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Gibbs energies of formation for hydrocerussite [$Pb(OH)_2 \cdot (PbCO_3)_2$(s)] and hydrozincite {$[Zn(OH)_2]_3 \cdot (ZnCO_3)_2$(s)} at 298 K and 1 bar from electrochemical cell measurements

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Abstract

New values are reported for the Gibbs energies of formation from the elements for hydrocerussite $Pb(OH)_2 \cdot (PbCO_3)_2$ and hydrozincite $[Zn(OH)_2]_3 \cdot (ZnCO_3)_2$. These ΔG_f^0 values were obtained from electrochemical cells without liquid junction. We determined ΔG_f^0 [$Pb(OH)_2 \cdot (PbCO_3)_2$(s)] = -1699.8 ± 1.6 kJ/mol for hydrocerussite and ΔG_f^0 {$[Zn(OH)_2]_3 \cdot (ZnCO_3)_2$} = -3163.3 ± 4 kJ/mol for hydrozincite. These results allow future electrochemical cell experiments to be performed to determine the ΔG_f^0 values of other hydroxycarbonate minerals using either the Pb amalgam-hydrocerussite or the Zn amalgam-hydrozincite as reference electrodes. These reference electrodes provide a strategy for establishing Gibbs energies for phases with two different anions, which are geochemically interesting but difficult to study experimentally.