

TRANSFORMATION OF LEAD(II) SALTS AND HYDROCERUSSITE
SOLUBILITY IN SEA WATER

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Summary

The precipitation of lead(II) salts in a seawater has been investigated. $2 \text{PbCO}_3 \cdot \text{Pb(OH)}_2(\text{s})$ was found to be the most stable solid phase and its solubility product in a seawater has been determined.

Résumé

On a examiné la précipitation de plomb(II) sels dans l'eau de mer. On a trouvé $2 \text{PbCO}_3 \cdot \text{Pb(OH)}_2(\text{s})$ la phase solide la plus stable et on a déterminé son produit de solubilité dans l'eau de mer.

This work is a continuation of our earlier studies on solubility of lead salts in electrolyte solutions with special interest to determine the most stable and least soluble lead salt in a seawater. Nriagu considers chloropyromorphite ($2\text{Pb}_5(\text{PO}_4)_3\text{Cl}$) as the most stable phosphate solid phase in the environment. Our earlier calculation of solubility of chloropyromorphite for conditions in Northern Adriatic seawater ($[\text{Pb}]_{\text{sol}} = 4.7 \cdot 10^{-9} \text{ mol dm}^{-3}$) was in excellent agreement with the experimental value for soluble lead in that region, determined by Branica et al.: $[\text{Pb}]_{\text{sol}} = 2.8 \cdot 10^{-9} \text{ mol dm}^{-3}$. Jedwab detected individual particles of laurionite (Pb(OH)Cl) among particulate matter filtered from Atlantic and Pacific deep water samples. A series of precipitation experiments was performed in a seawater to follow transformation of lead salts under

these conditions. Solid phases formed at various time intervals were identified using X-ray diffraction patterns. The precipitate formed within 10 minutes consists of phosgenite ($\text{PbCO}_3 \cdot \text{PbCl}_2$) and of an unidentified compound with three strongest lines: $d=3.55, 2.63, 2.11 \text{ \AA}$. In the time interval of 10 to 20 minutes hydrocerussite ($2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$) and cotunnite (PbCl_2) predominated while after 1 to 30 days hydrocerussite exists as the most stable solid phase.

The concentration of soluble lead in a seawater in equilibrium with hydrocerussite was experimentally determined as $[\text{Pb}]_{\text{sol}} = 5.8 \cdot 10^{-6} \text{ mol dm}^{-3}$, at $\text{pH} = 7.90 \pm 0.05$. Solubility product of hydrocerussite in seawater was determined using:

- concentration of soluble lead and the pH determined in this work ;
- concentrations of anionic components of seawater (OH^- , Cl^- , SO_4^{2-} , CO_3^{2-} , HCO_3^- , HPO_4^{2-}) and corresponding equilibrium constants $K_n(\text{L})$ for lead complexes with these anions (L), taken from literature

according to the equation:

$$K_s = ([\text{Pb}]_{\text{sol}}^3 [\text{CO}_3^{2-}]^2 [\text{OH}^-]^2) / (1 + \sum K_n(\text{L}) [\text{L}]^n)^3$$

The calculated values are: $\log K_s = -41.5 \pm 0.5$ (at $I=0.7 \text{ mol dm}^{-3}$) and -42.3 ± 0.5 (at $I=0.53 \text{ mol dm}^{-3}$). These values are somewhat higher than the values of solubility products determined earlier at $I=0.3 \text{ mol dm}^{-3}$ ($\log K_s = -43.77$) and at $I=0.1 \text{ mol dm}^{-3}$ ($\log K_s = -44.8$), what one expects for higher ionic strengths.