No FeS layer in Mercury: evidence from Ti/Al measured by MESSENGER

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In this study we investigate the likeliness of the existence of an iron sulfide layer (FeS matte) at the core-mantle boundary of Mercury by comparing new chemical surface data obtained by the MESSENGER spacecraft with geochemical models supported by high-pressure experiments under reducing conditions. We present a new data set consisting of 233 Ti/Si measurements. We also use Al/Si data and show that Mercury's surface displays a slightly subchondritic Ti/Al of 0.035 ± 0.008. We report multiphase equilibria experiments which show that in the conditions of Mercury's core formation Ti is chalcophile but not siderophile which makes Ti a useful tracer of a sulfide melt formation. We parameterize and use our partitioning data in a model to calculate the relative depletion of Ti in the bulk silicate fraction of Mercury as a function of a putative FeS layer thickness. By comparing the model results and surface data we show that the most likely scenario is that Mercury does not have a FeS layer, and in case it would have one, such a layer would only be a few kilometers thick (<13 km). We also show that Mercury's metallic Fe(Si) core cannot contain more than ~ 1.5 wt. % sulfur and that the formation of this core under reducing conditions is responsible for the slightly subchondritic Ti/Al ratio of Mercury's surface.