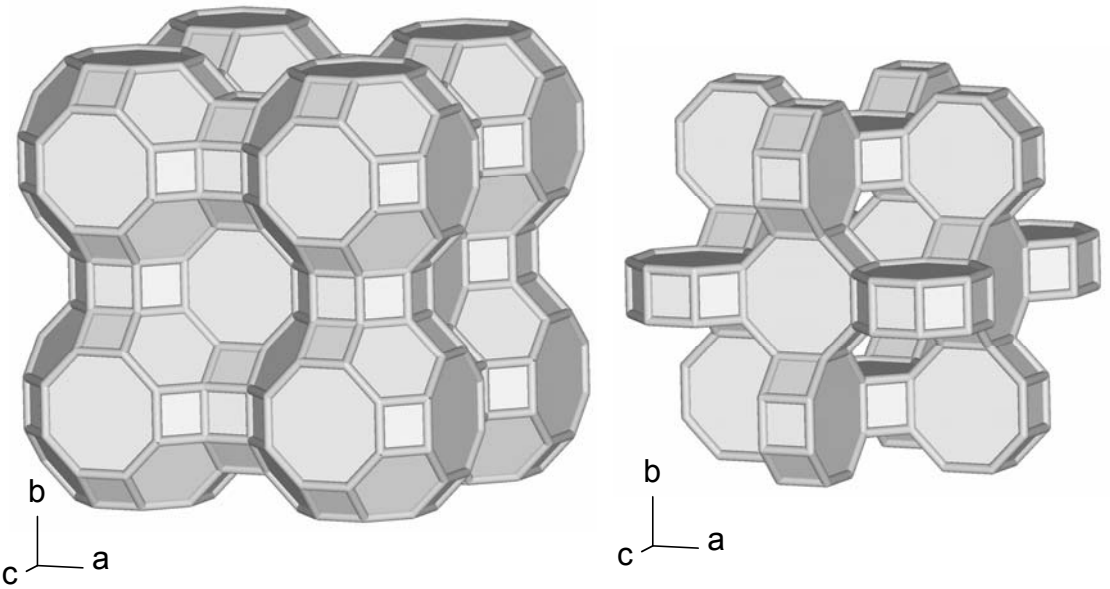
RHO

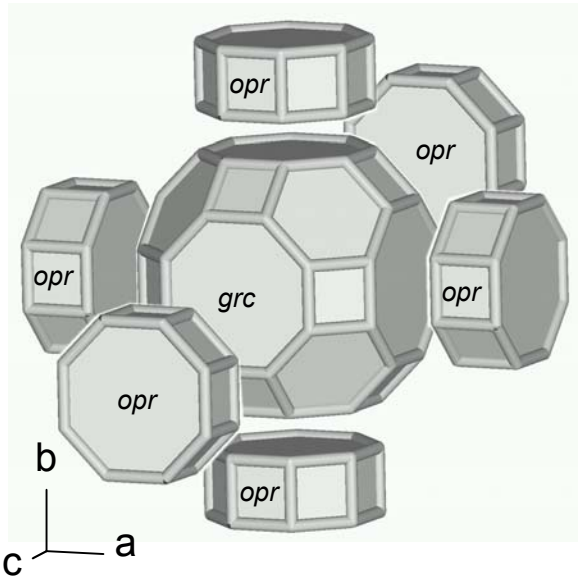
RHO.1 Zeolite framework type and topology

The designation of the FTC refers to zeolite **RHO**, a synthetic aluminosilicate with a typical composition of $Na_9Cs_3Al_{12}Si_{36}O_{96} \cdot nH_2O$ (n = 44 according to [2006Bae1], first synthesized and described in [73Rob1] and [75Rob1] after it has been proposed as a hypothetical framework structure by Meier [68Mei1]. It crystallizes in space group $I\,m\,\bar{3}\,m$ ($a \approx 15.0$ Å) and undergoes a phase transition to $I\,\bar{4}\,3\,m$ upon dehydration [83Par1]. Parise et al. [84Par1] showed by distance least squares calculations that the noncentrosymmetric space group generally is preferred for unit cells with a smaller than 14.95 Å. Zeolite rho has been extensively studied in various cation exchanged forms (see Table RHO.2.1) because of the outstanding catalytic properties of H-rho for the selective synthesis of dimethylamine [87Kea1] (see also chapter RHO.6) and its extreme framework flexibility as already noticed by Flank [77Fla1]. The catalytically active H-form (acid form) of zeolite rho is usually obtained by NH_4-exchange and subsequent calcination typically above 700 K when the ammonium ion decomposes into NH_3 and H^+, the latter forming the acidic hydroxyl groups in the zeolite cavities. The deammoniation process is accompanied by dealumination of the framework as described by Fischer et al. [86Fis1, 88Fis1].

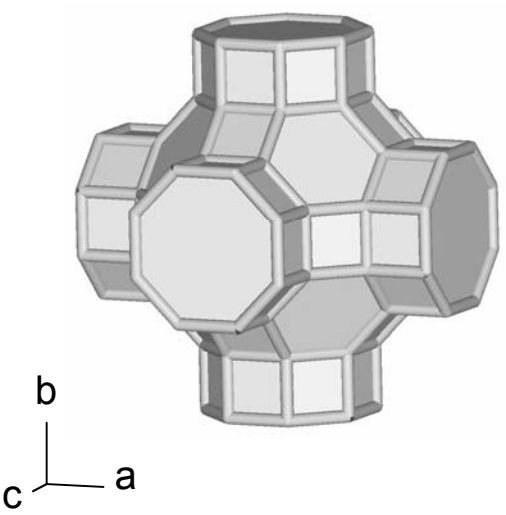


a Linkage of *grc* and *opr* units. **b** Linkage of *opr* units (Fig. a with *grc* units omitted).

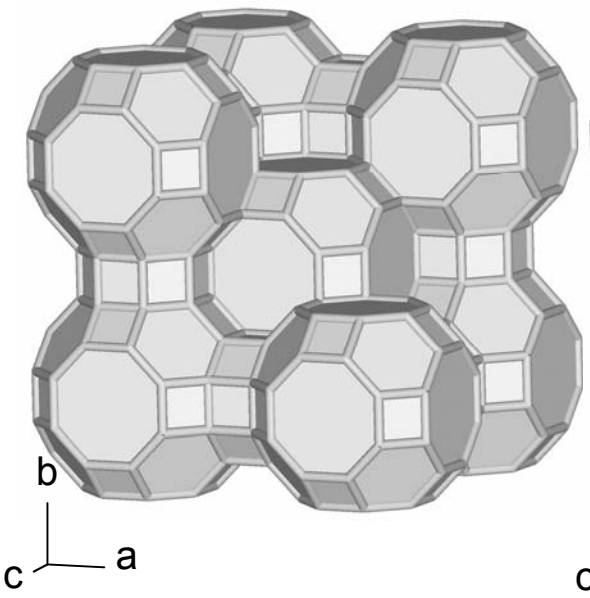
Fig. RHO.1.1. The framework structure of RHO-type compounds in the highest possible topological symmetry $I\,m\,\bar{3}\,m$. View parallel **c** rotated by 10° about **a** and 25° about **b**.



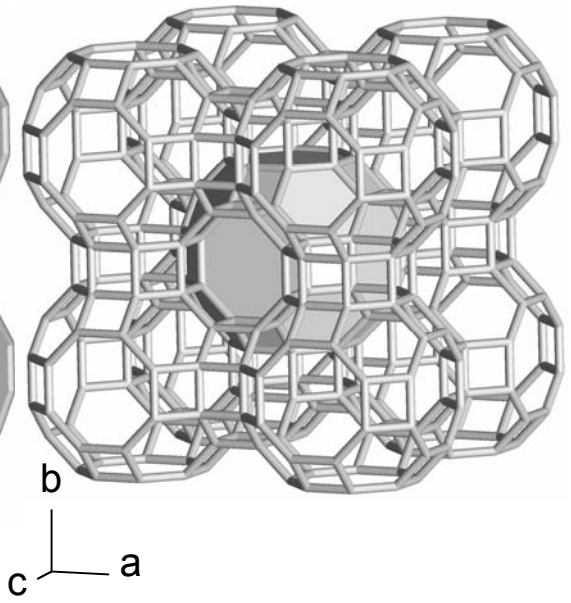
a Linkage of *opr* units around the central *grc* unit.



b The complete assemblage shown in a).



c The assemblage shown in b) extended in all three directions of the unit cell. The upper right front octant is omitted for better inside view.



d The framework structure as stick model with a solid *grc* unit in the center.

Fig. RHO.1.2. Building scheme of the RHO-type framework corresponding to the models shown in Fig. RHO.1.1. View parallel **c** rotated by 10° about **a** and 25° about **b**.

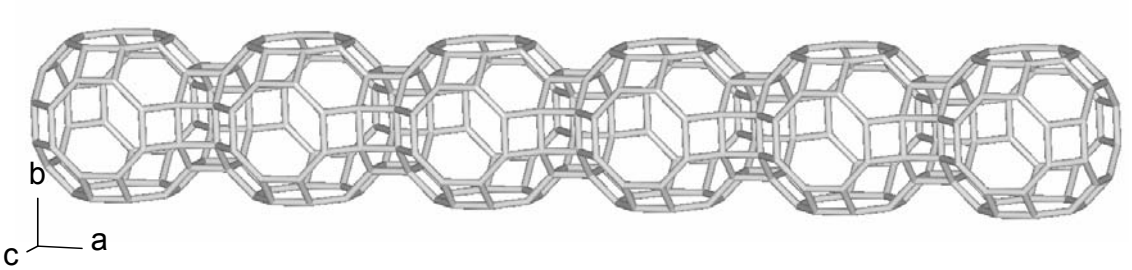


Fig. RHO.1.3 The 8-ring channel (**roh** unit) parallel **a**. View parallel **c** rotated by 10° about **a** and 20° about **b**.

High-silica zeolites rho have been synthesized in the presence of 18-crown-6 templates as described in [95Cha1]. The mineral pahasapaite, a beryllophosphate with the zeolite rho framework topology, was first described by Rouse et al. [87Rou1, 89Rou1]. It crystallizes in space group $I\,2\,3$ like its synthetic analogues (see Table RHO.2.1).

The framework structure (Fig. RHO.1.1) can be built from an alternating sequence of *grc* ($4^{12}6^{8}8^{6}$) units (so-called α-cages in the early zeolite literature) and *opr* ($4^{8}8^{2}$) units (double 8-rings) forming two noninterpenetrating three-dimensional systems of **roh** channels (Fig. RHO.1.3) parallel to the basis vectors of the unit cell symmetrically related to each other by I-centering.

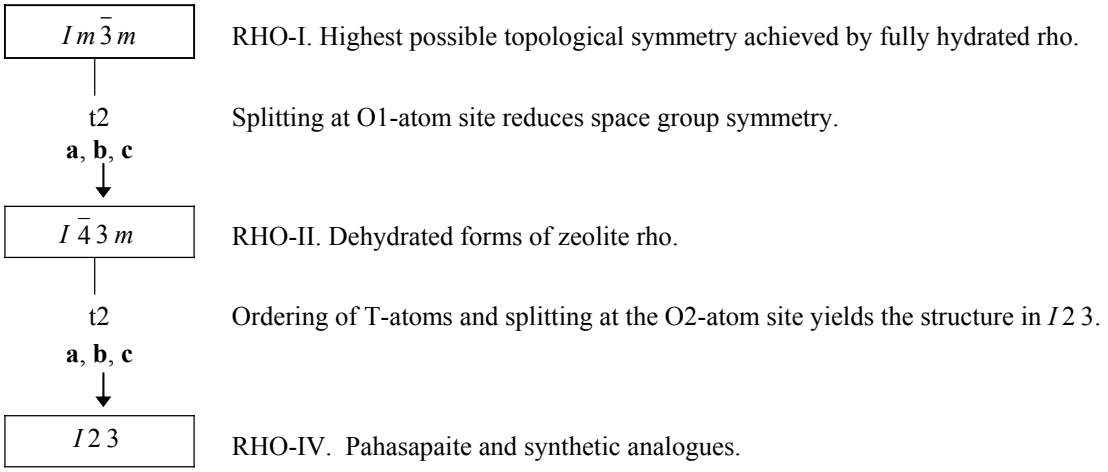


Fig. RHO.1.4 Symmetry relationships of the RHO types.

Table RHO.1.1 Atomic site relationships of the RHO types.

RHO-I $I\,m\,\bar{3}\,m$	RHO-II $I\,\bar{4}\,3\,m$	RHO-IV $I\,2\,3$
T1 [48(i), . . 2] →	T1 [48(h), 1] →	T11 [24(f), 1] T12 [24(f), 1]
O1 [48(k), . . *m*] →	O11 [24(g), . . *m*] →	O11 [24(f), 1]
	O12 [24(g), . . *m*] →	O12 [24(f), 1]
O2 [48(j), *m* . .] →	O2 [48(h), 1] →	O21 [24(f), 1] O22 [24(f), 1]

RHO.2 Compounds and crystal data

Table RHO.2.1 Chemical data.

M = mineral/compound name SM = source of material SR = sorbate TT = thermal treatment REF = reference
FD = framework density CE = cation exchange TE = template T = temperature of thermal treatment

code	chemical composition	M	FD	SM	CE	SR/TE	TT	T	REF
RHO-I $Im\bar{3}m$									
RHO1973a01	$H_{12} \cdot Al_{12}Si_{36}O_{96}$	[rho]	14.2	S	NH_4	-	C	673	73Rob1
RHO1984a02	$H_{11.85} \cdot Al_{11.85}Si_{36.15}O_{96}$	[rho]	14.3	S	Na,NH_4	-	C	773	84McC1
RHO1984b01	$Na_{10}Cs_2 \cdot Al_{12}Si_{36}O_{96} \cdot 73H_2O$	[rho]	14.1	S	Na	H_2O	-	-	84McC2
RHO1984c02	$CsD_9 \cdot Al_{10}Si_{38}O_{96} \cdot 8.4D_2O$	[rho]	14.1	S	NH_4,D	D_2O	C	873	84Par1
RHO1986a01	$(D,H)_{2.1}Cs_{1.1} \cdot Al_{3.2}Si_{44.8}O_{96}$. 9Al(nf)[1])	[rho]	14.7	S	NH_4,D	-	C	923	86Fis1
RHO1987a01	$D_{5.3}Cs_{0.7} \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)$[1])	[rho]	14.0	S	NH_4,D	-	C	773	87Fis1
RHO1987b01	$Cs_{0.2}D_{8.8} \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	13.9	S	NH_4,D	-	C	773	87Bau1
RHO1987b02	$Cs_{0.2}D_{8.8} \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	14.0	S	NH_4,D	-	C	773	87Bau1
RHO1987b03	$Cs_{0.2}D_{8.8} \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	14.0	S	NH_4,D	-	C	873	87Bau1
RHO1987b04	$Cs_{0.2}D_{8.8} \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	14.0	S	NH_4,D	-	C	873	87Bau1
RHO1988a02	$D_{5.3}Cs_{0.7} \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)$[1])	[rho]	14.0	S	NH_4,D	-	C	773	88Fis1
RHO1988a03	$D_{5.3}Cs_{0.7} \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)\ 30D_2O$[1])	[rho]	14.1	S	NH_4,D	D_2O	C	773	88Fis1
RHO1988c01	$Cs_{0.4}H_{8.2} \cdot Al_{8.6}Si_{39.4}O_{96} \cdot 2.6Al(nf)\ 4.2H_2O$[1,2])	[rho]	14.2	S	NH_4	H_2O	C	823	88Gam1
RHO1988c02	$Cs_{0.4}H_{8.2} \cdot Al_{8.6}Si_{39.4}O_{96} \cdot 2.6Al(nf)\ 4.2H_2O$[1,2])	[rho]	14.2	S	NH_4	H_2O	C	823	88Gam1
RHO1988c03	$Cs_{0.4}H_{8.2} \cdot Al_{8.6}Si_{39.4}O_{96} \cdot 2.6Al(nf)\ 4.2H_2O\ 1.7CH_3Cl$[1,2])	[rho]	14.1	S	NH_4	CH_3Cl, H_2O	C	823	88Gam1
RHO1988c04	$Cs_{0.4}H_{8.2} \cdot Al_{8.6}Si_{39.4}O_{96} \cdot 2.6Al(nf)\ 4.2H_2O\ 1.7CH_3Cl$[1,2])	[rho]	14.1	S	NH_4	CH_3Cl, H_2O	C	823	88Gam1
RHO1988c05	$Cs_{0.4}H_{8.2} \cdot Al_{8.6}Si_{39.4}O_{96} \cdot 2.6Al(nf)\ 4.2H_2O\ 1.7CH_3Cl$[1,2])	[rho]	14.1	S	NH_4	CH_3Cl, H_2O	C	823	88Gam1
RHO1988c06	$Cs_{0.4}H_{8.2} \cdot Al_{8.6}Si_{39.4}O_{96} \cdot 2.6Al(nf)\ 4.2H_2O\ 1.7CH_3Cl$[1,2])	[rho]	14.1	S	NH_4	CH_3Cl, H_2O	C	823	88Gam1
RHO1988c07	$Cs_{0.4}H_{8.2} \cdot Al_{8.6}Si_{39.4}O_{96} \cdot 2.6Al(nf)\ 4.2H_2O\ 1.7CH_3Cl$[1,2])	[rho]	14.1	S	NH_4	CH_3Cl, H_2O	C	823	88Gam1
RHO1988d01	SiO_2		14.3	T	-	-	-	-	88van1
RHO1991d02	$Cd_5 \cdot Al_{11}Si_{37}O_{96}$	[rho]	14.2	S	Cd	-	D	783	91Par1
RHO1992a03	$CsSr_4(NH_4)_3 \cdot Al_{12}Si_{36}O_{96} \cdot 56H_2O$	[rho]	14.1	S	NH_4,Sr	H_2O	-	-	92Bie1
RHO1994b02	$Na_{3.0}Cs_{5.5} \cdot Al_{8.5}Si_{39.5}O_{96} \cdot 17H_2O$	rho	14.1	S	-	H_2O	-	-	94Mey1
RHO1995a01	$Cs_{0.2}H_{3.8}((CH_3)_3NH)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 22H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HTrMA	C	873	95Wei1
RHO1995a02	$Cs_{0.2}H_{3.8}((CH_3)NH_3)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 28H_2O$[1])	[rho]	14.2	S	NH_4	H_2O, HMMA	C	873	95Wei1

Table RHO.2.1 (RHO-I $Im\bar{3}m$, continued)

code	chemical composition	M	FD	SM	CE	SR/TE	TT	T	REF
RHO1995a03	$Cs_{0.2}H_{3.8}((CH_3)_2NH_2)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 21H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HDMA	C	873	95Wei1
RHO1995a04	$Cs_{0.2}((CH_3)_2NH_2)_{8.8} \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 18H_2O$[1])	[rho]	14.0	S	NH_4	H_2O, HDMA	C	873	95Wei1
RHO1995a06	$Cs_{0.7}H_{0.3}((CH_3)_3NH)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)\ 22H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HTrMA	C	773	95Wei1
RHO1995a07	$Cs_{0.7}H_{0.30}((CH_3)NH_3)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)\ 23H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HMMA	C	773	95Wei1
RHO1995a08	$Cs_{0.7}H_{0.3}((CH_3)_2NH_2)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)\ 24H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HDMA	C	773	95Wei1
RHO1995a09	$Cs_{0.2}D_{3.8}((CD_3)_3ND)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	14.1	S	NH_4	HTrMA(D)	C	873	95Wei1
RHO1995a10	$Cs_{0.7}D_{0.3}((CD_3)_3ND)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)$[1])	[rho]	14.0	S	NH_4	HTrMA(D)	C	773	95Wei1
RHO1995b03	$AlGa_{20}Si_{27}O_{96}$		12.4	T	-	-	-	-	95New1
RHO1995c07	$Cd_{3.30}Cs_{0.25}H_{5.10} \cdot Al_{12}Si_{36}O_{96} \cdot 0.84Xe\ 8H_2O$	[rho]	14.1	S	Cd, NH_4	Xe, H_2O	C	673	95Par1
RHO1995d01	$H_{10.8}Cs_{0.7}Na_{0.5} \cdot Al_{12}Si_{36}O_{96} \cdot 0.96Xe$	[rho]	14.1	S	NH_4[3])	Xe	C[3])	n.s.	95Par2
RHO1995d02	$H_{10.8}Cs_{0.7}Na_{0.5} \cdot Al_{12}Si_{36}O_{96} \cdot 0.86Xe$	[rho]	14.1	S	NH_4[3])	Xe	C[3])	n.s.	95Par2
RHO1995d03	$H_{10.8}Cs_{0.7}Na_{0.5} \cdot Al_{12}Si_{36}O_{96} \cdot 1.13Xe$	[rho]	14.1	S	NH_4[3])	Xe	C[3])	n.s.	95Par2
RHO1995d04	$H_{10.8}Cs_{0.7}Na_{0.5} \cdot Al_{12}Si_{36}O_{96} \cdot 1.99Xe$	[rho]	14.0	S	NH_4[3])	Xe	C[3])	n.s.	95Par2
RHO1995d05	$H_{10.8}Cs_{0.7}Na_{0.5} \cdot Al_{12}Si_{36}O_{96} \cdot 3.46Xe$	[rho]	14.0	S	NH_4[3])	Xe	C[3])	n.s.	95Par2
RHO1997a01	$Cs_{0.2}H_{3.8}((CH_3)NH_3)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 28H_2O$[1])	[rho]	14.2	S	NH_4	H_2O, HMMA	C	873	97Wei1
RHO1997a05	$Cs_{0.7}H_{0.30}((CH_3)NH_3)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)\ 23H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HMMA	C	773	97Wei1
RHO1997b01	$Cs_{0.2}H_{3.8}((CH_3)_2NH_2)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 21H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HDMA	C	873	97Wei2
RHO1997b02	$Cs_{0.2}((CH_3)_2NH_2)_{8.8} \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 18H_2O$[1])	[rho]	14.0	S	NH_4	H_2O, HDMA	C	873	97Wei2
RHO1997b03	$Cs_{0.7}H_{0.3}((CH_3)_2NH_2)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)\ 24H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HDMA	C	773	97Wei2
RHO1997c01	$Cs_{0.2}H_{3.8}((CH_3)_3NH)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 22H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HTrMA	C	873	97Wei3
RHO1997c02	$Cs_{0.2}D_{3.8}((CD_3)_3ND)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	14.1	S	NH_4	HTrMA(D)	C	873	97Wei3
RHO1997c03	$Cs_{0.7}H_{0.3}((CH_3)_3NH)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)\ 22H_2O$[1])	[rho]	14.1	S	NH_4	H_2O, HTrMA	C	773	97Wei3
RHO1997c04	$Cs_{0.7}D_{0.3}((CD_3)_3ND)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)$[1])	[rho]	14.0	S	NH_4	HTrMA(D)	C	773	97Wei3
RHO2001a11	$Cd_{5.5}Cs_{0.3} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 51.22H_2O$	[rho]	14.1	S	Cd	H_2O	-	-	2001Lee1
RHO2001a13	$Cd_{5.5}Cs_{0.3} \cdot Al_{11.7}Si_{36.3}O_{96}$	[rho]	14.1	S	Cd	-	D	748	2001Lee1
RHO2001a14	$Cd_{5.5}Cs_{0.3} \cdot Al_{11.7}Si_{36.3}O_{96}$	[rho]	14.1	S	Cd	-	D	606	2001Lee1
RHO2001a16	$Cd_{5.5}Cs_{0.3} \cdot Al_{11.7}Si_{36.3}O_{96}$	[rho]	14.0	S	Cd	-	D	823	2001Lee1
RHO2001a17	$Cd_{5.5}Cs_{0.3} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 8.5Kr$	[rho]	14.0	S	Cd	Kr	D	823	2001Lee1
RHO2001a18	$Cd_{5.5}Cs_{0.3} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 4.18H_2O$	[rho]	14.0	S	Cd	H_2O	D	823	2001Lee1
RHO2001a19	$Cd_{5.5}Cs_{0.3} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 57.24H_2O$	[rho]	14.1	S	Cd	H_2O	R	823	2001Lee1

Table RHO.2.1 (continued)

code	chemical composition	M	FD	SM	CE	SR/TE	TT	T	REF
RHO-II ***I*** $\bar{4}$ **3** ***m***									
RHO1973a02	$H_{12} \cdot Al_{12}Si_{36}O_{96}$	[rho]	14.2	S	NH_4	-	C	673	73Rob1
RHO1983a01	$D_{4.8}Cs_{5.5} \cdot Al_{10.3}Si_{37.7}O_{96}$	[rho]	15.2	S	NH_4,Cs,D	-	C	623	83Par1
RHO1983a02	$D_{4.8}Cs_{5.5} \cdot Al_{10.3}Si_{37.7}O_{96}$	[rho]	15.1	S	NH_4,Cs,D	-	C	623	83Par1
RHO1983a03	$D_{4.8}Cs_{5.5} \cdot Al_{10.3}Si_{37.7}O_{96}$	[rho]	15.3	S	NH_4,Cs,D	-	C	623	83Par1
RHO1984a01	$(NH_4)_{11.85} \cdot Al_{11.85}Si_{36.15}O_{96}$	[rho]	14.7	S	NH_4	-	D	623	84McC1
RHO1984b02	$Na_{10}Cs_2 \cdot Al_{12}Si_{36}O_{96}$	[rho]	15.2	S	Na	-	D	373	84McC2
RHO1984c01	$CsD_9 \cdot Al_{10}Si_{38}O_{96}$	[rho]	15.1	S	NH_4,D	-	C	873	84Par1
RHO1984d01	$Cs_{1.2}D_{9.1} \cdot Al_{10.3}Si_{37.7}O_{96}$	[rho]	15.4	S	NH_4,D	-	C	923	84Par2
RHO1984d02	$Cs_{1.2}D_{9.1} \cdot Al_{10.3}Si_{37.7}O_{96}$	[rho]	15.0	S	NH_4,D	-	C	923	84Par2
RHO1984d03	$Cs_{1.2}D_{9.1} \cdot Al_{10.3}Si_{37.7}O_{96}$	[rho]	14.9	S	NH_4,D	-	C	923	84Par2
RHO1984d04	$Cs_{1.2}D_{9.1} \cdot Al_{10.3}Si_{37.7}O_{96}$	[rho]	14.6	S	NH_4,D	-	C	923	84Par2
RHO1986b01	$Li_9Cs_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	15.8	S	Li	-	-	-	86Stu1
RHO1986b02	$Ag_9Cs_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	16.7	S	Ag	-	-	-	86Stu1
RHO1988a01	$D_{5.3}Cs_{0.7} \cdot Al_6Si_{42}O_{96}$	[rho]	14.6	S	NH_4,D	-	C	773	88Fis1
RHO1988b01	$D_5Cs \cdot Al_6Si_{42}O_{96}$		14.6	T	-	-	-	-	88Bau1
RHO1988b02	$D_5CsH_2 \cdot Al_8Si_{40}O_{96}$		15.4	T	-	-	-	-	88Bau1
RHO1988b03	$D_{4.8}H_{1.6}Cs_{1.1} \cdot Al_{7.5}Si_{40.5}O_{96} \cdot 5Al(nf)^{1)}$	[rho]	15.4	S	NH_4,D	-	C	773	88Bau1
RHO1988b04	$Na_{10}Cs_2 \cdot Al_{12}Si_{36}O_{96}$		15.2	T	-	-	-	-	88Bau1
RHO1989a01	$Na_{8.4}Cs_{3.2} \cdot Al_{11.6}Si_{36.4}O_{96} \cdot 5D_2O$	[rho]	15.2	S	Na	D_2O	D	373	89Bau1
RHO1989b01	$D_{2.8}(ND_4)_{7.4}Cs_{0.7} \cdot Al_{10.9}Si_{37.1}O_{96}$	[rho]	15.7	S	NH_4,D	-	C	873	89Fis1
RHO1989b02	$D_{4.9}(ND_4)_{4.6}Cs_{0.6} \cdot Al_{10.1}Si_{37.9}O_{96}$	[rho]	16.0	S	NH_4,D	-	C	633	89Fis1
RHO1990a01	$(ND_4)_{12} \cdot Al_{12}Si_{36}O_{96}$	[rho]	16.0	S	NH_4,Ca,D	-	D	523	90Cor1
RHO1990a02	$Ca_6 \cdot Al_{12}Si_{36}O_{96}$	[rho]	17.1	S	NH_4,Ca,D	-	D	523	90Cor1
RHO1990a03	$Ca_4D_4 \cdot Al_{12}Si_{36}O_{96}$	[rho]	17.6	S	NH_4,Ca,D	-	C	673	90Cor1
RHO1991a01	$CsSr_4(NH_4)_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	15.6	S	NH_4,Sr	-	D	473	91Bie1
RHO1991a02	$CsSr_4(NH_4)_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	16.7	S	NH_4,Sr	-	D	473	91Bie1
RHO1991b01	$CsSr_4(NH_4)_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	15.5	S	NH_4,Sr	-	D	473	91Bie2
RHO1991b02	$CsSr_4(NH_4)_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	16.9	S	NH_4,Sr	-	D	573	91Bie2
RHO1991d01	$Cd_5 \cdot Al_{11}Si_{37}O_{96}$	[rho]	15.8	S	Cd	-	D	473	91Par1
RHO1992a01	$Na_{8.4}Cs_{3.2} \cdot Al_{11.6}Si_{36.4}O_{96} \cdot 5D_2O$	[rho]	15.2	S	Na	D_2O	D	n.s.	92Bie1
RHO1992a02	$Na_{8.4}Cs_{3.2} \cdot Al_{11.6}Si_{36.4}O_{96} \cdot 5D_2O$	[rho]	15.2	S	Na	D_2O	D	n.s.	92Bie1

Table RHO.2.1 (RHO-II $I\bar{4}3m$, continued)

code	chemical composition	M	FD	SM	CE	SR/TE	TT	T	REF
RHO1992a04	$CsSr_4(NH_4)_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	15.5	S	NH_4,Sr	-	D	473	92Bie1
RHO1992a05	$CsSr_4(NH_4)_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	15.6	S	NH_4,Sr	-	D	473	92Bie1
RHO1992a06	$CsSr_4(NH_4)_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	16.7	S	NH_4,Sr	-	D	473	92Bie1
RHO1992a07	$CsSr_4(NH_4)_3 \cdot Al_{12}Si_{36}O_{96}$	[rho]	16.9	S	NH_4,Sr	-	D	573	92Bie1
RHO1992a08	$Cs(NH_4)_{11} \cdot Al_{12}Si_{36}O_{96}$	[rho]	15.8	S	NH_4	-	D	573	92Bie1
RHO1992a09	$Cs(NH_4)_{11} \cdot Al_{12}Si_{36}O_{96}$	[rho]	14.8	S	NH_4	-	D	573	92Bie1
RHO1992a10	$Cs_{1.1}Ba_{5.2} \cdot Al_{11.5}Si_{36.5}°_{96}$	[rho]	16.6	S	NH_4,Ba	-	D	373	92Bie1
RHO1992b02	$Rb_{8.8}Na_{0.1}Cs_{0.1}D_{3.2} \cdot Al_{12.2}Si_{35.8}O_{96}$	[rho]	16.2	S	Rb,D	-	D	623	92Par1
RHO1993a01	$Cs(NH_4)_{11} \cdot Al_{12}Si_{36}O_{96}$	[rho]	15.8	S	NH_4	-	D	573	93Bie1
RHO1993a02	$Cs(NH_4)_{11} \cdot Al_{12}Si_{36}O_{96}$	[rho]	14.8	S	NH_4	-	D	573	93Bie1
RHO1994a01	$Tl_{9.8}Na_{0.3}Cs_{0.1}D_{0.8} \cdot Al_{11}Si_{37}O_{96}$	[rho]	15.9	S	Tl,D	-	D	623	94Par1
RHO1994b01	$Na_{3.0}Cs_{5.5} \cdot Al_{8.5}Si_{39.5}O_{96}$	[rho]	15.3	S	-	-	D	828	94Mey1
RHO1994b03	$Na_{3.0}Cs_{5.5} \cdot Al_{8.5}Si_{39.5}O_{96} \cdot 2.9N(CH_3)_3$	[rho]	15.2	S	-	TrMA	D	353	94Mey1
RHO1994b04	$Na_{3.0}Cs_{5.5} \cdot Al_{8.5}Si_{39.5}O_{96} \cdot 2.9N(CH_3)_3\ 4H_2O$	[rho]	15.5	S	-	TrMA	D	303	94Mey1
RHO1995a05	$Cs_{0.2}((CH_3)NH_3)_{8.8} \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 25H_2O$[1])	[rho]	14.3	S	NH_4	H_2O, HMMA	C	873	95Wei1
RHO1995a11	$Cs_{0.2}D_{3.8}((CD_3)ND_3)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	14.7	S	NH_4,D	HMMA(D)	C	873	95Wei1
RHO1995a12	$Cs_{0.2}D_{3.8}((CD_3)ND_3)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	15.7	S	NH_4,D	HMMA(D)	C	873	95Wei1
RHO1995a13	$Cs_{0.7}D_{0.3}((CD_3)ND_3)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)$[1])	[rho]	14.5	S	NH_4,D	HMMA(D)	C	773	95Wei1
RHO1995a14	$Cs_{0.7}D_{0.3}((CD_3)ND_3)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)$[1])	[rho]	15.3	S	NH_4,D	HMMA(D)	C	773	95Wei1
RHO1995b01	$Na_{11.6}Cs_{9.5} \cdot Ga_{21.4}Al_{0.2}Si_{26.4}O_{96}$	[ECR-10]	15.6	S	-	-	D	713	95New1
RHO1995b02	$AlGa_{20}Si_{27}O_{96}$		14.6	T	-	-	-	-	95New1
RHO1995c01	$Cd_{3.30}Cs_{0.25}H_{5.10} \cdot Al_{12}Si_{36}O_{96} \cdot 3.59Xe \cdot 1.4H_2O$	[rho]	15.1	S	NH_4,Cd	Xe	C	673	95Par1
RHO1995c02	$Cd_{3.30}Cs_{0.25}H_{5.10} \cdot Al_{12}Si_{36}O_{96} \cdot 3.35Xe \cdot 1.7H_2O$	[rho]	15.1	S	NH_4,Cd	Xe	C	673	95Par1
RHO1995c03	$Cd_{3.30}Cs_{0.25}H_{5.10} \cdot Al_{12}Si_{36}O_{96} \cdot 2.47Xe$	[rho]	16.3	S	NH_4,Cd	Xe	C	673	95Par1
RHO1995c04	$Cd_{3.30}Cs_{0.25}H_{5.10} \cdot Al_{12}Si_{36}O_{96} \cdot 2.31Xe$	[rho]	15.6	S	NH_4,Cd	Xe	C	673	95Par1
RHO1995c05	$Cd_{3.30}Cs_{0.25}H_{5.10} \cdot Al_{12}Si_{36}O_{96} \cdot 2.44Xe$	[rho]	15.2	S	NH_4,Cd	Xe	C	673	95Par1
RHO1995c06	$Cd_{3.30}Cs_{0.25}H_{5.10} \cdot Al_{12}Si_{36}O_{96} \cdot 3.03Xe$	[rho]	15.2	S	NH_4,Cd	Xe	C	673	95Par1
RHO1995d06	$Cd_{3.30}Cs_{0.25}H_{5.10} \cdot Al_{12}Si_{36}O_{96} \cdot 3.59Xe \cdot 1.4H_2O$	[rho]	15.1	S	NH_4,Cd	Xe	C	673	95Par2
RHO1995d07	$Cd_{3.30}Cs_{0.25}H_{5.10} \cdot Al_{12}Si_{36}O_{96} \cdot 3.35Xe \cdot 1.7H_2O$	[rho]	15.1	S	NH_4,Cd	Xe	C	673	95Par2
RHO1997a02	$Cs_{0.2}D_{3.8}((CD_3)ND_3)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	14.7	S	NH_4,D	HMMA(D)	C	873	97Wei1
RHO1997a03	$Cs_{0.2}D_{3.8}((CD_3)ND_3)_5 \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)$[1])	[rho]	15.7	S	NH_4,D	HMMA(D)	C	873	97Wei1
RHO1997a04	$Cs_{0.2}((CH_3)NH_3)_{8.8} \cdot Al_9Si_{39}O_{96} \cdot 2Al(nf)\ 25H_2O$[1])	[rho]	14.3	S	NH_4	H_2O, HMMA	C	873	97Wei1

Table RHO.2.1 (RHO-II $I\bar{4}3m$, continued)

code	chemical composition	M	FD	SM	CE	SR/TE	TT	T	REF
RHO1997a06	$Cs_{0.7}D_{0.3}((CD_3)ND_3)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)^{1})$	[rho]	14.5	S	NH_4,D	HMMA(D)	C	773	97Wei1
RHO1997a07	$Cs_{0.7}D_{0.3}((CD_3)ND_3)_5 \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)^{1})$	[rho]	15.3	S	NH_4,D	HMMA(D)	C	773	97Wei1
RHO1999b02	$Cs_{1.3}Li_{7.6}Na_{2.0} \cdot Al_{11.4}Si_{36.6}O_{96}$	[rho]	16.6	S	NH_4,Na,Li	-	D	573	99Joh1
RHO2001a01	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 5.28H_2O$	[rho]	15.4	S	Pb	H_2O	D	393	2001Lee1
RHO2001a02	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 5.16H_2O$	[rho]	15.4	S	Pb	H_2O	D	443	2001Lee1
RHO2001a03	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 4.50H_2O$	[rho]	15.5	S	Pb	H_2O	D	493	2001Lee1
RHO2001a04	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 3.12H_2O$	[rho]	15.7	S	Pb	H_2O	D	548	2001Lee1
RHO2001a05	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 1.62H_2O$	[rho]	16.1	S	Pb	H_2O	D	598	2001Lee1
RHO2001a06	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 1.14H_2O$	[rho]	16.2	S	Pb	H_2O	D	653	2001Lee1
RHO2001a07	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 0.96H_2O$	[rho]	16.2	S	Pb	H_2O	D	683	2001Lee1
RHO2001a08	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96} \cdot 7.06H_2O$	[rho]	15.6	S	Pb	H_2O	D	523	2001Lee1
RHO2001a09	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96}$	[rho]	16.5	S	Pb	-	D	823	2001Lee1
RHO2001a10	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96}$	[rho]	16.7	S	Pb	-	D	823	2001Lee1
RHO2001a12	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96}$	[rho]	15.9	S	Cd	-	D	678	2001Lee1
RHO2001a15	$Cs_{0.7}Pb_{6.7} \cdot Al_{11.7}Si_{36.3}O_{96}$	[rho]	15.4	S	Cd	-	D	563	2001Lee1
RHO2004a01	$Rb_{9.68} \cdot Al_{12}Si_{36}O_{96}$	[rho]	16.2	S	Rb	-	D	n.s.	2004And1
RHO2004a02	$Rb_{20.08} \cdot Al_{12}Si_{36}O_{96}$	[rho]	16.1	S	Rb	-	D	n.s.	2004And1
RHO2004a03	$Rb_{22.56} \cdot Al_{12}Si_{36}O_{96}$	[rho]	15.7	S	Rb	-	D	n.s.	2004And1
RHO-IV *I*2 3									
RHO1989c01	$Li_{11.6}Ca_{5.5}K_{1.2}Na_{0.2} \cdot Be_{24}P_{24}O_{96} \cdot 38H_2O$	pahasapaite	18.3	M	-	H_2O	-	-	89Rou1
RHO1991c01	$Li_{11.6}Ca_{5.5}K_{1.2}Na_{0.2} \cdot Be_{24}P_{24}O_{96} \cdot 38H_2O$	pahasapaite	18.3	M	-	H_2O	-	-	91Cor1
RHO1991c02	$Li_{11.6}Ca_{5.5}K_{1.2}Na_{0.2} \cdot Be_{24}P_{24}O_{96}$	[pahasapaite]	21.4	M	-	-	D	623	91Cor1
RHO1992b01	$Rb_{24} \cdot Be_{24}As_{24}O_{96} \cdot 3.2D_2O$	(pahasapaite)	17.5	S	-	D_2O	-	n.s.	92Par1
RHO1994a02	$Tl_{21}LiH \cdot Be_{24}P_{24}O_{96}$	(pahasapaite)	18.9	S	Tl	-	D	n.s.	94Par1
RHO1994a03	$Rb_{13}Li_{10}Na \cdot Be_{24}P_{24}O_{96}$	(pahasapaite)	19.6	S	Rb	-	D	n.s.	94Par1
RHO1994a04	$Tl_{19}Rb_3Na \cdot Be_{24}As_{24}O_{96}$	(pahasapaite)	17.5	S	Tl	-	D	n.s.	94Par1
RHO1994a05	$Li_{11.6}Ca_{5.5}K_{1.2}Na_{0..2} \cdot Be_{24}P_{24}O_{96}$	[pahasapaite]	21.4	M	-	-	D	623	94Par1
RHO1994a06	$Li_{11.6}Ca_{5.5}K_{1.2}Na_{0..2} \cdot Be_{24}P_{24}O_{96}$	[pahasapaite]	21.3	M	-	-	D	623	94Par1
RHO1994a07	$Li_{11.6}Ca_{5.5}K_{1.2}Na_{0..2} \cdot Be_{24}P_{24}O_{96}$	[pahasapaite]	21.3	M	-	-	D	623	94Par1
RHO1994a08	$Li_{11.6}Ca_{5.5}K_{1.2}Na_{0..2} \cdot Be_{24}P_{24}O_{96}$	[pahasapaite]	21.2	M	-	-	D	623	94Par1

Table RHO.2.1 (RHO-IV *I* 2 3, continued)

code	chemical composition	M	FD	SM	CE	SR/TE	TT	T	REF
RHO1995b04	$Ga_{24}Si_{24}O_{96}$		14.6	T	-	-	-	-	95New1
RHO1995b05	$Al_{24}Si_{24}O_{96}$		15.4	T	-	-	-	-	95New1
RHO1996a01	$K_{16.2}Li_{7.0}Na_{0.07} \cdot Be_{24}P_{24}O_{96}$	(pahasapaite)	20.1	S	K	-	-	-	96Nen1
RHO1996a02	$K_{16.2}Li_{7.0}Na_{0.07} \cdot Be_{24}P_{24}O_{96}$	(pahasapaite)	19.7	S	K	-	-	-	96Nen1
RHO1996a03	$Tl_{21.0}Li_{1.06}Na_{0.81} \cdot Be_{24}P_{24}O_{96}$	(pahasapaite)	18.9	S	Tl	-	-	-	96Nen1
RHO1996a04	$Tl_{21.0}Li_{1.06}Na_{0.81} \cdot Be_{24}P_{24}O_{96}$	(pahasapaite)	18.7	S	Tl	-	-	-	96Nen1
RHO1998a01	$Cs_8Na_{16} \cdot Al_{24}Ge_{24}O_{96}$	(pahasapaite)	15.2	S	-	-	D	673	98Joh1
RHO1998b01	$(C_9H_{24}N_2)_6 \cdot Al_{12}Co_{12}P_{24}O_{96}$		12.9	S	-	[4])	-	-	98Fen1
RHO1998b02	$(C_9H_{24}N_2)_6 \cdot Al_{12}Mn_{12}P_{24}O_{96}$		12.6	S	-	[4])	-	-	98Fen1
RHO1998b03	$(C_9H_{24}N_2)_6 \cdot Al_{12}Mg_{12}P_{24}O_{96}$		12.8	S	-	[4])	-	-	98Fen1
RHO1999a01	$Cs_{7.63}Na_{14.71} \cdot Al_{23.65}Ge_{24.35}O_{96}$		15.1	S	-	-	D	673	99Joh1
RHO1999a02	$Cs_{7.63}Na_{14.71} \cdot Al_{23.65}Ge_{24.35}O_{96}$		15.2	S	-	-	D	673	99Joh1
RHO1999a03	$Cs_{7.63}Na_{14.71} \cdot Al_{23.65}Ge_{24.35}O_{96}$		15.2	S	-	-	D	673	99Joh1
RHO1999b01	$Cs_{5.24}Li_{13.90}Na_{0.24} \cdot Al_{24.40}Ge_{23.60}O_{96}$		16.4	S	Li	-	D	573	99Joh2

[1]) Al(nf) refers to nonframework Al extracted from the aluminosilicate framework upon calcination and deammoniation of the NH_4-form
[2]) Sample preparation conditions from [86Gam1]. The authors assume that the water content stays constant upon heating.
[3]) No information is given how the H-form has been obtained. Here it is assumed that it has been produced by calcination of the NH_4-form.
[4]) DiPDAP

Table RHO.2.2 Structural parameters of RHO-type compounds.

code	*a* [Å]	*V* [Å^3]	*T* [K]	reference	code	*a* [Å]	*V* [Å^3]	*T* [K]	reference
RHO-I ***I m $\bar{3}$ m***									
RHO1973a01	15.02(1)	3389	n.s.	73Rob1	RHO1988a02	15.0620(3)	3417	623	88Fis1
RHO1984a02	14.982(1)	3363	773	84McC1	RHO1988a03	15.0387(5)	3401	RT	88Fis1
RHO1984b01	15.031(1)	3396	298	84McC2	RHO1988c01	15.012(1)	3383	25	88Gam1
RHO1984c02	15.027(2)	3393	423	84Par1	RHO1988c02	15.013(1)	3384	25	88Gam1
RHO1986a01	14.850(1)	3275	13	86Fis1	RHO1988c03	15.052(1)	3410	40	88Gam1
RHO1987a01	15.0620(3)	3417	623	87Fis1	RHO1988c04	15.047(1)	3407	100	88Gam1
RHO1987b01	15.0976(4)	3441	RT	87Bau1	RHO1988c05	15.042(1)	3403	160	88Gam1
RHO1987b02	15.0799(4)	3429	623	87Bau1	RHO1988c06	15.039(1)	3401	210	88Gam1
RHO1987b03	15.0686(7)	3422	RT	87Bau1	RHO1988c07	15.034(1)	3398	250	88Gam1
RHO1987b04	15.0696(4)	3422	623	87Bau1	RHO1988d01	14.97	3355	-	88van1

Table RHO.2.2 (RHO-I $Im\bar{3}m$, continued)

code	a [Å]	V [Å3]	T [K]	reference	code	a [Å]	V [Å3]	T [K]	reference
RHO1991d02	15.020(1)	3389	783	91Par1	RHO1995d05	15.070[1])	3422	300	95Par2
RHO1992a03	15.0318(5)	3397	293	92Bie1	RHO1997a01	14.9991(2)	3374	RT	97Wei1
RHO1994b02	15.0435(2)	3404	298	94Mey1	RHO1997a05	15.0323(2)	3397	RT	97Wei1
RHO1995a01	15.0542(2)	3412	RT	95Wei1	RHO1997b01	15.0590(2)	3415	RT	97Wei2
RHO1995a02	14.9991(2)	3374	RT	95Wei1	RHO1997b02	15.0680(2)	3421	RT	97Wei2
RHO1995a03	15.0590(2)	3415	RT	95Wei1	RHO1997b03	15.0596(2)	3415	RT	97Wei2
RHO1995a04	15.0680(2)	3421	RT	95Wei1	RHO1997c01	15.0542(2)	3412	RT	97Wei3
RHO1995a06	15.0574(2)	3414	RT	95Wei1	RHO1997c02	15.0467(4)	3407	5	97Wei3
RHO1995a07	15.0323(2)	3397	RT	95Wei1	RHO1997c03	15.0574(2)	3414	RT	97Wei3
RHO1995a08	15.0596(2)	3415	RT	95Wei1	RHO1997c04	15.0761(5)	3427	5	97Wei3
RHO1995a09	15.0468(4)	3407	5	95Wei1	RHO2001a11	15.029(1)	3395	298	2001Lee1
RHO1995a10	15.0761(5)	3427	5	95Wei1	RHO2001a13	15.0469(4)	3407	748	2001Lee1
RHO1995b03	15.686	3860	-	95New1	RHO2001a14	15.0518(4)	3410	606	2001Lee1
RHO1995c07	15.033(1)	3397	300	95Par1	RHO2001a16	15.0668(2)	3420	RT	2001Lee1
RHO1995d01	15.033(1)1)	3397	300	95Par2	RHO2001a17	15.0684(2)	3421	RT	2001Lee1
RHO1995d02	15.05751)	3414	300	95Par2	RHO2001a18	15.0666(2)	3420	RT	2001Lee1
RHO1995d03	15.0521)	3410	300	95Par2	RHO2001a19	15.0554(3)	3412	RT	2001Lee1
RHO1995d04	15.0711)	3423	300	95Par2					
RHO-II $I\bar{4}3m$									
RHO1973a02	15.02(1)	3389	n.s.	73Rob1	RHO1986b02	14.225(1)	2878	n.s.	86Stu1
RHO1983a01	14.6652(5)	3154	RT	83Par1	RHO1988a01	14.8803(4)	3295	RT	88Fis1
RHO1983a02	14.7014(8)	3177	493	83Par1	RHO1988b01	14.8803(4)	3295	-	88Bau1
RHO1983a03	14.6536(8)	3147	RT	83Par1	RHO1988b02	14.62(1)	3125	-	88Bau1
RHO1984a01	14.821(1)	3256	373	84McC1	RHO1988b03	14.62(1)	3125	13	88Bau1
RHO1984b02	14.678(1)	3162	373	84McC2	RHO1988b04	14.678(1)	3162	-	88Bau1
RHO1984c01	14.694(1)	3173	294	84Par1	RHO1989a01	14.6566(4)	3148	373	89Bau1
RHO1984d01	14.601(1)	3113	11	84Par2	RHO1989b01	14.5265(7)	3065	RT	89Fis1
RHO1984d02	14.7237(5)	3192	295	84Par2	RHO1989b02	14.4247(5)	3001	11	89Fis1
RHO1984d03	14.7580(5)	3214	423	84Par2	RHO1990a01	14.410(2)	2992	RT	90Cor1
RHO1984d04	14.8680(8)	3287	573	84Par2	RHO1990a02	14.110(1)	2809	RT	90Cor1
RHO1986b01	14.492(1)	3044	n.s.	86Stu1	RHO1990a03	13.9645(7)	2723	RT	90Cor1

[1]) Unit cell constants read from Fig. 2 in [95Par2].

Table RHO.2.2 (RHO-II $I\bar{4}3m$, continued)

code	a [Å]	V [Å3]	T [K]	reference
RHO1991a01	14.5578(4)	3085	373	91Bie1
RHO1991a02	14.2293(9)	2881	473	91Bie1
RHO1991b01	14.5882(4)	3105	293	91Bie2
RHO1991b02	14.1729(6)	2847	573	91Bie2
RHO1991d01	14.480(1)	3036	473	91Par1
RHO1992a01	14.6566(4)	3148	373	92Bie1
RHO1992a02	14.6633(7)	3153	373	92Bie1
RHO1992a04	14.5882(4)	3105	293	92Bie1
RHO1992a05	14.5578(4)	3085	373	92Bie1
RHO1992a06	14.2293(9)	2881	473	92Bie1
RHO1992a07	14.1729(6)	2847	573	92Bie1
RHO1992a08	14.4803(1)	3036	573	92Bie1
RHO1992a09	14.8168(2)	3253	295	92Bie1
RHO1992a10	14.2422(6)	2889	373	92Bie1
RHO1992b02	14.374(1)	2970	297	92Par1
RHO1993a01	14.4803(1)	3036	573	93Bie1
RHO1993a02	14.8168(2)	3253	295	93Bie1
RHO1994a01	14.4636(7)	3026	300	94Par1
RHO1994b01	14.6537(2)	3147	298	94Mey1
RHO1994b03	14.6677(2)	3156	298	94Mey1
RHO1994b04	14.5852(1)	3103	298	94Mey1
RHO1995a05	14.9771(2)	3360	RT	95Wei1
RHO1995a11	14.8389(6)	3267	5	95Wei1
RHO1995a12	14.525(1)	3064	5	95Wei1
RHO1995a13	14.9151(2)	3318	5	95Wei1
RHO1995a14	14.6475(8)	3143	5	95Wei1
RHO1995b01	14.545(1)	3077	298	95New1
RHO1995b02	14.8706	3288	-	95New1
RHO1995c01	14.6886(5)	3169	13	95Par1
RHO1995c02	14.7119(9)	3184	300	95Par1
RHO1995c03	14.3321(5)	2944	300	95Par1
RHO1995c04	14.5571(5)	3085	300	95Par1
RHO1995c05	14.6580(7)	3149	300	95Par1
RHO1995c06	14.657(2)	3149	300	95Par1
RHO1995d06	14.6886(6)	3169	13	95Par2
RHO1995d07	14.712(1)	3184	300	95Par2
RHO1997a02	14.8410(7)	3269	5	97Wei1
RHO1997a03	14.527(1)	3066	5	97Wei1
RHO1997a04	14.9771(2)	3360	n.s.	97Wei1
RHO1997a06	14.9151(2)	3318	5	97Wei1
RHO1997a07	14.6475(8)	3143	5	97Wei1
RHO1999b02	14.2609(3)	2900	RT	99Joh2
RHO2001a01	14.6102(2)	3119	393	2001Lee1
RHO2001a02	14.6063(4)	3116	443	2001Lee1
RHO2001a03	14.5827(4)	3101	493	2001Lee1
RHO2001a04	14.5075(5)	3053	548	2001Lee1
RHO2001a05	14.4056(6)	2989	598	2001Lee1
RHO2001a06	14.3755(6)	2971	653	2001Lee1
RHO2001a07	14.3583(8)	2960	683	2001Lee1
RHO2001a08	14.5301(4)	3068	298	2001Lee1
RHO2001a09	14.2643(5)	2902	823	2001Lee1
RHO2001a10	14.2321(3)	2883	298	2001Lee1
RHO2001a12	14.4568(3)	3021	678	2001Lee1
RHO2001a15	14.6010(3)	3113	563	2001Lee1
RHO2004a01	14.35830(5)	2960	n.s.	2004And1
RHO2004a02	14.3939(2)	2982	n.s.	2004And1
RHO2004a03	14.5097(3)	3055	n.s.	2004And1

Table RHO.2.2 (continued)

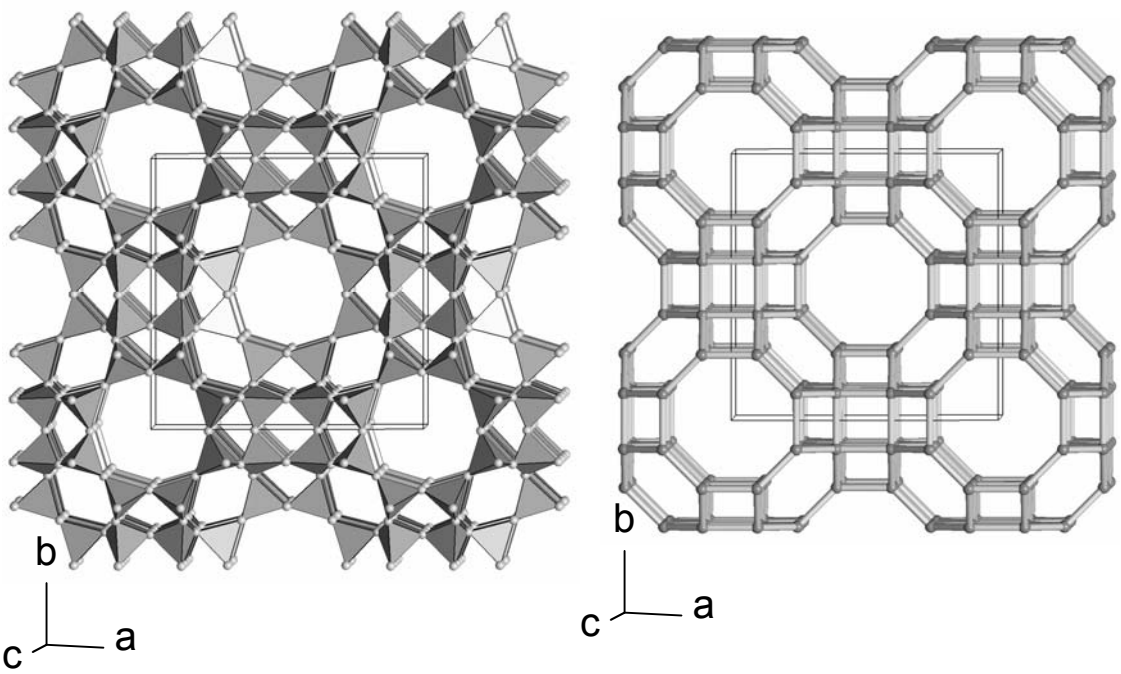
code	*a* [Å]	*V* [Å^3]	*T* [K]	reference
RHO-IV *I* 2 3				
RHO1989c01	13.781(4)	2617	n.s.	89Rou1
RHO1991c01	13.783(1)	2618	296	91Cor1
RHO1991c02	13.100(3)	2248	n.s.	91Cor1
RHO1992b01	14.001(1)	2745	300	92Par1
RHO1994a02	13.6469(6)	2542	300	94Par1
RHO1994a03	13.4791(5)	2449	300	94Par1
RHO1994a04	13.998(1)	2743	300	94Par1
RHO1994a05	13.09(1)	2243	298	94Par1
RHO1994a06	13.11(2)	2253	473	94Par1
RHO1994a07	13.12(1)	2258	573	94Par1
RHO1994a08	13.13(1)	2264	673	94Par1
RHO1995b04	14.8706	3288	-	95New1
RHO1995b05	14.6080	3117	-	95New1
RHO1996a01	13.3650(8)	2387	303	96Nen1
RHO1996a02	13.450(1)	2433	673	96Nen1
RHO1996a03	13.6512(8)	2544	383	96Nen1
RHO1996a04	13.6872(4)	2564	573	96Nen1
RHO1998a01	14.6737(2)	3160	298	98Joh1
RHO1998b01	15.4795(5)	3709	n.s.	98Fen1
RHO1998b02	15.6232(2)	3813	n.s.	98Fen1
RHO1998b03	15.5521(2)	3762	n.s.	98Fen1
RHO1999a01	14.6977(2)	3175	298	99Joh1
RHO1999a02	14.6734(7)	3159	298	99Joh1
RHO1999a03	14.6737(2)	3160	298	99Joh1
RHO1999b01	14.2926(5)	2920	RT	99Joh2

RHO.3 Framework structures

RHO.3.1 RHO-I compounds (*I m* $\bar{3}$ *m*, IT #229)

Table RHO.3.1.1 Atomic coordinates and site definitions for zeolite rho, $D_{5.3}Cs_{0.7} \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)$ (RHO1987a01, 87Fis1).

atom	*x*	*y*	*z*	*B* [Å^2]	Site symmetry	Wyckoff position	no. of atoms in unit cell
(Si,Al)1	¼	0.1029(2)	-*y*+½	1.0(1)	. . 2	48(i)	42 / 6
O1	0.1667(2)	*x*	0.3760(2)	2.9(1)	. . *m*	48(k)	48
O2	0	0.2173(3)	0.3841(2)	2.5(1)	*m* . .	48(j)	48
D1	0	0.381(1)	0.154(1)	3.8(7)	*m* . .	48(j)	8.4(5)
Cs1	0.452(4)	0	0	5.0	4 *m* . *m*	12(e)	1.7(2)
Al(nf)	0.208(2)	*x*	0.263(4)	5.0	. . *m*	48(k)	5.5(5)
O(nf)	0.303(1)	*x*	0.375(2)	5.0	. . *m*	48(k)	4.9(3)



a Polyhedral representation. **b** Ball and stick model corresponding to a).

Fig. RHO.3.1.1 Projections of the RHO-I crystal structure of zeolite rho, $D_{5.3}Cs_{0.7} \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)$ (RHO1987a01, 87Fis1). View parallel **c** rotated by 1° about **a** and **b**.

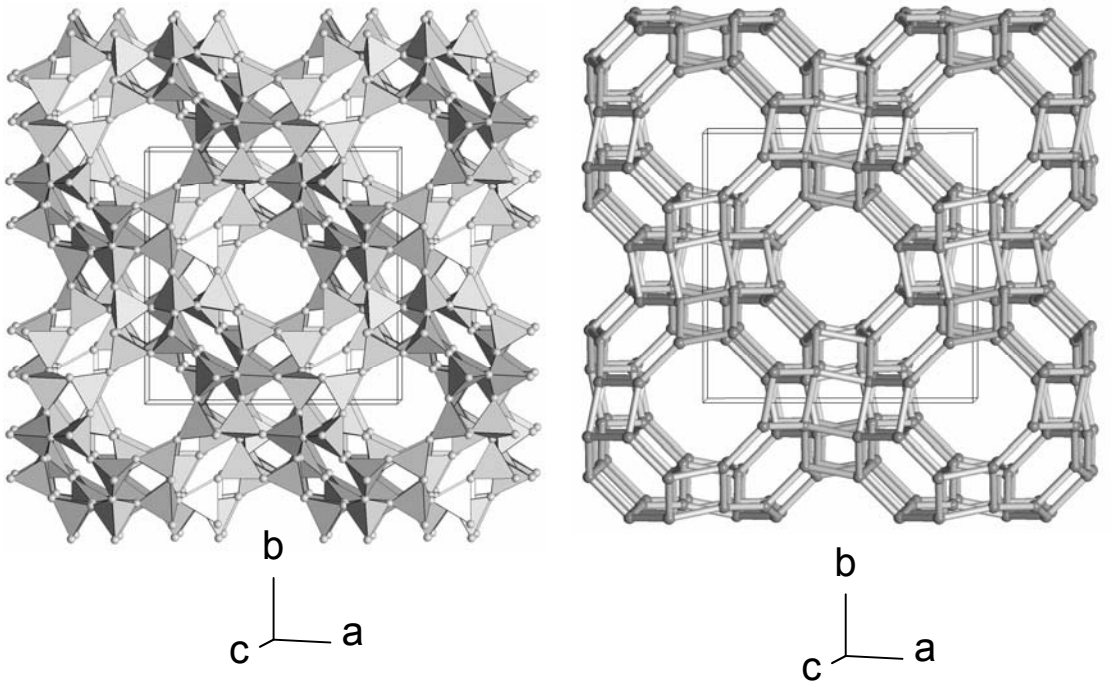
Table RHO.3.1.2 Selected interatomic distances and angles for zeolite rho, $D_{5.3}Cs_{0.7} \cdot Al_6Si_{42}O_{96} \cdot 5Al(nf)$ (RHO1987a01, 87Fis1).

	T - O [Å]	T - O - T [°]
(Si,Al)1 - O1	1.612(4)	153.8(3)
(Si,Al)1 - O1	1.612(4)	153.8(3)
(Si,Al)1 - O2	1.638(3)	142.2(3)
(Si,Al)1 - O2	1.638(3)	142.2(3)
mean	1.625	148.0

RHO.3.2 RHO-II compounds ($I\bar{4}3m$, IT #217)

Table RHO.3.2.2 Selected interatomic distances and angles for zeolite rho, $Na_{8.4}Cs_{3.2} \cdot Al_{11.6}Si_{36.4}O_{96} \cdot 5D_2O$ (RHO1989a01, 89Bau1).

	T - O [Å]	T - O - T [°]
(Si,Al)1 - O11	1.61(2)	146(1)
(Si,Al)1 - O12	1.63(1)	147(1)
(Si,Al)1 - O2	1.64(1)	135(1)
(Si,Al)1 - O2	1.67(2)	135(1)
mean	1.64	141



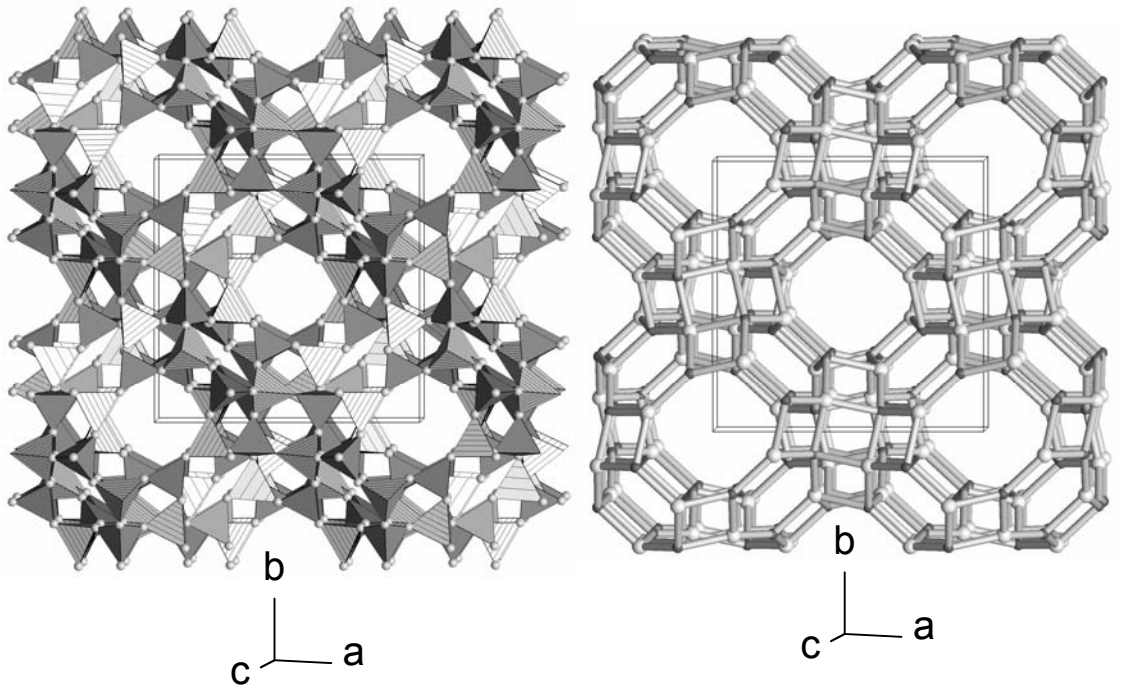
a Polyhedral representation. **b** Ball and stick model corresponding to a).

Fig. RHO.3.2.1 Projections of the RHO-II crystal structure of zeolite rho, $Na_{8.4}Cs_{3.2} \cdot Al_{11.6}Si_{36.4}O_{96} \cdot 5D_2O$ (RHO1989a01, 89Bau1). View parallel **c** rotated by 1° about **a** and **b**.

Table RHO.3.2.1 Atomic coordinates and site definitions for zeolite rho, $Na_{8.4}Cs_{3.2} \cdot Al_{11.6}Si_{36.4}O_{96} \cdot 5D_2O$ (RHO1989a01, 89Bau1).

atom	*x*	*y*	*z*	*B* [Å^2]	Site symmetry	Wyckoff position	no. of atoms in unit cell
(Si,Al)1	0.2692(7)	0.121(1)	0.4200(7)	1.0(2)	1	48(h)	36.38/11.62
O11	0.2092(6)	*x*	0.395(1)	2.1(3)	. . *m*	24(g)	24
O12	0.8667(6)	*x*	0.6232(9)	1.6(2)	. . *m*	24(g)	24
O2	0.0294(5)	0.2099(6)	0.3864(8)	2.0(2)	1	48(h)	48
Cs1	0	0	½	3(1)	2 . *m m*	12(e)	6.36
Na1	0.305(7)	*x*	*x*	3.0	. 3 *m*	8(c)	2.0(5)
Na2	0.040(8)	*x*	0.504(9)	3.0	. . *m*	24(g)	4.2(7)
OW1	0.218(8)	*x*	0.12(2)	3.0	. . *m*	24(g)	2.1(5)
OW2	0.040(8)	*x*	0.17(1)	3.0	. . *m*	24(g)	2.2(4)
OW3	0.43(1)	*x*	0.28(2)	3.0	. . *m*	24(g)	1.9(5)

RHO.3.3 RHO-IV compounds (*I* 2 3, IT #197)



a Polyhedral representation. PO_4-tetrahedra are dark grey, BeO_4-tetrahedra are light grey and hatched. **b** Ball and stick model corresponding to a).

Fig. RHO.3.3.1 Projections of the RHO-IV crystal structure of pahasapaite, $Li_{11.6}Ca_{5.5}K_{1.2}Na_{0.2} \cdot Be_{24}P_{24}O_{96} \cdot 38H_2O$ (RHO1989c01, 89Rou1). View parallel **c** rotated by 1° about **a** and **b**.

Table RHO.3.3.1 Atomic coordinates and site definitions for pahasapaite, $Li_{11.6}Ca_{5.5}K_{1.2}Na_{0.2} \cdot Be_{24}P_{24}O_{96} \cdot 38H_2O$ (RHO1989c01, 89Rou1).

atom	*x*	*y*	*z*	B_{eq} [Å^2]	Site symmetry	Wyckoff position	no. of atoms in unit cell
P11	0.2771(1)	0.1240(1)	0.4224(1)	0.71	1	24(f)	24
Be12	0.1210(5)	0.2675(5)	0.4207(5)	0.76	1	24(f)	24
O11	0.2246(3)	0.2178(3)	0.3914(3)	0.95	1	24(f)	24
O12	0.8766(3)	0.8781(3)	0.6245(3)	1.16	1	24(f)	24
O21	0.0329(3)	0.2041(3)	0.3791(3)	1.18	1	24(f)	24
O22	0.2160(3)	0.0383(3)	0.3889(3)	1.16	1	24(f)	24
Ca,Li,K, Na	0.3615(5)	0.0357(4)	0.0301(4)	3.66	1	24(f)	5.5/3.6/1.2/ 0.072
Li1	0.3013(8)	*x*	*x*	1.89	. 3 .	8(c)	8
OW1	0.3851(3)	*x*	*x*	3.08	. 3 .	8(c)	8
OW2	0.4768(8)	0	0	n.p.d.	2 . .	12(d)	6
OW3	0.217(1)	0.110(1)	0.071(2)	4.00	1	24(f)	12
OW4	0.246(2)	0.077(2)	0.050(2)	6.58	1	24(f)	12

Table RHO.3.3.2 Selected interatomic distances and angles pahasapaite, $Li_{11.6}Ca_{5.5}K_{1.2}Na_{0.2} \cdot Be_{24}P_{24}O_{96} \cdot 38H_2O$ (RHO1989c01, 89Rou1).

	T - O [Å]	T - O - T [°]		T - O [Å]	T - O - T [°]
P11 - O22	1.522(4)	135.6(4)	Be12 - O21	1.602(8)	131.7(4)
P11 - O12	1.528(4)	135.7(4)	Be12 - O12	1.615(8)	135.7(4)
P11 - O11	1.542(4)	133.9(4)	Be12 - O11	1.634(8)	133.9(4)
P11 - O21	1.545(4)	131.7(4)	Be12 - O22	1.642(8)	135.6(4)
mean	1.534	134.2	mean	1.623	134.2

RHO.4 Chemical composition

	D															
H																He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	L	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn

Fig. RHO.4.1 Chemical elements (highlighted) occurring in RHO-type compounds. Framework cations are in grey fields.

RHO.5 Flexibility and apertures

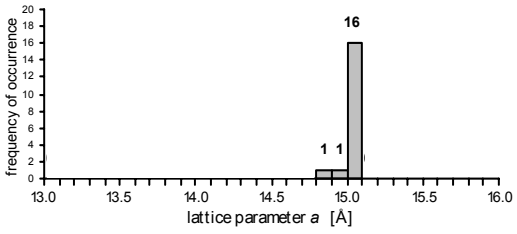


Fig. RHO.5.1 Histogram of 18 unit cell constants *a* of aluminosilicates of RHO-type in space group $I\,m\,\bar{3}\,m$. Only precise crystal structure determinations have been used. The extreme values of *a* are 14.850 Å and 15.098 Å, the mean value is 15.045 Å.

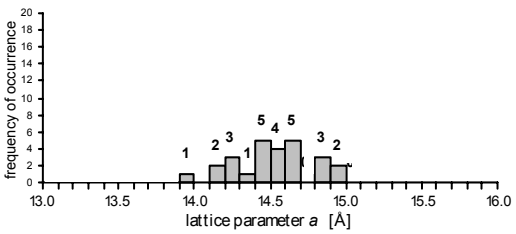


Fig. RHO.5.2 Histogram of 26 unit cell constants *a* of aluminosilicates of RHO-type in space group $I\,\bar{4}\,3\,m$. Only precise crystal structure determinations have been used. The extreme values of *a* are 13.965 Å and 14.977 Å, the mean value is 14.520 Å.

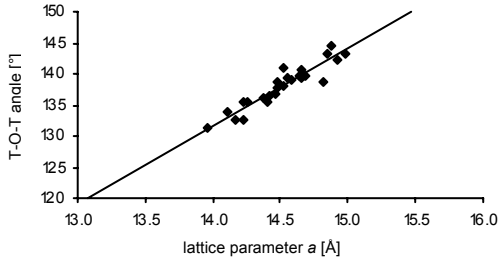


Fig. RHO.5.3 Mean T-O-T angles from 26 precise crystal structure determinations of aluminosilicates of RHO-type performed in space group $I\bar{4}3m$ are plotted against the unit cell constant a. The extreme values of a are 13.965 Å and 14.977 Å, the mean is 14.520 Å. The extreme values of T-O-T(mean) are 131.2° and 144.5°, the mean is 138.1°. The line is a least-squares fit to all points.

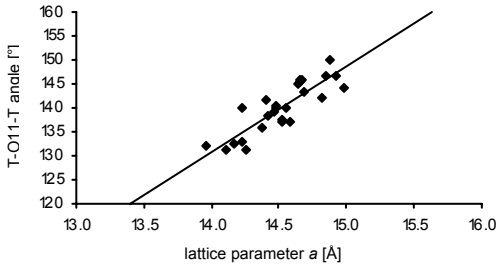


Fig. RHO.5.4 Mean T-O11-T angles from 26 precise crystal structure determinations of aluminosilicates of RHO-type performed in space group $I\bar{4}3m$ are plotted against the unit cell constant a. The extreme values of a are 13.965 Å and 14.977 Å, the mean is 14.520 Å. The extreme values of T-O11-T are 131.1° and 150.1°, the mean is 140.1°. The line is a least-squares fit to all points.

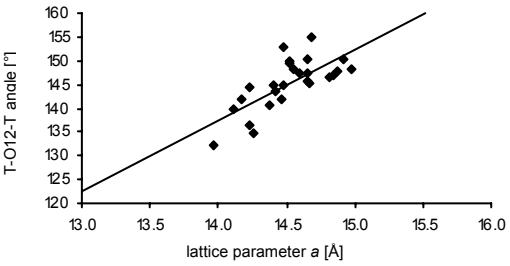


Fig. RHO.5.5 Mean T-O12-T angles from 26 precise crystal structure determinations of aluminosilicates of RHO-type performed in space group $I\bar{4}3m$ are plotted against the unit cell constant a. The extreme values of a are 13.965 Å and 14.977 Å, the mean is 14.520 Å. The extreme values of T-O12-T are 132.4° and 155.2°, the mean is 145.3°. The line is a least-squares fit to all points.

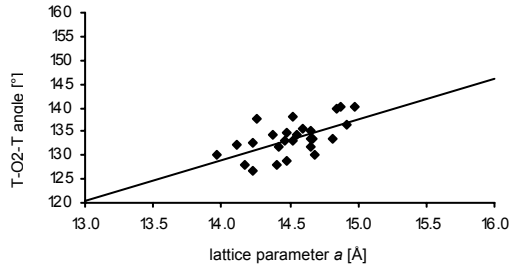


Fig. RHO.5.6 Mean T-O2-T angles from 26 precise crystal structure determinations of aluminosilicates of RHO-type performed in space group $I\bar{4}3m$ are plotted against the unit cell constant a. The extreme values of a are 13.965 Å and 14.977 Å, the mean is 14.520 Å. The extreme values of T-O2-T are 126.7° and 140.2°, the mean is 133.6°. The line is a least-squares fit to all points.

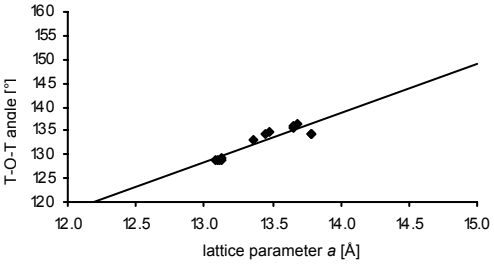


Fig. RHO.5.7 Mean T-O-T angles from all 13 available crystal structure determinations of beryllophosphates of RHO-type performed in space group $I23$ are plotted against the unit cell constant a. The extreme values of a are 13.090 Å and 13.783 Å, the mean is 13.415 Å. The extreme values of T-O-T(mean) are 128.8° and 136.4°, the mean is 132.6°. The line is a least-squares fit to all points.

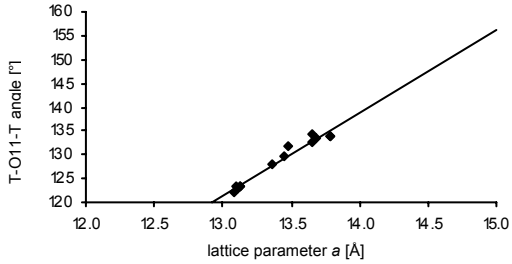


Fig. RHO.5.8 Mean T-O11-T angles from all 13 available crystal structure determinations of beryllophosphates of RHO-type performed in space group $I23$ are plotted against the unit cell constant a. The extreme values of a are 13.090 Å and 13.783 Å, the mean is 13.415 Å. The extreme values of T-O11-T are 122.3° and 134.2°, the mean is 128.7°. The line is a least-squares fit to all points.

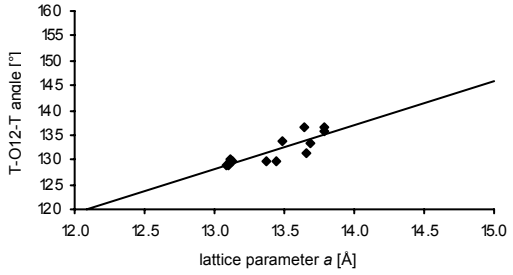


Fig. RHO.5.9 Mean T-O12-T angles from all 13 available crystal structure determinations of beryllophosphates of RHO-type performed in space group $I\,2\,3$ are plotted against the unit cell constant a. The extreme values of a are 13.090 Å and 13.783 Å, the mean is 13.415 Å. The extreme values of T-O12-T are 129.1° and 136.5°, the mean is 131.8°. The line is a least-squares fit to all points.

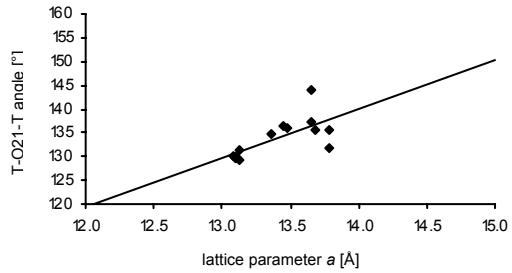


Fig. RHO.5.10 Mean T-O21-T angles from all 13 available crystal structure determinations of beryllophosphates of RHO-type performed in space group $I\,2\,3$ are plotted against the unit cell constant a. The extreme values of a are 13.090 Å and 13.783 Å, the mean is 13.415 Å. The extreme values of T-O21-T are 129.5° and 144.0°, the mean is 134.0°. The line is a least-squares fit to all points.

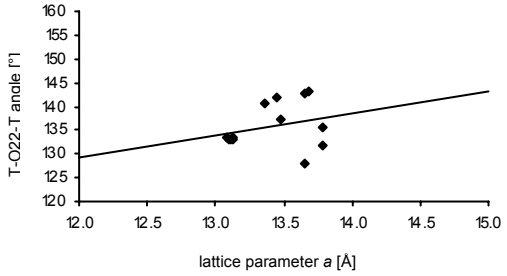


Fig. RHO.5.11 Mean T-O22-T angles from all 13 available crystal structure determinations of beryllophosphates of RHO-type performed in space group $I\,2\,3$ are plotted against the unit cell constant a. The extreme values of a are 13.090 Å and 13.783 Å, the mean is 13.415 Å. The extreme values of T-O22-T are 128.1° and 143.1°, the mean is 135.9°. The line is a least-squares fit to all points.

Aluminosilicate RHO-type frameworks crystallizing in space group $I\,m\,\bar{3}\,m$ have unit cell constant values very close to 15 Å. Actually the ratio between the largest and the smallest cell constants plotted in Fig. RHO.5.1 is only 1.017. As long as the framework maintains this symmetry it is rather inflexible. When a transformation to space group $I\,\bar{4}\,3\,m$ takes place, for example because of dehydration, it becomes apparent that the framework is collapsible. The ratio between the largest and the smallest cell constants shown in Fig. RHO.5.2 is 1.073 Å. This is a smaller ratio than observed for the a and b unit cell constants of natrolite (Figs. NAT.5.1 and NAT.5.2) but it still clearly indicates a collapsible framework. This is also shown by the plots of the various T-O-T angles in the aluminosilicate RHO-type frameworks against the unit cell constants. With an increase of the mean angle T-O-T the unit cell constant increases (Fig. RHO.5.3). This is also true for each of the individual T-O-T angles around oxygen atoms O11, O12 and O2 (Figs. RHO.5.4, RHO.5.5 and RHO.5.6). All the individual angles corotate as they do in all collapsible frameworks. None of them antirotates as observed for the noncollapsible FAU-, KFI- and LTA-type [92Bau1] frameworks. Analogous observations can be made for the beryllophosphates of the RHO-type, as can be seen in Figs. RHO.5.7 through RHO.5.11. The T-O2-T angle of 126.7° in RHO1996a04 is the narrowest T-O-T angle observed among the aluminosilicates of RHO-type displayed in Figs. RHO.5.4 through RHO.5.6. The T-O11-T angle of 122.3°among the beryllophosphates in RHO1994a05 is even narrower. Neither of these values is as small as the 113.9° angle T-O3-T in NAT1996a04. This indicates that the collapse of the RHO-framework is not stopped by small T-O-T angles, but instead by limits posed by pore-filling matter [92Bau2, 95Bau1].

The value of the mean angle of 138° in RHO-type aluminosilicates in space group $Im\bar{3}m$ is clearly smaller than the maximum of the distribution of T-O-T angles in aluminosilicate zeolites (about 143° [95Bau1]). In contrast that mean is 146° in RHO-type aluminosilicates in space group $I\bar{4}3m$ and thus larger than the average of all observed T-O-T angles in aluminosilicate zeolites. The average T-O-T of 142° for RHO-type aluminosilicates, however, is close to the overall mean for aluminosilicates.

The 8-ring openings in the framework of RHO-type aluminosilicates have a free diameter of about 3.5 Å. They are buckled compared with those in LTA where they measure over 4 Å.

RHO.6 Other information

Zeolite H-RHO is highly selective for the synthesis of dimethylamine from methanol and ammonia [88Sha1, 88Sha2, 89Ber1], while the yield of trimethylamine is reduced. The effect of the adsorption properties of zeolite rho on its methanol amination activity was studied by [2000Cal1]. Zeolite rho is mentioned in various patents and in other applications as well. One example is the dithioacetalization of carbonyl compounds [96Sab1].

Li-exchanged aluminogermanate zeolite rho has been shown to be rhombohedrally distorted [2002Lee1]. Details of the crystal structure were not given.

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