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THERMOLUMINESCENCE STUDY OF SCOLECITE

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Abstract – *The present paper reports the thermoluminescence characteristics of Scolecite mineral collected from Bhor Ghats near Sangamalner, Nasik Distric, Maharasta. The TL of as received minerals at varies heat treatment was recorded and also 5Gy beta dose was given to each sample prior to TL recording. TL of as received specimen (NTL) annealed for 1 hour and quenched from 200, 400, 600 and 800°C. The Scolecite mineral displayed a well resolved isolated peak around 162°Cfor AQ from 400°C. However annealing and quenching from 600 and 800°C TL peak temperature changes to 116°C and 141°C. TL peak temperatures of corresponding TL peak intensities of Scolecite mineral of gamma irradiation and X-ray irradiation are reported. XRD and TGA of Solecite mineral was reported.*

Keywords: Scolecite, XRD, thermoluminescence , mineral, NTL, TGA,

I. Introduction

Geology is the earliest disciplines to accept the TL technique in its fold in a variety of applications, such as dating of mineralization, igneous activities, sedimentation and evaluation of growth rate of beaches and sand dunes. The TL technique has been found useful in dating specimens of geologically recent origin where all other conventional methods fail. In a geological specimen, the TL would starts building up from the time of its crystallization and would normally continue throughout its existence due to the radioactivity present within the minerals and in the surrounding materials, till its saturates. The main basis in the Thermoluminescence Dosimetry (TLD) is that TL output is directly proportional to the radiation dose received by the phosphor and hence provides the means of estimating unknown irradiations [1-3]. Also, TL can provide a perfect passive measurement i.e. integrated irradiation levels over extended periods of the order of even three years. Thermoluminescent Dosimeters (TLDs) have found increasing application with the progress made in the development of solid thermoluminescent dosimeters and instrumentation for reading them.

The minerals Scolecite and Stilbite has the capability of thermoluminescence (TL), which is manifested by emission of light during heating of the mineral, before the temperature of red heat [4]. During the TL process, the energy of ionized radiation accumulated in Scolecite and Stilbite is transformed into heat and optical radiation [5]. Depending on the optical properties of the mineral and the conditions under which the light is emitted, a part of the light energy is always transformed into heat, because of absorption in the mineral itself. It must be borne in mind, too, that the heating of calcite mineral leads in certain cases to changes in the position and the structure of trapping centers, which may also be followed by liberation of heat [3,4]. The present paper repots thermoluminescence characteristics of Scolecite and Stilbite minerals collected from Bhor Ghats near Sangamalner, Nasik Distric,Maharasta.

II. Experimental

The as received minerals, were weighed carefully by using Citizen Model electronic weighing balance and grinded thoroughly about ~1 hour using agate mortar and pestle in order to get a powder size of 60 micron and TL was recorded by giving varies heat treatment. All the specimens are given 5Gy of beta dose prior to TL recording.For recording of TL curves, an Nucleonix thermoluminescence (TL) glow curve recorder was used in the present study[6-11]. The thermoluminescence glow curve reader consists of a specimen holder along with heater, a temperature programmer, a photomultiplier tube as detector, a high voltage unit, a DC amplifier and a suitable displaying or recording device. Every time 5mg of weighed irradiated sample using Sr-90 beta source was taken for TL measurement. The reproducibility of the system was found within3%.

III. Results and Discussion

TL of Scolecite-Beta Irradiation

Fig- 1 is the TL of Scolecite mineral annealed and quenched (AQ) from 400,600 and 800°C. The TL was recorded for 5mg weighed powder by giving 15 Gy beta dose from Sr-90 beta source. Curve-1 is the TL of 15 Gy beta irradiated Scolecite annealed and quenched from 400°C. It shows a sharp well resolved isolated peak around 162°C with intensity 48.8a.u. Curve-2 is the TL of 15 Gy beta irradiated Scolecite annealed and quenched from 600°C. It displays a broad peak around 116°C with less intensity when compared to curve-1. Curve-3 is the TL of 15 Gy beta irradiated Scolecite annealed and quenched from 800°C. From the graph it is observed, abroad peak around 141°C with a little high intensity than curve-2. From the figure it is also observed that as the annealing temperature increases from 400 to 800°C the entire TL pattern changes and finally a broad peak with decreased intensity is obtained. This may be due to various phase changes occurred while annealing the mineral from 400-800°C temperatures. Table-1 shows the TL peak temperatures and the corresponding TL peak intensities of Scolecite annealed and quenched from 400, 600 and 800°C temperatures.

Fig-1: TL of Scolecite Beta-Irradiation

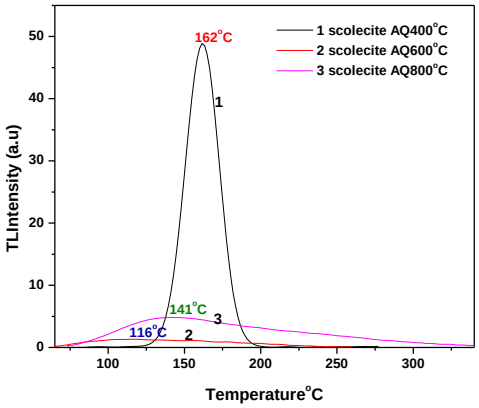


Table-1: TL of Scolecite-Beta Irradiation TL of Scolecite-gamma Irradiation Irradiation

S.No.	Treatment	TL Peak Temperature (°C)	TL Peak Intensity (a.u)
1	400°C	162	48.8
2	600°C	116	1.5
3	800°C	141	4.9

TL of Scolecite-gamma Irradiation Irradiation

Fig-2 is the TL of Scolecite mineral annealed and quenched (AQ) from 800°C. The TL was recorded for 5mg weighed powder by giving gamma irradiation. It shows a well resolved broad peak around 219°C with intensity 9.4a.u. This may be due to various phase changes occurred while annealing the mineral from 800°C temperature. Table-2 shows the TL peak temperatures and the corresponding TL peak intensities of Scolecite annealed and quenched from 800°C temperatures.

Fig-2: TL of Scolecite-gama Irradiation

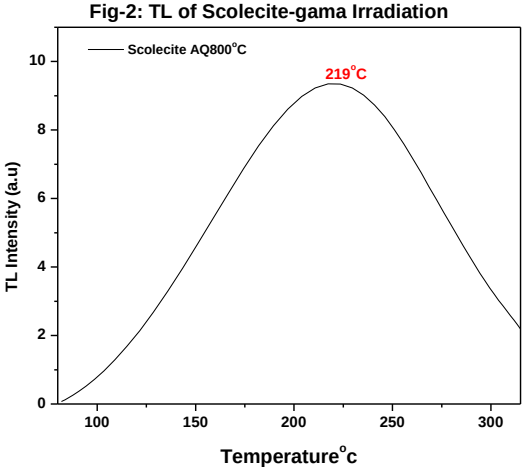


Table-2: TL of Scolecite-gamma Irradiation

S.No.	Treatment	TL Peak Temperature (°C)	TL Peak Intensity (a.u)
1	800°C	219	9.4

TL of Scolecite-X ray Irradiation

Fig- 3 is the TL of Scolecite mineral annealed and quenched (AQ) from 400,600 and 800°C. The TL was recorded for 5mg weighed powder by giving X-ray irradiation. Curve-1 is the TL of X-ray irradiated Scolecite annealed and quenched from 400°C. From curve-1 it is observed a sharp well defined isolated peak around 216°C with greater intensity 151.0a.u. Curve-2 is the TL of X-ray irradiated Scolecite annealed and quenched from 600°C. It shows a small broad peak around 207°C with very less intensity when compared to curve-1. Curve-3 is the TL of X-ray irradiated Scolecite annealed and quenched from 800°C. It displays a broad peak around 206°C with a little increased intensity when compared to curve-2. From the figure it is also observed that as the annealing temperature increases from 400 to 800°C entire TL pattern changes and the intensity at AQ 400°C is drastically fallout. This may be due to various phase changes occurred while annealing the mineral from 200-800°C temperatures.

Table-3 shows the TL peak temperatures and the corresponding TL peak intensities of Scolecite annealed and quenched from 400, 600 and 800°C temperatures.

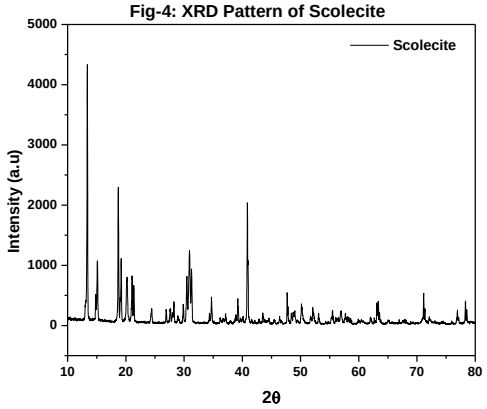
Table-3: TL of Scolecite-X ray Irradiation

S.No	Treatement	TL Peak Temperature (°C)	TL Peak Intensity (a.u)
1	400°C	216	151.0
2	600°C	207	2.99
3	800°C	206	5.4

XRD Pattern of Scolecite:

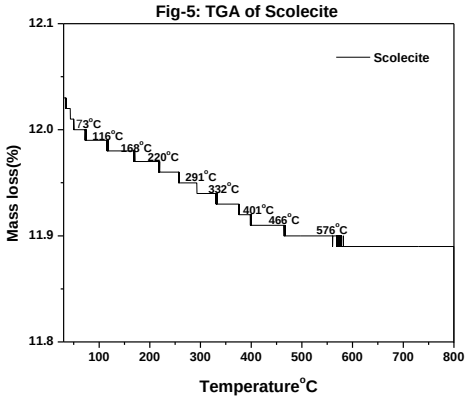
Fig-4 is the XRD pattern of Scolecite, it is clearly observed that the maximum peak obtained at 13.4°. The Crystallite size of Scolecite is calculated using Scherrer's formula and is found around **70nm**. The

XRD of the Scolecite is looks like amixed mineral of different phases havinga crystallite size of **70nm**.



TGA of Scolecite

Fig- 5 is the TGA of Scolecite. From figure it is found that there are many phase changes in the temperature range of 50°C - 600°C. There is a continuous dissociation from 50°C - 500°C which is nothing but loosing the structural water leads to collapse of channels.



VI. Conclusion

1. The annealing and quenched temperature increases the TL of β and X-ray irradiated Scolecite mineral is a well defined and well resolved peak around 162°C and 116°C.

2. The γ-irradiated Scolecite TL is a single peak having TL emission between 100-300°C with a peaking of 290°C.

3. Therefore it is concluded the TL observed for AQ from 800°C sample is nothing but the TL emission from SiO_2 and Al_2O_3 components present in the specimen.

4.The XRD of the Scolecite is looks like a mixed mineral of different phases having a crystallite size of **70nm** is calculated using Scherrer's formula.

5. In the TGA of Scolecite, there is a continuous dissociation from 50°C - 500°C which is nothing but loosing the structural water leads to collapse of channels.

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