Reaction Temperature and Pressure Constraints on Hydrogen Reduction of Ilmenite for ProSPA.

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Research Aims & Methods

• Demonstrate water production from lunar minerals

\[ FeTiO_3 + H_2 \rightleftharpoons Fe + TiO_2 + H_2O \]

Ilmenite + Hydrogen ⇌ Iron + Rutile + Water

• Optimize the reduction reaction procedure

• Perform reduction of lunar simulants and samples
Results

Higher temperatures give higher yields (focused on 1000°C)

Fig 1. Reaction rates for different H₂ pressures

![Graph showing reaction rates for different H₂ pressures](attachment:image.png)

Table 1. Yields from different sample types

<table>
<thead>
<tr>
<th>Sample</th>
<th>Water production total (ml)</th>
<th>Yield (wt. % O₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ilmenite</td>
<td>1.72</td>
<td>3.40</td>
</tr>
<tr>
<td>NU-LHT-2M</td>
<td>0.14</td>
<td>0.29</td>
</tr>
<tr>
<td>NWA12592</td>
<td>0.03</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Fig 3. Evidence of reduction in a.) Ilmenite, b.) plagioclase, and c.) pyroxene in the NU-LHT-2M reacted sample.
• Higher temp = more yield

• $\text{H}_2$ pressure ‘goldilocks zone’ in static system

• Highland simulants can reduce (likely to work on lunar highlands)

• Lunar meteorites give low yields (grain size? Impact melt?)

• Next steps, Apollo samples!

Fig 1. Effect of $\text{H}_2$ pressure on reaction process.