Grenmarite  

$$(\text{Zr},\text{Mn})_2(\text{Zr},\text{Ti})(\text{Mn},\text{Na})(\text{Na},\text{Ca})_4(\text{Si}_2\text{O}_7)_2(\text{O},\text{F})_4$$

Crystal Data: Monoclinic.  
**Point Group**: $2/m$.  
As semi-parallel aggregates of elongated, flattened crystals, to 1 cm. Crystals striated parallel to [010], slightly curved and dominated by {201} and {203}.

Physical Properties:  
**Cleavage**: Good on {001}.  
**Tenacity**: Brittle.  
**Fracture**: Uneven.

Hardness = 4.5  
$D_{(\text{meas.})} = 3.49(1) D_{(\text{calc.})} = 3.568$

Optical Properties:  
**Color**: Yellow brown, alters to brown.

**Luster**: Vitreous.

**Optical Class**: Biaxial (+).  
$\alpha = 1.694 \quad \beta = \text{n.d.} \quad \gamma = 1.735$  
**Orientation**: $X = \text{b, } Z \land a = 42^\circ$.  
**Pleochroism**: $X = \text{colorless, } Z = \text{light brown}.$

Cell Data:  
**Space Group**: $P2_1/c$.  
$\alpha = 5.608(1) \quad b = 7.139(1) \quad c = 18.575(5) \quad \beta = 102.60(2)^\circ \quad Z = 2$


2.898 (100), 3.027 (68), 2.613 (26), 2.459 (24), 1.853 (24), 3.949 (15), 1.786 (14), 1.650 (14)

Chemistry:

<table>
<thead>
<tr>
<th>Element</th>
<th>Formula</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO$_2$</td>
<td>29.85</td>
<td></td>
</tr>
<tr>
<td>TiO$_2$</td>
<td>4.51</td>
<td></td>
</tr>
<tr>
<td>CaO</td>
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<td></td>
</tr>
<tr>
<td>MnO</td>
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<tr>
<td>FeO</td>
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<tr>
<td>Na$_2$O</td>
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<tr>
<td>O$_2$F</td>
<td>2.22</td>
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</tr>
</tbody>
</table>

Total = 96.84

(1) Vesle Arøya, Langesundsfjord district, Vestfold, Norway; average of 15 electron microprobe analyses, absence of H$_2$O and OH$^-$ confirmed by IR spectroscopy and structure analysis; corresponds to $(\text{Zr}_{1.52}\text{Mn}_{0.48}\text{Y}_{0.02})_2\text{Zr}_{0.55}\text{Ti}_{0.45}\text{Mn}_{0.48}\text{Na}_{0.29}\text{Fe}_{0.23}\text{F}_{2.23}$.


Polymorphism & Series: Forms a series with seidozerite.

Occurrence: An early crystallization product, embedded in microcline and fine-grained albite in an alkaline nepheline syenite pegmatite dike cutting larvikite.

Association: Microcline, aegirine, biotite, nepheline, albite, astrophyllite, lavenite, catapleiite, leucophanite, pyrochlore, fluorite, and minor molybdenite, sphalerite, galena, löllingite.

Distribution: From a dike on the eastern side of the island of Vesle Aroya, Langesundsfjord district, Vestfold, Norway.

Name: For Grenmar, the Norse name of the Langesundsfjord.

Type Material: Natural History Museum, University of Pisa, Italy (2003-024) and at the Geological Museum, University of Oslo, Norway (33974).

References:  
(2) (2005) Amer. Mineral., 90, 1228 (abs. ref. 1).