

A: Plenary Lecture
15th International Symposium on Solubility Phenomena and Related
Equilibrium Processes (ISSP 2012)
**SOLUBILITY PHENOMENA IN SCIENCE AND EDUCATION -
EXPERIMENTS, THERMODYNAMIC ANALYSES AND
THEORETICAL ASPECTS**

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Solubility equilibria between solid salts, salt hydrates and water play an important role in fundamental and applied branches of chemistry. The continuous interest in this field is reflected by the 15th International Symposium on Solubility Phenomena as well as by the ongoing IUPAC-NIST Solubility Data Series (SDS), which by now comprises one hundred volumes.

Three examples concerning solubility phenomena of ionic solids in aqueous solutions will be described in detail.

- 1) Sparingly and easily soluble, simple molybdates.
- 2) Sparingly soluble ionic solids and solid-solutions with basic anions.
- 3) Hydrolysis of inert hexa-aqua-M(III) ions, where M is Ir, Rh or Cr.

In each case experimental specialities will be discussed, an outline of thermodynamic analyses will be given, theoretical aspects will be emphasized, and where appropriate educational suggestions will be made.

Solubility equilibria are described, discussed and depicted by two-dimensional phase diagrams. The common basis of these phase diagrams are Gibbs-Duhem equations with only three variable potentials, e.g. p , T , μ_i , whereas all the others are held constant. For binary systems temperature vs. mole fraction diagrams summarize and deal concisely with their thermodynamic properties. Plotting osmotic coefficient multiplied by total molality $\varphi \cdot \Sigma m$ vs. mole fraction x of the solid and dissolved compounds, respectively, plays an analogous role for ternary solid-solution aqueous-solution systems [1], [2]. In case sparingly soluble solid-solutions are investigated at constant ionic strength of a supporting electrolyte $\varphi \cdot \Sigma m - x$ and Lippmann diagrams are equivalent, the latter became a popular tool to visualize solid-solution aqueous-solution equilibria [3].

References

- [1] Königsberger E., Gamsjäger H. Graphical representation of solid solute phase equilibria in aqueous solution. *Ber. Bunsenges. Phys. Chem.*, **95**:734–737, 1991.
- [2] Königsberger E., Gamsjäger H. Comment: Solid-solution aqueous solution equilibria: Thermodynamic theory and representation. *Am. J. Sci.*, **292**:199–214, 1992.
- [3] Bruno J., Bosbach D., Kulik, D. Navrotsky A., *Chemical Thermodynamics of Solid Solutions of Interest in Radioactive Waste Management. A State of the Art Report*, 1st Ed. Nuclear Energy Agency Data Bank OECD, Ed., vol. 10, Chemical Thermodynamics, OECD Publications, (2007), 266 pp.