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Accreted metal did not strip Earth's mantle of HSEs during core formation

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The conventional explanation for mantle highly siderophile element (HSE) concentrations is that the HSEs were stripped from the mantle by segregating metal during core formation and were added back by a late veneer of CI material after core formation ended. During Earth's accretion, HSEs were added to the mantle by a small proportion of planetesimals that were fully-oxidized and therefore contained no metal. In order for the conventional explanation to work, such mantle HSEs had to have been stripped from the mantle to the core prior to the addition of a late veneer. Here we show that most accreted metal, originating from differentiated bodies, cannot strip the mantle of HSEs. This is because such metal already contains high HSE concentrations as a consequence of core-mantle differentiation at low pressure. On the contrary, re-equilibration of such metal in a deep magma ocean actually increases and fractionates HSE concentrations because metal-silicate partition coefficients decrease with increasing pressure and temperature. We therefore propose an alternative model in which HSEs are stripped from the mantle by late sulfide segregation that exsolves during magma ocean cooling.

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