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# Low-temperature electron paramagnetic resonance studies on natural calumetite from Khetri copper mine, Rajasthan, India

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## Abstract

We report here for the first time low-temperature (123–295 K) electron paramagnetic resonance (EPR) spectroscopic data on naturally occurring calumetite [$Cu(OH_2Cl_2)\cdot 2H_2O$] from the Khetri copper complex, Jhunjhunu district, Rajasthan, India. The sample was characterized by X-ray powder diffraction (XRD), differential thermal analysis (DTA), and thermogravimetric (TG) analysis techniques. DTA scans show two endothermic reactions at about 378 and 598 K, which are attributed to dehydration of the sample. TG data indicate weight loss of up to 24 wt% in the temperature region between 600 and 700 K. The room-temperature EPR spectrum exhibits parallel and perpendicular components centered at $g_{\parallel} = 2.26$ and $g_{\perp} = 2.10$, respectively. The evaluated spin-Hamiltonian parameters indicate that these resonance signals are characteristic of $Cu^{2+}$ ions in distorted octahedral symmetry. The population difference (N) between the Zeeman levels has been evaluated and is found to increase with decreasing temperature.

**Keywords:** Calumetite, EPR spectra, DTA, hydroxy mineral