

## REASONS OF TEMPERATURE DICORDANCE OF FORMATION QUARTZ- SULFED-SULFAT ASSEMBLAGES BASED ON ISOTOPIC AND TERMOBAROMETRIC DATA

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For establishment the genesis of ore deposits it is necessarily to know temperature conditions of mineralization. Such data could be obtained from the sulfur and oxygen isotopic composition of coexisting sulfides, sulfates and quartzes of on assemblage as well as one fluid inclusion data.

We made the comparison of temperature data obtained from fluid inclusion studies of quartz and anhydrite with that of isotopic geothermometers ( sulfide-anhydrite and quartz-anhydrite) used on samples from Darasun Au-Pb-Zn ore deposit (Baikal region).

The sulfides of this deposit are characterized by rather homogeneous isotopic composition:  $\delta^{34}\text{S}$  values are varying in the narrow range from +0.9 up to -2, 1‰, whereas the anhydrates have significant variations (9,6 to 15, 8‰).  $\Delta^{34}\text{S}$  value of coexisting sulfides and sulfates was found in the interval of 11,0 - 17, 5‰ [1]. According to the sulfide - sulfate geothermometric scale [2, 3] such data are corresponding to 580 - 400°C temperature interval (fig).

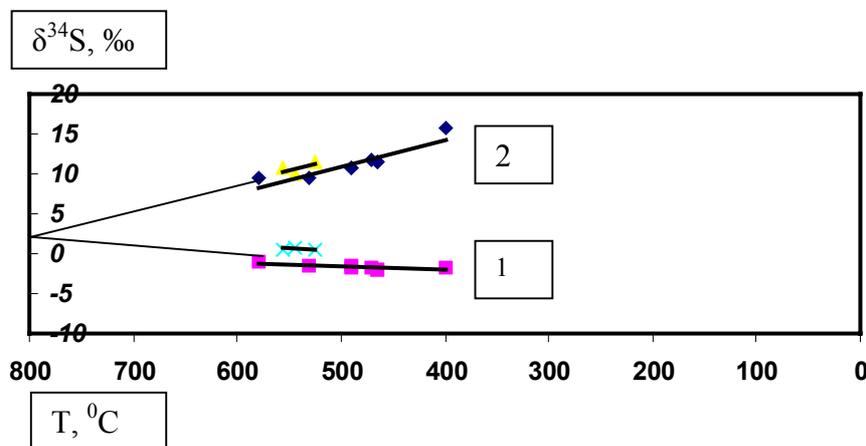


Fig.  $\delta^{34}\text{S}$  - T diagram for coexisting sulfates and sulfides. 1- sulfide, 2 - sulfate

The regression lines of  $\delta^{34}\text{S}$  in  $\delta^{34}\text{S}$  -  $\Delta^{34}\text{S}_{\text{sulfate-sulfide}}$  coordinates are crossing in the point corresponding  $\delta^{34}\text{S}$  near +2‰. This value is a characteristic value of mean isotopic composition of sulfur in a fluid indicating that the igneous rocks serve as a source of sulfur. Low variations of  $\delta^{34}\text{S}$  of sulfides in comparison of that of sulfates could be interpreted as an indication on the predominance of sulfide chemical form in the mineral forming fluid.  $\text{H}_2\text{S}/\text{SO}_4^{2-}$  ratio is estimated as 70:30.

The  $\delta^{18}\text{O}$  ( $\text{H}_2\text{O}$ ) values of fluids were determined using oxygen isotope composition of anhydrites or quartz and sulfur-isotope temperature. The high temperature minerals have the most high  $\delta^{18}\text{O}$  ( $\text{H}_2\text{O}$ ) values (+8‰), which correspond the water in equilibrium with igneous rocks under low ratio water/rock at high temperature. More low temperature anhydrites and quartz were deposited from fluid with lower  $\delta^{18}\text{O}$  ( $\text{H}_2\text{O}$ ) values. We connect this phenomenon with participation of "light" waters during formation of fluids.

The homogenization temperatures of fluid inclusion of quartz are 440-225°C, practically the same temperatures we have for anhydrites. In some samples of minerals the homogenization take place as in liquid, as in solid phase; in such occurrence we can assume this temperature as the "true temperature" of mineralization. According Prokofyev [4] for mineralization of Darasun the correction of the homogenization temperatures on the pressure is insignificant for the fluid inclusions with high concentration of gas and salts. Thus such high homogenization temperatures of fluid inclusion we can accept as real temperature of crystallization of anhydrites and quartzes.

There is an interesting problem: why markedly high temperature (580-400°C) data were obtained by use of sulfur isotope thermometer?

We suppose that the semiopen hydrothermal systems ( as for Darasun hydrothermal mineralization) are characterized by maximum variation of temperatures, pressure and gas/salt concentration; fluids of different origin could be involved in the process of mixing, their outgassing and temperature decrease are thought to be of great importance. In such conditions the sulfur isotope distribution between different sulfur bearing components of ore-forming high-temperature solutions reaching the zone of mineral deposition are to be considered as an indication of high fluid temperature. Thus, if the sulfide and anhydrite crystallization is proceeding with rather high rate, sulfur isotope system may not achieve the equilibrium state with the decrease of temperature. So this system could be considered as reflecting the intermediate temperature between that of high-temperature fluids transported to the ore deposition zone and markedly lower formation temperature of mixed fluid being responsible for mineral deposition. Such complicated model of mineral formation could explain the observed discrepancy between the isotopic and barothermometric temperature data.

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