

talc $Mg_3Si_4O_{10}(OH)_2$.

Essentially isostructural with Fe analog *minnesotaite* & Ni analog *willemseite*.
Structure: **JH Rayner G Brown** 1973 ClClM 21 103-14;
B Perdikatsis H Burzlaff 1981 ZK 156 177-86
FTIR, **S Petit & 4 others** 2004 AM 89 319-26.
High-P stability: **K Bose J Ganguly** 1995 EPSL 136 109-21 (B1449).
Equation of state: **AR Pawley SM Clark NJ Chinnery** 2002 AM 87 1172-82.
Thermal expansion & compressibility: **AR Pawley & 2 others** 1995 CMP 122 301-7 (P589).

Enthalpy of formation: **W Kahl WV Maresch** 2001 AM 86 1345-57.
Structural formula, FTIR/NMR/EPR/HRTEM/XRD/Mössbauer: **F Martin & 10 others** 1999 CM 37 997-1006.
Biodurability: **JB Jurinski JD Rimstidt** 2001 AM 86 392-9.
Ni sorption kinetics, thermodynamics vs T: **KG Scheckel DL Sparks** 2001 SSSAJ 65 719-28 (2097).
Dehydroxylation/proton migration/structure change in heated, IR: **M Zhang & 5 others** 2006 AM 91 816-25.
Occurrence: hydrothermal, St Paul/Conrad fracture zones, Atlantic, **M D'Orazio & 2 others** 2004 EJM 16 73-83 (10129).
Talc + *forsterite* = *enstatite* + *water*: 1-3.5 GPa, revised thermodynamics, **E Melekhova & 3 others** 2006 AM 91 1081-8.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
Synthetic Co-: **CWFT Pistorius** 1963 NJMM 30.
Synthetic (Ge,Si)-talc, EXAFS & FTIR: **F Martin & 5 others** 1996 EJM 8 289-99 (M1389);
H/D substitution, IR, **F Martin & 3 others** 1999 CIM 34 365-74 (2711).
Biopyribole polysomes: **BH Grobéty** 1996 AM 81 404-17.
10Å phase $Mg_3Si_4O_{10}(OH)_2.xaq$ is similar to talc.

talmessite $Ca_2Mg(AsO_4)_2.2aq$. *Fairfieldite* structure group.

Dimorphic with *roselite-beta* in the roselite group.
Structure: **M Catti G Ferraris G Ivaldi** 1977 BSFMC 100 230-6.
Occurrence: MM 32 983.

talnakhite $Cu_9(Fe,Ni)_8S_{16}$.

Complex derivative of *sphalerite*; some atomic positions differ from *tetrahedrite*.
Structure: **SR Hall EJ Gabe** 1972 AM 57 368-80 (386).
Matches *synthetic* beta-: **JE Hiller K Probsthain** 1956 ZK 108 108-29.
Occurrence: MM 36 1160.

tamaite $(Ca,K,Ba,Na)_{3-4}Mn_{24}(Si,Al)_{40}(O,OH)_{112}.21aq$.

Ganophyllite group.
Structure: orthorhombic dimorph, SC-XRD**: JM Hughes & 3 others** 2003 AM 88 1324-30.
Occurrence & SC-XRD: AM 86 769.

tamarugite $NaAl(SO_4)_2.6aq$. Review: **Sabelli** p. 19.

Structure: **PD Robinson JH Fang** 1969 AM 54 19-30.
Occurrence, New Zealand: **KM Mackenzie KA Rodgers PRL Browne** 1995 MM 59 754-7;
steam condensate, Taupo, **KA Rodgers & 4 others** 2000 MM 64 125-42.

tancoite $HNa_2LiAl(PO_4)_2OH$.

Contains $M(TO_4)_2$ chain also in *labuntsovite*, *metasideronatrite*, *nenadkevichite*, *sideronatrite* & *yftisite*.
Structure: **FC Hawthorne** 1983 TMPM 31 121-35 (H722).
Synthetic $Na_4Al(PO_4)_2OH$, similar except Na positions: **RE Morris & 4 others** 1995 JSSC 1995 118 412-6 (A655).
Synthetic Ga-F-organic compounds, structure: **RI Walton et al** 2000 ChM 12 1977-84 (W1018).
Occurrence: MM 43 1068.

taneyamalite $(Na,Ca)(Mn,Mg,Fe,Al)_{12}Si_{12}(O,OH)_{24}$.

Isostructural with Fe-rich analog *howieite*.
Structure determination not found.
Occurrence: **S Matsubara** 1981 MM 44 51-3 (M1474).

tangeite $CaCuVO_4OH$. *Conichalcite/descloizite* structure type. *Adelite* mineral group.

Structure: **R Basso A Palenzona L Zefiro** 1989 NJMM (7) 300-8 (B1354);
Sr-bearing, **R Basso L Zefiro** 1994 NJMM 205-8 (B1107).
Occurrence: MM 21 577-8.

tantalaeschynite-Y $(Y,Ce,Ca)(Ta,Ti,Nb)O_6$.

Isostructural series with Ti-rich analog *aeschnite-Y.*
Occurrence & XRPD of heated: **MS Adusimilli C Kieft EAJ Burke** 1974 MM 39 571-6.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

tantalite $(Mn,Fe)(Ta,Nb)_2O_6$. *Scrutinyite* structure type.

Mineralogically split into *ferrotantalite* & *manganotantalite*.
Composition gap with *ferrotapiolite*: **P Cerny TS Ercit MA Wise** 1992 CM 30 587-96.
[See *yttrotantalite* $(Y,U,Fe)(Ta,Nb)O_4$. Metamict.]

tantalcarbide TaC. Iso *niobocarbide*.
Occurrence: **MI Novgorodova ME Generalov NV Trubkin** 1997 ZVMO 126 76-80 (N481).

tantalum Ta. Body-centered cubic.

Structure: **Wells** p. 1015.
Occurrence & XRPD: **VV Seredin ME Generalov TL Evstigneeva** 1998 DAN 360 791-5.
tantalum carbide TaC. *Halite* structure type.
Structure: **Wells** p. 1014.
Occurrence: **C Frondel** 1962 AM 47 786-7.
tanteuxenite $(Y,Ce,Ca)(Ta,Ti,Nb)_2(O,OH)_6$. Metamict.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
tantite $(Ta,Nb)_2O_5$.
At least 2 types of *synthetic* Ta_2O_5: low-T alpha, structure, **NC Stephenson RS Roth** 1971 ACB 27 1037-44;
high-T beta, crystallography, **GM Wolten AB Chase** 1969 ZK 129 365-68.
Occurrence & crystallography: **AV Voloshin & 3 others** 1983 MZh 5 90-3 = AM 69 1193.
TAPIOLITE STRUCTURE TYPE Includes:

byströmite	$MgSb_2O_6$
manganotantalite	$(Mn,Fe)(Ta,Nb)_2O_6$
ordonezite	$ZnSb_2O_6$
tapiolite	$(Fe,Mn)(Ta,Nb)_2O_6$

Trirutile = tapiolite structure type.
Crystal chemistry: **MA Wise P Cerny** 1996 CM 34 631-47.
Composition gap with *tantalite*: **P Cerny TS Ercit MA Wise** 1992 CM 30 587-96.
Cation ordering waves: **S Hansen & 3 others** 1995 AC A51 514-9 (H1016).
Synthetic $FeNb_2O_6$: **A Aruga & 3 others** 1985 AC C41 663-5 (A627).
tapiolite $(Fe,Mn)(Ta,Nb)_2O_6$. Tapiolite structure group.
Structure: **VM Goldschmidt** 1926 Skr Nor Vidensk Akad Oslo no. 1 17-9;
XRD, **O von Heidenstam** 1966 Inorg Phys Chem Dat Inform Ser no. 28 Univ Stockholm;
ND, **do** 1968 Ark Kemi 28 375-87.
Synthetic $Cr^{2+}_{0.76}Ta_{2.09}O_6$ & $FeTa_2O_6$, structure: **E Peters H Müller-Buschbaum** 1995 ZN 50b 712-6 (P585).
taramellite $Ba_4(Fe^{3+},Ti,Fe^{2+},Mg,V)_4(B_2Si_8O_{27})O_2Cl_x$.
Isostructural series with Ti-rich analog *titantaramellite* & V analog *nagashimalite*.
Structure: **F Mazzi G Rossi** 1965 ZK 121 243-57 (M1040);
do 1980 AM 65 123-8.
taramite $Na_2Ca(Fe,Mg)_3Al_2Si_6Al_2O_{22}(OH)_2$.
Amphibole structure group; monoclinic subtype.
Natural potassian-: **FC Hawthorne HD Grundy** 1978 CM 16 53-62.
taranakite /potassium taranakite $?H_6K_3Al_5(PO_4)_8.18aq$.
Uncertain chemical composition for hydrated layer structure.
Longest c-axis (95Å): **S Dick & 6 others** 1998 Inorg Chim Acta 269 47-57 = AM 83 1120.
Important for P storage in soils.
Matches *synthetic* phase A, XRPD: **JP Smith WE Brown** 1959 AM 44 138-42.
Related to *ammonium taranakite*.
Speculation on composition & structure: **D McConnell** 1976 AM 61 329-31.
Occurs with *brushite*.
Occurrence: **JW Murray RV Dietrich** 1956 AM 41 616-26;
in fertilizers: **JR Lehr & 4 others** 1966 *Crystallographic Properties of Fertilizer Compounds*, Tenn Valley Auth Chem Eng Bull 6, 163p (L758);
Cioclovina Cave, IR, XRD: **S Marincea D Dumitraş** 2003 NJMM 127-44 (8777).
Synthesis at low T: **W Schweiger & 3 others** 1998 ZaaC 624 1712-7 (S1988);
residence time vs Fe perturbation, **C Liu PM Huang JM Zhou** 2002 SSSAJ 66 10-16 (4351).
tarapacaite K_2CrO_4.
Structure: **JA McGinnety** 1972 AC B28 2 845-52;
K Toriumi Y Saito 1978 AC B34 3149-56.
tarasovite $?(H_3O)KNa(Ca,Na)_{0.4}Al_8(Si,Al)_{16}(OH)_8.2aq$. *Mica/smectite* intergrowth.
Occurrence: **EK Lazarenko YuM Korolev** 1971 ZVMO 99 214-24 = AM 56 1123;
SW Bailey 1982 AM 67 394-8.

taseqite $Na_{12}Sr_3Ca_6Fe_3Zr_3NbSi_{25}O_{73}(O,OH,aq)_3Cl_2$. *Eudialyte* group.
Occurrence & SC-XRD structure: **OV Petersen & 4 others** 2004 NJMA 83-96 (10061).
tarbuttite $Zn_2(PO_4)OH$. Isostructural with As analog *paradamite*.
Structure: **G Cocco L Fanfani PF Zanazzi** 1966 ZK 123 321-9;
cell data, **JJ Finney** 1966 AM 51 1218-20;
synthetic, **EA Genkina BA Maksimov OK Mel'nikov** 1985 SPD30 329-31 (G591);
synthetic orthorhombic polymorph [jvs: ?isostructural with *adamite*], **A Kawahara H Moritani J Yamakawa** 1994 MJJ 17 132-9 (K723).
tarkianite $(Cu,Fe)(Re,Mo)_4S_8$. *Spinel* derivative.
Occurrence: Finland & XRPD, **KK Kojonen & 5 others** 2004 MM 68 539-44.
Occurrence: unnamed, Stillwater, & structure, **M Tarkian & 4 others** 1991 EJM 3 977-82.
Synthetic: structure, **M Kohlmann H Schoulz** 1993 ZK 204 287-88.
tatarskite $Ca_6Mg_2(SO_4)_2(CO_3)_2Cl_4(OH)_4.7aq$. Review: **Sabelli**, no structure.
Occurrence: **VV Lobanova** 1963 ZVMO 92 692-702.
tatyanaite $\sim(Pt,Pd,Cu)_3Sn$
Occurrence & description: **AY Barkov & 5 others** 2000 EJM 12 391-6 (B1995).
Taimyrite-tatyanaite series, Noril'sk, Siberia: **AY Barkov & 3 others** 2000 CM 38 599-609.
tauriscite $FeSO_4.7aq$.
Epsomite structure group, but detailed structure determination not seen.
Occurrence: **Dana**.
tausonite $SrTiO_3$. *Perovskite* structure group. Cubic structure: **Wells**.
Structure determination of mineral not found.
Occurrence: **EI Vorob'ev & 4 others** 1984 ZVMO 113 83-9;
REE-bearing, **RH Mitchell NV Vladykin** 1993 MM 57 651-64.
Occurrence: MM 48 584.
K,Cr-bearing (called K-Cr-*loparite*) in Zimbabwe *diamond*: **MG Kopylova & 5 others** 1997 Russ Geol Geop = AM 83 402.
tavorite $LiFePO_4(OH,F)$. *Amblygonite* structure group.
Structure: *synthetic*, **EA Genkina & 3 others** 1984 SPD 29 27-30 (T400);
natural, & electron density, **OV Yakubovich VS Urusov** 1997 GI 35 630-8 (Y197).
Occurrence: MM 30 747.
tazheranite $\sim(Zr,Ca,Ti,etc)O_2$.
Defect *fluorite* structure type; essentially cubic zirconia stabilized by substituents.
Structure: & relation to *calczirtite*, **RK Rastsvetaeva & 3 others** 1998 DES 359A 410-2 (R890);
SC-XRD, **M Prencipe G Ferraris SV Soboleva** 1999 ZK 214 373-7 (P840).
Occurrence & XRPD structure: **AA Kashaev ZF Ushchapovskaya** 1970 SPC 14 922-3 (K635A).
MM 37 965.
teallite $PbSnS_2$. Orthorhombic distortion of *galena* structure.
Cell data indicate isostructural with *herzenbergite* SnS, but Pb/Sn distribution not determined: **W Hoffman** 1935 ZK 92 161-73 (H947).
Occurrence: **Dana**;
coal fire, **J Sejkora & 4 others** 2002 NJMA 177 163-80 (7269).
Hydrous lead stannate, an earthy alteration, was called *hochschildite*, occurrence: MM 26 337.
tedhadleyite $Hg(II)Hg(I)_{10}O_4I_2(Cl,Br)_2$.
Occurrence: **AC Roberts & 5 others** 2002 CM 40 909-14.
teepleite $Na_2B(OH)_4Cl$. Isolated $B(OH)_4$.
Structure: **M Fornaseri** 1949 PM 18 103-25 = MA 11-241;
XRPD, IR & NMR, **V Ross JO Edwards** 1959 AM 44 875-7;
H Effenberger 1982 AC B38 82-5.
Occurrence: MM 25 646.
tegengrenite $(Mg,Mn,Zn)_2(Sb,Mn,Si,Ti,Al,Fe)O_4$.
Distorted *spinel* structure, rhombohedral.
Occurrence & structure: **D Holtstam A Larsson** 2000 AM 85 1315-20.
teinite $Cu(Te,S)O_3.2aq$. Review: (E289), framework.

Structure: **A Zemann J Zemann** 1962 AC 15 698-702 (Z13);
H Effenberger 1977 TMPM 24 287-98 (E335).
Occurrence: MM 25 646.

telargpalite ~$(Pd,Ag)_3Te$. Several complex formula proposed.

Structure determination not found. [jvs: checked for *synthetic*.]
Occurrence: **VA Kovalenker & 3 others** 1974 ZVMO 103 595-60;
VD Begizov EV Barashev 1978 DAN 243 1265-8 = AM 66 1103.
Unnamed Bi analog: **ND Tolstykh AP Krivenko** 1995 DES 344 114-8.

tellurantimony Sb_2Te_3.

Tetradymite mineral/structure group; tetradymite subgroup: **P Bayliss** 1991 AM 76 257-65.
Structure: **H Effenberger F Pertlik** 1987 Mitt Osterr Mineral Ges 132 157-61 = MA 88M/1826.
Occurrence: MM 39 928;
Romania, **G Simon & 3 others** 1995 MP 53 115-24.

tellurite TeO_2.

Yellow orthorhombic type; dimorphic with colorless tetragonal *paratellurite*.
Edge-sharing pairs of TeO_4 generating layer: earlier paper wrong.

Structure: **H Beyer** 1967 ZK 124 228-37.

tellurium Te. Isostructural with trigonal Se.

Tetradymite mineral/structure group, Te subgroup: **P Bayliss** 1991 AM 76 257-65.
Structure: **AJ Bradley** 1924 Phil Mag 48 477-96;
P Cherin P Unger 1967 AC 23 670-1;
C Adenis V Langer O Lindqvist 1989 AC C45 941-2 (A613);
P Bayliss 1991 AM 76 257-65;
crystal structure vs. optical activity, **PJ Brown JB Forsyth** 1996 AC A52 408-12 (B1491).
High-P: **JC Jamieson DB McWhan** 1965 J Chem Phys 43 1149-52;
J Donohue 1974 ZK 139 159-60;
R Keller WB Holzapfel H Schulz 1977 PRB 16 4404-12.
Occurrence: Erzgebirge, Germany, **H Forster** 2004 NJMA 180 101-13

tellurobismuthite Bi_2Te_3.

Tetradymite mineral/structure group; tetradymite subgroup: **P Bayliss** 1991 AM 76 257-65.
Structure: **H Effenberger F Pertlik** 1987 Mitt Osterr Mineral Ges 132 157-61 = MA 88M/1826.
Definition: MM 30 747.

tellurohauchecornite Ni_9BiTeS_8. *Hauchecornite* structure group.

Structure determination not found.
Occurrence & XRPD: **RI Gait DC Harris** 1980 MM 43 877-8.

telluromayingite $Ir(Te,Bi)_2$.

Analog of *mayingite* which would become $Ir(Bi,Te)_2$: AM 84 687.

Description: **Z Yu** 1998 Acta Mineral Sinica 18 134-7.

telluronevskite Bi_3TeSe_2. *Tsumoite* subgroup of *tetradymite* group.

Occurrence, SC-XRD structure: **T Ridkosil & 3 others** 2001 EJM 13 177-85 (1670).

telluropalladinite Pd_9Te_4. Matches *synthetic*.

Structure determination not found. [jvs: checked for *synthetic*.]
Occurrence & XRPD: **LF Cabri & 3 others** 1979 CM 17 589-94.

telyushenkoite $CsNa_6Be_2Al_3Si_{15}O_{39}F_2$. Isostructural with *leifite*.

Structure: SC-XRD, **E Sokolova & 5 others** 2002 CM 40 183-92.
Occurrence: **AA Agakhanov & 4 others** 2002 ZVMO.

temagamite Pd_3HgTe_3. Matches *synthetic*.

Structure determination not found. [jvs: checked for *synthetic*.]
Occurrence & XRPD: **LF Cabri JHG Laflamme JM Stewart** 1973 CM 12 193-8.

tengchongite $CaO.6UO_3.2MoO_3.12aq$.

Structure determination not found.
Occurrence & SC-XRD: **Z Chen & 4 others** 1986 Kexue Tongbao 31 396-401 = AM 73 195-6.

tengerite-Y $Y_2(CO_3)_3.2\text{-}3aq$.

Compare with *kimuraite*, *lokkaite* & *schomiokite-Y* implied by cell dimensions.
Redefinition & occurrence: **R Miyawaki J Kuriyama I Nakai** 1993 AM 78 425-32.
Review: (different formula) **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

tennantite $(Cu,Fe)_{12}As_4S_{13}$. *Tetrahedrite* structure group.

Structure: **L Pauling EW Neumann** 1934 ZK 88 54-62;
BJ Wuensch J Takéuchi W Nowacki 1965 ZK 123 1-20
XRPD, **LE Ochando & 4 others** 1998 Anales de Quimica Int Ed 94 359-62 (O402);
Fe-bearing synthetic, Mossbauer, **E Makovicky & 5 others** 2003 CM 41 1125-34;
Cu-rich, SC-XRD, **E Makovicky & 4 others** 2005 CM 43 679-88.
Oxidation natural/*synthetic*: **D Fullston D Fornasiero J Ralston** 1999a,b La 15 4524-9, 4530-6 (F661,662).

tenorite CuO.

Structure: **S Asbrink L Norrby** 1970 AC B26 8-15.
Synthesis of Zn-doped tenorite for hydrogenation catalysis (cf *aurichalcite*): **GJ de AA Soler-Illia & 3 others** 1997 ChM 9 184-91 (S1658).

tephroite Mn_2SiO_4. *Olivine* structure group.

Structure: **CA Francis PH Ribbe** 1980 AM 65 1263-9;
K Fujino & 3 others 1981 AC B37 513-8;
ND, *synthetic*, **W Lottemoser H Fuess** 1992 PCM 19 46-51.
Cation ordering in *fayalite*-tephroite series, ND: **SAT Redfern & 3 others** 1998 MM 62 607-15.

terlinguaite Hg_2ClO.

Structure: **S Scavnicar** 1956 AC 9 956-9 (S1543);
K Aurivillius L Folkmarson 1968 Acta Chem Scand 22 2529-40 (A674);
K Broderson G Goebel G Liehr 1987 ZaaC 575 145-53 (B1205).
Crystal-chemical review: **SV Borisov SA Magarill NV Pervukhina** 2004 J Struct Chem 44 441-7 (10206).
New occurrences & XRPD: **VI Vasil'ev** 1995 Russian Geol Geophys 36 108-14 (V239).

terlinguacreekite $Hg_3Cl_2O_2$.

Structure: not known.
Occurrence: **AC Roberts & 7 others** 2005 CM 43 1055-60.

ternesite $Ca_5(SiO_4)_2SO_4$. Isotypic with P analog *silicocarnotite*.

Structure: *synthetic*, **PD Brotherton & 3 others** 1974 Australian J Chem 27 657-60;
& occurrence: **E Irran E Tillmanns G Hentschel** 1997 MP 60 121-32 (I216).

ternovite $(Mg,Ca)Nb_4O_{11}.n$ aq.

Mg-dominant analog of *franconite*, Na-rich & *hochelagaite*, Ca-rich.
Occurrence & XRPD: **VV Subbotin & 4 others** 1997 NJMM 49-60 (S1693);
1997 ZVMO 3 98-104 (S1754).

terranovaite $\sim Na_4Ca_4Al_{12}Si_{68}O_{160}.30$ aq. *Zeolite*.

IZA-SC code TER. Consortium for Theoretical Frameworks net 1152.
Occurrence & structure: **E Galli & 4 others** 1997 AM 82 423-9.

terskite $Na_4ZrSi_6O_{16}.2$aq.

Structure & new formula: **ZV Pudovkina NM Chernitsova** 1991 SPD 36 201-3 (P458) = AM 77 452.
Occurrence: Lovozero, **AP Khomyakov & 3 others** 1983 ZVMO 112 226-32
Ililaussaq, 2001 GGSB 190 124.
Possible problem with water: *unnamed mineral* M37 is assigned $H_3NaZrSi_6O_{16}.n$aq with n 2-3.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

tertschite $Ca_4B_{10}O_{19}.20$aq.

Structure determination not found. [jvs: check for *synthetic*.]
Occurrence & XRPD: **H Meixner** 1953 Fort Mineral 31 39-42 & Beit Mineral Petr 3 445-55 = AM 39 849.

teruggite $Ca_4MgAs_2B_{12}O_{22}(OH)_{12}.12$aq.

Structure: **A Dal Negro I Kumbasar L Ungaretti** 1973 AM 58 1034-43 (D249).
Occurrence: MM 37 965;
KA Rodgers & 4 others 2002 MM 66 235-52..

teschemacherite NH_4HCO_3.

Structure: **F Pertlik** 1981 TMPM 29 67-74 (P453).

testibiopalladinite PdTe(Sb,Te). *Pyrite* MXY structure group; *ullmannite* subgroup.

Structure: **P Bayliss** 1986 CM 24 27-33.
Occurrence: MM 40 915.
Phase relations: **W Kim GY Chao** 1991 CM 29 401-9.

TETRA-AURICUPRIDE STRUCTURE GROUP Includes:

ferronickelplatinum	(Ni,Fe)Pt
tetrataenite	FeNi
tetra-auricupride	AuCu
tetraferroplatinum	FePt
tulameenite	(Cu,Fe)Pt

Pearson structure code tP_2.

tetra-auricupride / tetra-auricupride AuCu. *Tetra-auricupride* structure group.
Structure: **P Bayliss** 1990 CM 28 751-5.
Occurrence: MM 46 527;
(Au,Pt)Cu, Western Sayan: **N Tolstykh A Krivenko L Pospelova** 1997 EJM 9 457-65.
Occurrence, Switzerland: **N Meisser J Brugger** 2000 SMPM 80 291-8 (775).

TETRADYMITE STRUCTURE GROUP Includes:

		Subgroup
aleksite	$Bi_2PbS_2Te_2$?	aleksite
antimony	Sb	As
arsenic	As	As
baksanite	$Bi_6Te_2S_3$.	polysomatic
bismuth	Bi	As
bohdanowiczite	$AgBiSe_2$	tsumoite
[hedleyite	Bi_7Te_3	hedleyite [possible triple *c* superstructure]
ingodite	Bi(S,Te)	tsumoite
ikunolite	Bi_4S_3	josëite
josëite	$Bi_4(S,Te)_3$	josëite
jöseite-B	$Bi_4(Te,S)_3$	josëite
kawazulite	Bi_2Te_2Se	tetradymite
laitakarite	$Bi_4(Se,Te)_3$	josëite
matildite	$AgBiS_2$	tsumoite
nevskite	BiSe	tsumoite
paraguanajuatite	$Bi_2(Se,S)_3$	tetradymite
pilsenite	Bi_4Te_3	josëite
platynite	(Bi,Pb)(Se,S)?	tsumoite
poubaite	$(Bi,Pb)_3(Se,Te)_4$	josëite
protojosëite	$Bi_5(Te,S)_4$?	protojosëite
rucklidgeite	Bi_3Te_4	josëite
selenium	Se	Te
skippenite	$Bi_2(Se,Te)_3$	tetradymite
stibarsen	AsSb	As
sulphotsumoite	Bi(Te,S)	tsumoite
tellurium	Te	Te
tellurantimony	Sb_2Te_3	tetradymite
tellurobismuthite	Bi_2Te_3	tetradymite
telluronevskite	Bi_3TeSe_2	tsumoite
tetradymite	Bi_2Te_2S	tetradymite
tsumoite	BiTe	tsumoite
volynskite	$AgBiTe_2$	tsumoite

Crystal chemistry & crystallography: **P Bayliss** 1991 AM 76 257-65.

tetradymite Bi_2Te_2S. Tetradymite structure group.

Structure: **L Pauling** 1975 AM 60 994-7;
P Bayliss 1991 AM 76 259-68 (B1307).

tetraedingtonite $BaAl_2Si_3O_{10}.4aq$. See *edingtonite*.

Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

tetraferroplatinum PtFe. *Tetra-auricupride* structure group. **Pearson** structure code tP2.

Structure: **P Bayliss** 1990 CM 28 751-5.

Pt-Fe & Pt-Fe-Cu phase relations: **JFW Bowles** 1990 43 37-47 (B1345).

Occurrence: MM 40 915.

TETRAHEDRITE STRUCTURE GROUP Includes:

argentotennantite	$(Ag,Cu)_{10}(Zn,Fe)_2(As,Sb)_4S_{13}$
freibergite	$(Ag,Cu,Fe)_{12}(Sb,As)_4S_{13}$
galkhaite	$(Cs,Tl)\ (Hg,Cu,Zn)_6(As,Sb)_4S_{12}$
giraudite	$(Cu,Zn,Ag)_{12}(As,Sb)_4(Se,S)_{13}$
goldfieldite	$Cu_{12}(Sb,As)_4(Te,S)_{13}$
hakite	$(Cu,Hg)_{12}Sb_4(Se,S)_{13}$
nowackiite	$Cu_6Zn_3As_4S_{12}$
[schwatzite	$Cu_6(Cu_{4.4}Hg_{1.6})Sb_4S_{12}$.
	Can be described as mercurian tetrahedrite]
[pseudotetrahedrite	Variant of *tetrahedrite*. MM 39 924.]
sinnerite	$Cu_6As_4S_9$
tennantite	$(Cu,Fe)_{12}As_4S_{13}$
tetrahedrite	$Cu_{12}Sb_4S_{13}$
watanabeite	$Cu_4(As,Sb)_2S_5$

Synthetic $Cu_{24}As_{12}S_{31}$: **F Maske BJ Skinner** 1971 EG 66 901-8.

Topology of *sodalite* & tetrahedrite structures: **E Koch E Hellner** 1981 ZK 154 95-114 (K744).

Fe-bearing, Mössbauer: **JM Charnock & 3 others** 1989 MM 53 193-9.

Cu/Ag/Fe/Cd/Sb K-edge EXAFS: **do** 1989 JSSC 82 279-89 (C613).

Oxidation state/electronic state Cu, L-edge XAS: **RAD Pattrick & 3 others** 1993 PCM 20 395-401 (P503).

Substitution of Fe/Zn/Co/Ni/Mn/Cr/V/Pb: **E Makovicky S Karup Møller** 1994 NJMA 89-123.

Synthetic $Cu_{12-x}Te_4S_{13}$: **R Kalbskopf** 1974 TMPM 21 1-10.

Natural *tetrahedrite-Cd*, $(Cu_{6.9}Ag_{3.1}Cd_{1.0}Zn_{0.7}Fe_{0.1})(Sb_{4.0}As_{0.2})S_{13}$: **AV Voropayev EM Spridonov VI Shibrik** 1988 DAN 1446-8 = AM 75 710.

[*Talnakhite* $Cu_9(Fe,Ni)_8S_{16}$ is similar in structure, but has important differences.]

tetrahedrite $Cu_{12}Sb_4S_{13}$. Tetrahedrite structure group.

Structure: **BJ Wuensch** 1964 ZK 119 437-53;
T Tatsuka N Morimoto 1973 AM 58 425-34 (T199);
synthetic $Cu_{12+x}Sb_4S_{13}/Cu_{14-X}Sb_4S_{13}$: **E Makovicky BJ Skinner** 1976 NJMM 141-3;
do 1979 CM 17 619-34;
argentian, **ML Johnson CW Burnham** 1985 AM 70 165-70;
RC Peterson I Miller 1986 MM 50 717-21 (P632);
crystal chemistry, **NE Johnson JR Craig JD Rimstidt** 1988 AM 73 389-97;
mercurian, superstructure, **K Kucha EF Stumpfl W Osuch** 1995 = MA 96M/3522;
synthetic, T dependence, **A Pfitzner M Evain V Petricek** 1997 AC B53 337-45 (P678)
crystal chemistry, EPR & magnetics, **F Di Benedetto & 8 others** 2002 CM 40 837-44.

Exsolved $Cu_{12.3}Sb_4S_{13}$ & $Cu_{13.8}Sb_4S_{13}$ from *synthetic* ~$Cu_{12.5}Sb_4S_{13}$: **E Makovicky BJ Skinner** 1979 CM 17 619-33.

Synthetic Se and Te analogs: **S Karup-Møller E Makovicky** 1999 NJMM 385-99 (K1202).

[tetrakalsilite Name for synthetic phase now represented by *panunzite*.
Definition: MM 31 973.]

tetranatrolite [? Not = *gonnardite*, MR 30 175.] ~$Na_2K_{0.2}Al_{2.2}Si_{2.8}O_{10}.2aq$.

Zeolite mineral family. *Natrolite* structure type with tetragonal disorder.

Dehydration product of paranatrolite.
Different composition range to *gonnardite*.
Structure: **MG Mikheeva & 3 others** 1986 SPC 31 254-7 (M809);
F Pechar 1989 ZK 189 191-4;
RK Rastsvetaeva 1995 CrR 40 749-52 (R602)
SC-XRD, **HT Evans Jr JA Konnert M Ross** 2000 AM 85 1808-15
Occurrence: MM 43 1068 & 46 527.
Synthetic Ge, SC-XRD: **A Tripathi et al** 2000 JMC 10 451-5 (T653).

tetrarooseveltite $BiAsO_4$.beta. *Scheelite* structure type from XRPD.
Dimorph of *rooseveltite*.
Structure of *synthetic*: **RCL Mooney** 1948 AC 1 163-5.
Occurrence & XRPD: **J Sejkora T Ridkosil** 1994 NJMM 179-84 (S1250).

tetrataenite FeNi-gamma-ordered. *Tetra-auricupride* structure group.
Pearson structure code tP_2. Tetragonal CuAu-type superstructure of *taenite*.
Structure: **T Tagai H Takeda T Fukuda** 1995 ZK 210 14-8 (T418).
Occurrence: MM 46 527.
Intergrowth with low-spin antiferromagnetic FeNi-gamma, proposed as new mineral *antitaenite*:
DG Rancourt RB Scorzelli 1995 J Magn Magn Mater 150 30;
RB Scorzelli & 5 others 1997 MPS 32 Suppl A117.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

tetrawickmanite $MnSn(OH)_6$. Distorted ReO_3 structure type.
Schoenfliesite/stottite structure group. Tetragonal dimorph of cubic *wickmanite*.
Structure determination not found.
Occurrence: **JS White Jr JA Nelen** 1973 MR 4 24-30.
Synthetic $MnSn(OH)_6$, cell dimension: **AN Christensen RG Hazell** 1969 Acta Chem Scand 23 1219-24 (C804); also Ca/Fe/Co/Zn varieties.

texasite $Pr_2(SO_4)O_2$.
Matches *synthetic*.
Occurrence: MM 42 530.

thadeuite $Mg(Ca,Mn)(Mg,Fe,Mn)_2(PO_4)_2(OH,F)_2$.
Structure: **AM Isaacs DR Peacor** 1982 AM 67 120-5.
Occurrence: MM 43 1068.

thalcusite $Tl_2(Cu,Fe)_4S_4$.
Essentially isostructural with Se analog *bukovite* & K analog *murunskite* $K_2Cu_3FeS_4$.
Structure determination not found. [jvs: check synthetic $Cu_3Tl_2FeS_4$ with matching XRD.]
Occurrence & XRPD: **VA Kovalenker & 3 others** 1976 ZVMO 105 202-6;
Greenland, **S KarupMoller E Makovicky** 2001 GGSB 190 127-30 (8708).

thalenite-Y / thalénite-Y $Y_3Si_3O_{10}OH$. Analog of *fluorthalénite-Y*.
Structure: **AN Kornev & 4 others** 1972 SPD 17 88-90 (K630) = MA 73-1295;
OK Yakubovich & 3 others 1988 SPC 33 356-8.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

thalfenisite $Tl_6(Fe,Ni,Cu)_{25}S_{26}Cl$. *Djerfisherite* structure group.
Structure determination not found.
Occurrence: **NS Rudashevskiy & 4 others** 1979 IGR 24 116-22.
Cl-poor, Kola Peninsula: **AY Barkov & 4 others** 1998 CM 35 1421-30.

thallapite $H_6(Ca,Pb)_2(Cu,Zn)_3SO_4(TeO_3)_4TeO_6$.
Occurrence: **SA Williams M Duggan** 1978 MM 42 183.

thaumasite $Ca_3Si(OH)_6(CO_3)(SO_4).12aq$. *Ettringite* structure group.
Review: **HFW Taylor** 1973 MM 39 377-89; **Sabelli** p. 18.
Structure: **E Welin** 1957 Ark Mineral Geol 2 137-47;
RA Edge HFW Taylor 1969 N 224 363-4;
M Lafaille J Protas 1970 CRASP 270D 2151-4 = MA 70-3020;
RA Edge HFW Taylor 1971 AC B27 594-601 (E111);
H Effenberger & 3 others 1983 NJMM 60-8

SC-XRD at 130 & 298 K, **SD Jacobsen JR Smyth RJ Swope** 2003 PCM 30 321-9 (9339).
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

theisite $Cu_5Zn_5(As,Sb)_2O_8(OH)_{14}$.

Structure determination not found.
Occurrence: **SA Williams** 1982 MM 46 49-50;
P Bonazzi F Olmi 1989 NJMM 241-4 (B1353)
PE Haynes PF Hlava 1998 Rocks & Minerals Sept/Oct 356-9 (H1357).
"*geneveite*" was not accepted as new mineral because similar to theisite: **H Sarp J Deferne** 1983 Arch Sci Geneve 36 163-8 = AM 69 1191.

thenardite Na_2SO_4. Polymorph V. Review: **Sabelli** p.32.

Thenardite family, review: **BN Mehrota & 4 others** 1978 NJMM 408-21 (M1181).
Structure: **WH Zachariasen GE Ziegler** 1932 ZK 81 92-101;
AG Nord 1973 Acta Chem Scand 27 813-22;
FC Hawthorne RB Ferguson 1975 CM 13 181-7.
Hexagonal polymorph-I at 693K: structure, **H Naruse & 4 others** 1987 AC B43 143-6 (N374).
Transitions: topotactic III-I, **V Amirthalingam MD Karkhanavala URK Rao** 1977 AC A33 522;
V-III, **DR Das Gupta** 1954 AC 7 275-6;
confirming structures I, II, III & V, determination of II, XRPD refinement of all phases, **SE Rasmussen J Jorgensen B Lundtoft** 1996 JACr 29 42-7 (R662).
Synthetic analogs: $Na_2(S/Se)O_4$, $Ag_2(S/Se)O_4$, $AgHPO_4$, beta-$NaCdAsO_4$, $AgCdAsO_4$, Cd_2SiO_4, Hg_2GeO_4: **BN Mehrota & 4 others** 1978 NJMM 408-21 (M1181).
Synthetic Cr_2SiO_4: **WA Dollase F Seifert HStC O'Neill** 1994 PCM 21104-9 (D347).

theoparacelsite $Cu_3As_2O_7(OH)_2$.

Occurrence & SC-XRD structure: **H Sarp R Cerny** 2002 Arch Sci Geneve 54 7-14 = AM 87 356.

theophrastite $Ni(OH)_2$. *Brucite* structure group.

Structure: *synthetic*, XRD, **O Glemser J Einerhand** 1950 ZaaC 261 43-51;
ND, $Ni(OD)_2$, **C Greaves MA Thomas** 1986 AC B42 51-5.
Optics & crystal field: **K Ikeda S Vedanand** 1999 NJMM 21-6 (I247).
Occurrence: MM 46 527.

theresemanganite / theresmanganite $(Co,Zn,Ni)_6(SO_4)(OH,Cl)_{10}.8aq$.

Compare with *guarinoite* $(Zn,Co,Ni)_6(SO_4)(OH,Cl)_{10}.5aq$.

Structure determination not found.
Occurrence: **H Sarp** 1993 Archives des Sciences 46 37-44 = AM 78 1314-5.

thermonatrite $Na_2CO_3.aq$.

Structure: ND, **KK Wu ID Brown** 1975 AC B31 890-2.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

thomasclarkite-Y $Na(Y,REE)(HCO_3)(OH)_3.4aq$.

Description & structure: **JD Grice RA Gault** 1998 CM 36 1293-300.

thometzekite $Pb(Cu,Zn)_2(AsO_4)_2.2aq$.

XRPD like *tsumcorite-helmutwinklerite* but no structure determination: **K Schmetzer B Nuber O Medenbach** 1985 NJMM 446-52 (S1485).
Occurrence: MA 96M/2499.

thomsenolite $NaCaAlF_6.aq$. Dimorphic with *pachnolite*.

Structure: **G Cocco PC Castiglione G Vagliasindi** 1967 AC 23 162-6.

thomsonite $NaCa_2Al_5Si_5O_{20}.6aq$. *Zeolite* mineral group.

IZA-SC structure code THO. CTF net 259.
Structure: **A Alberti G Vezzalini V Tazzoli** 1981 Z 1 91-7;
orientation & geometry of unit cell, **R Nawaz JF Malone** 1981 MM 44 231-4;
SC-ND 293K, **JJ Pluth JV Smith Å Kvick** 1985 Z 5 74-80 (P583);
SC-ND 13K, **K Stähl Å Kvick JV Smith** 1990 AC C46 1370-3 (S1207);
dehydration, XRPD, **K Stähl R Thomasson** 1992 JAC 25 251-8 (S1246);
Sr-rich, Kola, SC-XRD, **OA Gurbanova & 3 others** 2001 DES 376 101-4 (1341).
High-P: <6 GPa, anisotropic compression, no phase change, **Y Lee & 3 others** 2004 PCM 31 22-7 (10015).

(Al/Ga)$Co_4P_5O_{20}$, structure: **P Feng X Bu GD Stucky** 1997 N 388 735-40 (F556).

Synthetic, hydrothermal & morphology: **H Ghobarkar O Schaf** 1997 Cryst Res Technol 32 653-7.

Synthetic zinc phosphate-organic, similar to thomsonite but with interruptions, SC-XRD structure: **S Neeraj S Natarajan** 2000 ChM 12 2753-62 (N534).

Synthetic $[C_8N_5H_{28}][Zn_5P_5O_{20}].aq$, SC-XRD structure: **do** 2001 JPCS 62 1499-505 (2957).

Synthetic $[C_5N_2H_{10}][Zn_2P_2O_8]$, SC-XRD structure: **HY Ng WTA Harrison** 2001 MMM 50 18794 (3980).

thomsonite-Ca $Na(Ca,Sr)_2Al_5Si_5O_{20}.6\text{-}7aq$.

thomsonite-Sr $Na(Sr,Ca)_2Al_5Si_5O_{20}.6\text{-}7aq$. *Zeolite* mineral group.

IZA-SC structure code THO. CTF net 259.

Occurrence & SC-XRD structure: **IV Pekov & 6 others** 2001 ZVMO 4 46-55.

thorbastnäsite = thorbastnaesite $Th(Ca,Ce)(CO_3)_2F_2.3aq$.

Essentially isostructural with *bastnäsite* based on XRPD, [jvs: but the role of molecular water needs explanation.]

Occurrence: **AS Pavlenko & 3 others** 1965 ZVMO 94 105-13.

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

thoreaulite $SnTa_2O_6$. Isostructural with *foordite* $SnNb_2O_6$.

Edge- & vertex-shared octahedral layer; 5-coordinated Sn.

Structure: early determinations are not fully correct;
WG Mumme 1970 AM 55 367-77;
commentary on symmetry, **TS Ercit P Cerny** 1988 CM 26 899-903.

Occurrence: MM 23 638.

Crystal chemistry of complex Nb & Ta oxides: **J Graham MR Thornber** 1974 AM 59 1026-39.

thorianite ThO_2. *Fluorite* structure type.

Structure; **RE Vogel CP Kempter** 1959 US Atomic Energy Comm Los Alamos 2317;
ES Makarov IM Lipova 1962 Geochemistry no. 7 676-83 = MA 16-511.

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

Synthetic CmO_2 & ThO_2: 1989 J Less-Common Metals 156 273 = SR 56A 271.

thorikosite $Pb_3(Sb/As)O_3(OH)Cl_2$. *Nadorite* family of Pb sheet structures.

Structure: **RC Rouse PJ Dunn** 1985 JSSC 57 389-95 = MM 50 759.

thorite $ThSiO_4$. *Zircon* structure group. Dimorphic with *huttonite*.

Structure: **M Taylor RC Ewing** 1978 ACB 34 1074-9;
JA Speer BJ Cooper 1982 AM 67 804-8.

Synthesis: **LH Fuchs E Gebert** 1958 AM 43 243-8.

Radiation damage in thorite & *zircon*, Zr & Th EXAFS: **F Farges G Calas** 1991 AM 76 60-73.

Heavy-ion irradiation, decomposition, amorphization, recrystallization: **A Meldrum & 3 others** 1999 PRB 59 3981-6.

thornasite $Na_{12}Th_3[Si_8O_{19}]_4.18aq$. *Zeolite* mineral group; interrupted silicate framework.

Structure: **Y Li SV Krivovichev P Burns** 2000 AM 85 1521-5.

Occurrence: **VE Ansell GY Chao** 1987 CM 25 181-3.

thorogummite $(Th,U)(SiO_4)_{1-x}(OH)_{4x}$.

Essentially *zircon* structure type, but typically metamict. Structure determination not found.

Occurrence: **C Frondel** 1958 USGS Bull 1064 280-5.

thorosteenstrupine $(Ca,Th,Mn)_3Si_4O_{11}F.6aq$. Amorphous. Ignore.

thortveitite $(Sc,Y)_2Si_2O_7$. Isostructural with *gittinsite* $CaZrSi_2O_7$ & *keivite* $Yb_2Si_2O_7$.

Zeisite beta-Cu_2O_7 is a distorted relative.

Structure: **WH Zachariasen** 1930 ZK 73 1-6;
DWJ Cruikshank H Kynton GA Barclay 1962 AC 15 491-8 (C69);
Yul Smolin YUF Shepelev AP Titov 1973 SPC 17 749-50 (S336);
R Bianchi & 4 others 1988 AM 73 601-7.

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

Synthetic high-beta-$Mg_2P_2O_7$: **C Calvo** 1965 Can J Chem 43 1139-46.

Synthetic $In_2Si_2O_7$: **J Ito** 1968 AM 53 1663-73.

Synthetic α-$Cu_2V_2O_7$ orthorhombic relative: **D Mercurio-Lavaud B Frit** 1973 AC B29 2737-41.

Synthetic $Mn_2V_2O_7$, high-T beta-, ND: **AG Nord** 1984 NJMM 283-8;

low-T alpha, **J-H Liao & 4 others** 1996 JSSC 121 214-24 (L714).
Synthetic $Mn_2P_2O_7$: **T Stefanidis AG Nord** 1984 AC C40 1995-9 (S1475.
Synthetic beta-$(Co/Ni/Mn)_2As_2O_7$: 1990 JSSC 86 1-15 = SR 57A 277.
Synthetic $In_2P_2O_7$: **GR Patzke R Wartchow M Binnewies** 2000 ZK 215 15-6 (2007).
Synthetic $FeInGe_2O_7$: XRPD structure, **L Bucio & 4 others** 2001 ZK 216 438-41 (3610).
Synthetic $YInGe_2O_7$: XRPD struct, **EA Juarez-Arellano & 5 others** 2001 ZK 217 201-4 (7941).
Synthetic beta'-$Zn_2V_2O_7$: XRPD structure, **TI Krasnenko & 4 others** 2003 CrR 48 35-8 (8788).
Synthetic $In_{1.1}Gd_{0.9}Ge_2O_7$: XRPD structure, **E Juarez-Arellano & 3 others** 2002 ACC 58 i135-7 (8243).
Synthetic $In_2P_2O_7$: XRD structure, **GJ Redhammer G Roth** 2003 ACC 59 i103 (9587).
Synthetic $In_{1.1}Ho_{0.9}Ge_2O_7$: XRPD structure, **E Juarez-Arellano & 6 others** 2004 ACC 60 i14-6 (1038).
thorutite $(Th,U,Ca)Ti_2(O,OH)_6$. Isostructural with *brannerite*.
Synthetic $ThTi_2O_6$: structure, **R Ruh AD Wadsley** 1966 AC 21 974-8.
Synthetic CuV_2O_6, **C Calvo D Manolescu** 1973 ACB 29 1743-5.
Synthetic $NaVMoO_6$: **B Darriet J Galy** 1968 BSFMC 91 325-31.
Synthetic Y-doped: XR&NPD structure, **M James ML Carter JN Watson** 2003 JSSC 174 329-33 ((324).
threadgoldite $Al(UO_2)_2(PO_4)_2OH.8aq$.
Review: **PC Burns ML Miller RC Ewing** 1996 CM 34 845-80.
Structure: **P Piret J-P Declercq D Wauters-Stoop** 1979 ACB 35 3017-20;
F Khosrawan-Sazedy 1982 TMPM 30 111-5 (K735).
Occurrence: MM 43 1068.
[tialite = tielite = tieilite Al_2TiO_5. Not a mineral. Synthetic abrasive.
*Pseudobrookit*e structure type.
Definition: MM 31 973.]
tiemannite HgSe. *Sphalerite* structure group.
Continuous series with S analog *metacinnabar*: **PM Bethke** 1956 GSAB 67 1671.
Structure determination not found.
Occurrence & crystallography: **JW Early** 1950 AM 35 337-64.
tienshanite $KNa_3(Na,K,void)_6(Ca,Y,RE)_2Ba_6(Mn,Fe,Zn,Ti)_6(Ti,Nb)_6B_{12}Si_{36}O_{114}[O_{5.5}(OH,F)_{3.5}F_2]$.
Structure: **YuA Malinovskii EA Pobedimskaya NV Belov** 1978 SPD 22 544-5 (T394);
MA Cooper FC Hawthorne ES Grew 1998 CM 36 1305-10.
[**tietaiyangite** Fe_4FeTiO_9. Not approved CNMMN.
Occurrence: AM 85 1324.]
tiettaite $(Na,K)_{17}FeTiSi_{16}O_{29}(OH)_{30}.2aq$.
Structure determination not found.
Occurrence & crystallography: **AP Khomyakov & 4 others** 1993 ZVMO 122 121-5 (K657).
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.
tikhonenkovite $SrAlF_4OH.aq$. Ca chemical analog is *gearksutite* $CaAlF_4(OH).aq$.
Polymorphic with *acuminite*. Compare with *artroite* $PbAlF_3(OH)_2$.
Structure: **ZV Pudovkina YuA Pyatenko** 1967 DAN 174 117-20 = MA 71-125;
ZV Pudovkina NM Chernitsova YuA Pyatenko 1973 Zhurnal Strukt Khimi 14 487, English trans.
Occurrence: MM 33 1152.
[tikhvinite $\sim Sr_2Al_6(PO_4)_2(SO_4)(OH)_{12}$.
Occurrence: MM 21 578.]
tilasite $CaMgFAsO_4$. *Titanite* structure group.
Structure: **KW Bladh & 3 others** 1972 AM 57 1880-4;
V Nermanec 1994 NJMM 289-94 (B1161).
tilleyite $Ca_5Si_2O_7(CO_3)_2$.
Structure: **JV Smith** 1953 AC 6 9-18;
SJ Louisnathan JV Smith 1970 ZK 132 288-306 (L230);
SC-XRD, **JD Grice** 2005 CM 43 1489-500.
Occurrence: MM 23 638.

tillmannsite $(Ag_3Hg)(V,As)O_4$.

Occurrence & XRD structure: **H Sarp & 4 others** 2003 EJM 15 177-80.

tin - grey Sn.

Low-T alpha type with *diamond* structure and tetrahedral connectivity.

Transition temperature is 286 K.

Structure: **Pearson**; **Wells**.

Occurrence of native tin and tin alloys in Pacific Rise sediments with summary of other occurrences on the Moon and in various terrestrial rocks: **VM Dekov ZK Damyanov ED Mandova** 1996 NJMM 385-405 (D616).

[jvs: Cu_6Sn_5 & Cu_3Sn might be describable as new minerals.]

tin - white Sn.

High-T beta type with distorted octahedral connectivity derivable from diamond structure by compression.

Structure: **Pearson**; **Wells**.

Melting curve & Hugoniot: **S Bernard JB Maillet** 2002 PRG 6 012103 (8069).

tinaksite $K_2NaCa_2TiSi_7O_{19}(OH)$. Near-isostructural with *tokkoite*.

Structure: **AA Petranina VV Ilyukhin NV Belov** 1971 SPD 16 338-40 (P470) = MA 72-1803; **G Bissert** 1980 ACB 36 259-63.

Occurrence: MM 35 1156.

tincalconite $Na_6[B_4O_5(OH)_4]_3.8aq$.

Structure: **C Giacovazzo S Menchetti P Scordari** 1973 AM 58 523-30; **DR Powell & 3 others** 1991 ACC 47 2279-82; boron K-edge XANES, **ME Fleet S Muthupari** 2000 AM 85 1009-21 *synthetic*, SC-XRD & revised formula, **RD Luck G Wang** 2002 AM 87 350-4.

tinsleyite $KAl_2(PO_4)_2OH.2aq$. *Leucophosphite* structure group .

Structure: *synthetic*, SC-XRD, **S Dick** 1999 ZN 54b 1385-9 (D791).

Occurrence: & crystallography, **PJ Dunn & 3 others** 1984 AM 69 374-6; in cave, optical, chemical, thermal, IR, XRD, **S Marincea D Dumitras R Gibert** 2002 EJM 14 157-64; in paint-covered quartzite wall, Brazil, **GM da Costa RR Viana** 2001 AM 86 1053-6.

tinticite $Fe_{5.3}(PO_4)_{3.6}(VO_4)_{0.4}(OH)_4.6.7aq$ (original); $Fe_6P_4O_{19}$ (new).

Structure: XRPD of average disordered structure, **J Rius & 4 others** 2000 EJM 12 581-8 (R946).

Occurrence: MM 28 740; & XRPD, **JC Melgarejo S Gali C Ayora** 1988 NJMM 446-53 (M1272); new data, **K Sakurai S Matsubara A Kato** 1991 MJJ 15 261-7.

tintinaite $Pb_{22}Cu_4(Sb,Bi)_{30}S_{69}$.

Orthorhombic Sb-rich analog of monoclinic Bi-rich *kobellite*. Kobellite homologous series N = 2.

Structure determination not found.

Occurrence: **Y Moelo J Jambor D Harris** 1984 CM 22 219-26.

tinzenite $(Ca,Mn,Fe)_2MnAl_2BSi_4O_{15}OH$. *Axinite* structure group.

See axinite for structure determinations.

Structure, high-Mn, SC-XRD: **EL Belokoneva & 3 others** 2001 CrR 37-9.

Occurrence: **C Milton FA Hildebrand AM Sherwood** 1953 AM 1148-54; nomenclature, **E Sanero G Gottardi** 1968 AM 53 1407-11.

[Low-Mn type, *severginite* in Russia, structure: **EL Belokoneva PA Pletnev EM Spiridonov** 1997 CrR 42 934-7 (B1792).]

tiptopite $\sim(K_2Li_{2.9}Na_{1.7}Ca_{0.7})(Be_6P_6O_{24})(OH)_2.1.3aq$. *Cancrinite* structure group.

Structure: **DR Peacor RC Rouse JH Ahn** 1987 AM 72 816-20.

Occurrence: MM 50 759.

tiragalloite $Mn_4AsSi_3O_{12}OH$. Compare with *medaite*.

Structure: **CM Gramaccioli T Pilati G Liborio** 1979 AC B35 2287-91.

Occurrence: MM 46 527.

tirodite $Mn_2(Mg,Fe)_5Si_8O_{22}(OH)_2$. *Amphibole.*

Zincian: structure, **FC Hawthorne HD Grundy** 1977 CM 15 309-20.

Occurrence: MM 25 646.

tischendorfite $Pd_8Hg_3Se_9$.

Occurrence & XRPD: **CJ Stanley & 3 others** 2002 CM 40 739-45.

tisinalite $Na_3H_3(Mn,Ca,Fe)TiSi_6(O,OH)_{18}.2aq$. *Lovozerite* structure group type I.
Structure: SC-XRD, **NA Yamnova & 3 others** 2003 CrR 48 551-6 (9228).
Occurrence & crystallography: **Yul Kapustin & 2 others** 1980 ZVMO 109 223-9 (K910).
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

TITANITE STRUCTURE GROUP Includes:

durangite	$NaAlFAsO_4$
isokite	$CaMgFPO_4$
lacroixite	$NaAl(PO_4)(F,OH)$
*malayait*e	$CaSnOSiO_4$
maxwellite	$NaFeFAsO_4$
panasqueiraite	$CaMg(OH,F)PO_4$
tilasite	$CaMgFAsO_4$
titanite	$CaTiSiO_5$
vanadomalayite	$CaVOSiO_4$

2-vertex-connected octa-tetra CTF net 1073.
Kieserite structure group of sulfates and phosphate has same topology.
Many other related materials: **JA Speer GV Gibbs** 1976 AM 61 238-47.
Synthetic $CaSiSiO_5$ at high-P: **JF Stebbins M Kankazi** 1991 S 251 294-**?**;
SC-XRD, structure, **RJ Angel & 3 others** 1996 N 384 441-4 (A728);
transformation triclinic to monoclinic ~ 0.2 GPa, SC-XRD, **RJ Angel** 1997 AM 82 836-9;
phase relations, **R Knoche & 3 others** 1998 AM 53 1168-75;
inclusion in diamond from Guinea, **W Joswig & 4 others** 1999 EPSL 173 1-6.
Synthetic $Ca(Ti/Sn)SiO_4$, XRPD refinement: **M Kunz & 4 others** 1997 SMPM 77 1-11 (K905).
Synthetic high-P $MnSi_2O_5$, SC-XRD: **T Arlt & 3 others** 1998 AM 83 657-60.
Synthetic $CaAlFSiO_4$, XRPD structure: **U Troitzsch DJ Ellis** 1999 AM 84 1162-9.
Solid solution $CaTi(Si,Ge)O_5$: SC- & P- XRD at high T: **R Ellemann-Olesen T Malcherek** 2005 AM 90 1325-34.
Synthetic $CaZrGeO_5$: XR-PD structure, displacive transition, triclinic instability of titanite, **T Malcherek R Elleman-Olesen** 2005 ZK 220 712-8.

titanite $CaTiSiO_5$. Titanite structure type: A2/a & $P2_1/a$ dimorphs.
Structure: **WH Zachariasen** 1930 ZK 73 7-17;
R Montgiorgi L Riva di Sanseverino 1968 Mineral Petrogr Acta 14 123-41;
JB Higgins PH Ribbe 1976 AM 61 878-88;
synthetic, **JA Speer GV Gibbs** 1976 AM 61 238-47;
high-T change of space group, **M Taylor GE Brown** 1976 AM 61 435-47;
Al-rich, **CL Hollabaugh FF Foit Jr** 1984 AM 69 725-32;
high-T, **S Ghose Y Ito DM Hatch** 1991 PCM 17 591-603;
IR of structural anomaly 825 K, **M Zhang E Salje U Bismayer** 1997 AM 82 30-5;
Ti K-edge XANES of partially metamict, **F Farges** 1997 AM 82 44-50;
synthetic in TiO-AlF, XRPD, TEM, **U Troitzsch & 3 others** 1999 EJM 11 955-65 (T633);
in situ XRPD 275-650 K, 0-5 GPa, **M Kunz T Arlt J Stolz** 2000 AM 85 1465-73;
diffuse scattering & phase transition, **T Malcherek & 3 others** 2001 JACr 34 108-13 (1677);
spontaneous strain, **T Malcherek** 2001 MM 65 709-15;
Nb-, Naples, SC-XRD, **MF Brigatti & 3 others** 2004 NJMM 117-26 (10214)
Na-, Nb-, Zr-, XRPD, **RP Liferovich RH Mitchell** 2005 CM 43 795-813.
MAS-NMR, ^{29}Si: **ML Balmer & 4 others** 1997 JPCB 101 9170-9 (B1738);
A Labouriau TG Higley WL Earl 1998 JPCB 102 2897-904.
Synthesis ideal composition & cell dimensions: **D Xirouchakis & 3 others** 1997 AM 82 748-53;
thermochemistry, **D Xirouchakis & 3 others** 1997 AM 82 754-9.
Natural with up to 13 wt. % Sb_2O_5: **E Perseil DC Smith** 1995 MM 59 717-34.
Nb,Ta-richest: **P Cerny M Novak R Chapman** 1995 MP 52 61-73 (C818).
Phase transition: IR, dielectric, heat capacity, **M Zhang & 5 others** 1995 PCM 22 41-9;
XRPD 7 GPa, **M Kunz & 3 others** 1996 AM 81 1527-30;
S Kek & 5 others 1997 ZK 212 9-19 (K899);

& antiphase boundaries, **J Chrosch U Bismayer EKH Salje** 1997 AM 82 677-81.
Antiferroelectric transition, model: **SA Hayward J del Cerro EKH Salje** 2000 AM 85 557-62.
OH indicator of hydrous activity in rocks:
FTIR & NRA, **VMF Hammer & 3 others** 1996 EJM 8 281-8 (H1098);
polarized IR of crystalline & metamict, **M Zhang & 3 others** 2001 AM 86 904-9.
Synthesis & thermochemistry: **J Tangeman D Xirouchakis** 2001 PCM 28 167-76 (1632).
Stabilization of A2/a by antiphase domains with RE: **JM Hughes & 3 others** 1997 AM 82 512-6.
Metamict, IR: dehydration, IR, **M Zhang & 4 others** 2000 CM 38 119-30;
recrystallization, **do** 2002 AM 87 882-90.
Melting disorder, NMR: **S Kroeker D Rice JF Stebbins** 2002 AM 87 572-9.
Stability with *olivine, pyroxenes*, Fe-Mg-Ti-oxides & *quartz*, theory & application: **D Xirouchakis DH Lindsley DJ Andersen** 2001 AM 86 247-53; **dx dhl BR Frost** 254-64.
Trace elements, experiments: **M Tiepolo R Oberti R Vannucci** 2002 ChG 191 105-20.
Low-T alteration & Ti mobility: **DB Tilley RA Eggleton** 2005 ClCIM 53 100-7.
Occurrence, Al/Fe/Nb/Zr-rich, Russia, XRPD-structure *synthetic* analog: **AR Chakhmouradian** 2004 AM 89 1752-62.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
Synthetic $CdGe_2O_5$: **EL Belokoneva & 3 others** 1976 SPC 21 163-5 = (B1141).
Synthetic $CaGe_2O_5$: **NN Nevskii VV Ilyukhin NV Belov** 1979 SPD 24 415-6 (N339).
Synthetic: Ti-substituted: **CL Hollabaugh PE Rosenberg** 1983 AM 68 177-80;
bulk moduli, **RJ Angel & 5 others** 1999 AM 84 282-7.
Synthetic $NaTiOPO_4$: **MLF Phillips & 5 others** 1992 ChMat 4 222-33 (P625).
Synthetic $CaTiOSiO_4/LiTaO(Si/Ge0O_4$: phase changes, **T Malcherek & 4 others** 2004 JSSC 177 3254-62 (10972).
Synthetic $Ca(Ti_{0.6}Al_{0.2}Ta_{0.16}Nb_{0.04})OSiO_4$: XRPD structure, **RP Liferovich RH Mitchell** 2006 MM 70 115-21.
titanium Ti.
Occurrence, *coesite* eclogite, Dabieshan, China: **J Chen J Li J Wu** 2000 EPSL 177 237-40 (C1160).
titanium carbide TiC.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
[titanohematite Ti-bearing *hematite* in rocks; ?not formally named as mineral type.
Valence state mapping: **U Golla A Putnis** 2001 PCM 28 119-29 (1637).]
[titanomagnetite $Fe_{3-x}Ti_xO_4$, x = 0 to 1.
Common name for Ti-bearing *magnetite* in rocks; ?not formally named as mineral type.
Titanmagnetite: MM 31 974.
Structure: **MZ Stout P Bayliss** 1975 CM 13 86-8 (S1526);
ND, x 0.6 & 1, **H Boysen E Schmidbauer** 1984 GRL 11 165-8;
annealed *synthetics*, **BA Wechsler DH Lindsley CT Prewitt** 1984 AM 69 754-70;
Mössbauer, x 0 & 0.2, **H Tanaka M Kono** 1987 J Geomagnet Geoelectric 39 463-75;
& cation distribution, nanocrystals, **N Millot & 3 others** 1998 JSSC 139 66-78 (M1665).
Transformation to *titanomaghemite*, slow 2-step oxidation-ordering in mid-ocean-ridge basalt: **W Xu** 1997 AM 82 1101-10.
Low-T magnetism & memory of Fe-rich: **Ö Özdemir DJ Dunlop** 2003 EPSL 216 193-200 (9536).
Oxidation state of V, basic layered intrusions: **E Balan & 8 others** 2006 AM 91 953-6.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.]
titanotaramellite / titanotaramellite $Ba_4(Ti,Fe,Mg)_4B_2Si_8O_{27}O_2Cl_x$.
Isostructural series with Fe-rich analog *taramellite* & V analog *nagashimalite*.
Structure determination not found.
Occurrence: **JT Alfors A Pabst** 1984 AM 69 358-73.
titanowodginite $MnTiTa_2O_8$. *Wodginite* group.
Occurrence and crystallography: **TS Ercit P Cerny FC Hawthorne** 1992 CM 30 633.
tivanite $VTiO_3OH$.
Structure: **IE Grey EH Nickel** 1981 AM 66 866-71.
Occurrence: MM 46 527.
[tizenite?]
tlalocite $Cu_{10}Zn_6(TeO_3)(TeO_4)_2Cl(OH)_{25}.27aq$.
Structure determination not found.
Occurrence: **SA Williams** 1975 MM 40 221-6.

tlapallite $H_6(Ca,Pb)_2(Cu,Zn)_3(SO_4)(TeO_3)_4(TeO_6)$. Review: **Sabelli**, no structure.
Structure determination not found.
Occurrence & crystallography: **SA Williams M Duggan** 1978 MM 42 183-6.
tobelite $(NH_4,K)Al_2(Si_3Al)O_{10}(OH)_2$. *Mica* structure group.
Structure: XRPD & IR, **DE Harlov M Andrut B Poter** 2002 PCM 28 268-76;
order-disorder in *synthetic* $N(D,H)_4$, **M Mookherjee & 3 others** 2002 AM 87 1686-91.
Occurrence & XRPD: **S Higashi** 1982 MJJ 11 138-46 = AM 68 850.
Enthalpy of formation: **GL Hovis D Harlov M Gottschalk** 2004 AM 89 85-93.
tobermorite ~$[Ca_4(Si_6O_{18}H_2)]$.8 or 4 or 0aq.
Includes four orthorhombic subtypes: *1.4 nm*, *normal 1.1 nm*, *anomalous 1.1 nm*, & *0.93 nm*:
review, **HFW Taylor** 1992 ZK 202 41-50 (T387).
Also monoclinic *1.1nm clinotorbermorite*: **C Henmi I Kusachi** 1989 JJAMPEG 84 374-9;
C Henmi I Kusachi 1992 MM 56 353-8.
Real structure & order-disorder: **S Merlino E Bonaccorsi T Armbruster** 1999 AM 84 1613-21.
Normal 1.1 nm tobermorite, crystal structure:
HD Megaw CH Kelsey 1956 N 177 390-1;
KhS Mamedov NV Belov 1958 DAN SSSR 123 163-5;
SA Hamid 1981 ZK 154 189-98 (H980);
TEM of weak disorder in layering along a-axis: **D Viehland & 4 others** 1997 JACeS 80 3021-8 (V296).
IR: **P Yu RJ Kirkpatrick B Poe PF McMillan X Cong** 1999 JACeS 82 742-8 (Y240);
SC-XRD of order-disorder, **S Merlino E Bonaccorsi T Armbruster** 2001 EJM 13 577-90 (2068);
Al-subst, zeolitic Ca/aq, XRPD structure, **S Yamazaki H Toraya** 2001 JACeS 84 2685-90 (3475).
Review: **AE Zadov et al** 1995 ZVMO 124 36-54.
Anomalous 1.1 nm tobermorite, may contain Al & have interlayer bridges: **M Huber & 3 others** 1998 EJM 138 (H1368).
Occurrence in Skye basalt: **A Livingstone** 1988 MM 52 711-3.
Hydrothermal synthesis & Al substitution: **S Diamond JL White WL Dolch** 1966 AM 51 388-401.
Cation exchange in Na,Al-substituted- vs *ganophyllite*: **S Komarneni S Guggenheim** 1988 MM 52 371-5.
Morphology of fiber/plate, *synthetic* pH 12.6 423 K: **NS Bell & 3 others** 1996 JACeS 79 2175-8 (B1526).
Compare with *tacharanite* & *jennite*.
Mesostructure, C-S-H gel, Portland cement paste:
? Viehland J Li L Yuan Z Xu 1996 JACeS 79 1731-44 (V255);
Z Xu D Viehland 1996 PRL 77 952-5 (X15).
Molecular dynamics, structures of Ca Si silicates: **P Faucon JM Delaye J Virlet** 1996 JSSC 127 92-7 (F586).
Product of *quartz-portlandite* reaction: **J Wang A Tomita** 1997 Ind Eng Chem Res 36 1464-9 = CA 126:240543t.
Ca-EXAFS, Si NMR: **N Lequex A Morau S Philippot P Boch** 1999 JACeS 82 1299-306 (L987).
Al in CaSi-hydrates vs. Ca/Si, XRPD: **P Faucon & 5 others** 1999 JPC B 103 7796-802 (F672).
Al,K-substituted, Khibiny, XRPD, ED, structure model: **NI Organova & 8 others** 2002 CrR 47 950-6 (8724).
Dehydration *hillebrandite/* tobermorite/*xonotlite*, TGA/DSC, SAXS/WAXS: **S Shaw & 2 others** 2000 CG 167 141-59.
Synthesis of tobermorite & *xonotlite*, importance of Al, XRPD, **S Shaw & 2 others** 2000 CG 167 129-40 (S2151).
Synthesis Al-substituted from *zeolites*; ?separation of radioactive Cs: **S Komarneni & 3 others** 2002 MRB 37 1025-32.
Synthesis of fibers, and thermal stability: **X Huang D Jiang S Tan** 2002 MRB 37 1885-92 (8107).
Synthetic Sr-: **AR Felmy & 3 others** 2003 AM 88 73-9.
tochilinite $6(Fe_{0.9}S).5(Mg_{0.7}Fe_{0.3})(OH)_2$. *Mackinawite/brucite* interlayer structure.
Structure: **NI Organova VA Drits AL Dmitrik** 1973 SPC 17 667-73; **do** 1974 18 606-9;
ED, two phases, **do** 1974 AM 59 190-200;
ME Zolensky IDR Mackinnon 1986 AM 71 1201-9. MM 39 529.
In meteorites (complex formula): **AE Rubin** 1997 MPS 32 231-47.
tocornalite (Ag,Hg)I.
[jvs: XRPD does not match simple *synthetic* polymorphs of AgI.]
Occurrence: **B Mason** 1972 Smithsonian Contr Earth Sci 9 79-80;
CJ Barclay JB Jones 1971 J Geol Soc Australia 18 149-57 = AM 58 348.
todorokite $(Mn,Ca,Mg)Mn_3O_7$.aq.
Tunnel structure with 3x3 octahedral walls; contrast *cryptomelane* & *hollandite* with 2x2 walls.
Structure: ED polymorphs 2, 4 & 5 super-repeats, **FV Chukhrov & 3 others** 1978 Izvest Akad Nauk SSSR Ser geol no. 12 86-95 = AM 64 1333-4;
family, **S Turner PR Buseck** 1981 S 212 1024-5;

synthetic, **DC Golden CC Chen JB Dixon** 1986 S 231 717-**?**;
JE Post DL Bish 1988 AM 73 861-9 (P414);
H Miura 1991 J Faculty Science Hokkaido Univ IV 23 41-51;
100-820-K, XRPD, **JE Post PJ Heaney J Hanson** 2003 AM 88 142-50.
Propane reactions over natural & H-: **TK Katranas & 3 others** 2004 MMM 69 165-72 (10223).
Occurrence: MM 24 624-5.
C-Tl/Pb-bearing, Dukat ore field: **LG Filimonova & 2 others** 2002 DES 382 96-9 (7447).
Thermochemistry, framework/layer manganese dioxides: **S Fritsch & 3 others** 1998 ChM 10 474-9 (F596).
Synthetic OMS-1 industrial Mn oxide octahedral molecular sieve with todorokite 3x3 connectivity: **Y Shen & 5 others** 1992 JCSCC 1213-4 (S1082);
magnetics of spin glasses, **SL Suib LE Iton** 1994 ChM 6 429-39 (S1249);
Mg/Co/Ni/Cu/Zn-doped, **Y Yin & 4 others** 1994 ChM 6 1803-8 (Y141);
macrocrysts of *buserite* & transformation to OMS-1: **DT Fortin & 5 others** 1994 JCSCC 2211-2 (F499);
effect of Mg^{2+} ions on synthesis: **Z Tian Y Yin SL Suib** 1997 ChM 9 1126-33 (Y192);
Cu(II) vs structure/reactivity, **E Nicolas-Tolentino & 4 others** 1999 ChM 11 1733-41 (N510);
synthesis with microwave heating, **E Vileno & 5 others** 1999 JCa 187 285-97 (V353);
do.,**KA Malinger & 3 others** 2004 ChM 16 4296-303 (10775).
Synthetic Cu/Mg/Ni- from *buserite*: **FA Al-Sagheer MI Zaki** 2004 MMM 67 43-52 (9656).
Synthesis from *birnessite*: **XH Feng & 4 others** 2004 ChM 16 4330-6 (10776).
Bacterial production, Raman: **H Kim PC Stair** 2004 JPCB 108 17019-26 (10852).

[**tohdite / akdalaite** $5Al_2O_3$.aq.
Has ABAC hexagonal closest packing like *kappa-prime alumina* : **M Okumiya G Yamaguchi O Yamada S Ono** 1971 Bull Chem Soc Japan 44 418-23;
also see *kappa-alumina*, which is superstructure , **P Liu J Skogsmo** 1991 AC B47 425-33 (L656)).
Synthetic: **G Yamaguchi H Yanagida S Ono** 1964 Chem Soc Japan Bull 37 155-7 (Y143) = MM 38 1000;
structure refinement, **G Yamaguchi M Okumiya S Ono** 1969 Chem Soc Japan Bull 42 2247-9;
H Krischner 1966 Ber Deutsch Keram Gesell 43 479-84.
Natural: **DB Tilley RA Eggleton** 1994 ClClM 42 485-8 (T404).
Cation array Al oxide/hydroxide/oxyhydroxides: **A Ramos-Gallardo A Vegas** 1996 ZK 211 299-303 (R665).
Akdalaite stated to be the name replacing *tohdite*: **DB Tilley RA Eggleton** 1996 ClClM 44 658-64(T499).
Synthetic AlF_3-Al_2O_3-aq-HF: 673-973 K, 6 solids, including *corundum, diaspore*, "tohdite" & ralstonite-like phase, **PE Rosenberg** 2006 CM 44 125-34.]

tokkoite $K_2Ca_4[Si_7O_{18}OH](F,OH)$. Near-isostructural with *tinaksite*.
Description: **IV Rozhdestvenskaya & 2 others** 1989 ZK 189 195-204 (R475).

tokyoite $Ba_2Mn(VO_4)_2OH$. Isostructural with Fe analog *gamagarite* in *brackebuschite* group.
Occurrence & XRPD structure: **S Matsubara & 4 others** 2004 Japan J Mineral Petrol Sci 99 363-7 = AM 90 1468.

tolbachite $CuCl_2$.
Structure: **PC Burns FC Hawthorne** 1993 AM 78 187-9 (B1615).
Occurrence: MM 48 584.

tolovkite InSbS. *Cobaltite* structure group.
Structure: **P Bayliss** CM 24 27-33;
P Bayliss 1989 AM 74 1168-76.
Occurrence: MM 46 527.

tombarthite-Y $Y_4(Si,H_4)_4O_{12-x}(OH)_{4+2x}$.
Crystallography indicates *monazite* structure group, but OH requires subtle structural differences.
Structure: **H Neumann B Nilsen** 1968 Li 1 113-23 = AM 54 327-8.
Occurrence: MM 37 966.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

tomichite $(V,Fe)_4Ti_3AsO_{13}OH$. Essentially isostructural with *derbylite* $Fe_4Ti_3SbO_{13}OH$.
Structure: **IE Grey IC Madsen DC Harris** 1987 AM 72 201-8.
Occurrence & XRD: **EH Nickel IE Grey** 1979 MM 43 469-71.
Barian tomichite $Ba_{0.5}AsTi_2(V,Fe)_5O_{13}OH$: structure, **IE Grey IC Madsen DC Harris** 1987 AM 72 201-8.

tongbaite Cr_3C_2.

XRPD matches *synthetic*: structure, **S Rundqvist G Runnsjö** 1969 ACSc 23 1191-9 (R611).
Occurrence, XRD: **P Tian & 3 others** 1983 Acta Mineral Sinica 4 241-5 = AM 70 218.
[tongxinite CuZn. Tentative, not approved CNMMN. AM 85 264.]
tooeleite $Fe_8[(As,S)O_4]_6.5aq$.
Occurrence & crystallography: **FP Cesbron SA Williams** 1992 MM 56 71.
topaz $Al_2SiO_4(F,OH)_2$.
Fluor-topaz $Al_2SiO_4F_2$ & *hydroxy-topaz* $Al_2SiO_4(OH)_2$ are endmembers.
Structure: **WA Alston J West** 1928 Proc Roy Soc London A 121 358-67;
PH Ribbe GV Gibbs 1971 AM 56 24-30 (R234);
OH-rich, XR&ND, **J Zemann E Zobetz G Heger H Voellenke** 1979 Osterr Akad Wiss 6 145-7 = MA 81-1194;
ND, evidence for lower symmetry, **JB Parise C Cuff FH Moore** 1980 MM 43 943-4;
H position in *synthetic* OH-, XRD, **PA Northrup K Leinenweber JB Parise** 1994 AM 79 401-4;
IR & OH dipole, **K Shinoda N Aikawa** 1994 PCM 21 24-8; 1997 PCM 24 551-4 (S1832);
electron density & topochemistry, **YuV Ivanov & 4 others** 1998 AC B54 774-81 (I245);
EPR/optical absorption, "Imperial" gem, **S Schott & 3 others** 2003 EJM 15 701-6(9331);
SC-XRD, F vs cell lengths, **A Alberico & 3 others** 2003 EJM 15 875-82;
model H positions $Al_2SiO_4(OH)_2$: **SV Churakov B Wunder** 1004 PCM 31 331-41 (10220)
IR <30 GPa/Raman <17,F-rich natural /synthetic OH, **K Komatsu & 5 others** 2005 AM 90 266-70.
High-P *synthesis* of OH-rich: **B Wunder M Andrut R Wirth** 1999 EJM 11 803-13 (W994).
OH vs P to 36 GPa, IR: **SE Bradbury Q Williams** 2003 AM 88 1460-70.
Gem, Brazil: **MN Taran & 5 others** 2003 PCM 30 506-55.
Synthetic $CuAl_2Si_2O_7(F,OH)_2$, topaz-$CuSiO_3$ layer structure: **PE Izokh & 6 others** 1998 JSSC 141 527-36 (I244).
Synthetic $CuAl_2Si_2O_7Al_2$, polysomatic topaz-$CuSiO_3$ layer structure, SC-XRD: **OV Yakubovich LN Dem'yanetz W Massa** 2000 ZaaC 626 1514-8 (Y269).
Synthetic $Al_2GeO_4F_2$: XRPD structure, **MD Mathews AK Tyagi J Köhler** 2003 ZK 218 276 (10007).
Occurrence with *woodhouseite*: **RY Zhang JG Liou JF Shu** 2002 AM 87 445-53.
Gem, Klein Spitzkoppe, Namibia: **B Cairncross** 2005 MR 36 317-35.
torbernite $Cu(UO_2)_2(PO_4)_2.8$-12aq. *Autunite* structure group.
Review of torbernite-related minerals: **M Ross HT Evans Jr** 1965 AM 50 1-12.
Structure determination not found.
Synthesis: **R Berman** 1957 AM 42 905-8.
Occurrence: **C Frondel** 1958 USGS Bull 1064 170-7.
törnebohmite-Ce / toernebohmite $(Ce,La)_2Al(SiO_4)_2OH$.
Essentially isostructural with *fornacite* $Pb_2(Cu,Fe)CrO_4(As,P)O_4OH$.
Structure: **J Shen PB Moore** 1982 AM 67 1021-8.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
Synthetic $La/Ce_2Ge_3O_9$: **O Jarchow & 3 others** 1996 ZK 211 4-7 (J269).
törnebohmite-La $(La,Ce)_2Al(SiO_4)_2OH$.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
torreyite $\sim(Mg,Mn)_5Zn_2(SO_4)(OH)_{12}.4aq$.
Essentially isostructural with *lawsonbauerite* $(Mn,Mg)_5Zn_2(SO_4)(OH)_{12}.4aq$.
Structure determination not found. Review: **Sabelli** p.24.
Early data (MM 29 995) partly wrong, new XRPD: **PJ Dunn DR Peacor BD Sturman** 1979 AM 64 949-52.
tosalite Fe-rich relative of *bementite*.
Incomplete description: **T Yoshimura** 1967 Sci Rept Fac Sci Kyushu Univ D 9 1-485 = AM 55 1070.
tosudite $(Na,K)_xAl_6(Si,Al)_8O_{20}(OH)_{10}.n$ aq. 1:1 interstratified *chlorite-smectite*.
Occurrence & crystallography: **VA Frank-Kamenetskii & 2 others** 1963 ZVMO 92 560-65 = AM 49 816;
S Shimoda 1969 ClClM 17 179-84;
SW Bailey 1982 AM 67 394-8.
Occurrence, graywackes, Spain: **MD Ruiz Cruz B Andreo** 1996 EJM 8 1391-9 (R703).
tounkite / tunkite $\sim(Na,Ca,K)_8Al_6Si_6O_{24}(SO_4)_2,Cl.aq$. *Cancrinite* structure group.
Occurrence & crystallography: **VG Ivanov & 3 others** 1992 ZVMO 121 92-5 (I119).
Occurrence & structure: **AN Sapozhnikov & 4 others** 2004 ZVMO 133 76-93.
Structure: SC-XRD, **KA Rozenberg & 4 others** 2004 CrR 49 635-42 (10588).

TOURMALINE STRUCTURE GROUP Includes:

buergerite	$NaFe_3Al_6B_3Si_6O_{30}F$
chromdravite	$NaMg_3Cr_6B_3Si_6O_{27}(OH)_4$
dravite	$NaMg_3Al_6B_3Si_6O_{27}(OH,F)_4$
elbaite	$Na(Li,Al)_3Al_6B_3Si_6O_{27}(OH)_4$
ferridravite	$(Na,K)(Mg,Fe)_3Fe_6B_3Si_6O_{27}(O,OH)_4$
feruvite	$CaFe_3(Al,Mg)_6B_3Si_6O_{27}(OH)_4$
foitite	$(Fe,Al)_3Al_6(Si_6O_{18})(BO_3)_3(OH)_4$
liddicoatite	$Ca(Li,Al)_3Al_6B_3Si_6O_{27}(O,OH,F)_4$
magnesiofoitite	$(Mg_2Al)Al_6(Si_6O_{18})(BO_3)_3(OH)_4$
olenite	$Na_{1-x}Al_3Al_6B_3Si_6O_{27}(O,OH)_4$
rossmanite	$void(LiAl_2)Al_6B_3Si_6O_{27}(OH)_4$
schorl	$NaFe_3Al_6B_3Si_6O_{27}(OH)_4$
tsilaisite	manganoan elbaite
uvite	$(Ca,Na)(Mg,Fe)_3Al_5MgB_3Si_6O_{27}(OH,F)_4$

Nickeloan, in metamorphosed karstbauxite: **DJ Henry BL Dutrow** 2001 AM 86 1130-42.
Schorl-dravite series: crystal chemistry, **F Bosi S Lucchesi** 2004 EJM 16 335-44 (10326).
Dravite-chromdravite series: crystal chemistry, **F Bosi & 2 others** 2004 EJM 16 345-52 (10326).
Structure: **G Donnay MJ Buerger** 1950 AC 3 379-88;
MJ Buerger CW Burnham DR Peacor 1962 AC 15 583-90 (B151);
G Donnay 1977 AC A33 927-32;
V-containing, **FF Foit Jr PE Rosenberg** 1979 AM 64 788-98;
FF Foit Jr 1989 AM 74 422-31;
tsilaisite, **JD Grice TS Ercit** 1993 NJMA 165(3) 245-66 (G676, 785);
optical absorption, **MN Taran AS Lebedev AN Platonov** 1993 PCM 20 209-20;
Cu-bearing, **DJ MacDonald FC Hawthorne** 1995 AC C51 555-7;
elbaite-schorl, IR, **C Castaneda et al** 2000 AM 85 1503-7;
SC-XRD, **F Camara L Ottolini FC Hawthorne** 2002 AM 87 1437-42;
Mn-rich, Austria, SC-XRD, **A Ertl & 5 others** 2003 AM 88 1369-76;
Mn-, Elba, SC-XRD, **F Bosi & 4 others** 2005 AM 90 1661-8..
Classification: **FC Hawthorne DJ Henry** 1999 EJM 11 201-15 (H1411).
Structural mechanisms for light-element variations: **FC Hawthorne** 1996 CM 34 123-32.
Statistics of structural parameters vs. cation ordering: **A Pieczka** 1999 EJM 11 243-51 (P384).
Raman: **B Gasharova B Mihailova L Konstantinov** 1997 EJM 9 935-40 (G975).
Mössbauer of Fe valence & site occupancy: **MB Dyar & 5 others** AM 83 848-64.
Polyhedral distortions: **A Ertl & 6 others** 2001 CM 40 153-62.
Bond-valence constraints on chemical composition: **FC Hawthorne** 2002 CM 40 789-98.
Schorl-dravite series, structural chemistry: **ES Bloodaxe & 4 others** 1999 AM 84 922-8.
Tetrahedral boron, MAS-NMR: **SL Tagg H Cho MD Dyar ES Grew** 1999 AM 84 1451-5;
K Hughes JM Hughes MD Dyar 2001 EJM 13 743-7 (3619).
Tourmaline-out isograd in migmatite: **Kawakami** 2001 JMG 19 61-75 (1679).
Oxidation of Fe-, deprotonation: **Y Fuchs M Lagache J Linares** 2002 CRG 334 245-9 (7343).
High-T,P optical spectroscopy of Fe(III)-bearing: **MN Taran GR Rossman** 2002 AM 87 1148-53.

Yellow color vs irradiation vs O^- hole center: **K Krambrock & 5 others** 2004 31 168-175.
Oxidized: chemistry/XRD/Mössbauer, **A Pieczka J Kraczka** 2004 EJM 16 309-21 (10325).
Diffusion-control of cations in zoned: **SH Büttner** 2005 AM 90 471-90.
Hourglass sector zoning, major/trace elements in metamorphic: **VJ van HInsberg & 4 others** 2006 AM 91 717-28.
Mn-, Elba: growth history/marks, EPMA & XRD topography: **G Agrosi & 4 others** 2006 AM 91 944-52.
Occurrence: schorl-*oxy-schorl* /dravite-*oxy-dravite*, Czeck Rep, **M Novák & 2 others** 2004 EJM 16 323-33 (10324);
nickeloan, Urals, **IA Baksheev OE Kudryavtseva** 2004 CM 42 1065-78;
Lake District, England, **SG Eeckhout & 4 others** 2004 AM 89 1743-51;
Mount Mica gem pegmatite, **WB Simmons & 4 others** 2005 Rocks & Minerals 396-408.
Synthetic Fe-, Mössbauer: **Y Fuchs M Lagache J Linares** 1998 AM 83 525-34.

Synthetic olenite: **W Schreyer et al** 2000 EJM 12 529-41 (S2189).
Synthetic X-site vacant, Al-: **U Wodara W Schreyer** 2001 EJM 13 521-32 (2145).
Synthetic in Na-Mg-Al-Si-B-oxides-aq-HCl: **G von Goerne G Franz W Heinrich** 2001 CMP 141 160-73 (2149).
Synthetic Ag-rich: XRD structure, **D London & 5 others** 2006 AM 91 680-4.

toyohaite $Ag_2FeSn_3S_8$. Disordered *spinel* structure type.

Analog of *rhodostannite* $Cu_2FeSn_3S_8$ & *silver-rhodostannite* $AgCuFeSn_3S_8$.

Occurrence & crystallography: **J Yajima E Ohta Y Kanazawa** 1991 MJJ 15 222.

trabzonite $Ca_4Si_3O_{10}.2aq$.

Structure determination not found.
Occurrence: **H Sarp G Burri** 1986 SMPM 66 453.

tranquillityite $Fe_8(Zr,Y)_2Ti_3Si_3O_{24}$.

Occurrence: MM 38 1000.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

traskite $Ba_9Fe_2Ti_2(SiO_3)_{12}(OH,Cl,F)_6.6aq$. Order-disorder structure.

Structure: **YuA Malinovskii EA Pobedimskaya NV Belov** 1976 SPD 21 426-8 (T393).
Occurrence: MM 35 1157.

trattnerite $(Fe,Mg)_2(Mg,Fe)_3Si_{12}O_{30}$. *Milarite* group.

Occurrence & structure: **W Postl & 4 others** 2004 EJM 16 375-80

treasurite $Ag_7Pb_6Bi_{15}S_{32}$ *Lillianite* homologous series; 4,8 subtype.

Structure determination not found.
Occurrence & crystallography: **E Makovicky S Karup-Møller** 1977 NJMA 131 56-82 (M1210).
Occurrence: MM 42 530.

trechmanite $AgAsS_2$. Dimorphic with *smithite*.

Structure: **T Matsumoto W Nowacki** 1969 ZK 129 163-77 (M281).

trembathite $(Mg,Fe)_3B_7O_{13}Cl$. Analog of *congolite*. Dimorph of *boracite*.

Structure: **M Schindler FC Hawthorne** 1998 CM 36 1195-201.
Occurrence, crystallogr: **PC Burns FC Hawthorne JAR Stirling** 1992 CM 30 445-8 (B1603).
Phase transition *boracite*-trembathite-*congolite*: **PC Burns MA Carpenter** 1996 CM 34 881-92.

tremolite $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$. *Amphibole* structure group; monoclinic subtype.

Structure: F-, **M Cameron GV Gibbs** 1973 AM 58 879-88;
high-T, 673 & 973 K, **S Sueno & 3 others** 1973 AM 58 649-64;
FC Hawthorne HD Grundy 1976 CM 14 334-45;
high-P, 4 GPa, **P Comodi & 3 others** 1991 EJM 3 485-99;
XRD refinements, 140 & 295 K, **H Yang BW Evans** 1996 AM 81 1117-25 (Y194).
Fe-Mg order-disorder, tremolite-*actinolite-ferroactinolite* ambient/high T: **BW Evans H Yang** 1998 AM 83 458-75.
Al/Si & Al/Mg order calculation: **EJ Palin & 3 others** 2005 MM 69 1-20.
Enthalpy of formation: **W Kahl WV Maresch** 2001 AM 86 1345-57.
Synthetic: crystallography, **R Zimmermann W Heinrich G Franz** 1996 EJM 8 767-76 (T486).
Synthetic aluminous, structure: **DM Jenkins & 3 others** 1997 AM 82 280-90;
short-range order, IR & MAS-NMR: **FC Hawthorne & 5 others** 2000 AM 85 1716-24.
Thermal decomposition, TEM: **H Xu DR Veblen G Luo J Xue** 1996 AM 81 1126-32.
Synthesis from oxides via pyribole, TEM: **KN Bozhilov DM Jenkins DR Veblen** 2004 AM 89 74-84.
Stability: **JV Chernovsky Jr RG Berman DM Jenkins** 1998 AM 83 726-39.

trevorite $NiFe_2O_4$. *Spinel* structure group.

Structure determination not found.
[jvs: structure of *synthetic* done, but reference needs finding.]
Occurrence: ferroan-, **SA deWaal** 1969 AM 54 1204-8;
NS Muravyeva VG Senin 1993 MM 57 171-3.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.

triangulite $Al_3(UO_2)_4(PO_4)_4$ $(OH)_5.5aq$.

XRPD similar to *mundite* & *ranunculite* [jvs: but proposed cell dimensions differ.]
Occurrence & SC-XRD: **M Deliens P Piret** 1982 BM 105 611-4.

tridymite-low(alpha) SiO_2.

Polymorph (actually several variants) of *coesite*, *cristobalite*, *melanophlogite*, *moganite*, *quartz*,

stishovite & many *synthetic* phases.
Nepheline family is based on stuffing of tridymite.
High-low transition from monoclinic (low) via orthorhombic varieties (intermediate) to hexagonal (high): review & new data, **D Cellai & 3 others** 1994 AM 79 606-1;
ED, **RL Withers & 3 others** 1994 PCM 21 421-33;
neutron total scattering, Rigid Unit Mode theory, **MT Dove AKA Pryde DA Keen** 2000 MM 64 267-83.
Superstructure: **WA Dollase WH Baur** 1976 AM 61 971-78.
Synthetic: **WH Baur** 1977 AC B33 2615-9 (B840).
Crystal structure: **JH Konnert DE Appleman** 1978 AC B34 391-403 (K776).
3 polymorphs at room T, MC, PO-n & MX-1, **H Graetsch OW Flörke** 1991 ZK 195 31-48 (G618).
Phase transitions: high-T, **RF de Dombal MA Carpenter** 1993 EJM 5 607-22;
IR, **D Cellai & 4 others** 1995 PCM 22 50-60.
^{29}Si NMR of MX-1: **Y Xiao RJ Kirkpatrick YJ Kim** 1995 PCM 22 30-40 (X11).
Synthetic L3-T_O (MX-1): **H Graetsch I Topalovic-Dierdorf** 1996 EJM 8 103-13 (G843);
characterization from 298 to 523 K, **H Graetsch** 1998 AM 83 872-80.
^{29}Si MAS-NMR & structure, monoclinic type, high T: **SJ Kitchin & 4 others** 1996 AM 81 550-60.
Raman, normal modes, disorder, monoclinic & higher-T orthorhombic: **K Kihara & 2 others** 2005 JMPS 100 91-103.
XRD, DTA. Raman, , disorder, monoclinic & higher-T orthorhombic: **H Hirose & 4 others** 2005 JMPS 100 55-69.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.
In meteorites: **AE Rubin** 1997 MPS 32 231-47.
[*yoshiokaite* $Ca_{8-0.5x}Al_{16-x}Si_xO_{32}$, x = 2.8-6.0.
Stuffed derivative of high tridymite; similar to *nepheline*.
Structure: **IM Steele JJ Pluth** 1990 AM 75 1186-9.]
Synthetic $BAsO_4/AlPO_4/GaPO_4/MnPO_4$?, summary: **E Philippot & 3 others** 1994 JSSC 110 356-62 (P452).
Synthetic $CsMnPO_4$: 1990 SPC 35 22-5.
Synthetic $KLiSO_4$: **PL Zhang QW Yan JX Boucherle** 1988 AC C44 592-5 (Z94).
Synthetic $AlPO_4$: NMR of phase transitions, **Y Xiao RJ Kirkpatrick** 1995 JMR 10 2586-90 (X13);
two types from XRPD, **do** 2000 AC C56 401-3 (3612);
hexagonal high-T, XRPD structure, **HA Graetsch** 2001 AC C57 665-7 (2150).
Synthetic $LiCsSO_4$, XR & NPD, transitions: **L Mestres & 5 others** 1999 CrR 44 78-83(M1718).
Synthetic alpha-$KZnPO_4$, phase transitions: **G Wallez & 3 others** 1999 MRB 34 1251-61 (W989).
Synthetic LiGaO, structure: **GM Kuz'micheva & 3 others** 2001 IMa 37 281-5 (1762).
tridymite-intermediate & high (beta) SiO_2. See above.
Orthorhombic (incommensurate) at 473K, **WA Dollase** 1967 AC 23 617-23 (S229);
orthorhombic at 378-453K, **K Kihara** 1977 ZK 146 185-203 (K450);
hexagonal at 733K, *synthetic*, **do** 1978 ZK 148 237-53 (K448);
A Nukui H Nakazawa M Akao 1978 AM 63 1252-9;
split-atom model for hexagonal, **K Kihara** 1980 ZK 152 95-101 (K449);
polymorphs & polytypes MC, MX-1 & PO, **M Wennemer AB Thompson** 1984 SMPM 64 335-53;
structural pathology, **OW Flörke A Nukui** 1988 NJMA 158 175-82;
orthorhombic-I at 443-693K, **K Kihara T Matsumoto M Imamura** 1986a,b ZK 177 27-38, 39-52;
T behavior, 2 types terrestrial tridymites, **EA Smelik RR Reeber** 1990 PCM 17 197-206;
modulated structure at 383-493 K, XRPD, **H Graetsch** 2001 PCM 28 313-21 (2151).
[trieuite $2Co_2O_3.CuO.6aq$. Amorphous. Occurrence: MM 24 625.]
trigonite $Pb_3Mn(AsO_3)_2AsO_2OH$. ?relation to *rouseite*.
Structure: **F Pertlik** 1978 TMPM 25 95-105 (P535) = MA 81-1241.
trikalsilite $(K,Na)AlSiO_4$. Stuffed *tridymite* structure type.
Polymorphic with *kaliophilite, kalsilite* & *panunzite (tetrakalsilite)*, but subtle differences in composition range.
Structure: **E Bonaccorsi S Merlino M Pasero** 1988 NJMM 559-67 (B936).
Definition: MM 31 974.
trilithionite *Mica* structure group; 1M & $2M_2$ polytypes.
Series with *polylithionite.*
Structure: $2M_2$ polytype, **MF Brigatti & 4 others** 205 EJM 17 476-81.

trimerite $CaMn_2Be_3(SiO_4)_3$. Structure contains same net as *beryllonite*.
Structure: **KH Klaska O Jarchow** 1977 ZK 145 46-65 (K613).
trimounsite-Y $(Y,REE)_2Ti_2SiO_9$.
Occurrence and crystallography: EJM 2 725.
Structure: **U Kolitsch** 2001 EJM 13 761-8 (3609).
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.
[trinepheline $NaAlSiO_4$. Not a mineral.
Synthetic distorted UDUDUD sequence of *tridymite* type, structure: **V Kahlenberg** 1997 EJM Suppl 9-1 177 (K966).
Synthetic, SC-XRD, structure: **V Kahlenburg H Böhm** 1998 AM 83 631-7.]
TRIPHYLITE STRUCTURE SUBGROUP Includes:

ferrisicklerite	$Li(Fe^{3+},Mn^{2+})PO_4$
heterosite	$(Fe,Mn)PO_4$
lithiophilite	$Li(Mn^{2+},Fe^{2+})PO_4$
purpurite	$(Mn,Fe)PO_4$
sicklerite	$Li(Mn^{2+},Fe^{3+})PO_4$
simferite	$\sim LiMg_2(PO_4)_2$
triphylite	$Li(Fe,Mn)PO_4$

Olivine structure type.
triphylite $Li(Fe,Mn)PO_4$. Triphylite structure subgroup in *olivine* structure group.
Structure: **LW Finger GR Rapp Jr** 1970 Carnegie Institution Year Book 68 290-3 (F140);
OV Yakubovich MA Simonov NV Belov 1978 SPD 22 347-50 (Y118);
VA Streltsov & 3 others 1993 AC B49 147-53;
Mössbauer, **Z Li I Shinno** 1997 MJ 19 99-107 (L921).
After oxidation at 943K, disordered olivine type: **S Deganello** 1978 NJMM 128-34.
triplite $(Mn,Fe,Mg,Ca)_2(PO_4)(F,OH)$.
Structural series with Mg_2PO_4F *wagnerite* & $(Fe,Mn,Mg,Ca)_2(PO_4)(F,OH)$ *zwieselite*.
Structure: **L Waldrop** 1969 ZK 130 1-14.
TRIPLOIDITE STRUCTURE GROUP Includes:

sarkinite	Mn_2AsO_4OH
triplite	$(Mn,Fe,Mg,Ca)_2(PO_4)(F,OH)$
triploidite	$(Mn,Fe)_2\ PO_4OH$
wagnerite	$Mg_2(PO_4)F$
wolfeite	$(Fe,Mn)_2(PO_4)OH$
zwieselite	$(Fe,Mn,Mg,Ca)_2(PO_4)(F,OH)$

triploidite $(Mn,Fe)_2PO_4OH$. Triploidite structure group.
Structure: **L Waldrop** 1970 ZK 131 1-20 (W713).
TRIPPKEITE STRUCTURE GROUP Includes:

minium	$PbPb_2O_4$
schafarzikite	$FeSb_2O_4$
trippkeite	$CuAs_2O_4$

[jvs: based on **Povarennykh** p.306; needs checking in detail.]
trippkeite $CuAs_2O_4$. Review: (E289).
Structure: *synthetic*, **F Pertlik** 1975 TMPM 22 211-7.
Synthesis: **F von Pertlik** 1977 ZaaC 436 201-6.
tripuhyite $FeSbO_4$. *Rutile* structure group. Probably rutile structure.
Squawcreekite may be distinct with *trirutile* structure.
Structure: SC-XRD, **P Berlepsch & 4 others** 2003 MM 67 31-46;
synthetic & natural, XRPD, **R Bassi & 4 others** 2003 NJMM 407-20 (9616).
Occurrence, -rutile solid solution, India: **R Cabella & 5 others** 2003 EJM 15 427-34.
trirutile See *rutile* & *tapiolite*.
tristramite $(Ca,U,Fe)(P/SO_4).2aq$. *Rhabdophane* structure group.

Occurrence: **D Atkin IR Basham JFW Bowles** 1983 MM 47 393-6.

tritomite-Ce $(Ce,La,Y,Th)_5(Si,B,Al)_3(O,OH,F)_{13}$.

Metamict, recrystallizes to *apatite* structure.

Review of occurrences & heat treatment: **HW Jaffe VJ Molinski** 1962 AM 47 9-25.

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

tritomite-Y $(Y,Ca,La,Fe)_5(Si,B,Al)_3(O,OH,F)_{13}$.

Metamict, recrystallizes to *apatite* structure.

Review of occurrences & heat treatment: **HW Jaffe VJ Molinski** 1962 AM 47 9-25.

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

trögerite = troegerite $(UO_2)_3(AsO_4)_2.12aq$. *(Meta?)-autunite* structure group.

Structure determination not found.

Occurrence: **C Frondel** 1958 USGS Bull 1064 187-91.

Phase transition tetragonal >~296K to lower symmetry: **MAR de Benyacar MEJ de Abeledo** 1974 AM 59 763-7.

Unnamed mineral phosphate analog: **LN Belova VI Litenkova LE Novorosova** 1963 = AM 50 265.

trogtalite $CoSe_2$. *Pyrite* structure group. Dimorphic with *hastite*.

Structure determination not found.

3d transition metal L-edge XAS, **JM Charnock & 3 others** 1996 PCM 23 403-8 (C878).

Occurrence: **P Ramdohr M Schmidt** 1955 NJMM 133-42 (R536) = AM 41 164-5.

troilite FeS. Ideal endmember of $Fe_{1-x}S$ series named *pyrrhotite*.

Niccolite-NiAs hexagonal structure type with root-3a,2c superstructure at low temperature.

Structure: **G Hägg I Sucksdorff** 1933 Z phys Chem B22 444-52;
EF Bertaut 1956 BSFMC 79 276-92;
ND, **AF Andresen** 1960 Acta Chem Scand 14 919-26;
ND, 873-373 K, **C Tenailleau & 5 others** 2005 MM 69 205-16;
inversion twinning, two meteoritic, one *synthetic*. **R Skála & 2 others** 2006 AM 91 917-21.

Lunar troilite: refinement of low-T superstructure, **HT Evans Jr** 1970 Proc Apollo 11 Lunar Sci Conf 1 399-408= MA 71-2118.

Meteoritic troilite: TEM, **J Töpel-Schadt WF Müller** 1982 PCM 8 175-9.

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

With increasing P, the type I structure transforms into MnP-type (FeS-II) at 3.4 GPa, FeS-III with uncertain structure (possibly monoclinic distortion of *niccolite* type) at 6.7 GPa & FeS-IV (NiAs superstructure with 2a,1c) at 6.7 GPa: **Y Fei CT Prewitt H Mao CM Bertka** 1995 S 268 1892-4 (F446);
K Kusaba & 3 others 1997 JPCS 58 241-6 (K978).

Phase II: **HE King Jr CT Prewitt** 1982 AC B38 1877-87.

Phase III: **CT Prewitt Y Fei** 1994 IMA Pisa 336-7.

Phase transition from P6sub3/mmc to Pbar62c in *synthetic* $Fe_{0.996}S$, high-T XRPD & DTA: **F Li F Franzen** 1996 JAlCo 238 73-80 (L756); also references to papers not listed above.

High-P ND, collinear antiferromagnetic MnP-type 4 GPa, & disordered Type III 9 GPa: **W Marshall & 5 others** 2000 PRB 61 11201-4 (M1834).

Electronic structure, XAS & band structure calculations: **M Womes & 6 others** 1997 JPCS 58 345-52 (W847).

Pyrrhotite consists of several structure types with composition $Fe_{1-x}S$.

Fe-FeS eutectic T to 6.2 GPa: **R Boehler** 1996 PEPI 96 181-6 (B1525).

Relative stability & equation-of-state of FeS polymorphs: **P Martin GD Price L Vocadlo** 2001 MM 65 181-91.

Phonon density/compression at high P: **H Kobayashi & 5 others** 2004 PRL 93 195503 (10971).

trolleite $Al_4(PO_4)_3(OH)_3$.

Structure: **PB Moore T Araki** 1974 AM 59 974-84.

[trömelite ~$7CaO.5P_2O_5$. *Synthetic*. MM 27 275.]

trona $Na_3(HCO_3)(CO_3).2aq$.

Structure: **CJ Brown HS Peiser A Turner-Jones** 1949 AC 2 167-74;
neutron, **GE Bacon NA Curry** 1956 AC 9 82-5;
CS Choi AD Mighell 1982 AC B38 2874-6.

Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995;
with *thermonatrite* in alkali soil , India: **S Datta & 6 others** 2002 Ep 25 236-9 (9557).

[trudellite $Al_2(SO_4)_3.4AlCl_3.4Al(OH)_3.30aq$.

Occurrence: MM 21 579.]

truscottite ~$2CaO.4SiO_2$.aq.
Structurally related to *gyrolite*, *minehillite* & *reyerite*: **PJ Dunn & 3 others** 1984 AM 69 1150-5;
AL Mackay HFW Taylor 1954 MM 30 450-7;
XaS Mamedov NV Belov 1958 DAN 121 720-3.
Synthetic K-phase (cement materials group) $Ca_7Si_{16}O_{40}H_2$: **JA Gard K Luke HFW Taylor** 1981 SPC 26 691-5 (G700).
trüstedtite / trustedtite Ni_3Se_4.
Linnaeite goup of sulfides, etc with *spinel* structure type. Dimorphic with *wilkmanite*.
Structure determination not found.
Occurrence: **Y Vuorelainen A Huhma A Häkli** 1964 Compt Rend Soc Geol Finlande 36 113-25 .
tsaregorodtsevite $N(CH_3)_4[Si_2(Si_{0.5}Al_{0.5})O_6]$.
Sodalite with encapsulated TMA (tetra-methyl-ammonium).
Structure: **EV Sokolova & 3 others** 1993 DAN 332 309-11;
changes on annealing, **BL Sherriff & 5 others** 1997 AM 82 405-15.
Occurrence: MM 60 684.
tschermakite $Ca_2(Mg,Fe)_3Al_2(Si_6Al_2)O_{22}(OH)_2$.
Amphibole structure group; monoclinic subtype.
Structure determination not found.
Occurrence: DHZ; MM 27 275.
tschermigite $(NH_4)Al(SO_4)_2.12aq$. *Alum* structure group. Review: *Sabelli* p. 10.
Structure: **AM Abdeen & 5 others** 1982 ZK 157 147-66.
Raman: **RL Frost JT Kloprogge** 2001 NJMA 27-40 (951).
Occurrence, steam condensate, Taupo, NZ: **KA Rodgers & 4 others** 2000 MM 64 125-42.
Synthetic $(NH_3OH)Al(SO_4)_2.12aq$: **AM Abdeen G Will A Weiss** 1981 ZK 154 45-57 (A610).
tschernichite $Ca_{1.0-0.7}Na_{0.0-0.1}Si_{6.0-6.3}Al_{2.0-1.7}O_{16}.4-8aq$.
Has the same net topology as the *synthetic* zeolite Beta.
Both the synthetic & natural phases are heavily faulted.
IZA-SC structure code BEA*.
Consortium for Theoretical Frameworks nets 577-9: Beta-A, -B, -C.
Structure: **JV Smith & 3 others** 1991 JCSCC 363-4 (S1530);
tetragonal & monoclinic polytypes, natural Antarctica, **A Alberti & 7 others** 2002 JPCB 106 10277-84 (804).
Occurrence: Goble, Oregon, **RC Boggs & 3 others** 1993 AM 78 822-5;
Antarctica, **E Galli & 3 others** 1995 EJM 7 1029-32 (G817).
Physical properties: **R Szostak KP Lillerud M Stöcker** 1994 J Catal 148 91-9 (S1366).
TEM imaging of extreme faulting: **R Szostak M Pan KP Lillerud** 1995 JPC 99 2104-9 (S1412).
Vibration spectroscopy, ammonium-: **A Zecchina & 4 others** 1997 JPC B 101 10128-35 (Z156).
Structure of *Beta*: **JB Higgins RB & 6 others** 1988 Z 8 446-52 (H716,1042), correction 9 398;
JM Newsam & 3 others 1988 Proc R Soc London A 420 375-405 (N394);
MMJ Treacy JM Newsam 1988 N 332 249-51 (T333);
NMR, **J Pérez-Pariente & 3 others** 1990 JCa 124 217-23 (P397);
lattice-energy model, **SM Tomlinson RA Jackson CRA Catlow** 1990 ChC 813-6 (T355);
R Boehme 1993 Phase Transitions 43 95-9;
Pt clusters vs reduction rate, **E Creyghton & 5 others** 1996 JCSF 92 4637-42;
Al XPS, **F Collignon & 3 others** 2001 JPCB 105 6812-6 (2336);
Beta-C overgrowth, ED, **T Ohsuna & 4 others** 2002 JPCB 106 5673-8 (7357);
FTIR of Al-Lewis site, **O Bortnovsky & 3 others** 2002 JCa 210 171-82;
NMR of dealuminated, **H Kao Y Chen** 2003 JPCB 107 3367-75 (9096);
de/re-aluminated, XRD/FTIR/NMR, **A Omegna & 4 others** 2004 PCCP 447-52 (9932);
Si/Al vs MAS-NMR, **A Abraham & 5 others** 2004 PCCP 6 3031-6 (10426).
Synthetic Fe-: **R Kumar & 3 others** 1990 Z 10 85-9;
Mössbauer, **R Kumar & 3 others** 1991 Z 11 211-3;
RB Borade A Clearfield 1994 MiMa 2 167-77.
Synthetic varied Al,Si-: NMR, **J Perez-Pariente & 3 others** 1990 JCa 124 217-23 (P397).
Synthetic protonated Al-: **E Bourgeat-Lami & 5 others** 1991 Appl Catal 72 139-52.
Synthetic Ti-: **T Blasco & 3 others** 1993 JAChS 115 11806-13;

XANES, EXAFS, **RJ Davis & 3 others** 1995 Catal Lett 34 101-13 = CA 123: 209735w;
XANES/EXAFS/NMR/XRD/IR/Raman/UV: **T Blasco & 7 others** 1998 JPCB 102 75-88.
Synthetic all-Si-: **JC van der Waal MS Rigutto H van Bekkum** 1994 JCSCC 1241-2 (V194);
hydrophibicity, **J Stelzer & 3 others** 1998 MMM 22 1-8 (S1968).
Synthetic V,Al,B-: **T Sen M Chatterjee S Sivasanker** 1995 JCSCC 207-8.
Synthesis of Beta & Ti-Beta: **U Lohse & 6 others** 1997 JCSF 93 505-12 (L805).
Synthetic V-containing: **S Chien J Ho S Mon** 1997 Z 18 182-7.
Synthetic Beta, Al sites vs acidic/basic media: **C Yang Q Xu** 1997 Z 19 404-10 (Y222).
Synthetic faulted, unique acidity at defects: **JC Jansen & 4 others** 1997 Catal Today 38 205-12.
Synthetic H-Beta, IR & thermal analysis: **B Su V Norberg** 1997 Z 19 65-74.
Synthetic Al-rich Beta: **F Vaudry & 4 others** 1997 Z 19 253-8.
Synthetic Beta Si & Al MAS-NMR: **G Valerio & 5 others** 1998 JACS 120 11426-31 (V317).

Synthetic Al-free Ti: **JC van der Waal & 3 others** 1998 MMM 25 43-57 (V321).
Synthetic Na-Beta-benxene complex, IR: **B Su V Norberg** 1998 La 14 7410-9 (S2003).
Synthetic zincosilicate CIT-6 with TEA-OH, extraction of TEA-OH with acetic acid, synthesis with
Al or post-synthesis insertion: **T Takewaki LW Beck ME Davis** 1999 JPCB 103 2674-9.
Synthetic, epitaxial growth on SSZ-31 fibers: **S Nair & 3 others** 1999 ChC 921-2 (N506).
Synthetic Ga-Beta: FTIR, adsorption, **ML Ocelli & 3 others** 1999 MMM 30 219-32 (O397);
from F-bearing media, XRPD etc, **JE Hazm & 4 others** 2001 MMM 43 11-25 (1389).
Synthetic Pt/Ga/H-, XAS: **KJ Chao & 3 others** 2000 MMM 35-36 413-24 (C1147).
Ammonium exchange & steaming, MAS-NMR, acid sites: **GH Kuehl HKC Timken** 2000 MMM 35-36 521-32 (K1230).
Benzene location in Na-Beta upon coadsorption of ammonia/methylamine: **B Su V Norberg** 2000 La16 6020-8 (S2191).
Dealuminated Beta & ZSM-12, ammonia-STPD, FTIR, MAS-NMR: **W Zhang & 3 others** 2000 JPCB 104 4122-9 (Z219).
Li accessibility in ZSM-5 & Beta, NMR: **RJ Accardi RF Lobo** 2000 MMM 40 25-34 (222).
Co-exchanged H-BEA: **O Bortnovsky Z Sobalik B Wichterlova** 2001 MMM 46 265-75 (2317).
Co(II) ions in dehydrated Beta, UV-Vis-NIR & FTIR: **F Dededcek & 4 others** 2002 JCa 211 198-207 (8192).
Synthetic Sn-, heterogeneous chemoselective catalyst: **A Corma & 3 others** 2001 N 412 423-5 (2902).
Synthetic all-Si, crystallization mechanism, F medium: **DP Serrano & 4 others** 2001 MMM 46 35-46 (2903).
Synthetic BEA, reversible dealumination: **Y Oumi & 6 others** 2001 MMM 49 103-9 (3483).
Synthetic BEA, Zn-exchanged, XAS, NMR: **J Penzien & 6 others** 2004 JCB 108 4116-26 (10158).
Synthetic Ti-Beta, effect of F on catalysis: **Y Goa P Wu T Tatsumi** 2004 JPCB 108 4242-4 (10143).
Growth defects in Beta, HRTEM: **PA Wright & 3 others** 2004 JAChS 127 494-5 (10982).
tschörtnerite $(K,Ca,Sr,Ba)_3Ca_4Cu_3[Si_{12}Al_{12}O_{48}(OH)_8.$~20aq. *Zeolite* family.
Consortium for Theoretical Frameworks net 207.

Structure: **H Ellenberger G Giester W Krause H Bernhardt** 1998 AM 83 607-17 (E443).
tsepinite-Ca $(Ca,K,Na,\square)_2(Ti,Nb)_2(Si_4O_{12})(OH,O)_2.4aq$. *Labuntsovite* group.
Occurrence & SC-XRD structure: **IV Pekov & 5 others** 2003 NJMM 461-80 (9500).
tsepinite-K $(K,Ba,Na)_2(Ti,Nb)_2(Si_4O_{12})(OH,O)_2.3aq$. *Labuntsovite* group.
Occurrence: **NV Chukanov & 6 others** 2003 ZVMO 132 38-51.
tsepinite-Na $(Na,H_3O,K,Sr,Ba)_2(Ti,Nb)_2[Si_4O_{12}](OH,O)_2.3aq$. *Labuntsovite* group.
Occurrence: **ZV Shlyukova & 5 others** 2001 ZVMO 3 439.
tsepinite-Sr $(\sim Na,Ca)KSr(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4.4aq$. *Labuntsovite* group.
Structure: **KA Rozenberg & 4 others** 2003 DAN 393 784-7 = AM 89 1929.
tsnigriite $Ag_9SbTe_3(S,Se)_3$.
Structure determination not found.
Occurrence, XRPD & EM: **SM Sandomirskaya & 6 others** 1992 ZVMO 121 95-101 (S1354).
tsugaruite $Pb_4As_2S_7$.
Occurrence & crystallography: **M Shimizu & 5 others** 1998 MM 62 793-9.
TSUMCORITE MINERAL GROUP

Lotharmeyerite subgroup

cabalzarite	$Ca(Mg,Al,Fe)_2(AsO_4)_2.2(aq,OH)$
cobaltlotharmeyerite	$Ca(Co,Fe,Ni)_2(AsO_4)_2(OH,aq)_2$
cobalttsumcorite	$Pb(Co,Fe)_2(AsO_4)_2.(aq/OH)_2$
ferrilotharmeyerite	$Ca(Fe,Zn)_2(AsO_4)_2(OH,aq)_2$
gartrellite	$Pb(Cu,Fe)_2(AsO_4)_2(OH,aq)_2$
helmutwinklerite	$Pb(Zn,Cu)_2(AsO_4)_2(OH,aq)_2$
lotharmeyerite	$Ca(Zn,Mn^{3+})_2(AsO_4)_2(aq,OH)$
lukrahnite	$CaCuFe(AsO_4)_2(OH).aq.$
manganlotharmeyerite	$Ca(Mn^{3+},void,Mg)_2\{(AsO_4,[(AsO_2(OH)_2]\ _2(OH,aq)_2$
mawbyite	$Pb(Fe,Zn)_2(AsO_4)_2(OH,aq)_2$
mounanaite	$PbFe_2(VO_4)_2(OH,aq)_2$
[natrochalcite	$NaCu,Fe_2S_2(OH,aq)_2]$
nickellotharmeyerite	$Ca(Ni,Fe)_2(AsO_4)_2.(aq/OH)_2$
nickelschneebergite	$BiNi_2(AsO_4)_2OH.aq.$
phosphogartrellite	$Pb(Cu,Fe)_2(PO_4)_2(OH,aq)_2$
schneebergite	$BiCo_2(AsO_4)_2OH.aq$
thometzekite	$Pb(Cu,Zn)_2(AsO_4)_2(OH,aq)_2$
thometzekite (sulfatian)	$Pb(Cu,Zn)_2\ [(As,S)O_4)]_2(OH,aq)_2$
tsumcorite	$PbZnFe(AsO_4)_2.aq$
rappoldite	$Pb(Co,Fe,Ni)_2(AsO_4)_2.2aq$
zincgartrellite	$Pb(Zn,Fe,Cu)_2(AsO_4)_2.2(aq,OH)$

Properties & crystal chemistry: **W Krause & 5 others** 1998 EJM 10 179-206 (K1056).
Raman/IR: **RL Frost M Weier** 2004 NJMM 317-36 (10660).
Synthetic $SrCo_2(AsO_4)(AsO_3OH)OH.aq$: SC-XRD structure, **T Mihajlovic H Effenberger** 2004 MM 68 757-67.
tsumcorite $PbZnFe(AsO_4)_2.aq$. *Tsumcorite* group.
Structure: **E Tillmans W Gebert** 1973 AC B29 2789-94 (T454).
Occurrence: MM 38 1000.
tsumebite $Pb_2Cu(PO_4)(SO_4)OH$. *Brackebuschite* structure group.
Review: **Sabelli** p. 35; (E289).
Structure: **L Fanfani PF Zanazzi** 1967 MM 36 522-9;
C Sabelli PF Zanazzi 1968 AC B24 1214-21.
tsumgallite GaO(OH). Isostructural with *goethite & diaspore*.
Occurrence & XRPD: **J Schlüter & 3 others** 2003 NJMM 521-7.
tsumoite BiTe.

Tetradymite mineral/structure group, tsumoite subgroup: **P Bayliss** 1991 AM 76 257-65.
Structure: **B Yamana K Kihara T Matsumoto** 1979 AC B35 147-9.
Occurrence: MM 43 1068.

tucekite $Ni_9Sb_2S_8$. *Hauchecornite* structure group.

Structure determination not found.
Occurrence & XRPD: **J Just CE Feather** 1978 MM 42 278 & M21-2.

tugarinovite MoO_2. Matches *synthetic*.

Occurrence: MM 46 527-8.

tugtupite $Na_4BeAlSi_4O_{12}Cl$. *Sodalite* structure group.

Structure: **I Hassan HD Grundy** 1991 CM 29 385-90;
M Dano 1966 AC 20 812-6;
MAS-NMR, **Z Xu BL Sherriff** 1994 CM 32 935-43;
compressibility to 6 GPa, **S Werner A Plech** 1995 ZK 210 418-20 (W712);
^{9}Be, ^{23}Na, ^{27}Al & ^{29}Si MAS-NMR & SC-XRD: **J Skibsted & 3 others** 1995 Solid State Nucl Magn Reson 5 239-55 = CA 124:74502r;
electronic & NMR quadrupole, **B Zhou BL Sherriff** 2004 AM 89 377-81;
XRPD, to 1255 K, **SM Antao I Hassan JB Parise** 2004 AM 89 402-7.
Occurrence: MM 33 1152.

tuhualite $(Na/K)Fe^{2+}Fe^{3+}Si_6O_{15}$.

Essentially isostructural with *zektzerite* $NaLi(Zr,Ti,Hf)Si_6O_{15}$ & $Na_2Mg_2Si_6O_{15}$.

2,3-connected octahedral-tetrahedral net.
Structure: **S Merlino** 1969 S 156 1399-401 (M289).
Optical spectra, **MN Taran GR Rossman** 2001 AM 86 973-80.
Occurrence: MM 23 638.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

tuite $Ca_3(PO_4)_2$–gamma. High-P polymorph of *whitlockite*.

Occurrrence in Suizhou L6 chondrite: **X Xie & 6 others** 2003 EJM 15 1001-5 (10001).

tulameenite (Cu,Fe)Pt. *Tetra-auricupride* structure group. Pearson structure code tP_2.

Structure & order-disorder: **P Bayliss** 1990 CM 28 751-5;
M Shahmiri S Murphy DJ Vaughan 1985 MM 49 549-54.
Occurrence: MM 39 929.
Phase relations in Pt-Fe & Pt-Fe-Cu systems: **JFW Bowles** 1990 MP 43 37-47 (B1345).
"*Cuproplatinum*" is actually tulameenite: **LJ Cabri AD Genkin** 1991 CM 29 419-25.

tuliokite $Na_6BaTh(CO_3)_6.6aq$.

Occurrence: **VN Yakovenchuk & 5 others** 1990 MZh 12 74-8 = MM 54 670.

tumchaite $Na_2(Zr,Sn)Si_4O_{11}.2aq$. Isotypic with *penkvilksite-1M*.

Occurrence & SC-XRD structure: **VV Subbotin & 8 other**s 2000 AM 85 1516-20.
Synthetic $Na_2(Zr/Hf)Si_4O_{11}.2aq$ = AV-14, structure, XRPD, SEM: **Z Lin J Rocha** 2004 MMM 76 99-104 (10909).

tundrite-Ce $Na_3(Ce,La)_4(Ti,Nb)_2(SiO_4)_2(CO_3)_3O_4OH.2aq$.

Occurrence: **ZV Zhlukova & 5 others** 1973 DAN SSSR 211 426; revised from MM 35 1157.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

tundrite-Nd $Na_3(Nd,La)_4(Ti,Nb)_2(SiO_4)_2(CO_3)_3O_4OH.2aq$.

Occurrence: **EI Semenov ME Kazakova RA Aleksandrova** 1967 Medd Grønland 181 no. 5 1.
Review: **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

tunellite $SrB_6O_9(OH)_2.3aq$. Isostructural with Ca analog *nobleite*.

Sheets generated by tetrahedra & triangles.
Structure: **JR Clark** 1963 S 141 1178; **do** 1964 AM 49 1549-68;
H location, **PC Burns FC Hawthorne** 1994 CM 32 895-902 (B1606).
Occurrence: MM 33 1152.

tungsten W. Body-centered cubic structure.

Structure: *synthetic*, **Pearson** p 561.
Occurrence in Urals with inclusions of Y_2O_3 & XRPD of cubic-I structure: **MI Novgorodova & 6 others** 1995 DAN 340 681-84 (N409) = AM 81 1284-5;

Tolbachik, Kamchatka, **SF Glavatskikh NV Trubkin** 2000 DES 373A 997-9 (192).

tungstenite WS_2.

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

tungstenixiolite $(Fe_{1.0}Mn_{0.5}Nb_{0.5})(Nb_{0.9}W_{0.8}Ta0.2Ti_{0.1})O_8$.

Alpha PbO_2 (*scrutinyite*) structure family. Monoclinic distortion of *ixiolite* structure.

Description: **S Wang Z Ma Z Peng** 1987 Sci Sinica no. 8 610.

Summary: **NA Yamnova DYu Pushcharovskii AV Volshin** 1995 CrR 40 428-33 (Y158).

tungstibite Sb_2WO_6.

Occurrence: **K Walenta** 1995 CEr 55 217-24 (W721) = AM 81 767.

tungstite WO_3.aq.

Structure: **JT Szymanski** 1984 CM 22 681-8.

tungusite $Ca_{14}(OH)_8Si_8O_{20}(Si_8O_{20})_2Fe_9(OH)_{14}$.

Structure model, similar to *gyrolite* & *tacharanite*: **G Ferraris A Pavese SV Soboleva** 1995 MM 59 535-43.

Occurrence: MM 36 1160.

tunisite $NaCa_2Al_4(CO_3)_4(OH)_8Cl$.

Structure: **H Effenberger & 3 others** 1981 TMPM 28 65-77 (E336).

Occurrence: MM 37 966.

tunkite / tounkite ~$(Na,Ca,K)_8Al_6Si_6O_{24}(SO_4)_2$,Cl.aq. *Cancrinite* structure group.

Occurrence & crystallography: **VG Ivanov & 3 others** 1992 ZVMO 121 92-5 (I119).

tuperssuatsiaite $NaFe_3Si_8O_{20}$.4aq.

Analog of *palygorskite* $(Mg,Al)_2Si_4O_{10}(OH)$.4aq & *yofortierite* $(Mn,Mg)_5Si_8O_{20}(OH)_2$.4-5aq.

Mn-rich, SC-XRD & TEM structure: **F Camara & 4 others** 2002 AM 87 1458-63.

Occurrence: MM 50 759.

turanite $Cu_5(VO_4)_2(OH)_4$.

Structure: SC-XRD, **E Sokolova & 4 others** 2004 CM 42 731-9.

Occurrence: **KA Nenadkevich** 1909 Proc Imp Acad Sci St Petersberg 3 185-7.

turkestanite $Th(Ca,Na)_2(K_{0.53}void_{0.47})[Si_8O_{20}]$.n aq. Analog of *steacyite*.

Occurrence: & structure, **YuK Kabalov & 3 others** 1998 CrR 43 584-8 (K1101);
& mineralogy, **LA Pautov & 3 others** 1997 ZVMO 76 45-54 (P809);
Ilimaussaq: **OV Petersen O Johnsen HI Micheelsen** 1999 NJMM 424-32 (P849).

turneaureite $Ca_5[(As,P)O_4]_3Cl$. *Apatite* structure type.

Structure determination not found.

Occurrence: **PJ Dunn EU Petersen DR Peacor** 1985 CM 23 251-4;
SV Malinko NV Chukanov 1998 ZVMO 93-5 (M1793), incorrect *tourneaureite*.

TURQUOISE STRUCTURE GROUP Includes

aheylite	$FeAl_6(PO_4)_4(OH)_8$.4aq
chalcosiderite	$CuFe_6(PO_4)_4(OH)_8$.4aq
coeruleolactite	$(Ca,Cu)Al_6(PO_4)_4(OH)_8$.4-5aq
faustite	$(Zn,Cu)Al_6(PO_4)_4(OH)_8$.4aq
planerite	$Al_6(PO_4)_2(PO_3OH)_2(OH)_8$.4aq. Variety of *turquoise*.
turquoise	$CuAl_6(PO_4)_4(OH)_8$.4aq

Review of group: **EE Foord JE Taggart Jr** 1998 MM 62 93-111.

Rashleighite is ferrian turquoise: **H Cid-Dressner HS Villaroel** 1972 AM 57 1681-91.

turquoise $CuAl_6(PO_4)_4(OH)_8$.4aq. Turquoise structure group. Review: (E289).

Structure: **H Cid-Dresdner** 1965 ZK 121 87-113 = MA 17-462;
SC-XRD, **U Kolitsch G Giester** 2000 MM 64 905-13.

Occurrence: Japan, MA 97M/2008;
Maanshan, China, **X Yang & 4 others** 2003 NJMM 97-112 (8775).

turtmannite $(Mn,Mg)_{22.5}Mg_{3-3x}[(V,As)O_4]_3(SiO_4)_3(AsO_3)_xO_{5-5x}(OH)_{20+x}$.

Mcgovernite group.

Occurrence & SC-XRD structure: **J Brugger & 4 others** 2001 AM 86 1494-505; erratum 87 184.

tuscanite $K(Ca,Na)_6(Si,Al)_{10}O_{22}(SO_4,CO_3,(OH)_2)$.aq. Review: **Sabelli** p.41.

Structure: **M Mellini S Merlino G Rossi** 1977 AM 62 1114-20;
M Mellini S Merlino 1983 NJMM 167-74 (M774).
Occurrence: MM 42 530.

tusionite $MnSn(BO_3)_2$. *Dolomite* structure group.

Structure: **LV Kalacheva & 3 others** SPC 37 843 (K617);
M Cooper & 3 others 1994 CM 32 903-7.
Occurrence: MM 48 584.

[**Tutton salt** $(ND_4)_2[Cu(D_2O)_6](SO_4)_2$.

NPD to 200 bar: **AJ Schultz et al** 1996 AC A52 Suppl C-436-7.]

tuzlaite $NaCa[B_5O_8(OH)_2].3aq$. Sheet structure.

Structure: **V Bermanec & 3 others** 1994 AM 79 562-9.
Dehydration, IR, Raman & DTA: **V Bermanec & 3 others** 2003 AM 88 271-6.

tvalchrelidzeite $Hg_{12}(Sb,As)_8S_{15}$.

Occurrence: MM 42 530.

tvedalite $(Ca,Mn)_4Be_3Si_6O_{17}(OH)_4.3aq$. Probable structural relation with *chiavennite*.

Occurrence and crystallography: **AO Larsen & 3 others** 1992 AM 77 438-43.

tveitite-Y $\sim Ca_{13}Y_6F_{42}(O,F)_1$. Related to *fluorite* structure.

Structure: **DJM Bevan O Geis J Strähle** 1980 AC A36 889-90.
Occurrence: MM 42 530-1.
Review: (different formula) **AP Jones F Wall CT Williams** 1996 Rare earth minerals.

tweddillite $CaSr(Mn^{3+},Fe^{3+})_2AlSi_3O_{12}(OH)$. *Epidote* structure.

Occurrence & SC-XRD structure: **T Armbruster & 6 others** 2002 MM 66 137-50.

twinnite $Pb(Sb,As)_2S_4$. Dimorphic with *guettardite*.

Occurrence: MM 36 1160.

TYCHITE STRUCTURE GROUP Includes

ferrotychite	$Na_6Fe_2(SO_4)(CO_3)_4$
manganotychite	$Na_6Mn_2(SO_4)(CO_3)_4$
northupite	$Na_3Mg(CO_3)_2Cl$
tychite	$Na_6Mg_2(SO_4)(CO_3)_4$

Northupite has the same general structure as the tychite members, but with subtle differences between the carbonate & chloride.

tychite $Na_6Mg_2(SO_4)(CO_3)_4$. *Tychite* structure group.

Structure: **H Shiba T Watanabé** 1931 CRASP 193 1421-3;
T Watanabé 1933 Tokyo Inst Phys Chem Res Sci Paper 21 40-63;
matches *synthetic* XRPD, **KL Keester GG Johnson Jr V Vand** 1969 AM 54 302-5.
Occurrence in hyperagpaitic alkaline rocks: **Khomyakov** 1995.

tyretskite-1A / tyretskite Tc $Ca_2B_5O_9(OH).aq$. Occurrence: MM 35 1158.

Compare with *hilgardite-1Tc*: **S Ghose** 1985 AM 70 636.

tyrolite $Ca_2Cu_9(AsO_4)_4(CO_3)(OH)_8.11\text{-}12aq$. 1M & 2M polytypes.

Cell dimensions: **Dana**, etc; BSFMC 79 7.
Structure: SC-XRD, **SV Krivovichev & 8 others** 2006 AM 91 1378-84.

tyrrellite $(Cu,Co,Ni)_3Se_4$. *Spinel* structure group; *linnaeite* subgroup.

Definition: MM 32 984.

[tysonite = fluocerite]

tyuyamunite $Ca(UO_2)_2V_2O_8.5\text{-}8aq$.