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Different Crustal Sources for Au-Rich and Au-Poor Ores of the Grasberg Porphyry Copper Deposit, Irian Jaya

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The source of ore-forming elements within mineralised systems is a central question of metallogenesis. The metallogenesis of Cu and Au have been particularly controversial. Here we use Re-Os isotopes to address this question in the Grasberg Cu-Au system. The elevated $^{187}Os/^{188}Os$ initial values from sulphides within the Grasberg intrusive complex indicate a dominantly crustal source for Cu, Fe and Au. Pyrite, chalcopyrite, and covellite from the mineralised plutons and associated Tertiary sediments form a 2.9 ±0.3 Ma isochron with an initial $^{187}Os/^{188}Os$ ratio of 0.56 ±0.02. The fit of the samples about an isochron indicates that these ores precipitated from an isotopically homogeneous hydrothermal system. Since the chondritic mantle $^{187}Os/^{188}Os$ lies around 0.13, the initial $^{187}Os/^{188}Os$ value of the sulphides at about 0.56 indicates a significant crustal component for the Cu and Au. Possible radiogenic sources in the subduction environment are the descending oceanic slab (and accompanying sediments), the upper/lower continental crust, and a partially metasomatised mantle wedge. Simple two component mixing models using chondritic or even metasomatised mantle with the mean lower crustal values from Northern Australian continental crust (1) suggest at least 40% of the metals were derived from a radiogenic lower crust. The relative proportion of crustal metals increases drastically if a lower concentration source such as the oceanic slab is considered. A younger mineralization event, characterized by increased Au and Cu contents, cross-cuts the peripheral border of the main intrusive complex. This younger ore has higher Re and Os concentrations, and more radiogenic $^{187}Os/^{188}Os$ isotopic values. The samples from this mineralization event do not form an isochron, instead they form a mixing trend with the youngest samples containing the most gold and highest $^{187}Os/^{188}Os$ initial values. In order to resolve the mixing trend, a high concentration, radiogenic material, such as black shale provides a plausible end member. Palaeozoic turbiditic and black shale sedimentary sequences dominate the lower crust beneath the Grasberg ore body. Previous work on black shales (2) of correlative Precambrian and Devonian age indicate that they could be the source of 20% to 30% of the metals present in the massive sulphide mineralization event. These Re-Os data suggest that the source for the gold-rich ores are dominantly in the Phanerozoic rocks that now reside in the lower crust, whereas the gold-poor ores have a more significant mantle component. Therefore, the lower-middle crust has a profound impact on the metal budget of the magmas generated in arc environments.

SaalAE , Rudnick RL, Ravizza GE, *Nature*, **393**, 58, (1998).
Horan M, Morgan JW, Coveney R, Murowchick J, Hulbert L, *Geochem. Cosmo. Acta*, **58**, 257, (1994).