AT PROBLEM OF DIFFUSION USE FOR PETROLOGTCAL INVESTIDATIONS

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1.The diffusion influence (DI) on mineral forming processes was described very badly. Some questions of diffusion use investigation in hydrogeology, isotope geochemistry etc. and in geochronology for investigation of migration radiogenic isotope processes and analyses forming mechanism of discordance, and time of display of lay processes. For investigation condition of ore and silicate systems the use of diffusion notion was had character of hypotetical talk. The main investigation volume in that sphere contained only experimental determination of diffusion parameters either in melts, or solid bodies for different temperature and pressers mainly in feldspars, nephelines, diopsides, biotites, muscovites, quartzes and some rocks. A diffusion role did not clear to decide reverse tasks (the analyses of forming mineral conditions). One of the problems is solid phase transitions (SPT) and the other is diffusion role at determination point of these transitions. These problems were investigated by B. Daansgaard, M.K. Stewart, J. Hoefs, W.F. Giggenbach, O.Mutsubaya, H. Sakai etc. A.A. Verbeck et al used these notions at describe of migrations of ^{39}K and ^{40}K isotopes at contact metamorphic zones, and used theoretical plates notions. А.М. Зякун и А.Д. Бондарь touched upon these problems at discription of condition of C isotope fractionation at CO_2 and CH_4 migration. They used notions of stationary and non-stationary diffusions. The notion of theoretical plates is more common idea, and they have been in sphere of industrial isotope separate (М. Шемля, 1980). The theoretical plate is distance, in which presence the particles will be separated according to ration of diffusion theoretical coefficients.

The practice of use of diffusion notion at decision of geological reverse tasks brings to light problems:

a. The absence of conceptual notions about necessity of diffusion investigation;

b. It is not clear ratio between diffusion parameters (DP), and forming mineral thermodynamic parameters;

c. Determination of DP, which different authors feasible at the same conditions, had been bad coincidence.

d. There are absence analyses of compensation equation $\ln D_o = aE + A$ and nature of crossover point D* and T* (E- diffusion activate energy). The problem of diffusion mechanism does not play role at decision geological reserve tasks.

2. The generalisation of diffusion notion allows constructing scheme of diffusion use at geological investigation. The private determination of D_i parameters at T_i is the private point.
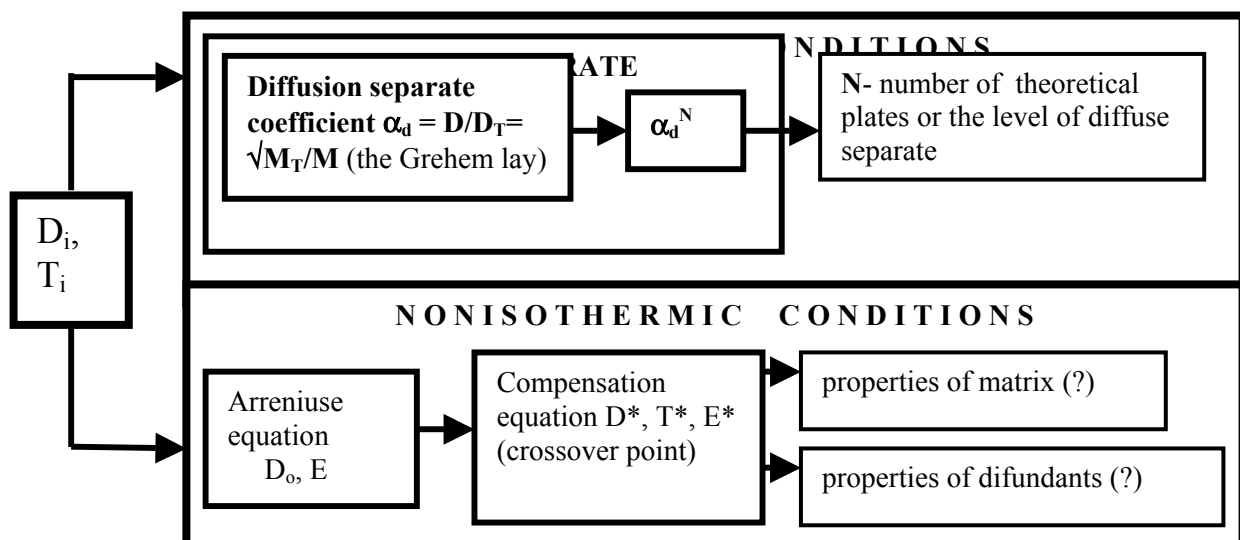
The subsequent generalisation may be perhaps to two directs (it is looking scheme):

A. The dislocation of two particles evokes their diffusion division, which was described the parameters of $\alpha_d = D/D_T = \sqrt{(M_T/M)}$ (D and D_h are diffusion coefficient; M and M_h are molecular weight of light and hard components accordingly). The notion about theoretical plates is generalisation

of diffusion parameters (М. Шемля и др.,1980). The common division was described equality $\alpha = \alpha_d^N$, in which N is number of theoretical plates. The number N determines elements diffusion division depth [1]. We used these factors for investigation of isotope ($\delta^{18}O$, $\delta^{13}C$ and δD) division in calcites, biotites, muscovites and amphiboles at wind temperature intervals, and determinated diffusion influence at mineral isotope components. In the time of forming carbonate (scarnes, marbles, nonmagmatic carbonatites). Significance of "n" were changed in limits of 0.03- 3.0 at HDO, $^{13}CH_4$, $^{13}CO_2$ и $C^{18}O_2$. The diffusion is absent in magmatic carbonatites. Practically this occurrence was used for determination of $T_{обр}$ by isotope dates [2]. HDO molecule is main diffident in minerals with hydroxyl: n= 0- 1.0 in muscovites of aplites, shists, granite- gneisses; n= 0-0,65 in biotites of alaskites, granodiorites, shists, gneisses; n=1,5 in amphiboles of granodiorites.

Б. Diffusion investigation at nonisotermic (variable) temperatures. Here first step is construction of diffusion right line, which was described by Arreniuse equation for concrete temperature interval. The physical meaning of D_o parameter is not clear, but dependent of D_o and E from structure of mineral-matrix is described. This allow determine of phase transition temperature. The significance of D_o was connected often with internal construction of crystal lattice: theory of Vert- Zinner- la Kler confirm, that $D_o = Va\nu$, (a is lattice constant, ν is atom vibration frequency, V is geometrical factor). Dines (1950) confirm, that $D_o= kv\delta^2exp(E /RT_{пл})$ (k is const, ν is Debye frequency, δ is interatom distance; $T_{пл}$ is melt temperature). В.М. Катлинский (1984) tries to value of exchange limits.

3. Further generalization is compensation equation (CE) $lnD_o= aE+A$, in which D_o and E are variable parameters. The CE arises in processes of selfdiffusion, heterodiffusion and interdiffusion. The CE is connected with notion about crossover point of D^* and T^*. Point of crossover is crossing point of some diffusion lines. This is least investigated region of diffusion, although Н.Д. Сорокин (1992), attempted to analyse this probleb. He connected CE with mechanisn of diffusion and separayed crossover point from CE by mistake, although function bond have been between their (К. Крон, Т. Крон, 1978; В.П. Макаров, 2000): CE parameters are functions of D^* and T^* coordinates ($A= lnD^*$, $a= -1/RT^*$).

4. The investigations showed that CE absent in simple systems (alloys of Fe, W, Mo, Nb and etc.). E were typical for complex systems. These are glasses, minerals, rocks. CE may investigate at two directs: it is investigation one and the same element in a few matrixes; for example, in glasses of variable compositions. In the case these are investigated some properties (?) of the same element.

Second direct: it is conduct a few diffundants in one and the same matrix. In the case these are investigated some properties (?) of the same matrix. First of all position of compensation lines were determinated by elements valency, but position of elements on compensation line were determinated by glass compositions. If Y^{+1} ion marks use, then compencation lines coincide. In simple glasses cations formed successions: if У= Na, then Na< Li< K< Rb< Cs; if Y=K, then K< Rb< Na< Cs; if Y= Cs, then Cs< Rb< Na; if Y= Rb, then Rb< K< Cs< Na. Here the elements of itself matrix have minimum energy E. More far the elements settle down according to growth of atom weight or ions radiuses. If Y^{+2} ions marks have been presented, then compencation lines do not coincide already. Complex relations between marks were typically for natural minerals matrix. In these minerals either $T^* > T_{пл}$ (in melts), or $T^* << T_{пл}$ (in crystals): albite (Al) $T^* = 421$ ($T_{обр} = 440^oC$), phlogopite – 483 (Mu- 490), K-feldspar - 507 (570), sphalerite – 624^oC, approaching at $T_{обр}$ their in conditional natures. There are connected lgD^* significance with these T^*: -15.10; -16.79; -14.36 и –12.04, like at D significance of water in Al melt at T= 1100- 1400^oC (Хитаров и др, 1975).

References:

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