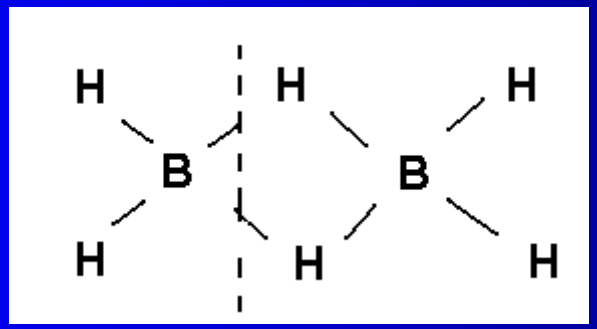
III

- Borani B_2H_6, B_4H_{10} …… $B_{10}H_{14}$
-
- $B_2H_6 + 6\ H_2O \rightarrow 2\ H_3BO_3 + 6\ H_2$
-
- $2\ Mg_3B_3 + 12\ H^+ \rightarrow 6\ Mg^{2+} + B_4H_{10} + H_2$

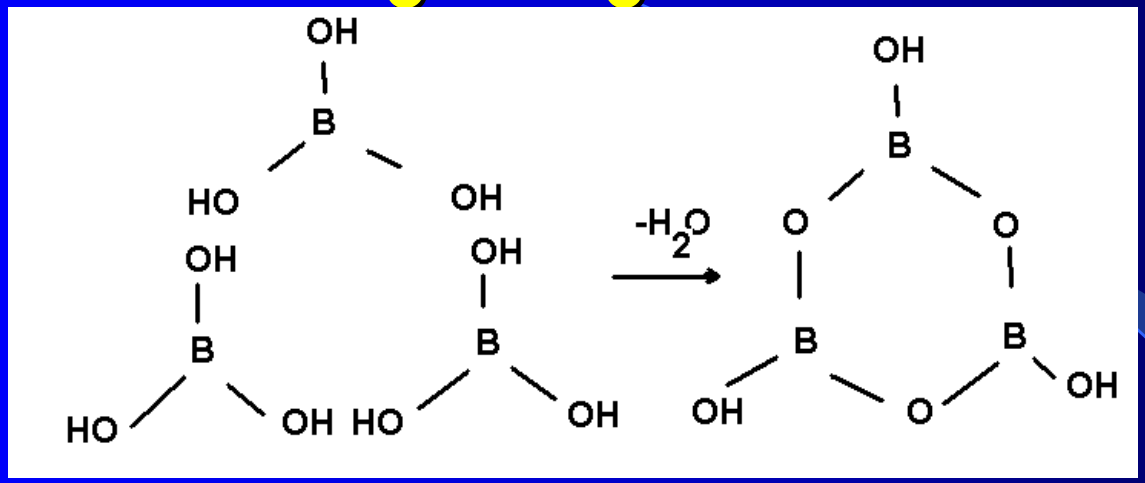


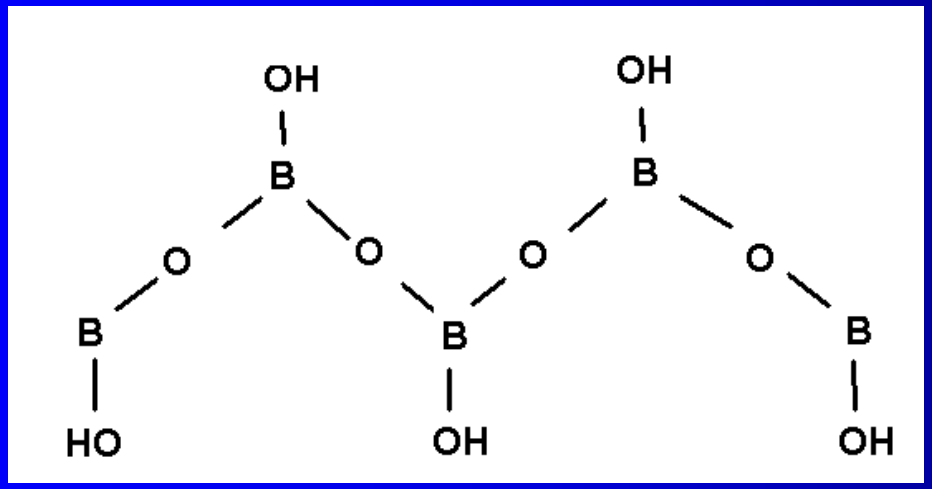
boranati
borhidridi

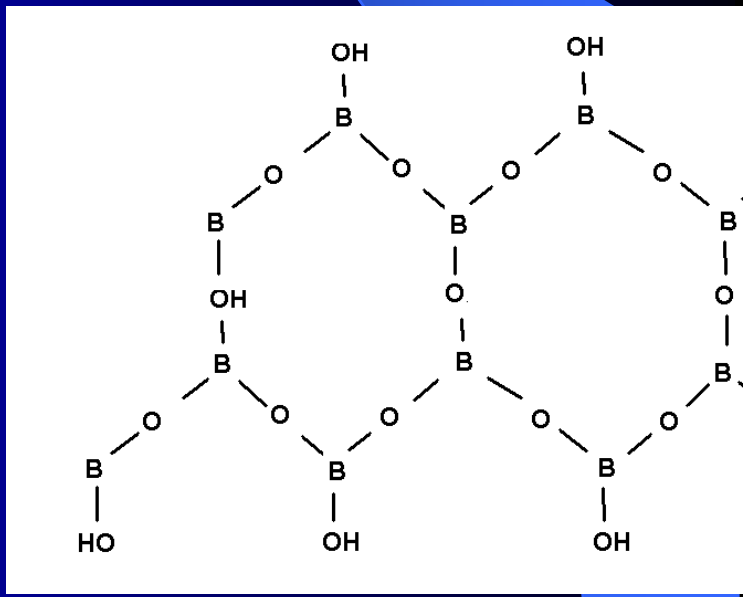
- $BCl_3 + 6\ MeH \xrightarrow{\text{eter}} B_2H_6 + 6\ MeCl$
- $B_2H_6 + 2\ LiH \rightarrow 2\ Li\ [BH_4]^-$
- B_2O_3

$$2\ H_3BO_3 \xrightarrow{-2H_2O} 2\ HBO_2 \xrightarrow[500\ ^\circ C]{-H_2O} B_2O_3$$

H_3BO_3

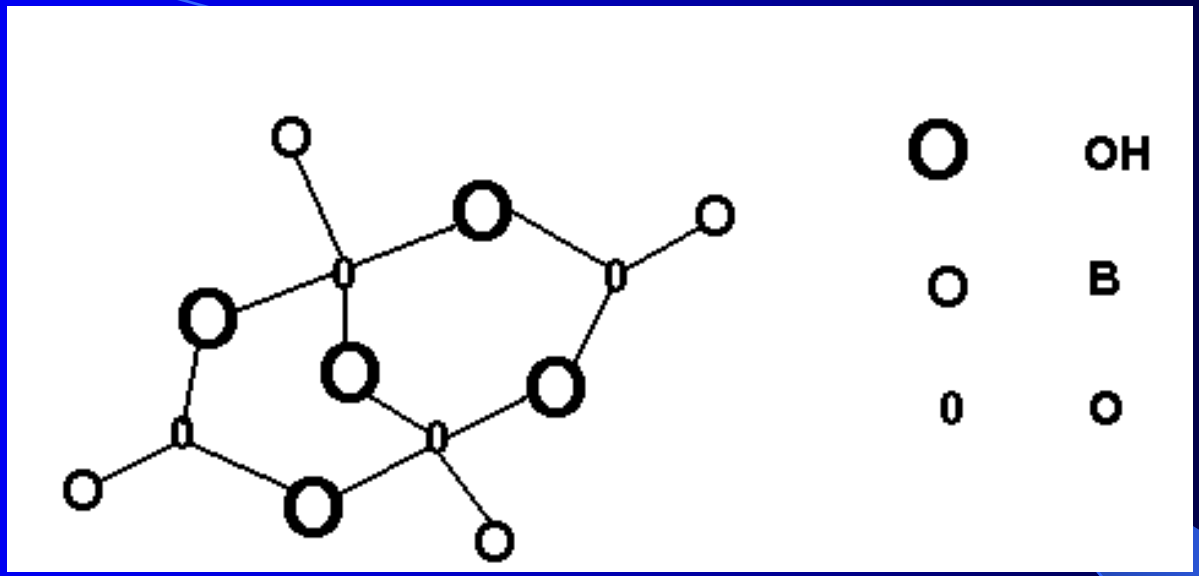


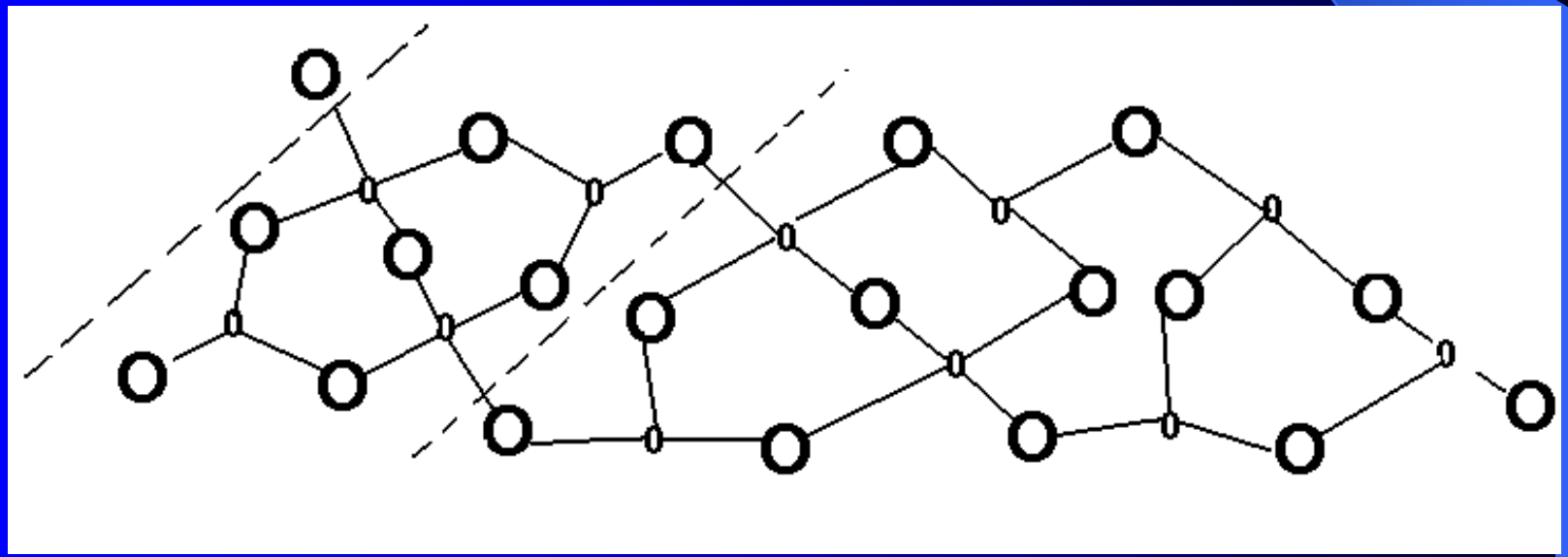




- $(HBO_2)_n$
- soli

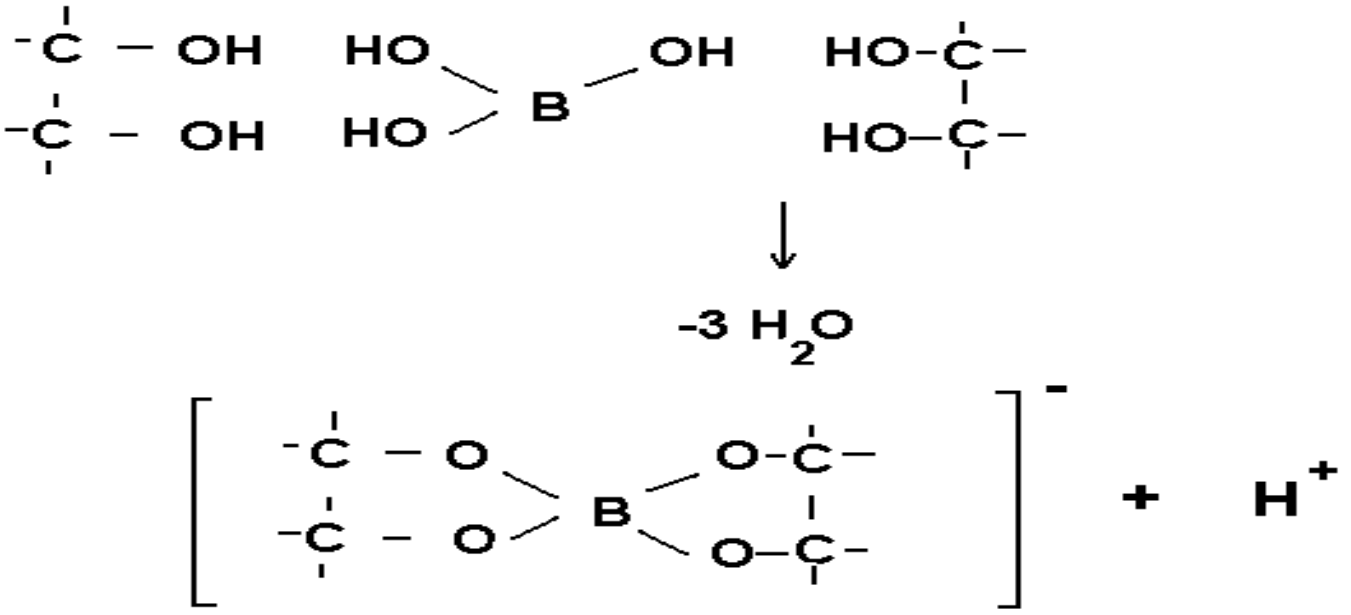
$(H_2B_4O_7)$ soli





$(Na_2B_4O_7)_n$

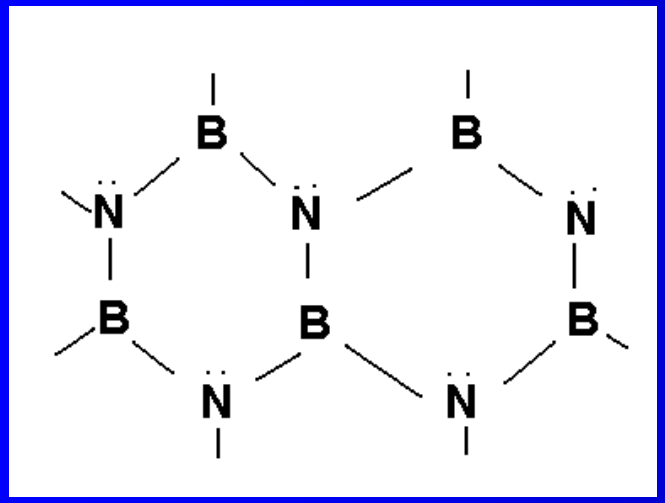
- $B_2O_3 + 3\ H_2O \rightarrow H_3BO_3$
- $Na_2B_4O_7 + 2\ H^+ + 5\ H_2O \rightarrow 4\ H_3BO_3 + 2\ Na^+$
- $Na_2B_4O_5(OH)_4 + 2\ H^+ + 3\ H_2O \rightarrow 4\ H_3BO_3 + 2\ Na^+$
- $H_3BO_3 \Leftrightarrow H^+ + H_2BO_3^-$ $\quad K_a = 6 \cdot 10^{-10}\ \text{moldm}^{-3}$
- $H_2BO_3^- + H_2O \rightarrow [B(OH)_4]^-$ jače hidratizirani oblik sp^3

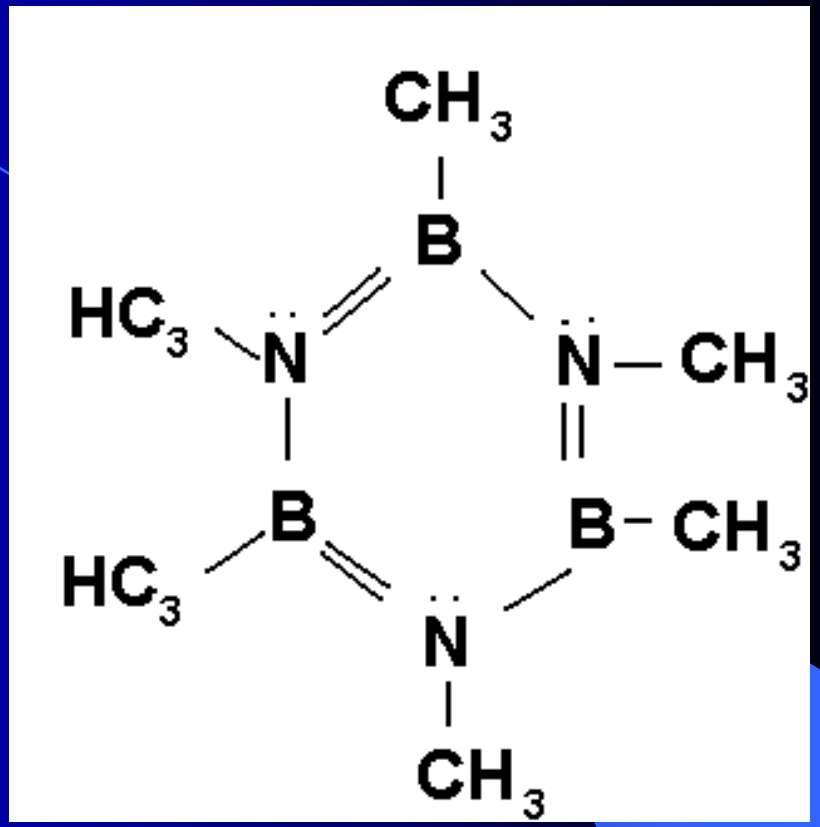


- $B_4O_5(OH)_4^{2-} + 5\ H_2O \Leftrightarrow 2\ H_3BO_3 + 2\ B(OH)_4^-$
- $B(OH)_4^- \Leftrightarrow H_3BO_3 + OH^-$
- $Na_2B_4O_7 + CoO \rightarrow 2\ NaBO_2 + Co(BO_2)_2$
- $\overset{+\ H_2O}{\longrightarrow}$
- $H_3BO_3 + NaOH + H_2O_2 \rightarrow NaBO_2 \cdot H_2O_2 \cdot 3H_2O$
- Kristalizacija

SPOJEVI S DUŠIKOM

B_3N_3 «anorganski grafit»





$B(CH_3)_3 + CH_3NH_2 \rightarrow (CH_3)_3B \Leftrightarrow NH_2CH_3$

$(CH_3)_2B \Leftrightarrow NHCH_3$

$(CH_3)B \Leftrightarrow NCH_3$

$[B(CH_3) \Leftrightarrow N(CH_3)^-]_3$

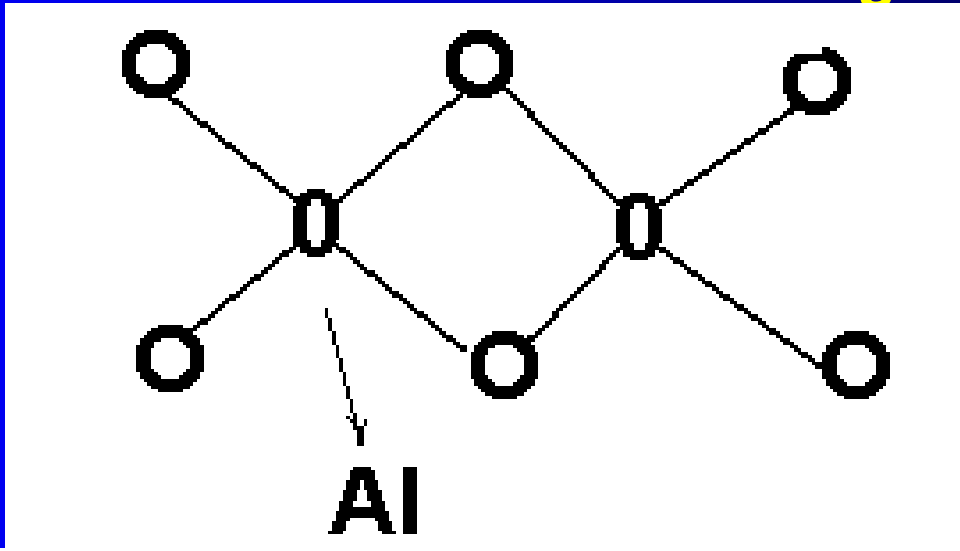
borazan

borazen

borazin

borazol

- **Aluminij**
- **Halogenidi** $2\ Al + 3\ X_2 \rightarrow 2\ AlX_3$
- AlF_3 $AlCl_3$ $AlBr_3$ AlI_3
- s ionska ionska
- l ionska kovalentna kovalentna
- g (ionska) kovalentna
- $H_2O \rightarrow$ ionizirani Al^{3+} hidroliza
- $2\ AlCl_3(s) \rightarrow Al_2Cl_3\ (l)$ pad: vodljivosti gustoće
-



- **Friedel-Craftsova sinteza**
  - **$R\text{-}H + R'\text{-}Cl \rightarrow R\text{-}R' + HCl$**
- **<u>Al^{3+} soli</u>**
- **$Al^{3+} + H_2O \Leftrightarrow Al(OH)^{2+} + H^+$**
- **Odnosno:**
- **$[\ Al(H_2O)_6]^{3+} + H_2O \Leftrightarrow [\ Al(H_2O)_5OH]^{2+} + H_3O^+$**
- **$K_a = 1.3 \cdot 10^{-5}$ mol/L**

Kompleksni halogenidi

- Na_3AlF_6 kriolit
- $Al_2O_3 + 12\ HF \rightarrow 2\ H_3AlF_6 + 3\ H_2O$
- $2H_3AlF_6 + 3\ Na_2CO_3 \rightarrow 2\ Na_3AlF_6 + 3\ H_2O + 3\ CO_2$

$Al(OH)^{x-}_{3+x}$

$Al^{3+} + 3\ OH^- \xrightarrow{+\ OH^-\uparrow} Al(OH)_3$ $\qquad Al_2O_3 \cdot x\ H_2O$

$2\ AlO(OH) = Al_2O_3 \cdot H_2O$

$Al(OH)_3 \xrightarrow{150°C} AlO(OH) \xrightarrow{300°C} \gamma\ Al_2O_3 \xrightarrow{1000°C} \alpha\ Al_2O_3$

Korund

Safir(Co)

Rubin(Cs)

SOLI:

$Al(OH)_3$ slaba baza

$$AlCl_3 + 3\ HAc(bezv.) \xrightarrow{180°C} Al(Ac)_3 + 3\ HCl$$

slaba kis.

$$Al(OH)_3 + 3\ H^+ \rightarrow Al^{3+} + 3\ H_2O$$

Jaka kis. $Al_2(SO_4)_3 \cdot 18\ H_2O$

$$2\ Al^{3+} + 3\ SO_4^{2-} + 3\ Ca^{2+} + 6\ OH^- \rightarrow 2\ Al(OH)_3 + 3\ CaSO_4$$

$$K\ Al\ (SO_4)_2 \cdot 12\ H_2O$$

(6 H_2O ob K; 6 H_2O ob Al)

1 SKUPINA ns^1

	Li	Na	K	Rb		Cs	Fr
Ei/eV		5.4	5.1	4.3	4.2		3.9
χ		1.0	0.9	0.8	0.8		0.7
$E^0_{M+/M}$/V		-3.2	-2.7	-2.9	-2.9		-2.9

- $2\ M + 2\ H_2O \rightarrow 2\ M^+ + 2\ OH^- + H_2$
- $[M(NH_3)_n]^+$ n NH_3 (l)

ELEMENTARNE TVARI

- *Li* silikatne i fosfatne rude
- DOB.: elektroliza taline LiCl
- $^{6}_{3}\mathrm{Li} + \mathrm{n} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{3}_{1}\mathrm{H}$
- *Na*
- Alumosilikati
- NaCl kamena sol
- morska sol
- $NaNO_3$, Na_3AlF_6
- Dob: elektroliza taline NaOH t_t = 320 °C
- NaCl t_t = 800 °C
- K: $Na^+ + e^- \rightarrow Na$
- A: $4\ OH^- \rightarrow O_2 + 2\ H_2O + 4\ e^-$

- *K*
- Glinenci
- KCl silvin
- Dob: elektroliza taline KOH
- Rb,Cs uz kalijeve spojeve
- Dob: redukcija hidroksida s Al

Pregled reakcija

$M + \frac{1}{2} X_2 \rightarrow MX$	
$2 M + \frac{1}{2} O_2 \rightarrow M_2O$	Li
$2 M + O_2 \rightarrow M_2O_2$	Na, K, Rb, Cs
$M + O_2 \rightarrow MO_2$	K, Rb, Cs
$2 M + S \rightarrow M_2S$	i za Se i Te
$3 M + \frac{1}{2} N_2 \rightarrow M_3N$	samo Li
$3 M + P \rightarrow M_3P$	i s As, Sb
$M + H_2O \rightarrow MOH + \frac{1}{2} H_2$	burno
$M + ROH \rightarrow MOR + \frac{1}{2} H_2$	
$M + NH_3 \rightarrow MNH_2 + \frac{1}{2} H_2$	katalizira Fe
$M + H^+ \rightarrow M^+ + \frac{1}{2} H^2$	snažno

2. SKUPINA ns^2

	Be	Mg	Ca	Sr	Ba	Ra
E_i (I+II)/ eV	27.5	22.6	18	16.7	15.2.	15.4
χ	1.5	1.2	1.0	1.0	0.9	0.9
$E^0_{M2+/M}$/V	-1.85	-2.37	-2.87	-2.89	-2.9	-2.92

- $-\Delta_h H = k \cdot z^2 / r$ energija hidratacije

	$Ca^+(g)$		$Ca^{2+}(g)$		$Ca^{3+}(g)$
E_i /eV	6.1		18		69.2
	1	:	3	:	11
$-\Delta_h H$	1	:	4	:	9

- $M(s) + 2\ H_2O \rightarrow M^{2+} + 2\ OH^- + H_2$

- **Elementarne tvari**
- ***Be*** **$3\ BeO \cdot Al_2O_3 \cdot 6\ SiO_2$ beril**
- **(smaragd, akvamarin)**
- **Dob: elektroliza taline BeF_2**
- **$BeF_2 + Mg \rightarrow Be + MgF_2$**
- ***Mg***
- **$CaCO_3 \cdot MgCO_3$ dolomit**
- **$MgCO_3$ magnezit**
- **$MgCl_2 \cdot KCl \cdot 6\ H_2O$ karnalit**
- **Do 0.3% $MgCl_2$ u morskoj vodi**
- **Mg silikati: olivin, milovka, azbest**
- **$MgSO_4 \cdot 7\ H_2O$ epsonit (gorka sol)**

- **Dob:**
- $MgO + C + Cl_2 \rightarrow MgCl_2 + CO$
- Elektrol.
- $MgCl_2 \rightarrow Mg + Cl_2$
- NaCl
- KCl
- $CaCl_2$

- $MgO + C \rightarrow Mg + CO$
- $\xrightarrow{H_2}$
- $Mg + H_2O(g) \rightarrow MgO + H_2$
- *Ca*
- $CaCO_3$ vapnenac
- $CaSO_4 \cdot 2\,H_2O$ sadra
- Fluorit, fosforit, silikati
- Dob: elektroliza taline CaF_2, $CaCl_2$
- *Sr*
- $SrSO_4$ celestin
- $SrCO_3$ stroncijanit
- Dob: elektroliza taline $SrCl_2$

- *Ba*
- $BaSO_4$ barit
- $BaCO_3$ viterit
- Elektroliza otopine $BaCl_2$ na Hg kat.- Davy 1808
- *Ra*
- $^{226}_{88}Ra \rightarrow ^{222}_{86}Rn + ^{4}_{2}He$ + energija

PREGLED REAKCIJA

- $M + X_2 \rightarrow MX_2$ — X_2 = halogen
- $M + \frac{1}{2} O_2 \rightarrow MO$
- $M + O_2 \rightarrow MO_2$ — Ba, Sr uz tlak i za Se i Te
- $M + S \rightarrow MS$
- $3\ M + N_2 \rightarrow M_3N_2$ — grijanjem
- $M + H_2 \rightarrow MH_2$ — Ca, Sr, Ba, Ra, grijati
- $M + 2\ H^+ \rightarrow M^{2+} + H_2$ — osim Be
- $M + 2H_2O \rightarrow M(OH)_2 + H_2$ — grijati, Be i Mg ne
- $M + OH^- + H_2O \rightarrow HMO_2^- + H_2$ — samo Be
- $M + 2\ H^+ \rightarrow M^{2+} + H_2$ spora za Ca, Sr, Ba- netopljivi sulfati
- $3\ M + 8\ H^+ + 2\ NO_3^- \rightarrow 3\ M^{2+} + 2\ NO + 4\ H_2O$ osim Be(Mg)

- SPOJEVI II
- Halogenidi i nitrati
- Oksidi i hidroksidi
- Karbonati
- Sulfati
- Be i spojevi jako otrovni
- $Be(OH)_2 + 2\ OH^- \rightarrow Be(OH)_3^-$ $K_a = 10^{-30}$ M
- $MgO + MgCl_2$ sorel cement
- $Mg(OH)_2 \cdot 4\ MgCO_3 \cdot 5\ H_2O$ magnesia alba
- $MgSO_4 \cdot 7\ H_2O$ gorka sol

- $CaCl_2 \cdot 6\ H_2O$, $CaCl_2$
- CaO
- $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$ vapneni mort
- $CaSO_4 \cdot \frac{1}{2}\ H_2O + 3/2\ H_2O \rightarrow CaSO_4 \cdot 2\ H_2O$
- Ba soli (topive) su otrovne
- $BaCO_3 + 2\ C \rightarrow BaO + 2\ CO$
- $BaCO \Leftrightarrow BaO + CO_2$
- $C + CO_2 \Leftrightarrow 2\ CO$
- 800 °C
- $BaSO_4 + 4\ C \rightarrow BaS + 4\ CO$
- $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$
- BaS Na_2SO_4 « permanentno bjelilo»
- $Ba^{2+} + S^{2-} + Zn^{2+} + SO_4^{2-} \rightarrow BaSO_4 + ZnS$
- Litopon