

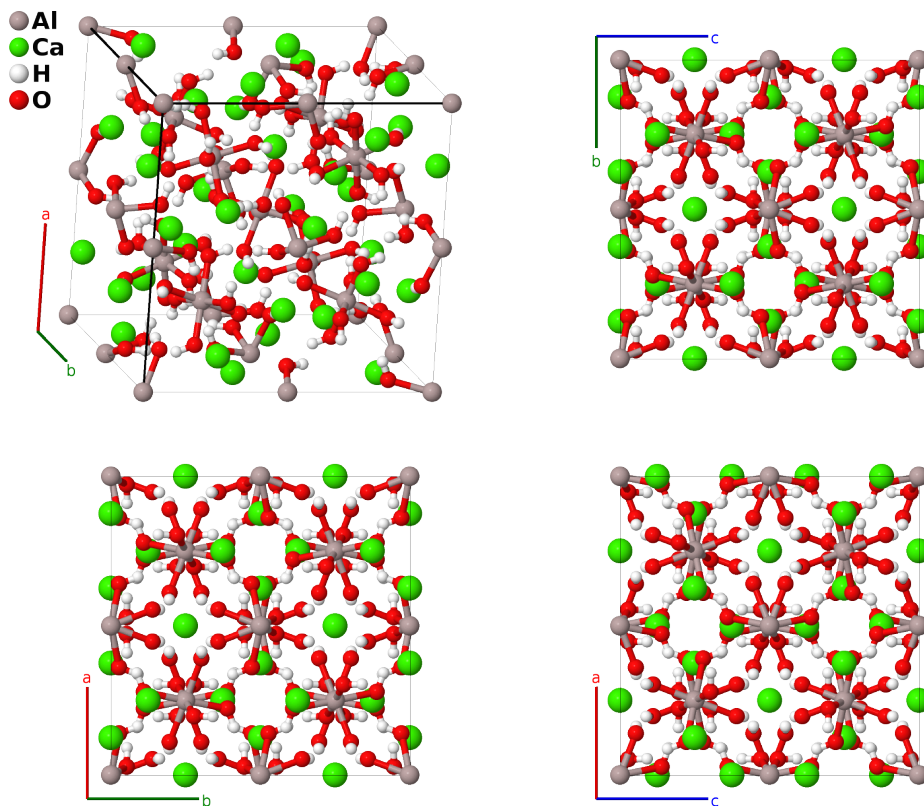
Ca₃Al₂(OH)₁₂ (*J*2₃) Structure: A2B3C12D12_cI232_230_a_c_h_h-001

This structure originally had the label A2B3C12D12_cI232_230_a_c_h_h. Calls to that address will be redirected here.

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<https://aflow.org/p/LL0W>

https://aflow.org/p/A2B3C12D12_cI232_230_a_c_h_h-001

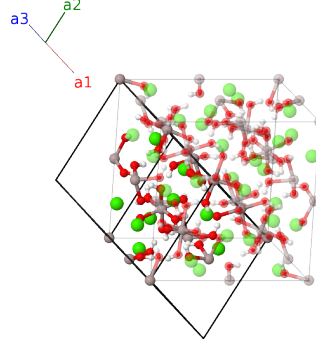


Prototype	Al ₂ Ca ₃ H ₁₂ O ₁₂
AFLOW prototype label	A2B3C12D12_cI232_230_a_c_h_h-001
<i>Strukturbericht</i> designation	<i>J</i> 2 ₃
ICSD	62704
Pearson symbol	cI232
Space group number	230
Space group symbol	<i>Ia</i> $\bar{3}$ <i>d</i>
AFLOW prototype command	<code>aflow --proto=A2B3C12D12_cI232_230_a_c_h_h-001 --params=a, x₃, y₃, z₃, x₄, y₄, z₄</code>

- The original determination of this structure by (Brandenberger, 1933) did not locate the hydrogen atoms, and according to (Gottfried, 1937) used the coordinates of garnet, $S1_4$. (Bartl, 1986) was able to locate the hydrogen atoms, and as they do not change the space group we include them in the $J2_3$ structure.

Body-centered Cubic primitive vectors

$$\begin{aligned} \mathbf{a}_1 &= -\frac{1}{2}a \hat{\mathbf{x}} + \frac{1}{2}a \hat{\mathbf{y}} + \frac{1}{2}a \hat{\mathbf{z}} \\ \mathbf{a}_2 &= \frac{1}{2}a \hat{\mathbf{x}} - \frac{1}{2}a \hat{\mathbf{y}} + \frac{1}{2}a \hat{\mathbf{z}} \\ \mathbf{a}_3 &= \frac{1}{2}a \hat{\mathbf{x}} + \frac{1}{2}a \hat{\mathbf{y}} - \frac{1}{2}a \hat{\mathbf{z}} \end{aligned}$$



Basis vectors

	Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
\mathbf{B}_1	0	$=$	0	(16a)	Al I
\mathbf{B}_2	$\frac{1}{2} \mathbf{a}_1 + \frac{1}{2} \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{y}}$	(16a)	Al I
\mathbf{B}_3	$\frac{1}{2} \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{x}}$	(16a)	Al I
\mathbf{B}_4	$\frac{1}{2} \mathbf{a}_1 + \frac{1}{2} \mathbf{a}_2$	$=$	$\frac{1}{2}a \hat{\mathbf{z}}$	(16a)	Al I
\mathbf{B}_5	$\frac{1}{2} \mathbf{a}_1$	$=$	$-\frac{1}{4}a \hat{\mathbf{x}} + \frac{1}{4}a \hat{\mathbf{y}} + \frac{1}{4}a \hat{\mathbf{z}}$	(16a)	Al I
\mathbf{B}_6	$\frac{1}{2} \mathbf{a}_1 + \frac{1}{2} \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$\frac{1}{4}a \hat{\mathbf{x}} + \frac{1}{4}a \hat{\mathbf{y}} + \frac{1}{4}a \hat{\mathbf{z}}$	(16a)	Al I
\mathbf{B}_7	$\frac{1}{2} \mathbf{a}_3$	$=$	$\frac{1}{4}a \hat{\mathbf{x}} + \frac{1}{4}a \hat{\mathbf{y}} - \frac{1}{4}a \hat{\mathbf{z}}$	(16a)	Al I
\mathbf{B}_8	$\frac{1}{2} \mathbf{a}_2$	$=$	$\frac{1}{4}a \hat{\mathbf{x}} - \frac{1}{4}a \hat{\mathbf{y}} + \frac{1}{4}a \hat{\mathbf{z}}$	(16a)	Al I
\mathbf{B}_9	$\frac{1}{4} \mathbf{a}_1 + \frac{3}{8} \mathbf{a}_2 + \frac{1}{8} \mathbf{a}_3$	$=$	$\frac{1}{8}a \hat{\mathbf{x}} + \frac{1}{4}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{10}	$\frac{3}{4} \mathbf{a}_1 + \frac{1}{8} \mathbf{a}_2 + \frac{3}{8} \mathbf{a}_3$	$=$	$-\frac{1}{8}a \hat{\mathbf{x}} + \frac{1}{2}a \hat{\mathbf{y}} + \frac{1}{4}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{11}	$\frac{1}{8} \mathbf{a}_1 + \frac{1}{4} \mathbf{a}_2 + \frac{3}{8} \mathbf{a}_3$	$=$	$\frac{1}{4}a \hat{\mathbf{x}} + \frac{1}{8}a \hat{\mathbf{y}}$	(24c)	Ca I
\mathbf{B}_{12}	$\frac{3}{8} \mathbf{a}_1 + \frac{3}{4} \mathbf{a}_2 + \frac{1}{8} \mathbf{a}_3$	$=$	$\frac{1}{4}a \hat{\mathbf{x}} - \frac{1}{8}a \hat{\mathbf{y}} + \frac{1}{2}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{13}	$\frac{3}{8} \mathbf{a}_1 + \frac{1}{8} \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3$	$=$	$\frac{1}{4}a \hat{\mathbf{y}} + \frac{1}{8}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{14}	$\frac{1}{8} \mathbf{a}_1 + \frac{3}{8} \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{x}} + \frac{1}{4}a \hat{\mathbf{y}} - \frac{1}{8}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{15}	$\frac{3}{4} \mathbf{a}_1 + \frac{5}{8} \mathbf{a}_2 + \frac{7}{8} \mathbf{a}_3$	$=$	$\frac{3}{8}a \hat{\mathbf{x}} + \frac{1}{2}a \hat{\mathbf{y}} + \frac{1}{4}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{16}	$\frac{1}{4} \mathbf{a}_1 + \frac{7}{8} \mathbf{a}_2 + \frac{5}{8} \mathbf{a}_3$	$=$	$\frac{5}{8}a \hat{\mathbf{x}} + \frac{1}{4}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{17}	$\frac{7}{8} \mathbf{a}_1 + \frac{3}{4} \mathbf{a}_2 + \frac{5}{8} \mathbf{a}_3$	$=$	$\frac{1}{4}a \hat{\mathbf{x}} + \frac{3}{8}a \hat{\mathbf{y}} + \frac{1}{2}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{18}	$\frac{5}{8} \mathbf{a}_1 + \frac{1}{4} \mathbf{a}_2 + \frac{7}{8} \mathbf{a}_3$	$=$	$\frac{1}{4}a \hat{\mathbf{x}} + \frac{5}{8}a \hat{\mathbf{y}}$	(24c)	Ca I
\mathbf{B}_{19}	$\frac{5}{8} \mathbf{a}_1 + \frac{7}{8} \mathbf{a}_2 + \frac{3}{4} \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{x}} + \frac{1}{4}a \hat{\mathbf{y}} + \frac{3}{8}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{20}	$\frac{7}{8} \mathbf{a}_1 + \frac{5}{8} \mathbf{a}_2 + \frac{1}{4} \mathbf{a}_3$	$=$	$\frac{1}{4}a \hat{\mathbf{y}} + \frac{5}{8}a \hat{\mathbf{z}}$	(24c)	Ca I
\mathbf{B}_{21}	$(y_3 + z_3) \mathbf{a}_1 + (x_3 + z_3) \mathbf{a}_2 + (x_3 + y_3) \mathbf{a}_3$	$=$	$ax_3 \hat{\mathbf{x}} + ay_3 \hat{\mathbf{y}} + az_3 \hat{\mathbf{z}}$	(96h)	H I
\mathbf{B}_{22}	$(-y_3 + z_3 + \frac{1}{2}) \mathbf{a}_1 - (x_3 - z_3) \mathbf{a}_2 - (x_3 + y_3 - \frac{1}{2}) \mathbf{a}_3$	$=$	$-ax_3 \hat{\mathbf{x}} - a(y_3 - \frac{1}{2}) \hat{\mathbf{y}} + az_3 \hat{\mathbf{z}}$	(96h)	H I
\mathbf{B}_{23}	$(y_3 - z_3) \mathbf{a}_1 - (x_3 + z_3 - \frac{1}{2}) \mathbf{a}_2 + (-x_3 + y_3 + \frac{1}{2}) \mathbf{a}_3$	$=$	$-a(x_3 - \frac{1}{2}) \hat{\mathbf{x}} + ay_3 \hat{\mathbf{y}} - az_3 \hat{\mathbf{z}}$	(96h)	H I

$$\begin{aligned}
\mathbf{B}_{46} &= \begin{pmatrix} (y_3 - z_3 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_3 - z_3) \mathbf{a}_2 + (x_3 + y_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = ax_3 \hat{\mathbf{x}} + a(y_3 + \frac{1}{2}) \hat{\mathbf{y}} - az_3 \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{47} &= \begin{pmatrix} -(y_3 - z_3) \mathbf{a}_1 + \\ (x_3 + z_3 + \frac{1}{2}) \mathbf{a}_2 + \\ (x_3 - y_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a(x_3 + \frac{1}{2}) \hat{\mathbf{x}} - ay_3 \hat{\mathbf{y}} + az_3 \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{48} &= \begin{pmatrix} (y_3 + z_3 + \frac{1}{2}) \mathbf{a}_1 + \\ (-x_3 + z_3 + \frac{1}{2}) \mathbf{a}_2 - (x_3 - y_3) \mathbf{a}_3 \end{pmatrix} = -ax_3 \hat{\mathbf{x}} + ay_3 \hat{\mathbf{y}} + a(z_3 + \frac{1}{2}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{49} &= \begin{pmatrix} -(x_3 + y_3) \mathbf{a}_1 - (y_3 + z_3) \mathbf{a}_2 - \\ (x_3 + z_3) \mathbf{a}_3 \end{pmatrix} = -az_3 \hat{\mathbf{x}} - ax_3 \hat{\mathbf{y}} - ay_3 \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{50} &= \begin{pmatrix} (x_3 + y_3 + \frac{1}{2}) \mathbf{a}_1 + \\ (y_3 - z_3 + \frac{1}{2}) \mathbf{a}_2 + (x_3 - z_3) \mathbf{a}_3 \end{pmatrix} = -az_3 \hat{\mathbf{x}} + ax_3 \hat{\mathbf{y}} + a(y_3 + \frac{1}{2}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{51} &= \begin{pmatrix} (x_3 - y_3 + \frac{1}{2}) \mathbf{a}_1 - \\ (y_3 - z_3) \mathbf{a}_2 + (x_3 + z_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = az_3 \hat{\mathbf{x}} + a(x_3 + \frac{1}{2}) \hat{\mathbf{y}} - ay_3 \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{52} &= \begin{pmatrix} -(x_3 - y_3) \mathbf{a}_1 + \\ (y_3 + z_3 + \frac{1}{2}) \mathbf{a}_2 + \\ (-x_3 + z_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a(z_3 + \frac{1}{2}) \hat{\mathbf{x}} - ax_3 \hat{\mathbf{y}} + ay_3 \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{53} &= \begin{pmatrix} -(x_3 + z_3) \mathbf{a}_1 - (x_3 + y_3) \mathbf{a}_2 - \\ (y_3 + z_3) \mathbf{a}_3 \end{pmatrix} = -ay_3 \hat{\mathbf{x}} - az_3 \hat{\mathbf{y}} - ax_3 \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{54} &= \begin{pmatrix} (x_3 - z_3) \mathbf{a}_1 + (x_3 + y_3 + \frac{1}{2}) \mathbf{a}_2 + \\ (y_3 - z_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a(y_3 + \frac{1}{2}) \hat{\mathbf{x}} - az_3 \hat{\mathbf{y}} + ax_3 \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{55} &= \begin{pmatrix} (x_3 + z_3 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_3 - y_3 + \frac{1}{2}) \mathbf{a}_2 - (y_3 - z_3) \mathbf{a}_3 \end{pmatrix} = -ay_3 \hat{\mathbf{x}} + az_3 \hat{\mathbf{y}} + a(x_3 + \frac{1}{2}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{56} &= \begin{pmatrix} (-x_3 + z_3 + \frac{1}{2}) \mathbf{a}_1 - \\ (x_3 - y_3) \mathbf{a}_2 + (y_3 + z_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = ay_3 \hat{\mathbf{x}} + a(z_3 + \frac{1}{2}) \hat{\mathbf{y}} - ax_3 \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{57} &= \begin{pmatrix} (-x_3 + z_3 + \frac{1}{2}) \mathbf{a}_1 - \\ (y_3 - z_3) \mathbf{a}_2 - (x_3 + y_3) \mathbf{a}_3 \end{pmatrix} = -a(y_3 + \frac{1}{4}) \hat{\mathbf{x}} - a(x_3 - \frac{1}{4}) \hat{\mathbf{y}} + a(z_3 + \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{58} &= \begin{pmatrix} (x_3 + z_3 + \frac{1}{2}) \mathbf{a}_1 + \\ (y_3 + z_3 + \frac{1}{2}) \mathbf{a}_2 + \\ (x_3 + y_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a(y_3 + \frac{1}{4}) \hat{\mathbf{x}} + a(x_3 + \frac{1}{4}) \hat{\mathbf{y}} + a(z_3 + \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{59} &= \begin{pmatrix} (x_3 - z_3) \mathbf{a}_1 - (y_3 + z_3) \mathbf{a}_2 + \\ (x_3 - y_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a(y_3 - \frac{1}{4}) \hat{\mathbf{x}} + a(x_3 + \frac{1}{4}) \hat{\mathbf{y}} - a(z_3 + \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{60} &= \begin{pmatrix} -(x_3 + z_3) \mathbf{a}_1 + \\ (y_3 - z_3 + \frac{1}{2}) \mathbf{a}_2 - (x_3 - y_3) \mathbf{a}_3 \end{pmatrix} = a(y_3 + \frac{1}{4}) \hat{\mathbf{x}} - a(x_3 + \frac{1}{4}) \hat{\mathbf{y}} - a(z_3 - \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{61} &= \begin{pmatrix} (y_3 - z_3 + \frac{1}{2}) \mathbf{a}_1 - \\ (x_3 - y_3) \mathbf{a}_2 - (x_3 + z_3) \mathbf{a}_3 \end{pmatrix} = -a(x_3 + \frac{1}{4}) \hat{\mathbf{x}} - a(z_3 - \frac{1}{4}) \hat{\mathbf{y}} + a(y_3 + \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{62} &= \begin{pmatrix} -(y_3 + z_3) \mathbf{a}_1 + \\ (x_3 - y_3 + \frac{1}{2}) \mathbf{a}_2 + (x_3 - z_3) \mathbf{a}_3 \end{pmatrix} = a(x_3 + \frac{1}{4}) \hat{\mathbf{x}} - a(z_3 + \frac{1}{4}) \hat{\mathbf{y}} - a(y_3 - \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{63} &= \begin{pmatrix} (y_3 + z_3 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_3 + y_3 + \frac{1}{2}) \mathbf{a}_2 + \\ (x_3 + z_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a(x_3 + \frac{1}{4}) \hat{\mathbf{x}} + a(z_3 + \frac{1}{4}) \hat{\mathbf{y}} + a(y_3 + \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{64} &= \begin{pmatrix} -(y_3 - z_3) \mathbf{a}_1 - (x_3 + y_3) \mathbf{a}_2 + \\ (-x_3 + z_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a(x_3 - \frac{1}{4}) \hat{\mathbf{x}} + a(z_3 + \frac{1}{4}) \hat{\mathbf{y}} - a(y_3 + \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{65} &= \begin{pmatrix} (x_3 - y_3 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_3 - z_3) \mathbf{a}_2 - (y_3 + z_3) \mathbf{a}_3 \end{pmatrix} = -a(z_3 + \frac{1}{4}) \hat{\mathbf{x}} - a(y_3 - \frac{1}{4}) \hat{\mathbf{y}} + a(x_3 + \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{66} &= \begin{pmatrix} -(x_3 - y_3) \mathbf{a}_1 - (x_3 + z_3) \mathbf{a}_2 + \\ (y_3 - z_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a(z_3 - \frac{1}{4}) \hat{\mathbf{x}} + a(y_3 + \frac{1}{4}) \hat{\mathbf{y}} - a(x_3 + \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{67} &= \begin{pmatrix} -(x_3 + y_3) \mathbf{a}_1 + \\ (-x_3 + z_3 + \frac{1}{2}) \mathbf{a}_2 - (y_3 - z_3) \mathbf{a}_3 \end{pmatrix} = a(z_3 + \frac{1}{4}) \hat{\mathbf{x}} - a(y_3 + \frac{1}{4}) \hat{\mathbf{y}} - a(x_3 - \frac{1}{4}) \hat{\mathbf{z}} & (96h) & \text{H I}
\end{aligned}$$

$$\begin{aligned}
\mathbf{B}_{68} &= \begin{pmatrix} (x_3 + y_3 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_3 + z_3 + \frac{1}{2}) \mathbf{a}_2 + \\ (y_3 + z_3 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a \left(z_3 + \frac{1}{4} \right) \hat{\mathbf{x}} + a \left(y_3 + \frac{1}{4} \right) \hat{\mathbf{y}} + a \left(x_3 + \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{H I} \\
\mathbf{B}_{69} &= \begin{pmatrix} (y_4 + z_4) \mathbf{a}_1 + (x_4 + z_4) \mathbf{a}_2 + \\ (x_4 + y_4) \mathbf{a}_3 \end{pmatrix} = ax_4 \hat{\mathbf{x}} + ay_4 \hat{\mathbf{y}} + az_4 \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{70} &= \begin{pmatrix} (-y_4 + z_4 + \frac{1}{2}) \mathbf{a}_1 - \\ (x_4 - z_4) \mathbf{a}_2 - (x_4 + y_4 - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -ax_4 \hat{\mathbf{x}} - a \left(y_4 - \frac{1}{2} \right) \hat{\mathbf{y}} + az_4 \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{71} &= \begin{pmatrix} (y_4 - z_4) \mathbf{a}_1 - (x_4 + z_4 - \frac{1}{2}) \mathbf{a}_2 + \\ (-x_4 + y_4 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a \left(x_4 - \frac{1}{2} \right) \hat{\mathbf{x}} + ay_4 \hat{\mathbf{y}} - az_4 \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{72} &= \begin{pmatrix} -(y_4 + z_4 - \frac{1}{2}) \mathbf{a}_1 + \\ (x_4 - z_4 + \frac{1}{2}) \mathbf{a}_2 + (x_4 - y_4) \mathbf{a}_3 \end{pmatrix} = ax_4 \hat{\mathbf{x}} - ay_4 \hat{\mathbf{y}} - a \left(z_4 - \frac{1}{2} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{73} &= \begin{pmatrix} (x_4 + y_4) \mathbf{a}_1 + (y_4 + z_4) \mathbf{a}_2 + \\ (x_4 + z_4) \mathbf{a}_3 \end{pmatrix} = az_4 \hat{\mathbf{x}} + ax_4 \hat{\mathbf{y}} + ay_4 \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{74} &= \begin{pmatrix} -(x_4 + y_4 - \frac{1}{2}) \mathbf{a}_1 + \\ (-y_4 + z_4 + \frac{1}{2}) \mathbf{a}_2 - (x_4 - z_4) \mathbf{a}_3 \end{pmatrix} = az_4 \hat{\mathbf{x}} - ax_4 \hat{\mathbf{y}} - a \left(y_4 - \frac{1}{2} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{75} &= \begin{pmatrix} (-x_4 + y_4 + \frac{1}{2}) \mathbf{a}_1 + \\ (y_4 - z_4) \mathbf{a}_2 - (x_4 + z_4 - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -az_4 \hat{\mathbf{x}} - a \left(x_4 - \frac{1}{2} \right) \hat{\mathbf{y}} + ay_4 \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{76} &= \begin{pmatrix} (x_4 - y_4) \mathbf{a}_1 - (y_4 + z_4 - \frac{1}{2}) \mathbf{a}_2 + \\ (x_4 - z_4 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a \left(z_4 - \frac{1}{2} \right) \hat{\mathbf{x}} + ax_4 \hat{\mathbf{y}} - ay_4 \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{77} &= \begin{pmatrix} (x_4 + z_4) \mathbf{a}_1 + (x_4 + y_4) \mathbf{a}_2 + \\ (y_4 + z_4) \mathbf{a}_3 \end{pmatrix} = ay_4 \hat{\mathbf{x}} + az_4 \hat{\mathbf{y}} + ax_4 \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{78} &= \begin{pmatrix} -(x_4 - z_4) \mathbf{a}_1 - \\ (x_4 + y_4 - \frac{1}{2}) \mathbf{a}_2 + \\ (-y_4 + z_4 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a \left(y_4 - \frac{1}{2} \right) \hat{\mathbf{x}} + az_4 \hat{\mathbf{y}} - ax_4 \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{79} &= \begin{pmatrix} -(x_4 + z_4 - \frac{1}{2}) \mathbf{a}_1 + \\ (-x_4 + y_4 + \frac{1}{2}) \mathbf{a}_2 + (y_4 - z_4) \mathbf{a}_3 \end{pmatrix} = ay_4 \hat{\mathbf{x}} - az_4 \hat{\mathbf{y}} - a \left(x_4 - \frac{1}{2} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{80} &= \begin{pmatrix} (x_4 - z_4 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_4 - y_4) \mathbf{a}_2 - (y_4 + z_4 - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -ay_4 \hat{\mathbf{x}} - a \left(z_4 - \frac{1}{2} \right) \hat{\mathbf{y}} + ax_4 \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{81} &= \begin{pmatrix} (x_4 - z_4 + \frac{1}{2}) \mathbf{a}_1 + \\ (y_4 - z_4) \mathbf{a}_2 + (x_4 + y_4) \mathbf{a}_3 \end{pmatrix} = a \left(y_4 - \frac{1}{4} \right) \hat{\mathbf{x}} + a \left(x_4 + \frac{1}{4} \right) \hat{\mathbf{y}} - a \left(z_4 - \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{82} &= \begin{pmatrix} -(x_4 + z_4 - \frac{1}{2}) \mathbf{a}_1 - \\ (y_4 + z_4 - \frac{1}{2}) \mathbf{a}_2 - \\ (x_4 + y_4 - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a \left(y_4 - \frac{1}{4} \right) \hat{\mathbf{x}} - a \left(x_4 - \frac{1}{4} \right) \hat{\mathbf{y}} - a \left(z_4 - \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{83} &= \begin{pmatrix} -(x_4 - z_4) \mathbf{a}_1 + (y_4 + z_4) \mathbf{a}_2 + \\ (-x_4 + y_4 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a \left(y_4 + \frac{1}{4} \right) \hat{\mathbf{x}} - a \left(x_4 - \frac{1}{4} \right) \hat{\mathbf{y}} + a \left(z_4 - \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{84} &= \begin{pmatrix} (x_4 + z_4) \mathbf{a}_1 + \\ (-y_4 + z_4 + \frac{1}{2}) \mathbf{a}_2 + (x_4 - y_4) \mathbf{a}_3 \end{pmatrix} = -a \left(y_4 - \frac{1}{4} \right) \hat{\mathbf{x}} + a \left(x_4 - \frac{1}{4} \right) \hat{\mathbf{y}} + a \left(z_4 + \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{85} &= \begin{pmatrix} (-y_4 + z_4 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_4 - y_4) \mathbf{a}_2 + (x_4 + z_4) \mathbf{a}_3 \end{pmatrix} = a \left(x_4 - \frac{1}{4} \right) \hat{\mathbf{x}} + a \left(z_4 + \frac{1}{4} \right) \hat{\mathbf{y}} - a \left(y_4 - \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{86} &= \begin{pmatrix} (y_4 + z_4) \mathbf{a}_1 + \\ (-x_4 + y_4 + \frac{1}{2}) \mathbf{a}_2 - (x_4 - z_4) \mathbf{a}_3 \end{pmatrix} = -a \left(x_4 - \frac{1}{4} \right) \hat{\mathbf{x}} + a \left(z_4 - \frac{1}{4} \right) \hat{\mathbf{y}} + a \left(y_4 + \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{87} &= \begin{pmatrix} -(y_4 + z_4 - \frac{1}{2}) \mathbf{a}_1 - \\ (x_4 + y_4 - \frac{1}{2}) \mathbf{a}_2 - \\ (x_4 + z_4 - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a \left(x_4 - \frac{1}{4} \right) \hat{\mathbf{x}} - a \left(z_4 - \frac{1}{4} \right) \hat{\mathbf{y}} - a \left(y_4 - \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{88} &= \begin{pmatrix} (y_4 - z_4) \mathbf{a}_1 + (x_4 + y_4) \mathbf{a}_2 + \\ (x_4 - z_4 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a \left(x_4 + \frac{1}{4} \right) \hat{\mathbf{x}} - a \left(z_4 - \frac{1}{4} \right) \hat{\mathbf{y}} + a \left(y_4 - \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{89} &= \begin{pmatrix} (-x_4 + y_4 + \frac{1}{2}) \mathbf{a}_1 - \\ (x_4 - z_4) \mathbf{a}_2 + (y_4 + z_4) \mathbf{a}_3 \end{pmatrix} = a \left(z_4 - \frac{1}{4} \right) \hat{\mathbf{x}} + a \left(y_4 + \frac{1}{4} \right) \hat{\mathbf{y}} - a \left(x_4 - \frac{1}{4} \right) \hat{\mathbf{z}} & (96h) & \text{O I}
\end{aligned}$$

$$\begin{aligned}
\mathbf{B}_{90} &= (x_4 - y_4) \mathbf{a}_1 + (x_4 + z_4) \mathbf{a}_2 + (-y_4 + z_4 + \frac{1}{2}) \mathbf{a}_3 &= a(z_4 + \frac{1}{4}) \hat{\mathbf{x}} - a(y_4 - \frac{1}{4}) \hat{\mathbf{y}} + a(x_4 - \frac{1}{4}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{91} &= (x_4 + y_4) \mathbf{a}_1 + (x_4 - z_4 + \frac{1}{2}) \mathbf{a}_2 + (y_4 - z_4) \mathbf{a}_3 &= -a(z_4 - \frac{1}{4}) \hat{\mathbf{x}} + a(y_4 - \frac{1}{4}) \hat{\mathbf{y}} + a(x_4 + \frac{1}{4}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{92} &= -(x_4 + y_4 - \frac{1}{2}) \mathbf{a}_1 - (x_4 + z_4 - \frac{1}{2}) \mathbf{a}_2 - (y_4 + z_4 - \frac{1}{2}) \mathbf{a}_3 &= -a(z_4 - \frac{1}{4}) \hat{\mathbf{x}} - a(y_4 - \frac{1}{4}) \hat{\mathbf{y}} - a(x_4 - \frac{1}{4}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{93} &= -(y_4 + z_4) \mathbf{a}_1 - (x_4 + z_4) \mathbf{a}_2 - (x_4 + y_4) \mathbf{a}_3 &= -ax_4 \hat{\mathbf{x}} - ay_4 \hat{\mathbf{y}} - az_4 \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{94} &= (y_4 - z_4 + \frac{1}{2}) \mathbf{a}_1 + (x_4 - z_4) \mathbf{a}_2 + (x_4 + y_4 + \frac{1}{2}) \mathbf{a}_3 &= ax_4 \hat{\mathbf{x}} + a(y_4 + \frac{1}{2}) \hat{\mathbf{y}} - az_4 \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{95} &= -(y_4 - z_4) \mathbf{a}_1 + (x_4 + z_4 + \frac{1}{2}) \mathbf{a}_2 + (x_4 - y_4 + \frac{1}{2}) \mathbf{a}_3 &= a(x_4 + \frac{1}{2}) \hat{\mathbf{x}} - ay_4 \hat{\mathbf{y}} + az_4 \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{96} &= (y_4 + z_4 + \frac{1}{2}) \mathbf{a}_1 + (-x_4 + z_4 + \frac{1}{2}) \mathbf{a}_2 - (x_4 - y_4) \mathbf{a}_3 &= -ax_4 \hat{\mathbf{x}} + ay_4 \hat{\mathbf{y}} + a(z_4 + \frac{1}{2}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{97} &= -(x_4 + y_4) \mathbf{a}_1 - (y_4 + z_4) \mathbf{a}_2 - (x_4 + z_4) \mathbf{a}_3 &= -az_4 \hat{\mathbf{x}} - ax_4 \hat{\mathbf{y}} - ay_4 \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{98} &= (x_4 + y_4 + \frac{1}{2}) \mathbf{a}_1 + (y_4 - z_4 + \frac{1}{2}) \mathbf{a}_2 + (x_4 - z_4) \mathbf{a}_3 &= -az_4 \hat{\mathbf{x}} + ax_4 \hat{\mathbf{y}} + a(y_4 + \frac{1}{2}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{99} &= (x_4 - y_4 + \frac{1}{2}) \mathbf{a}_1 - (y_4 - z_4) \mathbf{a}_2 + (x_4 + z_4 + \frac{1}{2}) \mathbf{a}_3 &= az_4 \hat{\mathbf{x}} + a(x_4 + \frac{1}{2}) \hat{\mathbf{y}} - ay_4 \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{100} &= -(x_4 - y_4) \mathbf{a}_1 + (y_4 + z_4 + \frac{1}{2}) \mathbf{a}_2 + (-x_4 + z_4 + \frac{1}{2}) \mathbf{a}_3 &= a(z_4 + \frac{1}{2}) \hat{\mathbf{x}} - ax_4 \hat{\mathbf{y}} + ay_4 \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{101} &= -(x_4 + z_4) \mathbf{a}_1 - (x_4 + y_4) \mathbf{a}_2 - (y_4 + z_4) \mathbf{a}_3 &= -ay_4 \hat{\mathbf{x}} - az_4 \hat{\mathbf{y}} - ax_4 \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{102} &= (x_4 - z_4) \mathbf{a}_1 + (x_4 + y_4 + \frac{1}{2}) \mathbf{a}_2 + (y_4 - z_4 + \frac{1}{2}) \mathbf{a}_3 &= a(y_4 + \frac{1}{2}) \hat{\mathbf{x}} - az_4 \hat{\mathbf{y}} + ax_4 \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{103} &= (x_4 + z_4 + \frac{1}{2}) \mathbf{a}_1 + (x_4 - y_4 + \frac{1}{2}) \mathbf{a}_2 - (y_4 - z_4) \mathbf{a}_3 &= -ay_4 \hat{\mathbf{x}} + az_4 \hat{\mathbf{y}} + a(x_4 + \frac{1}{2}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{104} &= (-x_4 + z_4 + \frac{1}{2}) \mathbf{a}_1 - (x_4 - y_4) \mathbf{a}_2 + (y_4 + z_4 + \frac{1}{2}) \mathbf{a}_3 &= ay_4 \hat{\mathbf{x}} + a(z_4 + \frac{1}{2}) \hat{\mathbf{y}} - ax_4 \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{105} &= (-x_4 + z_4 + \frac{1}{2}) \mathbf{a}_1 - (y_4 - z_4) \mathbf{a}_2 - (x_4 + y_4) \mathbf{a}_3 &= -a(y_4 + \frac{1}{4}) \hat{\mathbf{x}} - a(x_4 - \frac{1}{4}) \hat{\mathbf{y}} + a(z_4 + \frac{1}{4}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{106} &= (x_4 + z_4 + \frac{1}{2}) \mathbf{a}_1 + (y_4 + z_4 + \frac{1}{2}) \mathbf{a}_2 + (x_4 + y_4 + \frac{1}{2}) \mathbf{a}_3 &= a(y_4 + \frac{1}{4}) \hat{\mathbf{x}} + a(x_4 + \frac{1}{4}) \hat{\mathbf{y}} + a(z_4 + \frac{1}{4}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{107} &= (x_4 - z_4) \mathbf{a}_1 - (y_4 + z_4) \mathbf{a}_2 + (x_4 - y_4 + \frac{1}{2}) \mathbf{a}_3 &= -a(y_4 - \frac{1}{4}) \hat{\mathbf{x}} + a(x_4 + \frac{1}{4}) \hat{\mathbf{y}} - a(z_4 + \frac{1}{4}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{108} &= -(x_4 + z_4) \mathbf{a}_1 + (y_4 - z_4 + \frac{1}{2}) \mathbf{a}_2 - (x_4 - y_4) \mathbf{a}_3 &= a(y_4 + \frac{1}{4}) \hat{\mathbf{x}} - a(x_4 + \frac{1}{4}) \hat{\mathbf{y}} - a(z_4 - \frac{1}{4}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{109} &= (y_4 - z_4 + \frac{1}{2}) \mathbf{a}_1 - (x_4 - y_4) \mathbf{a}_2 - (x_4 + z_4) \mathbf{a}_3 &= -a(x_4 + \frac{1}{4}) \hat{\mathbf{x}} - a(z_4 - \frac{1}{4}) \hat{\mathbf{y}} + a(y_4 + \frac{1}{4}) \hat{\mathbf{z}} &(96h) & \text{O I} \\
\mathbf{B}_{110} &= -(y_4 + z_4) \mathbf{a}_1 + (x_4 - y_4 + \frac{1}{2}) \mathbf{a}_2 + (x_4 - z_4) \mathbf{a}_3 &= a(x_4 + \frac{1}{4}) \hat{\mathbf{x}} - a(z_4 + \frac{1}{4}) \hat{\mathbf{y}} - a(y_4 - \frac{1}{4}) \hat{\mathbf{z}} &(96h) & \text{O I}
\end{aligned}$$

$$\begin{aligned}
\mathbf{B}_{111} &= \begin{pmatrix} (y_4 + z_4 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_4 + y_4 + \frac{1}{2}) \mathbf{a}_2 + \\ (x_4 + z_4 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a \left(x_4 + \frac{1}{4}\right) \hat{\mathbf{x}} + a \left(z_4 + \frac{1}{4}\right) \hat{\mathbf{y}} + a \left(y_4 + \frac{1}{4}\right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{112} &= \begin{pmatrix} -(y_4 - z_4) \mathbf{a}_1 - (x_4 + y_4) \mathbf{a}_2 + \\ (-x_4 + z_4 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a \left(x_4 - \frac{1}{4}\right) \hat{\mathbf{x}} + a \left(z_4 + \frac{1}{4}\right) \hat{\mathbf{y}} - a \left(y_4 + \frac{1}{4}\right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{113} &= \begin{pmatrix} (x_4 - y_4 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_4 - z_4) \mathbf{a}_2 - (y_4 + z_4) \mathbf{a}_3 \end{pmatrix} = -a \left(z_4 + \frac{1}{4}\right) \hat{\mathbf{x}} - a \left(y_4 - \frac{1}{4}\right) \hat{\mathbf{y}} + a \left(x_4 + \frac{1}{4}\right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{114} &= \begin{pmatrix} -(x_4 - y_4) \mathbf{a}_1 - (x_4 + z_4) \mathbf{a}_2 + \\ (y_4 - z_4 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = -a \left(z_4 - \frac{1}{4}\right) \hat{\mathbf{x}} + a \left(y_4 + \frac{1}{4}\right) \hat{\mathbf{y}} - a \left(x_4 + \frac{1}{4}\right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{115} &= \begin{pmatrix} -(x_4 + y_4) \mathbf{a}_1 + \\ (-x_4 + z_4 + \frac{1}{2}) \mathbf{a}_2 - (y_4 - z_4) \mathbf{a}_3 \end{pmatrix} = a \left(z_4 + \frac{1}{4}\right) \hat{\mathbf{x}} - a \left(y_4 + \frac{1}{4}\right) \hat{\mathbf{y}} - a \left(x_4 - \frac{1}{4}\right) \hat{\mathbf{z}} & (96h) & \text{O I} \\
\mathbf{B}_{116} &= \begin{pmatrix} (x_4 + y_4 + \frac{1}{2}) \mathbf{a}_1 + \\ (x_4 + z_4 + \frac{1}{2}) \mathbf{a}_2 + \\ (y_4 + z_4 + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = a \left(z_4 + \frac{1}{4}\right) \hat{\mathbf{x}} + a \left(y_4 + \frac{1}{4}\right) \hat{\mathbf{y}} + a \left(x_4 + \frac{1}{4}\right) \hat{\mathbf{z}} & (96h) & \text{O I}
\end{aligned}$$

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