Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.4979

Role of crustal thickness in the formation of Au-rich porphyry deposits

HONGDA HAO[1], JUNG-WOO PARK[1] AND IAN H. CAMPBELL[2]

[1]Seoul National University

[2]Australian National University

Presenting Author: hongda@snu.ac.kr

Porphyry deposits, the world's most significant source of Cu and an important source of Au [1], are formed by precipitation of Cu and Au from magmatic hydrothermal fluids. Some porphyry deposits contain Au as major resources, but the others as by-products [2]. The high Au endowments in the porphyry deposits significantly increase the deposits value. However, the key factors that control the Au enrichment in porphyry systems remains unclear. Magmas traversing the thick crust are likely to become sulfide-saturated early [3, 4], due to the high-pressure differentiation and low Fe content, which decrease the sulfur solubility in silicate melts [5, 6]. Early sulfide saturation locks most of Au and some Cu in the sulfide phases that are retained in the lower crustal cumulates. The evolving magma will be significantly depleted in Au, but it may contain enough Cu to form a porphyry Cu-dominant deposit. In contrast, magmas evolving in the thin crust are suggested to reach sulfide saturation late [3, 4], so that most of the Cu and Au may be available by the time of fluids exsolution, favoring the formation of Au-rich porphyry deposits. Based on this relationship, we collect the global Au grade and crustal thickness data of giant porphyry deposits and show they are generally negatively correlated. As a consequence, we suggest that the Au fertility, which is dominantly controlled by the timing sulfide saturation and modulated by the crustal thickness, plays a critical role in the formation of Au-rich porphyry deposits.

References:

[1] Sillitoe, R. H. (2010). *Economic geology* 105, 3-41.

[2] Cooke, D. R., Hollings, P., & Walshe, J. L. (2005). *Economic geology* 100, 801-818.

[3] Chiaradia, M. (2014). *Nature Geoscience* 7, 43-46.

[4] Lee, C. T. A., & Tang, M. (2020). *Earth and Planetary Science Letters* 529, 115868.

[5] O'Neill, H. S. C., & Mavrogenes, J. A. (2002). *Journal of Petrology* 43, 1049-1087.

[6] Matjuschkin, V., Blundy, J. D., & Brooker, R. A. (2016). *Contributions to Mineralogy and Petrology* 171, 1-25.