Non-balanced minimal surfaces
IWP
(Schoen 1970)
Structural unit in a unit cell (a mirror cube).
Eight catenoidal tunnels in [111] directions

\[ \text{Im}3m \]
\[ A = 2\sqrt{3} \]
\[ = 3.4641 \]

\[ \chi = -12 \]
IWP

Translational subunit in a truncated octahedron (Voronoi region of bcc lattice)
IWP

8 cubic unit cells
IWP

unit inscribed in a rhombic dodecahedron
IWP
IWP-1
(IWP with one catenoidal tunnel missing)

Pm3m

area =
3.241 x 2 =
6.482

χ = -82
IWP-1
view of unit cell along 3-fold axis
IWP-2

IWP with 2 catenoids removed

\[ A = \]
\[ 3.0174 \times 2 = \]
\[ 6.0348 \]

\[ \chi = -68 \]
IWP/ Neovius hybrid

Pm3m

$A = 4.4562$

$\chi = -30$
Modulation (polytype) of C(P) /C(P)a

[The octagonal panels can be of four different types, 0, 1, 2 or 4 catenoids and can be combined in various ways.]
FRD
(Schoen)
$A = 4.7758$
$\chi = -40$

CaF$_2$ type
structure
FRD from a structural unit in a rhombic dodecahedron!
A minimal surface in a regular dodecahedron

Structural unit for a minimal surface in S3 rather than for a triply periodic surface in E3. 120 units in the polytope \{5,3,3\}. 
Minimal surface in an icosahedron

A structural unit for a minimal surface in S3 rather than for a triply periodic surface in E3. 600 tetrahedral units in the polytope \{3,3,5\}. 
OCTO
(Schoen)
P/IWP hybrid

This structural unit of OCTO derived from IWP by insertion of six tunnels through the cube faces

Pm3m

$A = 3.67612$

$\chi = -18$
A modification of IWP

Only 3 of the 6 possible tunnels through faces of the cubic unit cell are included. Eight units make a unit cell of the new surface
Another modified IWP

Only two of the six tunnels are retained
Another structural unit derived from IWP
Double P

$Pm3m$

$A = 3.972$

$\chi = -22$
Pm3m

$A = 4.0548$

$\chi = -28$
Pm3m

$A = 4.0548$

$\chi = -28$

Same surface, different choice of origin!
Triple P

Pm3m

$A = 4.5835$

$\chi = -46$
P/T2 hybrid
(Mackay)

Pm3
\( \chi = -30 \)
P/T2
hybrid
1/8 unit cell
ALM
P/T2 hybrid
A=5.3878
Pm3
\chi = -30
P, FRD
Hybrid P/T4
(unit cell)
Fm3m
$A = 5.7875$
$\chi = -44$
P,FRD
Hybrid
P,T4
Hexplane2
(Brakke)
1/8 unit cell
Hexplane2

Unit cell

$A = 5.3742$

$\chi = -88$

Fm3m
betaW

\text{Pm3n}

A = 4.3419

\chi = -20
OCTON

OCTO/Neovius hybrid

Pm3m

$A = 4.497$

$\chi = -36$
OCTON
Hybrid
OCTO/C(P)
NPin
Neovius with P tunnels inwards
Gozdz & Holyst’s

CPD
\( A = 4.3441 \)
\( \chi = -26 \)
NPin
(CPD)
1/8 unit cell
CPCPB

(Neovius with tunnels out; hybrid C(P)/C(P)b

Pm3m

A = 3.55836

χ = −22
CPCPB

alternative
origin
Hybrid P/T1
Structural unit,
1/8 unit cell
Hybrid P/T1

Unit cell
Pm3
A = 5.0745

χ = −28
Orthorhombic variants of the P surface
\( \chi = -46 \)
\( \chi = -52 \)
\[ \chi = -56 \]
$\chi = -56$

(Same as previous surface. Different origin!)
Batwing 1/8 unit cell

Pseudobatwing unit cell

Patches of two surfaces that are almost identical. This leads to interesting possibilities for hybrid surfaces, a 3D analogue of Truchet tilings.
Batwing
Im3m/Pm3m
unit cell

Pseudobatwing
R3̅m/R3m
unit cell
The four orientations of the 3D Truchet tile
Batwing3
Truchet-type
tessellation