Geophysical Research Abstracts
Vol. 12, EGU2010-4019, 2010
EGU General Assembly 2010

Gold (Au) Solubility in Arc Magmas: Effect of Pressure in S-free and S-bearing hydrous silicate melts

Sebastien Jego (1), Michihiko Nakamura (2), and Jun-Ichi Kimura (3)

(1) Institute of Earth Sciences, Academia Sinica, 128 Academia Road, Sec. 2, Nankang, Taipei 11529, Taiwan, ROC (sjego@earth.sinica.edu.tw), (2) Division of Earth and Planetary Materials Science, Department of Earth Science, Graduate School of Science, Tohoku University, Aoba-ku, Sendai 980-8578, Japan (nakamm@mail.tains.tohoku.ac.jp), (3) IFREE Promotion Department, JAMSTEC, 2-15 Natsushima-Cho, Yokosuka-City, Kanagawa 237-0061, Japan (jkimura@jamstec.go.jp)

Au-Cu-Mo deposits represent major metal resources known to be spatially and temporally associated with intrusive arc magmatism and, according to some studies, notably with adakites. Although the bulk of the ore metals seems to originate from the magmas, there is as yet no consensus on processes responsible for their concentration. The fact that primary ore minerals are predominantly sulfides has led to the suggestion that sulfur may play an important role in metal enrichment processes at the magmatic stage. Besides, although no previous study has focused so far on its pressure-dependency, the solubility of gold in silicate melts is expected to vary with depth in a significant way, independently of any fractionation process. If this is true, it may lead to important implications for the gold budget of arc magmas rising up through the mantle wedge and the crust.

In addition to recently published gold solubility data at 1000°C and 0.4 GPa (Jego et al., 2010, GCA, In press), we present here new data obtained from piston-cylinder experiments performed at 1000°C and 0.9 to 1.4 GPa on two natural dacitic magmas (with a distinct adakitic imprint) from the Philippines. The experimental fO2 stands around the NNO buffer, as estimated by the solid sensor technique. The experiments were carried out in pure Au capsules, the latter also serving as the source of gold, in the presence of variable amounts of H2O. Both S-free and S-bearing (∼1 wt% S added) runs were performed. Gold contents in glass were measured by LA-ICPMS. Charges consist of dominant silicate melt quenched to glass plus minor (< 5 wt%) silicate phases (mostly Cpx). All S-bearing charges are saturated with sulfides, while S-free charges display minor Fe-Cr-oxides. Our whole dataset shows that Au solubility in S-free charges is very low (min. 30 ppb) but increases with pressure by more than one order of magnitude. In S-bearing charges Au contents reach much higher values, ranging from ∼1 ppm at ∼NNO up to more than 5 ppm with increasing pressure. These important results suggest that (1) primary arc magmas are likely to incorporate most of gold available at depth in the magma sources (e.g., Au-rich massive sulfide-bearing subducting slab), and (2) the decreasing solubility of gold in rising arc magmas may favour the fractionation of gold from the melt towards other magmatic phases such as sulfides (and, to a minor extent, oxides), exsolving fluids, and Au-rich metal alloys (i.e., gold “nuggets”).

Another major consequence of this study is that sulfide crystallization does not scavenge all Au present in the magma, but allows gold-enriched residual magmas to be emplaced in the upper crust.