

Bergman [Mg₃₂(Al,Zn)₄₉] Structure: AB32C48_cI162_204_a_2efg_2gh-001

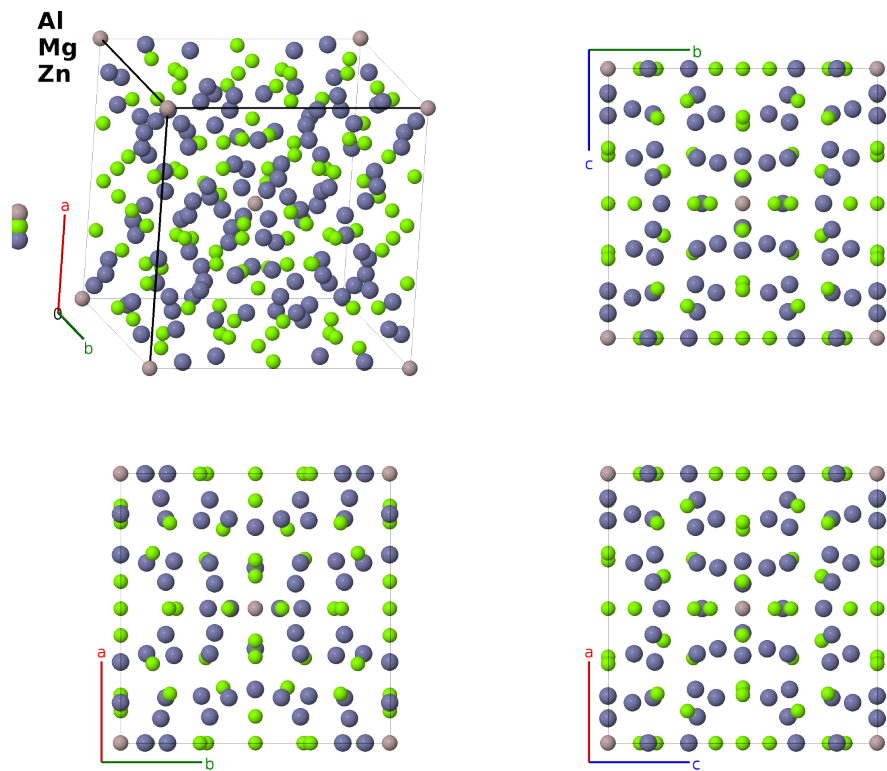
This structure previously used the label(s) **AB32C48_cI162_204_a_2efg_2gh**. Calls to these addresses will be redirected here.

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- D. Hicks, M. J. Mehl, M. Esters, C. Oses, O. Levy, G. L. W. Hart, C. Toher, and S. Curtarolo, *The AFLOW Library of Crystallographic Prototypes: Part 3*, Comput. Mater. Sci. **199**, 110450 (2021), doi: 10.1016/j.commatsci.2021.110450.

<https://aflow.org/prototype-encyclopedia/9AQF>

https://aflow.org/prototype-encyclopedia/AB32C48_cI162_204_a_2efg_2gh-001



Prototype	AlMg ₃₂ Zn ₄₈
AFLOW prototype label	AB32C48_cI162_204_a_2efg_2gh-001
<i>Strukturbericht</i> designation	<i>D</i> 8 _e
Mineral name	bergman structure
ICSD	57968
CCDC	1622006
Pearson symbol	cI162
Space group number	204
Space group symbol	<i>Im</i> $\bar{3}$

AFLOW prototype command `aflow --proto=AB32C48_cI162_204_a_2efg_2gh-001`
 `--params=a, x2, x3, x4, y5, z5, y6, z6, y7, z7, x8, y8, z8`

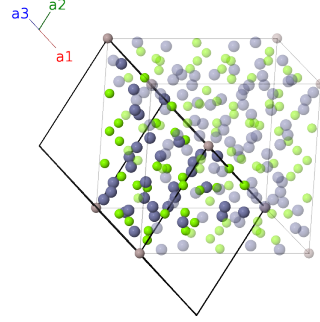
Other compounds with this structure

$\text{Li}_{20}\text{Mg}_6\text{Cu}_{13}\text{Al}_{42}$, Al_5CuLi_3

- Most of the sites in this lattice have random occupancy. In particular, according to (Bergman, 1957): The Al-I (2a) site is only occupied 80% of the time, the Zn-I (24g) site is occupied by Al 19% of the time, the Zn-II (24g) site is occupied by Al 43% of the time, and the Zn-III (48h) site is occupied by Al 36% of the time.
- The $\text{Li}_{20}\text{Mg}_6\text{Cu}_{13}\text{Al}_{42}$ structure found by (Pavlyuk, 2019) has all sites fully occupied.

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	(2a)	Al I
$\mathbf{B}_2$	$\frac{1}{2} \mathbf{a}_1 + (x_2 + \frac{1}{2}) \mathbf{a}_2 + x_2 \mathbf{a}_3$	$=$	$ax_2 \hat{\mathbf{x}} + \frac{1}{2}a \hat{\mathbf{z}}$	(12e)	Mg I
$\mathbf{B}_3$	$\frac{1}{2} \mathbf{a}_1 - (x_2 - \frac{1}{2}) \mathbf{a}_2 - x_2 \mathbf{a}_3$	$=$	$-ax_2 \hat{\mathbf{x}} + \frac{1}{2}a \hat{\mathbf{z}}$	(12e)	Mg I
$\mathbf{B}_4$	$x_2 \mathbf{a}_1 + \frac{1}{2} \mathbf{a}_2 + (x_2 + \frac{1}{2}) \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{x}} + ax_2 \hat{\mathbf{y}}$	(12e)	Mg I
$\mathbf{B}_5$	$-x_2 \mathbf{a}_1 + \frac{1}{2} \mathbf{a}_2 - (x_2 - \frac{1}{2}) \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{x}} - ax_2 \hat{\mathbf{y}}$	(12e)	Mg I
$\mathbf{B}_6$	$(x_2 + \frac{1}{2}) \mathbf{a}_1 + x_2 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{y}} + ax_2 \hat{\mathbf{z}}$	(12e)	Mg I
$\mathbf{B}_7$	$-(x_2 - \frac{1}{2}) \mathbf{a}_1 - x_2 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{y}} - ax_2 \hat{\mathbf{z}}$	(12e)	Mg I
$\mathbf{B}_8$	$\frac{1}{2} \mathbf{a}_1 + (x_3 + \frac{1}{2}) \mathbf{a}_2 + x_3 \mathbf{a}_3$	$=$	$ax_3 \hat{\mathbf{x}} + \frac{1}{2}a \hat{\mathbf{z}}$	(12e)	Mg II
$\mathbf{B}_9$	$\frac{1}{2} \mathbf{a}_1 - (x_3 - \frac{1}{2}) \mathbf{a}_2 - x_3 \mathbf{a}_3$	$=$	$-ax_3 \hat{\mathbf{x}} + \frac{1}{2}a \hat{\mathbf{z}}$	(12e)	Mg II
$\mathbf{B}_{10}$	$x_3 \mathbf{a}_1 + \frac{1}{2} \mathbf{a}_2 + (x_3 + \frac{1}{2}) \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{x}} + ax_3 \hat{\mathbf{y}}$	(12e)	Mg II
$\mathbf{B}_{11}$	$-x_3 \mathbf{a}_1 + \frac{1}{2} \mathbf{a}_2 - (x_3 - \frac{1}{2}) \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{x}} - ax_3 \hat{\mathbf{y}}$	(12e)	Mg II
$\mathbf{B}_{12}$	$(x_3 + \frac{1}{2}) \mathbf{a}_1 + x_3 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{y}} + ax_3 \hat{\mathbf{z}}$	(12e)	Mg II
$\mathbf{B}_{13}$	$-(x_3 - \frac{1}{2}) \mathbf{a}_1 - x_3 \mathbf{a}_2 + \frac{1}{2} \mathbf{a}_3$	$=$	$\frac{1}{2}a \hat{\mathbf{y}} - ax_3 \hat{\mathbf{z}}$	(12e)	Mg II
$\mathbf{B}_{14}$	$2x_4 \mathbf{a}_1 + 2x_4 \mathbf{a}_2 + 2x_4 \mathbf{a}_3$	$=$	$ax_4 \hat{\mathbf{x}} + ax_4 \hat{\mathbf{y}} + ax_4 \hat{\mathbf{z}}$	(16f)	Mg III
$\mathbf{B}_{15}$	$-2x_4 \mathbf{a}_3$	$=$	$-ax_4 \hat{\mathbf{x}} - ax_4 \hat{\mathbf{y}} + ax_4 \hat{\mathbf{z}}$	(16f)	Mg III
$\mathbf{B}_{16}$	$-2x_4 \mathbf{a}_2$	$=$	$-ax_4 \hat{\mathbf{x}} + ax_4 \hat{\mathbf{y}} - ax_4 \hat{\mathbf{z}}$	(16f)	Mg III
$\mathbf{B}_{17}$	$-2x_4 \mathbf{a}_1$	$=$	$ax_4 \hat{\mathbf{x}} - ax_4 \hat{\mathbf{y}} - ax_4 \hat{\mathbf{z}}$	(16f)	Mg III
$\mathbf{B}_{18}$	$-2x_4 \mathbf{a}_1 - 2x_4 \mathbf{a}_2 - 2x_4 \mathbf{a}_3$	$=$	$-ax_4 \hat{\mathbf{x}} - ax_4 \hat{\mathbf{y}} - ax_4 \hat{\mathbf{z}}$	(16f)	Mg III
$\mathbf{B}_{19}$	$2x_4 \mathbf{a}_3$	$=$	$ax_4 \hat{\mathbf{x}} + ax_4 \hat{\mathbf{y}} - ax_4 \hat{\mathbf{z}}$	(16f)	Mg III

$\mathbf{B}_{20} =$	$2x_4 \mathbf{a}_2$	$=$	$ax_4 \hat{\mathbf{x}} - ax_4 \hat{\mathbf{y}} + ax_4 \hat{\mathbf{z}}$	(16f)	Mg III
$\mathbf{B}_{21} =$	$2x_4 \mathbf{a}_1$	$=$	$-ax_4 \hat{\mathbf{x}} + ax_4 \hat{\mathbf{y}} + ax_4 \hat{\mathbf{z}}$	(16f)	Mg III
$\mathbf{B}_{22} =$	$(y_5 + z_5) \mathbf{a}_1 + z_5 \mathbf{a}_2 + y_5 \mathbf{a}_3$	$=$	$ay_5 \hat{\mathbf{y}} + az_5 \hat{\mathbf{z}}$	(24g)	Mg IV
$\mathbf{B}_{23} =$	$-(y_5 - z_5) \mathbf{a}_1 + z_5 \mathbf{a}_2 - y_5 \mathbf{a}_3$	$=$	$-ay_5 \hat{\mathbf{y}} + az_5 \hat{\mathbf{z}}$	(24g)	Mg IV
$\mathbf{B}_{24} =$	$(y_5 - z_5) \mathbf{a}_1 - z_5 \mathbf{a}_2 + y_5 \mathbf{a}_3$	$=$	$ay_5 \hat{\mathbf{y}} - az_5 \hat{\mathbf{z}}$	(24g)	Mg IV
$\mathbf{B}_{25} =$	$-(y_5 + z_5) \mathbf{a}_1 - z_5 \mathbf{a}_2 - y_5 \mathbf{a}_3$	$=$	$-ay_5 \hat{\mathbf{y}} - az_5 \hat{\mathbf{z}}$	(24g)	Mg IV
$\mathbf{B}_{26} =$	$y_5 \mathbf{a}_1 + (y_5 + z_5) \mathbf{a}_2 + z_5 \mathbf{a}_3$	$=$	$az_5 \hat{\mathbf{x}} + ay_5 \hat{\mathbf{z}}$	(24g)	Mg IV
$\mathbf{B}_{27} =$	$-y_5 \mathbf{a}_1 - (y_5 - z_5) \mathbf{a}_2 + z_5 \mathbf{a}_3$	$=$	$az_5 \hat{\mathbf{x}} - ay_5 \hat{\mathbf{z}}$	(24g)	Mg IV
$\mathbf{B}_{28} =$	$y_5 \mathbf{a}_1 + (y_5 - z_5) \mathbf{a}_2 - z_5 \mathbf{a}_3$	$=$	$-az_5 \hat{\mathbf{x}} + ay_5 \hat{\mathbf{z}}$	(24g)	Mg IV
$\mathbf{B}_{29} =$	$-y_5 \mathbf{a}_1 - (y_5 + z_5) \mathbf{a}_2 - z_5 \mathbf{a}_3$	$=$	$-az_5 \hat{\mathbf{x}} - ay_5 \hat{\mathbf{z}}$	(24g)	Mg IV
$\mathbf{B}_{30} =$	$z_5 \mathbf{a}_1 + y_5 \mathbf{a}_2 + (y_5 + z_5) \mathbf{a}_3$	$=$	$ay_5 \hat{\mathbf{x}} + az_5 \hat{\mathbf{y}}$	(24g)	Mg IV
$\mathbf{B}_{31} =$	$z_5 \mathbf{a}_1 - y_5 \mathbf{a}_2 - (y_5 - z_5) \mathbf{a}_3$	$=$	$-ay_5 \hat{\mathbf{x}} + az_5 \hat{\mathbf{y}}$	(24g)	Mg IV
$\mathbf{B}_{32} =$	$-z_5 \mathbf{a}_1 + y_5 \mathbf{a}_2 + (y_5 - z_5) \mathbf{a}_3$	$=$	$ay_5 \hat{\mathbf{x}} - az_5 \hat{\mathbf{y}}$	(24g)	Mg IV
$\mathbf{B}_{33} =$	$-z_5 \mathbf{a}_1 - y_5 \mathbf{a}_2 - (y_5 + z_5) \mathbf{a}_3$	$=$	$-ay_5 \hat{\mathbf{x}} - az_5 \hat{\mathbf{y}}$	(24g)	Mg IV
$\mathbf{B}_{34} =$	$(y_6 + z_6) \mathbf{a}_1 + z_6 \mathbf{a}_2 + y_6 \mathbf{a}_3$	$=$	$ay_6 \hat{\mathbf{y}} + az_6 \hat{\mathbf{z}}$	(24g)	Zn I
$\mathbf{B}_{35} =$	$-(y_6 - z_6) \mathbf{a}_1 + z_6 \mathbf{a}_2 - y_6 \mathbf{a}_3$	$=$	$-ay_6 \hat{\mathbf{y}} + az_6 \hat{\mathbf{z}}$	(24g)	Zn I
$\mathbf{B}_{36} =$	$(y_6 - z_6) \mathbf{a}_1 - z_6 \mathbf{a}_2 + y_6 \mathbf{a}_3$	$=$	$ay_6 \hat{\mathbf{y}} - az_6 \hat{\mathbf{z}}$	(24g)	Zn I
$\mathbf{B}_{37} =$	$-(y_6 + z_6) \mathbf{a}_1 - z_6 \mathbf{a}_2 - y_6 \mathbf{a}_3$	$=$	$-ay_6 \hat{\mathbf{y}} - az_6 \hat{\mathbf{z}}$	(24g)	Zn I
$\mathbf{B}_{38} =$	$y_6 \mathbf{a}_1 + (y_6 + z_6) \mathbf{a}_2 + z_6 \mathbf{a}_3$	$=$	$az_6 \hat{\mathbf{x}} + ay_6 \hat{\mathbf{z}}$	(24g)	Zn I
$\mathbf{B}_{39} =$	$-y_6 \mathbf{a}_1 - (y_6 - z_6) \mathbf{a}_2 + z_6 \mathbf{a}_3$	$=$	$az_6 \hat{\mathbf{x}} - ay_6 \hat{\mathbf{z}}$	(24g)	Zn I
$\mathbf{B}_{40} =$	$y_6 \mathbf{a}_1 + (y_6 - z_6) \mathbf{a}_2 - z_6 \mathbf{a}_3$	$=$	$-az_6 \hat{\mathbf{x}} + ay_6 \hat{\mathbf{z}}$	(24g)	Zn I
$\mathbf{B}_{41} =$	$-y_6 \mathbf{a}_1 - (y_6 + z_6) \mathbf{a}_2 - z_6 \mathbf{a}_3$	$=$	$-az_6 \hat{\mathbf{x}} - ay_6 \hat{\mathbf{z}}$	(24g)	Zn I
$\mathbf{B}_{42} =$	$z_6 \mathbf{a}_1 + y_6 \mathbf{a}_2 + (y_6 + z_6) \mathbf{a}_3$	$=$	$ay_6 \hat{\mathbf{x}} + az_6 \hat{\mathbf{y}}$	(24g)	Zn I
$\mathbf{B}_{43} =$	$z_6 \mathbf{a}_1 - y_6 \mathbf{a}_2 - (y_6 - z_6) \mathbf{a}_3$	$=$	$-ay_6 \hat{\mathbf{x}} + az_6 \hat{\mathbf{y}}$	(24g)	Zn I
$\mathbf{B}_{44} =$	$-z_6 \mathbf{a}_1 + y_6 \mathbf{a}_2 + (y_6 - z_6) \mathbf{a}_3$	$=$	$ay_6 \hat{\mathbf{x}} - az_6 \hat{\mathbf{y}}$	(24g)	Zn I
$\mathbf{B}_{45} =$	$-z_6 \mathbf{a}_1 - y_6 \mathbf{a}_2 - (y_6 + z_6) \mathbf{a}_3$	$=$	$-ay_6 \hat{\mathbf{x}} - az_6 \hat{\mathbf{y}}$	(24g)	Zn I
$\mathbf{B}_{46} =$	$(y_7 + z_7) \mathbf{a}_1 + z_7 \mathbf{a}_2 + y_7 \mathbf{a}_3$	$=$	$ay_7 \hat{\mathbf{y}} + az_7 \hat{\mathbf{z}}$	(24g)	Zn II
$\mathbf{B}_{47} =$	$-(y_7 - z_7) \mathbf{a}_1 + z_7 \mathbf{a}_2 - y_7 \mathbf{a}_3$	$=$	$-ay_7 \hat{\mathbf{y}} + az_7 \hat{\mathbf{z}}$	(24g)	Zn II
$\mathbf{B}_{48} =$	$(y_7 - z_7) \mathbf{a}_1 - z_7 \mathbf{a}_2 + y_7 \mathbf{a}_3$	$=$	$ay_7 \hat{\mathbf{y}} - az_7 \hat{\mathbf{z}}$	(24g)	Zn II
$\mathbf{B}_{49} =$	$-(y_7 + z_7) \mathbf{a}_1 - z_7 \mathbf{a}_2 - y_7 \mathbf{a}_3$	$=$	$-ay_7 \hat{\mathbf{y}} - az_7 \hat{\mathbf{z}}$	(24g)	Zn II
$\mathbf{B}_{50} =$	$y_7 \mathbf{a}_1 + (y_7 + z_7) \mathbf{a}_2 + z_7 \mathbf{a}_3$	$=$	$az_7 \hat{\mathbf{x}} + ay_7 \hat{\mathbf{z}}$	(24g)	Zn II
$\mathbf{B}_{51} =$	$-y_7 \mathbf{a}_1 - (y_7 - z_7) \mathbf{a}_2 + z_7 \mathbf{a}_3$	$=$	$az_7 \hat{\mathbf{x}} - ay_7 \hat{\mathbf{z}}$	(24g)	Zn II
$\mathbf{B}_{52} =$	$y_7 \mathbf{a}_1 + (y_7 - z_7) \mathbf{a}_2 - z_7 \mathbf{a}_3$	$=$	$-az_7 \hat{\mathbf{x}} + ay_7 \hat{\mathbf{z}}$	(24g)	Zn II
$\mathbf{B}_{53} =$	$-y_7 \mathbf{a}_1 - (y_7 + z_7) \mathbf{a}_2 - z_7 \mathbf{a}_3$	$=$	$-az_7 \hat{\mathbf{x}} - ay_7 \hat{\mathbf{z}}$	(24g)	Zn II
$\mathbf{B}_{54} =$	$z_7 \mathbf{a}_1 + y_7 \mathbf{a}_2 + (y_7 + z_7) \mathbf{a}_3$	$=$	$ay_7 \hat{\mathbf{x}} + az_7 \hat{\mathbf{y}}$	(24g)	Zn II
$\mathbf{B}_{55} =$	$z_7 \mathbf{a}_1 - y_7 \mathbf{a}_2 - (y_7 - z_7) \mathbf{a}_3$	$=$	$-ay_7 \hat{\mathbf{x}} + az_7 \hat{\mathbf{y}}$	(24g)	Zn II
$\mathbf{B}_{56} =$	$-z_7 \mathbf{a}_1 + y_7 \mathbf{a}_2 + (y_7 - z_7) \mathbf{a}_3$	$=$	$ay_7 \hat{\mathbf{x}} - az_7 \hat{\mathbf{y}}$	(24g)	Zn II
$\mathbf{B}_{57} =$	$-z_7 \mathbf{a}_1 - y_7 \mathbf{a}_2 - (y_7 + z_7) \mathbf{a}_3$	$=$	$-ay_7 \hat{\mathbf{x}} - az_7 \hat{\mathbf{y}}$	(24g)	Zn II
$\mathbf{B}_{58} =$	$(y_8 + z_8) \mathbf{a}_1 + (x_8 + z_8) \mathbf{a}_2 + (x_8 + y_8) \mathbf{a}_3$	$=$	$ax_8 \hat{\mathbf{x}} + ay_8 \hat{\mathbf{y}} + az_8 \hat{\mathbf{z}}$	(48h)	Zn III
$\mathbf{B}_{59} =$	$-(y_8 - z_8) \mathbf{a}_1 - (x_8 - z_8) \mathbf{a}_2 - (x_8 + y_8) \mathbf{a}_3$	$=$	$-ax_8 \hat{\mathbf{x}} - ay_8 \hat{\mathbf{y}} + az_8 \hat{\mathbf{z}}$	(48h)	Zn III

$$\begin{aligned}
\mathbf{B}_{60} &= \begin{pmatrix} (y_8 - z_8) \mathbf{a}_1 - (x_8 + z_8) \mathbf{a}_2 - \\ (x_8 - y_8) \mathbf{a}_3 \end{pmatrix} = -ax_8 \hat{\mathbf{x}} + ay_8 \hat{\mathbf{y}} - az_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{61} &= \begin{pmatrix} -(y_8 + z_8) \mathbf{a}_1 + (x_8 - z_8) \mathbf{a}_2 + \\ (x_8 - y_8) \mathbf{a}_3 \end{pmatrix} = ax_8 \hat{\mathbf{x}} - ay_8 \hat{\mathbf{y}} - az_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{62} &= \begin{pmatrix} (x_8 + y_8) \mathbf{a}_1 + (y_8 + z_8) \mathbf{a}_2 + \\ (x_8 + z_8) \mathbf{a}_3 \end{pmatrix} = az_8 \hat{\mathbf{x}} + ax_8 \hat{\mathbf{y}} + ay_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{63} &= \begin{pmatrix} -(x_8 + y_8) \mathbf{a}_1 - (y_8 - z_8) \mathbf{a}_2 - \\ (x_8 - z_8) \mathbf{a}_3 \end{pmatrix} = az_8 \hat{\mathbf{x}} - ax_8 \hat{\mathbf{y}} - ay_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{64} &= \begin{pmatrix} -(x_8 - y_8) \mathbf{a}_1 + (y_8 - z_8) \mathbf{a}_2 - \\ (x_8 + z_8) \mathbf{a}_3 \end{pmatrix} = -az_8 \hat{\mathbf{x}} - ax_8 \hat{\mathbf{y}} + ay_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{65} &= \begin{pmatrix} (x_8 - y_8) \mathbf{a}_1 - (y_8 + z_8) \mathbf{a}_2 + \\ (x_8 - z_8) \mathbf{a}_3 \end{pmatrix} = -az_8 \hat{\mathbf{x}} + ax_8 \hat{\mathbf{y}} - ay_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{66} &= \begin{pmatrix} (x_8 + z_8) \mathbf{a}_1 + (x_8 + y_8) \mathbf{a}_2 + \\ (y_8 + z_8) \mathbf{a}_3 \end{pmatrix} = ay_8 \hat{\mathbf{x}} + az_8 \hat{\mathbf{y}} + ax_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{67} &= \begin{pmatrix} -(x_8 - z_8) \mathbf{a}_1 - (x_8 + y_8) \mathbf{a}_2 - \\ (y_8 - z_8) \mathbf{a}_3 \end{pmatrix} = -ay_8 \hat{\mathbf{x}} + az_8 \hat{\mathbf{y}} - ax_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{68} &= \begin{pmatrix} -(x_8 + z_8) \mathbf{a}_1 - (x_8 - y_8) \mathbf{a}_2 + \\ (y_8 - z_8) \mathbf{a}_3 \end{pmatrix} = ay_8 \hat{\mathbf{x}} - az_8 \hat{\mathbf{y}} - ax_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{69} &= \begin{pmatrix} (x_8 - z_8) \mathbf{a}_1 + (x_8 - y_8) \mathbf{a}_2 - \\ (y_8 + z_8) \mathbf{a}_3 \end{pmatrix} = -ay_8 \hat{\mathbf{x}} - az_8 \hat{\mathbf{y}} + ax_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{70} &= \begin{pmatrix} -(y_8 + z_8) \mathbf{a}_1 - (x_8 + z_8) \mathbf{a}_2 - \\ (x_8 + y_8) \mathbf{a}_3 \end{pmatrix} = -ax_8 \hat{\mathbf{x}} - ay_8 \hat{\mathbf{y}} - az_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{71} &= \begin{pmatrix} (y_8 - z_8) \mathbf{a}_1 + (x_8 - z_8) \mathbf{a}_2 + \\ (x_8 + y_8) \mathbf{a}_3 \end{pmatrix} = ax_8 \hat{\mathbf{x}} + ay_8 \hat{\mathbf{y}} - az_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{72} &= \begin{pmatrix} -(y_8 - z_8) \mathbf{a}_1 + (x_8 + z_8) \mathbf{a}_2 + \\ (x_8 - y_8) \mathbf{a}_3 \end{pmatrix} = ax_8 \hat{\mathbf{x}} - ay_8 \hat{\mathbf{y}} + az_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{73} &= \begin{pmatrix} (y_8 + z_8) \mathbf{a}_1 - (x_8 - z_8) \mathbf{a}_2 - \\ (x_8 - y_8) \mathbf{a}_3 \end{pmatrix} = -ax_8 \hat{\mathbf{x}} + ay_8 \hat{\mathbf{y}} + az_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{74} &= \begin{pmatrix} -(x_8 + y_8) \mathbf{a}_1 - (y_8 + z_8) \mathbf{a}_2 - \\ (x_8 + z_8) \mathbf{a}_3 \end{pmatrix} = -az_8 \hat{\mathbf{x}} - ax_8 \hat{\mathbf{y}} - ay_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{75} &= \begin{pmatrix} (x_8 + y_8) \mathbf{a}_1 + (y_8 - z_8) \mathbf{a}_2 + \\ (x_8 - z_8) \mathbf{a}_3 \end{pmatrix} = -az_8 \hat{\mathbf{x}} + ax_8 \hat{\mathbf{y}} + ay_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{76} &= \begin{pmatrix} (x_8 - y_8) \mathbf{a}_1 - (y_8 - z_8) \mathbf{a}_2 + \\ (x_8 + z_8) \mathbf{a}_3 \end{pmatrix} = az_8 \hat{\mathbf{x}} + ax_8 \hat{\mathbf{y}} - ay_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{77} &= \begin{pmatrix} -(x_8 - y_8) \mathbf{a}_1 + (y_8 + z_8) \mathbf{a}_2 - \\ (x_8 - z_8) \mathbf{a}_3 \end{pmatrix} = az_8 \hat{\mathbf{x}} - ax_8 \hat{\mathbf{y}} + ay_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{78} &= \begin{pmatrix} -(x_8 + z_8) \mathbf{a}_1 - (x_8 + y_8) \mathbf{a}_2 - \\ (y_8 + z_8) \mathbf{a}_3 \end{pmatrix} = -ay_8 \hat{\mathbf{x}} - az_8 \hat{\mathbf{y}} - ax_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{79} &= \begin{pmatrix} (x_8 - z_8) \mathbf{a}_1 + (x_8 + y_8) \mathbf{a}_2 + \\ (y_8 - z_8) \mathbf{a}_3 \end{pmatrix} = ay_8 \hat{\mathbf{x}} - az_8 \hat{\mathbf{y}} + ax_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{80} &= \begin{pmatrix} (x_8 + z_8) \mathbf{a}_1 + (x_8 - y_8) \mathbf{a}_2 - \\ (y_8 - z_8) \mathbf{a}_3 \end{pmatrix} = -ay_8 \hat{\mathbf{x}} + az_8 \hat{\mathbf{y}} + ax_8 \hat{\mathbf{z}} & (48h) & \text{Zn III} \\
\mathbf{B}_{81} &= \begin{pmatrix} -(x_8 - z_8) \mathbf{a}_1 - (x_8 - y_8) \mathbf{a}_2 + \\ (y_8 + z_8) \mathbf{a}_3 \end{pmatrix} = ay_8 \hat{\mathbf{x}} + az_8 \hat{\mathbf{y}} - ax_8 \hat{\mathbf{z}} & (48h) & \text{Zn III}
\end{aligned}$$

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