Thermal study of Sulfate and other associated minerals of Hungund-Kushtagi Schist belt, Bagalkote, Karnataka

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Abstract: The present analysis explains the presence and reaction of Halloysite, Barite, Muscovite, Feldspar, Jarosite and Cristoballite when they are subjected to heating. The samples were collected from Gadisunkapura village and surrounding areas of Bagalkote District, Karnataka which falls under Survey of India (SOI) Toposheet No.56 D/4.. Further, the collected samples were heated up to some controlled temperature, after heating the characters such as endothermic, exothermic and weight loss has been studied with the help of graph obtained. From the present investigation the reaction like dehydration, dehydroxylation, thermal decomposition and alteration of feldspar were studied and minerals were identified.

Keywords: Sulfate, Gadisunkapura, Hungund-Kushtagi Schist belt, TGA, DTA.

I Introduction

Barite ($BaSO_4$) is a soft form crystalline material which is having composition of 65.7% Barium sulfate and 34.3% of sulphuric anhydrite (SO_3). Barite appears as white opaque to transparent color but sometime impurities may cause variation in color (Prameena et al, 2013). It has specific physical and chemical properties like heaviness, magnetic neutrality and high specific gravity. Further barite is used in industries like oil and gas, manufacture of ceramic and glass and as a raw material in manufacture of barium compounds. The Mangapet in Cuddapah District of Andra Pradesh is well known and biggest deposit in India.Apart from this deposit, recently barite were reported by Geological Survey of India (GSI, 2011) and Indian Bureau of Mines (IBM, 2013) around Gadisunkapura village of Hungund taluka, Bagalkote District, Karnataka which belong to Hungund-Kushtagi Schist belt of Eastern Dharwad Craton (EDC).

In the present investigation different minerals like Muscovite, Feldspar, Halloysite, Barite and Jarosite were identified with the help of TGA & DTA analysis. Barite and associated rock samples were colleceted at and around of Gadisunkapura village. Further collected samples were undergone to TGA & DTA analysis which provide information such as endothermic, exothermic and weight loss. From the data obtained the reactions like dehydration, dehydroxylation, decomposition of sulphur trioxide and alteration of feldspar were studied.

II Material and Methods

Thermogravimetric analysis is a technique in which weight loss of substance is studied when it is subjected to controlled temperature. TGA technique plays an important role in finding different minerals in geology. Many times TGA curve resembles to the DTA curve of the mineral. When powdered sample is subjected to heating up to temperature 1400^{O} c it loses its weight for a period of 15minutes at a regular interval of 100^{o}c. A 0.5gm of powder has been taken and the weight loss of substance is calculated and plotted in graph (Rajendra et al, 2018).

Differential thermal analysis (DTA) is a technique in which the temperature difference between a substance and a reference material is measured as a function of temperature, while the substance and reference material are subjected to the same controlled temperature. DTA requires reference material, which is known as substance, usually inactive thermally over the temperature range interest. The essential character of the reference material is its thermal characteristics and the particle size. DTA technique is very useful in finding minerals, which undergo transformation when heated to controlled temperature below 1400^{o}C (Rajendra et al, 2018).

DTA technique is useful in both qualitative and semi-qualitative studies, which liberate or absorb energy when they subjected to heating results in transformations such as dehydration, oxidation, decomposition, phase changes and dehydroxylation (Rajendra et al, 2018).

III Results and Discussions

Thermal analysis was carried out employing instrument TGA-DTA (Make SDT Q600 V20.9 TA). In the present study 07 samples were subjected to TGA & DTA analysis. Further, a brief description about sample number, name, type of reaction and minerals identified are tabulated in Table 1&2.

Table 1: Results of differential analysis of (DTA) of Barite of Gadisunkapura area

Sl.No	Sample name	Endothermic peak	Mineral identified	Type of Reaction
1	S-4	1162.22º-1167.72ºC	Biotite	Dehydroxylation
2	S-7	1163.47º-1169.99ºC	Biotite	Dehydroxylation
3	S-10	69.68º-70.77ºC 1162.25º-1167.29ºC	Halloysite Biotite	Dehydration Dehydroxylation
4	S-11	1151.64º-1157.55ºC	Biotite	Dehydroxylation
5	S-17	1101.11º-1141.44ºC	Biotite	Dehydroxylation
6	S-19	1107.36º-1129.61ºC	Biotite	Dehydroxylation
7	S-21	932.07º-1008.02ºC	Biotite	Dehydroxylation
8	S-23	1084.70º-1147.00ºC	Biotite	Dehydroxylation

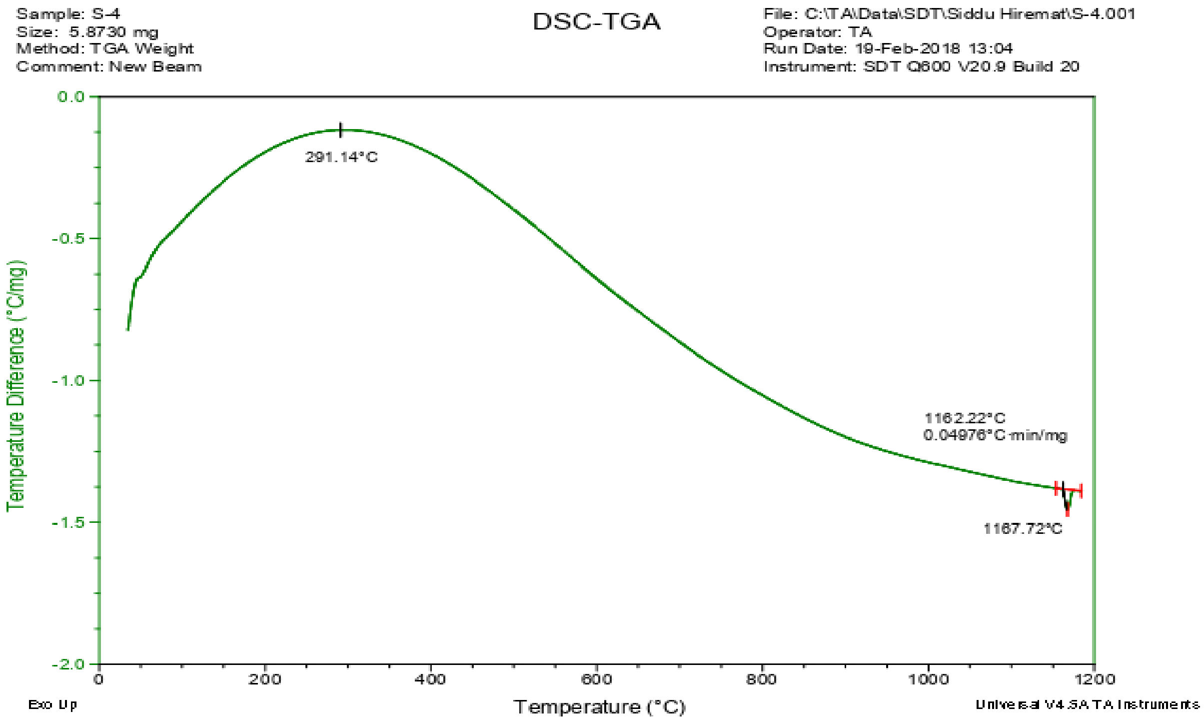

Fig.1 DTA Graph of sample S-4

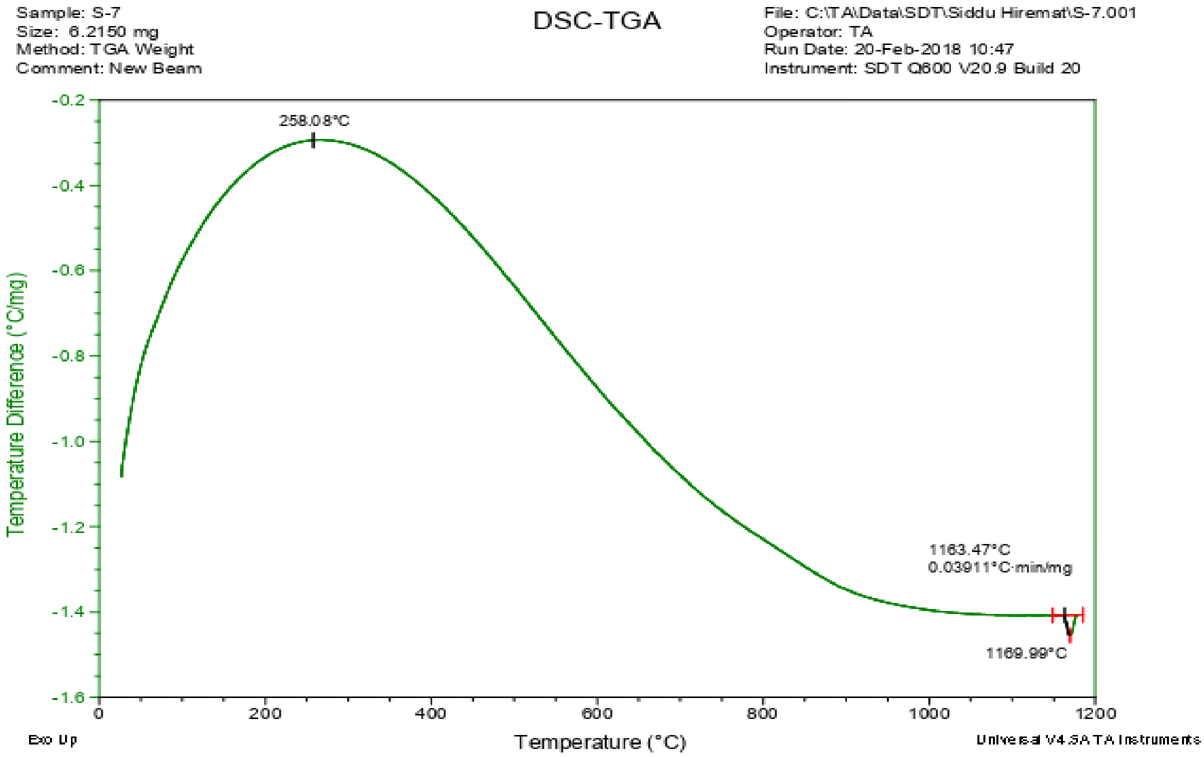

Fig. 2 DTA graph of Sample S-7

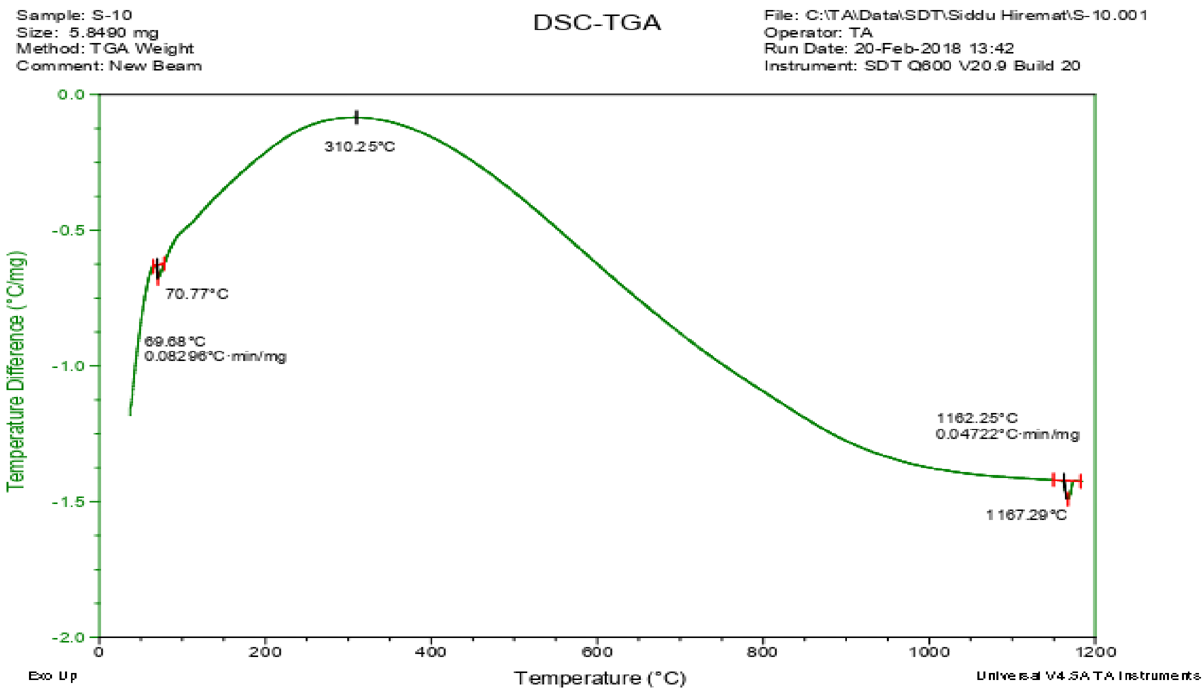

Fig. 3 DTA graph of Sample (S-10)

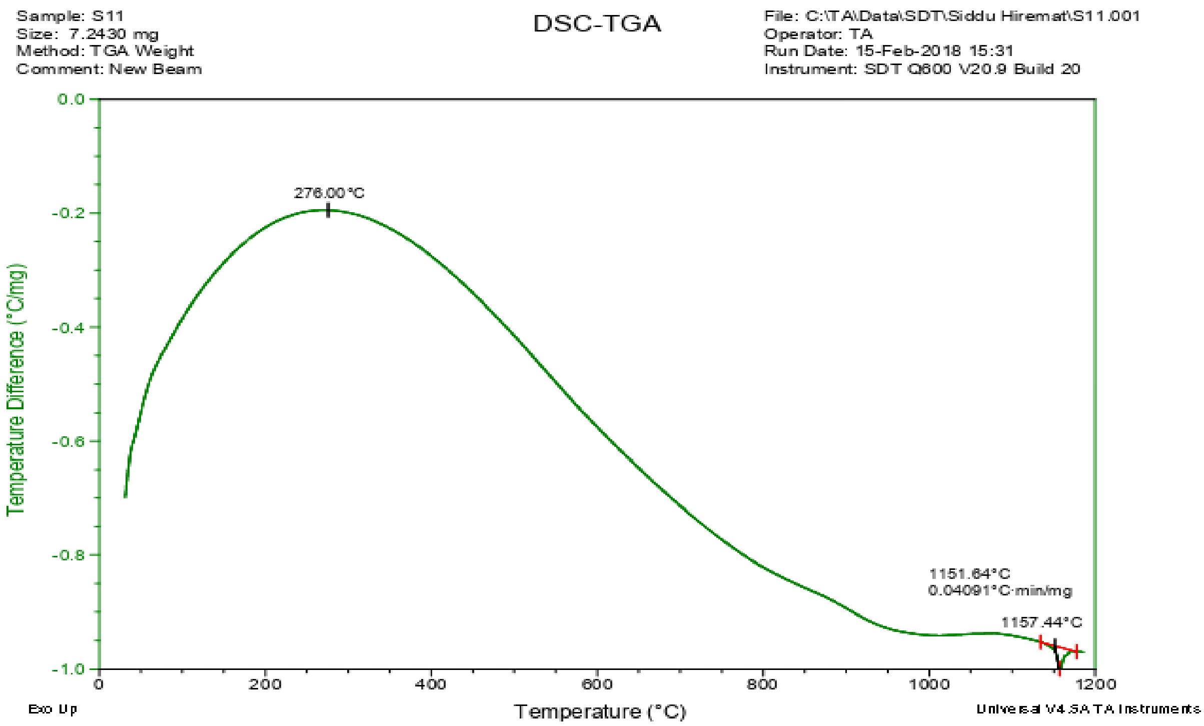

Fig. 4 DTA graph of Sample (S-11)

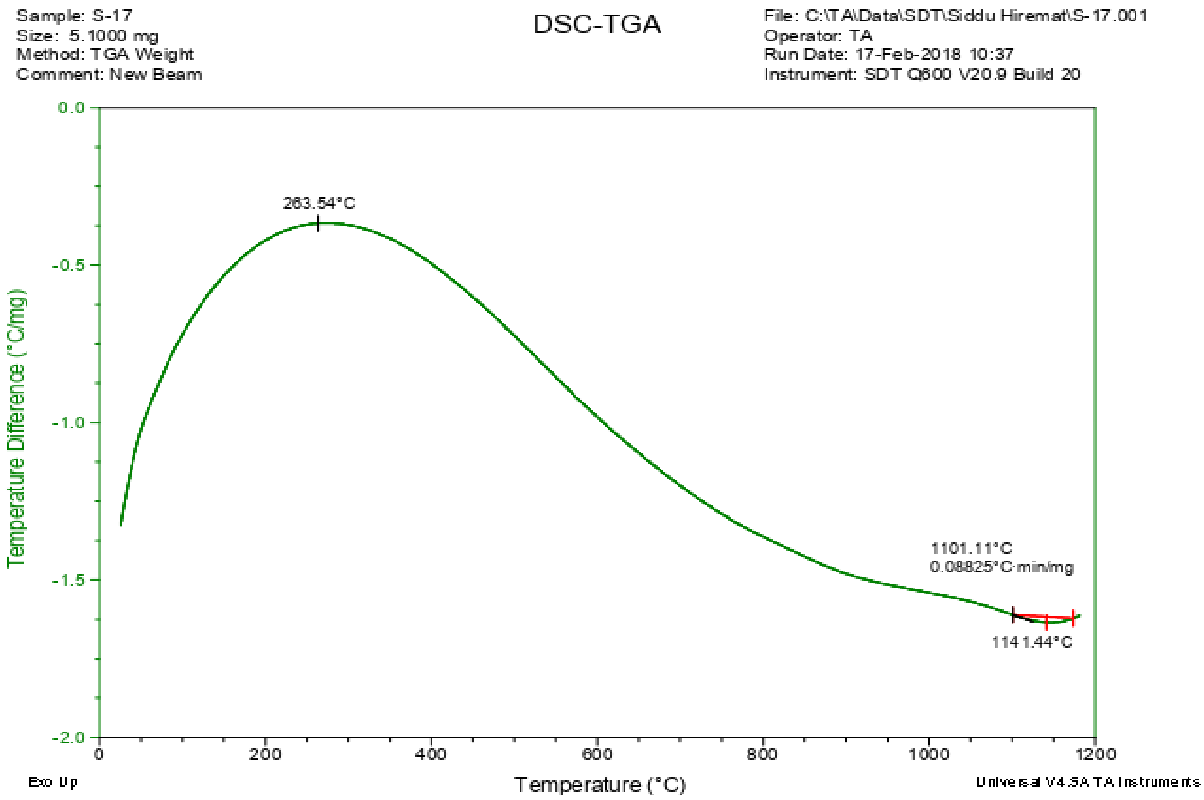

Fig. 5 DTA graph of Sample (S-17)

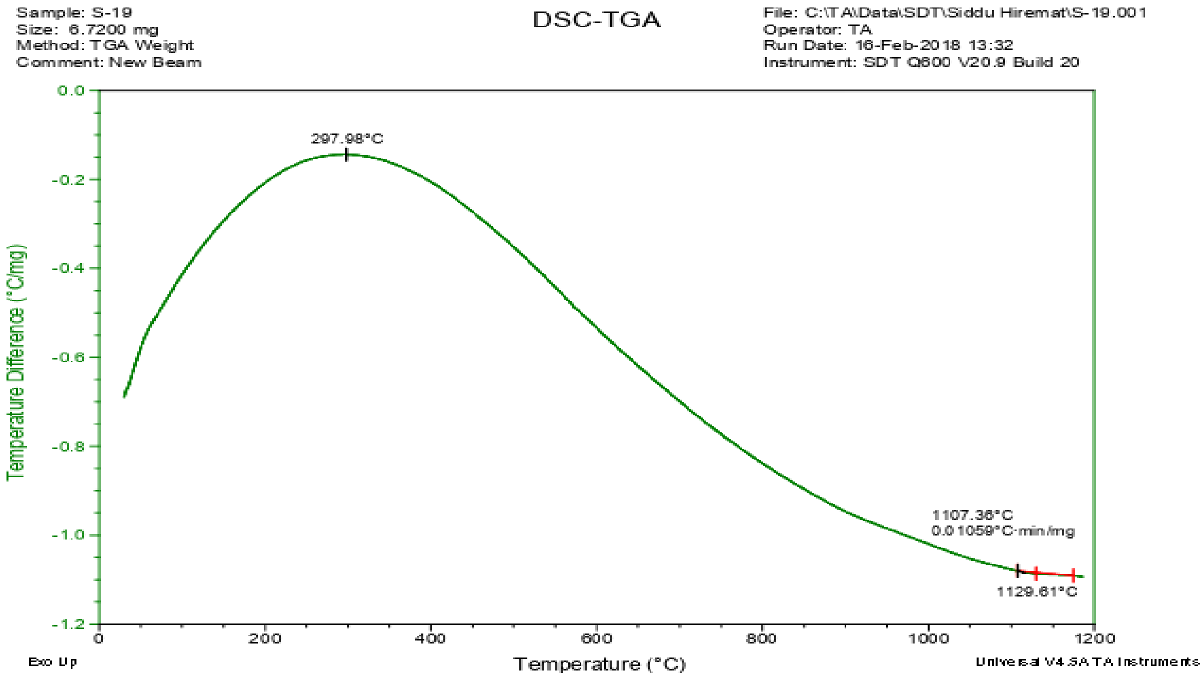

Fig. 6 DTA graph of Sample (S-19)

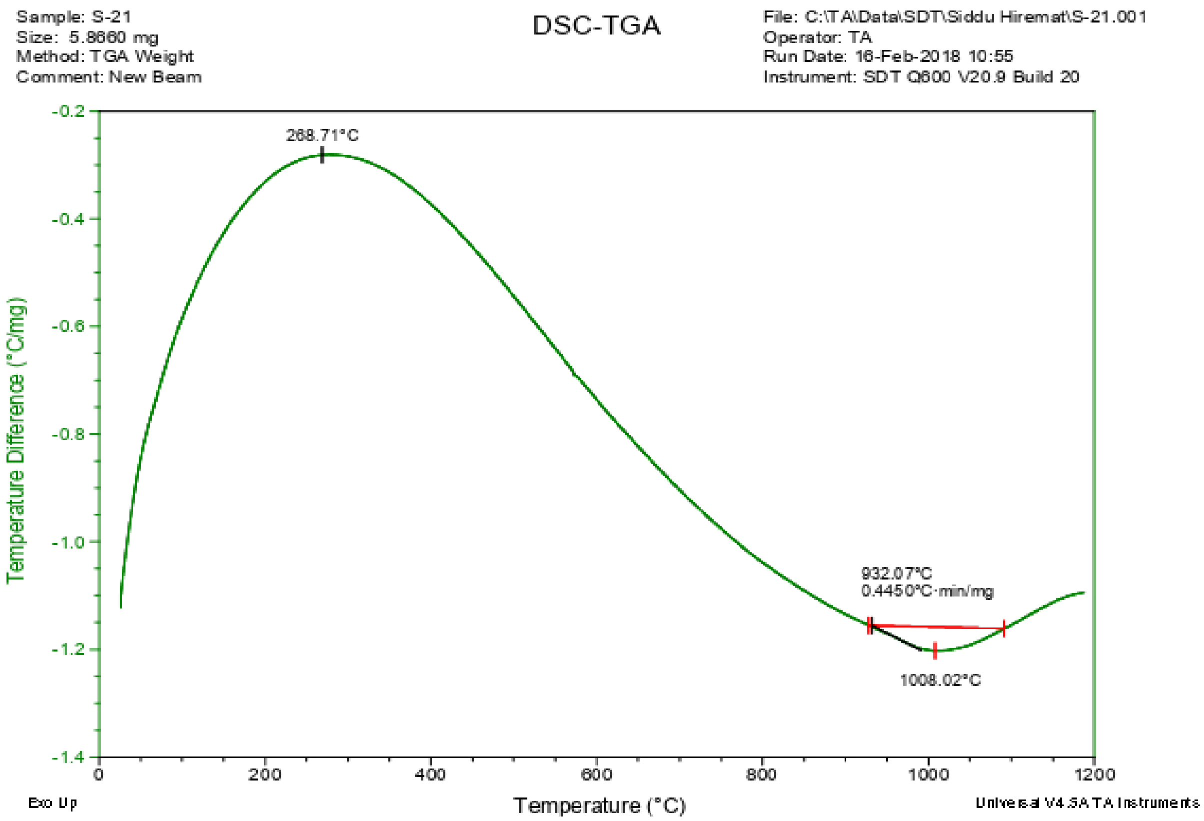

Fig. 7 DTA graph of Sample (S-21)

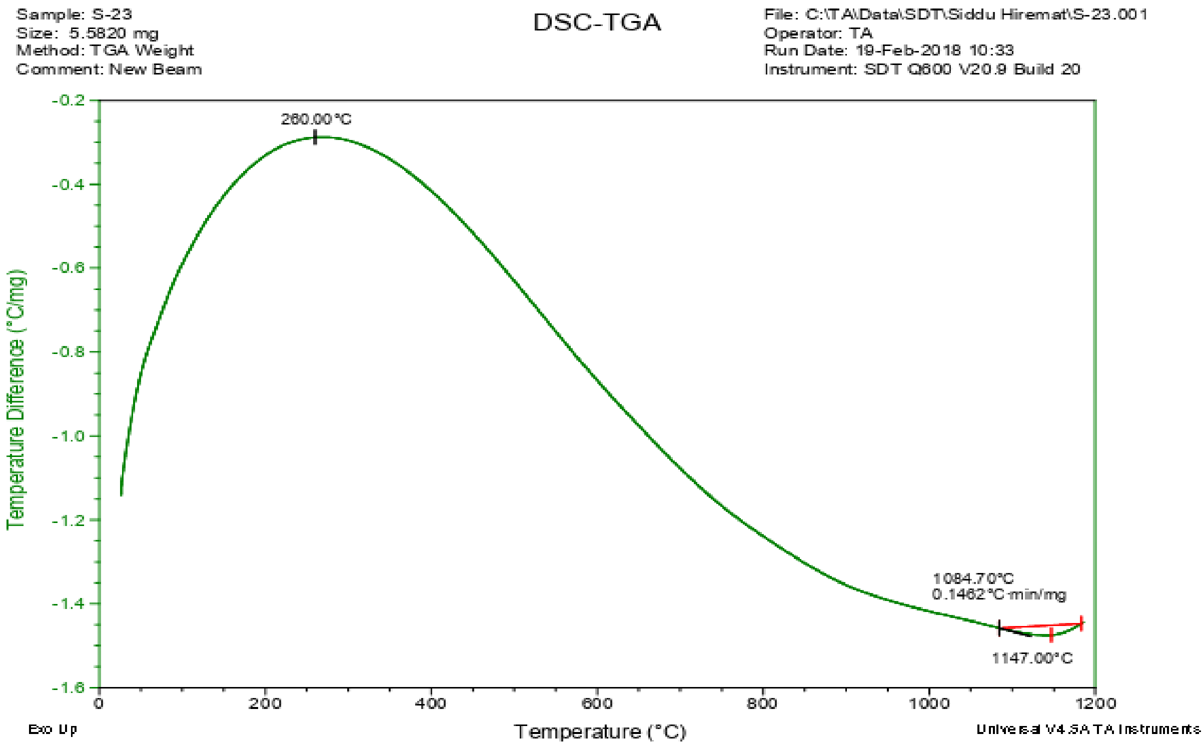

Fig. 8 DTA graph of Sample (S-23)

Table 2: Results of Thermo-Gravimetric- analysis (TGA) of Barite of Gadisunkapura area

Sl.No	Sample	Weight loss %	Temperature	Mineral Identified	Type of reaction
1	S-4	0.1575	203.95°-246.11°C	Muscovite	Dehydroxylation
		0.2377	362.48°-363.51°C	Muscovite	Dehydroxylation
		0.2577	381.81°-382.51°C	Muscovite	Dehydroxylation
		0.1468	433.42°-434.49°C	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		0.1897	623.04°-682.92°C	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		2.314	1066.84°-1145.71°C	Cristoballite	Dehydroxylation
2	S-7	0.2530	168.61°-278.49°C	Muscovite	Dehydroxylation
		0.1286	432.02°-433.06°	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		0.0988	490.05°-490.34°C	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		0.1984	624.75°-625.93°C	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		0.0501	686.17°-688.66°C	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation

		1.964	1027.13º-1127.63ºC	Cristobalite	Dehydroxylation
3	S-10	0.068	102.23º-137.86ºC	Halloysite	Dehydration
		0.333	201.67º-243.42ºC	Muscovite	Dehydroxylation
		0.225	384.70º-385.22ºC	Muscovite	Dehydroxylation
		0.081	456.49º-457.23ºC	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		0.153	604.58º-663.22ºC	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		1.863	1037.35º-1131.07ºC	Cristobalite	Dehydroxylation
4	S-11	0.554	393.70º-394.67ºC	Muscovite	Dehydroxylation
		5.647	883.78º-988.86ºC	Jarosite	Thermal decomposition
		3.338	1144.65º-1169.09ºC	Cristobalite	Dehydroxylation
5	S-17	0.105	108.51º-120.56ºC	Halloysite	Dehydration
		0.481	201.65º-271.21ºC	Muscovite	Dehydroxylation
		0.260	330.04º-369.56ºC	Muscovite	Dehydroxylation
		0.376	572.59º-668.77ºC	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		0.463	871.05º-992.17ºC	Jarosite	Thermal decomposition
		0.853	1097.80º-1098.84ºC	Cristobalite	Dehydroxylation
6	S-19	0.009	97.92º-121.85ºC	Halloysite	Dehydration
		0.103	201.79º-255.28ºC	Muscovite	Dehydroxylation
		0.084	342.07º-374.05ºC	Muscovite	Dehydroxylation
		0.423	535.92º-687.13ºC	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		0.282	883.73º-969.88ºC	Jarosite	Thermal decomposition
		0.275	1131.54º-1163.87ºC	Cristobalite	Dehydroxylation
7	S-21	0.100	116.68º-121.10ºC	Halloysite	Dehydration
		0.936	214.49º-308.23ºC	Muscovite	Dehydroxylation
		0.369	588.64º-643.18ºC	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation
		0.368	865.81º-901.53ºC	Cristobalite	Dehydroxylation
		0.528	1029.90º-1103.74ºC	Cristobalite	Dehydroxylation
8	S-23	0.017	64.15º-64.48ºC	Halloysite	Dehydration
		0.264	198.11º-251.37ºC	Muscovite	Dehydroxylation
		0.147	336.01º-372.75ºC	Muscovite	Dehydroxylation
		0.288	533.20º-651.15ºC	Quartz admixture of magnetite, olivine and spinel	Dehydroxylation

		1.242	942.89º-1143.50ºC	Jarosite	Thermal decomposition

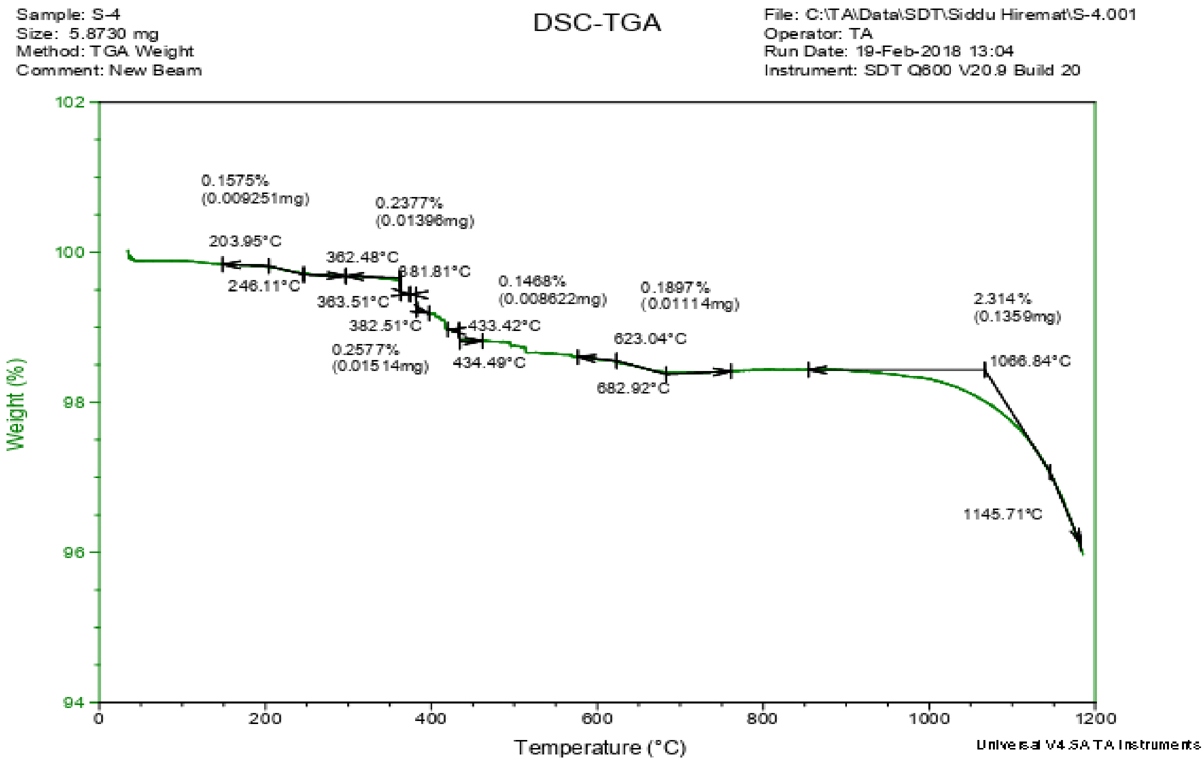

Fig. 9 TGA graph of sample S-4

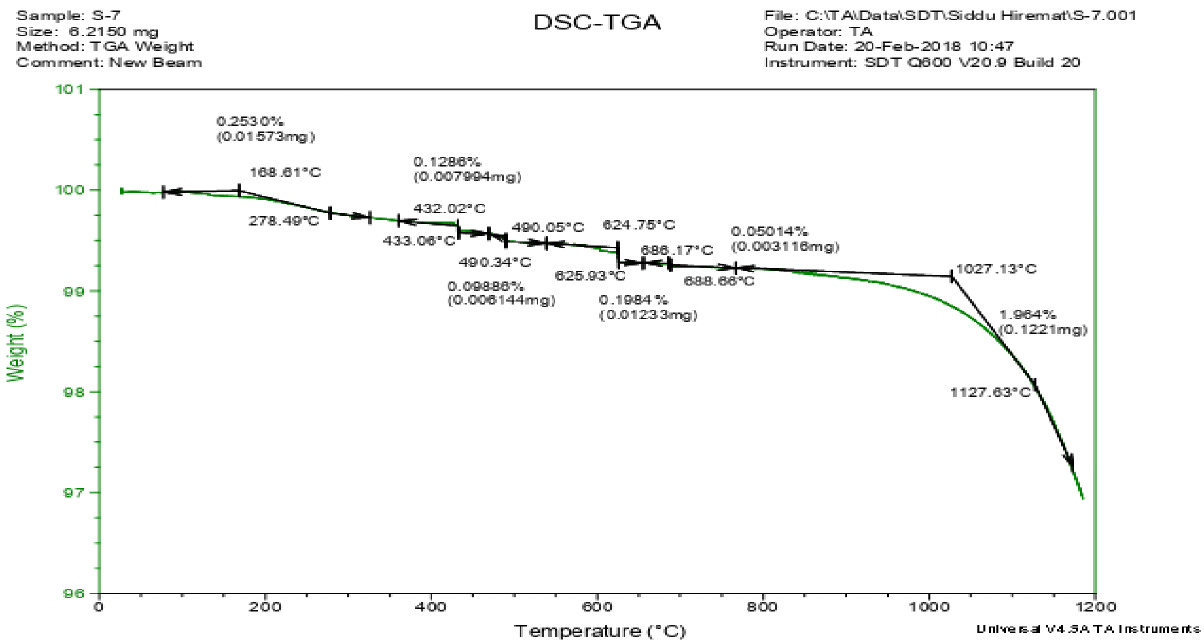

Fig. 10 TGA graph of sample S-7

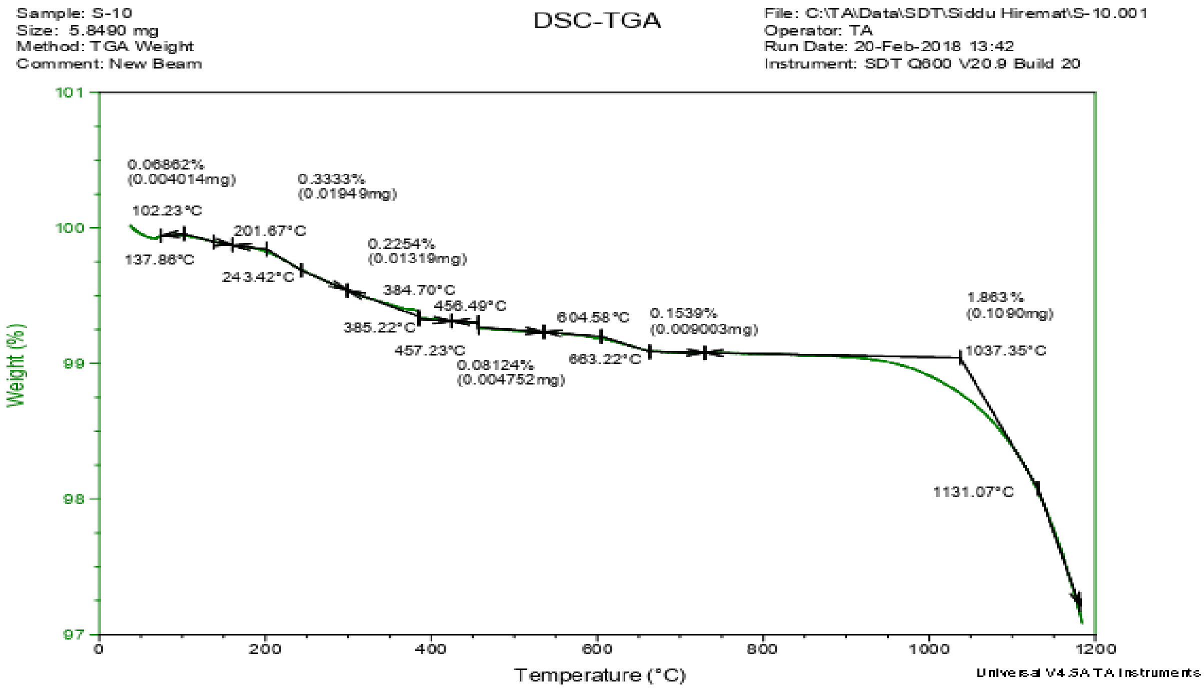

Fig. 11 TGA graph of sample S-10

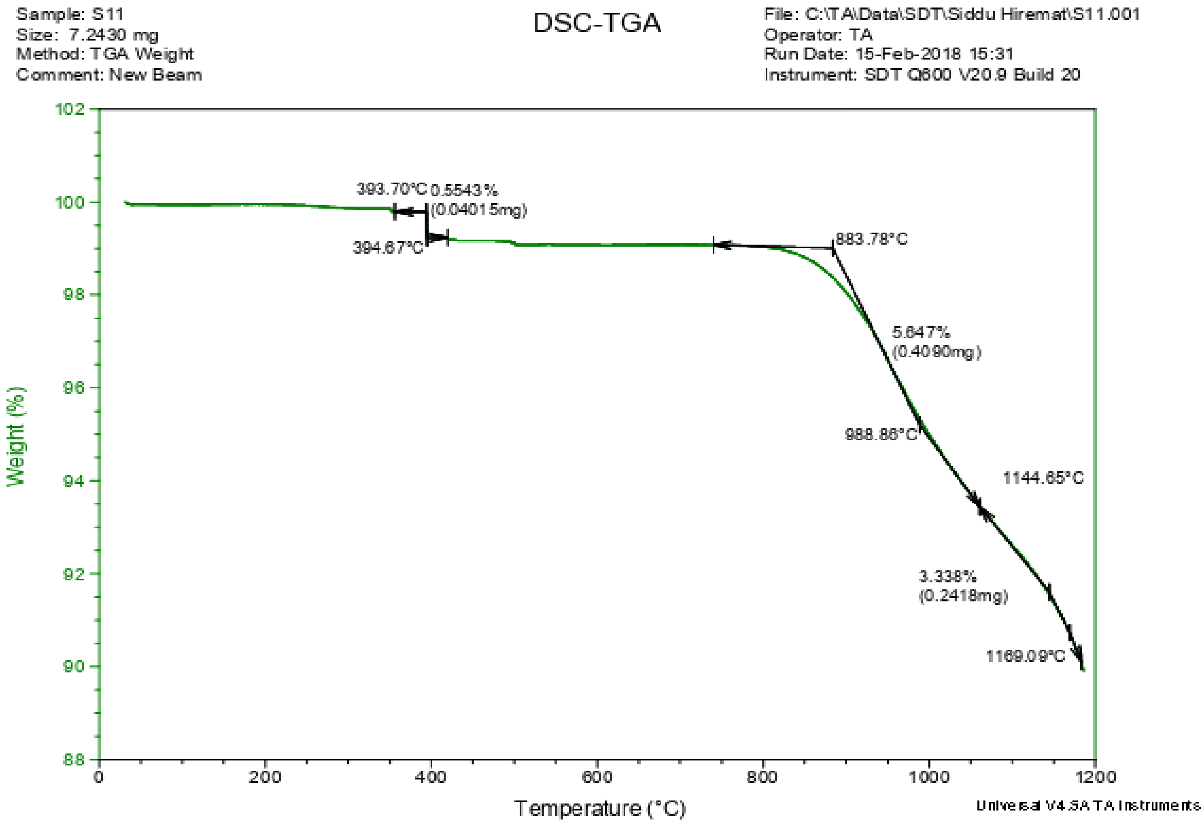

Fig 12 TGA graph of sample S-11

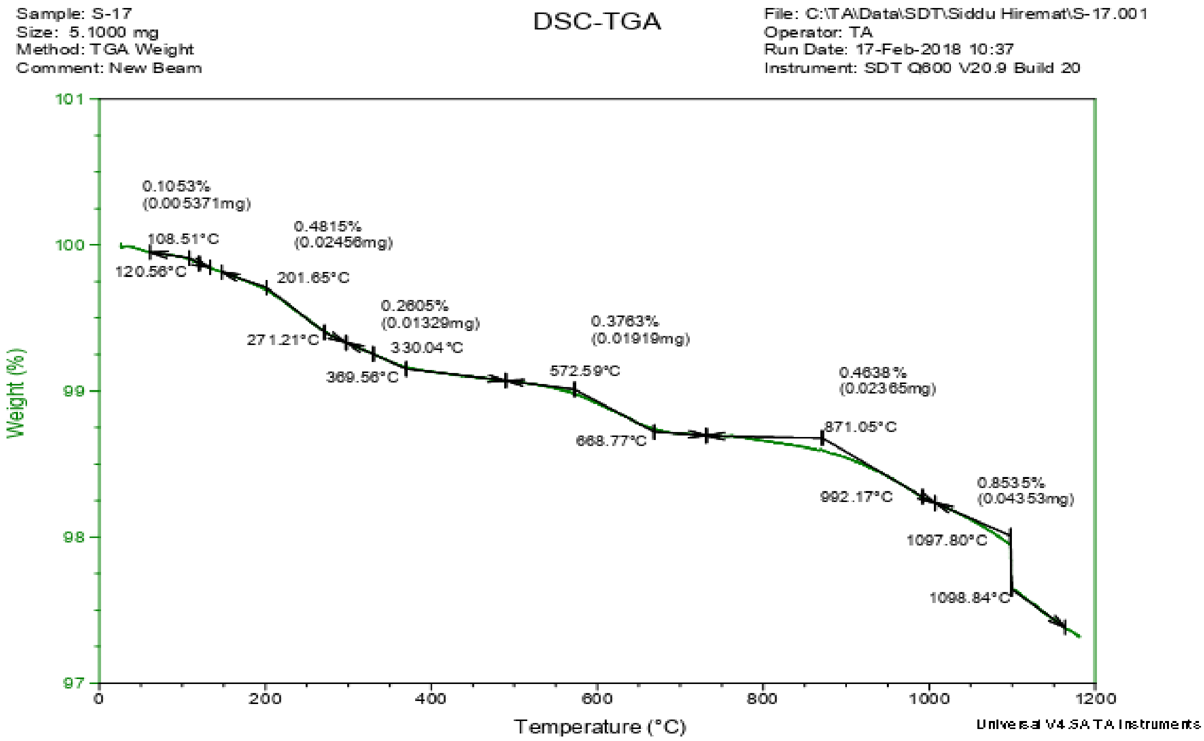

Fig. 13 TGA graph of sample S-17

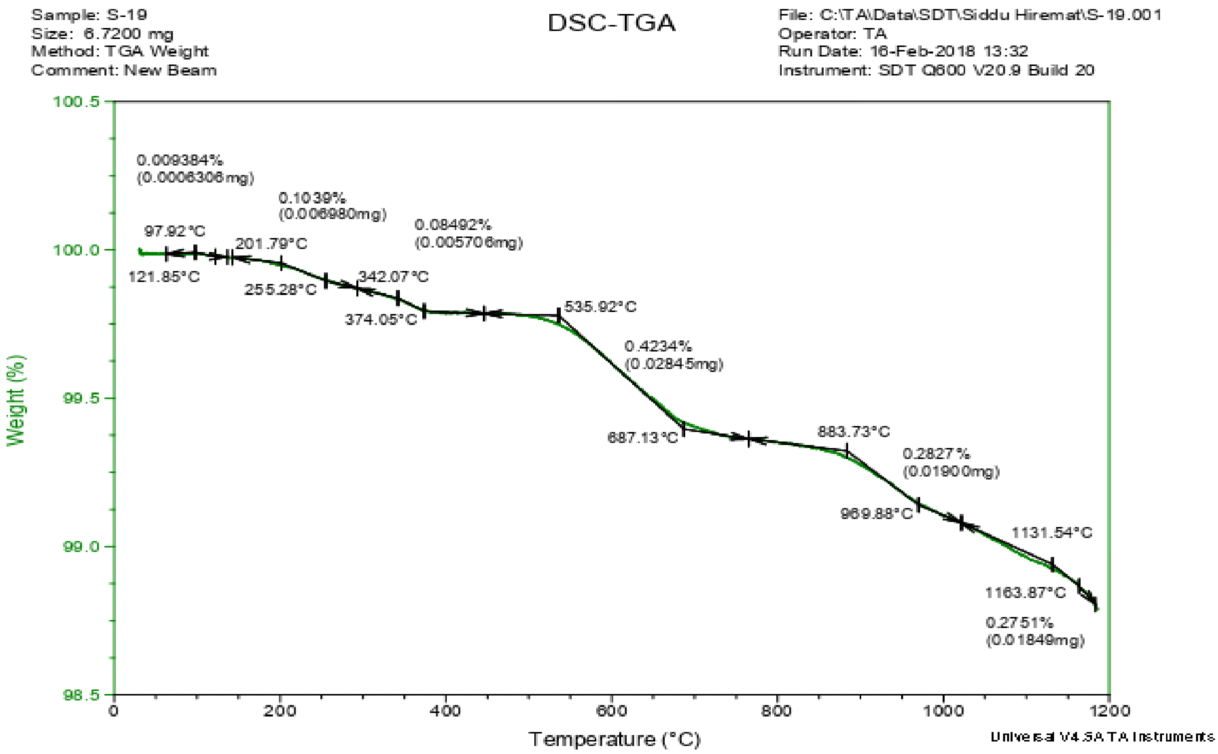

Fig. 14 TGA graph of sample S-19

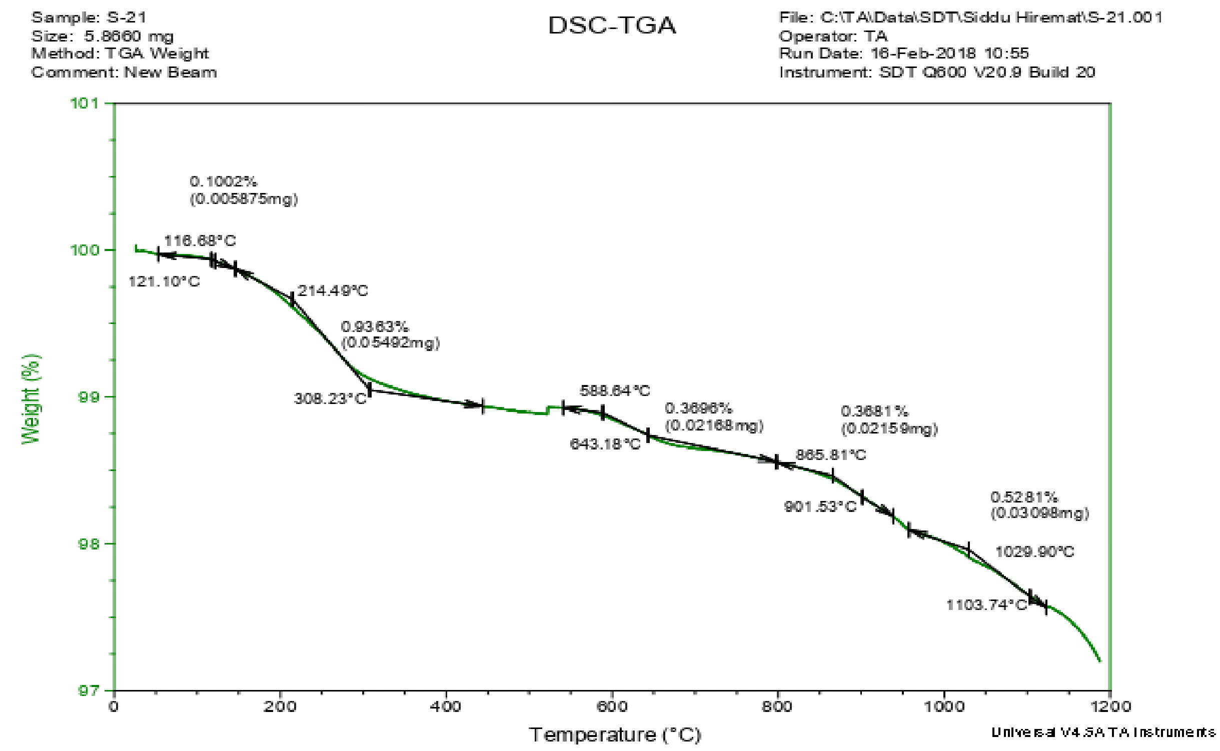

Fig. 15 TGA graph of sample S-21

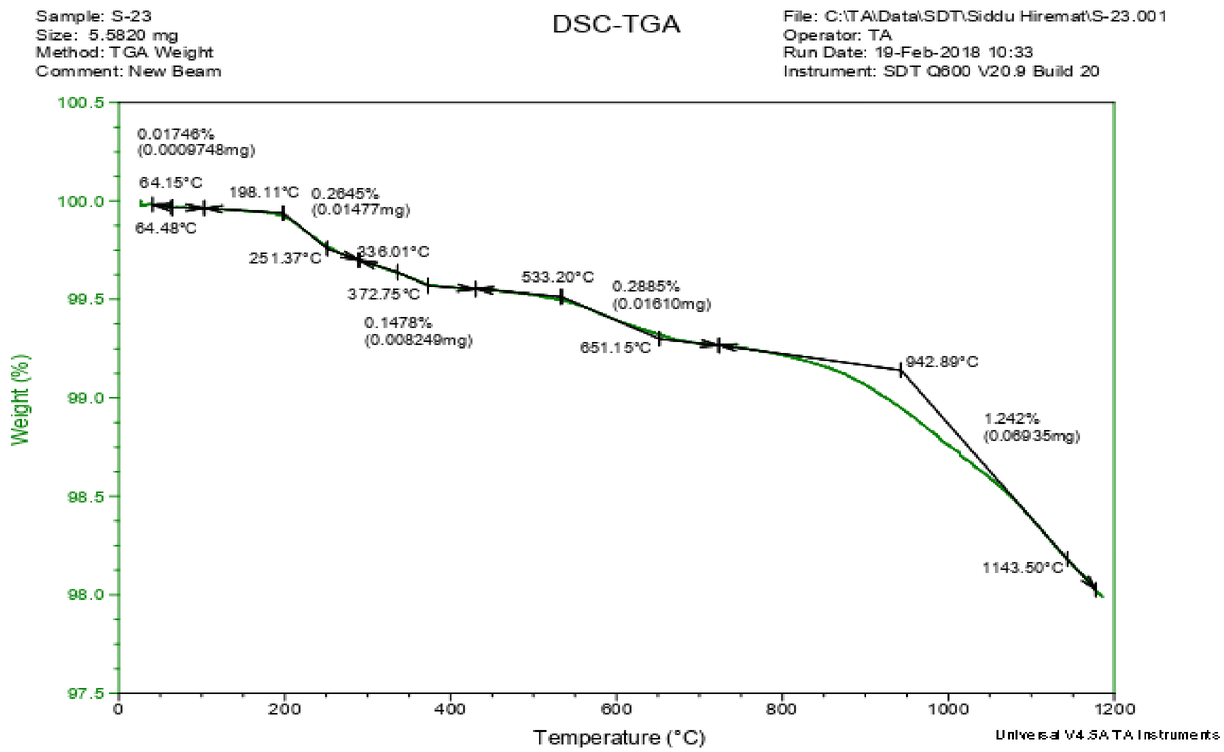

Fig. 16 TGA graph of sample S-23

IV Conclusion

The results of Differential Thermal Analysis (TGA) for samples of barite of Gadisunkapura area shows endothermic peaks between 69.68°C to 70.77°C for Halloysite mineral which shows dehydration type of reaction and peaks between 932°C to 1163°C shows dehydroxylation of Biotite.

From TGA graph obtained weight loss between temperatures 97.92° to 137.86°C is assigned to dehydration of Halloysite mineral. The temperature range between 168° to 394°C shows dehydroxylation of Biotite and temperature range between 433° to 688°C is showing weight loss due to dehydroxylation of Quartz admixture of magnetite. The temperature around 950°C is assigned to Thermal decomposition of Jarosite mineral whereas temperature range 1020° to 1169°C show weight loss due to dehydroxylation of Crystobalite mineral.

Acknowledgement

We would like to thank Chairman, Dept. of Studies in Geology, Karnatak University for providing all necessary help. First author would like to thank, funding agency DST PURSE PHASE-II (Department of Science and Technology) for providing financial support to carry out this work. First author would also like to thank, Mrs. Bharathi Murgod, University Science and Instrumentation Centre (USIC), Karnatak University, Dharwad and her technical assistant, Mr. Santosh Horatti for helping in handling instrumentation and providing FTIR data.

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