Electron spin resonance study of precipitation process of epsomite at different physical conditions

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Epsomite, MgSO4(7H2O) is a water soluble orthorhombic sulfate mineral. It exists as fibrous, hairy and aciculate crystals in nature. It occurs mainly in dry caves, which protect it from rain and moisture. It also occurs in coal mines, mineral springs and saline lakes. It forms mostly as evaporite and deposits. It has been reported that epsomite forms or dissolves in large quantities with respect to temperature fluctuations in some saline lakes. Epsomite occurs abundantly in Epsom, England and named after this location. It also occurs in Spain and South Africa. In Japan it is found in Myouhou mine, Wakayama and Iwadono Hills, Saitama. However, it is difficult to obtain them from natural source as they are very soluble in water. It is also difficult to preserve them as they effloresce easily in dry air. Epsomite is susceptible to change of various physical conditions.

In crystals of epsomite, Mg2+ is replaced by Mn2+ as impurity. Mn2+ has 3d5 electrons. From knowledge of the Mn2+ electron spin resonance (ESR) spectral parameters (g factor, D and E factors of fine structure constants, A factor of hyperfine structure constant) spin-orbit interactions between d-electrons and ligand fields can be known. Hence Mn2+ ESR signal is used to study the dependence of epsomite precipitation process on various physical conditions.

We obtained natural epsomite in Zaragoza, Spain and studied it with ESR. It was found that thousands of ppm of Mn2+ was included in it. Synthetic epsomite using reagent MgSO4 was prepared in a laboratory. Epsomites doped with several concentrations of Mn2+ were precipitated.

The signals of Mn2+ were present in both natural and synthetic epsomites. The change in the values of spectral parameters g, D, E was studied for samples having different concentrations of Mn2+. Hence ESR spectra include the information about precipitation conditions. However, the values of spectral parameters of natural epsomite were slightly different from those of synthetic one. Further ESR studies will be undertaken with synthetic epsomite samples precipitated at different temperatures and also at various precipitation rates for better understanding of the precipitation process of epsomite. We will report the possibility of assessment of precipitation conditions of natural epsomite with ESR.