Figure 4

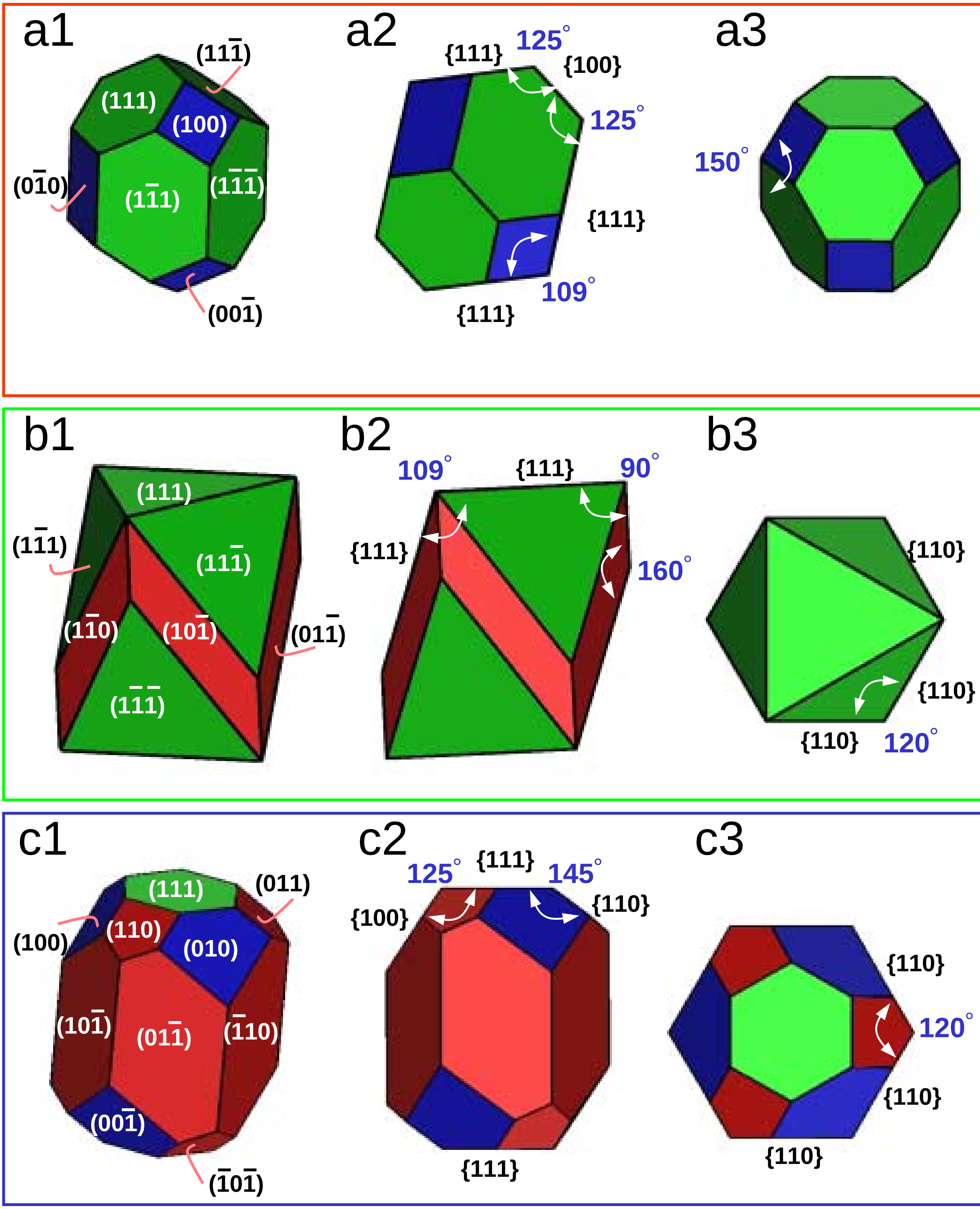
a1
(11$\bar{1}$)
(111)
(100)
(0$\bar{1}$0)
(1$\bar{1}$1)
(1$\bar{1}\bar{1}$)
(00$\bar{1}$)
a2
{111}
125°
{100}
125°
{111}
109°
{111}
a3
150°
b1
(111)
(1$\bar{1}$1)
(11$\bar{1}$)
(1$\bar{1}$0)
(10$\bar{1}$)
(01$\bar{1}$)
(1$\bar{1}\bar{1}$)
b2
109°
{111}
90°
{111}
160°
b3
{110}
{110}
{110}
120°
c1
(111)
(011)
(100)
(110)
(010)
(10$\bar{1}$)
(01$\bar{1}$)
($\bar{1}$10)
(00$\bar{1}$)
($\bar{1}$0$\bar{1}$)
c2
125°
{111}
145°
{100}
{110}
{111}
c3
{110}
120°
{110}
{110}

Figure 4. Three idealized geometries of elongated bacterial magnetite (adapted from Mann, 199110): elongated cubo-octahedron, hexa-octahedron vibroid, and hexa-octahedron coccid. Each crystal habit is shown in three orientations: overview, side view (viewed perpendicular to the [1-10] zone axis), and viewed down the [111] zone axis.

- (a1) The cubo-octachedron is elongated along the [112] axis (parallel to a (111) face) and displays {111} green and {100} blue faces.
- (a2) Elongated cubo-octahedron viewed down the [1-10] zone axis is an irregular hexagon. The dihedral angle is ~125° and the angle between two {111} faces is ~109°.
- (a3) Viewed down the [111] zone axis the elongated cubo-octahedron is a polygon with 12 edges.
- (b1) Hexa-octahedron vibroid, elongated along the [111] zone axis with eight {111} (green, octahedral) faces and six {110} (red, hexagonal) faces. Dihedral angle is ~109°. All {111} faces are equivalent in length; {100} faces are absent. Previous studies have suggested this crystal habit for magnetite formed by some strains of magnetotactic bacteria including MV-1.
- (b2) Hexa-octahedron vibroid viewed down the [1-10] zone axis.
- (b3) Viewed down the [111] zone axis, hexa-octahedron vibroid has a hexagonal projection with {110} faces at ~120°.
- (c1) The hexa-octahedron coccoid is elongated along the [111] zone axis and has {111} green capping faces bounded by {110} red and {100} blue faces. Note crystallographically equivalent {110} faces have non-equivalent surface areas.
- (c2) Hexa-octahedron coccoid viewed down the [1-10] zone axis. {111} and {100} faces intersect at ~125°; {111} and {110} faces intersect at ~145°. There are no intersecting {111} faces.
- (c3) Viewed down the [111] zone axis, hexa-octahedron coccoid has a hexagonal projection bounded by {110} faces at ~120°.

MV-1 and ALH84001 truncated hexa-octahedral magnetites have {111}, {100}, and {110} faces (Fig. 1). The elongated cubo-octahedron does not have {110} faces (Figs. 4a1-a3, Supplemental Material). The hexa-octahedron vibroid10 does not have {100} faces (Figs. 4b1-b3, Supplemental Material) and the {111} faces are of equal surface area. The hexa-octahedron coccoid10 does not have intersecting {111} faces (Figs. 4c1-c3, Supplemental Material). Hence we suggest that the crystal habit of MV-1 and ALH84001 magnetites described herein is similar to that of a hexa-octahedron vibroid10, but is modified by the presence of {100} truncating faces to give a crystal habit we describe as a truncated hexa-octahedral (Fig. 1).

Figure 5

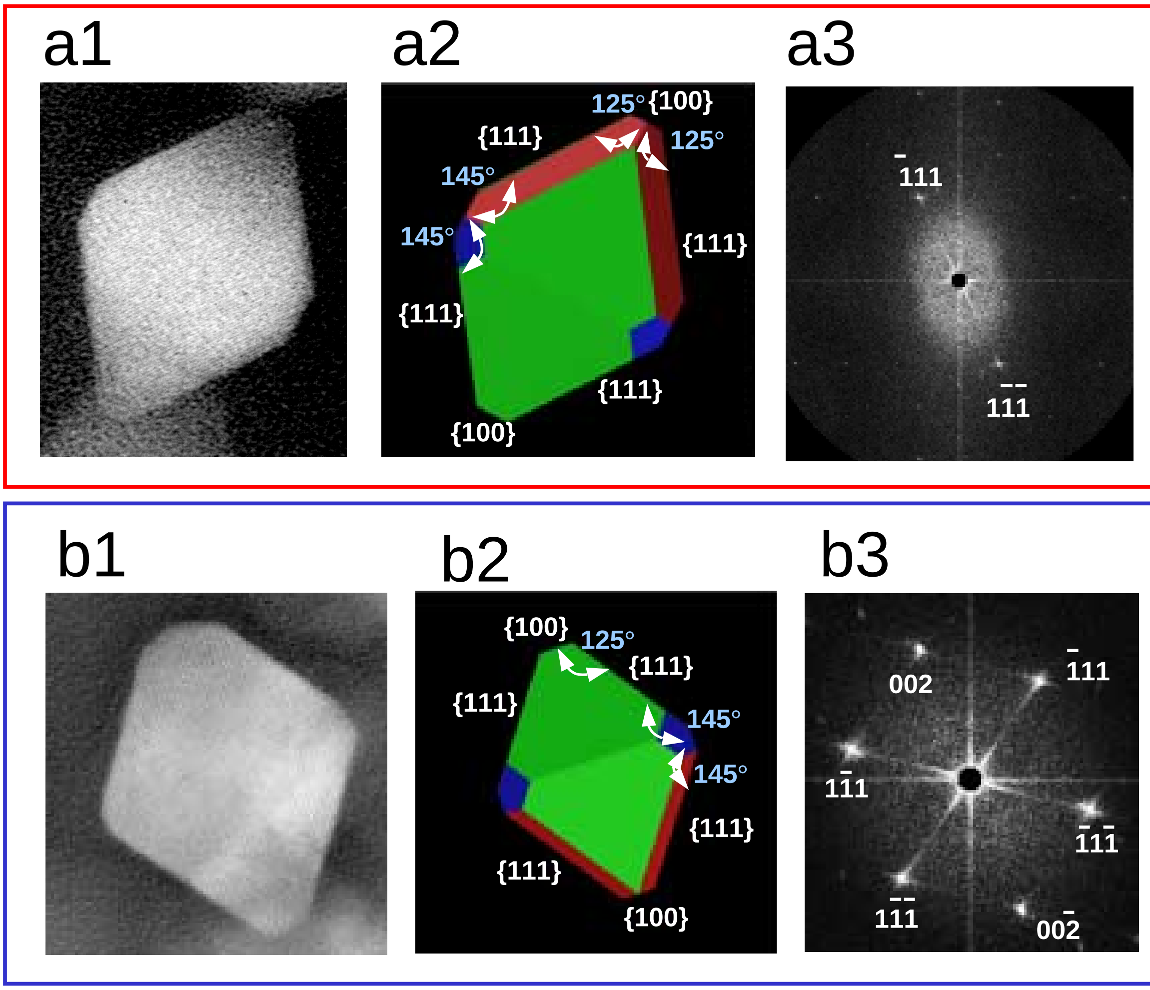

Figure 5.

(a1) MV-1 magnetite, ~50 nm in length, viewed down the [110] zone axis.

(a2) Simulated view of magnetite in (a1). Intersecting {111} and {100} faces are at ~125°; {111} face intersecting a {110} face is at 145°.

(a3) The 2-D spatial Fourier transform calculated from the TEM image in (a1).

(b1) ALH84001 magnetite, ~30 nm in length, extracted from Martian carbonate, viewed down [110] zone axis. This Martian magnetite is identical to MV-1 magnetite shown in (a1).

(b2) Simulated view of magnetite in (b1). Intersecting {111} and {100} faces are at ~125°; {111} face intersecting a {110} face is at 145°.

(b3) The 2-D spatial Fourier transform calculated from the TEM image in (b1).