Evaluation on the denudation of the Hadamengou and the Liubagou gold deposits in Inner Mongolia, China

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Located at the northern margin of North China Craton, the Hadamengou and the Liubagou gold deposits are hosted by Archean medium-high metamorphosed rocks, controlled by EW trend tectonic faults, and may be related to magmatic hydrothermal fluids. They are characterized by widespread K-feldsparthization, accompanying silicification, chloritization and epidotization [1]. Multi-methods are used here to evaluate the denudation extent of the two gold deposits.

In the Liubagou deposit, the vertical zoning is Zn-Bi-As-Ag-Cu-Ba-Au-Hg-Pb-W-Sb-Mo in its western part and Sb-Hg-Ba-Cu-Zn-As-W-Bi-Mo-Ag-Au-Pb in its eastern part; while it is Mo-Pb-Au-Cu-W-Cr-Ni-Ba-Bi-Zn-Co-V-Mn-As-Ti in the Hadamengou deposit. The cell parameter (a_0) values of quartz show a good positive correlation (0.89) with altitudes. The elevation of ore bodies from the Hadamengou deposit is about 300 ~ 900 meters lower than the one from the Liubagou deposit, and its a_0 values are obviously less than the ones of the Liubagou deposit. The average homogenization temperature of the Liubagou deposit roughly decreases from west to east (289°C→268°C→257°C); its overall average temperature (268°C) is slightly lower than the one of the Hadamengou deposit (286°C). The $\delta^{34}S$ values of pyrite from deep to shallow areas in the Hadamengou deposit change from large to small [2]. The average $\delta^{34}S$ values of pyrite in the western section (-7.44‰,-8.73‰) higher than the ones in the eastern part (-9.60‰,-10.03‰) at both the Hadamengou and the Liubagou deposits; the overall average $\delta^{34}S$ value of pyrite in the Hadamengou deposit (-8.59‰) is relatively higher than the one in the Liubagou deposit (-9.25‰). The primary halo, genetic mineralogy, fluid inclusions and sulfur isotopic geochemistry provide strong evidences for the denudation level of the Hadamengou and the Liubagou gold deposits whereby their western parts are less denudated than the eastern ones, while there is a less degree of denudation and a better ore prospecting potential for the Liubagou gold deposit.

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Oxygen diffusion in hydrous silicate melts

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Oxygen is the most major constituent in silicate melts. Quantifying oxygen diffusion is critical to understanding oxygen isotopic exchange, rates of reactions involving oxygen, and general mass transport in silicate melts. In anhydrous silicate melts, ^{18}O diffusivity is often found to be similar to Eyring diffusivity [1]. However, in hydrous silicate melts, ^{18}O diffusivity is often higher than the Eyring diffusivity by orders of magnitude, and is predictable quantitatively by assuming ^{18}O is carried by molecular H_2O [2, 3] and assuming isotopic equilibrium between hydrous and anhydrous oxygen species [4]. Recently, H_2O diffusivity in several melts has been determined as a function of temperature, pressure and water content [5-7]. From such relations and H_2O solubility (e.g. [8]), we can now compare ^{18}O diffusion flux in natural magmas due to anhydrous oxygen (such as nonbridging oxygen and free O^{2-}) mobility estimated from Eyring diffusivity, and ^{18}O diffusion flux due to $H_2{}^{18}O$ flux. We estimate that in rhyolitic melts at 1200 K, H_2O diffusion would dominate oxygen transport at ≥100 ppm total H_2O; in dacitic melt at 1200 K, H_2O diffusion would dominate oxygen transport at ≥500 ppm total H_2O; in basaltic melt at 1600 K, H_2O diffusion would dominate oxygen transport at ≥1.0 wt% total H_2O. Because natural rhyolitic to dacitic melts contain more than 500 ppm H_2O, oxygen diffusion in these melts is dominated by H_2O carrier. On the other hand, H_2O contents in mid-ocean ridge and ocean island basaltic melts are often less than 1 wt%, oxygen diffusion in these melts is mostly due to its own mobility. However, in island arc basaltic (IAB) melts that often contain wt% level H_2O, oxygen diffusion in IAB melts is often due to H_2O mobility. Quantitative relations between oxygen diffusivity in hydrous natural melts as a function of temperature, pressure and H_2O contens will be presented.

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