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Relative Temperature Dependence on Physical Quantity Variance During Characterizing Coal Properties

Bayarchimeg.L[1,2], Adashkevich.S.V[3], Lapchuk.N.M [3], Stelmach.V.F[3], Shilagardi.G[1] , R.Galbadrakh[1]

[1]- School of Physics and Electronics, National University of Mongolia
[2]- Institute of Physics and Technology, Mongolian Academy of Science
[3]- State University of Belarus, Minsk
Email: l.bayarchimeg@gmail.com, gshilagardi@yahoo.com

I. Introduction

The natural process of any metamorphism of carbonaceous matter is a complex chain of physical-chemical transformations where the most important are the physical and chemical transformation (CH) - (C) phases and the final structuring of the system carbon that is called metamorphism [1]. As a result of metamorphism, the oil shale is converted to a brown coal and the brown coal is converted to a coal and finally become anthracite. Naturally, the metamorphism process is always happening in organic substances and we consider the pyrolysis of coal as an accelerated process of metamorphism.

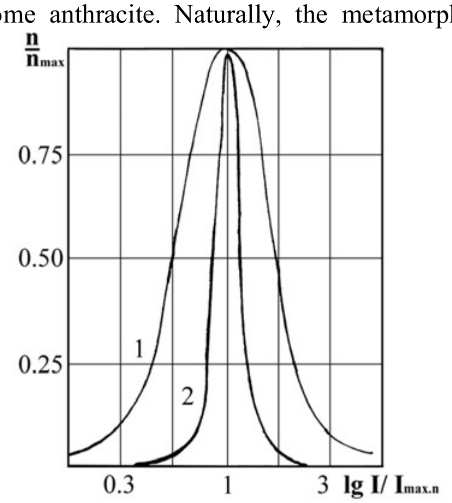

Fig 1. *The experimental distribution curves of the signal intensity n/n_{max} ($lg(I/I_{max})$) of paramagnetic centers with g=2.0027±0.0002. Curve 1 corresponds to the probe of sector with high ejection possibility, whereas curve 2 corresponds to a sector with low ejection possibility.*

The modifications in physical-chemical properties of coal in the course of the transformation result in an extremely dangerous critical state for carbons of an average metamorphism with potentiality to develop avalanche gas-dynamic phenomena (a sudden coal and gas ejection).

By studying this process carefully, we can decrease the baneful consequences that causes when stopping or accelerating the metamorphism by extrinsic influence. The results of micro and macro simulation of coal structure studies [2] has shown that the amount of C and CH phase heterogeneous (concentration and quantity) is maximum at average metamorphism coal and has maximum dispersion D(η) in the main physicochemical properties reflecting structural featured of the given critical metamorphism substance. Thus, we can measure the sudden ejection and combustion of coal by defining the physical measurement of dispersion.

Stelmach. V.F. and Adashkevich. K.V had taken the ESR spectrum intensity as a physical measurement in order to define the coal properties [2]. As shown in Figure 1, the experimental curve of relative intensity n/n_{max} ($lg(I/I_{max})$) of paramagnetic centers depend on dimensionless geological time η, which developed by Stelmach etc. This curve has shown the Gaussian like distribution and the dispersion of sudden high ejection coal samples were 3.7 times higher than the low ejection coal samples.

Here, the dimensionless geological time is defined by relative intensity (I/I_{max}). However, the intensity (I) depends on physical properties of coal such as temperature and pressure. Therefore, the aim of this work was to define the temperature role for dimensionless geological time.

II. Experimental methods and results

We have chosen Shivee-ovoo coal sample that is used for fourth power plant of Ulaanbaatar city where the ejection was observed quite frequently. The samples were heated for 20 min in isohron heat and detected their ESR spectra in room temperature by SEPR 2 spectrometer, and modulation amplitude was taken less than 0.1 Gs in order to decrease the signal aberration. Paramagnet center concentration was defined as a comparison of Y75 coal standard.

Figure 2 illustrates the measurement curve of our experimental result, which also shows the Gaussian like distribution and dispersion was 2.935.

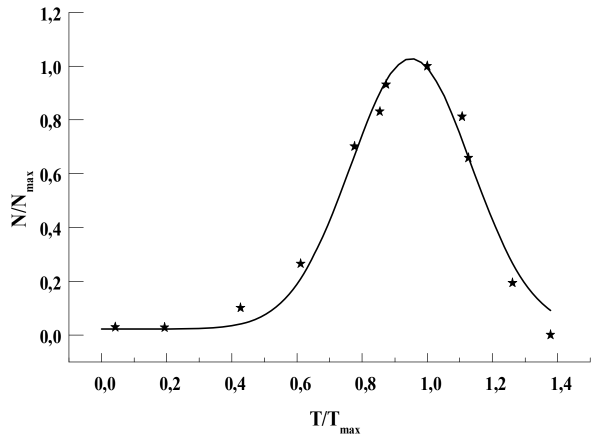

Fig 2. *Shivee-Ovoo's basins coal concentration of paramagnet center (I/I_{max}) vs. relative temperature (T/T_{max}).*

To a first approximation, the relative temperature (t/t_{max}) is important for dimensionless geological time when pressure is constant. If we consider that both temperature (T) and pressure (P) are major parameters for coal metamorphism process, then we can approximate:

$$D_I = D_T * D_P \quad (1)$$

In Table 1, the dispersion of intensity, pressure and temperatures of some coal basins that are defined using above formula are illustrated.

Table 1.

№	Basin	Intensity dispersion, D_I	Temperature dispersion, D_T	Pressure dispersion, D_P
1	Baganuur	0.19	4.039	0.047
2	Shivee-ovoo	0.23	2.935	0.078
3	Maanit	0.25	0.264	0.156
4	Tavantolgoi	0.071	0.455	0.725
5	Nariinsuhait	0.041	0.053	0.788

Table 1 shows Maanit, Nariinsuhait and Tavantolgoi coal samples have higher dispersion of pressure than dispersion of temperature. However, the samples with high sudden ejection possibility such as Baga-Nuur and Shivee-Ovoo have shown more dispersion of temperature.

III. Conclusion

Sudden ejection possibly will be lower, if pressure is important for metamorphism process, whereas, it will be higher, if temperature more important.

To a first approximation, we can conclude that intensity dispersion is equal to the pressure dispersion multiplied by temperature dispersion:

$$D_I = D_T * D_P$$

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