

A table of hybrid minerals

Most students learn that minerals can be categorized according to their anions as oxides, sulfides, chlorides, carbonates, sulfates, etc. This table shows that there are also hybrid minerals with anions from more than one of these categories. The most familiar example shown here is chlorapatite, a hybrid of the phosphate and chloride groups. More striking might be bradleyite (Na₃MgCO₃PO₄), a mineral that bridges the seemingly distinct carbonate and phosphate categories.

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|--|---|--|--|---|---|
| Borates | Pertsevite Mg ₂ BO ₃ F | Bandyite CuB(OH) ₄ Cl | | | |
| Carbonates | Brenkite Ca ₂ CO ₃ F ₂ | Phosgenite Pb ₂ CO ₃ Cl ₂ | Gaudfroyite Ca ₄ Mn ³⁺ _{3-x} (BO ₃) ₃ CO ₃ (O,OH) ₃ | | |
| | Taeniolite KLiMg ₂ Si ₄ O ₁₀ F ₂ | Assisitite Pb ₇ SiO ₈ Cl ₂ | Datolite CaBSiO ₄ OH | Tilleyite Ca ₅ Si ₂ O ₇ (CO ₃) ₂ | |
| Phosphates | Lacroixite NaAlPO ₄ F | Clorapatite Ca ₅ (PO ₄) ₃ Cl | Lünebergite Mg ₃ P ₂ (PO ₄) ₂ (OH) ₆ ·6H ₂ O | Bradleyite Na ₃ MgPO ₄ CO ₃ | Clinophosinaite Na ₃ CaPO ₄ SiO ₃ |
| | Kogarkoite Na ₃ SO ₄ F | Chlorothionite K ₂ CuSO ₄ Cl ₂ | Sulfoborite Mg ₃ B ₂ SO ₄ (OH) ₈ (OH,F) ₂ | Burkeite Na ₆ CO ₃ (SO ₄) ₂ | Nosean Na ₈ Al ₆ Si ₆ O ₂₄ SO ₄ |
| Sulfates | | Sveite KAl ₇ (NO ₃) ₄ Cl ₂ (OH) ₁₆ ·8H ₂ O | | | Svanbergite SrAl ₃ PO ₄ SO ₄ (OH) ₆ |
| | | | | | Darapskite Na ₃ NO ₃ SO ₄ ·H ₂ O |
| Vanadates | | Vanadinite Pb ₅ (VO ₄) ₃ Cl | Kurumsakite (Zn,Ni,Cu) ₈ Al ₈ V ₂ Si ₅ O ₃₅ ·27H ₂ O | | Cassedanite Pb ₅ (VO ₄) ₂ (CrO ₄) ₂ ·H ₂ O |
| | | | Macquarritite Pb ₃ CuCrO ₄ SiO ₃ (OH) ₄ ·2H ₂ O | Vauquelinite Pb ₂ CuCrO ₄ PO ₄ OH | |
| Chromates | | | | | |
| | | | Mongolite Ca ₄ Nb ₆ Si ₅ O ₂₄ (OH) ₁₀ ·nH ₂ O | | |
| Niobates | | | | | |
| | | | | | |
| Molybdates | | | | | |
| | | | | | |
| Tungstates | | Pinaite Pb ₃ WO ₅ Cl ₂ | | | |
| | | | | | |
| Arsenates | Maxwellite NaFeZn ₆ (AsO ₄)F | Mimetite Pb ₅ (AsO ₄) ₃ Cl | Cahnite Ca ₂ BAsO ₄ (OH) ₄ | Kraisslite (Mn,Mg) ₂₄ Zn ₄ (AsO ₄) ₄ (SiO ₄) ₈ (OH) ₁₂ | |
| | | Tlalocite Cu ₁₀ Zn ₆ (TeO ₃)(TeO ₄) ₂ Cl(OH) ₂₅ ·27H ₂ O | | | Lammerite Cu ₃ [(As,P)O ₄] ₂ |
| Selenates, Antimonates, & Tellurates | | | | | Weilerite BaAl ₃ AsO ₄ SO ₄ (OH) ₆ |
| | | | | | Dugganite Pb ₃ Zn ₃ (TeO ₆) _x (AsO ₄) _{2-x} (OH) _{6-3x} |
| Iodates | | Seeligerite Pb ₃ IO ₃ Cl ₃ O | | | |
| | | | | | |
| Arsenites | Nanlingite CaMg ₄ (AsO ₃) ₂ F ₄ | Erdkernite Pb ₆ As ₂ O ₇ Cl ₄ | | | |
| | | | | | |
| Selenites | | Sophiite Zn ₂ SeO ₃ Cl ₂ | | | |
| | | | | | |
| Tellurites | | Rodaquirarite H ₃ Fe ₂ ³⁺ (TeO ₃) ₄ Cl | Mroseite CaTeO ₂ CO ₃ | Tlalocite H ₆ (Ca,Pb) ₂ (Cu,Zn) ₃ SO ₄ (TeO ₃) ₄ TeO ₆ ⁶⁺ | |
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| Oxides | Zaravitskite BiOF | Bismocillite BiOCl | | | |
| Sulfides | | Corderoite Hg ₃ S ₂ Cl ₂ | Helvine Mn ₄ Be ₃ (SiO ₄) ₃ S | | |
| | | | | | |
| Fluorides | | Chlorides | Borates | Carbonates | Phosphates |
| | | | | | |
| | | | Silicates | Sulfates | Other oxysalts |
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In addition to the hybrids shown here, there are oxy-sulfides, of which kermesite (Sb₂S₂O) is an example. This table largely focuses on hybrids with two anions, but there are also minerals with three anions, such as hanksite (Na₂K(SO₄)₃(CO₃)₂Cl) and chlorillestadite (Ca₁₀(SiO₄)₃(SO₄)₃Cl₂).