COMPARATIVE THERMOLUMINESCENCE CHARACTERISTICS OF THE DIFFERENT ORIGIN NATURAL QUARTZ

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Introduction. Quartz (SiO_2) is one in more abundant rock-forming continental crust minerals. Their crystal modifications: hexagonal (β-quartz, is stable higher 573 °C) and trigonal (α- quartz, is stable up to 573 °C) are clear thermal history indicators for the geology objects, containing quartz of the certain modification. On the other hand, all kinds of microstructure defects of the silicates, partially, quartz [1] can be tested with help of the measuring their thermoluminescence (TL), as one of the more sensitive method.

Carried out by us before investigations [2] have shown, that the TL parameters (intensity of glow curve, temperature of a maximum of glow curve peaks etc.) for the optically clear natural quartz are the distinct indicators of the microstructure changes in their crystal lattice under influence of the shock loads.

TL of the number different natural quartz samples has been studied for purposes of obtained the common TL-characteristics with design of check variation due to possible of different natural conditions of their formation; different structural properties; and different chemical elements impurities at low concentrations.

Samples and method. Ten natural quartz samples were taken for the TL analysis: two from their – monocrystals of the clear quartz from druse of the crystal quartz deposits of Pamir (further in the article –Pam) and Dgeskazgan, Kazakhstan (Kaz). Eight other samples presented the different gold-containing quartzite deposits: Berezovskoye, Ural (Ber), Sukhoy Log (Log) and Verninskii (Ver), Bodaibo, Lenskii region; "Eldorado" field, Eniseiskii mountain-ridge (Eld); Selemdja, Amurskaya region (Sel); Muruntau, Uzbekistan (Mur); deposit Shkol'noye, Kolima (Shk); Tokur, Verkhneselemdjinskii region (Tok).

Methods of the sample preparing and measuring are described earlier in the papers [2-5]. Two tests by the weight of about 3 mg in each sample were taken for measuring TL. After highlighting of the natural TL, stored in the nature conditions, it was measured artificially induced by the X-ray irradiation TL. TL characteristics for the last are considered in this paper.

Results and discussion. X-ray induced glow curves for the quartz samples under investigation are shown in Fig 1(a, b). The total characteristic of these glow curves is the availability of a legible low-temperature peak (peak 1), with temperature of maximal TL in the field of 110-125 °C and high- temperature peak (peak 2) - 220-280 °C. However, in a sample Ber there is not a peak 2.Between the first and second peaks for the Log.and Eld samples the intermediate peak with the maximal TL emission temperature near 220 °C is observed.

The results of calculation for the peaks 1 and 2: of the maximal temperature (T_{P1}) and (T_{P2}); the TL emission intensity (total area under glow curve peak) for the peak 1 in the region 50-180 °C (S_1) and for the peak 2 – 180-350 °C (S_2); and also the values of S_1/S_2–ratio for the quartz samples under investigation are presented in Table. $S_1$and S_2 average values are obtained using the duble-measuring data of each sample. The mistake of these measuring is not higher 10%.

As it seen from the Table data, the essential difference of (S_1/S_2)-values, determined in the distinct temperature intervals is observed: for the all investigated quartz samples this ratio varies from 0.6 (sample Ber) up to 53 (sample Mur). As exclusion, the samples Eld, Shk and Tok with nearest values of T_{P1} – 121-125 °C, T_{P2} – 266-275 °C and S_1/S_2 - ratio, lying within the limits of 2.1-2.5, are presented. On this base it can be proposed that deposit formation conditions for the predominant investigated by us quartz samples were near the same. Still, the presence of the intermediate peak with the maximal TL emission temperature ≈225 °C in the Eld sample probably due to the availability of negligible quantity of the impurities and/or the structural features in this quartz, that is, no contact in the Shk and Tok samples.

Summary. Wide variation of the TL parameters, determined for the natural quartz samples from different gold-containing quartzite deposits, reflective their conditions of formation, was obtained. It can be possible due to high sensitivity of the using TL equipment. The more apprehensible Tl parameter – S_1/S_2 ratio varied in the frame of two orders of magnitude for the samples under investigation.

This can be connected, primarily, with microstructure features of quartz samples, that is due or to their different formation conditions, or the structural defects, generated, for example, at replacement of the Si^{4+} by Fe^{3+} and Al^{3+}ions [6].

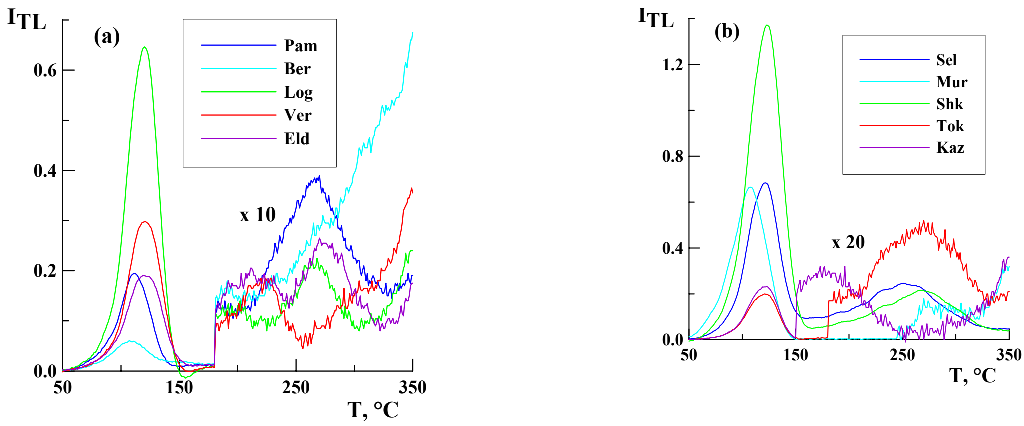

Fig.1. TL glow curves of the quartz samples from different deposits are shown: I_{TL} – TL emitting intensity in relative units. T – Sample heating temperature. The I_{TL} values in the temperature interval 180-350 ^{O}C in the Fig.1 (a) are enlargement by 10-fold. In the Fig. 1(b) only for the samples Mur and Tok (180-350 ^{O}C) and also Kaz (150-350 ^{O}C) I_{TL} values are enlargement by 20-fold.

Table1. Parameters of X-ray induced TL for the natural quartz samples from different deposits

Deposit	Sample	T_{P1}, °C	T_{P2}, °C	S_1	S_2	S_1/S_2
Berezovskoye, Ural	Ber	110±2	-	2.6	4.5	0.57±0.06
Sukhoy Log, Bodaibo	Log	120±2	268±2	22	2.3	9.6±0.9
Verninskii, Bodaibo	Ver	123±2	223±2	9.8	2.4	4.1±0.2
"Eldorado" field, Eniseiskii ridge	Eld	122±3	272±2	8.6	3.7	2.3±0.5
Selemdja, Amurskaya region	Sel	122±1	249±3	30	26	1.15±0.04
Muruntau, Uzbekistan	Mur	116±9	283±13	32	0.6	53±6
Shkol'noye, Kolima	Shk	121±2	266±1	55	22	2.5±0.2
Tokur, Verkhneselemdjinskii region	Tok	125±5	275±7	12	5.6	2.1±0.7
Kazakhstan, crystal quartz deposit	Kaz	125±5	230±2	8.5	1	8.5±0.2
Pamir, crystal quartz deposit	Pam	115±6	267±2	6.8	3.6	1.9±0.2

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