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Effects of H_2O content and oxygen fugacity on sulfur solubility and gold partitioning in hydrous dacitic melts: Implications for gold-rich magma formation

XINGCHENG LIU, TING XU, XIAOLIN XIONG AND JINTUAN WANG

Guangzhou Institute of Geochemistry, Chinese Academy of Sciences

Presenting Author: liuxingcheng@gig.ac.cn

Magmatic-hydrothermal deposits are a major source of Au production worldwide. Understanding how Au-rich magmas form is crucial for exploring Au deposits. In this study, we conducted piston-cylinder experiments (1.0 GPa and 850~950°C with oxygen fugacity of FMQ−1.5 to FMQ+3.3) to investigate the effects of H_2O content and oxygen fugacity on S solubility and Au partitioning between sulfide and coexisting hydrous dacitic silicate melts. The results show that increasing H_2O content in the dacitic melt enhances S solubility at sulfide ± anhydrite saturation, which also increases Au solubility in the melt and decreases the partitioning coefficients of Au between sulfide and silicate melt. These results suggest that highly hydrated felsic magmas have a high capacity for S dissolution[1], favoring sulfide mass deconstruction and Au-rich magma formation. Our modelling result also reveals that the Au transport ability of high hydrous magmas (H_2O > 8wt%) is not significantly different between oxidized and reduced magmas in the oxygen fugacity range of FMQ-1.5 to FMQ+2.4. We argue that forming such highly hydrated magmas at lower crustal conditions may be a key factor for producing Au-rich magma and facilitating subsequent magmatic-hydrothermal deposit formation.

[1] Ting Xu, Xingcheng Liu, Xiaolin Xiong & Jintuan Wang (2022). *Geochimica et Cosmochimica Acta*, 333, 107-123.