Solubility of gold in granitic silicate melts at 850°C, 100MPa

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A lot of gold deposits are closely associated with intrusive igneous granites. It is curious how about the transportation of Au in the magma system, how about the gold solubility in different silicate melts and coexisting aqueous fluids. So, experiments were conducted to measure the solubility of gold in granitic silicate melts and coexisting aqueous fluids at 850°C, 100 MPa, and oxygen fugacity near NNO.

Haplogranitic gels with different compositions, distilled water, hydrochloric acid solutions with different HCl concentration were employed as starting material in the experiments. The weight ratio of the starting solid material and starting aqueous fluids are 1:1. Pure gold capsule was used as container; it also provided Au in the experiments. The temperature, pressure and run time were 850°C, 100MPa and 96 hours, respectively. Moreover, the pressure of several experiments ranged from 60 MPa to 100MPa.

The results of the experiment show that the solubility of gold in different melts is ranged from several ppm to dozens of ppm. The lowest gold solubility in silicate melt phase is 2.27ppm, in which K-rich peralkaline gels and distill water were employed as starting material. The detected gold concentration in melt phase is higher when the starting fluid is hydrochloric acid bearing. The solubility of gold in coexisting aqueous fluids is ranged from several hundred ppb to several ppm, and it increases with the content of HCl in the hydrochloric acid solutions. The contents of gold in granitic silicate melts are obviously higher than those in coexisting aqueous fluid.

The solubility of gold is also affected by the composition of the melt. Gold solubility in peralkaline silicate melts is higher than that in peraluminous silicate melts. Especially, increase of Na_2O/K_2O mole ratio in melt could increase gold solubility in melt phase. Pressure also has evident effect on gold solubility in granitic silicate melts. The solubility of gold in granitic silicate melts increases with increasing pressure.

Concluded from the experimental results, gold solubility in granitic melts is affected by the composition of the melt, the volatiles in the magma and the pressure. Gold solubility in peralkaline, especially sodium-rcih peralkaline granitic silicate melts is relative high, and this kind of granitic silicate melt could extract gold and be as an important media for gold transportation.

A discussion on ore-forming fluid sources by gas composition of inclusion and stable isotope in Qinglong Antimony deposit, Guizhou China

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Gas compositions of quartz and fluorite intergrowth with stibnite are determined as follows, H_2O-95.00 mol% (mean, n=9), CO_2 -2.36 mol%, N_2-1.429 mol%, CH_4-0.516mol%, C_2H_6 -0.444 mol%, Ar-0.146, H_2S -0.001 mol %, and O_2 not detected. In xCO_2/xCH_4-xN_2 / xCH_4chart, 4 samples fall into formation water area, and 5 into atmospheric water area. In xCH_4-xC_2H_6- xCO_2 chart, all fall into gas area.

Data determined from inclusions in authigenic quartz show that δD compositions that range from-105.8 to -128.1‰ with a mean of -114.2 (n=5). The $\delta^{18}O$ values of authigenic quartz range from 3.8 to 6.9‰ with a mean of 5.4, converted into $\delta^{18}O$ of water range from- 7.8 to -10.2‰ with a mean of -8.08. In the δD-$\delta^{18}O$ figure, the data above fall into formation water, and lie in the left inferior of formation water area in Alberta basin.

The gas compositions and their proportion of Qinglong deposit are similar to Shuangjiang CO_2 pool (approximately 100 km E) with CO_2 values of 63.81%, N_2 21.49%, CH_4 14.57%, $C_2H_6$0. 015%. In this CO_2 pool, $^3He/He$ and $^{40}Ar/^{39}Ar$ respectively with1031 and 1.28% may be explained crust-derived causes. The $\delta^{13}C$ of methane is -35.7-35.8‰ and ethane is -38.8‰ which have the characteristics of the mixture of Coal type gas and oil type gas. The δ^{13} C of CO_2 with - 4.7 ‰ may be result of pyrolysis of lots of carbonate.

The freezing point temperature of fluorite inclusions range from - 0.2 to -1.3°C, and their salinity range from 0.4 to 2.2%NaCl. So the ore-forming fluid of Qinglong antimony deposit shows certain characteristics of low salinity formation water, and light hydrocarbon comes from coal and oil field.

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