

Magnesite:

- MgCO_3
- trigonal



Pinolite-Magnesite
from Sunk, Trieben,
Steiermark, Austria

Siderite

- FeCO_3
- trigonal
- rhombohedral crystals with bent surfaces or in globular concretions
- density 4.0 g cm^3



Mineralienkabinett (c) MZ 2000 <http://www.min.uni-bremen.de>

Siderite (iron-spat) with calc-spat from Siegerland

Aragonite series:

- Aragonite CaCO_3
- Strontianite SrCO_3
- Cerussite PbCO_3
- Witherite BaCO_3

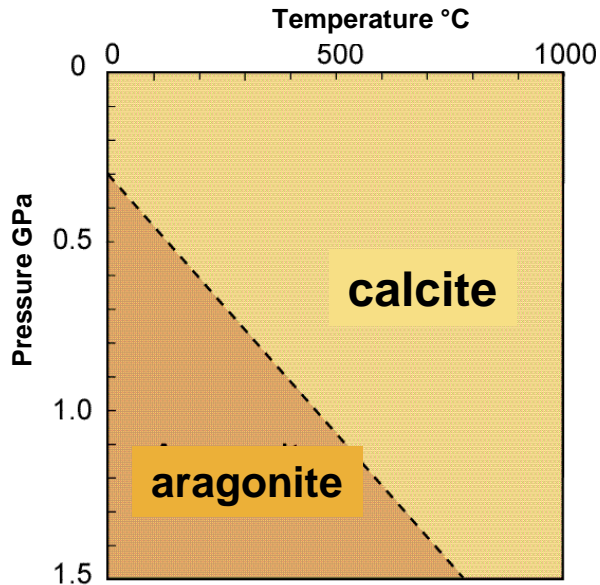
Aragonite

- CaCO_3
- orthorhombic
- hardness $3\frac{1}{2} - 4$
- modification of calcium carbonate
- often columnar-pyramidal, tabular and often pseudo hexagonal
- poor cleavage
- formed metamorphic by relative high pressure; but occur also sedimentary



Aragonite CaCO_3 twinning crystals
from Corocoro, Bolivia

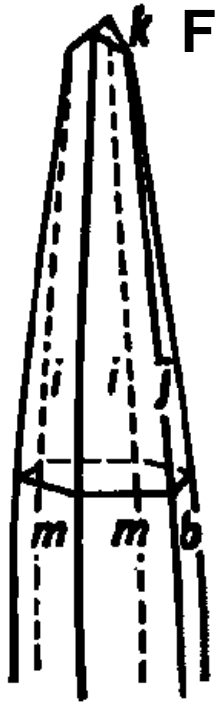
Aragonite



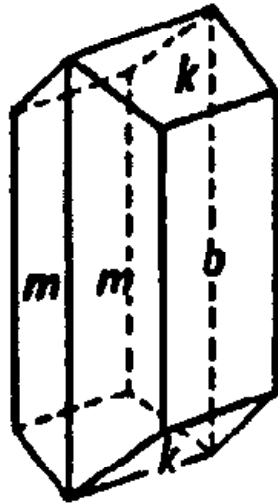
Aragonite CaCO_3 twinning crystals
from Corocoro, Bolivia

- occurrence: (under room temperature and pressure → metastable)
- cavities of volcanic rocks
- part of sinter incrustation
- as pisolite from hot springs or geyser
- organogenic as nacre layer natural pearls and shells from mollusks

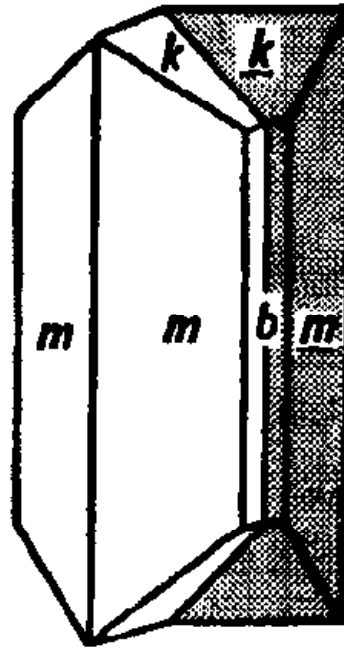
Formation of aragonite crystals (a,b) and twins (crystal)



(a)

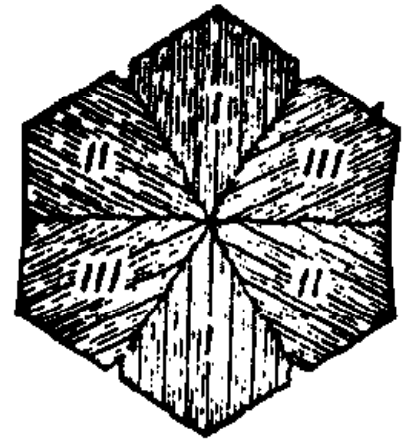


(b)



(c)

twinning

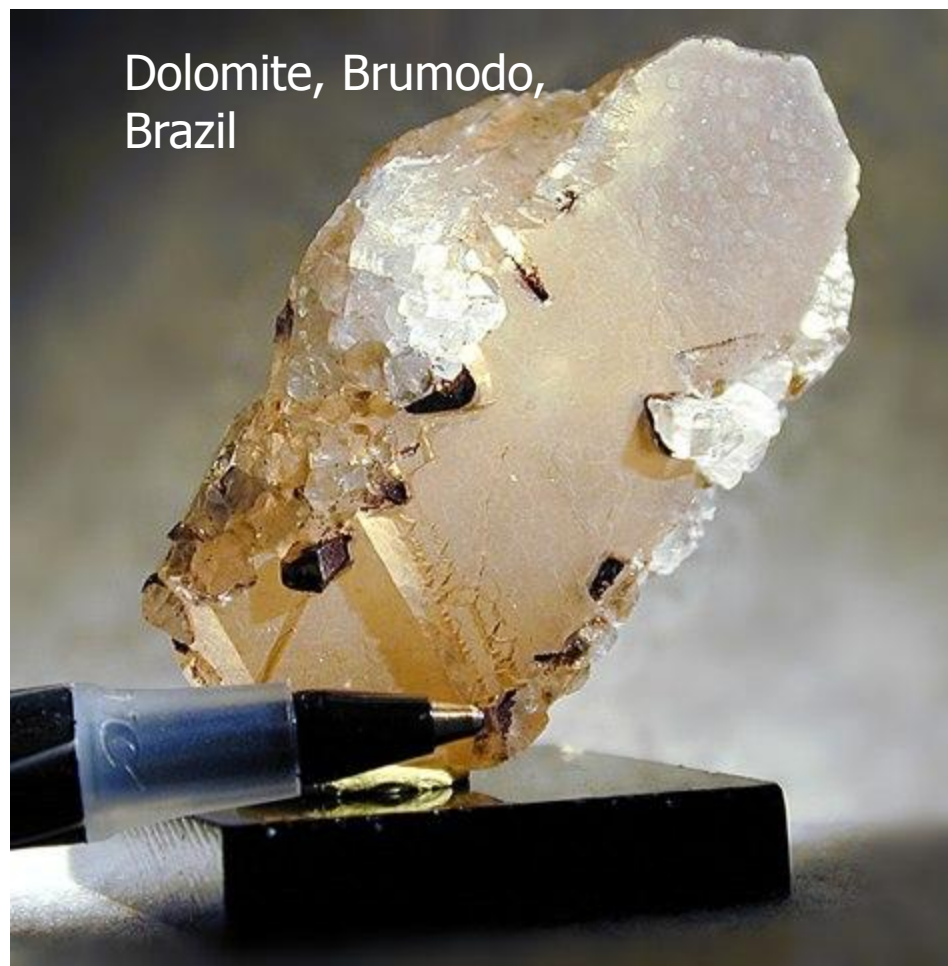


(d)

Pseudo hexagonal
symmetry

Dolomite series:

- Dolomite $\text{CaMg}(\text{CO}_3)_2$
- Ankerite $\text{CaFe}(\text{CO}_3)_2$



Dolomite- Ankerite

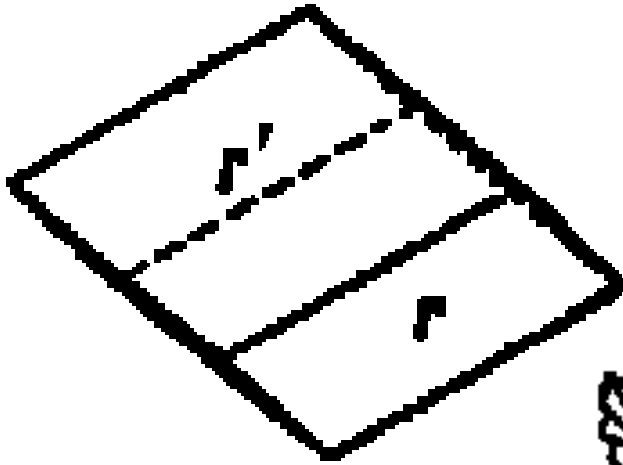
Idiomorphic **dolomite-crystals** together with quartz and sphalerite (dark) from the cavern Aurora, Velbert, Rhineland



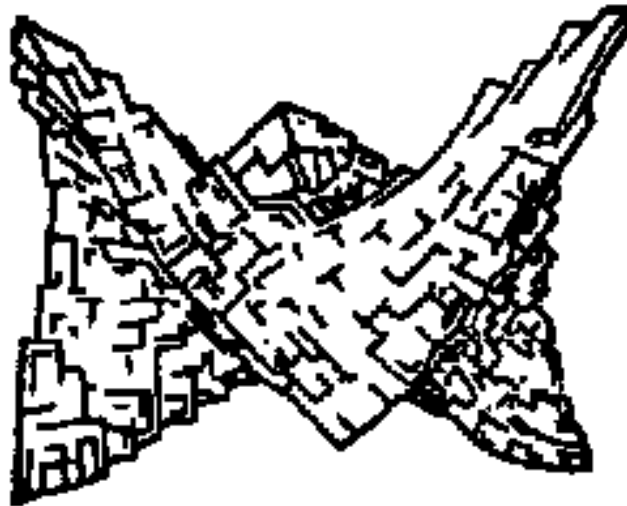
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- $\text{CaMg}(\text{CO}_3)_2$ - $\text{Ca}(\text{Mg}, \text{Fe}^{2+})(\text{CO}_3)_2$
- trigonal
- dolomite is formed often in good formed crystals with bent surfaces, on the other hand is Ankerite rarely.

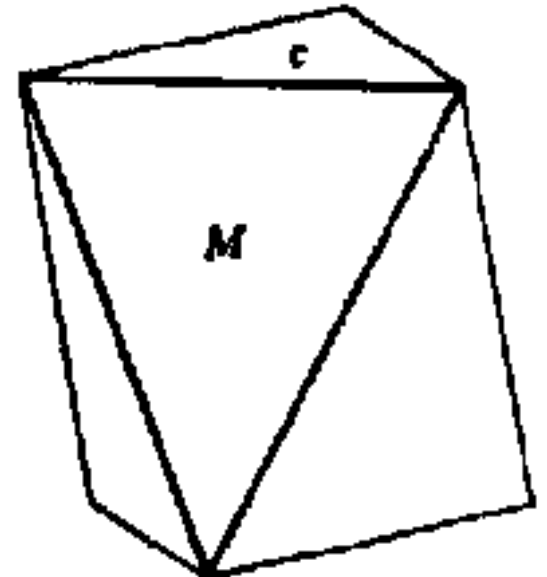
Formation of dolomite crystal



Rhombohedron



twinning

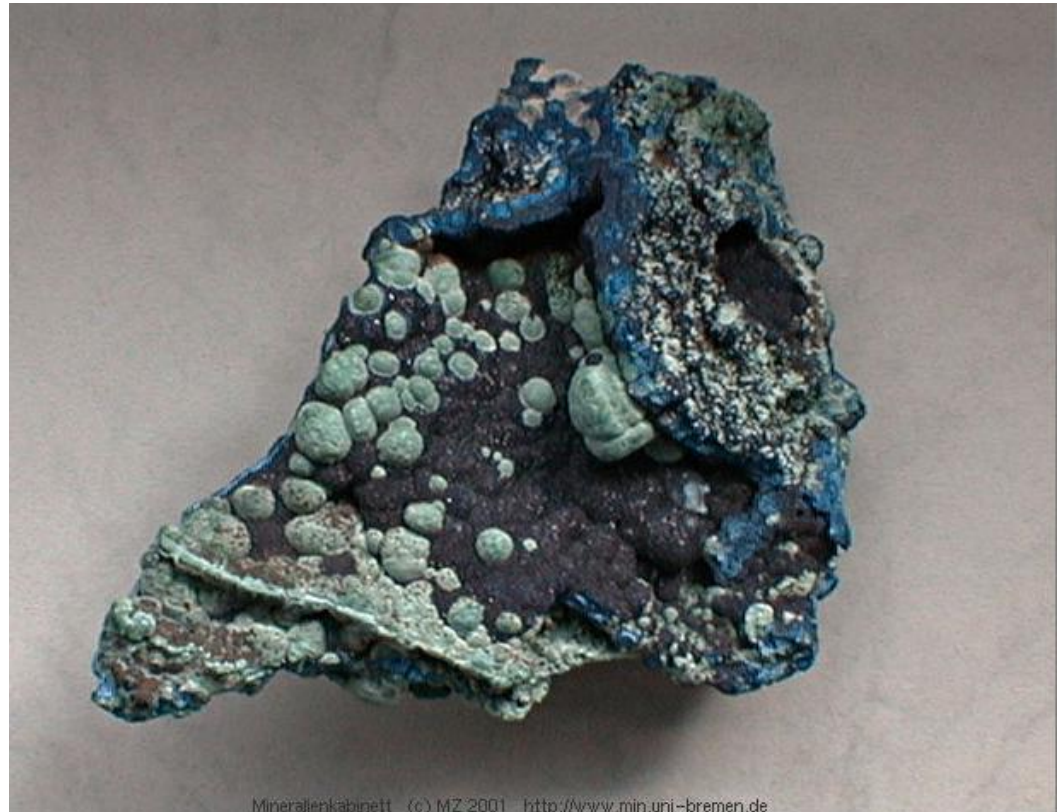


Water-base carbonates with OH-group

Malachite-Azurite-Group:

- Malachite
 $\text{Cu}_2[(\text{OH})_2/\text{CO}_3]$
- Azurite
 $\text{Cu}_3[(\text{OH})/\text{CO}_3]^2$

Azurite with malachite



Malachite

- $\text{Cu}_2(\text{CO}_3)(\text{OH})_2$
- monoclinic
- green crystals
- usually radiate or fibrous aggregates, also fine-grained rough massive
- Occurs in the oxidation zone of Cu-containing mineralization.



Banded **malachite-aggregates**
from Nishne Tagilsk, Ural, Russia

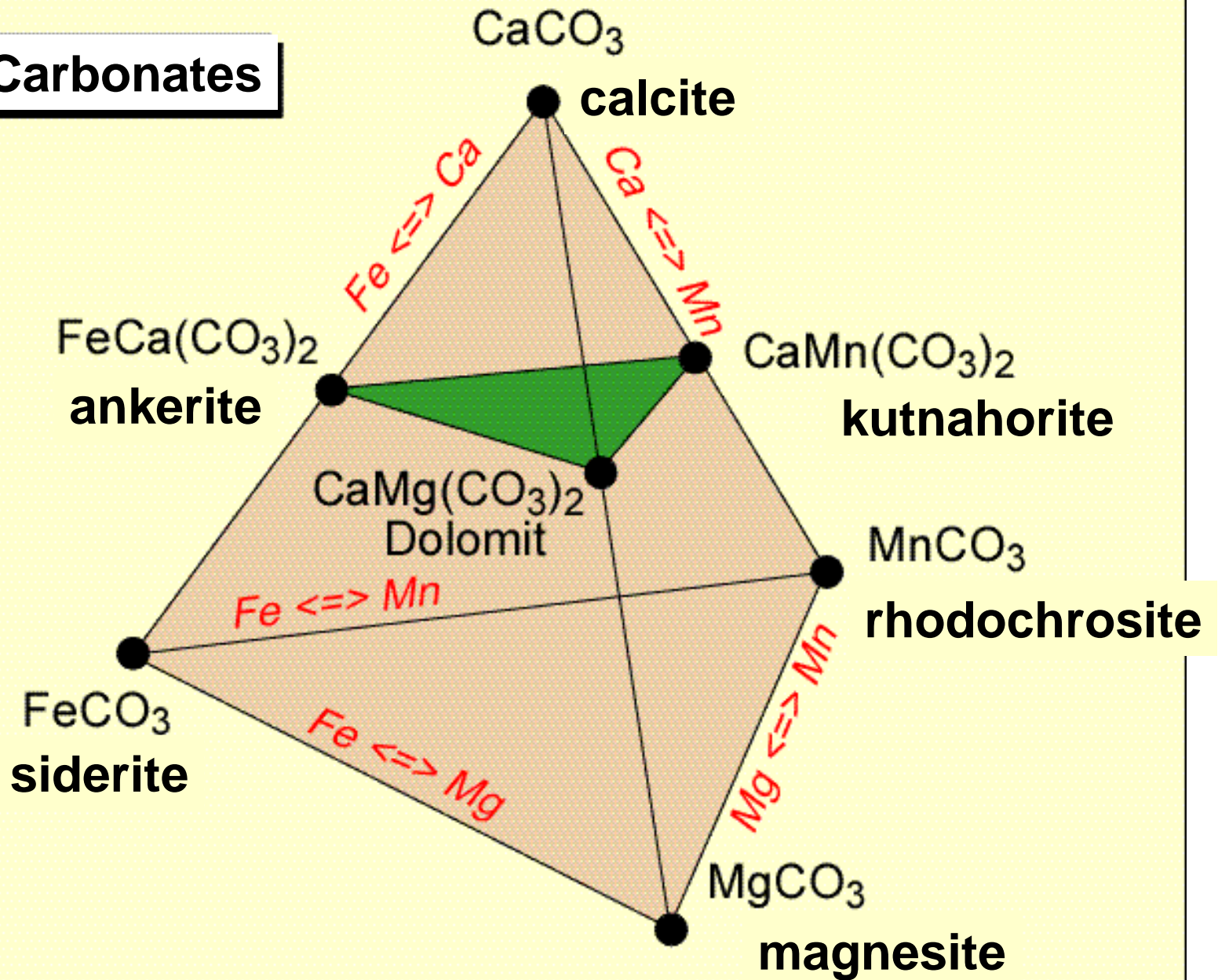
Malachite with azurite



Arizona



Carbonates



VI. Sulfates, Chromates, Molybdates, Wolframates

- anion complexes such as $[\text{SO}_4]^{2-}$, $[\text{WO}_4]^{2-}$, $[\text{MoO}_4]^{2-}$ and $[\text{CrO}_4]^{2-}$ (slightly distorted tetrahedron)
- the density depends on the involved cations: Pb is e.g. relative heavy, Ca in contrast relative light.
- hardness 3-4