

Phase equilibrium of the Cd-bearing systems at 298 K: $\text{Cd}^{2+}/\text{Cl}^-$, SO_4^{2-} , NO_3^- - H_2O quaternary system

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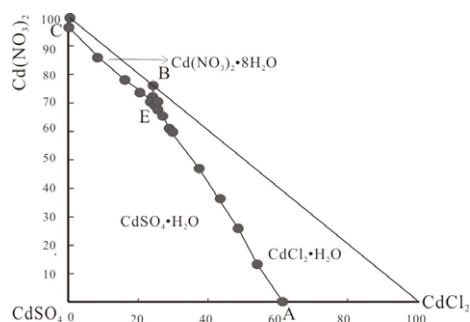
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Solid- Liquid Equilibrium of quaternary system $\text{Cd}^{2+}/\text{Cl}^-$, SO_4^{2-} , NO_3^- - H_2O at 298 K were studied by an isothermal solution saturation method. Experimental results indicate that there are three univariant curves BE, AE and CE, one invariant point E and three crystallization fields in the quaternary system. The quaternary system belongs to a simple type, and there're no double salts or solid solution existing. The crystallization zones of equilibrium solid phases are $\text{CdCl}_2 \cdot \text{H}_2\text{O}$, $\text{CdSO}_4 \cdot \text{H}_2\text{O}$, and $\text{Cd}(\text{NO}_3)_2 \cdot 8\text{H}_2\text{O}$, respectively. The composition of the invariant point is $\text{CdCl}_2 \cdot \text{H}_2\text{O}$, $\text{CdSO}_4 \cdot \text{H}_2\text{O}$, and $\text{Cd}(\text{NO}_3)_2 \cdot 8\text{H}_2\text{O}$, respectively. The physico-chemical properties of solution in the quaternary system show regular changes along with the increased cadmium concentration. The results indicated that $\text{Cd}(\text{NO}_3)_2 \cdot 8\text{H}_2\text{O}$ possessed the highest solubility among those three salts, which means a strong transfer of Cd ion and a high pollution risk of soil environment. And the solubility of $\text{CdSO}_4 \cdot \text{H}_2\text{O}$ would be restrained as the salts existing together.



A simulation study of hydrocarbon gas generation from Fischer–Tropsch synthesis with varying carbon source and hydrogen in a gold tube system

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The Fischer–Tropsch synthesis (FTS) is a widely accepted mechanism for the formation of abiogenic gases, but the experimental results from different laboratories vary considerably and can rarely match the natural occurrence [1–3]. Our FTS experiments were conducted in a sealed gold tube on Fe and Ni catalysts using graphite and CO_2 with distinctive isotopic composition as the starting material by reduction in pure hydrogen at 400 °C and 50 MPa for 2–60 h. Results show that synthesis between gaseous phase carbon (CO_2) and H_2 is easier than solid phase carbon (graphite) counterpart and ^{13}C depleted CO_2 is more reactive than ^{13}C enriched CO_2 . After short reaction time carbon isotopic compositions of hydrocarbons from all three FTS experiments decrease in $\delta^{13}\text{C}$ values of C_2 to C_4 alkanes with respect to CH_4 , showing so-called inverse trend. With increasing reaction time, synthesis was gradually shifted to thermal cracking. ^{13}C depleted gas from thermal cracking mixed with ^{13}C enriched residual gas leads to partial reversal and normal isotopic distribution among C_1 – C_4 alkanes. Hydrocarbon gases from the FTS will finally decompose to carbon and hydrogen if reaction time is longer enough.

FTS experiments running under laboratory condition from low to high temperature differs from abiogenic synthesis of hydrocarbons in natural systems, which is a cooling process from high to low temperature either under aqueous hydrothermal or volcanic intrusion condition. Hydrocarbons generated from the FTS experiments may be decomposed via thermal cracking and isotopic composition among gaseous components can show all possible distribution patterns. FTS-type natural reactions occur under certain PT condition and hydrocarbon gases generated have no further decomposition and may hold a fixed “inverse” isotopic distribution. This may explain the controversial isotopic distribution patterns observed from varying FTS experiments.

[1] Charlou *et al.* (1998) *GCA* **62**(13), 2323–2333. [2] McCollom *et al.* (2006) *EPSL* **43**(1–2), 74–84. [3] Taran *et al.* (2010) *GCA* **74**, 6112–6125.