

Experimental and theoretical study of malachite solubility in ammonia aqueous solutions

T.M. BUBLIKOVA, T.V. SETKOVA* AND V.S. BALITSKY

Institute of Experimental Mineralogy Russian Academy of Science, Acad. Osipian st, 4, Chernogolovka, Russian Federation, (*correspondence: tmb@iem.ac.ru)

Experimental and theoretical investigations of malachite solubility was carried out as a part of search of copper carbonates (malachite and azurite) crystallization conditions [1]. The solubility of $\text{CuCO}_3 \cdot \text{CuOH}_2$ was studied experimentally in 1.0, 2.0, 3.0M ammonia solutions at temperatures of 25, 50, 75°C. Moreover, thermodynamic calculations were performed for indicated ammonia concentrations and temperatures. An initial material was placed in ampoules made of thermal-resistant glass, then it was grouted of ammonia solution of necessary concentration. The ampoules were sealed and placed into thermostat. After equilibration the ampoules were unsealed, and an aliquot part of the solution was filtered and analysed for a total copper content. We used the volumetric iodometric method for estimation of the copper content and a total CO_2 content in solution was determined using AN-7529 express-analyzer.

The experimental study have shown that the equilibrium copper content increases with ammonia concentration increasing and decreases with temperature rise in ammonia solutions. Malachite is unstable in the ammonia solution at given condition it decomposes with tenorite forming, that was confirmed by the thermodynamic calculations. The results of the thermodynamic calculations and the experimental study of malachite solubility has a satisfactory fit in general (Fig.1).

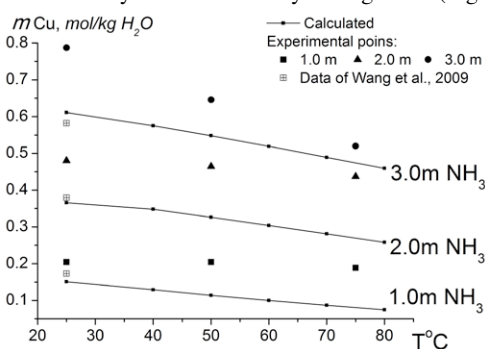


Figure 1: Calculated and experimental data of malachite solubility as functions of NH_3 concentration and temperature.

[1] Balitsky & Bublikova (1990) *Prog. Crystal Growth and Charact.*, **21**, 139-161. [2] Wang *et al.* (2009) *Hydrometallurgy*, **99**, 231-237.

Geochemical processes affecting stream water at European scale investigated by differential scaling operator (perturbation) in the simplex metric

A. BUCCIANTI¹, J.J. EGOZCUE²
AND V. PAWLOWSKY-GLAHN³

¹Dep. of Earth Science, University of Florence (I)

(*correspondence: antonella.buccianti@unifi.it)

²Dep. Applied Mathematics III, UPC, Barcelona (E)

³Dep. Inf. Mat Aplicada i Estadística, Univ. of Girona (E)

Compositional data consist of vectors whose components are parts of some whole. Their statistical analysis performed in the real Euclidean sample space is not able to capture their features. Data in fact lies in a constrained space, called simplex, where to characterise the difference, or changes from one composition to another, specific operators have to be considered. In this contribution, perturbation, the group operator working in the geometry of the simplex sample space [1], is applied to analyse the differences in the chemical composition of the solutes of stream waters at European scale [2]. The analysed data are from the FOREGS (Forum of European Geological Survey) [3] database. New numerical and graphical tools are proposed to investigate the behaviour of elements or chemical species in the constrained space. In the FOREGS project, running stream waters were collected from the small, second order, drainage basins (<100 km²) at the same site as the active stream sediments. Starting from the analytical results matrix, chemical data of some selected variables, considering their geochemical affinity, were ranked by taking into account their conductivity values. Perturbation vectors from one composition to the subsequent one are calculated and results plotted in variation diagrams. The aim is to investigate the relative behaviour of the ions and chemical species, as well as the effect of weathering and dilution processes on a European scale, by considering the use of calculus operators working in the simplex geometry. The possibility to model processes at the base of the distribution of chemical elements/species (e.g., presence of trends depending on space, chemostatic behaviour, ...) is also explored.

[1] Aitchison and Ng (2005), *Statistical Modeling*,

5, 173-185. [2] Buccianti (2011), *Zeitschrift fur Geologische Wissenschaften*, 40(4-5), 295-305.

[3] <http://www.gtk.fi/publ/foregsatlas/>