Sulfide saturation in evolving porphyry systems: El Abra porphyry Cu deposit, northern Chile, and the Grasberg-Ertsberg porphyry-skarn Cu-Au district, Papua, Indonesia

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Sulfide saturation during the magmatic evolution of porphyry systems is emerging as an important control on chalcophile element fertility. Platinum group elements (PGE) have extreme sulfide melt-silicate melt partition coefficients that make them sensitive indicators of the timing of sulfide saturation in an evolving magmatic system. We report PGE and Re concentrations of intrusions from the Grasberg-Ertsberg porphyry-skarn Cu-Au district, Papua, Indonesia. Unaltered to weakly altered samples contain up to 0.023 ppb Rh, 5.5 ppb Pt, 11.6 ppb Pd and 162 ppb Re. The most altered and/or mineralized samples typically contain greater concentrations; up to 0.065 ppb Rh, 17.6 ppb Pt, 95 ppb Pd and 218 ppb Re. The results suggest that sulfide saturation did not occur during magmatic evolution of the intrusions, and so Cu, Au, and PGE were concentrated by fractional crystallization and partitioned into the mineralizing fluid. These findings contrast with the intrusions of the El Abra-Pajonal suite and porphyry Cu deposit, Chile, where a rapid drop in Pt and Pd abundance indicates that sulfide saturation started before ore-fluid saturation. However, at El Abra, a porphyry Cu deposit was still able to form because the amount of sulfide melt that formed was small, stripping the magma of most of its Au and PGE but little Cu. Sulfide saturation therefore has a governing control over both the availability of the chalcophile elements to partition into the hydrothermal ore-fluid phase and the type of porphyry mineralization that can form, i.e. Cu, Cu-Au, or Cu-Au-(Pd).