Humite Group
\((\text{Mg,Fe})_{2+x}(\text{SiO}_4)_x(\text{F,OH})_2\)
where \(x = 1\) (norbergite), 2 (chondrodite), 3 (humite), and 4 (clinohumite).
In natural samples Mg >> Fe and F >> OH.

Humite End-Members
**Magnesium-fluorine end-members**
- Norbergite: \(\text{Mg}_2\text{SiO}_4 \cdot \text{MgF}_2\)
- Chondrodite: \(2\text{Mg}_2\text{SiO}_4 \cdot \text{MgF}_2\)
- Clinohumite: \(3\text{Mg}_2\text{SiO}_4 \cdot \text{MgF}_2\)
  (Forsterite: \(\text{Mg}_2\text{SiO}_4\))

**Magnesium-hydroxyl end-members**
- Hydroxyl-chondrodite: \(2\text{Mg}_2\text{SiO}_4 \cdot \text{Mg(OH)}_2\)
- Hydroxyl-clinohumite: \(4\text{Mg}_2\text{SiO}_4 \cdot \text{Mg(OH)}_2\)

**Manganese-hydroxyl isotypes**
- MAN: \(\text{Mn}_2\text{SiO}_4 \cdot \text{Mn(OH)}_2\)
- Alleghanyite: \(2\text{Mn}_2\text{SiO}_4 \cdot \text{Mn(OH)}_2\)
  (Tephroite: \(\text{Mn}_2\text{SiO}_4\))

Humite Occurrences
The principal occurrence is in high grade metamorphosed mafic and ultramafic rocks. They have been found in Monte Somma, Mount Vesuvius, Italy; Paragas, Finland; Varmland, Sweden; Tilly Foster Mine, Brewster, New York, USA and some other localities.

At one time, humites generated interest as a possible mineralogical site for water in the earth’s upper mantle. Titaniferous clinohumite was studied by Merrill et al. (1972) and was found to be stable as a hydrous mineral up to 1170°C at 3 GPa.
Humite Structure

<table>
<thead>
<tr>
<th>End Member</th>
<th>Norbergite</th>
<th>Chondrodite</th>
<th>Humite</th>
<th>Clinohumite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula</td>
<td>(Mg,Fe)3SiO4(F,OH)2</td>
<td>(Mg,Fe)5(SiO4)2(F,OH)2</td>
<td>(Mg,Fe)7(SiO4)3(F,OH)2</td>
<td>(Mg,Fe)9(SiO4)4(F,OH)2</td>
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<td>Ortho</td>
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<td>P21</td>
<td>Pnma</td>
<td>P21</td>
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<tr>
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<td>3.1516</td>
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<td>Volume</td>
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<tr>
<td>Molar Vol</td>
<td>63.73</td>
<td>108.20</td>
<td>152.70</td>
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<tr>
<td>Density</td>
<td>3.186</td>
<td>3.158</td>
<td>3.159</td>
<td>3.258</td>
</tr>
</tbody>
</table>

Humite Structure

Octahedral Sites
In the M sites, Ca substitutes up to 2 weight % CaO. Zn is also as abundant but is found more often in the Mn-isotypes. NiO as also been found in these sites. Ti is found to prefer the M3 site. Fe is also found to substitute for Mg.

Tetrahedral Sites
B and Be can substitute for Si.
Humite Compressibility

**TF chondrodite (X_{OH} = 0.42):** A bulk modulus of $K_0,T = 117.0(4)$ GPa was derived from P-V data with a pressure derivative of $K_T' = 5.6(1)$.

Previous compression studies of chondrodites revealed:
- $K_0,T = 115.5(6)$ GPa, $K_T' = 5.0(2)$, $X_{OH} = 1.0$, [1];
- $K_S = 118.4(1.6)$ GPa, $X_{OH} = 0.68$, [2];
- $K_0,T = 136(±9)$ GPa, $K_T' = 3.7(±0.4)$, $X_{OH} = 0.27$; if $K_T' = 4.9-5.5$: $K_0,T = 118-125$.

**KiL clinohumite (X_{OH} = 0.40):**
- $K_0,T = 119(3)$ GPa, $K_T' = 6.3(8)$.
- If $K_T' = 5$: $K_0,T = 123.6(8)$ GPa.

Previous compression studies of clinohumites revealed:
- $K_0,T = 119.4(7)$ GPa, $K_T' = 4.8(2)$, $X_{OH} = 1.0$ [1];
- $K_S = 125(2)$ GPa, $X_{OH} = 0.71$, [4].

These data suggest that chondrodite and clinohumite become less compressible with increasing F content.

From [http://www.louisville.edu/~galage01/hpc.pdf](http://www.louisville.edu/~galage01/hpc.pdf)

Compression and pressure-dependent structural studies of F-bearing chondrodite and clinohumite

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