Loveringite  \((\text{Ca}, \text{Ce})(\text{Ti}, \text{Fe}^{3+}, \text{Cr}, \text{Mg})_{21}\text{O}_{38}\)  

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Crystal Data: Hexagonal; metamict in part.  
Point Group: \(\overline{3}\). Commonly anhedral, to 120 \(\mu\)m; may be acicular; as inclusions in other minerals.

Physical Properties: Hardness = n.d.  
VHN = 421–464; 870–933 (100 g load).  
D(meas.) = n.d.  
D(calc.) = 4.42  

Optical Properties:  
Streak: Iron-gray.  
Color: Black; white to grayish white in reflected light.  
Optical Class: Uniaxial.

X-ray Powder Pattern: Near Norseman, Western Australia; after heating in air at 800\(^\circ\)C.  
1.433 (100), 3.037 (93), 1.589 (92), 3.384 (87), 2.465 (72), 1.791 (71), 2.129 (68)

Cell Data:  
Space Group: \(\overline{R}3\).  
a = 10.337(6) \(\text{Å}\)  
c = 20.677(12) \(\text{Å}\)  
Z = 3

Chemistry:  
<table>
<thead>
<tr>
<th>Compound</th>
<th>Formula</th>
<th>Stoichiometry</th>
<th>Stoichiometry</th>
<th>Stoichiometry</th>
<th>Stoichiometry</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_2O_5)</td>
<td>1.10</td>
<td>(\text{MnO} )</td>
<td>0.17</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>(\text{TiO}_2)</td>
<td>58.34</td>
<td>(\text{NiO} )</td>
<td>0.08</td>
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<tr>
<td>(\text{ZrO}_2)</td>
<td>4.18</td>
<td>(\text{PbO} )</td>
<td>0.22</td>
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<tr>
<td>(\text{HfO}_2)</td>
<td>0.35</td>
<td>(\text{MgO} )</td>
<td>2.18</td>
<td>1.77</td>
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<tr>
<td>(\text{ThO}_2)</td>
<td>0.09</td>
<td>(\text{CaO} )</td>
<td>2.37</td>
<td>3.90</td>
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<tr>
<td>(\text{UO}_2)</td>
<td>0.18</td>
<td>(\text{Fe}_2\text{O}_3)</td>
<td>15.77</td>
<td>15.81</td>
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<tr>
<td>(\text{Al}_2\text{O}_3)</td>
<td>1.15</td>
<td>(\text{Cr}_2\text{O}_3)</td>
<td>9.94</td>
<td>4.76</td>
<td></td>
</tr>
</tbody>
</table>

(1) Near Norseman, Western Australia; by electron microprobe, average of five analyses, total Fe as \(\text{Fe}_2\text{O}_5\); total V as \(\text{V}_2\text{O}_5\). RE\(_\text{E}\) estimated from chondrite-normalized rare earth patterns; corresponds to | \(\text{Ca}_{0.72}\text{RE}_{0.33}[(\text{Y},\text{Th},\text{U,Pb})_{0.05}]_{\Sigma=1.10}\text{(\text{Ti}_{12.48}\text{Fe}_{3.38}\text{Cr}_{2.24}\text{Mg}_{0.92}\text{Zr}_{0.58}\text{Al}_{0.39})_{\Sigma=20.24}\text{O}_{38}}\).  
(2) Western Laouni massif, Algeria; by electron microprobe, total Fe as \(\text{Fe}_2\text{O}_3\); corresponds to \(\text{Ca}_{1.13}\text{(Ti}_{14.66}\text{Fe}_{3.21}\text{Cr}_{1.02}\text{Mg}_{0.71}\text{Al}_{0.28}\text{Mn}_{0.08}\text{Zr}_{0.02})_{\Sigma=19.98}\text{O}_{38.04}\).

Mineral Group: Crichtonite group.

Occurrence: A late-stage mineral from residual intercumulus magma in the pyroxene, olivine-chromite, or plagioclase-rich layers of mafic intrusions.

Association: Quartz, potassium feldspar, phlogopite, enstatite, baddeleyite, apatite, zircon, titanite, rutile, ilmenite, chromeite (near Norseman, Australia); rutile, pseudobrookite, ilmenite, zirconolite, spinel, pargasite, phlogopite (Western Laouni massif, Algeria).

Distribution: In the Jimberlan intrusion, near Norseman, Western Australia. From St. Christophe and La Grave, near Bourg d’Oisans, Isère, France. In Austria, in the Lohning quarry, Rayris Valley. From the Koitelainen intrusion, Lappland, Finland. In the Western Laouni massif, Hoggar Mountains, Algeria.

Name: Honors Professor John Francis Lovering (1930–), Australian geochemist, University of Melbourne, Melbourne, Australia, for his work on fission-track methods in geochemistry.

Type Material: Museum Victoria, Melbourne, Australia, M34208; National Museum of Natural History, Washington, D.C., USA, 143350.

References:  

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