Extending the Field of Nickel Borates *via* High-Pressure Synthesis

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**ORAL**

**Abstract**

When comparing the systems Fe–B–O(–H), Co–B–O(–H), and Ni–B–O(–H), it is striking that the number of published high-pressure borates in each system decreases from five (Fe-borates), to four (Co-borates), to two (Ni-borates). Since the transition metals Fe, Co, and Ni have similar chemical properties and thus often form isotypic compounds, one would also expect that a similar number of corresponding transition metal borates exist. Therefore, the small number of already known nickel borates motivated us to further investigate the system Ni–B–O(–H).

Within this system, six compounds are known so far. Three hydrous phases and three anhydrous phases. Two of these anhydrous compounds were formed during high-pressure experiments at 7.5 GPa/680 °C (HP-NiB2O4)\(^1\) and 7.5 GPa/1150 °C (\(\gamma\)-NiB4O7)\(^2\), respectively.

Here, we present the crystal structures of another four nickel borates synthesized at elevated pressures using a Walker-type multianvil apparatus. The compositions, reaction conditions, and space groups are listed in Table 1.

**Table 1.** Compositions, reaction conditions, and space groups of the new nickel borates.

<table>
<thead>
<tr>
<th>Composition</th>
<th>(p)/GPa</th>
<th>(T)/°C</th>
<th>Crucible</th>
<th>Space group</th>
</tr>
</thead>
<tbody>
<tr>
<td>NiB(_3)O(_5)(OH)</td>
<td>4</td>
<td>750</td>
<td>Mo</td>
<td>(P2_1/c)</td>
</tr>
<tr>
<td>&quot;Ni(<em>3)B(</em>{18})O(_{32})&quot; (^a)</td>
<td>5</td>
<td>700</td>
<td>BN</td>
<td>(P\bar{6}2m)</td>
</tr>
<tr>
<td>(\gamma)-NiB(_4)O(_7)(^3)</td>
<td>5</td>
<td>900</td>
<td>BN</td>
<td>(P6s22)</td>
</tr>
<tr>
<td>Ni(<em>6)B(</em>{22})O(_{39}) \cdot H(_2)O</td>
<td>5</td>
<td>900</td>
<td>Pt</td>
<td>(Pmn2_1)</td>
</tr>
</tbody>
</table>

\(^a\) The exact composition could not be determined yet

The fact that these compounds were synthesized within the narrow pressure range of 3.5–5 GPa emphasizes once more the importance of the parameter pressure in solid state chemistry.

**References**

Brief Biographical Notes

Hubert Huppertz studied chemistry at the University of Bayreuth, Germany. In 1997, he finished his doctorate with a fundamental work on the structural extension of nitridosilicates in the group of Prof. Schnick. Changing to the Ludwig-Maximilians-University in Munich, he conducted his habilitation from 1998-2003 with a chemical focus on high-pressure/high-temperature syntheses. In 2008, he was appointed as full professor for General and Inorganic Chemistry at the University of Innsbruck, Austria. His main research interests are dedicated to the explorative synthetic discovery of new compounds in solid state chemistry, e.g. in the syntheses of novel borates and phosphor materials. Since 2013, he also fills the position of a Dean of the Faculty of Chemistry and Pharmacy at the University of Innsbruck.